Construction Environmental Management Plan

Woodfibre LNG Project

October 4, 2023

Prepared By:
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Prepared For:

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Woodfibre LNG

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 in Nexwnéwu7ts Átlḵ'a7tsem (Howe Sound), approximately seven kilometres south of Skwxwú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiy̓át. Swiy̓át and Nexwnéwu7ts Átlḵ'a7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh 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 Partnership recognizes the importance of these areas to the Skwxwú7mesh stélmexw (Squamish People), and other Indigenous Groups. Woodfibre LNG Limited Partnership seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Construction Environmental Management Plan is primarily written in English with important place names, species, phrases, and passages provided in the Sḵwx̱wú7mesh Sníchim (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 lands

We will continue to swim and fish in these clear waters.

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Table of Contents

PREAMBLE I

DOCUMENT REVISION HISTORY II

SQUAMISH-ENGLISH TRANSLATION VII

ABBREVIATIONS X

1.0 INTRODUCTION 1
1.1 PROJECT COMPONENTS OVERVIEW 2
1.2 PROJECT LOCATION & SITE DESCRIPTION 4
1.3 PROPOSED ACTIVITIES 6
1.4 CEMP CONTEXT 13
1.5 CEMP OBJECTIVES 15

2.0 REGULATORY CONTEXT 16
2.1 OVERVIEW OF REGULATORY CONSIDERATIONS 16
2.1.1 Regulatory Framework 16

3.0 ENVIRONMENTAL MANAGEMENT 21
3.1 ENVIRONMENTAL MANAGEMENT FRAMEWORK 21
3.1.1 Documentation Structure 21
3.1.2 Environmental Protection Plans 23
3.2 ROLES AND RESPONSIBILITIES 24
3.2.1 Woodfibre LNG 24
3.2.2 Contractor 24
3.3 ENVIRONMENTAL TRAINING & COMPETENCIES 28
3.3.1 Qualified Professional and Specialists 29

4.0 CONSULTATION AND ENGAGEMENT 31
4.1 MANAGEMENT PLANS 31
4.2 CONSULTATION WITH INDIGENOUS GROUPS 32
4.3 CONSULTATION AND NOTIFICATION OF MATERIAL CHANGE 32
4.4 GENERAL PROJECT NOTIFICATION 32
4.5 COMPLAINTS 33

5.0 IMPLEMENTATION 34
5.1 ENVIRONMENTAL MITIGATION MEASURES 34
5.2 GENERAL MANAGEMENT 34
5.3 BEST MANAGEMENT PRACTICES 35
5.3.1 Emergency Management and Response 35
5.3.2 Air Quality 35
5.3.3 Blasting Management 37
5.3.4 Erosion and Sediment Control 39
5.3.5 Concrete Management 40

5.3.6 Waste 41
5.3.7 Stak̲w (Water) Management 42
5.3.8 Shk̲weṉ (Marine Water) Quality 43
5.3.9 Marine Mammal Management 45
5.3.10 Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat 47
5.3.11 Vegetation 48
5.3.12 Sekw'ekw'inexw (Wildlife) 49
5.3.13 Lighting 50
5.3.14 Visual 50
5.3.15 Indigenous Heritage 52
5.3.16 Marine Transportation (Navigation) 52
5.3.17 Traffic Management 53
5.4 COMPONENT ENVIRONMENTAL MANAGEMENT PLANS 53
5.5 ENVIRONMENTAL SCHEDULES 54
5.6 ENVIRONMENTAL MAPPING 56
5.7 WORKING WINDOWS 56

6.0 ENVIRONMENTAL INCIDENTS 58
6.1 SPILLS 58
6.1.1 Spill Prevention 59
6.2 SPILL RESPONSE 59
6.2.1 Non-Reportable Spill Response 59
6.2.2 Reportable Spill Response 59
6.3 SPILL KITS 63
6.4 SPILL REPORTING 65
6.5 SPILL REPORTING REGULATION 65

7.0 ÍNEXWANTAS (MONITORING), REVIEW AND REPORTING 68
7.1 ENVIRONMENTAL ÍNEXWANTAS (MONITORING) PLAN 68
7.2 COMPLIANCE AUDITS 69
7.3 CONTRACTOR NON-CONFORMANCES & CORRECTIVE ACTIONS 70
7.4 REPORTING 70
7.4.1 Monthly Compliance Reports 71
7.4.2 Weekly Environmental Ínexwantas (Monitoring) Reports 71
7.5 CEMP REVIEW 72
7.6 MATERIAL CHANGE 72

LIST OF TABLES

Table 1-1: Proposed Project Components 2
Table 1-2: Proposed Activities 6
Table 1-3: Environmental Approval Register 13
Table 1-4: CEMP Objectives 15
Table 2-1: Federal Legislation 16
Table 2-2: Provincial Legislation and Skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Assessment 17
Table 2-3: Municipal Legislation 18
Table 3-1 : Project Environmental Management Documentation Requirements 22

Table 3-2: Environmental Training 29
Table 4-1: Notification and Communication 33
Table 5-1: General Management Requirements 34
Table 5-2: Air Quality Mitigation Measures 35
Table 5-3: Noise and Vibration Mitigation Measures 36
Table 5-4: Blasting Mitigation Measures 37
Table 5-5: Erosion and Sediment Control Mitigation Measures 39
Table 5-6: Concrete Management Mitigation Measures 40
Table 5-7: Waste Mitigation Measures 42
Table 5-8: Stak̲w (Water) Management Mitigation Measures 42
Table 5-9: Shk̲weṉ (Marine Water) Quality Mitigation Measures 43
Table 5-10: Marine Mammal Management Mitigation Measures 46
Table 5-11: Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Mitigation Measures 47
Table 5-12: Vegetation Mitigation Measures 48
Table 5-13: Wildlife Mitigation Measures 49
Table 5-14: Lighting Mitigation Measures 50
Table 5-15: Visual Mitigation Measures 51
Table 5-16: Indigenous Heritage Mitigation Measures 52
Table 5-17: Marine Transportation Mitigation Measures 52
Table 5-18: Traffic Management Mitigation Measures 53
Table 5-19: Component Plans to the CEMP 53
Table 5-20: Environmental Schedules 55
Table 6-1: Reportable Spill Quantities 66

LIST OF FIGURES

Figure 1-1: Site Overview Map 5
Figure 1-2: Site Layout Map 12
Figure 3-1: Environmental Management Framework 21
Figure 5-1: Environmentally Valuable Resources Maps 57

LIST OF APPENDICES

APPENDIX A TABLE OF CONCORDANCE A.1

APPENDIX B CORRECTIVE ACTIONS REGISTER B.1

APPENDIX C STAK̲W (WATER) MANAGEMENT PLAN C.1

APPENDIX D SHK̲WEṈ (MARINE WATER) QUALITY MANAGEMENT AND ÍNEXWANTAS (MONITORING) PLAN D.1

APPENDIX E MARINE STS'ÚKWI7 (FISH) AND STS'ÚKWI7 (FISH) HABITAT MANAGEMENT AND ÍNEXWANTAS (MONITORING) PLAN E.1

APPENDIX F MARINE MAMMAL MANAGEMENT AND ÍNEXWANTAS (MONITORING) PLAN F.1

APPENDIX G INVASIVE PLANT MANAGEMENT PLAN G.1

APPENDIX H SEKW'EKW'INEXW (WILDLIFE) MANAGEMENT AND ÍNEXWANTAS (MONITORING) PLAN – CONSTRUCTION PHASE H.1

APPENDIX I EROSION AND SEDIMENT CONTROL PLAN I.1

APPENDIX J WASTE MANAGEMENT PLAN J.1

APPENDIX K MATERIAL CHANGE COMPLIANCE REVIEW TEMPLATE K.2

Squamish-English Translation

Squamish	English
General Terms	
Shushá̓w̓	Bones
Té̓lnexw	Discover
Ch’áatl’am	Hunting
Temíxw	Land, earth, dirt
Ínexwantas	Monitoring
Smánit	Mountain
Shk̲weṅ	Ocean, saltwater
Sk̲wx̲wú7mesh Sníchim	Squamish language
Sk̲wx̲wú7mesh Úxwumixw	Squamish Nation
Sk̲wx̲wú7mesh stélmexw	Squamish people
Stak̲w	Water, river
Locations	
Shisháyu7ay	Britannia Beach
Kwtsá7tsutsin	Darrell Bay
Swiy̓át	Historic Sk̲wx̲wú7mesh Úxwumixw (Squamish Nation) village located at Woodfibre LNG site
Nexwnéwu7ts Átlk̲’a7tsem	Howe Sound
Sel̓íl̓wit Stak̲w	Indian River
K̲’íl̲k̲’elxn	Port Mellon
Skwelwíl̓em	Skwelwilem Wildlife Management Area
Sk̲wx̲wú7mesh	Squamish
Stá7mes	Stawamus
K̲’emk̲’emeláy	Vancouver
Marine Mammals	
K̲wex̲nís	California sea lion
Kw’únut’	Dall’s porpoise
K̲wenís	Grey whale
Asxw	Harbour seal
Sk̲wúmechn	Humpback whale
K̲wenís	Minke whale

Squamish	English
Yéwyews	Orca (Southern Resident and Transient) killer whale
Kw'únut'	Pacific white-sided dolphin
Kw'únut'	Harbour porpoise
Kwexnís	Steller sea lion
Wildlife	
Sp'ákw'us	Bald eagle
Nsexá7xem	Band-tailed pigeon
Kw'ekw'íkw'ehatl'	Barn swallow
Lams tl'a kw'ekw'íkw'ehatl'	Barn swallow nest cups
Skáp'kap'tsaylh	Bat
Skeɬáẇ	Beaver
Tsíptspí7lhtn	Bird nest
Wexés	Frog
Smekw'á7	Great blue heron
Stl'alhálem	Grizzly bear
Piyís	Marbled murrelet
Sekw'ekw'inexw tl'a shkwen	Marine bird
Nsxípim	Northern goshawk
Élhkaẏ	Snake
Shá7yu	Western screech-owl
Kw'áxwa7s tl'a Shá7yu	Western screech-owl nest boxes
Sekw'ekw'inexw	Wildlife
Fish	
Sts'úkwi7	Any fish
Cháyilhen	Any salmon
Kwu7s	Chinook/Spring salmon
Tsáẇin	Coho salmon
Tl'ítl'elxiws	Dolly varden
Aẏx	Dungeness crab
Slhawt'	Herring
Ch'éṁesh	Herring roe
Lháwichen	Pink salmon
Skiẇx	Rainbow trout

Squamish	English
Lhémk̲w'a	Sole
Plants	
Sáx̲wi	Grasses/sedges
K̲wáy̓stay	Hemlock tree
Kwlúl7ay	Red alder tree
X̲ápay̓ay	Red cedar tree
Ch'úukw'a	Skunk cabbage
X̲wáy̓ay	Willow tree
K̲'elhmáy̓	Yellow cedar tree

Abbreviations

BC	British Columbia
BCER	BC Energy Regulator[1]
BMP	Best Management Practice
CCG	Canadian Coast Guard
CCME	Canadian Council of Ministers of the Environment
CEAA	*Canadian Environmental Assessment Act*
CEMP	Construction Environmental Management Plan
CO_2	Carbon dioxide
COC	Certificate of Compliance
CPA	Certified Project Area
CSFP	Critical Stream Flow Periods
DFO	Fisheries and Oceans Canada
DOS	District of Squamish
EA	Environmental Assessment
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EC	Environment Canada
EEP	Environmental Emergency Program
EERO	Environmental Emergency Response Officer
EM	Environmental Monitor
EMBC	Emergency Management BC
EMP	Environmental Management Plan
EPCM	Engineering, Procurement and Construction Management
EPP	Environmental Protection Plan
ESC	Erosion and sediment control
EWP	Environmental Work Plan
FDS	Federal Decision Statement
FLNR	Ministry of Forest Lands and Natural Resources (now Ministry of Forests)
HSSE	Health, Safety, Security, and Environmental
HWR	Hazardous Waste Regulation
IFR	Instream flow requirement
IL	Industrial Land
IPMP	Invasive Plant Management Plan

LAA	Local Assessment Area (as defined in the Project environmental assessment)
LNG	Liquefied Natural Gas
LNGC	Liquefied Natural Gas Carrier
MLARD	Metal leaching and acid rock drainage
MOE	Ministry of Environment and Climate Change Strategy
MOH	Ministry of Health
MOF	Ministry of Forests[2]
MOTI	Ministry of Transportation and Infrastructure
NTU	Nephelometric Turbidity Units
OHS	Occupational Health and Safety
PAG	Potential acid generating
PAHs	Polycyclic aromatic hydrocarbons
PPE	Personal protective equipment
QA/QC	Quality assurance/quality control
QHSES	Quality, Health, Safety, Environment, and Security
QP	Qualified Professional
RAA	Riparian Assessment Area
RECPs	Rolled erosion control products
RPD	Relative percent difference
SNEAA	Squamish Nation Environmental Assessment Agreement
TC	Transport Canada
The Project	Woodfibre Liquified Natural Gas Project
TSS	Total Suspended Solids
VCH	Vancouver Coastal Health
Woodfibre LNG	Woodfibre LNG Limited Partnership
WQGs	Water Quality Guidelines

[1] The acronym BCER will be used in this document to mean Oil and Gas Commission (former name) or the British Columbia Energy Regulator (current name).[1]

[2] The acronym MOF will be used in this document to mean Ministry of Forests, Lands, Natural Resource Operations and Rural Development (former name) or the Ministry of Forests (current name).

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc., as General Partner on behalf of the Woodfibre LNG Limited Partnership (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) (Figure 1-1). The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas and a storage capacity of 250,000 cubic metres (m^3) and will export the liquefied natural gas (LNG) via tankers.

The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An Environmental Assessment Certificate (EAC) for the Certified Project Area (CPA) under the BC Environmental Assessment Act (EAC #E15-02) in 2015.
- An environmental assessment approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015.
- A positive Federal Decision Statement (FDS) under the Canadian Environmental Assessment Act, 2012 (CEAA 2012) in 2016.

Two EAC amendments were granted by the BC Environmental Assessment Office (BC EAO) in 2017 and 2019, and the FDS was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address.

Most of the Project is on fee simple, industrially zoned, brownfield lands with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Átl'ḵa7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro and gas will be supplied to the facility by Fortis BC.

Key Project components are:

- Land-based natural gas processing and liquefaction facilities.
- A floating storage and offloading unit.
- Construction worker accommodation.
- Supporting infrastructure.

The supporting infrastructure includes buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.

This Construction Environmental Management Plan (CEMP) is a management tool to be used and referred to by those planning and undertaking construction activities for the Project. The CEMP is

designed to ensure that potential Project related effects on the community and the environment are effectively and adaptively managed during the construction of the Project.

In accordance with General Condition 2.1 of the Project Decision Statement (issued by the Canadian Environmental Assessment Agency in March 2016); Condition 21 of Schedule B of the Environmental Assessment Certificate E15-02 (issued by the Environmental Assessment Office in October 2015); and Squamish Condition # 6 (4.6 Environmental Management Programs) of the Squamish Nation Environmental Assessment Agreement (issued by Skwxwú7mesh Úxwumixw [Squamish Nation] in October 2015), commitment in this CEMP is made to:

- Ensure actions to meet the conditions set out in the Project approvals:
    - 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 and are undertaken by qualified individual; and
    - Have applied the best available economically and technologically feasible mitigation measures.
- Undertaking Environmental Management Practices in accordance with the conditions attached to the FDS, EAC, and the SNEAA.
- Ensure management plans are implemented by a Qualified Professional.
- Support compliance to project-level commitments and ensure the mitigation measures outlined in management plans are accurately translated to activity specific measures.
- Align activity-specific ínexwantas (monitoring) and validation efforts undertaken by qualified individuals with project-level requirements.
- Support effective and efficient implementation of adaptive management and continuous improvement as informed by ínexwantas (monitoring) and validation efforts.

1.1 PROJECT COMPONENTS OVERVIEW

An overview of key Project Component is provided in Table 1-1.

Table 1-1: Proposed Project Components

Details	Description
LNG Reception and Processing	The LNG Facility will take pipeline quality gas, remove impurities and other components (mainly CO_2, trace sulfur and stak̲w [water]), and liquefy the natural gas to produce LNG. The liquefier will use equipment such as vessels, pumps, compressors, and heat exchangers to process the natural gas and produce LNG.
LNG Storage and Offloading	Two Floating Storage Tank barges (FSTs) will be permanently moored at the Marine Terminal. The FSTs are each approximately 208m long, 65m wide, and 25m high. The two FSTs are existing LNG carrier vessels which will be modified offsite and converted from carrier vessels to stationary storage barges for LNG. The LNG processed by the onshore facilities will be transferred to the FSTs through jumper

Details	Description
	arms located on transfer module M05. The two FSTs will be permanently moored at Site utilizing jacket and strut structures. LNG will be transferred from the FSTs to the LNG Carriers (LNGCs) through loading arms located on the loading platform on starboard side of FST 2.
Offloading Infrastructure	A permanent marine offloading platform will be installed off the shoreline on the west side of the facility. A permanent access ramp will be constructed using infill between the shore and platform. Areas surrounding the offloading platform and access ramp will be protected with rip rap armoring, which will be integrated with rip rap associated with the planned shoreline work. The platform will be used for light material loading and offloading from marine vessels during construction and operations. The platform will create a permanent surface impermeable to light.
Marine Mooring	The Project will use the existing shoreline marine terminal characteristics of the Project site and, where viable, will use existing marine infrastructure. It is anticipated that most of the existing infrastructure will need to be upgraded or replaced to address safety, regulatory compliance, and specific Project requirements. The WLNG Marine Facilities Terminal will be located on the steep coastal slope of Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) on the southeast corner of the LNG Facility. The Marine Facilities will consist of the LNG transfer and access modules (M05, M07, & M14). FST permanent mooring structures, two (2) FSTs, complete with the loading platform on FST2, LNGC berthing structures and mooring points located on the FSTs and associated gangways.
Cooling System	The primary process cooling will be supplied by air coolers.
Heating System	The primary process heating will be supplied by a closed loop heating medium system (hot oil) using a furnace to provide heat.
Safety and Vent Systems	Hydrocarbon safety reliefs will be sent to either a high-pressure or low-pressure elevated flare except the LNG Storage, which will be sent to atmosphere. Hydrocarbon vents will be processed in a thermal oxidizer. Non-hazardous utilities may be vented to the atmosphere.
Worker Accommodation	Floating construction worker accommodation (floatel) will be temporarily moored offshore of the facility during the construction phase. Floatel will be demobilized from the facility area prior to substantial completion of the overall facility. Floatel will have a minimum clearance of at least 2.0 m above all areas of the seabed at lowest low tides. The flaotel dimensions will be 171m long x 28m wide.
Ferry Terminal	Access to the site will only be via stak̲w (water) using private passenger ferry from Sk̲wx̲wú7mesh (Squamish) to the site. A permanent passenger ferry terminal and ferry berthing facility will be established at the Project site for connection between the site and Sk̲wx̲wú7mesh (Squamish).
Supporting Infrastructure	Lunch Tents Offices Concrete Batch Plant Warehouse Fuel Storage Tool Rooms Security Maintenance Shop Discipline specific facilities (paint, insulation, fireproofing, etc.)

1.2 PROJECT LOCATION & SITE DESCRIPTION

The Project area (the site) is located approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) on the northwestern shoreline of Nexwnéwu7ts Átlk'a7tsem (Howe Sound). The site is within the Traditional Territory of the Skwxwú7mesh Úxwumixw (Squamish Nation) at the historical site of Swiẏát, a Skwxwú7mesh Úxwumixw (Squamish Nation) village.

The site area comprises 86 hectares (ha) of privately owned, formerly developed brownfield industrial Temíxw (land), along with existing stak̲w (water) lots adjacent to the site (Figure 1-1) The site previously operated as a paper and pulp mill facility from 1912 until 2006.

The Project area is surrounded by steep, mountainous terrain with no Temíxw (land) or road access to the site. Current access to the site is via stak̲w (water) using a private passenger ferry from the Sḵwx̱wú7mesh (Squamish) Government Docks. Additional marine access considerations are under review and will be updated as Project decisions are progressed.

481000 481500 482000 482500

5503000 5502500 5502000 5501500 5501000 5500500

Existing Mill Creek Intake

Woodfibre LNG Site

Main Map

Squamish

Britannia Beach

99

Anvil Island

Gambier Island

Howe Sound

Lions Bay

Capilano River

Gibsons

Keats Island

Bowen Island

Horseshoe Bay

Capilano Lake

1

North Vancouver

Burrard Inlet

Existing Landfill

Mill Creek

East Creek (Upstream)

East Creek (Downstream)

Road / Blasting Area

LNG Facility

Northeast Ramp

0044927

FST 1 (CAPRICORN)

FST Transfer Platform Module M05

Pipe Bridge

Road Bridge

Center Ramp

FST 2 (TAURUS)

MOF

Offloading Platform/ Passenger Ferry Dock

0214724

Floatel

Ro-Ro Maintenance/ Upgrade

Raw Water Intake

Southwest Ramp

Woodfibre Creek

0044927

Howe Sound

Existing Mill Creek Water Intake
Watercourse
Limited Access Road
Green Zone
Lease (#0044927)
Licence Of Occupation (#0214724)
Certified Project Area (CPA)

Project Components

Raw Water Intake (Woodfibre Creek)
Floating Storage Tank (FST) / Blasting Area / Access Road
Floatel
Material Offloading Facility (MOF)
Offloading Platform / Passenger Ferry Dock
Shoreline Work
Ro-Ro Maintenance/Upgrade
Land-based Natural Gas Processing and Liquefaction Facilities
Pipe / Road Bridge
Supporting Infrastructure [4]
Existing Landfill
Transport Vessel

NOTES:
1. Contains information licensed under the Open Government Licence – British Columbia and Canada.
2. Projection: NAD 1983 CSRS UTM Zone 10N
3. Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community. Copyright:(c) 2014 Esri
4. Location of supporting infrastructure is subject to change based on final engineering design.

0 100 200 400 Metres

1:7,500

NORTH

Figure 1-1
Woodfibre LNG
Construction Environmental Management Plan
Site Overview Map

Woodfibre LNG

HATCH

File: WLNGH-369497-100-0100-CEMP-001

1.3 PROPOSED ACTIVITIES

A description of key construction phases, activities, and their respective timing are provided in Table 1-2 and shown in Figure 1-2. Construction activities are expected to commence in September 2023, with completion in July 2026.

Table 1-2: Proposed Activities

Phase	Activity	Description	Timing[1]
Site Preparation and Civil	Drainage Control systems	A west and east sedimentation pond will be established and managed by the culvert outfalls described below. Prior to commencing site clearance activities for either the preferred or alternative configuration, a temporary drainage system will be established to collect and control storm stak̲w (water) flows across the site throughout the construction period. Temporary drainage systems will be installed as required and may include perimeter ditches, internal ditches, and cut-off swales.	Sept 2023 – Nov 2023
	Site and vegetation clearance	Site preparation will begin with clearing approximately 9.5 ha of vegetation across the Project footprint as required. This will include the exclusion zones, perimeter fencing, drainage, and preparation for foundations for equipment. Site to be cleared and grubbed for new construction. Fuel break for perimeter fencing.	Sept 2023 – Oct 2023
	Sanitary sewage system	Treatment skid to be installed at site for treatment of sewage to permitted quality and quantity. Discharge at existing outfall.	TBD
	Waste material landfill	Solid waste to be collected and transported to offsite processing facility.	TBD
	Site access and storage	Construction roads to be established throughout site based on access needs. Designated site laydown areas to be used for storage.	Oct 2023 – Sept 2026
	Civil works / foundation works	Permitted civil works include clearing grub, excavation, demolition of existing structures, solid rock removal, soil improvement, concrete foundations, backfill.[2]	TBD
	Raw Stak̲w (Water) Water Intake	A temporary raw stak̲w (water) intake will be installed in Woodfibre Creek for the extraction of stak̲w (water) during construction phase of the Project at a maximum volume per day of 3,600m^3. The temporary raw stak̲w (water) intake system is expected to consist of a raw stak̲w (water) intake structure and sts'úkwi7 (fish) screen, pump skid(s), suction and discharge lines, and a holding tank. After completion of construction, the temporary components of the raw stak̲w (water) intake will be removed.	TBD

[1] Indicative timing is provided to describe the approximate sequence of activities, actual timing is subject to change.
[2] The demolition and removal or onsite remediation of existing terrestrial structures and facilities associated with the former Woodfibre Pulp Mill are not defined as construction activities under Schedule B of the EAC E15-02.

Phase	Activity	Description	Timing[1]
	Laydown and stockpile areas	Laydown and stockpile areas will be established for material storage and access (e.g., structural steel, piping, concrete materials, construction supplies, dimensional lumber, diesel fuel).	Oct 2023 – May 2024
	Shoreline Works	Existing shoreline presently devoid of riparian vegetation will be enhanced by the placement of riprap into the intertidal and marine areas. The shoreline work and installation will include modification of two existing barge landing areas along the shoreline. An additional barge landing / construction ramp will be constructed and integrated into the shoreline enhancement on the east side of the facility. The enhancement work will incorporate protection and reuse of existing riprap with algae or kelp materials. All work is intended to be performed from onshore using a long arm excavator to limit in-stak̲w (water) works. Barge landings will be constructed / improved by removing existing rock and soil material from upslope portions using excavators to form and smooth the ramps and landing areas. Gravel will be laid and compacted in areas of material removal for stabilization of the working surface.	Sept 2023 – Nov 2024
	East Creek Sheet Pile Wall	A sheet pile wall will be installed near the eastern end of the shoreline in an area above the High-Stak̲w (Water) Mark (HWM). The areas upslope of the sheet pile wall will be backfilled, and downslope will be protected with riprap armoring, which will be integrated with the planned shoreline work riprap.	TBD
	Bridges Over Mill Creek	Permanent road and pipe bridges will be installed across Mill Creek for access between the East and West areas of Project site. The bridges will be installed as modular structures with support by piles on piers located outside of the top of bank of Mill Creek within existing cleared areas of the site. Helical or driven steel pipe piles will be used to support both bridges. The bridges will be directly connected by welding or bolting to the piles or pile cap plates. Both bridges will be assembled into modular structures which will be lifted and set in place on the foundations using a crane. A cast-in-place concrete abutment will be installed upslope of the piles on each end of the road bridge. After placement of the bridge, fill soil will be placed and compacted behind the abutments to support the roadway approach slabs.	Jan 2024 – Mar 2024
	Culvert Outfalls Installation	Seven drainage culvert outfalls will be installed at the shoreline for controlled drainage of treated and non-contact stak̲w (water) from the site for discharge into Nexwnéwu7ts Átlk'a7tsem (Howe Sound). Three are new outfalls and four are replacements of existing culverts. Outfalls from the west and east sedimentation ponds will include precast outfall structures with manually operable frame gates and weirs. Drainage pipes on the upstream and downstream sides of the outfall control structures will be elevated above the high-stak̲w (water) mark such that	Sept 2023 – Jan 2024

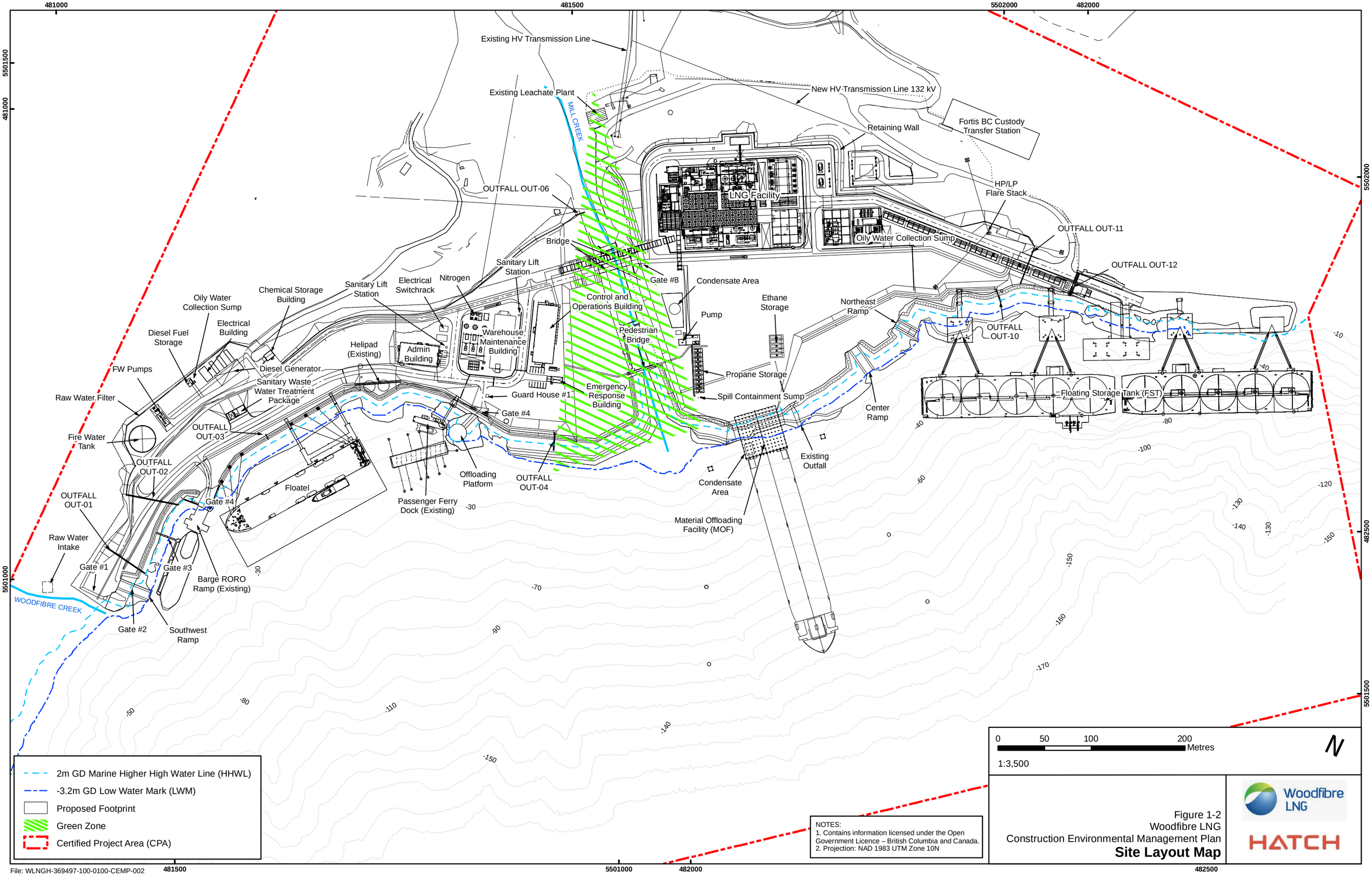
Phase	Activity	Description	Timing[1]
		they are inaccessible to sts'úkwi7 (fish) from Nexwnéwu7ts Átlk'a7tsem (Howe Sound). The outfall for East Creek will include two parallel culverts penetrating through the sheet pile wall. Outfall culverts and precast control structures will be set in their location on the shoreline by an onshore crane or lifter. All outfall discharge areas will be protected with riprap and incorporated into the shoreline works.	
Offshore Structures	Temporary floating construction worker accommodations (Floatel)	The floatel will be temporarily moored offshore of the facility during the construction phase. The floatel is 171m x 28m. The capacity of the floatel is 651 plus crew. The number of beds occupied will vary depending on the phase of the project however at peak workforce it is anticipated that all beds will be occupied. Fixed walkways between the floatel and shoreline will allow personnel access to the construction site. The fixed walkways and moving gangways will support electrical conduit for power supply and steel piping for potable stak̲w (water) to the floatel. The floatel will be brought to the facility using tugs and temporarily moored using berthing and mooring dolphins. The floatel will be demobilized from the facility area after completion of construction using the same method.	Jan 2024 – Sept 2026
	Floatel Berthing Dolphins & Gangways Installations	A total of 9 steel pipe piles (1828mm diameter or smaller) will be installed into the seabed to support berthing / mooring dolphins for the floatel. A metal mooring dolphin and berthing fender will be installed by a marine vessel atop 5 of the piles for berthing. A metal mooring dolphin will be installed by a marine vessel atop the remaining 4 piles for berthing. An additional 42 steel pipe piles (610mm diameter or smaller) will be installed into the seabed to support fixed walkways and moving gangways between the floatel and shoreline. The fixed walkways and moving gangways will be constructed of metal beam framing with metal grating and handrails. Piles will be driven into the seabed from a converted marine piling barge using vibratory pile driving methods, and impact pile driving to seat piles to tip elevation 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. The support frames will be installed on supporting piles using an onshore crane, with support from marine vessel as required for alignment and connections. Upon demobilization of the floatel from the facility, the walkways, gangways, conduit, utility piping, and support frames will be removed from the facility using the same methods. All piles will remain in place.	Sept 2023 – Jan 2024
	RORO Ramp Dock and	An existing roll-on roll-off (RORO) ramp dock at the south end of the facility will be repaired for continued use as a	Aug 2024 – Mar 2025

Phase	Activity	Description	Timing[1]
	Dolphin Refurbishment	road dock for the facility. The repairs will be contained within the existing marine footprint of the RORO. Refurbishment and repair works are expected to consist of localized repair of steel sheet piles and replacement of existing timber piles. Pile replacement will be completed from a marine piling barge and steel sheet pile repairs or recoating will be completed onshore. 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.	
	Offloading Platform	A permanent marine offloading platform will be installed off the shoreline on the west side of the facility. A permanent access ramp will be constructed using infill between the shore and platform. Areas surrounding the offloading platform and access ramp will be protected with rip rap armoring. The platform will primarily be composed of an infilled circular, cellular sheet pile structure (19.1m diameter) placed into the marine seabed. Sheet piles will be driven into the seabed from a marine piling barge using vibratory pile driving methods, and impact pile driving to seat piles to finish elevation if required. After all sheet piles are installed, the enclosed area will be infilled from onshore with graded base material using onshore excavators and/or cranes. Graded base material will be compacted to support the platform. The access ramp will be constructed from onshore to the platform using excavators, rollers, and compactors to install fill rock and graded base material to infill from the shore to the platform. The top surfaces of the access ramp and offloading platform will be finished with high fines surfacing aggregate using excavators, rollers, and compactors.	Nov 2023 – Nov 2024
	Material Offloading Facility (MOF)	A 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 MOF will be a concrete deck wharf structure extending approximately 40m over the stakw (water). The MOF will be supported by 175 or fewer steel pipe piles (1000mm diameter or smaller). Two mooring dolphin structures supported by piles will be installed on each side of the MOF. Four mooring buoys will be installed on each side of the MOF. The buoys will be connected by mooring chains or wire rope to dead-man anchors which will be placed on the seabed. 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. Piles will be installed by onshore pilling rig or a marine piling barge depending on location. A prefabricated steel tubular cap will be bolted or	Sep 2023 – Jan 2025

Phase	Activity	Description	Timing[1]
		welded onto the top of each pile and fastened to steel beams to form a grid. Precast concrete deck panels will be placed on top of the steel framing via onshore crane. All gaps between the precast panels and perimeter formwork will be sealed. A reinforced concrete topping slab will be poured atop the panels using onshore concrete pump trucks. After completion of construction, the MOF, mooring piles, and mooring buoys will remain in place.	
Marine Facility	Marine Facility Terminal	The Marine Facility Terminal consists of the following components[3]: One Transfer Platform (Module 05) with two supporting substructures. The two substructures will consist of structural steel which is preassembled offsite. The substructures will be set in place by a marine vessel on top of the substructure installation support piles. The permanent piles will be installed through the vertical tubular members (legs) of the substructures and grouted or welded to the substructure and bedrock. 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. Subsequently a portion of the deck will have cast-in-place concrete installed within solid, sealed formwork via onshore concrete pump trucks. Three permanent mooring system support substructures. Permanent steel pipe piles will be installed into the bedrock through the substructure's legs by a marine vessel with a crane as described above. The deck will consist of a steel plate top and steel grating which is preassembled offsite. The Permanent Mooring Topsides framework will be set in place and welded to the substructure by a marine vessel with a crane and welding equipment onboard. Three permanent mooring system tie-back structures with cast-in-place concrete installed within solid, sealed formwork. One permanent mooring anchor structure embedded in a rock face. The existing onshore rock outcrop will require blasting and removal of rock. Steel rock anchors 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. The two strut arms will be connected to the topsides dampening system at a later stage once the FSTs are on site. One piping trestle and one roadway trestle will be installed to connect the transfer platform (M05) to the onshore facilities. Two permanently moored FSTs for stationary storage of LNG. To moor the FSTs, each of the strut arms (2 each per permanent mooring structure) will be set in position and	Nov 2023 – Aug 2025

[3] The components associated with the Marine FST Terminal are subject to change in the final design arrangement.

Phase	Activity	Description	Timing[1]
		secured between the permanent mooring structures and the FSTs using a crane barge.	



NOTES:
1. Contains information licensed under the Open Government Licence – British Columbia and Canada.
2. Projection: NAD 1983 UTM Zone 10N

Figure 1-2
Woodfibre LNG
Construction Environmental Management Plan
Site Layout Map

Woodfibre LNG

HATCH

File: WLNGH-369497-100-0100-CEMP-002

1.4 CEMP CONTEXT

This CEMP has been prepared to outline the compliance requirements to be achieved during construction and facilitate implementation of mitigation measures to satisfy conditions of approval in accordance with Condition 21 (Environmental Management Plans) of the Project Environmental Assessment Certificate (EAC) #E15-02[4]. A summary of the Project environmental approvals on which this CEMP is based is provided in Table 1-3. Under Schedule B of the EAC E15-02, construction is defined as:

- 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 Schedule B, Construction does not include the following:
    1. Any activities conducted solely for investigative purposes under a valid permit or authorization;
    2. The demolition and removal or onsite remediation of existing terrestrial structures and facilities associated with the former Woodfibre Pulp Mill;
    3. The closure of the existing pulp mill landfill; and
    4. Ongoing maintenance or upgrades to the existing work or infrastructure to address safety, environment, or regulatory compliance.

Table 1-3: Environmental Approval Register

No.	Issuing Authority	Approval	Date	Context
1.0	Impact Assessment Agency of Canada (the Agency)	(Federal) Decision Statement	March 2016	Issued under Section 54 of the Canadian Environmental Assessment Act, 2012
1.1		(Federal) Decision Statement – REISSUED	March 2018	Following amendment to the Project design, modification was made to the following conditions 3.3.3, 3.3.4, 3.7, 4.3, and 9.3
1.2		(Federal) Decision Statement – REISSUED		Following amendment to the Project design, modification was made to the following conditions 2.10, 2,11, 3.8, and 6.4
2.0	Environmental Assessment Office (EAO)	Environmental Assessment Certificate (EAC) # E15-02	October 2015	On November 27, 2013, a Project Lead of the EAO issued an Order under Section 10(1)I of the Act stating that an EAC was required for the Project and that the Proponent could not proceed with the Project in the absence of an assessment.
2.1		Environmental Assessment Certificate (EAC) # E15-02 Amendment # 1	July 2017	Amendment to the EAC (# E15-02) was granted under Section 19(3) of the BC Environmental Assessment Act to support the following update to the Project Description: Change the cooling technology from seawater cooling to air cooling; Use the existing Mill Creek intake, including screenhouse, flume, and penstock, as an alternative to constructing a new intake for stak̲w (water) withdrawals; and Withdraw stak̲w (water) from Woodfibre Creek for short-term needs during construction.

[4] Under Condition 21 of the EAC, all requirements pertaining to the certificate of compliance or onsite landfill in section 13.2 of the EAC Application are excluded from this CEMP.

No.	Issuing Authority	Approval	Date	Context
2.2		Environmental Assessment Certificate (EAC) # E15-02 Amendment # 2	July 2019	Amendment to Schedule B of the EAC (# E15-02) was granted to update: Amendment to the definition of 'Construction' (described above) Condition 21 Environmental Management Plans to exclude requirements regarding the certificate of compliance or onsite landfill in section 13.2 of the Application from the CEMP.
2.3		Environmental Assessment Certificate (EAC) # E15-02 Amendment # 3	Anticipated mid to late Q3 2023	Application for a floatel for worker accommodation
3.0	Skwxwú7mesh Úxwumixw (Squamish Nation)	Squamish Nation Environmental Certificate #2015-001	October 2015	Environmental Assessment approval from Skwxwú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA)

1.5 CEMP OBJECTIVES

The objectives of the CEMP are summarized in Table 1-4 below.

Table 1-4: CEMP Objectives

Objective	Commitment
Demonstrate commitment to all Project environmental approvals and associated environmental management requirements.	Section 2.0
Define roles and responsibilities of all personnel involved in the delivery of the works.	Section 3.1.2
Identify environmental training and competency requirements for all personnel involved in the delivery of works.	Section 3.3
Document commitment to environmental performance ínexwantas (monitoring) and reporting.	Section 7.0
Ensure environmental risk is understood for the proposed scope of work, and appropriate management control measures have been identified for key environmental aspects.	Section 3.1
Provide clear and effective description of environmental management controls required.	Section 3.1
Define ínexwantas (monitoring) procedures for environmental performance/compliance for key environmental aspects.	Section 3.1
Define procedures for environmental incidents, non-conformances, and emergency response.	Section 7.3
Identify procedures for evaluation of environmental compliance.	Section 7.2 Section 7.3

2.0 REGULATORY CONTEXT

2.1 OVERVIEW OF REGULATORY CONSIDERATIONS

2.1.1 Regulatory Framework

The federal, provincial and municipal legislation applicable to the Project is detailed in Table 2-1,

Table 2-2, and

Table 2-3 below.

Table 2-1: Federal Legislation

Name	Agency	Relevance to Project
Canadian Environmental Assessment Act, 2012 (S.C. 2012 c. 19) (CEAA 2012)	Canadian Environmental Assessment Agency (the Agency)	The Project was assessed under CEAA 2012, which sets the responsibilities and procedures for environmental assessments of projects which involve federal government decision making. The federal government issued a Federal Decision Statement (FDS) as part of a substituted process in March 2016, which was reissued in March 2018. On February 19, 2014, the Minister of the Environment, under the authority of section 32 of the Canadian Environmental Assessment Act, 2012, granted the substitution of the environmental assessment process set out in British Columbia's Environmental Assessment Act for the Canadian Environmental Assessment Act, 2012 process.
Canadian Navigable Waters Act (RSC 1985 c. N-22)	Transport Canada	An Act protecting stak̲w (waters) on which the public has the right to travel (navigable stak̲w [waters]).
Fisheries Act (RSC 1985, c. F-14)	Fisheries and Oceans Canada	Safeguards sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat. It is also an offence for anyone to deposit or permit the deposit of deleterious substance in stak̲w (water) frequented by sts'úkwi7 (fish) without a permit or under a regulation.
Canadian Environmental Protection Act, 1999 (S.C. 1999)	Department of Environment and Climate Change	An Act aiming to prevent pollution and protect the environment and human health in order to contribute to sustainable development.
Canada Explosives Act (RSC 1985 c. E-17)	Department of Natural Resources	Pertinent to the storage and transportation of explosives used during drilling and blasting. These are implemented through the Explosives Regulation.

Name	Agency	Relevance to Project
Migratory Birds Convention Act (S.C. 1994 c. 22)	Environment and Climate Change Canada	Prohibits the unauthorized taking or killing of migratory birds, their nests and eggs, and the deposition of harmful substances in areas frequented by migratory birds.
Hazardous Products Act (RSC 1985 c. H-3)	Health Canada	Requires suppliers of hazardous products to communicate the hazards associated with their products using product labels and Safety Data Sheets as a condition of sale and importation for workplace use.
Species at Risk Act (S.C. 2002 c. 29)	Environment and Climate Change Canada or Fisheries and Oceans Canada	Provides for legal protection of sekw'ekw'inexw (wildlife) species and the conservation of their biological diversity. The Act outlines the commitment to prevent sekw'ekw'inexw (wildlife) species from becoming extinct and securing the necessary actions for their recovery.
Transportation of Dangerous Goods Act (S.C. 1994 c. 34)	Transport Canada	Regulates the movement of dangerous goods on roads, rail, air, and ship in Canada.
Canada Shipping Act (S.C. 2001 c. 26)	Transport Canada	Governs safety of marine transportation and recreational boating, as well as protection of the marine environment.

Table 2-2: Provincial Legislation and Skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Assessment

Name	Agency	Relevance to Project
Environmental Assessment Act, 2002 (British Columbia)	BC Ministry of Environment and Climate Change Strategy Environmental Assessment Office (EAO) (issuing authority)	The Project was assessed under the Environmental Assessment Act 2002, which provides a mechanism for assessing major projects for potentially adverse environmental, economic, social, heritage, and health effects. The process also ensures the concerns of the public, Indigenous, communities, and government agencies are appropriately considered. The EAO is responsible for the assessment of all major projects in BC under the Environmental Assessment Act 2002. The EAO conducted an environmental assessment of the Designated Project in accordance with the substitution conditions set out in subsection 34(1) of the Canadian Environmental Assessment Act 2012, including those additional conditions set by the Minister of the Environment, and in consideration of the Memorandum of Understanding on Substitution of Environmental Assessments (2013) entered into by the Agency and the EAO.

Name	Agency	Relevance to Project
		An EAC was issued by the EAO in October 2015 (# EAC E15-02)
Environmental Management Act, 2003 (British Columbia)	BC Ministry of Environment and Climate Change Strategy	The Environmental Management Act 2003 regulates the introduction of waste into the environment, including industrial and municipal waste discharge, pollution, hazardous waste, and contaminated site remediation.
Squamish Nation Environmental Assessment Agreement (SNEAA)	Skwxwú7mesh Úxwumixw (Squamish Nation)	The Skwxwú7mesh Úxwumixw (Squamish Nation) conducted an independent review of the EAC application and issued an Environmental Certificate for the Project (2015-001).
Forest Act	BC Ministry of Forests BC Energy Regulator (BCER) (issuing authority)	Law responsible for managing forestry resources and timber sales throughout the province. For tree clearing on Crown land, the BCER will issue a cutting permit under the Forest Act. For tree clearing on private temíxw (land), a Timber Mark will be issued by the Ministry of Forests under the Forest Act.
Riparian Areas Protection Act	BC Ministry of Forests BCER (issuing authority)	Calls on local governments to protect riparian areas during residential, commercial, and industrial development by establishing that Qualified Professionals provide assessments of proposed activities.
Heritage Conservation Act	BC Ministry of Forests BC Energy Regulator (BCER) (issuing authority)	Encourages and facilitates the protection and conservation of archaeological findings and heritage property in British Columbia.
Oil and Gas Activities Act	BC Ministry of Energy, Mines and Low Carbon Innovation BCER (issuing authority)	Regulates oil and gas related activities in British Columbia through permits, authorizations, orders, and regulations.
Water Sustainability Act	BC Ministry of Forests BCER (issuing authority)	Principal law for managing the diversion and use of stak̲w (water) resources.
Weed Control Act	BC Ministry of Forests BCER (issuing authority)	Requires that the occupier of temíxw (land) must control noxious weeds on their property. It is an offense to knowingly contravene this Act or to refuse to comply with an order to control noxious weeds.
Wildlife Act	BC Ministry of Forests BCER (issuing authority)	Protects sekw'ekw'inexw (wildlife) , endangered species, and sekw'ekw'inexw (wildlife) habitat.
Wildfire Act	BC Ministry of Forests BCER (issuing authority)	Legislation for the responsibility, compliance, and enforcement of fire management are provided in the Wildfire Act and Wildfire Regulation.

Table 2-3: Municipal Legislation

Name	Agency	Relevance to Project
District of Squamish Official Community Plan	District of Skwxwú7mesh (Squamish)	This is the District of Skwxwú7mesh (Squamish's) Official Community Plan, which sets out the requirements for development permits in development

Name	Agency	Relevance to Project
Bylaw 2500, 2017 "Schedule A"		permit areas. Development permit areas relevant to the Project include Development Permit Area 1 and Development Permit Area 10.
District of Squamish Blasting By-Law No. 188, 1965	District of Skwxwú7mesh (Squamish)	Requires a blasting permit for use of any explosive substance within the Municipality.
District of Squamish Noise Regulation Bylaw No. 2312, 2014	District of Skwxwú7mesh (Squamish)	Permits Construction Noise: • 7:00 am to 8:00 pm on any day other than Saturday, Sunday or a statutory holiday • 8:00 am to 7:00 pm on Saturdays • 10:00 am to 4:00 pm on Sunday or statutory holidays A Temporary Noise Exemption Permit may be obtained. Note that construction work which does not generate noise is allowed outside of these hours.
District of Squamish Solid Waste Utility and Regulation Bylaw No. 2870, 2021	District of Skwxwú7mesh (Squamish)	Construction and demolition waste is subject to this bylaw, which requires recyclables and organic waste to be separated from landfill waste (e.g., separating wood waste, metal, cardboard, plastic, etc.).
District of Squamish Demolition Waste Diversion Bylaw No. 2813, 2021	District of Skwxwú7mesh (Squamish)	Applies to the diversion and disposal of waste generated by demolition activities (demolition, deconstruction or systematic disassembly of an existing building, structure or improvement regulated by the Building Bylaw).
District of Squamish Wildlife Attractant Bylaw No. 2781, 2020	District of Skwxwú7mesh (Squamish)	This bylaw is intended to avoid human-sekw'ekw'inexw (wildlife) conflicts. It outlines the following waste management requirements: have bear resistant bins for all food waste; keep barbeques on-site clean; store grease, antifreeze, paint or petroleum products so they are inaccessible to sekw'ekw'inexw (wildlife) ; and, keep food waste out of construction waste bins.
District of Squamish Soils Management Bylaw No. 2641, 2018	District of Skwxwú7mesh (Squamish)	This bylaw regulates the deposit and removal of soil, requiring a Soil Management Permit. Note: no permit is required for deposit of soil or other materials undertaken per the Environmental Management Act regarding remediation of contaminated temíxw (land); if deposit or removal is directed by the District of Skwxwú7mesh (Squamish) ; if deposit or removal is for a Habitat Restoration project, etc.
District of Squamish Tree Management Bylaw No. 2640, 2018	District of Skwxwú7mesh (Squamish)	This bylaw regulates the removal of trees and outlines the requirements for a Tree Permit.
District of Squamish Invasive Species Management Bylaw No. 2786, 2020	District of Skwxwú7mesh (Squamish)	This bylaw prohibits the accumulation of invasive species.
Unsightly Premises and Objectionable Situations Bylaw No. 1868, 2005	District of Skwxwú7mesh (Squamish)	This bylaw requires that noxious weeds, unsanitary conditions and garbage do not accumulate and are removed from the property, among other conditions.

Numerous permits, licenses, and authorizations are required by the regulations listed above. All relevant permits, licenses and authorizations must be obtained from the appropriate authority prior to conducting the associated works.

In addition, construction activities will follow all established and applicable BMPs. The Contractor ((inclusive of all contractors (and their subcontractors) under Woodfibre LNG)) Environmental Protection Plans (EPPs) will provide details on which BMPs, specifically which components of the BMPs, apply to construction activities and Contractor Environmental Work Plans (EWPs) will provide details on how the BMPs will be implemented and operationalized.

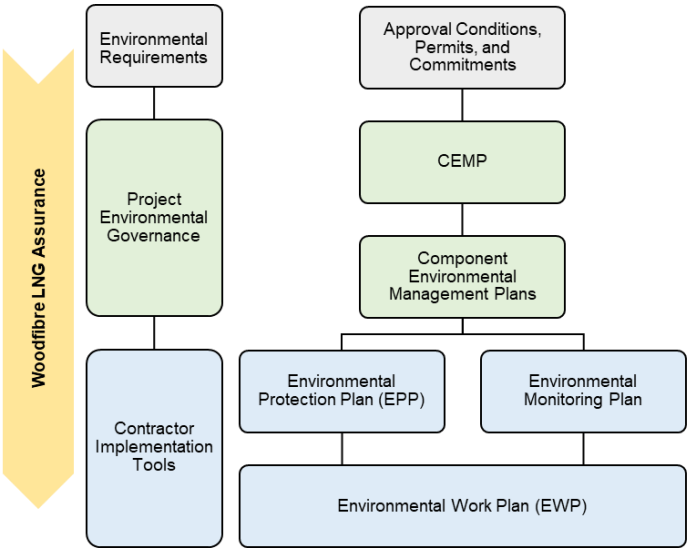
3.0 ENVIRONMENTAL MANAGEMENT

3.1 ENVIRONMENTAL MANAGEMENT FRAMEWORK

3.1.1 Documentation Structure

The Project Environmental Management Framework is illustrated in Figure 3-1:

Figure 3-1: Environmental Management Framework



The Project Environmental Governance documents (this CEMP and supporting Component Environmental Management Plans) provide the overarching approach to environmental management on the Project. The Governance documents compile the Project's environmental requirements and describe the process by which environmental management will be carried out. The CEMP also acts as a central repository to detail relevant environmental assessment conditions and commitments, legislative requirements, and relevant permits; management roles and responsibilities, engagement, and reporting requirements; and environmental and Project Ínexwantas (monitoring) and inspection requirements.

Environmental management requirements made in the Project Environmental Governance documents are translated into activity and site-specific actions in the Contractor Implementation Tools (the EPPs, Environmental Monitoring Plan, and EWPs). The EPPs will build on the EA level project-wide requirements described within the Management Plans, providing detail on an activity specific level what mitigation measures will be implemented. EPPs will also describe which BMP mitigation measures will be implemented. A detailed description of environmental ínexwantas (monitoring) requirements identified in the Component Environmental Management Plans or EPPs will be included in the Project Environmental Monitoring Plan. For works identified as high-risk in the EPPs, including works in or near environmental

sensitive areas, Environmental Works Plan (EWPs) will be developed. EWPs describe the environmental aspects of defined work activities within those locations and outline the mitigation measures which will be implemented to protect the environment while completing the work activities. EWPs provide a granular level of detail and are designed to be used by construction crews working in specific sensitive locations. Minimum requirements for Project documents are provided in Table 3-1.

As design and construction progress various EPPs and EWPs will be created to address activity/area specific scopes of work. The Contractor will produce EPPs that outline activity/area specific scopes of work that identify mitigation measures that may be used during the construction. The Owner's Environmental Manager will review and approve the Contractors EPPs. Prior to the start of a new construction activity, the sub-contractor will produce activity specific EWPs that outline the specific mitigation measures that will be installed for each phased of a specific activity. The Contractors Environmental Manager will approve the sub-contractors EWPs.

The CEMP outlines EA level commitments and general BMP mitigation measure that are expected by Woodfibre LNG to be a part of the Contractor EPPs and EWPs. The EPPs and EWPs will provide the details related to how the EA level commitments and general BMPs mitigation measures will be implemented and operationalized. Woodfibre LNG has an approval role for the Contractor EPPs and has the opportunity to review the EWPs and will work to ensure that relevant BMPs that meet the expectations of the rigorous environmental and regulatory landscape of British Columbia, and the expectations of Skwxwú7mesh Úxwumixw (Squamish Nation) as an environmental regulator of the Project are reflected. A current list of EPPs that are in development for the early part of the Project scope are listed in Section 3.1.2. Quarterly updates of the EPPs that are being developed will be provided to key stakeholders of this CEMP.

Table 3-1 : Project Environmental Management Documentation Requirements

Document	Minimum Requirements
Component Environmental Management Plan	• Environmental assessment conditions and commitments. • Legislative requirements and permits. • Roles and Responsibilities of Project personnel. • Environmental setting and potential risks. • Best Management Practices considered. • Mitigation measures to be implemented. • Working windows. • Training and orientation requirements. • Ínexwantas (Monitoring), reporting, and record keeping requirements.
Environmental Protection Plan	• A description of which elements of relevant Best Management Practices will be utilized. • Roles and responsibilities. • Detailed description of reporting processes including sharing of ínexwantas (monitoring) results. • Activities and locations covered by the EPP; • Reference to applicable Compliance requirements;

Document	Minimum Requirements
	• Reference to applicable EMP requirement; • Workplace and activity specific mitigation measures to prevent environmental damage from the activities covered by the EPP; • Details regarding the construction techniques that will be used to ensure the Work being conducted is consistent with EMPs and all applicable Compliance Requirements; and • Drawings showing the locations covered by the EPP and the mitigation measures to be implemented.
Environmental Work Plan	• Roles and responsibilities. • Summary of Works to be conducted and a detailed description of the proposed activities intended to be addressed in the EWP. • Equipment and materials that will be used. • Schedule of works including duration and reference to environmental timing constraints, where relevant. • Detailed Environmental Maps (as described in Section 5.6) including work locations, environmental sensitivities, and mitigation measures to be implemented. • List of applicable Compliance Requirements including the start date and expiry date for any applicable Permits and approvals and key terms and conditions. As appropriate the relevant Compliance Requirements shall be included as an attachment to the EWP. • Reference to applicable CEMP, EMPs, and EPP. • Mitigation measures and best management practices to be implemented including a detailed description of how, when, and by who the measures and practices will be implemented. • Relevant spill prevention and emergency response procedures applicable to the Work being conducted as an attachment the EWP, including contact information (i.e., office number, cell phone number and email).

3.1.2 Environmental Protection Plans

EPPs will be developed to support various activities during construction. The initial phase of the Project will require the following EPPs that will be shared with Indigenous Groups for the activities listed below:

- Clearing and Grubbing – Including soil and vegetation removal, stockpile management, non-contaminated and contaminated sites management.
- Shoreline Works – Including ESC measures, sedimentation pond construction, and adaptive management for turbidity.
- Marine Piling Works – Including marine excavated material, placement of rip-rap, demolition of rip-rap, marine and intertidal soil management, and seawater management.
- Marine General – Including transportation, vessels, marine traffic, separate biosecurity management plan related to overseas cargos, marine ínexwantas (monitoring) protocols, hydroacoustic ínexwantas (monitoring), stak̲w (water) sampling and marine mammal ínexwantas (monitoring).
- Waste Management – Including site wide waste management requirements for the project, regular domestic waste and hazardous waste management.

- Spill Response and Material Management – Including spill response, material management and reporting procedures that will be followed by all Project personnel.

As the construction schedule progresses, EPPs to support construction activities will be developed prior to the works commencing. To reduce the risk of duplicating plan names all Woodfibre LNG Plans will be titled as Environmental Management Plans, all Contractor plans will be Environmental Protection Plans or Environmental Work Plans.

3.2 ROLES AND RESPONSIBILITIES

3.2.1 Woodfibre LNG

Woodfibre LNG is responsible for ensuring development of the Project Environmental Governance documentation is in accordance with the Project's environmental requirements and obtaining approval of these documents from all relevant regulators and authorities. Woodfibre LNG is ultimately accountable for implementation of the CEMP. Woodfibre LNG is also responsible for approval of the Contractor Implementation Tools, ensuring they effectively establish the means and methods to achieve the project-wide environmental requirements agreed within the approved Governance documents.

In addition, Woodfibre LNG will provide continual oversight of the implementation of environmental management practices across the entire Management Framework to ensure environmental requirements are consistently met. Woodfibre LNG will report on compliance with the Project environmental requirements and the effectiveness of environmental management at the project-level (see Section 4.0). Where environmental requirements are not met, Woodfibre LNG is responsible for implementing adaptive management processes to improve management measures and processes to ensure environmental requirements are met.

3.2.1.1 Woodfibre LNG Environmental Monitor

A Qualified Environmental Professional will be retained by Woodfibre LNG as the Environmental Monitor throughout the duration of the Construction phase of the Project to satisfy Condition 1 of Schedule B of the EAC. Woodfibre LNG's Environmental Monitor will be responsible for overseeing the Contractor's Environmental Monitor to determine compliance with Project environmental approval conditions and implementation tools. The Woodfibre Environmental Monitor will be provided the Contractor Implementation Tools (EPPs and EWPs) to support compliance ínexwantas (monitoring) and surveillance audits. The Environmental Monitor has the authority to stop Project work if they determine that environmental approval conditions are not met or if necessary to prevent or reduce significant environmental harm.

3.2.2 Contractor

The Contractor(s) is responsible for the implementation of the CEMP as well as the development of Contractor Implementation Tools (EPPs and EWPs), which must outline the management measures included in this CEMP. Ínexwantas (Monitoring) results must be reported by the Contractor to Woodfibre

LNG. The Contractor will actively participate in adaptive management processes where required, including review and update of the Implementation Tools. An ínexwantas (monitoring) plan will be developed, and will be approved by the Project Owner, outlining the specific activities that will be monitored for, frequency of, methodologies used, and identifying key personnel.

Specific Contractor Roles and Responsibilities are detailed below.

3.2.2.1 Contractor Project Director

The Contractor Project Director is ultimately accountable for implementation of the EPPs and EWPs. The Construction Director will ensure:

- The EPPs and EWPs are developed in accordance with the Project's environmental requirements and approved Project Environmental Governance Documents.
- The Project complies with the requirements of the EPPs and EWPs.
- Personnel, facilities, and other resources necessary to effectively implement the environmental requirements of the Project are provided.

3.2.2.2 Contractor Construction Director / Site Manager

The Contractor Construction Director / Site Manager is responsible for ensuring the implementation of the EPPs and EWPs. The Contractor Construction Director / Site Manager will:

- Report to the Contractor Project Director on the implementation of the EPPs, identifying additional requirements for personnel, facilities, and other resources required to meet Project environmental requirements.
- Provide leadership and motivation to the Contractor Team.
- Actively develop and maintain a culture in line with the Contractors Health, Safety, Security, and Environmental (HSSE) policies and procedures.
- Ensure that the EPPs and EWPs are adhered to.
- Actively participate in HSSE compliance audits, inspections, reviews, and programs.
- Close out corrective actions and programs within specified deadlines as informed by the Contractor HSSE Manager or Contractor Environmental Manager.

3.2.2.3 Contractor Construction Supervisor

The Contractor Supervisor includes area construction managers, superintendents, and other supervision roles under the Contractor Organizational Chart. The Contractor Construction Supervision is responsible for the field implementation of the EPPs including:

- Ensuring all personnel adhere to the requirements of the EPPs and EWPs.
- Implementing a culture in line with the Contractors HSSE policies and procedures.

- Implementing environmental management measurers under advice of the Contractor Environmental Manager.
- Leading and supporting investigations and ensuring the implementation of corrective actions.

3.2.2.4 Contractor HSSE Manager

The Contractor HSSE Manager is responsible for ensuring construction activities are performed in compliance with the requirements outlined in the EPPs and EWPs, Company Environmental Management Plan(s), applicable approvals, permits, licensed and federal/provincial/local regulations, in addition to Contractor Quality, Health, Safety, Environment, and Security (QHSES) Management System. Contractor HSSE Manager is accountable for the planning and effective implementation of the Site HSSE program. To deliver these plans the Contractor HSSE Manager has explicit responsibility for the following tasks:

- Consult on HSSE matters, including environmental aspects related to the EPPs and EWPs or Project compliance as required.
- Lead the development, implementation, and ínexwantas (monitoring) of the Project HSSE Management System and ensuring alignment of the EPPs with the System.
- Leads and participates in investigations of environmental incidents or regulatory non-compliance events, compliance audits, and site inspections as required.
- Support the Contractor Environmental Manager in the implementation and compliance of the Project Environmental Management Process.

3.2.2.5 Contractor Environmental Manager

The Contractor Environmental Manager is responsible for the planning and effective implementation of environmental management measures during activities related to the Contractor scope of work. Reporting to the Contractor HSSE Manager, the Contractor Environmental Manager will:

- Ensure environmental management measures are completed in accordance with the Project environmental requirements, Environmental Governance Documents, and the Contractor Implementation Tools.
- Serve as the principal point of contact for Woodfibre LNG environmental representatives.
- Develop and approve Contractor Implementation Tools including the EPPs and EWPs and any other plan and / or procedures required throughout the duration of Contractor scope of work. The Contractor Environmental Manager will submit Implementation Tools to Woodfibre LNG environmental representatives for approval.
- Approve any Subcontractor EWPs, method statements, risk assessments, or any additional procedures or documents required throughout the duration of Subcontractors scope of work.
- Lead and approve environmental reporting deliverables in alignment with Project environmental requirements.

- Provide guidance to the Contractor Supervisors and field personnel on how to meet Project environmental requirements.
- Make sure adequate resources (e.g., equipment, materials, training, personnel, etc.) necessary to meet environmental requirements are available.
- Ensure the Contractor site orientation incorporates applicable environmental requirements, as well as applicable additional training is identified and available for site personnel.
- Supervise and coordinate environmental compliance and ínexwantas (monitoring) activities under the Contractor scope of work.
- Support and guide construction activities for compliance with the overall Project environmental requirements.
- Coordinate environmental risk assessments and associated work planning process.
- Ensure adequate ínexwantas (monitoring), auditing, reporting, and documentation are captured and actioned according to the Project requirements.
- Ensure compliance of environmental protection plan(s), HSSE plan(s) and procedure(s), and general documents with contract, Project specifications and overall requirements.
- Ensure environmental incidents are investigated and reported within the specified timeline.
- Lead and participate in investigations of environmental incidents or regulatory non-compliance events, compliance audits, and site inspection as required.
- Ensure environmental lessons learned, corrective, and preventive actions are captured and implemented.
- Liaise with the Contractor Construction Management Team and other Project stakeholders to review environmental compliance on the jobsite, evaluate the success and effectiveness of the environmental program, and seek opportunities for continuous improvement.
- Support the Contractor HSSE Manager in the implementation and compliance of the Project HSSE Program including Best Management Practices.

3.2.2.6 Contractor Environmental Monitor

The Contractor Environmental Monitors will be responsible for ínexwantas (monitoring) construction activities to determine compliance with Project environmental conditions of approval and implementation tools. All Contractor Environmental Monitors will be supervised by a QEP, as defined by the *Professional Governance Act* and applicable regulatory bodies (e.g. College of Applied Biology). At a minimum, a QEP will be available by phone to provide guidance and consult on issues that may arise on site. Key responsibilities include:

- Conducting field ínexwantas (monitoring) as required (e.g., stak̲w [water] quality ínexwantas [monitoring], air quality ínexwantas [monitoring], identifying invasive plants, and sts'úkwi7 [fish] observations).

- Monitor construction activities to determine whether the works are resulting in any adverse effects on the environment (e.g., potential impacts from underwater noise on sekw'ekw'inexw [wildlife]) and advise on corrective mitigation measures, if necessary.
- Prepare reporting documentation including but not limited to ínexwantas (monitoring) activities, effective implementation of mitigation measures, and performance against quality indicators.
- Evaluate the performance of mitigation measures and when not performing, provide recommendations, and evaluate the effectiveness of, on modifying or improving mitigation measures.
- Ensure that any non-conformances and incidents are appropriately reported, addressed, and that corrective and preventative actions are effective.
- Review the Contractor EPPs and EWPs for consistency with the CEMP and Component Environmental Management Plans.
- Implementation of the Environmental Ínexwantas (Monitoring) Plan.
- Submit reports to Woodfibre LNG on the above tasks.

3.3 ENVIRONMENTAL TRAINING & COMPETENCIES

All Project personnel must receive a Project-specific orientation and training to achieve a level of environmental awareness and competence necessary for performance of the proposed activities.

A qualified professional will oversee the development of the environmental portion of the Project orientation. The Environmental content of the Project orientation will be reviewed by Woodfibre LNG. The Contractor Environmental Manager, or delegate, is responsible for delivering the environmental portion of the Project orientation to all Project personnel.

The Project orientation shall be completed prior to the commencement of works, and to personnel joining the Project at their commencement.

Records of attendance (e.g., for orientation, training, toolbox talks) shall be maintained including:

- The person inducted/trained, their position/role, and signature (which could be in the form of record of completion of an online training session).
- When the person was inducted/trained.
- The name of the inductor/trainer.
- Description of the orientation/training content.

Records of attendance shall be kept electronically for the duration of the Project.

Details of environmental training requirements are provided in Table 3-2.

Table 3-2: Environmental Training

Training	Requirements
Project Orientation	• An overview of the CEMP and associated environmental approval documentation including purpose, key objectives, accessibility and relevant conditions of permits and approvals. • An overview of Project-specific environmentally sensitive areas and aspects. • An overview of site-specific environmental risks and hazards and control measures as identified in the CEMP and supporting documentation. • Locations of sensitive receptors and appropriate work practices to minimize impacts. • Heritage items and legislative considerations of working on/near heritage items. • High-risk Project activities with respect to environmental risk. • Roles and responsibilities related to environmental management for the Project. Location and contact information of key environmental personnel. • An overview of environmental and safety protocols and emergency and incident response procedures. • Cultural heritage awareness (including chance find procedures), responsibilities, management procedures.
Archaeological training	• An overview of archaeology, its importance in cultural resource management, and its relevance to the LNG facility construction. • A review of relevant federal, provincial, and regional legislation and regulations governing archaeological resources and their protection. • Understanding the importance of engaging with First Nations communities, respecting their knowledge, cultural heritage, and traditional territories. • Techniques for recognizing and evaluating potential archaeological sites during ground disturbances. • Guidelines for proper recording, reporting, and documenting archaeological findings and their associated artifacts. The training will be conducted in-person and will take one-hour to complete. This training may be complemented by additional online materials. An assessment of participants' understanding, and application of the training materials will also be undertaken, following which certification will be issued upon successful completion.
Toolbox / pre-start meetings	• Activities and potential risks. • Issues and incidents. • Changes to procedures and standards. • New environmental risks.
Specialist Environmental Training	• Requirements for Specialist Environmental Training will be detailed in relevant Component Management Plans (e.g., Sekw'ekw'inexw tl'a shkwen [Marine Bird] Training).

3.3.1 Qualified Professional and Specialists

Development, implementation, and supervision of environmental management plans including component plans must be completed by a Qualified Professional. A Qualified Professional must be registered and in

good standing with an appropriate B.C. professional organization constituted under the *Professional Governance Act*.

Development, implementation, supervision, and ínexwantas (monitoring) must be completed or overseen by a Qualified Professional for, but not limited to, the following tasks and activities:

- Development of environmental management plans (including this CEMP).
- Stak̲w (Water) quality ínexwantas (monitoring) (marine and fresh stak̲w [water]).
- Determining and ínexwantas (monitoring) instream flow requirements for Mill and Woodfibre Creek.
- Observation of marine mammals during selected in-stak̲w (water) or near-stak̲w (water) construction activities.
- Identification and management of invasive plants.
- Evaluation of marine sts'úkwi7 (fish) species.
- Pre-vegetation clearance sekw'ekw'inexw (wildlife) surveys.

Specific requirements are detailed within the applicable component Management Plans appended to this CEMP.

4.0 CONSULTATION AND ENGAGEMENT

4.1 MANAGEMENT PLANS

Environmental management plans for the below valued components must be submitted to Indigenous Groups and Project stakeholders no less than 30 days prior to the planned date to commence construction. Management plans must be available electronically. Indigenous Groups and stakeholders for each plan are identified below:

- CEMP: EAO, MOF, BCER, and Indigenous Groups.
- Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Management Plan: EAO, DFO, BCER, and Indigenous Groups.
- Invasive Plants: EAO, MOF, BCER, and Skwxwú7mesh Úxwumixw (Squamish Nation).
- Sekw'ekw'inexw (Wildlife) : EAO, Environment Canada (EC), MOF, BCER, and Indigenous Groups.
- Traffic: EAO, Ministry of Transportation and Infrastructure (MOTI), and the District of Skwxwú7mesh (Squamish) (DOS).
- Marine Transportation: EAO, Transport Canada (TC), Canadian Coast Guard (CCG), Pacific Pilotage Authority, DFO, the DOS, BC Ferries, Skwxwú7mesh (Squamish) Terminals, and Indigenous Groups.

Environmental management plans for the below valued components must be submitted to EAO 60 days prior to commencement of construction works. Indigenous Groups and stakeholders for each plan are identified below:

- Sh̲kwe̓ (Marine Water): MOE, MOH, DFO, BCER, VCH and Indigenous Groups (submitted prior to construction); and
- Marine Mammals: EAO, DFO, BCER, and Indigenous Groups (submitted 30 days prior to the planned date to commence Construction in the marine environment).

Consultation with identified Indigenous Groups and stakeholders regarding management plans will be completed as follows:

- Written notice will be provided to each party that:
    1. Includes a copy of the management plan;
    2. Invites the party to provide its views on the content of such management plan; and
    3. Provides the timeframe for each party to provide such views. A reasonable period of time will be provided to permit the party or parties being consulted to prepare their views and information. A timeframe of 30 days will be adopted, unless otherwise agreed between the consulted party or parties. Extensions to the timeframe may be requested and granted.
- A full and impartial consideration of any views and other information provided by a party in accordance with the timelines specified;
- Written explanation is to be provided to each party that provided comments as to how the views and information provided 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;

- A record of consultation with each such party regarding the management plan must be maintained; and
- A copy of management plan consultation record must be provided to the EAO, the relevant party, or both, promptly upon the written request of the EAO or such party.

4.2 CONSULTATION WITH INDIGENOUS GROUPS

Consultation with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) will be conducted in accordance with the EAC and SNEAA consultation and engagement requirements.

Where consultation with Indigenous Groups, apart from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), is required, communication with each group will be completed prior to initiating consultation to determine how to satisfy the consultation requirements including:

- Methods of notification.
- The type of information and the time period to be provided when seeking input.
- The process for full and impartial consideration of any views and information presented.
- How each Indigenous Group will be informed of how the views and information received have been considered.

Where consultation with Indigenous Groups is a requirement of a follow-up program, the Proponent shall discuss with each Indigenous Group opportunities for the participation of that Indigenous Group in the implementation of the follow-up program.

Indigenous Groups are to be provided opportunity to participate in ínexwantas (monitoring) activities within their asserted traditional territory. Engagement regarding ínexwantas (monitoring) activities is to be completed during development of submission of ínexwantas (monitoring) plans (see Section 7.0).

4.3 CONSULTATION AND NOTIFICATION OF MATERIAL CHANGE

Prior to initiating any material change to the Project, consultation with Indigenous Groups is required. The Agency shall be notified in writing no later than 60 days prior to initiating the change.

Requirements for consultation and notification are provided in Section 7.6.

4.4 GENERAL PROJECT NOTIFICATION

Notification and Public Communications are provided in Table 4-1.

Table 4-1: Notification and Communication

Notification and Communication	Requirements
Commencement	The Holder must notify EAO Compliance and Enforcement staff, in writing, three months prior to commencing the construction, operations, and decommissioning phases of the Project.
Project Contact Change	Should the primary contact for the Project change, the Holder must notify EAO Compliance and Enforcement staff, in writing, within 30 days and provide the physical address, email address and phone number(s).
Project Timing and Updates	This schedule will be updated and published on a regular basis and will be posted on the Woodfibre LNG website (https://woodfibrelng.ca/).

4.5 COMPLAINTS

A mechanism for receiving complaints has been established. Complaints can be submitted via Woodfibre LNG's website. Complaints will be recorded in a Complaints Register and investigated in a timely manner. Non-conformances or mitigation improvements are to be recorded and managed as per Section 7.3.

5.0 IMPLEMENTATION

5.1 ENVIRONMENTAL MITIGATION MEASURES

5.2 GENERAL MANAGEMENT

General management requirements to be implemented during Construction are provided in Table 5-1.

Table 5-1: General Management Requirements

Activity/Task	Requirements
Management Plans	CEMP and the Component Environmental Management Plans are to be developed by a Qualified Professional.
Orientation and Training	All Project personnel are to be provided an orientation that outlines the environmental risks and management requirements of the Project. Orientation and additional training / competency requirements are detailed in Section 3.3
Documentation Accessibility	The following documentation must be readily available at the Project site. The documentation must be current. • This CEMP • Component Plans described in this CEMP (Section 5.3). • The Project EPPs. • Current EWPs (i.e., those in use). • Applicable permits and licenses • Project Environmental Approval documentation (Section 1.4) • Environmental Ínexwantas (Monitoring) Plan • Non-conformance register (Section 7.3) • Incident Register (Section 6.0) • Corrective Action Register (Section 7.3)
Corrective Actions	Requirements for Corrective Actions are detailed in Section 7.3.
Record Keeping	A written record or a record in a compatible electronic format must be maintained throughout the Construction phase of the Project at a facility close to the Designated Project in Canada (local facility). The record shall include information related to the implementation of the CEMP and 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 • The results of the analyses.
Reporting	Reporting requirements are detailed in Section 7.4.
Incidents	Requirements for incident management and reporting are provided in Section 6.0.

5.3 BEST MANAGEMENT PRACTICES

5.3.1 Emergency Management and Response

An Emergency Response Plan (ERP) has been developed by Woodfibre LNG to satisfy the EAC Application requirements (see Section 13.2.2.6 and Table 22-1 M7.2-5), FDS and Section 38.1 under the *Oil and Gas Activities Act* and Emergency Management Regulation for the BCER. It is noted that the ERP does not form part of this CEMP as it is a standalone document, however, the ERP describes incident and emergency reporting requirements, investigation procedures including requirements for when an investigation must be completed and the responsible role. If required, the report and investigation must include a level of detail appropriate to the incident or emergency rating.

The ERP was developed with input from local, regional, and provincial emergency response authorities, including, but not limited to, Squamish Fire Department, the Squamish RCMP, Vancouver Coastal Health, and BC Ambulance Service. The Emergency Response Plan will be communicated to emergency response authorities and service providers.

Further detail for non-emergency environmental incidents is provided in Section 6.0.

5.3.2 Air Quality

The Project will follow best management practices to control emissions (greenhouse gas emissions and dust emissions) to reduce potential effects on air quality and the environment during construction.

Table 5-2 outlines key mitigation measures to be implemented to reduce potential impacts to air quality from greenhouse gas emissions and dust as outlined in the EA Application. Activity specific EWPs will include mitigation measures to reduce greenhouse gas emissions.

Table 5-2: Air Quality Mitigation Measures

Activity/Tasks	Mitigation Measures
Greenhouse Gases- (Scope 1 emissions)	• Maintain equipment / vehicles in good working order. • Switch off vehicles / machinery when not in use – implement engine idling time restrictions. • Use solar area lighting where feasible. • Use appropriate planning and scheduling to minimize unnecessary movement of materials into, around and out of the site.
Greenhouse Gases- (Scope 2 emissions)	• The Project will use renewable electrical power sourced from BC Hydro.
Minimize release of exhaust gases from fuel combustion	• Maintain equipment / vehicles in good working order. • Use fuel for all equipment that meets the manufacturer's specifications. • Switch off vehicles / machinery when not in use – implement engine idling time restrictions.
Dust Control	The following mitigation measures will be implemented to reduce the emission of fugitive particulate matter (i.e., dust) and prevent offsite dust impacts during construction.

Activity/Tasks	Mitigation Measures
	• Stakw (Water) exposed surfaces (using non-potable stakw [water] source where possible). • Cover soil stockpiles and exposed areas (e.g., tarpaulins, geotextile fabric). • Progressively restore disturbed surfaces. • Modify or cease work in windy conditions. • Modify site layout (place stockpiles away from sensitive receivers). • Reduce height of material drop if dust emission is evident. • Vegetate exposed areas using appropriate seeding. • Cover all transported waste. • Cover material loads that may emit dust when being hauled. • Minimize vertical drop distance of materials to transfer points to the extent feasible. • Load trucks with adequate freeboard so that loads do not spill during movement. • Maintain paved surfaces to reduce dust build up. • Demarcate traffic and parking areas to limit ground disturbance. • Control the speed of vehicles within the Site.

5.3.2.1 Dust Control

General dust control measures are outlined in Table 5-2. The Contractor will develop a dust suppression EPP including required dust control mitigation measures to prevent and control dust emissions associated with construction activities as well as ínexwantas (monitoring) requirements. Activity specific dust control measures will be included in the Dust Suppression Environmental Protection Plan as well as EWPs.

5.3.2.2 Noise and Vibration

Construction activities, including blasting, pile driving, and general facility construction, have the potential for adverse effects associated with noise and vibration. Table 5-3 outlines key mitigation measures to be implemented to reduce noise and vibration impacts to the surrounding environment and sensitive receptors (i.e. nearby communities). Details related to the implementation of activity specific mitigation measures will be included in the appropriate EWPs.

Table 5-3: Noise and Vibration Mitigation Measures

Activity/Tasks	Mitigation Measures
Communication with potential receptors	• Notify residents prior to high noise-emitting maintenance activities if appropriate. • A means (via Woodfibre LNGs website) for people to provide input if experiencing a high-noise activity is to be implemented. Complaints are to be recorded on complaints register and responded to in a timely manner.
Plant, equipment attenuation measures	• Equipment will be fit with standard mufflers or silencers. Mufflers and silencers are to be maintained to ensure they remain in good working order.

Arrange sites to reduce noise impact	• Existing onsite barriers are to be used for screening nearby dwellings from construction equipment sound. • Heavy equipment muster points will be located at least 500m from any receptor. • Orientate noisy equipment away from receptors. • Maximize offset distance between noisy equipment and receptors.
Schedule works to reduce noise impact	• High noise activities will be scheduled to reduce noise disruption whenever possible. • Schedule noisy activities during times of high-background noise where possible. • Where possible, heavy earthmoving equipment will be used between 0700 hours and 2200 hours. Works outside of these hours require a Temporary noise exemption permit issued by District of Skwxwú7mesh (Squamish). • High noise emitting maintenance activities are to be scheduled during the day whenever possible.

To ensure the effectiveness of these mitigation measures, short- and long-term ínexwantas (monitoring) will be implemented. The Contractor will develop specific noise ínexwantas (monitoring) requirements within the Ínexwantas (Monitoring) Plan which will outline the frequency, methodology, and reporting mechanisms for noise ínexwantas (monitoring) to determine compliance within permitted criteria. This ínexwantas (monitoring) will enable ongoing evaluation and assessment of the measures' performance in mitigating noise and vibration impacts throughout the construction phase.

5.3.3 Blasting Management

The following section outlines the key risks from blasting, as well as the measures required to mitigate, manage, and monitor impacts from blasting activities on the surrounding environment.

Construction blasting activities have the potential to impact the environment, including:

- Generation of noise and vibration
- Generation of fugitive dust and fumes
- Contamination from seepage and accidental spills of explosive materials
- Release of nitrogen compounds (i.e., total ammonia, nitrate, and nitrate)
- Ground disturbance (e.g., shaking loose of silt, sand, and rock particles) which can increase turbidity and TSS in stak̲w (water) runoff near or in blasting areas, and
- Flyrock

Blasting will be carried out by a certified blasting contractor and follow all relevant blasting regulations and guidelines. Table 5-4 outlines the key mitigation measures to reduce effects from blasting activities. Further details of mitigation measures for blasting with specific consideration to Sts'úkwi7 (Fish) are in Appendix E and marine mammals are in Appendix F.

Table 5-4: Blasting Mitigation Measures

Activity/Tasks	Mitigation Measures
Blasting	• 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 are at the lowest number (likely the summer) , where practicable. • A maximum of one underwater blast per day or at intervals of several hours. • Noises or blasts (e.g., thunderflashes) to scare birds away from the immediate vicinity of the blast will be emitted immediately prior to detonation. • Establish an appropriate blast clearance zone. • Use silt fences and curtains in blasting areas where surface stak̲w (water) runoff is high. • Schedule blasting activities during dry periods, where practicable. • Limit the use of ANFO. • Monitor stak̲w (water) quality downgradient of blasting areas. • Implement surface stak̲w (water) diversion and bench dewatering prior to blasting. • Direct surface stak̲w (water) runoff away from the drilled blast holes before loading begins. • Stak̲w (Water) runoff from blasting areas will be routed to a retention area and tested to meet BC Stak̲w (Water) Quality Guidelines prior to discharge, where practicable. • Dispose of explosives using a licensed person, or person under the supervision of a licensed person, and ensure disposal methods are appropriate to the type and condition of explosives. • Personnel to be trained in the proper handling of explosives. • Check blast holes for the presence of stak̲w (water) before loading. ANFO is only to be loaded into dry holes that have been effectively dewatered. • Use stak̲w (water)-resistant cartridge emulsion explosives for blast holes that cannot be effectively dewatered. • Use stak̲w (water)-resistant emulsion-based explosives during wet conditions. • Use a loading funnel in the collar of the blast holes to avoid spillage. • Use blast borehole liners when loading fractured ground or for blast holes with minor groundwater seepage.
Prevent accidental spills of blasting materials	• Ensure proper handling of the polyethylene bags or other containers during loading and unloading to mitigate potential for spills. • Explosive storage bags will be double-lined. • Shrink-wrap explosives stored on wooden pallets. • Ensure all poured explosive goes into the blasthole and sweep explosive material(s) surrounding the blast hole into the blast hole when loading is complete. • Keep loading sites clean by shoveling spilled explosives into the nearest blast hole prior to detonation. • Store explosives in proper explosives magazine(s). • Use blast hole liners in all blast holes containing stak̲w (water) to prevent seepage into rock and groundwater. • Spilled explosives will be cleaned up immediately using safe work procedures following the manufacturers recommendations.

The EM (if safe to do so) or Blasting Contractor will conduct regular inspections of the temporary explosive storage facilities.

A Blasting EPP will be developed which will include mitigation measures to reduce noise, exposed nitrates, metal leaching and ARD potential, blasting residuals, waste rock, material handling and

explosives storage. Details related to the implementation of activity specific mitigation measures will be included in the appropriate Environmental Work Plans.

5.3.4 Erosion and Sediment Control

Table 5-5 outlines key mitigation measures to be implemented to reduce erosion and sediment issues during construction. An Erosion and Sediment Control Plan (Appendix I) has been developed to satisfy the EAC Application requirements (see Section 13.2.2.9 and Table 22-1 M5.8-1)**.** The ESCP aims to mitigate erosion and sediment transport. Unmitigated erosion and the subsequent generation of sediment could have potential adverse environmental effects on aquatic and terrestrial environments.

Table 5-5: Erosion and Sediment Control Mitigation Measures

Activity/Tasks	Mitigation Measures
Avoid unnecessary disturbance of soils	• Silt fences, filter fabric, straw bales, gravel filter dikes, sedimentation ponds, perimeter ditches, cut- off swales or other stakw (water) quality management measures, will be selected, implemented, monitored, maintained, and repaired as required. • Divert surface runoff away from disturbed soil and stockpiles. • 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. • Install erosion and sediment controls before construction starts. • Inspect controls weekly, daily during rainfall, and immediately after rainfall. • Rectify damaged controls immediately. • Remove controls once surfaces have been stabilized, including removing trapped sediment in drainage lines. • Minimize ground disturbance and stabilize disturbed areas progressively. • 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 stakw (water) quality effects. • Stop work if soils become waterlogged or when there is a risk of sediment loss off site. • Sweep up any sediment/soil transferred off site at least daily. • Eliminate ponding and erosion by restoring natural landforms to the pre-works condition.
Effectively manage stormwater and overland flow	• Flows will be diverted from undisturbed areas away from or around construction areas. • Temporary and/or permanent stormwater drainage systems are to be developed during the construction phase (Section 1.3) • 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. • 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.

Activity/Tasks	Mitigation Measures
Maintain integrity of riparian zones	• 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. • No erodible materials will be stockpiled within riparian management areas. • 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

Further details of specific Erosion and Sediment Control measures are detailed in the Erosion and Sediment Control Plan. Details related to the of activity specific (i.e. site infilling) mitigation measures will be included in the appropriate EPPs (i.e. clear, strip and grubbing EPP, stormwater EPP) and the implementation of those measures in the appropriate EWPs.

5.3.5 Concrete Management

The following section outlines the key risks from concrete works, as well as the measures required to mitigate, and manage potential impacts from concrete activities on the surrounding environment.

Concrete works during construction have the potential to impact the environment, including:

- Contamination of stak̲w (water) (e.g., groundwater, surface stak̲w [water]) from:
  - Concrete contact runoff during pouring and curing;
  - Concrete vehicle and equipment wash pads and rinse stak̲w (water); and
  - Concrete batch plant area runoff stak̲w (water).
- Generation of noise and vibration
- Generation of fugitive dust

Table 5-6 outlines key mitigation measures to be implemented to reduce potential impacts from concrete works.

Table 5-6: Concrete Management Mitigation Measures

Activity/Tasks	Mitigation Measures
Concrete works	• When pouring concrete, spills of fresh concrete will be prevented from entering into the marine environment at the site through use of secondary containment, barriers or other exclusion means. • If 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 stak̲w (water) from leaking into surrounding stak̲w (water). • If fresh stak̲w (water) is used to cure concrete, the run-off will be monitored for acceptable pH levels, if the pH levels are outside the allowable limits, then the run-off stak̲w (water) will be contained and neutralized. • During inclement weather, uncured concrete will be protected or covered in a manner that minimizes creation of high pH stak̲w (water).

Activity/Tasks	Mitigation Measures
	• Barriers will be used as appropriate to prevent splashing over forms and into the stak̲w (water). • Wash equipment and tools that have come into contact with concrete will be stored in a designated area away from the marine environment and drainages, so that concrete affected stak̲w (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, stak̲w (water) pH and TSS levels will be monitored not to exceed allowable limits from the effect of dust and fines when discharging directly into the environment. 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 sts'úkwi7 (fish) from entering a contaminated area or constructing catch basins to recover the run-off and neutralizing it prior to disposal. • Concrete will be poured carefully to minimize spillage. • Appropriate spill cleanup materials will be readily available and easily accessible. Personnel will be trained in • Excess or spilled concrete will be contained, immediately clean up and disposed of in an environmentally acceptable manner. • Concrete vehicles and equipment will be cleaned at designated concrete wash pads that are segregated from other contaminated- stak̲w (water) streams. Designate containers (e.g. chute washout bins, chute washout bucket and pump, lined washout pits, washout roll-off bins) to collect, retain, and recycle the washout stak̲w (water) and solids from washing down concrete equipment. • Protect concrete being poured or setting from precipitation using polyethylene covers and tarps. Freshly poured concrete should be protected from precipitation for 48 to 72 hours. • Unused concrete will be disposed of properly. • Treat concrete contact stak̲w (water) onsite through sedimentation and chemical treatment. • Contain all runoff associated with concrete use stak̲w (water) (reclaimed or not) for treatment before it is introduced to the overall wastewater treatment system.

A concrete environmental protection plan will be developed in conjunction with the concrete batch plant operator that will include the requirements for transportation, storage, processing, using, cleaning and disposing of concrete materials. It will also address the known risks associated with concrete management around environmentally sensitive areas. If any concrete works occur prior to the batch plant operations the required mitigation measures will be detailed in an EWP.

5.3.6 Waste

Table 5-7 outlines key mitigation measures to be implemented to prevent and or reduce adverse effects from waste generated during construction.

A Waste Management Plan (Appendix J) has been developed to satisfy the EAC Application requirements (see Section 13.2.2.16 and Table 22-1 M5.10-4). The Waste Management Plan aims to ensure that generation of hazardous and non-hazardous wastes from the Project is minimized, and that waste is properly stored and disposed of. The contractor will develop a site specific Waste Management Environmental Protection Plan that will support the objectives in the Waste Management Plan (Appendix

J) and describe site specific details related to waste such as waste bin types and locations, segregation procedures, criteria for waste storage locations, waste inspection frequencies, record keeping requirements and reporting frequencies. Activity specific EWPs will include details on how waste will be handled to comply with site waste management requirements and a separate Floatel Waste Management Plan (focusing on waste specific to the Floatel and its operations) will be developed to supplement the Waste Management Plan.

Table 5-7: Waste Mitigation Measures

Activity/Tasks	Mitigation Measures
Hazardous Waste Management	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 Waste Management	• 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.

Further details of specific Waste Management practices are detailed in Appendix J.

5.3.7 Stak̲w (Water) Management

Table 5-8 outlines key mitigation measures to be implemented to reduce adverse effects on stak̲w (water) resources and, subsequently, freshwater sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat.

A Stak̲w (Water) Management Plan (Appendix C) has been developed to satisfy Condition 5 of Schedule B of the EAC and SNEAA Condition 3. The Stak̲w (Water) Management Plan aims to protect and manage the use of Stak̲w (Water) resources. Unmanaged Stak̲w (Water) resources have the potential to adversely impact freshwater sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat.

Table 5-8: Stak̲w (Water) Management Mitigation Measures

Activity/Tasks	Mitigation Measures
Instream works	• Isolate instream construction activities from stream flow where possible. • Undertake instream works during periods of reduced flow where possible. • All fill materials or materials that will contact watercourse stak̲w (waters), including shoreline works or surfacing, will be clean and free of organic material and deleterious substances. • Minimize duration and extent of activities within watercourses and riparian setbacks where possible.

Activity/Tasks	Mitigation Measures
	• Avoid instream use of equipment where possible. • Undertake instream works during the reduced risk instream work window.
Stak̲w (Water) take and release	• Manage instream flow releases to prevent impact to the Creek. • Manage stak̲w (water) take to ensure minimum flow requirements are maintained. • Salvage and relocate sts'úkwi7 (fish) prior to instream work where possible.

5.3.8 Shk̲weṅ (Marine Water) Quality

Table 5-9 outlines key mitigation measures to be implemented to prevent and or minimize impacts to marine water quality as a direct result of construction activities.

A Shk̲weṅ (Marine Water) Quality Management and Ínexwantas (Monitoring) Plan (Appendix D) has been developed to satisfy Condition 6 of Schedule B of the EAC. The requirements from the EA Application for Shk̲weṅ (Marine Water) Management Plan (Table 22-1 M5.10-1) and the Underwater Noise Management Plan (Table 22-1 M5.17-6) are addressed in the Shk̲weṅ (Marine Water) Quality Management and Ínexwantas (Monitoring) Plan.

The MWQMMP is aimed at minimizing sediment disturbance during construction and prevent discharge or runoff containing high TSS, concrete wash stak̲w (water) and fuel from entering the marine environment.

If there are competing requirements between BC or CCME, stak̲w (water) quality criteria and permit requirements (i.e., Waste Discharge Authorization) activities will comply with Project specific commitments and permit conditions.

Table 5-9: Shk̲weṅ (Marine Water) Quality Mitigation Measures

Activity/Tasks	Mitigation Measures
Marine Works	• 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 Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) is currently August 16 - January 31 (DFO 2014). 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 Skwxwú7mesh Úxwumixw (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. • 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.

Activity/Tasks	Mitigation Measures
	• All works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment or sediment laden stakw (water), turbid stakw (water) or any other deleterious substance into the marine environment. All discharges from construction activities shall meet BC stakw (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 stakw (water) quality regulatory criteria during Project works. • The following stakw (water) quality criteria will be applied based on BC stakw (water) quality guidelines (MOE 2009) with regards to discharge or introduction of sediment or sediment- laden stakw (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 ▪ 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 stakw (waters). This may include use of silt curtains and other silt control measures.
Prevent unnecessary entrainment of sediment within the marine environment	• Vessels and other equipment involved in pile driving, dredging, and construction activities will be positioned in a manner that will prevent damage to the seafloor and shoreline. • Avoid marine works during weather conditions that may increase sediment suspension. • Clearly demarcate areas of seafloor to be disturbed (e.g, dredging) to limit the disturbance area. For dredging activities, the following mitigation measures will be followed: • Use methodologies that reduce seafloor disturbances (e.g., making additional dredge passes rather than dragging a bucket or beam to level the dredge surface, not stockpiling material underwater) • Use of environmental clam shell bucket to minimize sediment loss during dredging.
Prevent unnecessary sediment disturbance and discharge / runoff of	• Ensure any direct discharge of stakw (water) to the marine environment meets relevant stakw (water) quality guidelines. • 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.

Activity/Tasks	Mitigation Measures
sediment, concrete, chemicals, or other deleterious material to the marine environment	• Install sediment curtains and other sediment control devices to isolate activities likely to result in an increase in turbidity of shk̲weṅ (marine water). • Stak̲w (Water) collected in temporary sediment control structures will be analyzed and its quality determined. If stak̲w (water) quality meets acceptable guidelines, it will be discharged into Nexwnéwu7ts Átlk'a7tsem (Howe Sound); otherwise, it will be treated prior to discharge or disposed offsite
	For creosote pile removal: • 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 temíxw (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 approved.
Underwater Noise Management	Pile Driving and Related Activities: • Multiple underwater noise generating activities will be minimized when practicable (e.g., avoid multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced to minimize construction duration. • Works in the marine environment will be conducted during the least risk fisheries work window specified by DFO for the region unless otherwise agreed upon by DFO. The prescribed work window for Nexwnéwu7ts Átlk'a7tsem (Howe Sound) is August 16 – January 31 (DFO 2014b). • Where possible, pile driving activities will avoid impacting hard substrates to prevent disturbance to sts'úkwi7 (fish) habitat. • The use of vibrational pile driving will be used where practical and feasible as impact pile driving is associated with louder sound pressure levels underwater. The use of vibro-hammers for pile installation minimizes the effects on sts'úkwi7 (fish) by decreasing the anticipated noise levels. • A ramp up or soft start technique will be used. Where equipment allows, power will be built up slowly from a low energy start-up to give adequate time for marine sekw'ekw'inexw (wildlife) to leave the vicinity before exposure to the maximum sound pressure level. There will be a soft start every time pile driving is resumed following an interval of no pile driving. Prior to pile driving, the perimeter of the pile driving area will be identified, so that work occurs within the confines of the pile driving area.

Further details of specific Shk̲weṅ (Marine Water) Quality measures are detailed in Appendix D.

5.3.9 Marine Mammal Management

Table 5-10 outlines key mitigation measures to be implemented to reduce adverse effects to marine mammals.

A Marine Mammal Management and Ínexwantas (Monitoring) Plan (Appendix F) has been developed to satisfy Condition 9 of Schedule B of the EAC and FDS Condition 3.8. The MMMMP aims to reduce displacement and direct mortality of marine mammals.

Table 5-10: Marine Mammal Management Mitigation Measures

Activity/Tasks	Mitigation Measures
Identify opportunities to reduce potential harm and disruption to marine mammals	• Detect and report the presence of marine mammal species prior to and during works that may impact the area – stop works if a potential for impact to the marine mammal is identified • Utilize sound dampening technology and soft-start procedures where possible to reduce underwater noise impact Schedule activities (e.g., pile driving) with consideration for: • Periods of elevated marine mammal occupancy
Avoid / reduce human-sekw'ekw'inexw (wildlife) interactions	• Limit sea-vessels speeds within the Project area to minimize potential for contact with marine mammals • Clearly demarcate sea-vessel shipping / transport routes • All Project vessels will maintain a constant course and constant speed, to the extent practical, when operating in the Riparian Assessment Area (RAA). • Under no circumstances, other than in the case of an emergency, will vessels approach within 200 m of any marine mammal or 400 m of a yéwyews (killer whale). • If marine mammals approach within 200 m, or 400m by a yéwyews (killer whale), of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal. If it is not possible for a vessel to move away from or detour around a stationary marine mammal or group of marine mammals, the vessel will reduce its speed and wait until the animal(s) moves at least 200 m, or 400 m for a yéwyews (killer whale), from the vessel prior to resuming speed.

Further details of specific Marine Mammal measures are detailed in Appendix F.

5.3.10 Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat

Table 5-11 outlines key mitigation measures to be implemented to reduce impacts to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat in the marine environment.

A Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Management and Ínexwantas (Monitoring) Plan (Appendix E) has been developed to satisfy Condition 8 of Schedule B of the EAC and FDS condition 3. The Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Management and Ínexwantas (Monitoring) Plan aims to protect marine sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat and should be read in conjunction with mitigation measures detailed within the Erosion and Sediment Control Plan (Appendix I) and the Shx̱weṉ (Marine Water) Quality Management and Ínexwantas (Monitoring) Plan (Appendix D),

Table 5-11: Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Mitigation Measures

Activity/Tasks	Mitigation Measures
Prevent harm to sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat	• 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 Nexwnéwu7ts Átlk'a7tsem (Howe Sound) is currently August 16–- January 31 (DFO 2014).

Further details of specific Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat measures are detailed in Appendix E.

5.3.11 Vegetation

Table 5-12 outlines key mitigation measures to be implemented to prevent potential impacts of construction on vegetation and minimize the spread of invasive plant species.

An Invasive Plant Management Plan (Appendix G) has been developed to satisfy Condition 10 of Schedule B of the EAC. The Invasive Plant Management Plan aims to prevent and control the establishment and spread of invasive plant species. Unmanaged invasive plants have the potential to adversely impact the environment, including effects on native vegetation, ecosystems, and biodiversity.

Table 5-12: Vegetation Mitigation Measures

Activity/Tasks	Mitigation Measures
Vegetation clearing areas	• Clearly delineate vegetation to be cleared using signage. • Install signage and barriers to prevent access / harm to vegetation not approved from removal. • Limit clearing to approved areas. • Restrict vehicle access to designated tracks / roadways. • Avoid vegetation clearing within the riparian area along Mill Creek (outside of the Green Zone), Woodfibre Creek, and the adjacent mature forest. • In the event of a spill, vegetation and soil may be removed to facilitate cleanup. Any removed vegetation will be replaced after cleanup to encourage re- establishment of natural vegetation communities
Prevent unnecessary harm to vegetation	• Limit clearing of native vegetation communities to the extent required for construction of Project facilities. • Install tree protection prior to commencing works. • Where feasible, temporary construction features, such as laydown areas, will be located on paved or previously disturbed areas to reduce clearing. • Avoid stockpiling of materials and equipment within the drip-line of vegetation. • Preferentially tie-back or trim vegetation rather than remove where possible
Weeds and pest management	• Bag all plant parts and excavated topsoil that may be infested with weed propagules and dispose at a licensed waste disposal facility or as outlined in the Invasive Plant Management Plan. • All construction vehicles are to be free of any soil, mud and plant debris adhering to tires, undercarriage, or chassis before entering the site to prevent introduction of plant and soil borne pathogens. • Minimize soil transportation within, into or out of the site area to reduce the spread of weeds
Rare Plant Management	• Rare plant surveys will be conducted in areas to be disturbed by the Project (i.e., the footprint) to identify the locations of any listed plant species that may be affected by clearing activities. • Surveys will be conducted in the spring to coincide with flowering and maximize the detectability of rare plants. • Any listed plant species that are identified within the Project footprint will be salvaged and replanted in appropriate microsites elsewhere in the Local Assessment Area (LAA).

Further details of specific Invasive Plant Species control measures are detailed in Appendix G.

5.3.12 Sekw'ekw'inexw (Wildlife)

Table 5-13 outlines key mitigation measures to be implemented to reduce impacts to sekw'ekw'inexw (wildlife) . A Sekw'ekw'inexw (Wildlife) Management and Ínexwantas (Monitoring) Plan (Appendix H) has been developed to satisfy Condition 11 of Schedule B of the EAC and components of FDS conditions 4 9 and addresses the requirements from the EA Application of the Sekw'ekw'inexw tl'a shkwen (Marine Bird) Management Plan (Table 22-1 M5.17-8). The Sekw'ekw'inexw (Wildlife) Management and Ínexwantas (Monitoring) Plan aims to prevent and reduce potential adverse effects to sekw'ekw'inexw (wildlife) from construction activities.

Table 5-13: Wildlife Mitigation Measures

Activity/Tasks	Mitigation Measures
Identify opportunities to reduce potential harm and disruption to sekw'ekw'inexw (wildlife)	Schedule activities (e.g., vegetation clearance, blasting) with consideration for: • Migratory bird timing • Nesting seasons
Clearing of high-value habitat and habitat features (e.g., nesting areas)	• Install no-go fencing around areas to be retained • Avoid clearing vegetation during nesting seasons where possible. • Complete pre-construction / clearance surveys to identify the presence of terrestrial sekw'ekw'inexw (wildlife) including sensitive species • Prior to site clearing, sekw'ekw'inexw (wildlife) habitat features to be retained will be demarcated with no-go fencing and signage. • Maintain appropriate vegetation buffers and setbacks around high-value habitat features (e.g., roosts) where possible • Install habitat features to support sekw'ekw'inexw (wildlife) e.g., skáp'kap'tsaylh (bat) boxes to provide additional roosting habitat (following removal of roosting sites) • Salvage coarse woody debris that has been removed in upland areas to facilitate Project construction and relocate it along linear features and within the Green Zone upon completion of the construction phase
Avoid / reduce human-sekw'ekw'inexw (wildlife) interactions	• Clearly sign post sekw'ekw'inexw (wildlife) crossing locations • Limit speed on roadways within the Project area to 30 km/h • Include sign posting and information sheets on the Project site (e.g., lunch room) regarding identification of sensitive species and management requirements • Subject to safety requirements, blue or green lighting is to be used preferentially over red or white to reduce attractiveness to birds. Ensure food and/or domestic waste is removed from the construction site daily, or if such waste is to remain on-site overnight, store in animal resistant waste receptables or inside a locked storage structure/container or building.

Further details of specific Sekw'ekw'inexw (Wildlife) Management measures are detailed in Appendix H.

5.3.13 Lighting

The purpose of this section is to outline the measures required to reduce potential impacts from light and light pollution on the surrounding environment. Construction lighting may be utilized during construction activities for the Project to meet health and safety requirements. Light pollution may impact sekw'ekw'inexw (wildlife) habitat, behaviour, and movement as well as impact humans, other sensitive receptors (i.e. nearby communities), and dark sky values. The Project will require the installation and maintenance of temporary exterior lighting during construction. Light design will be developed in accordance with the International Commission on Illumination's CIE 150:2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations and with consideration to marine transport and bird safety requirements (Pollard et al., 2017).

Table 5-14 outlines key mitigation measures to be implemented to reduce effects from light pollution during construction. Further details of specific light mitigation measures to reduce impacts on marine sts'úkwi7 (fish) and sekw'ekw'inexw (wildlife) are detailed in Appendix E and Appendix H, respectively.

Table 5-14: Lighting Mitigation Measures

Activity/Tasks	Mitigation Measures
Construction Activities	• Direct artificial light away from sensitive receivers where possible (i.e., residents, fauna, or roadways). • Utilize directional and motion activated security lighting to reduce light pollution. • For lights that are not required to be continuously lit, use controls such as timers, sensors, or motion detectors to reduce unnecessary nighttime illumination. • Light to be directed only where it is needed. Light fittings / shielding should be used to direct light downwards to avoid light spill. • Use lighting technology that minimizes the amount of ultraviolet light generated. • Minimize lighting to the amount necessary to meet requirements and safely perform work. Intensity should be reduced to as low as possible. • Subject to safety and operational requirements, blue or green lighting rather than red and white lighting will be used to reduce the attractiveness to birds. • Consider curfews (e.g., turn unnecessary lights off late at night) where possible. • Switch off all construction lighting when not in use.

Details related to the implementation of activity specific mitigation measures will be included in the appropriate EWPs.

A separate Floatel Management Plan will be developed that details the specific lighting considerations and commitments for the floatel. This plan does not form part of this CEMP.

5.3.14 Visual

Table 5-15 outlines key mitigation measures to be implemented to reduce impact on visual quality. The following mitigation measures aim to effectively reduce effects on the visual quality during construction.

Table 5-15: Visual Mitigation Measures

Activity/Tasks	Mitigation Measures
Prevent unnecessary impact to the visual resources of the Project area and surrounding landscape	• Initiate decommissioning and maintenance planting programs during the construction phase, recognizing that results will not be realized until the operation or decommissioning phases of the Project. Preserve the level of contrast for Project infrastructure by re-finishing and maintaining external surfaces as required. • Direct artificial light away from sensitive receivers where possible (i.e., residents, fauna, or roadways). • Prevent excessive / unnecessary emanation of light from the Project site. • Maintain work areas in a clean and tidy condition. • All personnel will maintain a tidy appearance and exercise courtesy in dealings with the public. • All work equipment and materials will be contained within the designated boundaries of the work site. • All waste generated during the course of the works will be reused or removed from the work areas as soon as practicable and disposed of in accordance with the waste disposal safeguards (Appendix J – Waste Management Plan).Where possible, utilize colors for the facility that blend with the surrounding environment.

Condition 20 of Schedule B of the EAC requires a Visual Quality Management Plan be developed. The focus of the plan is related to mitigation of impacts to visual quality associated with the final design of the Project as well as potential cumulative impacts from the Project, BC Hydro, and Fortis BC. This plan will be developed during construction and distributed for consultation under separate cover.

5.3.15 Indigenous Heritage

Table 5-16 outlines key mitigation measures to be implemented to prevent harm to heritage resources. An Archaeological and Heritage Resources Management Plan has been developed by Woodfibre LNG to satisfy the EAC Application requirements (see Section 13.2.2.11) and FDS Condition 8.1. This plan does not form part of this CEMP.

Table 5-16: Indigenous Heritage Mitigation Measures

Activity/Tasks	Mitigation Measures
Prevent harm to Indigenous artifacts and relics	• Heritage Resource Chance Find Management Procedure to be followed. • Induct Project construction personnel to the identification of heritage items and required chance find management requirements.

5.3.16 Marine Transportation (Navigation)

Table 5-17 outlines key mitigation measures to be implemented within the Marine Transport Management and Monitoring Plan to reduce impacts of Project-related marine transportation during construction.

A Marine Transport Management and Monitoring Plan has been developed to satisfy Condition 16 of Schedule B of the EAC, Condition 7 of the FDS and mitigation M6.3-1 of Table 22-1 of the EA Application and does not form part of this CEMP.

Table 5-17: Marine Transportation Mitigation Measures

Activity/Tasks	Mitigation Measures
Prevent impact to existing and traditional navigational routes, fishing areas, habitat, harvesting areas, commercial shipping use, and recreational use	• Ensure ongoing effective communication with Indigenous Groups, stakeholders, and public authorities to ensure mutual understanding of potential interference including timing, duration, and type of interference. • Install navigational lights. • Update navigational charts and other nautical publications with relevant construction details.
Maintain access for Indigenous Groups to traditional use areas	• Consult with Indigenous Groups to identify potential areas of issue. • Where possible, maintain access to stak̲w (water) and temíxw (land) areas for Indigenous Groups.

5.3.17 Traffic Management

Table 5-18 outlines key mitigation measures to be implemented within the Traffic Control Management Plan to reduce impacts of Project-related transportation during construction:

A Traffic Control Management Plan has been developed by Woodfibre LNG to satisfy Condition 15 of Schedule B of the EAC and does not form part of this CEMP.

Table 5-18: Traffic Management Mitigation Measures

Activity/Tasks	Mitigation Measures
Prevent disruption to local traffic	• Work vehicles should not obstruct local roadways or restrict access to any private driveways. • Truck movements will be scheduled to cause minimum disruption and queuing. • Work vehicles will not obstruct vehicular or pedestrian traffic unless necessary. • Designate parking areas. • All temporary closures, diversions or obstructions on roads or parking areas should be clearly marked and equipped with signage explaining the duration and conditions of the closure or obstruction. • Pedestrian access ways should be maintained unless the access poses a safety threat to the community/Project staff. • Erect signs to inform road users of any temporary road closures. Ensure work vehicles do not obstruct vehicular or pedestrian traffic, or private driveways, public facilities, or business access unless necessary and only if appropriate notification has been provided.
Prevent unauthorized access to the Project site	As required, install fences and barricades around the site to prevent access

5.4 COMPONENT ENVIRONMENTAL MANAGEMENT PLANS

The EA Application described addition component plans to support the CEMP. Table 5-19 provides details as to where the requirements of those component plans have been, or will be, addressed.

Table 5-19: Component Plans to the CEMP

Component Plan	Status Update
Environmental Ínexwantas (Monitoring) Plan	The environmental ínexwantas (monitoring) plan will be a standalone document. Details related to the environmental monitoring plan can be found in Section 7.1
Blasting Management Plan	Section 5.3.3 contains general blasting mitigation measures. A Blasting EPP will be completed in advance of blasting activities (blasting to commence in 2024). A description of the content of the EPP is include in Section 5.3.3. Blasting will also be addressed in the appropriate activity EWPs.
Construction Emergency Response Plan	The Construction Emergency Response Plan has been developed under separate cover and has been accepted by the BC Energy Regulator.

Component Plan	Status Update
Creosote Pile Removal	The requirements of this plan are addressed in the Sḵwex̱ (Marine Water) Quality Management and Ínexwantas (Monitoring) Plan (Appendix D).
Concrete Works Management Plan	Section 5.3.5 contains general concrete mitigation measures. A Concrete Works Environmental Protection Plan will be developed in conjunction with the concrete batch plant operator. Details related to the content of the plan are included in Section 5.3.5. In the interim mitigation measures required for concrete work prior to the construction of the concrete batch plant (early concrete work – bollards and sedimentation ponds) will be included in EWPs.
Dust Control Management Plan	Section 5.3.2.1 contains general dust control mitigation measures. A Dust Suppression EPP will be developed to detail which components of BMPs will be utilized to control dust and the activity specific implementation details of dust control mitigation measures will be addressed in EWPs.
Erosion Prevention and Sediment Control	Section 5.3.4 and Appendix I of the CEMP contain general erosion and sediment control measures. Site specific details related to the implementation of mitigation measures will be documented in activity specific EPPs (i.e. clearing, grubbing and stripping and stormwater management) as well as EWPs.
Heritage Resources and Chance Find	The Archaeological and Heritage Resources Plan, which includes the chance find protocol, has been developed under separate cover. Table 3-2 provides details related to the archaeological and heritage resources component of the Project orientation.
Invasive Plants Management	The Invasive Plant Management Plan is Appendix G.
Marine Works Management Plan	Requirements of the Marine Works Management Plan are included in the Sḵwex̱ (Marine Water) Quality Management and Ínexwantas (Monitoring) Plan (Appendix D) and Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Management and Ínexwantas (Monitoring) Plan (Appendix E).
Underwater Noise Plan	Requirements of the Underwater Noise Plan are included in the Marine Mammal Management and Ínexwantas (Monitoring) Plan (Appendix F), Sekw'ekw'inexw (Wildlife) Management and Ínexwantas (Monitoring) Plan (Appendix H) and the Marine Sts'úkwi7 (Fish) and Sts'úkwi7 (Fish) Habitat Management and Ínexwantas (Monitoring) Plan (Appendix E). In addition, the Contractor will develop a hydroacoustic plan to support construction activities.
Marine Mammal Management	The Marine Mammal Management and Ínexwantas (Monitoring) Plan is in Appendix F.
Noise Vibration, and Ambient Light Management Plan	The general noise, vibration and light mitigations are outlined in the Sections 0 and 5.3.13, respectively. Further scope and activity specific mitigations related to noise, vibration and ambient light will be included in activity specific EPPs and EWPs.
Waste Management	General mitigation measures related to waste handling and management are included in Section 5.3.6 and Appendix J. A Waste Management Environmental Protection Plan will be developed, the details of which are outlined in Section 5.3.6. In addition activity specific waste management handling practices to ensure compliance with the Project requirements will be detailed in EWPs.

5.5 ENVIRONMENTAL SCHEDULES

Up to date records of Project Environmental Schedules are to be maintained on site. Environmental Schedules are provided in Table 5-20.

The Contractor Environmental Manager is responsible for ensuring all Environmental Schedules are up to date. The Contractor Environmental Manager may delegate maintenance of an Environmental Schedule.

Table 5-20: Environmental Schedules

Schedule	Description
Orientation Register	Register of personnel inducted to the Project.
Training and Qualification Register	Register of personnel training and qualifications required to perform environmental management tasks prescribed by this CEMP.
Waste Register	Register to track transport and disposal of waste material. Register to include: • Site address and responsible person (for management of waste) • Date waste was removed from site. • Waste type (classification) and estimated quantity. • Waste transporter (company name) and waste transporter vehicle registration. • Intended waste disposal facility and licence number. • Disposal docket (or similar) number and confirmed disposal volume. • Intended waste facility and facility license/approval number.
Chemical Register	Register of all chemicals stored onsite and their respective Safety Data Sheets
Complaints Register	Register to record environmental related complaints received throughout the Project. Register to include: • Complainant details • Date of complaint • How the complaint was made • Description of complaint • Date Environmental Manager was informed of the complaint. • Identification of incidents, non-conformances, and any corrective actions pursuant to the complaint are to be recorded in their respective locations.
Incident Register	Register of environmental incidents on the Project.
Sekw'ekw'inexw (Wildlife) Mortality	A database of sekw'ekw'inexw (wildlife) mortality associated with construction of the Project activities.

5.6 ENVIRONMENTAL MAPPING

The Project has developed environmentally valuable resources maps to inform construction planning (. The maps include:

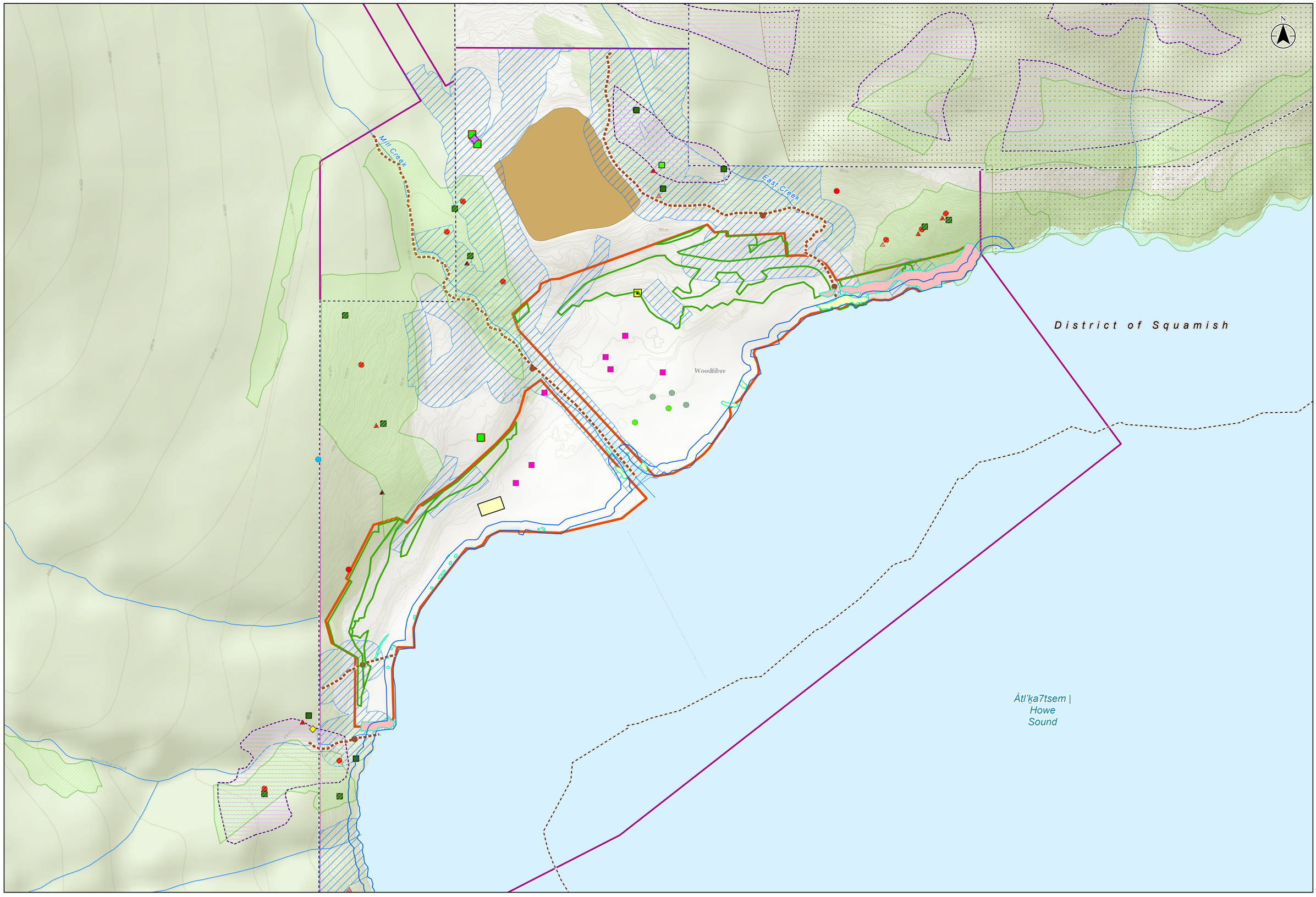
- Environmental Considerations:
    1. Environmentally sensitive areas (e.g., riparian areas)
    2. Sekw'ekw'inexw (Wildlife) features (i.e. sp'ákw'us [bald eagle] nest).
    3. Protected environmental areas/sites (e.g., heritage structures, protected vegetation).
    4. Watercourses (Mill Creek, Woodfibre Creek, 2 x ephemeral creeks), and other relevant topographic features (e.g., drainage channels).

EWPs will contain maps which will include:

1. Environmental features
2. Mitigation measures and locations (e.g., erosion and sediment control measures, noise protection, visual screens)

5.7 WORKING WINDOWS

Working windows are prescribed in Component Environmental Management Plans. If any works are required to be completed outside the prescribed working window, the work will be reviewed by a QP and supplemental mitigation will be developed and implemented in agreement with Skwxwú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh, and other regulating authority as required.



Service Layer Credits: World Topographic Map: District of Squamish, Sunshine Coast Regional District, Province of British Columbia, Esri Canada, Esri, HERE, Garmin, INCREMENT P, USGS, EPA, USDA, AAFC, NRCan

Western Screech-Owl Nesting Habitat Suitability Rating

- Moderate (2)
- Low (3)
- High (1)
- Moderate (2)
- Low (3)
- Suitable nesting habitat (Hemmera 2019)
- Western Toad, Northern Alligator Lizard, and Potential Snake Hibernaculum (2023)

Observation (prior to 2023)

- Coastal tailed frog
- Pacific Treefrog (Tadpole)
- Amphibian Breeding Site
- Band-tailed Pigeon
- Potential Western-Screech-Owl Nest Site - Dead (Snag)
- Barn Swallow Nest Sites (prior to 2023)
- Location of Barn Swallow Compensation Structure
- Location of Bat Boxes

Wildlife Feature Type and Status

- Potential Western-Screech-Owl Nest Site - Dead (Snag)
- Stream with Coastal tailed frog detected
- Bald Eagle Nest (Protected Year Round)
- Marbled Murrelet
- Spotted Owl Habitat
- Riparian Setback Protection Area
- Shoreline Buffer
- Marine Riparian Area - Low
- Marine Riparian Area - High
- Watercourse
- Capped Landfill
- Administration Building
- Municipal Boundary
- Certified Project Area
- Proposed Clearing Area
- Timber Cruise Area

0 100 200 300 400 m

1:4,000 (at original document size of 18x24)

ISSUED FOR DISCUSSION

This diagram is representative of what is known or anticipated as of August 9, 2023.
Information will change as project design evolves and details continue to emerge.
This map figure contains information different to prior figures due to the design evolution process.

Stantec | Woodfibre LNG

Project Location	Project Number 123221624
Howe Sound, British Columbia	Prepared by PKASIANCHUK on 20230901
Client/Project/Report	Requested by BKADLER on 20230831

Woodfibre LNG General Partner Inc

Figure No.	Revision
5-1	0

Title
Environmental Valuable Resources - No Facilites

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6.0 ENVIRONMENTAL INCIDENTS

An environmental incident is defined as an event that caused or has the potential to cause an adverse environmental impact. Examples of Environmental Incidents include, but are not limited to:

- Spills of oil, fuel, hazardous chemicals.
- Unauthorized discharges of deleterious substances into sts'úkwi7 (fish)-bearing stak̲w (water) bodies (e.g., sediment-laden stak̲w [water]).
- Unauthorized harmful alteration, disruption, or destruction of aquatic or terrestrial habitat.
- Alteration of, or damage to, heritage or archeological resources.
- Fires related to construction activities.
- Unauthorized release of air pollutants.

Incidents will be immediately reported to the Contractor Environmental Monitor and Manager and Woodfibre LNG Environmental Manager. The Woodfibre LNG Environmental Manager will report the incident to the appropriate authority if required.

Within five (5) working days of the Environmental Incident (or such longer time as the nature of the incident requires) the Contractor will provide to the Woodfibre LNG Environmental Manager a written environmental incident report that includes appropriate photo documentation and describes the:

- Cause and nature of the incident.
- Approximate magnitude and duration of the incident.
- Area or habitat affected.
- Environmental resources affected.
- Description of the sequences events leading up to and following the incident
- Results of any sample analysis taken in conjunction with the incident (e.g., stak̲w [water] samples).
- Mitigation measures (preventive and corrective actions) to control or limit the activity causing the incident, including a time frame for implementation.
- Additional proposed remedial or corrective actions recommended.
- Depending on the nature of the environmental incident, collection and analysis of samples may be required to characterize the extent and nature of the release.
- Reports will be available to regulators or Indigenous Nations upon request.

6.1 SPILLS

A spill is reportable under legislation if:

- an actual or potential contravention of a permit/approval condition occurs; or
- if the volume of a substance spilled, or likely to be spilled, is equal to or greater than the minimum quantity outlined in the BC Spill Reporting Regulation; or

if the spill of a listed substance enters, or is likely to enter, a body of stak̲w (water). The following measures shall be applied to reduce the likelihood of an environmental incident related to a spill from occurring.

6.1.1 Spill Prevention

- Equipment will be kept clean and in good working condition (e.g., free of leaks, excess oil, and grease). At a minimum, daily inspections of heavy equipment (e.g., drill rigs) must be conducted by the Contractor and documented.
- Where possible, all equipment working on or near stak̲w (water) will use bio-degradable hydraulic fluid unless the specifications of the equipment preclude its use (e.g., extreme high heat or high-pressure applications).
- Shore based equipment maintenance and fueling will be conducted greater than 30 m from freshwater or shk̲wen̓ (marine water), or as approved by the EM.
- A minimum of one of the Contractors' staff, trained in spill response and the specifics of the Contractors' Spill Response Plan will be on-site at all times.
- Drip trays will be used under non-mobile stationary equipment.
- Fuel and other hazardous material will be stored at least 50 m from a watercourse or Nexwnéwu7ts Átlk'a7tsem (Howe Sound) unless approved by Woodfibre LNG.
- Used spill response materials and/or contaminated soils will be disposed of at a registered, licensed waste disposal facility.
- A spill containment kit will be accessible onsite and in each piece of equipment.

6.2 SPILL RESPONSE

6.2.1 Non-Reportable Spill Response

In the event of a minor, non-reportable spill (Level 1), the general procedure outlined below is to be followed:

- Immediately cease work, if necessary to clean the spill.
- Stop the spill at its source, if safe to do so.
- Notify the Site Manager and Environmental Monitor of the spill.
- Contain and clean the spill in an appropriate manner (e.g., use of spill kits).
- Once cleaned, the Site Manager can remove environmental controls around the spill (as required) to continue work.

6.2.2 Reportable Spill Response

In the event of a reportable spill (Level 2 and Level 3), the Contractor will immediately implement the following Spill Response Procedure. The Procedure will be posted at the site office, anywhere hazardous materials are stored and at other strategic locations around site.

- **Assess the Situation** – Immediately cease work, assess the hazards and safety risk, determine the source and type of material spilled, and secure the area.
- **Stop the Source** – If safe to do so, stop the source of the spill.
- **Notify** – Immediately notify the Site Manager and the Environmental Monitor of the spill.
- **Contain the Spill** – Contain the spill in an appropriate manner using absorbent products (e.g., spill pads, socks, booms), drip trays and/or containment berms.
- **Clean-up and Dispose Impacted Materials** – Clean-up impacted material (e.g., soil) and used absorbent products. Dispose of impacted material in appropriate storage or transport offsite in accordance with applicable regulations.
- **Report** – All spills are reportable to the Environmental Monitor, regardless of the size.
- **Restock the Spill Kit** – Replace absorbent materials that were used during clean-up.

The following sections provide additional details on the Spill Response Procedure.

Assess the Situation

If there is imminent danger of explosion, evacuate the site. If evacuation is required, wait for the emergency responders to give approval to re-enter the site.

To ensure the safety of Project personnel and the public, it is essential that the situation be appropriately assessed. Appropriate assessment includes identification of the following:

- Type of material that has been spilled (e.g., workplace label, Safety Data Sheet).
- The source of the release.
- All sources of ignition and stop them it is safe to do so.
- Estimate the quantity of spilled/released materials.
- Potential and actual receptors (e.g., watercourse(s), ditches, catch basins, etc.).

Depending on the outcome of the assessment, the volume and type of product spilled may require that the area be secured (e.g., flagged off), and access limited.

Stop the Source

If safe to do so, immediately stop the flow at the source. This includes, but is not limited to, closing the valve, shutting off the pumps, plugging the leak/hole, or using the shut-off switch. Construction personnel working around equipment with an emergency shut-off switch will be made familiar with the location of this switch through daily tailgate meetings.

Notify

Upon identification of a spill that requires containment, clean-up, or disposal of material, immediately notify site supervision, who will notify the Contractor Environmental Monitor. The Contractor Environmental Monitor will immediately notify the Contractor Environmental Manager or delegate who will follow the reporting requirements described below.

When notifying the Contractor Environmental Monitor or delegate, provide as much information as possible, including, but not limited to:

- Location of the spill
- Type and estimated volume (litres) of substance spilled.
- Cause of the spill.
- Time of incident or incident discovery.
- Initial response actions taken.
- Area and environment (ground or stak̲w [water]) affected by the spill.
- Names of and contact information for personnel involved with spill discovery and response.
- Include photographs where possible to support the above information.

Contain the Spill

For spills to temíxw (land), contain the spilled materials and prevent spilled materials from flowing away from the spill site or from flowing into watercourses (e.g., creek, drainage ditch, or catch basin). Contain the spill with sorbents, booms, berms, diversion channels, or other non-combustible materials. If necessary, use nearby materials and equipment to build earthen containment berms if available and safe to do so.

For spills of petroleum products to stak̲w (water), deploy booms or other devices to contain the stak̲w (water) and/or the spilled materials and prevent further flow of materials into the environment.

For spills that cannot managed and contained internally, the Contractor will retain a third-party spill response company that will be on standby 24/7. Once the third-party spill response company has been retained this Plan will be updated with the name and contact information.

Dispose of Used Materials

The Contractor Environmental Manager or delegate, in consultation with Construction personnel, will determine cleanup options and requirements, including the need to bring in a third-party spill clean-up company. Prior to commencing with clean-up activities on reportable spills, a field level health and safety plan will be developed. This plan will identify the product being cleaned up and the appropriate personal protective equipment (PPE) that is required to be worn. Upon completion of the plan, mobilize recovery equipment and conduct clean-up activities.

Clean-up efforts will continue until such time as the Contractor Environmental Manager or delegate determines that the clean-up has been completed in accordance with regulatory and project requirements. Depending on the nature and extent of spill impacts to be cleaned up, the Contractor Environmental Manager or delegate will consult with a Contaminated Site Specialist, and/or the necessary regulatory agencies to ensure clean-up measures meet their requirements.

Spill-impacted material including spill abatement materials (e.g., absorbents, impacted berm materials), will be disposed of according to the nature and extent of contamination within the impacted material. For

example, small volumes of soil impacted by hazardous liquids will be disposed in a waste receptacle (e.g., drum) specifically designated to receive such materials. The designated receptacle will be identified with signage, covered, and be located at a minimum of 30 m from a watercourse or an environmentally sensitive area, or catch basin connecting to a watercourse or ESA. If it is not possible to locate receptacles 30 m from a watercourse or ESA, then secondary containment will be installed if not already built in. As necessary, the receptacle or the contents of the receptacle will be classified and disposed of at a licensed facility, as transported by an appropriately licensed hauler. The Contractor Environmental Manager or delegate will retain the manifests and/or bills of lading for all hazardous materials transported offsite.

In the event impacted material is to be directly hauled from the site of the spill to a designated facility, the Contractor Environmental Manager or delegate must notify Environmental Emergency Program (EEP) and request an Exemption from a Provincial Environmental Emergency Response Officer (EERO) during normal work hours, or from the on-call EERO for incidents that occur outside normal work hours. An EERO will immediately receive the report from EEP and assess whether a Section 52 Exemption under the Hazardous Waste Regulation (HWR) will be issued. This EERO may impose specific limits to determine to what extent the Section 52 offers relief from the HWR and will communicate this information to the Contractor or their delegate. Should a Section 52 exemption under the HWR be provided by the EERO, the space that normally notes the BC Generator Registration Number, will now have “Sec 52 HWR” followed by the assigned “Dangerous Goods Incident Report (DGIR) number” for the spill incident recorded in that space of the Hazardous Waste Manifest. An alternative to obtaining a Section 52 Exemption is to retain a Contaminated Site Specialist to characterize the material to confirm whether it is contaminated.

Site remediation may be required depending upon a variety of conditions including but not limited to, the size of the spill, type of hazardous substance spilled, and time between release and identification of a spill. The Contractor Environmental Manager and, if necessary, a Contaminated Sites Specialist, will determine whether site assessment and possible remediation is required, as per the Contaminated Sites Regulation (CSR). In the event remediation is required, the party responsible for the spill will complete the work in accordance with applicable law and regulation.

Restock the Spill Kit

The Contractor will maintain an adequate supply of surplus spill response equipment to ensure that spill kits can be replenished after use. It is the responsibility of the crew/supervisor responding to a spill to check the spill kit following clean-up operation and determine whether the spill kit requires immediate restocking. If restocking is required, the Contractor Environmental Monitor must be immediately notified. The Contractor Environmental Monitor will also conduct weekly inspections of spill kits deployed in the field and inform both the Contractor Environmental Manager and construction personnel of spill kit deficiencies. Visual inspections of spill kits must ensure that kits are onsite and readily available (i.e., easily accessible in the case of deployment), and contain the minimum required spill response equipment described in Section 6.3.

The Contractor Environmental Monitor will also conduct follow-up inspections after a known spill event to ensure that the spill kits are adequately stocked.

6.3 SPILL KITS

During the Project, all heavy equipment should be equipped with a spill kit. Typical equipment/vehicle spill kit contents are listed below:

- 15 to 20 all-purpose universal absorbent pads.
- Personal protective equipment, including nitrile gloves and eye protection (goggles).
- Heavy duty hazmat disposal bags.
- 2 to 3 absorbent socks.
- Laminated instruction sheets.
- Plug putty to plug punctured drums or tanks.

A barrel/tote spill kit will be placed near construction activities and will be immediately accessible in the event of a significant spill. These typically contain:

- Absorbent pillows
- Bag of granular absorbent
- 6 to 8 containment booms
- Tarp
- Disposable bags
- Neoprene drain cover
- 100 absorbent pads
- Nitril gloves
- Plug putty
- Goggles
- Laminated instruction sheet

General Spill Response Equipment Cache to be stored in the environmental spill container seacan:

- Communication
- Up-to-date Emergency Spill Response Plan
- Inventory of spill response equipment and locations
- Spill assessment forms (i.e., Environmental, safety, and spill assessments)
- Two-way radios, cell phone or other appropriate radio transmitter/receiver
- Personal Protection and Safety
- PVC gloves, insulated rubber gloves, leather gloves
- Rain gear (pants and jackets), steel toed rubber boots
- Safety glasses, hard hat, hearing protection
- 20:BC rated fire extinguisher, first aid kits
- Hand tools
- Tool kit, drum bung-wrench
- Pointed and/or broad shovels
- Flagging / barrier tape, traffic cones
- Tie wire, duct tape, 100 m of nylon rope (braided or twisted)
- Containment

- 1L of commercially available bentonite clay or equivalent (in dry or pre-mixed form) used to plug holes in leaking containers
- 3 tarps (large and medium)
- 80-100 empty sandbags (to be filled when requested)
- River boom (30-180 m)
- Re-bar (12 stakes)
- Rope ¼" diameter x 300 ft (200 m)
- 5 PVC pipes, 4" x 12'
- Recovery and Storage
- 3-6 bails of sorbent pads
- 2-4 bails of sorbent booms
- 1 roll of sorbent blanket
- 1,000-gallon (4,546 litre) port-a-tank
- 45-gallon drums – open tops with lids
- Plastic drum liners

Equipment for 500 L truck-box fuel tanks, 200 L drums and pails:

- Personal Protective Equipment
- Rubber steel toe boots, hard hat
- Rain gear, PVC gloves, eye/ splash protection
- Hand Tools
- Shovel
- Flagging / barrier tape
- Containment
- 250ml commercially available bentonite clay (in dry or pre-mixed form) used to plug holes in leaking containers
- 1 tarp (4m x 5m) and rope
- 10-20 empty sandbags (to be filled when needed)
- Plywood (1m x 2m)
- Recovery and Storage
- Plastic drum liners (heavy plastic bags)
- 25 absorbent pads (for petroleum)
- 1 absorbent boom (3m) and rope

Equipment for 2,000L – 5,000L tanks & 10,000L fuel trucks:

- Personal Protection and Safety
- Rubber steel toe boots, hard hat
- Rain gear, PVC gloves, eye/ splash protection
- Hand Tools
- 2 shovels
- Tool kit
- Reflective traffic warning triangles
- Containment
- 1L of commercially available bentonite clay (in dry or pre-mixed form) used to plug holes in leaking containers.
- 2 tarps (medium and large)
- Hatch-cone kit and hatch lock kit
- 3 plastic pails

Mobile Operations:

- • Plastic drum liners (heavy plastic bags)
- • 25 absorbent pads (for petroleum)
- • 1 sorbent boom (3m) and rope

6.4 SPILL REPORTING

All spills and environmental incidents on stak̲w (water) or Temíxw (land) will be immediately reported to Woodfibre LNG. All reportable spills will be reported by Woodfibre LNG to Emergency Management BC (EMBC) by calling 1-800-663-3456. All spills into a stak̲w (water) body are reportable and will require notification to DFO, Violations and Reporting at 604-666-3500 in addition to EMBC and Skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Manager. Indigenous groups (as defined in the LNG Project Federal Decision Statement) will also be notified of the spills as soon as possible.

An initial verbal report must be made immediately in the event of a reportable spill or release; the initial report will include the following information, where available without delaying reporting, with additional details provided as they become available:

- Contact information for the individual making the report, the responsible person for the spill, and the owner of the substance spilled.
- Date and time of the spill.
- Location of the spill site.
- Description of the spill site and the surrounding area.
- Description of the source of the spill.
- Type and quantity of the substance spilled.
- Description of the circumstances, cause, and adverse effects of the spill.
- Details of any action taken or proposed to:
    - Identify and evaluate the immediate risks to and impacts on the environment, human health, or infrastructure.
    - Address the threat or hazard caused by the spill.
    - Assess, monitor, and prevent, or prevent the continuation of, the threat or hazard.
    - Stabilize, contain, remove, and clean up the spill.
    - Advise persons to take protective action in relation to the spill.
    - Protect, recover, and restore the environment and infrastructure.
    - Identify and evaluate the long-term effect and resolve or mitigate immediate and long-term effects.
    - Names of any provincial, federal, local, and/or Indigenous government agencies at the spill site.
    - The names of other persons or government, federal government, local government or Indigenous government agencies advised about the spill.

6.5 SPILL REPORTING REGULATION

Spill quantities per the BC *Environmental Management Act* Spill Reporting Regulation are included in Table 6-1 below.

Table 6-1: Reportable Spill Quantities

Item	Substance Spilled	Specified Amount
1	Class 1, Explosives as defined in section 2.9 of the Federal Regulations	50 kg, or less if the substance poses a danger to public safety
2	Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a) of the Federal Regulations	10 kg
3	Class 2.2 Non-Flammable and Non-Toxic Gases as defined in section 2.14 (b) of the Federal Regulations	10 kg
4	Class 2.3, Toxic Gases as defined in section 2.14 I of the Federal Regulations	5 kg
5	Class 3, Flammable Liquids as defined in section 2.18 of the Federal Regulations	100 L
6	Class 4, Flammable Solids as defined in section 2.20 of the Federal Regulations	25 kg
7	Class 5.1, Oxidizing Substances as defined in section 2.24 (a) of the Federal Regulations	50 kg or 50 L
8	Class 5.2, Organic Peroxides as defined in section 2.24 (b) of the Federal Regulations	1 kg or 1 L
9	Class 6.1, Toxic Substances as defined in section 2.27 (a) of the Federal Regulations	5 kg or 5 L
10	Class 6.2, Infectious Substances as defined in section 2.27 (b) of the Federal Regulations	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
11	Class 7, Radioactive Materials as defined in section 2.37 of the Federal Regulations	Any quantity that could pose a danger to public safety and an emission level greater than the emission level established in section 20 of the Packaging and Transport of Nuclear Substances Regulations, 2015 (Canada)
12	Class 8, Corrosives as defined in section 2.40 of the Federal Regulations	5 kg or 5 L
13	Class 9, Miscellaneous Products, Substances or Organisms as defined in section 2.43 of the Federal Regulations	25 kg or 25 L

Item	Substance Spilled	Specified Amount
14	Waste containing dioxin as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
15	Leachable toxic waste as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
16	Waste containing polycyclic aromatic hydrocarbons as defined in section 1 of the hazardous Waste Regulation	5 kg or 5 L
17	Waste asbestos as defined in section 1 of the Hazardous Waste Regulation	50 kg
18	Waste oil as defined in section 1 of the Hazardous Waste Regulation	100 L
19	Waste that contains a pest control product as defined in section 1 of the Hazardous Waste Regulation	5 kg or 5 L
20	PCB Wastes as defined in section 1 of the Hazardous Waste Regulation	25 kg or 25 L
21	Waste containing tetrachloroethylene as defined in section 1 of the Hazardous Waste Regulation	50 kg or 50 L
22	Biomedical waste as defined in section 1 of the Hazardous Waste Regulation	1 kg or 1 L, or less if the waste poses a danger to public safety or the environment
23	A hazardous waste as defined in section 1 of the Hazardous Waste Regulation and not covered under items 1 – 22	25 kg or 25 L
24	A substance, not covered by items 1 to 23, that can cause pollution	200 kg or 200 L
25	Natural gas	10 kg

7.0 ÍNEXWANTAS (MONITORING), REVIEW AND REPORTING

Environmental ínexwantas (monitoring) and review will be completed with consideration for the principles of Adaptive Management. The Adaptive Management process is used to:

- Drive environmental monitoring requirements;
- Monitor the effectiveness of mitigation measures;
- Identify deficiencies in implemented environmental mitigation measures;
- Identify improvements to or additional environmental mitigation measures;
- Track and report on environmental non-conformances; and
- Track and report on corrective actions.

7.1 ENVIRONMENTAL ÍNEXWANTAS (MONITORING) PLAN

Environmental Ínexwantas (Monitoring) will include regular, periodic, or continuous ínexwantas (monitoring) of environmental mitigation measures and observations required to determine effectiveness and performance of implemented mitigation measures and identify the requirement for additional or amended mitigation measures.

As part of the Project Environmental Management Framework, an Environmental Monitoring Plan shall be developed by the Contractor. The Environmental Monitoring Plan will consolidate all environmental Ínexwantas (Monitoring) requirements as detailed in the Project certificates, permits, conditions, commitments, management plans, and the EPPs. The Monitoring Plan will also describe how the ínexwantas (monitoring) will be conducted (e.g., frequency, location), roles and responsibilities for ínexwantas (monitoring) activities, trigger values (where applicable) for ínexwantas (monitoring) activities, reporting mechanism and frequency and compliance values.

The Contractor Environmental Monitor is responsible for implementing the Environmental Monitoring Plan. Woodfibre LNG's Environmental Monitor is responsible for auditing the Environmental Monitoring Plan for compliance as described in Section 7.2.

At a minimum, ínexwantas (monitoring) records will include:

- Date;
- Location;
- Description of activities;
- Description of environmental risks and respective mitigation measures implemented;
- Summary of effectiveness of implemented mitigation measures
- Deficiency list; and
- Non-conformances.

Weekly Environmental Monitoring Reports are to be submitted by the Contractor Environmental Monitor to Woodfibre LNG and Skwxwú7mesh Úxwumixw (Squamish Nation) (see Section 7.4.2).

7.2 COMPLIANCE AUDITS

In addition to the ínexwantas (monitoring) and reporting requirements documented in the Monitoring Plan, surveillance and compliance audits will be undertaken. The Woodfibre LNG Environmental Monitor will conduct surveillance audits at regular intervals (e.g. minimum bi-weekly or more frequently based on environmental sensitivity of activities being conducted) to verify that work is proceeding in accordance with statutory requirements and the CEMP. The Woodfibre LNG Environmental Manager will conduct compliance audits of the environmental management systems quarterly, at a minimum.

The environmental auditing programme (surveillance and compliance) will be established by the Woodfibre Environmental Manager for the Project consisting of:

- Compliance with approvals permits and licences relevant to construction activities;
- Compliance with the CEMP, component plans and procedures;
- Stakeholder consultation and response;
- Contractor compliance requirements;
- Environmental training records; and
- Environmental records, ínexwantas (monitoring) and inspection records.

An environmental ínexwantas (monitoring) checklist will be developed to be used for auditing purposes

Compliance audit reports/actions will be provided to the Contractor Environmental Manager. Results of the surveillance audits will be documented in the Woodfibre LNG weekly ínexwantas (monitoring) reports which will be provided to the Contractor Environmental Manager.

7.3 CONTRACTOR NON-CONFORMANCES & CORRECTIVE ACTIONS

All non-conformances of work activities identified (during ínexwantas [monitoring] activities or otherwise) will be documented and reported to the Contractor Environmental Manager to identify the cause(s), and to identify required action(s) to prevent recurrence.

Woodfibre LNG and the Contractor Environmental Monitor will be notified immediately or at first available opportunity following notification of any affected authorities. The Contractor Environmental Monitor has the authority to stop Project work if works do not fully comply with environmental approval requirements and stopping works is necessary to prevent or reduce significant harm. Woodfibre LNG will notify EAO of any non-conformance with the Certificate within 48 hours of becoming aware of any such non-conformance, or immediately for any non-conformance that may cause significant adverse effects.

The Contractor Environmental Monitor is responsible for immediately taking steps to detect the cause of the non- conformance and advise on preventative action necessary to prevent recurrence. The Contractor Environmental Manager shall implement the action requests within the agreed time-period.

Action requests will be implemented within a period reasonably required by the Contractor Environmental Manager or relevant authority. Corrective actions shall be monitored for effectiveness by the Contractor Environmental Monitor. Duration of ínexwantas (monitoring) and reporting requirements shall be confirmed with the Contractor Environmental Monitor on an action-by-action basis.

The Contractor Environmental Manager will develop new or alternative mitigation measures, with input from a QP if required, considering any recommendations or feedback provided, if the measures identified in this CEMP prove ineffective or may be improved to avoid or reduce adverse environmental effects. The implementation of the proposed change in mitigation measures is subject to the approval and judgement of the Contractor Environmental Monitor to ensure compliance with environmental objectives and regulatory obligations. Following approval, the change in mitigation measures will be documented and communicated to relevant personnel. Ínexwantas (Monitoring) of the effectiveness of the new or alternative mitigation measures will be conducted.

Non-conformances and corresponding corrective actions shall be recorded on the Corrective Actions Register (Appendix B). Verification of successful implementation of corrective actions is required for each action. Verification may include sampling results, photographic evidence, or other such items which appropriately demonstrate effective implementation of the action.

Woodfibre LNG will prepare monthly reports detailing compliance with approval requirements. Reports will be retained by Woodfibre LNG throughout the construction phase of the Project and for five years after commencing the operations phase.

7.4 REPORTING

7.4.1 Monthly Compliance Reports

EAC Schedule B Compliance Reports will be submitted to the EAO Compliance and Enforcement staff at least 30 days prior to the start of construction. Monthly reports will be developed throughout the Construction phase of the Project. The Compliance Reports will include:

- Status of Compliance with the EAC.

Reports will be retained by Woodfibre LNG through the Construction phase of the Project and for five years after commencing operations.

7.4.2 Weekly Environmental Ínexwantas (Monitoring) Reports

The Contractor Environmental Monitor will produce daily records that will be complied into weekly ínexwantas (monitoring) reports to ensure ongoing effectiveness of implemented mitigation measures. The Contractor weekly ínexwantas (monitoring) reports are to be submitted to Woodfibre LNG. Woodfibre LNG's Environmental Monitor will produce weekly Environmental Ínexwantas (Monitoring) Reports that summarize all ínexwantas (monitoring) activities and quality assurance assessments (contractor weekly ínexwantas [monitoring] reports to be appended or similar). Evidence of ínexwantas (monitoring) results is to be included where relevant (e.g., photographs, sampling results).

Woodfibre LNG will provide weekly EM reports to Skwxwú7mesh Úxwumixw (Squamish Nation) when available, and to other Indigenous Groups if interest is expressed.

7.5 CEMP REVIEW

Woodfibre LNG Environmental Personnel shall review this CEMP (and associated documents) and update where required, at the following frequency:

- Annually (12 months) from commencement of construction works.

In addition, Woodfibre LNG shall review and update this CEMP (and associated documents) and update where required, if:

- A significant actual or potential incident resulting in or having potential to result in significant environmental harm occurs;
- Environmental ínexwantas (monitoring) determines implemented environmental management measures are not effectively managing Project environmental risks; or
- Material change to the Project scope, construction methodology, or any other change that occurs that is material in nature.

7.6 MATERIAL CHANGE

Written request to the Chief Executive Assessment Officer for determination of material change must be made if Project activities, components, and/or locations described in Schedule A (Project Activities) of the EAC (E15-02) require change, amendment, or are otherwise identified as inconsistent.

Written request must include, where relevant, details regarding:

- A description of the change to the Project;
- The proximity of the proposed location to the location referenced in Schedule A;
- The purpose of the proposed changes to Project activities described in the change request;
- Whether the proposed activities were considered in any regulatory or approval process that concluded after the date of the EAC;
- Whether or to what extent the proposed activities or similar activities were considered in the EA;
- Whether, after any consultation with Indigenous Groups undertaken or any further such consultation directed or undertaken by the Executive Director, the proposed activities may adversely affect Indigenous Interests that were not (i) considered in the Application and assessment, or (ii) considered in any regulatory or approval processes that concluded after the date of this Certificate;
- Description and analysis of the adverse environmental effects of the change(s);
- Any modified or additional measures to mitigate any environmental effect and additional follow-up requirements resulting from the change; and
- Whether and to what extent the conditions in the EAC constitute practical means of preventing or reducing any potential adverse effects that will, or are reasonably likely to, result from the proposed activities.

In addition, consultation with Skwxwú7mesh Úxwumixw (Squamish Nation) via the Rights and Title department is required prior to material change to determine if the change is material to the existing scope of this CEMP and / or Project approval.

If any material change(s) occur from the initial schedule, a revised implementation schedule will be provided to the Agency and anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012* at least 30 days prior to the implementation of the change.

A template for assessment of Material Change and determining updates to this CEMP and supporting documents is provided in Appendix K. As required, figures, ínexwantas (monitoring) results, or other details are to be appended to the template.

Appendix A Table of Concordance

Table A-1: FDS Approval Conditions (relevant to this CEMP)

Note – Within the concordance tables agency and regulator names and Aboriginal Groups are used verbatim from the condition text indicated; FLNR is now MOF, OGC is now BCER and Aboriginal Groups are now referenced as Indigenous Nations

No.	Condition	CEMP Reference
FDS		
2.1	The Proponent shall, throughout all phases of the Designated Project, ensure that its actions in meeting the conditions set out in this Decision Statement are considered in a careful and precautionary manner, promote sustainable development, are informed by the best available information and knowledge, including community and Aboriginal 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.	Section 1.0
2.2	The Proponent shall, where consultation is a requirement of a condition set out in this Decision Statement: • (2.2.1) provide a written notice of the opportunity for the party or parties being consulted to present their views and information on the subject of the consultation; • (2.2.2) provide sufficient information and a reasonable period of time to permit the party or parties being consulted to prepare their views and information; Page 5 of 15 • (2.2.3) provide a full and impartial consideration of any views and information presented by the party or parties being consulted; and (2.2.4) advise the party or parties that have provided comments on how the views and information received have been considered by the Proponent	Section 4.0
2.3	Where consultation with Aboriginal groups is a requirement of a condition set out in this Decision Statement, and prior to initiating that consultation, communicate with each Aboriginal group to determine the manner by which to satisfy the consultation requirements referred to in condition 2.2, including methods of notification, the type of information and the period of time to be provided when seeking input, the process for full and impartial consideration of any views and information presented and the means by which each Aboriginal group will be informed of how the views and information received have been considered by the Proponent.	Section 4.2
2.4	Where a follow-up program is a requirement of a condition set out in the Decision Statement, undertake monitoring and analysis to verify the accuracy of the environmental assessment as it pertains to the particular condition and/or to determine the effectiveness of any mitigation measure(s). Determine whether additional mitigation measures are required based on the monitoring and analysis undertaken and if additional mitigation measures are required, implement the additional mitigation measures and monitor them accordingly.	Section 7.0
2.6	The Proponent shall, commencing in the reporting year that implementation of the conditions set out in this Decision Statement begins, prepare an annual report that sets out:	N/A

No.	Condition	CEMP Reference
	• (2.6.1) the activities undertaken in the reporting year to comply with each of the conditions set out in this Decision Statement; • (2.6.2) how the Proponent complied with condition 2.1; • (2.6.3) for conditions set out in this Decision Statement for which consultation is a requirement, how the Proponent considered any views and information that the Proponent received during or as a result of the consultation; • (2.6.4) the results of the follow-up program requirements identified in conditions 3.14, 4.3, 6.5, 7.2 and 9.3; and (2.6.5) any additional mitigation measures implemented or proposed to be implemented by the Proponent, as determined under condition 2.4.	
2.7	The Proponent shall submit to the Agency the annual report referred to in condition 2.6, including an executive summary in both official languages, no later than March 31 following the reporting year to which the annual report applies.	N/A
2.8	Publish on the Internet, or any medium which is widely publicly available, the annual report and the executive summaries referred to in conditions 2.6 and 2.7, any plan(s) to offset the loss of fish and fish habitat referred to in condition 3.11, the archaeological and heritage resources management plan referred to in condition 8.1, the decommissioning plan referred to in condition 10.1, the annual report referred to in condition 10.3, the reports referred to in conditions 11.4, the communication plan referred to in condition 11.5, the implementation schedule referred to in condition 12.1 and any update(s) or revision(s) to the above documents, upon submission of these documents to the parties referenced in the respective conditions. The Proponent shall keep these documents publicly available for 25 years following the end of operation or until the end of decommissioning of the Designated Project, whichever comes first. The Proponent shall notify the Agency and Aboriginal groups of the availability of these documents once they are published	N/A
2.9	Notify the Agency and Aboriginal groups no later than 60 days after the day on which there is a transfer of ownership, care, control, or management of the Designated Project in whole or in part.	Section 4.4
2.10	Consult with Aboriginal groups prior to initiating any material change(s) to the Designated Project that may result in adverse environmental effects, and shall notify the Agency in writing no later than 60 days prior to initiating the change(s)	Section 4.3
2.11	In notifying the Agency pursuant to condition 2.10, the Proponent shall provide the Agency with an analysis of the adverse environmental effects of the change(s) to the Designated Project, as well as the results of the consultation with Aboriginal groups.	Section 4.3
3.1	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 Aboriginal groups, to protect fish during sensitive life stages	Section 5.3.7 Appendix C
3.2	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:	Section 5.3.3 Appendix I

No.	Condition	CEMP Reference
	• (3.2.1) implementing erosion control measures and sediment control measures during all phases of the Designated Project. • (3.2.2) revegetating disturbed riparian areas, using native plant species, after construction. • (3.2.3) using silt control measures around in-water construction activities. • (3.2.4) preventing wet concrete or cement-laden water from entering the marine environment.	
3.3	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on fish, including mortality, physical injury and behavioral change, during all phases of the Designated Project. The mitigation measures shall include: • (3.3.1) isolating instream construction activities in Mill Creek from adjacent streamflow. • (3.3.2) salvaging and relocating fish during instream construction activities requiring isolation of freshwater fish habitat in Mill Creek. • (3.3.3) maintaining minimum flow in Mill Creek and Woodfibre Creek to support fish and fish habitat. (3.3.4) designing, installing, and operating a water intake structure to avoid or reduce the risk of injury and mortality to fish in Mill Creek and Woodfibre Creek	Section 5.3.7 Appendix C
3.4	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 5.3.7 Appendix E
3.5	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 5.3.8 Appendix D
3.6	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 herring (*Clupea pallasi*) larvae.	Section 5.3.7 Appendix C
3.7	Design, install, and operate any marine discharge diffuser to prevent the deposit of a deleterious substance in water frequented by fish.	Section 5.3.10 Appendix E
3.8	The Proponent shall establish and maintain marine mammal underwater noise impact areas for all construction activities to avoid adverse behavioural change in or injury to marine mammals. In doing so, the Proponent shall: • (3.8.1) identify each construction activity that generates underwater noise levels greater than 160 decibels and 190 decibels at a reference pressure of one micropascal and the periods of time when each activity occurs. • (3.8.2) for cetaceans, establish the boundary of the marine mammal underwater noise impact area for each construction activity identified in condition 3.8.1 at the distance from the activity at which the underwater noise level is predicted to reach 160 decibels.	Section 5.3.9 Appendix F

No.	Condition	CEMP Reference
	• (3.8.3) for all other marine mammals, including pinnipeds, establish the boundary of the marine mammal underwater noise impact area for each construction activity identified in condition 3.8.1 at the distance from the activity where underwater noise levels reach 190 decibels or at a distance of 125 metres, whichever is the greater distance. • (3.8.4) employ a marine mammal observer, who is a qualified individual, and require that person to detect and report the presence of marine mammals in the marine mammal underwater noise impact areas identified in conditions 3.8.2 and 3.8.3 during construction activities identified in condition 3.8.1. • (3.8.5) stop or not start the construction activities identified in condition 3.8.1 if a cetacean is detected in the underwater noise impact area identified in condition 3.8.2 or if a pinniped is detected in the underwater noise impact area identified in condition 3.8.3, and only begin or continue the construction activities identified in condition 3.8.1 once the cetacean or pinniped has moved out of their respective underwater noise impact area. (3.8.6) implement mitigation measures, including sound dampening technology and soft-start procedures, to reduce construction noise levels in the marine mammal underwater noise impact areas identified in conditions 3.8.2 and 3.8.3.	
3.9	Require that LNG vessels associated with the Designated Project respect speed profiles applicable to the operation of the Designated Project, subject to navigational safety, to prevent or reduce the risks of collisions between LNG vessels and marine mammals	Section 5.3.16
3.10	Require that LNG vessels and tug operators associated with the Designated Project report collisions with marine mammals in Howe Sound to the Canadian Coast Guard within two hours of a collision occurrence, and notify Aboriginal groups in writing	Section 5.3.16
3.11	In consultation with Fisheries and Oceans Canada and Aboriginal 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	Appendix E
3.12	For any fish habitat offset areas proposed in any offsetting plan(s) under condition 3.11, and prior to submitting the offsetting plan to Fisheries and Oceans Canada, the Proponent shall determine whether there are adverse effects: • (3.12.1) on migratory birds and their habitats • (3.12.2) on terrestrial species, including amphibians and reptiles, and their habitats • (3.12.3) on listed species at risk and their habitats • (3.12.4) on the current use of lands and resources for traditional purposes by Aboriginal peoples • (3.12.5) on the flow rates, water depths or water widths that may affect the passage of a vessel, including a vessel used by Aboriginal peoples in the context of their current use of lands and resources for traditional purposes • (3.12.6) on physical and cultural heritage and structure, site or thing that is of historical, archaeological, paleontological or architectural significance to Aboriginal peoples (3.12.7) 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.	N/A
3.13	Avoid or lessen adverse effects on elements in conditions 3.12.1 to 3.12.7	N/A

No.	Condition	CEMP Reference
3.14	In consultation with Fisheries and Oceans Canada and Aboriginal 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.	Appendix E
4.1	Carry out all phases of the Designated Project in a manner that protects migratory birds and avoids harming, killing or disturbing migratory birds or destroying, disturbing or taking their nests or eggs. In this regard, the Proponent shall take into account Environment and Climate Change Canada's Avoidance Guidelines. The Proponent's actions in applying the Avoidance Guidelines shall be in compliance with the Migratory Birds Convention Act, 1994 and with the Species at Risk Act.	Section 5.3.12 Appendix H
4.3	Develop, prior to construction and in consultation with Aboriginal groups, and implement, during all phases of the Designated Project, a follow-up program to verify the accuracy of the environmental assessment as it pertains to the environmental effects of the air cooling system on migratory birds and to determine the effectiveness of the mitigation measures used to avoid harm to migratory birds, their eggs and nests, including the measures used to comply with condition 4.1.	N/A
6.1	The Proponent shall implement noise and air emission reduction measures during all phases of the Designated Project to avoid or reduce adverse environmental effects on human health, including: (6.1.2) following best management practices and guidance from the British Columbia Oil and Gas Commission's Noise Control Best Practices Guidelines.	Section 5.3.2.2
6.2	The Proponent shall, in consultation with Aboriginal groups and other parties who may be adversely affected by the noise caused by the Designated Project, develop, prior to construction, and implement, during all phases of the Designated Project, a mechanism for receiving noise complaints associated with the Designated Project. The Proponent shall respond in a timely manner to any noise compliant(s) received.	Section 5.3.2.2
6.3	The Proponent shall install and manage exterior lighting from all components of the Designated Project and during all phases of the Designated Project to prevent excessive emanation of light, by following the International Commission on Illumination's CIE 150:2003 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, while meeting marine transportation and aviation safety requirements.	Section 5.3.13
6.4	Monitor water quality and sediment, using as a benchmarks the Canadian Council of Ministers of the Environment's Water Quality Guidelines for the Protection of Aquatic Life and Interim Sediment Quality Guidelines for the Protection of Aquatic Life, and shall communicate any exceedance(s) of the Guidelines to relevant government authorities and Aboriginal groups, and implement additional mitigation measures to remedy those exceedances.	Section 5.3.8 Appendix D
6.5	The Proponent shall, in consultation with Aboriginal groups and relevant health authorities, develop, prior to construction, and implement a follow-up program to verify the assessment predictions regarding the bioavailability and bioaccumulation of contaminants in fish consumed by humans. The follow-up program shall include: • (6.5.1) prior to the commencement of marine in-water construction activities, establishing baseline conditions in the tissue of shellfish and groundfish for polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins and furans, copper, lead, zinc, tributyltin, arsenic, cadmium and methylmercury and using this information to update the human health risk assessment for the consumption of shellfish and groundfish;	N/A

No.	Condition	CEMP Reference
	• (6.5.2) during marine in-water construction activities, monitoring the re-suspension and bioavailability of polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butyltin, arsenic, cadmium and methyl-mercury in the tissue of shellfish and groundfish; and • (6.5.3) if a potential for human health risk is identified in the updated human health risk assessment for the consumption of shellfish and groundfish referred in condition 6.5.1 or through monitoring referred in condition 6.5.2, conducting additional sampling of polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butyltin, arsenic, cadmium and methyl-mercury in the tissue of shellfish and groundfish to confirm the assessment predictions regarding the bioavailability and bioaccumulation of contaminants in fish consumed by humans. If required, additional sampling shall start immediately upon completion of marine in-water construction activities and continue for one year following completion of marine in-water construction activities. The Proponent shall communicate the results of the follow-up program, including the results of any additional sampling, to Aboriginal groups.	
7.1	The Proponent shall, in consultation with Aboriginal groups and other marine users, develop, prior to construction, and implement, during all phases of the Designated Project, a communication protocol related to marine transportation. The communication protocol shall include procedures and practices for sharing information between the Proponent and Aboriginal groups and other marine users on the following: • (7.1.1) location and timing of construction activities associated with the Designated Project-related, location and timing of ferry and water taxi traffic associated with the Designated Project and location of marine access route to be used by LNG vessels associated with the Designated Project in Howe Sound; • (7.1.2) location and timing of traditional activities by Aboriginal groups and of activities by other marine users; • (7.1.3) Designated Project-related safety procedures, such as navigation aids, updated navigational charts and use of escort tugboats; • (7.1.4) areas where navigation may be controlled for safety reasons; • (7.1.5) speed profiles and schedules applicable to the operation of LNG vessels associated with the Designated Project; and • (7.1.6) ways in which Aboriginal groups and other marine users can provide feedback to the Proponent about adverse environmental effects related to navigation caused by activities associated with the Designated Project, including construction activities and the operation of ferry and water taxi and LNG vessels.	Section 5.3.16
7.2	Project and location of the marine access route to be used by LNG vessels associated with the Designated Project in Howe Sound; location and timing of traditional activities by Aboriginal groups and of activities by other marine users; Designated Project-related safety procedures, such as navigation aids, updated navigational charts and use of escort tugboats; areas where navigation may be controlled for safety reasons; speed profiles and schedules applicable to the operation of LNG vessels associated with the Designated Project; and ways in which Aboriginal groups and other marine users can provide feedback to the Proponent about adverse environmental effects related to navigation caused by activities associated with the Designated Project, including construction activities and the operation of ferry and water taxi and LNG vessels	Section 5.3.16

No.	Condition	CEMP Reference
7.3	Prior to construction, consult with Aboriginal groups to seek opportunities for marine and land access around the Project area for Aboriginal groups to practice their current use of land and resources for traditional purposes and to pursue socioeconomic opportunities, subject to safety requirements in the Project area.	N/A
7.4	Provide Aboriginal groups with the implementation schedule and any update(s) or revision(s) to that schedule as stated in condition 12 at the same time the Proponent provides the schedule to the Agency	Section 4.2
8.1	The Proponent shall, in consultation with Aboriginal groups, develop, prior to construction, and implement, during all phase of the Designated Project, an archaeological and heritage resources management plan for the Designated Project. The archaeological and heritage resources management plan shall take into account the *British Columbia's Handbook for the Identification and Recording of Culturally Modified Trees*. The archaeological and heritage resources management plan shall include: • (8.1.1) a description of structures, sites or things of historical, archaeological, paleontological or architectural significance (including culturally modified trees) that may be encountered by the Proponent during construction • (8.1.2) procedures and practices for on-site monitoring of construction activities that may affect a structure, site or thing of historical, archaeological, paleontological or architectural significance (including culturally modified trees) and for the identification and removal of that structure, site or thing. • (8.1.3) a chance find protocol, should a previously unidentified structure, site or thing of historical, archaeological, paleontological or architectural significance (including culturally modified trees) be discovered by the Proponent or brought to the attention of the Proponent, during construction, by an Aboriginal group or another party.	Section 5.3.15
9.1	Conduct pre-clearing surveys to determine the distribution of little brown myotis (Myotis lucifugus), and establish, in consultation with relevant government authorities, buffer zones around active hibernacula and active roosts.	Section 5.3.12 Appendix H
9.2	Prior to construction and throughout all phases of the Designated Project, install and maintain roosting structures to offset any loss of little brown myotis (Myotis lucifugus) roosting habitat.	Section 5.3.12 Appendix H
9.3	Develop and implement a follow-up program to monitor the little brown myotis (Myotis lucifugus) usage of buffer zones and roosting structures to determine the effectiveness of the mitigation measures throughout all phases of the Designated Project and to verify the accuracy of the environmental assessment as it pertains to the environmental effects of the air cooling system on little brown myotis (Myotis lucifugus).	Section 5.3.12 Appendix H
11.1	Take all reasonable measures to prevent accidents or malfunctions that may result in adverse environmental effects.	Section 5.3.1
11.2	Prior to construction, the Project Proponent shall consult with Aboriginal groups on measures to be implemented to prevent accidents or malfunctions.	Section 5.3.1
11.3	Prior to construction and in consultation with relevant federal and provincial authorities and Aboriginal groups, develop an emergency response plan in relation to the Designated Project	Section 5.3.1

No.	Condition	CEMP Reference
11.4	• In the event of an accident or malfunction with the potential to cause adverse environmental effects, the Proponent shall implement the emergency response plan referred to in condition 11.3 and shall: • (11.4.1) notify relevant federal and provincial authorities and Aboriginal groups of the accident or malfunction as soon as possible and, in writing, the Agency; • (11.4.2) implement immediate measures to mitigate any adverse environmental effects associated with the accident or malfunction; • (11.4.3) submit a written report to the Agency no later than 30 days after the day on which the accident or malfunction took place. The written report shall include: • (11.4.3.1) a description of the accident or malfunction and of its adverse environmental effects; • (11.4.3.2) the measures that were taken by the Proponent to mitigate the adverse environmental effects of the accident or malfunction; • (11.4.3.3) any views received from relevant federal and provincial authorities and Aboriginal groups with respect to the accident or malfunction, its adverse environmental effects or measures taken by the Proponent to mitigate adverse environmental effects; • (11.4.3.4) a description of any residual adverse environmental effects, and any additional measures required by the Proponent to mitigate residual adverse environmental effects; and • (11.4.3.5) details concerning the implementation of the emergency response plan referred to in condition 11.3; • (11.4.4) submit a written report to the Agency no later than 90 days after the day on which the accident or malfunction took place, on the changes made to avoid a subsequent occurrence of the accident or malfunction, and on the implementation of any additional measures to mitigate residual adverse environmental effects taking into account the information in the written report submitted pursuant to condition 11.4.3.	Section 5.3.1
11.5	Develop and implement a communication plan in consultation with Aboriginal groups. The communication plan shall be developed prior to construction and shall be implemented and maintained up to date during all phases of the Designated Project. The plan shall include: the types of accidents or malfunctions requiring a notification by the Proponent to the respective Aboriginal groups; the manner by which Aboriginal groups shall be notified by the Proponent of an accident or malfunction and of any opportunities for the Aboriginal groups to assist in the response to the accident or malfunction; and the contact information of the representatives of the Proponent that the Aboriginal groups may contact and of the representatives of the respective Aboriginal groups to which the Proponent provides notification	Section 5.3.1
12.1	Submit an implementation schedule for conditions contained in this Decision Statement to the Agency, or anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012*, at least 30 days prior to the start of construction. The Page 15 of 15 implementation schedule shall indicate the commencement and completion dates for each activity relating to conditions set out in this Decision Statement.	N/A

No.	Condition	CEMP Reference
12.2	The Proponent shall submit an update to this implementation schedule in writing to the Agency, or anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012*, every two years on or before March 31, until completion of the activities	N/A
12.3	Provide the Agency, or anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012*, with a revised implementation schedule if any material change(s) occur from the initial schedule referred to in condition 12.1 or any subsequent update(s). The Proponent shall provide the revised implementation schedule at least 30 days prior to the implementation of the change.	N/A
13.1	Maintain a written record, or a record in an electronic format compatible with that used by the Agency, and retain and make available that record to the Agency, or anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012*, at a facility close to the Designated Project in Canada (local facility). The record shall include information related to the implementation of the conditions set out in this Decision Statement, and the results of all associated monitoring, including: • (13.1.1) the place, date and time of any sampling, as well as techniques, methods or procedures used; • (13.1.2 the dates and the analyses that were performed; • (13.1.3) the analytical techniques, methods or procedures used in the analyses; • (13.1.4) 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 (13.1.5) the results of the analyses.	N/A
13.2	The Proponent shall retain and make available upon demand to the Agency, or anyone designated pursuant to section 89 of the *Canadian Environmental Assessment Act, 2012*, the information referred to in condition 13.1 at a facility in Canada close to the Designated Project (or at another location within Canada and agreed upon by the Agency, should the local facility no longer be maintained). The information shall be retained and made available throughout construction and operation, and for 25 years following the end of operation or until the end of decommissioning of the Designated Project, whichever comes first.	N/A

Table A-2: EAC Approval Conditions (relevant to this CEMP)

No.	Condition	CEMP 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	Section 3.2.1.1

No.	Condition	CEMP Reference
	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.	

Condition 2	**Consultation Regarding Management Plans**
	Where a condition of this EA Certificate requires the Holder to consult 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: i) 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 ii) why such views and information have not been addressed in a revised version of the management plan; and
	  • Maintain a record of consultation with each such party regarding the management plan; and e) 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 7.6

Condition 3	**Satisfaction of Agencies** Where a condition of this EA Certificate requires the Holder develop a management plan or other document to the satisfaction of one or more agencies (which may include the EAO), after submitting a draft of the management plan or other document to the agency or agencies listed in the relevant condition the Holder will not need to make further revisions to, or obtain further approval of, such management plan or other document unless any such listed agency communicates to the Holder that further revisions to such management plan or other document are required. Any such required changes or approval must be pursued by the Holder in accordance with the timelines and in a manner that is acceptable to the agency that made such request. Where a condition of this EA Certificate requires the Holder implement a management plan to the satisfaction of the EAO, the Holder must ensure that it implements such management plan in a manner and on timelines that are acceptable to	N/A

No.	Condition	CEMP Reference
	the EAO. If changes or further approval are requested, the Holder must continue to implement the then current management plan unless the Holder is advised to the contrary by the EAO.	
Condition 4	**Air Quality** The Holder must develop, in consultation with MOE, MOH, OGC, VCH and Aboriginal Groups, an air quality mitigation and monitoring plan, which must include at a minimum: • Measures to monitor liquefaction facility air emissions and contaminants of concern for sources modelled in the Application; • Procedures for regular reporting of liquefaction facility air emission data gathered, including reporting to the appropriate government agencies, Aboriginal Groups and the public; and • An adaptive management plan to address effects of the Project related to air quality from liquefaction facility emissions in the event: ○ Those effects are not mitigated to the extent identified in the Application, or ○ Effects related to air quality occur that were not predicted in the Application. A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, MOE, MOH, OGC, VCH and Aboriginal Groups no less than 30 days prior to the Holder's planned date to commence Commissioning. The Holder must implement the plan to the satisfaction of EAO.	N/A
Condition 5	**Instream Flow Requirements** The Holder must require a Qualified Professional to prepare an instream flow requirements (IFR) report for Mill Creek and Woodfibre Creek, in consultation with FLNR and OGC. The IFR report must be completed at least 60 days prior to the commencement of Construction. The IFR report must include: • An interim IFR regime and a procedure for establishing a long-term IFR regime for Mill Creek; • An IFR regime for Woodfibre Creek for the duration of anticipated water withdrawal for Woodfibre Creek; • A record of the data utilized to support the IFR regimes for Mill Creek and Woodfibre Creek; • Monitoring locations, methods, and procedures for the IFR regimes for Mill Creek and Woodfibre Creek; • The content and frequency for monitoring reports on the implementation of the IFR program and a list of agencies, including, but not limited to, FLNR, OGC and Aboriginal Groups, that will receive copies of the reports; and • The process by which the Holder can revise the IFR, including any consultation with OGC, FLNR, and EAO that would occur in connection with any such revisions. The Holder must monitor and report on instream flow in Mill Creek during Construction and Operations phases of the Project provided that water withdrawals continue. The Holder must also monitor and report on instream flow in Woodfibre Creek during the Construction phase or, if water withdrawals from Woodfibre Creek extend beyond the Construction period, for the duration of water withdrawal from Woodfibre Creek. Monitoring and reporting for both Creeks must be done	Section 5.3.7 Appendix C

No.	Condition	CEMP Reference
	in accordance with the IFR report for Mill Creek and Woodfibre Creek required by this condition. The Holder must obtain approval from the EAO for the IFR report prior to implementing the IFR regimes. The Holder must provide a copy of the IFR report to Aboriginal Groups within seven days of the report being approved by the EAO.	

Condition 8	**Marine Fish and Fish Habitat**
	The Holder must develop, in consultation with DFO and Aboriginal Groups, a marine fish and fish habitat management and 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 Herring Survey Summary Report, section 4.0 (May 2015) will be implemented;
	• 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; and
	• An adaptive management plan to address the effects of the Project on fish and fish habitat in the event:
	  • those effects on fish and fish habitat are not mitigated to the extent identified in the Application, or
	  • effects on fish and fish habitat occur that were not predicted in the Application.
	
	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 Aboriginal 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.
		Section 5.3.10
		Appendix E

Condition 9	**Marine Mammals** The Holder must develop, in consultation with DFO, OGC and Aboriginal Groups, a marine mammal management and monitoring plan for Construction that must at a minimum: • Set out the means by which the mitigation measures related to Construction in the Application Table 22-1 under the heading "Marine Mammals" will be implemented; • Identify the geographic areas where, and periods of time when, Construction could cause injury to marine mammals; • Identify the geographic areas where, and periods of time when, Construction could cause behavioural change to marine mammals; • Identify the time periods when elevated marine mammal occupancy is anticipated within the areas of potential injury to marine mammals or areas of potential behavioural change; • Specify the role of a Qualified Professional in observing and reporting marine mammals in the areas of potential injury to marine mammals during Construction;	Section 5.3.9 Appendix F

No.	Condition	CEMP Reference
	• Specify the Construction activities (e.g. blasting, pile driving) which must stop or not start if a marine mammal is sighted in the areas of potential injury to marine mammals, and not re-start until the marine mammal has moved out of the relevant area, to the satisfaction of the Qualified Professional; and • Specify mitigation measures for Construction underwater noise that will prevent or reduce behavioural change or injury to marine mammals. A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO no less than 60 days prior to the Holder's planned date to commence Construction in the marine environment. The Holder must provide the plan to EAO, DFO, OGC and Aboriginal Groups no less than 30 days prior to the Holder's planned date to commence Construction in the marine environment. The Holder must implement the plan to the satisfaction of EAO	
Condition 10	**Invasive Plant Management** The Holder must develop, in consultation with FLNR, OGC and Squamish Nation an invasive plant management plan that describes measures to prevent, monitor and control the establishment and spread of invasive plant species in the terrestrial portions of the Certified Project Area during Construction and Operations. A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, FLNR, OGC, and Squamish Nation 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.	Section 5.3.11 Appendix G
Condition 11	**Wildlife – Construction** The Holder must develop, in consultation with EC, FLNR, OGC and Aboriginal Groups, a wildlife management and monitoring plan for Construction that must at a minimum: • Set out the means by which the wildlife mitigation measures related to Construction in the Application Table 22-1 (sections 5.12 – 5.14 and 5.17) will be implemented; • Include results of completed marbled murrelet presence and habitat surveys, plans for additional presence surveys, and specify mitigation to avoid or reduce adverse effects of the Project on birds, including marbled murrelets and marbled murrelet habitat, to the satisfaction of a Qualified Professional. • Include mitigation measures to avoid or reduce human-wildlife conflicts and to avoid or reduce direct and indirect wildlife mortality; • Specify the mitigation measures that will be implemented for the protection of wildlife habitat features that are encountered within the terrestrial portions of the Certified Project Area; • Specify mitigation measures to identify and avoid clearing high-value nesting habitat for western screech-owl; • Specify the consideration of migratory bird timing windows when scheduling planned flaring events, where feasible from a technical and safety perspective to the satisfaction of a Qualified Professional, to minimize the risk of mortality and injury to birds during Commissioning; and	Section 5.3.12 Appendix H

No.	Condition	CEMP Reference
	• Design a monitoring and follow-up program with respect to impacts to wildlife within the terrestrial portions of the Certified Project Area during Construction. A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, EC, FLNR, OGC and Aboriginal 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. Marbled murrelet survey results must be provided to EC and FLNR prior to site clearing.	
Condition 13	**Local Economic Opportunities** The Holder must design and deliver programs to support local and Aboriginal employment and contracting opportunities, skills training and education. The Holder must provide Project information related to job opportunities and subcontracting business opportunities to the affected communities and Chambers of Commerce within the labour market Local Assessment Area identified in the Application, including holding at least one job fair in Squamish at least 30 days prior to Construction. At the time of submitting compliance reports required by this EA Certificate's clause 1, the Holder must report to EAO on the implementation of these programs. The programs must be implemented during Construction.	N/A
Condition 14	**Community Services and Infrastructure** The Holder must develop, in consultation with Aboriginal Groups, local governments, provincial government infrastructure and service providers, a plan to adaptively manage and monitor effects on services and infrastructure delivered by provincial agencies and local governments. The scope of the plan is for effects that are directly attributable to the Project, and related to Construction. The plan must include the mitigation measures in the Application Table 22-1 under the heading "infrastructure and community services". The plan must include specific actions to address the following: • Communication with potentially affected Aboriginal Groups, local governments and regional districts, and provincial government infrastructure and service providers regarding Project activities and actions; and • An approach for monitoring and reporting on the effectiveness of the mitigation measures set out in the plan. The Holder must provide the plan to EAO no less than 60 days prior to the Holder's planned date to commence Construction. The Holder must not commence Construction until the plan has been approved by EAO, unless otherwise authorized by EAO. Once approved, the Holder must also provide the approved plan to EAO, local governments, and provincial government infrastructure and service providers, and Aboriginal Groups. The Holder is required to implement the plan to the satisfaction of EAO, as of the start of Construction until two years after the completion of Construction, unless otherwise directed by EAO.	N/A
Condition 15	**Transportation** The Holder must develop, in consultation with MOTI and the DOS, a traffic control management plan and a traffic impact assessment. The traffic impact assessment must be developed in accordance with MOTI's Planning and Designing Access to Developments manual (2009 or as updated from time to time). The traffic impact assessment must include, at a minimum, an analysis of the Project's effects on vehicular traffic and infrastructure and proposed mitigation measures for the Highway 99 and Darrell Bay Road intersection.	Section 5.3.17

No.	Condition	CEMP Reference
	The traffic management plan must at a minimum: • Identify measures to mitigate the impacts of Project-related transportation during Construction on the safety of other users and the efficiency of the transportation network on Highway 99 and the Darrell Bay ferry location; • Include measures for traffic control, public communications, incident management and response, and plan implementation; and • Identify measures to reduce the number of vehicles of Project employees commuting on Highway 99 and at the Darrell Bay ferry location. The Holder must provide the traffic control management plan to EAO, MOTI, and the DOS 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.	
Condition 16	**Marine Transportation – Construction** The Holder must develop, in consultation with TC, DFO, CCG, Pacific Pilotage Authority, the DOS, BC Ferries, Squamish Terminals and Aboriginal Groups a marine transport management and monitoring plan for Construction. The plan must identify at a minimum: • The means by which the marine transportation mitigation measures related to Construction in the Application Table 22-1 under the heading "marine transport" (section 7.3, M7.3-1 to M7.3-17) will be implemented; • Construction activities that have the potential to interfere with marine navigation; • Existing and traditional navigational routes, fishing areas, habitat areas, harvesting areas, commercial shipping use, recreational and tourism use, Aboriginal Groups' use, and any associated timing windows; • Actions to inform affected stakeholders and Aboriginal Groups of potential interference with marine navigation as a result of Construction activities; • Methods to coordinate activities with other marine users, including FortisBC; • Methods to minimize displacement of marine-based recreational activities; • Mitigation measures to reduce disruption of marine navigation in Howe Sound as a result of Construction activities; and • Methods to monitor the effects of the Holder's shipping activities on marine users during Construction. The Holder must provide the plan to EAO, TC, CCG, Pacific Pilotage Authority, DFO, the DOS, BC Ferries, Squamish Terminals and Aboriginal 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.	Section 5.3.16
Condition 19	**Engagement with Forest Tenure Holders** At least six months prior to the Holder's planned date to commence Construction, the Holder must engage with tenure holders: • that hold a form of agreement listed in Section 12 of the Forest Act as of at least six months prior to the Holder's planned date to commence Construction, and	N/A

No.	Condition	CEMP Reference
	• (ii) that are affected by the Project. The purpose of this engagement is to seek opportunities for future ongoing access for forestry operations, while ensuring the safety and security of the site. The Holder must provide a report to FLNR and EAO on the results of such engagement at least 30 days prior to the Holder's planned date to commence Construction.	
Condition 20	**Visual Quality** The Holder must develop and implement a visual quality management plan in consultation with FLNR, OGC, Aboriginal Groups, Tourism Squamish and the Sea to Sky Gondola that must at a minimum: • Specify mitigation measures to reduce the level of contrast, and provide for additional screening of land-based infrastructure to blend infrastructure with the existing landforms in the context of surrounding landscape features; • Specify mitigation measures to promote screening, including but not limited to, the establishment of new native vegetation; • Specify the selection of natural colours and flat or low glare external finishes on buildings and structures; • Include measures to monitor and maintain natural screening and external finishes, whereby the reduced the level of contrast is maintained for minimal visibility of infrastructure; and • Specify approach to engaging with Aboriginal Groups, Tourism Squamish, and the Sea to Sky Gondola Limited Partnership. The Holder must consult with BC Hydro and FortisBC on the final designs of the Woodfibre sub-station and Eagle Mountain-Woodfibre Pipeline projects and determine whether additional mitigation measures are required to ensure that cumulative effects to visual quality are no greater than identified in the Application.	Section 5.3.14
Condition 21	**Environmental Management Plans** The Holder must develop, in consultation with FLNR, OGC and Aboriginal Groups, a construction environmental management plan and an operations environmental management plan in accordance with section 13.2 of the Application. All requirements pertaining to Mill Creek in section 13.2 of the Application must also be applied to Woodfibre Creek. All requirements pertaining to the certificate of compliance or onsite landfill in section 13.2 of the Application are excluded from the construction environmental management plan and operations environmental management plan. A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the construction environmental management plan to EAO, FLNR, OGC and Aboriginal Groups no less than 30 days prior to the Holder's planned date to commence Construction. The Holder must provide the operation environmental management plan to EAO, FLNR, OGC and Aboriginal Groups no less than 60 days prior to the Holder's planned date to commence Operations. The Holder must develop and implement the plans to the satisfaction of EAO.	Entire CEMP
Condition 22	**Aboriginal Consultation** The Holder must continue to engage Aboriginal 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	Section 4.2

No.	Condition	CEMP Reference
	the conditions of this Certificate. The Holder must provide, to the satisfaction of EAO, an Aboriginal 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 Aboriginal consultation summary report with Aboriginal Groups for no less than 30 days review and comment prior to providing it to EAO.	
Condition 23	**Aboriginal Monitoring** The Holder must, through discussion with Aboriginal Groups, seek to provide opportunities for members of Aboriginal Groups to participate in monitoring activities identified in the plans in this Table of Conditions that are occurring within their asserted traditional territory. In the Aboriginal consultation reports required by Condition # 22 to EAO, the Holder must include information regarding the opportunities provided and the participation of members of Aboriginal Groups in monitoring activities.	N/A
Condition 24	**Public Consultation** The Holder must continue to engage the public for the life of the Project. Consultation and 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, a public consultation summary report no later than: Two years after the commencement of Construction; and One year after the commencement of Operations.	Section 4.0
Condition 25	**Public Communications** The Holder must establish and maintain for the life of the Project a dedicated publicly available Project website. The website must be used for communicating information on Project status in order to promote public awareness of ongoing activities and Construction schedules, and to ensure general safety in and surrounding the Project area. Information available on the website must be kept up to date to achieve the above goals	Section 4.0

Table A 3: Skwxwú7mesh Úxwumixw (Squamish Nation) Approval Conditions (relevant to this CEMP)

No.	Condition	CEMP Reference
Skwxwú7mesh (Squamish)		
4.3 -Condition #3 (a)	Prior to commencing construction, a water management plan for Mill Creek will be developed and will develop interim minimum instream flow releases (IFRs) on Mill Creek to protect aquatic life as well as the procedure for establishing long-term IFRs, if required in accordance with Squamish Condition #3: 4.3 (c).	Section 5.3.7 Appendix C

No.	Condition	CEMP Reference
Skwxwú7mesh (Squamish) Condition #3: 4.3 (b) Mill Creek	The Holder will engage with Squamish Nation through the Environmental Working Group in establishing the minimum IFRs, which will be initially determined based on the standard-setting guidelines defined by *Instream Flow Thresholds for Fish and Fish Habitat as Guidelines for Reviewing Proposed Water Uses* (Hatfield et al 2003)	Section 5.3.7 Appendix C
Skwxwú7mesh (Squamish) Condition #3: 4.3 (c) Mill Creek	The IFR regime in Mill Creek will not be changed during the critical stream flow periods (CSFP) prior to completion of a detailed study, based on Lewis et al. (2004), and will review the results of any associated studies with Squamish Nation through the Environmental Working Group.	Section 5.3.7 Appendix C
Skwxwú7mesh (Squamish) Condition #3: 4.3 (d) Mill Creek	If minimum instream flow is not available on Mill Creek during CSFP for both fish habitat and Project needs, alternative water sources will be identified to meet requirements subject to emergency provisions for fire suppression. Unless otherwise shown through site-specific studies, the CSFP will be from August 1 through October 31.	Section 5.3.7 Appendix C
Skwxwú7mesh (Squamish) Condition #3: 4.3 (e) Mill Creek	Any on-site hydrometric data collection and long-term compliance monitoring shall be undertaken in accordance with the *Manual of British Columbia Hydrometric Standards* (RISC 2009).	Section 5.3.7 Appendix C
4.6 - Condition #6 (a)	**Environmental Management Programs** Woodfibre LNG Limited is committed to undertaking EMP in accordance with the conditions attached to the Environmental Assessment Certificate and the Decision Statement and will Co-Manage such EMP according to the terms and conditions under this section 4.6.	Section 1.0 Section 1.5
4.6 - Condition #6 (b)	Woodfibre LNG will provide a list of EMP to Squamish Nation through the Woodfibre Environment Working Group, and within 30 days of receipt of the EMP list, Squamish Nation will inform Woodfibre LNG which of the EMP are Non-regulated EMP (as defined below) and which of the EMP are Regulated EMP (as defined below).	Section 4.1
4.6 - Condition #6 (d)	Non-regulated EMP remain subject to consultation requirements with Squamish Nation. Woodfibre LNG agrees to make all EMP available electronically at the same times such plans are made available to relevant regulatory agencies. Where Squamish Nation provides comments in writing on such EMP within 30 days of receipt, Woodfibre LNG will reasonably accommodate the requests for revision or clarification; where Woodfibre LNG considers the requested revisions to be unnecessary or impracticable, rationale will be provided to Squamish Nation in writing. Should there be a dispute arising from this section 4.6(d) either Party may submit the matter to the dispute resolution process set out in section 8.1.	Section 4.1
4.6 - Condition #6 (e)	In respect of the Regulated EMP, Woodfibre LNG will submit the Regulated EMP to Squamish Nation for approval, which will be undertaken based on the following principles:	Section 4.1

No.	Condition	CEMP Reference
	• The process and timing for consultation and approval will be aligned with the process for approval through the applicable regulatory agency including the review period; • In the event that multiple regulatory agencies are involved with varying review periods, Squamish Nation's review period shall align with the longest option; • For cases where there is no regulatory agency-defined review period, Squamish Nation will review the request for approval and provide a written decision in a timely manner and in any event within 30 days of receipt of the request for approval (the "Decision Period"), and if Squamish Nation does not provide written notice to Woodfibre LNG by the end of the Decision Period, the consultation will be deemed to have been approved; • Squamish Nation may either approve the Regulated EMP or withhold its approval pending incorporation by Woodfibre LNG of amendments recommended by the Squamish Nation to the Regulated EMP; • If Squamish Nation withholds approval subject to the incorporation of the recommended amendments, Woodfibre LNG will work with Squamish Nation through the Woodfibre Environmental Working Group to incorporate such amendments into the Regulated EMP and re-submit the Regulated EMP to Squamish Nation for approval; and • Should there be a dispute arising from this section 4.6(e) either Party may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the amendments is at issue the expert or expert panel shall consider the following when making its decision: whether the amendment has a material impact on constructability, cost, operability, safety, environment, or schedule; whether the amendment creates unacceptable risk or legal liability for the Project; whether the amendment conflicts with any legal, regulatory, or pre-existing contractual obligations of Woodfibre LNG; whether the Woodfibre LNG response to the proposed amendment(s) conforms to Good Industry Practice; and any other information the expert or expert panel considers relevant.	
4.10 - Condition #10 (a)	**Marine Mammals** Woodfibre LNG agrees to conduct a noise monitoring program that will involve collecting data from a hydrophone deployed within the Project area, the purpose of which program will be: • To collect local data on underwater sound levels; • To supplement existing data on presence, frequency and seasonality of use by marine mammals; • To establish baseline data against which to compare ambient underwater sound levels and marine mammal use throughout the life of the Project; and • Prior to commencement of construction, prepare, for approval by Squamish Nation in accordance with section 4.6, an Underwater Noise Management Plan and a Marine Mammals Management Plan that include mitigation measures and monitoring programs design to address potential residual adverse effects on marine mammals from underwater noise.	Appendix F
4.10 - Condition #10 (b)	Woodfibre LNG will participate in studies of sub-lethal acoustic impacts on marine mammals by sharing its noise monitoring data and marine mammal monitoring data collected in respect of the Project, where and when such data are requested by qualified and reputable researchers. Woodfibre LNG also agrees to adopt in its adaptive management	Appendix F

No.	Condition	CEMP Reference
	framework progressive strategies to minimize cumulative impacts on underwater noise on marine mammals. Woodfibre LNG's funding commitment for this work will be as set out in the IBA.	

Table A 4: EA Application Commitments

No.	Condition	CEMP Reference
M5.2-1	Woodfibre LNG Limited will prepare and implement a Dust Control Plan for construction, operation, and decommissioning activities. The objectives of this plan will be to prevent and control dust emissions. Monitoring will be conducted to make sure that mitigation measures are properly implemented and are effective. Mitigation measures to reduce the emission of fugitive particulate matter (i.e., dust) may include activities such as • Watering of exposed surfaces; • Reducing the height of material drops; • Covering stockpiles; and • Controlling the speed of onsite off-road vehicles.	Section 5.3.2.1
M5.3-1	Woodfibre LNG Limited will develop and implement best management practices to reduce GHG emissions. Woodfibre LNG Limited will be compliant with regulations and permitting and associated reporting requirements (see Section 14.0 Compliance Reporting). Best management practices will include the following: • Reduce emissions from mobile equipment (such as through ongoing vehicle maintenance and reducing the idling time of vehicles). • Develop and implement a leak detection and repair program for Project facilities. • Develop control philosophies to minimize the amount of flared and vented gases and select chemicals which minimize contributions to global warming. These best mitigation approaches will address regulatory developments on both a provincial and federal level through the incorporation of new processes and operations. Annual compliance reports will track the implementation and success of the best management practices. Compliance will be demonstrated through reporting emission to the BC MOE, according to the regulation outlined in Appendix 5.3-1 Greenhouse Gas Methodology. Leak detection will follow the recommendations of the American Petroleum Institute (2013) and leak repair will follow the engineering design of the Project.	Section 5.3.2
M5.4-1	Woodfibre LNG Limited will conduct earthmoving equipment construction using heavy earthmoving equipment between 0700 hours and 2200 hours to reduce the potential effect of construction sound on nearby dwellings whenever possible.	Section 5.3.2.2

No.	Condition	CEMP Reference
M5.4-2	Woodfibre LNG Limited will schedule high noise activities to reduce disruption whenever possible.	Section 5.3.2.2
M5.4-3	Woodfibre LNG Limited will establish heavy equipment muster points at least 500 m from any receptor.	Section 5.3.2.2
M5.4-4	Woodfibre LNG Limited will fit equipment with standard mufflers or silencers and keep these mufflers and silencers in good working order.	Section 5.3.2.2
M5.4-5	Woodfibre LNG Limited will take advantage of acoustical screening from existing onsite barriers to shield dwellings from construction equipment sound.	Section 5.3.2.2
M5.8-1	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 1993) • 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	Section 5.3.3 Appendix I

No.	Condition	CEMP Reference
	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.	
M5.8-3	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).	Section 5.3.7 Appendix C
M5.8-4	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.	Section 3.2.1.1
M5.8-5	Woodfibre LNG Limited will develop and implement a water quality 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.	Section 5.3.7 Appendix C
M5.9-1	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.	Section 5.3.7 Appendix C
M5.9-2	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 minimum amount required to accommodate the Project footprint will reduce the direct loss of vegetation communities and wildlife habitat. Monitoring will be conducted to ensure that mitigation measures are properly implemented and effective.	Section 5.3.11

No.	Condition	CEMP Reference
M5.10-1	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 monitoring will be detailed in a 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 herring (e.g., 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. • 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 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: 1. 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 2. TSS: ▪ change from background of 5 mg/L when background is less than 25 mg/L	Section 5.3.8 Appendix D Appendix E

No.	Condition	CEMP Reference
	▪ 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: 1. 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. 2. 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. 3. Water quality 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. 4. 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). 5. 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	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.	Section 5.3.5

No.	Condition	CEMP Reference
	• 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.	
M5.10-3	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.	Section 5.3.8 Appendix D
M5.10-4	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:	Section 5.3.6 Appendix J

No.	Condition	CEMP Reference
	1. 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. 2. 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: 1. 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 2. Whenever possible, the materials used in construction will be reused and recycled. Recyclable materials will be separated and transported off site. 3. Clearly labelled garbage bins with lids and recycling containers will be made available for food waste and recyclables. Food waste will be stored in wildlife-proof bins.	
M5.11-1	Woodfibre LNG Limited will develop an Invasive Plant Management Plan to mitigate the introduction, transport, and extent expansion of invasive plant species (including noxious weeds) to and from the Project area during construction and operation. The objectives of this plan will be to detect, control (i.e., remove), and monitor invasive plant species in the Project footprint area. Part of this plan will include mapping invasive plant extent and tracking this extent over the life of the Project to record invasive species proliferation.	Section 5.3.11 Appendix G
M5.11-2	Woodfibre LNG Limited will, where possible, design the Project to avoid the riparian area along Mill Creek (outside of the Green Zone) and the mature forest adjacent to the Creek.	Section 5.3.11 Appendix G
M5.11-3	Rare plant surveys will be conducted in areas to be disturbed by the Project (i.e., the footprint) to identify the locations of any listed plant species that may be affected by clearing activities. Surveys will be conducted in the spring to coincide with flowering and maximize the detectability of rare plants. Any listed plant species that are identified within the Project footprint will be salvaged and replanted in appropriate microsites elsewhere in the LAA.	Section 5.3.11 Appendix G
M5.12-1	Woodfibre LNG Limited will develop and implement a Wildlife Management Plan prior to initiation of the construction phase of the Project. The Wildlife Management Plan will provide the following information: • Details regarding any required pre-construction surveys and wildlife monitoring: • Call-playback surveys prior to clearing that specifically focus on western screech-owl at night to ensure the cleared areas are not being used as post-fledgling areas • Pre-construction surveys to assess potential western screech-owl nesting habitat in the potential corridors for the gas and water pipeline ROWs, and avoidance of such habitat in the final design for the Project	Section 5.3.12 Appendix H

No.	Condition	CEMP Reference
	• Surveys will also be conducted in areas to be cleared to confirm that natural mineral sites (i.e., mineral water springs) that may be used by band-tailed pigeon are not impacted by the Project • Information on how to report and record wildlife conflicts, including wildlife mortality due to vehicles and equipment. A database of wildlife mortality associated with construction and operation of the Project should be maintained through the construction and operation phases. Observations of Red and Blue-listed species will be conveyed to the CDC. • Limit speed on roadways within the Project area to 30 km/h • Measures to identify amphibian crossings (if any) details regarding posting signage and educating workers to ensure vigilance for amphibians during peak movement periods (i.e., rainy nights in April and September)	
M5.12-2	Woodfibre LNG Limited will retain wildlife habitat features, including those for avifauna and bats, such as snags and wildlife trees (mature trees are included in M5.9-2) wherever possible and safe to do so. Prior to site clearing, wildlife habitat features to be retained will be demarcated with no-go fencing and signage. Habitat features to be field identified and retained will be included on Project Environmental Management Plan mapping.	Section 5.3.12 Section 5.6 Appendix H
M5.12-3	Woodfibre LNG Limited will establish and retain vegetative buffers around raptor nests to mitigate sensory disturbance in accordance with Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (MOE 2013). These guidelines suggest that a 100-m vegetated buffer be retained around osprey and bald eagle nests and a 200-m vegetated buffer be retained around western screech-owl nests. An additional 100-m no-disturbance buffer for each species nests is recommended during the nesting season.	Section 5.3.12 Appendix H
M5.12-4	Where possible, Woodfibre LNG Limited will avoid vegetation clearing during the nesting season for bald eagles, osprey and western screech-owl in accordance with MOE (2013). The least risk periods for development outlined in MOE's Develop with Care 2014 guidelines (MOE 2014) are identified as follows: • bald eagle – September 1 to December 31 • osprey – September 15 to March 31 • other raptors – October 1 to February 28 Woodfibre LNG Limited will avoid clearing during nesting season for passerines in accordance with least risk development windows to passerines (September 1 to February 28) provided in MOE (2014). Pre-clearing bird nest surveys will be undertaken if the aforementioned least risk windows cannot be maintained. Appropriate, species-specific setback buffers will be established and maintained around any confirmed or suspected active nests that are detected.	Section 5.3.12 Appendix H
M5.12-5	Subject to safety and operational requirements, Woodfibre LNG Limited will use blue or green lighting rather than red or white lighting in order to reduce attractiveness to birds.	Section 5.3.12 Appendix H
M5.12-6	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 marine birds. Monitoring of effects should be incorporated into the	Section 5.3.3 Section 5.3.12

No.	Condition	CEMP Reference
	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).	Appendix E
M5.12-9	Woodfibre LNG Limited will design building facilities to reduce the potential for bird strikes and bird mortality. Design features will include minimizing the amount of glass and applying tints or facades where glass is required to provide visual cues.	Section 5.3.12 Appendix H
M5.12-10	Woodfibre LNG Limited will meet with BC Hydro (i.e., Woodfibre Substation project) and FortisBC (i.e., Eagle Mountain – Woodfibre Gas Pipeline Project) to identify further measures to minimize potential adverse cumulative effects on wildlife.	Section 5.3.12
M5.13-1	Woodfibre LNG Limited will avoid clearing when maternity roosts of at-risk bat species are likely to be active. The least risk season for bats in the Project area (i.e., when females are not heavily pregnant, nor when juvenile bats are present and unable to fly) is expected to occur between September 1 and May 15, therefore clearing will be avoided when possible between May 16 and August 31. Pre-clearing maternity roost surveys will be undertaken if the least-risk windows cannot be maintained. Acceptable non-disturbance buffers will be established around active maternity roosts.	Section 5.3.12 Appendix H
M5.13-2	Woodfibre LNG Limited will, where possible, use lighting technology that minimizes the amount of ultraviolet light generated, thereby minimizing its attractiveness to insects.	Section 5.3.13 Appendix H
M5.14-1	Where safe to do so, WLNG will avoid falling trees into the watercourse where clearing is necessary adjacent to a watercourse (e.g., Mill Creek).	Section 5.3.12 Appendix H
M5.14-2	Prior to initiation of the construction phase of the Project, WLNG will identify important habitat to be retained by including it in construction plans and by field- identified with no-go fencing.	Section 5.3.12 Appendix H
M5.14-3	Woodfibre LNG Limited will salvage coarse woody debris that has been removed in upland areas to facilitate Project construction and will relocate it along linear features and within the Green Zone upon completion of the construction phase.	Section 5.3.12 Appendix H
M5.14-4	Woodfibre LNG Limited will develop and implement an Environmental Protection Plan specific to works required in and around Mill Creek. The Plan will be developed prior to the initiation of instream works. This plan will require coastal tailed frog salvage for instream construction.	Section 3.0
M5.15-1	Implement instream works best management practices: • Reduced risk instream work windows ▪ Undertake Project activities and physical works in freshwater fish habit during the reduced risk instream work window unless otherwise approved by MFLNRO. The reduced risk instream work windows for the	Section 5.3.7 Appendix C

No.	Condition	CEMP Reference
	Lower Mainland (Region 2) are between July 15 and September 15 for salmon, and between August 1 and 31 for trout and 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.	
M5.15-2	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 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	Section 5.3.7 Appendix C

No.	Condition	CEMP Reference
	with the methods outlined in Development of Instream Flow Thresholds as Guidelines for Reviewing Proposed Water Uses (Hatfield et al. 2003) Monitoring will be a requirement of the Water Management Plan to confirm that the plan is effective in protecting fish and fish habitat. Effective monitoring will include a combination of compliance monitoring and biotic response monitoring and the definition of program objectives. Design of a monitoring program will consider program objectives, scope of effort, timing, and duration. Typical designs include, though are not limited to, the following: • continuous streamflow monitoring downstream of point of withdrawal • intermittent monitoring of biotic variables (e.g., fish abundance or density) • random IFR compliance audits	
M5.17-1	Woodfibre LNG Limited will follow guidelines for restricted activity periods to protect nesting marine birds to comply with the federal Migratory Birds Convention Act and the provincial Wildlife Act. The site is located within the A1 bird nesting zone in Canada, which has a regional nesting period of March 19 to August 17 (EC 2014b); however, the breeding season for colonial waterbirds extends from March into September (EC 2013a). Based on the locations of recorded colonial waterbird nesting habitat, colonial waterbirds are unlikely to be affected by clearing activities associated with the Project; therefore, the A1 bird nesting zone period (March 19 to August 17) will be followed and the clearing activities will be avoided during the nesting season where feasible. When clearing is required during the nesting season, pre-clearing surveys for nesting birds will be conducted and appropriate, species-specific setback buffers will be established and maintained around any confirmed or suspected active nests to reduce potential mortality. This mitigation measure is predicted to be effective in reducing potential marine bird mortality.	Section 5.3.12 Appendix H
M5.17-2	Project activities will maintain a minimum 30 m setback distance from active marine bird nests identified in the Project area. Larger setbacks may be established for listed species and will be considered on a species-by-species case.	Section 5.3.12 Appendix H
M5.17-3	Woodfibre LNG Limited will comply or require its contractors to comply with the recommended 300 m minimum setback from waterbird colonies (see Figure 5.17-2) for Project – related marine vessel traffic, and subject to safety concerns, refrain from blowing horns or whistles and maintain constant engine noise while passing near the colonies (EC 2013a).	Section 5.3.12 Appendix H
M5.17-4	During inbound travel, LNG carriers will be moving at a maximum speed of 8 to 10 knots at the south end of Passage Island (entrance to Howe Sound and the RAA) until they reach the immediate vicinity surrounding the Project area (LAA) where speeds will be reduced to 6 knots. To the extent practical, all other Project vessels will limit their speed while travelling within the RAA.	Section 5.3.16
M5.17-5	Woodfibre LNG Limited will minimize the duration of necessary activities, including both dismantling and construction of structures, that must occur within the intertidal zone to the extent possible to reduce the disturbance of marine birds and marine bird habitat. Where practicable, activities will be scheduled during low tide.	Section 5.3.12 Appendix H
M5.17-6	Woodfibre LNG Limited will prepare and implement an Underwater Noise Management Plan as a component of the Marine Works Management Plan (M5.10-1) to mitigate potential mortality and behavioural changes to birds, fish and	Section 5.3.8 Appendix E

No.	Condition	CEMP Reference
	marine mammals. The plan will reference DFO's BMP for Pile Driving and Related Operations (BCMPDCA and DFO 2003), and will contain the following measures: Pile Driving and Related Activities: • Multiple underwater noise generating activities will be minimized when practicable (e.g., avoid multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced to minimize construction duration. • Works in the marine environment will be conducted during the least risk fisheries work window specified by DFO for the region unless otherwise agreed upon by DFO. The prescribed work window for Howe Sound is August 16 – January 31 (DFO 2014b). • Where possible, pile driving activities will avoid impacting hard substrates to prevent disturbance to fish habitat. • The use of vibrational pile driving will be used where practical and feasible as impact pile driving is associated with louder sound pressure levels underwater. The use of vibro-hammers for pile installation minimizes the effects on fish by decreasing the anticipated noise levels. • A ramp up or soft start technique will be used. Where equipment allows, power will be built up slowly from a low energy start-up to give adequate time for marine wildlife to leave the vicinity before exposure to the maximum sound pressure level. There will be a soft start every time pile driving is resumed following an interval of no pile driving. Prior to pile driving, the perimeter of the pile driving area will be identified, so that work occurs within the confines of the pile driving area.	Appendix F Appendix H
M5.17-8	Woodfibre LNG Limited will develop and implement a Marine Bird Management Plan (MBMP) prior to the initiation of the construction phase of the Project. This MBMP will be part of an overall Wildlife Management Plan document. This plan will include: • Pre-construction surveys within mapped (but not field-verified) marbled murrelet critical nesting habitat to be cleared as part of the Project will be undertaken following appropriate standards developed by the Resource Information Standards Committee for marbled murrelet inventory (MELP 2001). These surveys will determine if marbled murrelets are currently nesting in these areas (if timing of Project construction allows for these surveys to be conducted during nesting season), or if these areas provide suitable nesting habitat (if timing of Project construction prevents surveys of during active nesting activity). • Provision of information and training to all workers (contractors, staff, and employees) on how to report and record marine bird conflicts in the Project area, specifically vessel strikes (bird species, location of carcass on vessel, weather conditions) in a database during construction, operation and decommissioning. • Should regular review of the database identify areas of persistent conflict or mortality rates that would affect populations, the Project operations will be reviewed to identify potential mitigation measures. Survey methods may include stand watches during migratory periods (spring and fall) in an adaptive management approach.	Section 5.3.12 Appendix H

No.	Condition	CEMP Reference
M5.17-9	Woodfibre LNG Limited will coordinate with BURNCO to mutually share results of marine bird monitoring studies to contribute to the knowledge base for marine bird interactions.	Section 5.3.12 Appendix H
M5.19-1	In addition to the mitigation measures described in M5.17-6, WLNG will prevent pile driving activities from impacting hard substrates, where possible. During impact pile-driving activities, a qualified specialist marine mammal observer will monitor for marine mammals and will communicate presence or absence to the contractor.	Section 5.3.9 Appendix F
M5.19-2	Woodfibre LNG Limited will produce a Marine Mammal Management Plan for the Project. This plan will include vessel speed reductions and avoidance of marine mammals: • LNG carrier and other deep-sea vessel speeds will be kept at a maximum of 8 to 10 knots when operating in the LAA. • All Project vessels will follow established shipping lanes/navigational routes typically used in the area. • All Project vessels will maintain a constant course and constant speed, to the extent practical, when operating in the RAA. • Under no circumstances, other than in the case of an emergency, will vessels approach within 100 m of any marine mammal. • If marine mammals approach within 100 m of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal. If it is not possible for a vessel to move away from or detour around a stationary marine mammal or group of marine mammals, the vessel will reduce its speed and wait until the animal(s) moves at least 100 m from the vessel prior to resuming speed. • During impact pile-driving activities, a qualified specialist marine mammal observer will monitor for marine mammals and will communicate presence or absence to the contractor.	Section 5.3.9 Appendix F
M6.3-1	Woodfibre LNG Limited will develop and implement strategies, best management practices, and guidelines to avoid and minimize Project-related disruption of marine-based recreational activities in the Squamish Harbour area during construction and operation. In developing this plan, WLNG will consult with key marine user groups (e.g., Squamish Terminals, yacht clubs, kiteboard clubs, and kayaking operators) to identify the routes of all Project-associated marine traffic (e.g., ferries and water taxis) and discuss strategies to manage the interaction of Project vessel traffic with recreational and tourism areas during the high season months. Woodfibre LNG Limited's use of the Darrell Bay terminal for the worker ferry is part of this plan as it minimizes interaction with recreationists and tourists who are using the marine waters of Squamish Harbour and the head of Howe Sound. This traffic plan will include a procedure for marine stakeholders to consult with WLNG regarding special events such as yacht races, regattas, and marine-based festivals to ensure that additional passage planning and scheduling can be reviewed.	Section 5.3.16
M7.2-5	Prior to commencing construction, WLNG will develop and implement an Emergency Response Plan for the construction phase of the project. The Emergency Response Plan will be developed with input from local, regional and provincial emergency response authorities, such as Squamish Fire Department, the Squamish RCMP, Vancouver Coastal Health and BC Ambulance Service. The Emergency Response Plan will be communicated to emergency response authorities and service providers.	Section 5.3.1

No.	Condition	CEMP Reference
M7.2-7	Woodfibre LNG Limited will continue to participate in Transport Canada's voluntary shipping and navigational risk assessment TERMPOL review process. TERMPOL studies will be agreed to by Transport Canada and will include a systematic assessment of safety and risk management in the joint use of the waterway. Any recommendations from the TERMPOL Review Committee will be integrated into the Project design and operating procedures, including but not limited to those related to navigation, passage planning, traffic management, suitability of the terminal location, orientation, and operation.	Section 5.3.16
M7.3-1	Woodfibre LNG Limited will prepare and implement a marine transport management plan prior to construction activities or as outlined through TERMPOL. This plan will outline measures to ensure all vessel traffic is aware of Project activities. The plan will also provide details of the communication channels to be used and the Project-related safety procedures to be followed.	Section 5.3.16
M7.3-2	Woodfibre LNG Limited will install aids and navigational lights based on recommendations following the NPA review process.	Section 5.3.16
M7.3-3	Woodfibre LNG Limited will notify the relevant authorities, including the CCG, so that Notices to Mariners and Notices to Shipping can be issued.	Section 5.3.16
M7.3-4	Woodfibre LNG Limited will ensure CHS navigational charts and other appropriate nautical publications are updated to show the terminal and other marine features, where appropriate.	Section 5.3.16
M7.3-5	Woodfibre LNG Limited will conduct all Project shipping and transportation of passengers in accordance with the requirements of the Canada Shipping Act, in compliance with the CCG and PPA. Maritime legislation and other requirements are outlined in Section 7.3.1.1.2. In addition, shipping activities will also comply with all other applicable national and international safety regulations that have not been listed, such as requirements established by the International Maritime Organization. Where applicable, consideration will also be given to best practice criteria for the safe operation of LNG vessels presented by the Society of International Gas Tanker and Terminal Operators, and the World Association for Waterborne Transport Infrastructure.	Section 5.3.16
M7.3-6	Woodfibre LNG Limited commits to further consult with BC Ferries and Squamish Terminals regarding potential interference, vessel routes, and current operating practices.	Section 5.3.16
M7.3-14	Woodfibre LNG Limited commits to further consultation with recreational stakeholder groups in Howe Sound to identify areas of concerns and where practicable, to identify additional mitigation that can be implemented to reduce effects.	Section 5.3.16
M7.4-2	As discussed, WLNG will develop a Squamish Harbour Vessel Traffic Plan (M6.3-1) to identify strategies to minimize effects to marine-based recreational activities. Its development will incorporate consultations with Squamish Harbour users. To help avoid cumulative effects, as a component of the Squamish Harbour Vessel Traffic Plan, WLNG will also work with Matthews Southwest and Bethel Lands Corporation and District of Squamish to minimize displacement of recreation activity by Project-associated ferry and water taxi traffic that travels to the Project site.	Section 5.3.16
M7.5-1	Reduce the level of contrast by finishing new buildings' external surfaces or re-finishing existing buildings' external surfaces and structures as appropriate for required functional utility. The finish will have low glare and natural colours to reduce contrast with the qualities of the surrounding landscape features.	N/A

No.	Condition	CEMP Reference
M7.5-2	Provide additional screening of land-based infrastructure not currently screened by existing vegetation through temporary or permanent planting, where possible and safe to do so.	N/A
M7.5-3	Initiate decommissioning and maintenance planting programs during the construction phase, recognizing that results will not be realized until the operation or decommissioning phases of the Project.	N/A
M7.5-4	Monitor and maintain natural screening to ensure minimal visibility of infrastructure and activity in operational areas by establishing vegetation and avoiding surface and root disturbance.	N/A
M7.5-5	Preserve the level of contrast for Project infrastructure by re-finishing and maintaining external surfaces as required. As part of the integrity management program, or other maintenance program, WLNG will establish re-finishing and maintenance schedules for site buildings and infrastructure external surfaces.	N/A
M7.5-6	Re-vegetate or treat exposed slopes throughout the operation phase (where possible) to reduce contrast and ensure blending with the existing landform. This mitigation can include planting ground covers and colour treatment. Promote successful establishment of vegetation screening and minimize visibility of infrastructure and activity in operational areas.	N/A
M7.5-7	Re-contour disturbed areas not required for the future operation or maintenance of the Project area to approximate natural slopes and reduce form contrast between disturbed and natural environments.	N/A
M7.5-8	Consult with BC Hydro and FortisBC to determine construction areas and operation design options so that additional mitigation measures can be identified to avoid and minimize potential cumulative effects on visual quality from both development projects.	N/A
M7.6-1	Consult with Tsleil-Waututh Nation on additional mitigation for Aboriginal Interests	Section 4.2
M8.2-1	Woodfibre LNG Limited will avoid effects to heritage resources, if present, through partial Project redesign or relocation. This will result in minimal effect to the heritage site and is the preferred option from a cultural resource management perspective. It can also be the least expensive option from a construction or operation perspective. A site investigation may be required to define the heritage site limits.	Section 5.3.15
M8.2-2	Woodfibre LNG Limited will employ non-intrusive systematic data recovery techniques. This may include the documentation of heritage resources, if present, such as a canoe run or fish trap, historic structure or a heritage wreck; detailed recording of culturally modified trees, or surface collection of palaeontological material; activities which may or may not require a Section 14 HCA permit, in addition to a Section 12 HCA permit prior to site alteration.	Section 5.3.15
M8.2-3	Woodfibre LNG Limited will employ systematic data recovery (archaeological salvage or emergency excavation), if necessary. In addition to a Section 12 HCA permit prior to site alteration, this option will likely require a Section 14 HCA permit and can delay construction or operation by up to several weeks and additionally involve extensive artifact analysis. Consequently, salvage or emergency excavation is not a preferred option.	Section 5.3.15
M8.2-4	In the event that no newly identified heritage resources are identified within the LAA, it remains possible that yet undetected heritage resources could still be encountered once ground-disturbing activities begin. This mitigation option	Section 5.3.15

No.	Condition	CEMP Reference
	may require an HCA Site Alteration permit from the Archaeology Branch if a registerable or new archaeological site that has not been previously identified is discovered. Woodfibre LNG Limited will continue monitoring where site-specific Project effects cannot be predicted or evaluated before construction or operation, especially near the margins of a heritage site, or in cases where deeply buried deposits are expected that cannot be accessed without the assistance of heavy machinery. Monitoring may also be appropriate where systematic data recovery has been undertaken, but where significant heritage deposits (potentially archaeological or palaeontological) remain.	
M8.2-5	To provide a cost-effective method of managing heritage resources throughout the life of the Project, WLNG will develop Heritage Resource Chance Find Management Procedures that would provide direction to the Proponent and its contractors if unforeseen heritage resources are encountered.	Section 5.3.15
M11-1	In the event of a spill, vegetation and soil may be removed to facilitate cleanup. Any removed vegetation will be replaced after cleanup to encourage re- establishment of natural vegetation communities	Section 5.3.1
M11-2	Development of Spill Contingency and Cleanup Measures Plan for Marine Birds This plan will be developed in keeping with the province of BC's Marine Oil Spill Prevention and Preparedness Strategy (MOE, 1991) and will include the EPA suggestions (US EPA 2014).	Section 6.2
M11-3	Develop Heritage Site-specific Clean-up Plan: If the spill occurs over or into ground where a paleontological, archeological, or historical site exists or where potential for a paleontological site has been identified but not assessed, a professional paleontologist, archaeologist, historic archaeologist or built-heritage specialist respectively will be engaged to participate in the non-emergency development of the EMP specific to the spill event.	Section 5.3.1 Section 5.3.15
M12-1	Woodfibre LNG Limited will conduct a fuel hazard assessment based on the Guide to Fuel Hazard Assessment and Abatement in British Colombia (wildfire Management Branch 2012) pursuant to the Wildfire Act.	Section 5.3.1

Appendix B Corrective Actions Register

Client:		**Project:**	
Site Address:			
Work Description:		**Sign off:**	

Report Number	Hazard Identified	Corrective and Preventative Action	Action By	Date Due	Sign-Off	Date

Appendix C Water Management Plan

WATER MANAGEMENT PLAN - CONSTRUCTION
Woodfibre LNG Project

WLNG-W0001-EV-EMP-0012.REV 7

Prepared for:
Woodfibre LNG Limited

Prepared by:

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V6C 2T8

June 2023

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 Átlk̲'a7tsem (Howe Sound), approximately seven kilometres south of Sk̲wx̲wú7mesh (Squamish). The Project is on the historical location of a Sk̲wx̲wú7mesh Úxwumixw (Squamish Nation) village known as Swiy̓át. Swiy̓át and Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) are tied to the cultural well-being of Sk̲wx̲wú7mesh 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 Sk̲wx̲wú7mesh 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 Water Management Plan is primarily written in English with important place names, species, phrases, and passages provided in the Sk̲wx̲wú7mesh Sníchim (Squamish language).

Temíxwiy̓ik̲w chet wa naantem chet ti temíxw Swiy̓át
Chet wa sméṅhemswit kwis ns7éyx̲nitas chet ti temíxw
We7ú chet kwis t'ích̓imwit iy íẇas chet ek̲' I tti.

Our ancient ancestors named this place Swiy̓át
We, as their descendants safeguard these lands
We will continue to swim and fish in these clear waters.

REVISION HISTORY

Version	Date Issued	Distribution	Comments
1	October 2018	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation)	Preliminary Draft
2	June 2019	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Draft
3	August 2019	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Draft
4	October 2019	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Draft
5	December 2020	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests, Lands, Natural Resource Operations and Rural Development Tsleil-Waututh Nation	Draft
6	November 2022	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests Tsleil-Waututh Nation	Draft
7	June 2023	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Oil and Gas Commission Ministry of Forests Tsleil-Waututh Nation	Draft

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
BC	British Columbia
BCER	BC Energy Regulator (formerly Oil and Gas Commission)
CSFP	critical stream flow period
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EFN	Environmental flow needs
EM	Environmental Monitor
ENV	Ministry of Environment and Climate Change Strategy
EPPs	Environmental Protection Plans
FDS	Federal Decision Statement
FLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
IFR	instream flow requirement
KP	Knight Piésold Ltd.
LNG	liquefied natural gas
MAD	mean annual discharge
MOF	Ministry of Forests
OGC	Oil and Gas Commission (now BC Energy Regulator)
PoD	point of diversion
Project	Woodfibre LNG Project
QEP	qualified environmental professional
SNEAA	Squamish Nation Environmental Assessment Agreement
TWN	Tsleil-Waututh Nation
Woodfibre LNG	Woodfibre LNG Limited
Working Group	Squamish Nation–Woodfibre LNG Environmental Working Group
WMP	Water Management Plan
WMP-C	Water Management Plan for Construction
WSA	Water Sustainability Act

SYMBOLS AND UNITS OF MEASUREMENT

Unit of Measurement	Definition
%	Percent
cm/hr	centimetres per hour
m	metres
m^3/s	cubic metres per second

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS ..... **III**

SYMBOLS AND UNITS OF MEASUREMENT ..... **III**

1.0 PROJECT DESCRIPTION **1**

2.0 CONSULTATION AND PLAN DEVELOPMENT **6**

3.0 REGULATORY FRAMEWORK **7**

3.1 Environmental Assessment Conditions and Commitments 7

3.2 Legislative Requirements and Criteria 12

3.3 Best Management Practices and Standards 13

3.4 Water Sustainability Act Approvals 13

4.0 ROLES AND RESPONSIBILITIES **14**

5.0 INSTREAM FLOW REQUIREMENT **16**

5.1 Water Needs 16

5.2 Allowable Diversion Rates 16

6.0 MONITORING AND FOLLOW UP PLANS **18**

6.1 Overview 18

6.2 Monitoring 18

6.2.1 Hydrology Compliance Monitoring 18

6.2.2 Fish Habitat Monitoring 19

6.2.3 Ramping Rate Monitoring 21

6.2.4 Tributary Streams Connectivity 23

6.3 Adaptive Management 23

7.0 REPORTING AND COMMUNICATIONS **24**

7.1 Monitoring Reports 24

7.2 Environmental Incident Reports 24

8.0 REFERENCES **26**

9.0 PROFESSIONAL STATEMENT **27**

List of Tables

Table 3.1 Table of Concordance for EA Conditions and Application Mitigations 7

Table 3.2 Regulatory Framework for the Water Management Plan 12

Table 4.1 Summary of Roles and Responsibilities for the Water Management Plan 14

Table 9.1 Qualified Professionals 27

List of Figures

Figure 1 Location of the Woodfibre Liquefied Natural Gas Project 2
Figure 2 Certified Project Area 3
Figure 3 Monitoring Sites 20

List of Appendices

Appendix A Mill Creek Instream Flow Requirement, Construction Water Study (Rev 6)
Appendix B Woodfibre Creek Instream Flow Requirement, Construction Water Study (Rev 4)

1.0 PROJECT DESCRIPTION

Woodfibre LNG Limited Partnership (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) (Figure 1). The Project will have the capacity to liquefy up to 2.1 million tonnes per year of liquefied natural gas (LNG), have a storage capacity of 250,000 cubic metres (m^3), and export the LNG via tankers. The Project underwent a comprehensive environmental assessment process from 2013 to 2015, and Woodfibre LNG received the following approvals:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (EAC #E15-02) in 2015;
- An environmental assessment approval from Skwxwú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015, and;
- A positive federal Decision Statement (FDS) under the *Canadian Environmental Assessment Act*, *2012* in 2016.

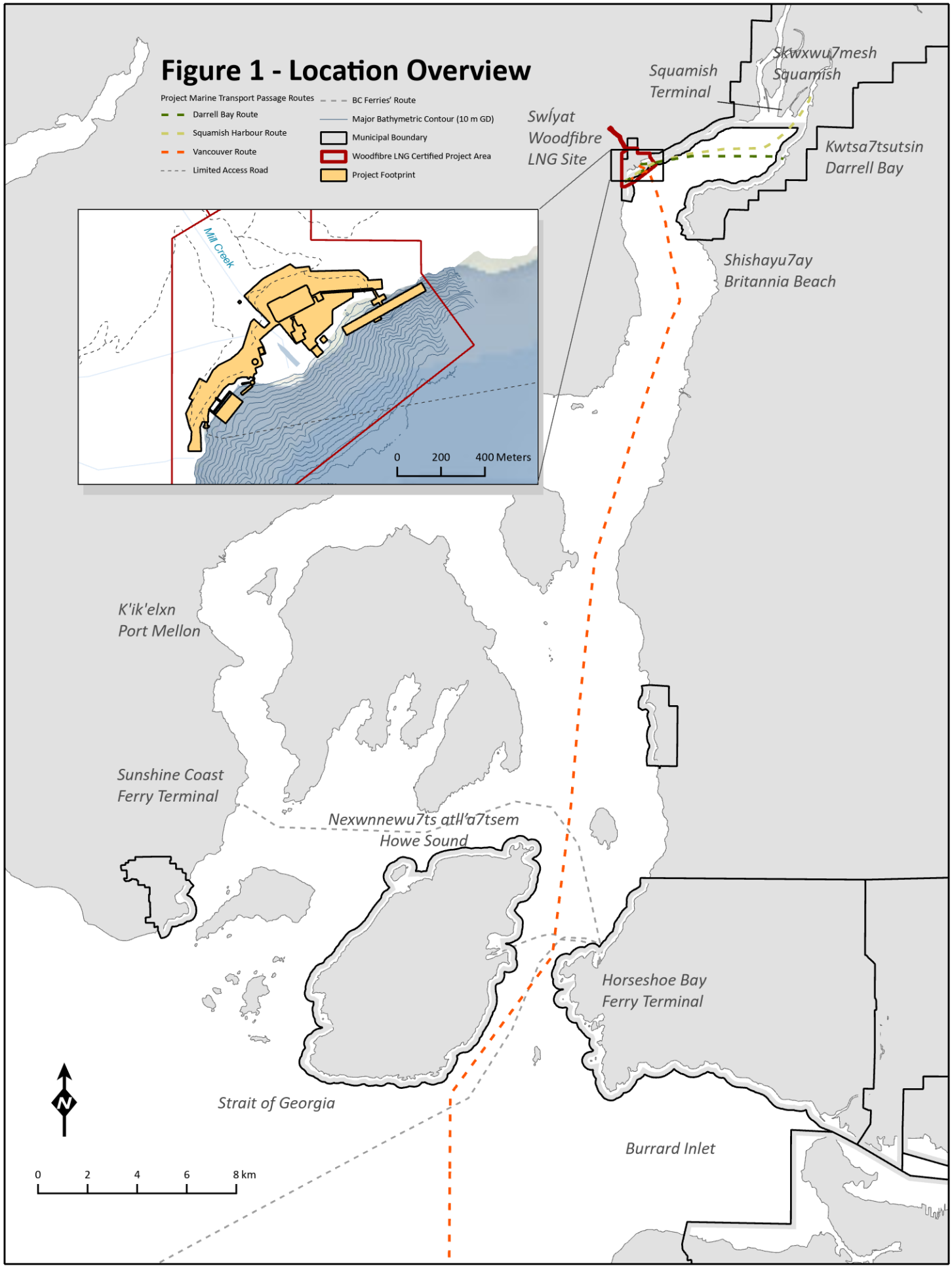
Two EAC amendments were granted by the BC Environmental Assessment Office (EAO) in 2017 and 2019, and the FDS was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address.

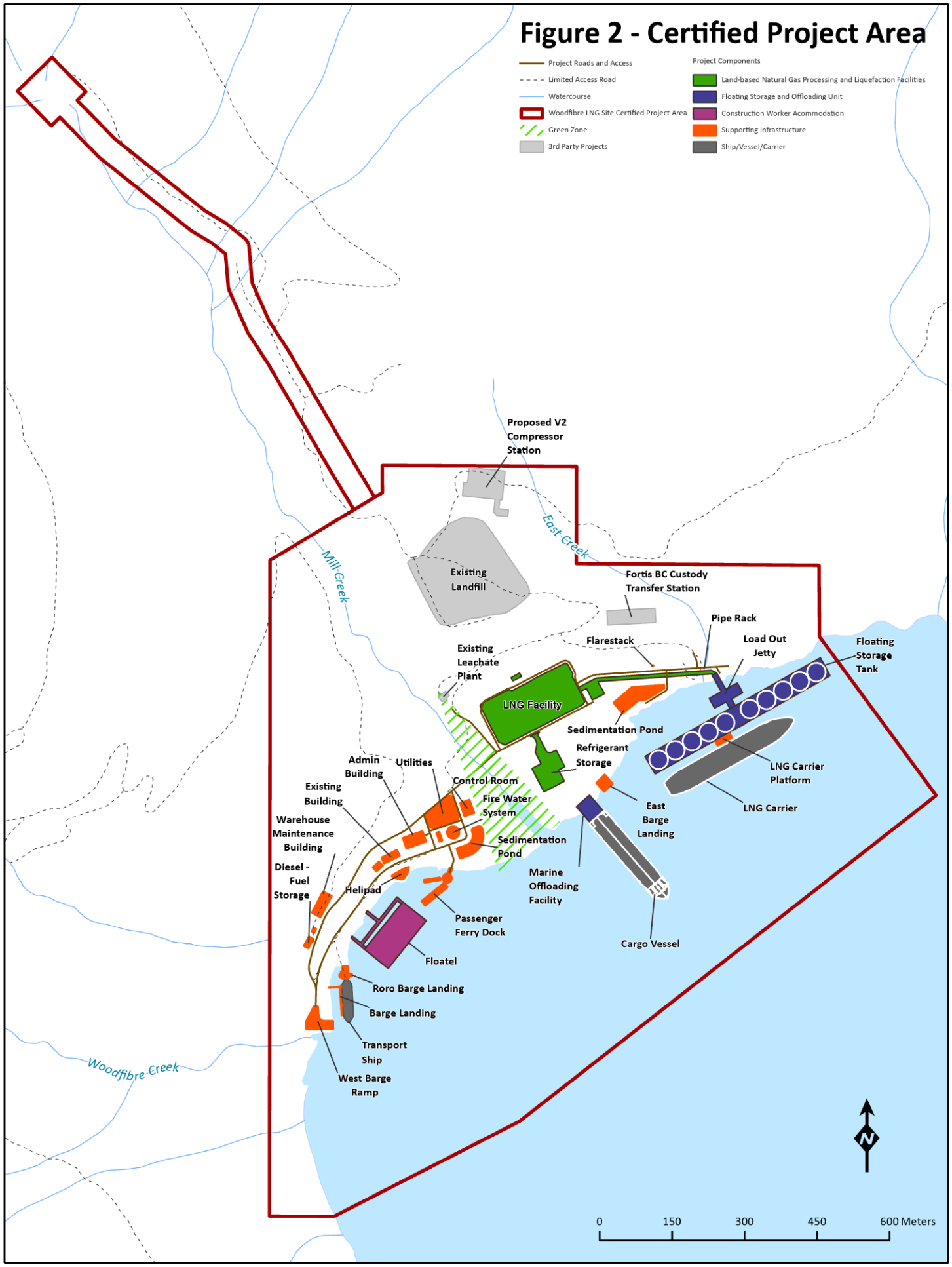
The certified project description is outlined in EAC #15-02 Schedule A. Most of the Project is on fee simple, industrially zoned, brownfield lands with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Nexwnnewu7ts atll'a7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro, and gas will be supplied by Fortis BC to the facility for export.

The CPA and key project components are illustrated in Figure 2. Key project components are:

- Land-based natural gas processing and liquefaction facilities
- Floating storage and offloading unit
- Construction worker accommodation (pending approval of EAC Application amendment 3)
- Supporting infrastructure

The supporting infrastructure includes such things as buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.


Figure 1 - Location Overview
Project Marine Transport Passage Routes
Darrell Bay Route
Squamish Harbour Route
Vancouver Route
Limited Access Road
BC Ferries' Route
Major Bathymetric Contour (10 m GD)
Municipal Boundary
Woodfibre LNG Certified Project Area
Project Footprint
Squamish Terminal
Skwxwu7mesh Squamish
Swíyat Woodfibre LNG Site
Kwtsa7tsutsin Darrell Bay
Shishayu7ay Britannia Beach
Mill Creek
0 200 400 Meters
K'ik'elxn Port Mellon
Sunshine Coast Ferry Terminal
Nexwnnewu7ts atll'a7tsem Howe Sound
Horseshoe Bay Ferry Terminal
Strait of Georgia
Burrard Inlet
N
0 2 4 6 8 km


Figure 2 - Certified Project Area
Project Roads and Access
Limited Access Road
Watercourse
Woodfibre LNG Site Certified Project Area
Green Zone
3rd Party Projects
Project Components
Land-based Natural Gas Processing and Liquefaction Facilities
Floating Storage and Offloading Unit
Construction Worker Acommodation
Supporting Infrastructure
Ship/Vessel/Carrier
Proposed V2 Compressor Station
Mill Creek
East Creek
Existing Landfill
Fortis BC Custody Transfer Station
Pipe Rack
Flarestack
Load Out Jetty
Floating Storage Tank
Existing Leachate Plant
LNG Facility
Sedimentation Pond
Refrigerant Storage
LNG Carrier Platform
LNG Carrier
East Barge Landing
Admin Building
Utilities
Control Room
Fire Water System
Existing Building
Warehouse Maintenance Building
Sedimentation Pond
Diesel - Fuel Storage
Helipad
Marine Offloading Facility
Passenger Ferry Dock
Cargo Vessel
Floatel
Roro Barge Landing
Barge Landing
Transport Ship
West Barge Ramp
Woodfibre Creek
N
0
150
300
450
600 Meters

The works and activities that will occur as part of construction include, but are not limited to:

- Marine early works (e.g., shoreline improvements, dock replacement or repairs), including improvements to the existing in-service (east) barge landing
- Clearing vegetation and grubbing
- Stripping and grading
- Demolition
- Drilling and blasting, including excavation, crushing, screening, and hauling
- Grouting and rock stabilization
- Road, culvert, and bridge works
- Construction of land-based natural gas processing and liquefaction facility
- Construction support structures, services, and equipment
- Construction of the floating storage and offloading unit
- Marine early works including dock replacement, south barge landing improvements, shoreline armoring, and placement of riprap, cobble, or sand in the intertidal and shallow subtidal marine environment
- Marine facility construction of mooring dolphin supports and connecting trestles, and gangways dredging if required

Woodfibre LNG will obtain water required for construction and operation activities for the Project from two streams in the Project area, Mill Creek and Woodfibre Creek, and is required to present a withdrawal regime and monitoring program for each of the creeks that will be protective of Environmental Flow Needs (EFN) in both creeks. This Water Management Plan for construction (WMP-C) presents the interim minimum Instream Flow Requirements (IFR) for the creeks during the construction phase; presents the regulatory framework that enables water withdrawals; outlines the roles and responsibilities for developing and implementing this plan; and presents the process to update the WMP for the operations phase.

Water use for Project construction includes sanitary purposes, concrete mixing, dust suppression, vehicle washing, lubrication, or other as required. Consistent with Amendment 2 to EAC #15-02, construction includes physical activities in connection with preparation, building, or installation of the components of the Project but excludes:

- Activities conducted solely for investigative purposes under a valid permit or authorization
- Demolition and removal or on-site remediation of existing terrestrial structures and facilities associated with the former Woodfibre Pulp Mill
- Closure of the existing pulp mill landfill
- On-going maintenance work or upgrades to existing infrastructure to maintain safety, environment, or regulatory compliance

Project Construction is scheduled to commence September 2023 with commissioning scheduled to commence in 2026. This WMP-C will be updated to present a long-term minimum IFR for the Operations phase and will be prepared in consultation with the Ministry of Forests (MOF), the BC Energy Regulator (BCER) (formerly BC Oil and Gas Commission (OGC)), Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation. The Operations WMP will be completed consistent with the EAC approval.

2.0 CONSULTATION AND PLAN DEVELOPMENT

The WMP-C has been developed by Qualified Professionals and updated based on input from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), OGC (now BCER), FLNRORD (now Ministry of Forests (MOF)), and Tsleil-Waututh Nation. Draft versions of the plan were provided to these parties for review in 2018, 2019, 2020, and 2022.

Per EAC #15-02 Condition 5 (as amended by Amendment 1 (air cooling)), the draft WMP-C was submitted to the EAO no less than 60 days prior to the start of construction; and was submitted to the MOF and BCER for review prior to submitting to the EAO. A copy of the WMP-C, containing the IFR reports for each of the creeks, will be provided to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation within seven days of the report being approved by the EAO.

The WMP-C is considered a Regulated Plan under the SNEAA and must also be approved by the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) representative prior to the start of construction. Versions, parties consulted, and dates of review are summarized in the Revision History table (p. ii) and each successive revision of WLNG-W0001-EV-EMP-0012 incorporates edits and addresses comments received from stakeholders regarding the previous version.

The WMP-C is a living document and revisions will be made as relevant new information becomes available through the progression of the detailed engineering design of the Project, changes in legislation, if performance objectives are not met, or as required by other regulatory approvals. In the event that the WMP-C requires updates, Woodfibre LNG will prepare an updated version of the document identifying the changes that were made. The updated version will be issued to Sḵwx̱wú7mesh (Squamish Nation), Tsleil-Waututh Nation, and regulatory agencies for a 30-day (excluding statutory holidays) review and comment period. After comments are received, the document will be updated and issued as a clean final revision for approval by the BC EAO.

3.0 REGULATORY FRAMEWORK

The Project is to be designed, constructed, and operated in alignment with the requirements of the provincial, federal, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes, including:

- EAC #15-02 issued on October 26, 2015 as updated from time to time including amendments issued on July 12, 2017 and July 19, 2019
- FDS issued under Section 54 of the *Canadian Environmental Assessment Act, 2012* on March 18, 2016 as updated from time to time including a revised FDS on March 7, 2018
- Skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Assessment Agreement certificate issued on October 14, 2015 as updated from time to time including a Clarifying Interpretation on July 8, 2019 and Clarifying Interpretation #3 on June 24, 2020
- Permits, licenses, and authorizations issued for the Project
- Regulatory requirements of federal and provincial legislation and regulations
- Squamish Lillooet Regional District bylaws
- District of Squamish bylaws
- Guidance documents as applicable to the WMP-C.

Information that is applicable to this WMP-C is provided in the following sections.

3.1 ENVIRONMENTAL ASSESSMENT CONDITIONS AND COMMITMENTS

The sections of the WMP-C where the conditions of the EAC #15-02, FDS, and the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Environmental Assessment Agreement (SNEAA) are addressed are cross-referenced in Table 3.1.

Table 3.1 Table of Concordance for EA Conditions and Application Mitigations

Condition Number	Condition	WMP Reference
EAC Amendment # 1 Condition 5 – Instream Flow Requirements	The Holder must require a Qualified Professional to prepare an instream flow requirements (IFR) report for Mill Creek and Woodfibre Creek, in consultation with FLNRO and BCER. The IFR report must be completed at least 60 days prior to the commencement of Construction.	This WMP-C, which includes IFR reports for Mill Creek (Appendix A) and Woodfibre Creek (Appendix B), has been prepared by a Qualified Professional and has been reviewed by MOF and BCER. The IFR reports propose stepped thresholds to reduce water diversions for Project construction to keep withdrawals in the low risk management category (level 1, BC EFN Policy, 2022), and recommend that when EFNs cannot be met, water diversions be reduced or halted based on real time hydrometric monitoring on each creek. The proposed flow regime has been superseded by the BCER short-term use approval requirement and MOF recommendation to cease withdrawal at 20% MAD in both creeks.

Condition Number	Condition	WMP Reference
	The IFR report must include an interim IFR regime and a procedure for establishing a long-term IFR regime for Mill Creek.	An interim IFR was determined for Mill Creek (Appendix A). The proposed flow regime has been superseded by the short-term use approval requirement and MOF recommendation to cease withdrawal if flows fall below 20% MAD. A long-term IFR regime will be determined to meet the operations water requirements.
	The IFR report must include an IFR regime for Woodfibre Creek for the duration of anticipated water withdrawal for Woodfibre Creek;	An interim IFR has been determined for Woodfibre Creek (Appendix B). The proposed flow regime has been superseded by the BCER short-term use approval requirement and MOF recommendation to cease withdrawal if flows fall below 20% MAD.
	The IFR report must include a record of the data utilized to support the IFR regimes for Mill Creek and Woodfibre Creek;	Hydrology data to support the proposed interim IFRs are presented in Appendices A and B. The proposed flow regime has been superseded by the BCER short-term use approval requirement and MOF recommendation to cease withdrawal if flows fall below 20% MAD. Data utilized to support the long-term IFR will be presented at the time of development.
	The IFR report must include monitoring locations, methods and procedures for the IFR regimes for Mill Creek and Woodfibre Creek;	Included in Sections 6 and 7 of this WMP-C. Monitoring locations, methods, and procedures to support the long-term IFR will be presented at the time of development.
	The IFR report must include the content and frequency for monitoring reports on the implementation of the IFR program and a list of the agencies, including, but not limited to, FLNRO, BCER and Aboriginal Groups, that will receive copies of the reports; and	The content of monitoring reports is described in Section 6 of this WMP-C. Copies of the annual monitoring reports will be delivered to MOF, BCER, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation.
	The IFR report must include the process by which the Holder can revise the IFR, including any consultation with BCER, FLNRO and EAO that would occur in connection with any such revisions.	The long-term IFR will be presented in an Operations Water IFR report and WMP, prepared in consultation with MOF, BCER, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation. The process for revising the IFR is described in Section 6.3 of this WMP-C.

Condition Number	Condition	WMP Reference
	The Holder must monitor and report on instream flow in Mill Creek during Construction and Operations phases of the Project provided that water withdrawals continue. The Holder must also monitor and report on instream flow in Woodfibre Creek during the Construction phase or, if water withdrawals from Woodfibre Creek extend beyond the Construction period, for the duration of water withdrawal from Woodfibre Creek. Monitoring and reporting for both Creeks must be done in accordance with the IFR report for Mill Creek and Woodfibre Creek required by this condition.	Construction period monitoring is described in Section 6 (Monitoring) and Section 7 (Reporting) of this WMP-C. Operations monitoring will be described in the Operations WMP.
	The Holder must obtain approval from the EAO for the IFR report prior to implementing the IFR regimes.	To be completed following MOF, BCER and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation review.
	The Holder must provide a copy of the IFR report to Aboriginal Groups within seven days of the report being approved by the EAO.	To be completed following EAO approval.
Application Mitigations	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.	The IFR reports for Mill Creek (Appendix A) and Woodfibre Creek (Appendix B) were prepared by qualified professionals. The IFR reports propose stepped thresholds to reduce water diversions for Project construction to keep withdrawals in the low risk management category (level 1, BC EFN Policy, 2022), and recommend that when EFNs cannot be met, water diversions be reduced or halted based on real time hydrometric monitoring on each creek. The proposed flow regime has been superseded by the BCER short-term use approval requirement and MOF recommendation to cease withdrawal if flows fall below 20% MAD in both creeks.

Condition Number	Condition	WMP Reference
Application Mitigations	M5.15-2 Water Management Plan. 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 Application to Dam, Divert, or Extract Water from Streams in British Columbia (Lewis et a. 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). Monitoring will be a requirement of the Water Management Plan to confirm that the plan is effective in protecting fish and fish habitat. Effective monitoring will include a combination of compliance monitoring and biotic response monitoring and the definition of program objectives, scope of effort, timing, and duration. Typical designs include, though are not limited to, the following: Continuous streamflow monitoring downstream of point of withdrawal Intermittent monitoring of biotic variables (e.g., fish abundance or density) Random IFR compliance audits	As agreed with the Working Group, Woodfibre LNG applied the framework in the Environmental Flow Needs Policy (FLNRORD and Ministry of Environment and Climate Change Strategy (ENV) 2014, updated 2022) in lieu of Hatfield et al. (2003) to establish the minimum IFRs. This document considers fish presence / absence, baseline hydrologic regime, and stream size. These values were superseded by the BCER short-term use approval requirement and MOF recommendation to cease withdrawal if flows fall below 20% MAD. Monitoring is described in Section 6 of this WMP-C.
FDS Condition 3.3	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on fish, including mortality, physical injury and behavioral change, during all phases of the Designated Project. The mitigation measures shall include: 3.3.3 maintaining minimum flow in Mill Creek and Woodfibre Creek to support fish and fish habitat	Appendix A Appendix B

Condition Number	Condition	WMP Reference
	3.3.4 designing, installing and operating a water intake structure to avoid or reduce the risk of injury and mortality to fish in Mill Creek and Woodfibre Creek	
FDS Condition 3.14	The Proponent shall, in consultation with Fisheries and Oceans Canada and Aboriginal 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 6 of this WMP-C.
SNEAA 4.3	Prior to commencing construction, Woodfibre LNG will develop a water management plan for Mill Creek and will develop interim minimum instream flow releases ("IFR"s) on Mill Creek to protect aquatic life as well as the procedure for establishing long-term IFRs, if required in accordance with 4.3(c).	This WMP-C and Appendix A, which proposes an interim IFR regime for construction based on the risk level as defined by the BC EFN Policy (FLNRORD and ENV, 2022). The proposed flow regime has been superseded by the BCER short-term use approval requirement and MOF recommendation to maintain a minimum flow of 20% MAD in both creeks. Section 6.2 of this WMP-C - A long-term IFR regime will be determined to meet the operations water requirements, prepared in consultation with MOF, BCER and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation).
	Woodfibre LNG will engage with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Environmental Working Group in establishing the minimum IFRs, which will be initially determined based on the standard-setting guidelines defined by Instream Flow Thresholds for Fish and Fish Habitat as Guidelines for Reviewing Proposed Water Uses (Hatfield et al. 2003).	As agreed with the Working Group, Woodfibre LNG applied FLNRORD and ENV (2022) in lieu of the standard-setting guidelines in Hatfield et al. (2003) to establish the minimum IFRs. The proposed flow regime presented in the IFRs report has been superseded by the BCER short-term use approval requirement and MOF recommendation to maintain a minimum flow of 20% MAD in both creeks.
	Woodfibre LNG will not change the IFR regime in Mill Creek during the critical stream flow periods ("CSFP") prior to completion of a detailed study, based on Lewis et al. (2004), and will review the results of any associated studies with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Woodfibre Environmental Working Group.	A final IFR will be determined prior to operations, in consultation with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, MOF and BCER. Any revisions to the WMP during construction will follow the procedure defined in Section 6.3.

Condition Number	Condition	WMP Reference
	If minimum instream flow is not available on Mill Creek during CSFP for both fish habitat and Project needs, Woodfibre LNG will identify alternative water sources to meet its requirements subject to emergency provisions for fire suppression. For clarity, unless otherwise shown through site-specific studies, the CSFP will be from August 1 through October 31.	Woodfibre Creek will be used as a water source and on-site storage is anticipated to provide capacity during low flow periods. The CSFP will be from August 1 through October 31.
	Any on-site hydrometric data collection and long-term compliance monitoring shall be undertaken in accordance with the Manual of British Columbia Hydrometric Standards (RISC 2009).	Section 3.3 of this WMP-C Appendix A Appendix B

3.2 LEGISLATIVE REQUIREMENTS AND CRITERIA

The diversion and use of water throughout BC is mandated through the *Water Sustainability Act* (WSA), SBC 2014, c. 15, specifically to ensure the beneficial use, management, and protection of water in an efficient way. The *WSA* and Water Sustainability Regulation legislate the diversion and use of water through licences (long-term) or use approvals (use of water for a period of up to 24 months), as well as changes in and about a stream, EFN, and for the introduction of foreign matter into a stream.

The harmful alteration, disruption or destruction of fish habitat is prohibited without prior authorization, under section 35 of the *Fisheries Act*, RSC 1985, c. F-14. This legislation also provides for the protection of fish under Section 34, and from the introduction of deleterious substances or the harmful alteration, disruption or destruction of fish habitat, under Sections 36 and 37.

The regulatory framework for the WMP-C is summarized in Table 3.2.

Table 3.2 Regulatory Framework for the Water Management Plan

Name	Jurisdiction	Description
Fisheries Act, RSC 1985, c. F-14	Federal	Protects Canada's fisheries as a natural resource by safeguarding 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.
Water Sustainability Act, SBC 2014, c. 15	Provincial	The Act and associated regulations and operational policies are intended to ensure sustainable supply of fresh, clean water that meets the needs of BC residents today and in the future. Sections 9 and 11 of the Act allow for water licensing and water use approvals respectively.

3.3 BEST MANAGEMENT PRACTICES AND STANDARDS

Data collection and assessment methods were developed based on the guidelines and methods outlined in the following documents:

- Manual of British Columbia Hydrometric Standards, prepared by Ministry of Environment for Resources Information Standards Committee (RISC 2009, updated 2018)
- British Columbia Environmental Flow Needs Policy (FLNRORD and ENV, 2022)
- Assessment Methods for Aquatic Habitat and Instream Flow Characteristics in Support of Applications to Dam, Divert, or Extract Water from Streams in BC (Lewis et. al. 2004)
- Guidelines for the Collection and Analysis of Fish and Fish Habitat Data for the Purpose of Assessing Impacts from Small Hydropower Projects in British Columbia (Hatfield et. al., 2007)
- Fish Collection Methods and Standards. Version 4. (Ministry of Environment, 1997).

3.4 WATER SUSTAINABILITY ACT APPROVALS

Woodfibre LNG received approval from the BCER under Section 10 of the WSA, allowing short term use of water (Determination of Application Number 100117204) from Mill Creek and Woodfibre Creek, and Section 11 of the WSA, allowing changes in and about a stream in Woodfibre Creek (Determination of Application Number 100117209).

The Section 10 permit allows for the diversion, storage, and use of water from Mill Creek and Woodfibre Creek at the established points of diversion from April 12, 2023 to April 11, 2025. Water withdrawn under this authorization may not be used to operate worker accommodations.

The Section 11 permit allows removal of some large boulders and stream bed in order to install a sump for an instream intake structure in Woodfibre Creek within the Woodfibre LNG CPA.

4.0 ROLES AND RESPONSIBILITIES

This section outlines the roles and responsibilities of Woodfibre LNG, Woodfibre LNG's Environmental Representative, the Contractor(s), and Environmental Monitor(s) for updating, implementing, inspecting, and reporting on the effectiveness of environmental protection and mitigation measures (Table 4.1). This section will focus on the roles and responsibilities for the WMP-C.

Table 4.1 Summary of Roles and Responsibilities for the Water Management Plan

Entity	Role and Responsibility

Woodfibre LNG Environmental Representative	• Responsible for overall compliance with regulatory permits, and approvals, including EAC conditions, FDS conditions, and SNEAA environmental assessment certificate conditions.
	• The Woodfibre LNG Environmental Representative will appoint an environmental team which will be accountable for the following activities relevant to the WMP-C during construction of the Project.
	  ○ Retain the Environmental Monitor (EM) and Qualified Professionals as necessary to implement the WMP-C
	  ○ Review and approve Contractor Environmental Protection Plans (EPPs) for compliance with the WMP-C
	  ○ Verify Contractor compliance with the WMP-C
	• Communicate monitoring results externally and other information in accordance with the WMP-C

Contractor	• Undertake work in compliance with management plans, EPPs, environmental approvals, permits, and authorizations. • Withdraw water from Mill and Woodfibre creeks in accordance with permits/approval and this WMP-C • Install structures consistent with this WMP-C
Environmental Monitor	• Monitor and review compliance of construction activities with management plans, EPPs, permits, approvals, and other environmental requirements. • Attend Project planning and tailgate meetings to communicate potential environmental concerns and requirements. • Maintain monitoring records regarding implementation of management plans, EPPs, permits, and approvals. This will include any measurements taken (e.g. streamflow), sampling conducted, field notes, photographs, and environmental incident reports. • Monitor streamflow data and inform the Contractor of streamflow conditions • Verify the effectiveness of mitigation measures • Prepare and submit reports, at least monthly, on environmental monitoring to Woodfibre LNG for relevant management plans and EPPs. • Stop or modify site activities if environmental mitigation measures are not considered to be effective, if there is an imminent risk to the environment, or if work does not comply with the terms and conditions of the WMP-C.

Entity	Role and Responsibility
Qualified Environmental Professional (QEP)	• Prepare the WMP-C including the IFR reports • Provide discipline-specific expertise (e.g., hydrology monitoring, biotic sampling, and IFR audits). • Establish and maintain hydrometric stations. • Oversee surveys / monitoring associated with the implementation of the WMP-C • Prepare annual reports as outlined in this WMP-C
Aboriginal Monitors	• Condition 23 of the EAC requires that Woodfibre LNG seek to provide opportunities for members of Aboriginal Groups to participate in monitoring activities that are occurring within their asserted traditional territory

5.0 INSTREAM FLOW REQUIREMENT

5.1 WATER NEEDS

The water diversion rate proposed in the environmental assessment application was estimated as 0.07 m^3/s for the construction phase. Advancement of Project design and refinement of information on construction activities now indicates that the Project requires up to 0.10 m^3/s of water year-round for construction of the LNG facility and ancillary works. The water will be sourced from Mill Creek and/or Woodfibre Creek. This quantity may not be required continuously but may be required at any time during the construction phase, depending on the evolution of the construction schedule. Approximately 0.005 m^3/s of this total diversion (0.10 m^3/s) is proposed to be withdrawn for Woodfibre Creek during construction to supply water to the floating worker accommodations, pending approval of the associated EAC amendment application and request for amendment to the WSA permit (Application Determination Number: 100117204).

Water diversions during the operations phase are estimated as 0.007 m^3/s for regular use and additional requirements for fire fighting water. In the event that water diversions would be needed for firefighting, the anticipated withdrawal rate would be 0.03 m^3/s. Water will be diverted from Mill Creek and/or Woodfibre to the LNG facility area. The design and location of the intake structures for operations will be determined as part of detailed design of the Project, and this WMP-C will be updated in consultation with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, MOF, and the BCER. The operations WMP will be submitted to the EAO prior to commencement of LNG facility operations.

5.2 ALLOWABLE DIVERSION RATES

Water diversions for use during construction are proposed at a maximum instantaneous diversion limit of 0.10 m^3/s. This may be achieved from either Woodfibre Creek or Mill Creek or any combination thereof, provided the diversion rate from each stream does not exceed 0.10 m^3/s. The BC EFN Policy (FLNRORD and ENV, 2022) presents a risk-based assessment approach that considers fish presence/absence, baseline hydrologic regime, and stream size. The policy was used to quantify the risk level of withdrawals from Mill Creek and Woodfibre Creek based on the proposed construction water requirement – the detailed methodology and results of the risk assessment can be found in Appendices A and B, for Mill Creek and Woodfibre Creek, respectively.

The proposed flow regimes in Appendices A and B have been superseded by the BCER short-term use approval (Determination of Application Number 100117204) issued on April 12, 2023, and the MOF recommendation to maintain a minimum flow of 20% MAD in both creeks (MOF Personal Communication, 2023).

The permitted allowable maximum diversion limit from both creeks is 0.10 m^3/s, a total daily withdrawal of 3,600 m^3/day (based on a 10-hour construction day), and a total annual withdrawal of 1,314,000 m^3. Flows will only be diverted when streamflows at the hydrometric gauging stations are greater than or equal to 20% MAD, which equate to:

- Mill Creek: no water withdrawals are authorized if the discharge measured at the hydrometric gauging station is less than 0.81 m^3/s.
- Woodfibre Creek: no water withdrawals are authorized if the discharge measured at the hydrometric gauging station is less than 0.47 m^3/s

This regime applies year round.

The permitted diversion rate and flow restrictions supersede the IFR regime proposed in the IFR reports for Mill Creek (Appendix A) and Woodfibre Creek (Appendix B). These reports are included for information only – water will be diverted in accordance with the WSA approval rather than following the flow regime presented in these reports.

A long-term IFR regime will be determined to meet the operations water requirements, prepared in consultation with MOF, BCER and Skwxwú7mesh Úxwumixw (Squamish Nation).

6.0 MONITORING AND FOLLOW UP PLANS

6.1 OVERVIEW

Monitoring for the IFR regime includes hydrology compliance monitoring (IFR audits), fish habitat and fish passage monitoring, and ramping rate assessment. Additional monitoring as part of a freshwater Fisheries and Aquatic Life Monitoring Program to be included within the Construction Environmental Management Plan will further supplement the monitoring outlined herein. As determined by the QEP, data from other studies will be used to inform the IFR, as the data become available.

6.2 MONITORING

6.2.1 Hydrology Compliance Monitoring

Streamflow data collection will continue on both Mill and Woodfibre creeks for the duration of water withdrawals. If water diversion is discontinued, gauging may also be discontinued on that creek at Woodfibre LNG's discretion.

Woodfibre LNG, under direction of the QEP, will maintain active telemetered gauging stations on Mill Creek and Woodfibre Creek, currently located upstream of the historic hydropower intakes, for the duration of water withdrawals. In accordance with SNEAA 4.3, all on-site hydrometric data collection and long-term compliance monitoring will be undertaken following the most recent version of the Manual of British Columbia Hydrometric Standards (RISC 2009, updated in 2018).

The EM will monitor Mill Creek and Woodfibre Creek flows at the active gauging stations and communicate available flows to the Contractor, who is responsible for complying with approved diversion quantities.

The EM will review streamflow conditions at the gauging station daily via the telemetry software, prior to any water diversion, and inform the Contractor if flows are dropping and approaching the flow diversion threshold of 20% MAD. Alarms will be set on the telemetry and email and/or text notifications will be sent to the EM when flows are 10% higher than the diversion threshold:

1. In Mill Creek the EM will notify the Contractor that the diversion rate may have to be reduced when the instantaneous flow is 0.89 m^3/s
2. In Woodfibre Creek the EM will notify the Contractor that the diversion rate may have to be reduced when the instantaneous flow is 0.57 m^3/s.

The EM will continue to monitor the gauging stations and inform the contractor to cease diverting water from the intakes when the instantaneous flow in Mill Creek is 0.81 m^3/s and the instantaneous flow in Woodfibre Creek is 0.47 m^3/s.

An inline flow meter has been installed on the Mill Creek intake pipeline to monitor the quantity of flow withdrawn at the point of diversion (PoD). Flows pumped from Woodfibre Creek will be monitored. Woodfibre LNG will maintain accurate records of all water withdrawal quantities for each PoD throughout the term authorized and document compliance with the allowable diversion rates (Section 5.2).

6.2.2 Fish Habitat Monitoring

A QEP will conduct at least three fish habitat assessments during low flow periods (less than 30% MAD), focussing on the CSFP, to document changes in habitat (wetted width, depth, velocity) in the sections of Mill Creek and Woodfibre Creek impacted by flow reductions, with and without diversion occurring. Methodology will be adapted from the BC Instream Flow Methodology standardized approach to the collection of instream flow information in relation to fish and fish habitat (Lewis et al., 2004).

The BC Instream Flow Methodology recommends that transect sites be located in habitats important to the fish stock(s) of interest (Lewis et al., 2004); transects will therefore be established in monitoring sites in Mill Creek downstream of the anadromous barrier, to focus on pink salmon spawning habitat, and upstream of the anadromous barrier to focus on rainbow trout and Dolly Varden rearing habitat. Transects will be established in Woodfibre Creek downstream of the diversion, which will be located downstream of the anadromous barrier.

Monitoring will occur at two locations in Mill Creek and one location in Woodfibre Creek downstream of the intakes – approximate locations are shown on Figure 3:

- MT-04: In Mill Creek approximately 300 metres from the mouth of the creek in step-pool habitat, upstream of tidal influence and downstream of the anadromous barrier.
- MT-06: In Mill Creek approximately 1000 metres from the mouth of the creek in pool-cascade habitat; upstream of the anadromous barrier.
- WT-01: located in Woodfibre Creek approximately 50 metres from the mouth of the creek in pool-cascade habitat; within tidal influence and downstream of the anadromous barrier.

Transects will be established perpendicular to flow and marked using rock bolts drilled into large boulders along each bank so that water level measurements can be referenced to the same fixed location for each site visit. Each transect will be geo-referenced using a handheld GPS unit using the NAD83 map datum and marked with flagging tape to allow easy identification in the field. Two habitat monitoring transects will be established at each site – transects will be established in areas that will show the greatest change in depth and velocity with changes in discharge (e.g., in a wide, shallow section with sloping banks rather than in a confined bedrock pool, as pools often show limited change in wetted width, depth, or velocity with flow change (Lewis et al., 2004).







LEGEND:

- CPA
- WATER DIVERSION
- FISH HABITAT MONITORING SITE
- TRIBUTARY STREAM CONNECTIVITY MONITORING SITE
- RAMPING SITE
- STREAM

HABITAT UNIT

- POOL CASCADE
- TIDALLY INFLUENCED
- STEP POOL

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	7JUN'23	ISSUED WITH TRANSMITTAL	TJP	KK	TJP

100 50 0 100 200 Meters

NOTES:

1. BASE MAP: ESRI ONLINE WORLD IMAGERY.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:10,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MONITORING LOCATIONS

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-494/28	VA23-01004

FIGURE 3 REV 0

SAVED: \\KPL\VA-Prj$\11\03\00494\28\A\GIS\Figs\VA23-00784\Fig3_MonitoringLocations_r0.mxd, Jun 07, 2023 11:08 AM, dalexander

During each monitoring event at each transect the QEP will:

- Install a tag line (meter tape) on the rock bolt hangers on the left and right banks
- Record the time at the start of the survey
- Record the wetted width of the transect in meters (m) to the nearest centimeter (0.01 m)
- Measure depth, velocity, and dominant substrate at 20 evenly-spaced verticals ("cells") measured from the established bolt anchors. As the purpose of the monitoring program is to document change in depth and velocity with change in flow, the verticals will be repeated in the same locations during each monitoring event. To facilitate this, the left bank pin will be assigned as the horizontal datum (distance = 0 m) and verticals will be referenced to this datum:
- Measure the depth of the water using the metering rod, recording the depth in metres to the nearest 0.01 m
- Measure the water velocity at each vertical using a meter: velocity measurements will be taken at 0.4 x depth if the water depth is ≤1 m, and at 0.2 and 0.8 x depth if the water depth is >1 m
- Visually estimate and record dominant substrate based on the categories presented in Lewis et al. (2004)
- Record the time at the end of the survey
- Take photographs (view upstream at the transect, view downstream at the transect, view from left bank to right bank along the transect, view from right bank to left bank along the transect)
- Record instantaneous streamflow data from telemetered gauging stations on Mill Creek and Woodfibre Creek at the start and end of each transect measurement.

Weighted usable width will be calculated at each transect using the following equation (Lewis et al., 2004):

$$WUWdvs = \sum_{i}^{n} (Wi \times Di \times Vi \times Si)$$

Where:

- Wi *is the width of cell "i" on the transect*
- Di *is the suitability of depth at cell "i" on the transect*
- Vi *is the suitability of velocity at cell "i" on the transect*
- Si *is the suitability of substrate at cell "I" on the transect*.

Suitability parameters will be based on the Habitat Suitability Index curves developed by the BC Ministry of Environment for rainbow trout juvenile rearing and pink salmon spawning (Ptolemy, 2001).

6.2.3 Ramping Rate Monitoring

When water diversion commences, streamflow will decrease, and water level will drop. The purpose of ramping rate monitoring is to determine if the rate of flow withdrawal will result in fish stranding downstream of the intakes. Fish stranding is any event where fish become trapped in pools and isolated from a main body of water or are beached due to rapid fluctuations in flow regime Fisheries and Oceans Canada (2017).

River stage, shoreline slopes less than 6%, heavily structured littoral zones, cooler water temperatures and abrupt water levels changes increase the likelihood of fish stranding events (Fisheries and Oceans Canada, 2017).

Ramping rate is defined by Fisheries and Oceans Canada (2012) as the rate of change in discharge measured as a flow per unit time (i.e., m^3/s per second) or as the rate of change in stage and measured as vertical change in water surface per unit time (i.e., centimetres per hour (cm/hr)). The ramping rate monitoring protocol has been adapted from Fisheries and Oceans Canada (2012) - the components involved in determining the impacts of flow ramping are included below:

- Sample Area: monitoring sites will be established in sensitive habitats downstream of the intakes. Sensitive habitats (areas with a high risk of fish stranding) in Mill Creek will be identified; monitoring sites will be established in locations that exhibit large changes in wetted area as stage or discharge change (e.g., broad active channel sections and shallow sloping banks). It is expected that monitoring sites in Mill Creek will be limited, as the diversion reach has primarily step-pool morphology and/or is incised within a bedrock canyon, often with near vertical walls exceeding 10 m in height. Therefore, an initial monitoring site has been identified in the tidally influenced zone for each creek (see Figure 3).
- Method: Water level transducers will be installed at each monitoring site to record continuous stage during the CSFP. water will be diverted at the intakes at the maximum withdrawal rate (0.1 m^3/s) and the resulting stage change will be recorded at each monitoring area. Data will be retrieved from the water level transducers and stage change rates (in cm/hour) will be calculated for a pre-determined period prior to, during, and following the start of water diversion, accounting for lag time. Rates will be compared to the DFO criteria rates of 2.5 cm/h when fry are present, and 5.0 cm/h at all other times, as well as to background stage change rates.
    - Biotic monitoring: following the initiation of water withdrawal, a QEP will conduct a visual survey of sensitive habitats for fish stranding. The number and location of any stranded fish will be recorded. Fish will be returned to the wetted portion of the streams.
    - Operational Monitoring: the ability of the contractor to accurately and precisely start, stop, and ramp flow diversion will be assessed. Specifically, at Mill Creek where diversion will be controlled by regulation at the LNG facility, 2 km downstream of the intake.
- Frequency:
    - Water level transducers will record continuous stage during the CSFP.
    - Biotic and operational monitoring will be conducted three times during low flows, targeting the range of 10% to 30% MAD, to assess variability.
    - Ramping rate monitoring will occur in August or September, during the CSFP, when the withdrawal ratio is greatest (6% and 5%, respectively, of the natural monthly flows in Mill Creek and 8% for both months in Woodfibre Creek).

6.2.4 Tributary Streams Connectivity

Three first-order streams are mapped flowing into Mill Creek from the northeast downstream of the intake site. These streams will be visually assessed where they cross the access road to the intake to document flow (monitoring sites TS-1, TS-2, TS-3 on Figure 3), and if they are flowing and if safe to do so, the confluence of the tributaries with Mill Creek will be assessed to document surface connectivity (wetted width, depth) to determine if fish passage is maintained when water is being diverted from Mill Creek.

No streams flow into Woodfibre Creek between the intake site and the mouth of the creek.

6.3 ADAPTIVE MANAGEMENT

A QEP will review the hydrology and fisheries data collected. If the QEP determines that adjustments to the WMP or IFR are required based on the additional data collected, this WMP-C will be updated. Updates to the plan and IFR will follow the approach outlined in Section 2. The QEP may increase the IFR flow diversion threshold above 20% MAD for the purposes of protection of aquatic life.

The QEP will verify effectiveness of new/revised mitigations and will provide a monitoring report based on these assessments and any adaptive management recommendations.

7.0 REPORTING AND COMMUNICATIONS

7.1 MONITORING REPORTS

Reporting will occur for the duration over which water is being withdrawn from Mill or Woodfibre creeks as authorized by environmental assessment approvals. Flow and/or water level measurements and observations related to water quantity, work activities, and employed actions taken will be recorded by the EM and will form the basis of environmental monitoring reports.

A monthly report will be prepared by the EM during construction that will include a summary of actions completed related to this plan.

Water withdrawal records will be submitted to the BCER on a quarterly basis: reports are due on or before April 25, July 25, October 25, and January 25.

An annual report will be prepared by the QEP to present streamflow data and diverted flow quantities, along with documentation of actions completed if the maximum diversion limits at the gauging station did not meet the streamflow triggers. Documentation to be included in the report is listed as follows:

1. Stage-discharge measurements and gauging station maintenance records
2. Hydrograph showing flow upstream of the PoD
3. Quantity of flow diverted, recorded at the inline flow meter or pumped
4. Summary of any environmental incident reports (Section 7.2)

The annual monitoring report will also include fish habitat, ramping rate, and tributary streams connectivity in the years that this work is completed. The annual report will be shared with MOF, BCER, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and Tsleil-Waututh Nation.

7.2 ENVIRONMENTAL INCIDENT REPORTS

An Environmental Incident with respect to surface water quantity is one that has caused, or has the potential for causing, one or more of the following:

- Exceedance of approved maximum diversion limits (0.1 m^3/s).
- Adverse alteration of habitat (e.g., dewatering) following water withdrawal at the approved maximum diversion limits.
- Fish stranding following water withdrawal at the approved maximum diversion limits.
- Water withdrawal if the discharge measured at the hydrometric monitoring stations is less than 0.81 m^3/s in Mill Creek and less than 0.47 m^3/s in Woodfibre Creek

The Environmental Incident Report will characterize and document the:

- Cause and nature of the incident.
- Approximate magnitude (area or habitat affected) and duration.
- Actions taken to control or limit the activity causing the incident, and

- Proposed remedial or corrective actions to prevent recurrence of the incident.

Incident reporting will be included in monthly and annual reports, however, where permit requirements establish that an incident report is to be submitted, these will be prepared and submitted consistent with permit requirements and shared with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation.

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9.0 PROFESSIONAL STATEMENT

Knight Piésold Ltd. confirms that this report, titled Water Management Plan-Construction, has been prepared in general conformance with the *Water Sustainability Act*.

Report authors Toby Perkins and Stephanie Eagen of Knight Piésold Ltd. have demonstrable experience in the preparation of water management plans and are familiar with the investigation carried out at the Site.

Table 9.1 lists the Qualified Professionals and designations who prepared the Project's WMP.

Table 9.1 Qualified Professionals

Name	Qualifications
Toby Perkins	P.Eng.
Stephanie Eagen	R.P.Bio.

.

APPENDIX A

Mill Creek Instream Flow Requirement, Construction Water Study (Rev 6)

Prepared for
Woodfibre LNG Limited
1020-1075 West Georgia St
Vancouver, British Columbia
Canada, V6E 3C9

Prepared by
Knight Piésold Ltd.
Suite 1400 - 750 West Pender Street
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VA103-494/24-2

MILL CREEK INSTREAM FLOW REQUIREMENT
CONSTRUCTION WATER STUDY

Rev	Description	Date
0	Issued in Final	July 20, 2018
1	Revised Point of Diversion and Diversion Rate	February 26, 2019
2	Revised Hydrology and Monitoring Plan	May 21, 2019
3	Updated to Address Agency Review Comments	August 30, 2019
4	Updated to Include Revised Point of Diversion Location	December 11, 2020
5	Updated to Address Review Comments. Updated Hydrology. Updated Maximum Diversion Rate.	August 16, 2022
6	Updated to Address Client Comments	September 23, 2022

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

EXECUTIVE SUMMARY

Woodfibre LNG Ltd. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas (LNG) Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia. The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the LNG via tankers. The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (BCEAA; EAC #E15-02) in 2015
- An environmental assessment approval from Squamish Nation through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015
- A positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016

Two EAC amendments were granted by the British Columbia Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Skwxwú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address, including that Woodfibre LNG undertake an instream flow requirements (IFR) study to assess the potential effects of diverting water for construction and operation from Mill Creek and Woodfibre Creek.

Water is required for construction of the facility and will be sourced from Mill Creek or Woodfibre Creek. The proposed Mill Creek construction water source point of diversion (PoD) is located approximately 2 km upstream from the mouth of the Creek at Howe Sound. This IFR report is intended to support assessment of construction water diversion from Mill Creek and presents:

- A description of watershed, hydrological and fisheries baseline studies
- A summary of proposed Project water use and current water infrastructure
- A risk assessment of the proposed withdrawals following the BC Environmental Flow Needs Policy
- Supplementary measures to mitigate any residual risk

This report is intended to meet Condition 5 of the Project's provincial Environmental Assessment Certificate for instream flow requirements. Specifically, this report supports the construction water requirements for the Project, and for use in the Project's Water Management Plan. This report only addresses Woodfibre Creek.

Physical Setting, Hydrology and Fisheries Studies

Mill Creek is a tributary of Howe Sound, located in the southern Coast Mountains approximately 7 km southwest of Squamish and 45 km north of Vancouver in BC. The Mill Creek watershed area is approximately 41 km^2 at the mouth and ranges in elevation from over 2,000 meters above sea level (masl) at the peak of Mount Sedgewick to sea level at the mouth, where the stream discharges into Howe Sound.

Fish and aquatic habitat information for Mill Creek are based on publicly available datasets, sampling and interpretation completed previously as part of the Project environmental assessment, and sampling and

interpretation completed by Knight Piésold Ltd. (KP) during 2017 and 2018. Anadromous fish are present in Mill Creek from Howe Sound to approximately 600 m upstream, where the gradient increase and large cascades and waterfalls prevent access. Several species of salmon, trout, char and sculpin were documented below the barrier. Above the barrier, only Dolly Varden and rainbow trout were documented; fish densities are very low.

Woodfibre LNG operates an active streamflow gauging station, located just upstream of the historic hydropower intake site, at an elevation of approximately 200 masl and 2 km from the mouth. This station was established in April 2017 and remains active to support instream flow monitoring and management.

Long-term hydrologic conditions in Mill Creek were assessed based on over four years of measured streamflow records collected at the Mill Creek gauging station. These data were correlated with streamflow data collected by Water Survey of Canada (WSC) on the Capilano River to produce a long-term synthetic daily flow series for the gauging station. This synthetic daily flow series was used as the basis of assessing baseline and Project affected flow conditions. The mean annual discharge (MAD) for Mill Creek at the gauging station was estimated to be 4.05 m^3/s (1960 to 2020 period), which equates to a mean annual unit runoff of 107 $L/s/km^2$ for the 38 km^2 watershed. The gauging station is located approximately 100 m upstream of the PoD and flow conditions are equivalent at the two locations.

Proposed Construction Water Use and Water Infrastructure

Woodfibre LNG will require up to 0.10 m^3/s of fresh water year-round during the construction phase of the Project, which will be used for sanitary purposes, concrete mixing, dust suppression, vehicle washing, lubrication or other, as required. Woodfibre LNG currently holds three water licences for water use on Mill Creek; however, these licences are for power generation and pulp mill purposes and cannot be used prior to a change in use. Woodfibre LNG will request approval for construction water use pursuant to the *Water Sustainability Act* (WSA). Any amendments to Woodfibre LNG's existing Mill Creek water licences would occur later when the permanent water requirements are known.

Woodfibre LNG is proposing to use the existing intake and flume on Mill Creek to divert water for construction. The intake will be upgraded to include fish screening and diverted to a holding tank for subsequent construction use. A flow meter will be installed on the pipeline to measure the diverted water quantity.

Construction Water Withdrawal Risk Assessment

The Environmental Flow Needs (*EFN) Implementation Guidance for British Columbia* and BC EFN Policy were used to assess the proposed construction water need of 0.10 m^3/s (maximum withdrawal rate). No other water is currently permitted for withdrawal. Based on the BC EFN Policy criteria, the Mill Creek construction withdrawal is considered low risk.

Supplementary Measures

The risk to fish from the proposed construction water withdrawal is considered low, overall. However, during late summer there are periods when baseline streamflow can be low and water withdrawal could represent a substantial portion of the available water. Supplementary measures to avoid impacting the lowest flows are proposed, which would limit construction water withdrawal if streamflow falls below 0.81 m^3/s at the PoD, such that the proportion of flow withdrawn remains low (<15% of streamflow). As streamflow reduces further, the allowable diversion rate as a proportion of real-time flow reduces to 10% then 5% to reduce risk to fish. Between August 1 and October 31, a minimum instream flow requirement of 0.81 m^3/s (20% MAD)

has been set to maintain pink salmon migration and spawning habitat. If flows fall below 0.81 m^3/s, no water will be diverted.

TABLE OF CONTENTS

PAGE

Executive Summary I

Table of Contents i

1.0 Introduction 1
1.1 Project Description 1
1.2 Scope of Report 1
1.3 Construction Water Requirements 2

2.0 Physical Setting 4
2.1.1 Mill Creek Watershed 4
2.1.2 Mill Creek Channel Morphology 4

3.0 Fisheries and Aquatic Habitat Baseline 13
3.1 Historical Information 13
3.2 IFR Study -Specific Surveys 14
3.3 Post-EA Monitoring 15
3.4 Summary 15

4.0 Hydrology 18
4.1 Mill Creek Baseline Hydrology 18
4.1.1 Measured Streamflow Data 18
4.1.2 Mill Creek Long Term Synthetic Hydrology 20

5.0 Construction Environmental Flow Needs 23
5.1 Construction Environmental Flow Needs Assessment Methodology 23
5.2 Construction IFR for Mill Creek 24
5.2.1 Area of Influence 24
5.2.2 Application Risk Screening 24
5.2.3 Screen for Fish Bearing Status and High Sensitivity Species 25
5.2.4 Flow Sensitivity 25
5.2.5 Stream Size 25
5.2.6 Cumulative Withdrawal 25
5.2.7 Risk Rating 26
5.2.8 Results 26

6.0 Summary and Recommendations 28
6.1 Summary 28
6.2 Supplementary Measures 28

7.0 References 30

8.0 Certification 32

TABLES

Table 3.1 Fish Species Capture Data, Hemmera (2016) 14
Table 3.2 Fish Species Capture Data, Knight Piésold Ltd. (2017-2018) 15
Table 3.3 Mill Creek Fish Presence Summary 16
Table 3.4 Pink Salmon Periodicity Chart 17
Table 3.5 Dolly Varden Char Periodicity Chart 17
Table 3.6 Rainbow Trout Periodicity Chart 17
Table 4.1 Average, Minimum and Maximum Monthly Flows - Mill Creek at the PoD 21
Table 5.1 Existing Mill Creek Water Licences 25
Table 5.2 Mill Creek Flow Sensitivity at the PoD 25
Table 5.3 Risk Assessment for Cumulative Withdrawals in Mill Creek near the Mouth 26
Table 5.4 Baseline and Construction Mean Monthly Flows – Mill Creek at the PoD 27
Table 6.1 Construction Management Plan Flow Diversion Limits 29

FIGURES

Figure 1.1 Point of Diversion 3
Figure 2.1 Mill Creek Watershed 5
Figure 2.2 Lower Mill Creek Reach Characterization 6
Figure 2.3 Mill Creek Reach Characterization 7
Figure 4.1 Mill Creek (MILL) Rating Curve 19
Figure 4.2 Mill Creek (MILL-R2) Rating Curve 19
Figure 4.3 Mill Creek (MILL) Daily Average Discharge Hydrograph 20
Figure 4.4 Mean Monthly Hydrograph – Mill Creek at the PoD 21
Figure 4.5 2009 Daily Hydrograph – Mill Creek at the PoD Synthetic Daily Flow Series 22
Figure 5.1 Risk Management Decision-Making Process for Consideration of Environmental Flow Needs within the BC EFN Policy 24
Figure 5.2 Baseline and Construction Mean Monthly Flows – Mill Creek at the PoD 27

PHOTOS

Photo 2.1 Reach 1 at low tide, showing riparian conditions on the left and right banks 8
Photo 2.2 Reach 1 at low tide looking downstream to the mouth 9
Photo 2.3 Reach 2 showing an increase in channel gradient compared to Reach 1, and step-pool morphology 10
Photo 2.4 Upstream boundary of Reach 2 (0+350) showing the partial fish barrier at low flows 10
Photo 2.5 Downstream boundary of Reach 3 showing difficult access as a result of vertical bedrock walls, and deep pools interspersed with cascades 11
Photo 2.6 Aerial view of stream channel of Reach 3 showing falls and cascade barriers to upstream migrating fish 12

APPENDICES

Appendix A Mill Creek Hydrologic Analysis and Synthetic Flow Record (VA22-01362)
Appendix B Mill Creek Synthetic Flow Duration Curves

ABBREVIATIONS

BC ..... British Columbia
CPUE ..... Catch Per Unit Effort
EAC ..... Environmental Assessment Certificate
EAO ..... Environmental Assessment Office
EFN ..... Environmental Flow Needs
ENV ..... British Columbia Ministry of Environment and Climate Change Strategy
FIDQ ..... Fish Inventories Data Queries
FLNRORD ..... Ministry of Forests, Lands, Natural Resource Operations and Rural Development
IFR ..... Instream Flow Requirements
JTH ..... J.Termuende Hydrological
km ..... kilometers
KP ..... Knight Piésold Ltd.
LNG ..... liquefied natural gas
m ..... meters
MAD ..... Mean Annual Discharge
masl ..... meters above sea level
OGC ..... BC Oil and Gas Commission
Project ..... the Woodfibre LNG Project
PoD ..... Point of Diversion
SN ..... Squamish Nation
Woodfibre LNG ..... Woodfibre LNG Limited
WSA ..... Water Sustainability Act
WSC ..... Water Survey of Canada

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Woodfibre LNG Ltd. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas (LNG) Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia. The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the LNG via tankers. The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (BCEAA; EAC #E15-02) in 2015
- An environmental assessment approval from Squamish Nation through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015
- A positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016

Two EAC amendments were granted by the British Columbia Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Skwxwú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address, including that Woodfibre LNG undertake an instream flow requirements (IFR) study to assess the potential effects of diverting water for construction and operation from Mill Creek and Woodfibre Creek.

1.2 SCOPE OF REPORT

Knight Piésold Ltd (KP) has been retained by Woodfibre LNG to conduct an instream flow requirement (IFR) study for Mill Creek to assess the effects of the proposed water withdrawals of construction and operations water. This report has been prepared to support Woodfibre LNG's application for approval for construction water use pursuant to the *Water Sustainability Act* (WSA) and Condition 5 of the Project's provincial Environmental Assessment Certificate for instream flow requirements. Some of the conditions placed on Woodfibre LNG by Squamish Nation (SN), the federal Minister of Environment and Climate Change, and the BC EAO are addressed in this report. However, a subsequent detailed IFR study that assesses the proposed water withdrawals for operation of the Woodfibre LNG facilities will be presented in an Operational Water Study report to address any outstanding water related conditions.

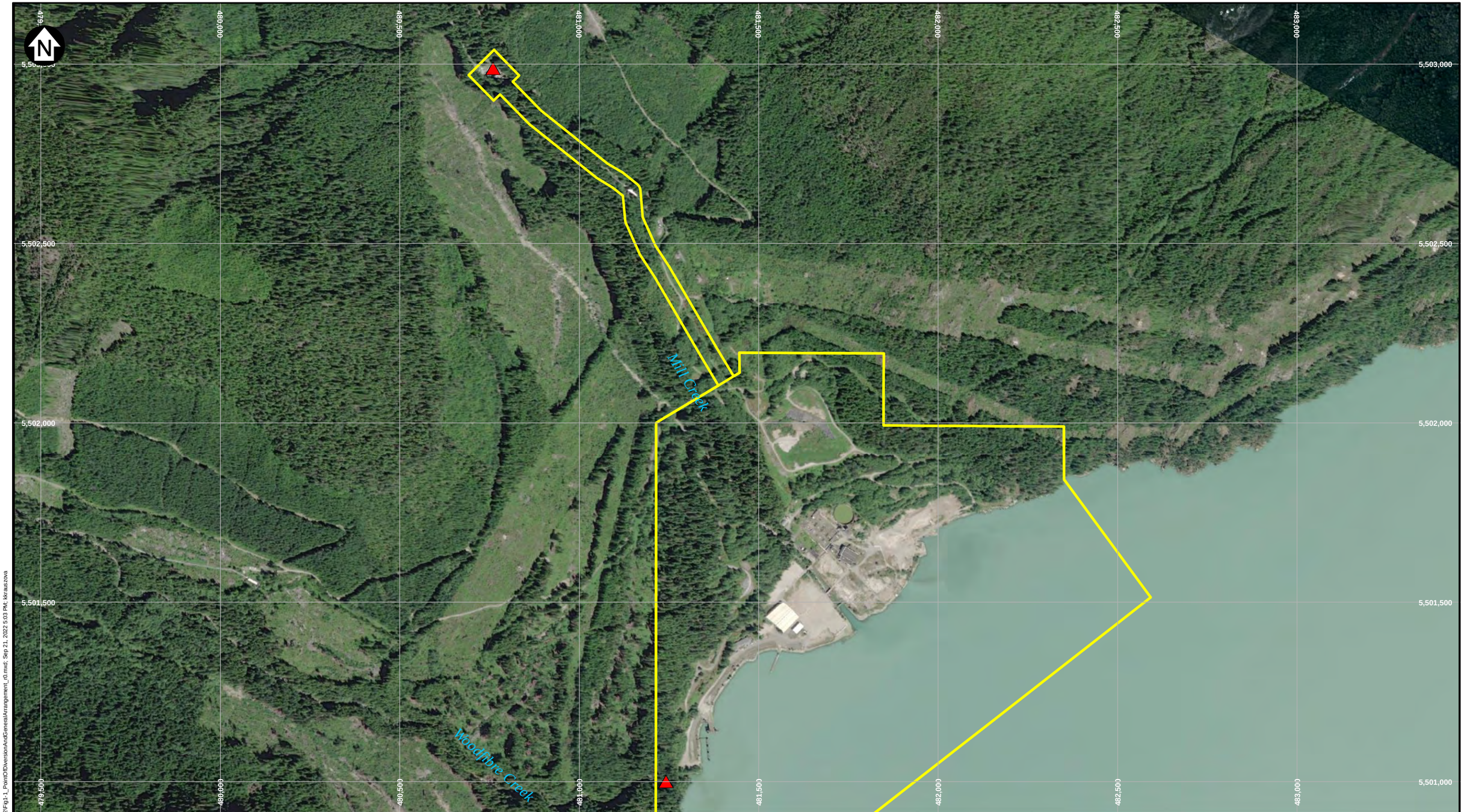
This IFR report presents:

1. A comprehensive description of the physical characteristics of Mill Creek including watershed, channel morphology and hydrological conditions.
2. A fisheries baseline description, providing a summary of fish presence, distribution, periodicity, and habitat requirements.
3. A summary of proposed Project construction water use and water infrastructure.
4. Proposed allowable diversion rates and supplementary measured to mitigate any residual risk.

1.3 CONSTRUCTION WATER REQUIREMENTS

The Project requires up to 0.10 m^3/s of water, year-round, to provide water for construction of the LNG facility and ancillary facilities, to be sourced from Mill Creek or Woodfibre Creek. Water will be diverted from either stream, depending on construction requirements, but the maximum diversion rate from Mill Creek shall not exceed 0.10 m^3/s. Water use for construction of the project includes sanitary purposes, concrete mixing, dust suppression, vehicle washing, lubrication or other as required. The duration and quantity of the water withdrawals (up to the permitted limit) will be dependent upon the construction schedule and Project logistics. For the purpose of this assessment, it is assumed that the maximum water requirement is diverted continuously, to provide a conservative assessment of potential effects.

Water will be diverted from the existing Mill Creek intake, located approximately 2 km upstream from the mouth of the creek. The intake is currently only partially functional but will be upgraded for construction water use to provide diversion rate control, flow measurement and fish screening, to meet Fisheries and Oceans Canada interim code of practice for end-of-pipe fish protection screens (Fisheries and Oceans Canada, 2020). Water will be directed to the construction site via the existing penstock infrastructure and stored in a holding tank for subsequent use at the Project. The point of diversion is shown on Figure 1.1.



LEGEND:

- CPA
- PROPOSED WATER DIVERSION

100 50 0 100 200 Meters

NOTES:

1. BASE MAP: ESRI ONLINE WORLD IMAGERY.
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:10,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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1	10AUG'22	ISSUED WITH REPORT	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

POINT OF DIVERSION

Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF NO. 2

FIGURE 1.1

REV 0

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2.0 PHYSICAL SETTING

2.1.1 MILL CREEK WATERSHED

Mill Creek is a tributary of Howe Sound, as shown on Figure 2.1, located in the southern Coast Mountains approximately 7 km southwest of Squamish and 45 km north of Vancouver, BC. The Mill Creek watershed and Howe Sound have physiographic characteristics that are typical of the Coast Mountains, a mountain range created by tectonic uplift and intense glacial erosion. These characteristics include high mountain peaks composed of plutonic bedrock, active glaciers in high-elevation headwater areas, U-shaped valleys that were intensely scoured by much larger glaciers during the Ice Age and discordant valley bottom elevations between tributary and main valleys due to variable degrees of glacial scour. Howe Sound is one of many fjords along the British Columbia coast, where a glacially scoured valley was flooded by the sea following deglaciation at the end of the Pleistocene Epoch around 10,000 years ago. Mill Creek flows into Howe Sound near the head of the fjord. Howe Sound is essentially the flooded lower section of the Squamish River valley.

The Canadian Hydrographic Service publishes tidal information for a station located near Squamish. The typical diurnal tidal range is 3 m to 4 m, and the extreme range is over 5 m.

The Mill Creek watershed is approximately 41 km^2 at the mouth and ranges in elevation from over 2,000 meters above sea level (masl) at the peak of Mount Sedgewick to sea level at the mouth, where the stream discharges into Howe Sound. In the upper watershed, the stream channel is largely confined by a series of colluvial/alluvial fans and coupled with hillslope processes.

Mill Creek flows in a southeasterly direction into Howe Sound, roughly through the middle of the Woodfibre LNG property. Mill Creek has a densely vegetated but previously logged watershed with a mean basin elevation of 975 masl. The Mill Creek watershed contains one lake, Scott Lake, located at 1,300 masl. Glaciers cover a negligible area of the watershed.

2.1.2 MILL CREEK CHANNEL MORPHOLOGY

Mill Creek has a mainstem length of approximately 9 km from its source near Mount Sedgwick to its mouth at sea level and an average gradient of approximately 7.5%. As is typical of glaciated valleys of the Coast mountains, channel gradient is steepest in the upper headwaters, moderate in the mid reaches, then steepening again in the lower reaches as the watershed meets the parent valley. Woodfibre LNG operates an active hydrometric gauging station just upstream of the historic Mill Creek intake location at an elevation of approximately 200 masl and 2 km from the mouth. The median watershed elevation above the gauge is 1,050 masl. The reach from the gauge to the mouth has an average gradient of 10%. Channel gradient decreases near the mouth as the channel flows over the historic fan deposits and channel gradient reduces to approximately 4%. The channel on the fan has been confined by the historic pulp mill infrastructure.

Between the mouth of Mill Creek and the proposed intake site, the channel was divided into three reaches. These reaches are shown on Figure 2.2 to Figure 2.3 and described in the following sections.



MILL CREEK WATERSHED

LOCATION TO:	DRAINAGE AREA (km²)
Mill Creek Mouth	41
Point of Diversion	38
Mill Creek Gauge	38

LEGEND:

- PROPOSED WATER DIVERSION
- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

1 0.5 0 1 2 3 4 5 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:50,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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WOODFIBRE LNG LIMITED

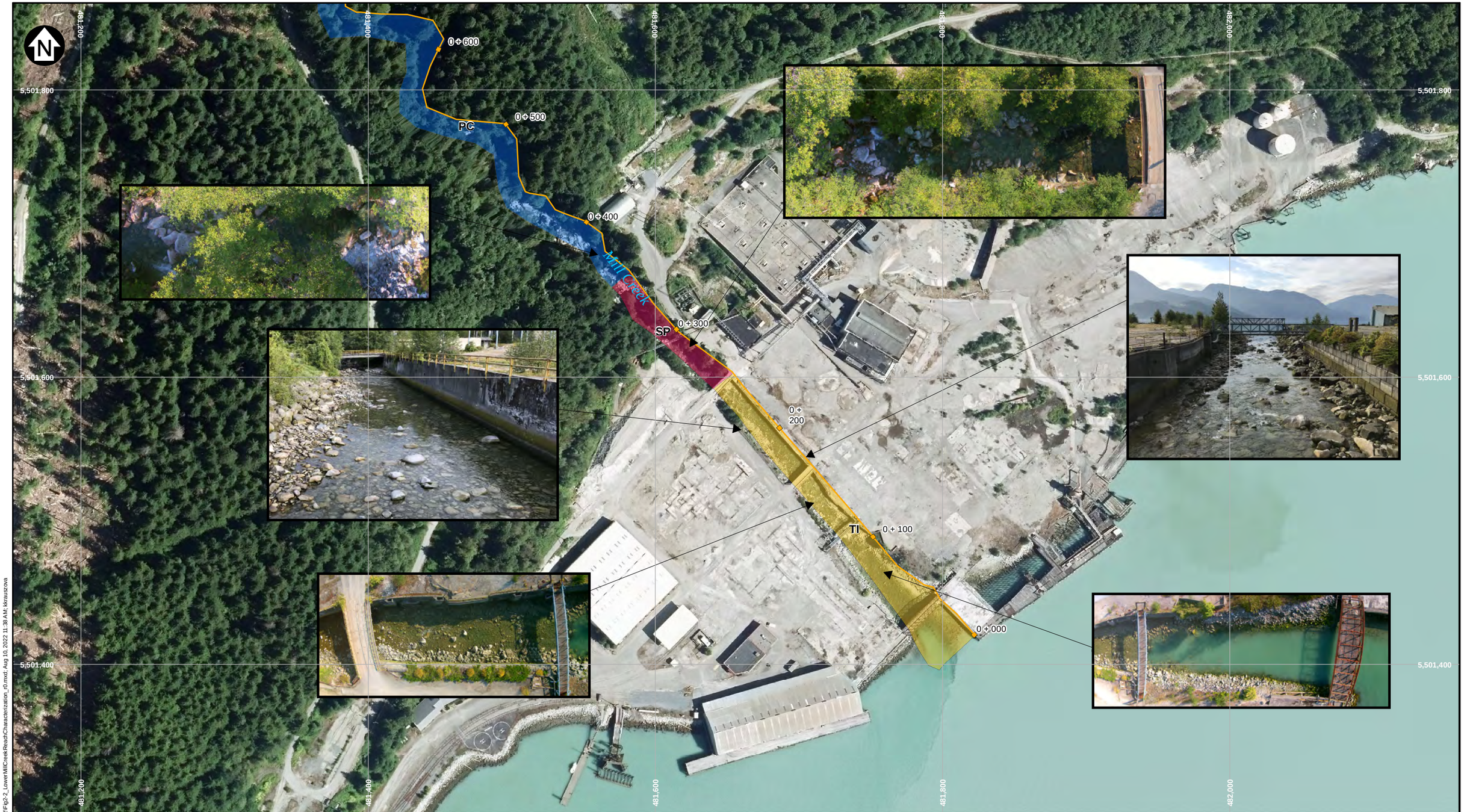
WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MILL CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-00494/24	2

FIGURE 2.1 REV 0



LEGEND:

GENERAL

- FISH HABITAT TRANSECT
- CREEK CHAINAGE (METERS)
- PROPOSED WATER DIVERSION

HABITAT UNIT

- TI TIDALLY INFLUENCED
- SP STEP POOL
- PC POOL CASCADE

100 50 0 100 200 Meters

NOTES:

1. BASE MAP: PROJECT IMAGERY.
2. COORDINATE GRID IS IN METRES. COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:2,500 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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WOODFIBRE LNG LIMITED

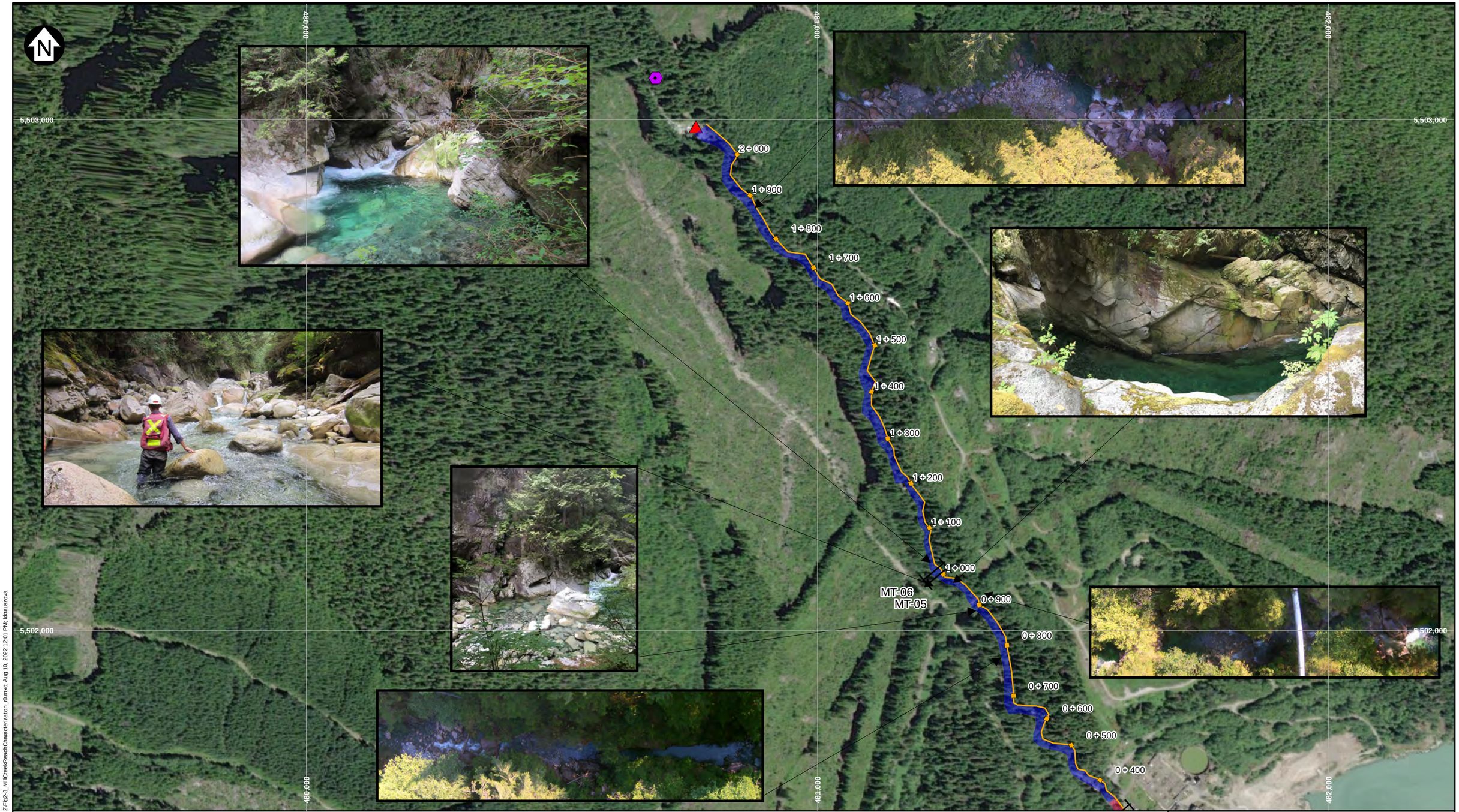
WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

LOWER MILL CREEK REACH CHARACTERIZATION

Knight Piésold CONSULTING

PIA NO.	REF NO.
VA103-494/24	2

FIGURE 2.2 REV 0



LEGEND:

- FISH HABITAT TRANSECT
- CREEK CHAINAGE (METERS)
- PROPOSED WATER DIVERSION
- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE

HABITAT UNIT

- SP — STEP POOL
- PC — POOL CASCADE

100 50 0 100 200 300 400 500 Meters

NOTES:

1. BASE MAP: ESRI ONLINE.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:7,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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WOODFIBRE LNG LIMITED

MILL CREEK INSTREAM FLOW STUDY

MILL CREEK REACH CHARACTERIZATION

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-494/24	2

FIGURE 2.3 REV 0

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Reach 1

Starting from the mouth, between chainage 0+000 to 0+250 m of Mill Creek, the channel is tidally influenced, and water levels fall and rise with the tides. At low tide, this reach is classified as plane bed morphology and glide habitat (following the classifications in Montgomery and Buffington, 1997). This reach is also confined by fill placed for the historic pulp mill site. Riparian conditions are vertical concrete walls on the left bank and riprap on the right bank (Photos 2.1 and 2.2).



Photo 2.1 Reach 1 at low tide, showing riparian conditions on the left and right banks



Photo 2.2 Reach 1 at low tide looking downstream to the mouth

The channel is confined by vertical concrete walls on the left bank and both rip rap and concrete walls on the right bank.

Reach 2

Between chainage 0+250 and 0+350, the gradient increases slightly and channel morphology and habitat are classified as step-pool. Bed material is dominated by cobbles and boulders, as shown in Photos 2.3 and 2.4. Photo 2.4 was taken on August 29, 2017 when pink salmon spawners were seen holding in the pool downstream. The upstream limit of anadromous fish is a barrier at chainage 0+600 (in Reach 3).

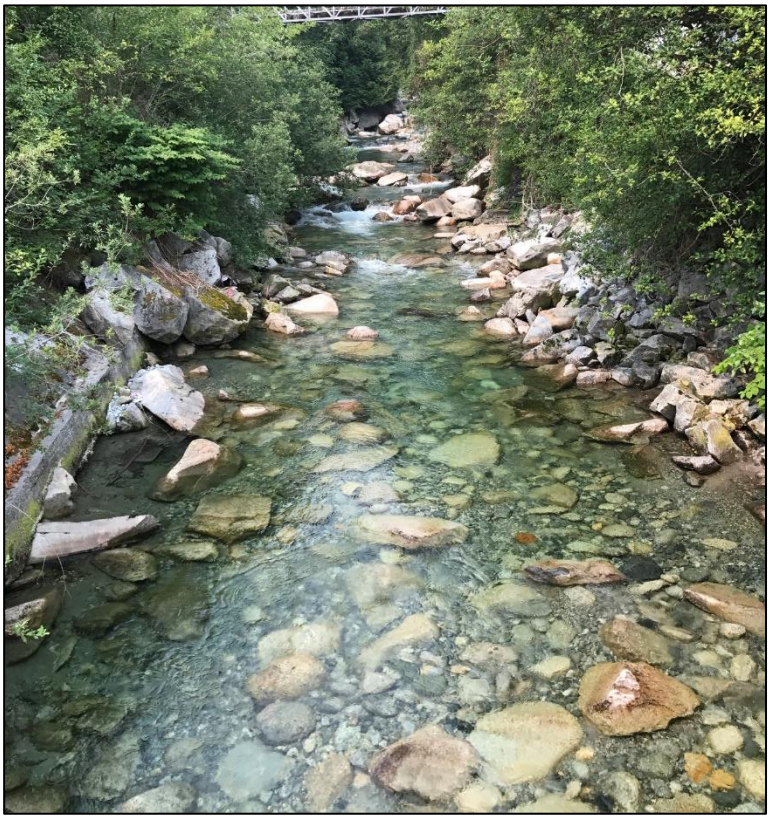


Photo 2.3 **Reach 2 showing an increase in channel gradient compared to Reach 1, and step-pool morphology**

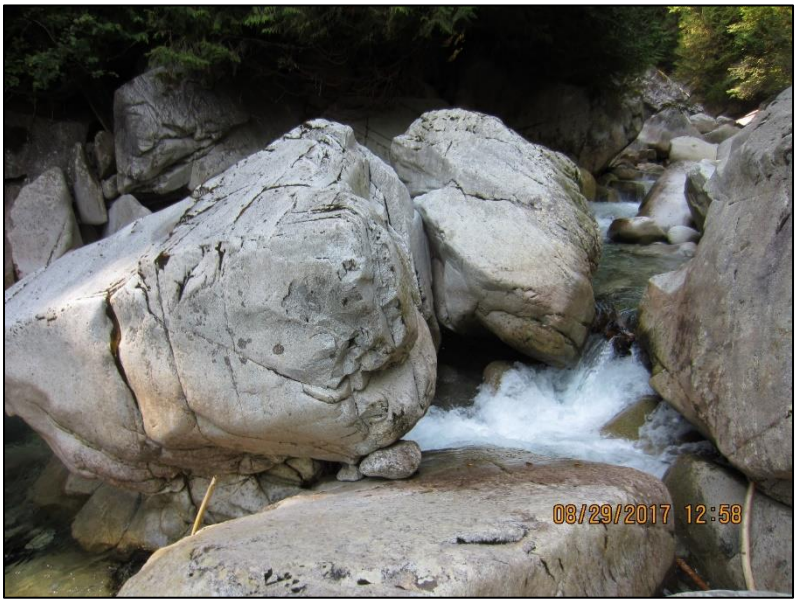


Photo 2.4 **Upstream boundary of Reach 2 (0+350) showing the partial fish barrier at low flows**

Reach 3

Above chainage 0+350 to the PoD at chainage 2+090, the channel gradient increases to an average gradient of approximately 10%. The channel is incised within a bedrock canyon, often with near vertical walls exceeding 10 m in height, as shown on Photo 2.5. Access to the channel on foot is difficult and is only possible in a small number of locations. Channel morphology is characterized as cascade (following the classifications in Montgomery and Buffington, 1997), with frequent bedrock outcrops and large non-alluvial boulders dominating the channel form. Water tumbles off these steps, creating barriers (permanent or flow dependent) to upstream fish migration (see Photo 2.6). Between these falls are short reaches with semi-alluvial step-pool morphology. At approximately chainage 0+415 there is a 4 m high falls that limits upstream migration of most Pacific salmon species at some flows, and at chainage 0+600 there is a 15 m high waterfall representing an absolute anadromous fish barrier (Golder, 2014). Fish habitat in this reach is characterized as pool-cascade.



Photo 2.5 **Downstream boundary of Reach 3 showing difficult access as a result of vertical bedrock walls, and deep pools interspersed with cascades**



Photo 2.6 Aerial view of stream channel of Reach 3 showing falls and cascade barriers to upstream migrating fish

3.0 FISHERIES AND AQUATIC HABITAT BASELINE

3.1 HISTORICAL INFORMATION

Fish and aquatic habitat information for Mill Creek presented in this section is based on publicly available data, sampling and interpretation completed previously as part of the Project environmental assessment, and sampling and interpretation completed by KP during 2017 and 2018.

Limited publicly available historical fish and aquatic information exists for Mill Creek, and fisheries information in the provincial database (Fish Inventories Data Queries, FIDQ) is sparse and outdated (Ministry of Environment and Climate Change Strategy, 2022). Fish observations recorded in the provincial database are from 1979 and 1980, and are restricted to Dolly Varden char, steelhead trout, and coho salmon. Escapement data are provided for chum salmon and coho salmon but is limited to one year of data (1985), with the maximum escapement recorded as eight chum salmon and one coho salmon (Ministry of Environment and Climate Change Strategy, 2022).

Golder Associates prepared a Freshwater Fish Baseline Study for the Project environmental assessment (Golder, 2014). Golder described the Mill Creek aquatic habitat in the channelized section of the Woodfibre property as glide-riffle habitat, ranging in width from 4 m to 31 m, with substrates predominantly boulder and cobble (Golder, 2014). Extending from the mouth of the creek, this 250 m reach of channel is tidally influenced, and water levels rise and fall with the tides. Gradient is moderate within the channelized section (4%) and increases to 15% or more, in some sections, upstream of the property. Instream cover for fish was estimated as 8% of the total creek in the lower channelized section, comprised of cobbles and boulders. Riparian vegetation, and hence the overstream canopy, is sparse as a result of the riprap and concrete walls. Golder identified several barriers to upstream fish passage: a 4 m high falls located 415 m from the mouth of the creek, and two 15 m high falls located approximately 600 m upstream from the mouth.

Golder conducted fish sampling at two sites in Mill Creek in the Project area and at one site upstream of the intake on several dates in 2013 and 2014, and conducted an adult salmon count on September 10, 2013. Golder recorded 1,860 live pink salmon and 219 dead fish on the one-day survey in September 2013, with the majority of live salmon observed between 210 m to 285 m and 385 m to 415 m from the mouth in riffle-glide and cascade-pool habitat, respectively. Golder surmised that the cascade-pool habitat was being used for holding, prior to fish returning downstream to select areas for spawning. Golder noted that the pink salmon were exhibiting redd guarding and spawning behaviour in the creek upstream of tidal influence, although the area and distribution of spawning habitat was limited. Golder concluded that the fish production potential from Mill Creek was habitat-limited.

Minnow trapping by Golder at two sites in lower Mill Creek over three sampling events yielded coho salmon, rainbow trout, and sculpins, as well as gunnel fish. Sculpin were the predominant species: only one coho was captured, in the July 2014 survey, and the gunnel fish was/were not included in the sample summary. The Catch Per Unit Effort (CPUE) in the lower creek ranged from a high of 1.98 fish/24 hours in July 2014 at Site 3 (from the mouth of the creek to approximately chainage 0+150) to a low of 0.13 fish/24 hours in April 2014 at Site 4 (between chainage 0+150 and the cascades, above tidal influence). Rainbow trout were predominantly captured at Site 4. No fish were captured in minnow traps at Site 5 (immediately upstream of the historic hydropower intake located at chainage 0+2000) in July 2014; however, fishing effort was low, and 10 traps were set for approximately 2 hours each.

Coho salmon, rainbow trout, and sculpins were also the only species captured by Golder while electrofishing in lower Mill Creek, with sculpin comprising the majority of the catch. The CPUE ranged from a high of 4.29 fish/minute at Site 3 in July 2014 (36 fish captured in 574 seconds of electrofishing) to a low of zero fish in April 2014 (no fish captured in 574 seconds of electrofishing). Only one rainbow trout was captured at Site 5 by electrofishing in July 2014 in 280 seconds of electrofishing, for a CPUE of 0.21 fish/min.

Hemmera conducted minnow trapping in spring 2016 in Mill Creek between the third and fourth bridge (chainage 0+150 and 0+250) as part of a study to assess pink salmon fry outmigration (Hemmera, 2016). The Hemmera catch information is summarized in Table 3.1.

Table 3.1 Fish Species Capture Data, Hemmera (2016)

Date	# Fish Captured	CPUE (fish/24 hours)	Species
March 23	10	1	Pink salmon fry, Chinook salmon juvenile Unidentified char
March 30	3	0.3	Rainbow trout, Coastrange sculpin
April 4	6	0.35	Rainbow trout Sculpin general
April 13	6	0.3	Rainbow trout, Sculpin general

In addition, two chum salmon were observed (one each in March and April of 2016), but no information on size or life stage was reported.

3.2 IFR STUDY -SPECIFIC SURVEYS

KP conducted fish sampling in support of the IFR assessment in 2017 and 2018 (KP, 2018). Fish sampling methods included electrofishing upstream of the barriers to anadromous salmonids (in accordance with the federal fish collection permit) and minnow trapping in the channelized section near the mouth of the creek as well as upstream of the falls. A snorkel survey was also conducted in the channelized section near the mouth of the creek in February 2018 to assess overwinter use of the habitat. Aerial drone photography was used to map habitat at a high level in August and October 2017 (Figure 2.2), and channel characteristics were recorded at the fish sampling sites in April 2018 at moderate flows.

Coho salmon, rainbow trout, and sculpins were captured by minnow trapping in Mill Creek below the partial cascades barrier at chainage 0+415. A single Dolly Varden was captured at a site upstream of the set of 15 m falls (chainage 0+600), and rainbow trout was the only fish species captured upstream of the historic intake: the minnow trapping CPUE for these sampling events is provided in Table 3.2. The two coho salmon fry captured downstream of the cascade on August 9, 2017 had fork lengths of 46 mm and 74 mm: the presence of the 46 mm fry could indicate that some coho spawn in Mill Creek. The rainbow trout fry captured upstream of the historic intake had a fork length of 62 mm. Numerous adult pink salmon were incidentally observed during low flows on August 28 and 29, 2017 holding in a pool at the base of the cascade downstream of the first falls.

Five rainbow trout fry were captured by electrofishing upstream of the historic intake in August 2017 (for a CPUE of 0.28 fish/minute), and two rainbow trout and two sculpins were captured by electrofishing upstream of the first cascade below the barrier falls in April 2018 (for a CPUE of 1.21 fish/minute). No fish were captured by electrofishing upstream of the set of 15 m falls or upstream of the intake in April 2018.

No fish were observed during the snorkel survey conducted by KP from the mouth of the creek to the top of the pool above the first cascade in February 2018.

Table 3.2 Fish Species Capture Data, Knight Piésold Ltd. (2017-2018)

Date	Site	# Fish Captured	CPUE (fish/24 hours)	Species
August 9, 2017	MC-01 (Below falls)	3	0.62	Sculpin
August 9, 2017	MC-02 (Below falls)	7	1.45	Sculpin Coho salmon
August 9, 2017	MC-10 (Above intake)	1	0.24	Rainbow trout
August 30, 2017	MC-03 (Below falls)	7	1.22	Rainbow trout Coho salmon
August 30, 2017	MC-06 (Above falls)	1	0.17	Dolly Varden char

3.3 POST-EA MONITORING

Keystone Environmental (2021) conducted fish sampling downstream of the barrier falls in Mill Creek in 2020: six baited minnow traps were set for approximately 46 hours each on May 12, 2020 and eight baited minnow traps were set for approximately 22 hours each on September 30, 2020. Six sculpin were the only fish captured in the minnow traps in May. One Chinook salmon, two rainbow, and 14 sculpin were captured in October.

3.4 SUMMARY

A summary of the fish capture data to date is provided in Table 3.3.

Table 3.3 Mill Creek Fish Presence Summary

Reach	Fish Species Present	Life Stage	Reference
Downstream of Barrier Falls	Dolly Varden, steelhead	n/a	FIDQ
	Coho salmon, chum salmon	adult	FIDQ
	Pink salmon	adult	Golder
	Coho salmon, rainbow trout, sculpin, gunnel fish	n/a	Golder
	Pink salmon	fry	Hemmera
	Chinook salmon	juvenile	Hemmera
	Unidentified char, Rainbow trout, Coastrange sculpin, sculpin general, chum salmon	n/a	Hemmera
	Pink salmon	adult	Knight Piésold Ltd.
	Coho salmon	parr	Knight Piésold Ltd.
	Rainbow trout	juvenile	Knight Piésold Ltd.
	Sculpin	n/a	Knight Piésold Ltd.
	Sculpin	n/a	Keystone Environmental
	Chinook salmon	juvenile	Keystone Environmental
	Rainbow trout	juvenile	Keystone Environmental
Between Falls and Historic Intake	Dolly Varden	adult	Knight Piésold Ltd.
Upstream of Intake	Rainbow trout	n/a	Golder
	Dolly Varden	n/a	Fish Inventories Data Queries
	Rainbow trout	juvenile	Knight Piésold Ltd.

The rainbow trout captured by KP ranged from 51 mm to 62 mm fork length, while the Dolly Varden captured upstream of the falls had a fork length of 185 mm. The single rainbow trout captured by Golder at the site upstream of the historic intake in 2014 had a fork length of approximately 50 mm. The sculpin captured by Keystone Environmental ranged in size from 41 mm to 95 mm in May 2020 and 10 mm to 140 mm in October. The Chinook salmon captured by Keystone Environmental in October 2020 had a fork length of 103 mm, while the two rainbow trout had fork lengths of 120 mm and 151 mm.

Although only one Dolly Varden adult has been captured upstream of the falls in Mill Creek, it is likely that the resident rainbow trout and Dolly Varden populations are small-bodied, similar to other high-gradient streams confluent with Howe Sound. Adult rainbow trout captured upstream of impassable barriers on Woodfibre Creek ranged from 136 mm to 209 mm fork length (FSCI Biological Consultants, 2010). In the McNab Creek watershed, cutthroat trout aged 2+ had fork lengths ranging from 151 mm to 179 mm, while Dolly Varden char aged 3+ in the Potlatch Creek watershed had fork lengths ranging from 133 mm to 179 mm (M.A. Whelen and Associates Ltd., 1999). The largest rainbow trout captured in Rainy River by Hatfield Consulting Ltd. (2013) had a fork length of 304 mm. Fish sampling by Hatfield Consultants Ltd. in 1998 in Rainy River found rainbow trout ranging in size from 102 mm to 195 mm, with fish aged as 2+ ranging in size from 126 mm to 132 mm. Rainbow trout ranged from 112 mm to 235 mm in McNair Creek and 112 mm to 197 mm in Dakota Creek, while Dolly Varden char ranged from 157 mm to 194 mm (Hatfield Consultants Ltd., 1998).

In contrast, rainbow trout from larger systems such as the Babine River can attain sizes of 308 mm by age 3 and 531 mm by age 5 (Narver, 1975), and 600 mm rainbow trout have been recorded in the Salmo River (Baxter Environmental, 2002).

Species habitat use for key life history timing events can be shown graphically on Species Periodicity Charts. General species periodicity charts for pink salmon, Dolly Varden char, and rainbow trout are shown in Tables 3.4, 3.5, and 3.6 respectively, and are based on available species life history information for creeks in the Howe Sound region (Ministry of Environment and Climate Change Strategy, 2022).

Table 3.4 Pink Salmon Periodicity Chart

Species	Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Pink salmon	migration																								
	spawning																								
	incubation/emergence																								
	rearing																								

Table 3.5 Dolly Varden Char Periodicity Chart

Species	Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Dolly Varden char	migration																								
	spawning																								
	incubation/emergence																								
	rearing																								

Table 3.6 Rainbow Trout Periodicity Chart

Species	Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Rainbow trout	migration																								
	spawning																								
	incubation/emergence																								
	rearing																								

4.0 HYDROLOGY

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains), on the boundary with Zone 26, as delineated by Obedkoff (2003). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime.

Hydrologic conditions in Mill Creek were assessed based on over two years of measured streamflow records collected on Mill Creek near the historic hydropower intake location. These data were correlated with streamflow data collected by Water Survey of Canada (WSC) on the Capilano River to produce a long-term synthetic daily flow series. This synthetic daily flow series was used for the basis of assessing baseline and project affected (construction) flow conditions.

4.1 MILL CREEK BASELINE HYDROLOGY

4.1.1 MEASURED STREAMFLOW DATA

The measured hydrologic record on Mill Creek consists of both historical data collected by J.Termuende Hydrological (JTH) from 2009 to 2010, and measured data collected by KP since April 2017. Both JTH and KP operated streamflow gauging stations located just upstream of the historic hydropower intake location. KP operates two active streamflow gauging stations on Mill Creek, referred to as MILL and MILL-R2. The current rating curves for each active streamflow gauging station on Mill Creek, are shown on Figure 4.1 and Figure 4.2.

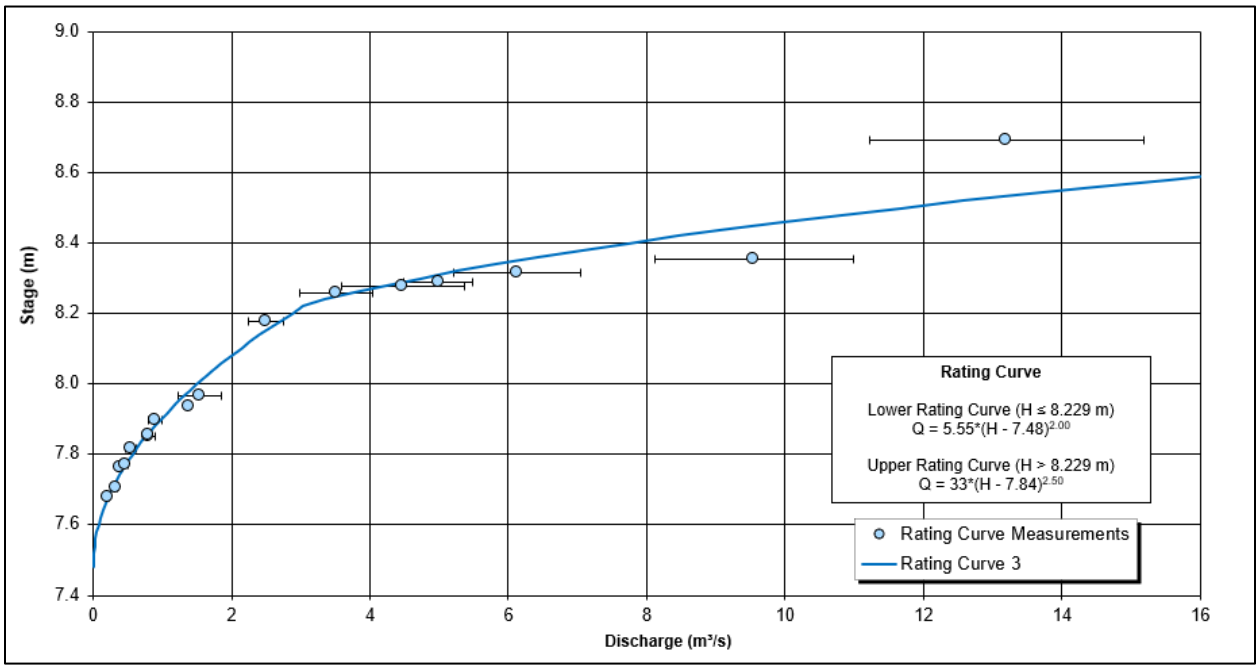


Figure 4.1 Mill Creek (MILL) Rating Curve

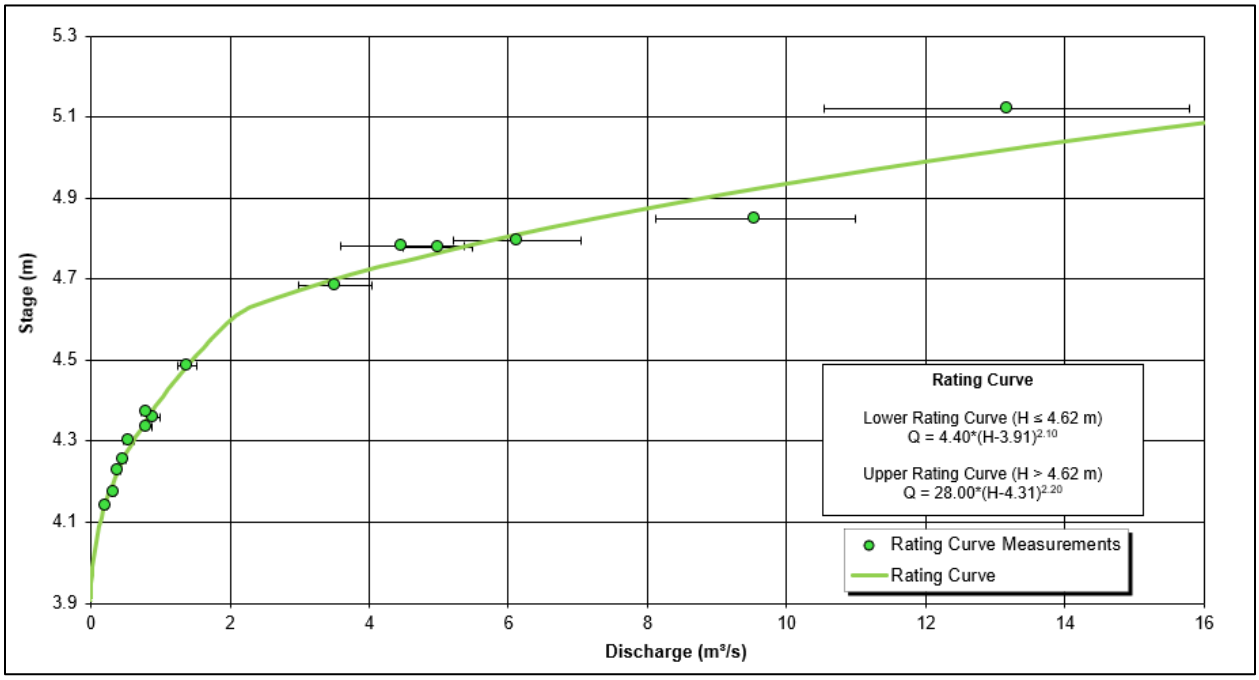


Figure 4.2 Mill Creek (MILL-R2) Rating Curve

The daily average discharge hydrograph for the MILL streamflow gauging station is presented on Figure 4.3.

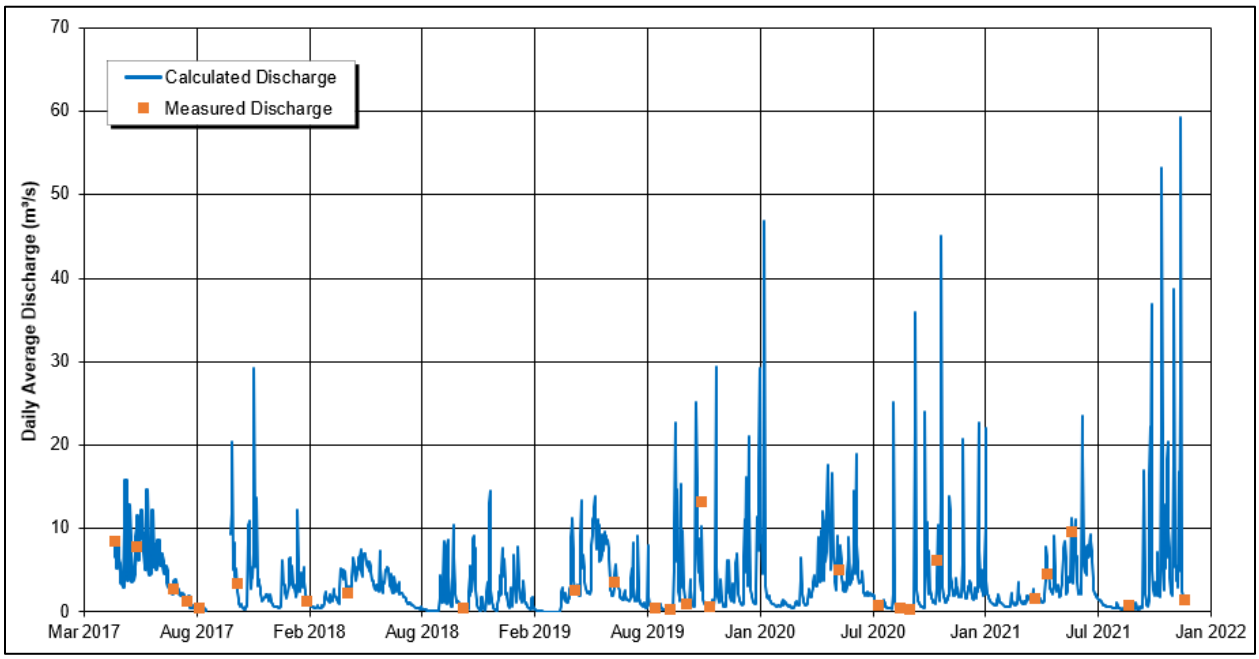


Figure 4.3 Mill Creek (MILL) Daily Average Discharge Hydrograph

Details of the hydrology data collection and processing are discussed in the *Mill Creek Hydrologic Analysis and Synthetic Flow Record* (KP, 2022), provided in Appendix A.

4.1.2 MILL CREEK LONG TERM SYNTHETIC HYDROLOGY

As part of a baseline hydrology characterization of Mill Creek, a synthetic long-term flow record using site-specific and regional measured streamflow records was developed. Fifty-five complete years of record are available from the WSC station “Capilano River above Intake” (08GA010), which, in conjunction with discharge data from Palisade Lake provided by Metro Vancouver, were used in an empirical frequency pairing analysis. Capilano River is a regulated system due to summer releases from Palisades Lake reservoir, which are managed by Metro Vancouver. Details on regulated flows are not consistently available; however, a naturalized streamflow record for Capilano has previously been developed for the Project for the period of record between 1960 and early 2018 using records of release rates from Metro Vancouver or by comparison of unit runoff between regulated and unregulated rivers.

Periods with regulation were also removed from the Capilano River dataset for April 1, 2019 to May 28, 2021 by removal of periods with sudden, steady increases in Capilano River flow that are not reflected in the Mill Creek data, which is an unregulated system. The naturalized flow record for Capilano River therefore includes 55 complete years of record and six years with incomplete records.

The mean annual discharge (MAD) for Mill Creek at the KP hydrology gauge was estimated to be 4.05 m^3/s (1960 to 2021 period), which equates to a mean annual unit runoff of 107 $L/s/km^2$ for the 38 km^2 watershed. At the time of this analysis, more than four years of data are available at Mill Creek, and the synthetic flow record is considered to be of good quality. Further data collection may reduce uncertainty in the long-term synthetic record, as discussed in Appendix A.

Streamflow at the proposed PoD is equivalent to the hydrology gauge data and the mean monthly hydrograph is relatively uniform with sustained flows though the fall and winter, and a modest nival freshet in spring, indicating that a substantial proportion of winter precipitation falls as rain (rather than snow). Flows decrease through June, July and August as snowmelt and precipitation decrease.

The mean monthly hydrograph is relatively uniform with sustained flows though the fall and winter, and a modest nival freshet in spring, indicating that a substantial proportion of winter precipitation falls as rain (rather than snow). Flows decrease through June, July and August as snowmelt and precipitation decrease. The mean monthly hydrograph is shown on Figure 4.4. Average, minimum and maximum monthly mean flow conditions for the synthetic 1960 to 2021 dataset are presented in Table 4.1. Daily flow conditions tend to be more variable than monthly flow conditions, with the watershed responding rapidly to intense rainfall events. Synthetic daily flows during 2009, a year where the annual average discharge was close to the long-term MAD, are shown on Figure 4.5.

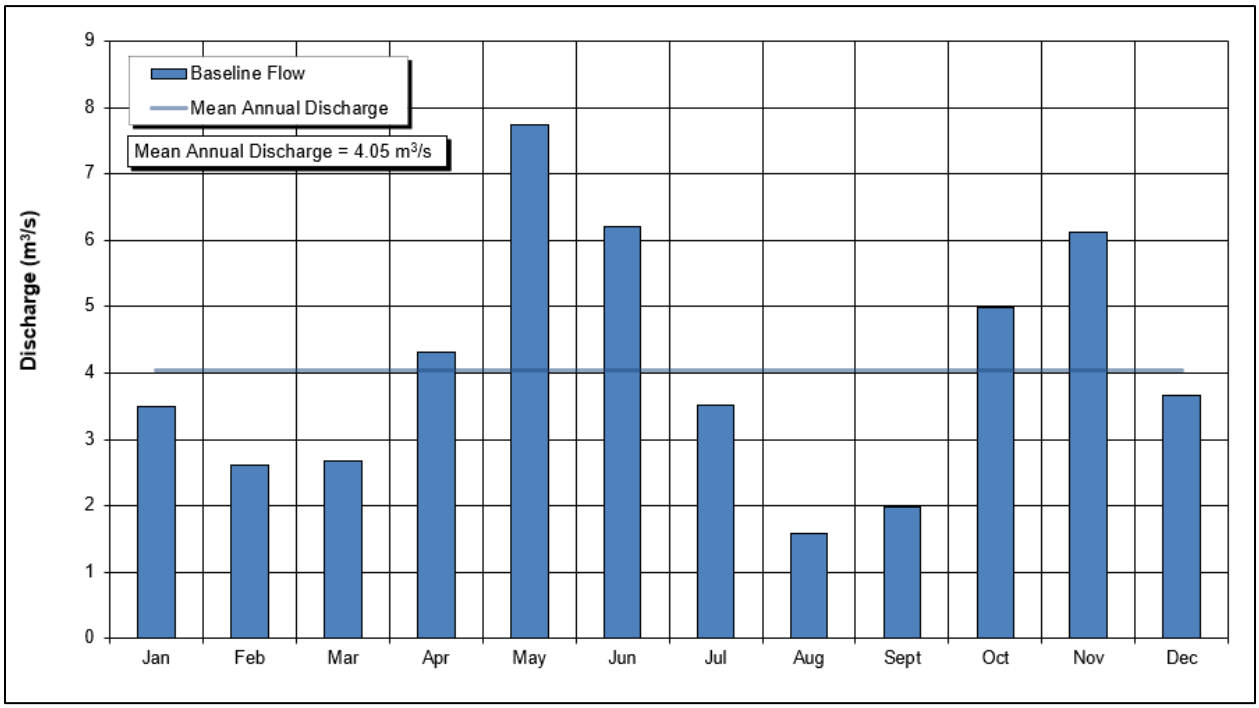


Figure 4.4 Mean Monthly Hydrograph – Mill Creek at the PoD

Table 4.1 Average, Minimum and Maximum Monthly Flows - Mill Creek at the PoD

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m^3/s)	3.49	2.62	2.67	4.32	7.74	6.21	3.51	1.58	1.97	4.98	6.13	3.66	**4.05**
Maximum (m^3/s)	9.68	8.73	7.32	7.64	12.26	11.33	9.46	6.82	6.81	13.00	13.68	10.42	**5.51**
Minimum (m^3/s)	0.35	0.71	0.78	1.79	1.13	1.16	0.35	0.37	0.28	0.23	1.87	0.63	**2.82**

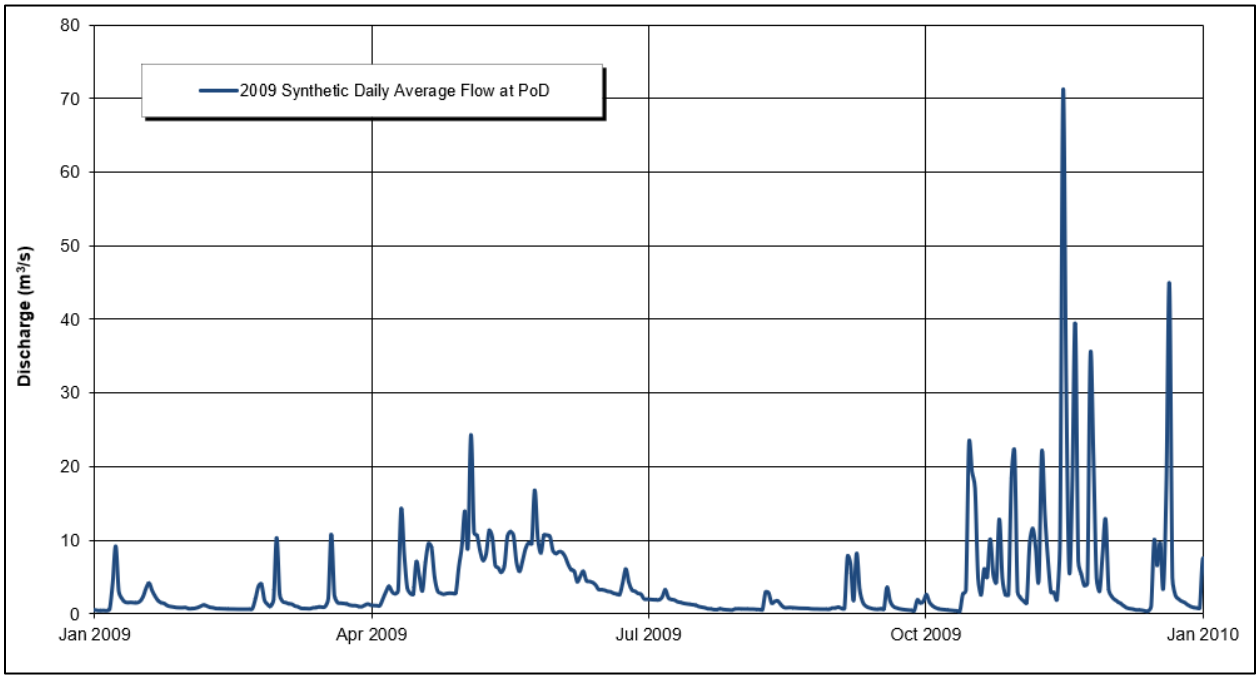


Figure 4.5 2009 Daily Hydrograph – Mill Creek at the PoD Synthetic Daily Flow Series

5.0 CONSTRUCTION ENVIRONMENTAL FLOW NEEDS

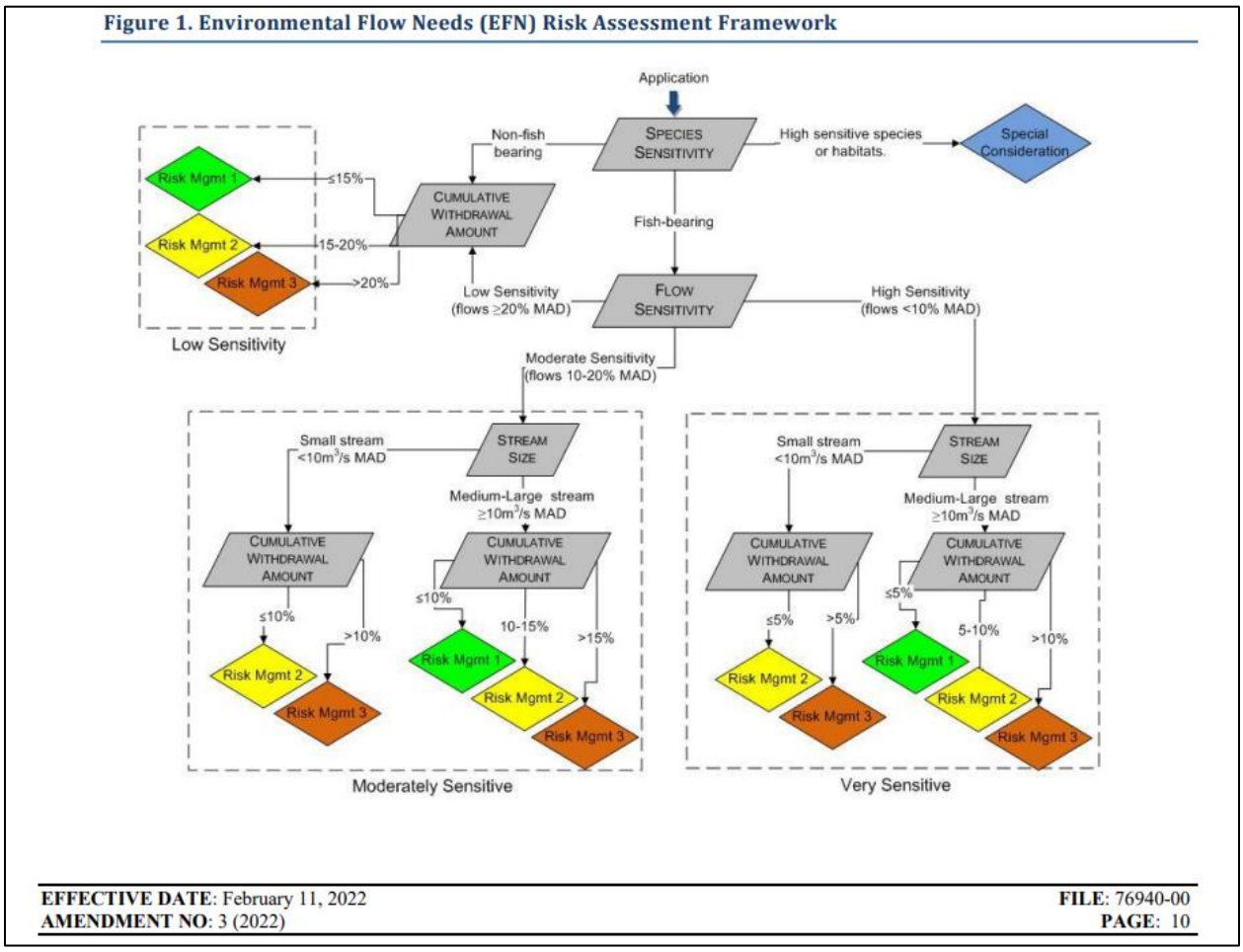
5.1 CONSTRUCTION ENVIRONMENTAL FLOW NEEDS ASSESSMENT METHODOLOGY

The BC EFN Policy (FLNRORD and ENV, 2016 and updated in 2022) presents a risk-based assessment approach that considers fish presence/absence, baseline hydrologic regime and stream size. KP has used this guidance document to assess the proposed construction water requirement and quantify the risk level of withdrawals from Mill Creek.

The BC EFN policy presents an “Environmental Flow Needs Risk Assessment Framework” for applications for water licences and use approvals under the Water Sustainability Act (*WSA)*. This framework includes the following steps:

1. Determine the Area of Influence
2. Application Risk Screening
3. Screen for Fish Bearing Status and High Sensitivity Species
4. Determine Flow Sensitivity
5. Determine Stream Size
6. Determine Cumulative Withdrawal within the Area of Influence
7. Assign Preliminary Risk Rating

A flowchart, reproduced from the policy and presented on Figure 5.1 for reference.



Note(s):

1. Source: FLNRORD and ENV (2022)

Figure 5.1 Risk Management Decision-Making Process for Consideration of Environmental Flow Needs within the BC EFN Policy

5.2 CONSTRUCTION IFR FOR MILL CREEK

5.2.1 AREA OF INFLUENCE

The point of diversion considered in this assessment is the existing Mill Creek intake, located approximately 2 km from the mouth. There is only a small difference in watershed area between the intake (38 km^2) and the mouth of Mill Creek (41 km^2). The area of influence for this flow reduction is the lower 2 km of Mill Creek to the confluence with Howe Sound.

5.2.2 APPLICATION RISK SCREENING

Woodfibre LNG currently holds water licences for power generation and pulp mill operation from Mill Creek; however, no water is currently being diverted or used under these licences. Details of these licences are presented in Table 5.1. No other users have active licences to divert water in Mill Creek.

Table 5.1 Existing Mill Creek Water Licences

Licensee	Number	Purpose	POD	Priority Date	Quantity (m^3/s)
Woodfibre LNG Limited	F007219	Power: Commercial	PD44666	25/6/1909	0.63
			PD44669		
Woodfibre LNG Limited	F017347	Pulp Mill	PD44666	1/10/1959	0.63
			PD44669		
Woodfibre LNG Limited	F044330	Pulp Mill	PD44666	25/6/1909	0.106
			PD44669		

5.2.3 SCREEN FOR FISH BEARING STATUS AND HIGH SENSITIVITY SPECIES

Mill Creek is fish bearing as discussed in Section 3. There are no federal *Species at Risk Act* listed or provincially listed fish species documented in Mill Creek. The EFN Guideline allows for cultural sensitivities under Special Considerations. The importance of restoring salmon productivity (all anadromous species) is a high cultural priority for Squamish Nation (Squamish Nation, 2001).

5.2.4 FLOW SENSITIVITY

Flow sensitivity refers to whether flow withdrawal is expected to cause a negative effect, with less tolerance for flow withdrawal from “high” sensitivity streams. High sensitivity is defined as a month where the ratio of mean monthly flow to mean annual flow is less than 10%, indicating that flows are low in that month compared to normal conditions and there is little tolerance for additional withdrawal. Flow sensitivity in Mill Creek is classified as “Low” year-round, meaning that the ratio of mean monthly flow to mean annual flow is greater than 20%. The flow sensitivity for Mill Creek is shown in Table 5.2.

Table 5.2 Mill Creek Flow Sensitivity at the PoD

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Discharge (m^3/s)	3.49	2.62	2.67	4.32	7.74	6.21	3.51	1.58	1.97	4.98	6.13	3.66
Ratio Monthly/Annual (%MAD)	86%	65%	66%	107%	191%	154%	87%	39%	49%	123%	152%	90%
Sensitivity	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

5.2.5 STREAM SIZE

Small streams, defined as streams with a MAD less than 10 m^3/s, (and streams that freeze over in winter) are considered more ecologically sensitive to water withdrawals. The estimated MAD in Mill Creek at the PoD location is 4.05 m^3/s. Using the metrics in the EFN policy, this creek is classified as “Small”.

5.2.6 CUMULATIVE WITHDRAWAL

Although Woodfibre LNG holds active licenses on Mill Creek, they cannot currently be used, as their purpose is for power and pulp mill. The licences will require an amendment for a change in works (maintenance or updating) and change in purpose prior to being used to support the LNG Project, or abandonment and removal of works.

During construction, the only water diversion will be for the proposed construction water requirement.

5.2.7 RISK RATING

The risk rating, based on the BC EFN Policy (FLNRORD and ENV, 2022) is presented in Table 5.3 based on the proposed construction withdrawal.

Table 5.3 Risk Assessment for Cumulative Withdrawals in Mill Creek near the Mouth

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natural Flow (m^3/s)	3.49	2.62	2.67	4.32	7.74	6.21	3.51	1.58	1.97	4.98	6.13	3.66
Cumulative Withdrawal Amount (m^3/s)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Withdrawal Ratio (%)	3%	4%	4%	2%	1%	2%	3%	6%	5%	2%	2%	3%
Risk Management Level	1	1	1	1	1	1	1	1	1	1	1	1

Note(s):

1. The actual diversion will be less than 0.1 m^3/s because this quantity is not required continuously and may be sourced from mill creek rather than Woodfibre Creek.

Because the stream is classified as low sensitivity and cumulative withdrawals are less than 15% of the mean monthly flow, the risk rating is Risk Level 1 across all months indicating a low level of risk.

5.2.8 RESULTS

This assessment indicates there is sufficient water in Mill Creek to meet construction water needs of 0.10 m^3/s while fulfilling environmental needs. Any residual risk can be addressed through monitoring and supplemental measures.

5.2.8.1 CONSTRUCTION FLOW CONDITIONS

Allowing for the continuous diversion of 0.10 m^3/s (subject to the supplemental measures described in Section 6.2) during Project construction, mean monthly baseline and operational flows are summarized on Figure 5.2 and in Table 5.4, which show that the proposed reduction in MAD is 2% on an average annual basis. It is noted that the percentage flow reductions in Table 5.4 are less than Table 5.3, due to the diversion restrictions imposed by the supplemental measures (Section 6.2). Flow duration curves of daily flow, presented on a monthly basis, showing baseline and construction flow conditions are included in Appendix B.

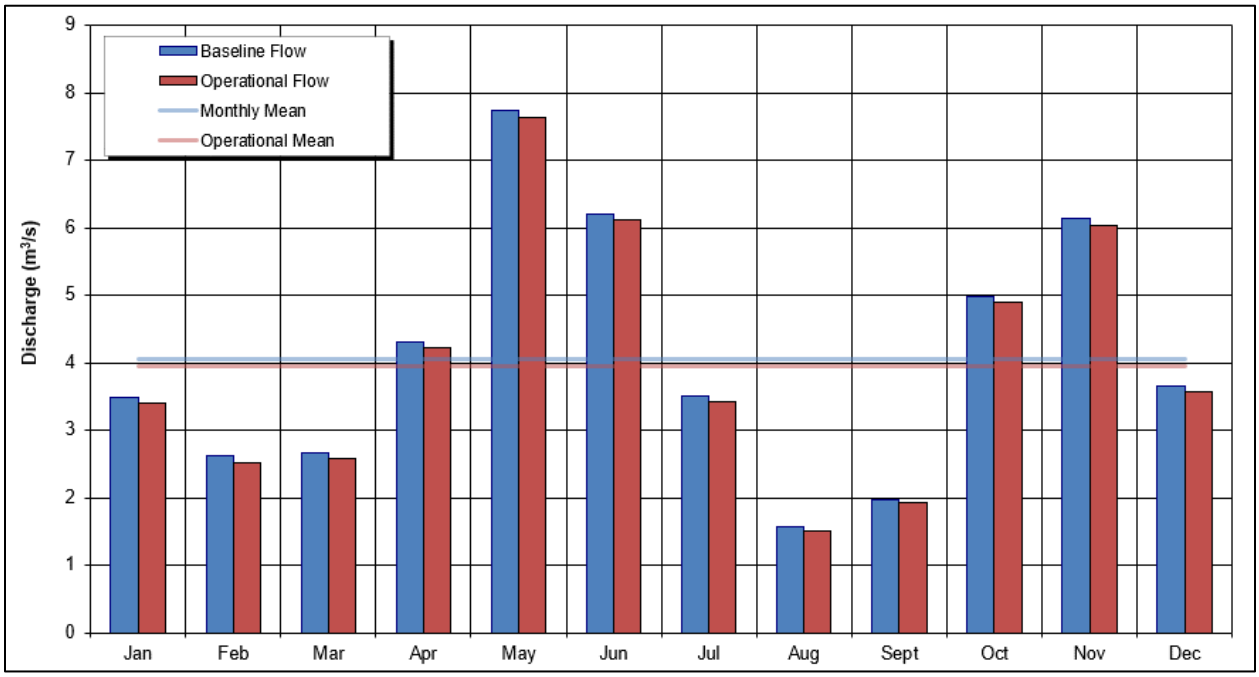


Figure 5.2 Baseline and Construction Mean Monthly Flows – Mill Creek at the PoD

Table 5.4 Baseline and Construction Mean Monthly Flows – Mill Creek at the PoD

Month	Baseline Flows	Operational Instream Flows	
	Q (m^3/s)	Q (m^3/s)	% Reduction
Jan	3.49	3.40	3%
Feb	2.62	2.53	3%
Mar	2.67	2.57	4%
Apr	4.32	4.22	2%
May	7.74	7.64	1%
Jun	6.21	6.11	2%
Jul	3.51	3.41	3%
Aug	1.58	1.51	3%
Sep	1.97	1.92	3%
Oct	4.98	4.90	1%
Nov	6.13	6.03	2%
Dec	3.66	3.57	2%
Annual	**4.05**	**3.96**	**2%**

6.0 SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

Woodfibre LNG is proposing the development and operation of a LNG processing and export facility on the previous Woodfibre pulp and paper mill site near Squamish, BC. Water is required for construction of the facility, a portion of which may be sourced from Mill Creek. The proposed water source is a gravity intake with fish screening, located approximately 2 km upstream from the mouth of Mill Creek.

The conclusion of this study is that the proposed flow withdrawals are small (approximately 2% of streamflow on average) and the risk to fish from the proposed short-term construction water withdrawal is considered low, overall. However, there are times of the year (particularly during July, August, and September) when baseline streamflow can be low and water withdrawal could represent a large portion of the available water. It is proposed that supplementary measures be incorporated into the water management plan to mitigate risk to fish during low-flow periods.

6.2 SUPPLEMENTARY MEASURES

Stated objectives of the BC EFN Policy include avoiding fish-flow conflicts and being scientifically-defensible; the policy was derived in part from methods currently used in B.C., scientific literature, and expert opinion (FLNRORD and ENV 2022). As noted in Section 3, pink salmon are the predominant species found in Mill Creek, with low densities of other salmon species (chinook, chum, coho), rainbow trout, and Dolly Varden char. The canyonised reach is not considered sensitive to flow reductions due to the channel morphology (cascade and step-pool). The key species and life stage of interest were therefore identified as pink salmon spawning and migration. The pink salmon migration period, based on site observations and regional data, is identified as the months of August and September, while the spawning period is identified as August through October.

As shown on Figure 5.2 and detailed in Table 5.4, the instream flow with the withdrawal of construction water of 0.10 m^3/s equates to a reduction in baseline monthly flows of 1% - 4% throughout the year. Although these construction flow withdrawals are expected to have minimal impact of fish habitat, consistent with Risk Management Level 1, supplementary measures suggested for Risk Management Level 2 have been or will be implemented, including:

1. Establish adequate baseline hydrology data
2. Collection of site-specific fisheries information
3. Real-time streamflow monitoring during construction
4. Real-time monitoring of diverted flows
5. Flow diversion restrictions.

The allowable flow diversion rate (diversion limit) will be reduced as instream flow falls to reduce risk during higher habitat stress conditions. Water withdrawal will be limited to:

- Less than 15% of total streamflow, up to a maximum of 0.10 m^3/s when instantaneous flows are more than 20% MAD (low sensitivity conditions)
- 10% of total streamflow when instantaneous flow is between 10 - 20% MAD (moderate sensitivity conditions)

- 5% of total streamflow when instantaneous flow is < 10% MAD (high flow sensitivity)

Additionally, between August 1 and October 31 (the critical stream flow periods, CSFP, as defined by Squamish Nation) if flows fall below 0.81 m^3/s (20% MAD), no water will be diverted.

Allowable flow diversion rates are shown in Table 6.1. Although the diversion rate could be adjusted continuously to meet the percentage withdrawal limits, a look-up table with discrete steps has been proposed to provide a an easy-to-understand and practical protocol that the Environmental Monitor and Contractor can follow.

Table 6.1 Construction Management Plan Flow Diversion Limits

Streamflow at Gauging Station/PoD (m^3/s)	% MAD	November 1 to July 31		August 1 to October 31	
		Maximum Diversion Limit (m^3/s)	% Diverted	Maximum Diversion Limit (m^3/s)	% Diverted
≥0.81	>20%	0.10	<12%	0.10	<12%
≥0.70	17%	0.07	10%	0.00	0%
≥0.61	15%	0.06	10%	0.0	0%
≥0.50	12%	0.05	10%	0.0	0%
≥0.41	10%	0.04	10%	0.0	0%
≥0.30	7%	0.02	5%	0.0	0%
≥0.20	5%	0.01	5%	0.0	0%
<0.20	5%	5% of measured flow	5%	0.0	0%

In order to manage construction water requirements during restricted diversion periods, the following will be conducted:

1. Schedule high water demand activities outside the low flow period, to the extent practical
2. Provide water storage to accommodate short term flow restrictions
3. Use Woodfibre Creek to supplement Mill Creek withdrawals to meet construction water requirements

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8.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

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APPENDIX A

Mill Creek Hydrologic Analysis and Synthetic Flow Record (VA22-01362)

(Pages A-1 to A-31)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

September 23, 2022

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Dear Darren,

RE: Mill Creek Hydrologic Analysis and Synthetic Flow Record

Woodfibre LNG Limited (Woodfibre LNG) is proposing the development and operation of a liquefied natural gas (LNG) processing and export facility (the Project) on the previous Woodfibre Pulp and Paper Mill site located approximately 7 km west-southwest of Squamish, British Columbia (BC). Water is required for construction and operation of the facility, which will be sourced from Mill Creek or Woodfibre Creek. Knight Piésold Ltd. (KP) has been retained by Woodfibre LNG to assist with hydrology studies for the Project, and as part of this work KP has installed and operated streamflow gauging stations on Mill Creek since April 2017.

A regional hydrologic analysis was completed to identify trends and characteristics in precipitation and runoff, then the short-term measured data were correlated with data collected by Water Survey of Canada (WSC) at a suitable surrogate station to develop a long-term synthetic daily streamflow series for Mill Creek. A hydrologic analysis of Mill Creek was conducted previously (KP, 2018). However, since completion of the previous analysis, over 2.5 years of additional data have been collected in Mill Creek. This letter presents the synthetic flow series development, based on data measured between April 2017 and May 2021.

1.0 HYDROLOGIC SETTING

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains) as delineated by Ahmed (2017). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime. In general, streamflow in South Coast watersheds like Mill Creek (i.e., coastal, but also with high-elevation mountainous terrain) are highest in autumn due to frontal rainstorm activity, with a secondary peak in spring due to snowmelt. Flows are lowest in late summer when precipitation is low. Winter flows tend to be moderate as much of the precipitation falls as snow but can be punctuated by warm rainfall events and rainfall at lower elevation.

Mean annual precipitation varies dramatically from only 1,490 mm at Gibsons, located approximately 35 km southwest of the Project, to 3,320 mm at Port Mellon, located 25 km southwest of the Project and then to 2,230 mm in Squamish. This is indicative of topographic convergence of frontal systems in Howe Sound, and extreme orographic enhancement of precipitation due to rapid uplift. Similarly, mean annual unit runoff

varies dramatically from 125 L/s/km^2 (or 4,000 mm) in Rainy River and 118 L/s/km^2 (or 3,660 mm) in Capilano River, located close to the Project area, to only 32 L/s/km^2 (or 1,000 mm) in Roberts Creek, located 20 km to the southwest and with a lower elevation basin.

2.0 STREAMFLOW DATA COLLECTION

A synthetic daily streamflow series was developed by correlation of measured streamflow data at the Mill Creek gauging station, MILL, with concurrent data from a streamflow gauging station operated by WSC with the intent of assessing long-term streamflow conditions in Mill Creek. A secondary station on Mill Creek (MILL-R2) is not used in this analysis, but is operated as backup and validation of the MILL station.

2.1 MILL STATION

KP installed a hydrometric station in April 2017 (MILL) on Mill Creek, approximately 2 km upstream from the mouth of the Creek and near the inactive hydropower intake. The site was selected primarily due to accessibility and gauging characteristics with the objective of collecting high-quality streamflow data, but also considering potential water diversion locations. Mill Creek downstream of the gauging location is more canyon-like, with steep or vertical bedrock banks, and safe access year-round is challenging. Additionally, locations that allow high-quality streamflow measurements at a range of flow conditions are limited. Near the mouth of Mill Creek, much of the accessible reach is backwatered by tides and therefore not suitable for stream gauging.

The station is located on the left bank of a pool, downstream of a cascade, as shown on Photo 1a. The gauge is approximately 100 meters upstream of the historic Mill Creek hydropower intake. Water level is hydraulically controlled by a cascade at the outlet of the pool, shown on Photo 1b. The low-flow control section consists of cobbles and boulders, while the high-flow control also includes the bedrock banks. The hydrometric station consists of a pressure transducer connected to a datalogger that records stage at fifteen-minute intervals. The Mill Creek gauging location and watershed is shown on Figure 1.



Photo 1 MILL Station – Apr 18, 2018



Photo 2 Hydraulic Control at MILL Aug 29, 2017

2.2 MILL RATING CURVE AND DISCHARGE HYDROGRAPH

A total of 26 stage/discharge measurements have been made at MILL. The discharge measurements were conducted using area-velocity and Rhodamine dye dilution measurements, depending on flow conditions at the time of each site visit.

The station includes three benchmarks, located in bedrock above the normal high-water level, as well as a staff gauge and a reference mark for determining stage. Benchmark 1 was assigned an elevation of 10 m and this datum is used for converting water level to gauge height (stage). These stage-discharge measurements were used to develop rating curves for the gauge.

A high flow event on November 22, 2017 was identified as causing a change in the hydraulic control, due to deposition of material at the control section, which required a new stage-discharge rating curve. Rating Curve 1 is applied from April 18, 2017 to November 22, 2017. A second rating curve (Rating Curve 2) was developed, but only three stage-discharge measurements were collected before another shift was detected. This change in the hydraulic control appears to have occurred between the October 17, 2018 and April 10, 2019 site visits, possibly due to high flow events that caused scouring of material deposited during the November 22, 2017 event within the control section. It is unknown what date this change occurred, or whether it was gradual during the time interval between site visits. The new rating curve (Rating Curve 3), developed for flows after the second hydraulic control change, results in a higher discharge for a given stage. Data collected since November 2021 (following the atmospheric river event that caused widespread flooding in southwest British Columbia) indicate that a further control shift may have occurred. Data collection and rating curve adjustment is ongoing. Details of the field data collection and rating curve development to the end of 2021 are presented in Appendix A.

Rating Curve 1 was plotted through the six available stage-discharge points collected prior to the first rating curve shift using the standard form for a rating curve equation (power function) with the constant, offset, and exponent constrained within expected values based on hydraulic theory (Maidment, 1993) and experience with similar conditions in mountainous streams. Rating Curve 2 is based on the shape of Rating Curve 1, as the three available stage-discharge measurements are insufficient to independently delineate a new rating curve. Rating Curve 3 is based on the 15 stage-discharge measurements collected since the April 2019 shift. Due to the limited number of measurements available to develop Rating Curve 1 and Rating Curve 2, and a data gap from September 6, 2017 to October 17, 2017, only streamflow data developed from Rating Curve 3 (April 2019 to July 2021) were used in this hydrologic analysis.

A high flow measurement was collected in May 2021, and Rating Curve 3 was updated to include this point. The current rating curve has two segments, as shown on Figure 2. The first is applied up to a stage of 8.229 m. The second segment is extrapolated to the maximum recorded stage-discharge measurement collected during its period of application.

The daily average discharge hydrograph for MILL is presented on Figure 3 and was developed by applying Rating Curve 3 to the relevant period of stage record and then averaging the fifteen-minute streamflow record over a calendar day.

3.0 LONG-TERM SYNTHETIC FLOW SERIES

A synthetic daily streamflow series was developed to assess long-term streamflow conditions in Mill Creek by correlating Mill Creek measured streamflow data with concurrent data from a streamflow gauging station operated by WSC.

3.1 HYDROGRAPH COMPARISON

The median watershed elevation above the Mill Creek gauge is 1,050 meters above sea level and glaciers cover a negligible area in the watershed. Several WSC stations were reviewed to determine an appropriate surrogate station, as shown on Figure 4. A suitable site should be close in proximity and have similar watershed characteristics to Mill Creek and have available concurrent data. Roberts Creek at Roberts Creek (08GA047) was excluded due to differences in watershed characteristics and flow regulation. Clowhom River near Clowhom Lake (08GB013) was considered, but correlation of concurrent daily flows found that the stations had differences in timing and magnitude of response to precipitation events. Seymour River Below Orchid Creek (08GA077) was also considered and although not noted as regulated by WSC, summer regulation was evident in the flow record (visually and by chronological correlation of concurrent flows) and Metro Vancouver records note regulation of Loch Lemond. Capilano River Above Intake (08GA010) was identified as the most representative long-term WSC station due to availability of concurrent data, its proximity to the Project and similarity of drainage area and basin characteristics such as median drainage elevation and negligible glacial cover. Daily discharge records are available at Capilano River between 1914 and 2021, except 1972,1973, and portions of 2007 and 2017. A summary of the regional WSC gauging stations, along with the Mill Creek station, is presented in Table 1.

Table 1 Regional WSC Gauging Station Summary

Station Name	Station ID	Gauge Elevation (masl)	Years of Record	Years of Complete Record	Start Year	End Year	Drainage Area (km^2)	Mean Annual Discharge (m^3/s)	Average Annual Unit Runoff ($L/s/km^2$)
Clowhom River Near Clowhom Lake	08GB013	60	30	28	1993	2022	147	15.6	106
Seymour River below Orchid Creek	08GA077	290	31	29	1992	2022	63	6.5	103
Capilano River above the Intake	08GA010	160	92	108	1914	2022	173	20.3	118
Mill Creek	MILL	208	6	4	2017	2022	38	4.1	106

Capilano River is a regulated system due to summer releases from Palisades Lake reservoir, which are managed by Metro Vancouver. Details on flow regulation are not consistently available; however, a naturalized streamflow record for Capilano River Above Intake (08GA010) has previously been developed for the Project for the period of record between 1960 and early 2018 using records of release rates from Metro Vancouver. Periods with regulation were also removed from the Capilano River Above Intake (08GA010) and Mill Creek records for the April 1, 2019 to May 28, 2021 concurrent period of record, conducted by visual comparison of the two datasets and removal of periods with sudden, steady increases in Capilano River Above Intake (08GA010) flow that are not reflected in the Mill Creek data. The naturalized flow record for Capilano River Above Intake (08GA010) therefore includes 55 complete years of record (i.e. 1960 – 1971, 1974 – 2006, 2008 – 2016) and six years with incomplete records (2007 and 2017 – 2021). This station has a watershed area of 173 km^2 and a mean annual unit runoff or 118 $L/s/km^2$.

A comparison of concurrent records between Mill Creek and Capilano River for April 1, 2019 to May 28, 2021 are presented on Figure 5. Mill Creek data prior to April 1, 2019 were removed due to the data quality concerns for this period discussed above. The two streams have similar runoff and seasonal flow patterns for the measured concurrent period, as shown on Figure 5. Unit runoff in Mill Creek appears to be lower than the Capilano River flows in the fall and winter, potentially due to Mill Creek's slightly higher median watershed elevation and less exposed location, which may result in increased winter snow storage at Mill Creek and decreased precipitation from incoming rainstorms off the coast, when compared to the

Capilano River drainage. Unit runoff in Mill Creek is higher than at Capilano River through the summer, potentially due to snowmelt from a larger snowpack. Fall peak flows also tend to be higher in Mill Creek due to its smaller and higher elevation watershed producing a flashier response.

3.2 EMPIRICAL FREQUENCY PAIRING ANALYSIS

Monthly discharge relationships were developed by correlating the frequency distributions of concurrent daily flows for Mill Creek versus Capilano River. The discharge relationships were developed using an analytical technique known as Empirical Frequency Pairing (EFP) (Butt, 2013). EFP requires that daily flows for the concurrent period of record for two datasets be ranked in descending order of magnitude. When comparing these sets of data, each flow value of equal rank has an equal probability of exceedance within its respective dataset (since the datasets are of equal length). A comparison of ranked daily flows therefore amounts to a comparison of flow frequency distributions. The EFP technique assumes that the correlation of the flow frequency relationship developed from the sample (concurrent record) is generally representative of the correlation that would exist between concurrent long-term records. Butt (2013) demonstrated the general validity of this assumption for watershed pairs that are located in regional proximity to one another and have similar hydrologic regimes.

The frequency pairing approach, rather than the more common chronological pairing approach, overcomes the often substantial differences in the timing and magnitude of rainstorm or snowmelt events between watersheds and differences in storage and attenuation, and has been shown to be a more accurate and precise model for synthetically generating long-term flow patterns (Butt, 2013). The objective of the EFP analysis is not necessarily to reproduce exact historical flow patterns at the point of interest, so that one can determine what the flow was on any given day, but rather to generate a dataset that provides a representation of the expected long-term mean annual discharge and associated variability of flows.

EFP relationships were developed for the available data and an example correlation for May is shown on Figure 6. The line of equivalent unit runoff was also plotted to assess whether the trends in proportional flow are consistent with the expected hydrologic characteristics of the respective watersheds, and to guide the extrapolation of the EFP relationships to highest recorded flows at the WSC station. The seasonal EFP relationships were applied to the corresponding long-term Capilano River records to produce a long-term synthetic discharge series for the Mill Creek gauge.

3.3 RESULTS

The estimated long-term monthly and annual flows at the intake location are summarized in Table 2. The corresponding annual hydrograph of mean monthly discharge at the Mill Creek gauge is shown on Figure 7. The flow duration curve for the long-term synthetic series at the gauge is shown on Figure 8. The mean annual discharge (MAD) is estimated to be 4.05 m^3/s (1960 to 2020 period), which equates to a mean annual unit runoff of 106 $L/s/km^2$ for the 38 km^2 watershed.

4.0 DISCUSSION

Mill Creek gauge measured streamflow between April 2019 and May 2021 were correlated with WSC data from Capilano River to produce a long-term synthetic streamflow timeseries that is of sufficient length for the purpose of assessing “normal” streamflow conditions, where “normal” includes flows between approximately 5% and 200% MAD.

The continued field data collection at the MILL and MILL-R2 gauges is recommended in order to:

- Increase the quality of the stage/discharge rating curves for the purpose of improving the quality of the streamflow records.
- Increase the length of the streamflow records concurrent with regional stations to improve calibration regressions for the purpose of generating a reliable long-term synthetic streamflow series.
- Support permitting and monitoring of water withdrawals.

If you have any questions or comments, please contact the undersigned.

Yours truly,
Knight Piésold Ltd.

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Attachments:

Table 2 Rev 0	Long-Term Synthetic Discharge at Mill Creek (MILL) Gauge
Figure 1 Rev 0	Mill Creek Watershed
Figure 2 Rev 0	Mill Creek (MILL) – Rating Curve 3 – Extrapolated to Maximum Recorded Stage
Figure 3 Rev 0	Mill Creek (MILL) Gauge – Daily Average Discharge Hydrograph
Figure 4 Rev 0	Hydrologic Zones and Regional Hydrology Stations
Figure 5 Rev 0	Mill Creek and Capilano River – Concurrent Unit Runoff
Figure 6 Rev 0	Mill Creek and Capilano River – Frequency Paired Relationship: May
Figure 7 Rev 0	Mill Creek – Mean Monthly Hydrograph
Figure 8 Rev 0	Mill Creek Synthetic Series - Flow Duration Curves
Appendix A	Mill Creek Hydrologic Analysis

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/skc

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TABLE 2

WOODFIBRE LNG LTD.
WOODFIBRE LNG PROJECT

LONG-TERM SYNTHETIC DISCHARGE AT MILL CREEK (MILL) GAUGE
(m^3/s)

Print: Aug/31/21 09:27:22

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1960	2.36	1.66	1.58	4.47	6.86	5.24	2.40	2.08	1.29	6.16	2.95	3.27	3.36
1961	7.16	6.28	2.64	4.04	10.39	7.08	2.63	1.68	1.58	5.17	5.22	3.28	4.76
1962	2.82	2.46	0.78	4.57	5.45	6.56	2.95	3.71	2.20	6.20	6.91	5.72	4.20
1963	1.73	4.93	1.91	3.63	4.70	3.46	3.43	1.28	0.85	7.34	7.69	3.98	3.74
1964	2.33	1.31	1.11	2.97	8.97	11.33	8.68	3.03	3.45	3.17	4.54	1.92	4.40
1965	1.35	1.65	1.28	4.36	7.22	5.26	2.28	0.98	0.44	7.37	6.65	3.76	3.55
1966	2.76	1.58	2.64	4.50	8.85	8.19	4.98	1.60	1.46	4.49	5.88	10.42	4.78
1967	3.87	2.24	2.76	2.58	10.65	10.77	4.32	1.45	1.16	13.00	3.47	3.33	4.97
1968	6.37	4.42	3.74	2.25	8.46	7.85	4.79	1.56	2.47	8.80	4.93	3.86	4.96
1969	2.00	1.33	1.81	6.64	11.23	7.84	3.14	2.00	5.85	3.60	2.99	3.02	4.29
1970	2.25	1.55	2.05	5.08	4.17	4.03	1.91	1.44	3.28	3.83	4.61	2.65	3.07
1971	2.51	3.60	1.48	2.86	8.83	8.29	6.34	1.84	2.17	4.31	4.59	0.86	3.97
1974	3.73	1.79	3.99	4.06	9.46	9.55	8.68	2.76	1.79	1.20	5.94	3.18	4.68
1975	1.09	0.77	1.97	2.00	10.09	8.41	4.63	3.65	1.00	10.65	9.30	5.30	4.91
1976	1.85	1.10	1.10	3.43	11.39	8.21	7.49	3.47	2.39	2.07	2.05	3.75	4.03
1977	1.59	2.29	1.53	4.25	5.38	4.72	1.99	1.31	3.55	5.41	6.40	4.13	3.55
1978	2.30	1.96	2.75	2.69	6.33	4.70	1.63	2.17	5.20	1.21	2.26	0.63	2.82
1979	0.35	1.99	3.21	3.34	7.69	5.02	2.90	0.51	2.98	4.84	1.87	7.53	3.52
1980	1.28	6.19	1.36	5.48	5.34	4.52	3.74	0.89	2.45	1.07	10.80	7.16	4.19
1981	1.59	3.81	1.39	5.20	5.57	6.36	1.88	0.53	3.78	9.69	6.21	3.60	4.13
1982	1.33	4.18	1.56	3.40	9.59	10.28	4.44	1.31	0.58	7.71	4.09	3.82	4.36
1983	4.13	8.59	4.31	3.10	7.94	6.91	7.12	1.72	1.81	2.71	12.98	0.72	5.17
1984	3.93	3.70	3.01	3.82	8.52	7.90	4.88	1.13	1.14	6.11	6.53	1.19	4.32
1985	0.98	0.71	0.82	4.83	7.62	6.10	2.27	0.73	0.69	7.16	2.45	1.22	2.96
1986	4.84	3.43	4.31	2.43	9.59	4.57	2.56	0.44	0.78	1.32	4.59	4.48	3.61
1987	4.02	2.15	5.40	3.81	9.73	4.96	2.48	0.48	0.48	0.47	4.62	3.55	3.51
1988	2.01	1.54	1.69	5.37	10.02	6.21	3.38	0.97	1.61	2.44	8.23	2.41	3.82
1989	2.18	1.55	1.90	5.85	7.89	6.37	3.70	1.26	0.37	5.30	6.07	2.63	3.76
1990	2.29	1.27	1.78	5.44	6.08	6.59	1.84	1.34	0.91	4.05	13.14	2.16	3.91
1991	2.54	8.73	0.93	4.58	6.19	4.66	2.36	6.82	0.92	0.25	6.66	3.57	4.02
1992	9.68	3.33	1.61	6.52	2.82	2.93	1.79	0.90	2.04	6.86	4.93	1.19	3.72
1993	1.58	1.23	3.96	7.20	8.20	4.05	1.89	0.90	0.34	2.00	2.89	5.75	3.33
1994	4.84	3.56	6.27	4.67	5.33	5.22	2.70	0.54	0.67	2.97	3.28	7.71	3.98
1995	5.10	4.97	3.99	3.37	7.74	4.96	2.44	1.93	0.67	7.27	13.68	6.55	5.22
1996	4.98	3.23	1.92	6.78	4.79	3.12	1.84	0.57	0.84	6.01	4.47	2.36	3.41
1997	5.27	1.09	5.29	6.53	11.24	7.54	5.07	0.97	4.49	9.52	6.33	2.75	5.51
1998	4.84	3.61	1.90	1.98	7.09	4.31	2.74	0.60	0.28	3.65	10.77	5.32	3.92
1999	3.57	2.13	2.26	3.76	8.78	10.74	9.46	4.59	1.10	3.70	9.08	3.75	5.24
2000	1.28	1.44	1.53	3.97	9.42	9.18	4.34	1.07	1.29	4.62	1.91	1.70	3.48
2001	2.23	0.81	1.87	3.63	7.34	4.68	1.82	4.66	1.06	3.31	7.34	3.15	3.49
2002	5.15	1.96	1.11	6.47	9.55	8.78	3.03	0.93	1.37	0.23	7.77	3.05	4.12
2003	5.08	1.06	5.63	4.48	3.82	3.76	1.68	0.37	0.74	9.83	3.00	3.05	3.54
2004	4.00	1.53	2.02	3.23	5.13	4.29	1.35	1.24	3.04	4.10	5.28	3.87	3.26
2005	7.64	0.88	2.66	6.09	6.10	2.98	3.24	0.38	0.91	6.09	4.08	6.37	3.95
2006	4.40	1.50	1.76	3.39	8.29	7.17	2.29	0.61	0.50	1.23	10.87	3.45	3.79
2007	3.10	2.15	7.32	5.18	9.18	8.21			1.72	7.64	5.10	4.58	
2008	1.52	0.97	1.50	1.93	12.26	7.37	4.09	2.90	0.75	4.37	6.18	1.10	3.74
2009	1.84	1.08	1.85	4.00	9.75	4.74	1.33	0.93	1.74	5.76	12.52	4.06	4.13
2010	8.06	3.21	1.72	4.45	5.60	6.71	3.01	0.74	3.12	5.85	3.52	6.05	4.34
2011	3.52	1.74	2.94	2.75	9.30	9.45	7.11	3.26	2.98	4.14	4.24	1.86	4.44
2012	3.85	1.49	1.60	5.91	8.85	8.95	5.27	0.89	0.34	5.79	8.37	3.37	4.56
2013	1.05	1.12	5.70	6.72	9.72	5.46	1.70	1.32	5.16	2.00	2.31	1.01	3.61
2014	2.38	0.94	4.52	4.73	7.50	3.20	1.64	0.62	1.53	9.69	8.94	7.63	4.44
2015	3.59	5.81	4.02	1.79	1.13	1.16	0.35	1.45	3.56	2.17	6.24	7.19	3.20
2016	7.90	3.80	5.28	4.27	3.46	3.88	2.42	0.49	0.88	10.31	10.93	0.82	4.54
2017	3.15	3.43	3.81	7.64	12.17	8.08	2.91	0.57			10.35	1.54	
2018	5.79												
2019				4.88	4.57	2.31	1.62	0.54	5.85	4.04	2.09	2.18	
2020	7.58	2.48	1.22	3.01	9.29	5.16	2.30	1.82	6.81	3.72	4.53	3.55	4.29
2021	5.07	1.13	1.51	3.26	7.04	7.60	1.50						
Average	**3.52**	**2.59**	**2.65**	**4.30**	**7.72**	**6.24**	**3.39**	**1.58**	**1.97**	**4.98**	**6.13**	**3.66**	**4.05**
Maximum	**9.68**	**8.73**	**7.32**	**7.64**	**12.26**	**11.33**	**9.46**	**6.82**	**6.81**	**13.00**	**13.68**	**10.42**	**5.51**
Minimum	**0.35**	**0.71**	**0.78**	**1.79**	**1.13**	**1.16**	**0.35**	**0.37**	**0.28**	**0.23**	**1.87**	**0.63**	**2.82**

\\KPL\VA-Prj$\1\03\00494\19\A\Data\Hydrology\Synthetic Flow Development\Mill\EFP Analysis\[MILL-Capilano EFP Analysis.xlsb]TABLE 2

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER VA22-01362	SKC	TJP



MILL CREEK WATERSHED

LOCATION TO:	DRAINAGE AREA (km²)
Mill Creek Mouth	41
Mill Creek Gauge	38

LEGEND:

- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

1 0.5 0 1 2 3 4 5 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:50,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	23SEP'22	ISSUED WITH LETTER	ELK	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

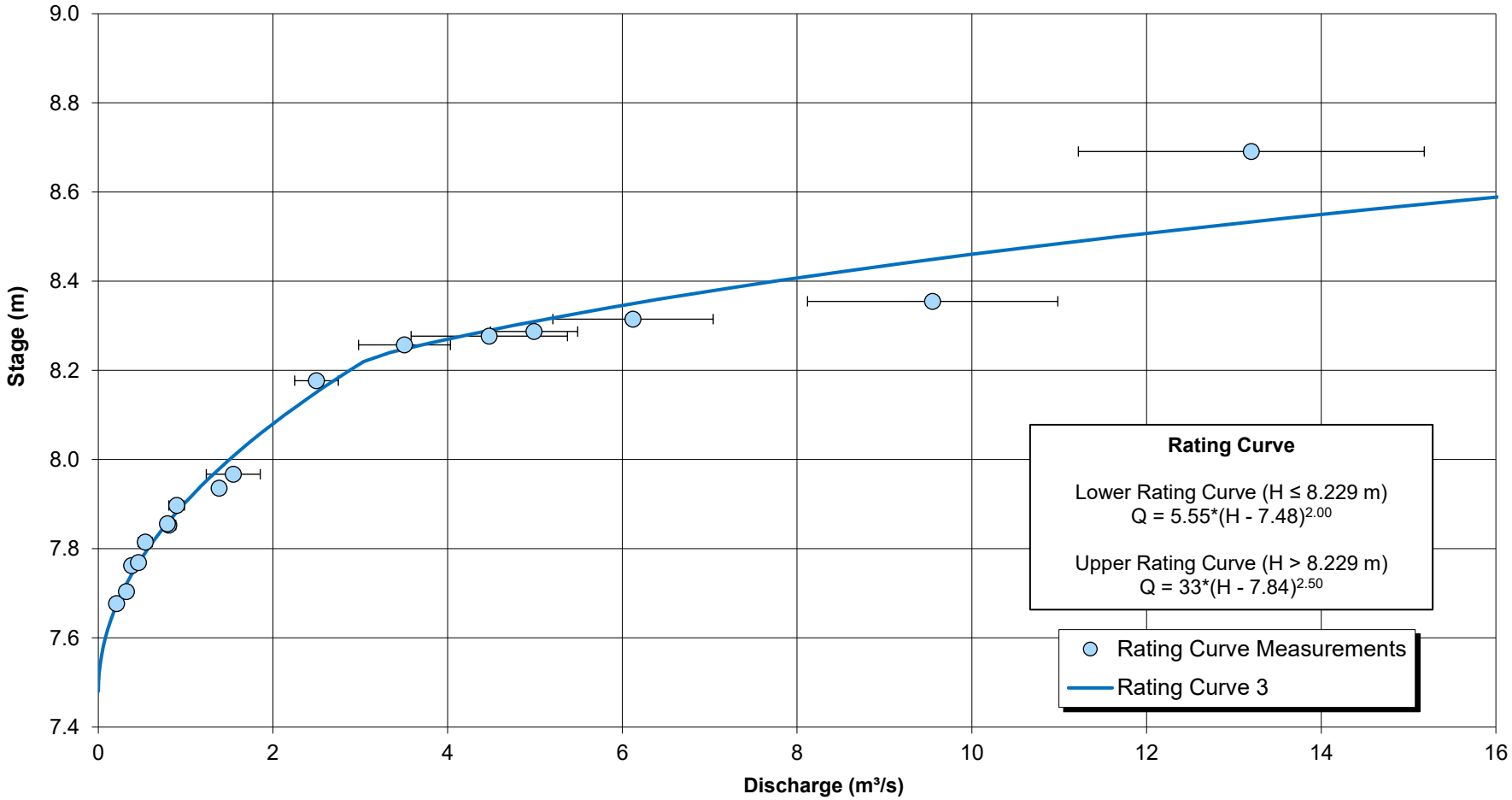
MILL CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO. VA103-00494/24 | REF NO. VA22-01362

FIGURE 1 | REV 0

SAVED: M:\1\03\00494\24\A\GIS\Figs\VA22-01362\Fig1_MillCreekWatershed_r0.mxd; Sep 23, 2022 9:39 AM; kkrauszova



REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL)
RATING CURVE 3
EXTRAPOLATED TO MAXIMUM RECORDED STAGE

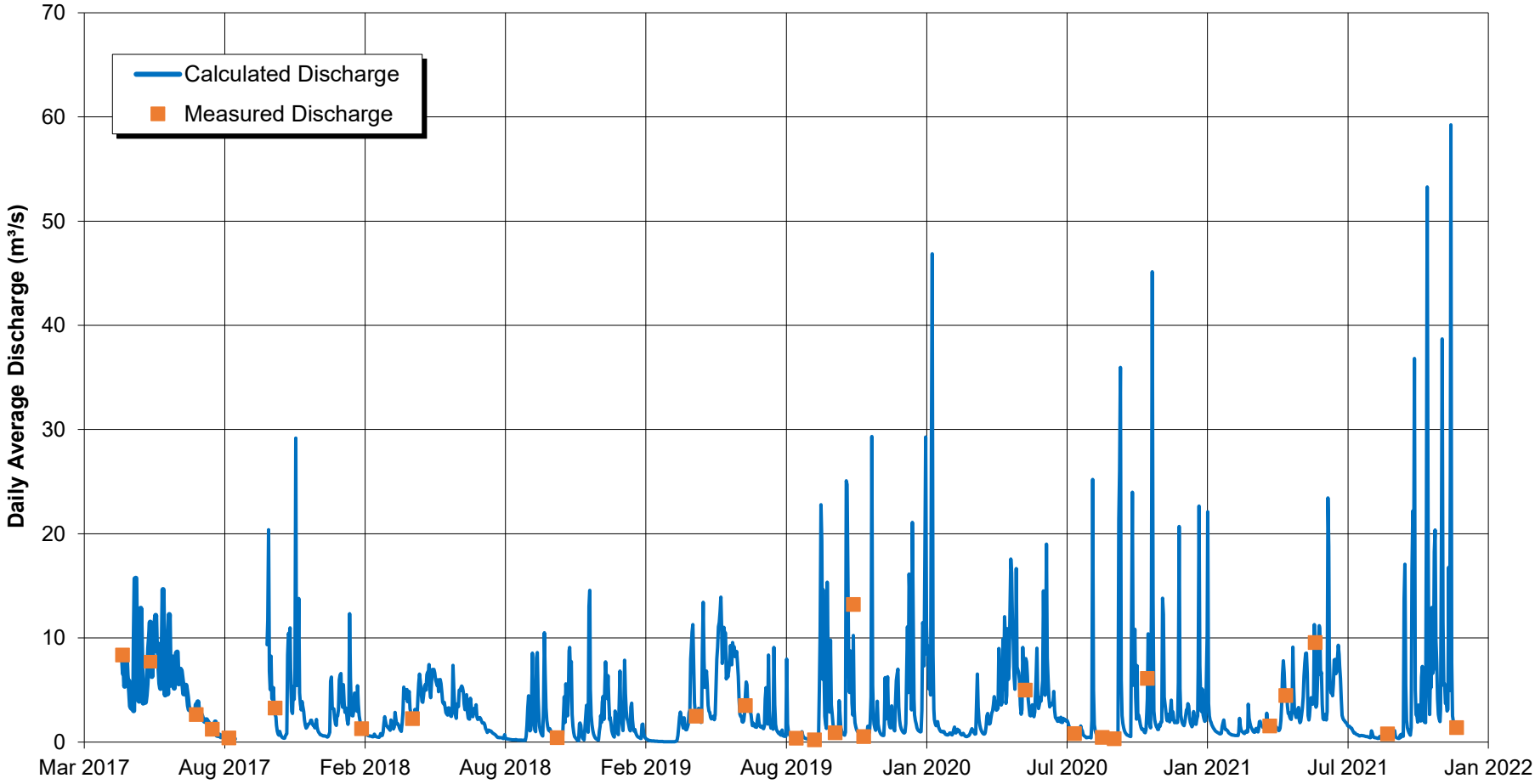
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 2

REV 0



NOTE:
1. MANUAL MEASUREMENTS OF INSTANTANEOUS DISCHARGE DO NOT NECESSARILY MATCH DAILY AVERAGE DISCHARGE ON THE SAME DATE DUE TO DAILY FLUCTUATIONS IN DISCHARGE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL) GAUGE
DAILY AVERAGE DISCHARGE HYDROGRAPH

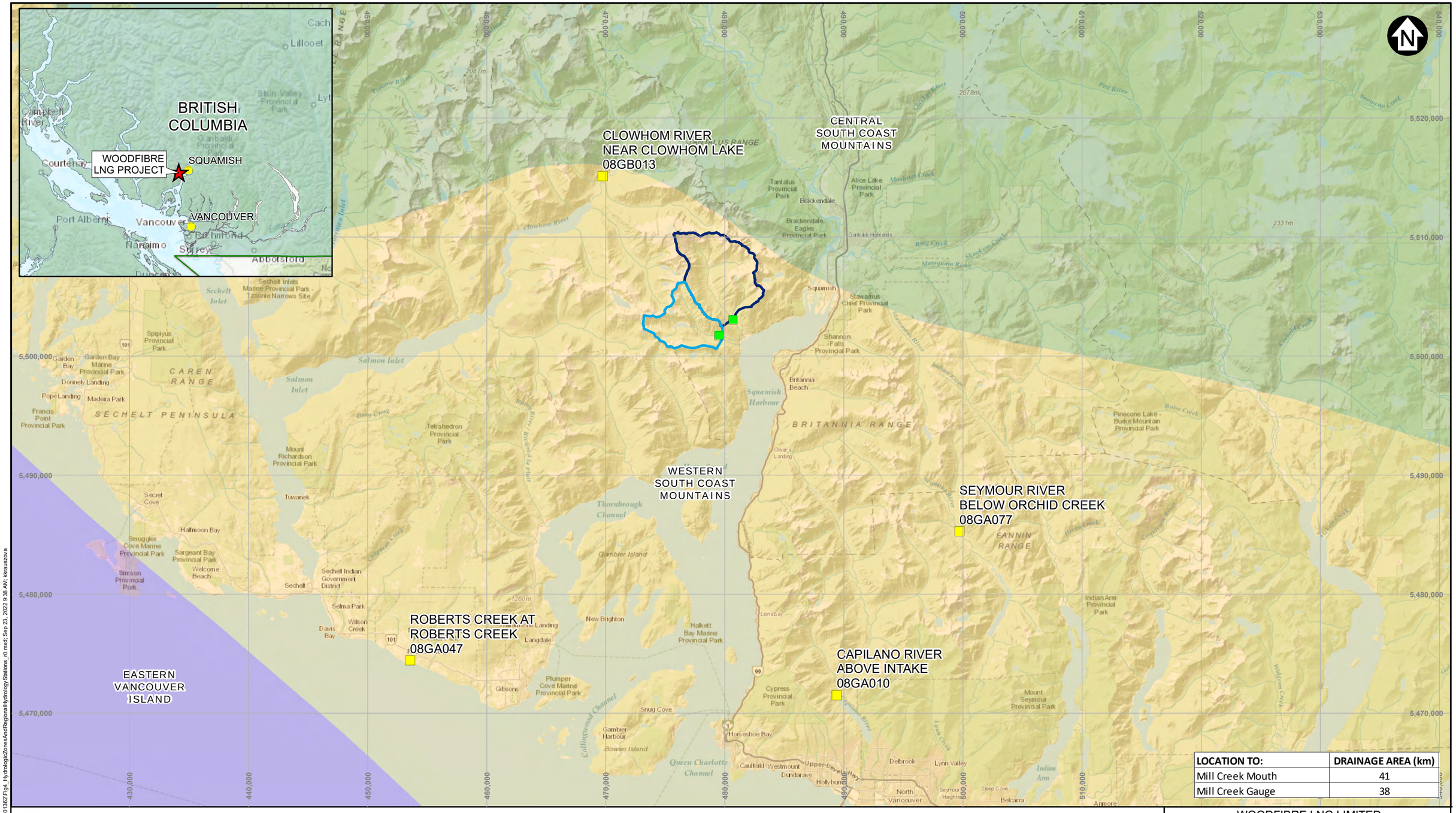
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 3

REV 0



LOCATION TO:	DRAINAGE AREA (km)
Mill Creek Mouth	41
Mill Creek Gauge	38

LEGEND:

- WSC STATION
- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WOODFIBRE CREEK WATERSHED BOUNDARY
- MILL CREEK WATERSHED BOUNDARY

HYDROLOGIC ZONE

- CENTRAL SOUTH COAST MOUNTAINS (ZONE 26)
- EASTERN VANCOUVER ISLAND (ZONE 28)
- WESTERN SOUTH COAST MOUNTAINS (ZONE 27)

0 3.75 7.5 15 22.5 30 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:300,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	23SEP'22	ISSUED WITH LETTER	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

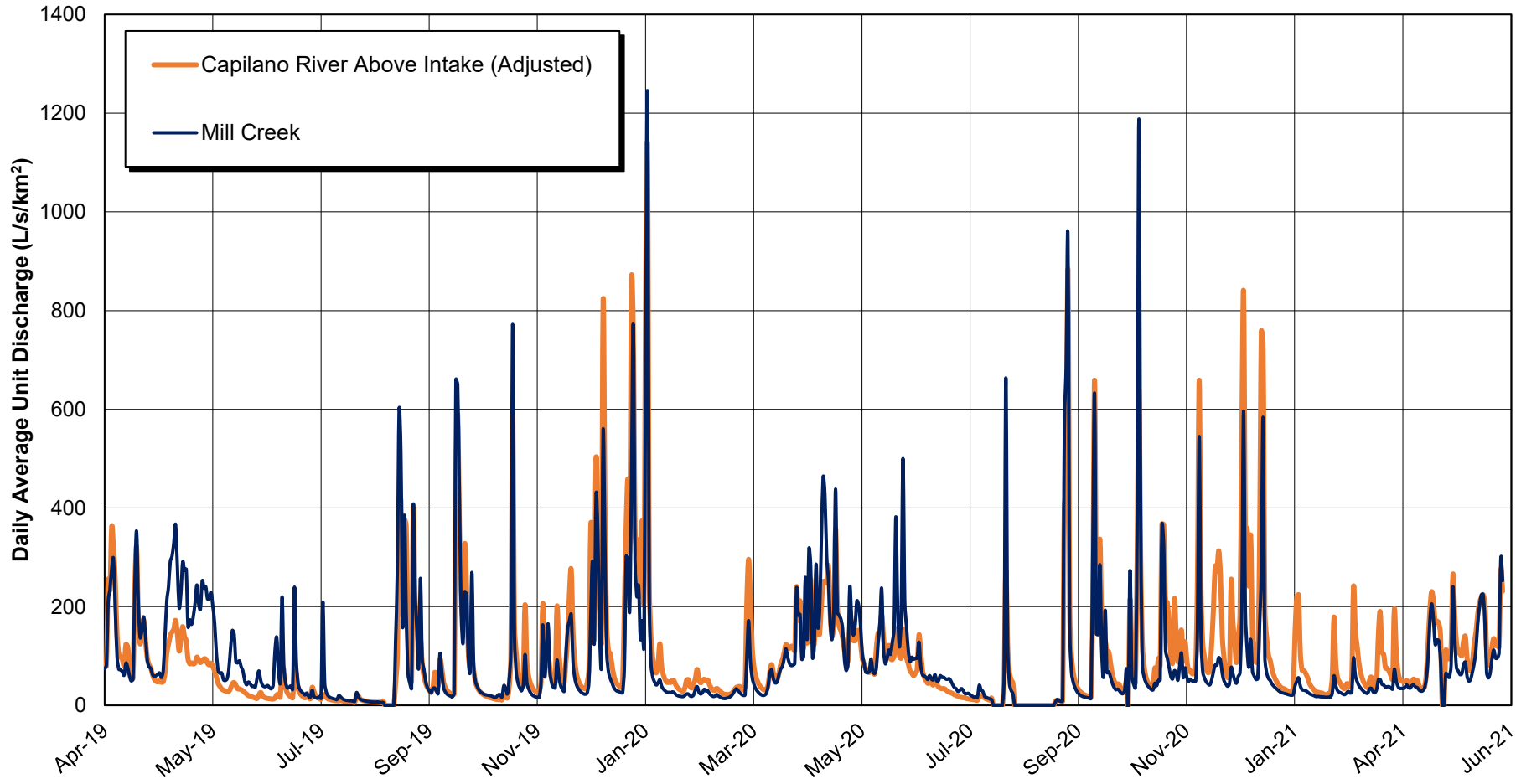
HYDROLOGIC ZONES AND REGIONAL HYDROLOGY STATIONS

Knight Piésold CONSULTING

P/A NO. VA103-00494/24 | REF NO. VA21-01362

FIGURE 4 REV 0

SAVED: M:\103\00494\24\A\GIS\Figs\VA22-01362\Fig4_HydrologicZonesAndRegionalHydrologyStations_r0.mxd: Sep 23, 2022 9:38 AM: kkrauszova



NOTES:
1. PERIOD OF RECORD USED FOR CONCURRENT PROJECT AND WSC STATION DISCHARGE IS APRIL 1, 2019 TO MAY 28, 2021

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK AND CAPILANO RIVER CONCURRENT UNIT RUNOFF

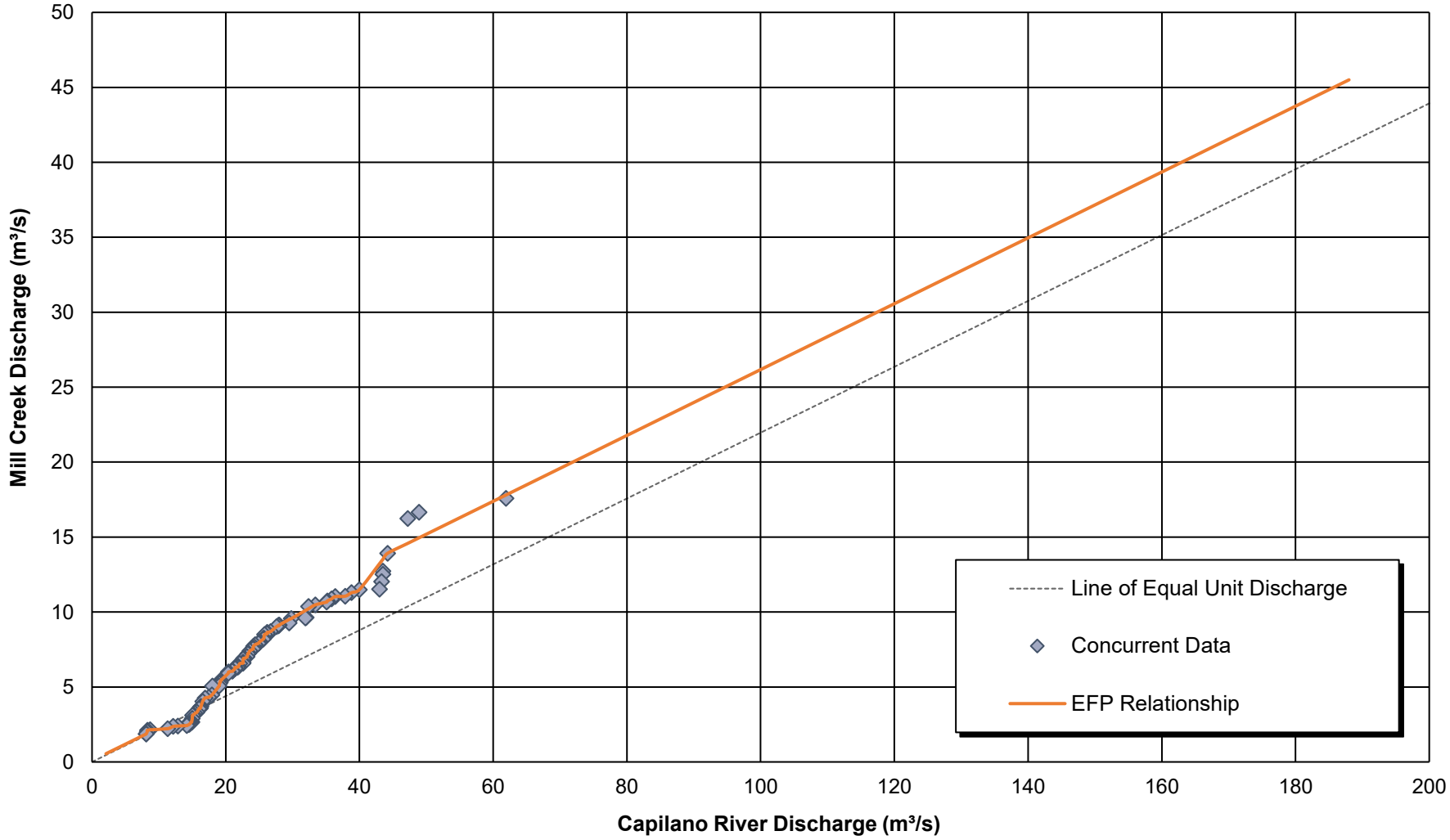
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 5

REV 0



NOTES:
1. PERIOD OF RECORD USED FOR CONCURRENT PROJECT AND WSC STATION DISCHARGE IS APRIL 1, 2019 TO MAY 28, 2021

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK AND CAPILANO RIVER FREQUENCY PAIRED RELATIONSHIP: MAY

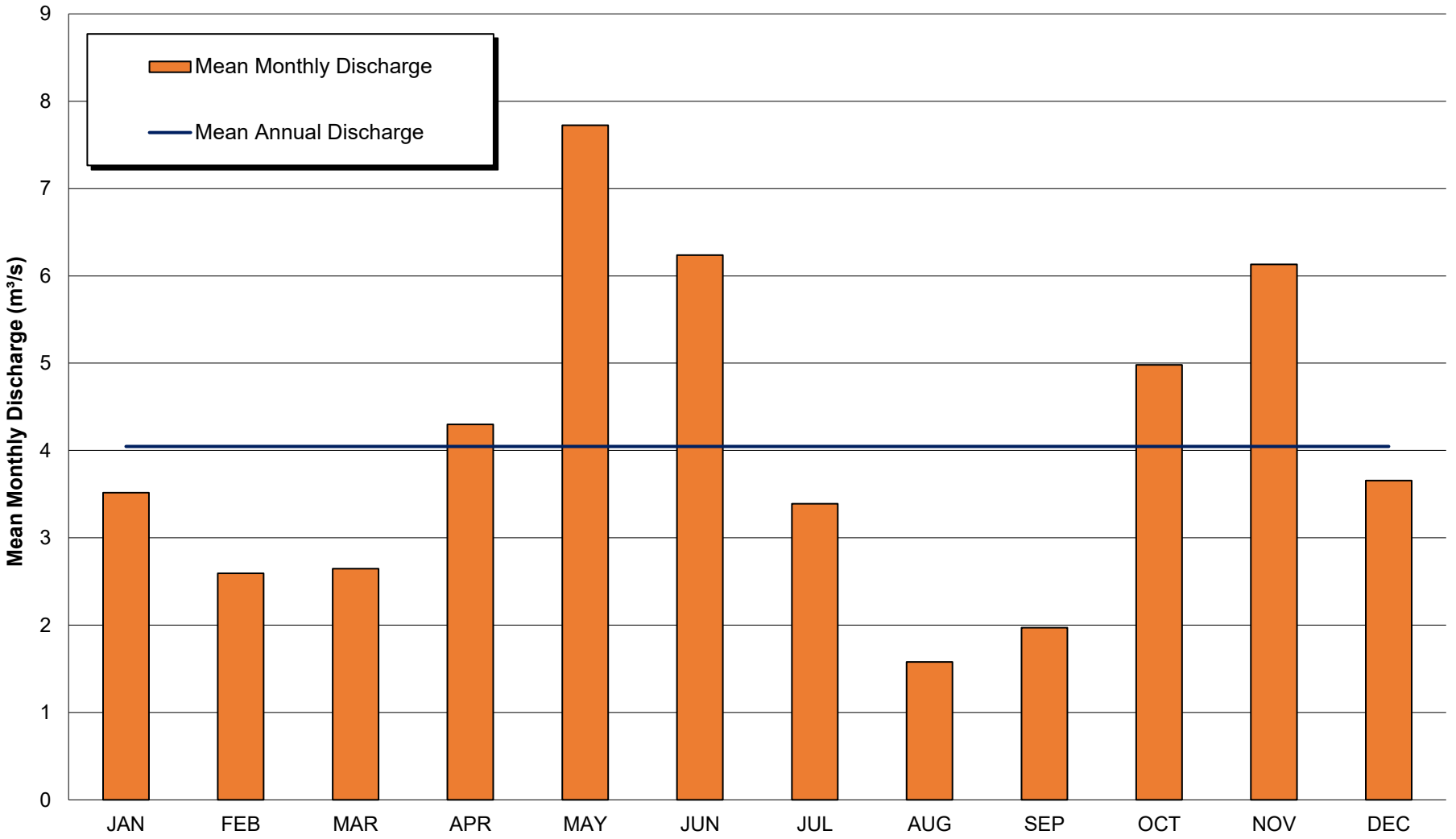
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 6

REV 0



NOTES:
1. MEAN MONTHLY FLOWS ESTIMATED FROM LONG-TERM SYNTHETIC SERIES (1960 - 2021).
2. MEAN ANNUAL DISCHARGE IS 4.06 m³/s

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK
MEAN MONTHLY HYDROGRAPH

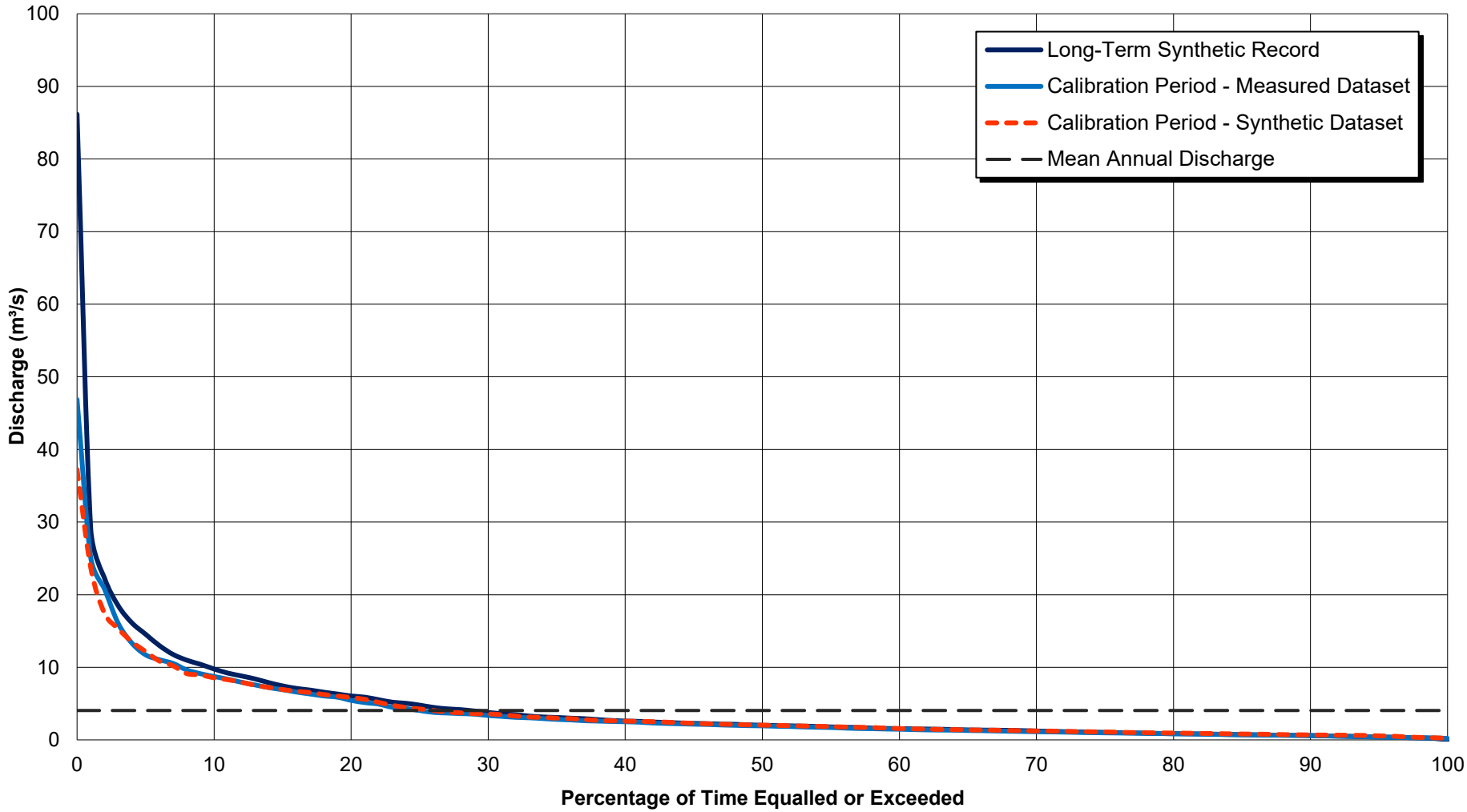
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 7

REV 0



NOTES:
1. THE PERIOD OF RECORD FOR THE CONCURRENT MEASURED AND SYNTHETIC FLOWS IS APRIL 1, 2019 TO MAY 28, 2021.
2. THE PERIOD OF RECORD FOR THE LONG-TERM SYNTHETIC SERIES IS JAN 1, 1960 TO MAY 28, 2021, WITH GAPS IN THE RECORD IN 1972 - 1973 AND 2017 - 2021.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK SYNTHETIC SERIES FLOW DURATION CURVES

Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01362

FIGURE 8

REV 0

APPENDIX A

Mill Creek Hydrologic Analysis

(Pages A-1 to A-14)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

February 22, 2022

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Permitting Manager
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Canada, V6E 4E6

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Dear Darren,

RE: Mill Creek Hydrologic Analysis

Woodfibre LNG Limited (Woodfibre LNG) is developing a liquefied natural gas (LNG) export facility (the Project) on the former Woodfibre Pulp and Paper Mill site, located near Squamish, British Columbia (BC). Knight Piésold Ltd. (KP) has been retained by WLNG to assist with the hydrometric monitoring of Mill Creek, in support of instream flow studies and Project permitting. As part of this work, KP has installed and operated streamflow gauging stations on Mill Creek and Woodfibre Creek. Two gauging stations are operated on Mill Creek and referred to as MILL and MILL-R2. This letter presents the details of the Mill Creek field data collection by KP and the available measured record, covering April 2017 to November 2021.

1.0 HYDROLOGIC SETTING

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains), on the boundary with Zone 26, as presented by Ahmed (2017). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime. In general, streamflow in South Coast watersheds like Mill Creek (i.e. coastal, but also with high elevation mountainous terrain) is highest in autumn due to frontal rainstorm activity, with a secondary peak in spring due to snowmelt. Flows are lowest in late summer when precipitation is low. Winter flows tend to be moderate as much of the precipitation falls as snow but can be punctuated by warm rainfall events and rainfall at lower elevation.

Mean annual precipitation varies from only 1,490 mm at Gibsons, located approximately 35 km southwest of the Project, to 3,322 mm at Port Mellon, located 25 km southwest of the Project and then to 2,230 mm in Squamish. This is indicative of topographic convergence of frontal systems in Howe Sound, and extreme orographic enhancement of precipitation due to rapid uplift. Similarly, mean annual unit runoff varies dramatically from 125 l/s/km^2 (or 4,000 mm) in Rainy River, located near Port Mellon, and 116 l/s/km^2 (or 3,660 mm) in Capilano River, located close to the Project area, to only 32 l/s/km^2 (or 1,000 mm) in Roberts Creek, located 40 km to the southwest and with a lower elevation basin.

The Mill Creek watershed is shown on Figure 1.

2.0 STREAMFLOW DATA COLLECTION

2.1 MILL STATION

KP installed a hydrometric station (MILL) on Mill Creek in April 2017. The station is approximately 2 km upstream from the mouth of the Creek, as shown on Figure 1, and approximately 100 meters upstream of the historic hydropower intake. The site was selected primarily due to accessibility and gauging characteristics with the objective of collecting accurate and reliable streamflow data, but also considering potential future and existing water diversion locations. Mill Creek downstream of the gauging location lies in a canyon with steep or vertical bedrock banks, and safe access year-round is challenging. Additionally, locations that allow high quality streamflow measurements at a range of flow conditions are limited. Near the mouth of Mill Creek, much of the accessible reach is backwatered by tides and therefore not suitable for stream gauging.

The station is located on the left bank of a pool, downstream of a cascade, as shown on Photo 1a. Water level is hydraulically controlled by a cascade at the outlet of the pool, shown on Photo 1b. The low-flow control section consists of cobbles and boulders, while the high-flow control also includes the bedrock banks. The hydrometric station consists of a pressure transducer connected to a datalogger that records stage at fifteen-minute intervals.



(a) (b)

Photo 1 – (a) MILL Station looking upstream at the pressure transducer and staff gauge (Apr 10, 2019), and (b) looking downstream at the hydraulic control section (Aug 29, 2017)

2.1.1 MILL RATING CURVE AND DISCHARGE HYDROGRAPH

A total of 26 stage/discharge measurements have been collected at MILL, as summarized in Table 1. The discharge measurements were conducted using area-velocity or Rhodamine dye dilution measurements, depending on flow conditions at the time of each site visit. The station includes three benchmarks located in bedrock above the normal high-water level, a staff gauge, and three reference marks for determining stage. Benchmark 1 was assigned an elevation of 10 m and this datum is used for converting water level to gauge height (stage). These stage-discharge measurements were used to develop a rating curve for the gauge.

A high flow event on November 22, 2017, resulting in a deposition of gravel and cobbles at the control section, was identified as causing a change in the hydraulic control, which required a new stage-discharge rating curve. Rating Curve 1 is applied from April 18, 2017 to November 22, 2017.

Another change in the hydraulic control appears to have occurred between the October 17, 2018 and April 10, 2019 site visits, possibly due to high flow events that caused scouring of material deposited during the November 22, 2017 event within the control section. It is unknown when the exact date of this change occurred or if it was gradual during the time interval between site visits. A second rating curve (Rating Curve 2) was developed, but only three stage-discharge measurements were collected before another shift was detected. Rating Curve 3 is applied from April 1, 2019 to the most recent site visit on November 22, 2021. All three rating curves are shown on Figure 2.

Rating Curve 1 was plotted through the six available stage-discharge points using the standard form for a rating curve equation (power function) with the constant, offset, and exponent constrained within expected values based on hydraulic theory (Maidment, 1993) and experience with similar conditions in mountainous streams. Rating Curve 2 is based on the shape of Rating Curve 1 as the three available stage-discharge measurements are insufficient to independently delineate a new rating curve. Rating Curve 3 is based on the 17 stage-discharge measurements collected since the April 2019 shift. The latest measurement (recorded November 22, 2021) falls on Rating Curve 3. As data collection continues, the need to create a new rating curve will be assessed.

The most recent rating curve (Rating Curve 3) is shown on Figure 3. The rating curve meets the number and distribution of stage-discharge measurements compared to RISC (2018) recommendations over the range of "normal" flows and, in particular, over the range of flows most relevant for the instream flow studies and Project permitting. Rating Curve 1 also meets the RISC (2018) recommendations over the range of measured flows. Rating Curve 2 does not meet the RISC (2018) recommendations over the range of measured flows due to a lack of discharge measurements collected to delineate this rating curve. Based on the B.C. Hydrometric standards (RISC, 2018) the data collected at MILL is considered to meet Grade A standards for the period of record, with the following exceptions: during the period when Rating Curve 2 is applied (November 22, 2017 to April 01, 2019) due to insufficient stage-discharge measurements, and RISC (2018) notes that rating curves developed from dilution methods should be graded as "BP" (i.e., Best Practice) due to lack of Provincial guidelines on the method.

The daily average discharge hydrograph for MILL is presented on Figure 4 and was developed by applying the rating curves to their respective periods of stage record and then averaging the fifteen-minute streamflow record over a calendar day. The MILL hydrograph has one gap from September 6, 2017 to October 17, 2017 (dates are inclusive) due to depleted logger battery.

As evidenced above, the hydraulic control at the MILL station is not stable and the rating curve has shifted twice since the installation of the station in April 2017. Given the reliance on the Mill Creek station for low flow mitigation, a new sensor was installed near the current MILL station. The new station location, MILL-R2, is considered more stable than the previous MILL station location and conditions are considered suitable for telemetry, if required in the future. Both MILL and MILL-R2 are operated concurrently to provide redundancy and improved accuracy.

2.2 MILL-R2 STATION

KP installed an additional hydrometric station (MILL-R2) in June 2019. The gauge. is approximately 50 meters upstream of the historic Mill Creek hydropower intake and 50 meters downstream from the original

MILL station. The station is located on the left bank of a pool, downstream of a cascade, as shown on Photo 3a. Water level is hydraulically controlled by a constriction of the bedrock banks, as shown on Photo 3b. The low-flow control section consists of cobbles and boulders, while the high-flow control also includes the bedrock banks. The hydrometric station consists of a pressure transducer connected to a datalogger that records stage at fifteen-minute intervals.



(a) (b)

Photo 3 – (a) MILL-R2 Station looking upstream at the pressure transducer (October 2, 2019), and (b) looking upstream showing the Hydraulic Control (Aug 14, 2019). The gauge location is identified by the red dot.

2.2.1 MILL-R2 RATING CURVE AND DISCHARGE HYDROGRAPH

A total of 15 stage/discharge measurements have been made at MILL-R2, as summarized in Table 2. The discharge measurements were conducted using area-velocity and Rhodamine dye dilution methods depending on flow conditions at the time of each site visit. The station includes three benchmarks, located in bedrock above the normal high-water level and one reference mark for determining stage. Benchmark 1 was assigned an elevation of 5 m and this datum is used for converting water level to gauge height (stage). On two occasions this year, high flow events have damaged the station and the benchmarks. On April 1, 2021, KP staff arrived on site to a damaged sensor with the protective aluminum housing pipe missing. The sensor was replaced during the April 21, 2021 site visit. KP staff returned for the final site visit of the year on November 22, 2021 to again find the new sensor was missing along with the protective aluminum pipe. All dipping points and one benchmark need to be re-established in 2022.

One rating curve was plotted through the 15 available stage-discharge points using the standard form for a rating curve equation (power function) with the constant, offset, and exponent constrained within expected values based on hydraulic theory (Maidment, 1993) and experience with similar conditions in mountainous streams. The rating curve, showing up to the maximum recorded stage-discharge measurement collected over the monitored time period, is shown on Figure 5. The rating curve was adjusted based on additional stage-discharge measurements collected during the 2021 monitoring program to better delineate the curve. The May 28, 2021 measurement was a high flow rating curve point that fell to the right of the previously established rating curve. The upper portion of the old curve was driven by a high flow measurement taken on October 25, 2019. The new rating curve takes both of these high flow measurements into account as there is no certainty on whether there has been a control shift at the site. Future high flow measurements

will determine if there has been a control shift or if one of these points are simply anomalous. The rating curve meets the RISC (2018) recommendations over the range of measured flows, including over the range of flows most relevant to the instream flows studies and Project permitting, due to the number and distribution of discharge measurements delineating the curve. Based on the B.C. Hydrometric standards (RISC, 2018) the data collected at MILL-R2 is considered to meet Grade A standards for the period of record, except RISC (2018) notes that rating curves developed from dilution methods should be graded as "BP" (i.e., Best Practice) due to lack of Provincial guidelines on the method.

The daily average discharge hydrograph for MILL-R2 is presented on Figure 6 and was developed by applying the rating curve to the available stage record and then averaging the fifteen-minute streamflow record over a calendar day. The MILL-R2 hydrograph has three gaps:

- May 28, 2020 to July 29, 2020 – due to depleted logger battery.
- October 29, 2020 to April 21, 2021 – due to station damage.
- September 29, 2021 to next station installation – due to station damage, station needs to be replaced and is currently not logging.

Although these data are missing at MILL-R2, stage data are available from the MILL gauging station during these time periods.

3.0 DISCUSSION

Streamflow gauging will continue on Mill Creek to support instream flow studies and Project permitting. The rating curves at MILL and MILL-R2 are believed to accurately calculate streamflow over the range of conditions most relevant for the instream flow studies and Project permitting. It is recommended that both the MILL and MILL-R2 gauges continue to be operated to provide improved accuracy and redundancy. MILL-R2 is the better candidate for telemetry, if required, as the rating curve appears to be more stable than MILL. Despite the station being damaged on two occasions this year, it is believed that with the addition of more clamps the station will become more robust. At least five site visits covering an adequate range of streamflows should be conducted annually at the Mill Creek gauging stations to increase the accuracy and confirm stability of the stage-discharge rating curves and meet the Grade A standard for data collection guidelines outlined in RISC (2018). It is also recommended that the instrumentation (pressure transducer and data logger) at the MILL station be replaced during 2022 as part of routine maintenance to maintain data accuracy.

Yours truly,
Knight Piésold Ltd.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
T. J. PERKINS
32079
2022-02-22

Prepared: Kaelan Hagen, GIT
Project Scientist

Reviewed: Toby Perkins, M.A.Sc., P.Eng.
Senior Engineer

Approval that this document adheres to the Knight Piésold Quality System: SRM

Attachments:

Table 1 Rev 0	Summary of Discharge Measurements
Table 2 Rev 0	Summary of Discharge Measurements
Figure 1 Rev 0	Mill Creek Watershed
Figure 2 Rev 0	Mill Creek (MILL) Rating Curves - Measured Range
Figure 3 Rev 0	Mill Creek (MILL) Rating Curve 3 - Extrapolated to Maximum Recorded Stage-Discharge Measurement
Figure 4 Rev 0	Mill Creek (MILL) Daily Average Discharge Hydrograph
Figure 5 Rev 0	Mill Creek (MILL-R2) Rating Curve - Extrapolated to Maximum Recorded Stage-Discharge Measurement
Figure 6 Rev 0	Mill Creek (MILL-R2) Daily Average Discharge Hydrograph

References

Ahmed, A. (2017). “Inventory of Streamflow in the South Coast and West Coast Regions”, October 2017, Knowledge Management Branch, British Columbia Ministry of Environment and Climate Change Strategy, Victoria, B.C.

Maidment, David R. (1993). Handbook of hydrology. Vol. 9780070. McGraw-Hill, New York.

Resources Information Standards Committee (RISC). 2018. Manual of British Columbia Hydrometric Standards, Version 2.0, December 2018. Knowledge Management Branch, B.C. Ministry of Environment and Climate Change Strategy, Victoria, B.C.

/krh

Knight Piésold CONSULTING

TABLE 1

WOODFIBRE LNG LTD.
WOODFIBRE LNG PROJECT

MILL CREEK (MILL)
SUMMARY OF DISCHARGE MEASUREMENTS

Print Feb/22/22 10:44:12

Date	Number of Gaugings	Method	Stage [m]	Stage +/- [m]	Discharge [m^3/s]	Discharge Error
4/18/2017	4	Dye Dilution	8.30	0.010	8.36	10%
5/24/2017	3	Dye Dilution	8.26	0.010	7.74	10%
7/20/2017	2	Area-Velocity	7.90	0.002	2.65	5%
8/9/2017	2	Area-Velocity	7.74	0.010	1.23	5%
8/30/2017	2	Area-Velocity	7.52	0.002	0.39	5%
10/27/2017	3	Dye Dilution	7.94	0.005	3.27	10%
2/13/2018	3	Dye Dilution	8.15	0.005	1.28	10%
4/18/2018	3	Dye Dilution	8.26	0.010	2.25	10%
10/17/2018	2	Area-Velocity	7.94	0.010	0.44	10%
4/10/2019	4	Dye Dilution	8.18	0.020	2.50	10%
6/11/2019	3	Dye Dilution	8.26	0.020	3.51	15%
8/14/2019	2	Area-Velocity	7.76	0.005	0.38	10%
9/6/2019	2	Area-Velocity	7.68	0.005	0.21	10%
10/2/2019	2	Area-Velocity	7.90	0.002	0.90	10%
10/25/2019	4	Dye Dilution	8.69	0.030	13.20	15%
11/7/2019	1	Area-Velocity	7.82	0.005	0.54	15%
5/28/2020	3	Dye Dilution	8.29	0.020	4.99	10%
7/29/2020	2	Dye Dilution	7.85	0.010	0.81	10%
9/2/2020	2	Dye Dilution	7.77	0.010	0.46	10%
9/17/2020	2	Dye Dilution	7.70	0.005	0.32	10%
10/29/2020	2	Dye Dilution	8.32	0.030	6.12	15%
4/1/2021	2	Dye Dilution	7.97	0.020	1.55	20%
4/21/2021	2	Dye Dilution	8.28	0.020	4.48	20%
5/28/2021	2	Dye Dilution	8.36	0.020	9.55	15%
8/27/2021	2	Dye Dilution	7.86	0.010	0.79	10%
11/22/2021	2	Area-Velocity	7.94	0.020	1.38	15%

\\KPL\VA-Prj$\1\03\00494\18\A\Data\Hydrology\End of Year 2021 QAQC\MILL\[MILL_QAQC 2021_NEW.xlsm]Q Table

NOTES:

1) NUMBER OF GAUGINGS REFERS TO THE NUMBER OF GAUGINGS AVERAGED TO PRODUCE ONE RATING POINT.
2) STAGE ERROR IS BASED ON A VISUAL ASSESSMENT OF THE WAVE AMPLITUDE IN THE GAUGE POOL.
3) DISCHARGE ERROR REFERS TO THE IN-SITU MEASUREMENT ERROR ESTIMATED BY THE FIELD ENGINEER.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER VA21-02130	KRH	TJP

Knight Piésold CONSULTING

TABLE 2

WOODFIBRE LNG LTD.
WOODFIBRE LNG PROJECT

MILL CREEK (MILL-R2)
SUMMARY OF DISCHARGE MEASUREMENTS

Print Feb/22/22 10:50:06

Date	Number of Gaugings	Method	Stage [m]	Stage +/- [m]	Discharge [m^3/s]	Discharge Error
6/11/2019	3	Dye Dilution	4.69	0.020	3.51	15%
8/14/2019	2	Area-Velocity	4.23	0.010	0.38	10%
9/6/2019	2	Area-Velocity	4.14	0.005	0.21	10%
10/2/2019	2	Area-Velocity	4.36	0.005	0.90	10%
10/25/2019	4	Dye Dilution	5.12	0.050	13.17	20%
11/7/2019	1	Area-Velocity	4.30	0.010	0.54	15%
5/28/2020	3	Dye Dilution	4.78	0.020	4.99	10%
7/29/2020	2	Area-Velocity	4.37	0.005	0.81	10%
9/2/2020	2	Area-Velocity	4.26	0.010	0.46	10%
9/17/2020	2	Area-Velocity	4.17	0.005	0.32	10%
10/29/2020	3	Dye Dilution	4.79	0.050	6.12	15%
4/1/2021	3	Dye Dilution	-	-	1.55	-
4/21/2021	3	Dye Dilution	4.78	0.050	4.48	20%
5/28/2021	3	Dye Dilution	4.85	0.050	9.55	15%
8/27/2021	2	Area-Velocity	4.34	0.010	0.79	10%
11/22/2021	2	Area-Velocity	4.49	0.020	1.38	10%

\\KPL\VA-Prj$\1\03\00494\18\A\Data\Hydrology\End of Year 2021 QAQC\MILL-R2\[MILL-R2 QAQC 2021.xlsm]Q Table

NOTES:

1) NUMBER OF GAUGINGS REFERS TO THE NUMBER OF GAUGINGS AVERAGED TO PRODUCE ONE RATING POINT.
2) DISCHARGE ERROR REFERS TO THE IN-SITU MEASUREMENT ERROR ESTIMATED BY THE FIELD ENGINEER.
3) STAGE ERROR IS BASED ON A VISUAL ASSESSMENT OF THE WAVE AMPLITUDE IN THE GAUGE POOL.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER VA21-02130	KRH	TJP



MILL CREEK WATERSHED

N

5,510,000

5,505,000

470,000

480,000

490,000

500,000

LOCATION TO:	DRAINAGE AREA (km²)
Mill Creek Mouth	41
Mill Creek Gauge	38

LEGEND:

- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

1 0.5 0 1 2 3 4 5 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:50,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22FEB'22	ISSUED WITH LETTER	ELK	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

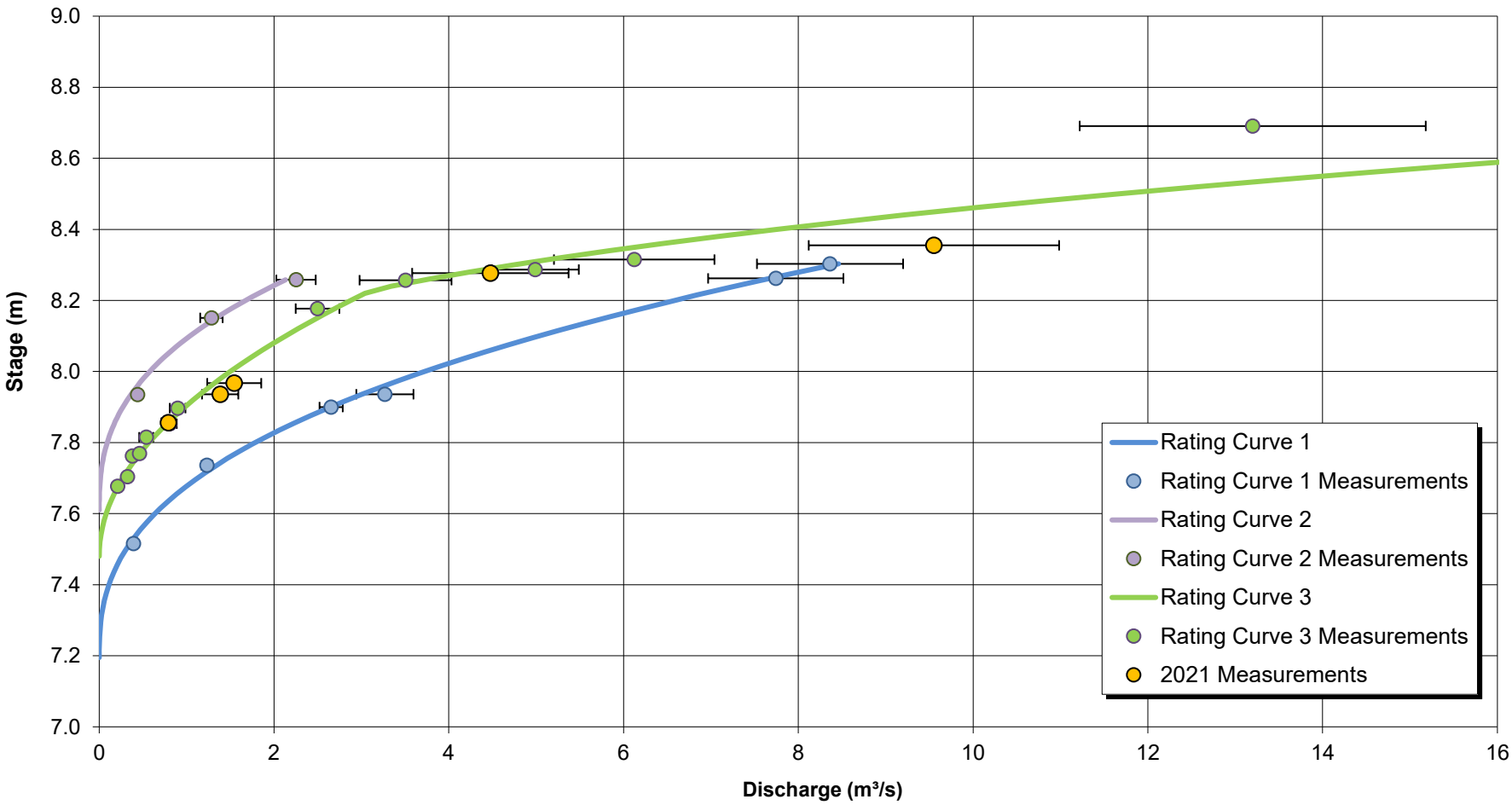
MILL CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-00494/18	VA21-02130

FIGURE 1 REV 0

SAVED: M:\1\03\00494\18\A\GIS\Figs\VA21-02130\Fig1_MillCreekWatershed_R0.mxd: Feb 22, 2022 9:27 AM: kkrauszova



REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL)
RATING CURVES - MEASURED RANGE

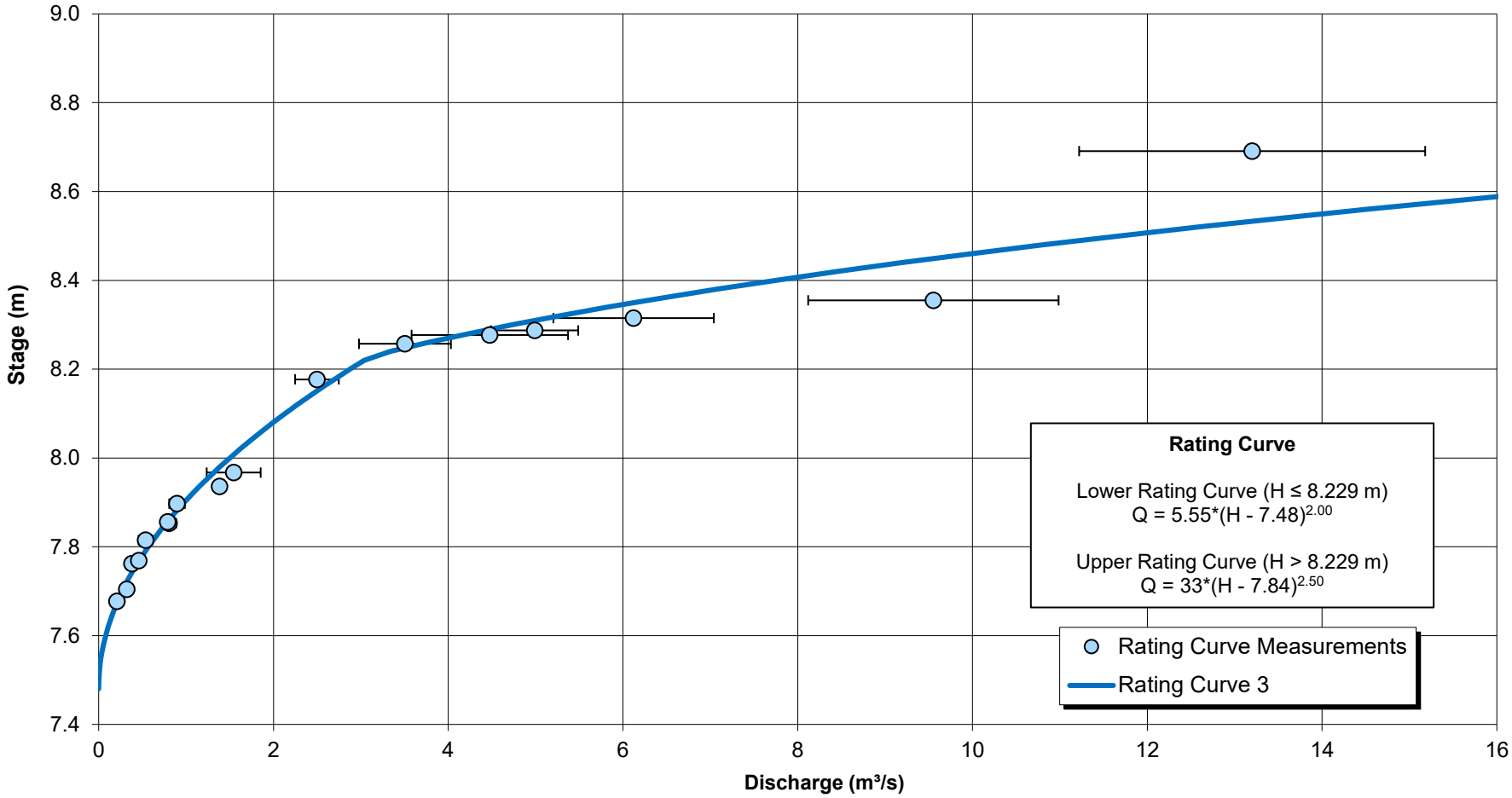
Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02130

FIGURE 2

REV 0



REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL)
RATING CURVE 3 - EXTRAPOLATED TO MAXIMUM RECORDED STAGE-DISCHARGE MEASUREMENT

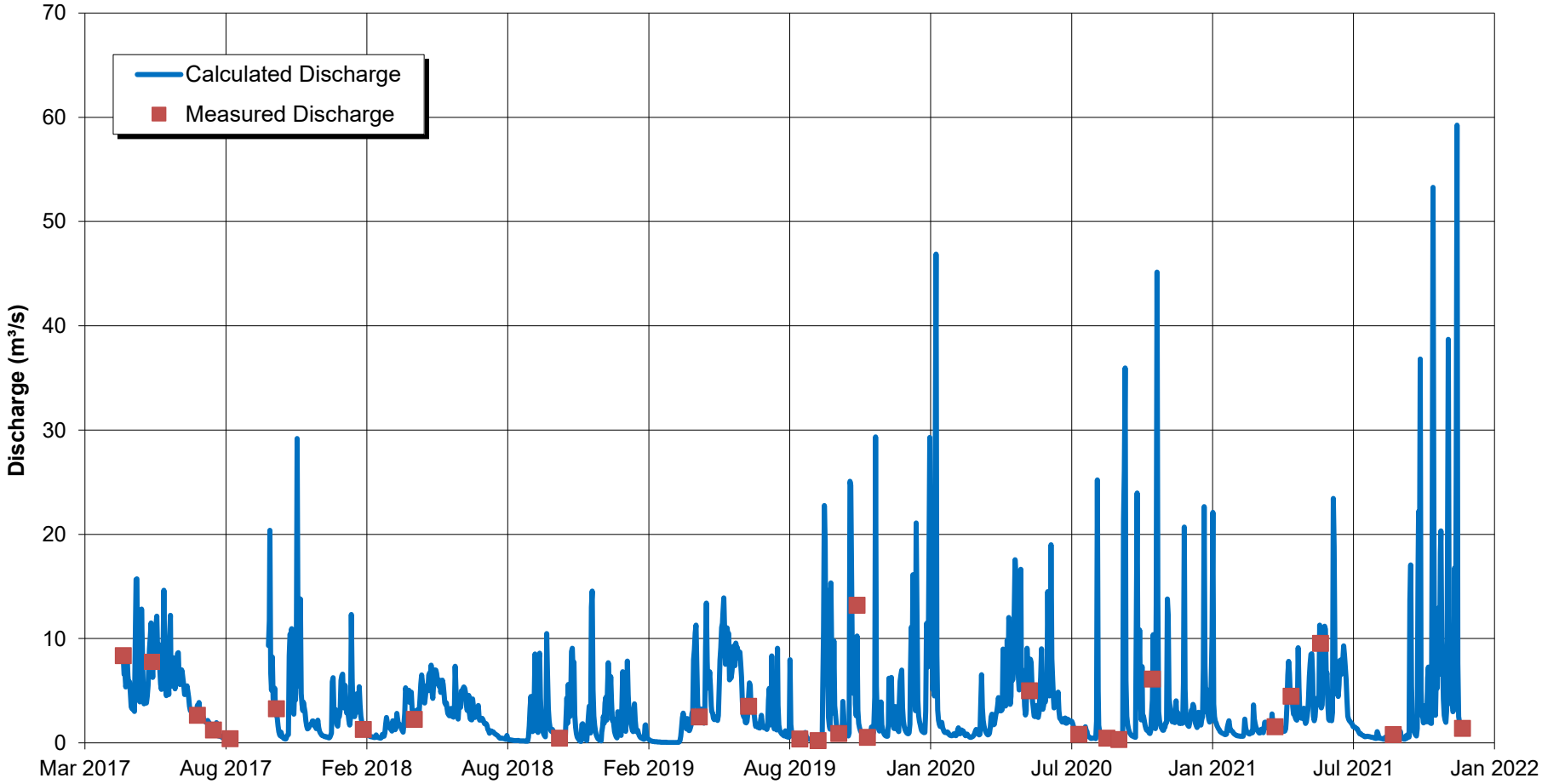
Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02130

FIGURE 3

REV 0



NOTE:
1. MANUAL MEASUREMENTS OF INSTANTANEOUS DISCHARGE DO NOT NECESSARILY MATCH DAILY AVERAGE DISCHARGE ON THE SAME DATE DUE TO DAILY FLUCTUATIONS IN DISCHARGE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL)
DAILY AVERAGE DISCHARGE HYDROGRAPH

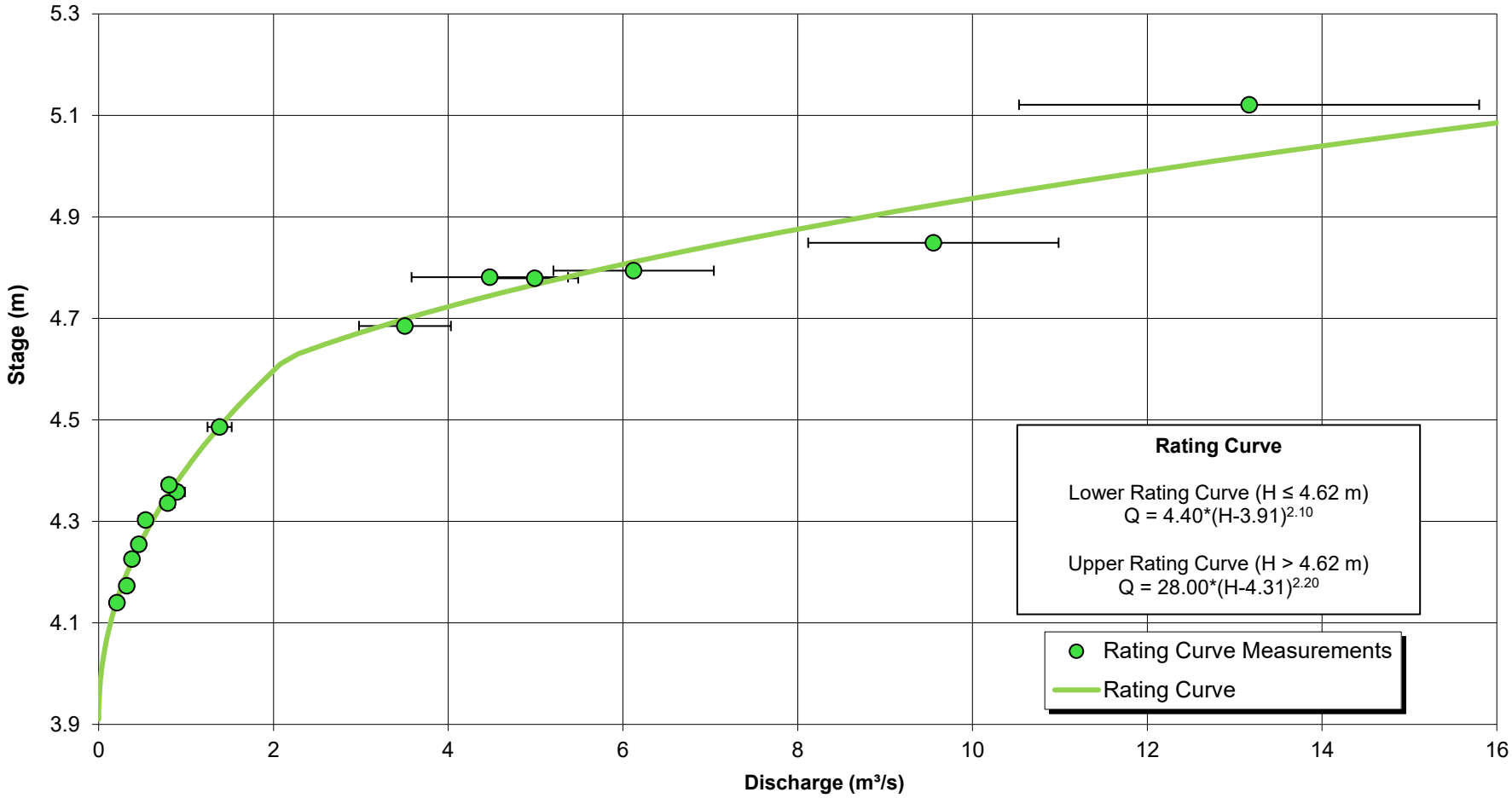
Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02130

FIGURE 4

REV 0



REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL-R2)
RATING CURVE - EXTRAPOLATED TO MAXIMUM RECORDED STAGE-DISCHARGE MEASUREMENT

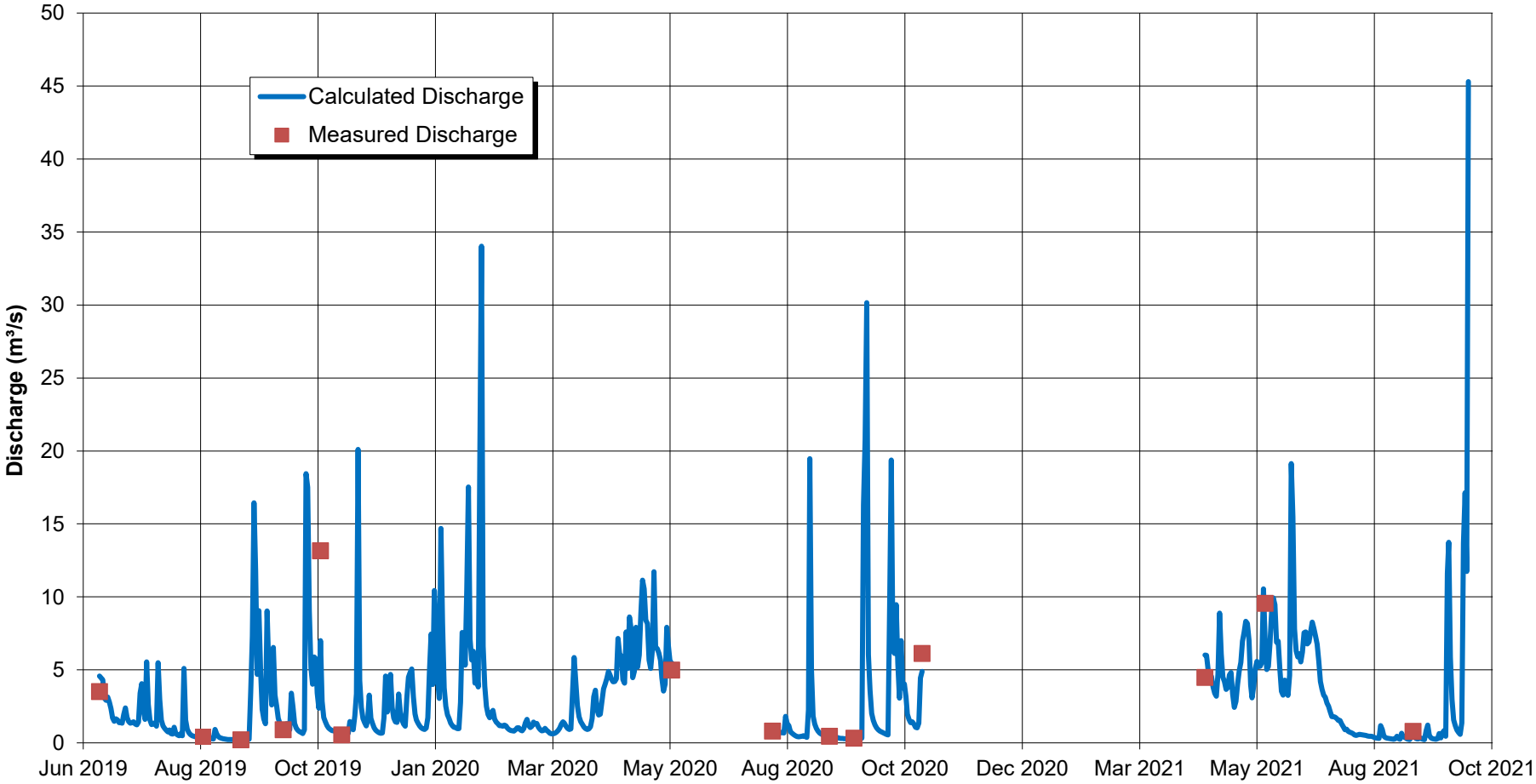
Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02130

FIGURE 5

REV 0



NOTE:
1. MANUAL MEASUREMENTS OF INSTANTANEOUS DISCHARGE DO NOT NECESSARILY MATCH DAILY AVERAGE DISCHARGE ON THE SAME DATE DUE TO DAILY FLUCTUATIONS IN DISCHARGE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

MILL CREEK (MILL-R2)
DAILY AVERAGE DISCHARGE HYDROGRAPH

Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02130

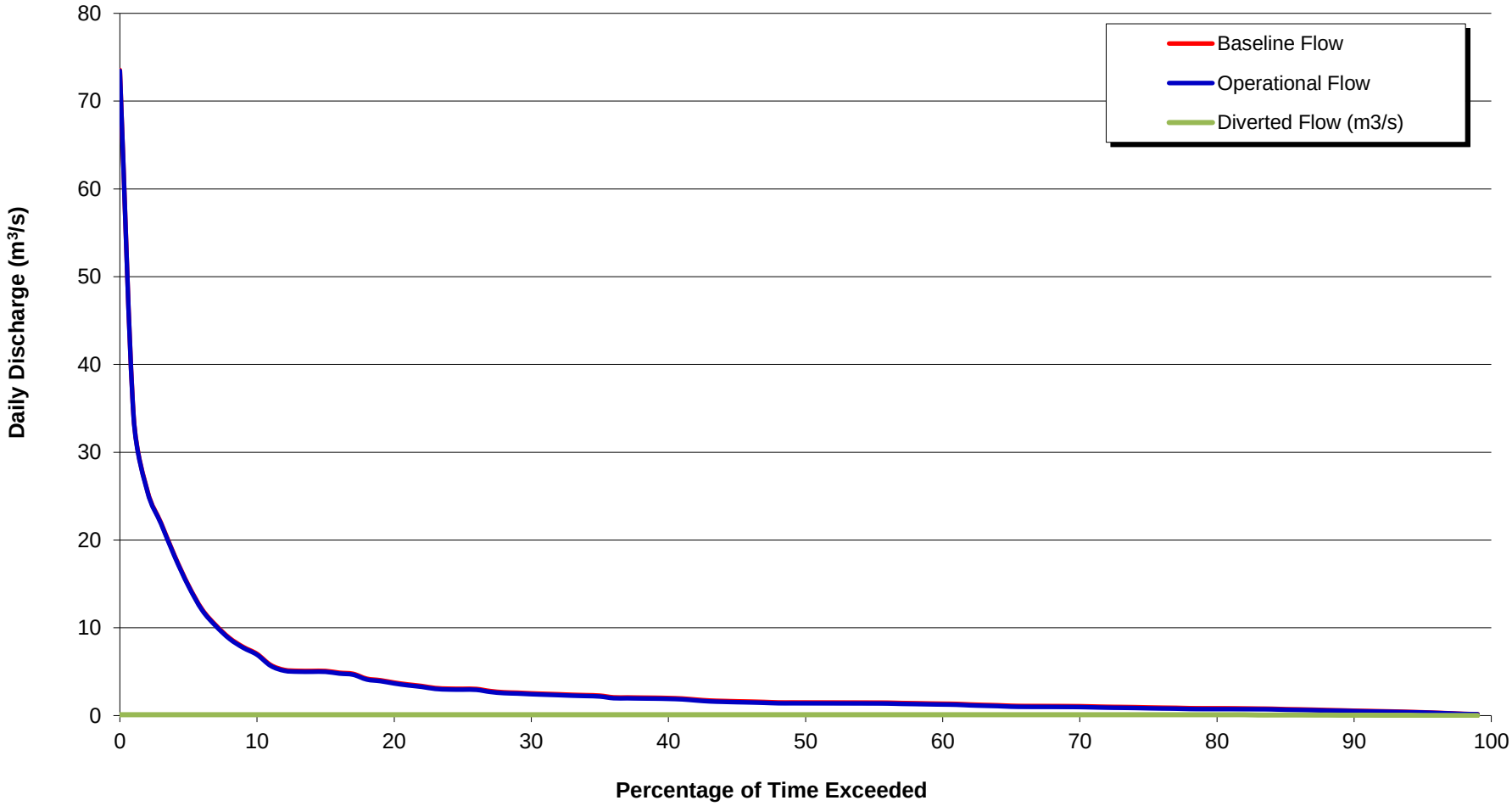
FIGURE 6

REV 0

APPENDIX B

Mill Creek Synthetic Flow Duration Curves

(Figures B-1 to B-12)



6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP
REV	DATE	DESCRIPTION	PREP'D	RVW'D

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JANUARY FLOW DURATION CURVE
MILL CREEK INTAKE

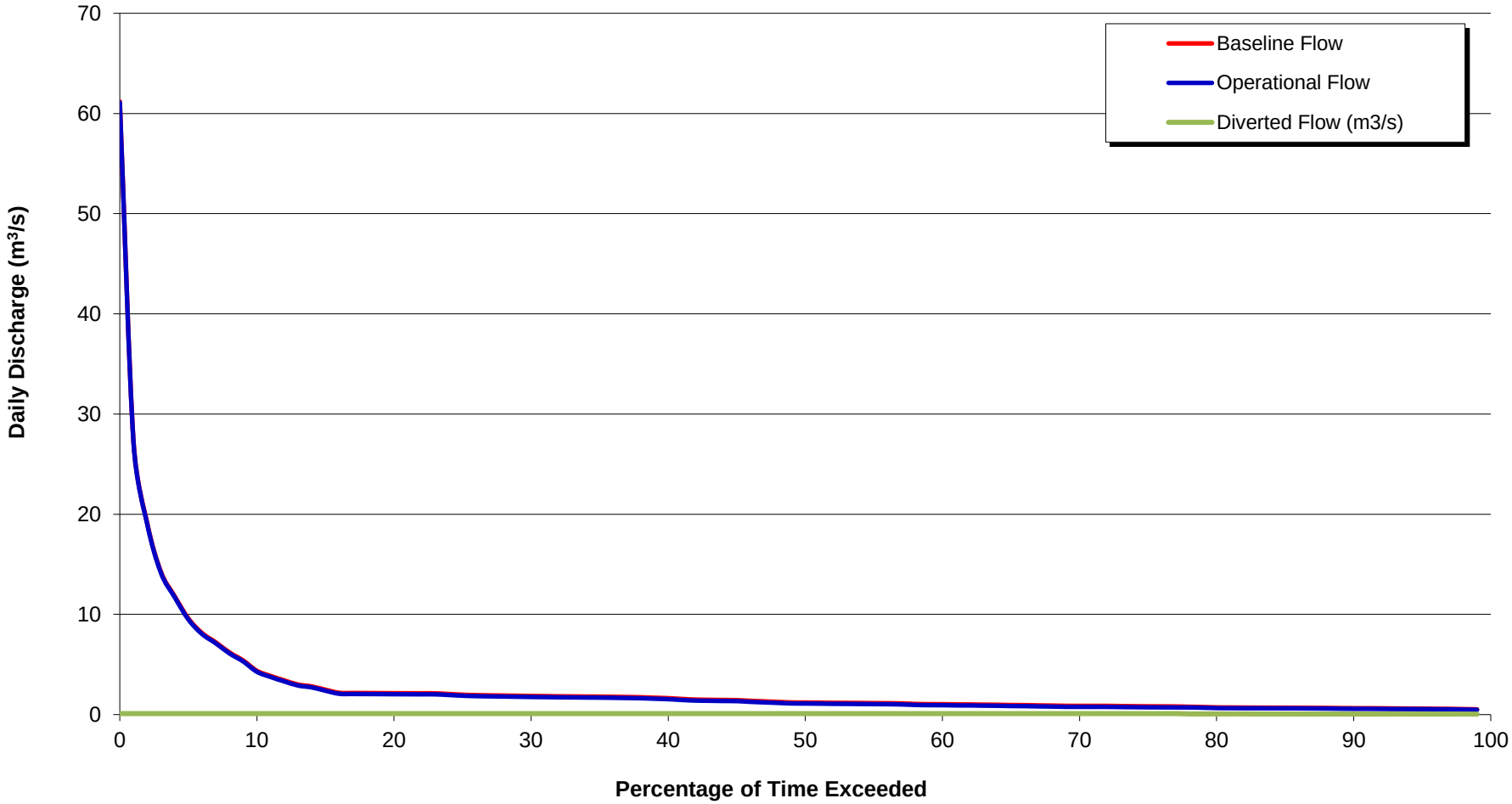
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-1

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

FEBRUARY FLOW DURATION CURVE
MILL CREEK INTAKE

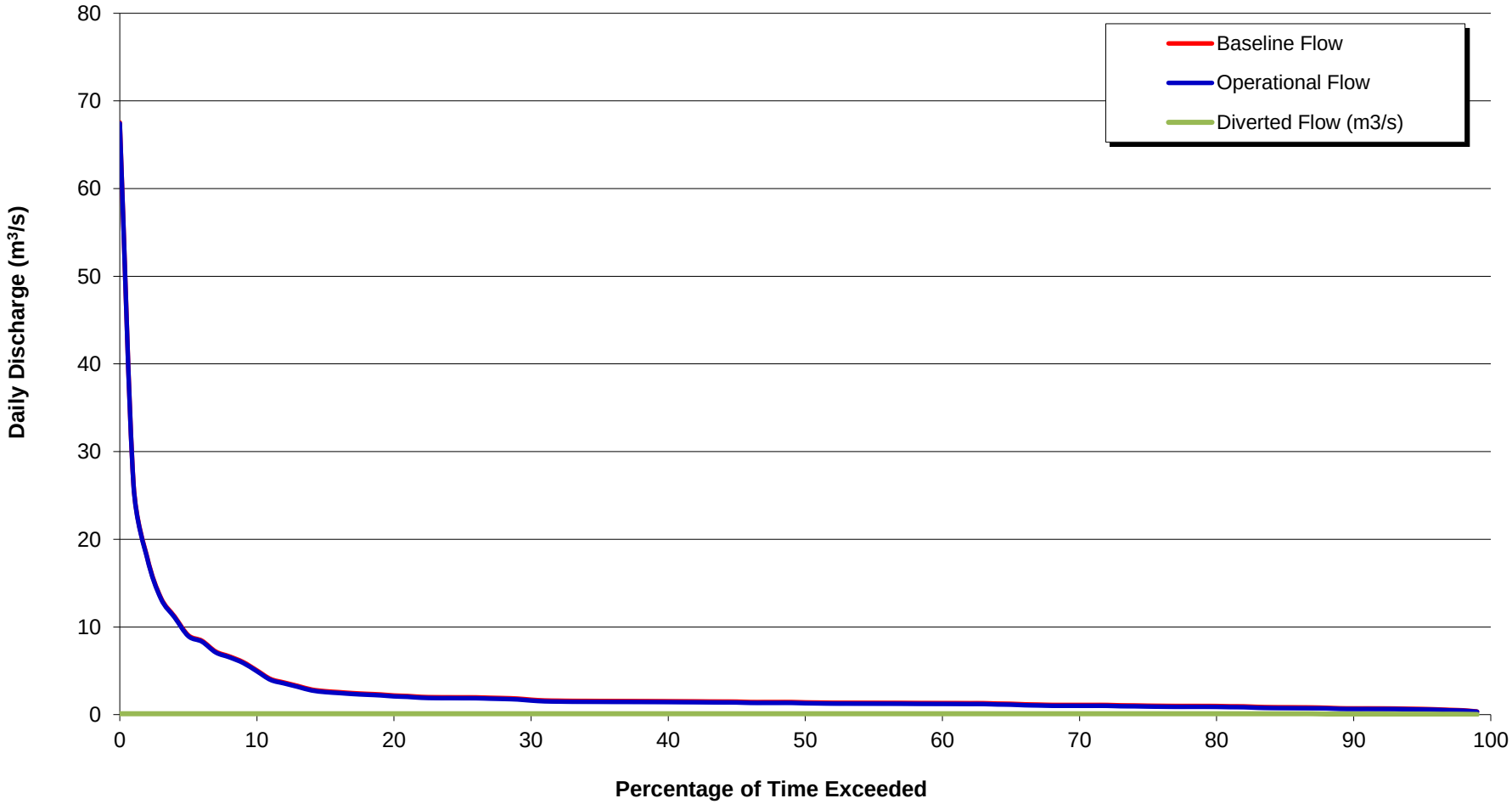
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-2

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MARCH FLOW DURATION CURVE
MILL CREEK INTAKE

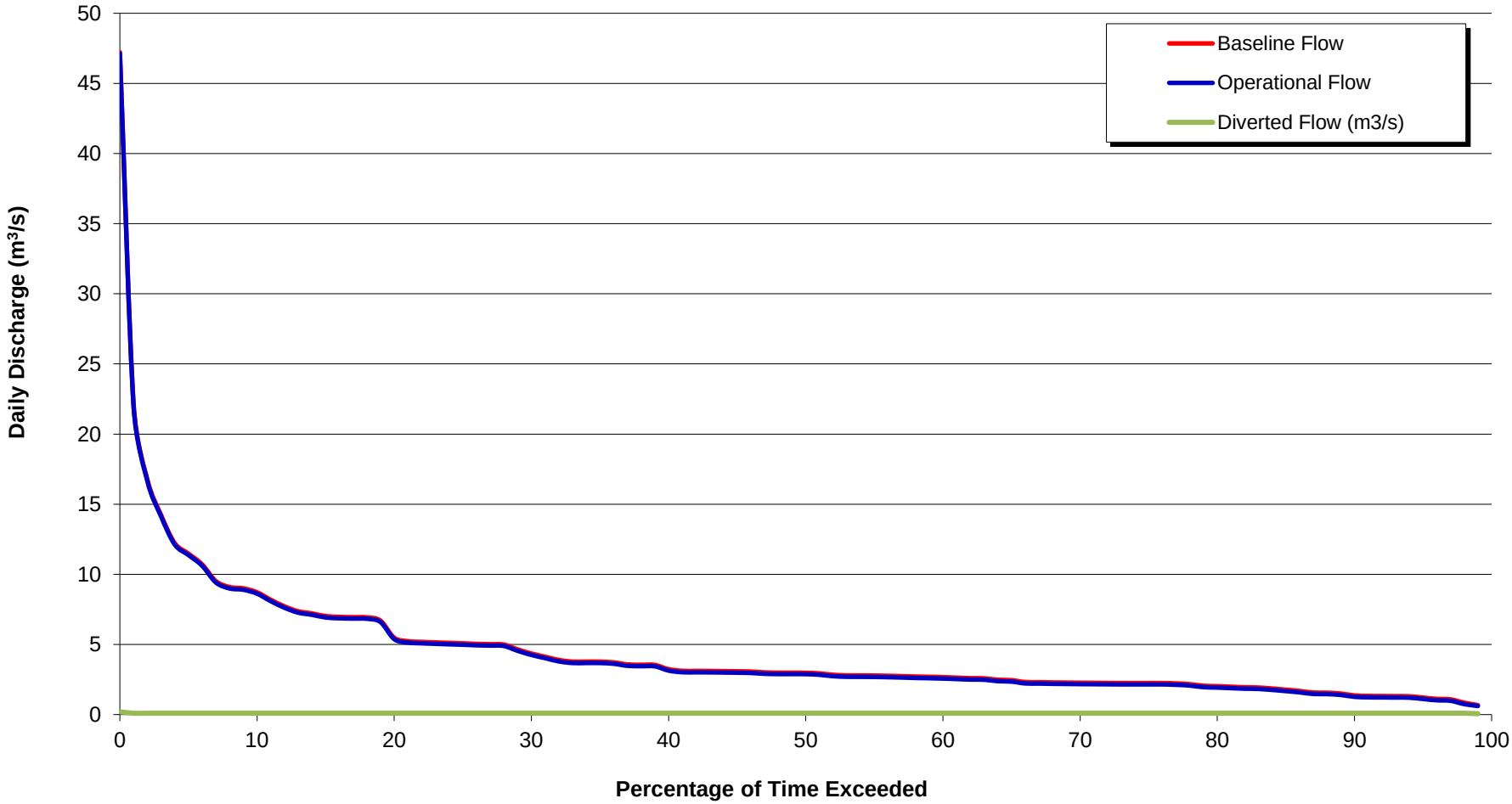
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-3

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

APRIL FLOW DURATION CURVE
MILL CREEK INTAKE

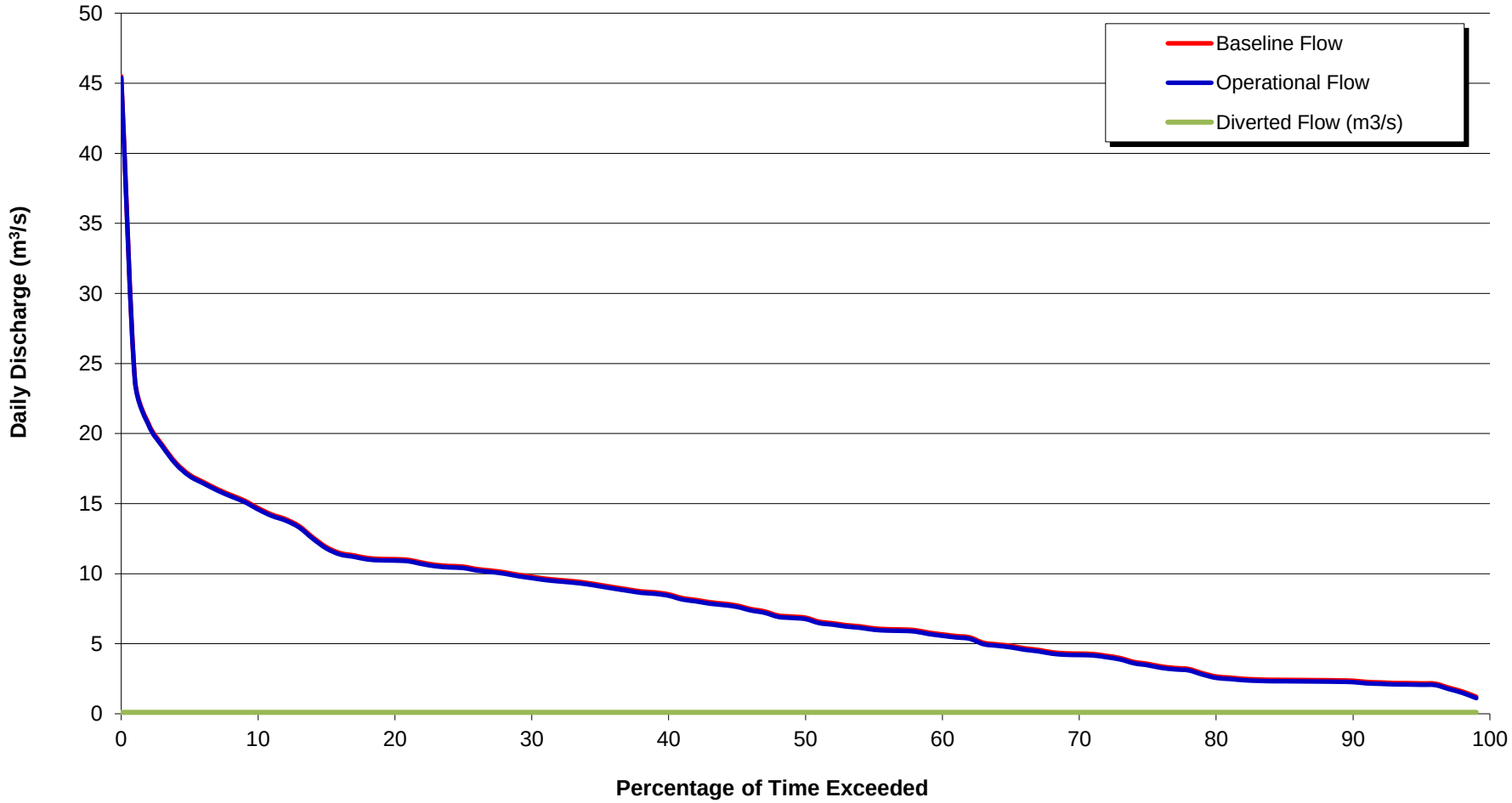
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-4

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MAY FLOW DURATION CURVE
MILL CREEK INTAKE

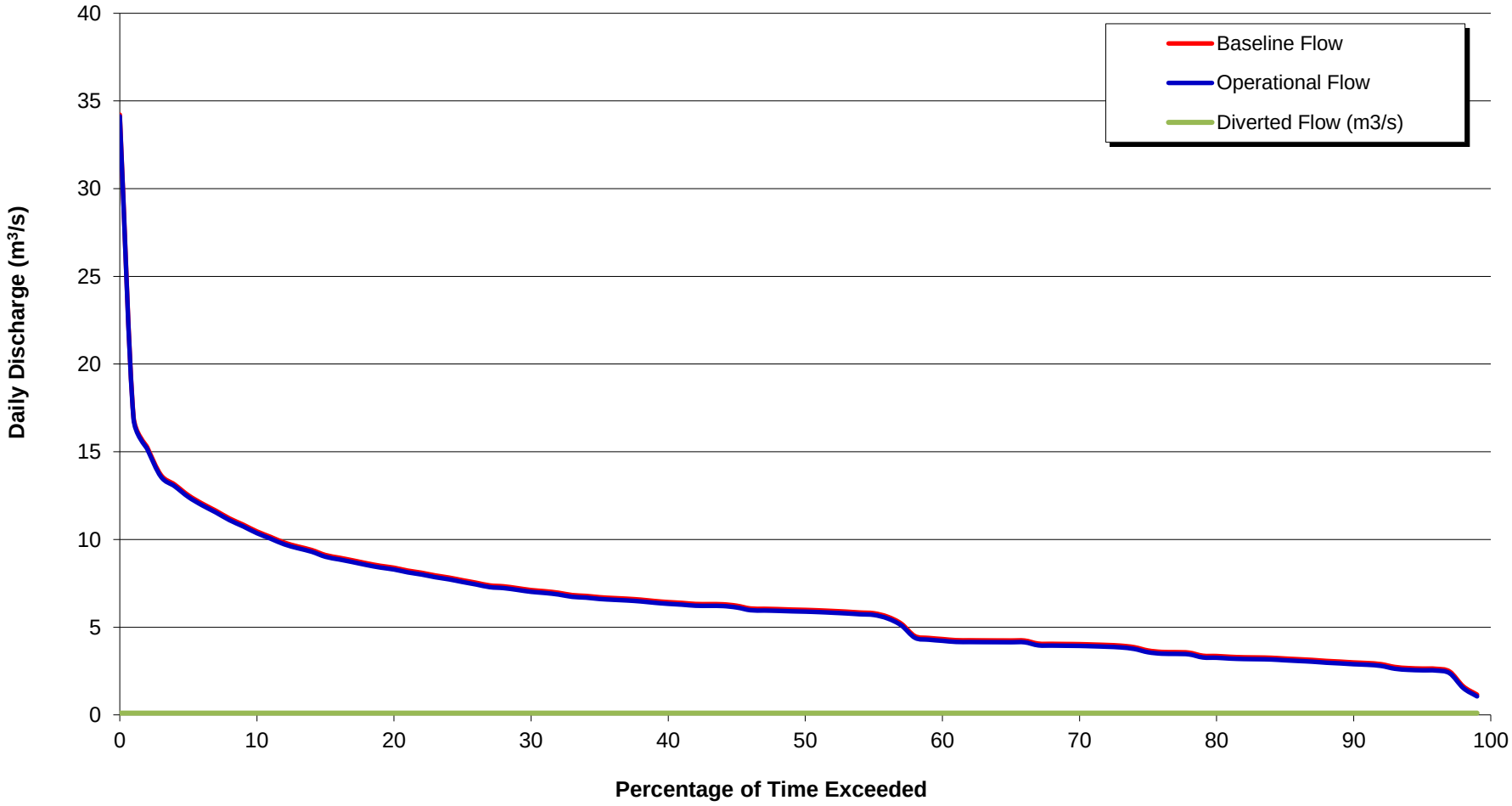
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-5

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JUNE FLOW DURATION CURVE
MILL CREEK INTAKE

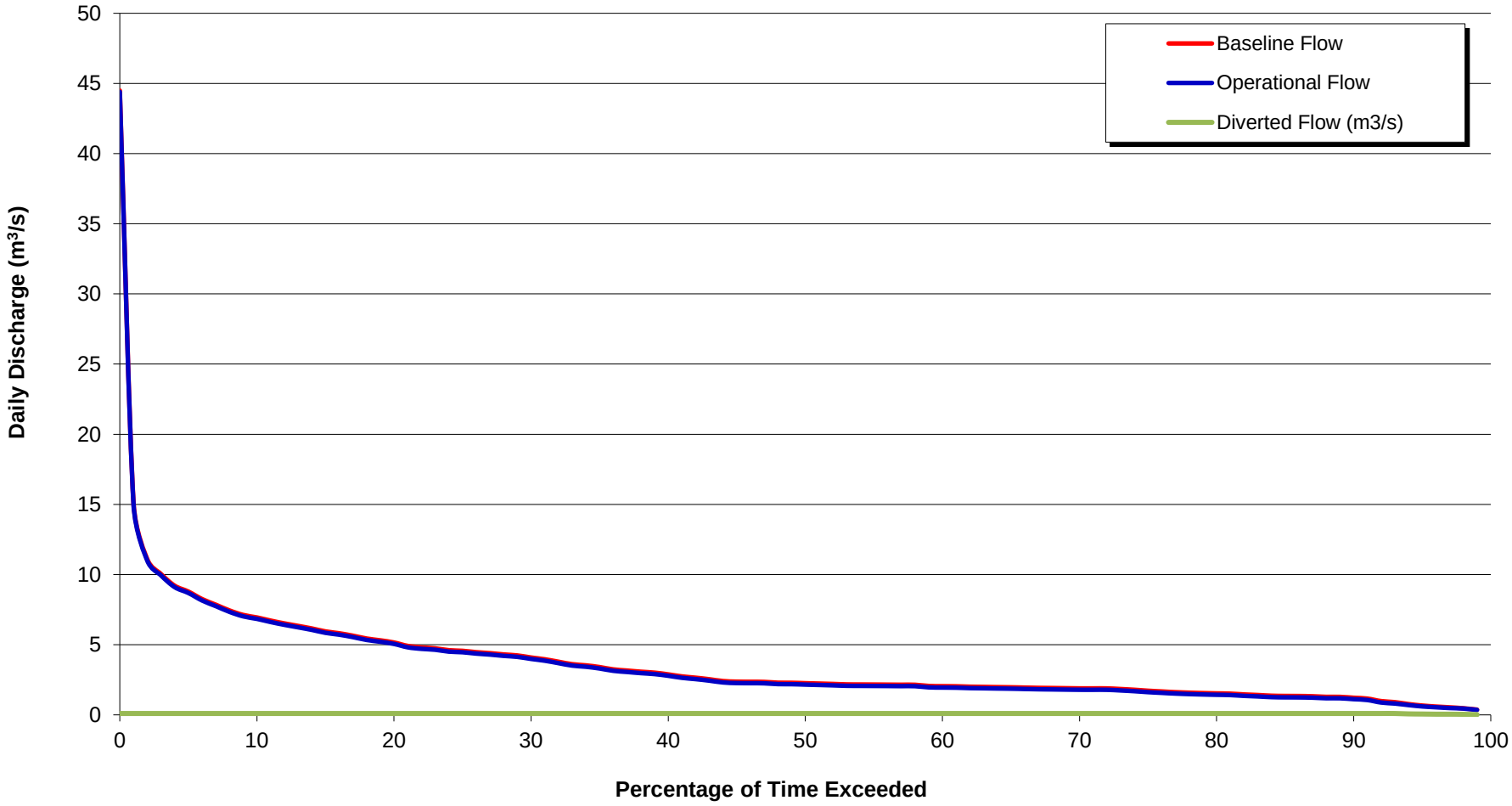
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-6

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JULY FLOW DURATION CURVE
MILL CREEK INTAKE

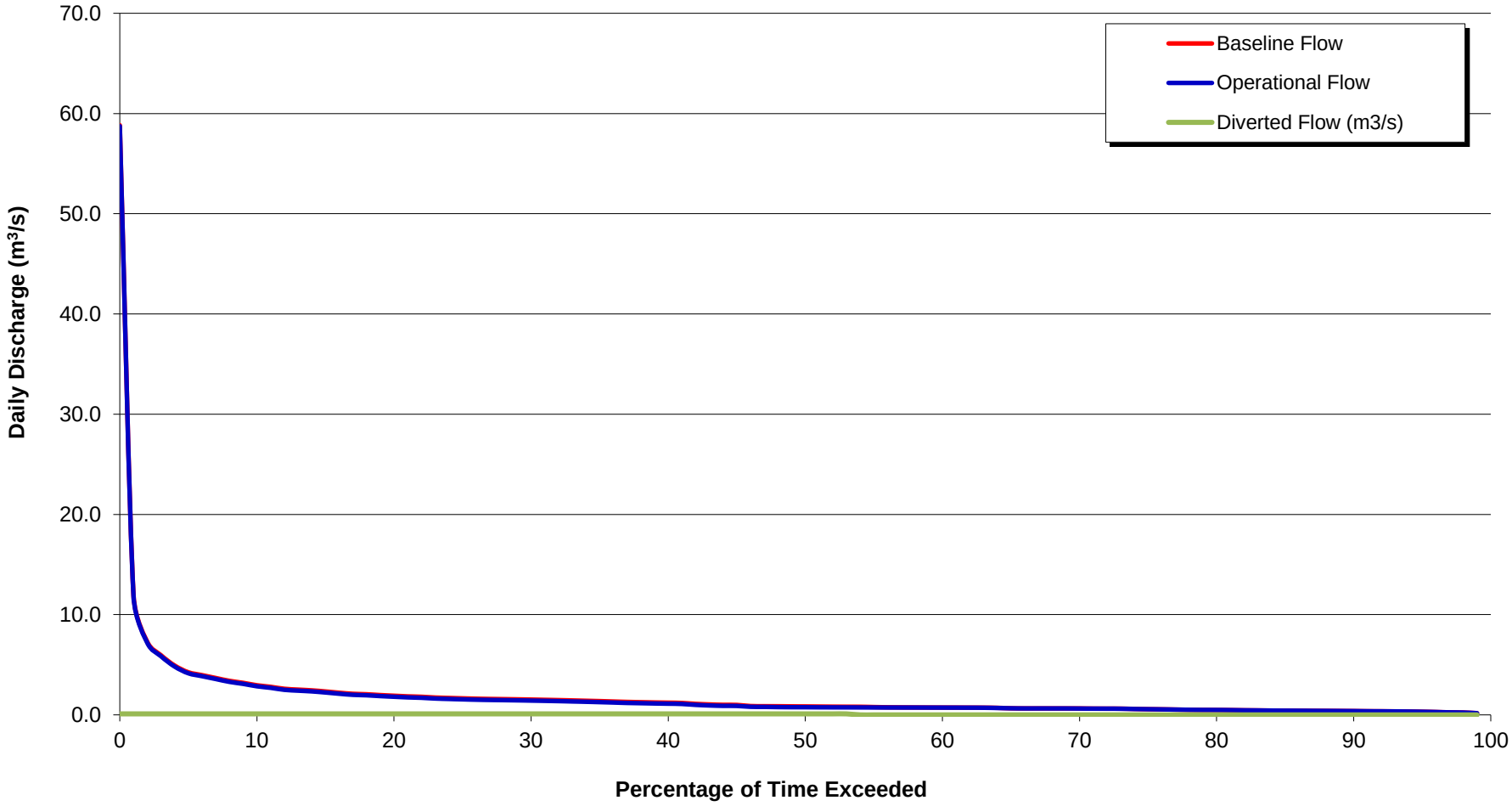
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-7

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

AUGUST FLOW DURATION CURVE
MILL CREEK INTAKE

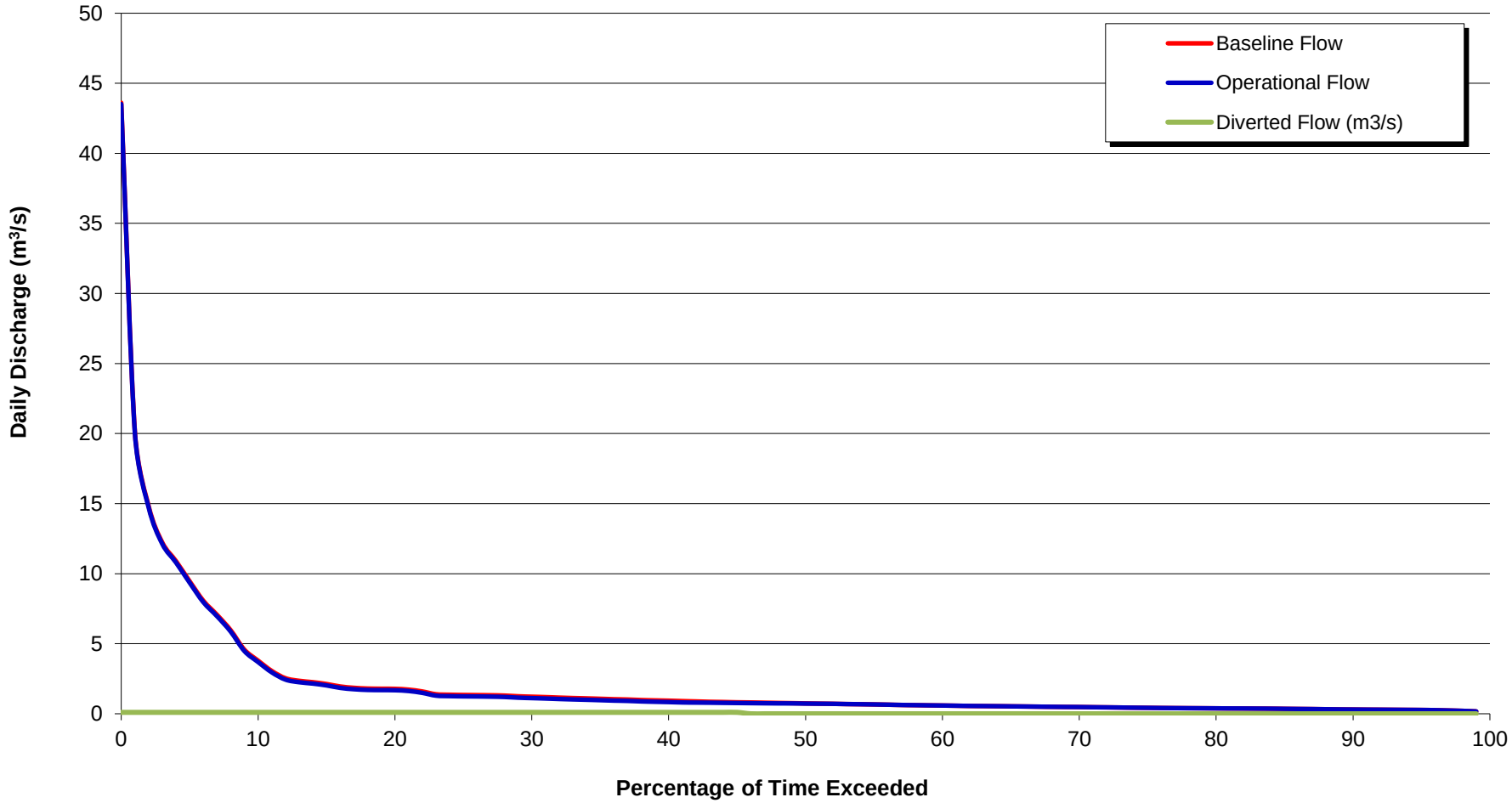
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-8

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

SEPTEMBER FLOW DURATION CURVE
MILL CREEK INTAKE

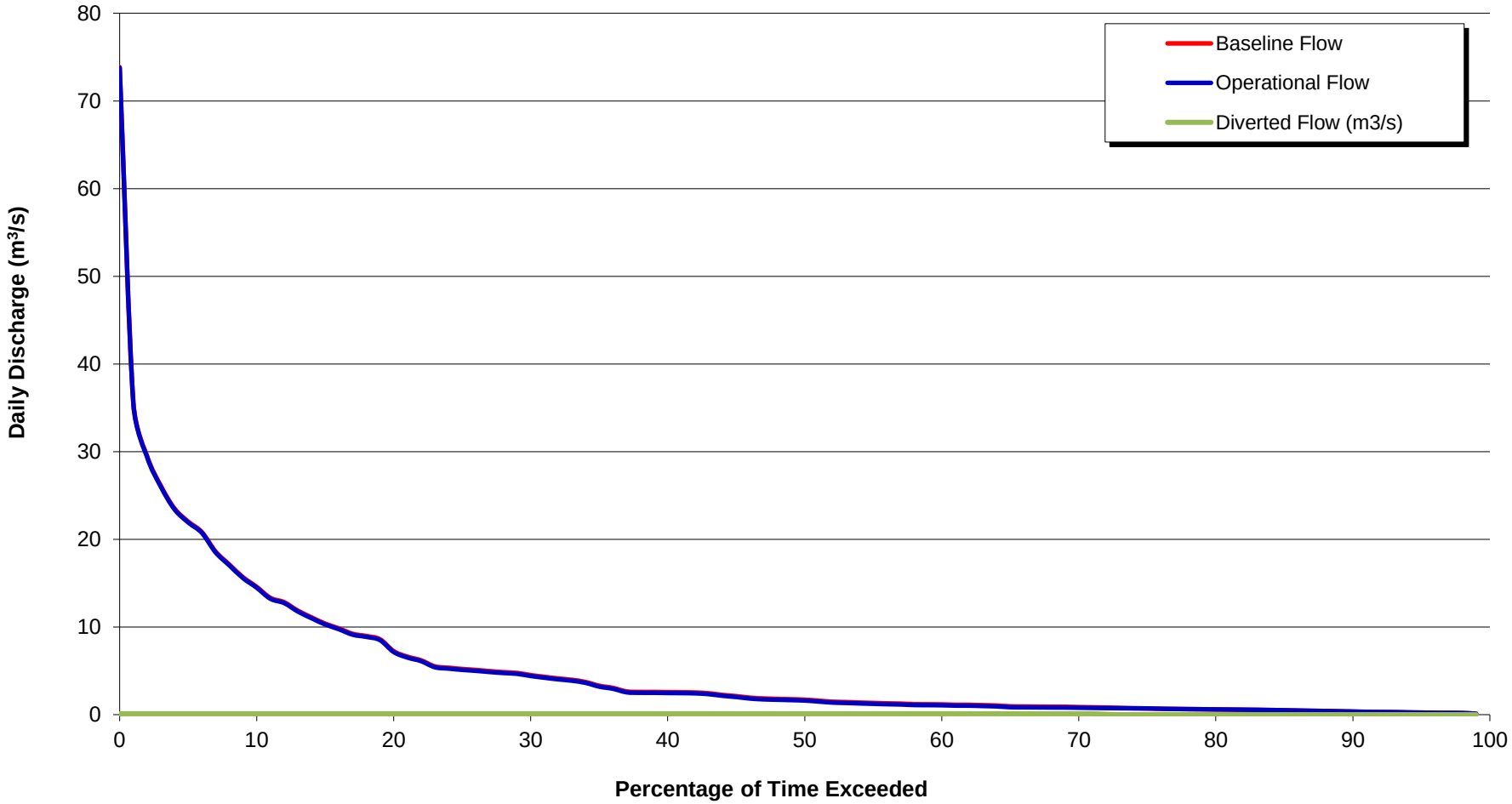
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-9

REV 6



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

OCTOBER FLOW DURATION CURVE
MILL CREEK INTAKE

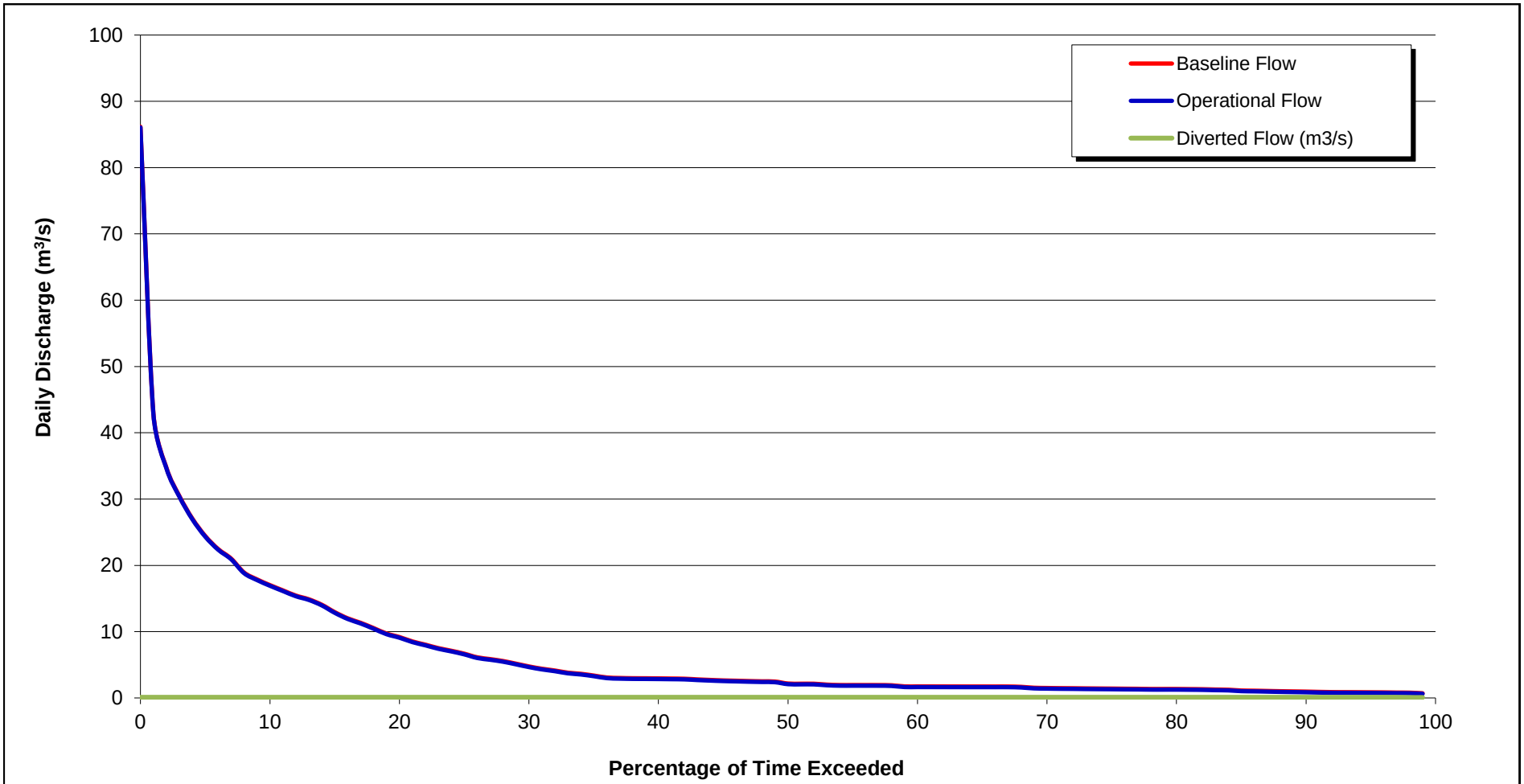
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P/A NO. 103-494/24

REF. NO. 2

FIGURE B-10

REV 6



WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

NOVEMBER FLOW DURATION CURVE
MILL CREEK INTAKE

Knight Piésold CONSULTING

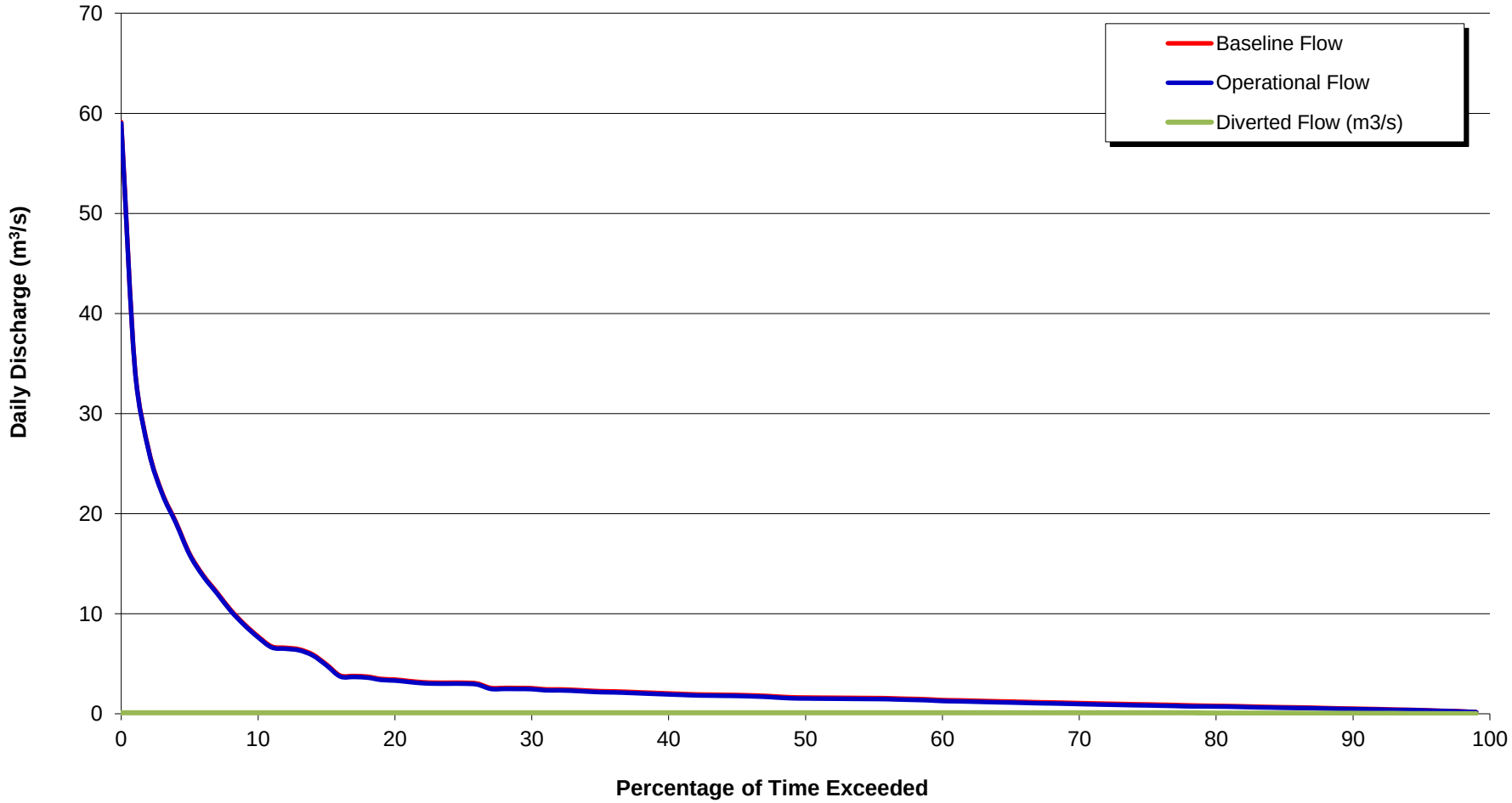
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FIGURE B-11

REV 6

REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP



REV	DATE	DESCRIPTION	PREP'D	RVW'D
6	16AUG'22	ISSUED WITH REPORT VA103-494/24-2	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

DECEMBER FLOW DURATION CURVE
MILL CREEK INTAKE

Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 2

FIGURE B-12

REV 6

APPENDIX B

Woodfibre Creek Instream Flow Requirement, Construction Water Study (Rev 4)

Prepared for
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VA103-494/24-3

WOODFIBRE CREEK INSTREAM FLOW REQUIREMENT
CONSTRUCTION WATER STUDY

Rev	Description	Date
0	Issued in Final	May 21, 2019
1	Updated to Address Agency Review Comments	August 30, 2019
2	Updated to Include Construction Camp Water Requirements.	December 11, 2020
3	Updated to Address Review Comments. Updated Hydrology. Updated Maximum Diversion Rate.	August 16, 2022
4	Updated to Address Client Review Comments	September 23, 2022

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

EXECUTIVE SUMMARY

Woodfibre LNG Ltd. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas (LNG) Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia. The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the LNG via tankers. The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (BCEAA; EAC #E15-02) in 201
- An environmental assessment approval from Squamish Nation through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015
- A positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016

Two EAC amendments were granted by the British Columbia Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Skwxwú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address, including that Woodfibre LNG undertake an instream flow requirements (IFR) study to assess the potential effects of diverting water for construction and operation from Mill Creek and Woodfibre Creek.

Water is required for construction of the facility and will be sourced from Mill Creek or Woodfibre Creek. The proposed Woodfibre Creek construction water source point of diversion (PoD) is located approximately 100 m upstream from the mouth of the Creek at Howe Sound. This IFR report is intended to support assessment of construction water diversion from Woodfibre Creek and presents:

- A description of watershed, hydrological and fisheries baseline studies
- A summary of proposed Project water use and current water infrastructure
- A risk assessment of the proposed withdrawals following the BC Environmental Flow Needs Policy
- Supplementary measures to mitigate any residual risk

This report is intended to meet Condition 5 of the Project's provincial Environmental Assessment Certificate for instream flow requirements. Specifically, this report supports the construction water requirements for the Project, and for use in the Project's Water Management Plan. This report only addresses Woodfibre Creek.

Physical Setting, Hydrology and Fisheries Studies

Woodfibre Creek is a tributary of Howe Sound, located in the southern Coast Mountains approximately 7 km southwest of Squamish and 45 km north of Vancouver in BC. The Woodfibre Creek watershed area is approximately 22 km^2 at the mouth, where the stream discharges into Howe Sound. Woodfibre LNG operates an active streamflow gauging station, located just upstream of the hydropower intake site, at an elevation of approximately 350 metres above sea level (masl) and 2 km from the mouth. The Creek has a

mainstem length of approximately 6.8 km from the source to the mouth, and a mean channel slope of approximately 15%.

Fish and aquatic habitat information for Woodfibre Creek are based on publicly available datasets, and sampling and interpretation completed previously as part of the Project environmental assessment. Anadromous fish are present in Woodfibre Creek from Howe Sound to approximately 150 m upstream, where a 10 m high falls prevents upstream access. Several species of salmon, trout, and sculpin were captured below the falls. Rainbow trout were captured above the falls; and it is assumed that fish densities are very low.

Hydrologic conditions in Woodfibre Creek were assessed based on approximately four years of measured streamflow records collected at the Woodfibre Creek gauging station. These data were correlated with streamflow data collected by Water Survey of Canada (WSC) on the Capilano River to produce a long-term synthetic daily flow series for the gauging station. This synthetic daily flow series was used as the basis of assessing baseline and Project affected flow conditions. The mean annual discharge (MAD) for Woodfibre Creek at the gauging was estimated to be 2.35 m^3/s (1960 to 2020 period), which equates to a mean annual unit runoff of 118 $L/s/km^2$ for the 20 km^2 watershed.

Proposed Short-Term Project Water Use and Water Infrastructure

Woodfibre LNG will require up to 0.10 m^3/s of fresh water year-round during the construction phase of the Project, which will be used for sanitary purposes, concrete mixing, dust suppression, vehicle washing, lubrication or other, as required. Woodfibre LNG currently holds five water licences for water use on Woodfibre Creek; however, these licences are for power generation and cannot be used prior to a change in use. The existing powerhouse will be demolished in preparation for construction. Woodfibre LNG is proposing to pump water from Woodfibre Creek via a fish-screened intake, located approximately 100 m from the mouth of the creek to a holding tank for subsequent use. A flow meter will be installed on the pipeline to measure the diverted water quantity.

Woodfibre LNG will request approval for construction water use pursuant to the *Water Sustainability Act* (WSA). Any amendments to Woodfibre LNG's existing Woodfibre Creek water licences would occur at a later date when the permanent water requirements are known.

Construction Water Withdrawal Risk Assessment

The Environmental Flow Needs (*EFN) Implementation Guidance for British Columbia* and BC EFN Policy were used to assess the proposed construction water need of 0.10 m^3/s (maximum withdrawal rate). No other water is currently permitted for withdrawal. Based on the BC EFN Policy criteria, the Woodfibre Creek construction withdrawal is considered low risk.

Supplementary Measures

The risk to fish from the proposed construction water withdrawal is considered low, overall. However, during late summer, there are periods when baseline streamflow can be low and water withdrawal could represent a large portion of the available water. Supplementary measures to avoid impacting the lowest flows is proposed, which would limit construction water withdrawal and reduce the allowable diversion rate if streamflow goes below 0.67 m^3/s at the PoD, such that the proportion of flow withdrawn remains low (<15% of streamflow). As streamflow reduces further, the allowable diversion rate as a proportion of real-time flow reduces to 10% then 5% to reduce risk to fish. Between August 1 and October 31, a minimum instream

flow requirement of 0.47 m^3/s (20% MAD) has been set to maintain resident rainbow trout rearing and pink salmon spawning habitat. If flows fall below 0.47 m^3/s, a maximum flow of 0.005 m^3/s (5 L/s) will be diverted for the residential construction camp.

TABLE OF CONTENTS

PAGE

Executive Summary ..... **I**

Table of Contents ..... **i**

1.0 Introduction **1**
1.1 Project Description 1
1.2 Scope of Report 1
1.3 Construction Water Requirements 2

2.0 Physical Setting **4**
2.1.1 Woodfibre Creek Watershed 4
2.1.2 Woodfibre Creek Channel Morphology 4

3.0 Fisheries and Aquatic Habitat Baseline **10**
3.1 Historical Information 10
3.2 Post EA-Monitoring 11
3.3 Summary 12

4.0 Hydrology **13**
4.1 Woodfibre Creek Baseline Hydrology 13
4.1.1 Measured Streamflow Data 13
4.1.2 Woodfibre Creek Long Term Synthetic Hydrology 14

5.0 Construction Environmental Flow Needs **17**
5.1 Construction Environmental Flow Needs Methodology 17
5.2 Construction IFR for Woodfibre Creek 18
5.2.1 Area of Influence 18
5.2.2 Application Risk Screening 18
5.2.3 Screen for Fish Bearing Status and High Sensitivity Species 19
5.2.4 Flow Sensitivity 19
5.2.5 Stream Size 19
5.2.6 Cumulative Withdrawal 20
5.2.7 Risk Rating 20
5.2.8 Results 20

6.0 Summary and Recommendations **22**
6.1 Summary 22
6.2 Supplementary Measures 22

7.0 References **24**

8.0 Certification 26

TABLES

Table 3.1 Woodfibre Creek Fish Presence Summary 11
Table 3.2 Pink Salmon Periodicity Chart 12
Table 3.3 Rainbow Trout Periodicity Chart 12
Table 4.1 Average, Minimum and Maximum Monthly Flows - Woodfibre Creek at the PoD 16
Table 5.1 Existing Woodfibre Creek Water Licences 19
Table 5.2 Woodfibre Creek Flow Sensitivity at the PoD 19
Table 5.3 Risk Assessment for Cumulative Withdrawals in Woodfibre Creek at the PoD 20
Table 5.4 Baseline and Construction Mean Monthly Flows – Woodfibre Creek at the PoD 21
Table 6.1 Construction Management Plan Flow Diversion Limits 23

FIGURES

Figure 1.1 Point of Diversion 3
Figure 2.1 Woodfibre Creek Watershed 5
Figure 4.1 Woodfibre Creek (WOOD) Rating Curve 13
Figure 4.2 Woodfibre Creek (WOOD) Daily Average Discharge Hydrograph 14
Figure 4.3 Mean Monthly Hydrograph – Woodfibre Creek at the PoD 15
Figure 4.4 2009 Daily Hydrograph – Woodfibre Creek at the PoD Synthetic Daily Flow Series 16
Figure 5.1 Risk Management Decision-Making Process for Consideration of Environmental Flow Needs within the BC EFN Policy 18
Figure 5.2 Baseline and Construction Mean Monthly Flows – Woodfibre Creek at the PoD 21

PHOTOS

Photo 2.1 Reach 1 looking upstream to the end of the tidally influenced zone 6
Photo 2.2 Reach 1 looking downstream to the mouth 7
Photo 2.3 First small falls within Reach 1 that presents an upstream barrier to fish at low flows 7
Photo 2.4 10 m high falls at approximately 0+150 m chainage that presents an upstream barrier to fish 8
Photo 2.5 Looking downstream of the hydropower intake showing the steep cascade-pool morphology at approximately 2 km upstream of the mouth 9
Photo 2.6 Upstream of the hydropower intake, looking downstream at the channel confined by bedrock and large boulders 9

APPENDICES

Appendix A Woodfibre Creek Hydrologic Analysis (VA22-01360)
Appendix B Woodfibre Creek Synthetic Flow Duration Curves

ABBREVIATIONS

BC ..... British Columbia
CPUE ..... Catch Per Unit Effort
EAC ..... Environmental Assessment Certificate
EAO ..... Environmental Assessment Office
EFN ..... Environmental Flow Needs
ENV ..... British Columbia Ministry of Environment and Climate Change Strategy
FLNRORD ..... Ministry of Forests, Lands, Natural Resource Operations and Rural Development
IFR ..... Instream Flow Requirements
JTH ..... J.Termuende Hydrological
km ..... kilometers
KP ..... Knight Piésold Ltd.
LNG ..... liquefied natural gas
m ..... meters
MAD ..... Mean Annual Discharge
masl ..... meters above sea level
OGC ..... BC Oil and Gas Commission
Project ..... the Woodfibre LNG Project
PoD ..... Point of Diversion
SN ..... Squamish Nation
Woodfibre LNG ..... Woodfibre LNG Limited
WSA ..... Water Sustainability Act
WSC ..... Water Survey of Canada

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

Woodfibre LNG Ltd. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas (LNG) Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia. The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the LNG via tankers. The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (BCEAA; EAC #E15-02) in 2015
- An environmental assessment approval from Squamish Nation through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015
- A positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016

Two EAC amendments were granted by the British Columbia Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Skwxwú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address, including that Woodfibre LNG undertake an instream flow requirements (IFR) study to assess the potential effects of diverting water for construction and operation from Mill Creek and Woodfibre Creek.

1.2 SCOPE OF REPORT

Knight Piésold Ltd (KP) has been retained by Woodfibre LNG to conduct an instream flow requirement (IFR) study for Woodfibre Creek to assess the effects of the proposed water withdrawals of construction and operations water. This report has been prepared to support Woodfibre LNG's application for approval for construction water use pursuant to the *Water Sustainability Act* (WSA) and Condition 5 of the Project's provincial Environmental Assessment Certificate for instream flow requirements. Some of the conditions placed on Woodfibre LNG by Squamish Nation (SN), federal Minister of Environment and Climate Change (ENV) and the BC EAO are addressed in this report. However, a subsequent detailed IFR study that assesses the proposed water withdrawals for operation of the Woodfibre LNG facilities will be presented in an Operational Water Requirements report to address any outstanding water related conditions.

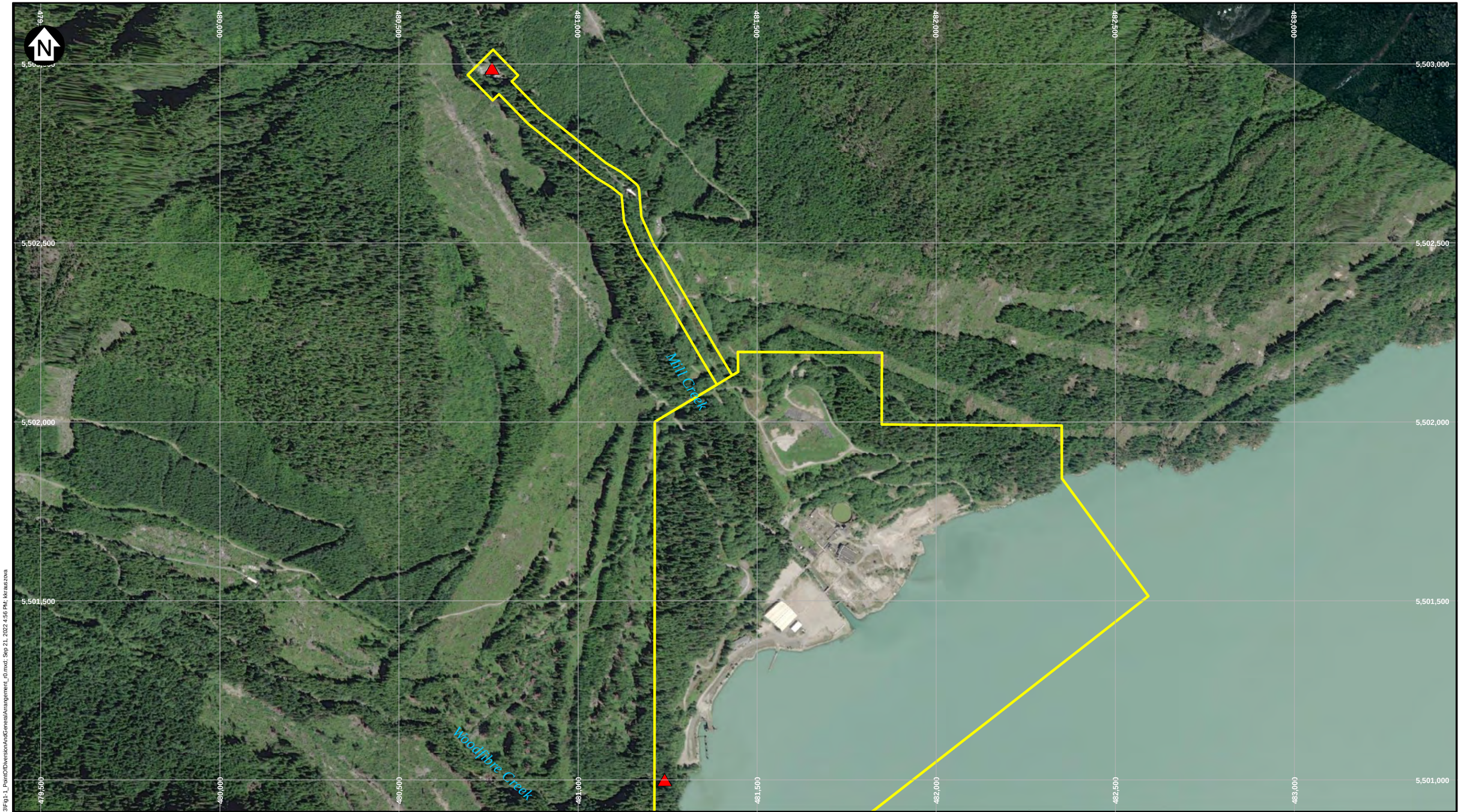
This IFR report presents:

1. A description of the physical characteristics of Woodfibre Creek including watershed, channel morphology and hydrological conditions.
2. A fisheries baseline description, providing a summary of fish presence/absence, distribution, periodicity, and habitat requirements.
3. A summary of proposed Project water use and water infrastructure.
4. Proposed allowable diversion rates and supplementary measured to mitigate any residual risk.

1.3 CONSTRUCTION WATER REQUIREMENTS

The Project requires up to 0.10 m^3/s of water year-round to provide water for construction of the LNG facility and ancillary works, to be sourced from Mill Creek or Woodfibre Creek. Water will be diverted from either stream, depending on construction requirements, but the maximum diversion rate from Woodfibre Creek shall not exceed 0.10 m^3/s. Water use for the construction for the project includes sanitary purposes, concrete mixing, dust suppression, vehicle washing, lubrication or other as required. The duration and quantity of the water withdrawals (up to the permitted limit) will be dependent upon the construction schedule and Project logistics. For the purpose of this assessment, it is assumed that the maximum water requirement is diverted continuously, to provide a conservative assessment of potential effects.

Water will be diverted from Woodfibre Creek via a pump intake to be located approximately 100 m upstream from the mouth of the creek. The intake will be fitted with a fish screen to meet DFO (2020) guidelines. Water is anticipated to be pumped to a holding tank, for subsequent use at the Project. The Woodfibre Creek proposed point of diversion are shown on Figure 1.1.



LEGEND:

- CPA
- PROPOSED WATER DIVERSION

100 50 0 100 200 Meters

NOTES:

1. BASE MAP: ESRI ONLINE WORLD IMAGERY.
2. COORDINATE GRID IS IN METRES.
   COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:10,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
1	21SEP'22	ISSUED WITH REPORT	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

POINT OF DIVERSION

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-494/24	3

FIGURE 1.1 REV 0

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2.0 PHYSICAL SETTING

2.1.1 WOODFIBRE CREEK WATERSHED

Woodfibre Creek is a tributary of Howe Sound, as shown on Figure 2.1, located in the southern Coast Mountains approximately 7 km southwest of Squamish and 45 km north of Vancouver, BC. The Woodfibre Creek watershed and Howe Sound have physiographic characteristics that are typical of the Coast Mountains, a mountain range created by tectonic uplift and intense glacial erosion. These characteristics include high mountain peaks composed of plutonic bedrock, active glaciers in high-elevation headwater areas, U-shaped valleys that were intensely scoured by much larger glaciers during the Ice Age, and discordant valley bottom elevations between tributary and main valleys due to variable degrees of glacial scour. Howe Sound is one of many fjords along the British Columbia coast, where a glacially scoured valley was flooded by the sea following deglaciation at the end of the Pleistocene Epoch around 10,000 years ago. Woodfibre Creek flows into Howe Sound near the head of the fjord. Howe Sound is essentially the flooded lower section of the Squamish River valley.

The Canadian Hydrographic Service publishes tidal information for a station located near Squamish. The typical diurnal tidal range is 3 m to 4 m, and the extreme range is over 5 m.

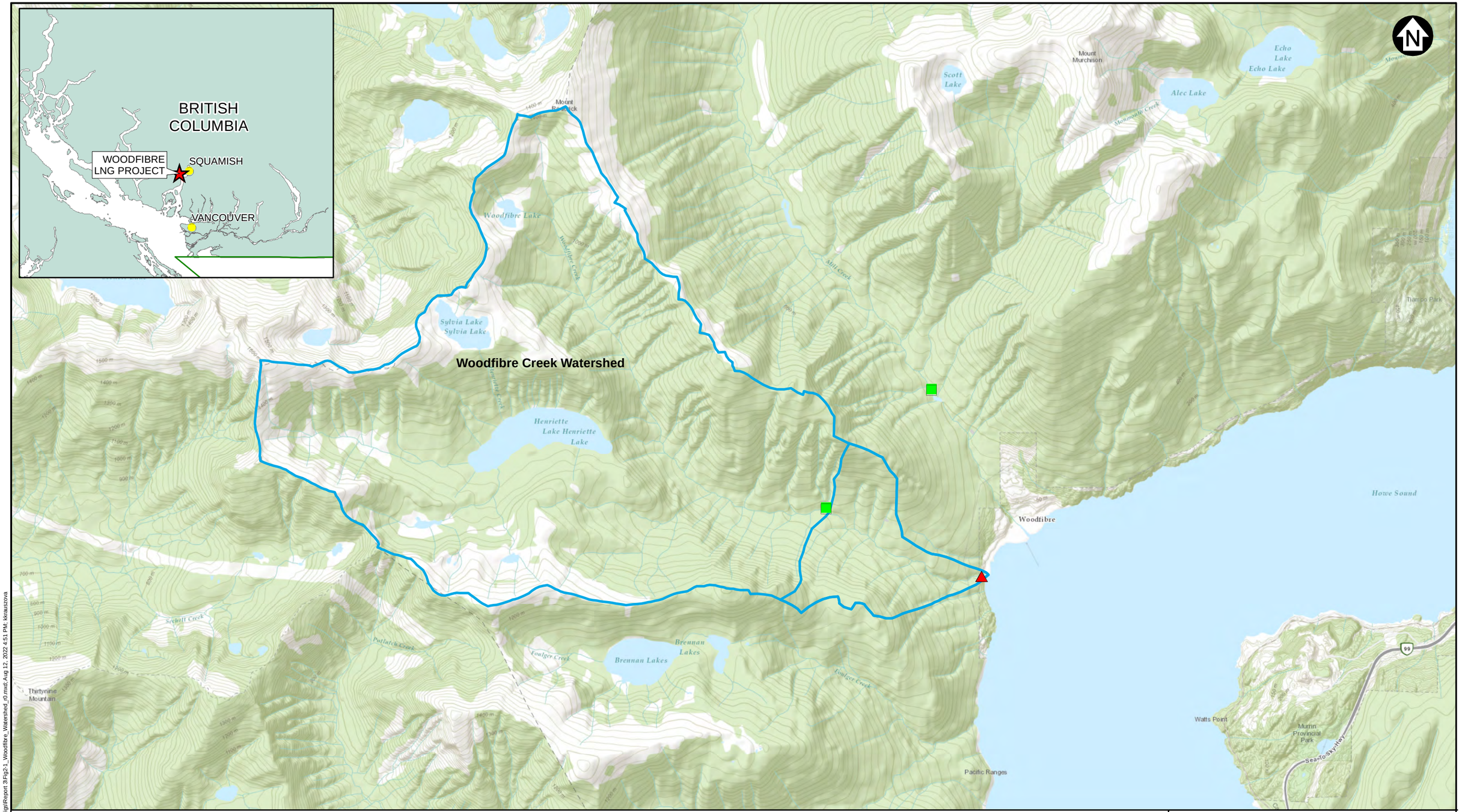
The Woodfibre Creek watershed is approximately 22 km^2 at the mouth and ranges in elevation from 1,600 metres above sea level (masl) to sea level at the mouth, where the stream discharges into Howe Sound.

Woodfibre Creek flows in a southeast direction, and crosses the southeast corner of the Woodfibre property, before discharging into Howe Sound. Woodfibre Creek has a densely vegetated but previously logged watershed with a mean basin elevation of 928 m. Glaciers cover a negligible area of the watershed. The Woodfibre Creek watershed contains five lakes: Henriette Lake, Sylvia Lake, Woodfibre Lake, and two smaller unnamed lakes. Henriette Lake has a control structure at the outlet, which was used historically to regulate streamflow for power and mill operations. The control structure is not currently operated by Woodfibre LNG; it is left in a set position. Although not currently operated, this structure is evident in streamflow conditions in Woodfibre Creek, resulting in relatively high flows during summer and reduced freshet flows.

2.1.2 WOODFIBRE CREEK CHANNEL MORPHOLOGY

Woodfibre Creek has a mainstem length of approximately 6.8 km from its source near Woodfibre Lake to its mouth at sea level and a mean channel slope of approximately 15%. Channel gradient remains quite high to the confluence with Howe Sound and there is a negligible fan, creating a relatively short tidally influenced zone.

A brief overview of the creek is provided in the following sections, based on review of data collected from Golder (2014), Google Earth imagery and from KP visits to site in 2017 and 2018.



LEGEND:

- PROPOSED WATER DIVERSION
- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

LOCATION TO:	DRAINAGE AREA:
POINT OF DIVERSION	22 KM2
WOODFIBRE CREEK GAUGE	20 KM2

0 0.5 1 2 3 4 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	05AUG'22	ISSUED WITH REPORT	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

WOODFIBRE CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-00494/24	3

FIGURE 2.1 REV 0

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2.1.2.1 REACH 1

Between the mouth and the 10 m high falls at approximately 0+150 m chainage, the creek has a prevailing canyonized cascade-pool morphology, with no gravel bars or islands. Additional smaller falls or cascades were noted between the mouth and 0+150 m chainage; however, the anadromous boundary was noted to be the 10 m high falls (Golder, 2014). The stream gradient between the mouth and the 10 m high falls is 19%. The tidally influenced area is relatively short, as the gradient steepens with a first set of small falls at approximately 50 m upstream of the mouth. The surrounding forest varies in successional stage along the distance of the creek, dominated by western hemlock, western red cedar and amabilis fir. Riparian conditions near the mouth include a deciduous understory of red alder and big leaf maple (Golder, 2014).



Photo 2.1 Reach 1 looking upstream to the end of the tidally influenced zone



Photo 2.2 Reach 1 looking downstream to the mouth



Photo 2.3 First small falls within Reach 1 that presents an upstream barrier to fish at low flows



Photo 2.4 10 m high falls at approximately 0+150 m chainage that presents an upstream barrier to fish

2.1.2.2 REACH 2

The creek upstream of the 10 m high falls continues to have a pool-cascade morphology with scattered falls, largely confined within rock canyon walls. A hydropower water intake exists at approximately 2 km upstream from the mouth, at an elevation of approximately 350 m, at the top of a large falls.



Photo 2.5 **Looking downstream of the hydropower intake showing the steep cascade-pool morphology at approximately 2 km upstream of the mouth**



Photo 2.6 **Upstream of the hydropower intake, looking downstream at the channel confined by bedrock and large boulders**

3.0 FISHERIES AND AQUATIC HABITAT BASELINE

3.1 HISTORICAL INFORMATION

Fish and aquatic habitat information for Woodfibre Creek presented in this section are based on publicly available data, and a review of sampling and interpretation completed previously as part of the Project environmental assessment. KP has not conducted any additional fish or fish habitat data sampling in Woodfibre Creek.

Limited publicly available historical fish and aquatic information exists for Woodfibre Creek, and fisheries information in the provincial database, Fish Inventories Data Queries (FIDQ), is sparse and outdated (Ministry of Environment and Climate Change Strategy, 2022). Fish observations recorded in the provincial database are from 1979, 1980, and 2010, and identification was restricted to rainbow trout and coastal cutthroat trout. The watershed is identified as anadromous, however there are no escapement data provided on the FIDQ.

Golder Associates prepared a Freshwater Fish Baseline Study for Woodfibre LNG for the Project environmental assessment (Golder, 2014). Golder described the Woodfibre Creek aquatic habitat as cascade-pool morphology within steep rock canyon walls, and no presence of gravel bars or islands. The predominant bed substrate was identified as boulders, with the secondary substrate comprised of fines, cobbles, and bedrock. Spawning substrates were noted to be limited and patchy in the lower section of Woodfibre Creek (Reach 1), located in pool tailouts and glide habitats where water velocity is lower. Spawning rainbow trout utilize the pool tailouts and returning salmon utilize the glides for spawning; however overall spawning substrates were limited. Golder noted the upstream barrier to anadromous fish to be at the 10 m high falls approximately 150 m upstream of the confluence with Howe Sound. While the average gradient in Reach 1 is 19.1%, it was noted to vary locally at the meso-habitat scale. Channel widths were noted to range from 4 m to 19 m (Golder, 2014).

Instream cover for fish was noted to be abundant, estimated at 30% of the total creek in the lower section comprised primarily of boulders and deep pools. Riparian vegetation is predominantly early successional forest with deciduous riparian shrubs in the lower reach, blending into a more mature riparian forest upstream.

Golder conducted fish sampling at two sites within the lower section in Woodfibre Creek in the Project area in 2013 and 2014 and conducted an adult salmon count on September 10, 2013. Golder recorded 1 live pink salmon and 2 dead pink salmon on the one-day survey in September 2013, all within the lower 25 m of the creek. Golder noted that the pinks were all located in a pool with low water velocity and boulder cover. This pool was identified as one of three potential spawning locations in lower Woodfibre Creek.

Minnow trapping at two sites in lower Woodfibre Creek over three sampling events yielded rainbow trout, sculpins, and chinook salmon. Rainbow trout were the predominant species throughout each of the three minnow trapping events: only one chinook was captured in the July 2014 survey, and sculpin species had a lower Catch Per Unit Effort (CPUE) than rainbow trout on all sampling dates. The CPUE in the lower creek ranged from a high of 1.19 fish/24 hours in July 2014 at Site 2 (below the falls) to a low of 0.37 fish/24 hours in April 2014 at Site 2. Sampling at Site 1 only occurred on September 11, 2013 and did not occur on the April and July 2014 sampling days.

Rainbow trout and sculpins were also the only species captured by Golder while electrofishing in lower Woodfibre Creek, however, rainbow trout were also captured upstream of the 10 m falls, confirming that there are resident fish above the anadromous barrier. The CPUE downstream of the falls ranged from a low of 0 to a high of 1.86 fish/minute in July 2014, and sculpins comprised the majority of the electrofishing catch.

FSCI Biological Consultants conducted backpack electrofishing in August 2010 just downstream of the hydropower intake, approximately 2 km upstream of the mouth. Rainbow trout were the only fish species captured, and the average CPUE throughout sampling was 0.82 fish/minute (FSCI, 2010).

A summary of the fish capture data to date is provided in Table 3.1.

Table 3.1 Woodfibre Creek Fish Presence Summary

Reach	Fish Species Present	Life Stage	Reference
Downstream of 10 m High Barrier Falls	Rainbow trout, coastal cutthroat trout	n/a	Fish Inventories Data Queries
	Pink salmon	adult	Golder
	Coho salmon, chinook salmon, rainbow trout, sculpin	n/a	Golder
Upstream of the 10 m High Barrier Falls	Rainbow trout	n/a	Golder
	Rainbow trout	juvenile	FSCI Biological Consultants
	Rainbow trout	adult	FSCI Biological Consultants

Although a limited number of fish have been captured in Woodfibre Creek, it is likely that the resident rainbow trout and coastal cutthroat populations are small-bodied, similar to other high-gradient streams confluent with Howe Sound. Life stage was not assigned to the rainbow trout captured during Golder's sampling upstream of the anadromous barriers on Woodfibre Creek; however, fork length ranged from 44 mm to 126 mm (Golder, 2014). Both adult and juvenile rainbow trout were captured upstream of the anadromous barrier during FSCI Biological Consultants' sampling; however, not all fish were measured to fork length. Adult rainbow trout fork length ranged from 136 mm to 208 mm, and juvenile fork length ranged from 66 mm to 209 mm. In the McNab Creek watershed, cutthroat trout aged 2+ had fork lengths ranging from 151 mm to 179 mm (M.A. Whelen and Associates Ltd., 1999), and the largest rainbow trout captured in Rainy River by Hatfield Consulting Ltd. (2013) had a fork length of 304 mm. Fish sampling by Hatfield Consultants Ltd. in 1998 in Rainy River found rainbow trout ranging in size from 102 mm to 195 mm, with fish aged as 2+ ranging in size from 126 mm to 132 mm. Rainbow trout ranged from 112 mm to 235 mm in McNair Creek and 112 mm to 197 mm in Dakota Creek (Hatfield Consultants Ltd., 1998). In contrast, rainbow trout from larger systems such as the Babine River can attain sizes of 308 mm by age three and 531 mm by age 5 (Narver, 1975), and 600 mm rainbow trout have been recorded in the Salmo River (Baxter Environmental, 2002).

3.2 POST EA-MONITORING

Keystone Environmental (2021) conducted fish sampling downstream of the barrier falls in Woodfibre Creek in 2020: five baited minnow traps were set for approximately 46 hours each on May 12, 2020 and seven baited minnow traps were set for approximately 22 hours each on September 30, 2020. One sculpin and one rainbow trout were the only fish captured in the minnow traps in May. Five rainbow, and four sculpin were captured in October.

The sculpin captured by Keystone Environmental (2021) was 71 mm in length in May 2020 and ranged in size from 80 mm to 102 mm in October. The rainbow trout had captured in May had a fork length of 115 mm and the rainbow trout captured in October ranged in size from 55 mm to 102 mm.

3.3 SUMMARY

Species habitat use for key life history timing events can be shown graphically on Species Periodicity Charts. These charts can be helpful for determining seasonal instream flow needs for fish species of concern throughout the year. The species periodicity charts for pink salmon and rainbow trout are shown in Tables 3.2 and 3.3, respectively, and are based on available species life history information for creeks in the Howe Sound region (Ministry of Environment and Climate Change Strategy, 2018).

Table 3.2 Pink Salmon Periodicity Chart

Species	Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Pink salmon	migration																								
	spawning																								
	incubation/emergence																								
	rearing																								

Table 3.3 Rainbow Trout Periodicity Chart

Species	Phase	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Rainbow trout	migration																								
	spawning																								
	incubation/emergence																								
	rearing																								

4.0 HYDROLOGY

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains), on the boundary with Zone 26, as delineated by Obedkoff (2003). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime.

4.1 WOODFIBRE CREEK BASELINE HYDROLOGY

4.1.1 MEASURED STREAMFLOW DATA

Woodfibre LNG operates an active hydrometric gauging station just upstream of the Woodfibre Creek hydropower intake location at an elevation of approximately 350 masl and 2 km from the mouth. The median watershed elevation above the gauge is 1,057 masl. The watershed area at the gauge is 20 km^2. The measured hydrologic record on Woodfibre Creek consists of measured data collected by KP since April 2017. The current rating curve for the active hydrometric gauging station on Woodfibre Creek is shown on Figure 4.1.

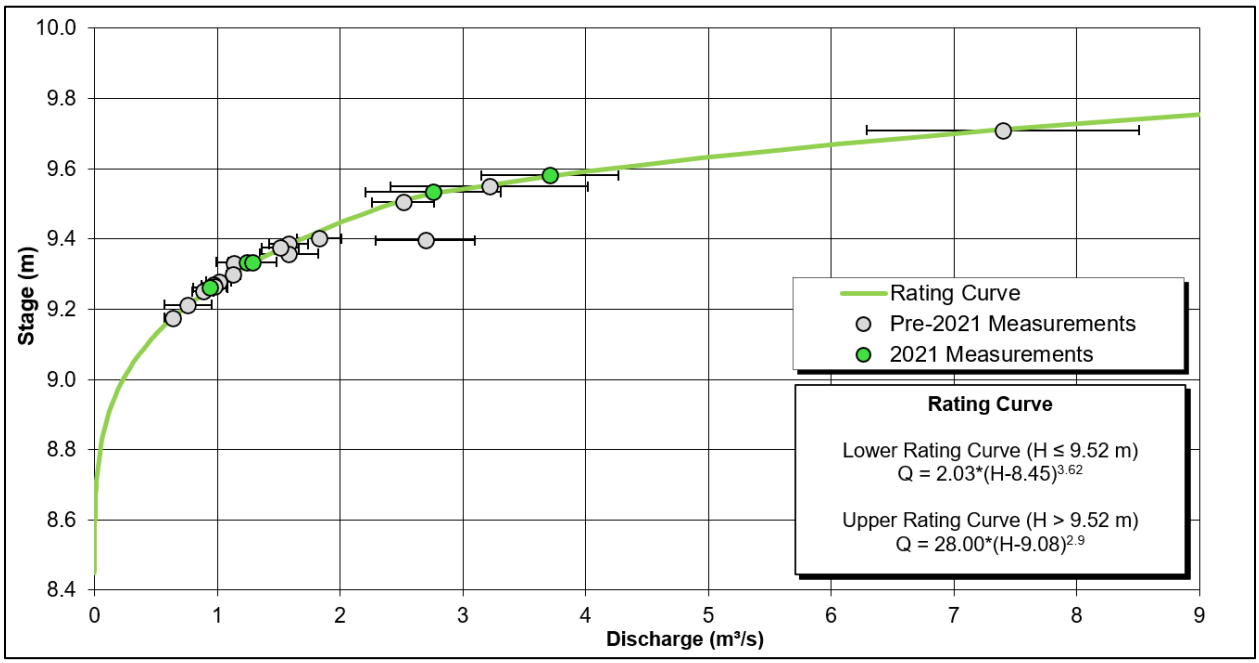


Figure 4.1 Woodfibre Creek (WOOD) Rating Curve

The daily average discharge hydrograph for the Woodfibre Creek hydrometric station is presented on Figure 4.2.

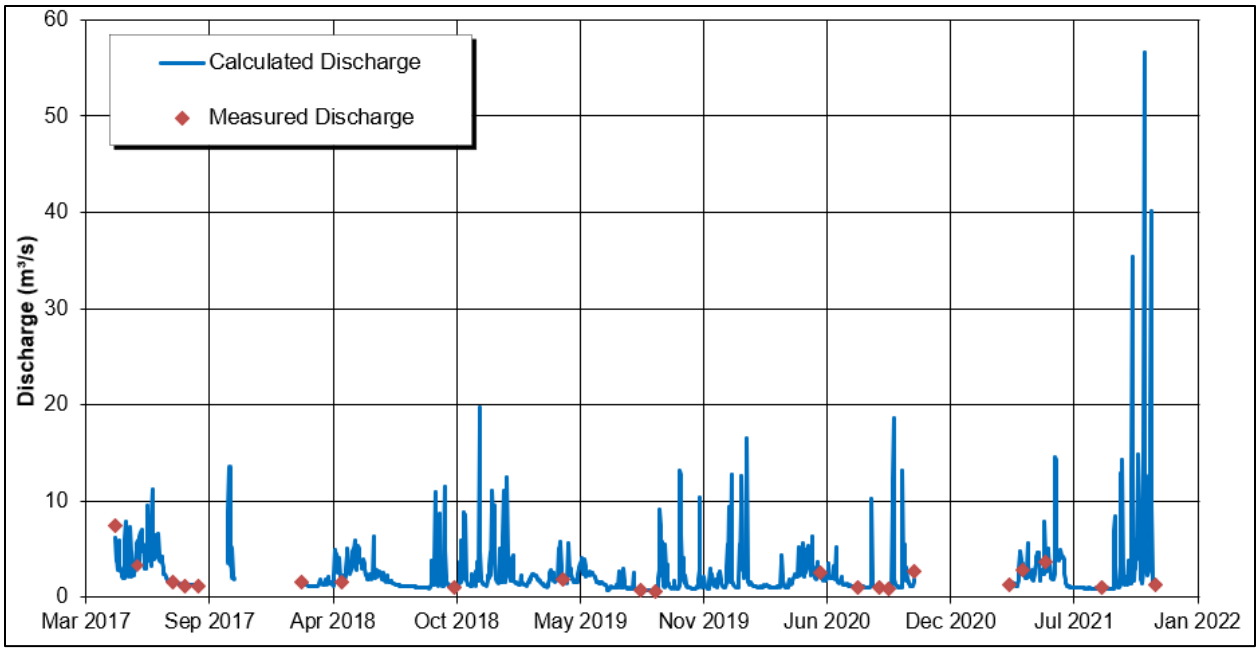


Figure 4.2 Woodfibre Creek (WOOD) Daily Average Discharge Hydrograph

Details of the hydrology data collection and processing are discussed in the *Woodfibre Creek Hydrologic Analysis* (KP, 2022), provided in Appendix A.

4.1.2 WOODFIBRE CREEK LONG TERM SYNTHETIC HYDROLOGY

As part of a baseline hydrology characterization of Woodfibre Creek, a synthetic long-term flow record using site-specific and regional measured streamflow records was developed. Fifty-five complete years of record are available from the WSC Station “Capilano River above Intake” (08GA010), which, in conjunction with discharge data from Palisade Lake provided by Metro Vancouver, were used in an empirical frequency pairing analysis. Capilano River is a regulated system due to summer releases from Palisades Lake reservoir, which are managed by Metro Vancouver. Details on regulated flows are not consistently available; however, a naturalized streamflow record for Capilano has previously been developed for the Project for the period of record between 1960 and early 2018 using records of release rates from Metro Vancouver or by comparison of unit runoff between regulated and unregulated rivers.

Periods with regulation were also removed from the Capilano River dataset for April 1, 2019 to May 28, 2021 by removal of periods with sudden, steady increases in Capilano River flow that are not reflected in the Mill Creek data, which is an unregulated system. This analysis cannot be done directly with the Woodfibre Creek data, as during the early 1900s, dams and a flow control structure was built on Henriette Lake to regulate releases. This flow control structure is not operated by Woodfibre LNG but remains in place. The naturalized flow record for Capilano River therefore includes 55 complete years of record and six years with incomplete records.

The mean annual discharge (MAD) for Woodfibre Creek at the KP hydrology gauge was estimated to be 2.35 m^3/s (1960 to 2020 period), which equates to a mean annual unit runoff of 118 $L/s/km^2$ for the 20 km^2 portion of the watershed. At the time of this analysis, more than 4 years of data are available at Woodfibre

Creek, and the synthetic flow record is considered to be good quality. Further details of the long-term synthetic recorded development are discussed in Appendix A.

Streamflow at the proposed PoD has been conservatively assumed to be equivalent to the hydrology gauge data, despite the 10% increase in drainage area (20 km^2 at the gauge and 22 km^2 at the PoD). The mean monthly hydrograph is relatively uniform with sustained flows though the fall and winter, and a modest nival freshet in spring, indicating that a substantial proportion of winter precipitation falls as rain (rather than snow). Flows decrease through June, July and August as snowmelt and precipitation decrease.

The mean monthly hydrograph is shown on Figure 4.3. Average, minimum and maximum monthly mean flow conditions for the synthetic dataset are presented in Table 4.1. Daily flow conditions tend to be more variable than monthly flow conditions, with the watershed responding rapidly to intense rainfall events, although the effect of regulation at Henriette Lake are evident and daily flows remain quite high in August and September compared to regional datasets. Synthetic daily flows during 2009, a year where the annual average discharge was equal to the long-term MAD, are shown on Figure 4.4.

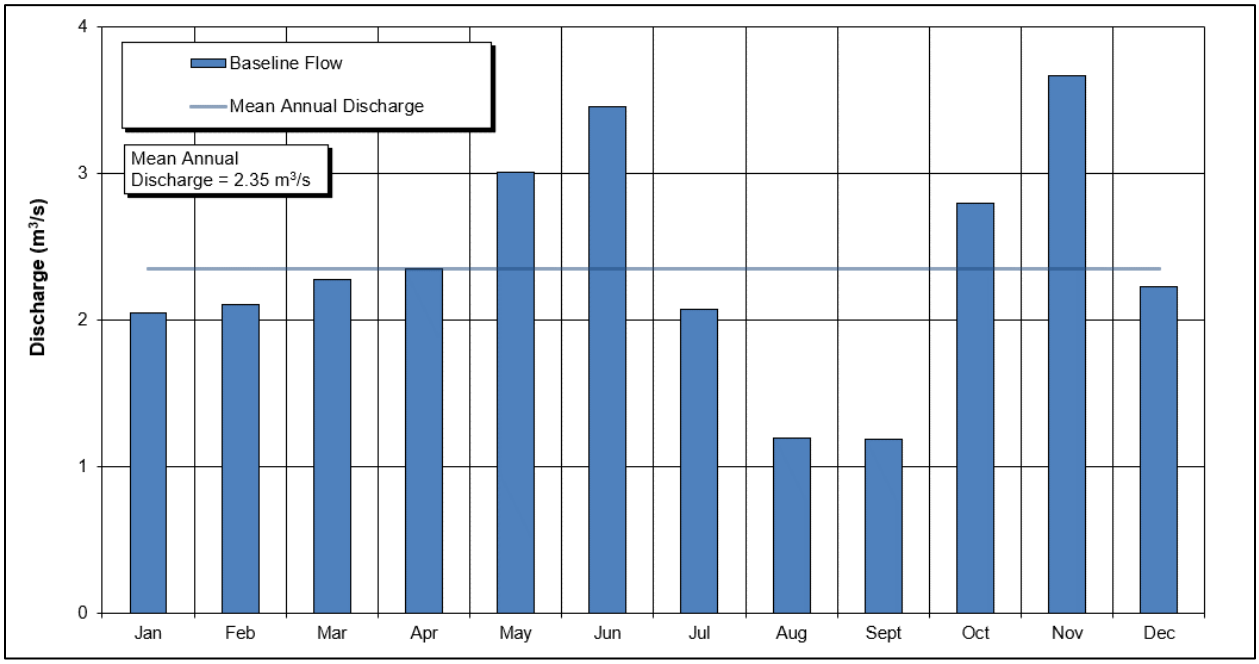


Figure 4.3 Mean Monthly Hydrograph – Woodfibre Creek at the PoD

Table 4.1 Average, Minimum and Maximum Monthly Flows - Woodfibre Creek at the PoD

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average (m^3/s)	2.05	2.10	2.27	2.35	3.01	3.46	2.08	1.19	1.19	2.80	3.67	2.23	**2.35**
Max (m^3/s)	4.65	5.42	5.11	3.67	4.44	6.95	5.51	2.91	3.22	6.58	7.54	5.14	**2.99**
Min (m^3/s)	0.77	0.97	1.06	1.30	0.99	0.58	0.63	0.81	0.64	0.69	1.49	0.90	**1.74**

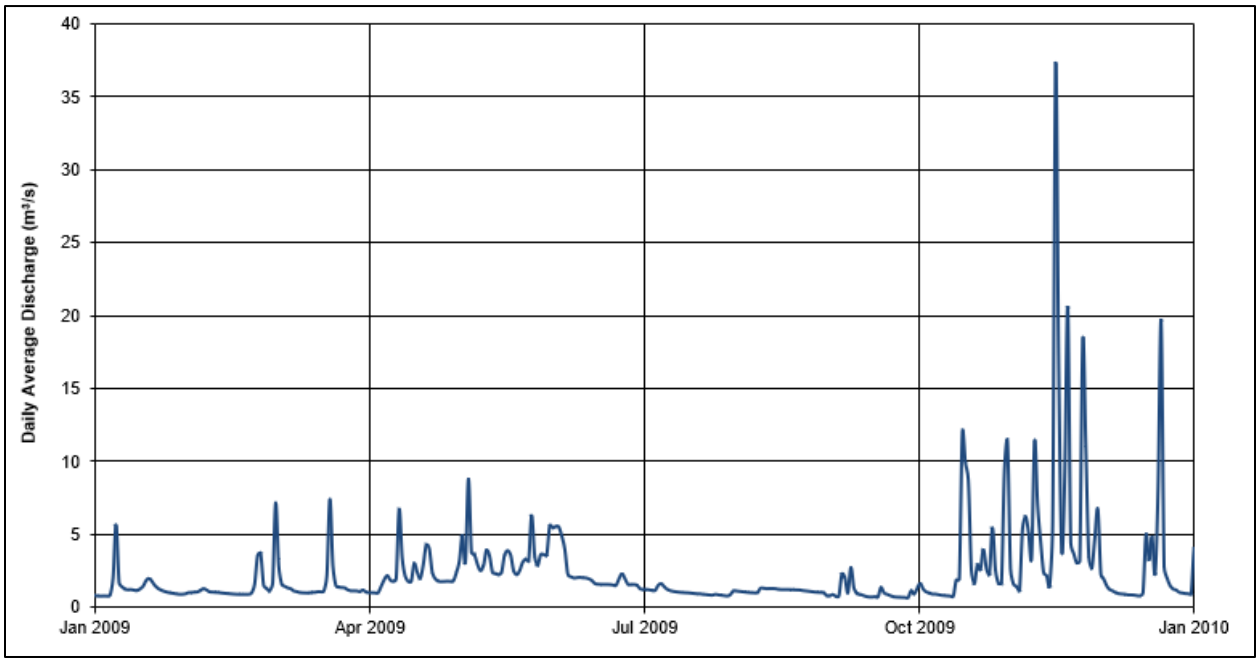


Figure 4.4 2009 Daily Hydrograph – Woodfibre Creek at the PoD Synthetic Daily Flow Series

5.0 CONSTRUCTION ENVIRONMENTAL FLOW NEEDS

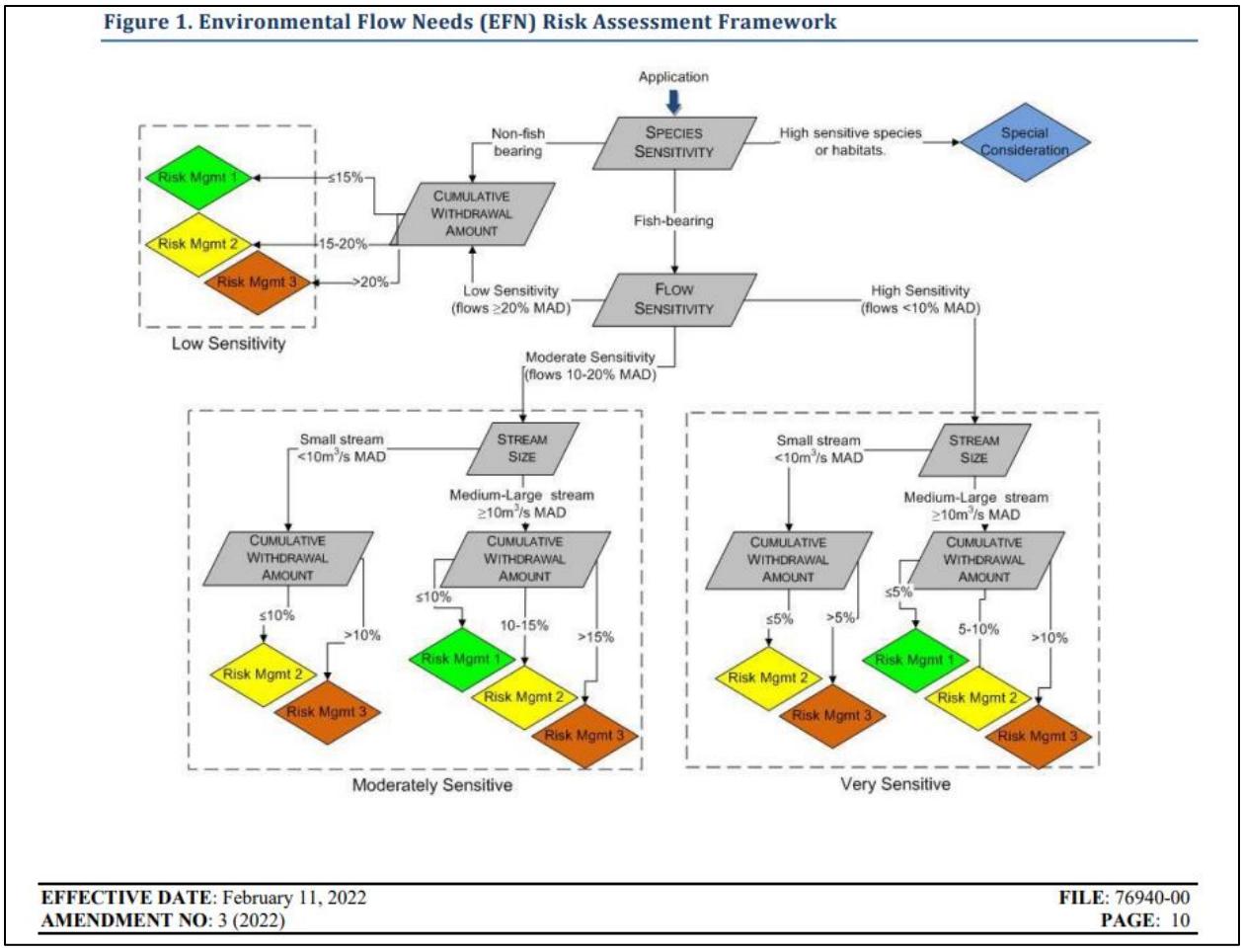
5.1 CONSTRUCTION ENVIRONMENTAL FLOW NEEDS METHODOLOGY

The BC EFN Policy (FLNRORD and ENV, 2016 and updated in 2022) presents a risk-based assessment approach that considers fish presence/absence, baseline hydrologic regime and stream size. KP has used this guidance document to assess the proposed construction water requirement and quantify the risk level of withdrawals from Woodfibre Creek.

The BC EFN policy presents an “Environmental Flow Needs Risk Assessment Framework” for applications for water licences and use approvals under the Water Sustainability Act (*WSA)*. This framework includes the following steps:

1. Determine the Area of Influence
2. Application Risk Screening
3. Screen for Fish Bearing Status and High Sensitivity Species
4. Determine Flow Sensitivity
5. Determine Stream Size
6. Determine Cumulative Withdrawal within the Area of Influence
7. Assign Preliminary Risk Rating

A flowchart, reproduced from the policy and presented on Figure 5.1 for reference.



Note(s):

1. Source: FLNRORD and ENV (2022)

Figure 5.1 Risk Management Decision-Making Process for Consideration of Environmental Flow Needs within the BC EFN Policy

5.2 CONSTRUCTION IFR FOR WOODFIBRE CREEK

5.2.1 AREA OF INFLUENCE

The point of diversion considered in this assessment is approximately 100 m from the mouth of Woodfibre Creek. The area of influence for this flow reduction is the lower 100 m of Woodfibre Creek to the confluence with Howe Sound.

5.2.2 APPLICATION RISK SCREENING

Woodfibre LNG currently holds water licences for power generation within the Woodfibre Creek watershed. Details of these licences are presented in Table 5.1. No other users have active licences to divert water in Woodfibre Creek or its upstream tributaries.

Table 5.1 Existing Woodfibre Creek Water Licences

Licensee	License Number:	Purpose:	POD Number:	POD Location	Priority Date	Quantity
Woodfibre LNG Limited (131378)	F126502	Power: General	PD46518	Sylvia Lake	30-Sep-1959	0.0566 m^3/sec
	F004897	Power: Stream Storage	PD46518	Sylvia Creek	28-Sep-1920	431,718 m^3/year
	F126616	Power: General	PD44677	Henriette Lake	30-Sep-1959	0.9982 m^3/sec
	F126618	Power: Stream Storage	PD44675	Henriette Creek	8-May-1946	10,348,897.2 m^3/year
	F126617	Power: General	PD44673	Woodfibre Creek	24-Jun-1909	0.4248 m^3/sec

5.2.3 SCREEN FOR FISH BEARING STATUS AND HIGH SENSITIVITY SPECIES

Woodfibre Creek is fish-bearing, as discussed in Section 3. There are no known *SARA* listed or provincially listed fish species documented in Woodfibre Creek. The EFN Guideline allows for cultural sensitivities under Special Considerations. The importance of restoring salmon productivity (all anadromous species) is a high cultural priority for Squamish Nation (Xay Temixw, 2001).

5.2.4 FLOW SENSITIVITY

Flow sensitivity refers to whether flow withdrawal is expected to cause a negative effect, with less tolerance for flow withdrawal from “high” sensitivity streams. High sensitivity is defined as a month where the ratio of mean monthly flow to mean annual flow is less than 10%, indicating that flows are low in that month compared to normal conditions and there is little tolerance for additional withdrawal. Flow sensitivity in Woodfibre Creek is classified as “Low” year-round, meaning that the ratio of mean monthly flow to mean annual flow is greater than 20%. The flow sensitivity for Woodfibre Creek is shown in Table 5.2, and there is sufficient water availability for the proposed withdrawal.

Table 5.2 Woodfibre Creek Flow Sensitivity at the PoD

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Discharge (m^3/s)	2.05	2.10	2.27	2.35	3.01	3.46	2.08	1.19	1.19	2.80	3.67	2.23
Ratio Monthly/Annual (% MAD)	87%	89%	97%	100%	128%	147%	88%	51%	50%	119%	156%	95%
Sensitivity	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

5.2.5 STREAM SIZE

Small streams, defined as streams with a MAD less than 10 m^3/s, and streams that freeze over in winter are considered more ecologically sensitive to water withdrawals. The estimated MAD in Woodfibre Creek at the PoD location is 2.35 m^3/s. Using the metrics in the guidance document, this creek is classified as “Small”.

5.2.6 CUMULATIVE WITHDRAWAL

Woodfibre LNG holds active licenses on Woodfibre Creek, which are currently used to produce power. Both the pulp mill and powerhouse for the hydropower facility will be demolished during construction of the LNG facility. No water will be diverted under these licenses during construction. During construction, the only water diversion will be for the proposed construction water requirement.

5.2.7 RISK RATING

The risk rating, based on the BC EFN Policy (FLNRORD and ENV, 2022) is presented in Table 5.3 based on the proposed construction withdrawal.

Table 5.3 Risk Assessment for Cumulative Withdrawals in Woodfibre Creek at the PoD

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natural Flow (m^3/s)	2.05	2.10	2.27	2.35	3.01	3.46	2.08	1.19	1.19	2.80	3.67	2.23
Cumulative Withdrawal Amount[1] (m^3/s)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Withdrawal Ratio (%)	5%	5%	4%	4%	3%	3%	5%	8%	8%	4%	3%	4%
Risk Management Level	1	1	1	1	1	1	1	1	1	1	1	1

Note(s):

1. The actual diversion will be less than 0.10 m^3/s because this quantity is not required continuously and may be sourced from mill creek rather than Woodfibre Creek.

Because the stream is classified as low sensitivity and cumulative withdrawals are less than 15% of the mean monthly flow, the risk rating is Risk Level 1 across all months indicating a low level of risk.

5.2.8 RESULTS

This assessment indicates there is sufficient water in Woodfibre Creek to meet construction water needs of 0.10 m^3/s while fulfilling environmental needs. Any residual risk can be addressed through monitoring and supplemental measures.

5.2.8.1 CONSTRUCTION FLOW CONDITIONS

Allowing for the continuous diversion of 0.10 m^3/s (subject to the supplemental measures described in Section 6.2) during Project construction, mean monthly baseline and operational flows are summarized on Figure 5.2 and in Table 5.4, which show that the proposed reduction in MAD is 4% on an average annual basis. The largest percentage reductions occur in August and September, when streamflows are lowest. Monthly flow duration curves, showing baseline and operational flow conditions are included in Appendix B.

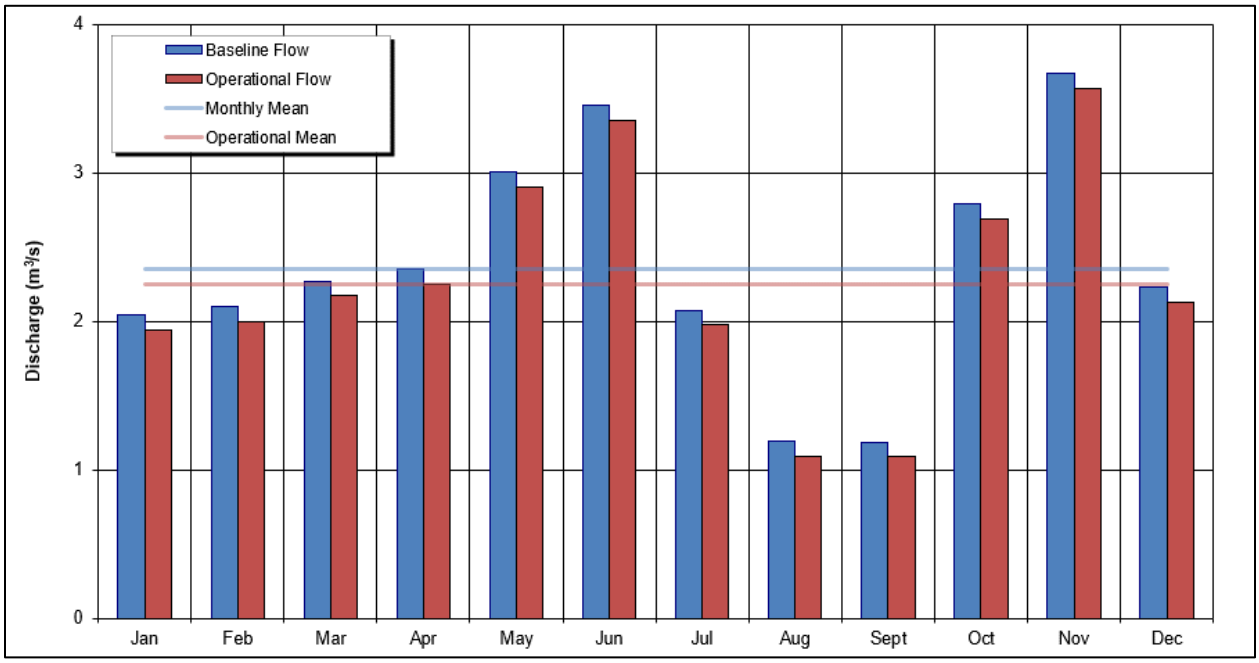


Figure 5.2 Baseline and Construction Mean Monthly Flows – Woodfibre Creek at the PoD

Table 5.4 Baseline and Construction Mean Monthly Flows – Woodfibre Creek at the PoD

Month	Baseline Flows	Construction Instream Flows	
	Q (m^3/s)	Q (m^3/s)	% Reduction
Jan	2.05	1.95	5%
Feb	2.10	2.00	5%
Mar	2.27	2.17	4%
Apr	2.35	2.25	4%
May	3.01	2.91	3%
Jun	3.46	3.36	3%
Jul	2.08	1.98	5%
Aug	1.19	1.09	8%
Sep	1.19	1.09	8%
Oct	2.80	2.70	4%
Nov	3.67	3.57	3%
Dec	2.23	2.13	4%
Annual	**2.35**	**2.25**	**4%**

6.0 SUMMARY AND RECOMMENDATIONS

6.1 SUMMARY

Woodfibre LNG is proposing the development and operation of a LNG processing and export facility on the previous Woodfibre pulp and paper mill site near Squamish, BC. Water is required for construction of the facility, a portion of which may be sourced from Woodfibre Creek. The proposed water source is a pump intake with fish screening, located approximately 100 m upstream from the mouth of Woodfibre Creek.

The conclusion of this study is that the proposed flow withdrawals are small (approximately 4% of streamflow on average) and the risk to fish from the proposed short-term construction water withdrawal is considered low, overall. However, there are times of the year (particularly during July, August, and September) when baseline streamflow can be low and water withdrawal could represent a large portion of the available water. It is proposed that supplementary measures be incorporated into the water management plan to mitigate risk to fish during low-flow periods.

6.2 SUPPLEMENTARY MEASURES

Stated objectives of the BC EFN Policy include avoiding fish-flow conflicts and being scientifically defensible; the policy was derived in part from methods currently used in B.C., scientific literature, and expert opinion (FLNRORD and ENV, 2022). As noted above (Section 3), small-bodied rainbow trout are the predominant species found in Woodfibre Creek, with low densities of other salmon species (pink, chinook, coho) and coastal cutthroat trout. The species and life stage of interest downstream of the barrier falls were therefore identified as rainbow trout during the rearing period when flows are low, and pink salmon spawning.

As shown on Figure 5.2 and detailed in Table 5.4 the instream flow with the withdrawal of construction water of 0.10 m^3/s and the supplemental measured described below equates to a reduction in baseline flows of 3% - 8% throughout the year. Although these construction flow withdrawals are expected to have minimal impact of fish habitat, consistent with Risk Management Level 1, supplementary measures consistent with Risk Management Level 2 have been or will be implemented, including:

1. Establish adequate baseline hydrology data
2. Collection of site-specific fisheries information
3. Real-time streamflow monitoring during construction
4. Real-time monitoring of diverted flows
5. Flow diversion restrictions

The allowable flow diversion rate (diversion limit) will be reduced as instream flow falls to reduce risk during higher habitat stress conditions. Water withdrawal will be limited to:

- 15% of total streamflow, up to a maximum of 0.10 m^3/s when instantaneous flows are more than 20% MAD (low sensitivity conditions)
- 10% of total streamflow when instantaneous flow is between 10 - 20% MAD (moderate sensitivity conditions)
- 5% of total streamflow when instantaneous flow is < 10% MAD (high flow sensitivity)

Additionally, between August 1 and October 31 (the critical stream flow periods, CSFP, as defined by Squamish Nation), a minimum instream flow requirement of 0.47 m^3/s (20% MAD) has been set to maintain resident rainbow trout rearing and pink salmon spawning habitat. If flows fall below 0.47 m^3/s, a maximum flow of 0.005 m^3/s for the residential camp for workers will be diverted.

Allowable flow diversion rates are shown in Table 6.1. Although the diversion rate could be adjusted continuously to meet the percentage withdrawal limits, a look-up table with discrete steps has been proposed to provide a an easy-to-understand and practical protocol that the Environmental Monitor and Contractor can follow.

Table 6.1 Construction Management Plan Flow Diversion Limits

Streamflow at Gauging Station/PoD (m^3/s)	%MAD	November 1 to July 31		August 1 to October 31	
		Maximum Diversion Limit (m^3/s)	% Diversion	Maximum Diversion Limit (m^3/s)	% Diversion
≥0.67	>28%	0.10	<15%	0.10	<15%
≥0.60	26%	0.09	15%	0.09	15%
≥0.50	21%	0.08	15%	0.08	15%
≥0.47	20%	0.05	10%	0.005	1%
≥0.40	17%	0.04	10%	0.005	1%
≥0.30	13%	0.03	10%	0.005	2%
≥0.24	11%	0.02	10%	0.005	2%
<0.24	<11%	5% of measured flow	5%	0.005	>2%

In order to manage construction water requirements during restricted diversion periods, the following will be conducted:

1. Schedule high water demand activities outside the low flow period, to the extent practical.
2. Provide water storage to accommodate short term flow restrictions.
3. Use Mill Creek to supplement Woodfibre Creek withdrawals to meet construction water requirements.

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KNIGHT PIÉSOLD LTD.
PERMIT NUMBER
1001011
EGBC PERMIT TO PRACTICE

8.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

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Project Engineer

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Approval that this document adheres to Knight Piésold Quality Systems: SRM

APPENDIX A

Woodfibre Creek Hydrologic Analysis (VA22-01360)

(Pages A-1 to A-24)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

September 23, 2022

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Mr. Darren Cowan
Woodfibre LNG Limited
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Dear Darren,

RE: Woodfibre Creek Hydrologic Analysis

Woodfibre LNG Limited (Woodfibre LNG) is proposing the development and operation of a liquefied natural gas (LNG) processing and export facility (the Project) on the previous Woodfibre Pulp and Paper Mill site located approximately 7 km west-southwest of Squamish, British Columbia (BC). Water is required for construction and operation of the facility, which will be sourced from Mill Creek or Woodfibre Creek. Knight Piésold Ltd. (KP) has been retained by WLNG to assist with the hydrometric monitoring of Woodfibre Creek, in support of water availability studies and Project permitting.

A regional hydrologic analysis was completed to identify trends and characteristics in precipitation and runoff, then the short-term measured data were correlated with data collected by Water Survey of Canada (WSC) at a suitable surrogate station to develop a long-term synthetic daily streamflow series for Woodfibre Creek. A hydrologic analysis of Woodfibre Creek was conducted previously (KP, 2018). However, since completion of the previous analysis, over 2.5 years of additional data have been collected in Woodfibre Creek. This letter presents the synthetic flow series development, based on data measured between April 2017 and May 2021.

1.0 HYDROLOGIC SETTING

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains), as delineated by Ahmed (2017). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime. In general, streamflow in South Coast watersheds like Woodfibre Creek (i.e., coastal, but also with high-elevation mountainous terrain) are highest in autumn due to frontal rainstorm activity, with a secondary peak in spring due to snowmelt. Flows are lowest in late summer when precipitation is low. Winter flows tend to be moderate as much of the precipitation falls as snow but can be punctuated by warm rainfall events and rainfall at lower elevation.

Mean annual precipitation varies dramatically from only 1,490 mm at Gibsons, located approximately 35 km southwest of the Project, to 3,320 mm at Port Mellon, located 25 km southwest of the Project and then to 2,230 mm in Squamish. This is indicative of topographic convergence of frontal systems in Howe Sound, and extreme orographic enhancement of precipitation due to rapid uplift. Similarly, mean annual unit runoff

varies dramatically from 125 L/s/km^2 (or 4,000 mm) in Rainy River and 118 L/s/km^2 (or 3,660 mm) in Capilano River, located close to the Project area, to only 32 L/s/km^2 (or 1,000 mm) in Roberts Creek, located 20 km to the southwest and with a lower-elevation basin.

The median watershed elevation above the Woodfibre Creek gauge is 1,057 meters above sea level and glaciers cover a negligible area in the watershed. The watershed area is 20 km^2 at the gauge and 22 km^2 at the mouth. Over the 100+ year history of activity at the Woodfibre mill site, there has been a significant amount of water management infrastructure built in the Woodfibre Creek watershed. Flow diversions, reservoir construction, and flow regulation were undertaken to provide water for power and mill operations. Although not currently operated, these structures continue to affect streamflow conditions in Woodfibre Creek and the flow regime should be considered regulated. The Woodfibre Creek watershed is shown on Figure 1.

2.0 STREAMFLOW DATA COLLECTION

KP installed a hydrometric station (WOOD) on Woodfibre Creek approximately 100 meters upstream of the existing hydropower intake in April 2017. The station is located on the left bank of a pool, downstream of a cascade, as shown on Photo 1. Water level is hydraulically controlled by a cascade at the outlet of the pool, shown on Photo 2. The low-flow control section consists of cobbles between large boulders, while the high-flow control also includes the bedrock banks. The hydrometric station consists of a pressure transducer connected to a datalogger that records stage at fifteen-minute intervals.



Photo 1 WOOD Station – May 24, 2017



Photo 2 Hydraulic Control at WOOD – July 20, 2017

2.1 WOOD RATING CURVE AND DISCHARGE HYDROGRAPH

A total of twenty-one stage/discharge measurements have been collected at WOOD. The discharge measurements were conducted using area-velocity and Rhodamine dye dilution measurements depending on flow conditions at the time of each site visit. The station includes three benchmarks, located in bedrock above the normal high-water level, and two reference marks for determining stage. Benchmark 1 was assigned an elevation of 10 m and this datum is used for converting water level to gauge height (stage).

One rating curve was plotted through the 21 stage-discharge points using the standard form for a rating curve equation (power function) with the constant, offset, and exponent constrained within expected values

based on hydraulic theory (Maidment, 1993) and experience with similar conditions in mountainous streams. The rating curve has two segments for defining low and high flows, as shown on Figure 2. The first is applied up to a stage of 9.520 m. The second segment is extrapolated to the maximum recorded stage-discharge measurement collected during its period of application. Due to upstream flow regulation, low flows collected at the WOOD station have not fallen below 0.63 m^3/s and are well-distributed up to 5.4 m^3/s. The highest flow recorded is 19.6 m^3/s.

The daily average discharge hydrograph for WOOD is presented on Figure 3, which was developed by applying the rating curve to the available stage record and then averaging the fifteen-minute streamflow record over 24-hour periods. The hydrograph has gaps due to logger malfunctions on the following dates (inclusive):

- September 5, 2017 to October 17, 2017
- October 25, 2017 to February 13, 2018
- October 20, 2020 to April 1, 2021

Further details of the hydrometric monitoring are presented in Appendix A.

3.0 LONG-TERM SYNTHETIC FLOW SERIES

A synthetic daily streamflow series was developed with the intent of assessing long-term streamflow conditions in Woodfibre Creek by correlation of Woodfibre Creek measured streamflow data with concurrent data from a streamflow gauging station operated by Water Survey of Canada (WSC).

3.1 HYDROGRAPH COMPARISON

The median watershed elevation above the Woodfibre Creek gauge is 1,057 meters above sea level and glaciers cover a negligible area in the watershed. Several WSC stations, shown on Figure 4, were reviewed to determine an appropriate surrogate station. A suitable site should have similar watershed characteristics to Woodfibre Creek and have available concurrent data. Roberts Creek at Roberts Creek (08GA0470) was excluded due to differences in watershed characteristics and flow regulation. Clowhom River near Clowhom Lake (08GB013) was considered, but correlation of concurrent daily flows found that the stations had substantial differences in timing and magnitude of response to precipitation events. Seymour River above Below Orchid Creek (08GA077) was also considered and although not noted as regulated by WSC, summer regulation was evident in the flow record (visually and by chronological correlation of concurrent flows) and Metro Vancouver records note regulation of Loch Lemond. A summary of the regional WSC gauging stations, along with the Mill Creek station, is presented in Table 1.

Table 1 Regional WSC Gauging Station Summary

Station Name	Station ID	Gauge Elevation (masl)	Years of Record	Years of Complete Record	Start Year	End Year	Drainage Area (km^2)	Mean Annual Discharge (m^3/s)	Average Annual Unit Runoff ($L/s/km^2$)
Clowhom River Near Clowhom Lake	08GB013	60	30	28	1993	2022	147	15.6	106
Seymour River below Orchid Creek	08GA077	290	31	29	1992	2022	63	6.5	103
Capilano River above the Intake	08GA010	160	92	108	1914	2022	173	20.3	118
Woodfibre Creek	WOOD	350	6	4	2017	2022	20	2.35	118

Capilano River Above Intake (08GA010) was identified as the most representative long-term WSC station due to availability of concurrent data, its proximity to the Project and similarity of drainage area and basin characteristics such as median drainage elevation and negligible glacial cover. Daily discharge records are available at Capilano River between 1914 and 2021, except 1972 and 1973, and portions of 2007 and 2017. This station has a watershed area of 173 km^2 and a mean annual unit runoff or 118 $L/s/km^2$.

Capilano River is a regulated system due to summer releases from Palisades Lake reservoir, which are managed by Metro Vancouver. Details on regulated flows are not consistently available; however, a naturalized streamflow record for Capilano has previously been developed for the Project for the period of record between 1960 and early 2018 using records of release rates from Metro Vancouver. Periods with regulation were also removed from the Capilano River dataset for April 1, 2019 to May 28, 2021 by removal of periods with sudden, steady increases in Capilano River flow that are not reflected in the Mill Creek data, which is an unregulated system (refer to VA22-01362). These periods were also removed from the Woodfibre Creek data.

The naturalized flow record for Capilano River therefore includes 55 complete years of record (i.e. 1960 – 1971, 1974 – 2006, 2008 – 2016) and six years with incomplete records (2007 and 2017 – 2021).

A comparison of concurrent records between Woodfibre Creek and Capilano River for April 18, 2017 to May 28, 2021 are presented on Figure 5. This figure confirms that the two streams have similar runoff and seasonal flow patterns for the measured concurrent period, although unit runoff in Woodfibre Creek is higher than that in Capilano River in late summer and during low winter flow conditions, due to regulation of Henriette Lake.

3.2 EMPIRICAL FREQUENCY PAIRING ANALYSIS

A discharge relationship was developed by correlating the frequency distributions of concurrent daily flows for Woodfibre Creek versus Capilano River. As more than three years of data are available for the concurrent record, the data were evaluated on a month-by-month basis.

The discharge relationships were developed using an analytical technique known as EFP (Butt, 2013). EFP requires that daily flows for the concurrent period of record for two datasets be ranked in descending order of magnitude. When comparing these sets of data, each flow value of equal rank has an equal probability of exceedance within its respective dataset (since the datasets are of equal length). A comparison of ranked daily flows therefore amounts to a comparison of flow frequency distributions. The EFP technique assumes that the correlation of the flow frequency relationship developed from the sample (concurrent record) is generally representative of the correlation that would exist between concurrent long-term records. Butt (2013) demonstrated the general validity of this assumption for watershed pairs that are in regional proximity to one another and have similar hydrologic regimes.

The frequency pairing approach, rather than the more common chronological pairing approach, overcomes the often substantial differences in the timing and magnitude of rainstorm or snowmelt events between watersheds and differences in storage and attenuation, and has been shown to be a more accurate and precise model for synthetically generating long-term flow patterns (Butt, 2013). The objective of the EFP is not necessarily to reproduce exact historical flow patterns at the point of interest, so that one can determine what the flow was on any particular day, but rather to generate a dataset that provides a representation of the expected long-term mean annual discharge and associated variability of flows.

3.3 WOODFIBRE CREEK REGULATION ADJUSTMENTS

EFP analysis assumes that the flows in Woodfibre Creek can be predicted by the magnitude and timing of hydrologic events on Capilano River. During the period of gauging on Woodfibre Creek, Woodfibre LNG has not adjusted the gates on Henriette Lake (Woodfibre LNG, pers. comm.) so the measured record varies in response to hydrologic events, although the dam and gates act to attenuate the lake outflows resulting in reduced peak flows and increased flows during naturally low flow periods. The watershed area above Henriette Dam is approximately 8 km, or 40% of the watershed area above the WOOD gauge. Synthetic flows for Woodfibre Creek were developed by correlation of the measured WOOD flows with Capilano flows on a monthly basis. This approach produces synthetic daily flows that retain the effect of Henriette Dam. High and low flows were extrapolated with consideration of the line of equal runoff and generally assumed that WOOD would have lower unit runoff at high flows and higher unit runoff at low flows due to Henriette Lake attenuation. EFP relationships were developed from the available data, and an example correlation for May is shown on Figure 6. The EFP relationships were applied to the corresponding long-term Capilano River records to produce a long-term synthetic discharge series for the Woodfibre Creek gauge.

3.4 RESULTS

The estimated long-term monthly and annual flows at the intake location are summarized in Table 1. The corresponding annual hydrograph of mean monthly discharge at the Woodfibre Creek gauge is shown on Figure 7. The flow duration curve for the long-term synthetic series at the gauge is shown on Figure 8. The mean annual discharge (MAD) is estimated to be 2.35 m^3/s (1992 to 2020 period), which equates to a mean annual unit runoff of 118 $L/s/km^2$ for the 20 km^2 watershed.

4.0 DISCUSSION

The available Woodfibre Creek gauge measured streamflow record includes approximately four years of measured data, producing a long-term synthetic streamflow timeseries that is of sufficient length for the purpose of assessing “normal” streamflow conditions, where “normal” includes flows between approximately 5% and 200% MAD. The long-term synthetic flow series is considered to be of moderate quality, as Woodfibre Creek is a regulated system where the impacts of regulation cannot be defined with certainty.

The continued field data collection at the Woodfibre Creek gauge is recommended in order to:

- Increase the quality of the stage/discharge rating curves for the purpose of improving the quality of the streamflow records.
- Increase the length of the streamflow records with regional stations to improve calibration regressions for the purpose of generating a reliable long-term synthetic streamflow series.

If you have any questions or comments, please contact the undersigned.

Yours truly,
Knight Piésold Ltd.

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Approval that this document adheres to the Knight Piésold Quality System: SRM

Attachments:

Table 2 Rev 0	Long-Term Synthetic Discharge at Woodfibre Creek (WOOD) Gauge
Figure 1 Rev 0	Woodfibre Creek Watershed
Figure 2 Rev 0	Woodfibre Creek (WOOD) – Rating Curve – Extrapolated to Maximum Recorded Stage
Figure 3 Rev 0	Woodfibre Creek (WOOD) Gauge – Daily Average Discharge Hydrograph
Figure 4 Rev 0	Hydrologic Zones and Regional Hydrology Stations
Figure 5 Rev 0	Woodfibre Creek and Capilano River – Concurrent Unit Runoff
Figure 6 Rev 0	Woodfibre Creek and Capilano River – Frequency Paired Relationship: July
Figure 7 Rev 0	Woodfibre Creek Synthetic Series – Mean Monthly Hydrograph
Figure 8 Rev 0	Woodfibre Creek Synthetic Series – Flow Duration Curves
Appendix A	Woodfibre Creek Hydrologic Analysis

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Ahmed, A., 2017. "Inventory of Streamflow in the South Coast and West Coast Regions", October 2017, Knowledge Management Branch, British Columbia Ministry of Environment and Climate Change Strategy, Victoria, B.C.

Butt, C., (2013). Evaluation of the Performance of Frequency and Chronological Pairing Techniques in Synthesizing Long-Term Streamflow. Master's Thesis, Dept. of Civil Engineering, Faculty of Applied Science, University of British Columbia, Vancouver, BC, Canada.

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Maidment, D.R., 1993. Handbook of Hydrology. McGraw-Hill, Inc., New York, New York.

/skc

Knight Piésold CONSULTING

TABLE 2

WOODFIBRE LNG LTD.
WOODFIBRE LNG PROJECT

LONG-TERM SYNTHETIC DISCHARGE AT WOODFIBRE CREEK (WOOD) GAUGE
(m^3/s)

Print: Aug/31/21 09:27:22

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1960	1.58	1.70	1.65	2.41	2.91	2.75	1.42	1.30	0.94	3.25	2.01	2.02	1.99
1961	3.48	4.26	2.33	2.29	3.74	3.92	1.49	1.29	1.04	2.92	3.08	2.10	2.66
1962	1.75	2.10	1.06	2.41	2.36	3.39	1.66	1.39	1.25	3.27	4.12	3.15	2.33
1963	1.36	3.29	1.79	2.06	2.17	1.73	2.03	1.27	0.83	3.95	4.56	2.36	2.28
1964	1.53	1.34	1.22	1.85	3.37	6.95	5.00	1.31	1.66	1.95	2.79	1.49	2.54
1965	1.13	1.58	1.38	2.32	2.74	2.73	1.34	1.23	0.67	3.88	3.98	2.25	2.10
1966	1.82	1.47	2.27	2.41	3.37	4.66	2.64	1.28	0.98	2.45	3.52	5.14	2.67
1967	2.19	1.91	2.19	1.70	3.88	6.53	2.27	1.28	0.90	6.58	2.28	2.10	2.82
1968	3.29	3.29	3.10	1.49	3.14	4.38	2.72	1.25	1.39	4.38	3.10	2.34	2.82
1969	1.41	1.35	1.72	3.24	4.11	4.70	1.74	1.30	2.70	2.12	2.09	1.94	2.37
1970	1.44	1.49	1.90	2.81	2.00	1.98	1.26	1.29	1.45	2.25	2.86	1.77	1.87
1971	1.68	2.66	1.54	1.75	3.14	4.73	3.66	1.29	1.09	2.45	2.96	0.98	2.33
1974	2.22	1.60	3.14	2.21	3.85	5.87	5.09	1.31	1.08	1.13	3.63	2.08	2.77
1975	1.02	1.02	1.77	1.44	3.71	5.00	2.74	1.52	0.86	5.39	5.24	2.93	2.72
1976	1.30	1.19	1.29	1.94	4.10	4.90	4.29	1.32	1.27	1.51	1.55	2.29	2.25
1977	1.32	1.97	1.53	2.24	2.43	2.56	1.28	1.20	1.68	3.04	3.88	2.42	2.13
1978	1.51	1.78	2.45	1.72	2.69	2.44	1.18	1.18	2.20	1.13	1.65	0.90	1.74
1979	0.77	1.77	2.60	1.93	2.95	2.59	1.77	0.95	1.47	2.80	1.49	3.97	2.09
1980	1.08	3.96	1.38	2.84	2.30	2.20	2.10	1.15	1.27	1.08	6.05	3.79	2.43
1981	1.20	2.78	1.45	2.81	2.39	3.46	1.23	0.86	1.77	5.13	3.72	2.24	2.42
1982	1.12	3.00	1.54	1.97	3.47	6.43	2.43	1.21	0.72	4.14	2.60	2.25	2.57
1983	2.41	5.40	3.29	1.82	3.04	3.77	3.86	1.27	1.10	1.70	7.22	0.95	2.99
1984	2.16	2.76	2.58	2.13	3.24	4.54	2.65	1.21	0.88	3.36	3.91	1.15	2.55
1985	0.98	0.97	1.06	2.52	2.98	3.38	1.35	1.08	0.76	3.60	1.75	1.15	1.80
1986	2.53	2.49	3.22	1.57	3.63	2.36	1.56	0.88	0.77	1.10	2.86	2.58	2.13
1987	2.24	1.98	3.88	2.11	3.80	2.42	1.57	0.93	0.69	0.80	2.90	2.20	2.13
1988	1.42	1.52	1.74	2.69	3.75	3.24	1.85	1.21	1.05	1.59	4.71	1.73	2.21
1989	1.54	1.45	1.89	2.80	3.02	3.43	2.14	1.23	0.66	3.01	3.69	1.78	2.22
1990	1.53	1.35	1.77	2.60	2.50	3.63	1.24	1.22	0.84	2.21	7.28	1.58	2.31
1991	1.71	5.42	1.13	2.42	2.60	2.18	1.39	2.91	0.81	0.71	3.94	2.19	2.28
1992	4.65	2.66	1.59	3.50	1.58	1.59	1.19	1.17	1.14	3.91	3.09	1.10	2.26
1993	1.26	1.25	3.05	3.65	2.99	2.12	1.24	1.19	0.65	1.46	1.97	3.16	2.00
1994	2.51	2.55	4.29	2.40	2.32	2.61	1.66	0.97	0.75	1.86	2.18	3.96	2.34
1995	2.65	3.44	3.19	1.98	2.78	2.39	1.49	1.29	0.73	3.77	7.54	3.51	2.90
1996	2.79	2.53	1.77	3.42	2.14	1.63	1.24	1.02	0.78	3.08	2.78	1.72	2.08
1997	2.80	1.18	3.58	3.35	4.08	4.10	2.81	1.15	2.10	4.92	3.76	1.83	2.97
1998	2.64	2.82	1.91	1.36	2.73	2.05	1.69	1.04	0.64	2.23	6.00	2.98	2.34
1999	2.03	1.88	2.16	2.04	3.26	6.71	5.51	1.32	0.89	2.31	5.26	2.37	2.98
2000	1.10	1.46	1.55	2.15	3.42	5.56	2.29	1.20	0.88	2.65	1.50	1.40	2.09
2001	1.50	1.01	1.79	1.99	2.87	2.40	1.21	1.71	0.85	1.90	4.28	2.01	1.96
2002	2.75	1.74	1.24	3.41	3.51	5.35	1.67	1.10	0.92	0.69	4.43	1.98	2.40
2003	2.75	1.18	4.04	2.52	1.90	1.87	1.17	0.81	0.75	5.19	2.05	2.04	2.19
2004	2.23	1.45	2.06	1.96	2.25	2.03	1.06	1.08	1.44	2.30	3.31	2.37	1.96
2005	3.72	1.06	2.26	3.01	2.71	1.58	1.97	0.81	0.84	3.21	2.75	3.38	2.27
2006	2.47	1.48	1.67	2.00	3.20	4.05	1.39	1.07	0.70	1.07	6.07	2.18	2.28
2007	1.83	2.00	5.11	2.73	3.25	4.71			1.31	3.86	3.11	2.61	
2008	1.16	1.10	1.50	1.36	4.44	4.33	2.32	1.29	0.77	2.46	3.75	1.12	2.13
2009	1.34	1.25	1.74	2.19	3.44	2.48	1.06	1.15	1.00	3.17	7.01	2.38	2.35
2010	3.95	2.47	1.62	2.37	2.38	3.36	1.71	1.06	1.54	3.31	2.36	3.26	2.45
2011	2.20	1.65	2.51	1.71	3.37	5.98	4.14	1.35	1.54	2.32	2.67	1.45	2.57
2012	2.20	1.48	1.64	3.15	3.25	5.31	3.03	1.09	0.65	3.21	4.77	2.04	2.65
2013	1.00	1.25	4.05	3.45	3.78	2.93	1.21	0.85	2.68	1.41	1.68	1.06	2.11
2014	1.54	1.08	3.49	2.54	2.92	1.63	1.21	1.07	1.04	5.02	5.11	3.90	2.55
2015	2.10	3.62	3.14	1.30	0.99	0.58	0.63	1.00	1.77	1.56	3.74	3.73	2.01
2016	3.86	2.97	4.07	2.23	1.82	1.95	1.53	0.94	0.81	5.16	6.04	1.00	2.70
2017	1.92	2.46	3.26	3.67	4.36	4.64	1.68	0.98			5.79	1.27	
2018	3.07												
2019				2.55	2.10	1.28	1.13	0.94	2.48	2.33	1.59	1.59	
2020	3.94	1.92	1.37	1.80	3.33	2.61	1.44	1.18	3.22	2.11	2.88	2.20	2.33
2021	2.77	1.31	1.56	1.85	2.71	4.34	1.11						
Average	**2.06**	**2.09**	**2.26**	**2.34**	**3.00**	**3.47**	**2.01**	**1.19**	**1.19**	**2.80**	**3.67**	**2.23**	**2.35**
Maximum	**4.65**	**5.42**	**5.11**	**3.67**	**4.44**	**6.95**	**5.51**	**2.91**	**3.22**	**6.58**	**7.54**	**5.14**	**2.99**
Minimum	**0.77**	**0.97**	**1.06**	**1.30**	**0.99**	**0.58**	**0.63**	**0.81**	**0.64**	**0.69**	**1.49**	**0.90**	**1.74**

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER VA22-01360	SKC	TJP



Woodfibre Creek Watershed

LOCATION TO:	DRAINAGE AREA (km)
Woodfibre Creek Mouth	22
Woodfibre Creek Gauge	20

LEGEND:

- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

0 0.5 1 2 3 4 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	23SEP'22	ISSUED WITH LETTER	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

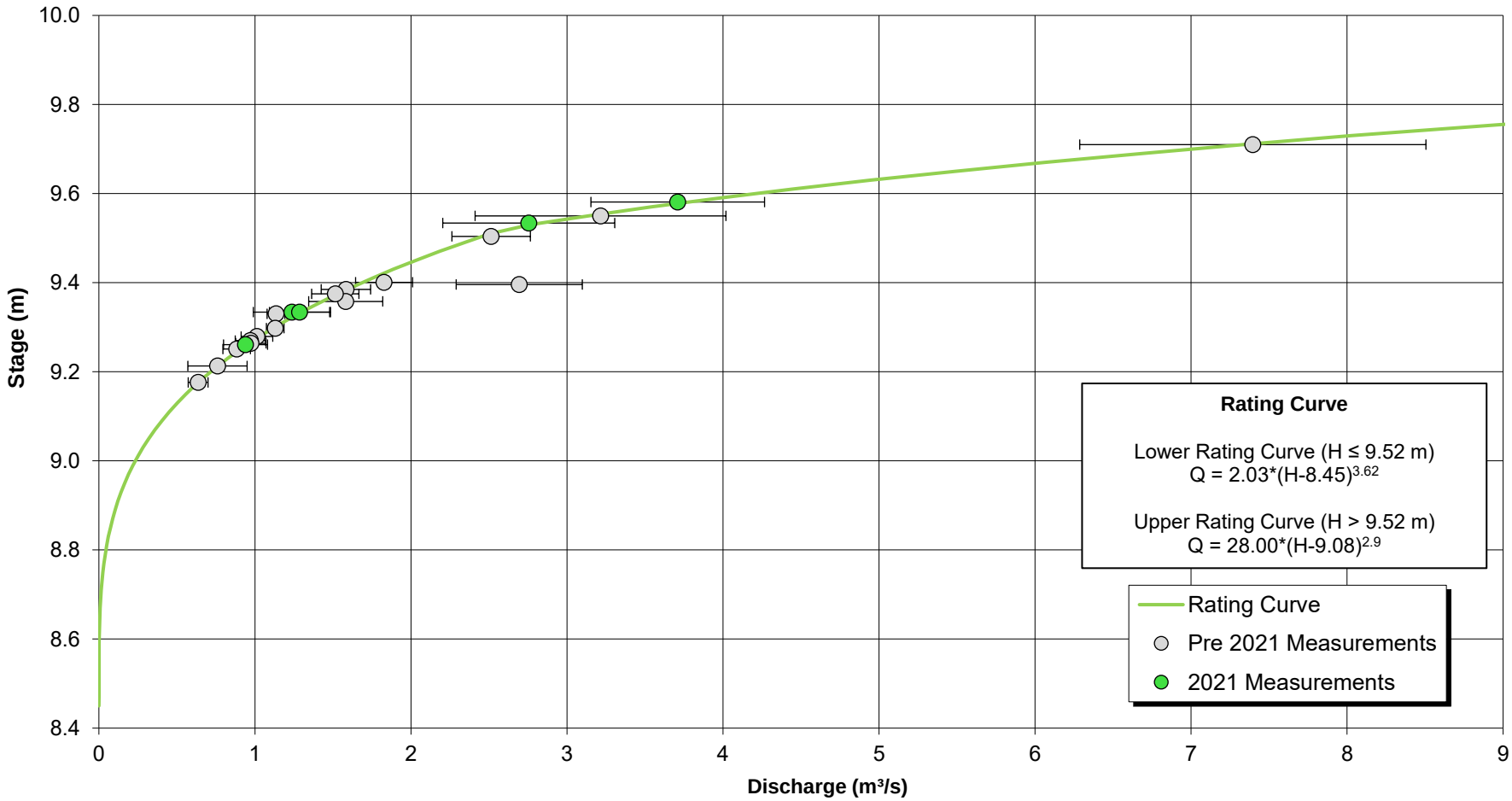
WOODFIBRE CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-00494/24	VA22-01360

FIGURE 1 REV 0

SAVED: M:\103\00494\24\A\GIS\Figs\VA22-01360\Fig1_Woodfibre_Watershed_r0.mxd: Sep. 23, 2022 9:30 AM: kkrauszova



REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER VA22-01360	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK (WOOD)
RATING CURVE
EXTRAPOLATED TO MAXIMUM RECORDED STAGE

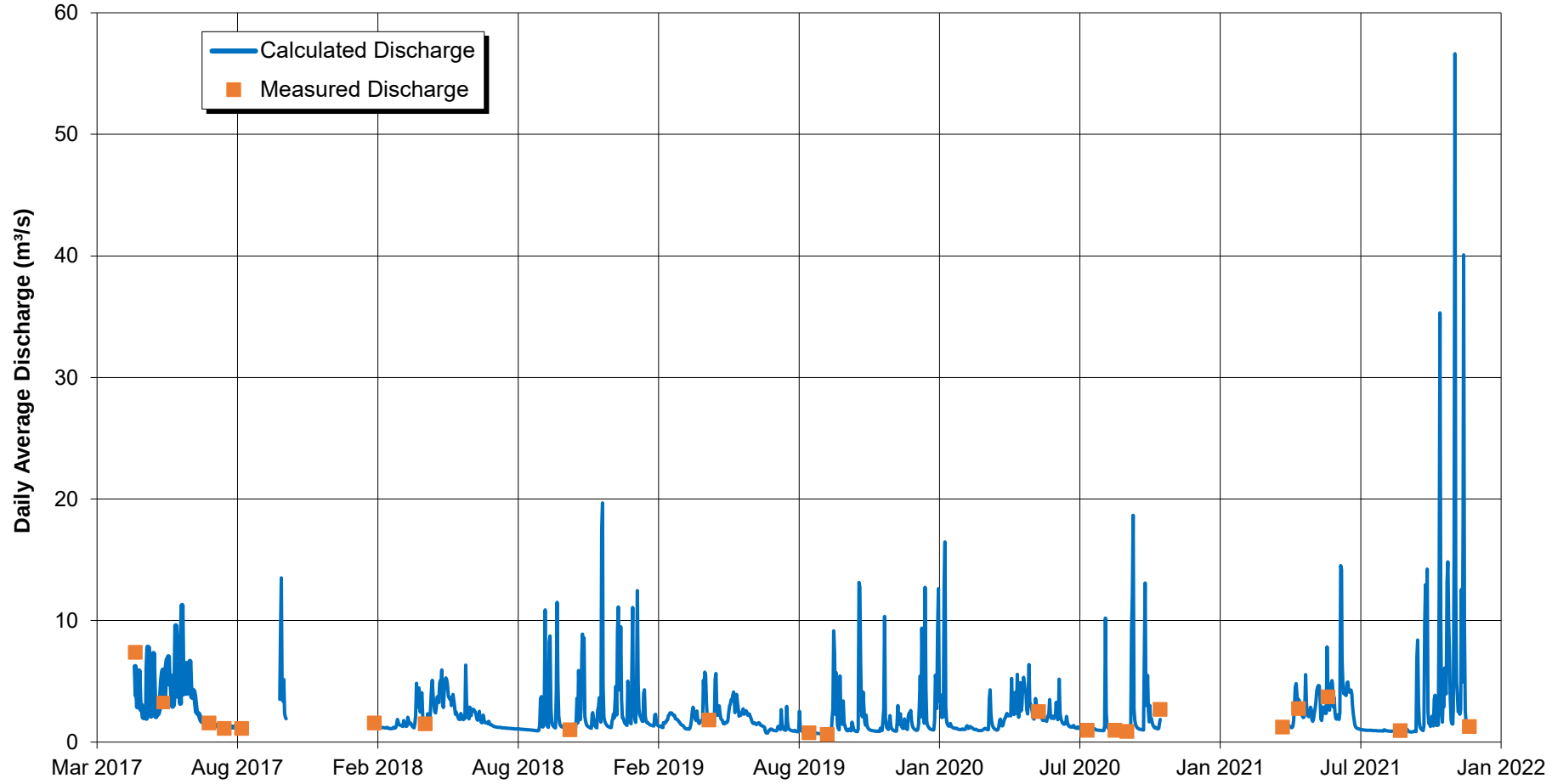
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 2

REV 0



NOTE:
1. MANUAL MEASUREMENTS OF INSTANTANEOUS DISCHARGE DO NOT NECESSARILY MATCH DAILY AVERAGE DISCHARGE ON THE SAME DATE DUE TO DAILY FLUCTUATIONS IN DISCHARGE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER VA22-01360	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK (WOOD) GAUGE
DAILY AVERAGE DISCHARGE HYDROGRAPH

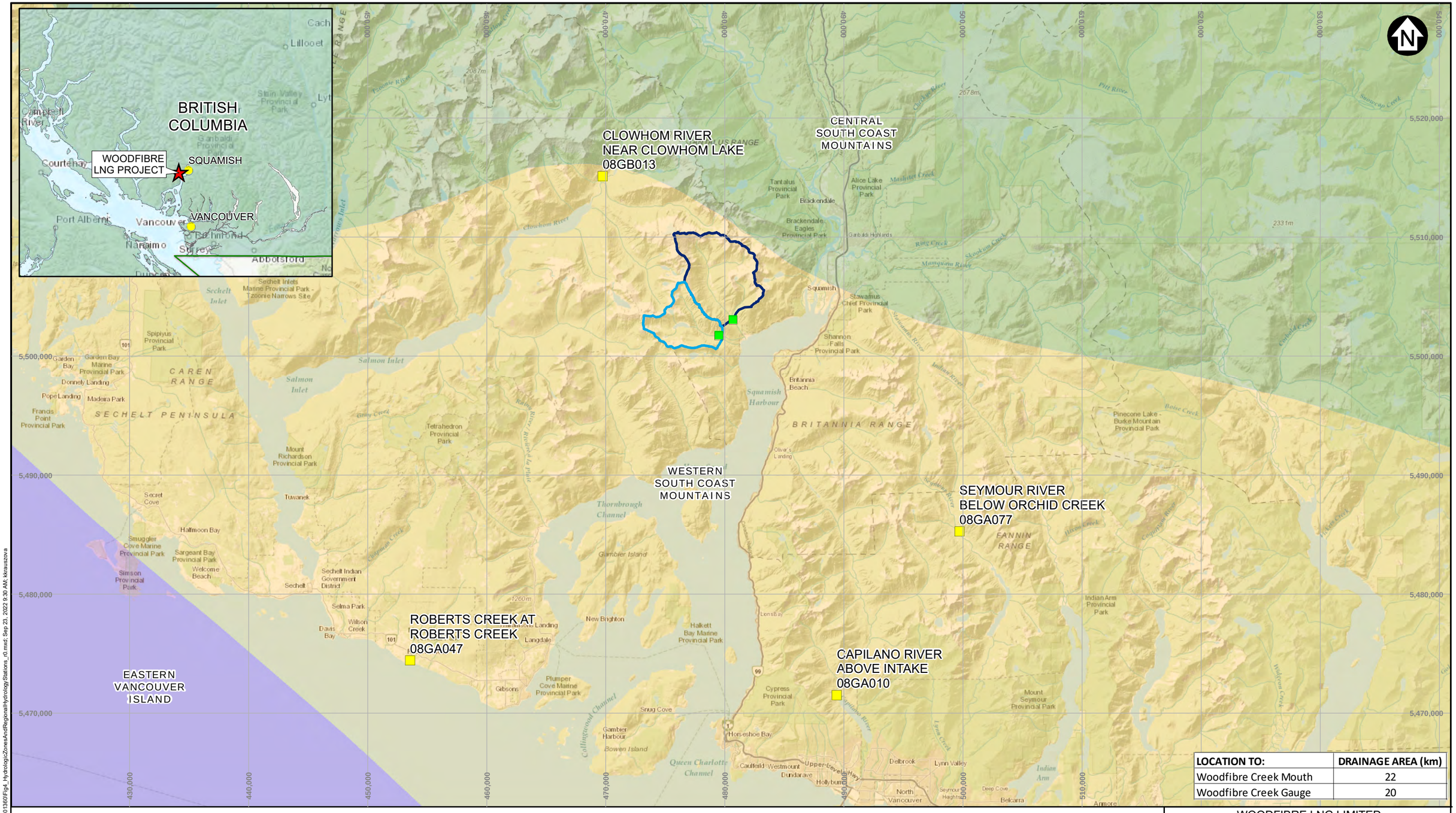
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 3

REV 0



LOCATION TO:	DRAINAGE AREA (km)
Woodfibre Creek Mouth	22
Woodfibre Creek Gauge	20

LEGEND:

- WSC STATION
- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WOODFIBRE CREEK WATERSHED BOUNDARY
- MILL CREEK WATERSHED BOUNDARY

HYDROLOGIC ZONE

- CENTRAL SOUTH COAST MOUNTAINS (ZONE 26)
- EASTERN VANCOUVER ISLAND (ZONE 28)
- WESTERN SOUTH COAST MOUNTAINS (ZONE 27)

0 3.75 7.5 15 22.5 30 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:300,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	23SEP'22	ISSUED WITH LETTER	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

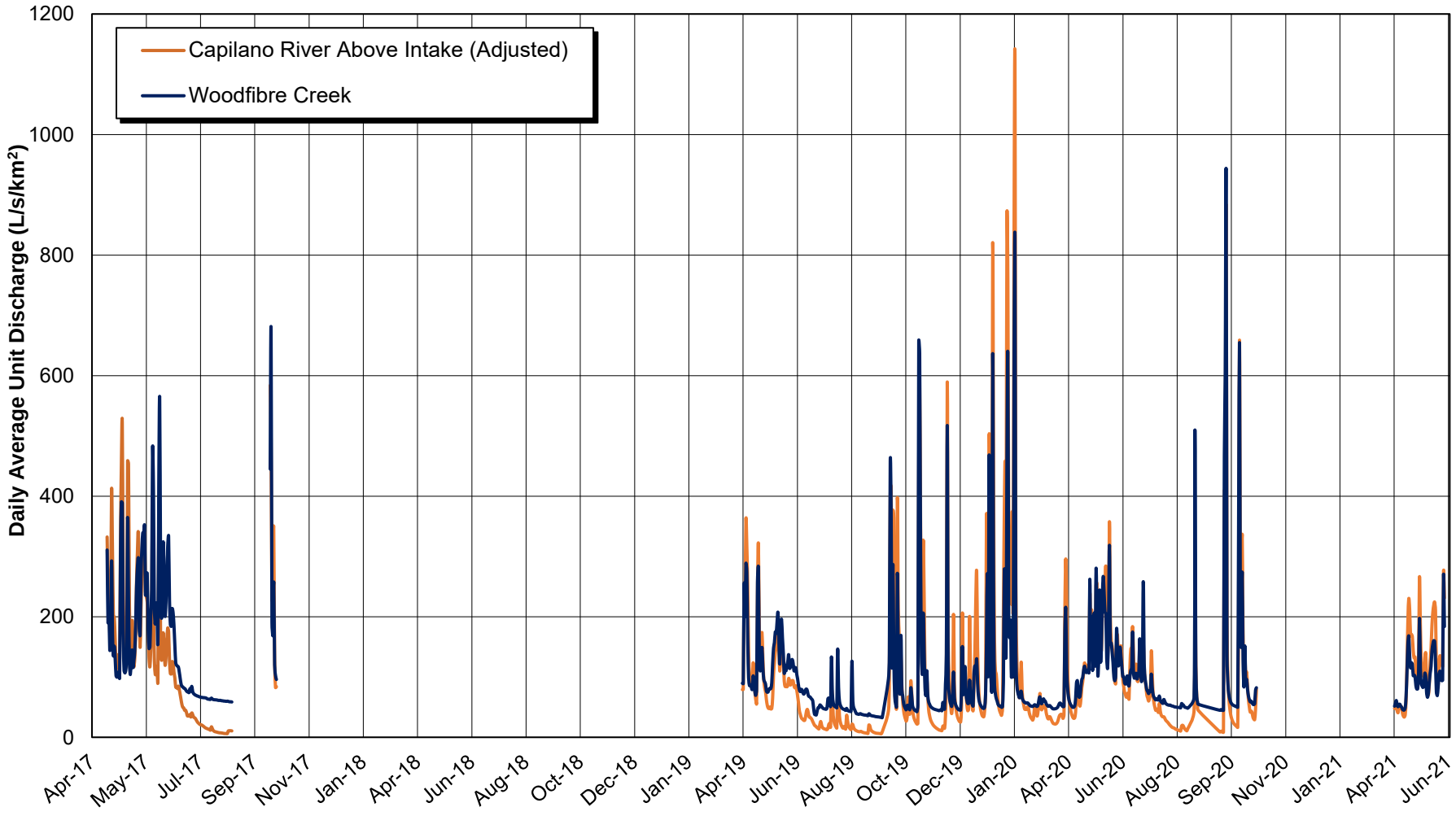
HYDROLOGIC ZONES AND REGIONAL HYDROLOGY STATIONS

Knight Piésold CONSULTING

P/A NO. VA103-00494/24 | REF NO. VA22-01360

FIGURE 4 REV 0

SAVED: M:\103\00494\24\A\GIS\Figs\VA22-01360\Fig4_HydrologicZonesAndRegionalHydrologyStations_r0.mxd: Sep 23, 2022 9:30 AM: kkrauszova



NOTES:
1. PERIOD OF RECORD FOR CONCURRENT PROJECT AND WSC STATION DISCHARGE IS APRIL 2017 TO MAY 2021.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK AND CAPILANO RIVER CONCURRENT UNIT RUNOFF

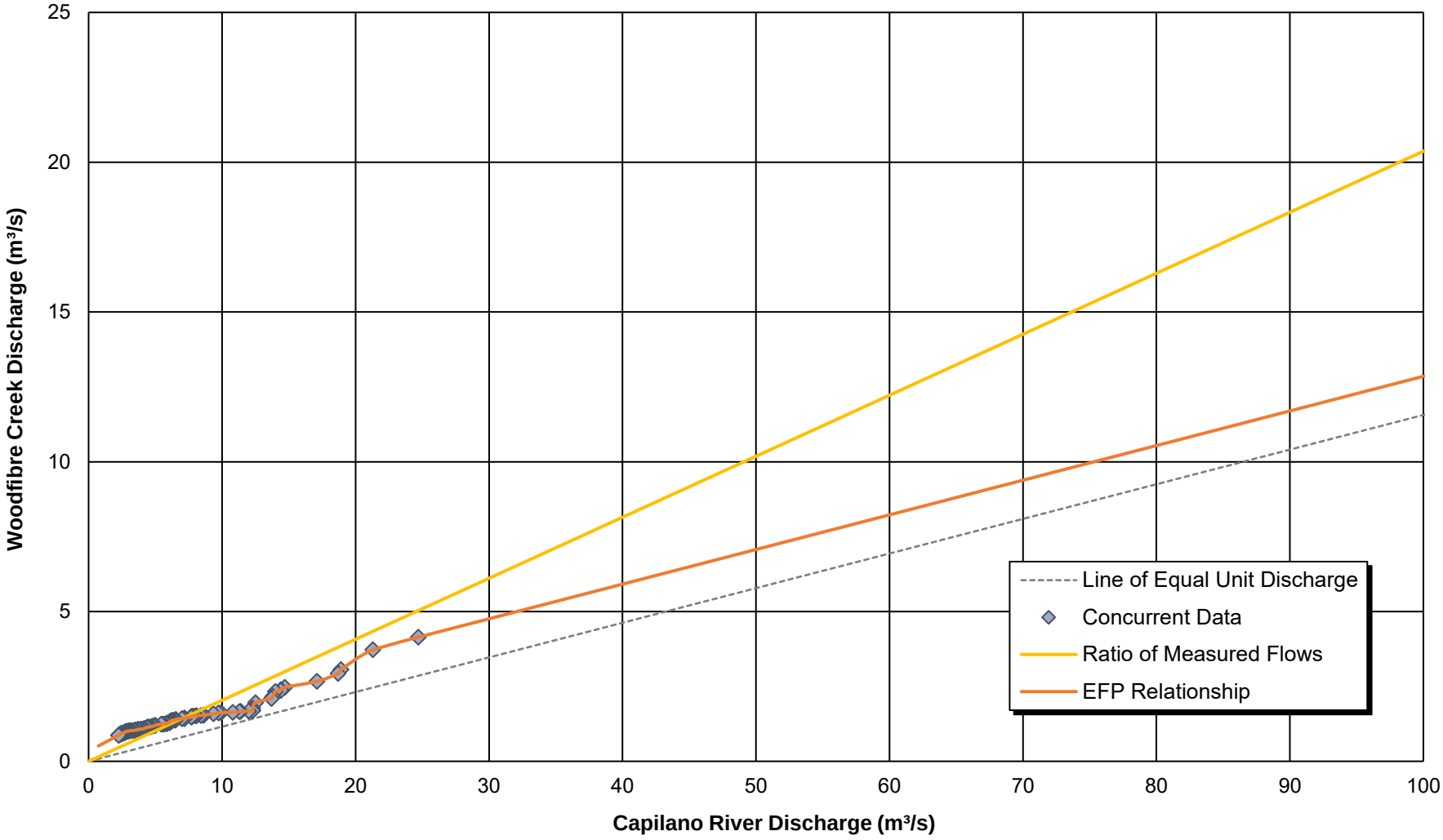
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 5

REV 0



NOTES:
1. PERIOD OF RECORD USED FOR CONCURRENT PROJECT AND WSC STATION DISCHARGE IS APRIL 1, 2019 TO MAY 28, 2021

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK AND CAPILANO RIVER FREQUENCY PAIRED RELATIONSHIP: JULY

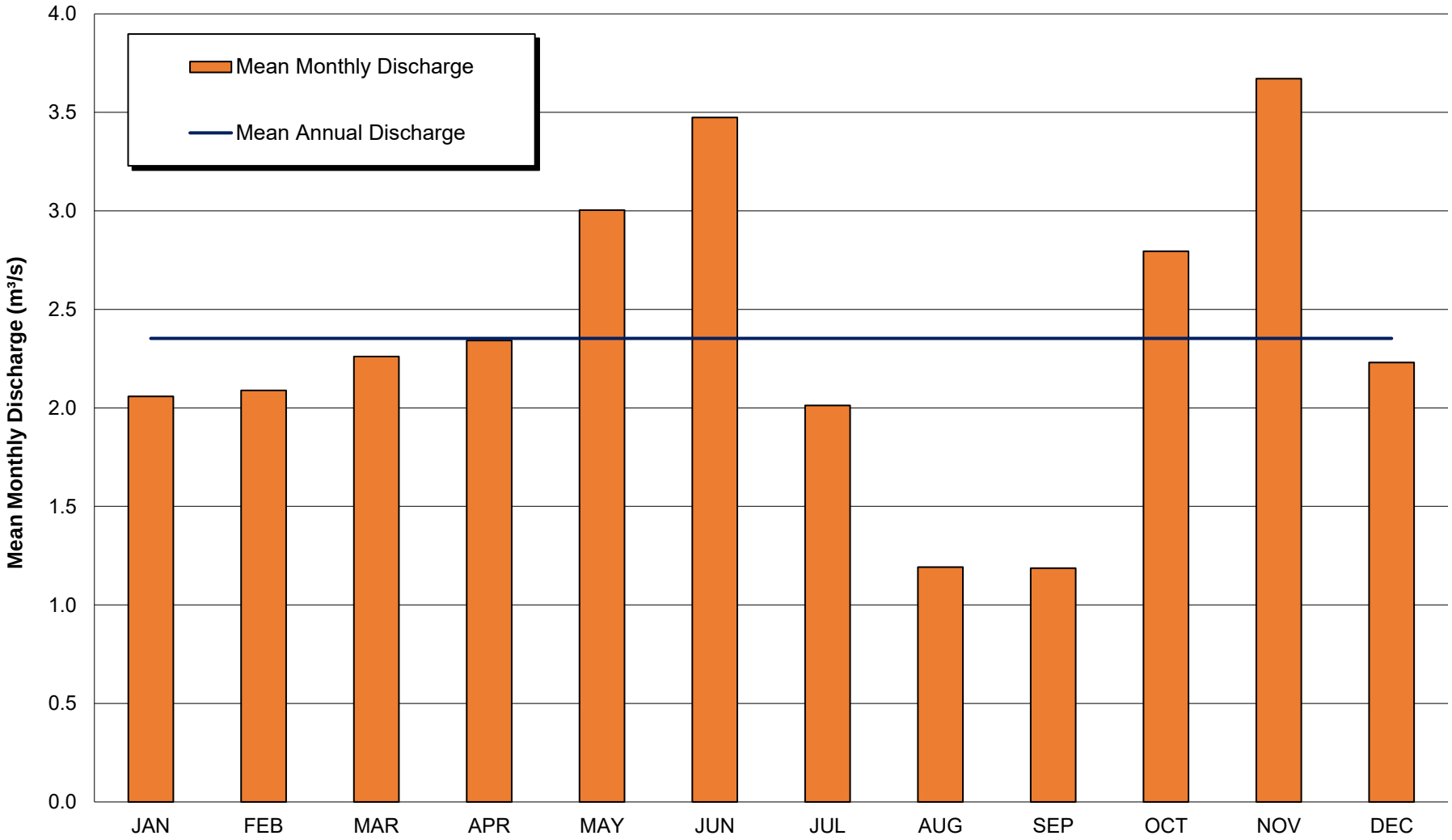
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 6

REV 0



NOTES:
1. MEAN MONTHLY FLOWS ESTIMATED FROM LONG-TERM SYNTHETIC SERIES (1960 - 2021).
2. MEAN ANNUAL DISCHARGE IS 2.35 m^3/s

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK SYNTHETIC SERIES MEAN MONTHLY HYDROGRAPH

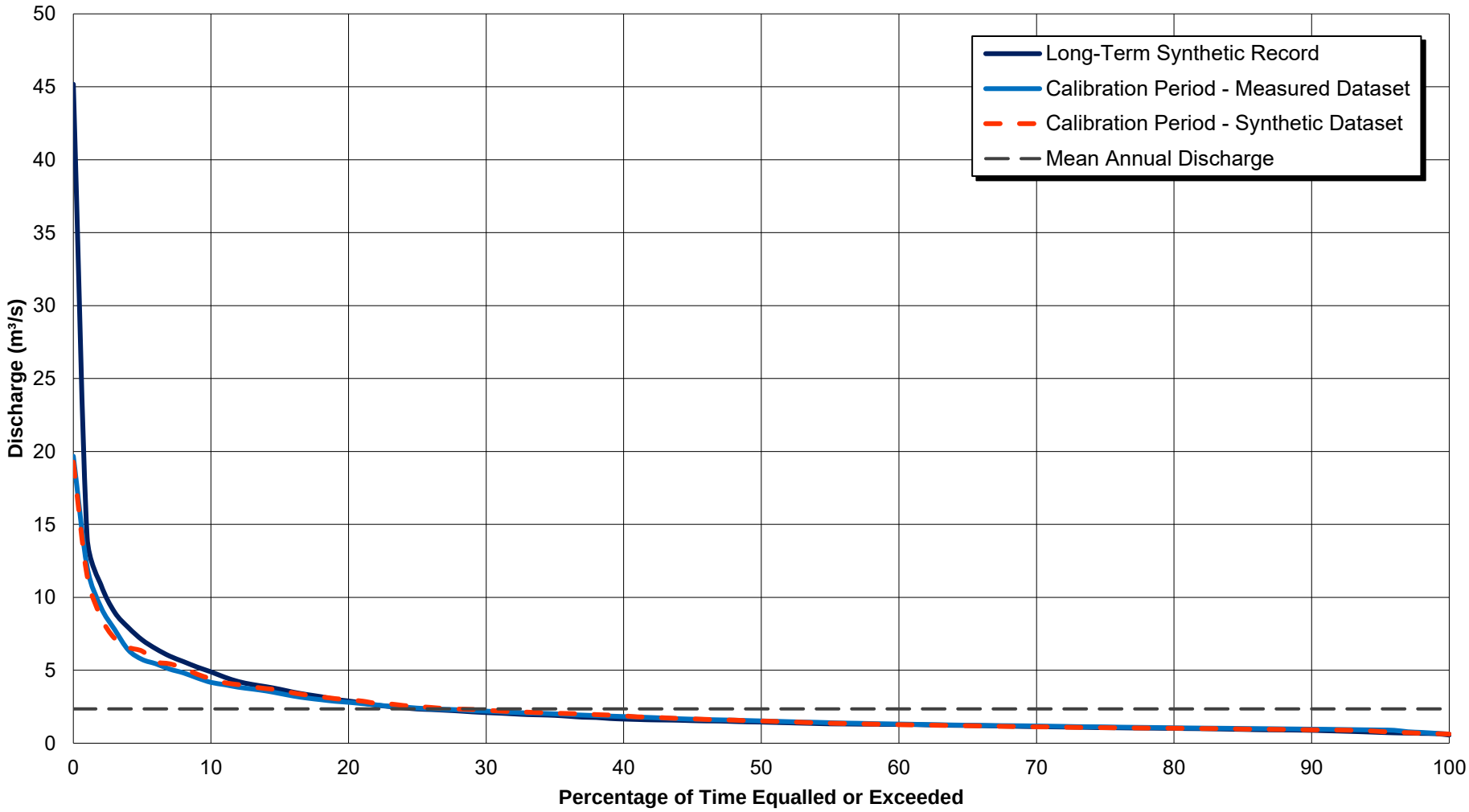
Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 7

REV 0



NOTES:
1. PERIOD OF RECORD FOR CONCURRENT PROJECT AND WSC STATION DISCHARGE IS APRIL 2017 TO MAY 2021.
2. THE PERIOD OF RECORD FOR THE LONG-TERM SYNTHETIC SERIES IS JAN 1, 1960 TO JULY 25, 2021, WITH GAPS IN THE RECORD IN 1972-1973 AND 2017-2021.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	26JUL'22	ISSUED WITH LETTER	SKC	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK SYNTHETIC SERIES FLOW DURATION CURVES

Knight Piésold CONSULTING

P/A NO. VA103-494/24

REF. NO. VA22-01360

FIGURE 8

REV 0

APPENDIX A

Woodfibre Creek Hydrologic Analysis

(Pages A-1 to A-8)

Knight Piésold CONSULTING

Management System Certified by: bsi ISO 9001 ISO 14001 ISO 45001 CERTIFIED

February 22, 2022

Darren Cowan
Permitting Manager
Woodfibre LNG Limited
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Canada, V6E 4E6

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Dear Darren,

RE: Woodfibre Creek Hydrologic Analysis

Woodfibre LNG Limited (Woodfibre LNG) is developing a liquefied natural gas (LNG) export facility (the Project) on the former Woodfibre Pulp and Paper Mill site, located near Squamish, British Columbia (BC). Knight Piésold Ltd. (KP) has been retained by Woodfibre LNG to assist with the hydrometric monitoring of Woodfibre Creek, in support of water availability studies and Project permitting. As part of this work, KP has installed and operated streamflow gauging stations on Mill Creek and Woodfibre Creek. This letter presents the details of the Woodfibre Creek field data collection by KP and the available measured record from April 2017 to November 2021.

1.0 HYDROLOGIC SETTING

The Project area is located within Hydrologic Zone 27 (Western South Coast Mountains), on the boundary with Zone 26, as presented by Ahmed (2017). In this zone, Pacific frontal systems encounter the abruptly rising terrain of the Coast Mountains and produce large quantities of precipitation as they are forced upward. Spatial variability in annual precipitation is extensive due to orographic enhancement on windward slopes and rain shadow effects in leeward areas. The proportion of precipitation falling as snow varies with elevation, with little snow falling at sea level and large snowpacks accumulating on upper mountain slopes. Even at high elevations, however, winter rainfall and snowmelt are common, leading to a complex hydrologic regime. In general, streamflow in South Coast watersheds like Woodfibre Creek (i.e. coastal, but also with high elevation mountainous terrain) is highest in autumn due to frontal rainstorm activity, with a secondary peak in spring due to snowmelt. Flows are lowest in late summer when precipitation is low. Winter flows tend to be moderate as much of the precipitation falls as snow but can be punctuated by warm rainfall events and rainfall at lower elevation.

Mean annual precipitation varies from only 1,490 mm at Gibsons, located approximately 35 km southwest of the Project, to 3,322 mm at Port Mellon, located 25 km southwest of the Project and then to 2,230 mm in Squamish. This is indicative of topographic convergence of frontal systems in Howe Sound, and extreme orographic enhancement of precipitation due to rapid uplift. Similarly, mean annual unit runoff varies dramatically from 125 l/s/km^2 (or 4,000 mm) in Rainy River, located near Port Mellon and 116 l/s/km^2 (or 3,660 mm) in Capilano River, located close to the Project area, to only 32 l/s/km2 (or 1,000 mm) in Roberts Creek, located 40 km to the southwest and with a lower elevation basin.

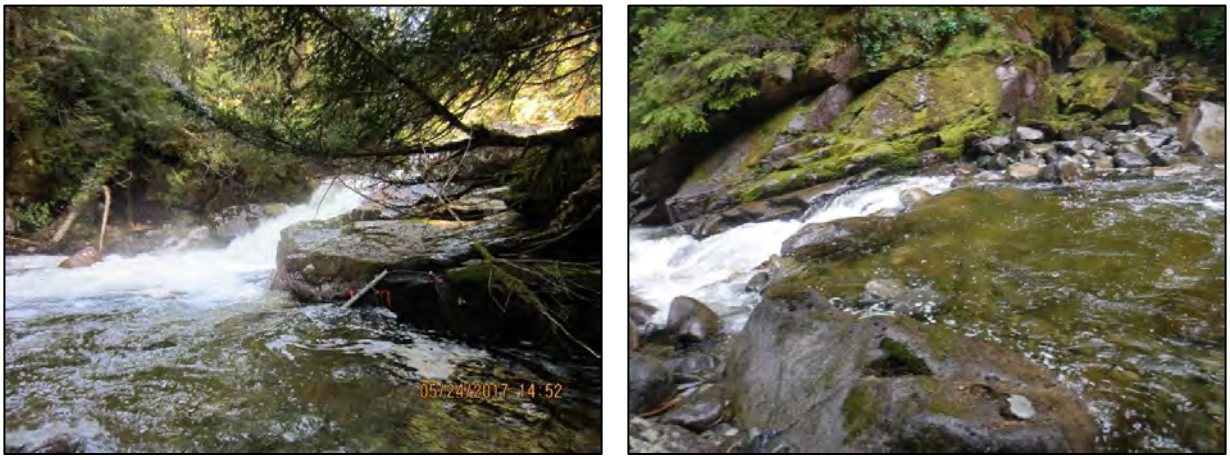
The median watershed elevation above the Woodfibre Creek gauge is 1,057 meters above sea level and glaciers cover a negligible area in the watershed. The watershed area at the streamflow gauging station is

20 km^2, increasing to 22 km^2 at the mouth. Over the 100+ year history of activity at the Woodfibre mill site, there has been a significant amount of water management infrastructure built in the Woodfibre Creek watershed. Flow diversions, reservoir construction and flow regulation were undertaken to provide water for power and mill operations. Although not currently operated, these structures continue to effect streamflow conditions in Woodfibre Creek and the flow regime should be considered regulated. The Woodfibre Creek watershed is shown on Figure 1.

2.0 STREAMFLOW DATA COLLECTION

2.1 WOOD STATION

KP installed a hydrometric station (WOOD) on Woodfibre Creek approximately 100 meters upstream of the existing hydropower intake in April 2017. The location is shown on Figure 1. The station is located on the left bank of a pool, downstream of a cascade, as shown on Photo 1a. Water level is hydraulically controlled by a cascade at the outlet of the pool, shown on Photo 1b. The low-flow control section consists of cobbles between large boulders, while the high-flow control also includes the bedrock banks. The hydrometric station consists of a pressure transducer connected to a datalogger that records stage at fifteen-minute intervals. The pressure transducer and datalogger were replaced at the end of the 2020 monitoring program as part of routine maintenance.



(a) (b)

Photo 1 (a) WOOD Station looking upstream (May 24, 2017), and (b) looking downstream at the hydraulic control (July 20, 2017)

2.1.1 WOOD RATING CURVE AND DISCHARGE HYDROGRAPH

A total of 21 stage/discharge measurements have been collected at WOOD, as summarized in Table 1. The discharge measurements were conducted using area-velocity or Rhodamine dye dilution methods, depending on flow conditions at the time of each site visit. The station includes three benchmarks, located in bedrock above the normal high-water level, and two reference marks for determining stage. Benchmark 1 was assigned an elevation of 10 m and this datum is used for converting water level to gauge height (stage). Twenty of the 21 stage-discharge measurements were used to develop a rating curve for the gauge. One data point, collected in October 2020, falls outside the rating curve and is considered erroneous.

One rating curve was plotted through the 20 applicable stage-discharge points using the standard form for a rating curve equation (power function), with the constant, offset, and exponent constrained within

expected values based on hydraulic theory (Maidment, 1993) and experience with similar conditions in mountainous streams. The rating curve is shown on Figure 2. The number and distribution of discharge measurements delineating the rating curve meets the RISC (2018) recommendations over the measured range of flows and, in particular, over the range of flows most relevant to the water availability studies and Project permitting. Due to upstream flow regulation, low flows collected at the WOOD station have not fallen below 0.6 m^3/s and are concentrated between 0.6 m^3/s to 1.1 m^3/s.

All data points collected in 2021 fall on the rating curve, suggesting that the curve is stable and no shift has occurred during the period of record. The data collected at WOOD is considered to meet Grade A standards based on the B.C. Hydrometric RISC standards (2018), except RISC (2018) notes that rating curves developed from dilution methods should be graded as "BP" (i.e., Best Practice) due to lack of Provincial guidelines on the method.

The daily average discharge hydrograph for WOOD is presented on Figure 3, which was developed by applying the rating curve to the available stage record and then averaging the fifteen-minute streamflow record over a calendar day. The hydrograph has gaps from September 5, 2017 to October 17, 2017, from October 25, 2017 to February 13, 2017, and from October 29, 2020 to April 1, 2021 (dates are inclusive) due to logger malfunctions.

3.0 DISCUSSION

Streamflow gauging will continue on Woodfibre Creek to support the water availability studies and Project permitting. The rating curve is believed to accurately calculate streamflow over the range of conditions most important for the water availability studies and Project permitting. However, over the last three years of monitoring flows have not fallen below 0.6 m^3/s. Low flow measurements will continue to be targeted to improve low flow rating curve accuracy. At least five site visits covering an adequate range of streamflows should be conducted annually at the Woodfibre Creek gauging station to confirm rating curve stability and meet the Grade A standard for data collection guidelines outlined in RISC (2018).

Yours truly,
Knight Piésold Ltd.

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
T. J. PERKINS
32079
2022-02-22

Prepared: Kaelan Hagen, GIT
Project Scientist

Reviewed: Toby Perkins, M.A.Sc., P.Eng.
Senior Engineer

Approval that this document adheres to the Knight Piésold Quality System: SRW

Attachments:

Table 1 Rev 0	Summary of Discharge Measurements
Figure 1 Rev 0	Woodfibre Creek Watershed
Figure 2 Rev 0	Woodfibre Creek (WOOD) Rating Curve – Extrapolated to Maximum Recorded Stage-Discharge Measurement
Figure 3 Rev 0	Woodfibre Creek (WOOD) Daily Average Discharge Hydrograph

References

Ahmed, A. (2017). “Inventory of Streamflow in the South Coast and West Coast Regions”, October 2017, Knowledge Management Branch, British Columbia Ministry of Environment and Climate Change Strategy, Victoria, B.C.

Maidment, David R. (1993). Handbook of hydrology. Vol. 9780070. McGraw-Hill, New York.

Resources Information Standards Committee (RISC). 2018. Manual of British Columbia Hydrometric Standards, Version 2.0, December 2018. Knowledge Management Branch, B.C. Ministry of Environment and Climate Change Strategy, Victoria, B.C.

/krh

Knight Piésold CONSULTING

TABLE 1

WOODFIBRE LNG LTD.
WOODFIBRE LNG PROJECT

WOODFIBRE CREEK (WOOD)
SUMMARY OF DISCHARGE MEASUREMENTS

Print Feb/22/22 10:53:33

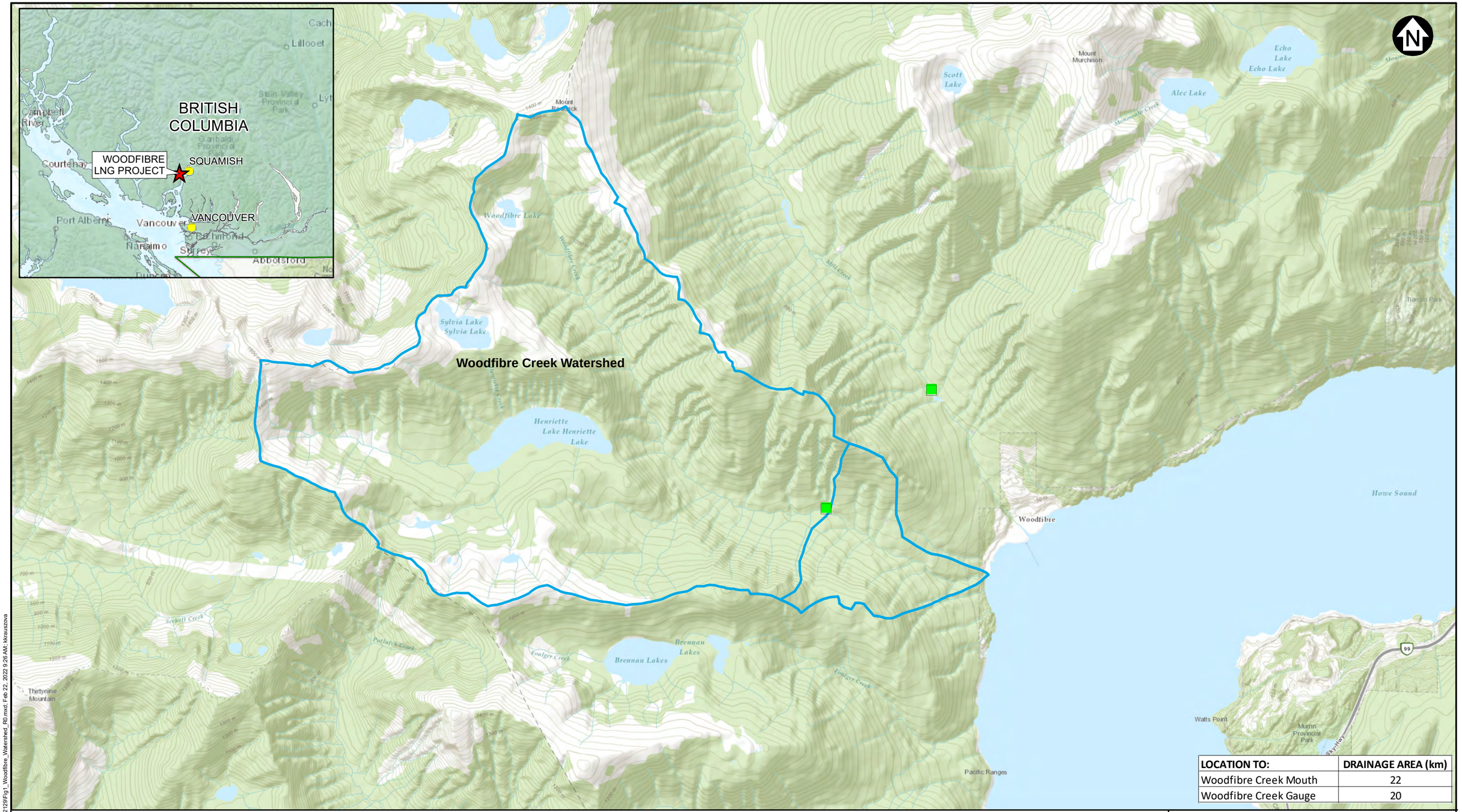
Date	Number of Gaugings	Method	Stage [m]	Stage +/- [m]	Discharge [m^3/s]	Discharge Error
4/18/2017	3	Dye Dilution	9.71	0.010	7.40	15%
5/24/2017	3	Dye Dilution	9.55	0.010	3.22	>25 %
7/20/2017	2	Area-Velocity	9.39	0.005	1.58	10%
8/8/2017	2	Area-Velocity	9.33	0.005	1.14	5%
8/30/2017	2	Area-Velocity	9.30	0.010	1.13	5%
2/13/2018	4	Dye Dilution	9.36	0.010	1.58	15%
4/18/2018	4	Dye Dilution	9.38	0.010	1.52	10%
10/17/2018	2	Area-Velocity	9.28	0.020	1.01	10%
4/10/2019	5	Dye Dilution	9.40	0.010	1.83	10%
8/14/2019	2	Area-Velocity	9.21	0.005	0.76	5%
9/6/2019	2	Area-Velocity	9.18	0.002	0.64	10%
5/29/2020	4	Dye Dilution	9.50	0.020	2.51	10%
7/29/2020	2	Area-Velocity	9.27	0.010	0.97	10%
9/2/2020	2	Area-Velocity	9.26	0.020	0.97	10%
9/17/2020	2	Area-Velocity	9.25	0.005	0.88	10%
10/29/2020	3	Dye Dilution	9.40	0.010	2.69	15%
4/1/2021	3	Dye Dilution	9.33	0.010	1.24	20%
4/21/2021	3	Dye Dilution	9.53	0.020	2.76	20%
5/28/2021	3	Dye Dilution	9.58	0.020	3.71	15%
8/27/2021	4	Dye Dilution	9.26	0.010	0.94	15%
11/22/2021	4	Dye Dilution	9.33	0.020	1.29	15%

\\KPL\VA-Prj$\1\03\00494\18\A\Data\Hydrology\End of Year 2021 QAQC\WOOD\[WOOD QAQC_Nov2021.xlsm]Q Table

NOTES:

1) NUMBER OF GAUGINGS REFERS TO THE NUMBER OF GAUGINGS AVERAGED TO PRODUCE ONE RATING POINT.
2) DISCHARGE ERROR REFERS TO THE IN-SITU MEASUREMENT ERROR ESTIMATED BY THE FIELD ENGINEER.
3) STAGE ERROR IS BASED ON A VISUAL ASSESSMENT OF THE WAVE AMPLITUDE IN THE GAUGE POOL.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER VA21-02129	KRH	TJP



LOCATION TO:	DRAINAGE AREA (km)
Woodfibre Creek Mouth	22
Woodfibre Creek Gauge	20

LEGEND:

- ACTIVE WOODFIBRE LNG HYDROLOGY GAUGE
- WATERSHED BOUNDARY

0 0.5 1 2 3 4 Km

NOTES:

1. BASE MAP: ESRI WORLD TOPOGRAPHIC MAP.
2. COORDINATE GRID IS IN METRES.
COORDINATE SYSTEM: NAD 1983 UTM ZONE 10N.
3. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:40,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

REV	DATE	DESCRIPTION	DESIGNED	DRAWN	REVIEWED
0	22FEB'22	ISSUED WITH LETTER	TJP	KK	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

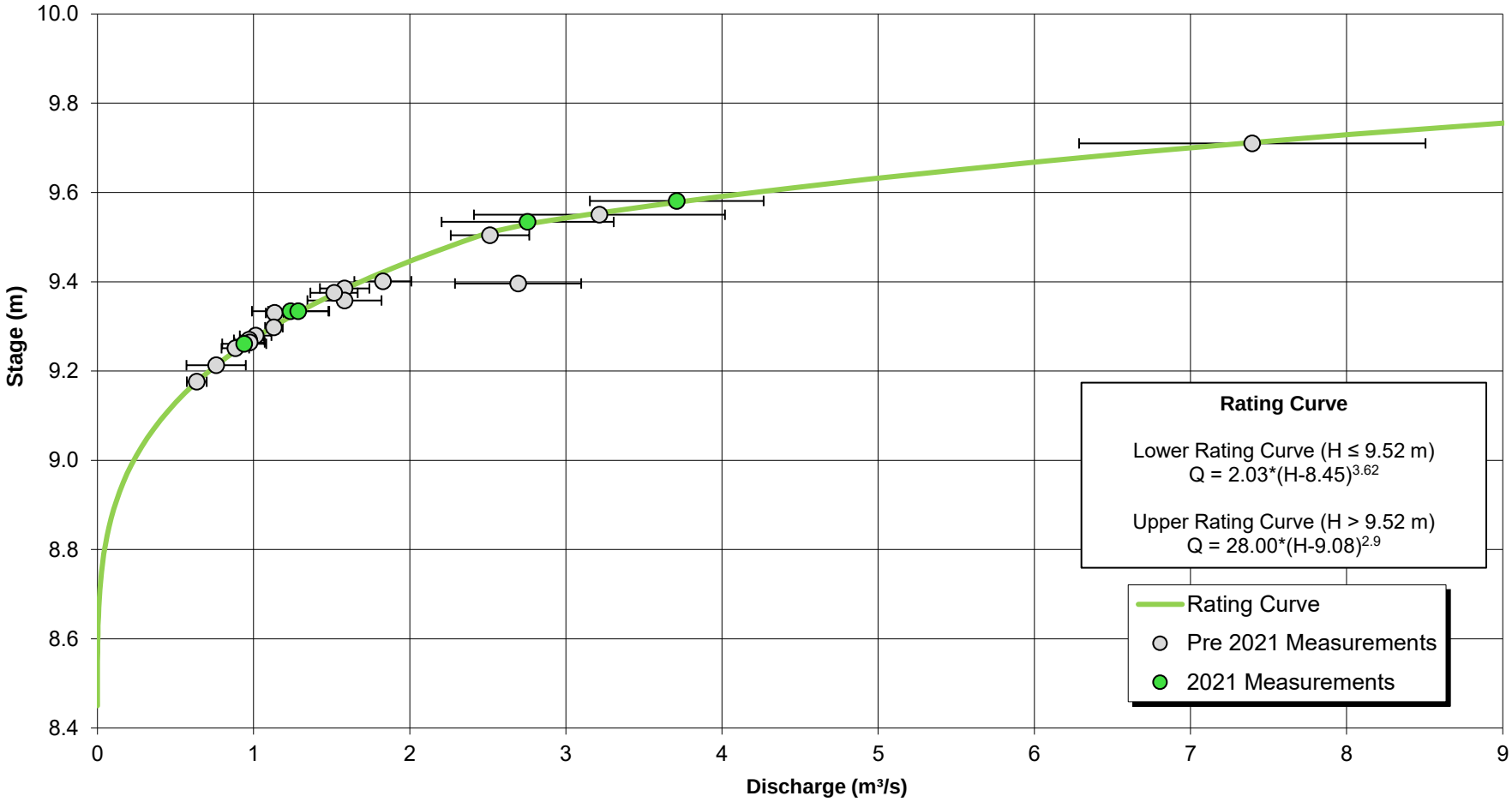
WOODFIBRE CREEK WATERSHED

Knight Piésold CONSULTING

P/A NO.	REF NO.
VA103-00494/18	VA21-02129

FIGURE 1 REV 0

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REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER VA21-02129	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK (WOOD)
RATING CURVE - EXTRAPOLATED TO MAXIMUM RECORDED STAGE-DISCHARGE MEASUREMENT

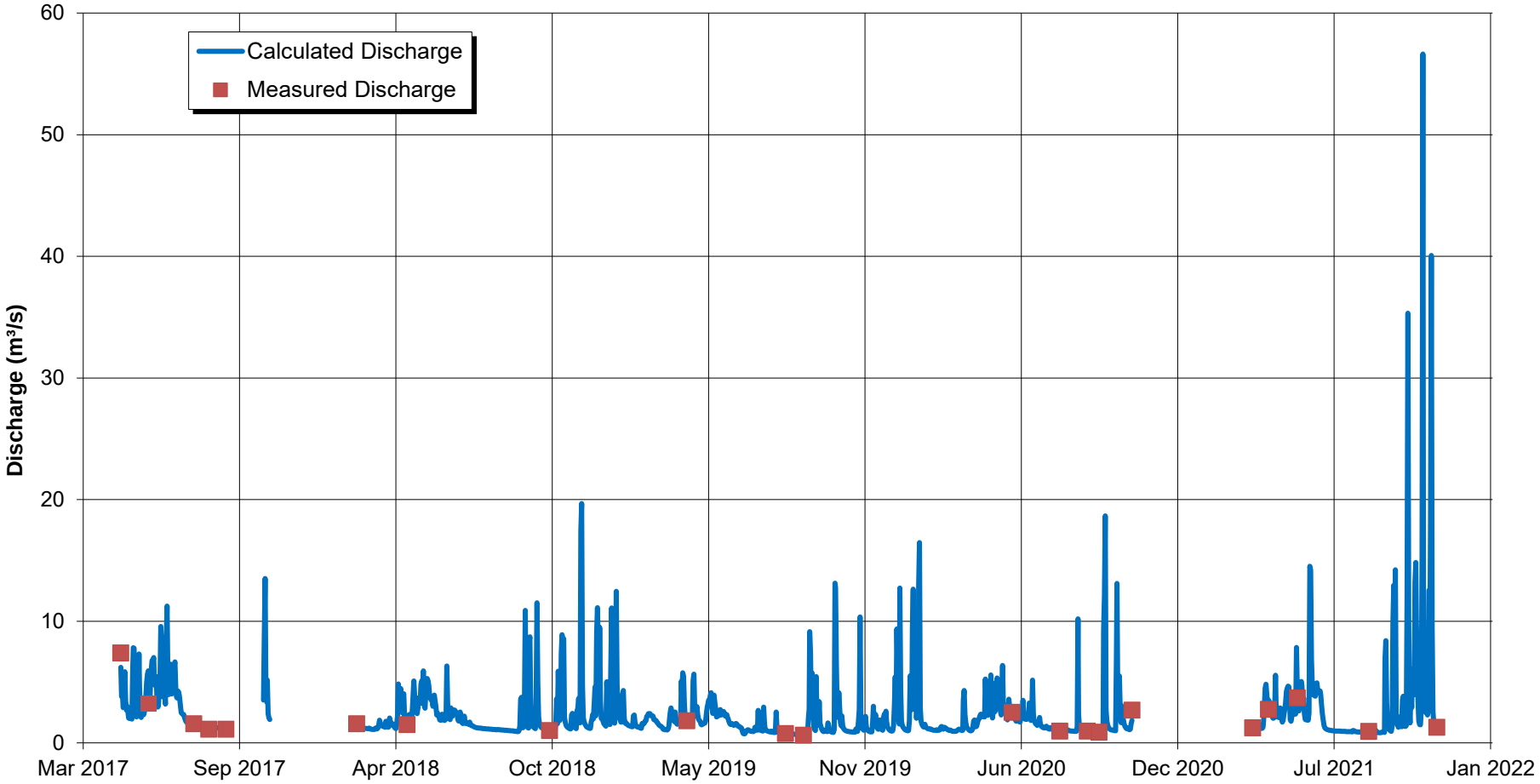
Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02129

FIGURE 2

REV 0



NOTE:
1. MANUAL MEASUREMENTS OF INSTANTANEOUS DISCHARGE DO NOT NECESSARILY MATCH DAILY AVERAGE DISCHARGE ON THE SAME DATE DUE TO DAILY FLUCTUATIONS IN DISCHARGE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
0	22FEB'22	ISSUED WITH LETTER VA21-02129	KRH	TJP

WOODFIBRE LNG LTD.

WOODFIBRE LNG PROJECT

WOODFIBRE CREEK (WOOD)
DAILY AVERAGE DISCHARGE HYDROGRAPH

Knight Piésold CONSULTING

P/A NO. VA103-494/18

REF. NO. VA21-02129

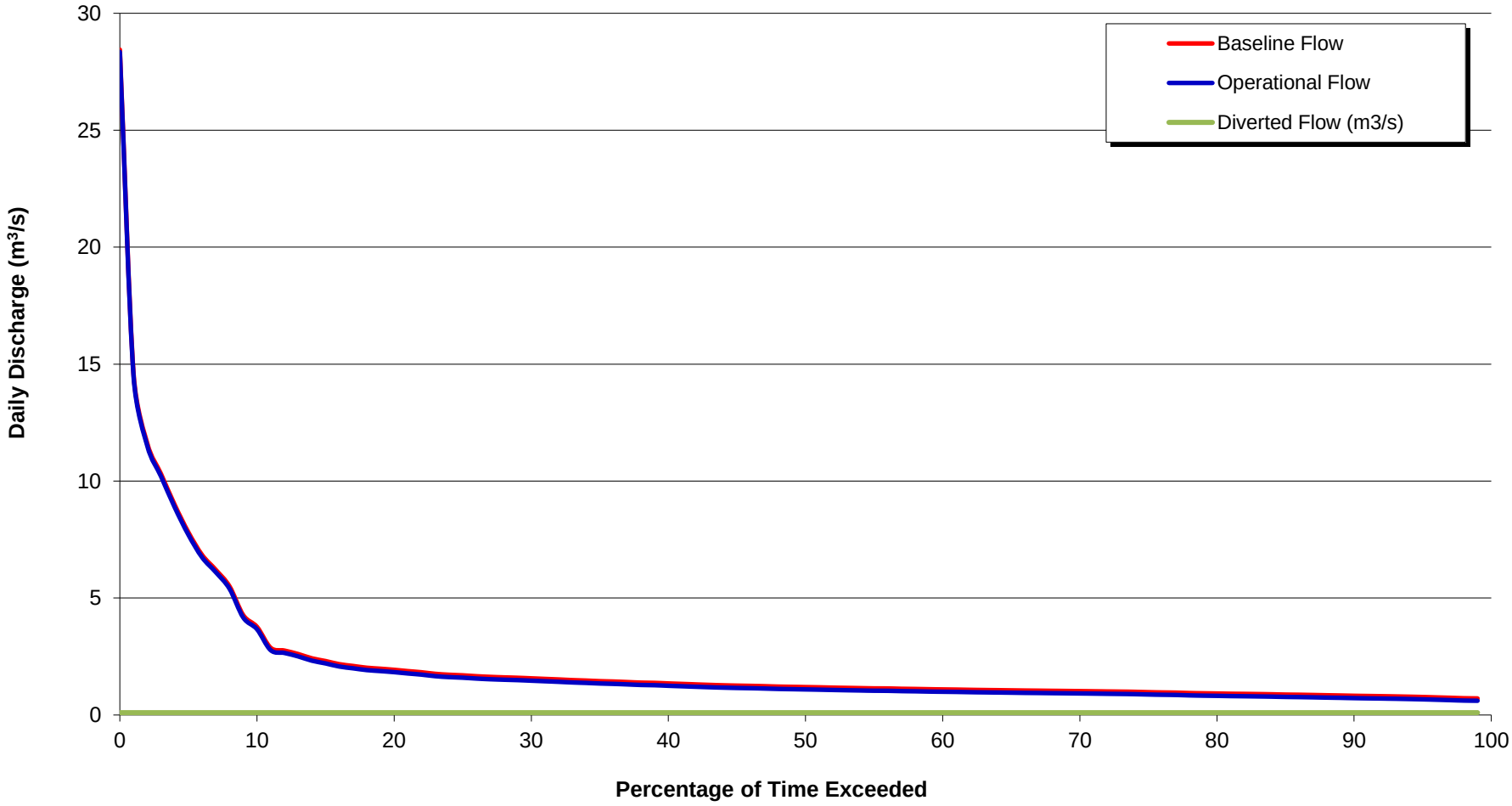
FIGURE 3

REV 0

APPENDIX B

Woodfibre Creek Synthetic Flow Duration Curves

(Figures B-1 to B-12)



3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP
REV	DATE	DESCRIPTION	PREP'D	RVW'D

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JANUARY FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

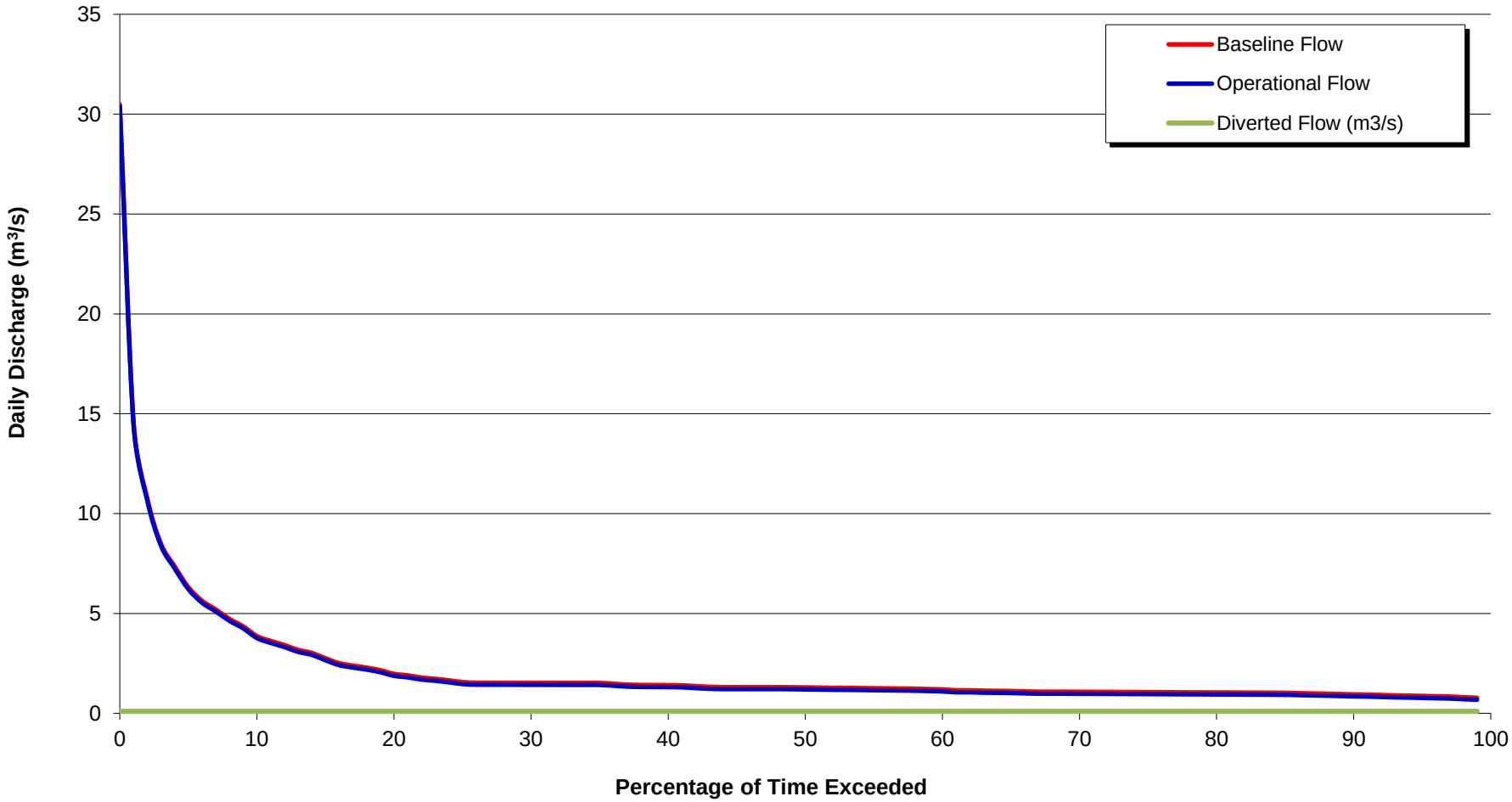
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-1

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

FEBRUARY FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

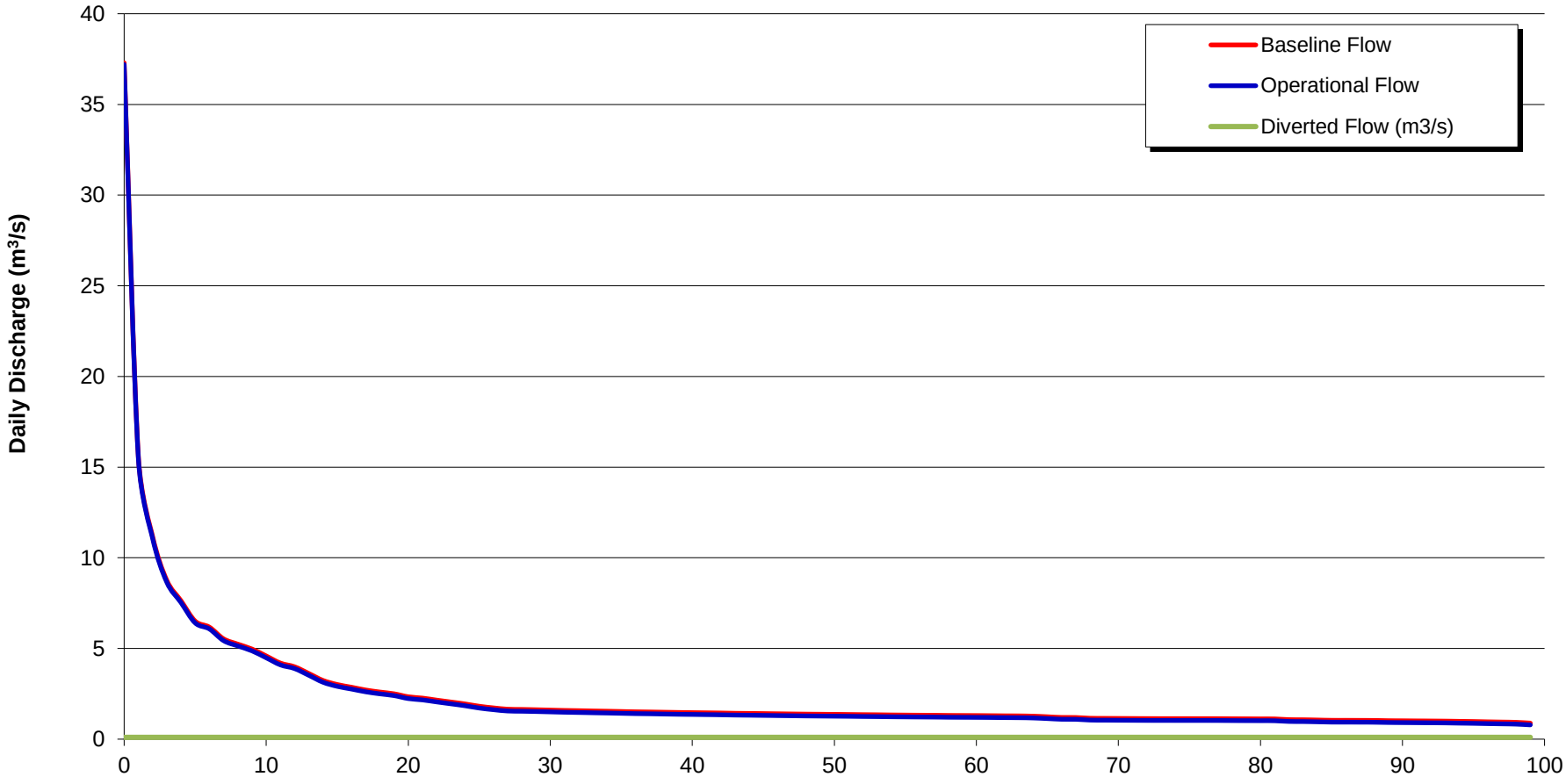
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-2

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MARCH FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

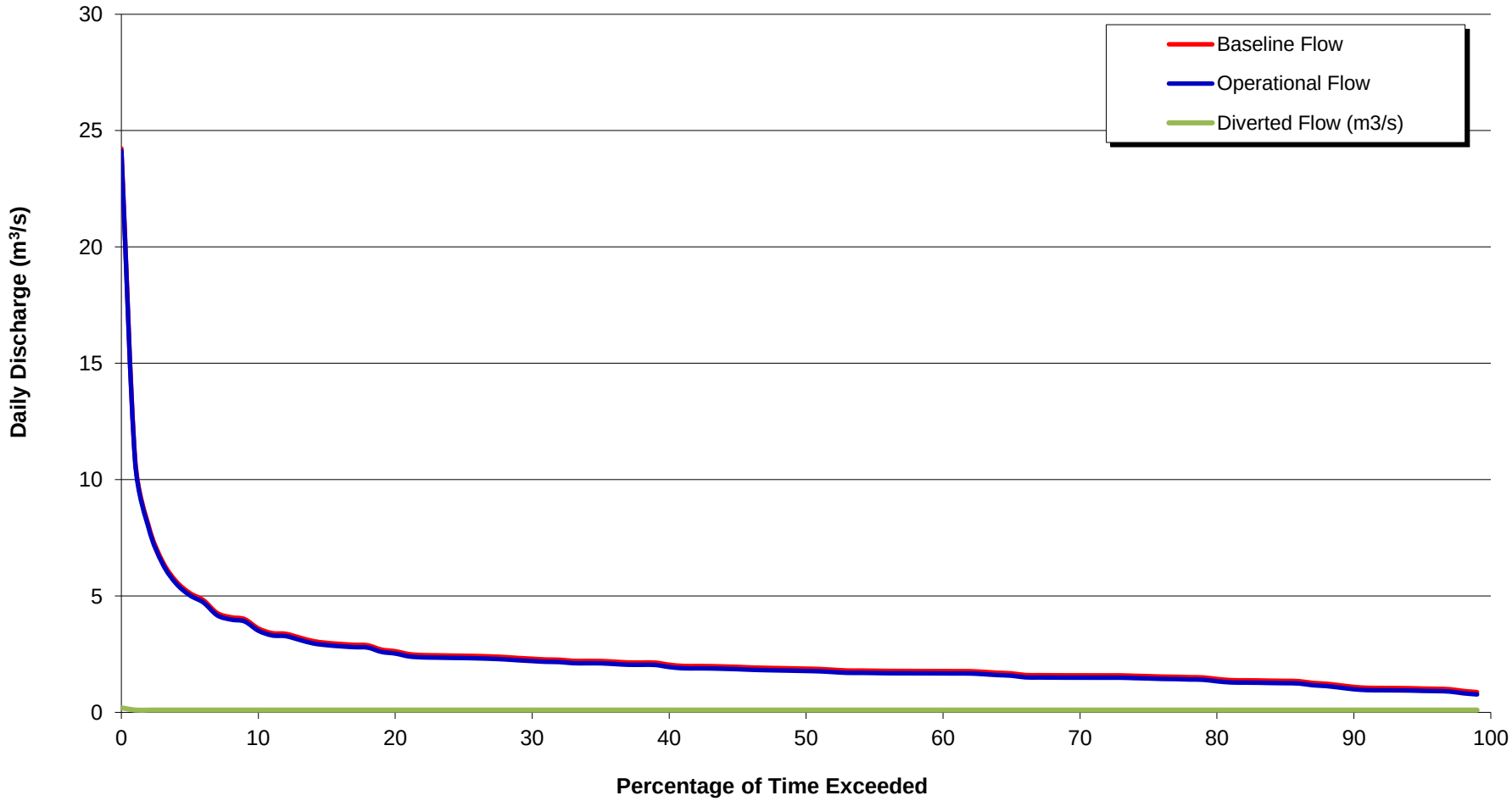
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-3

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

APRIL FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

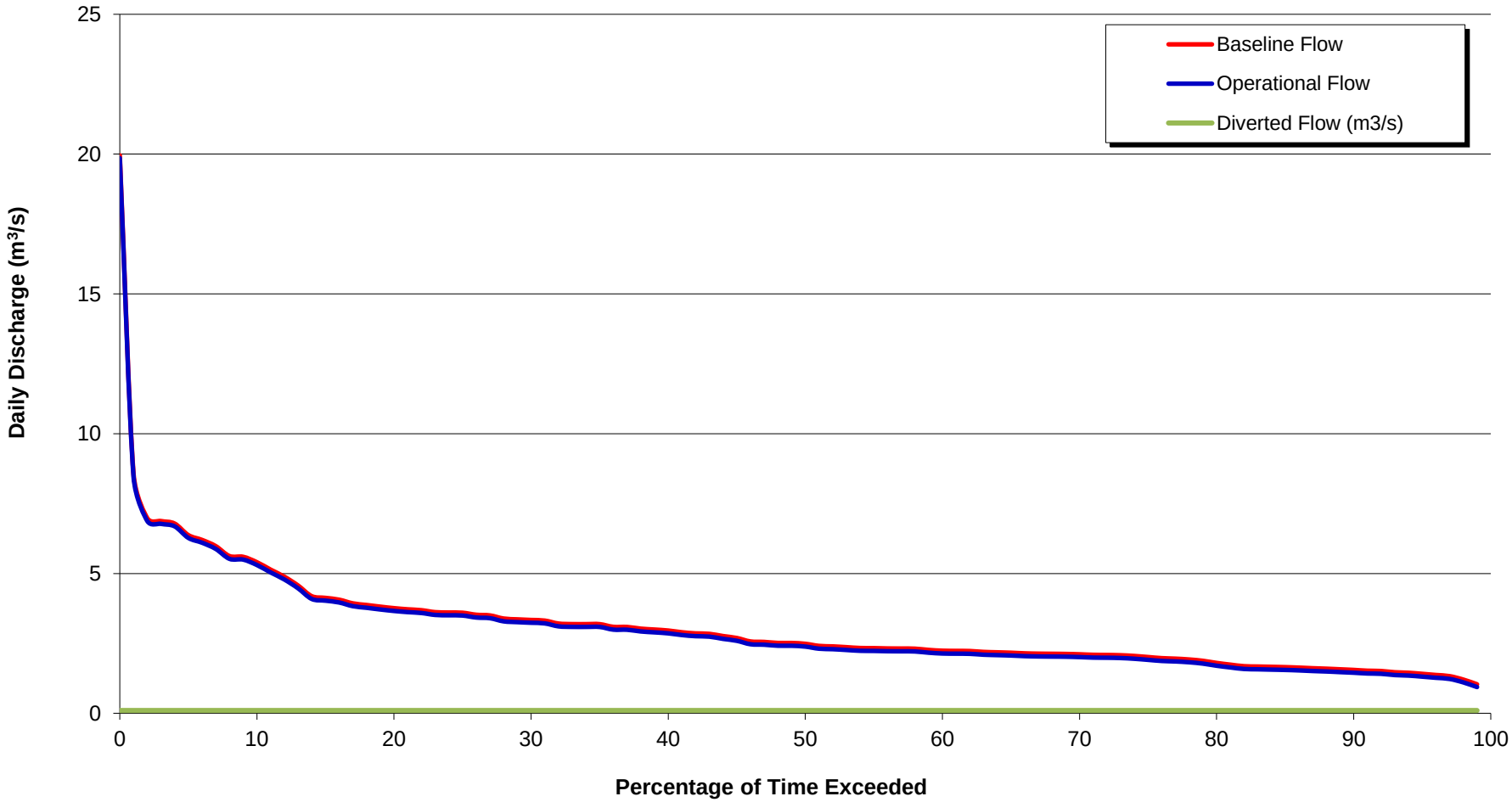
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-4

REV 3



3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP
REV	DATE	DESCRIPTION	PREP'D	RVW'D

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

MAY FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

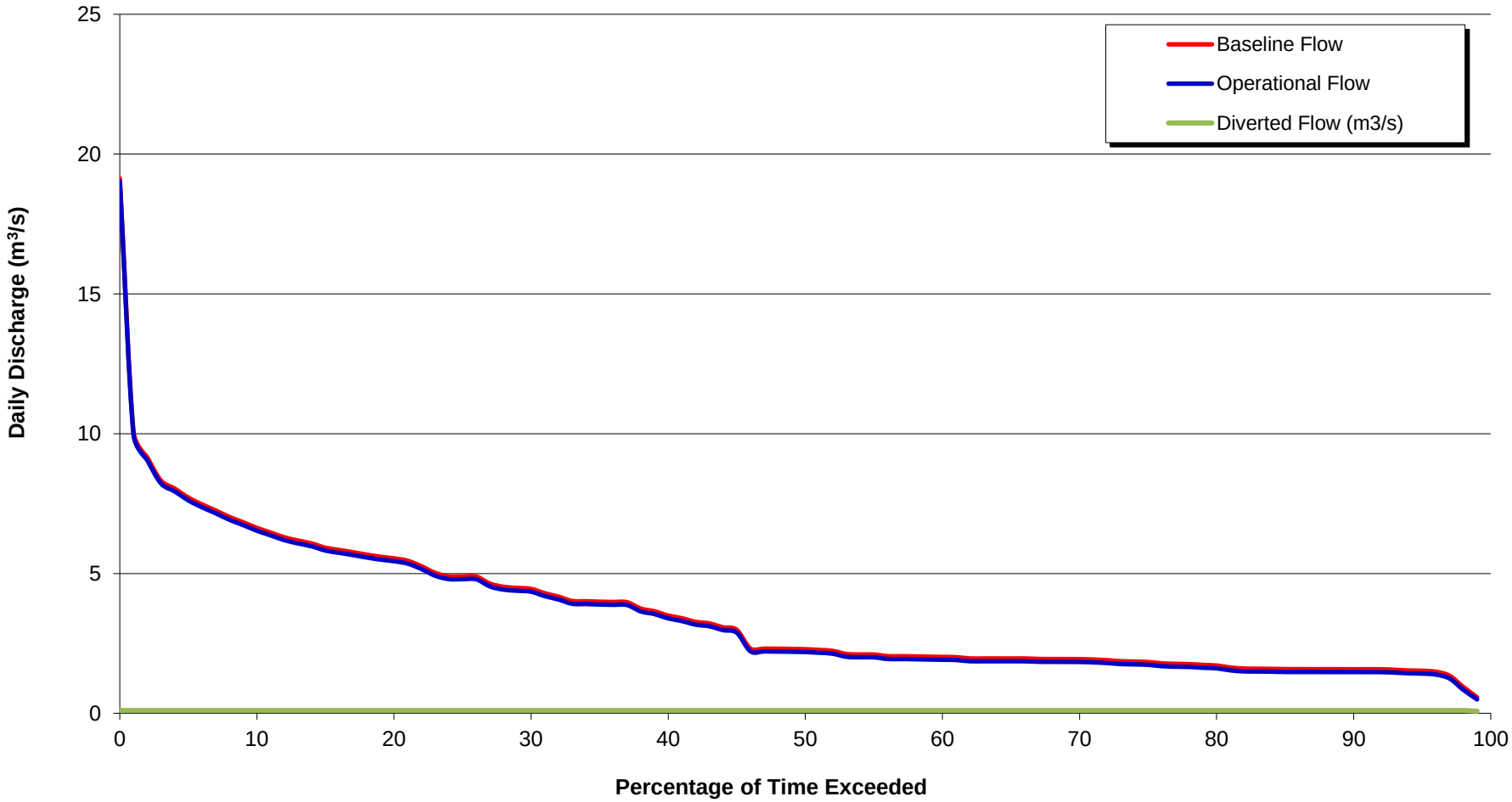
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-5

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JUNE FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

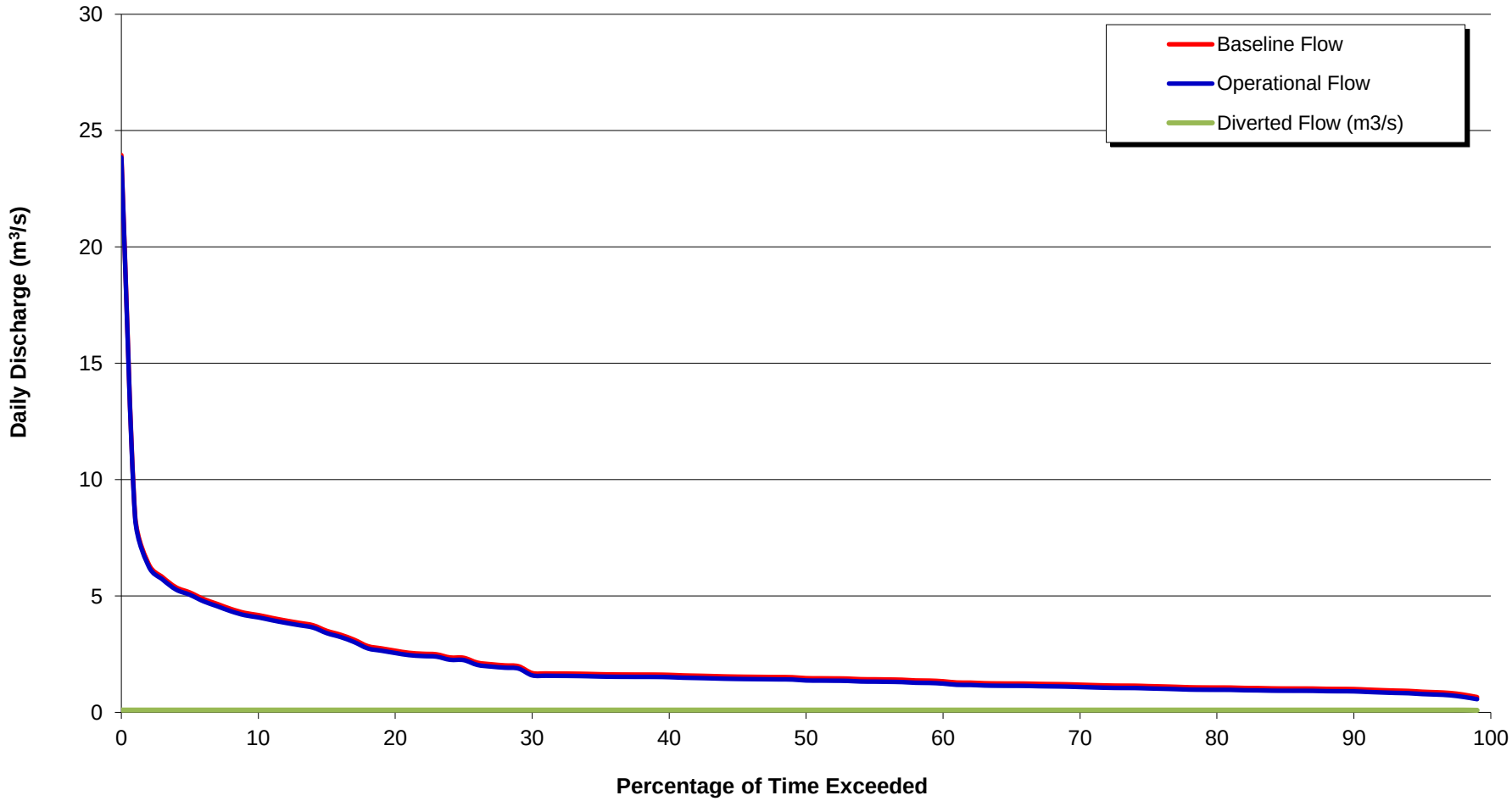
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-6

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

JULY FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

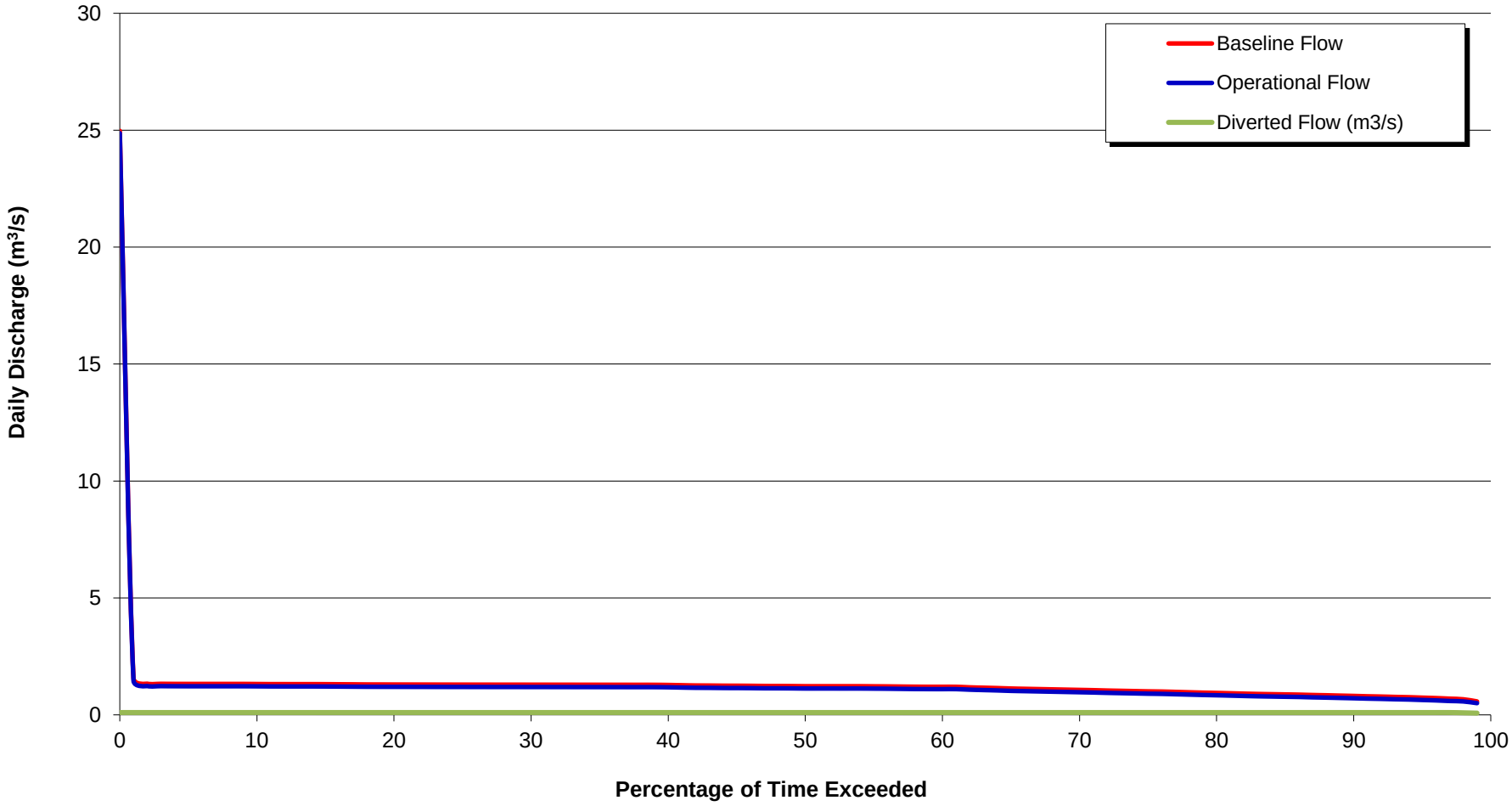
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-7

REV 3



3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP
REV	DATE	DESCRIPTION	PREP'D	RVW'D

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

AUGUST FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

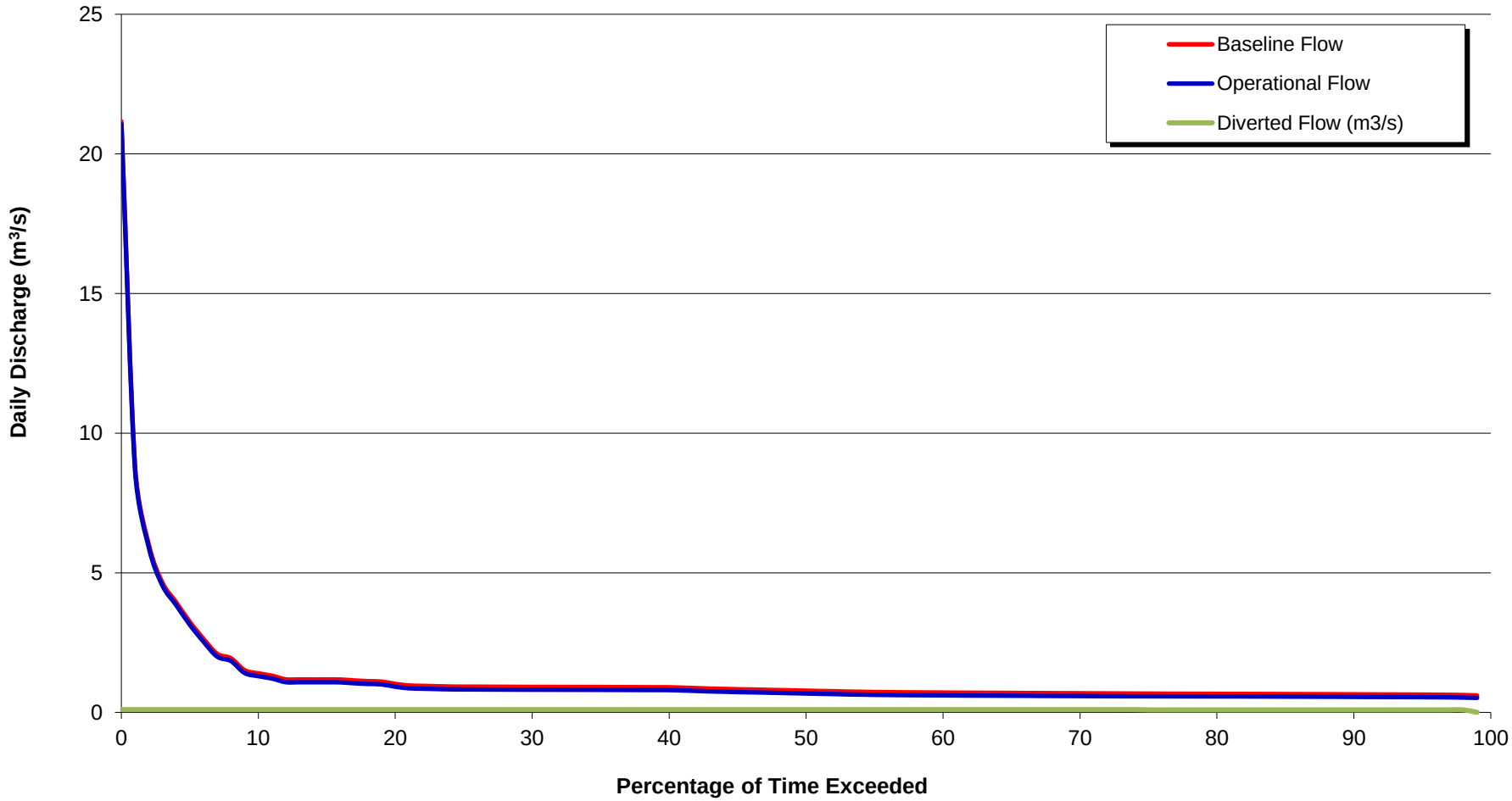
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-8

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

SEPTEMBER FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

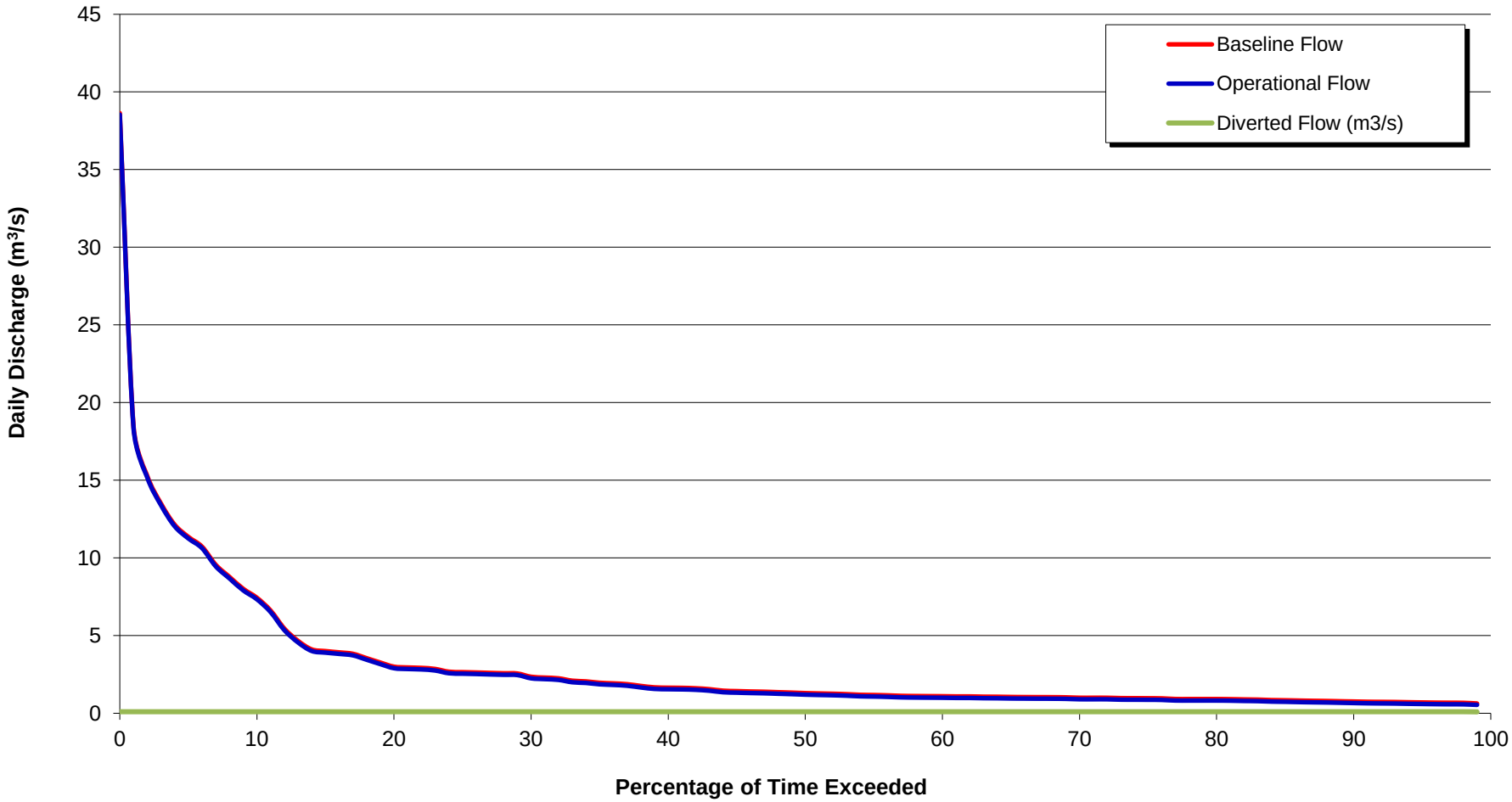
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-9

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

OCTOBER FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

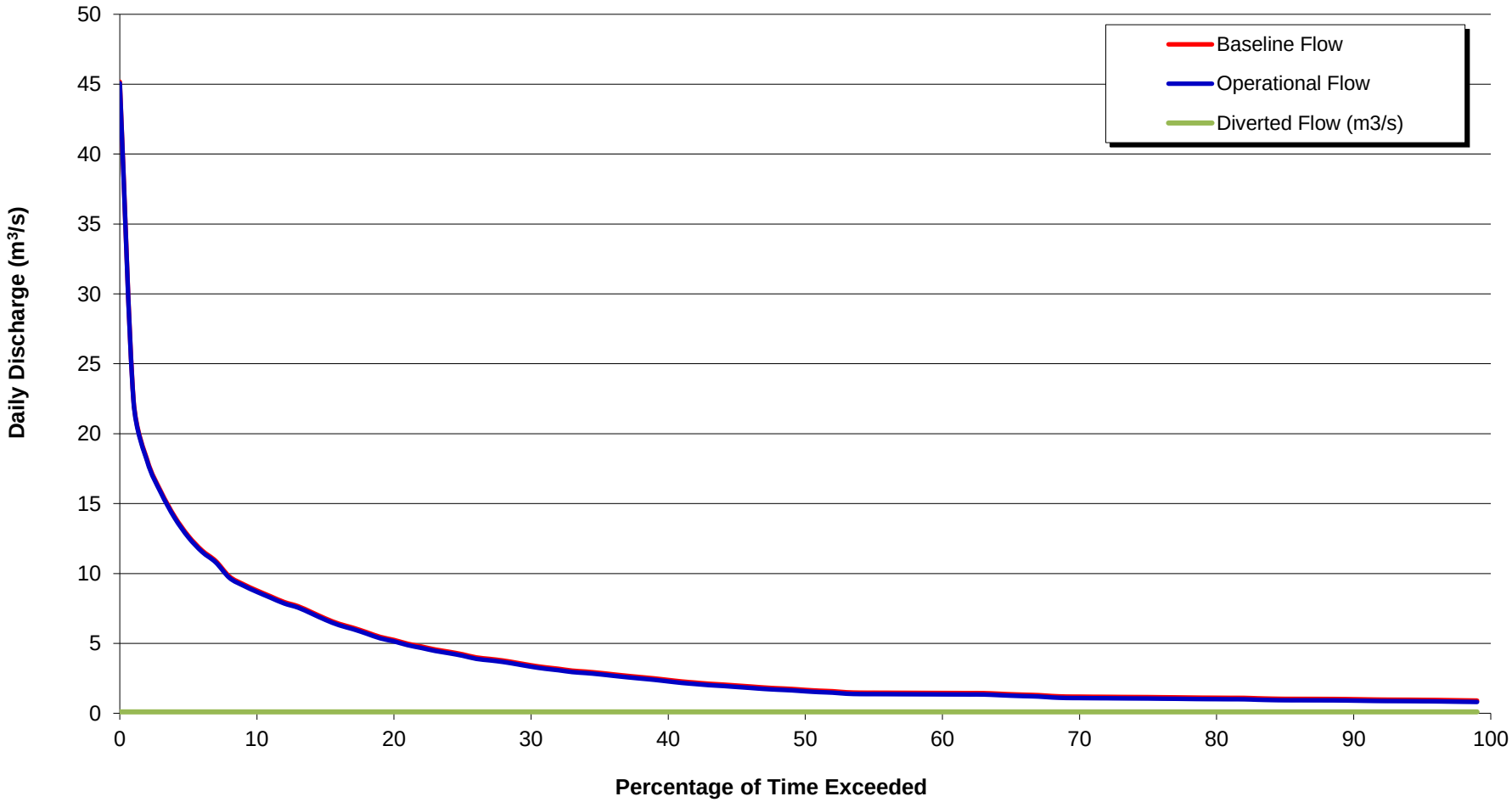
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-10

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

NOVEMBER FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

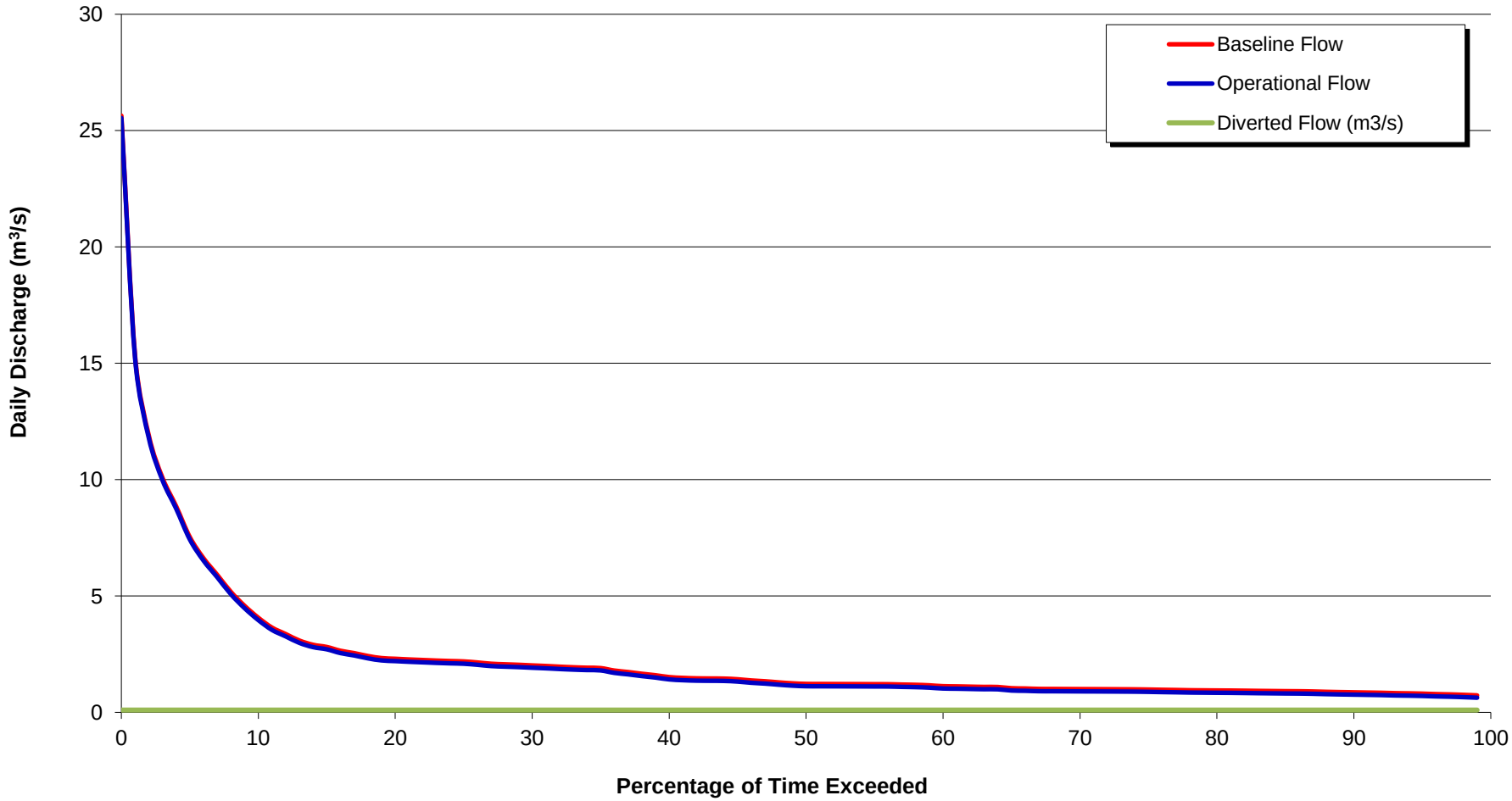
Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-11

REV 3



REV	DATE	DESCRIPTION	PREP'D	RVW'D
3	16AUG'22	ISSUED WITH REPORT VA103-494/24-3	SKC	TJP

WOODFIBRE LNG LIMITED

WOODFIBRE LNG CONSTRUCTION WATER SUPPLY

DECEMBER FLOW DURATION CURVE
WOODFIBRE CREEK INTAKE

Knight Piésold CONSULTING

P/A NO. 103-494/24

REF. NO. 3

FIGURE B-12

REV 3

Appendix D Marine Water Quality Management and Monitoring Plan

July 17, 2023

Woodfibre Natural Gas Ltd.
580 Hornby Street
Vancouver BC V6C 3B6
Via Email: scott_wagner@wlng.ca

Attn: Scott Wagner

Re: Marine staq̓w (Water) Quality Management and ínexwantas (Monitoring) Plan for Construction
Woodfibre LNG, Skwxwú7mesh (Squamish), BC
Project No. 17953-109

Please find attached the *Marine* staq̓w *(Water) Quality Management and* ínexwantas *(Monitoring) Plan for Construction*. We trust this Draft report meets your requirements and thank Woodfibre LNG for the opportunity to work on this exciting Project. If you have any questions, please do not hesitate to contact us.

Sincerely,

Keystone Environmental Ltd.

Warren Appleton, R.P. Bio.
Senior Biologist

I:\17900-17999\17953 WLNG 2023 Bio\109 EMPs\Marine Water Quality EMP\Reporting\MWQMMP FINAL\17953-109 230717 FINAL MWQMMP.docx

encl.

Suite 320-4400 Dominion Street
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Fax: 604.430.0672
keyinfo@keystoneenvironmental.ca
keystoneenvironmental.ca



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MARINE STAḴW (WATER) QUALITY MANAGEMENT AND ÍNEXWANTAS (MONITORING) PLAN FOR CONSTRUCTION

Woodfibre LNG Site
Woodfibre, BC

Prepared For: Woodfibre LNG Ltd.

Project No: 17953-109
July 2023

TABLE OF CONTENTS

Page

TABLE OF CONTENTS i

LIST OF ACRONYMS vi

1. INTRODUCTION 2

1.2 Purpose 9

1.3 Objective 9

1.4 Scope 11

1.5 Project Description and Activities 12

1.5.1 Project Location 12

1.5.2 Site History 12

1.5.3 Project Overview 14

2. CONSULTATION AND PLAN DEVELOPMENT 15

2.1 Management of Change 16

3. PRIMARY INFRASTRUCTURE 17

3.1 Marine FST Terminal 19

3.1.1 Substructure Installation Support Piles 19

3.1.2 FST Transfer Platform Module M05 19

3.1.3 FST Permanent Mooring Structures 20

3.1.4 Piping Trestle Module M07 and Roadway Trestle Module M14 21

3.1.5 Floating Storage Tanks (FSTs) 21

3.2 Material Offloading Facility (MOF) 22

3.3 Offloading Platform 23

3.4 Temporary Floating Worker Accommodations (Floatel) 24

3.5 Shoreline Repair 25

3.6 Ro-Ro Ramp Dock & Dolphin Refurbishments (Existing Industrial Infrastructure) 27

3.7 Culvert Outfalls 28

3.8 East Creek Hydraulic Modifications 28

3.9 Mill Creek and Woodfibre Creek Staq̓w (water) Intakes and Withdrawals 29

3.9.1 Mill Creek 29

3.9.2 Woodfibre Creek 29

TABLE OF CONTENTS (CONT'D)

Page

3.10 Timeline 30
4. REGULATORY FRAMEWORK 32
4.1 Environmental Assessment Conditions and Commitments 32
4.2 Legislative Requirements and Criteria 32
4.3 Best Management Practices and Standards 32
5. ROLES AND RESPONSIBILITIES 34
6. BASELINE ENVIRONMENTAL CONDITIONS 38
6.1 Staq̓w (water) Quality Baseline Conditions 38
6.1.1 Historical Staq̓w (water) Quality Studies (2014) 38
6.1.2 Historical Staq̓w (water) Quality Studies (2020/2021) 42
6.1.3 Historical Staq̓w (water) Quality Studies (2022) 45
6.1.4 Existing Discharge Permits 46
6.2 Sediment Quality Baseline Conditions 47
6.3 Human Health and Ecological Risk Assessment Investigation Summary 54
6.4 Tissue Quality Baseline Conditions 57
6.5 Human Health Risk Assessment – Tissue Quality 57
6.5.1 Receptor Characteristics 57
6.5.2 Exposure Point Concentrations 61
6.5.3 Contaminant Intakes 63
6.5.4 Toxicity Reference Values 63
6.5.5 Risk Estimation 65
6.5.6 Uncertainty Analysis 69
6.5.7 Conclusions and Risk Management Recommendations 69
6.6 Human Health Risk Assessment for the Seafood Monitoring Program (2022) 69
7. EFFECTS SUMMARY AND MITIGATION MEASURES 71
7.1 Avoidance Measures 72
7.1.1 Site Selection 72
7.1.2 Construction Phase 72
7.1.3 Operation Phase 72

TABLE OF CONTENTS (CONT'D)

Page

7.2 General Marine Works Management and Timing Windows ... 73
7.3 Pile Driving ... 74
7.4 Creosote Pile Removal ... 75
7.5 Dredging ... 76
7.6 Concrete Works ... 77
7.7 Seabed Disturbance and Placement of Materials ... 78
7.8 Spills from Industrial Equipment ... 79
7.9 Upland Mitigations ... 80
7.9.1 Erosion Prevention and Sediment Control ... 80
7.9.2 Stormwater Management ... 81
7.9.3 Waste Management Plan ... 81
7.9.4 Upland Blasting and Road Construction ... 82
8. Marine Staq̓w (water) Quality ínexwantas (monitoring) And Follow-up Plans ... 84
8.1 Overview ... 84
8.2 Staq̓w (water) Quality Monitoring ... 85
8.2.1 Turbidity Correlation Establishment ... 85
8.2.2 In-situ ínexwantas (Monitoring) ... 87
8.2.3 Routine Sampling ... 90
8.2.4 Non-Routine Sampling ... 91
8.2.5 Existing Permit Monitoring ... 94
8.2.6 Construction Staq̓w (water) Discharge ... 94
8.2.7 Staq̓w (water) Quality Assurance and Quality Control ... 94
8.3 Sediment Sampling ... 96
8.3.1 Sediment Sampling for Compliance and Verification ínexwantas (Monitoring) during Construction and Post Construction ... 96
8.3.2 Sediment Sampling for Dredging ... 97
8.3.3 Sediment Sampling Methods ... 99
8.3.4 Sediment Sample Analytical Testing ... 99
8.3.5 Sediment Sampling Quality Assurance and Quality Control ... 101

TABLE OF CONTENTS (CONT'D)

Page

8.4 Tissue Sampling 101
8.4.1 Tissue Sampling Quality Assurance and Quality Control 102
8.5 Adaptive Management 102
9. REPORTING AND COMMUNICATIONS 104
9.1 Routine ínexwantas (Monitoring) Reporting and Communication 104
9.2 Non-Routine ínexwantas (Monitoring) Reporting and Communication (Exceedances) 104
9.3 Environmental Incident Reports 105
10. INFORMATION MANAGEMENT 106
11. REFERENCES 107
12. PROFESSIONAL STATEMENT AND LIMITATIONS 110

LIST OF IN-TEXT FIGURES

Page

Figure 1-1 Location Plan 8
Figure 1-2 Site Layout 13
Figure 3-1 Project Overview 18
Figure 6-1 Staq̓w (water) and Sediment Quality Baseline Sampling Locations 40
Figure 6-2 Staq̓w (water) Quality Baseline Sampling Results (Data from Golder, 2014) 41
Figure 6-3 Sediment Quality Baseline Sampling Results (Data from Golder, 2014) 51
Figure 6-4 Areas Dredged in August 2013 55
Figure 8-1 Staq̓w (water) Quality Sampling Locations 86
Figure 8-2 Number of Samples per Area (ECCC 2018) 98
Figure 8-3 MWQMMP Adaptive Management Cycle 103

LIST OF IN-TEXT TABLES

Page

Table 1-1 Conditions for Marine Stak̲w (water) Quality Management and ínexwantas (Monitoring) Plan.2
Table 2-1 Qualified Professionals 15
Table 2-2 Aboriginal Groups, Government, Public and Other Parties Engaged 15
Table 2-3 Report Version History 16
Table 3-1 List of Project Components, Area, and Location 17
Table 4-1 Regulatory Framework for MWQMMP 32
Table 4-2 Applicable Best Management Practices for the MWQMMP 33
Table 5-1 Summary of Participant and Specific Work Activity from CEMP 34
Table 6-1 Summary of Baseline Stak̲w (water) Quality (Golder Associates, 2014) 38
Table 6-2 Summary of Baseline Stak̲w (water) Quality – Shallow Stak̲w (water) (2020/2021) 42
Table 6-3 Summary of Baseline Stak̲w (water) Quality – Deep Stak̲w (water) (2020/2021) 44
Table 6-4 Summary of Authorized Discharges to Marine Stak̲w (water) 46
Table 6-5 Summary of Leachate Treatment Plant Effluent (Permit 1239) and Sanitary Treatment Plant Effluent (Permit 2334) Sample Results, 2018-2023 47
Table 6-6 Summary of Baseline Sediment Quality (Golder Associates, 2014) 48
Table 6-7 Summary of 2019 Sediment Quality (Keystone Environmental Ltd., 2019) 52
Table 6-8 Summary of Baseline Sts'úkwi7 (fish) & Crab Tissue Quality Analyzed Parameters 58
Table 6-9 Physical Exposure Variables and Consumption Rates Assumed for the Aboriginal Receptor .. 61
Table 6-10 Physical Exposure Variables and Consumption Rates Assumed for the Recreational Receptor 61
Table 6-11 Maximum Exposure Point Concentrations of Dietary Items 62
Table 6-12 Toxicity Reference Values – Human Health 64
Table 6-13 Non-Carcinogenic Hazard Quotients – Aboriginal Toddler Receptor 65
Table 6-14 Non-Carcinogenic Hazard Quotients – Recreational Toddler Receptor 66
Table 6-15 Incremental Lifetime Cancer Risks – Aboriginal Receptors 67
Table 6-16 Incremental Lifetime Cancer Risks – Recreational Receptors 68
Table 7-1 Marine Stak̲w (water) Quality Mitigations for the Construction Phase 71
Table 8-1 Summary of Proposed Construction Verification ínexwantas (Monitoring) Programs for Marine Stak̲w (water) Quality and Human Health 85
Table 8-2 Summary of Marine Stak̲w (water) Quality Baseline Correlation ínexwantas (Monitoring) 87
Table 8-3 Stak̲w (water) Quality Criteria for Evaluating Terrestrial Project Works 88
Table 8-4 Stak̲w (water) Quality Criteria for Evaluating Marine Works 89
Table 8-5 Summary of Routine Marine Stak̲w (water) Quality Baseline Sampling Plan. 90
Table 8-6 Summary of Parameters for In-situ and Analytical Non-routine Stak̲w (water) Quality ínexwantas (Monitoring) 92
Table 8-7 Summary of Potential Sediment Impact Parameters (CCME ISQG Marine) 97
Table 8-8 Summary of Sediment Quality Threshold 100
Table 8-9 Summary of Sts'úkwi7 (fish) and Crab Tissue Sampling Program 102

LIST OF ACRONYMS

BC	British Columbia
BMP	Best Management Practice
CCME	Canadian Council of Ministers of the Environment
CD	Chart Datum
CEAA	Canadian Environmental Assessment Agency
CEMP	Construction Environmental Management Plan
CEPA	Canadian Environmental Protection Act
COC	Contaminant of Concern
CofC	Certificate of Compliance
CPA	Certified Project Area
CSR	British Columbia Contaminated Sites Regulation
DAS	Disposal at Sea Regulations
DFO	Fisheries and Oceans Canada
EAC	Environmental Assessment Certificate
EAO	Environmental Assessment Office
EM	Environmental Monitor
EPC	Engineering, Procurement, and Construction
FDS	Federal Decision Statement (as amended 2018)
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
ILCR	Incremental Lifetime Cancer Risk
LNG	Liquefied Natural Gas
MFFHMMP	Marine Sts'úkwi7 (fish) and Sts'úkwi7 (fish) Habitat Management and ínexwantas (Monitoring) Plan
MMMMP	Marine Mammal Management and ínexwantas (Monitoring) Plan
MOECC	Ministry of the Environment and Climate Change
MOH	Ministry of Health
MWQMMP	Marine Staq̓w (water) Quality Management and ínexwantas (Monitoring) Plan
OGC	Oil and Gas Commission
Project	Woodfibre LNG Project
PAH	Polycyclic Aromatic Hydrocarbons

LIST OF ACRONYMS (CONT'D)

SNEAA	Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) ínexwantas (Monitoring) Environmental Assessment Agreement
TOC	Total Organic Carbon
TRV	Toxicity Reference Value
TSS	Total Suspended Solids
VCH	K'emk'emeláy (Vancouver) Coastal Health
Woodfibre LNG	Woodfibre LNG Limited
WQG	Stak̲w (water) Quality Guidelines

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 Átlq̓'a7tsem (Howe Sound), approximately seven kilometres south of Sq̓wx̱wú7mesh (Squamish). The Project is on the historical location of a Skwxwú7mesh Úxwumixw (Squamish Nation) village known as Swiy̓át. Swiy̓át and Nexwnéwu7ts Átlq̓'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 Squamish language.

Temíxwiy̓iq̓w chet wa naantem chet ti temíxw Swiy̓át
Chet wa sméṅhemswit kwis ns7éyx̱nitas chet ti temíxw
We7ú chet kwis t'íchimwit iy íẇas chet eq̓' 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 staq̓w (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. INTRODUCTION

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) (Figure 1-1). The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- An environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the BC Environmental Assessment Act (EAC #E15-02) in 2015
- An environmental assessment approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through Sḵwx̱wú7mesh Úxwumixw (the Squamish Nation) Environmental Assessment Agreement (SNEAA) in 2015
- A positive Federal Decision Statement (FDS) under the Canadian *Environmental Assessment Act*, 2012 (CEAA 2012) in 2016

Two EAC amendments were granted by the BC Environmental Assessment Office (BC EAO) in 2017 and 2019, and the FDS was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address. Conditions and commitments that relate to this Plan are summarized in (**Table 1-1)**.

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 Aboriginal 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 1-1 Conditions for Marine Staq̓w (water) Quality Management and ínexwantas (Monitoring) Plan

Condition Number	Condition	MWQMMP Reference
SNEAA 4.12 – Condition 12	Making certain mitigation measures proposed in its EA application that are considered voluntary measures legally binding under a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Certificate of Project Approval.	Entire plan
SNEAA 4.6 – Condition #6	This Plan is considered a Regulated Plan under the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Environmental Assessment Agreement (SNEAA) and must be approved by the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) representative of the Woodfibre Environmental Working Group (the Working Group) prior to construction commencing.	Entire plan

Condition Number	Condition	MWQMMP 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.	Section 5, 7, 8, 9
EAC Condition 2 Consultation Regarding Management Plans	Where a condition of this EA Certificate requires the Holder to consult particular party or parties regarding the content of a management plan, the Holder must: a) Provide written notice to each such party that: i). includes a copy of the management plan; ii). Invites the party to provide its views on the content of such management plan; and iii). Indicates: i. 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 ii. 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; b) 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); c) Provide a written explanation to each party that provided comments in accordance with a notice given pursuant to paragraph (a) as to: i). 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 ii). Why such views and information have not been addressed in a revised version of the management plan; d) Maintain a record of consultation with each such party regarding the management plan; and e) 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 2

Condition Number	Condition	MWQMMP Reference
EAC Condition 6 Marine Stak̲w (Water) Quality	The Holder must develop, in consultation with MOE, Ministry of Health (MOH), DFO, OGC, K'emk'emeláy (Vancouver) Coastal Health (VCH) and Aboriginal Groups, a marine stak̲w (water) quality management and ínexwantas (monitoring) plan for Construction.	Section 2
	Results of the baseline shellfish and groundfish tissue sampling and the human health risk assessment, including arsenic, cadmium, copper, lead, zinc, methylmercury, tributyltin, polycyclic aromatic hydrocarbons, and polychlorinated dibenzo-p-dioxins and furans.	Section 6.3, 6.4, 6.5, 6.6
	The means by which the mitigation measures related to Construction in the Application Table 22-1 under the heading "Marine Stak̲w (water) Quality" and the recommendations in the Creosote Piles Removal Memo (April 27, 2015) will be implemented.	Section 7, 7.4
	Measures to monitor onsite sediment and stak̲w (water) quality and an approach to communicate any exceedances of CCME Stak̲w (water) Quality and Interim Sediment Quality Guidelines and BC Stak̲w (water) Quality Guidelines to the appropriate regulatory authorities.	Section 8
	A post-Construction follow-up program to confirm human health risk assessment, including potential additional tissue sampling to confirm the assessment predictions regarding the bioavailability and bioaccumulation of toxins in marine organisms consumed by humans, if the potential for human health risk is identified in the baseline human health risk assessment.	Section 8.2
	An adaptive management plan to address the effects of the Project on stak̲w (water) quality in the event (i) those effects are not mitigated to the extent identified in the Application, or (ii) effects on stak̲w (water) quality occur that were not predicted in the Application.	Section 8.5
	A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO no less than 60 days prior to the Holder's planned date to commence Construction in the marine environment. The Holder must not commence Construction in the marine environment until the plan is approved by EAO. Once approved, the Holder must also provide the final plan to MOE, MOH, DFO, OGC, VCH and Aboriginal Groups. The Holder must implement the plan to the satisfaction of EAO.	Section 8
EAC Condition 22 Aboriginal Consultation	The Holder must continue to engage Aboriginal 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 Aboriginal 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 Aboriginal consultation summary report with Aboriginal Groups for no less than 30 days review and comment prior to providing it to EAO.	Section 2

Condition Number	Condition	MWQMMP Reference
FDS Condition 3.2 Marine Staq̓w (water) Quality	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on Sts'úkwi7 (fish) and Sts'úkwi7 (fish) habitat from changes to staq̓w (water) quality during all phases of the Designated Project.	Section 7
	.1 Implementing erosion control measures and sediment control measures during all phases of the Designated Project	Section 7
	.2 Revegetating disturbed riparian areas, using native plant species, after construction.	CEMP
	.3 Using silt control measures around in-staq̓w (water) construction activities.	Section 7
	.4 Preventing wet concrete or cement-laden staq̓w (water) from entering the marine environment.	Section 7, 7.6
FDS Condition 3.3 Harmful Alteration Disruption or Destruction of Sts'úkwi7 (fish) and Sts'úkwi7 (fish) Habitat	.5 taking into consideration the British Columbia Marine and Pile Driving Contractors Association's Best Management Practices for Pile Driving and Related Operations when conducting pile installation.	Section 7.3
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 staq̓w (water) frequented by Sts'úkwi7 (fish), and taking into consideration navigational safety.	Section 7.4
FDS Condition 3.6 Staq̓w (water) Intake	The Proponent shall design, install and operate any marine staq̓w (water) intake to avoid or reduce the incidental capture of Sts'úkwi7 (fish) through entrainment and impingement, including the risk of entrainment of Slhawt' (Pacific herring) (*Clupea pallasii*) larvae.	MFFHMMP
FDS Condition 3.7	The Proponent shall design, install and operate any marine discharge diffuser to prevent the deposit of a deleterious substance in staq̓w (water) frequented by Sts'úkwi7 (fish).	Section 7.1
FDS Condition 3.14 Verification ínexwantas (Monitoring) of EA Accuracy	The Proponent shall, in consultation with Fisheries and Oceans Canada and Aboriginal 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.	MWQMMP MFFHMMP MMMMP CEMP
FDS Condition 6.4	The Proponent shall monitor staq̓w (water) quality and sediment, using as a benchmarks the Canadian Council of Ministers of the Environment's Staq̓w (water) Quality Guidelines for the Protection of Aquatic Life and Interim Sediment Quality Guidelines for the Protection of Aquatic Life, and shall communicate any exceedance(s) of the Guidelines to relevant government authorities and Aboriginal groups, and implement additional mitigation measures to remedy those exceedances.	Section 8

Condition Number	Condition	MWQMMP Reference
FDS Condition 6.5	The Proponent shall, in consultation with Aboriginal groups and relevant health authorities, develop, prior to construction, and implement a follow-up program to verify the assessment predictions regarding the bioavailability and bioaccumulation of contaminants in Sts'úkwi7 (fish) consumed by humans.	Section 8.4
	.1 Prior to the commencement of marine in-staq̓w (water) construction activities, establishing baseline conditions in the tissue of shellfish and groundfish for polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins and furans, copper, lead, zinc, tributyltin, arsenic, cadmium and methylmercury and using this information to update the human health risk assessment for the consumption of shellfish and groundfish.	Section 6.5, 6.6
	.2 During marine in-staq̓w (water) construction activities, ínexwantas (monitoring) the re-suspension and bioavailability of polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butvltin, arsenic, cadmium and methylmercury in the tissue of shellfish and groundfish.	Section 8.2, 8.3, 8.4
	.3 If a potential for human health risk is identified in the updated human health risk assessment for the consumption of shellfish and groundfish referred in condition 6.5.1 or through ínexwantas (monitoring) referred in condition 6.5.2, conducting additional sampling of polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butvltin, arsenic, cadmium and methylmercury in the tissue of shellfish and groundfish to confirm the assessment predictions regarding the bioavailability and bioaccumulation of contaminants in Sts'úkwi7 (fish) consumed by humans. If required, additional sampling shall start immediately upon completion of marine in-staq̓w (water) construction activities and continue for one year following completion of marine in-staq̓w (water) construction activities. The Proponent shall communicate the results of the follow-up program, including the results of any additional sampling, to Aboriginal groups.	Section 8.2, 8.3, 8.4

The SNEAA Condition 12, which has applicability to the IPMP, states:

4.12 Binding Mitigation Measures - Skwxwú7mesh (Squamish) Condition #12

(a) Woodfibre LNG identifies approximately 119 distinct mitigation measures in Table 22-1 of Woodfibre LNG's EA application. If Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) determines that it wishes to monitor any of the mitigation measures, then Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) will issue a notice to Woodfibre LNG identifying which mitigation measures it intends to monitor ("Monitored Mitigation Measures") and the manner it proposes to undertake such monitoring.

(b) Where Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) is of the opinion that any Monitored Mitigation Measure is not being followed, it will notify Woodfibre LNG. Woodfibre LNG will respond to the notification with one of the following (the "'Response"):

(i) Woodfibre LNG's explanation of how the mitigation measure is being followed;

(ii) a written explanation why the mitigation measure is not being followed, and the measure that replaces it (with an explanation of how the new measure provides equal or greater levels of environmental protection);

(iii) A written explanation of why the mitigation measure is not being followed, with justification for:

a. why it has not been replaced with another measure, or

b. why it has been replaced with a measure that provides less levels of environmental protection

(c) Woodfibre LNG will develop a Monitored Mitigation Measures plan with the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) that will include the frequency of guided tours for the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) during construction and operations and a budget to implement the plan, which plan will be fully funded by Woodfibre LNG.

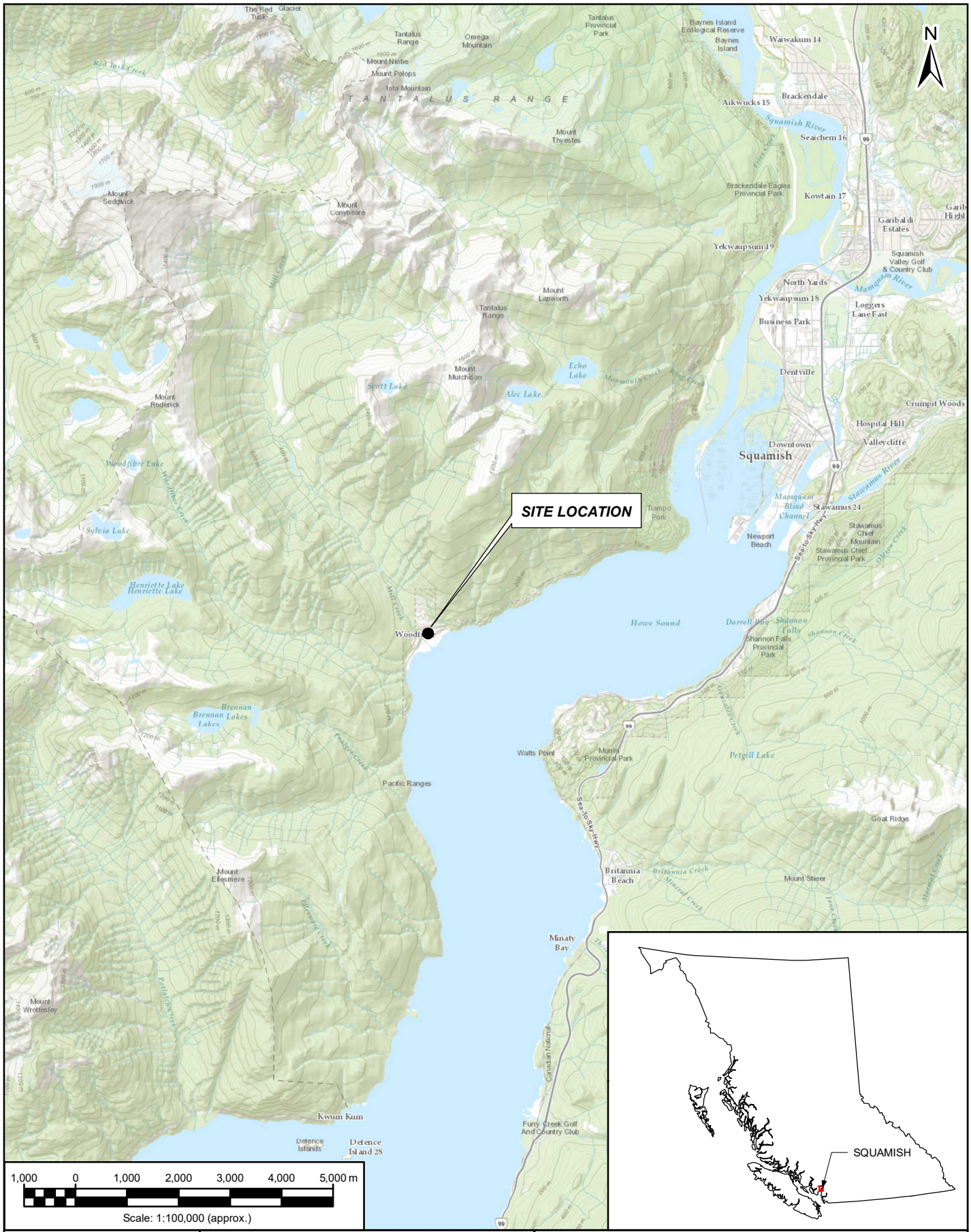
(d) Should Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) not be satisfied with the Response, then the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the Response is at issue the expert or expert panel shall consider the following when making its decision: whether the mitigation measure has a material impact on constructability, cost, operability, safety, environment, or schedule; whether the mitigation measure creates unacceptable risk or legal liability for the Project; whether the mitigation measure conflicts with any legal, regulatory, or pre-existing contractual obligations of Woodfibre LNG; whether the Woodfibre LNG response to the proposed mitigation measure(s) conforms to Good Industry Practice; and any other information the expert or expert panel considers relevant.

Most of the Project is on fee simple, industrially zoned, brownfield temíxw (lands) with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Átl'ḵa7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro and gas will be supplied to the facility by Fortis BC.

The CPA and key project components are illustrated in **Figure 1-2**. Key project components are:

- temíxw (land)-based natural gas processing and liquefaction facilities
- A floating storage and offloading unit
- Construction worker accommodation
- Supporting infrastructure

The supporting infrastructure includes buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.



Keystone Environmental	Woodfibre Squamish, B C Woodfibre LNG Limited		**Figure 1-1** Location Plan
	REVISION No. 00	DATE Mar. 2023	PROJECT No. 17953-109

DRAWN BY: CS DOCUMENT PATH: I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig1-1-LocationPlan-R0.mxd

The works and activities that will occur as part of construction include, but are not limited to:

- Marine early works (e.g., shoreline improvements and armoring, dock replacement or repairs), including improvements to the existing in-service (east and south) barge landing
- Vegetation clearing and grubbing[1]
- Stripping and grading[2]
- Drilling and blasting, including excavation, crushing, screening, and hauling
- Grouting and rock stabilization
- Road, culvert, and bridge works
- Construction of temíxw (land)-based natural gas processing and liquefaction facility
- Construction support structures, services, and equipment
- Construction of the floating storage and offloading unit
- Marine facility construction of mooring dolphin supports and connecting trestles and gangways
- Dredging, if required

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.

1.2 Purpose

The purpose of this Plan is to guide the implementation of mitigation measures and Ínexwantas (monitoring) to determine the effectiveness of those measures in managing potential Project related effects to marine stak̲w (water) quality during construction and to inform Human Health Risk Assessment, consistent with regulatory and legislative requirements. This Plan includes an adaptive management process in the case where measures are found not effective at mitigating effects the extent identified in the Environmental Assessment Application, or where effects are measured that were not predicted in the Environmental Assessment Application.

1.3 Objective

The objectives of the MWQMMP are to provide guidance to fulfill conditions of the Federal Decision Statement (FDS) and Provincial Environmental Assessment Certificate (EAC), Skwxwú7mesh Úxwumixw (Squamish Nation) Environmental Assessment (SNEAA) and outline mitigation measures and best management practices in relation to the protection of marine stak̲w (water) quality during construction of the Project.

1 Clearing vegetation refers to cutting and/or mowing vegetation, which could include trees, shrubs, and/or herbs. Grubbing refers to removal of roots from the soil using machinery and follows clearing.

2 Stripping refers to removal of soil, including vegetation, if present. Soil refers to the organic topsoil, mineral soil (i.e., A and B horizons), and overburden (i.e., C horizon, or "subsoil"). Grading refers to adjusting the slope and elevation of soil and/or rock; generally, vegetation has been removed prior to grading.

The MWQMMP also:

- Identifies and sets out the means by which regulatory and legislative requirements are met, including SNEAA Certificate Conditions, EAC Condition 6 and applicable FDS conditions in section 3.2, section 6.4 and section 6.5; with respect to marine stak̲w (water) quality and the potential human health effects and environmental effects associated with the resuspension of previously contaminated sediment.
- Identifies measures to manage marine stak̲w (water) quality during construction phases of the Project;
- Outlines mitigation measures to reduce or eliminate environmental effects to marine stak̲w (water) quality as described in the EAC and FDS during the Project; and
- Describes both compliance and verification ínexwantas (monitoring) programs to assess the effectiveness of mitigation measures, particularly as they apply to marine stak̲w (water) quality.

In order to achieve the MWQMMP 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 frameworks for the Project including applicable guidelines, regulations and thresholds for marine stak̲w (water) quality, sediment and tissue;
- **Section 5** outlines the Project roles and responsibilities;
- **Section 6** reviews baseline environmental conditions and presents result of baseline shellfish and groundfish tissue sampling and human health risk assessment (HHRA);
- **Section 7** prescribes mitigation measures regarding general marine works management including marine timing windows, erosion and sediment control (ESC), piling, dredging, creosote pile removal, concrete works, stormwater management, and waste management;
- **Section 8** outlines in-situ and analytical stak̲w (water) quality Ínexwantas (monitoring) and follow-up plans, sediment sampling, tissue sampling, and adaptive management;
- **Section 9** describes reporting and communication procedures; and
- Section 10 describes information management.

Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) conducted an independent review of the Application for an EAC under its own environmental assessment process and on October 14, 2015, Sḵwx̲wú7mesh 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, Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) collaborated on early scoping of this document, and Woodfibre LNG requires written approval from Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) on the final version of this document prior to construction.

1.4 Scope

The scope of the MWQMMP is for the construction phase (Construction) of the Project and follow-up programs relating to human health. For the purposes of defining Construction, the MWQMMP 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. Upland works are not anticipated to impact the marine environment and are expected to begin in September of 2023.

The marine least risk fisheries window for the Project is August 16 through January 31 (DFO Area 28 – Howe Sound). Intertidal and subtidal works will begin in the marine least risk window (MLRW) in the fall of 2023. The anticipated timeline for Construction is provided in **Table 3-2**.

The operational life of the Project is expected to be 25 years post-Construction. Marine staq̓w (water) quality management and ínexwantas (monitoring) for Project Operations will be documented in an Operations Environmental Management Plan.

The spatial area of the MWQMMP is the CPA (marine portions thereof) and proximal locations in Nexwnéwu7ts Átlk̓a7tsem (Howe Sound) outside the CPA to monitor marine staq̓w (water) quality, marine Sts'úkwi7 (fish) tissue samples, and sediments potentially influenced by Construction activities.

The MWQMMP works with the following linked management plans:

- Marine Mammal Management and ínexwantas (monitoring) Plan includes measures to manage effects to marine mammals during Construction and operations;
- Marine Sts'úkwi7 (fish) and Sts'úkwi7 (fish) Habitat Management Plan includes measures to manage potential effects to Sts'úkwi7 (fish) and Sts'úkwi7 (fish) habitat (including marine benthos) during Construction and operations;
- Construction Environmental Management Plan includes a comprehensive overview of objectives and measures to mitigate potential environmental effects during Construction.

While linked to these other management plans, the document has been developed as a standalone document for management and ínexwantas (monitoring) of marine staq̓w (water) quality during Construction.

1.5 Project Description and Activities

1.5.1 Project Location

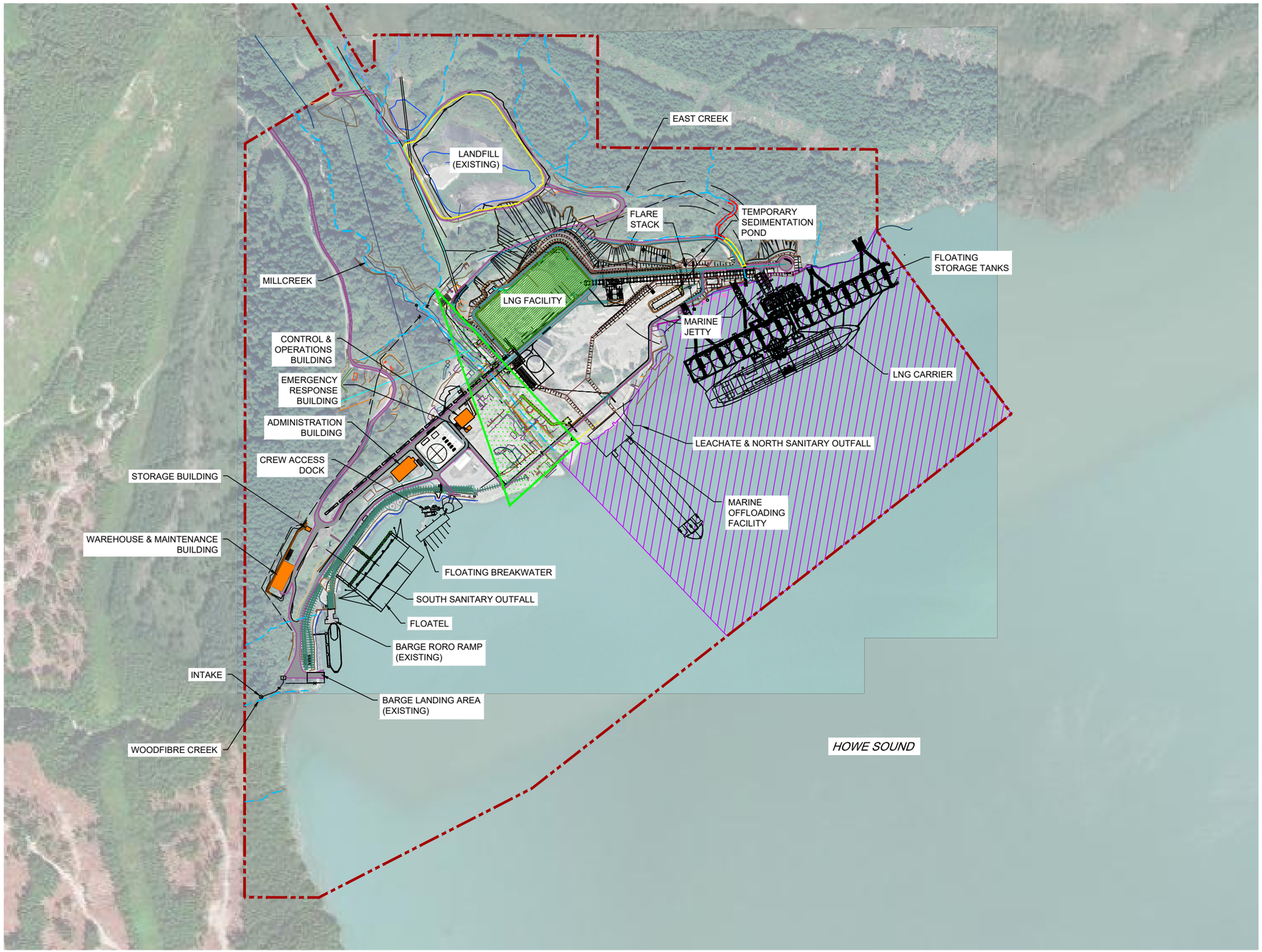
The Project is located at the former Woodfibre Pulp and Paper Mill, approximately seven (7) kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia (BC) within the District of Skwxwú7mesh (Squamish) municipal boundaries (the Site) (**Figure 1-1**). The Project location, layout and Certified Project Area (CPA) is shown in **Figure 1-2**. In addition to the Certified Project Area, the Project will use Kwtsá7tsutsin (Darrell Bay) and Skwxwú7mesh (Squamish) to transfer workers to and from the Woodfibre Site. A direct transfer option for workers from K̓emk̓emeláy (Vancouver) will also be implemented.

1.5.2 Site History

The Site is historically a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village named Swiýát, with use and occupation by Skwxwú7mesh stélmexw (Squamish People) for millennia. Industrial use of the site began recently, in 1908 with the construction of a pulp mill on Mill Creek that was 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. Woodfibre LNG took ownership of the Site from Western Forest Products on February 6, 2015. Prior to the temíxw (land) transfer in 2015, Western Forest Products received two Certificates of Compliance (CofC, temíxw (land) and staq̓w (water) lots) from the BC Ministry of Environment, which were a condition of the sale agreement.

The property is a fee simple, industrially zoned brownfield site with deep-staq̓w (water) marine access and a history of more than 100 years of industrial use. The infrastructure included an active landfill, which is now in the proces of being closed, a leachate treatment system, a wastewater treatment system, a dam at the outlet of Henriette Lake, an operational small hydro project (which has since been decomissioned), and failing infrastructure associated with the pulp and paper mill. In 2018 and 2019, Woodfibre LNG decommissioned 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, and large concrete slab.

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 K̓ík̓elxn (Port Mellon) is approximately 22 km southwest. K̓emk̓emeláy (Vancouver) is situated approximately 50 km southeast of the Project area. From 1917 until 1973, the townsite of Woodfibre was present, where mill staff and their families resided. Boat traffic was present in the Woodfibre waterlot during active mill operations, with both ships associated with Woodfibre's operations and ferry traffic from Skwxwú7mesh (Squamish) to Woodfibre accessing the waterlot. Current access to Site that will continue throughout the Project is the transfer of management personnel from Skwxwú7mesh (Squamish) Harbour. In addition, construction access to the Site is planned to be marine-based from near Skwxwú7mesh (Squamish), BC.



N

LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- REACH 2 MODIFICATIONS
- REACH 3 MODIFICATIONS
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- ROADWAY

Keystone Environmental

NOTES:
1. 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.

50m 0 250m

SCALE: 1:7500(approx.)

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

REVISION No.	DATE	PROJECT No.
00	Mar. 2023	17953-109

Figure 1-2
Site Layout

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig1-2-Site Layout-R0.dwg

1.5.3 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 1-2**). This application will be used to discuss the following infrastructure:

1. Construction of a marine terminal with floating storage tanks (FSTs), including upland blasting to create an upland road and concrete foundation for a 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 Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) and Mill Creek;
9. East Creek hydraulic modifications;
10. Stak̲w (water) withdrawals from an existing instream stak̲w (water) intake in Mill Creek and installation of a supplemental intake in Woodfibre Creek including stak̲w (water) withdrawals; and
11. Habitat offsetting.

Minor additional works are anticipated to support marine construction and installation vessels maneuvering and anchoring around the project. Potential minor effects to Sts'úkwi7 (fish) and Sts'úkwi7 (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, as described in **Section 9.1** of the *Fisheries Act* Authorization application Aquatic Effects Assessment.

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	Expertise
Mr. Warren Appleton	B.Sc., R.P.Bio.	Marine biology and fisheries regulatory issues
Mr. Duncan Clark	B.Sc., R.P.Bio.	Marine biology and fisheries regulatory issues

This Plan is being developed in consultation with Aboriginal Groups including Sḵwx̲wú7mesh 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 was 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 EAO or the relevant party.

The Plan is considered a Regulated Plan under the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) Environmental Assessment Agreement (SNEAA) and must be approved by the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) representative of the Woodfibre Environmental Working Group (the Working Group) prior to construction commencing. Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) participation in implementation of the MWQMMP will occur in accordance with the SNEAA and through contractual opportunities for Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) members or businesses in accordance with the Impact Benefit Agreement.

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

Aboriginal Group/ Agency/Party	Date	Action
Sḵwx̲wú7mesh Úxwumixw (Squamish Nation)	May, 2019	Provide document for review (comments received from Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) May 31, 2019)
Oil and Gas Commission	August 16, 2019	Review of draft (confirmed no comments at this time – October 29, 2019)
Fisheries and Oceans Canada	August 16, 2019	Review of draft – DFO indicated will review plans as part of approvals and not stand alone documents
Sḵwx̲wú7mesh Úxwumixw (Squamish Nation)	August 16, 2019	Updated draft provided for review and written response to comments received in May, 2019 (comments received from Sḵwx̲wú7mesh Úxwumixw (Squamish Nation), September 10, 2019)
Tsleil-Waututh Nation	August 27, 2019	Provide draft document for review
Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) Tsleil-Waututh Nation	June 19, 2023	Provide draft document for review (Version 0.3)

This Plan must be provided to BC EAO no less than 60 days prior to commencing construction. Once approved by the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) and EAO, the final Plan will be provided to MOE, MOH, DFO, BCER (formerly BC OGC), VCH, and Aboriginal Groups prior to the planned date to commence construction.

2.1 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, Aboriginal Groups as defined in the FDS, regulatory agencies or the public, the results of monitoring, and recommendations of the Qualified Environmental Professional (QEP) implementing the Plan.

Table 2-3 Report Version History

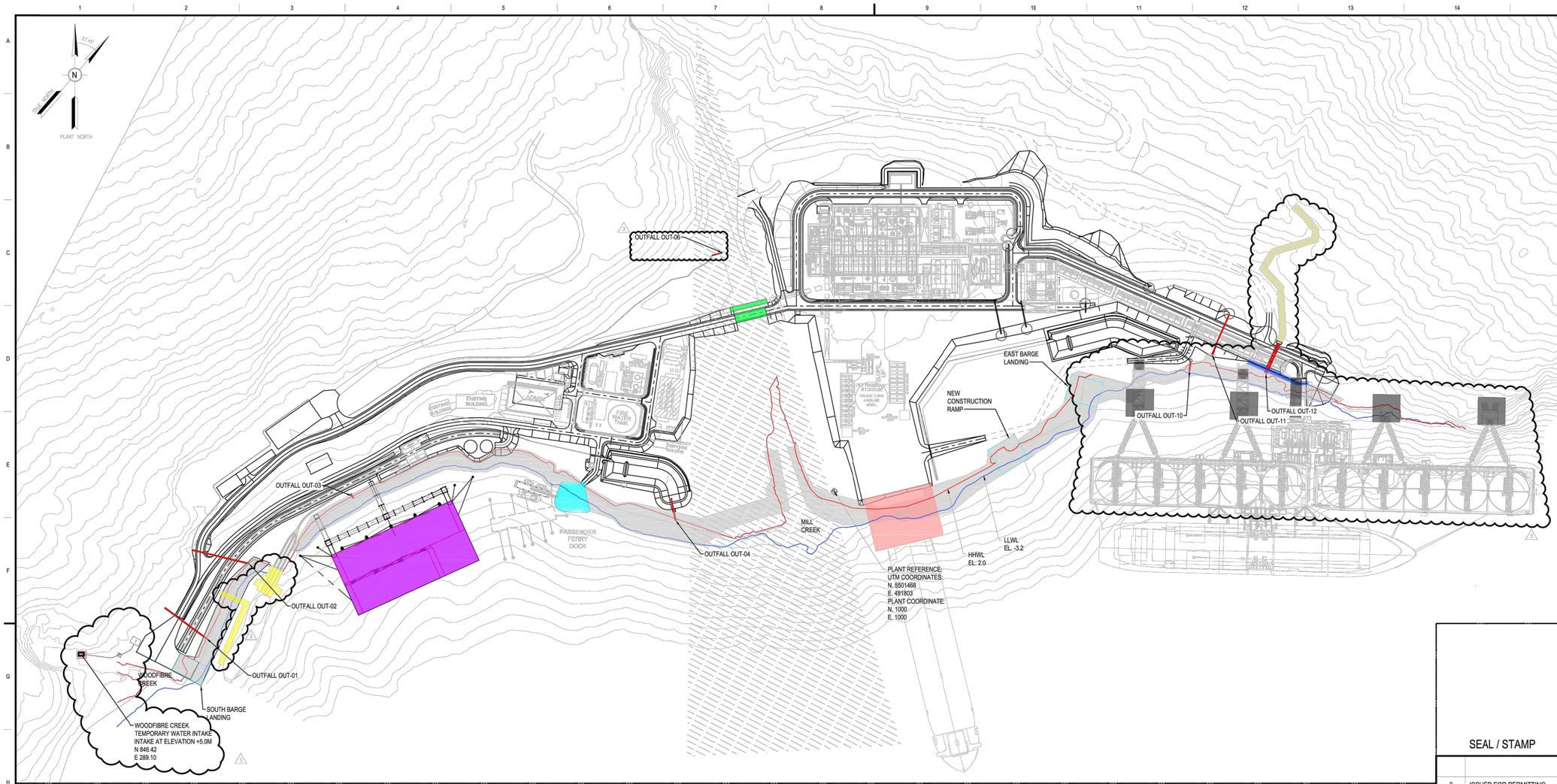
Version	Date Issued	Distribution	Purpose
0.1	May 2019	Sḵwx̲wú7mesh Úxwumixw (Squamish Nation)	Draft for comment
0.2	August 2019	Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) Tsleil-Waututh Nation Fisheries and Oceans Canada Oil and Gas Commission	Draft for comment responding to Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) comments from May 2019
0.3	June 2023	Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) Tsleil-Waututh Nation	Draft for comment

3. PRIMARY INFRASTRUCTURE

An overview of infrastructure included in the Project is shown on **Figure 3-1**. Details regarding the individual work activities are provided in **Section 3.1** through **Section 3.10**. For additional detail on project components and areas, refer to the *Fisheries Act* Authorization and Aquatic Effects Assessment for Construction (Keystone Environmental 2023).

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

Project Component	Location	Comments
Marine FST Terminal	49.6677992 N -123.2470597 W	Total Area includes floating structures or raised platforms with no shading impacts.
MOF	49.6653513 N -123.2512062 W	
Offloading Platform	49.6643043 N -123.2552212 W	
Floatel	49.6632422 N -123.2570407 W	
Shoreline Armour	**Western Point** 49.6615847 N -123.258646 W **Eastern Point** 49.6679829 N -123.2466843 W	
Ro-Ro	49.662360 N -123.258172 W	Project works are limited to repair of an existing structure.
Clear Span Bridges	49.666543 N -123.254328 W	Bridges will be designed and installed to meet the requirements of the BC Staq̓w (water) Sustainability Regulation.
Culverts and Outfalls	Within Shoreline Armour Footprint	Stormwater outfall culverts will be installed above the higher high staq̓w (water) level (HHWL) in areas of existing man-made structures.
Hydraulic Modifications	49.668733 N -123.248452 W	Hydraulic Modifications to mitigate flood and erosion will be completed in non-Sts'úkwi7 (fish) bearing watercourses.
Staq̓w (water) Withdrawals	Woodfibre Creek: 49.661286 N -123.259931 W Mill Creek: 49.679102 N -123.266845 W	Mill Creek – an existing intake will be used. Woodfibre Creek – small, temporary intake footprint minimal relocation of rocks by hand.



MONUMENT POINTS						
POINT	NORTHING	EASTING	ELEV. (GD)	PLANT NORTH	PLANT EAST	DESC.
1	5501502.508	481707.493	3.094	1074.679	931.126	WLNG001
2	5501754.591	481643.517	29.326	1327.972	990.580	WLNG002
3	5501702.839	481836.696	15.111	1192.942	1138.212	WLNG003
4	5501554.780	481915.267	3.077	1025.268	1139.686	WLNG004
5	5501381.877	481623.786	3.068	1006.189	801.184	WLNG005
6	5501369.173	481457.777	3.172	1071.467	647.949	WLNG006
101	5501162.976	481376.282	3.543	925.994	480.511	MON101
102	5501390.753	481496.906	3.148	1072.580	692.638	MON102

SUMMARY TIDAL DATA

TIDE	ELEVATION TO GD (m)	ELEVATION TO CD (m)
EXTREME HIGHEST HIGH WATER LEVEL, EHHW	2.4	5.6
HIGHER HIGH WATER LEVEL - LARGE TIDE, HHWL	2.0	5.2
HIGH WATER LEVEL - MEAN TIDE, HWL	1.3	4.5
MEAN WATER LEVEL, MWL	0.0	3.1
LOW WATER LEVEL - MEAN TIDE, LWL	-2.0	1.2
LOWER LOW WATER LEVEL - LARGE TIDE, LLWL	-3.2	0.0

NOTES:

1. ALL ELEVATIONS ARE SHOWN IN PROJECT DATUM (EQUIVALENT TO GEODETIC DATUM).
2. HORIZONTAL DATUM REFERENCE TO UTM NAD83 ZONE 10

LEGEND

- SHORELINE WORK - REF EXHIBIT 2
- MOF - REF EXHIBIT 4
- OFFLOADING PLATFORM - REF EXHIBIT 5
- FLOATEL - REF EXHIBIT 7
- BRIDGES OVER MILL CREEK - REF EXHIBIT 8
- OUTFALLS - REF EXHIBIT 9
- LANDING AND RAMPS
- EAST CREEK (WOODFIBRE LNG H&H ASSESSMENT OF EAST CREEK)
- RORO MAINTENANCE / UPGRADE
- SHEET PILE WALL - (REF EXHIBIT 2)
- MARINE TERMINAL
- WOODFIBRE CREEK TEMPORARY RAW WATER INTAKE

NOT FOR CONSTRUCTION

PERMIT TO PRACTICE
CB&I LLC
Signature : _____
Date: _____
PERMIT NUMBER: P 1002575
The Association of Professional Engineers and Geoscientist of British Columbia

SEAL / STAMP

NO.	REVISION	DRWN	CK'D	APP'D	DATE
3	ISSUED FOR PERMITTING	TDS	PGS	DS	19 OCT 2022
2	ISSUED FOR PERMITTING	TDS	PGS	DS	15 JUL 2022
1	ISSUED FOR PERMITTING	TDS	PGS	DS	08 JUL 2022
0	ISSUED FOR PERMITTING	TDS	HR	DS	01 APR 2022
A	ISSUED FOR CLIENT REVIEW	TDS	PES	RP	28 JAN 2022

MCDERMOTT

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Drawn By	Drwn Date	Chkd By	Chkd Date	Aprvd By	Aprvd Date	Scale
TDS	28JAN2022	PES	28JAN2022	RP	28JAN2022	NTS

Woodfibre LNG

Woodfibre LNG Project

CLIENT DWG NO:

EXHIBIT 1:
LOCATION OF MARINE PROJECT COMPONENTS

FOR: Woodfibre LNG Limited

PROJ. NO:	DWG NO:	REV:
350106	350106-PER-002001.04	3

Woodfibre LNG Limited - Reference Drawing Number 350106-PER-002001.04 Rev 3 - Issued for Permitting

Keystone Environmental

NOTES:
1. ORIGINAL DRAWING REFERENCED FROM MCDERMOTT.

Woodfibre
Squamish, B C
Woodfibre LNG Limited

REVISION No.	DATE	PROJECT No.
00	Mar. 2023	17953-109

Figure 3-1
Overview Drawing
350106-PER-002001.04

PLOT SCALE: DRAWN BY: CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig3-1-Overview Drawing-R0.dwg

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. Coatings will be applied in the module yard

prior to transport to the Woodfibre LNG site. There may be the need to do small touchups onsite but they will be small and controlled and application will occur away from watercourses or Howe Sound.

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.

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 stak̲w (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-stak̲w (water) mark will be installed from a marine piling barge, and piles above the current high-stak̲w (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 staq̓w (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., sheetpile), 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 via the use of cranes or excavators to fill the area with clean, graded, base material. Fill material will be free of contaminants, any natural leachable metals, and will not be acid generating. The Contractor will be required to provide proof of quality of the material prior to its placement. The bulk of fill material will be riprap imported from a commercial quarry. Infill will be isolated from marine staq̓w (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.

The24ccesss 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-fines 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 is 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 on-shore mooring structures to secure the Floatel in place.

Fixed walkways and gangways will support electrical conduits for power supply and steel piping for potable staq̓w (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 staq̓w (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 Sts'úkwi7 (fish) and Sts'úḵwi7 (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. The berthing dolphins and walkway piles are anticipated to be left in place to facilitate facility maintenance during operation and eventual decommissioning activities in the future.

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;

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. 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.

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 temíxw (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 on-shore 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-staq̓w (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-staq̓w (water) marine activities that have the potential to harm Sts'úkwi7 (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. In terms of staq̓w (water) quality, the ínexwantas (monitoring) criteria are outlined in Section 8.2.1 of MWQMMP. In the event, these criteria are not met, then adaptive management measures (which may include the use of silt curtains) will be implemented. The use of silt curtains will be mandatory for shoreline repair works. Additionally, confirmatory sampling of excavated sediments will be required to inform sediment management requirements.

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 works below the high-staq̓w (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. 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.

3.7 Culvert Outfalls

Seven drainage culvert outfalls will be installed in the shoreline for controlled drainage of treated and non-contact stak̲w (water) from the site for discharge into Nexwnéwu7ts Átlk̲'a7tsem (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 Sts'úkwi7 (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.

3.8 East Creek Hydraulic Modifications

A pre- and post-development hydrology and hydraulics model was developed to assess flood and erosion risks on non-Sts'úkwi7 (fish) bearing East Creek. The assessment considered risks related to significant (1:200-year annual event probability) storm events (Stantec 2022a) and identified that lower reaches of East Creek may require modification to mitigate risks of flooding and erosion.

Evidence of historical channel modifications and armouring, presumed to have been completed by the previous industrial operator, are in place to protect the access road from scour and erosion along the upstream reach of the watercourse, near the northeast boundary of the Woodfibre LNG site.

The hydrology and hydraulics assessment has identified high flow velocities are anticipated, with associated flooding, scour and erosion risk along specific sections of the watercourse. To mitigate these risks, recommendations along sections of the watercourse to improve mitigation include existing road culvert replacements, riprap erosion armoring, and multiple rock check structures to reduce flow velocities and erosion potential.

Modifications and related mitigation for specific reaches of this watercourse are in preliminary design (Stantec 2022a). Given the preliminary design and the non-Sts'úkwi7 (fish) bearing status of the ephemeral watercourse as defined by site-specific assessment (Keystone Environmental 2021), Woodfibre LNG considers these modifications, to mitigate flood and erosion risk improvements to the current condition, of negligible consequence to Sts'úkwi7 (fish) and Sts'úkwi7 (fish) habitat. Further refinements for these watercourse modifications are expected by Q2 2023 and can be provided where necessary. Woodfibre LNG

will also provide the necessary information to BC ER for approval under Section 11 of the provincial *Staq̓w (water) Sustainability Act* once modification design is complete.

3.9 Mill Creek and Woodfibre Creek Staq̓w (water) Intakes and Withdrawals

Woodfibre LNG will require up to 0.10 m^3/s of freshwater year-round during the construction phase of the Project and the staq̓w (water) is proposed to be primarily sourced from Mill Creek. Woodfibre Creek flows are regulated by Henriette Dam upstream and is proposed as a supplemental source of staq̓w (water) during construction to ensure potential effects to Sts'úkwi7 (fish) and Sts'úkwi7 (fish) habitat are mitigated by managing instream flow requirements (IFR). Both proposed points of diversion are located with the CPA.

Mill Creek is proposed as the preferred staq̓w (water) source given the existing permanent upgraded staq̓w (water) intake, a higher mean annual discharge, and its location capable of support a gravity feed without the need for distribution pumps. Woodfibre Creek, while having the advantage of regulated flow due to Henriette Dam, has a relatively lower mean annual discharge (MAD) resulting in increased base flow reductions during withdrawal, has significant pump requirements and is prone to more intense flash storm events given its higher gradient.

The provincial, Skwxwú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address, including that Woodfibre LNG undertake an instream flow requirements study to assess the potential effects of diverting staq̓w (water) for construction and operation from Mill Creek and Woodfibre Creek. Hydrometric data collection on both creeks has been underway since 2017. Woodfibre LNG will request the necessary approvals, pursuant to the *Staq̓w (water) Sustainability Act* (WSA), to facilitate staq̓w (water) use in both Mill Creek and Woodfibre Creek through the BC ER.

3.9.1 Mill Creek

The Mill Creek construction staq̓w (water) source point of diversion (PoD) is located approximately 2 km upstream from the mouth of the Creek. It is an existing staq̓w (water) intake that was previously used to supply staq̓w (water) to the former pulp mill operations at the Site. The intake was recently upgraded in preparation for staq̓w (water) withdrawal for usage during the construction phase of the Project under a letter of advice (DFO File No. 22-HPAC-00433). DFO's review was limited to the upgrades and did not include operation of the intake to provide staq̓w (water) for Project construction. The Mill Creek staq̓w (water) intake upgrades included Sts'úkwi7 (fish) screening and it will be used to divert staq̓w (water) to a holding tank for subsequent construction use. A flow meter will be installed on the pipeline to measure the diverted staq̓w (water) quantity.

Withdrawals of up to 3,600 m^3 per day at a rate of no more than 0.1 m^3/s from Mill Creek are proposed during construction.

3.9.2 Woodfibre Creek

The supplemental Woodfibre Creek construction staq̓w (water) source point of diversion is located approximately 40 m upstream from the mouth of the Creek at Howe Sound. Woodfibre LNG is proposing to withdraw 3,600 m^3 of staq̓w (water) per day from Woodfibre Creek at a rate of no more than 0.1 m3/s, using a portable 6" skid or trailer mounted pump with 6" or smaller flexible suction and discharge

lines. The pump will be operated using temporary power generated to support Woodfibre LNG onsite construction activities, or a self-contained pump system generating power independently using diesel. A flow meter will be installed to measure and record the diverted stak̲w (water) quantity. The installation of the in-stream intake structure and Sts'úkwi7 (fish) screen may require the relocation or removal of rocks and other in-stream materials within an estimated 3 m x 5 m footprint. The in-stream materials will be moved by hand or using light construction equipment situated outside of the creek banks.

The intake structure and Sts'úkwi7 (fish) screen will be secured using driven steel dowels, tee posts, and precast concrete lock blocks as required to secure the components to the bed of the creek. Clearing of riparian vegetation will be required to facilitate machinery access from the existing gravel laydown area west of the Ro-Ro to the proposed intake location. The flexible suction line will be routed at grade from the intake structure along the creek bank to the pump positioned downstream from the intake structure, adjacent to Woodfibre Creek and an existing gravel road. The suction line will be secured in place using driven steel dowels and tee posts. Hand clearing of vegetation will avoid large woody debris along the stak̲w (water) line route and will be minimized to facilitate pump access and above ground stak̲w (water) line installation.

The pump will discharge into a temporary holding tank positioned near the existing access road. Regular maintenance of the pump and pipelines shall be performed by construction personnel throughout the operations of the temporary intake. After completion of construction activities, the temporary raw stak̲w (water) intake will be removed using equivalent methods and equipment.

Detailed equipment specifications will be confirmed once the equipment (pump, stak̲w (water) lines, and storage) has been requisitioned.

3.10 Timeline

Construction periods for the Project marine infrastructure components are outlined in **Table 3-2**. 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-stak̲w (water) construction activities that have the potential to affect Sts'úkwi7 (fish) within the Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) August 16 through January 31 MLRW.

Table 3-2 Anticipated Schedule of Marine Construction Activities

Component	Start	Finish	In-Stak̲w (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	01-Sep-23	01-Oct-23	Yes
All Other Outfalls – Installation	01-Sep-23	31-Jan-24	Yes

Component	Start	Finish	In-Staq̓w (water) Works within Least Risk Window
Floatel			
Piles, Berthing Dolphins, Gangways	01-Sep-23	01-Dec-23	Yes
Floatel Berthing & Hook-Up	01-Sep-23	15-Mar-24	No
Floatel Operation	01-Jan-24	2024 – Q1 Commissioning	No
Offloading Platform			
Sheet Piling and Riprap Installation	18-Nov-23	30-Jan-24	Yes
Infilling and Grading	16-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	Yes
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 Staq̓w (water) Intakes	01-Sep-23	Through construction 01-Mar-26	Yes
Marine Terminal			
Blasting	01-Nov-23	31-Jan-24	No in-staq̓w (water) works
Marine Pile Installation	01-Nov-23	31-Jan-25	Yes
Marine Terminal Structure Installation	16-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

Environmental Assessment Conditions and Commitments are outlined in Section 1.0.

4.2 Legislative Requirements and Criteria

A summary of the federal and provincial regulatory and policy settings relevant to marine stak̲w (water) quality are provided in **Table 4-1**.

Table 4-1 Regulatory Framework for MWQMMP

Name	Jurisdiction	Description
Fisheries Act, RSC 1985, c. F-14 (including 2013 and 2019 amendments)	Federal	Safeguards both Sts'úkwi7 (fish) and Sts'úkwi7 (fish) habitat. It is also an offence for anyone to deposit or permit the deposit of any type of deleterious substance in stak̲w (water) frequented by Sts'úkwi7 (fish) without a permit or under a regulation.
Canada Shipping Act, SC 2001, c. 26	Federal	Protects the marine environment from damage due to navigation and shipping activities (e.g., from discharges).
Environmental Management Act, SBC 2003, c. 53	Provincial	Regulates industrial and municipal waste discharge, pollution, hazardous waste and contaminated site remediation

Both the provincial (BC ENV 2018a, 2018b) and federal (CCME 1999b) governments publish stak̲w (water) quality guidelines for marine stak̲w (waters). As well, both governments publish sediment quality guidelines (BC ENV 2018a, 2018b; CCME 1999a). Parameters relevant to the Project, as well as application guidelines, are presented in **Section 6** and **Section 8**.

The Canadian Council of Ministers on the Environment (CCME) Canadian Stak̲w (water) Quality Guidelines for the Protection of Aquatic Life, BC Approved Stak̲w (water) Quality Guidelines and CCME Interim Sediment Quality Guidelines for the Protection of Aquatic Life are the benchmarks against with stak̲w (water) quality and sediment quality will be compared.

4.3 Best Management Practices and Standards

A list of Best Management Practices (BMPs) used to inform the MWQMMP are provided in **Table 4-2**. Guidance documents used in the HHERA guide determination of acceptable and unacceptable conditions for human and ecological health by Approved Professionals, while other Best Management Practices have been identified by the EAC and/or FDS and are included as conditions for management and monitoring.

Table 4-2 Applicable Best Management Practices for the MWQMMP

Best Management Practice	Description
Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA), version 2.0 (2012).	Human Health Risk Assessment
Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors, version 2.0 (2010a).	Human Health Risk Assessment
Supplemental Guidance on Human Health Risk Assessment for Country Foods (HHRA Foods) (2010b).	Human Health Risk Assessment
Best Management Practices for Pile Driving and Related Operations (BCMPDCA and DFO 2003)	Marine Stak̲w (water) Quality
Guidelines to Protect Sts'úkwi7 (fish) and Sts'úkwi7 (fish) Habitat from Treated Wood Used in Aquatic Environments in the Pacific Region (Hutton and Samis 2000)	Marine Stak̲w (water) Quality

5. ROLES AND RESPONSIBILITIES

The Construction Environmental Management Plan (CEMP) provides details on the roles and responsibilities of Woodfibre LNG, the Environmental Monitor, and the Contractor, including the Contractor's Project Director, Construction Director / Site Manager, Construction Supervisor, HSSE Manager, Environmental Manager, and Environmental Monitor. A summary of the participant and specific work activity for each is provided in Table 5-1.

Table 5-1 Summary of Participant and Specific Work Activity from CEMP

Participant	Specific Work Activity
Woodfibre LNG (Section 3.2.1. of CEMP)	Woodfibre LNG is responsible for ensuring development of the Project Environmental Governance documentation is in accordance with the Project's environmental requirements and obtaining approval of these documents from all relevant regulators and authorities. Woodfibre LNG is also responsible for approval of the Contractor Implementation Tools, ensuring they effectively establish the means and methods to achieve the project-wide environmental requirements agreed within the approved Governance documents. In addition, Woodfibre LNG will provide continual oversight of the implementation of environmental management practices across the entire Management Framework to ensure environmental requirements are consistently met. Woodfibre will report on compliance with the Project environmental requirements and the effectiveness of environmental management at the project-level. Where environmental requirements are not met, Woodfibre LNG is responsible for implementing adaptive management processes to improve management measures and processes to ensure environmental requirements are met.
Environmental Monitor (Section 3.2.2 of CEMP)	A Qualified Environmental Professional will be retained as the Environmental Monitor throughout the duration of the Construction phase of the Project and will be responsible for overseeing the Contractors Environmental Monitor to determine compliance with Project environmental approval conditions and implementation tools. The Environmental Monitor has the authority to stop Project work if they determine that environmental approval conditions are not met or if necessary to prevent or reduce significant environmental harm.
Contractor (Section 3.2.3. of CEMP)	The Contractor (s) is responsible for the development of Contractor Implementation Tools, which must outline the management measures included in this report. ínexwantas (monitoring) results must be reported by the Contractor to Woodfibre LNG. The Contractor will actively participate in adaptive management processes where required, including review and update of the Implementation Tools.
Contractors Project Director (3.2.3.1 of CEMP)	The Contractor Project Director is ultimately accountable for implementation of the EPP. The Construction Director will ensure: • The EPP is developed in accordance with the Project's environmental requirements and approved Project Environmental Governance Documents. • The Project complies with the requirements of the EPP. • Personnel, facilities, and other resources necessary to effectively implement the environmental requirements of the Project are provided.

Participant	Specific Work Activity
Contractor Construction Director / Site Manager (Section 3.2.3.2 of CEMP)	The Contractor Construction Director / Site Manager is responsible for ensuring the implementation of the EPP. The Contractor Construction Director / Site Manager will: • Report to the Contractor Project Director on the implementation of the EPP, identifying additional requirements for personnel, facilities, and other resources required to meet Project environmental requirements. • Provide leadership and motivation to the Contractor Team. • Actively develop and maintain a culture in line with the Contractors Health, Safety, Security, and Environmental (HSSE) policies and procedures. • Ensure that the EPP is adhered to. • Actively participate in HSSE compliance audits, inspections, reviews, and programs. • Close out corrective actions and programs within specified deadlines as informed by the Contractor HSSE Manager or Contractor Environmental Manager.
Contractor Construction Supervisor (Section 3.2.3.3 of CEMP)	The Contractor Supervisor includes area construction managers, superintendents, and other supervision roles under the Contractor Organizational Chart. The Contractor Construction Supervision is responsible for the field implementation of the EPP including: • Ensuring all personnel adhere to the requirements of the EPP. • Implementing a culture in line with the Contractors Health, Safety, Security, and Environmental (HSSE) policies and procedures. • Implementing environmental management measurers under advice of the Contractor Environmental Manager. Leading and supporting investigations and ensuring the implementation of corrective actions.
Contractor HSSE Manager (Section 3.2.3.4 of CEMP)	The Contractor HSSE Manager is responsible for ensuring construction activities are performed in compliance with the requirements outlined in this Construction Environmental Protection Plan (CEPP), Company Environmental Management Plan(s), applicable approvals, permits, licensed and federal/provincial/local regulations, in addition to Contractor QHSES Management System. Contractor HSSE Manager is accountable for the planning and effective implementation of the Site HSSE program. To deliver these plans the Contractor HSSE Manager has explicit responsibility for the following tasks: • Consult on HSSE matters, including environmental aspects related to this CEPP or Project compliance as required. • Lead the development, implementation, and ínexwantas (monitoring) of the Project HSSE Management System and ensuring alignment of the EPP with the System. • Leads and participates in investigations of environmental incidents or regulatory non-compliance events, compliance audits, and site inspections as required. • Support the Contractor Environmental Manager in the implementation and compliance of the Project Environmental Management Process.

Participant	Specific Work Activity
Contractor Environmental Manager (Section 3.2.3.5 of CEMP)	The Contractor Environmental Manager is responsible for the planning and effective implementation of environmental management measures during activities related to the Contractor scope of work. Reporting to the Contractor HSSE Manager, the Contractor Environmental Manager will: • Ensure environmental management measures are completed in accordance with the Project environmental requirements, Environmental Governance Documents, and the Contractor Implementation Tools. • Serve as the principal point of contact for Woodfibre LNG environmental representatives. • Develop and approve Contractor Implementation Tools including the EPP and EWPs and any other plan and / or procedures required throughout the duration of Contractor scope of work. The Contractor Environmental Manager will submit Implementation Tools to Woodfibre LNG environmental representatives for approval. • Approve any Subcontractor EWPs, method statements, risk assessments, or any additional procedures or documents required throughout the duration of Subcontractors scope of work. • Lead and approve environmental reporting deliverables in alignment with Project environmental requirements. • Provide guidance to the Contractor Supervisors and field personnel on how to meet Project environmental requirements. • Make sure adequate resources (e.g., equipment, materials, training, personnel, etc.) necessary to meet environmental requirements are available. • Ensure the Contractor site orientation incorporates applicable environmental requirements, as well as applicable additional training is identified and available for site personnel. • Supervise and coordinate environmental compliance and ínexwantas (monitoring) activities under the Contractor scope of work. • Support and guide construction activities for compliance with the overall Project environmental requirements. • Coordinate environmental risk assessments and associated work planning process. • Ensure adequate monitoring, auditing, reporting, and documentation are captured and actioned according to the Project requirements. • Ensure compliance of environmental protection plan(s), HSSE plan(s) and procedure(s), and general documents with contract, Project specifications and overall requirements. • Ensure environmental incidents are investigated and reported within the specified timeline. • Lead and participate in investigations of environmental incidents or regulatory non-compliance events, compliance audits, and site inspection as required. • Ensure environmental lessons learned, corrective, and preventive actions are captured and implemented. • Liaise with the Contractor Construction Management Team and other Project stakeholders to review environmental compliance on the jobsite, evaluate the success and effectiveness of the environmental program, and seek opportunities for continuous improvement. • Support the Contractor HSSE Manager in the implementation and compliance of the Project HSSE Program including Best Management Practices.

Participant	Specific Work Activity
Contractor Environmental Monitor (Section 3.2.3.6 of CEMP)	The Contractor Environmental Monitor will be responsible for ínexwantas (monitoring) construction activities to determine compliance with Project environmental conditions of approval and implementation tools. Key responsibilities include: • Conducting field ínexwantas (monitoring) as required (e.g., stak̲w (water) quality monitoring, air quality monitoring, identifying invasive plants, and Sts'úkwi7 (fish) observations). • Monitor construction activities to determine whether the works are resulting in any adverse effects on the environment (e.g., potential impacts from underwater noise on Sekw'ekw'inexw (wildlife)) and advise on corrective mitigation measures, if necessary. • Prepare reporting documentation including but not limited to ínexwantas (monitoring) activities, effective implementation of mitigation measures, and performance against quality indicators. • Evaluate the performance of mitigation measures and when not performing, provide recommendations, and evaluate the effectiveness of, on modifying or improving mitigation measures. • Ensure that any non-conformances and incidents are appropriately reported, addressed, and that corrective and preventative actions are effective. • Review the Contractor EPP and EWPs for consistency with the CEMP and Component Environmental Management Plans. • Submit reports to Woodfibre LNG on the above tasks.

6. BASELINE ENVIRONMENTAL CONDITIONS

Baseline environmental conditions have included characterisation of the existing contamination as it relates to staq̓w (water) quality, sediment quality, shellfish and groundfish tissue, and subsequent Human Health Risk Assessment. This work has been ongoing since 2013 with sampling continuing into 2023.

6.1 Staq̓w (water) Quality Baseline Conditions

6.1.1 Historical Staq̓w (water) Quality Studies (2014)

As part of the environmental assessment, seasonal field studies were conducted to characterize existing conditions within the CPA (i.e., eight stations) and reference area (i.e., two stations) in July and September 2013, and April to June 2014. The results are presented in greater detail in Appendix 5.10-1 (Golder Associates, 2014) of the Application for an EAC.

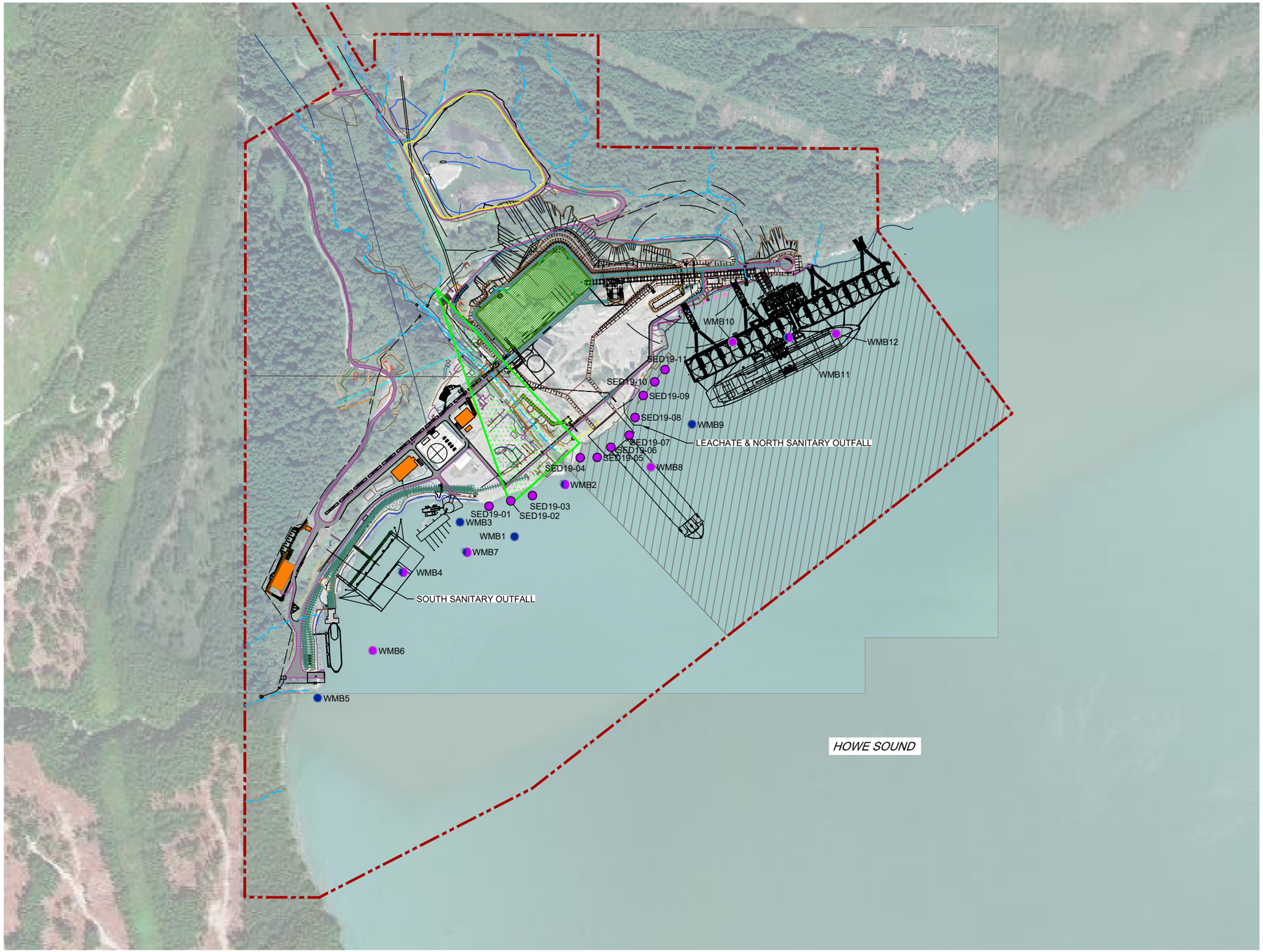
Figure 6-1 and **Figure 6-2** summarize the 2014 baseline sampling program. Of the analysed parameters, total boron, copper, and zinc had elevated concentrations above the BC WQG for marine aquatic life. The average total copper and zinc concentrations were less than the BC WQG for marine aquatic life. pH and field dissolved oxygen were below the BC WQG and CCME guidelines for marine aquatic life for some samples.

Table 6-1 Summary of Baseline Staq̓w (water) Quality (Golder Associates, 2014)

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
*pH	unitless	6.54 – 7.92 *(7.55)*	47	6.82 – 7.91 *(7.56)*	7.0 – 8.7	7.0 – 8.7
*Field Dissolved Oxygen (DO)	mg/L	5.8 – 15.0 *(8.1)*	-[c]	-	n/g	8-11[a] *5 – 6 instant. minimum
Conductivity	µs/cm	884 – 46,400 *(21,788)*	47	662 – 45,900 *(20,093)*	n/g	n/g
Hardness	mg/L	71 – 5,370 *(2,559)*	43	64 – 5,360 *(2,294)*	n/g	n/g
Salinity	psu	<1 – 31 *(18)*	40	<1 – 31 *(18)*	n/g	n/g
Total Organic Carbon (TOC)	mg/L	0.59 – 2.33 *(1.12)*	48	0.8 – 2 *(1)*	n/g	n/g
Total Suspended Solids (TSS)	mg/L	<2 – 29 *(17)*	47	<2 – 39 *(20)*	n/g	*change from background
Total Dissolved Solids (TDS)	mg/L	513 – 31,400 *(9,364)*	19	323 – 30,200 *(7,294)*	n/g	n/g

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
Turbidity	NTU	0.3 – 47 *(9)*	47	0.3 – 31 *(11)*	n/g	*change from background
Nutrients						
Total Nitrogen (TN)	mg/L	<0.05 – 0.5 *(0.3)*	30	<0.05 – 0.5 *(0.3)*	n/g	n/g
Total Kjeldahl Nitrogen (TKN)	mg/L	<0.05 - 0.2 *(0.1)*	48	<0.05 – 0.2 *(0.1)*	n/g	n/g
Ammonia	mg/L	<0.005 - 0.05 *(0.02)*	48	<0.005 – 0.04 *(0.02)*	*guidance framework	2[a] 13[b] *salinity 10 ppt, pH 8, temperature 10°C
Nitrate	mg/L	<0.005 - 0.8 *(0.4)*	47	<0.005 – 0.6 *(0.3)*	200[a] 1500[b]	3.7[a]
Total Phosphorus (TP)	mg/L	0.007 – 0.09 *(0.04)*	48	– 0.08 *(0.04)*	n/g	n/g
Dissolved Orthophosphate	mg/L	<0.001 - 0.08 *(0.03)*	47	<0.001 – 0.08 *(0.03)*	n/g	n/g
Hydrocarbons						
Extractable Petroleum Hydrocarbons (EPH)	mg/L	<RDL	9	<RDL	n/g	n/g
Polycyclic Aromatic Hydrocarbons (TPAH)	mg/L	Varies	11	<RDL	Varies	Varies
Non-Organic						
*Total Boron	mg/L	<0.1 – 4.4 *(2.1)*	43	<0.1 – 4.3 *(2.0)*	n/g	1.2[a]
*Total Copper	mg/L	<0.0005 – 0.0065 *(0.0019)*	43	<0.005 – 0.0036 *(0.0015)*	n/g	≤0.002[a] 0.003[b]
*Total Zinc	mg/L	<0.003 – 0.012 *(0.006)*	43	<0.003 – 0.012 *(0.006)*	n/g	0.010[a] 0.055[b]
Dissolved Metals		Varies	43	Varies	Varies	Varies

Note:
* greater than guideline(s)
n/g no guideline
b short-term chronic guideline
- no information
a long-term chronic guideline
c *in situ* only





REFERENCE AREA

N

LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- ROADWAY
- WATER SAMPLE (GOLDER, 2014)
- WATER/SEDIMENT SAMPLE (GOLDER, 2014)
- SEDIMENT SAMPLE (GOLDER, 2014)
- KEYSTONE SEDIMENT SAMPLE (2019)

Keystone Environmental

NOTES:
1. ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY. PROJECT FEATURES MAY BE SUBJECT TO CHANGE.
SOURCES:
2. CERTIFIED PROJECT AREA, CERTIFIED MARINE TERMINAL AREA, GREEN ZONE, FLOATEL, AND WATERCOURSES, WERE PROVIDED BY HEMMERA, AN AUSENCO COMPANY.
3. OTHER FEATURES SHOWN WERE OBTAINED FROM McDERMOTT OVERALL PLOT PLAN, DWG NO: 239348-0000-00PI-DWG-P0A-0002, REV E.
4. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM GOOGLE MAPS.

50m 0 250m

SCALE: 1:7500(approx.)

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

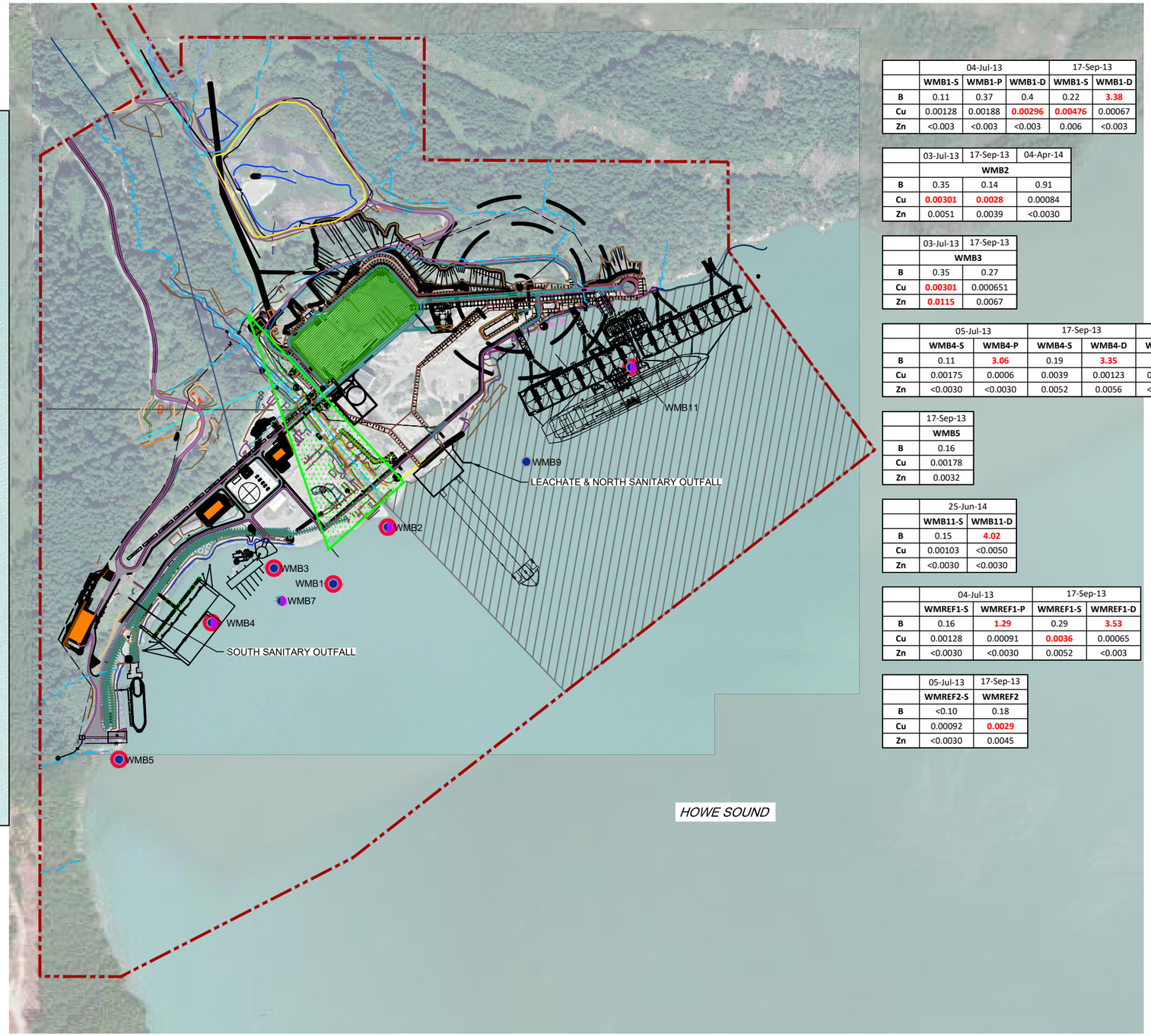
REVISION No.	DATE	PROJECT No.
00	Mar. 2023	17953-109

Figure 6-1
Water & Sediment Quality Baseline Sampling Locations

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig6-1-Water Sed Sample Location Plan-R0.dwg



REFERENCE AREA



	04-Jul-13			17-Sep-13	
	WMB1-S	WMB1-P	WMB1-D	WMB1-S	WMB1-D
B	0.11	0.37	0.4	0.22	3.38
Cu	0.00128	0.00188	0.00296	0.00476	0.00067
Zn	<0.003	<0.003	<0.003	0.006	<0.003

	03-Jul-13	17-Sep-13	04-Apr-14
	WMB2		
B	0.35	0.14	0.91
Cu	0.00301	0.0028	0.00084
Zn	0.0051	0.0039	<0.0030

	03-Jul-13	17-Sep-13
	WMB3	
B	0.35	0.27
Cu	0.00301	0.000651
Zn	0.0115	0.0067

	05-Jul-13		17-Sep-13		04-Apr-14	
	WMB4-S	WMB4-P	WMB4-S	WMB4-D	WMB4-S	WMB4-D
B	0.11	3.06	0.19	3.35	1.26	3.84
Cu	0.00175	0.0006	0.0039	0.00123	0.00072	<0.00050
Zn	<0.0030	<0.0030	0.0052	0.0056	<0.0030	<0.0030

	17-Sep-13
	WMB5
B	0.16
Cu	0.00178
Zn	0.0032

	25-Jun-14	
	WMB11-S	WMB11-D
B	0.15	4.02
Cu	0.00103	<0.0050
Zn	<0.0030	<0.0030

	04-Jul-13		17-Sep-13	
	WMREF1-S	WMREF1-P	WMREF1-S	WMREF1-D
B	0.16	1.29	0.29	3.53
Cu	0.00128	0.00091	0.0036	0.00065
Zn	<0.0030	<0.0030	0.0052	<0.003

	05-Jul-13	17-Sep-13
	WMREF2-S	WMREF2
B	<0.10	0.18
Cu	0.00092	0.0029
Zn	<0.0030	0.0045

N

LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- ROADWAY
- WATER SAMPLE (GOLDER, 2014)
- WATER/SEDIMENT SAMPLE (GOLDER, 2014)
- PCOC CONCENTRATION(S) IN GROUNDWATER LESS THAN BCWQG GUIDELINES
- PCOC CONCENTRATION(S) IN GROUNDWATER GREATER THAN BCWQG GUIDELINES

B	BORON
Cu	COPPER
Zn	ZINC
D	DEEP
S	SURFACE
P	PYCNOCLINE
BCWQG	BC WATER QUALITY GUIDELINES MARINE
PCOC	POTENTIAL CONTAMINANT OF CONCERN

	05-Jul-13	— DATE SAMPLED
	WMREF2-S	— SAMPLE I.D.
ANALYTE — B	<0.10	— RESULTS

NOTES:
1. SAMPLE VALUES ARE PRESENTED AS MILLIGRAMS PER LITRE (mg/L) [PARTS PER BILLION (ppb)].
2. PCOC CONCENTRATION(S) IN SAMPLE EXCEEDING BCWQG GUIDELINES IN RED.
3. RESULTS ARE PRESENTED FOR PARAMETERS THAT WERE ANALYZED AND EXCEEDED THE GUIDELINES.

Keystone Environmental

NOTES:
1. ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY. PROJECT FEATURES MAY BE SUBJECT TO CHANGE.
SOURCES:
2. CERTIFIED PROJECT AREA, CERTIFIED MARINE TERMINAL AREA, GREEN ZONE, FLOATEL, AND WATERCOURSES, WERE PROVIDED BY HEMMERA, AN AUSENCO COMPANY.
3. OTHER FEATURES SHOWN WERE OBTAINED FROM McDERMOTT OVERALL PLOT PLAN, DWG NO: 239348-0000-00PI-DWG-P0A-0002, REV E.
4. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM GOOGLE MAPS.

50m 0 250m

SCALE: 1:7500(approx.)

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

REVISION No.	DATE	PROJECT No.
00	June 2023	17953-109

Figure 6-2
Golder Water Quality Baseline Results

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig6-2-WQ Baseline Results-R0.dwg

6.1.2 Historical Staq̓w (water) Quality Studies (2020/2021)

Subsequent to the 2014 environmental assessment, seasonal field studies were also conducted to characterize existing conditions within the CPA (i.e., four stations) and reference area (i.e., two stations) from May 2020 to December 2021. For the 2020/2021 sampling events, one shallow (approximately 2.0 m below the staq̓w (water) surface) and one deep (approximately 2.0 m above the seafloor) staq̓w (water) sample were collected from each sampling station.

Table 6-2 and **Table 6-3** summarize the 2020/2021 baseline sampling program for the shallow and deep sampling locations, respectively. Of the analysed parameters, total boron, cadmium, chromium, copper, mercury, and zinc, as well as benzo(a)pyrene and nitrate, had elevated maximum concentrations above the BC WQG and/or CCME guidelines for marine aquatic life. However, with the exception of total boron and benzo(a)pyrene (shallow and deep), the average concentrations for each of these parameters were less than the BC WQG and CCME guidelines. In addition, pH was outside the BC WQG and CCME acceptable range for marine aquatic life for some samples, but the average pH was within the BC WQG and CCME acceptable ranges.

Table 6-2 Summary of Baseline Staq̓w (water) Quality – Shallow Staq̓w (water) (2020/2021)

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
pH	unitless	6.9 – 8.3 *(7.4)*	107	6.9 – 8.3 *(7.5)*	7.0 – 8.7	7.0 – 8.7
Dissolved Oxygen (DO)	mg/L	**8.2 – 11.8 *(10.3)***	104	9.0-11.7 *(10.2)*	n/g	8-11[a] *5 – 6 instant. minimum
Conductivity (field) 2020	µs/cm	1,645 – 24,900 *(12,100)*	44	4,500 – 25,300 *(12,200)*	n/g	n/g
Conductivity (field) 2021	µs/cm	1,200 – 32,000 (12,000)	44	1,100 – 27,000 (8,200)	n/g	n/g
Hardness	mg/L	148 – 5,180 *(1,720)*	126	150 – 5,820 *(1,890)*	n/g	n/g
Salinity (field) 2020	psu	1.2 – 21.7 *(10.6)*	40	2.4 – 20.4 *(11.1)*	n/g	n/g
Salinity (field) 2021	psu	0.89 – 27 (11)	48	0.76 – 26 (7.4)	n/g	n/g
Total Suspended Solids (TSS)	mg/L	2 – 28.6 *(6.0)*	126	<2 – 21.5 *(6.7)*	n/g	*change from background
Turbidity (field) 2020	NTU	0.33 – 19 *(5.0)*	44	0.21 – 14 *(4.9)*	n/g	*change from background
Turbidity (field) 2021	NTU	0.18 – 16 (2.8)	52	0.25 – 20 (3.3)	n/g	*change from background

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
Nutrients						
Ammonia	mg/L	<0.05 – 0.425 *(0.06)*	101	<0.05 – 0.157 *(0.06)*	*guidance framework	2[a] 13[b] *salinity 10 ppt, pH 8, temperature 10°C
Nitrate	mg/L	<0.01 - 14.8 *(1.4)*	100	<0.01 – <10 *(< 1.3)*	200[a] 1500[b]	3.7[a]
Hydrocarbons						
Benzo(a)pyrene	Mg/L	**<0.00001 – 0.000066** ***(0.000012)***	100	<0.00001 – 0.00005 *(0.000011)*	n/g	0.00001[a]
Non-Organic						
Total Boron	mg/L	**<0.0024 – 3.8** ***(1.3)***	126	0.11 – 4.3 *(1.4)*	n/g	1.2[a]
Total Cadmium	mg/L	**<0.000002 – 0.0004** ***(0.000036)***	126	0.0000081 – 0.000089 *(0.000034)*	0.00012[a]	0.00012[a]
Total Chromium	mg/L	**0.0001 – <0.001** ***(0.0009)***	126	<0.0004 – 0.0012 *(0.0009)*	0.0015[a]	0.0015[a]
Total Copper	mg/L	**<0.0002 – 0.0093** ***(0.0017)***	126	<0.0008 – 0.0097 *(0.0017)*	n/g	≤0.002[a] 0.003[b]
Total Mercury	mg/L	**<0.000005 - <0.00001** ***(0.0000098)***	126	<0.000005 - <0.00001 *(0.0000098)*	0.000016[a]	n/g
Total Zinc	mg/L	<0.001 – 0.018 ***(0.0076)***	126	0.0015 – 0.078 *(0.0097)*	n/g	0.010[a] 0.055[b]

Note:
Bolded values indicate greater than BCWQ guideline(s)
n/g no guideline
b short-term chronic guideline
- no information
a long-term chronic guideline

Table 6-3 Summary of Baseline Staq̓w (water) Quality – Deep Staq̓w (water) (2020/2021)

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
*pH	unitless	6.9 – 7.7 *(7.5)*	107	7.0 – 7.7 *(7.5)*	7.0 – 8.7	7.0 – 8.7
Dissolved Oxygen (DO) (field)	mg/L	**8.0 – 11.4 *(9.7)***	104	8.5-11.5 *(9.8)*	n/g	8-11[a] *5 – 6 instant. minimum
Conductivity 2020	µs/cm	15,700 – 46,000 *(32,900)*	44	31,800 – 45,800 *(33,600)*	n/g	n/g
Conductivity 2021	µs/cm	26,000 – 32,000 (32,000)	44	23,000 – 32,000 (32,000)	n/g	n/g
Hardness	mg/L	2,520 – 6,770 *(5,630)*	127	305 – 10,200 *(5,700)*	n/g	n/g
Salinity 2020	psu	26.4 – 30.2 *(29.6)*	40	29.2 – 30.2 *(29.7)*	n/g	n/g
Salinity 2021	psu	22 – 32 (*29*)	48	18 – 32 (*29*)	n/g	n/g
Total Suspended Solids (TSS)	mg/L	<2 – 29 *(3.8)*	125	<2 – 17.4 *(3.5)*	n/g	*change from background
Turbidity 2020	NTU	0.0 – 15.3 *(0.79)*	43	0.0 – 0.87 *(0.43)*	n/g	*change from background
Turbidity 2021	NTU	<0.10 – 193 (0.49)	52	0.0 – 3.1 (0.*41*)	n/g	*change from background
Nutrients						
Ammonia	mg/L	<0.05 – 0.165 *(0.055)*	100	<0.05 – 0.139 *(0.056)*	*guidance framework	2[a] 13[b] *salinity 10 ppt, pH 8, temperature 10°C
Nitrate	mg/L	<1 - <10 *(< 1.5)*	100	<1 – <10 *(< 1.5)*	200[a] 1500[b]	3.7[a]
Hydrocarbons						
Benzo(a)pyrene	Mg/L	**<0.00001 – 0.000043 *(0.000011)***	100	<0.00001 – <0.00001 *(<0.00001)*	n/g	0.00001[a]

Parameters	Units	Range *(Average)*	No. of Samples	Reference Area Range *(Average)*	CCME	BC WQG Marine
Non-Organic						
Total Boron	mg/L	**2.0 – 5.4** ***(4.1)***	127	0.26 – 8.4 *(4.2)*	n/g	1.2[a]
Total Cadmium	mg/L	**<0.000033 – 0.00012** ***(0.000080)***	127	<0.00002 – 0.00017 *(0.000083)*	0.00012[a]	0.00012[a]
Total Chromium	mg/L	**0.00027 – 0.0023** ***(0.00099)***	126	<0.0005 – 0.0019 *(0.0010)*	0.0015[a]	0.0015[a]
Total Copper	mg/L	**<0.0004 – 0.0050** ***(0.0012)***	127	<0.00058 – 0.0044 *(0.0013)*	n/g	≤0.002[a] 0.003[b]
Total Mercury	mg/L	**<0.000005 - <0.0001** ***(0.000011)***	128	<0.000005 - 0.000014 *(0.0000099)*	0.000016[a]	n/g
Total Zinc	mg/L	**0.0003 – 0.126** ***(0.010)***	127	<0.0004 – 0.074 *(0.010)*	n/g	0.010[a] 0.055[b]

Note:
Bolded values indicate greater than BCWQ guideline(s)
n/g no guideline
b short-term chronic guideline
- no information
a long-term chronic guideline

6.1.3 Historical Staq̓w (water) Quality Studies (2022)

This section presents a summary of the 2022 staq̓w (water) quality baseline data (Lorax 2022).

Overall, the 2022 staq̓w (water) quality ínexwantas (monitoring) results illustrate the expected seasonal influences from snowmelt on the shallow marine staq̓w (waters) of Howe Sound. The marine staq̓w (water) column at the CPA and reference ínexwantas (monitoring) stations was generally stratified with shallow marine staq̓w (water) quality strongly influenced by discharge from the Sḵwx̱wú7mesh (Squamish) staq̓w (River). The deep marine staq̓w (water) quality remained relatively constant throughout the year. The marine staq̓w (water) quality at CPA and reference stations was generally similar at the time of sampling.

The BC or Federal WQG for the protection of marine staq̓w (water) aquatic life (MWAL) were met for all parameters in the 2022 marine staq̓w (water) quality ínexwantas (monitoring) sample dataset, except pH, DO, nitrate, fluoride, select total metals (i.e., boron, cadmium, chromium, copper, lead, nickel, selenium, vanadium, zinc), benzo(a)pyrene, chrysene, and naphthalene. Exceedances for fluoride, benzo(a)pyrene, chrysene, and naphthalene were all attributed to raised analytical detection limits. Similarly, exceedances for nitrate, total chromium, vanadium, and zinc are frequently attributed to raised detection limits. Total B exceeded the BC WQG in all deep staq̓w (water) samples and in many shallow staq̓w (water) samples. Results for total lead and nickel only exceeded BC WQGs in the shallow marine staq̓w (waters) (n = 3 and 1,

respectively). Exceedances of DO were frequently observed in deep marine staq̓w (water) samples and occasionally in shallow marine staq̓w (waters), consistent with the stratification of the marine staq̓w (water) column in the CPA and reference stations. Exceedances of WQG at ínexwantas (monitoring) stations within the CPA and at the reference station locations were generally infrequently observed and comparable in type and magnitude. *Escherichia coli* (*E. coli*) was generally detected at low concentrations within the CPA and at reference locations. Detectable levels of total iron, dissolved aluminum, toluene, and total BTEX in field and travel blanks show similar concentrations to the maximum values observed in the marine ínexwantas (monitoring) samples; therefore, these parameters may indicate some uncertainty in the ínexwantas (monitoring) results.

6.1.4 Existing Discharge Permits

Woodfibre LNG has three existing discharge permits issued under Section 14 of the *Environmental Management Act*. These permits include the following:

- Permit 1239 – Leachate Permit: authorized to discharge effluent (treated leachate from leachate treatment plant) to marine staq̓w (water).
- Permit 2334 – Sewage Permit: authorized to discharge effluent to the staq̓w (water) from sewage sources (treated sewage from sewage treatment plant).
- Permit 7322 – Landfill Permit: authorized to discharge refuse to the temíxw (land) (existing industrial landfill).

The Leachate and Sewage permits (Permits 1239 and 2334, respectively) authorize discharge to the marine environment (Howe Sound). These discharge permits have specific discharge staq̓w (water) quality and volumetric limits, sampling analyses, and reporting requirements. **Table 6-4** summarizes the authorized discharges for each permit (authorized limits are end of pipe requirements).

Table 6-4 Summary of Authorized Discharges to Marine Staq̓w (water)

Description	Permit 1239	Permit 2334
Discharge Rate	2,500 m^3/day	Total of 40 m^3/day *(20 m^3/day at each plant)*
Discharge Period	Continuous	Continuous
Discharge Limits		
TSS	Max 60 mg/L	Max 30 mg/L
BOD	Max 45 mg/L	Max 20 mg/L
Sḵiẇx̱ (Rainbow Trout) LT50	Max 96 hrs	---
pH	Max 8.5, Min 5.5	---
DO	Min 2 mg/L	---

One non-compliant TSS result was recorded from the leachate treatment plant effluent in 2021, no further quantity or quality exceedances have been recorded for the sewage treatment plant or leachate treatment plant effluent discharges. **Table 6-5** summarizes the sampling results from 2018 through 2023 for Permits 1239 and 2334.

Table 6-5 Summary of Leachate Treatment Plant Effluent (Permit 1239) and Sanitary Treatment Plant Effluent (Permit 2334) Sample Results, 2018-2023

Sample	Parameter	Units	Result	Criteria
Leachate Treatment Plant Effluent (Permit 1239) 2018-2023	pH	-	5.7 – 8.4	5.5 – 8.5
	Dissolved Oxygen	mg/L	2.7 – 13.1	≥ 2
	Total Suspended Solids (TSS)	mg/L	<2.0 – **78**	60
	Biological Oxygen Demand (BOD5)	mg/L	<1.0 – 33	45
	Toxicity, Sḵiẃx̱ (Rainbow Trout) 96-hour	Hours	**<24*** – >96	≥ 96
Sanitary Treatment Plant Effluent (Permit 2334) 2021-2023	Total Suspended Solids (TSS)	mg/L	6.5 – 24.4	30
	Biological Oxygen Demand (BOD5)	mg/L	4.6 – 17.1	20

Note:
* result was due to laboratory error and is not representative of leachate effluent staq̓w (water) quality.
Bold results are not compliant with permit limits.

6.2 Sediment Quality Baseline Conditions

As part of the environmental assessment, seasonal field studies were conducted to characterize existing conditions within the CPA (i.e., eight stations) and outside the CPA (i.e., two stations) in July and September 2013, and April to June 2014. The results are presented in greater detail in Appendix 5.10-1 (Golder Associates, 2014) to the Application for an EAC.

Table 6-5 and **Table 6-6** summarizes the baseline sediment quality of the parameters that were analyzed and compares them to the following criteria: CCME Sediment Quality Guidelines for the Protection of Aquatic Life Interim Sediment Quality Guidelines (ISQG) and Probable Effects Levels (PEL), *Canadian Environmental Protection Act* (CEPA) *Disposal at Sea* (DAS) *Regulations* and *Contaminated Sites Regulation* (CSR) Marine and Estuarine Typical Sediment.

Chemical concentrations below and above ISQG levels are rarely and occasionally (respectively) associated with adverse biological effects, whereas chemical concentrations above PELs are frequently associated with adverse biological effects (Environment Canada 1998). CEPA DAS criteria are concentrations of specific substances identified as the Lower Level of the National Action List in the *Disposal at Sea Regulations*. Typically these criteria are conservative and material that contains any of the substances in concentrations above these criteria must be assessed further using biological tests to be considered for DAS. CSR Marine and Estuarine Typical Sediment standards are specific to the protection of marine and estuarine aquatic life at sites containing sediment that is not used as habitat for sensitive components of ecosystems.

Generally, the baseline sediment quality data showed instances of elevated concentration of metals (arsenic, cadmium, copper, and zinc), PAHs, total PCBs and dioxin and furans, when compared to the CCME ISQG, while only PAHs were above the CSR Typical Sediment criteria (acenaphthene, fluoranthene, fluorene, naphthalene) and CCME PEL guidelines (acenaphthene, fluorene, napthalene). Total PCBs were below the CEPA DAS regulations criteria.

Table 6-6 Summary of Baseline Sediment Quality (Golder Associates, 2014)

Parameter	Units	Range *(Average)*	Reference Range (Average)	No. of Samples (incl. 2 ref samples)	*ISQG Marine*	*CEPA DAS*	*PEL*	*CSR Sed_T*
pH	Unitless	7.54 – 8.07 (7.85)	7.54 – 7.6 (7.57)	10	---		---	---
Moisture	%	49 – 73 (56)	57 – 61 (59)	10	---		---	---
Leachable Anions & Nutrients								
Bromide	mg/kg	45 – 113 (63)	62 – 68 (65)	10	---		---	---
Chloride	mg/kg	13,100 – 32,500 (17,900)	18,000 – 19,500 (18,750)	10	---		---	---
Nitrate	mg/kg	<2.5	<2.5	10	---		---	---
Nitrite	mg/kg	<0.50	<0.50	10	---	---	---	---
Sulfate	mg/kg	1,760 – 4,320 (2,424)	2,210 – 2,650 (2,430)	10	---	---	---	---
Total Carbon	%	1.6 – 13 (5.6)	3.0 – 4.1 (3.6)	10	---	---	---	---
Hydrocarbons								
EPH10-19	mg/kg	<200 - <360 (<220)	<200	10	---	---	---	---
EPH19-32	mg/kg	<200 –<360 (<220)	<220 - 250 (235)	10	---	---	---	---
LEPH	mg/kg	<200 - <360 (<220)	<200 - <220 (<210)	10	---	---	---	---
HEPH	mg/kg	<200 –<360 (<220)	<220 - 250 (235)	10	---	---	---	---
Metals								
Arsenic	mg/kg	4.35 – 7.28 (5.57)	4.15 -5.54 (4.85)	10	*7.24*	---	*41.6*	*50*
Cadmium	mg/kg	0.2 – 0.9 (0.5)	0.2 – 0.2 (0.2)	10	*0.7*	*0.60*	*4.2*	*5.0*
Copper	mg/kg	43.0 – 72.5 (57.11)	42.8 – 74.9 (58.8)	10	*18.7*	---	*108*	*130*
Zinc	mg/kg	61 – 140 (88)	65 – 83 (74)	10	*124*	---	*271*	*330*
PAH								
Acenaphthene	mg/kg	0.0124 – 0.3680 (0.1619)	<0.0050 – 0,0052 (0.0051)	10	*0.00671*	---	*0.0889*	*0.11*
Acenaphthylene	mg/kg	0.0069 – 0.0663 (0.0348)	<0.0050	10	*0.00587*	---	*0.128*	*0.15*

Parameter	Units	Range *(Average)*	Reference Range (Average)	No. of Samples (incl. 2 ref samples)	*ISQG Marine*	*CEPA DAS*	*PEL*	*CSR Sed$_T$*
Anthracene	mg/kg	0.0128 – 0.1280 (0.0674)	0.0071 – 0.0098 (0.0085)	10	*0.0469*	---	*0.245*	*0.29*
Benz(a)anthracene	mg/kg	0.016 – 0.234 (0.112)	0.014 - <0.020 (0.017)	10	*0.0748*	---	*0.693*	*0.83*
Benzo(a)pyrene	mg/kg	<0.010 – 0.14 (0.058)	<0.010 - <0.020 (0.015)	10	*0.0888*	---	*0.763*	*0.92*
Chrysene	mg/kg	0.025 – 0.286 (0.141)	0.027 - <0.030 (0.164)	10	*0.108*	---	*0.846*	*1.0*
Dibenz(a,h)anthracene	mg/kg	<0.0070 – 0.014 (0.0258)	<0.0050	10	*0.00622*	---	*0.135*	*0.16*
Fluoranthene	mg/kg	0.055 – 0.685 (0.3)	0.024 – 0.057 (0.041)	10	*0.113*	---	*1.494*	*1.8*
Fluorene	mg/kg	0.012 – 0.195 (0.102)	<0.010	10	*0.0212*	---	*0.144*	*0.17*
2-Methylnaphthalene	mg/kg	<0.010 – 0.184 (0.0774)	<0.010	10	*0.0202*	---	*0.201*	*0.24*
Naphthalene	mg/kg	0.046 – 0.759 (0.285)	0.017 – 0.024 (0.021)	10	*0.0346*	---	*0.391*	*0.47*
Phenanthrene	mg/kg	0.032 – 0.533 (0.278)	0.017 – 0.027 (0.022)	10	*0.0867*	---	*0.544*	*0.65*
Pyrene	mg/kg	0.017 – 0.481 (0.269)	0.017 – 0.039 (0.028)	10	*0.153*	---	*1.398*	*1.7*
PCB								
Total PCB	mg/kg	<0.020 – 0.069 (0.027)	<0.020	10	*0.0215*	*0.10*	*0.189*	---
Dixon & Furans TEQ								
PCDD/F TEQ	pg/g	4.71 – 60 (25.4)	3.52	5	*0.85*	---	*21.5*	*260*

Notes:
ISQG – CCME & BC ENV Interim Sediment Quality Guidelines
CEPA DAS – *Canadian Environmental Protection Act, 1999, Disposal at Sea Regulations*
PEL – CCME & BC ENV Probable Effect Level guidelines
CSR Sed – BC Contaminated Sites Regulation for sediments
TEQ – Toxic equivalency
- Shaded text indicates exceedance of minimum, maximum or mean relative to ISQG

In May 2019, divers collected sediment samples from around the dock structures and piles removed by WLNG in 2018 as part of site cleanup. Samples had not previously been collected in the areas of the former location of the deep sea wharf and former location of the timber wharf and hogfuel unloading dock for safety reasons.

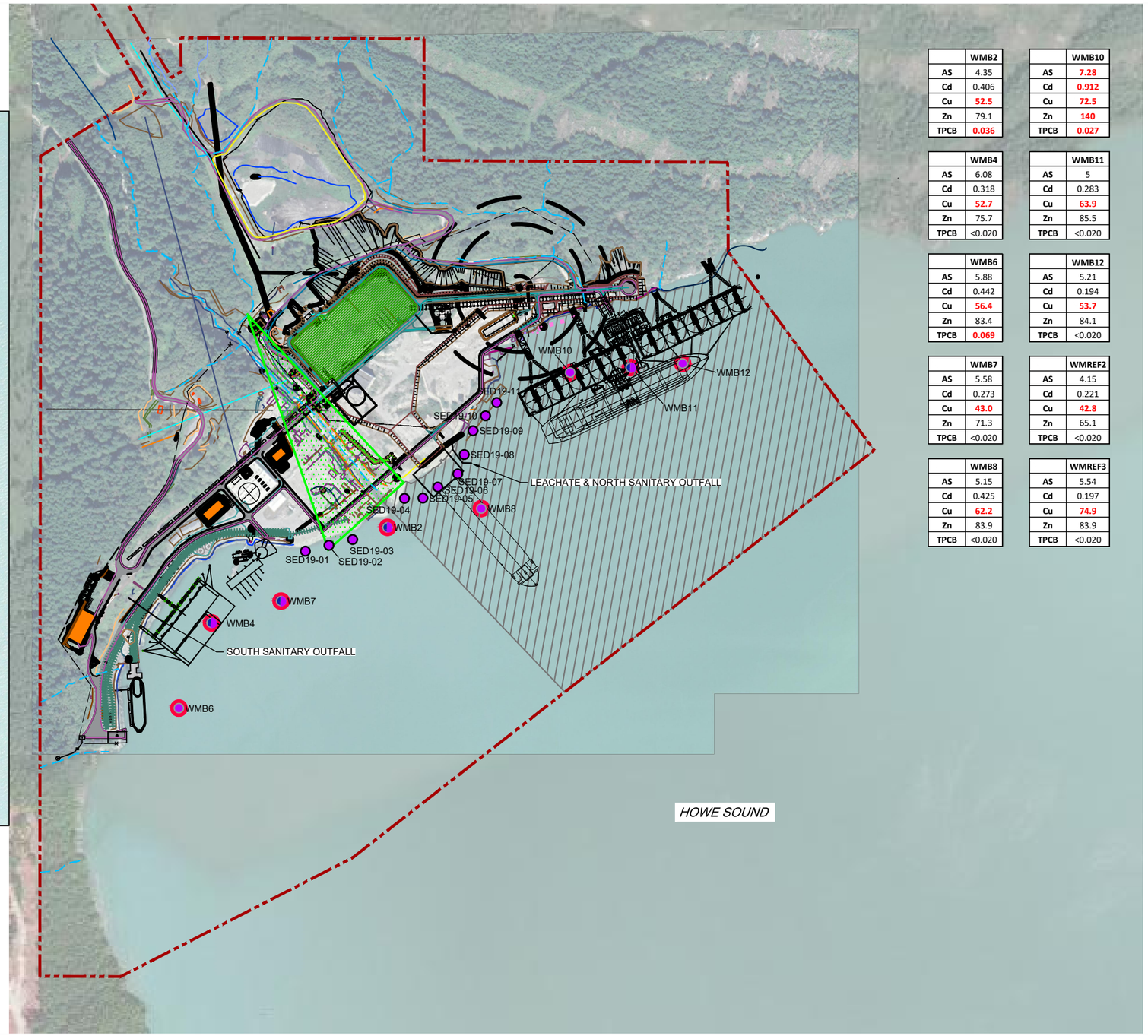


The sediment samples were submitted for analysis. Concentrations of constituents of concern (polycyclic aromatic hydrocarbons [PAHs], copper, lead, mercury, zinc and tributyltin [TBT]) were generally less than the risk-based standards established by the HHERA completed for the CofC application with the exception of one sample collected east of Mill Creek that had total PAH concentrations approximately two times greater than the previously measured maximum.

Table 6-7 summarizes the May 2019 sediment quality results in areas that were not included in the 2014 baseline study or the HHERA. These sampling locations (SED 19-01 to SED 19-02) are shown in **Figure 6-3**. Physical remediation (capping or dredging) of these sediments was proposed (Keystone Environmental 2019) and remediation approaches are being reviewed as part of future activities to mitigate future exposure pathways, including marine habitat offsetting focused on degraded habitats as part of a *Fisheries Act* Authorization currently under regulatory review (Keystone Environmental 2023).



REFERENCE AREA



	WMB2
AS	4.35
Cd	0.406
Cu	52.5
Zn	79.1
TPCB	0.036

	WMB10
AS	7.28
Cd	0.912
Cu	72.5
Zn	140
TPCB	0.027

	WMB4
AS	6.08
Cd	0.318
Cu	52.7
Zn	75.7
TPCB	<0.020

	WMB11
AS	5
Cd	0.283
Cu	63.9
Zn	85.5
TPCB	<0.020

	WMB6
AS	5.88
Cd	0.442
Cu	56.4
Zn	83.4
TPCB	0.069

	WMB12
AS	5.21
Cd	0.194
Cu	53.7
Zn	84.1
TPCB	<0.020

	WMB7
AS	5.58
Cd	0.273
Cu	43.0
Zn	71.3
TPCB	<0.020

	WMREF2
AS	4.15
Cd	0.221
Cu	42.8
Zn	65.1
TPCB	<0.020

	WMB8
AS	5.15
Cd	0.425
Cu	62.2
Zn	83.9
TPCB	<0.020

	WMREF3
AS	5.54
Cd	0.197
Cu	74.9
Zn	83.9
TPCB	<0.020

N

LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- ROADWAY
- WATER/SEDIMENT SAMPLE (GOLDER, 2014)
- SEDIMENT SAMPLE (GOLDER, 2014)
- KEYSTONE SEDIMENT SAMPLE (2019)
- PCOC CONCENTRATION(S) IN GROUNDWATER LESS THAN CCME & BC ENV GUIDELINES
- PCOC CONCENTRATION(S) IN GROUNDWATER GREATER THAN CCME & BC ENV GUIDELINES

AS	ARSENIC
Cu	COPPER
Cd	CADMIUM
Zn	ZINC
TPCB	TOTAL POLYCHLORINATED BIPHENYL
CCME	CANADIAN COUNCIL OF MINISTERS OF THE ENVIRONMENT
BC ENV	BC ENVIRONMENT AND CLIMATE CHANGE STRATEGY
ISQG	INTERIM SEDIMENT QUALITY GUIDELINES
PCOC	POTENTIAL CONTAMINANT OF CONCERN

ANALYTE — | | WMB2 | — SAMPLE I.D.
| AS | 4.35 | — RESULTS

NOTES:
1. SAMPLE VALUES ARE PRESENTED AS MILLIGRAMS PER KILOGRAM (mg/kg) [PARTS PER BILLION (ppb)].
2. PCOC CONCENTRATION(S) IN SAMPLE EXCEEDING CCME & BC ENV ISQG GUIDELINES IN RED.
3. RESULTS ARE PRESENTED FOR PARAMETERS THAT WERE ANALYZED AND EXCEEDED THE INTERIM SEDIMENT QUALITY GUIDELINES (ISQG).
4. CERTAIN PAHS WERE ALSO FOUND TO EXCEED THE GUIDELINES; HOWEVER, NO TPAH RESULTS WERE PROVIDED IN GOLDER 2014.

Keystone Environmental

NOTES:
1. ALL MAPPED FEATURES ARE APPROXIMATE AND SHOULD BE USED FOR DISCUSSION PURPOSES ONLY. PROJECT FEATURES MAY BE SUBJECT TO CHANGE.
SOURCES:
2. CERTIFIED PROJECT AREA, CERTIFIED MARINE TERMINAL AREA, GREEN ZONE, FLOATEL, AND WATERCOURSES, WERE PROVIDED BY HEMMERA, AN AUSENCO COMPANY.
3. OTHER FEATURES SHOWN WERE OBTAINED FROM McDERMOTT OVERALL PLOT PLAN, DWG NO: 239348-0000-00PI-DWG-P0A-0002, REV E.
4. DATE OF AERIAL PHOTO IS 2019, OBTAINED FROM GOOGLE MAPS.

50m 0 250m

SCALE: 1:7500(approx.)

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

REVISION No.	DATE	PROJECT No.
00	June 2023	17953-109

Figure 6-3
Golder Sediment Quality Baseline Results

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig6-3-SED Q Baseline Results-R0.dwg

Table 6-7 Summary of 2019 Sediment Quality (Keystone Environmental Ltd., 2019)

Area	Parameter	Units	Range *(Average)*	No. of Samples	*ISQG Marine*	*PEL*	*CSR Sed$_T$*
1	pH	-	7.97–8.39 *(8.14)*	3	---	---	---
	Metals						
	Copper	mg/kg	34–109 *(83)*	3	*18.7*	*108*	*130*
	Lead	mg/kg	28–103 *(62)*	3	*30.2*	*112*	*130*
	Mercury	mg/kg	0.04–0.05 *(0.04)*	3	*0.13*	*0.7*	*0.84*
	Zinc	mg/kg	66–90 *(79)*	3	*124*	*271*	*330*
	PAH						
	Acenaphthene	mg/kg	0.3–5 *(2)*	3	*0.00671*	*0.0889*	*0.11*
	Acenaphthylene	mg/kg	0.06–0.4 *(0.2)*	3	*0.00587*	*0.128*	*0.15*
	Anthracene	mg/kg	0.3–4 *(2)*	3	*0.0469*	*0.245*	*0.29*
	Benz(a)anthracene	mg/kg	0.9–11 *(4)*	3	*0.0748*	*0.693*	*0.83*
	Benzo(a)pyrene	mg/kg	0.5–4 *(2)*	3	*0.0888*	*0.763*	*0.92*
	Chrysene	mg/kg	1–11 *(5)*	3	*0.108*	*0.846*	*1.0*
	Dibenz(a,h)anthracene	mg/kg	0.07–0.5 *(0.3)*	3	*0.00622*	*0.135*	*0.16*
	Fluoranthene	mg/kg	2–34 *(14)*	3	*0.113*	*1.494*	*1.8*
	Fluorene	mg/kg	0.1–3 *(2)*	3	*0.0212*	*0.144*	*0.17*
	2-Methylnaphthalene	mg/kg	0.07–0.7 *(0.4)*	3	*0.0202*	*0.201*	*0.24*
	Naphthalene	mg/kg	0.1–1.6 *(0.7)*	3	*0.0346*	*0.391*	*0.47*
	Phenanthrene	mg/kg	0.7–12 *(6)*	3	*0.0867*	*0.544*	*0.65*
	Pyrene	mg/kg	2–30 *(12)*	3	*0.153*	*1.398*	*1.7*
	TBT	mg/kg	<0.001–0.002 *(0.002)*	3	---	---	---

Area	Parameter	Units	Range *(Average)*	No. of Samples	*ISQG Marine*	*PEL*	*CSR Sed$_T$*
2	pH	Unitless	6.71–8.33 *(7.88)*	7	---	---	---
	Metals						
	Copper	mg/kg	32–105 *(62)*	7	*18.7*	*108*	*130*
	Zinc	mg/kg	57–117 *(85)*	7	*124*	*271*	*330*
	PAH						
	Acenaphthene	mg/kg	0.3–14 *(5)*	7	*0.00671*	*0.0889*	*0.11*
	Acenaphthylene	mg/kg	0.1–1 *(0.4)*	7	*0.00587*	*0.128*	*0.15*
	Anthracene	mg/kg	0.6–33 *(7)*	7	*0.0469*	*0.245*	*0.29*
	Benz(a)anthracene	mg/kg	0.4–14 *(4)*	7	*0.0748*	*0.693*	*0.83*
	Benzo(a)pyrene	mg/kg	0.1–5 *(2)*	7	*0.0888*	*0.763*	*0.92*
	Chrysene	mg/kg	0.3–10 *(5)*	7	*0.108*	*0.846*	*1.0*
	Dibenz(a,h)anthracene	mg/kg	0.07–0.4 *(0.2)*	7	*0.00622*	*0.135*	*0.16*
	Fluoranthene	mg/kg	3–68 *(21)*	7	*0.113*	*1.494*	*1.8*
	Fluorene	mg/kg	0.2–21 *(5)*	7	*0.0212*	*0.144*	*0.17*
	2-Methylnaphthalene	mg/kg	0.07–5 *(2)*	7	*0.0202*	*0.201*	*0.24*
	Naphthalene	mg/kg	0.3–11 *(5)*	7	*0.0346*	*0.391*	*0.47*
	Phenanthrene	mg/kg	0.8–107 *(22)*	7	*0.0867*	*0.544*	*0.65*
	Pyrene	mg/kg	2–24 *(11)*	7	*0.153*	*1.398*	*1.7*

Notes:
ISQG – CCME & BC ENV Interim Sediment Quality Guidelines
PEL – CCME & BC ENV Probable Effect Level guidelines
CSR Sed – BC Contaminated Sites Regulation for sediments
- Shaded text indicates exceedance of minimum, maximum or mean relative to ISQG

Sediment sampling once the creosote treated timber piles associated with the former wharf and dock structures were removed indicated that concentrations of PAHs and metals in sediment immediately west of Mill Creek were generally less than the risk-based standards established by the HHERA completed for the CofC application. However, east of Mill Creek proximal to the proposed MOF and portions of the FSTs,

while metals concentrations were less than risk-based standards, the PAH concentrations in sediment were higher than the risk-based standards for the site previously evaluated during the HHERA.

Baseline samples were not collected in the wharf and dock areas during the sediment HHERA as sampling under the infrastructure was considered a safety hazard. Rationale for the increase in sediment PAH concentrations in the area east of Mill Creek is uncertain; however, it could be related to the presence of remaining creosote treated pilings associated with the former dock structure, presence of creosote treated wood debris from removal of the wharf and dock structures, or variation in sampling method (sampling by divers collects smaller discrete samples from specific locations, whereas ponar grab samples collect a larger sample over a larger area for analysis).

6.3 Human Health and Ecological Risk Assessment Investigation Summary

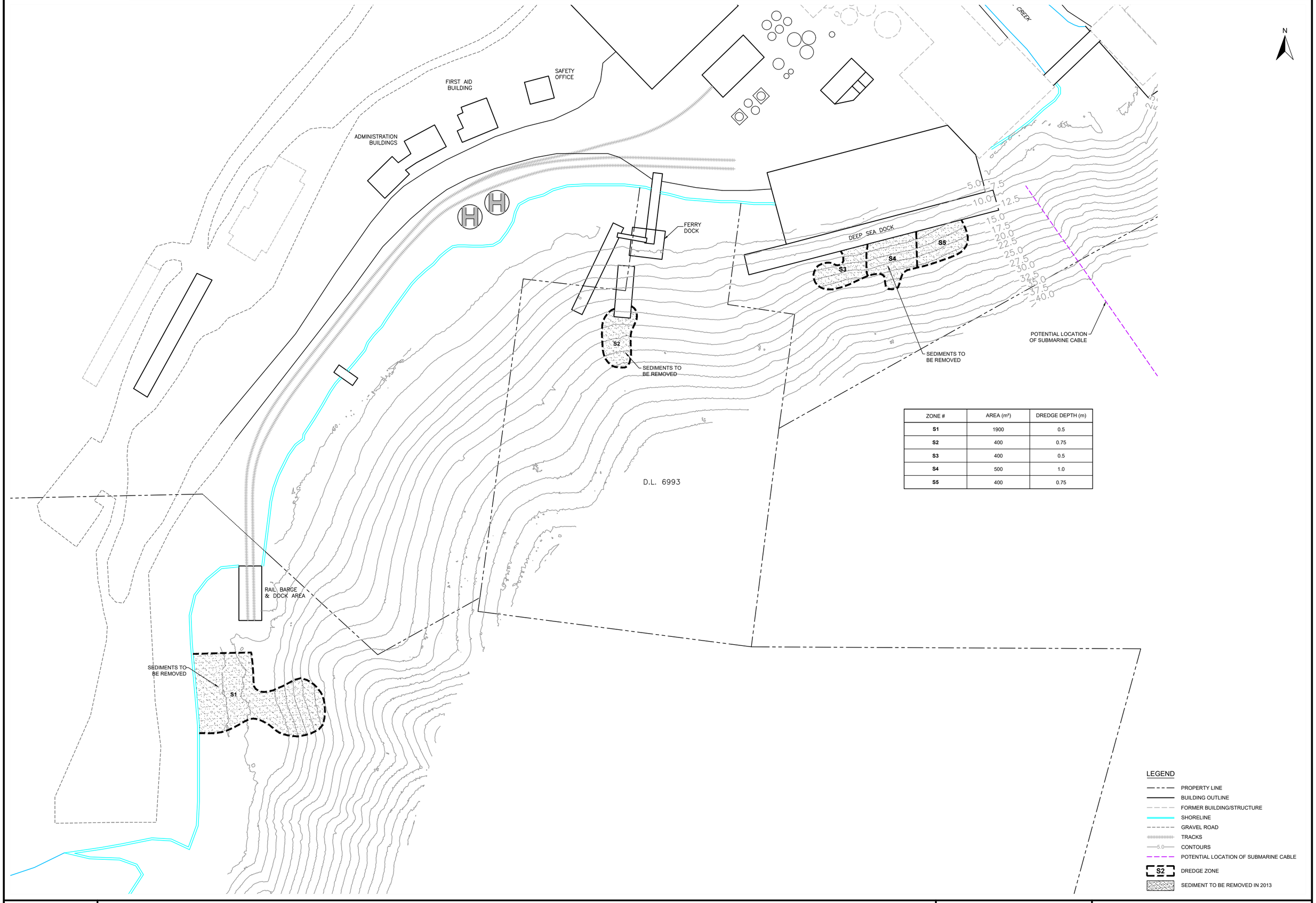
Intrusive environmental investigations identified regulated substances in media at concentrations greater than British Columbia Contaminated Sites Regulation (CSR) standards. Risk assessments were undertaken to evaluate whether the identified regulated substances in environmental media pose unacceptable risks to human health and the environment, and if so, to recommend appropriate mitigation measures. Risk assessments were conducted prior to and following remediation and evaluated current and future temíxw (land) uses. The risk assessments were used to support an application for separate risk-based certificates of compliance (CofCs) under the CSR for the upland area and staq̓w (water) lot.

With respect to the staq̓w (water) lot, the sediment human health and ecological risk assessment conducted by Keystone Environmental (2014a) evaluated human and ecological risks prior to remediation works. Keystone Environmental (2014a) considered human receptors (future recreational and Aboriginal users; construction/utility workers) and ecological receptors (such as mammals, birds, Sts'úkwi7 (fish), benthic communities, etc.). Keystone Environmental (2014a) considered the effects sediment resuspension on the environment related to tidal/current action, and physical resuspension caused by man-made activities such as prop-wash. Keystone Environmental (2014a) integrated field survey information, toxicity test results, and analytical results in a weighted evidence approach to assess risk.

Keystone Environmental (2014a) identified three areas of unacceptable risk in sediments, and these areas were dredged in August 2013 as per the Keystone Environmental (2014b) confirmation of remediation report. Approximately 4,900 m^3 of sediment was removed from in front of the warehouse, the boat dock, and the old barge dock. The dredged sediments were disposed of at the Site landfill under the existing landfill permit. The 2013 dredged areas are presented in **Figure 6-4**.

Following remediation works[3] (i.e., dredging) outlined in the confirmation of remediation report (Keystone Environmental 2014b), an addendum report (Keystone Environmental 2014c) was issued to the sediment human health and ecological risk assessment (Keystone Environmental 2014a).

[3] Dredging activities were completed in accordance with the requirements of DFO and ECCC. A total of approximately 23,000 tonnes of sediment, woodchips, and debris was removed from the foreshore area.



ZONE #	AREA (m²)	DREDGE DEPTH (m)
S1	1900	0.5
S2	400	0.75
S3	400	0.5
S4	500	1.0
S5	400	0.75

Keystone Environmental

NOTE: THIS DRAWING IS FOR GENERAL INFORMATION ONLY. LOT BOUNDARIES AND FEATURES ARE APPROXIMATE.

10m 0 50m

SCALE: 1:1250(approx.)

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

REVISION No.	DATE	PROJECT No.
00	June 2023	17953-100

Figure 6-4
Sediment Dredge Area

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00100\2023_03Mar_28__DFO_FAA\Fig6-4-SED Dredge Area-R0.dwg

The addendum report (Keystone Environmental 2014c) re-evaluated the site risks with the dredged sediments removed and concluded that residual contaminants pose unacceptable carcinogenic risks to human health due to consumption of Sts'úkwi7 (fish) and crab collected from the stak̲w (water) lot. However, these calculated risks were due to PAH concentrations in tissues that were based on elevated detection limits. Since the concentrations used in the risk assessment were less than the elevated detection limits, there was a great degree of uncertainty associated with these results. Unacceptable risks to the environment were not identified in the report. The report recommended that polycyclic aromatic hydrocarbons (PAHs) in Sts'úkwi7 (fish) and shellfish tissue be re-evaluated as the laboratory detection limits in the original sampling were higher than what was subsequently achievable.

Performance verification plans (PVP) were prepared for the sediment portion of the stak̲w (water) lot (Keystone Environmental 2014d) and the upland portion of the Site (Keystone Environmental 2014e). The principal risk controls listed in the PVP for the sediment portion of the Site included the implementation and maintenance of a maritime exclusion zone to prevent entry by the public and the implementation of an inspection program to confirm that the maritime exclusion zone was enforced.

The CofC application was reviewed by independent members of the Society of Contaminated Sites Approved Professionals of British Columbia (CSAP) prior to submission to the BC ENV. In December 2014, the BC ENV issued a risk-based Certificate of Compliance for the stak̲w (water) lot portion of the Woodfibre LNG site. A separate CofC was issued for the uplands portion.

The Ministry of Health and Ministry of Environment provided comments about the exceedances of threshold concentrations in sediment, dioxin and furan testing in tissue sampling, and sediment sampling around the stak̲w (water) lot. Keystone Environmental addressed these comments in a Technical Memorandum (Keystone Environmental 2015b), and the final conclusion of the HHRA did not change (i.e., that residual effects are negligible or not significant). The 2015 addendum further qualified predicted risks, extrapolating off-Site historical data to fill the data gap left by the non-detectable PAH concentrations measure in tissues for the 2014 risk assessment.

As per the Keystone Environmental (2014c) addendum report, there was a need for a Sts'úkwi7 (fish) and shellfish tissue assessment program to quantify human health risks that might be associated with the consumption of shellfish harvested within the boundaries of the stak̲w (water) lot of the site. Keystone Environmental subsequently designed a Sts'úkwi7 (fish) and shellfish sampling program with input from provincial and federal agencies in 2015 (refer to **Section 6.4**). The human health risk assessment (HHRA) was updated (Keystone Environmental 2016) utilizing the results of a 2015 Sts'úkwi7 (fish) and Shellfish Tissue Assessment Program. The updated Keystone Environmental (2016) HHRA is discussed further in **Section 6.5**.

In summary, the risk assessments examined the worst-case scenarios and the issued risk based certificate of compliance provides suitable risk controls for current and future temíxw (land) use scenarios to limit potential unacceptable risks to human health and the environment. The Keystone Environmental reports (2014a, 2014b, 2016) collectively provide suitable information to establish baseline conditions with respect to marine stak̲w (water) quality, sediment quality, and tissue concentrations within shellfish and Sts'úkwi7 (fish) within the bounds of the certificate of compliance, and meet the requirements of FDS 6.5.1.

6.4 Tissue Quality Baseline Conditions

A sampling program collected benthic Sts'úkwi7 (fish) and crab in May and July 2015. Sts'úkwi7 (fish) (English Lhémq̓w'a (sole)) and crabs (Aẏx (Dungeness crab)) were collected from the Site, as well as two locations outside the CPA in Howe Sound. The site-specific tissue chemistry results (metals, PAHs, and dioxins/furans) obtained from the sampling were used to estimate baseline exposure concentrations as a part of the public HHRA of marine food consumed by people in the local assessment area (LAA) and regional assessment area (RAA). Dioxins and furans were analyzed in tissue at the request of federal and provincial health agencies, even though the sediment dioxin and furan parameters were found to be below the sediment quality standards set by the CSR, there was still interest in assessing their presence in organisms. There could be potential bioaccumulation of these chemicals in organisms despite sediment levels being below the guidelines. In addition to the 2015 baseline sampling data, historical Sts'úkwi7 (fish) and crab tissue collected in the area from 2006 and 2013 was also used in the HHRA.

Tissue concentrations in benthic Sts'úkwi7 (fish) were assumed to be representative of all Sts'úkwi7 (fish) in the staq̓w (water) lot, and crab tissues were assumed to be representative of all shellfish. Crab are benthic dwelling shellfish that bury in sediments and therefore are in high contact with sediments making it a good indicator species. English Lhémq̓w'a (sole) is a common benthic dwelling Sts'úkwi7 (fish) in high contact with sediments, making it a good indicator species.

The results of this risk assessment showed the potential for risks to human consumers due to consumption of Sts'úkwi7 (fish) and crab collected from the staq̓w (water) lot. These calculated risks were due to PAH concentrations in the tissues; however, concentrations were measured as below detection limits, and hence a great degree of uncertainty was associated with these results. A summary of the baseline tissue data for select parameters from 2006 and 2015 are presented in **Table 6-8**.

6.5 Human Health Risk Assessment – Tissue Quality

The Keystone Environmental (2016) *Updated Human Health Risk Assessment – Aboriginal and Recreational Receptors* was conducted to re-evaluate exposures to Site COCs by Aboriginal and Recreational Receptors to include measured concentrations of COCs in Sts'úkwi7 (fish) and crab tissues collected during the July 2015 'Sts'úkwi7 (fish) and Shellfish Tissue Sampling Program'. This Updated HHRA also supports the requirements of FDS 6.5.1.

6.5.1 Receptor Characteristics

Receptor characteristics used for the Aboriginal Receptor and Recreational Receptor in this report are presented in **Table 6-9** and **Table 6-10** respectively.

Table 6-8 Summary of Baseline Sts'úkwi7 (fish) & Crab Tissue Quality Analyzed Parameters

Parameter	Sts'úkwi7 (fish) Tissue		Crab Tissue		Crab Hepatopancreas		TRV (RfD)	TRV (SF)
	Concentration Range (Average) (mg/kg)	n[4]	Concentration Range (Average) (mg/kg)	n	Concentration Range (Average) (mg/kg)	n		
Metals								
Arsenic	0.215 – 6.04 (3.42)	12	4.24 – 14.2 (7.46)	14	2.99 – 14.1 (6.07)	12	3.0E-04a	1.8E+00b
Cadmium	0.0075 – 0.138 (0.028)	12	0.0041 – 0.0202 (0.0097)	14	0.223 – 3.67 (0.77)	12	1.0E-03b	-
Copper	0.262 – 3.74 (0.95)	18	3.14 – 8.95 (5.96)	20	10.5 – 71.1 (30.3)	18	9.1E-02b	-
Lead	0.0164 – 0.216 (0.065)	18	0.0027 – <0.020 (0.0062)	20	0.0112 – 0.272 (0.0473)	18	1.3E-03 / 6.0E-04c	-
Zinc	9.42 – 18.6 (13.3)	18	24.9 – 49.3 (36.8)	20	8.52 – 17.3 (12.7)	18	3.0E-01a	-
Organometallics								
Methyl Mercury	0.0048 – 0.0343 (0.015)	17	0.0081 – 0.19 (0.041)	20	0.0104 – 0.144 (0.028)	12	2.0E-04 / 4.7E-04b	-
Tributyltin	0.01 – 0.015 (0.0083)	8	0.001 – <0.01 (0.0076)	9	<0.001	1	2.5E-04b	-
Polycyclic Aromatic Hydrocarbons (PAH)								
Acenaphthene	<0.010 – 4.87 (0.84)	17	<0.010 - 2.03 (0.29)	9	<0.020	1	6.0E-02a	-

[4] n = number of samples

Parameter	Sts'úkwi7 (fish) Tissue		Crab Tissue		Crab Hepatopancreas		TRV (RfD)	TRV (SF)
	Concentration Range (Average) (mg/kg)	n[4]	Concentration Range (Average) (mg/kg)	n	Concentration Range (Average) (mg/kg)	n		
Acenaphthylene	<0.010 – 0.504 (0.097)	17	<0.010 - 0.159 (0.044)	9	<0.010	1	2.0E-02b	-
Anthracene	<0.010 – 1.62 (0.32)	17	<0.010 - 0.093 (0.036)	9	<0.010	1	3.0E-01a	-
Benz(a)anthracene	<0.010 – 1.44 (0.22)	17	<0.0053 - 0.226 (0.0357)	9	<0.010	1	3.0E-02b	2.30E-01b
Benzo(a)pyrene	<0.010 – 0.419 (0.081)	17	<0.010 - 0.0356 (0.021)	9	<0.010	1	3.0E-02b	2.3b
Benzo(b)fluoranthene	<0.010 – 0.722 (0.12)	17	<0.0075 - 0.067 (0.019)	9	<0.010	1	3.0E-02b	2.30E-01b
Benzo(g,h,i)perylene	<0.010 – 0.168 (0.044)	17	<0.010 - 0.038 (0.016)	9	<0.010	1	3.0E-02b	2.30E-02b
Benzo(k)fluoranthene	<0.010 – 0.657 (0.11)	17	<0.0087 - 0.0249 (0.014)	9	<0.010	1	3.0E-02b	2.30E-01b
Chrysene	<0.010 – 1.48 (0.23)	17	<0.010 - 0.152 (0.037)	9	<0.030	1	3.0E-02b	2.30E-02b
Dibenz(a,h)anthracene	<0.010 – 0.041 (0.017)	17	<0.010 - 0.0235 (0.015)	9	<0.010	1	3.0E-02b	2.3b
Fluoranthene	<0.010 – 7.54 (1.22)	17	<0.010 - 0.219 (0.076)	9	<0.010	1	4.0E-02a	2.30E-03b

Parameter	Sts'úkwi7 (fish) Tissue		Crab Tissue		Crab Hepatopancreas		TRV (RfD)	TRV (SF)
	Concentration Range (Average) (mg/kg)	n[4]	Concentration Range (Average) (mg/kg)	n	Concentration Range (Average) (mg/kg)	n		
Fluorene	<0.010 – 2.89 (0.54)	17	<0.010 - 0.275 (0.0637)	9	<0.010	1	4.0E-02a	-
Indeno(1,2,3-c,d)pyrene	<0.010 – 0.208 (0.047)	17	<0.010 - 0.0243 (0.015)	9	<0.010	1	3.0E-02b	2.30E-01b
2-methylnaphthalene	<0.010 – 1.7 (0.30)	17	<0.010 - 0.757 (0.48)	7	<0.010	1	4.0E-03b	-
Naphthalene	<0.010 – 3.58 (0.74)	17	<0.010 - 2.91 (1.53)	9	<0.010	1	2.0E-02b	-
Phenanthrene	<0.010 – 14.7 (3.23)	17	<0.010 - 0.549 (0.22)	9	<0.010	1	2.0E-02b	2.30E-03b
Pyrene	<0.010 – 4.46 (0.70)	17	<0.010 - 0.476 (0.14)	9	<0.050	1	3.0E-02b	-
Dioxins & Furans								
PCDF/F TEQ	0.05 – 0.51 (0.34)	7	0.15 – 1.01 (0.49)	8	4.67	1	2.3E-09b	-

Notes:
TRV – Toxicity Reference Value
SF – Slope Factor (carcinogenic)
b – Health Canada 2010
RfD – Reference Dose (non-carcinogenic)
a – US EPA 2019
c – Wilson and Richardson (2012)

Table 6-9 Physical Exposure Variables and Consumption Rates Assumed for the Aboriginal Receptor

Exposure Variable	Adult	Toddler	Reference
Physical Variables			
Body Weight [kg]	70.7	16.5	Health Canada (2012)
Lifetime adjustment factor [lifestage years / lifetime]; (for carcinogens only)	80 years / 80 years	Not applicable	Health Canada (2012)
Consumption Rates			
Crab [kg/day]	0.04	0.019	Wiseman and Gobas (2002) for Adults US EPA (2011) for Toddlers.
Hepatopancreas [kg/day]	0.0044	0.0024	Marion et al., (1997)
Sts'úkwi7 (fish) [kg/day]	0.223	0.094	Richardson (1997)

Table 6-10 Physical Exposure Variables and Consumption Rates Assumed for the Recreational Receptor

Exposure Variable	Adult	Toddler	Reference
Physical Variables			
Body Weight [kg]	70.7	16.5	Health Canada (2012)
Lifetime adjustment factor [lifestage years / lifetime]; (for carcinogens only)	80 years / 80 years	Not applicable	Health Canada (2012)
Consumption Rates			
Crab [kg/day]	0.006	0.001	US EPA (2011)
Sts'úkwi7 (fish) [kg/day]	0.022	0.010	Health Canada (2007)
Hepatopancreas [kg/day]	0.0044	0.0024	Marion et al. (1997)

6.5.2 Exposure Point Concentrations

The maximum exposure point concentrations (EPCs) for COCs in dietary items (i.e., whole Sts'úkwi7 (fish), crab meat or muscle and crab hepatopancreas), as measured in the tissues collected during the July 2015 sampling program, is presented in **Table 6-11.**

Table 6-11 Maximum Exposure Point Concentrations of Dietary Items

COC	Crab Muscle [mg/kg-WW]	Crab Hepatopancreas [mg/kg-WW]	Sts'úkwi7 (fish) [mg/kg-WW]
Metal			
Copper	5.3	41.2	3.74
Lead	0.0054	0.0621	0.0938
Zinc	35.9	17.3	11.6
Methylmercury	0.0481	0.0138	0.019
Tributyltin	<0.01	<0.01	0.015
Low Molecular Weight (LMW) PAHs			
2-Methylnaphthalene	0.000757	0.000719	0.0017
Acenaphthene	0.00203	0.00172	0.00487
Acenaphthylene	0.000159	0.000174	0.000504
Anthracene	0.000093	0.000426	0.00162
Fluorene	0.000275	0.000574	0.00289
Naphthalene	0.00291	0.00104	0.00358
Phenanthrene	0.000549	0.00335	0.0147
High Molecular Weight (HMW) PAHs			
Benz(a)anthracene	0.000226	0.00109	0.00144
Benzo(a)pyrene	0.0000356	0.000129	0.000419
Benzo(b)fluoranthene	0.000067	0.000104	0.000722
Benzo(g,h,i)perylene	0.0000249	0.000307	0.000657
Benzo(k)fluoranthene	0.000059	0.00004	0.000168
Chrysene	0.000152	0.00221	0.00148
Dibenz(a,h)anthracene	0.0000235	0.0000387	0.000041
Fluoranthene	0.000219	0.00109	0.00754
Indeno(1,2,3-c,d)pyrene	0.0000243	0.0000479	0.000208
Pyrene	0.000476	0.000236	0.00446
Dioxins/Furans			
Toxic Equivalency (TEQ)*	1.01E-06	4.67E-06	5.12E-07

Notes:
< Denotes that concentrations are below the method detection limit value. Conservatively, it was assumed that the concentration was equal to the detection limit
'*' – TEQ calculated using TEFs from Health Canada ([2010], according to the WHO [2005])

The HHRA assumed that seafood intake from the Site accounted for 1% of overall Sts'úkwi7 (fish) and shellfish consumption (equivalent to the proportion of the Woodfibre staq̓w (water) lot relative to the "fishable" portion of Howe Sound). The approach taken is likely conservative due to several factors. Firstly, the area of staq̓w (water) affected by the Site's activities is considerably smaller compared to the entire Howe Sound. Additionally, the absence of significant marine conservation areas and eelgrass habitats near the Site suggests that the Sts'úkwi7 (fish) habitat in the vicinity may not be optimal. While there are some



minor spawning sites scattered across the Site, most of them are located near the mouth of the Sḵwx̲wú7mesh (Squamish) stak̲w (River) and Mamquam Bind Channel (Golder, 2014). This indicates that the 1% may be an overestimate thus a conservative approach.

6.5.3 Contaminant Intakes

The EPCs were used to calculate chronic exposures from the intake of seafood from the Site. The following equations were used to calculate exposures for the Aboriginal and Recreational Group receptor:

Dietary Consumption of Seafood (Aboriginal and Recreational Group Receptor)

$$CDI_F = \frac{EPC_F \times IR_F}{BW}$$

where
CDI_F = chronic daily intake food (mg/kg/day)
EPC_F = exposure point concentration of COC in seafood (mg/kg WW)
IR_F = seafood ingestion rate (kg/day)
BW = body weight (kg)

Total Exposure (Aboriginal and Recreational Group receptor)

$$CDI_T = SSEF * (CDI_F + CDI_C + CDI_H)$$

where:
SSEF = Site Specific Exposure Factor, i.e., the "fishable" area of Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) (1%)
CDI_T = total chronic daily intake (mg/kg/day)
CDI_F = chronic daily intake from Sts'úkwi7 (fish) (mg/kg/day)
CDI_M = chronic daily intake crab muscle (mg/kg/day)
CDI_H = chronic daily intake crab hepatopancreas (mg/kg/day)

The probable/known carcinogens identified for the Site are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(b&j)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. In addition, because benzo(g,h,i)perylene and phenanthrene have carcinogenic potency factors in Health Canada guidance (2012), they are included in this assessment as well.

6.5.4 Toxicity Reference Values

A toxicity reference value (TRV) is an exposure concentration of a COC that is not expected to cause an unacceptable level of effect in a receptor. The TRVs for the non-carcinogenic COCs (reference dose) and the carcinogenic COCs (slope factor) are presented in **Table 6-12**.

A reference dose in non-carcinogen COC represents the maximum acceptable level of exposure to a chemical that is considered safe for human health. Slope factor in carcinogen COC represents the potency or risk associated with exposure to a specific carcinogenic substance.

Table 6-12 Toxicity Reference Values – Human Health

COC	Oral Reference Dose (mg/kg/day)	Reference	Oral Slope Factor (mg/kg/day)-1	Reference
Metals				
Copper	9.1E-02	Health Canada 2010a	n/c	n/a
Lead	5.0E-03	US EPA 2015	n/c	n/a
Zinc	3.0E-1	US EPA 2015	n/c	n/a
Methylmercury	2.0E-04a	Health Canada 2010a	n/c	n/a
Methylmercury	4.7E-04b	Health Canada 2010a	n/c	n/a
Tributyltin	2.5E-04	Health Canada 2010a	n/c	n/a
Polycyclic Aromatic Hydrocarbons				
LMW PAHs				
2-Methylnaphthalene	4.0E-03	Health Canada 2010a	n/c	n/a
Acenaphthene	6.0E-02	US EPA 2015	n/c	n/a
Acenaphthylene	2.0E-02c	Health Canada 2010a	n/c	n/a
Anthracene	3.0E-01	US EPA 2015	n/c	n/a
Fluorene	4.0E-02	US EPA 2015	n/c	n/a
Naphthalene	2.0E-02	Health Canada 2010a	n/c	n/a
Phenanthrene	2.0E-02c	Health Canada 2010a	2.3E-03e	Health Canada 2010a
HMW PAHs				
Benz(a)anthracene	3.0E-02[d]	Health Canada 2010a	2.3E-01[e]	Health Canada 2010a
Benzo(a)pyrene	3.0E-02[d]	Health Canada 2010a	2.3	Health Canada 2010a
Benzo(b)fluoranthene	3.0E-02[d]	Health Canada 2010a	2.3E-01[e]	Health Canada 2010a
Benzo(k)fluoranthene	3.0E-02[d]	Health Canada 2010a	2.3E-01[e]	Health Canada 2010a
Benzo(g,h,i)perylene	3.0E-02[d]	Health Canada 2010a	2.3E-02[e]	Health Canada 2010a
Chrysene	3.0E-02[d]	Health Canada 2010a	2.3E-02[e]	Health Canada 2010a
Dibenz[ah]anthracene	3.0E-02[d]	Health Canada 2010a	2.3[e]	Health Canada 2010a
Fluoranthene	4.0E-02	US EPA 2015	2.3E-03[e]	Health Canada 2010a
Indeno(123-cd)perylene	3.0E-02[d]	Health Canada 2010a	2.3E-01[e]	Health Canada 2010a
Pyrene	3.0E-02[d]	Health Canada 2010a	n/c	n/c
Dioxins/Furans				
PCDDs/PCDFs	2.3E-09	Health Canada 2010a	n/c	n/a

Notes:
[a] The TRV for methylmercury should be applied to sensitive populations such as women of child-bearing age and children under the age of 12 years.
[b] The TRV for methylmercury should be applied to the general adult population.
[c] In lieu of a Reference Dose (RfD) specific to the PAH of concern, the RfD for a structurally similar PAH, naphthalene was used.
[d] In lieu of a Reference Dose (RfD) specific to the PAH of concern, the RfD for a structurally similar PAH, pyrene was used.
[e] In lieu of a Slope Factor specific to the PAH of concern, the RfD for a structurally similar PAH, benzo(a)pyrene was used, and a potency equivalency factor (PEF) was applied (as per Health Canada, 2012).
n/c – Not currently classified as a probable or known human carcinogen.

6.5.5 Risk Estimation

Risk estimation involves the calculation of non-carcinogenic hazard quotients (HQ) and the incremental lifetime cancer risks (ILCR) using the COC intakes calculated using the above equations and the TRVs identified in **Table 6-8**.

6.5.5.1 Non-Carcinogenic Health Risks

The non-carcinogenic HQ values for the most sensitive life stage (i.e., toddler) for the Aboriginal Receptor and Recreational Receptor are presented in **Table 6-13** and **Table 6-14**, respectively.

Table 6-13 Non-Carcinogenic Hazard Quotients – Aboriginal Toddler Receptor

Contaminant of Concern (COC)	Crab Muscle Chronic HQ	Crab Hepatopancreas Chronic HQ	Sts'úkwi7 (fish) HQ	COC-Specific HQ
Metals				
Copper	6.7E-04	6.6E-04	2.3E-03	3.7E-03
Lead	4.1E-05	6.0E-05	3.6E-03	3.7E-03
Zinc	1.4E-03	8.4E-05	2.2E-03	3.7E-03
Methylmercury	2.8E-03	1.0E-04	5.4E-03	8.3E-03
Tributyltin	4.6E-04	5.8E-05	3.4E-03	3.9E-03
Polycyclic Aromatic Hydrocarbons				
LMW PAHs				
2-Methylnaphthalene	2.2E-04	2.6E-05	2.4E-03	2.7E-05
Acenaphthene	3.9E-07	4.2E-08	4.6E-06	5.1E-06
Acenaphthylene	9.2E-08	1.3E-08	1.4E-06	1.5E-06
Anthracene	3.6E-09	2.1E-09	3.1E-07	3.1E-07
Fluorene	7.9E-08	2.1E-08	4.1E-06	4.2E-06
Naphthalene	1.7E-06	7.6E-08	1.0E-05	1.2E-05
Phenanthrene	3.2E-07	2.4E-07	4.2E-05	4.2E-05
HMW PAHs				
Benz(a)anthracene	8.7E-08	5.3E-08	2.7E-06	2.9E-06
Benzo(a)pyrene	1.4E-08	6.3E-09	8.0E-07	8.2E-07
Benzo(b)fluoranthene	2.6E-08	5.0E-09	1.4E-06	1.4E-06
Benzo(k)fluoranthene	9.6E-09	1.5E-08	1.2E-06	1.3E-06
Benzo(g,h,i)perylene	2.3E-08	1.9E-09	3.2E-07	3.4E-07
Chrysene	5.8E-08	1.1E-07	2.8E-06	3.0E-06
Dibenz[ah]anthracene	9.0E-09	1.9E-09	7.8E-08	8.9E-08

Contaminant of Concern (COC)	Crab Muscle Chronic HQ	Crab Hepatopancreas Chronic HQ	Sts'úkwi7 (fish) HQ	COC-Specific HQ
Fluoranthene	6.3E-08	4.0E-08	1.1E-05	1.1E-05
Indeno(1,2,3-c,d)perylene	9.3E-09	2.3E-09	3.9E-07	4.1E-07
Pyrene	1.8E-07	1.1E-08	8.5E-06	8.7E-06
Total PAH Pathway-Specific HI	3.5E-06	6.9E-07	9.6E-05	1.0E-04
Dioxins/Furans				
PCDD/PCDF TEQ	3.5E-06	6.9E-07	1.3E-02	1.0E-04

Notes:
Bold = Exceeds BC Ministry of Health / Health Canada benchmark of 0.2

Table 6-14 Non-Carcinogenic Hazard Quotients – Recreational Toddler Receptor

COC	Crab Muscle Ingestion	Crab Hepatopancreas Ingestion	Sts'úkwi7 (fish) Ingestion	COC-Specific HQ
Metals				
Copper	3.5E-05	6.6E-04	2.5E-04	9.4E-04
Lead	2.2E-06	6.0E-05	3.8E-04	4.4E-04
Zinc	7.3E-05	8.4E-05	2.3E-04	3.9E-04
Methylmercury	1.5E-04	1.0E-04	5.8E-04	8.2E-04
Tributyltin	2.4E-05	5.8E-05	3.6E-04	4.5E-04
Polycyclic Aromatic Hydrocarbons				
LMW PAHs				
2-Methylnaphthalene	1.1E-05	2.6E-05	2.6E-04	3.0E-06
Acenaphthene	2.1E-08	4.2E-08	4.9E-07	5.5E-07
Acenaphthylene	4.8E-09	1.3E-08	1.5E-07	1.7E-07
Anthracene	1.9E-10	2.1E-09	3.3E-08	3.5E-08
Fluorene	4.2E-09	2.1E-08	4.4E-07	4.6E-07
Naphthalene	8.8E-08	7.6E-08	1.1E-06	1.2E-06
Phenanthrene	1.7E-08	2.4E-07	4.5E-06	4.7E-06
HMW PAHs				
Benz(a)anthracene	4.6E-09	5.3E-08	2.9E-07	3.5E-07
Benzo(a)pyrene	7.2E-10	6.3E-09	8.5E-08	9.2E-08
Benzo(b)fluoranthene	1.4E-09	5.0E-09	1.5E-07	1.5E-07

COC	Crab Muscle Ingestion	Crab Hepatopancreas Ingestion	Sts'úkwi7 (fish) Ingestion	COC-Specific HQ
Benzo(k)fluoranthene	5.0E-10	1.5E-08	1.3E-07	1.5E-07
Benzo(g,h,i)perylene	1.2E-09	1.9E-09	3.4E-08	3.7E-08
Chrysene	3.1E-09	1.1E-07	3.0E-07	4.1E-07
Dibenz[ah]anthracene	4.7E-10	1.9E-09	8.3E-09	1.1E-08
Fluoranthene	3.3E-09	4.0E-08	1.1E-06	1.2E-06
Indeno(1,2,3-c,d)perylene	4.9E-10	2.3E-09	4.2E-08	4.5E-08
Pyrene	9.6E-09	1.1E-08	9.0E-07	9.2E-07
Total PAH Pathway-Specific HI	1.8E-07	6.9E-07	1.0E-05	1.1E-05
Dioxins/Furans				
PCDD/PCDF TEQ	2.7E-04	3.0E-03	1.3E-03	4.6E-03

Notes:
Bold = Exceeds BC Ministry of Health / Health Canada benchmark of 0.2

The PAH COCs have been assumed to have additive effects; therefore, their HQs were summed to calculate a total hazard index (HI) for each receptor group. The acceptability standard for HQs and HIs is 0.2 for HHRAs conducted using federal guidance.

The HQs and HIs calculated for the Aboriginal Receptor (toddler) and Recreational Receptor (toddler) were less than the federal threshold of 0.2; therefore, additional unacceptable risks of non-carcinogenic effects for the Aboriginal Receptor and Recreational Receptor were not predicted.

6.5.5.2 Carcinogenic Health Risks

The ILCR values for the for the Aboriginal Receptor (adult) and Recreational Receptor are presented in **Table 6-15** and **Table 6-16**, respectively.

Table 6-15 Incremental Lifetime Cancer Risks – Aboriginal Receptors

COC	Crab Muscle Ingestion	Crab Hepatopancreas Ingestion	Sts'úkwi7 (fish) Ingestion	COC-Specific ILCR
Polycyclic Aromatic Hydrocarbons				
LMW PAHs				
Phenanthrene	7.1E-12	4.8E-12	1.1E-09	1.1E-09
HMW PAHs				
Benz(a)anthracene	2.9E-10	1.6E-10	1.0E-08	1.1E-08
Benzo(a)pyrene	4.6E-10	1.8E-10	3.0E-08	3.1E-08
Benzo(b)fluoranthene	8.7E-11	1.5E-11	5.2E-09	5.3E-09

COC	Crab Muscle Ingestion	Crab Hepatopancreas Ingestion	Sts'úkwi7 (fish) Ingestion	COC-Specific ILCR
Benzo(k)fluoranthene	3.2E-11	4.4E-11	4.8E-09	4.8E-09
Benzo(g,h,i)perylene	7.7E-12	5.7E-13	1.2E-10	1.3E-10
Chrysene	2.0E-11	3.2E-11	1.1E-09	1.1E-09
Dibenz[a,h]anthracene	3.1E-10	5.5E-11	3.0E-09	3.3E-09
Fluoranthene	2.8E-12	1.6E-12	5.5E-10	5.5E-10
Indeno(1,2,3-c,d)perylene	3.2E-11	6.9E-12	1.5E-09	1.5E-09
Total PAH Pathway Specific ILCR	1.3E-09	5.0E-10	5.8E-08	6.0E-08

Notes**:**
Bold = Exceeds Health Canada guidance / BC CSR standard of 1.0E-05.

Table 6-16 Incremental Lifetime Cancer Risks – Recreational Receptors

COC	Crab Muscle Ingestion	Crab Hepatopancreas Ingestion	Sts'úkwi7 (fish) Ingestion	COC-Specific ILCR
Polycyclic Aromatic Hydrocarbons				
LMW PAHs				
Phenanthrene	1.1E-12	4.8E-12	1.1E-10	1.1E-10
HMW PAHs				
Benz(a)anthracene	4.4E-11	1.6E-10	1.0E-09	1.2E-09
Benzo(a)pyrene	6.9E-11	1.8E-10	3.0E-09	3.3E-09
Benzo(b)fluoranthene	1.3E-11	1.5E-11	5.2E-10	5.4E-10
Benzo(k)fluoranthene	4.9E-12	4.4E-11	4.7E-10	5.2E-10
Benzo(g,h,i)perylene	1.2E-12	5.7E-13	1.2E-11	1.4E-11
Chrysene	3.0E-12	3.2E-11	1.1E-10	1.4E-10
Dibenz[a,h]anthracene	4.6E-11	5.5E-11	2.9E-10	3.9E-10
Fluoranthene	4.3E-13	1.6E-12	5.4E-11	5.6E-11
Indeno(1,2,3-c,d)perylene	4.7E-12	6.9E-12	1.5E-10	1.6E-10
Total PAH Pathway Specific ILCR	1.9E-10	5.0E-10	5.7E-09	6.4E-09

Notes:
Bold = Exceeds Health Canada guidance / BC CSR standard of 1.0E-05.

The cumulative/additive risks of structurally-related carcinogenic PAHs were evaluated. The Health Canada guideline (Health Canada, 2012) for incremental cancer risk is 1 in 100,000 or 1.0E-05.

The ILCRs calculated for the Aboriginal Receptor (adult) and Recreational Receptor (adult) were less than the standard of 1.0E-05; therefore, unacceptable cancer risks for the Aboriginal Receptor and Recreational Receptor were not predicted.



6.5.6 Uncertainty Analysis

Some degree of uncertainty is inherent in any risk assessment process; however, based on the conservative assumptions used in the risk assessment, the risk estimates presented in the assessment are considered to be an upper bound estimate of risk. The "true risk" to an individual is likely to be much less than predicted in this assessment.

Factors that contribute uncertainty to the human exposures estimated in the assessment include:

- Intake parameters were based on professional judgment and literature values, not Site or Receptor specific data. In all cases, however, intakes were based on conservative assumptions. These conservative intake parameters are expected to have resulted in overestimates of actual exposure. In particular, the Sts'úkwi7 (fish) consumption rate selected is expected to be biased high (i.e., conservative), as it is the arithmetic mean of the amount of Sts'úkwi7 (fish) eaten by those who recalled eating Sts'úkwi7 (fish) in the past 24 hours, rather than the mean of the amount of Sts'úkwi7 (fish) eaten by all people surveyed.
- Published consumption rates typically survey a large number of people for various areas in order to derive general values. These values are not specific to particular populations, so uncertainty is present regarding the applicability of these generic guidelines.
- Crab consumption rates were based US EPA (2011) for several seafood commodities (e.g., shrimp, crab, squid, oysters, clams, lobster, mussel, scallops, etc.). Therefore, the crab meat COC concentrations are assumed representative of all shellfish food commodities.
- The assumption that one percent of seafood consumed is from the Woodfibre site has a moderate degree of uncertainty. This assumption is based on the ratio of the site area over the "fishable" area of seabed of Howe Sound. A more accurate assumption could be derived from a country foods study.

6.5.7 Conclusions and Risk Management Recommendations

Based on Human Health and Ecological Risk Assessments summarized in this document, unacceptable risks to humans consuming Sts'úkwi7 (fish) and shellfish within the Woodfibre waterlot were not identified. Risk management specific to recommendations to prohibit fishing and crabbing within the waterlot are not required; however, mitigation measures, monitoring, and adaptive management to protect marine staq̓w (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).

6.6 Human Health Risk Assessment for the Seafood Monitoring Program (2022)

In 2022, Stantec Consulting Ltd (Stantec) prepared an additional HHRA based on the results of a seafood ínexwantas (monitoring) program that was conducted prior to the commencement of marine construction activities at the Site, in support of FDS 6.5.1. The seafood ínexwantas (monitoring) program included the ínexwantas (monitoring) of Aẏ̓x (Dungeness crab) meat, crab hepatopancreas, and English Lhémq̓w'a (sole) meat for COCs, which included metals[5] (cadmium, copper, lead, mercury, and zinc), organometallics

[5] Arsenic was not carried forward for evaluation in the HHRA as it was assumed that the arsenic found in seafood would be predominantly in the non-toxic arsenobetaine form.

(methylmercury TBT), PAHs, and dioxins/furans. Two study areas were included in the seafood ínexwantas (monitoring) program, which consisted of the Woodfibre study area (extending up to 500 m into Nexwnéwu7ts Átlk̓a7tsem (Howe Sound) from the shoreline of the Site) and a site located outside the Project CPA, upstream of the Woodfibre study area near the mouth of Skwxwú7mesh (Squamish) Harbour, referred to as the Skwxwú7mesh (Squamish) study area. Members of Skwxwú7mesh Úxwumixw (Squamish Nation) (toddlers and adults) were identified as the primary human receptors of interest in the HHRA.

The Seafood ínexwantas (monitoring) Program (Stantec 2022b) concluded the following regarding health risks to Indigenous toddlers and adults associated with exposure to COCs in seafood from the Site:

- Health risks were negligible for PAH, dioxins/furans, TBT, and copper
- Health risks were negligible to low for cadmium, lead, and zinc
- Health risks were low to moderate for mercury and methylmercury

It was noted that the concentrations of mercury and methylmercury in seafood collected from the Skwxwú7mesh (Squamish) study area were approximately twice what was found in the Woodfibre study area, suggesting that Skwxwú7mesh (Squamish) Harbour is the source or near a source of mercury contamination, and not the Woodfibre study area.

The findings of the Seafood ínexwantas (monitoring) Program (Stantec 2022b) will be used as a benchmark for comparison of the construction and post-construction phases. This is because the initial study by Keystone was conducted in 2016, while the Stantec study was conducted in 2022. Therefore, the results from the more recent Stantec study, based on updated data, supersede the findings of the Keystone study from 2016.

More details about this study can be found the report called "Human Health Risk Assessment for the Seafood Monitoring Program: Woodfibre LNG Project" which was submitted to Woodfibre LNG in May 2022 (Stantec 2022b).

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 environmental assessment approval (BC EAO 2015) concluded that, after the application of mitigation measures, the remaining residual effects to marine staq̓w (water) quality were not significant:

> *No Project-related changes in marine staq̓w (water) quality beyond natural variability and exceeding staq̓w (water) quality guidelines, including increase in levels of suspended sediments, turbidity and contaminants, due to increased site erosion, sediment transport, seabed disturbance, concrete works, pile removal, and other construction activities. Identified potential interactions will be mitigated by development and implementation of a CEMP [Construction Environmental Management Plan] and associated management plans, and environmental monitoring.*

The proposed mitigations for the Construction phase from the Project Environmental Assessment Section 5.10, Table 5.10-6 are listed in **Table 7-1**. These are consistent with those in Table 22-1 of the Project Environmental Assessment under the heading 'Marine Staq̓w (water) Quality'. Mitigation ID relates to the unique ID assigned to mitigations in the Environmental Assessment Application.

Table 7-1 Marine Staq̓w (water) Quality Mitigations for the Construction Phase

Summary of Potential Effect	Project Design Measure / Mitigation	Mitigation ID
Potential change in marine staq̓w (water) quality due to site erosion and sediment transport	Erosion Prevention and Sediment Control Plan	M5.8-1
	Design for Stormwater Management	M5.8-2
Potential change in marine staq̓w (water) quality due to seabed disturbance and siltation during marine construction	Marine Works Management Plan	M5.10-1
Potential change in marine staq̓w (water) quality due to release of cementitious material during cast in place works	Concrete Works Management Plan	M5.10-2
Potential change in marine staq̓w (water) quality from creosote during removal of old piles	Minimize the Effects of Creosote Pile Removal	M5.10-3
Potential change in marine staq̓w (water) quality from waste material leaching	Project design	Project design
	Waste Management Plan	M5.10-4

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 Construction Environmental Management Plan (CEMP) and 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 Certificate of Compliance (CofC) process.

The Environmental Assessment application concluded for the Human Health Risk Assessment, after the application of mitigations measures (Section 9.9.2 of the Environmental Assessment and subsequent amendment applications), that residual effects in the HHRA were determined to be negligible or not significant. This was, relative to the marine environment, determined due to the findings of the marine stak̲w (water) quality effects assessment and supplemental tissue and sediment studies, and based on the lack of increase in tissue burdens in Sts'úkwi7 (fish) and shellfish.

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

7.1 Avoidance Measures

Numerous avoidance measures have been incorporated into the overall Project design during planning, regulatory review and consultation.

7.1.1 Site Selection

The Woodfibre location was selected as a site for a large LNG facility in part due to its brownfield history and generally low environmental value. The Site is also surrounded by other industrial marine projects such as Skwxwú7mesh (Squamish) Terminals and historical contamination of Nexwnéwu7ts Átlk̲'a7tsem (Howe Sound) at Britannia Mine. The Site allows for a marine terminal with floating storage and offloading over deep stak̲w (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, it 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 Construction Phase

All project components have been incorporated to minimize the amount of aquatic disturbance, which could result in mobilization of sediment.

7.1.3 Operation Phase

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 temíxw (land) air cooling.

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 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 stak̲w (water) will be tested for compliance with the BC Stak̲w (water) Quality Guidelines. If it meets guidelines, stormwater will be discharged directly into Howe Sound; if not, stormwater will be pumped to the stak̲w (water) treatment plant prior to being discharged into 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 and therefore will not use their own propellers (except for emergency or safety requirements) or will use them at a considerably 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. Staq̓w (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 staq̓w (water) column before reaching the seafloor.

7.2 General Marine Works Management and Timing Windows

The following mitigation measures for marine staq̓w (water) quality effects will be adhered to during marine construction works:

- 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 full-time during sensitive and higher risk in-staq̓w (water) works (as determined by a QEP) and at all times when construction is to occur outside the timing work window. Adverse effects will be reported to DFO.
- Where there is potential for Sts'úkwi7 (fish) to be harmed by changes in staq̓w (water) quality (e.g., observance of Sts'úkwi7 (fish) in high turbidity areas within a silt curtain), 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 will meet requirements in salvage permits.
- Where possible, all equipment working on or near staq̓w (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 at a distance of greater than 30 m from marine staq̓w (water) and freshwater environmental features, or as approved by the Environmental Monitor.
- Works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment, or sediment-laden staq̓w (water), turbid staq̓w (water), or any other deleterious substance into aquatic environments. All discharges from construction activities shall meet BC WQG or CCME staq̓w (water) quality guidelines unless otherwise authorized through a Waste Discharge Permit. The BCER is currently reviewing a Waste Discharge Authorization application from Woodfibre LNG which contemplates discharge limits for TSS of 75 mg/L and pH limits of 5.5 – 9.0 based off baseline data presenting lower pH than existing staq̓w (water) quality guidelines. This Plan does not set discharge criteria and the BCER permit must be referenced for on-Site compliance.
- Construction works within intertidal work zones will be scheduled during low tide periods. If works cannot be scheduled during low tide periods, the Environmental Monitor will provide justification during reporting and full-time ínexwantas (monitoring) if outside the MLRW.
- 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 stak̲w (waters) around in-stak̲w (water) construction activities (such as dredging and excavation activities along the shoreline) with the potential to adversely affect stak̲w (water) quality (i.e., to contain suspended sediment). Silt control measures will be maintained and/or replaced by the Contractor as needed to maintain their effectiveness.
- When construction vessels are required to operate in shallow stak̲w (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 stak̲w (water) vessel operations, with additional mitigation being developed and deployed as required to avoid resuspension of marine sediments resulting from seabed scouring (**Section 7.7**).
- Stak̲w (water)-based equipment (i.e., boats and barges) shall manage runoff from deck surfaces such that it meets BC Stak̲w (water) Quality Guidelines outlined in **Section 8.**
- 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 stak̲w (water) quality. These conditions will be documented in the applicable Contractor Environmental Protection Plan (EPP).
- Marine works will be conducted during the least risk fisheries work window. If the work window cannot be followed, additional mitigation measures including the advice provided by DFO will be implemented.
- Work activities will cease and DFO will be contacted, if aggregations of Slhawt' (herring) (e.g., Slhawt' (herring) spawn) and Cháyilhen (salmonids) (e.g., smolts) are observed within the work area.
- The Contractor will have a contractual obligation to adhere to the mitigation contained within this MWQMMP and their EPP, as well as project approvals (for example, the Fisheries Act Authorization). Environmental monitor(s) will be onsite to enforce this obligation. All contractor responsibilities are contractual requirements and subject to the process described in the CEMP.
- Corrosion resistant coatings required for the protection of marine structures will be applied in the module yard prior to transport to the Woodfibre LNG site. If there is a need for smaller applications (e.g., touch-ups), they would be applied in a controlled manner and isolated from watercourses or Howe Sound.

7.3 Pile Driving

The Contractor will be responsible for developing an EPP which will include a pile driving component and it will follow the structural and approval requirements set out in the CEMP. 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 Marine Fish and Fish Habitat Mitigation and Monitoring Plan (MFFHMMP) and the Marine Mammal Mitigation and Management Plan (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 stak̲w (water) quality:

- Implementing the British Columbia Marine and Pile Driving Contractors Association's *Best Management Practices for Pile Driving and Related Operations*

- General Marine Works Management measures will be applied (**Section 7.2**);
- 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 staq̓w (water) borne equipment will be avoided in order to minimize disturbance of the seabed and resuspension of sediment;
- 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 staq̓w (water) quality regulatory criteria during Project works;
- Silt control measures will be installed around the marine work area during pile driving if required, as determined by a QEP based on the results of staq̓w (water) quality monitoring;
- 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 staq̓w (water) quality; and
- Where clean-out of pipe piles is required (e.g., air lifting and rotary drilling), the sediment will be contained (e.g., on a scow) and appropriately disposed of at an approved facility.

7.4 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.
- Staq̓w (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.

7.5 Dredging

In accordance with the provincial environmental assessment approval, up to 80,000 m^3 of material may be dredged from the Certified Marine Area (EAC E15-02 or as amended). Dredging activities are regulated by federal and provincial agencies (such as review under the *Fisheries Act*) and dredging plans and controls to prevent or minimize release of sediment (re-suspension) during dredging are mandatory.

It is anticipated dredging works will require a response from DFO confirming the works can proceed (i.e., a letter of advice, or if needed an authorization). If dredging is planned around the mouth of a stream a *Staq̓w (water) Sustainability Act* approval also may be required.

Dredging may be required during Project construction and the Contractor will be responsible for developing a Dredging EPP. The contractor will be responsible for adhering to all regulatory requirements.

The following mitigation measures for potential staq̓w (water) quality effects from dredging will be implemented:

- General Marine Works Management measures will be applied (**Section 7.2**).
- A preconstruction meeting will be conducted with the Contractor and Environmental Monitor to review environmental requirements and the proposed dredging plan.
- Prior to dredging, the perimeter of the dredge area will be clearly delineated, 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 staq̓w (water) filtering devices on the barge to meet the TSS and turbidity criteria outlined in **Section 8.2**. This may require containment and treatment of barge dewatering effluent that exceeds BC Staq̓w (water) Quality Guidelines, or the work areas and activities contributing to these conditions will be isolated from tidal and flowing staq̓w (waters) through silt curtains or other silt control measures;
- Use of a fully enclosed silt control measure (i.e., silt curtain), where appropriate, to help reduce the spread of sediment-laden staq̓w (waters) and reduce the deposition of sand and silt to adjacent areas.

Silt curtains should be deployed around the dredge area or rig, and around scows where dredged material is deposited;

- If used, the silt curtain must be sufficient to minimize the lateral dispersal of turbid stak̲w (water) and sediments by current. Chains or equivalent will be used to weight the silt curtain down to prevent sediment from escaping underneath. Anchors or other devices may be required to hold the silt curtain in place. Details on silt curtain installation must be provided as part of the Contractor's EPP in order to confirm it meets project requirements.
- If used, the silt curtain is to be inspected every day by the Contractor and the environmental monitor. Works will be stopped if the silt curtain is observed to be damaged or has malfunctioned, or if exceedances of stak̲w (water) quality criteria are observed. The Contractor will be responsible for fixing the silt curtain or installation of additional mitigation measures if required to comply with stak̲w (water) quality requirements.
- Stak̲w (water) quality ínexwantas (monitoring) will be conducted by the Environmental Monitor 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.
- Operational controls will be implemented 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.
- Grounding of the barge will be avoided in order to minimize disturbance of the seabed and resuspension of sediment; spuds may be used to anchor the barge.
- Equipment used in dredging operations will be inspected daily to confirm it is in good working order and free of leaks or excess grease.

7.6 Concrete Works

The Contractor will develop and will implement a Concrete Works EPP describing specific mitigation measures and environmental protection procedures for works that involve concrete preparation, cutting, chipping, grinding, pouring, or curing within or in proximity to aquatic environments.

Consistent with, and in addition to, the Best Management Practices provided in BC Marine and Pile Driving Contractors Association (BCMPDCA) and DFO (2003), the following mitigation measures for stak̲w (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 may be achieved through location of storage or secondary containment.
- Concrete forms will be constructed in a manner to prevent concrete or cement laden stak̲w (water) from leaking into the marine environment whether piped or poured.
- Barriers will be used as appropriate to prevent splashing over forms and into the stak̲w (water).

- 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.
- Concrete will be covered while curing if significant rainfall (25 mm within a 24-hour period) is forecast to prevent inducing alkalinity in stormwater runoff. Concrete or cement laden stak̲w (water) from runoff or washing will be retained or treated if required to maintain accepted criteria.
- If fresh stak̲w (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.
- 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 polyethylene) and full-time ínexwantas (monitoring) for pH and turbidity levels will occur.
- Excess or spilled concrete will be contained, cleaned up, and disposed of in an environmentally acceptable manner.
- 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.
- 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 stak̲w (water) quality remaining within accepted criteria. Stak̲w (water) quality ínexwantas (monitoring) (Section 8.2) will be conducted to ensure the containment is effective and any exceedances will require adaptive management measures.
- Equipment and tools used for pouring or finishing concrete will be cleaned in a way that prevents wash stak̲w (water) from entering watercourses or the marine environment.
- In the event accepted stak̲w (water) quality criteria are exceeded, remedial measures will be applied.

7.7 Seabed Disturbance and Placement of Materials

The Contractor will develop an EPP and will implement specific mitigation measures and environmental protection procedures for works that involve activities not specified above that may include seabed disturbance during placement of anchor blocks, rip rap 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 or tugs moving barges supporting equipment, larger barges or ships bringing equipment to and from the Site, and boats transporting workers. The following mitigation measures for stak̲w (water) quality effects will be implemented:

- General Marine Works Management measures will be applied (**Section 7.2**) for physical works in the marine environment.
- Use of a fully enclosed silt curtain where required by the *Fisheries Act* Authorization to reduce the spread of sediment-laden stak̲w (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.
- When used, the silt curtain shall be inspected every day by the Contractor and the Environmental Monitor. Works will stop if the silt curtain is damaged or has malfunctioned. The Contractor will be responsible for fixing the silt curtain or installation of additional mitigation measures if required to comply with stak̲w (water) quality requirements.
- When construction vessels are required to operate in shallow stak̲w (water) (i.e. a few metres depth), additional mitigations will be implemented to minimize propeller wash, where possible, including:
  - Propeller wash will not be directed towards shore.
  - Vessels to operate below 5 knots.
  - 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 materials in stak̲w (water) 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 stak̲w (water) column.
- The placement of materials in the subtidal will occur during periods of low stak̲w (water) movement (to be determined during installation) and during calm weather to reduce environmental factors influencing material installation (i.e., swaying from crane).
- Stak̲w (water) quality ínexwantas (monitoring) will be conducted by the Environmental Monitor during excavation 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.

7.8 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 stak̲w (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 stak̲w (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 stak̲w (water).
- Where possible, all equipment working on or near stak̲w (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 stak̲w (water), or as approved by the Environmental Monitor.

7.9 Upland Mitigations

A number of upland mitigation measures (e.g., erosion prevention and sediment control) will be implemented to avoid or mitigate potential impacts to the marine environment. While these are described in detail in respective plans (i.e., CEMP), key mitigations are summated here for compliance with EAC condition 6.

7.9.1 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**.**

Additionally, the following measures and general procedures will be implemented to reduce probability of marine stak̲w (water) quality effects resulting from erosion or sedimentation:

- Disturbance of vegetation will be minimized to the extent required for construction as determined by the Environmental Monitor 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 stak̲w (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 stak̲w (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 marine foreshore and will be covered when not in use.
- 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 works are completed.

7.9.2 Stormwater Management

Stormwater Management for the Project Construction phase will be addressed through implementation of the mitigation measures described in the CEMP. Stormwater management measures to mitigate potential changes in marine stak̲w (water) quality include:

- 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 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 lined stormwater retention pond. The stak̲w (water) will be tested for compliance with the BC stak̲w (water) quality guidelines. If it meets guidelines, stormwater will be discharged directly into Howe Sound; if not, stormwater will be pumped to the stak̲w (water) treatment plant prior to being discharged into Howe Sound.

7.9.3 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 change in marine stak̲w (water) quality 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. For the nearshore activities, the Plan will contain the following measures:

For 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; and
- disposal certification documents.

For 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 wildlife-proof bins.

Moreover, the measures below will be adhered to prevent marine staq̓w (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 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 or indoor garbage cans and will be removed from derricks and work areas each day.
- Used acid-lead batteries must be stored on an impervious surface, under cover, and disposed of at an approved recycling facility.
- Liquid waste and wastewater from the Floatel will be stored upland and removed via a barge regularly to an offsite disposal facility to ensure holding capacity is maintained.

7.9.4 Upland Blasting and Road Construction

Mitigations that will be used during upland blasting and road construction for the FST structure that relate to marine staq̓w (water) quality include, but are not limited to, the following:

- Erosion Prevention and Sediment Control measures will be implemented prior to the start of upland blasting (Section 7.9.1) to mitigate blast debris from entering the marine environment.
- Near-shore blasting will be phased such that areas further from the shore are phased first to provide site specific field measures to inform adaptive measures for subsequent works.
- During the initial blasting, a full height silt curtain will be deployed around the blasting area 10 m from shore to contain any material that enters the marine environment. The bottom of the curtain will need to 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.

- If measures are ineffective at mitigating blast debris from entering the marine environment, Woodfibre LNG will install temporary debris nets anchored to the rock face as an adaptive measure. Blasting mats will be used as required to control fly-rock.

8. MARINE STAQ̓W (WATER) QUALITY ÍNEXWANTAS (MONITORING) AND FOLLOW-UP PLANS

ínexwantas (monitoring) is proposed to verify the accuracy of the environmental assessment and determine effectiveness of mitigation measures related to Construction. The following subsections describe the Project staq̓w (water) quality ínexwantas (monitoring) program during Construction. This ínexwantas (monitoring) and follow-up plan has been developed to address criteria set out in Section 13 of the environmental assessment (WLNG 2015), particularly as it relates to marine staq̓w (water) quality EAC condition 6 and FDS condition 6.5.

The general approach includes an adaptive management component (**Section 8.5**), whereby if effects are observed that were not predicted in the Environmental Assessment, or if through ínexwantas (monitoring) it is determined mitigation is ineffective, additional mitigation will be applied and its effectiveness monitored.

8.1 Overview

The marine staq̓w (water) quality ínexwantas (monitoring) plan is developed to provide verification ínexwantas (monitoring) for the environmental assessment determinations of no significant Project-related effects to marine staq̓w (water) quality and human health. The marine staq̓w (water) quality ínexwantas (monitoring) plan will also assess whether mitigation measures are effective in supporting the conclusions of the environmental assessment.

Potential effects include:

- Re-suspension and bioavailability of polycyclic aromatic hydrocarbons, dioxins, furans, copper, lead, zinc, tri-n-butvltin (tributyltin [TBT]), arsenic, cadmium and methylmercury (Contaminants of Concern) to shellfish and groundfish during construction.
- An increase in bioavailability and bioaccumulation of contaminants in Sts'úkwi7 (fish) (i.e., shellfish and groundfish) consumed by humans, particularly polycyclic aromatic hydrocarbons, polychlorinated dibenzo-p-dioxins and furans, copper, lead, zinc, tributyltin, arsenic, cadmium and methylmercury.

The proposed mitigation verification ínexwantas (monitoring) programs for the Construction phase are aligned with the proposed mitigations from the Project Environmental Assessment Section 5.10, Table 5.10-6; refer to **Table 7-1**.

Potential effects, mitigation measures, and verification metrics are listed in **Table 8-1**, and described below.

As previously stated, this is focused on mitigating seabed disturbance (i.e., resuspension of potentially contaminated material) and avoiding introducing materials into the marine environment (e.g., cementitious material). In addition, and in consideration of potential pathways of effect, ínexwantas (monitoring) also includes marine sediments, and shellfish and groundfish tissue, which may trigger an update to the HHRA.

Table 8-1 Summary of Proposed Construction Verification ínexwantas (Monitoring) Programs for Marine Stak̲w (water) Quality and Human Health

Summary of Potential Effect	Project Design Measure / Mitigation	Metric
Potential change in marine stak̲w (water) quality due to site erosion and sediment transport	Erosion Prevention and Sediment Control Plan (CEMP)	Monitor for change in stak̲w (water) quality
	Design for Stormwater Management (CEMP)	Monitor for change in stak̲w (water) quality
Potential change in marine stak̲w (water) quality due to seabed disturbance and siltation during marine construction	CEMP	Monitor for change in stak̲w (water) quality and change in seabed structure (i.e., scour and deposition)
Potential change in marine stak̲w (water) quality due to release of cementitious material during cast in place works	CEMP	Monitor for change in stak̲w (water) quality
Potential change in marine stak̲w (water) quality from waste material leaching	Waste Management Plan (CEMP)	Monitor for change in stak̲w (water) quality
Bioaccumulation of Contaminants of Concern in shellfish and groundfish	Establish baseline conditions (HHRA)	Monitor for change in tissue quality of shellfish and groundfish

8.2 Stak̲w (water) Quality Monitoring

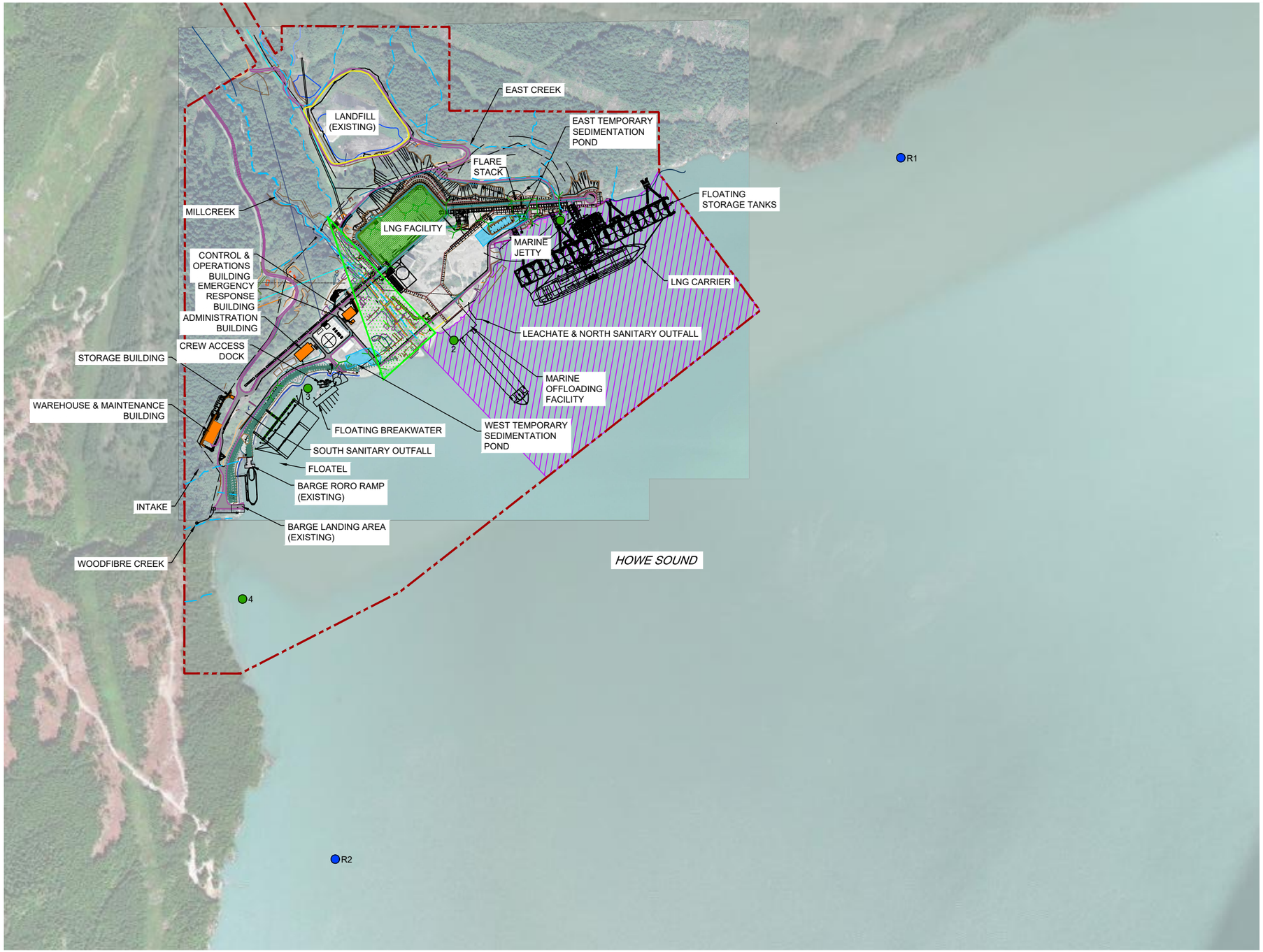
Stak̲w (water) quality ínexwantas (monitoring) will consist of in-situ/ analytical baseline establishment, routine in-situ, routine analytical, and non-routine (exceedance) analytical. Each of these ínexwantas (monitoring) requirements are described in detail below.

8.2.1 Turbidity Correlation Establishment

Correlations between in-situ turbidity readings and analytical parameters for non-soluble constituents including PAHs, hydrocarbons, and total metals, can be derived and used to gauge when mitigation measures are effective and when laboratory analysis will be required.

To develop a correlation of in-situ turbidity/TSS readings and potential contaminants of concern concentrations to guide environmental monitoring, a minimum of 20 sample collections will occur prior to construction and 20 sample collections will occur over a 30-day period during marine construction.

Analytical sampling will be completed at locations within the CPA and outside the CPA (**Figure 8-1)**; samples at each location will be collected from two metres below the surface and two metres above the seafloor. A summary of the baseline correlation ínexwantas (monitoring) is proved in **Table 8-2**.



LEGEND

- CERTIFIED PROJECT AREA
- WATERCOURSE
- CULVERT
- GREENZONE
- CERTIFIED MARINE TERMINAL AREA
- LNG FACILITY
- NON-PROCESS FACILITY
- TEMPORARY SEDIMENTATION POND
- ROADWAY
- WATER QUALITY SAMPLE (ON-SITE LOCATION)
- WATER QUALITY SAMPLE (REFERENCE 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	July 2023	17953-109

Figure 8-1
Water Quality Sampling Location

PLOT SCALE: 1:1 DRAWN BY: TL CADD FILE No. I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17953\00109\2023_07July_14__Sed_Pond\Fig8-1-Sample Location Plan-R0.dwg

Table 8-2 Summary of Marine Stak̲w (water) Quality Baseline Correlation ínexwantas (Monitoring)

Location	Sample Site	Depth	Parameters	Frequency
In-situ				
Within CPA	1-4	2m below surface, 2m above seafloor	Turbidity, Salinity, pH, dissolved oxygen, conductivity, temperature, ORP	20 samples prior to construction; 20 samples during first 30 days of marine construction
Outside CPA Reference 500m North and 500m South of CPA	R1, R2	2m below surface, 2m above seafloor	Turbidity, salinity, pH, dissolved oxygen, conductivity, temperature, ORP	20 samples prior to construction; 20 samples during first 30 days of marine construction
Analytical				
CPA	1-4	2m below surface, 2m above seafloor	pH, DO, TSS, ammonia, nitrate, PAHs and total PAH, BTEX, total metals, dioxins, furans, TBT	20 samples prior to construction; 20 samples during first 30 days of marine construction
Outside CPA Reference 500m North and 500m South of CPA	R1, R2	2m below surface, 2m above seafloor	pH, DO, TSS, ammonia, nitrate, PAHs and total PAH, BTEX, total metals, dioxins, furans, TBT	20 samples prior to construction; 20 samples during first 30 days of marine construction

This sampling is intended to provide a range of turbidity levels across the site to develop a correlation. The exact number of samples will depend on the correlation established and will be determined by a QEP. The correlation will be updated with ongoing routine and non-routine sampling events described in **Section 8.2.3** and **Section 8.2.4**.

In-situ stak̲w (water) quality readings using a YSI and stak̲w (water) quality grab samples using a van Dorne (according to BC Field Sampling Manual).

Field or laboratory analysis will include at a minimum the following parameters:

- pH, DO, salinity, turbidity, TSS, ammonia, nitrate, PAHs, total PAH, BTEX, total metals, methylmercury, tri-butyltin, dioxins, furans

The resultant correlation will be used to inform the effectiveness of mitigation measures based on in-situ measurements of turbidity (NTU).

8.2.2 In-situ ínexwantas (Monitoring)

8.2.2.1 In-situ ínexwantas (Monitoring) Terrestrial Works

Stak̲w (water) quality will be measured by an Environmental Monitor for compliance against criteria from the BC WQG, CCME Canadian Stak̲w (water) Quality Guidelines for the Protection of Aquatic Life and the

DFO temíxw (land) Development Guidelines for the Protection of Aquatic Habitat (1992) during project works.

An appropriately qualified Environmental Monitor will be retained to conduct stak̲w (water) quality monitoring. Stak̲w (water) quality ínexwantas (monitoring) will be conducted during works with the potential to impact marine stak̲w (water) quality as determined by a QEP (i.e., works causing discharge or run-off).

- During stak̲w (water) quality monitoring, in-situ stak̲w (water) quality measurements will be collected by the Environmental Monitor:
- Prior to works; and
- Approximately every two hours during works with the potential to impact stak̲w (water) quality as determined by a QEP.
- If conditions are within stak̲w (water) quality guidelines, ínexwantas (monitoring) frequency may be reduced at the QEP or Environmental Monitor discretion.

Stak̲w (water) runoff and discharge from the work area to the marine or freshwater environment must meet the following guidelines:

- Contain less than 25 mg/L of total suspended solids (TSS) above background during normal dry weather;
- Contain less than 75 mg/L of TSS above background during rainfall events of >25 mm in 24 hours; and
- Be within the acceptable pH range of 6.5–9.0 (freshwater) and 7.0–8.7 (marine stak̲w (water)).

TSS values will be approximated using field turbidity measurements (NTU). Confirmatory TSS samples may be collected for laboratory analysis when NTU measurements approach the maximum allowable TSS values above. Laboratory analysis of TSS completed prior to construction start or during pre-construction work activities may be used to assist in establishing/adjusting the correlative relationship between TSS and NTU during construction work activities, at the discretion of the Environmental Monitor.

The Contractor will be required to maintain stak̲w (water) quality criteria from the CCME Canadian Stak̲w (water) Quality Guidelines for the Protection of Aquatic Life outlined in **Table 8-3**.

Table 8-3 Stak̲w (water) Quality Criteria for Evaluating Terrestrial Project Works

Stak̲w (water) Body	Turbidity	pH
Marine, freshwater	Maximum increase of 8 NTUs from background levels at any one time for a duration of 24 hours in all stak̲w (waters) during clear flows or in clear stak̲w (Waters) Maximum average increase of 2 NTUs from background at any one time for a duration of 30 days in all stak̲w (Waters) during clear flows or in clear stak̲w (Waters) Maximum increase of 8 NTUs from background levels at any time when background is 8-80 NTUs during high flows or in turbid stak̲w (waters) Maximum increase from background of 10% when background is >80 NTUs at any time during high flows or in turbid stak̲w (water)	7.0 to 8.7 (marine) 6.5 to 9.0 (freshwater)

8.2.2.2 In-situ ínexwantas (Monitoring) Marine Works

When in-stak̲w (water) works are taking place, the Contractor will be required to maintain stak̲w (water) quality criteria from the CCME Canadian Stak̲w (water) Quality Guidelines for the Protection of Aquatic Life outlined in **Table 8-4**.

Table 8-4 Stak̲w (water) Quality Criteria for Evaluating Marine Works

Stak̲w (water) Body	Turbidity	pH
Marine	Maximum increase of 8 NTUs from background levels at any one time for a duration of 24 hours in all stak̲w (waters) during clear flows or in clear waters Maximum average increase of 2 NTUs from background at any one time for a duration of 30 days in all stak̲w (waters) during clear flows or in clear waters Maximum increase of 8 NTUs from background levels at any time when background is 8-80 NTUs during high flows or in turbid stak̲w (waters) Maximum increase from background of 10% when background is >80 NTUs at any time during high flows or in turbid stak̲w (waters)	7.0 to 8.7

Stak̲w (water) quality samples will be collected at multiple stations within the work area and at a background location that is located at a suitable distance from the work area such that it is not influenced by project works, as determined by the Environmental Monitor. The sample stations will consist of:

- A warning station located within 25 m of the work area.
- A compliance station located within 75 m of the work area.
- A warning station located within 10 m of the silt curtain when in place (e.g., during shoreline repair).
- A compliance station located within 20 m of the silt curtain when in place (e.g., during shoreline repair).

Stak̲w (water) quality measurements will be collected at two depths (tide and depth dependent) in the stak̲w (water) column at each station:

- 1-2 m below the stak̲w (water) surface;
- 1–2 m above the seabed.

If stak̲w (water) quality data exceed criteria (**Table 8-4**) at the warning station, the Environmental Monitor will advise Woodfibre LNG, so they may instruct the Contractor to consider adaptive measures as required to prevent exceedances at the compliance station.

If stak̲w (water) quality data exceed regulatory criteria at one or more compliance stations at any point, the Environmental Monitor will advise Woodfibre LNG that work must stop and adaptive measures be implemented by the Contractor to address the issue(s). Work may resume when stak̲w (water) quality returns to below the criteria in **Table 8-4** and the Environmental Monitor has observed implementation of, or repair to, adaptive mitigation measures.

If in-situ measurements are above 80% of in-situ stak̲w (water) quality criteria or the NTU at which 90% of a stak̲w (water) quality guideline is reached as determined through the established correlation, then a second round of in-situ ínexwantas (monitoring) will be conducted for those works and comparison will be made to background (outside CPA) ínexwantas (monitoring) results.

If the second round of in-situ ínexwantas (monitoring) confirms the exceedance of these thresholds, the Environmental Monitor will advise Woodfibre LNG so they may instruct the Contractor such that measures can be taken to limit potential increases in the parameter and inform the application of environmental mitigations. In situ ínexwantas (monitoring) will increase, as determined by the Environmental Monitor, to inform decision making regarding the activity and effectiveness of mitigation measures. Stak̲w (water) quality sampling for laboratory analysis may be initiated if considered necessary by the Environmental Monitor. The Environmental Monitor has the authority to stop works based on stak̲w (water) quality observations if required to prevent exceedances.

If in-situ measurements exceed marine CCME guidelines for the protection of marine aquatic life, or BC Stak̲w (water) Quality Guidelines for marine aquatic life (or is suspected to based on the correlation of with turbidity) and after comparison and verification of background (outside CPA) ínexwantas (monitoring) data, the Environmental Monitor will inform Woodfibre LNG so they may instruct the Contractor to cease work associated with the exceedance.

Additional measures will be implemented to address the exceedance (e.g., slowing down dredging operations, installing additional containment). Once confirmed by the Environmental Monitor that stak̲w (water) quality is consistent with guidelines, work may restart and in-situ ínexwantas (monitoring) will be implemented at an increased frequency, as determined by the Environmental Monitor to confirm additional mitigation measures are effective and stak̲w (water) quality parameters stabilized within the acceptable criteria.

Continuous ínexwantas (monitoring) using stationary buoys may be deployed at the site / in background (outside CPA) areas to provide real time in-situ monitoring.

8.2.3 Routine Sampling

During construction, routine monthly verification sampling of marine stak̲w (water) quality will be completed under the direction of a QEP consultant hired by Woodfibre LNG. This will be completed at six sites (two outside the CPA, four within the CPA), two metres below the surface and two metres above the seafloor; the same as baseline correlation sampling. Approximate locations are shown in **Figure 8-1**. Results will be included in monthly and annual reporting. Laboratory analysis will include the following parameters:

- pH, DO, TSS, ammonia, nitrate, PAHs and total PAH, BTEX, *E. coli* and total metals.

Field measurements will be collected at the time of sampling including turbidity to continue to inform the established correlation between contaminant of potential concern and turbidity. A summary of the marine stak̲w (water) quality routine ínexwantas (monitoring) plan is provided in **Table 8-5**.

Table 8-5 Summary of Routine Marine Stak̲w (water) Quality Baseline Sampling Plan.

Location	Site No	Depth	Parameters	Frequency
In-situ				
Within CPA	1-4	2 m below surface, 2 m above seafloor	Turbidity, Salinity, pH, dissolved oxygen, conductivity, temperature, ORP	12 monthly; plus 3 additional weekly samples in May and 3 weekly in November to supplement 30-day chronic stak̲w (water) quality testing
Outside CPA (Reference)	R1, R2	2 m below surface, 2 m above seafloor	Turbidity, salinity, pH, dissolved oxygen,	12 monthly; plus 3 additional weekly samples in May and

Location	Site No	Depth	Parameters	Frequency
500 m North and 500 m South of CPA			conductivity, temperature, ORP	3 weekly in November to supplement 30-day chronic stak̲w (water) quality testing
Analytical				
Within CPA	1-4	2 m below surface, 2 m above seafloor	pH, DO, TSS, ammonia, nitrate, PAHs & total PAH, BTEX, total metals, dioxins and furans, *E. coli*	12 monthly; plus 3 additional weekly samples in May and 3 weekly in November to supplement 30-day chronic stak̲w (water) quality testing
Outside CPA (Reference) 500 m North and 500 m South of CPA	R1, R2	2 m below surface, 2 m above seafloor	pH, DO, TSS, ammonia, nitrate, PAHs & total PAH, BTEX, total metals, dioxins and furans, *E. coli*	12 monthly; plus 3 additional weekly samples in May and 3 weekly in November to supplement 30-day chronic stak̲w (water) quality testing

8.2.4 Non-Routine Sampling

Non-routine sampling will be initiated where in-situ measurements for a given activity exceed the acceptable criteria (e.g., NTU). Samples will be submitted to an analytical laboratory for analysis and comparison to the stak̲w (water) quality criteria outlined in **Table 8-4**. Rush analysis will be requested. Stak̲w (water) sampling frequency will be increased as determined by the Environmental Monitor.

Marine stak̲w (water) quality sampling results will be compared to results from historical baseline and to established background sites. Historical baseline marine stak̲w (water) quality values are outlined in **Section 6.1**. Analytical parameters to be collected are as listed in **Section 8.2.3**, and the thresholds and criteria to be compared against, are also listed in **Table 8-6**.

If analytical results are above 80% of guidelines, the Environmental Monitor will compare to results from historical baseline data and to established background sites, and report to Woodfibre LNG. Marine works being undertaken at the time will be reviewed and where required revised mitigation may be applied in discussion with the Environmental Monitor. Additional stak̲w (water) quality ínexwantas (monitoring) may be conducted, at the discretion of the Environmental Monitor. The Environmental Monitor has the authority to stop works based on stak̲w (water) quality observations if required to prevent exceedances.

If analytical results from the accredited laboratory report exceedances of CCME or BC WQG during routine or non-routine sampling, the Environmental Monitor will compare to results from historical baseline data and to established background sites, and report to Woodfibre LNG so they may instruct the Contractor to cease work associated with the exceedance. Construction activities occurring at the time of sampling will be reviewed. Additional mitigation measures, if not already implemented from the results of in-situ monitoring, will be implemented by the Contractor in consultation with Woodfibre LNG and the Environmental Monitor.

Table 8-6 Summary of Parameters for In-situ and Analytical Non-routine Stak̲w (water) Quality ínexwantas (Monitoring)

Parameters	Units	80% Threshold	CCME	BC WQG Marine
*pH	unitless	7.2 – 8.5	7.0 – 8.7	7.0 – 8.7
*Field Dissolved Oxygen (DO)	mg/L	8.3 – 10.7 *5.1 – 5.9 Instant. Min.	n/g	8-11[a] *5 – 6 instantaneous minimum
Total Suspended Solids (TSS)	mg/L	Max. increase of 20 mg/L from background in 24 h Max. avg. increase of 4 mg/L from background in 30 d Max. increase of 8 mg/L from background when background is between 25–100 mg/L Max. increase of 20 mg/L from background between >100–250 mg/L No more than 8% increase from background when > 100 mg/L	Maximum increase of 25 mg/L from background levels for any short-term exposure (e.g. 24 h period) Maximum average increase of 5 mg/L from background levels for longer term exposures (e.g. inputs lasting between 24 h and 30 d) Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L Should not increase more than 10 % background levels when background is ≥ 250 mg/L	Change from background of 25 m/L at any one time for a duration of 24 h in all stak̲w (waters) during clear flows or in clear stak̲w (waters) Change from background of 5 mg/L at any one time for a duration of 30 d in all stak̲w (waters) during clear flows or in clear stak̲w (waters) Change from background of 10 mg/L at any time when background is 25–100 mg/L during high flows or in turbid stak̲w (waters) Change from background of 10% when background is > 100 mg/L at any time during high flows or in turbid stak̲w (waters)
Turbidity	NTU	Max. increase of 6.4 NTU from background in 24 h Max. avg. increase of 1.6 NTU from background in 30 d Max. increase of 4 NTU from background when background is between 8–50 NTU Max. increase of 6.4 NTU from background when background is between >50–80 NTU No more than 8% increase from background when background is >50 NTU	Maximum increase of 8 NTUs from background levels for any short-term exposure (e.g. 24 h period) Maximum average increase of 2 NTUs from background levels for longer term exposure (e.g. 30 d period) Maximum increase of 8 NTUs from background levels at any time when background levels are between 8–80 NTUs Should not increase more than 10% background levels when background is > 80 NTUs	Change from background of 8 NTU at any one time for a duration of 24 h in all stak̲w (Water)during clear flows or in clear stak̲w (waters) Change from background of 2 NTU at any one time for a duration of 30 d in all stak̲w (waters) during clear flows or in clear stak̲w (Waters) Change from background of 5 NTU at any time when background is 8–50 NTU during high flows or in turbid stak̲w (waters) Change from background of 10% when background is > 50 NTU at any time during high flows or in turbid stak̲w (waters)

Parameters	Units	80% Threshold	CCME	BC WQG Marine
Ammonia	mg/L	1.6[a] 10.4[b] *salinity 10 ppt, pH 8, temperature 10°C	*guidance framework	2[a] 13[b] *salinity 10 ppt, pH 8, temperature 10°C
Nitrate	mg/L	160[a] *CCME* 1200[b] *CCME* 3.07[a] *BC WQG*	200[a] 1500[b]	3.7[a]
Polycyclic Aromatic Hydrocarbons (PAH)	mg/L	Varies	Varies	Varies
BTEX	µg/L	Benzene = 88 Ethylbenzene = 20 Toluene = 172	Benzene = 110 Ethylbenzene = 25 Toluene = 215	Benzene = 110 Ethylbenzene = 25
Total Metals		Varies	Varies	Varies
*Total Boron	mg/L	0.96[a]	n/g	1.2[a]
*Total Copper	mg/L	≤0.002[a] 0.0024[b]	n/g	≤0.002[a] 0.003[b]
*Total Zinc	mg/L	0.008[a] 0.044[b]	n/g	0.010[a] 0.055[b]
Dissolved Metals	mg/L	Varies	Varies	Varies
E. Coli	# /100 mL	≤380[a] ≤160[b]	≤400[a] ≤200[b]	≤400[a] ≤200[b]

Note:
* greater than guideline(s)
n/g no guideline
[b] short-term chronic guideline
- no information
[a] long-term chronic guideline

With respect to *E. coli*, the Canadian Recreational Staq̓w (water) Quality Guideline (2012) and the BC Recreational Staq̓w (water) Quality Guidelines (2019), both recommend beach staq̓w (water) is monitored for the presence of *E. coli* using two limits: a geometric mean of ≤ 200 *E. coli*/100 mL based on the previous five samples and a single sample limit of ≤ 400 *E. coli*/100 mL.

Woodfibre LNG will use these parameters; however, as this is an industrial site, recreational exposure is not expected as recreational activities will not be permitted in the CPA.

8.2.5 Existing Permit Monitoring

Woodfibre LNG's existing discharge permits (Leachate and Sewage permits 1239 and 2334, respectively) authorize discharge directly to the marine environment. ínexwantas (monitoring) and sampling of the authorized discharge will continue in accordance with the applicable permit conditions; however, the sampling programs are not included in the scope of the MWQMMP.

Where authorized effluent may influence the results of marine staq̓w (water) quality sampling required by this plan, context may be provided with ínexwantas (monitoring) reports.

8.2.6 Construction Staq̓w (water) Discharge

Construction staq̓w (water) will be managed to meet the requirements of a Waste Discharge Authorization that is currently under application review, and it is expected that construction effluent will be discharged from two sedimentation ponds, one located east of Mill Creek and other west of the creek.

8.2.7 Staq̓w (water) Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) and will be completed to support the collection of meaningful and credible data, integrity of sample collection, handling, analysis and data management. Quality procedures will follow the BC Field Sampling Manual – Part A Quality Control and Quality Assurance and procedures set out by industry standards for the collection and handling of staq̓w (water) samples and analysis by laboratories. Data quality objectives (DQOs) will be consistent with the BC Field Sampling Manual as well as holding times specific in BC Laboratory Manuals.

8.2.7.1 Field QA/QC

The Environmental Monitor will employ field measures to confirm quality assurance and quality control (QA/QC) when performing both sample collection for laboratory analyses and general fieldwork. Sampling will be completed by an Environmental Monitor with training in sampling techniques relevant to the staq̓w (water) quality ínexwantas (monitoring) program. The Environmental Monitor will be audited by the QEP as at frequency determined by the QEP.

Data records will be backed digitally and stored as per Information Management outlined in **Section 10**. Standardized field forms will be used to collect field data including environmental information that may inform interpretation of results.

To reduce the potential for cross-contamination of samples, the following quality assurance procedures will be used:

- New nitrile gloves were used for each sample collected.
- Sampling devices will be washed between sampling.
- Samples will placed in laboratory-supplied containers suitable for the analysis.
- Samples will labelled and stored in a chilled cooler while in the field and during transport to the laboratory.

To confirm the effectiveness of these measures field quality control (QC) samples will be used to assess sample variability and evaluate potential sources of contamination. Field QC samples will include field replicates, and equipment rinsate blanks. The following QC samples will be collected in the field and analyzed by the analytical laboratory.

Field Calibration - Meter(s) used to obtain field measurements will be calibrated daily before the start of work and checked against the calibration solutions at the end of the sampling day. Any instrument "drift" from prior calibration will be recorded in a field notebook. Calibration will be in accordance with procedures and schedules outlined in the particular instrument's operations and maintenance manual. If calibration fails, a second attempt will be made to calibrate the unit. If the second attempt fails, the unit will be replaced with a backup.

Field Replicate Samples - Blind field replicate samples will be collected and analyzed to assess the environmental, sample processing, and laboratory variability within a sampling location. Field replicates will be collected in the same manner as the original field sample and will be assigned a unique sample number so that the laboratory will not know it is a QC sample. Field replicates will be collected at the same stak̲w (water) depth and same location as the parent sample and at a minimum frequency of 1 per sampling day or 10 percent, rounded up, whichever is greater.

Equipment Blanks (or Field Blank) - Equipment blanks will be collected to help identify possible contamination from the sampling process or from the sampling equipment (e.g., Van Dorn sampler). One equipment blank will be generated for each sampling event. Equipment rinsate blanks will consist of running distilled/deionized stak̲w (water) through the sampling equipment after decontamination.

Travel Blanks – a travel blank will be shipped and follow the handling of sample bottles and remain unopened in the field. One travel blank will be generated for each sampling event. Travel blanks will consist of lab supplied distilled/deionized stak̲w (water).

Samples will be submitted for analyses under chain of custody documentation. A duplicate will be collected for every ten samples and travel and field blanks submitted with sampling events. The data quality objectives for duplicate samples include:

- Satisfactory laboratory QA/QC results of duplicate sample, sample blank, and spike analyses
- Relative Percent Difference (RPD) values less than 20% in stak̲w (water).

Sample equipment must be in good working order within manufacturers recommended maintenance and calibrated schedule.

8.2.7.2 Laboratory QA/QC

Samples will be analyzed by a laboratory certified by the Canadian Association for Laboratory Accreditation Inc. Methods employed for analysis of stak̲w (water) will be recommended methods by the BC ENV and other regulatory agencies including the US Environmental Protection Agency. In addition to field QC samples, the laboratory will initiate their own QA/QC measures. The laboratory QA/QC measures include method blanks, duplicate analysis, and spike and matrix spike recoveries, which will be reviewed in addition to the laboratories quality assurance and quality control calculations. The laboratory RPD values will be within acceptable limits, or less than five times the detection limits. The sample blank and spike analyses will also be within the acceptable limits.

8.3 Sediment Sampling

8.3.1 Sediment Sampling for Compliance and Verification ínexwantas (Monitoring) during Construction and Post Construction

As part of compliance and verification monitoring, sediment sampling will be completed within two years of the start of construction in the marine environment (i.e., during Construction). Sampling will take place within the CPA (i.e., eight stations) and outside the CPA (i.e., two stations).

Sediment quality parameters analyzed for compliance and verification ínexwantas (monitoring) during construction and post-construction will be consistent with baseline sediment quality analysis parameters (Golder Associates, 2014), summarized in **Section 6.2**.

If the sediment sampling conducted during in-stak̲w (water) marine construction indicates a potential for human health risk, then additional sediment sampling will be conducted immediately on the completion of marine in-stak̲w (water) construction activities.

Post-construction (e.g., within one year after the Construction phase is complete) sampling of sediments in the work area and background areas will be conducted to determine sediment quality, and whether the post-construction conditions are comparable to baseline, show signs of recovery, or require corrective action.

In accordance with the requirements of 6.4 of the FDS, the CCME Interim Sediment Quality Guidelines for the Protection of Aquatic Life (ISQG) will be used for sediment sampling. For the waterlot CofC, the BC CSR Schedule 3.4 sediment standards for typical site use were applied, with the areas in front of Mill Creek and Woodfibre Creek evaluated for sensitive site use. Arsenic, cadmium, dioxins and furans were not found at the Site at concentrations exceeding CSR sediment standards; however, as they are included in FDS Condition 6.4, they are carried forward for sediment sampling.

Table 8-7 provides the applicable CCME ISQG and parameters.

Table 8-7 Summary of Potential Sediment Impact Parameters (CCME ISQG Marine)

Contaminant	Sediment Standards	Reference
naphthalene	0.0346 µg/g	CCME ISQG
2-methylnaphthalene	0.0202 µg/g	CCME ISQG
acenaphthene	0.00671 µg/g	CCME ISQG
acenaphthylene	0.00587 µg/g	CCME ISQG
fluorene	0.0212 µg/g	CCME ISQG
phenanthrene	0.0867 µg/g	CCME ISQG
anthracene	0.0469 µg/g	CCME ISQG
fluoranthene	0.113 µg/g	CCME ISQG
pyrene	0.153 µg/g	CCME ISQG
benz(a)anthracene	0.0748 µg/g	CCME ISQG
chrysene	0.108 µg/g	CCME ISQG
benzo(a)pyrene	0.0888 µg/g	CCME ISQG
dibenz(a,h)anthracene	6.22 µg/g	CCME ISQG
arsenic	7.240 µg/g	CCME ISQG
cadmium	0.700 µg/g	CCME ISQG
copper	18.7 µg/g	CCME ISQG
lead	30.2 µg/g	CCME ISQG
mercury	0.130 µg/g	CCME ISQG
zinc	124 µg/g	CCME ISQG
tributyltin	0.0073 µg/g	Puget Sound Dredge Disposal Analysis (PSDDA)
dioxins and furans	0.85 ng TEQ/kg	CCME ISQG
Total PCBs	0.0215 µg/g	CCME ISQG

Results of the sediment sampling will also be compared to the 95 upper confidence limit of the means (95 UCLM) of the historical sediment data, to determine if parameter concentrations have increased. If the results of sediment sampling during construction do not exceed 95 UCLM of the historical data, the HHRA will not be updated. Additionally, where sediment sampling identifies elevated risk for PCB resuspension, additional adaptive ínexwantas (monitoring) will include total PCB as an analytical parameter for turbidity correlation establishment.

8.3.2 Sediment Sampling for Dredging

Where dredging is required as part of the shoreline protection activity, sampling will be conducted prior to dredging by the Environmental Monitor within 100 m of the dredge cut to determine background



concentrations of contaminants of concern. A Qualified Professional will prepare a sampling plan that includes evenly-spaced surface samples distribution every 20 m, which is approximated from ECCC (2018)[6] guidance as shown in **Figure 8-2**.

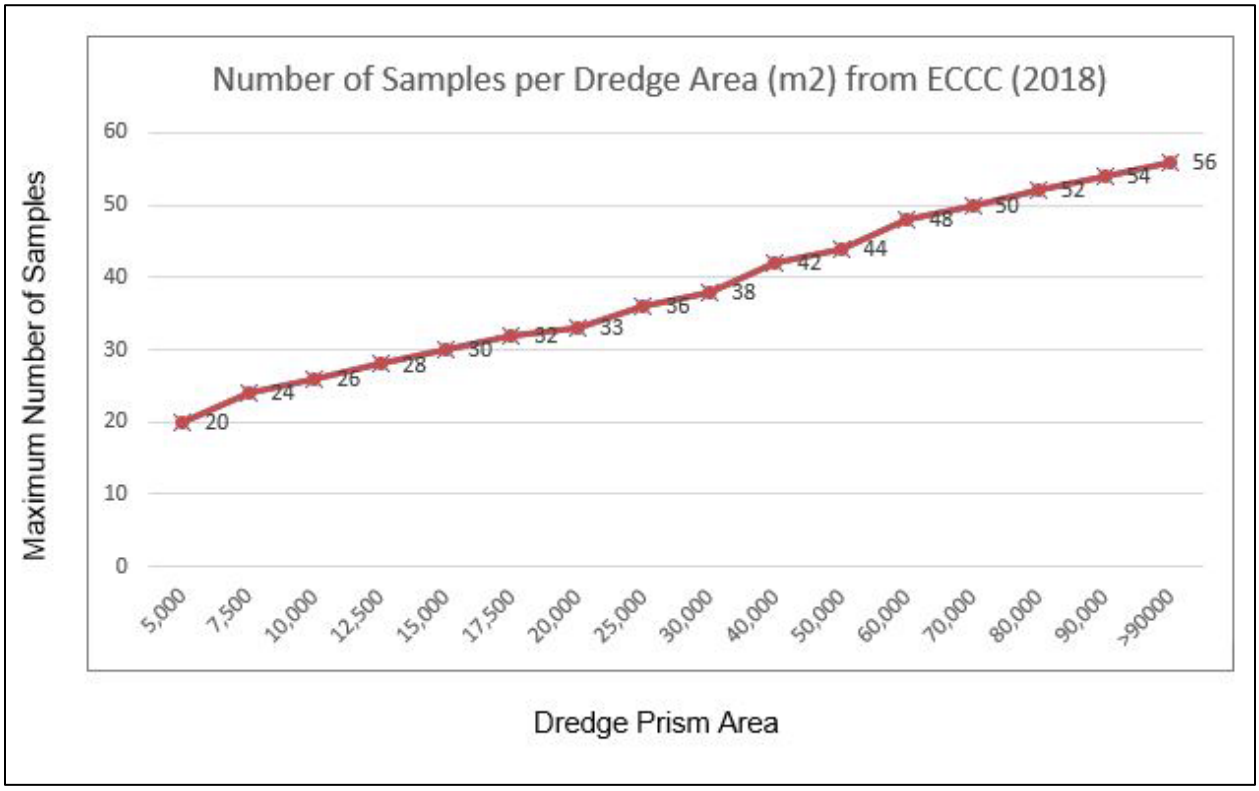


Figure 8-2 Number of Samples per Area (ECCC 2018)

During dredging, contractors will be responsible for maintaining environmental control systems such as silt curtains for compliance with permit conditions and stak̓w (water) quality requirements. They will remove debris from the seabed, perform sediment removal using mechanical dredging techniques, dewater the dredged sediment, and transport it along with woodchips and debris to the onshore offloading area. Surveys will be conducted during dredging, and offloading will take place at the designated area.

For temíxw (land)-based activities, contractors will be responsible for environmental control systems such as erosion and sediment control measures. They will construct a containment area, manage dewatering, and handle the hauling, placement, stockpiling, or offsite disposal of sediments, woodchips, and debris.

[6] Environment and Climate Change Canada (ECCC). 2018. Disposal at Sea Technical Guidance: Chemical Characterization of Dredged Material Proposed for Disposal at Sea [BETA]. Environment and Climate Change Canada.

If offsite disposal options are proposed, soil quality data must be compared to applicable standards, and confirmation is needed from receiving facilities that the transported soil meets their acceptance criteria.

In the event of a stak̲w (water) quality exceedance or upon completion of the dredge works, the inner-most sampling station(s) will be re-tested to identify if additional exceedances were created. If observed, 10 m step-out sampling will be conducted to identify the extent of the exceedances. A qualified professional will be retained to identify a remediation strategy, and the contractor will be responsible for re-instating those areas to their pre-dredge condition.

8.3.3 Sediment Sampling Methods

The surface grab (i.e., 10-15 cm depth) may be deployed from a boat and retrieved by hand or with a boat-mounted winch. Upon retrieval, the grab contents will be carefully emptied into a stainless steel pan using a fresh pair of nitrile gloves at each sampling location. The representative sample matrix will be homogenized, photographed, and contained in jars provided by an accredited analytical laboratory and labelled with project information. Care will be taken not to touch the inside of the jars or lids to prevent potential contamination while inserting sediment. A stainless steel spoon cleaned after each sample may be used to transfer sediment into the jars. The geographic coordinates, collection date, method of collection, approximate substrate depth, and general observations such as colour, odour, biological features, and anthropogenic debris will be recorded for each location. The samples will be kept cool (i.e., on ice and in a cooler) following collection and during transport.

8.3.4 Sediment Sample Analytical Testing

The samples will be submitted with a completed chain of custody record to an accredited laboratory for regular turn-around-time and analysis. At a minimum, the following parameters will be tested (additional parameters may be added if required by a qualified professional):

- total metals with pH (full scan) including arsenic, cadmium, copper, lead and zinc;
- methylmercury
- tributyltin
- AVS/SEM
- dioxins and furans
- total PCBs;
- total PAHs;
- TOC,
- BTEX,
- moisture;
- grain size distribution (% gravel, sand, silt and clay).

Analytical data will be tabulated and compared to CCME, BC ENV Interim Sediment Quality Guidelines and Probable Effect Levels and other applicable guidelines or criteria. **Table 8-8** summarizes the sediment quality 80% threshold to assess if further actions will be required.

Table 8-8 Summary of Sediment Quality Threshold

Parameter	Units	80% Threshold	*ISQG Marine*	*PEL*	*CSR Sed$_T$*
Metals*					
arsenic	mg/kg	5.79	*7.24*	*41.6*	*50*
cadmium	mg/kg	0.6	*0.7*	*4.2*	*5.0*
copper	mg/kg	15.0	*18.7*	*108*	*130*
zinc	mg/kg	99	*124*	*271*	*330*
tributyltin	mg/kg	0.0058	0.0073 *Puget Sound Dredge Disposal Analysis (PSDDA)*		
PAH*					
Acenaphthene	mg/kg	0.00537	*0.00671*	*0.0889*	*0.11*
Acenaphthylene	mg/kg	0.00470	*0.00587*	*0.128*	*0.15*
Anthracene	mg/kg	0.0375	*0.0469*	*0.245*	*0.29*
Benz(a)anthracene	mg/kg	0.0560	*0.0748*	*0.693*	*0.83*
Benzo(a)pyrene	mg/kg	0.0710	*0.0888*	*0.763*	*0.92*
Chrysene	mg/kg	0.086	*0.108*	*0.846*	*1.0*
Dibenz(a,h)anthracene	mg/kg	0.00497	*0.00622*	*0.135*	*0.16*
Fluoranthene	mg/kg	0.090	*0.113*	*1.494*	*1.8*
Fluorene	mg/kg	0.0170	*0.0212*	*0.144*	*0.17*
2-Methylnaphthalene	mg/kg	0.0162	*0.0202*	*0.201*	*0.24*
Naphthalene	mg/kg	0.0277	*0.0346*	*0.391*	*0.47*
Phenanthrene	mg/kg	0.0694	*0.0867*	*0.544*	*0.65*
Pyrene	mg/kg	0.122	*0.153*	*1.398*	*1.7*
PCB*					
Total PCB	mg/kg	0.0172	*0.0215*	*0.189*	---
Dixon & Furans TEQ					
PCDF/F TEQ	pg/g	0.68	*0.85*	*21.5*	*260*

*Only showing constituents with guidelines and/or regulations
ISQG – CCME & BC ENV Interim Sediment Quality Guidelines
PEL – CCME & BC ENV Probable Effect Level guidelines
CSR Sed – BC Contaminated Sites Regulation for sediments
TEQ – Toxic equivalency

8.3.5 Sediment Sampling Quality Assurance and Quality Control

Consistent with procedures outlined for stak̲w (water) quality, QA/QC procedures for sediment sampling will follow the BC Field Sampling Manual. Split sediment samples will be developed for at least 1 or 10 % of samples collected (whichever is greater). Split samples are sub-samples from one large sample which has been homogenized and divided into two or more sub samples.

8.4 Tissue Sampling

Previous results of HHRA studies did not identify high risks to humans consuming Sts'úkwi7 (fish) and shellfish within the Woodfibre waterlot (**Section 6.3, 6.4, 6.5, 6.6**).

Based on the findings of the baseline HHRA and consistent with the FDS condition 6.5.2 and 6.5.3, follow-up tissue sampling will be undertaken;

- Within two years of the start of Construction in the marine environment (i.e., during Construction), and
- If the tissue sampling conducted during in-stak̲w (water) marine construction indicates a potential for human health risk, a Qualified Professional would develop a sampling program with a minimum of three years (i.e., years 1, 3 and 5 post-construction).

The purpose of the sampling will be to confirm assessment predictions regarding the re-suspension and bioavailability of PAHs, dioxins, furans, arsenic, cadmium, copper, lead, zinc, TBT, arsenic, cadmium and methylmercury in the tissue of shellfish (Aẏx (Dungeness crab), *Metacarinus magister*) and groundfish (English Lhémk̲w'a (sole), *Parophys vetulus*)

Tissue samples will be collected in the same manner for the same species (i.e., Aẏx (Dungeness crab) and English Lhémk̲w'a (sole)) as those collected previously, including the general study design, sample size (up to 15 samples), analyte list, and QA/QC sampling. It should be noted that previous sampling programs composited samples due to small tissue amounts of individuals.

Sample locations will be consistent with the previous sampling programs, including sample collection from within the waterlot at the Woodfibre Site, near-field background area located 2.5 km to the northeast and southwest of the Site, and far-field background area located 10 km south of the Site. **Table 8-9** summarizes the Sts'úkwi7 (fish) and crab sampling program.

Results of the tissue sampling during construction will also be compared to the 95 upper confidence limit of the means (95 UCLM) of the historical data, to determine if parameter concentrations have increased. If the results of tissue sampling during construction do not exceed 95 UCLM of the historical data, the HHRA will not be updated.

Table 8-9 Summary of Sts'úkwi7 (fish) and Crab Tissue Sampling Program

Sample Locations	Sample Species	Sample Size	Parameters
5 in total	Sts'úkwi7 (fish) (English Lhémq̓w'a (sole), *Parophys vetulus*) Crab (Aẏx (Dungeness crab), *Metacarinus magister*) Crab Hepatopancreas	Minimum of 15 at each sampling location	Arsenic, cadmium, copper, lead, zinc Methylmercury Tributyltin PAH Dioxins & Furans

8.4.1 Tissue Sampling Quality Assurance and Quality Control

Consistent with procedures outlined for staq̓w (water) quality, QA/QC procedures for tissue sampling will follow the BC Field Sampling Manual. Split samples will be developed for at least 1 or 10 % of samples collected. Split samples are sub-samples from one large sample which has been homogenized and divided into two or more sub samples.

8.5 Adaptive Management

Marine staq̓w (water) quality management and ínexwantas (monitoring) will be implemented following an adaptive management approach, as per condition 6 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 MWQMMP is considered to be a living document and may be revised, as needed based on results of the ínexwantas (monitoring) program.

Further, consistent with EAC condition 6, this plan supports the management of outcomes during the Project Construction phase for marine staq̓w (water) quality for where effects are not mitigated to the extent anticipated by the environmental assessment review, and/or for effects not previously predicted. This is achieved by activity specific mitigation and monitoring, routing ínexwantas (monitoring) that is not task/activity specific and through evaluation of ínexwantas (monitoring) results documented in monthly and annual reports. The adaptive management process of will use the process of creating management and ínexwantas (monitoring) mitigations, ínexwantas (monitoring) for effectiveness, reviewing for improvements, adjusting mitigation and management measures.

When updates to this Plan are required as a result of adaptive management measures, Woodfibre LNG will prepare a red-line version of the document that identifies what triggered the need for improvement (i.e., which target, threshold, or site objective was not met) and the changes that were made to address a concern. The red-line version will be issued to Indigenous groups and regulatory agencies for a 30-day review and comment period. After comments are received, the document will be updated and issued as the next revision.

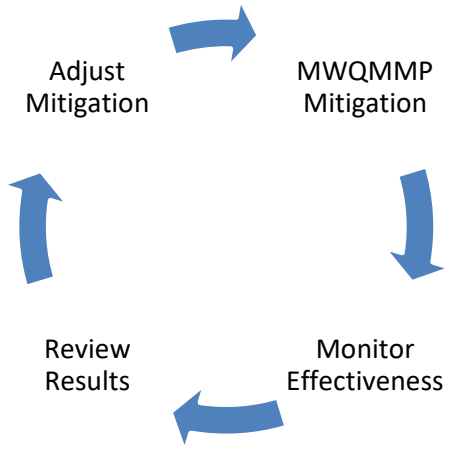


Figure 8-3 MWQMMP Adaptive Management Cycle

If stak̲w (water) quality mitigation or ínexwantas (monitoring) measures are not effective in preventing adverse environmental effects, the Environmental Monitor will work with the Contractor and the Environmental Representative (or designate) to implement additional or alternative mitigation measures. The determination of effectiveness will be made by the Environmental Monitor based on visual observations, documented inspections and supported by the results of ínexwantas (monitoring) data (e.g., in-situ or analytical stak̲w (water) quality data). In the case an unpredicted effect is observed, the Woodfibre LNG Environmental Representative, Environmental Monitor and Contractor will work together to develop a mitigation and subject it to the adaptive management cycle.

9. REPORTING AND COMMUNICATIONS

9.1 Routine ínexwantas (Monitoring) Reporting and Communication

The weekly and monthly environmental ínexwantas (monitoring) reports will be prepared by the Environmental Monitor and reviewed by a QEP to summarize construction activities and progress, in-situ marine stak̲w (water) quality data, photographs of site conditions, the effectiveness of avoidance or mitigation measures implemented during works, environmental concerns relevant marine stak̲w (water) quality, recommendations for adaptive management and other relevant environmental data (e.g., weather conditions).

An annual ínexwantas (monitoring) report will be prepared by the Environmental Monitor and reviewed by the appropriate discipline-specific QEP summarizing the Marine Stak̲w (water) Quality ínexwantas (monitoring) program and reports for the year. Annual reports will be shared with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation for review and input.

9.2 Non-Routine ínexwantas (Monitoring) Reporting and Communication (Exceedances)

Consistent with EAC Condition 6 and FDS 6.4, any exceedance of the following guidelines are to be communicated to the Woodfibre LNG Environmental Representative, relevant government agencies and Aboriginal Groups (as defined in the FDS section 1.1);

- CCME ISQG for the Protection of Aquatic Life;
- CCME WQG for the Protection of Aquatic Life; and
- BC WQG.

While exceedances for BC WQG are only required to be reported to relevant government agencies, for consistency and transparency they will be communicated consistent with CCME guidelines. Given jurisdiction in the marine environment and differing purposes, exceedances will be reported as outlined below:

- Exceedances of recreational stak̲w (water) quality guidelines – VCH and MOH
- Exceedances of all other WQ guidelines – ECCC and BC Ministry of Environment and Climate Change Strategy
- Exceedances of any WQ guidelines – Aboriginal Groups

Any exceedances of these guidelines will be reported to the Woodfibre LNG Environmental Representative within 24 hours, once known, and included in weekly and monthly reporting. It is noted both baseline stak̲w (water) quality and sediment quality exceed stak̲w (water) quality and sediment quality guidelines. As such the report will include, where appropriate, results of background or baseline sampling for context and additional mitigation measures to remedy the exceedance, if required.

9.3 Environmental Incident Reports

The Contractor will be responsible for reporting environmental incidents that adversely influence staq̓w (water) quality, including spills or release of deleterious substances. The Contractor shall immediately notify the Environmental Monitor when safe to do so following any environmental incident. The Environmental Monitor will notify the QEP, and the Contractor will notify the Woodfibre LNG Environmental Representative. Woodfibre LNG will determine if external reporting is required and will be responsible for external reporting.

10. 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:

Telephone: 1-888-801-7929
E-mail: info@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 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 stak̲w (water) quality guideline exceedances, if any.

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12. PROFESSIONAL STATEMENT AND LIMITATIONS

Keystone Environmental Ltd. confirms that this report titled *Marine Staq̓w (water) Quality Management and ínexwantas (Monitoring) Plan - Construction*, 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.

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 temíxw (landsm). 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.

This report has been reviewed and updated since the previous revision by Varsha Rani, Kevin Hall, Thuy Wong, Jenna Tracey, Duncan Clark and Warren Appleton. Warren Appleton is the professional of record.

July 17, 2023
Date

_____

Warren Appleton, R.P.Bio.
Senior Biologist

Appendix E Marine Fish and Fish Habitat Management and Monitoring Plan

August 15, 2023

Woodfibre Natural Gas Ltd.
580 Hornby Street
K'emk'emeláy (Vancouver) BC V6C 3B6
Via Email: scott_wagner@wlng.ca

Attn: Scott Wagner, P. Biol, Permitting Manager

Re: Marine Fish and Fish Habitat Management and ínexwantas (Monitoring) Plan
Woodfibre LNG, Skwxwú7mesh (Squamish), BC
Project No. 17953-109

We have enclosed the Marine Fish and Fish Habitat Management and ínexwantas (Monitoring) Plan for the construction of the Woodfibre LNG Project. We trust this report meets your requirements and thank Woodfibre LNG for the opportunity to work on this exciting Project.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Keystone Environmental Ltd.

Duncan Clark, RP. Bio
Senior Biologist

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encl.



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

August 2023

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TABLE OF CONTENTS

Page

1. BACKGROUND 1
   - 1.1 Purpose 1
   - 1.2 Objective 2
   - 1.3 Scope 3
   - 1.4 Project Description and Activities 4
     - 1.4.1 Project Location 4
     - 1.4.2 Site History 6
     - 1.4.3 Project Overview 7
2. CONSULTATION AND PLAN DEVELOPMENT 8
     - 2.1.1 Tsleil-Waututh Nation Summary 9
     - 2.1.2 Squamish Nation Summary 9
     - 2.1.3 Musqueam Indian Band 10
     - 2.1.4 Additional Indigenous Groups 10
   - 2.2 Best Management Practices and Standards 10
   - 2.3 Management of Change 10
3. PRIMARY INFRASTRUCTURE 12
   - 3.1 Marine FST Terminal 15
     - 3.1.1 Substructure Installation Support Piles 15
     - 3.1.2 FST Transfer Platform Module M05 15
     - 3.1.3 FST Permanent Mooring Structures 16
     - 3.1.4 Piping Trestle Module M07 and Roadway Trestle Module M14 17
     - 3.1.5 Floating Storage Tanks (FSTs) 18
   - 3.2 Material Offloading Facility (MOF) 18
   - 3.3 Offloading Platform 19
   - 3.4 Temporary Floating Worker Accommodations (Floatel) 20
   - 3.5 Shoreline Repair 21
   - 3.6 Ro-Ro Ramp Dock & Dolphin Refurbishments (Existing Industrial Infrastructure) 24
   - 3.7 Bridges Over Mill Creek 24

TABLE OF CONTENTS (CONT'D)

Page

3.8 Culvert Outfalls ... 25
3.9 Timeline ... 25
4. REGULATORY FRAMEWORK ... 28
4.1 Environmental Assessment Conditions and Commitments ... 28
4.2 Legislative Requirements and Criteria ... 41
4.3 Best Management Practices and Standards ... 42
5. ROLES AND RESPONSIBILITIES ... 44
6. BASELINE ENVIRONMENTAL CONDITIONS ... 45
6.1 Ecological Setting ... 48
6.2 Marine Existing Conditions ... 48
6.2.1 Marine Intertidal Conditions ... 50
6.2.2 Marine Subtidal Conditions ... 59
6.2.3 Sediment Existing Conditions ... 73
6.3 Fish and Fish Habitat ... 73
6.3.1 2020 Marine Fish Surveys ... 78
6.3.1.1 Beach Seine ... 78
6.3.2 2021 Marine Fisheries Data ... 81
6.3.2.1 Beach Seine ... 81
6.3.2.2 Purse Seine ... 84
6.3.3 2022 Marine Fisheries Data ... 85
6.3.3.1 Beach Seine ... 85
6.3.3.2 Purse Seine ... 92
6.4 Marine Invasive Species ... 97
6.5 Species at Risk ... 99
7. EFFECTS SUMMARY AND MITIGATION MEASURES ... 103
7.1 Avoidance Measures ... 105
7.1.1 Site Selection ... 105
7.1.2 Design Measures ... 105

TABLE OF CONTENTS (CONT'D)

Page

7.1.3 Construction Phase 106
7.1.4 Operation Phase 107
7.2 General Mitigation Measures 107
7.2.1 Tree and Vegetation Protection 107
7.2.2 Erosion and Sediment Control 108
7.2.3 Invasive Species Management 108
7.2.4 Water Quality and Turbidity 109
7.2.5 Spills from Industrial Equipment 110
7.2.6 Site Stabilization and Restoration 111
7.2.7 Environmental Monitoring 112
7.3 General Marine Works Management and Timing Windows 112
7.3.1 Marine Work Timing Windows 114
7.3.2 Construction Scheduling 114
7.3.3 Pacific Herring Protection Measures 115
7.3.4 Juvenile Salmonid Protection Measures 115
7.3.5 Fish Protection Measures 116
7.4 Marine Shading and Lighting 116
7.5 Underwater Noise 118
7.6 Fish Exclusion and Fish Salvage 121
7.7 Concrete Works 122
7.8 Pile Driving 123
7.9 Creosote Pile Removal 123
7.10 Ballast Water Management – Marine Construction Vessel, Construction and Operations 124
7.11 Seabed Disturbance and Placement of Materials 125
7.12 Upland Mitigations 126
7.12.1 Erosion Prevention and Sediment Control 126
7.12.2 Stormwater Management 126
7.12.3 Waste Management Plan 127

TABLE OF CONTENTS (CONT'D)

Page

7.13 Verification Monitoring Overview 127
7.13.1 Juvenile Fish and Salmonid Presence and Migration 129
7.13.1.1 Monitoring Locations 130
7.13.1.2 Visual Assessment 131
7.13.1.3 Beach and Purse Seining 131
7.13.2 Herring Spawn and Lingcod Egg Mass Monitoring 132
7.13.3 Aquatic Invasive Species 133
7.13.4 Environmental Monitoring to Verify Mitigation Measures 137
7.13.4.1 FDS Condition 3.1 – Timing Windows 137
7.13.4.2 FDS Condition 3.2 – Marine Water Quality 137
7.13.4.3 FDS Condition 3.3 – Harmful Alteration, Disruption, or Destruction of Fish and Fish Habitat 137
8. HABITAT OFFSETTING PLAN 138
8.1 Habitat Offsetting Requirements 138
8.2 Offsetting Approach 140
8.2.1 Sediment Restoration 140
8.2.2 Cobble Blanket 140
8.2.3 Rock Reefs 141
8.2.4 Riparian Areas 141
8.3 Complementary Measures 141
8.3.1 Site Remediation and Clean-up 141
8.3.2 The Green Zone 142
8.4 Location 143
8.5 Marine Offsetting 143
8.5.1 Offsetting Concept A – Deep Rock Reefs and Fish Habitat Enhancement 143
8.5.2 Cobble Blanket 148
8.5.3 Shallow Rock Reefs 148
8.5.4 Sand Blanket 148

TABLE OF CONTENTS (CONT'D)

Page

8.5.5 Deep Rock Reefs 151
8.5.6 Materials and Methods for Offsetting Construction 151
8.6 Riparian Offsetting 151
8.6.1 Site Preparation 153
8.6.1.1 Clearing and Grubbing 153
8.6.1.2 Removal of Non-Native Species 154
8.6.1.3 Japanese Knotweed 154
8.6.1.4 Himalayan Blackberry 155
8.6.1.5 Soil Remediation and Regrading 156
8.6.2 General Planting Requirements 156
8.6.3 Habitat Features 157
8.7 Offsetting Construction Schedule 157
8.8 Cost Estimate 158
8.9 Existing Conditions in Habitat Offsetting Areas 159
8.9.1 Marine Habitat Offsetting Reference Areas 160
8.10 Potential Effects of Offsetting Habitats 161
8.10.1 Migratory Birds and Their Habitats 161
8.10.2 Terrestrial Species, including Amphibians and Reptiles, and Their Habitats 161
8.10.3 Listed Species at Risk and Their Habitats 161
8.10.4 Current Use of Lands and Resources for Traditional Purposes by Indigenous Peoples 162
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 162
8.10.6 Physical and Cultural Heritage and Structure, Site or Thing that is of Historical, Archaeological, Paleontological or Architectural Significance to Indigenous Peoples 162
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 163

TABLE OF CONTENTS (CONT'D)

Page

9. HABITAT OFFSETTING EFFECTIVENESS PERFORMANCE OBJECTIVES, MONITORING, AND ADAPTIVE MANAGEMENT PLAN 164
- 9.1 Performance Objectives 164
- 9.2 Riparian Offsetting 165
  - 9.2.1 Criteria 165
  - 9.2.2 Methods 173
- 9.3 Cobble Blanket 173
  - 9.3.1 Criteria 173
    - 9.3.1.1 Primary metrics: 174
    - 9.3.1.2 Secondary metrics: 174
  - 9.3.2 Methods 174
    - 9.3.2.1 General Requirements for All Surveys 174
    - 9.3.2.2 Dive Surveys 175
    - 9.3.2.3 Herring Specific Dive Surveys 176
    - 9.3.2.4 Drop Camera Surveys 177
    - 9.3.2.5 Underwater Video Continuous Surveys 177
    - 9.3.2.6 Seining 177
  - 9.3.3 Reporting Requirements 178
- 9.4 Shallow Rock Reef 178
  - 9.4.1 Criteria 178
    - 9.4.1.1 Primary metrics: 178
    - 9.4.1.2 Secondary Metrics 179
  - 9.4.2 Methods 179
    - 9.4.2.1 General Requirements for All Surveys 179
    - 9.4.2.2 Dive Surveys 179
    - 9.4.2.3 Herring Specific Dive Surveys 181
    - 9.4.2.4 Drop Camera Surveys 181
    - 9.4.2.5 Underwater Video Continuous Surveys 181

TABLE OF CONTENTS (CONT'D)

Page

9.4.2.6 Seining ... 182
9.4.3 Reporting Requirements ... 182
9.5 Sediment Restoration ... 183
9.5.1 Criteria ... 183
9.5.1.1 Primary metrics: ... 184
9.5.1.2 Secondary metrics: ... 184
9.5.2 Methods ... 184
9.5.2.1 General Requirements for All Surveys ... 184
9.5.2.2 Divers ... 185
9.5.2.3 Sediment Grabs and Cores ... 186
9.5.3 Reporting Requirement ... 186
9.6 Deep Reef Mounds and Reefs ... 187
9.6.1 Criteria ... 187
9.6.1.1 Primary metrics: ... 187
9.6.1.2 Secondary metrics: ... 187
9.6.2 Methods ... 187
9.6.2.1 General Requirements for All Surveys ... 187
9.6.2.2 Dive Surveys ... 188
9.6.2.3 Drop Camera Surveys ... 189
9.6.2.4 Underwater Video Continuous Surveys ... 189
9.6.2.5 Seining ... 190
9.6.3 Reporting Requirements ... 190
9.7 Adaptive Management Plan and Contingency Measures ... 191
9.7.1 Juvenile Salmon Migration ... 192
9.7.2 Herring Spawning ... 192
9.7.3 Shoreline Alterations within Project Footprint ... 192
9.7.4 Habitat Offsetting ... 192
9.7.5 Habitat Offsetting Metrics Effectiveness Monitoring ... 196

TABLE OF CONTENTS (CONT'D)

Page

9.7.6 Confirmation of Shoreline Protection Effects 196
10. REPORTING AND COMMUNICATIONS 197
10.1 Routine Reporting 197
10.2 Non-Routine Reporting 197
10.3 Environmental Incident Reports 198
11. INFORMATION MANAGEMENT 199
12. PROFESSIONAL STATEMENT 200
13. REFERENCES 201

LIST OF IN-TEXT FIGURES

Page

Figure 1-1 Location Plan 5
Figure 3-1 Project Overview 14
Figure 6-1 Marine Fish Survey Locations for 2020-2023 46
Figure 6-2 Water Quality Sampling Locations 47
Figure 6-3A Habitat Substrate – South 67
Figure 6-3B Habitat Substrate – Central 68
Figure 6-3C Habitat Substrate – North 69
Figure 6-4A Marine Vegetation and Fish – South 70
Figure 6-4B Marine Vegetation and Fish – Central 71
Figure 6-4C Marine Vegetation and Fish – North 72
Figure 7-1 Summary of Marine Timing Windows 114
Figure 7-2 Aquatic Invasive Species Sampling Stations in, and adjacent to, the CPA 135
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) 136
Figure 8-1 Habitat Offsetting Overview 144
Figure 8-2A Habitat Offsetting Southwest of Mill Creek 145
Figure 8-2B Habitat Offsetting Concepts A and B 146
Figure 8-3A Habitat Offsetting (Northeast of Mill Creek) 147
Figure 8-3B Habitat Offsetting Cross Section C and D 149
Figure 8-3C Habitat Offsetting Cross Section E and F 150
Figure 8-4 Riparian Offsetting 152

LIST OF IN-TEXT FIGURES (CONT'D)

Page

Figure 8-5 Potential offsetting reference site locations considered. 160
Figure 9-1 Continency Riparian Offsetting 194
Figure 9-2 Potential Contingency Offsetting Location 195

LIST OF IN-TEXT TABLES

Page

Table 2-1 Qualified Professionals 8
Table 2-2 Indigenous Groups, Government, Public and Other Parties Engaged 8
Table 2-3 Examples of Best Management Practices Reviewed 10
Table 2-4 Report Version History 11
Table 3-1 List of Project Components, Area, and Location 12
Table 3-2 Shoreline Works – Excavation Volumes Below HHWL 22
Table 3-3 Anticipated Schedule of Marine Construction Activities 26
Table 4-1 Conditions for Marine Fish and Fish Habitat Management and Monitoring Plan 28
Table 4-2 Proposed Mitigation Measures (Woodfibre LNG Application for an Environmental Assessment Certificate) 33
Table 4-3 Regulatory Framework for the Marine Fish and Fish Habitat Management and Monitoring Plan 41
Table 4-4 Regulatory Framework for MFFHMMP Best Management Practices 42
Table 6-1 Average Annual Precipitation and Temperature from Environment Canada's Squamish STP Central Station (1981–2010) 48
Table 6-2 Substrate Classification (Scale adapted from Wentworth 1922) 49
Table 6-3 Seine Sample Locations for 2020-2022 77
Table 6-4 Fish Presence May 2020 Summary 78
Table 6-5 Fish Presence September 2020 Summary 79
Table 6-6 Fish Presence April 2021 Summary 81
Table 6-7 Fish Presence July 2021 Summary 82
Table 6-8 Fish Presence May 2021 Summary 84
Table 6-9 Fish Presence July 2021 Summary 85
Table 6-10 Fish Presence March 3 and 4, 2022 Summary 86
Table 6-11 Fish Presence March 28, 29 and 31, 2022 Summary 87
Table 6-12 Fish Presence June 23 and 24, 2022 Summary 87
Table 6-13 Fish Presence July 18 and 19, 2022 Summary 88
Table 6-14 Fish Presence March 1 and 2, 2022 Summary 93
Table 6-15 Fish Presence March 30, 31 and April 1, 2022 Summary 93

LIST OF IN-TEXT TABLES (CONT'D)

Page

Table 6-16 Fish Presence from June 27 and 28, 2022 Summary....94
Table 6-17 Fish Presence from July 20 and 21, 2022 Summary....94
Table 6-18 Marine Invasive Species Listed by the IUCN as Having Occurrence Reports in BC (GISD, 2022)....98
Table 6-19 Aquatic Species at Risk that have the Potential to Use the Habitat or Surrounding Area (2 km) of the Project....101
Table 7-1 Summary of Proposed Mitigations from Environmental Assessment Sections 5.16 and 5.18....103
Table 7-2 Water Quality Criteria for Evaluating Project Works (BCENV, 2018a and 2018b)....110
Table 7-3 Summary of Proposed Verification Monitoring Programs for Marine Fish and Fish Habitat....128
Table 7-4 Verification Monitoring Locations....130
Table 7-5 Categorization of the Percent (%) Cover of AIS....137
Table 8-1 Summary of Proposed Marine Aquatic Offsetting....138
Table 8-2 Marine Aquatic Fish Habitat Summary Table....139
Table 8-3 Summary of Proposed Marine Riparian Offsetting....139
Table 8-4 Marine Riparian Fish Habitat Summary Balance Table....139
Table 8-5 Habitat Offsetting Measures Including Area, Habitat Types, and Location....143
Table 8-6 Proposed Riparian Planting from Figure 8-4....153
Table 8-7 Estimated Construction Schedule for Offsetting Areas....158
Table 8-8 Cost Estimate for Offsetting Construction at Woodfibre LNG....158
Table 9-1 Riparian Habitat Offsetting Metrics Summary Table....166
Table 9-2 Shallow Cobble Blanket Offsetting Metrics Summary Table....167
Table 9-3 Shallow Rock Reef Offsetting Summary Table....169
Table 9-4 Sand Blanket Summary Table....171
Table 9-5 Rock Mounds in Sand Blanket Area and Deep Rock Reef....172

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 Átlḵ'a7tsem (Howe Sound), approximately seven kilometres south of Skwxwú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Nexwnéwu7ts Átlḵ'a7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants. Woodfibre LNG Limited recognizes the importance of these areas to the Sḵwx̱wú7mesh stélmexw (Squamish People) and seeks to construct and operate the LNG facility and export terminal in a manner that is respectful of Sḵwx̱wú7mesh 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 K'íḵ'elxn (Port Mellon) is approximately 22 km southwest. K'emḵ'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 Sḵwx̱wú7mesh 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'úḵwi7 (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. The FAA includes a detailed Aquatic Effects Assessment and details supporting the subsequent offsetting commitments which are duplicated in this Plan for completeness. As the regulatory review process continues on the FAA, this Plan will be updated as necessary to ensure it captures the intent and commitments forthcoming as part of the pending Authorization. This Plan will ultimately guide the implementation of the FAA and compliance with the FDS 3.14 and EAC 8.

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.

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 Átlk̲'a7tsem) outside the CPA.

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

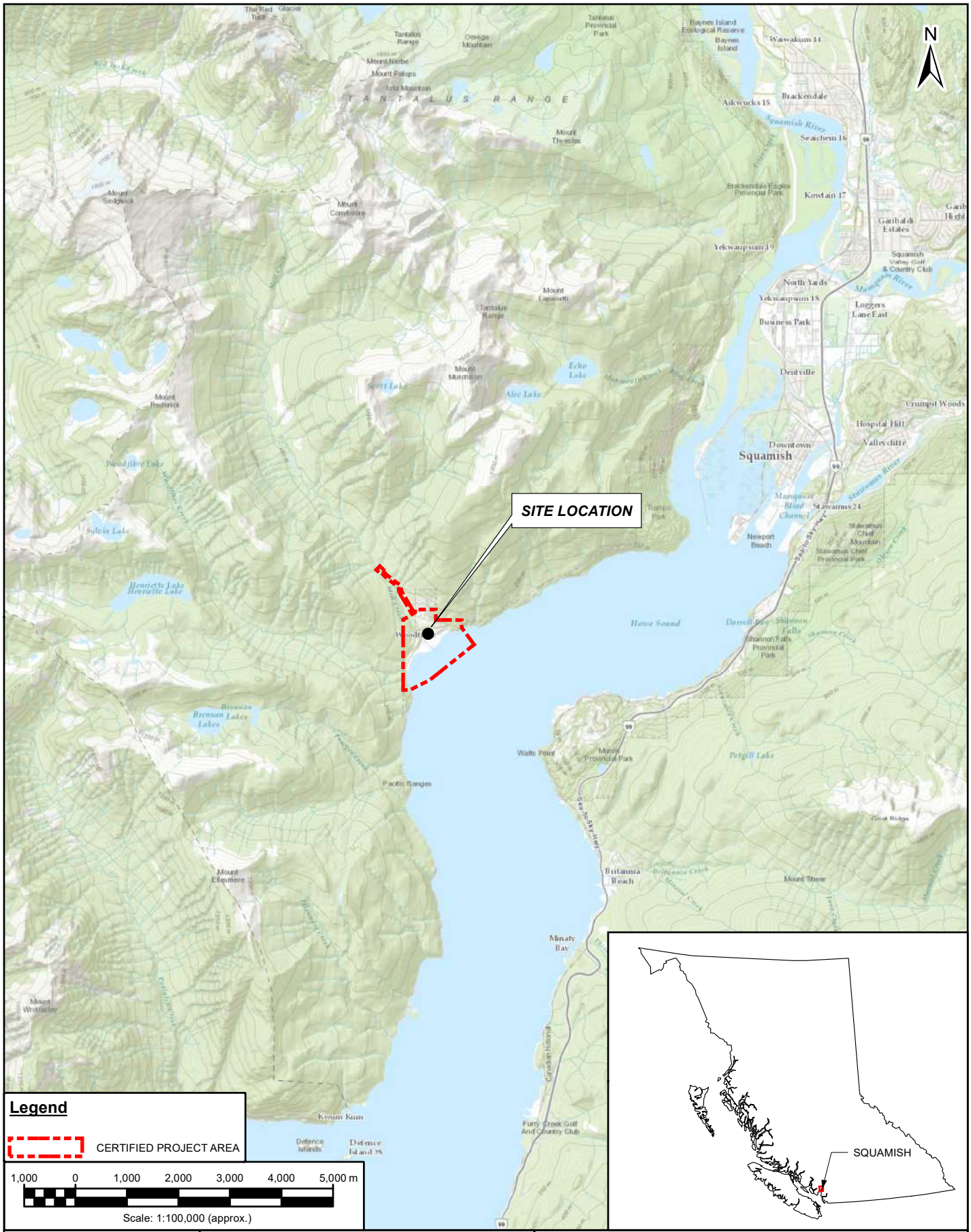
- Marine Mammal Management and Ínexwantas (monitoring) Plan (MMMMP) that describes measures to manage potential Project related effects on marine mammals during Construction and operations;
- Marine Water Quality Management and Ínexwantas (monitoring) Plan (MWQMMP) that describes measures and Ínexwantas (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.



Keystone Environmental

Woodfibre
Squamish, B C
Woodfibre LNG Limited

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

Figure 1-1
Location Plan

DRAWN BY: CS DOCUMENT PATH: I:\0-GIS\1-Projects\1-WLNG\GIS_CADD\17227\00100\2022_10Oct_07__DFO_FA_Authorization\Fig1-1-LocationPlan-R0.mxd

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.

1.4.2 Site History

The Site is historically a skwxwú7mesh 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	October 28, 2019	Meeting to discuss draft
Squamish Nation	October 29, 2019	Review comments on draft
Tsleil-Waututh Nation	December 19, 2019	Review comments on draft
Squamish Nation Working Group	January 20, 2020	Review offsetting plan
Fisheries and Oceans Canada (DFO)	November 3, 2020	Review of Project, fisheries studies and offsetting plan
Squamish Nation Working Group	February 25, 2022	Review of Project, fisheries studies and offsetting plan

Indigenous Group/ Agency/Party	Date	Action
Tsleil-Waututh Nation	August 2, 2022	*Fisheries Act* Authorization (FAA) provided for comment
Squamish 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.
Squamish Nation	August 25, 2022	On-going dialogue and discussion on offsetting plans and the FAA in general.
Squamish Nation	September 6, 2022	On-going dialogue and discussion on offsetting plans and the FAA in general.

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

Legacy engagement in 2019 with skwxwú7mesh Úxwumixw (Squamish Nation) on earlier versions of this plan identified concerns related to the lack of detail on marine activity project scope, habitat offsetting and associated Ínexwantas (monitoring), and lack of detail on follow-up programs. Since then, skwxwú7mesh Úxwumixw (Squamish Nation) and Woodfibre LNG have been engaged on the development of the Fisheries Act authorization scope of work, including offsetting and associated performance Ínexwantas (monitoring), including marine activity scoping Technical meetings with skwxwú7mesh Úxwumixw (Squamish Nation) commenced in early 2020, and a process has been established to continue collaboration through an Environmental Working Group. To reduce uncertainties related to cumulative project related effects, Woodfibre LNG has progressed engineering design and included all project components in the submission rather than presenting a phased approach as originally contemplated. While engineering refinements are anticipated in the future as the project continues to progress towards the September 2023 construction start date, Woodfibre LNG considers the approach of inclusivity for all major project components beneficial, as it better represents the broader project in its entirety and provides the scope and scale needed to improve the consideration of potential project related effects that support the mitigation and habitat offset commitments. Additional meetings have also occurred as indicated in **Table 2-2**, where improvements have been made to the habitat offsetting performance metrics in relation to two new reference locations, and a pilot Ínexwantas (monitoring) program is now contemplated to test various methods of Ínexwantas

(monitoring), validate the most effective measures, and better understand the natural range of variability at the habitat offsetting reference locations in terms of both quantitative and qualitative metrics.

Woodfibre LNG is committed to ongoing engagement and information sharing through the sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Environmental Working Group, in tandem with any Crown consultation through the FAA regulatory review period, and subsequent habitat offset implementation and performance Ínexwantas (monitoring).

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)
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

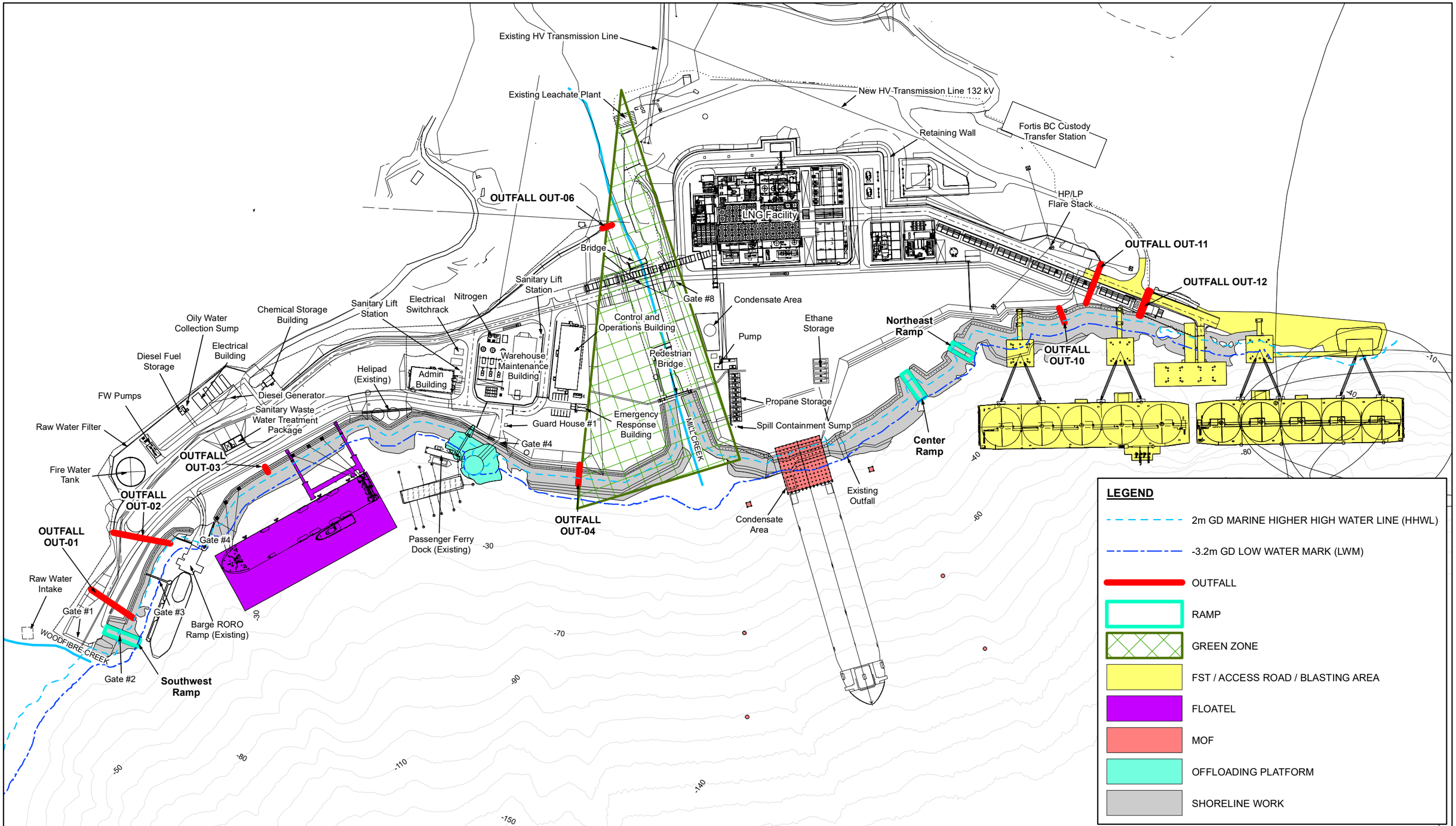
An overview of infrastructure included in the Project is shown in **Table 3-1** and **Figure 3-1**. Details regarding the individual work activities are provided in **Section 3.1** through **Section 3.8.** For additional detail on project components and areas, refer to the *Fisheries Act* Authorization 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	Excavation Volume Estimate (m^3)	Description
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 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



Component	Start	Finish	In-Water Works within Least Risk Window
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

Mitigation Number	Mitigation Name	Proposed Mitigation	Project Phase	Timing of Implementation	MFFHMMP Reference
M5.10-2	**Concrete Works Management Plan**	See description for M5.10-2 above.	Construction	Pre-construction	Section 7.7; MWQMMP
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 may be needed for proposed works associated with the terminal. Regulated information requirements will include an offsetting plan and an effectiveness Ínexwantas (monitoring) plan in support of the Authorization application.
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.

Name	Jurisdiction	Description
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.
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 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)	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.

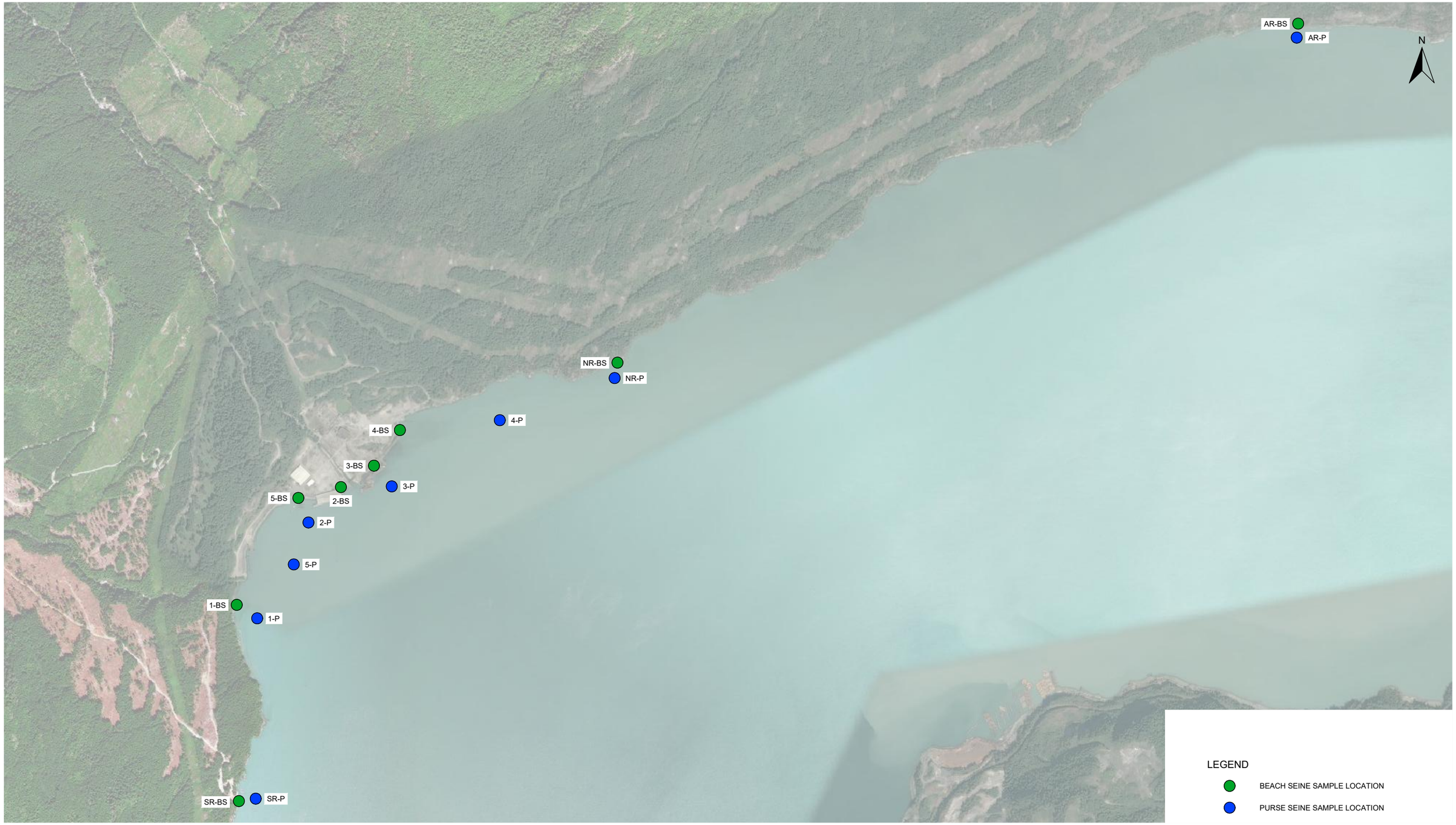
6. BASELINE ENVIRONMENTAL CONDITIONS

This section 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)
- Floatel Marine Habitat Report (Hemmera 2019)
- 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 and 2021)
- Marine Fish Presence Surveys (Keystone Environmental 2020, 2021 and 2022)
- 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.



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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

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6.1 Ecological Setting

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

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.

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

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

6.2.1 Marine Intertidal Conditions

The intertidal zone is mainly hard substrate (e.g., riprap, boulders, cobble or bedrock) (**Phorograph 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.

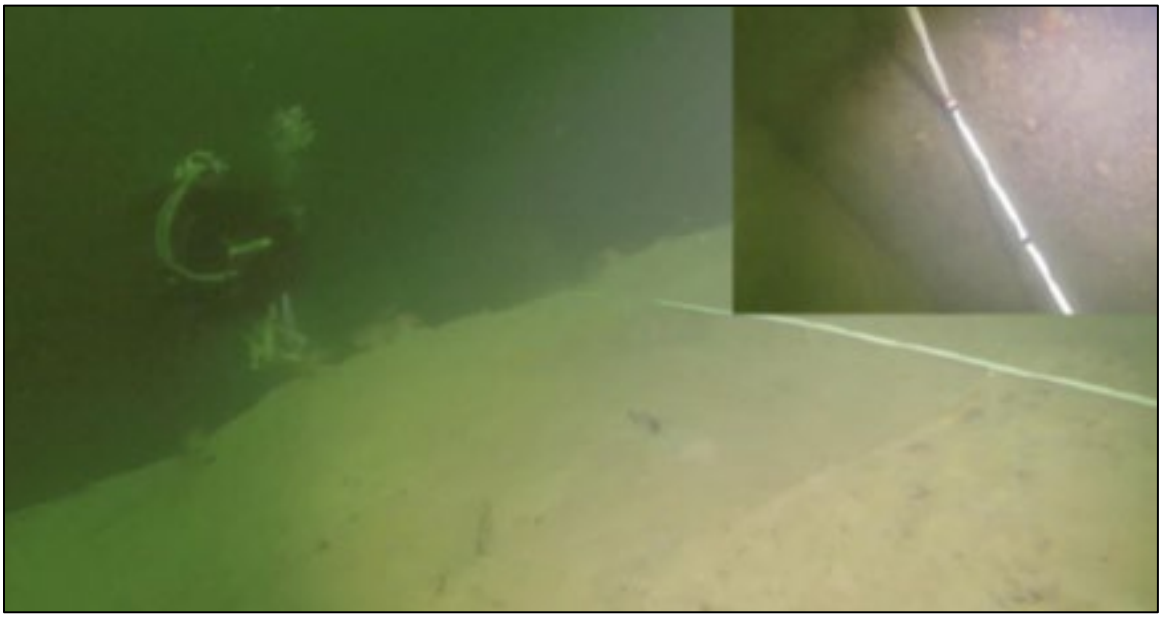
As per the results of the consolidated marine vegetation and sessile invertebrate community mapping, the intertidal zone (approximately 5.1 m CD to 0.0 m CD) generally contained a low diversity of benthic invertebrates and a greater amount of macroalgae compared to the subtidal zone. Dive surveys performed by Keystone Environmental and Hemmera (2015 and 2016a) 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 dive surveys performed by Keystone Environmental and Hemmera (2015 and 2016a).



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

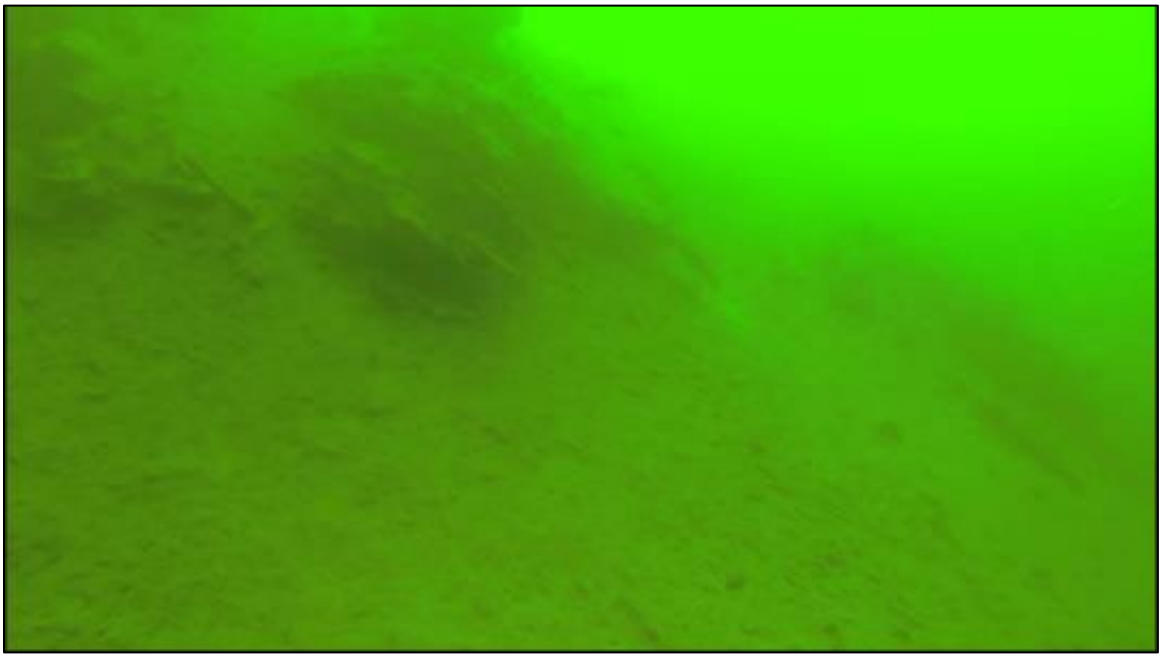
The subtidal zone is dominated by soft sediment with varying mixtures of sand, silt and wood debris throughout the Site (**Photograph 18, Photograph 19)**. Wood chips (estimated >0.3 m thick) covers the seafloor at water depths of up to approximately -30.0 m CD (Hemmera 2016a) northeast of Mill Creek. 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 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.

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**).

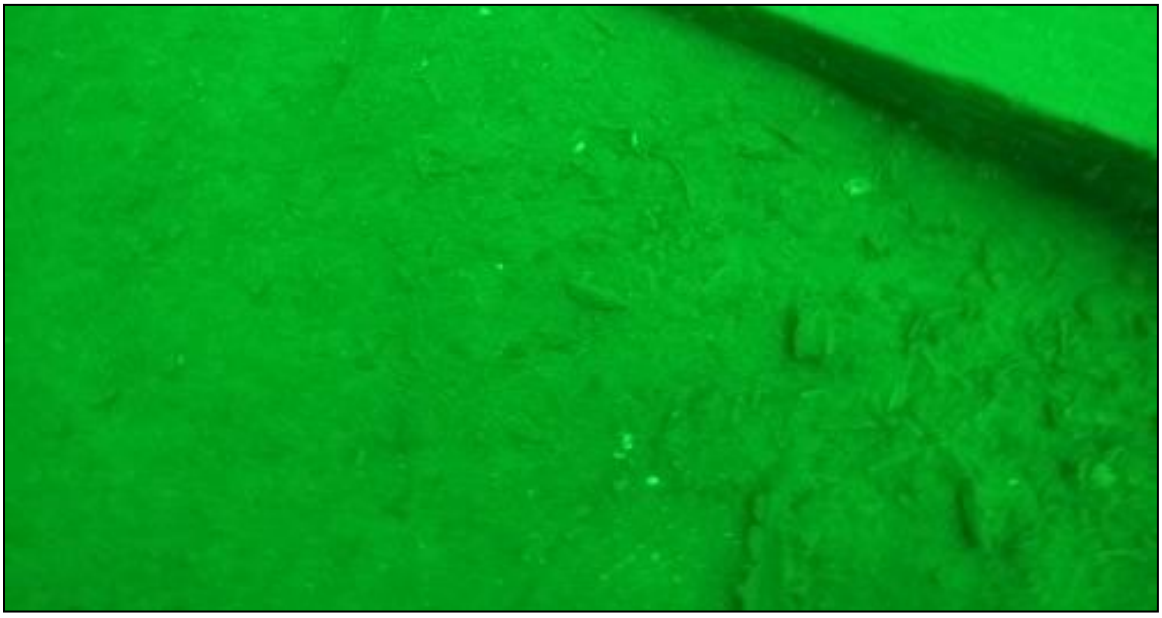
The subtidal zone (beginning at 0.0 m CD) contained a low abundance and diversity of macroalgae and a greater abundance and diversity of benthic invertebrates. Small pockets of laminarian kelps (mainly *Saccharina 60 aggregate*) were identified in the subtidal area from approximately -1.0 m CD to -9.0 m CD (**Photograph 26**). Benthic epifauna observations by Hemmera (2015, 2016a and 2016b) 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.



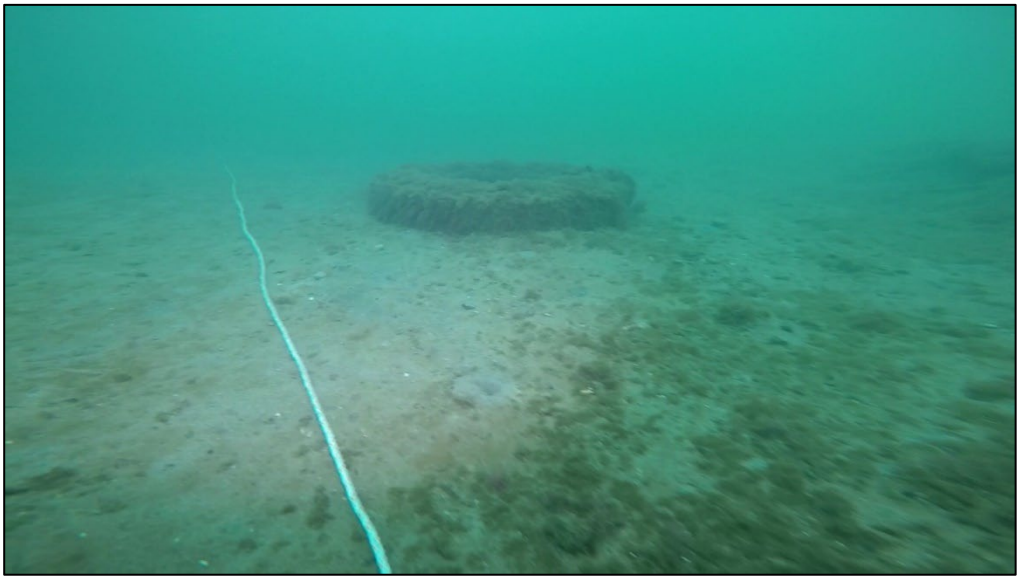
Photograph 18: Side view of thick wood debris present in historic dredge pocket with thin silt covering near future FSTs.



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



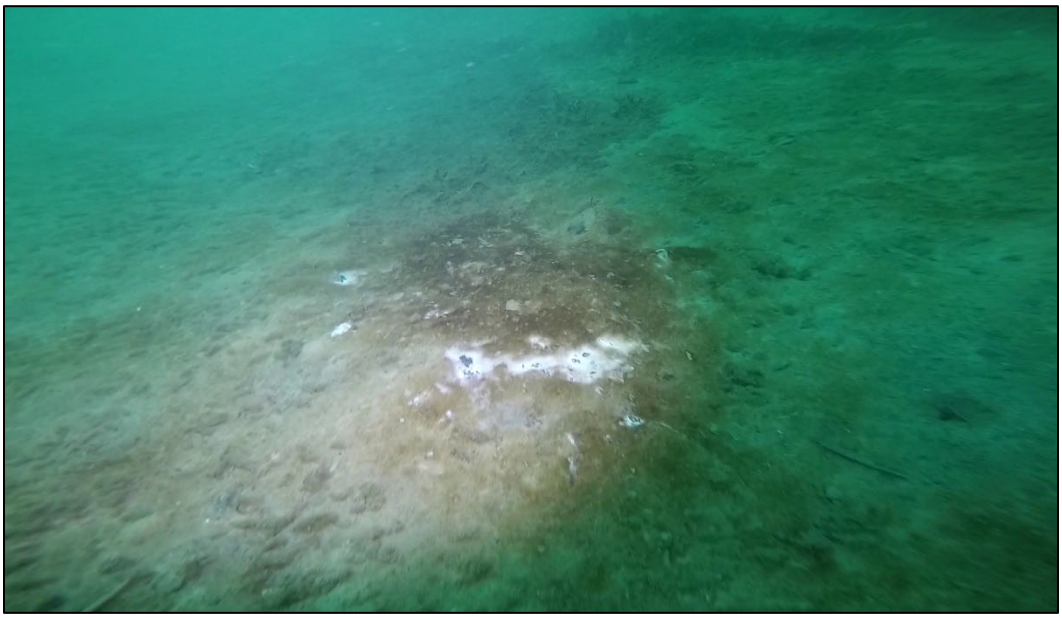
Photograph 20: Sediment core taken in 2019 to assess sediment composition and benthic infauna.



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.



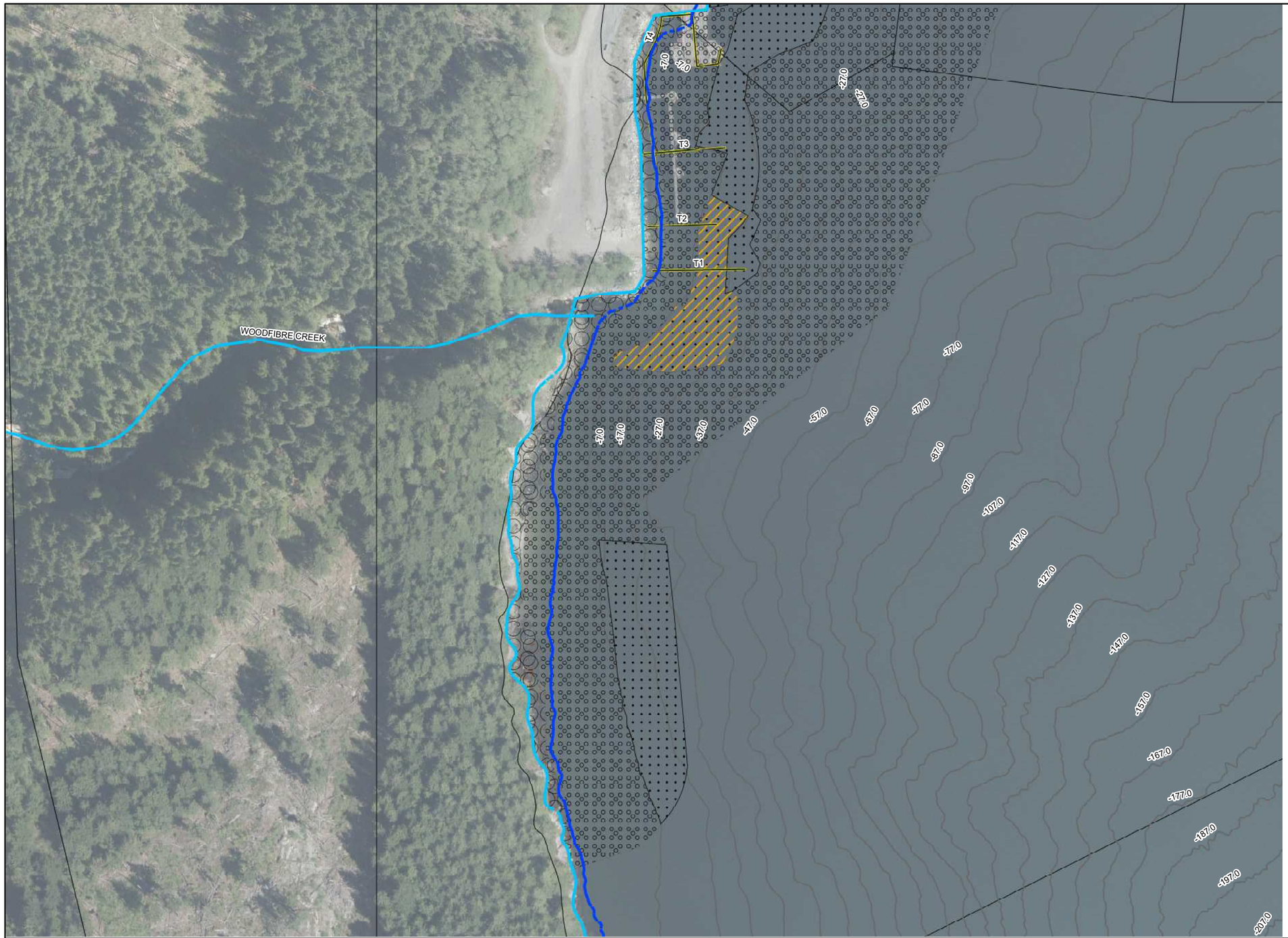
Photograph 26: Sugar kelp growing on a cobble patch within the CPA.



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

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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.*
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

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SCALE: 1:2,000 (approx.)

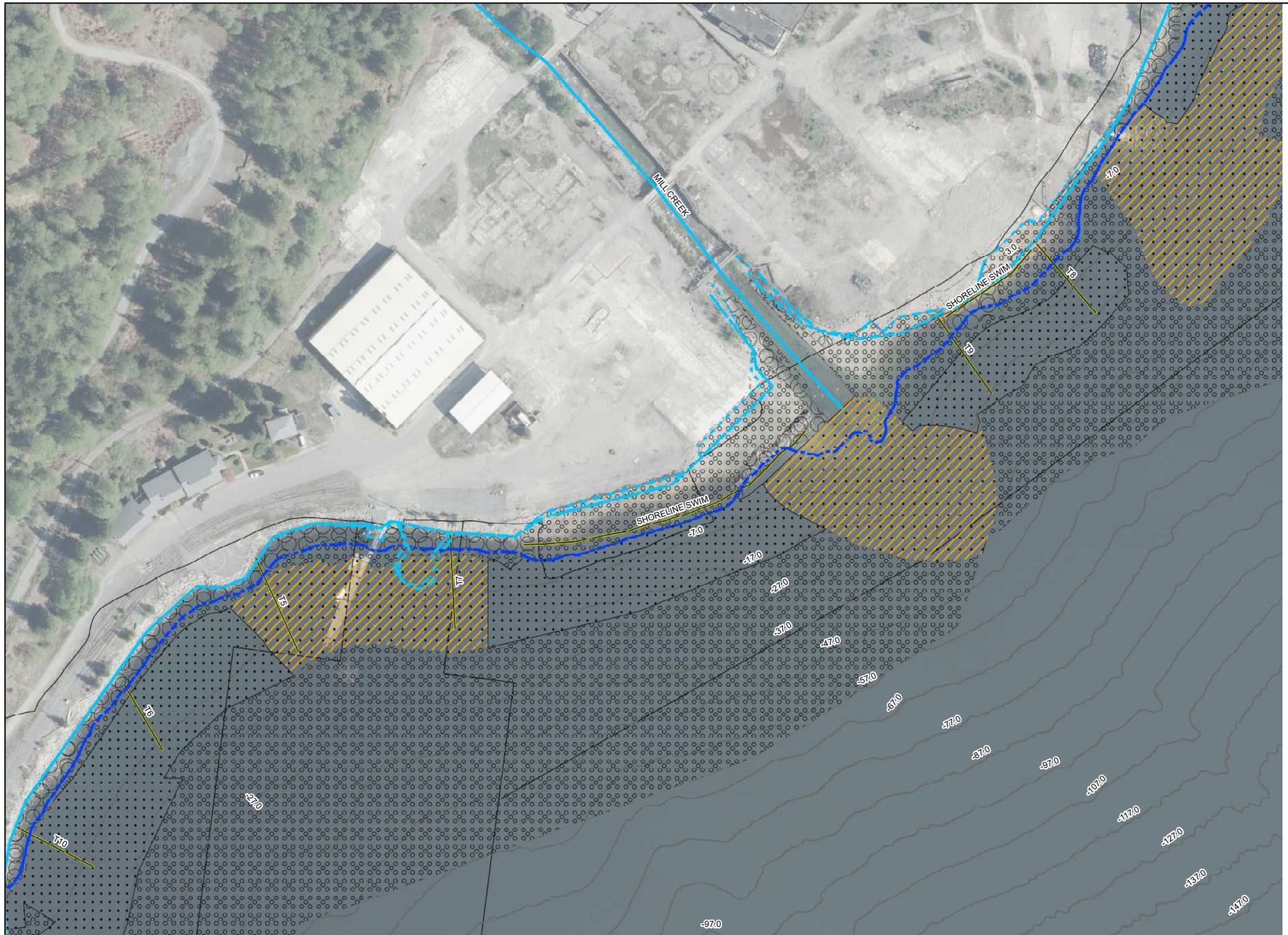
Woodfibre
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Woodfibre LNG Limited

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Figure 6-3A

Habitat Substrate Feature
(Southwest of Mill Creek)

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

25 0 100 m

SCALE: 1:2,000 (approx.)

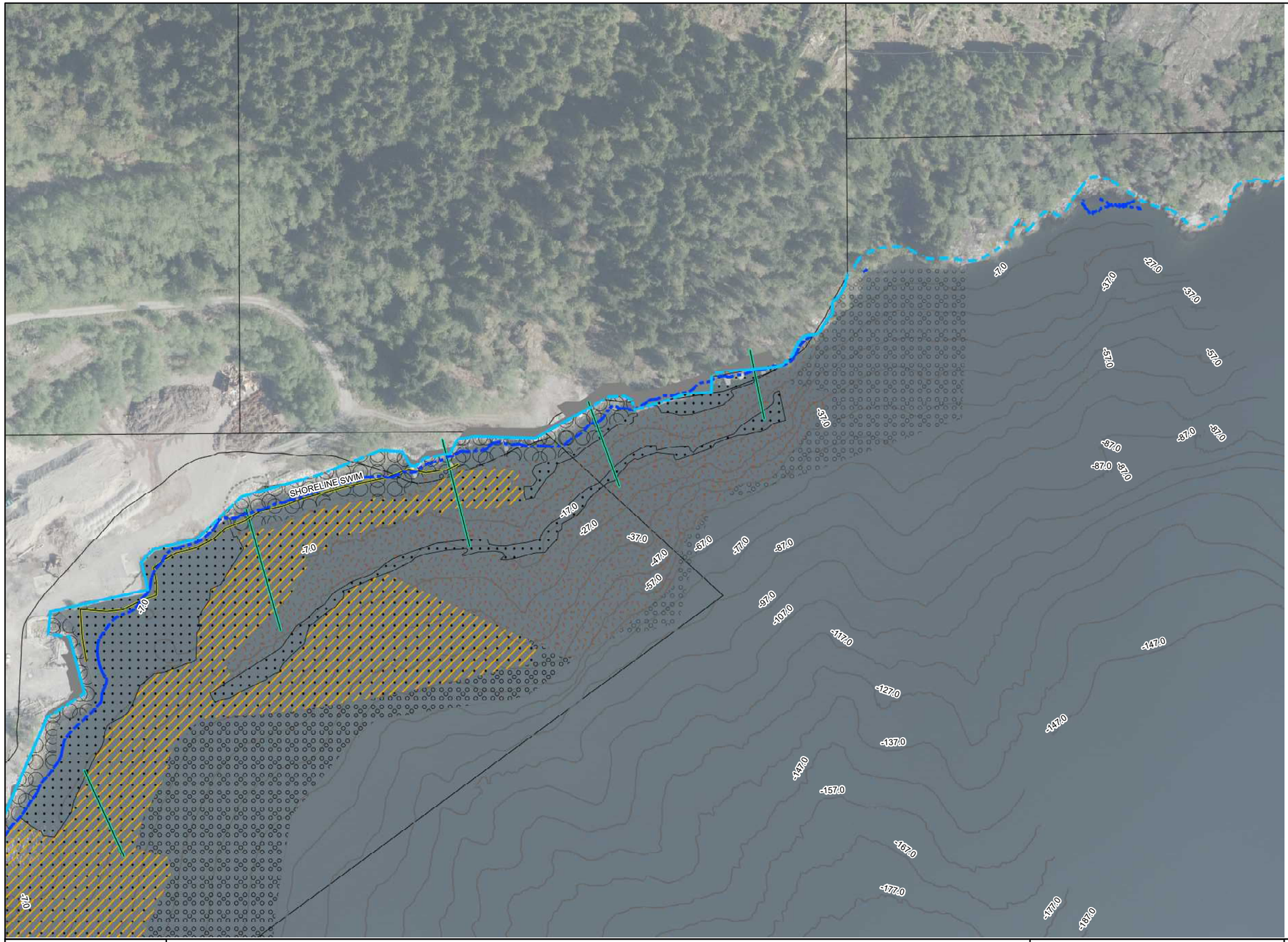
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Figure 6-3B

Habitat Substrate Feature
(Central Mill Creek)

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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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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.)

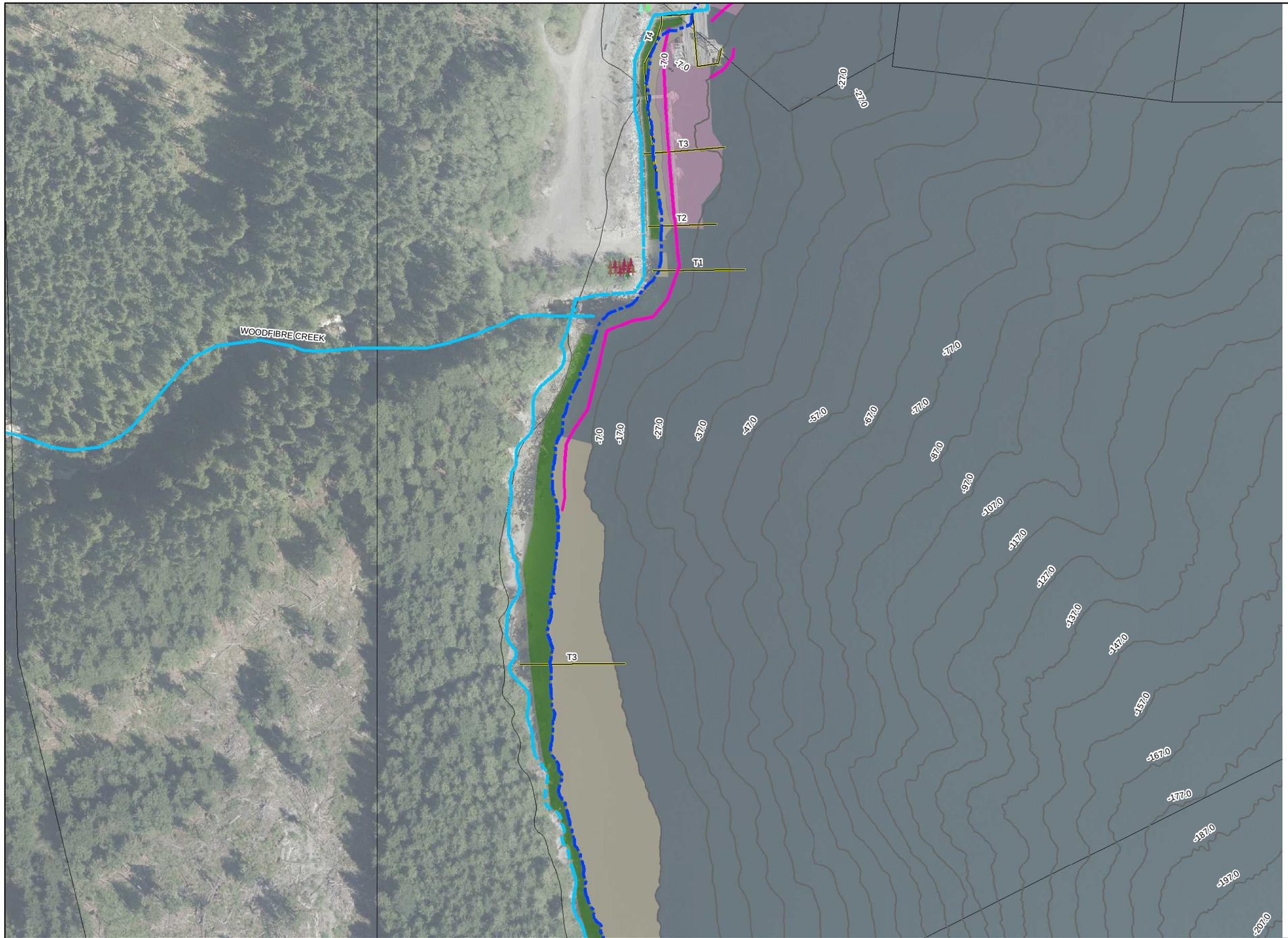
Woodfibre
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00	Jan. 2023	17227-100

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

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.)

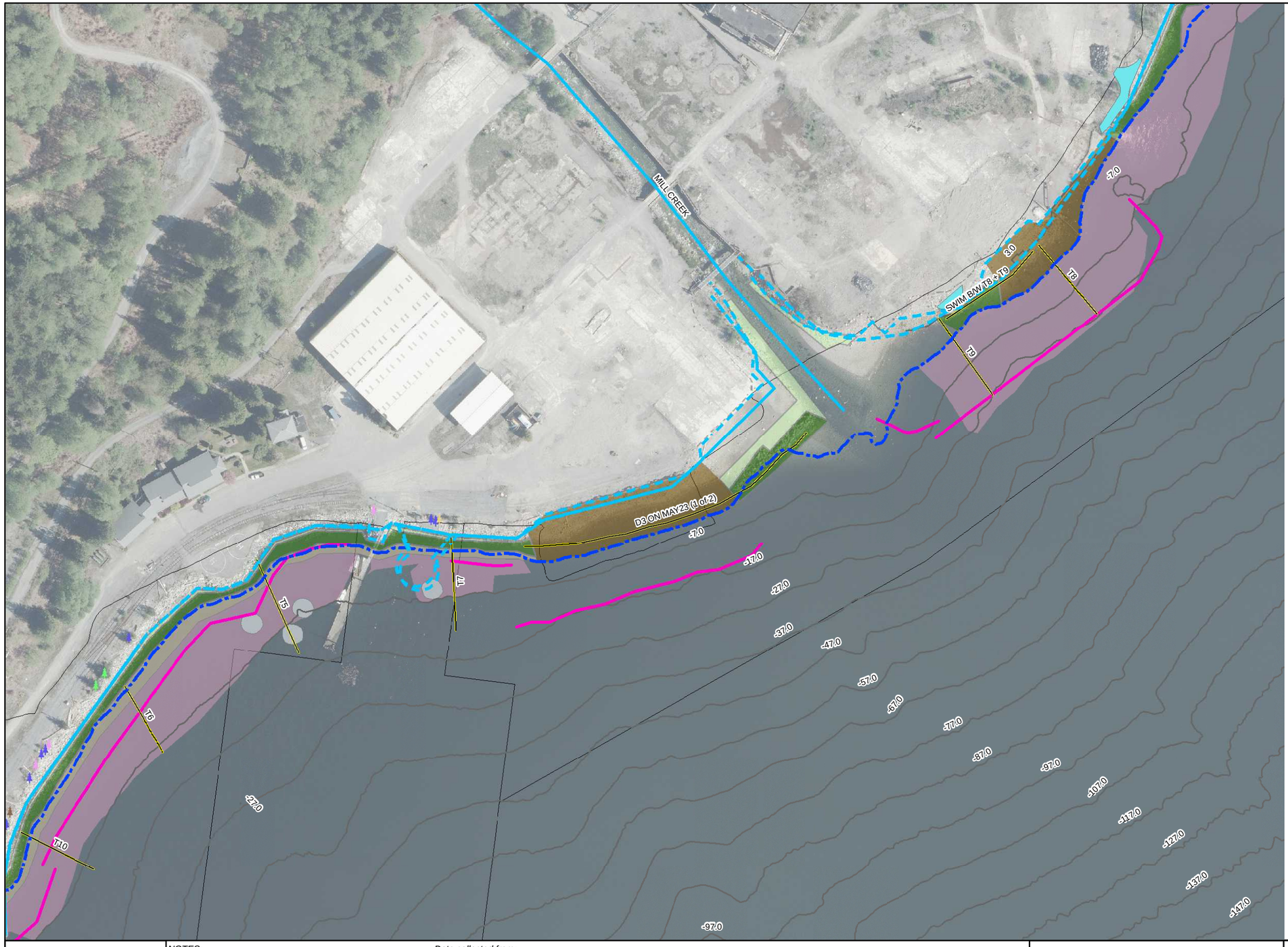
Woodfibre
Squamish, B C
Woodfibre LNG Limited

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

Figure 6-4A

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

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 6-4B

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:
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 6-4C

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

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 sḵwx̱wú7mesh Úxwumixw (Squamish Nation).

6.3 Fish and Fish Habitat

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

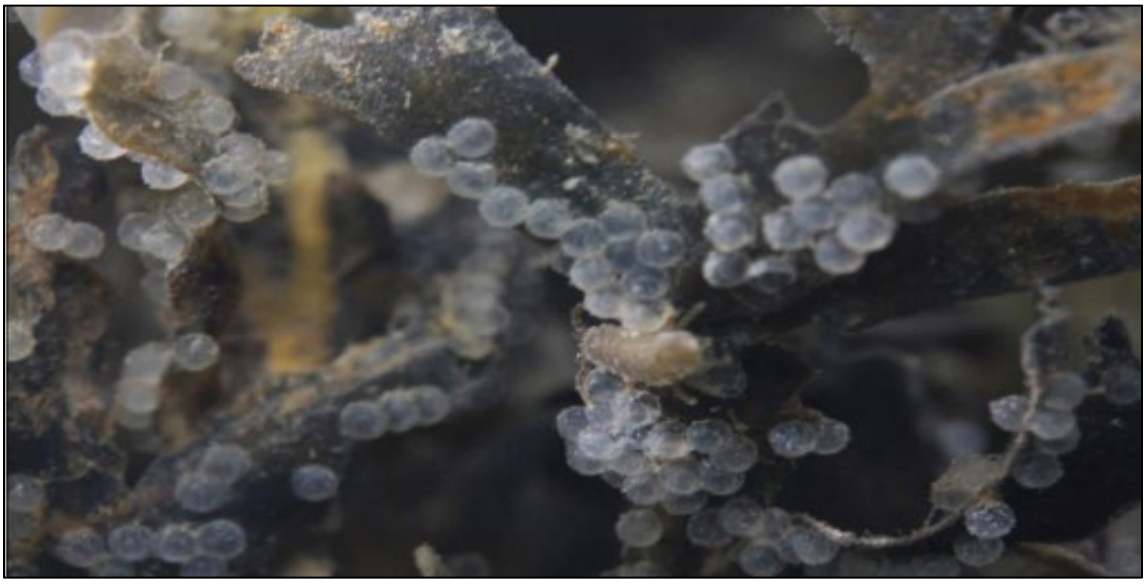
- Pacific salmon: chum (*Oncorhynchus keta*), tsáẃin (coho) (*O. kisutch*), Kwu7s (Chinook; *O. tshawytscha*), lháwichen (pink; *O. gorbuscha*);
- Trout: rainbow/steelhead (*O. mykiss*), cutthroat (*O. clarkii*);
- Char: Tl'ítl'elxiws (Dolly Varden) (*Salvelinus malma*);
- Forage fish: Pacific slhawt' (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*), élhḵaẏ̓ (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. In 2015 and 2016, The spawns were observed only on timber piles; however, in 2019 spawning was observed on the sheet piles and rockweed (**Photograph 29**)

in addition to timber piles. foreshore of CPA in the years 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, 2021 (Keystone 2020, 2021) or 2022 (Keystone 2022 unpublished).

Mill Creek and Woodfibre Creek provide freshwater input to the marine environment of the CPA and act as spawning areas for salmonids. Sḵiẇx̱ (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 shḵweṉ (ocean) and may intermittently seek shelter amongst boulders and beneath marine structures during the spring and early summer.

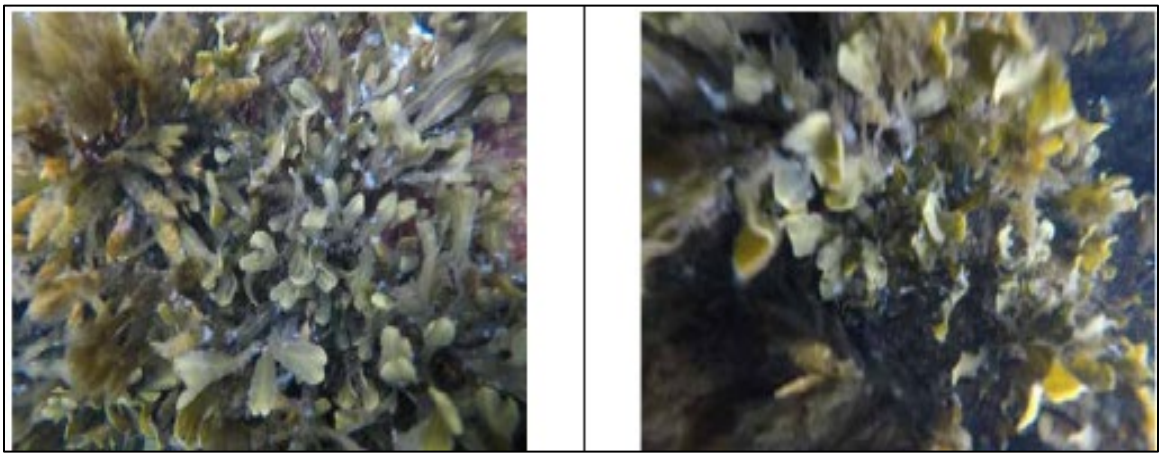
Subtidal and intertidal marine habitat within the CPA may serve as feeding, migratory, and spawning habitat for other marine fish species such as, gunnel, sculpin, perch, greenling, eelpout and several species of flatfish observed during dive surveys in 2015, 2016, 2019, 2020, 2021, and 2022. For example, 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 4: Pacific herring eggs observed on rockweed (Hemmera 2015)



Photograph 5: Pacific herring eggs observed on timber pile (Hemmera 2016b)



Photograph 61: 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

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**
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**

Species	1-BS	2-BS	3-BS	4-BS	Mean	FL[3]	SR-BS	NR-BS	Mean	FL
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'itl'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

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.

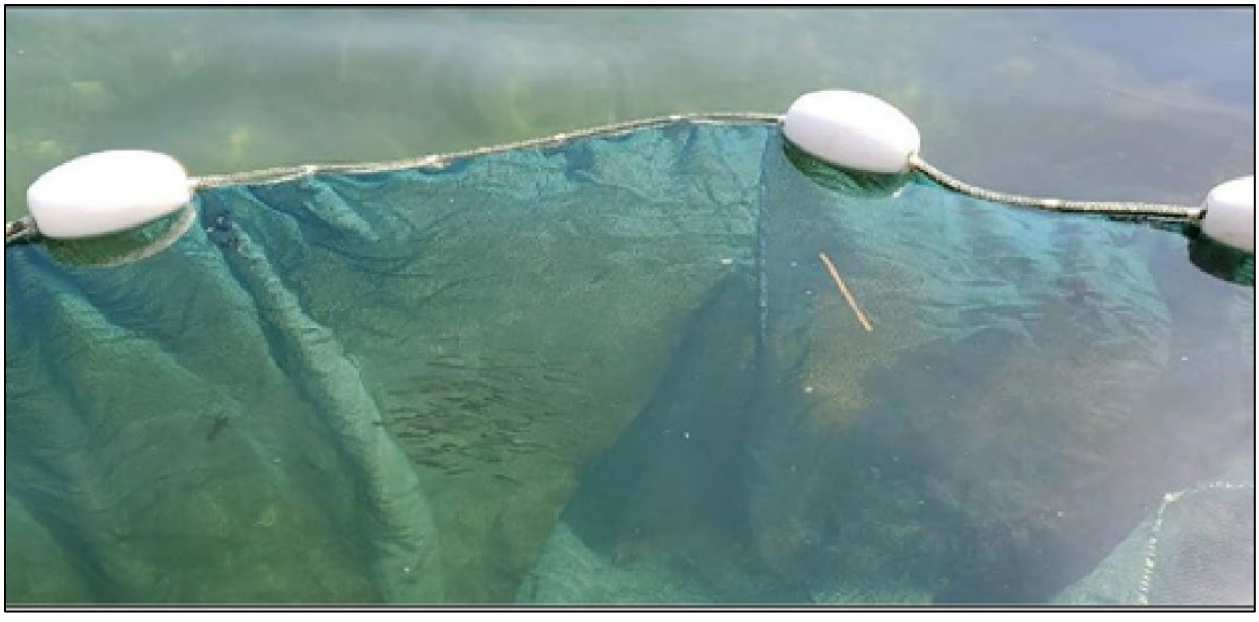
Fewer than ten salmonids were caught at each of 1-BS, 2-BS and 3-BS. 4-BS had the largest catch of salmonids, with a total of 21 tsáẃin (coho) caught. Most of the salmonids caught during the July sampling were coho, with one Kwu7s (Chinook) caught at NR-BS, and one chum caught at SR-BS. The results indicate 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

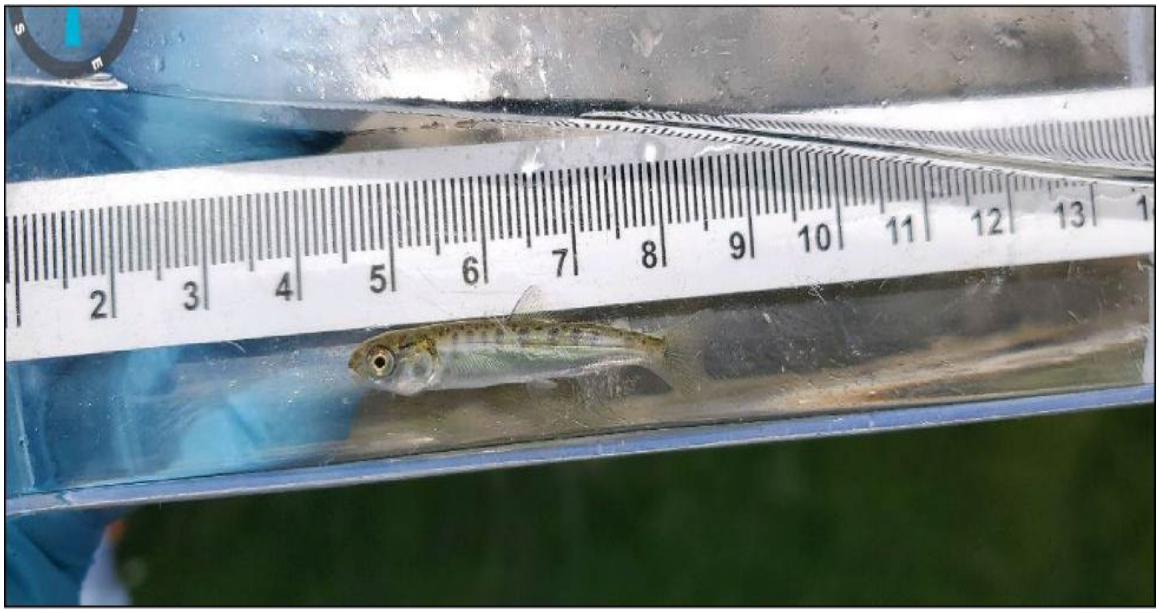
Site/Spp	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean / Site	FL
Kwu7s (Chinook)	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Coho	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Chum	3	4	9	131	36.8	36.0± 0.6	654	52	353.0	36.1± 0.4
Rainbow/ Steelhead Trout	0	0	0	0	0.00	0.0	0	0	0.0	0.0
Tl'ítl'elxiws (Dolly Varden)	0	0	0	0	0.00	0.0	0	0	0.0	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

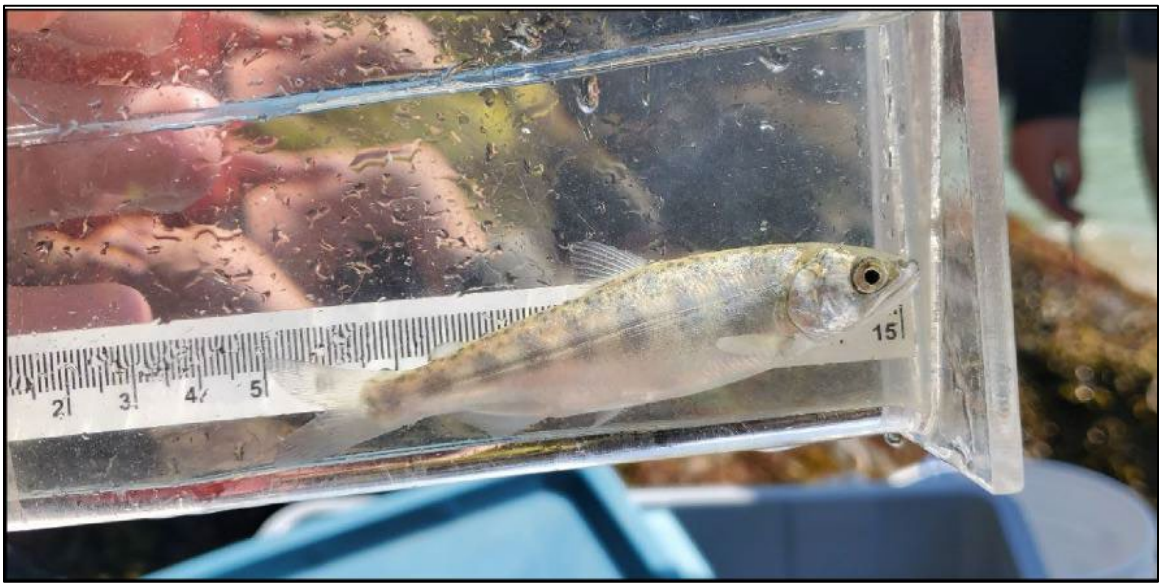
Site/Spp	1-BS	2-BS	3-BS	4-BS	Mean	FL	SR-BS	NR-BS	Mean / Site	FL
Kwu7s (Chinook)	0	0	0	0	0.0	0.0	0	1	1.0	91.0
Coho	3	6	1	21	7.8	62.0 ± 3.3	0	3	2.0	65.0± 3.3
Chum	0	0	0	0	0.0	0.0	1	0	0.5	76.0
Rainbow/ Steelhead Trout	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Dolly Varden	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Pacific Slhawt' (herring)	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**	



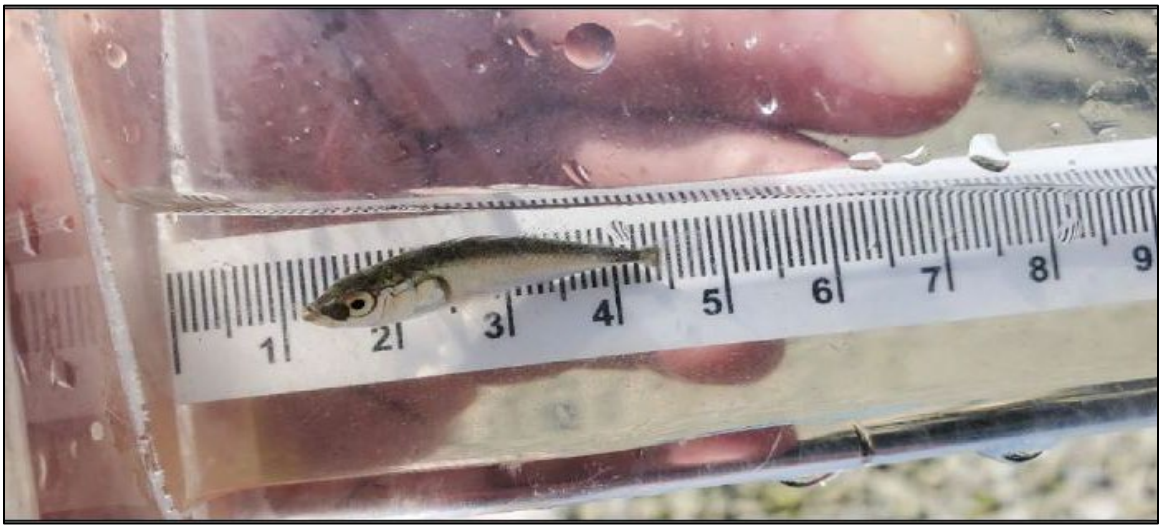
Photograph 37: Schooling juvenile chum salmon at 4-BS during the April 2021 sampling.



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 7: 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 tsáẃin (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 tsáẃin (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'ítl'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'ítl'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

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 tsáẃin (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. Tsáẃin (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

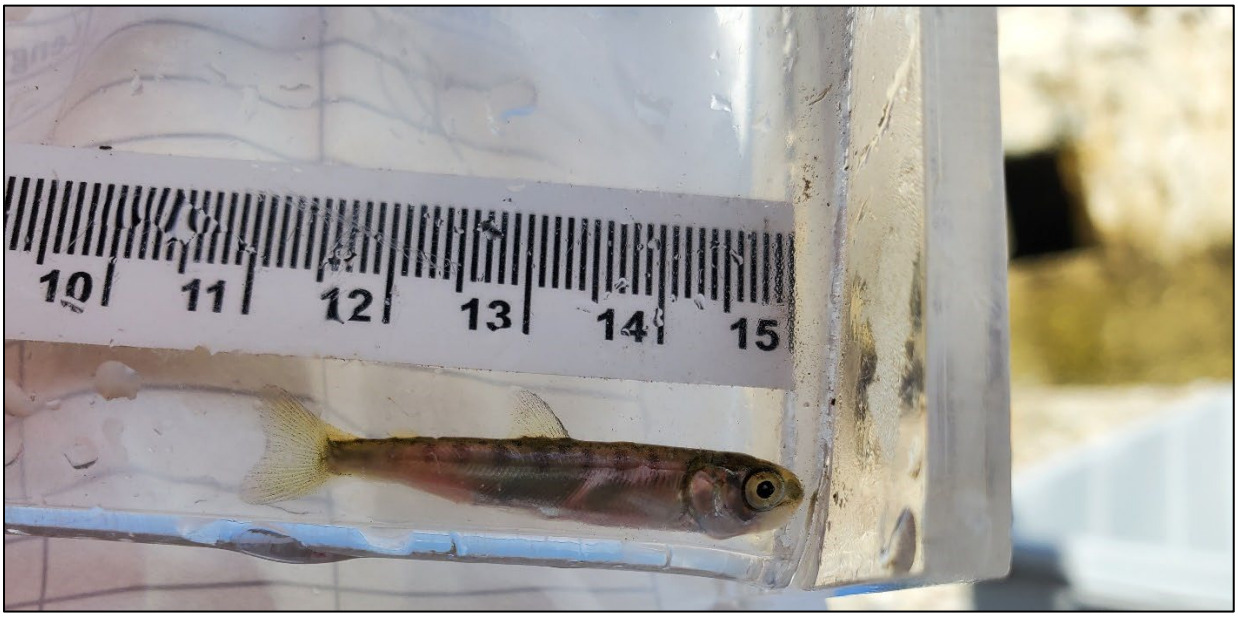
Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean /Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Lháwichen (pink)	0	0	0	0	0	0	0	20	0	2	7.3	32.79± 0.68	22
Chum	1	0	0	0	0	0.17	38	111	1	5	39	36± 0.65	118
Clupeidae	0	0	0	0	0	0	0	0	4	0	1.3	26±2.09	4
Other Forage Fish	19	2	0	1	4	4.33	N/A	3	1	15	6.3	N/A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

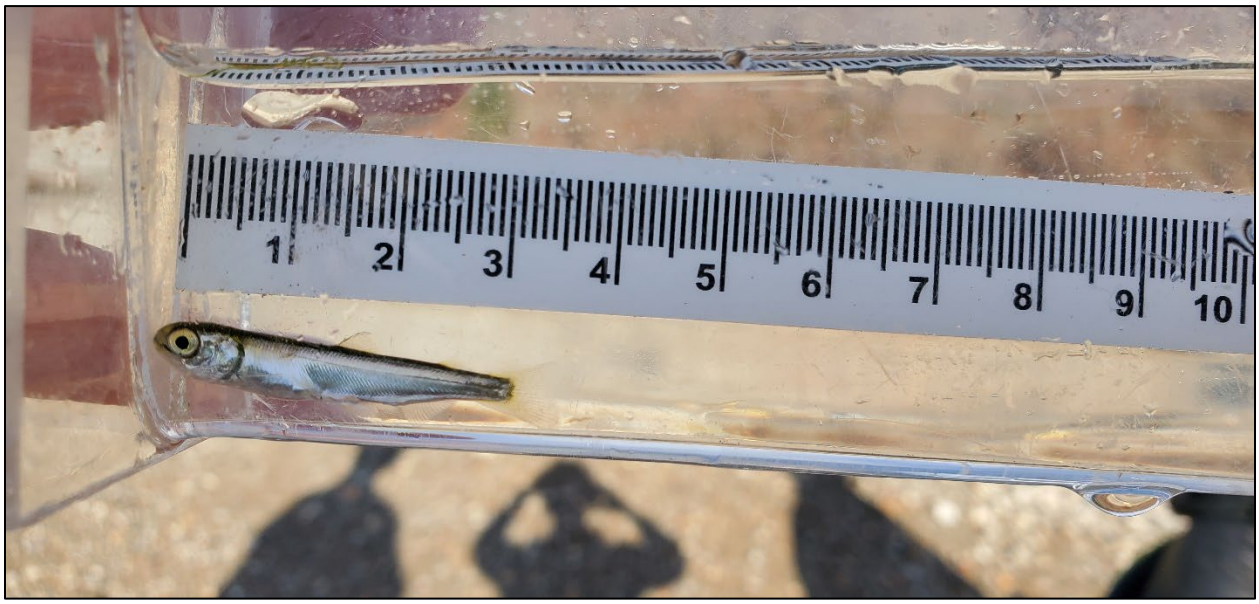
Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean/ Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Chum	17	0	0	2	1	4	52.9 ± 1.75	1	2	1	1.3	59.25 ± 6.75	24
Coho	1	0	0	0	1	0.4	39.50 ± 0.50	0	0	0	0		2
Kwu7s (Chinook)	4	0	0	0	1	1	64.00 ± 6.95	0	0	7	2.3	80.43 ± 2.94	12
Three Spine Stickleback	1	1	0	0	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

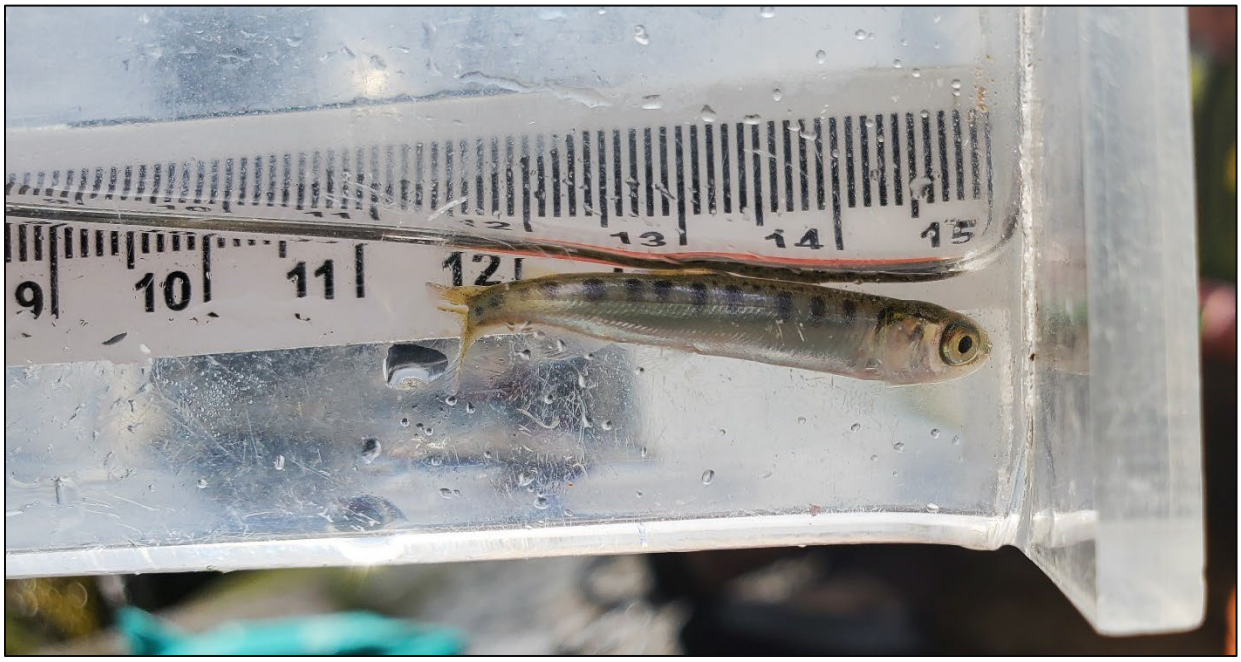
Species	Site												
	1-BS	2-BS	3-BS	4-BS	5-BS	Mean/ Site	FL	SR-BS	NR-BS	AR-BS	Mean/ Site	FL	Total
Chum	0	0	0	0	0	0		0	0	6	2	59.27 ± 3.13	6
Coho	0	1	0	0	1	0.4	43.00 ± 6.00	1	2	0	1	68.33 ± 18.00	5
Kwu7s (Chinook)	1	1	0	0	5	1.4	90.86 ± 3.72	0	0	1	0.3	104	8
Three Spine Stickleback	0	0	0	0	0	0		0	0	1	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
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**		



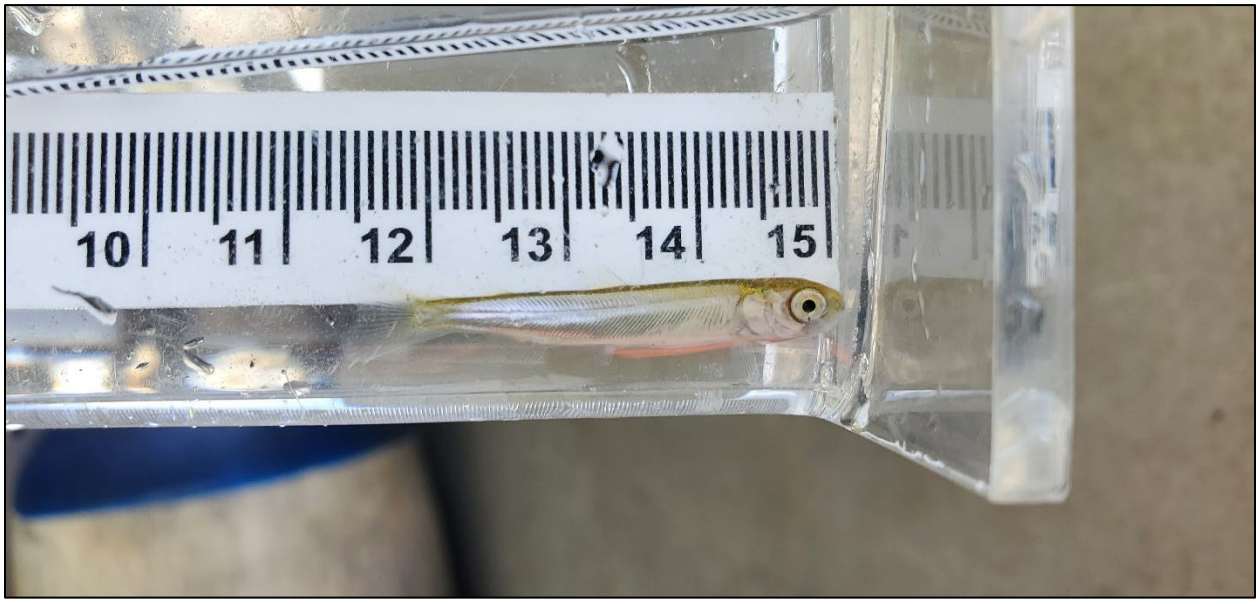
Photograph 41: Juvenile chum salmon caught at 3-BS during early March 2022 sampling.



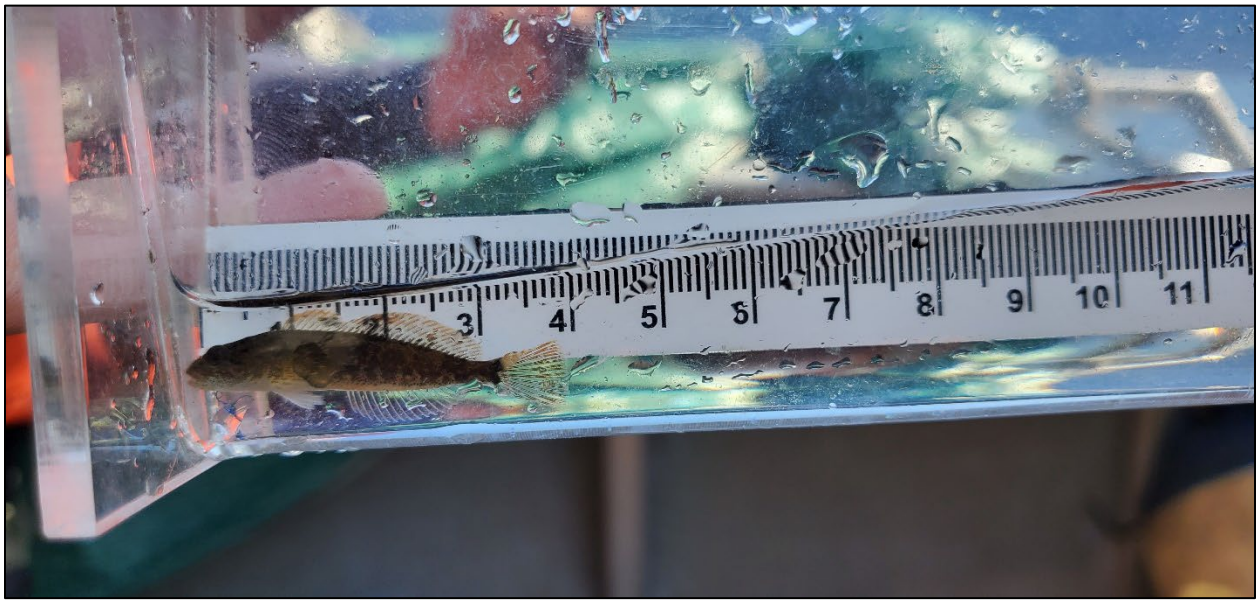
Photograph 42: Juvenile pink salmon caught at 4-BS during early March 2022 sampling.



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



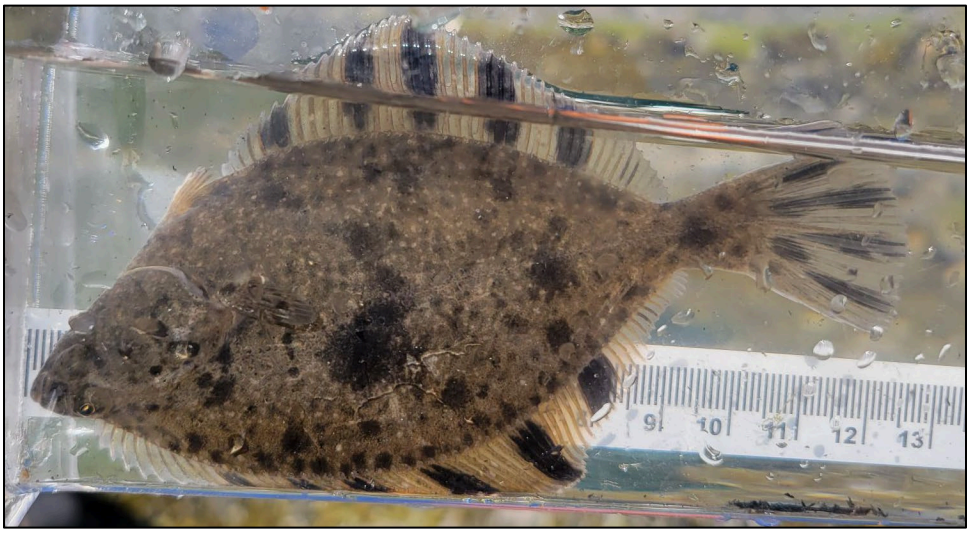
Photograph 44: Juvenile pink salmon captured at AR-BS during late March 2022 sampling.



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
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

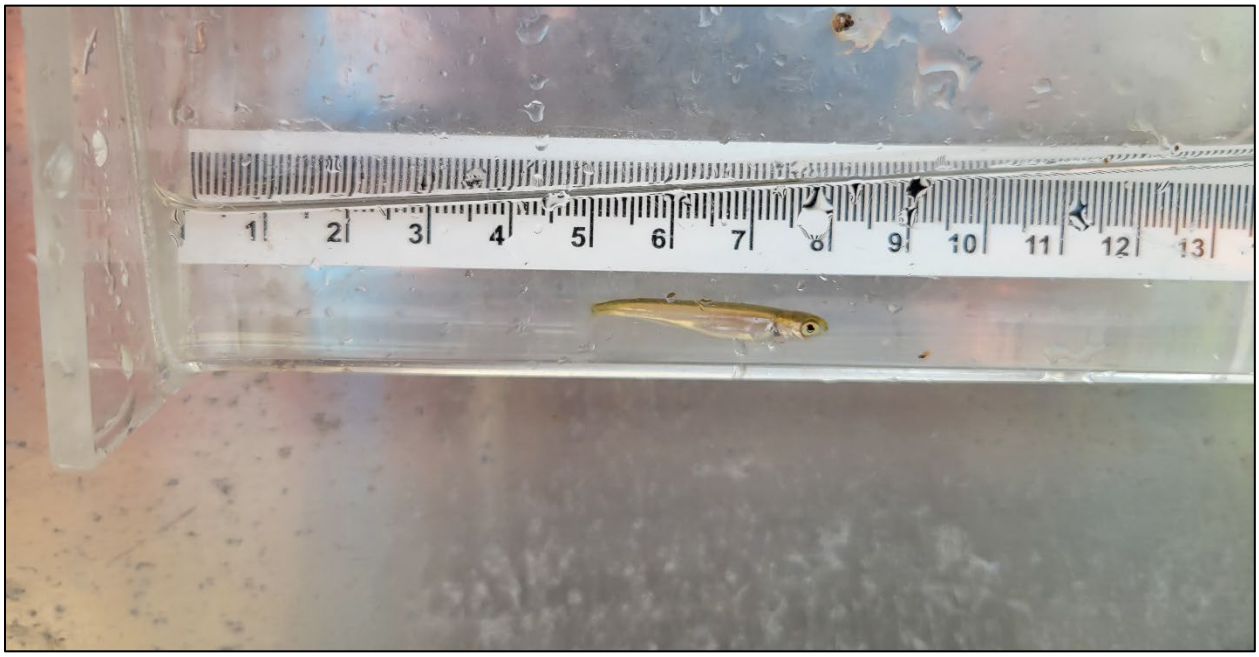
Species	Site											
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Lháwichen (pink)	6	48	0	7	0	12.2	39.24± 0.76	0	0	0	0	NA	61
Chum	21	50	0	5	0	15.2	34.62± 0.57	0	0	0	0	NA	76
Three Spine Stickleback	0	7	0	1	1	1.8	45.56± 1.96	2	0	26	9.3	58.17± 1.95	37
Total	**27**	**105**	**0**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

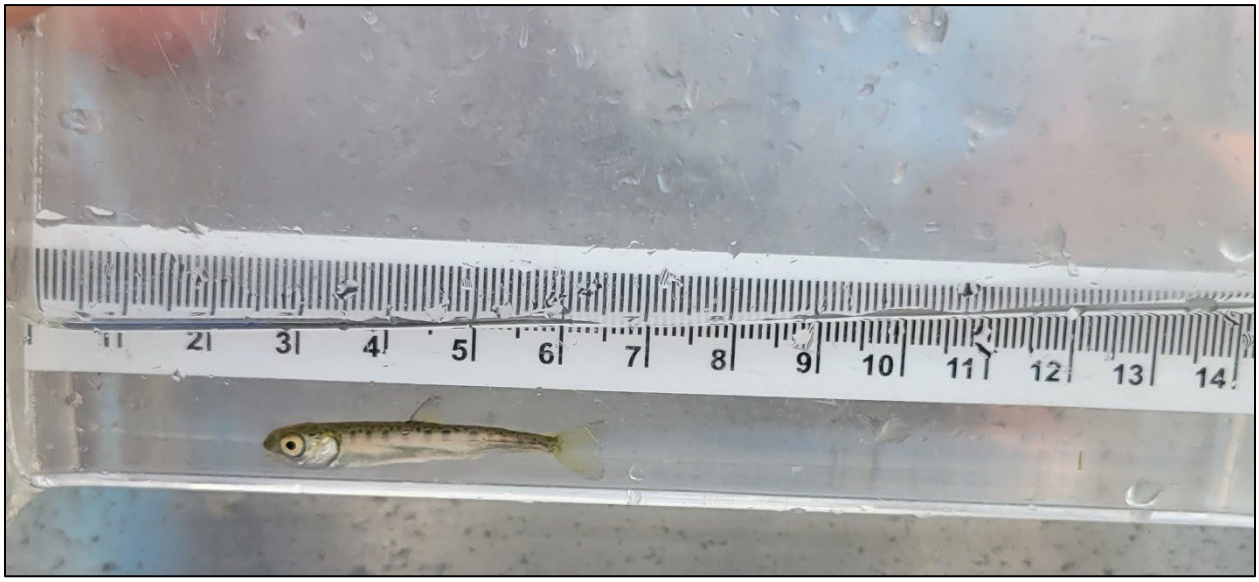
Species	Site												
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Kwu7s (Chinook)	4	0	1	0	1	1.2	90.17 ± 3.43	0	0	2	0.7	71.00 ± 28.99	8
Three Spine Stickleback	0	0	0	0	1	0.2	67.00 ± 0.0	0	0	2	0.7	38.00 ± 0.0	3
Pacific Slhawt' (herring)	1	0	0	7	3	2.2	118.09 ± 13.16	0	3	1	1.3	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

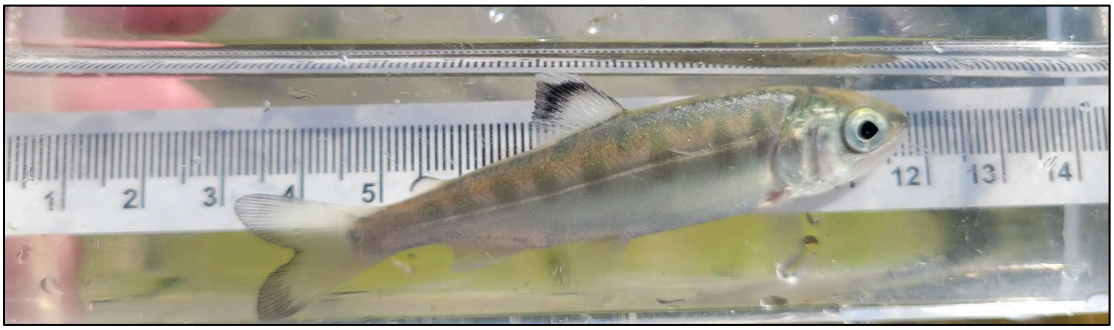
Species	Site												
	1-P	2-P	3-P	4-P	5-P	Mean/ Site	FL	SR-P	NR-P	AR-P	Mean/ Site	FL	Total
Kwu7s (Chinook)	0	2	2	0	0	0.8	97.00 ± 12.05	3	2	0	1.7	96.40 ± 6.99	9
Pacific Slhawt' (herring)	0	55	3	0	0	11.6	137.35 ± 2.45	0	0	0	0	NA	58
Total	**0**	**57**	**5**	**0**	**0**	**12.4**		**3**	**2**	**0**	**1.7**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



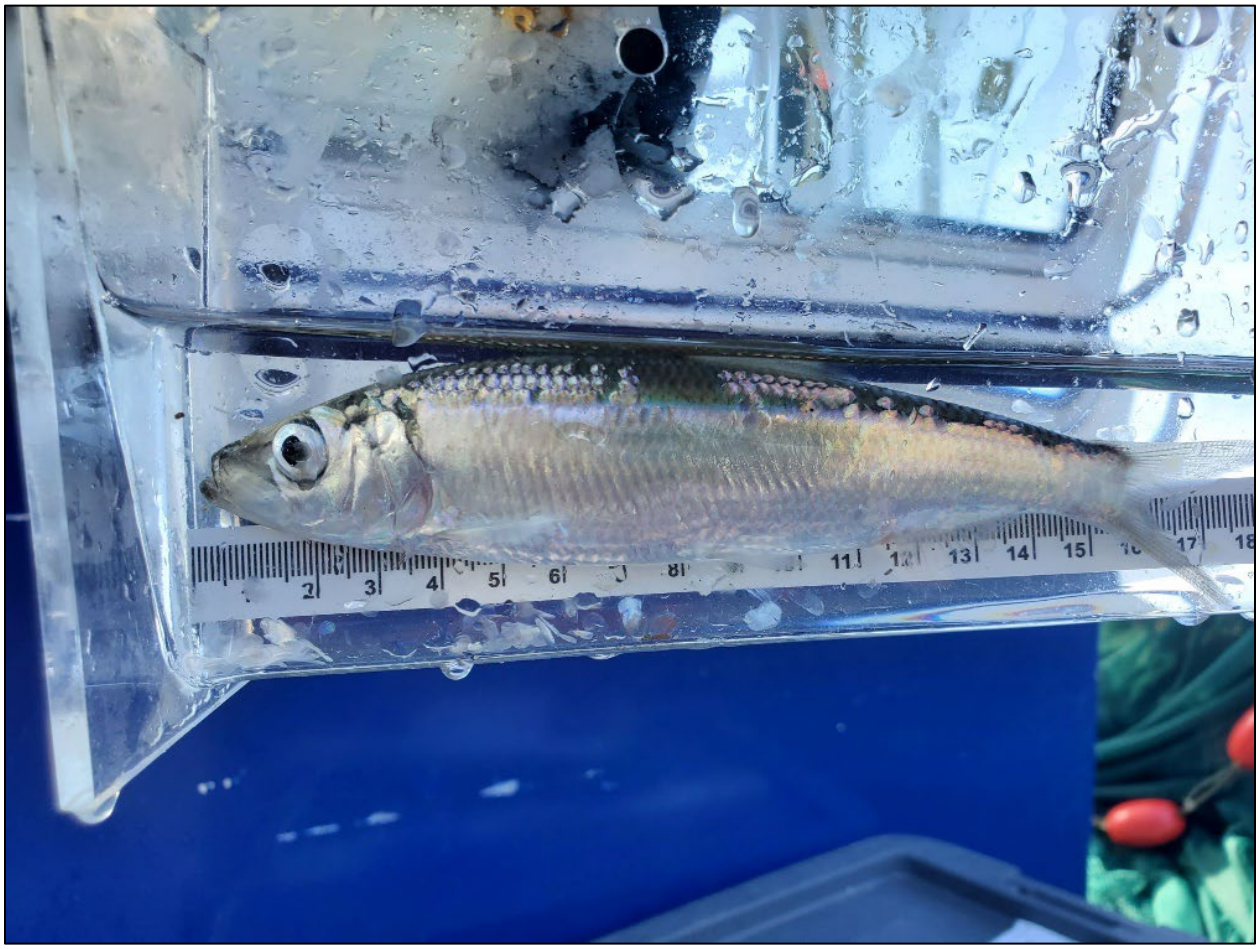
Photograph 50: Juvenile Chinook salmon captured at 1-P during June 2022 sampling.



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

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.
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.



Species	Habitat	Impact	Possible Presence
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 shḵwe̓n (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

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
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

[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
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.

The Floatel has been positioned to allow for 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 fish passage in this respect and will not prevent fish from utilizing the area between the structure and shore or between the structure and the benthos.

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.
- 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 0** 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 0** 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, sḵwx̱wú7mesh 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:

- 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.

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.

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

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.

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[3] 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 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

[3] Increase, decrease or change is defined as ±2 SD from the pre-construction mean.

Potential Adverse Residual Effect	Mitigation	Metric	Phase
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 (in Draft under review) and summarized below.

7.13.1 Juvenile Fish and Salmonid Presence and Migration

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 Sḵwx̱wú7mesh Stak̲w (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

Site ID	Site Location Description	Latitude Longitude	Timing
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

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

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.

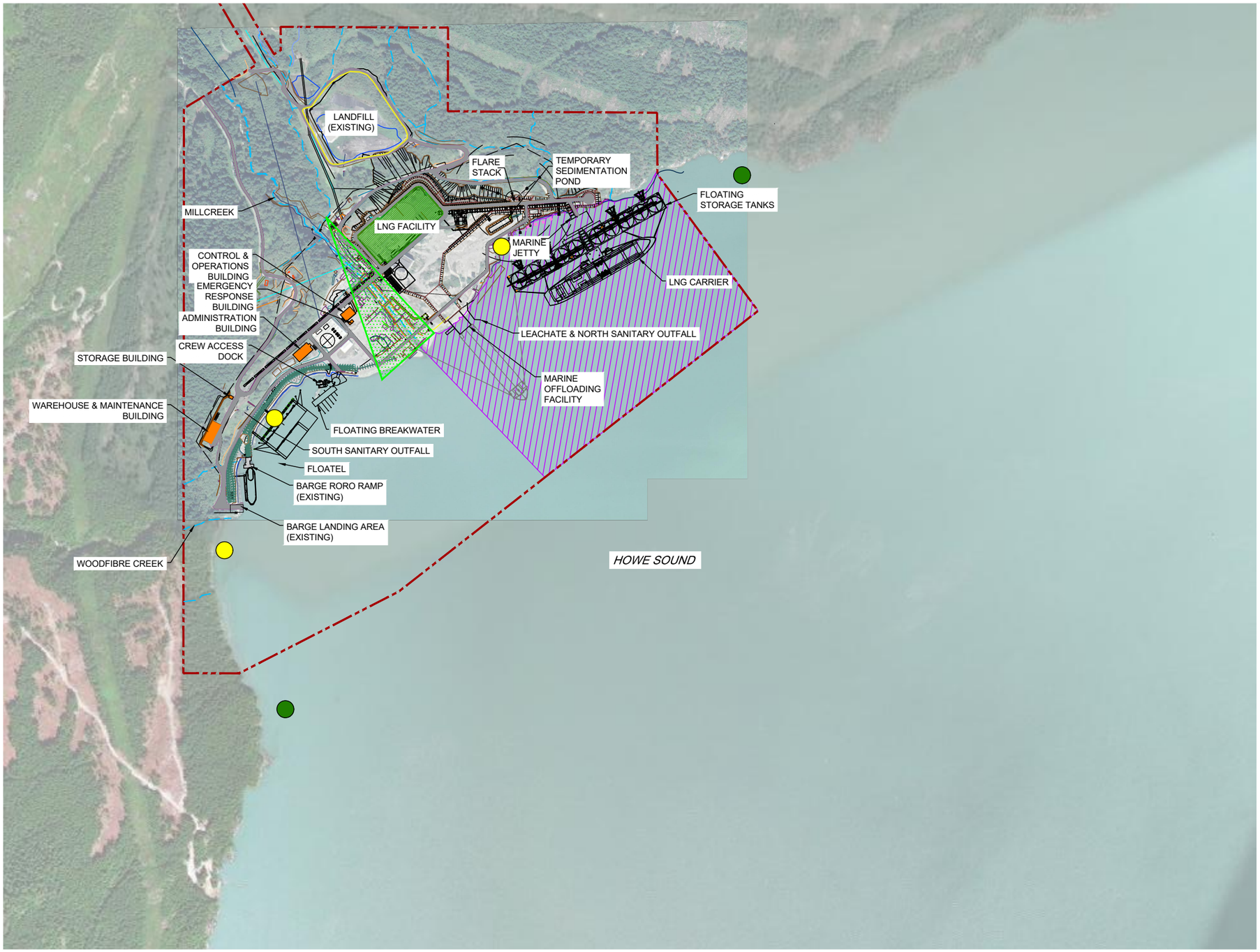
The collector-plate method follows that used by DFO, as described in Sephton et al. (2011, 2014). Modified versions of this method have been used in Nova Scotia (Moore et al. 2014), coastal BC (Gartner et al. 2016) and San Francisco Bay, California (Marraffini et al. 2017) and by PRPA (Anderson and LaRoche 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.

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.





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

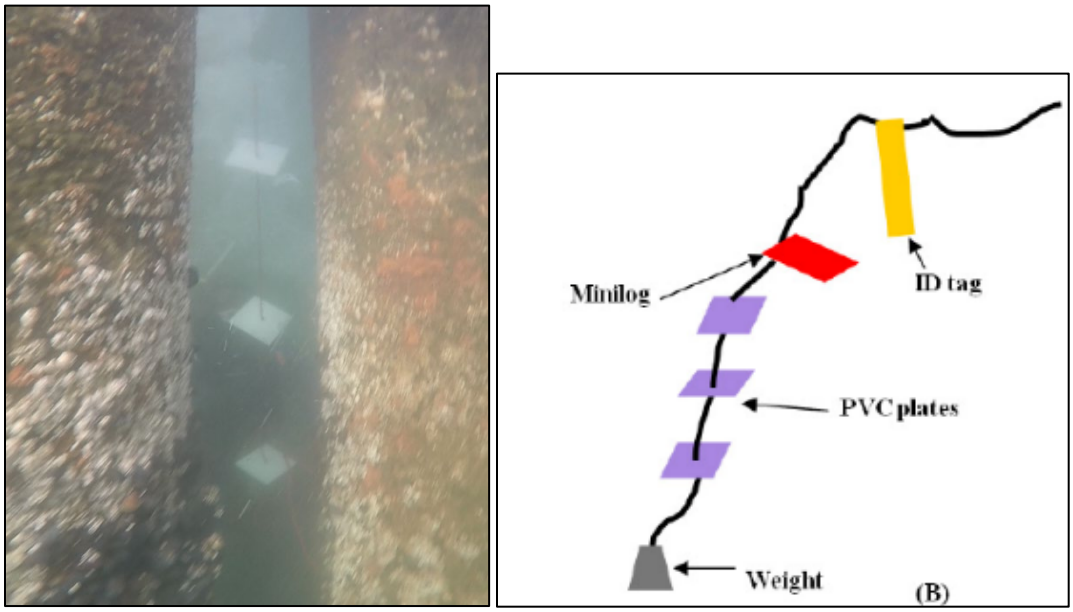


Figure 7-3 Photo of AIS collector deployed near the Ro-Ro (left) and a simple schematic of a collector-plate array design (Sephton et al. 2011)

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

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 Stak̲w (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

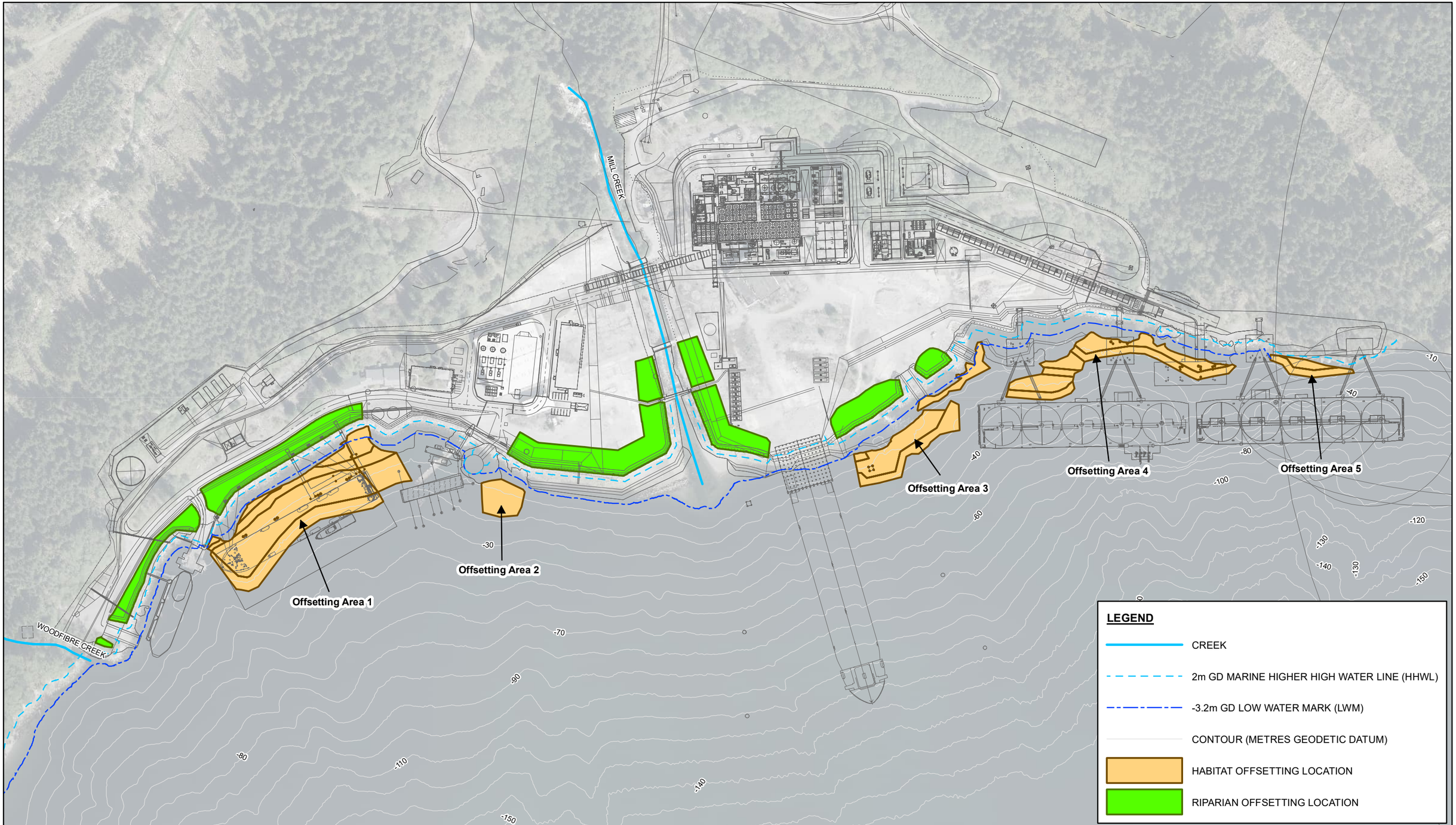
There are four marine aquatic habitat concepts proposed to offset the residual effects associated with the Project (**Table 8-5**) across five areas (Areas 1 through Area 5). These habitat offsetting areas are shown in **Figure 8-1, 8-2A, 8-2B, 8-3A, 8-3B,** and **8-3C** and are summarized below.

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**).



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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

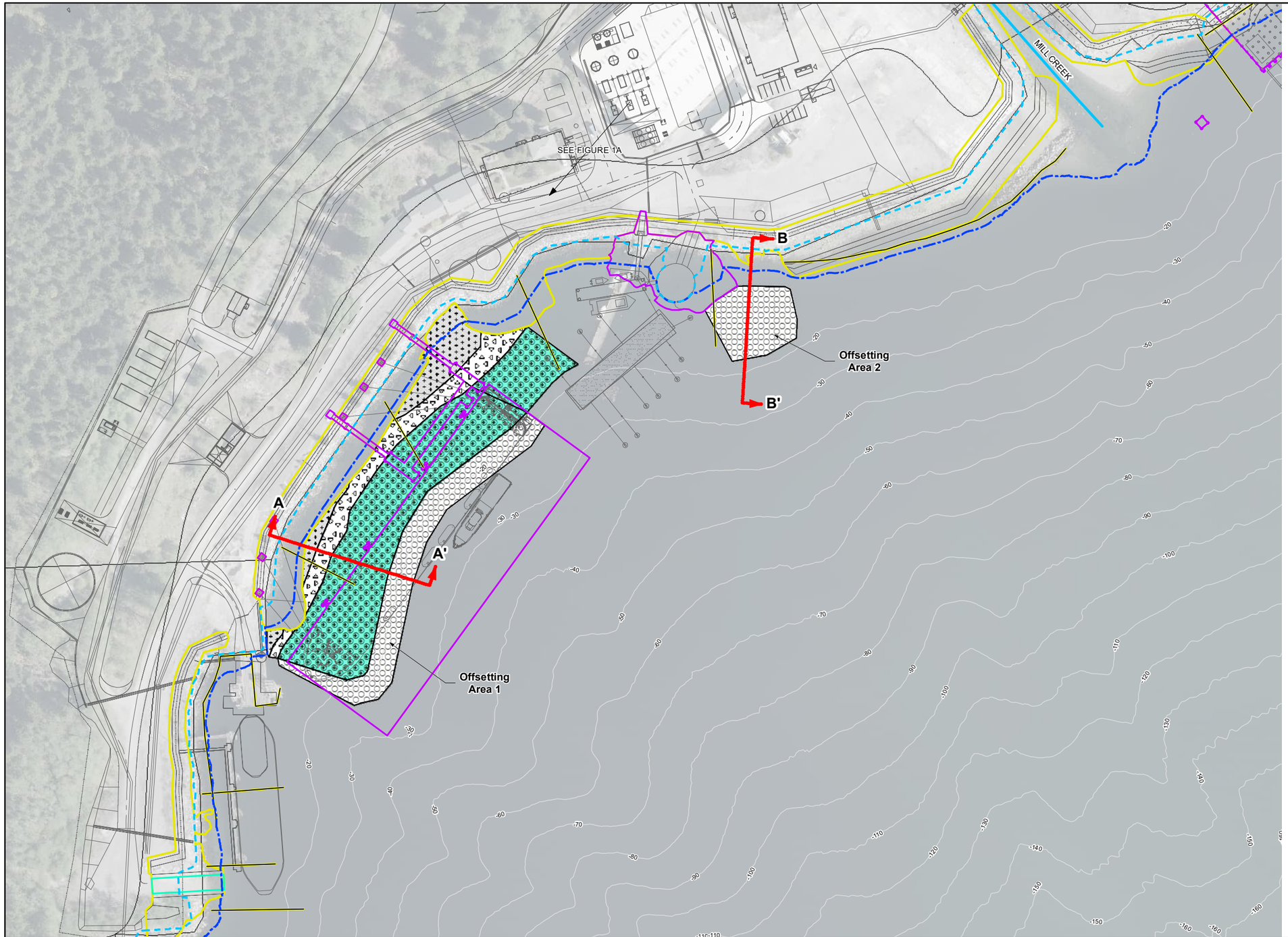
SCALE: 1:0 (approx.)

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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

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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.)

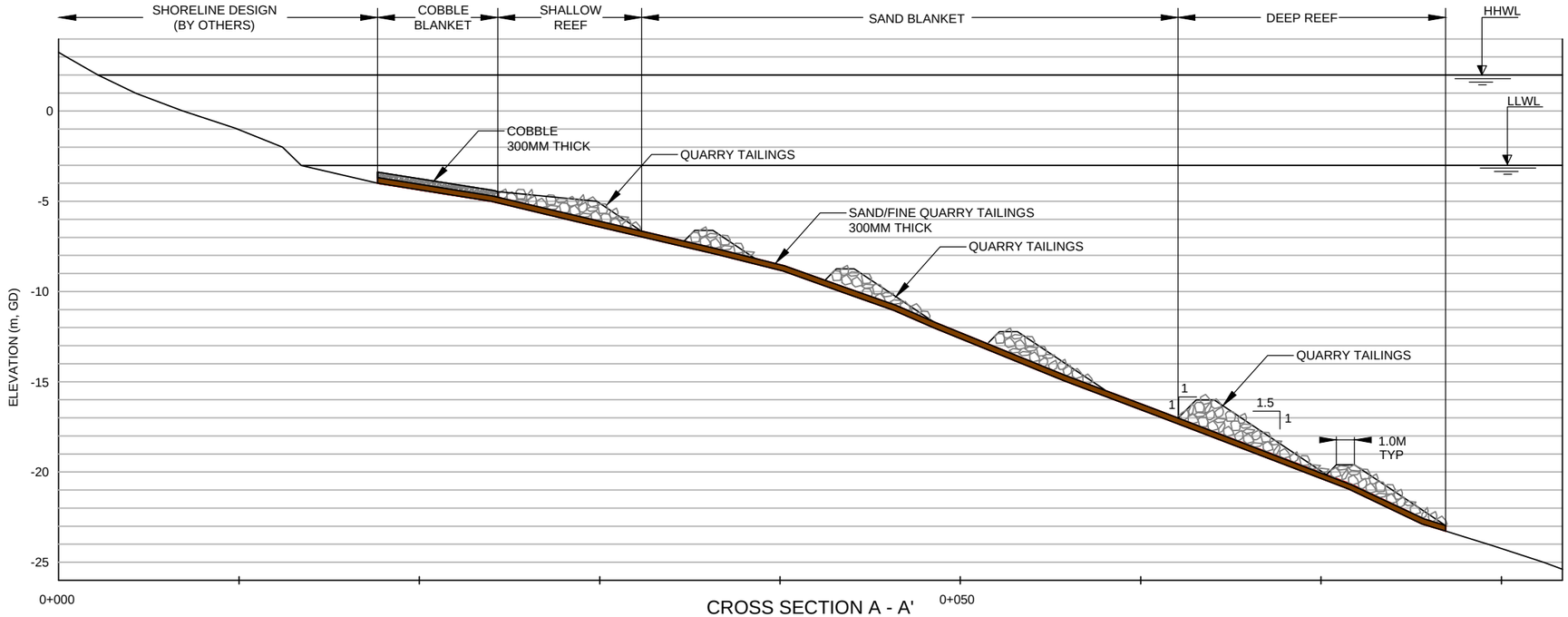
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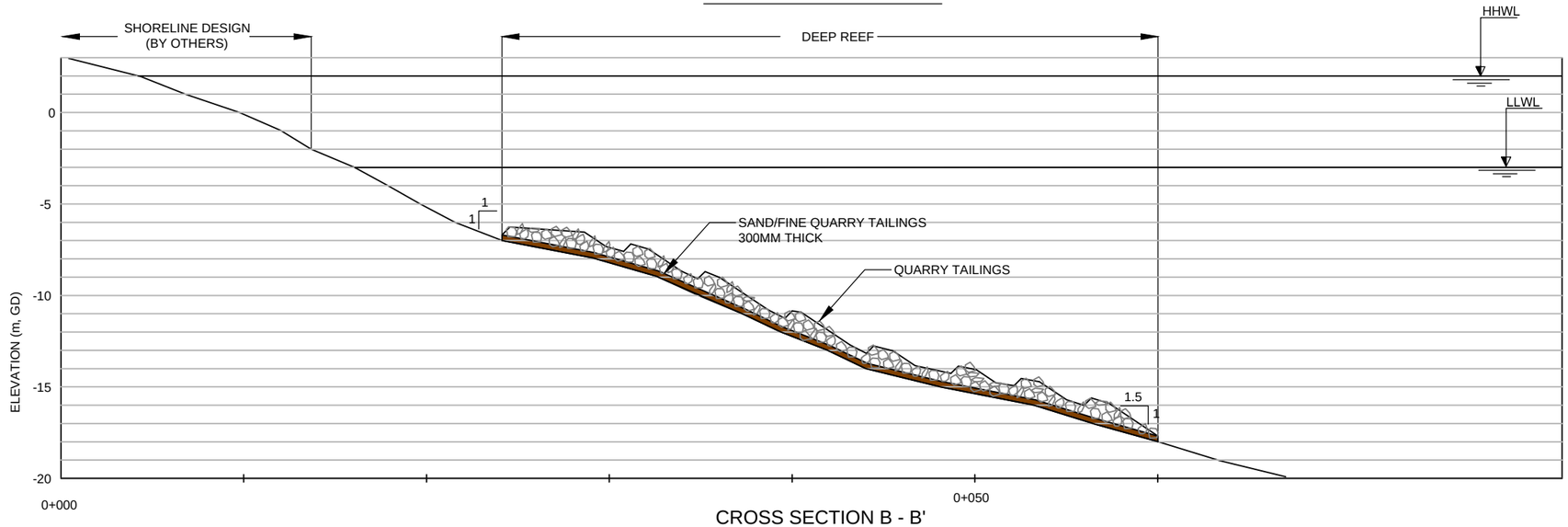
Figure 8-2A

Habitat Offsetting Options
(Southwest of Mill Creek)

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CROSS SECTION A - A'



CROSS SECTION B - B'

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5m 0 10m

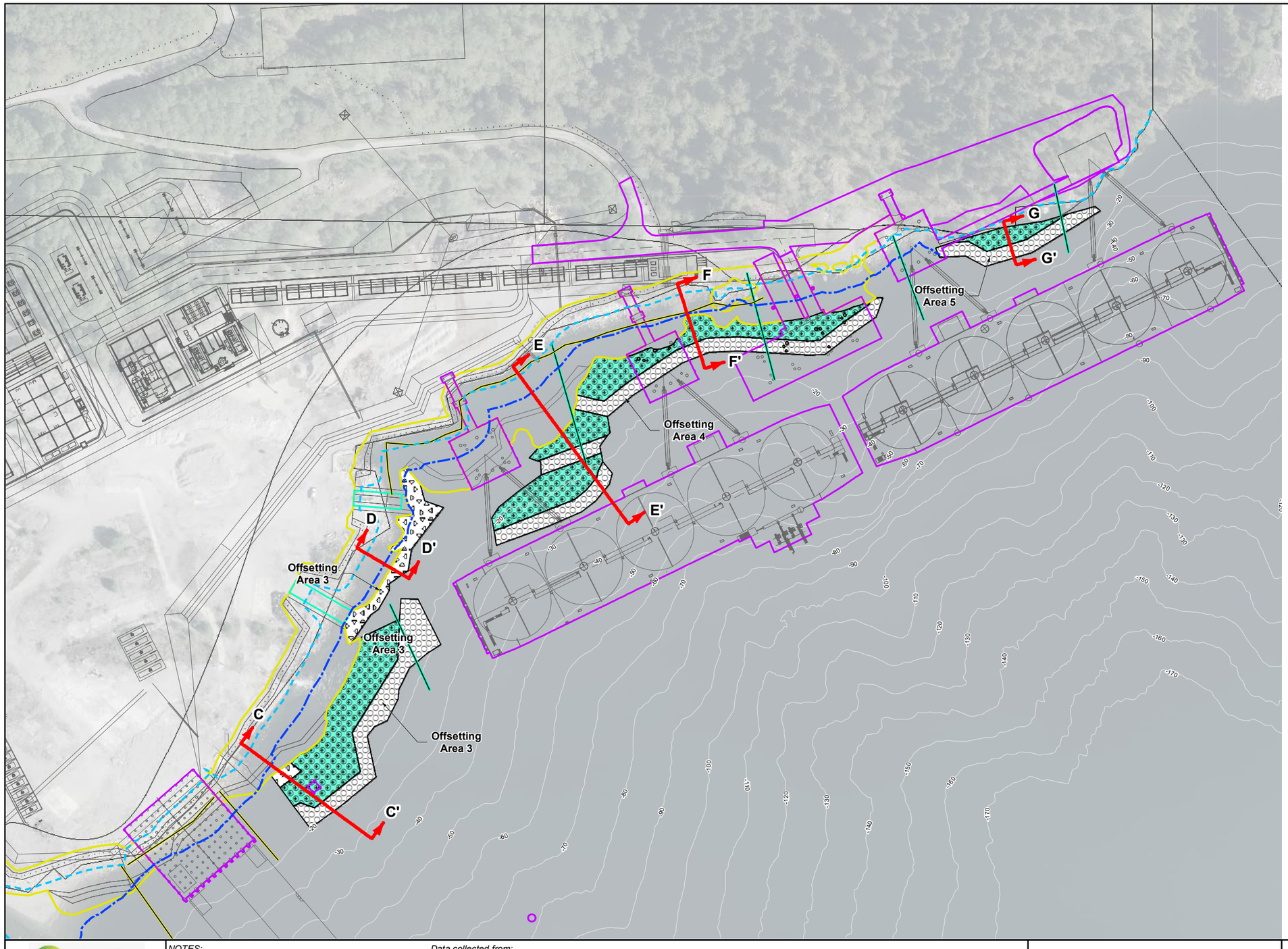
SCALE: 1:300(approx.)

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REVISION No.	DATE	PROJECT No.
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Figure 8-2B
Habitat Offsetting Sections A and B

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



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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

15 0 75 m

SCALE: 1:1,500 (approx.)

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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

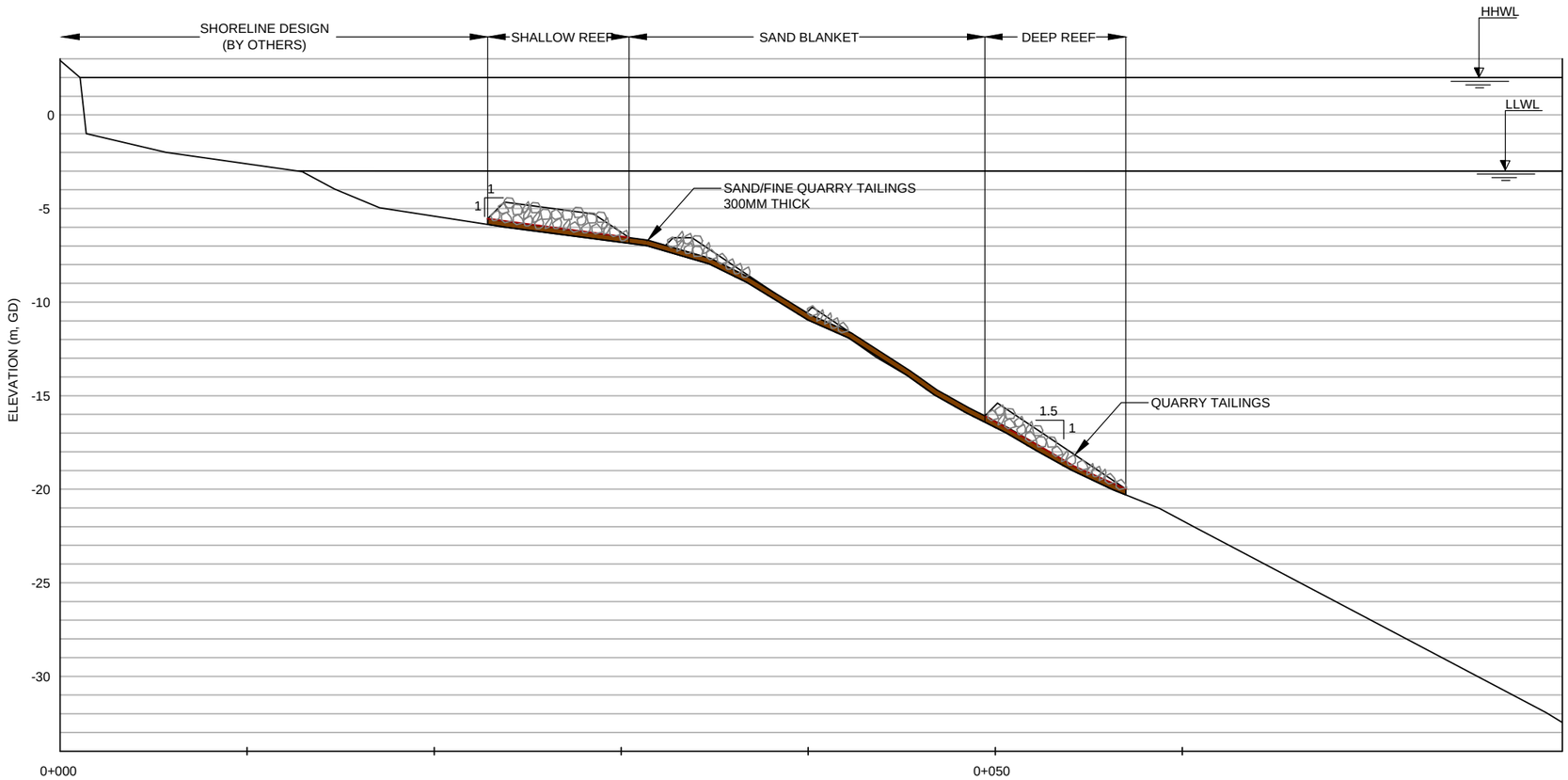
The shallow rock reef will be 2,463 m^2 and constructed of quarry tailing rock (D_{Max}=0.5 m) at -2 to -4 CD (-5 to -7m GD) as shown on **Figures 8-2B and 8-3B**. The top of the reef will generally be around -2 m CD to provide adequate insolation for kelp growth. The berm will act as a stabilizing rock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

8.5.4 Sand Blanket

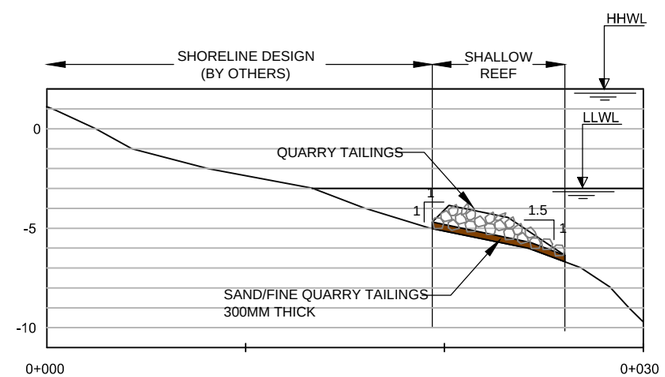
Sand blankets are proposed to be constructed on both sides of Mill Creek (**Figure 8-2A and 8-3A)**. The concept consists of a sand/ sparse gravel cap and is designed to improve habitat conditions for benthic infauna[4] (e.g., clams and worms).

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.

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



CROSS SECTION C - C'



CROSS SECTION D - D'

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5m 0 10m

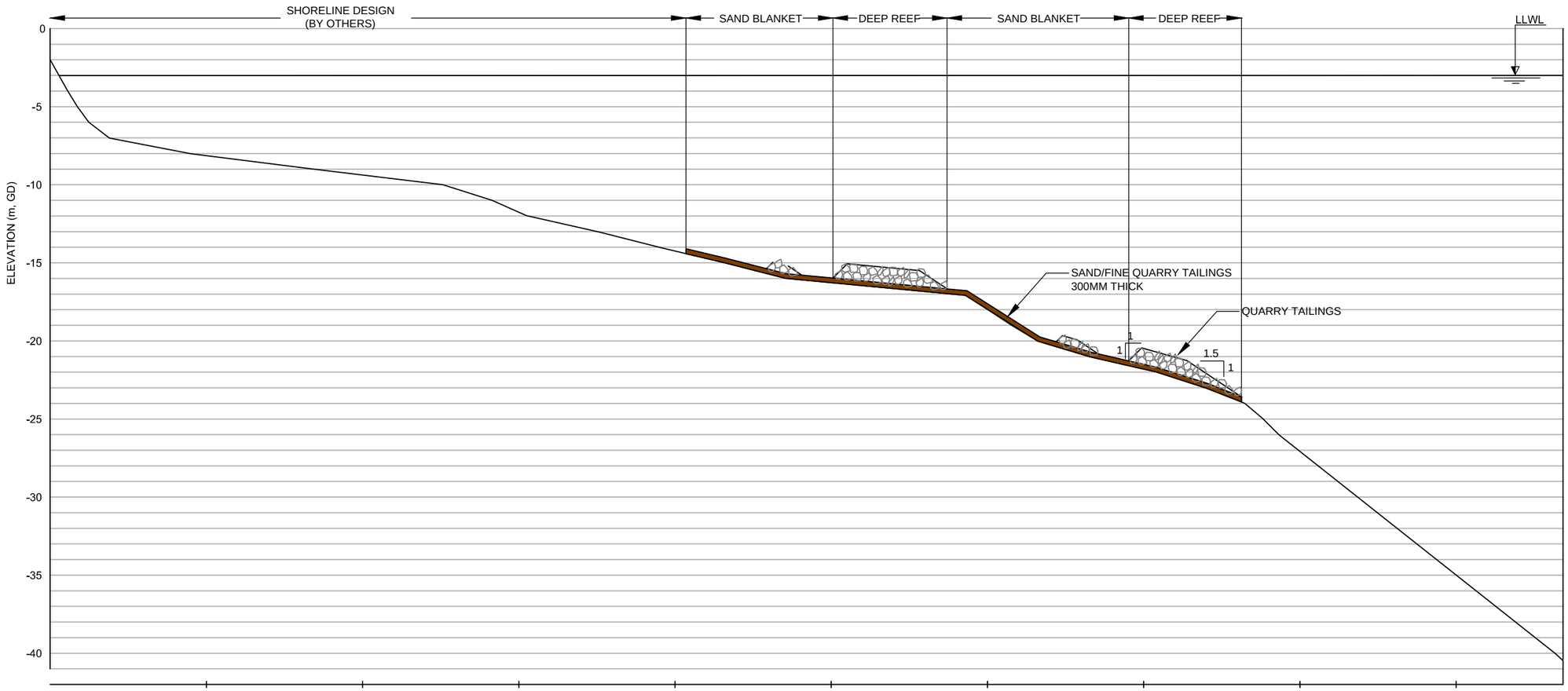
SCALE: 1:300(approx.)

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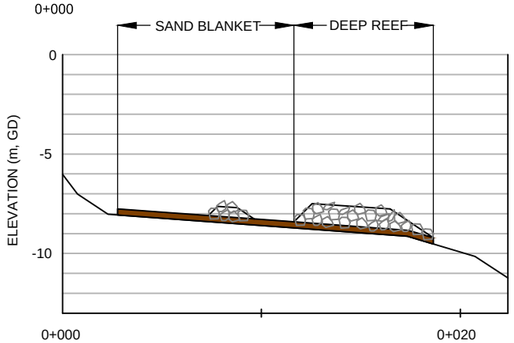
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Figure 8-3B
Habitat Offsetting Section C and D

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'

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5m 0 10m

SCALE: 1:300(approx.)

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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

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2. DATE OF AERIAL PHOTO IS 2019.

50 0 250 m

SCALE: 1:4,750 (approx.)

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Figure 84

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[5]
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[6]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**

[5] Monitoring is proposed for 5 periods over 7 years including years 1, 2, 3, 5, and 7 post-construction.
[6] 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

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.

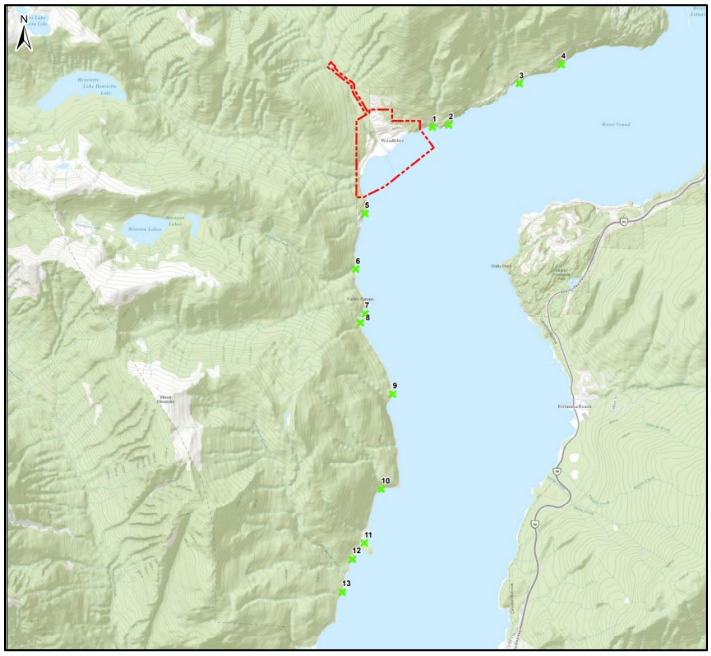


Figure 8-5 Potential offsetting reference site locations considered.

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

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 infuna. 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 shx̱wen̓ (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, Duncan Clark, and Professional(s) of Record and Warren Appleton, Senior Reviewer Warren Appleton, have demonstrable experience in the Marine Biology and are familiar with the investigation carried out at the Site.

This report has been reviewed and updated since the previous revision by Matt Husband, Varsha Rani, Nolan White, Carlos Moreno Rios, Duncan Clark. and Warren Appleton. Warren Appleton is the professional of record.

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.

August 15, 2023
Date

Keystone Environmental Ltd.

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Duncan Clark, R.P. Bio.
Senior Biologist

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Appendix F Marine Mammal Management and Monitoring Plan

Marine Mammal Management and Monitoring Plan

Woodfibre LNG Project: Rev 2

August 15, 2023

Prepared By:
Woodfibre LNG General Partner Inc.

123221624EN-RPT0009

Woodfibre LNG

Preamble

The Woodfibre Liquefied Natural Gas Project (the Project) is a liquefied natural gas export facility being constructed on the former Woodfibre Pulp and Paper Mill site in Átl'ḵa7tsem (Howe Sound), approximately seven kilometres south of Sḵwx̱wú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Átl'ḵa7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants, and to other Indigenous groups as defined in the Project's Environmental Assessment Certificates. The Project is also operating within the traditional, ancestral, and unceded territory of the səlilwətaɬ (Tsleil-Waututh) Nation. Woodfibre LNG General Partner Inc. recognizes the importance of these areas to the Sḵwx̱wú7mesh stélmexw (Squamish People), and other Indigenous groups. Woodfibre LNG General Partner Inc. seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Marine Mammal Management and Monitoring Plan is primarily written in English with important place names, species, phrases, and passages provided in the Squamish language.

Temíxwiẏiḵw chet wa naantem chet ti temíxw Swiẏát
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 Swiẏát
We, as their descendants safeguard these lands
We will continue to swim and fish in these clear waters.

Limitations and Sign-off

This document entitled Marine Mammal Management and Monitoring Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Woodfibre LNG General Partner Inc. (the "Client").[1] Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Qualified Professional Sign-off:

_____
Signature

_____
Andrea Ahrens, M.Sc., R.P.Bio

[1] A draft version of this Estéteýwilhs iy Ínexwantas ta Sekw'ekw'inexw (Marine Mammal Management and Monitoring Plan) was prepared by Hemmera, a subsidiary of Ausenco. The draft version has been revised and updated by Stantec Consulting Limited (Stantec) at the request of Woodfibre LNG General Partner Inc.

Table of Contents

PREAMBLE ..... **I**

LIMITATIONS AND SIGN-OFF ..... **II**

SQUAMISH-ENGLISH TRANSLATIONS ..... **V**

ABBREVIATIONS ..... **VI**

1.0 INTRODUCTION **1**
1.1 OBJECTIVE 6
1.2 PROJECT APPROVAL AND CONDITIONS 6
1.3 SQUAMISH NATION ENVIRONMENTAL ASSESSMENT AGREEMENT 11
1.4 APPLICATION TABLE 22-1 COMMITMENTS 13

2.0 REGULATORY FRAMEWORK **16**
2.1 REGULATORY REQUIREMENTS 16
2.2 FEDERAL REGULATIONS 16
2.2.1 Marine Mammal Regulations (SOR/93-56) of the *Fisheries Act* 16
2.2.2 *Species at Risk Act* 16

3.0 ROLES AND RESPONSIBILITIES **17**

4.0 MARINE MAMMAL SETTING **18**
4.1 MARINE MAMMALS 18
4.2 UNDERWATER NOISE 20
4.3 VESSEL TRAFFIC LEVELS 20

5.0 MARINE MAMMAL MITIGATION MEASURES **21**
5.1 BEST MANAGEMENT PRACTICES AND GUIDELINES 21
5.1.1 Acoustic Thresholds 21
5.1.2 In-Water and Near-shore Land-Based Blasting 22
5.1.3 Pile Installation 23
5.2 GENERAL MITIGATION MEASURES 23
5.3 UNDERWATER NOISE 31
5.3.1 Importance of Sound to Marine Mammals 31
5.3.2 Environmental Assessment Effects Summary 31
5.3.3 Underwater Acoustic Noise Modelling 32
5.4 VESSEL STRIKES 33
5.4.1 Environmental Assessment Effects Summary 34

6.0 MARINE SHIPPING ASSOCIATED WITH THE PROJECT OUTSIDE OF ÁTL'ḴA7TSEM (HOWE SOUND) **35**

7.0 MARINE MAMMAL ÍNEXWANTAS (MONITORING) AND ADAPTIVE MANAGEMENT 36
7.1 ÍNEXWANTAS (MONITORING) 36
7.1.1 Pile Installation and Blasting 36
7.1.2 Shoreline Revetment Work 37
7.1.3 Project Operations 37
7.1.4 Adaptive Management 38

8.0 REPORTING AND COMMUNICATIONS 39
8.1 ÍNEXWANTAS (MONITORING) REPORTS 39
8.2 ENVIRONMENTAL INCIDENT REPORTS 40
8.3 RECORDS OF INFORMATION 40

9.0 REFERENCES 42
9.1 LITERATURE CITED 42
9.2 PERSONAL COMMUNICATIONS 44

LIST OF TABLES

Table 1: EAC Conditions Relevant to the Marine Mammal Management and Monitoring Plan 7
Table 2: FDS Conditions Relevant to the Marine Mammal Management and Monitoring Plan 9
Table 3: Marine Mammal Mitigation Measures Related to Construction in Table 22-1 of the Application 13
Table 4: Marine Mammal Species Potentially Occurring in Átl'ka7tsem (Howe Sound) 19
Table 5: Mitigation Measures for Marine Mammals During Construction and Operations 24
Table 6: Construction Activity-based Estimated Distances To SPL Threshold Criteria 33

LIST OF FIGURES

Figure 1: Location Overview 2
Figure 2: Certified Project Area and Key Project Components 3
Figure 3: Project Location and Marine Transportation Passage Routes 5

LIST OF APPENDICES

APPENDIX A UNDERWATER NOISE DATA SHEET A.1

APPENDIX B MARINE MAMMAL OBSERVATION FORM B.1

Squamish-English Translations

Squamish	English
asxw	harbour seal
Átl'ka7tsem	Howe Sound
Estéteýwilhs iy Ínexwantas ta Sekw'ekw'inexw tla Shkweń	Marine Mammal Mitigation and Monitoring Plan
ínexwantas	monitoring
kw'únut'	porpoise/dolphin
kwenís	grey whale/minke whale
kwexnís	Steller sea lion/California sea lion
cháyilhen	salmon
sekw'ekw'inexw	wildlife
skwúmechn	humpback whale
Skwxwú7mesh	Squamish
Skwxwú7mesh stélmexw	Squamish people
Skwxwú7mesh Úxwumixw	Squamish Nation
slhawt'	herring
sts'úkwi7	fish
yéwyews	orca (southern resident and transient) killer whale

Abbreviations

µPa	micropascal
Application	Application for an Environmental Assessment Certificate
BC	British Columbia
BC EAO	British Columbia Environmental Assessment Office
BCCSN	British Columbia Cetacean Sightings Network
BMP	best management practice
CEMP	Construction Environmental Management Plan
CPA	Certified Project Area
dB	decibel
DFO	Fisheries and Oceans Canada
EAC	Environmental Assessment Certificate
ECHO	Enhancing Cetacean Habitat and Observation
FDS	Federal Decision Statement
FSO	floating storage and offloading
km	kilometre
kPA	kilopascal
LAA	Local Assessment Area
LNG	liquefied natural gas
MMMMP	Marine Mammal Management and Monitoring Plan
MMO	Marine Mammal Observer
NOAA Fisheries	National Marine Fisheries Service of the National Oceanic and Atmospheric Administration
the Project	Woodfibre Liquefied Natural Gas Project
QP	Qualified Professional
RAA	Regional Assessment Area
rms	root mean square
SARA	*Species at Risk Act*

SNEAA	Squamish Nation Environmental Assessment Agreement
SPL	sound pressure level
TERMPOL	Technical Review Process of Marine Terminal Systems and Transshipment Sites
Woodfibre LNG	Woodfibre LNG General Partner Inc.

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) (Figure 1). The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the liquefied natural gas (LNG) via tankers.

The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- an environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (EAC #E15-02) in 2015;
- an environmental assessment approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015, and;
- a positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016.

Two EAC amendments were granted by the BC Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address.

Most of the Project is on fee simple, industrially zoned, brownfield lands with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Átl'ḵa7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro, and gas will be supplied to the facility by Fortis BC.

The CPA and key project components are illustrated in Figure 2. Key project components are:

- land-based natural gas processing and liquefaction facilities
- a floating storage and offloading unit
- construction worker accommodation
- supporting infrastructure

The supporting infrastructure includes buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.

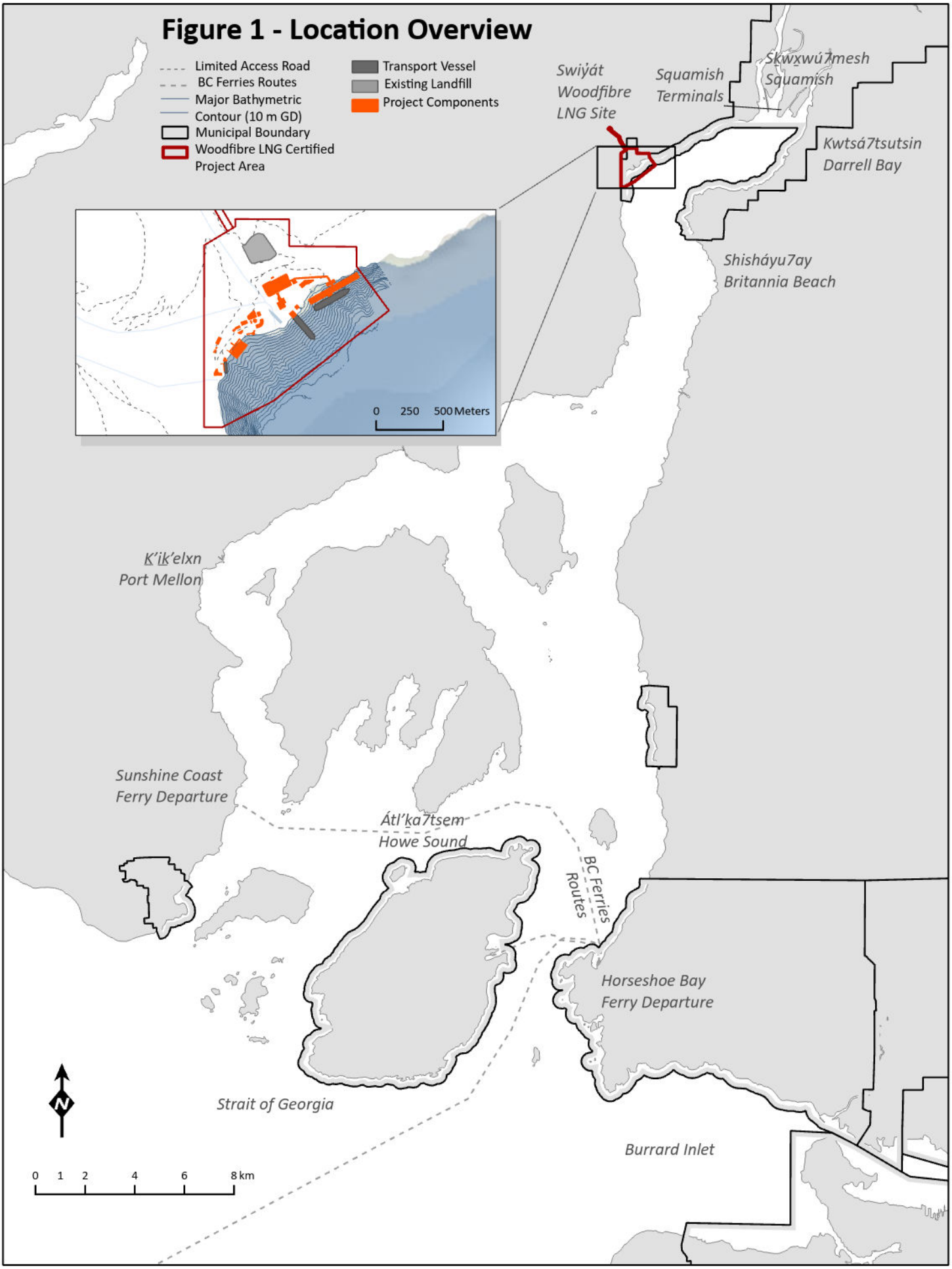
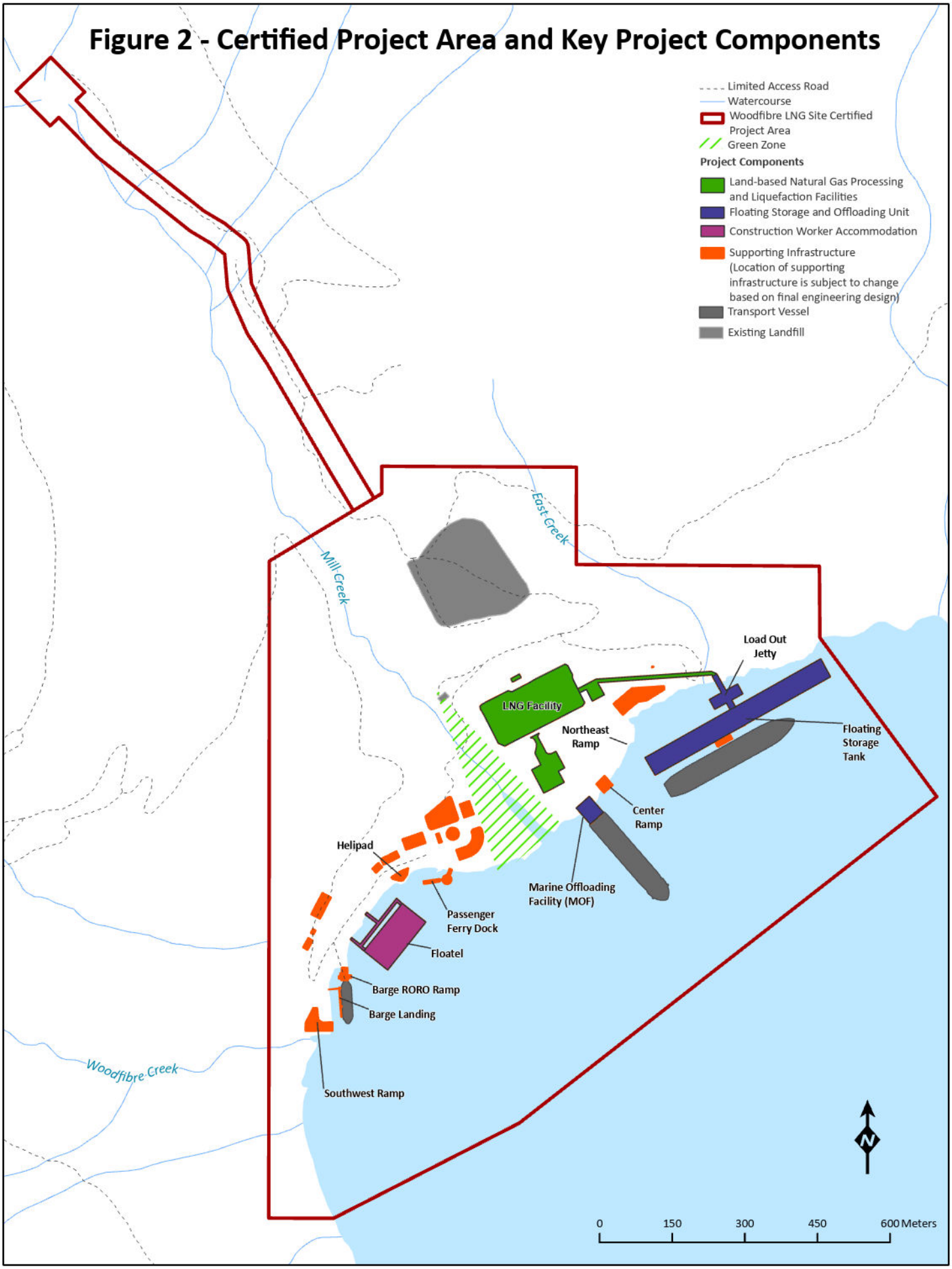

Figure 1 - Location Overview
Limited Access Road
BC Ferries Routes
Major Bathymetric Contour (10 m GD)
Municipal Boundary
Woodfibre LNG Certified Project Area
Transport Vessel
Existing Landfill
Project Components
Swiy̓át
Woodfibre LNG Site
Squamish Terminals
Sḵwx̱wú7mesh Squamish
Kwtsá7tsutsin Darrell Bay
Shishá̱yu7ay Britannia Beach
0 250 500 Meters
K'ik'elxn Port Mellon
Sunshine Coast Ferry Departure
Átl'ka7tsem Howe Sound
BC Ferries Routes
Horseshoe Bay Ferry Departure
Strait of Georgia
Burrard Inlet
N
0 1 2 4 6 8 km

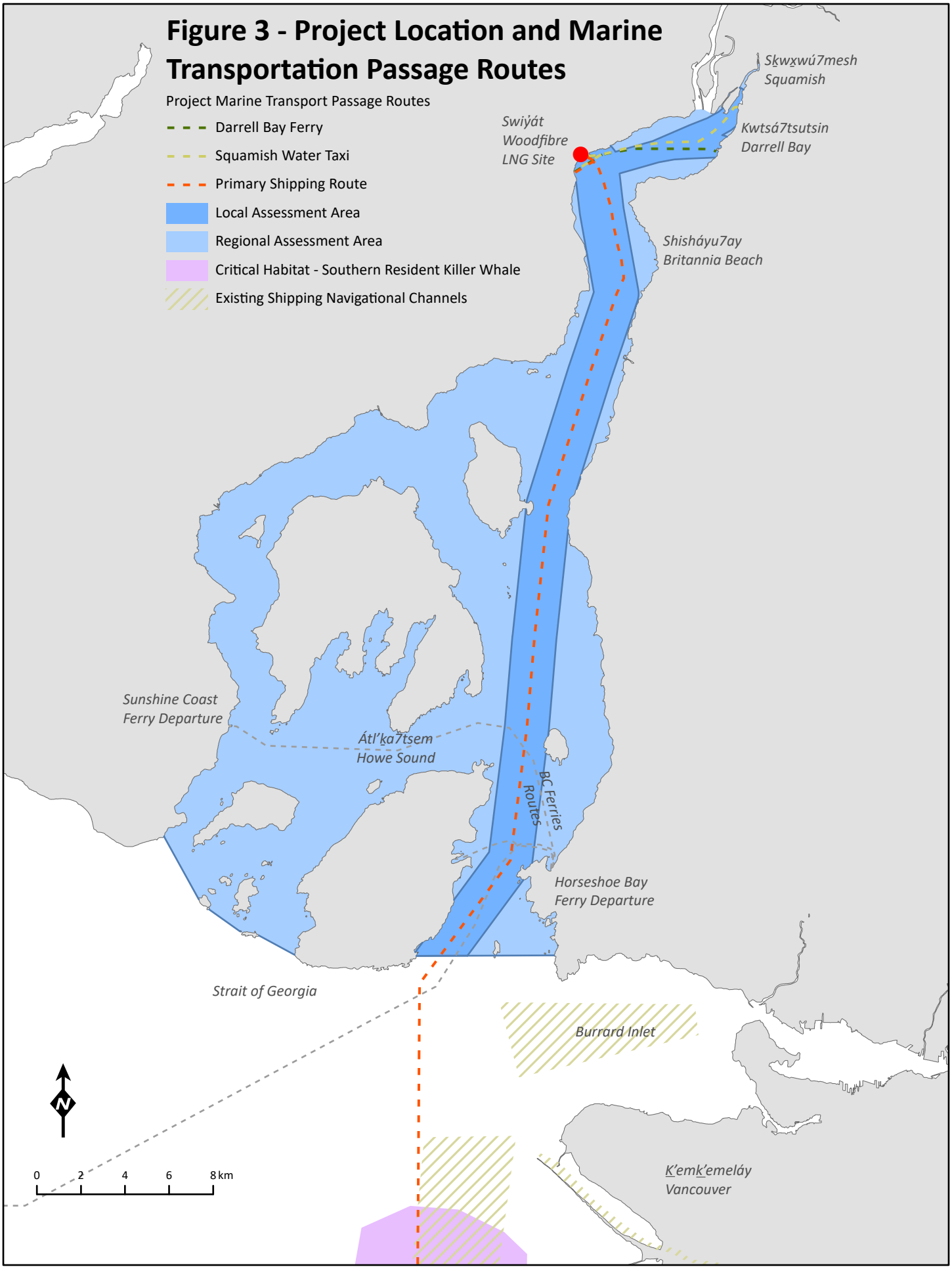
Figure 2 - Certified Project Area and Key Project Components



The works and activities that will occur as part of construction include, but are not limited to:

- marine early works (e.g., shoreline improvements and armoring, dock replacement or repairs), including improvements to the existing in-service (east and south) barge landing
- clearing vegetation and grubbing
- stripping and grading
- drilling and blasting, including excavation, crushing, screening, and hauling
- grouting and rock stabilization
- road, culvert, and bridge works
- construction of land-based natural gas processing and liquefaction facility
- construction support structures, services, and equipment
- construction of the floating storage and offloading unit
- marine facility construction of mooring dolphin supports and connecting trestles and gangways
- dredging if required

Figure 3 shows the Project location and primary shipping routes.


Figure 3 - Project Location and Marine Transportation Passage Routes
Project Marine Transport Passage Routes
Darrell Bay Ferry
Squamish Water Taxi
Primary Shipping Route
Local Assessment Area
Regional Assessment Area
Critical Habitat - Southern Resident Killer Whale
Existing Shipping Navigational Channels
Sḵwx̱wú7mesh
Squamish
Swiýát
Woodfibre
LNG Site
Kwtsá7tsutsin
Darrell Bay
Shisháyu7ay
Britannia Beach
Sunshine Coast
Ferry Departure
Átl'ka7tsem
Howe Sound
BC Ferries
Routes
Horseshoe Bay
Ferry Departure
Strait of Georgia
Burrard Inlet
K'emḵ'emeláy
Vancouver
N
0
2
4
6
8 km

1.1 OBJECTIVE

The primary objective of this Estéteýwilhs iy Ínexwantas ta Sekw'ekw'inexw tla Shkweń (Marine Mammal Management and Monitoring Plan [MMMMP]) is to detail mitigation measures and ínexwantas (monitoring) protocols that will be employed to reduce the potential for adverse effects on marine mammals during construction and operation of the Project. This includes information on requirements for:

- ínexwantas (monitoring) activities
- procedures for reporting Project interactions with marine mammals
- implementation of best management practices (BMPs) and mitigation measures identified in the environmental assessment and provincial and federal environmental assessment conditions.

This MMMMP is a living document and revisions will be made if relevant new information becomes available through the progression of the detailed engineering design of the Project, changes in legislation or regulation, if performance objectives are not met, or as required by Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, and/or regulatory agencies. If the MMMMP requires updating, Woodfibre LNG will prepare a red-line version identifying the changes that are made. The red-line version will be issued to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, and regulatory agencies for a 30-day review and comment period. After comments are received, the document will be updated and issued as a clean final revision for approval by Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and for submittal to the BC EAO. As standard practice, the latest version of the MMMMP will be implemented.

Annual tracking of updates to the status of listed species identified by the Government of British Columbia through the British Columbia Conservation Data Centre, Committee on the Status of Endangered Wildlife in Canada, or the *Species at Risk Act* (SARA) will be completed by Woodfibre LNG. Updates to the status of listed species will be included in annual ínexwantas (monitoring) reports. As necessary, additional BMPs or mitigation measures will be implemented to reduce or avoid effects of the Project on the affected species in accordance with species recovery plans should the status of a listed species change during construction of the Project.

1.2 PROJECT APPROVAL AND CONDITIONS

The following are the Project's marine mammal-related conditions:

- EAC Conditions 9 and 17
- FDS Conditions 3.3, 3.8, 3.9, 3.10, and 3.14
- SNEAA Condition 4.10(a)(iv) and 4.12
- Project commitments presented in Sections 5.19 and 13.0 of Woodfibre LNG's EAC Application (Application).

Concordance tables that cross-reference the sections of this MMMMP to the specific conditions are provided for the provincial (Table 1), and federal (Table 2) environmental assessment decisions. The Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) assessment process and conditions are discussed in Section 1.3. Project construction-related marine mammal commitments from the Application are provided in Section 1.4. Consistent with the commitments made during the environmental assessment, the BMPs and standards were used to inform this MMMMP, as described below.

Comments received during consultation on the development of this MMMMP, and Woodfibre LNG's responses, are provided in a Consultation Record, as required by EAC Condition 2.

Table 1: EAC Conditions Relevant to the Marine Mammal Management and Monitoring Plan

Condition Number	Condition	MMMMP Reference
EAC Condition 9	The Holder must develop, in consultation with DFO, OGC and Aboriginal Groups, a marine mammal management and monitoring plan for Construction that must at a minimum: a) Set out the means by which the mitigation measures related to Construction in the Application Table 22-1 under the heading "Marine Mammals" will be implemented; b) Identify the geographic areas where, and periods of time when, Construction could cause injury to marine mammals; c) Identify the geographic areas where, and periods of time when, Construction could cause behavioural change to marine mammals; d) Identify the time periods when elevated marine mammal occupancy is anticipated within the areas of potential injury to marine mammals or areas of potential behavioural change; e) Specify the role of a Qualified Professional in observing and reporting marine mammals in the areas of potential injury to marine mammals during Construction; f) Specify the Construction activities (e.g., blasting, pile driving) which must stop or not start if a marine mammal is sighted in the areas of potential injury to marine mammals, and not re-start until the marine mammal has moved out of the relevant area, to the satisfaction of the Qualified Professional; g) Specify mitigation measures for Construction underwater noise that will prevent or reduce behavioural change or injury to marine mammals; and h) A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO no less than 60 days prior to the Holder's planned date to commence Construction in the marine environment. The Holder must provide the plan to EAO, DFO, OGC and Aboriginal Groups no less than 30 days prior to the Holder's planned date to commence Construction in the marine environment. The Holder must implement the plan to the satisfaction of EAO.	Section 1.2 Section 5.0 Section 7.0 Section 4.0 Section 3.0

Table 1: EAC Conditions Relevant to the Marine Mammal Management and Monitoring Plan

Condition Number	Condition	MMMMP Reference
EAC Condition 17	The Holder must develop, in consultation with TC, CCG, Pacific Pilotage Authority, DFO and Aboriginal Groups, a marine transport management and monitoring plan for Operations. The plan must identify at a minimum: a) The means by which the marine transportation mitigation measures related to Operations in the Application Table 22-1 under the heading "marine transportation & use" (section 7.3, M5.19-3, M6.3-1, M7.3-1 – M7.3-17) will be implemented; b) Operations activities that have the potential to interfere with marine navigation; c) Existing and traditional navigational routes, fishing areas, habitat areas, harvesting areas, commercial shipping use, recreational and tourism use, Aboriginal Groups' use, and any associated timing windows; d) Methods to inform affected stakeholders and Aboriginal Groups of potential interference with marine navigation as a result of Operations activities; e) Mitigation measures to reduce disruption of marine navigation in Howe Sound as a result of Operations activities; f) Practices to reduce disruption and collision risk with marine mammals along the shipping route in Howe Sound; g) Methods to inform the public, commercial marine user groups, and Aboriginal Groups about the results of the Technical Review Process of Marine Terminal Systems and Transshipment Sites (TERMPOL) process respecting the Project; and h) Methods to monitor the effects of the Holder's shipping activities during Operations. The Holder must provide the plan to EAO no less than 60 days prior to the Holder's planned date to commence Operations. The Holder must also provide the final plan to TC, CCG, Pacific Pilotage Authority, DFO, the DOS, BC Ferries, Squamish Terminals and Aboriginal Groups. The Holder must implement the plan to the satisfaction of EAO.	Section 5.4 Section 6.0
The regulator name in the conditions reflect the names that were in place when the conditions were written. OGC (Oil and Gas Commission) is now BC Energy Regulator		

Table 2: FDS Conditions Relevant to the Marine Mammal Management and Monitoring Plan

Condition Number	Condition	MMMMP Reference
FDS Condition 2.4	The Proponent shall, where a follow-up program is a requirement of a condition set out in this Decision Statement: 2.4.1 Undertake monitoring and analysis to verify the accuracy of the environmental assessment as it pertains to the particular condition and/or to determine the effectiveness of any mitigation measure(s); 2.4.2 Determine whether additional mitigation measures are required based on the monitoring and analysis undertaken pursuant to condition 2.4.1; and 2.4.3 If additional mitigation measures are required pursuant to condition 2.4.2, implement the additional mitigation measures and monitor them pursuant to condition 2.4.1.	Section 7.0
FDS Condition 2.5	Where consultation with Aboriginal groups is a requirement of a follow-up program, the Proponent shall discuss with each Aboriginal group opportunities for the participation of that Aboriginal group in the implementation of the follow-up program as set out in condition 2.4.	Section 7.0
FDS Condition 3.3	The Proponent shall implement measures to mitigate adverse environmental effects of the Designated Project on fish, including mortality, physical injury, and behavioral change, during all phases of the Designated Project. The mitigation measures shall include: 3.3.5 Taking into consideration the British Columbia Marine and Pile Driving Contractors Association's Best Management Practices for Pile Driving and Related Operations 2003 when conducting pile installation; and 3.3.6 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.	Section 5.1
FDS Condition 3.8	The Proponent shall establish and maintain marine mammal underwater noise impact areas[2] for all construction activities to avoid adverse behavioural change in or injury to marine mammals. In doing so, the Proponent shall: 3.8.1 Identify each construction activity that generates underwater noise levels greater than 160 decibels and 190 decibels at a reference pressure of one micropascal and the periods of time when each activity occurs; 3.8.2 For all marine mammals except pinnipeds, establish the boundary of the underwater noise impact area for each construction activity identified in condition 3.8.1 at the distance from the activity where the underwater noise level is predicted to reach 160 decibels;	Section 5.2 Section 7.0

[2] The term 'underwater noise impact area' referenced in the FDS conditions is used synonymously with 'exclusion zone', 'exclusion area', and 'safety area', in this and other conditions and commitments made in this MMMMP.

Table 2: FDS Conditions Relevant to the Marine Mammal Management and Monitoring Plan

Condition Number	Condition	MMMMP Reference
FDS Condition 3.8 (cont'd.)	3.8.3 For pinnipeds, establish the boundary of the marine mammal underwater noise impact area for each construction activity identified in condition 3.8.1 at the distance from the activity where underwater noise levels reach 190 decibels or at a distance of 150 metres, whichever is the greater distance; 3.8.4 Employ a marine mammal observer, who is a qualified individual, and require that person to detect and report the presence of marine mammals in the marine mammal underwater noise impact areas identified in conditions 3.8.2 and 3.8.3 during construction activities identified in condition 3.8.1; 3.8.5 Stop or not start the construction activities identified in condition 3.8.1 if marine mammal(s) are detected in their respective marine mammal underwater noise impact areas identified in condition 3.8.2 or condition 3.8.3, and only begin or continue the construction activities identified in condition 3.8.1 once the marine mammal(s) have moved out of their respective underwater noise impact area; 3.8.6 Implement mitigation measures, including sound dampening technology such as bubble curtains and soft-start procedures, to reduce construction noise levels in the underwater noise impact areas identified in conditions 3.8.2 and 3.8.8. 3.8.7 Monitor continuously the levels of underwater noise at the boundaries of both marine mammal underwater noise impact areas while the construction activities identified in condition 3.8.1 are ongoing. The Proponent shall immediately halt the construction activities if hydroacoustic monitoring indicates that noise levels at either boundary exceed their respective threshold, and not resume without implementing sound attenuation measure(s), which could include increasing the distance of the underwater noise impact areas, to reduce noise levels below the thresholds.	Section 5.2 Section 7.0
FDS Condition 3.9	The Proponent shall require that liquefied natural gas (LNG) vessels associated with the Designated Project respect speed profiles applicable to the operation of the Designated Project, subject to navigational safety, to prevent or reduce the risks of collisions between LNG vessels and marine mammals.	Section 5.4
FDS Condition 3.10	The Proponent shall require that LNG vessels and tug operators associated with the Designated Project report collisions with marine mammals in Howe Sound to the Canadian Coast Guard within two hours of a collision occurrence, and notify Aboriginal groups in writing.	Section 5.4.1
FDS Condition 3.14	The Proponent shall, in consultation with Fisheries and Oceans Canada and Aboriginal 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 8.0

1.3 SQUAMISH NATION ENVIRONMENTAL ASSESSMENT AGREEMENT

The Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment process for the Project was designed to parallel the provincial and federal environmental assessment processes, whereby Project effects on the Sḵwx̱wú7mesh stélmexw (Squamish people's) rights and title interests are identified, understood, and properly avoided or mitigated. The process for the Project ultimately resulted in the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) issuing an EAC (#2015-001), which includes conditions described in the SNEAA that was issued on October 14, 2015. Per SNEAA, "*Squamish Nation has agreed that Woodfibre may proceed with carrying out the Project, subject to Woodfibre LNG meeting, and (as applicable) continuing to meet, the Squamish Nation Conditions as provided for in this Agreement*."

The SNEAA Condition 12, which has applicability to the MMMMP, states

4.12 Binding Mitigation Measures - Squamish Condition #12

(a) Woodfibre LNG identifies approximately 119 distinct mitigation measures in Table 22-1 of Woodfibre LNG's EA application. If Squamish Nation determines that it wishes to monitor any of the mitigation measures, then Squamish Nation will issue a notice to Woodfibre LNG identifying which mitigation measures it intends to monitor ("Monitored Mitigation Measures") and the manner it proposes to undertake such monitoring.

(b) Where Squamish Nation is of the opinion that any Monitored Mitigation Measure is not being followed, it will notify Woodfibre LNG. Woodfibre LNG will respond to the notification with one of the following (the "'Response"):

(i) Woodfibre LNG's explanation of how the mitigation measure is being followed;

(ii) a written explanation why the mitigation measure is not being followed, and the measure that replaces it (with an explanation of how the new measure provides equal or greater levels of environmental protection);

(iii) A written explanation of why the mitigation measure is not being followed, with justification for:

a. why it has not been replaced with another measure, or

b. why it has been replaced with a measure that provides less levels of environmental protection

(c) Woodfibre LNG will develop a Monitored Mitigation Measures plan with the Squamish Nation that will include the frequency of guided tours for the Squamish Nation during construction and operations and a budget to implement the plan, which plan will be fully funded by Woodfibre LNG.

(d) Should Squamish Nation not be satisfied with the Response, then the Squamish Nation may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the Response is at issue the expert or expert panel shall consider the following when making its decision: whether the mitigation measure has a material impact on constructability, cost, operability, safety, environment, or schedule; whether the mitigation measure creates unacceptable risk or legal liability for the Project; whether the mitigation measure conflicts with any legal, regulatory, or pre-existing contractual obligations of Woodfibre LNG; whether the Woodfibre LNG response to the proposed mitigation measure(s) conforms to Good Industry Practice; and any other information the expert or expert panel considers relevant.

Per Condition 6 (Section 4.6) of the SNEAA, the MMMMP is considered a Regulated Environmental Management Plan, meaning that it is an Environmental Management Plan requiring approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) in accordance with Section 4.6(e) of the SNEAA.

The SNEAA Condition 10, which has applicability to the MMMMP, states

4.10 Marine Mammals - Squamish Condition #10

(a) Woodfibre LNG agrees to conduct a noise monitoring program that will involve collecting data from a hydrophone deployed within the Project area, the purpose of which program will be:

(iv) to collect local data on underwater sound levels;

(v) to supplement existing data on presence, frequency and seasonality of use by marine mammals;

(vi) to establish baseline data against which to compare ambient underwater sound levels and marine mammal use throughout the life of the Project; and

(vii) prior to commencement of construction, prepare, for approval by Squamish Nation in accordance with section 4.6, an Underwater Noise Management Plan and a Marine Mammals Management Plan that include mitigation measures and monitoring programs designed to address potential residual adverse effects on marine mammals from underwater noise.

(b) Woodfibre LNG will participate in studies of sub-lethal acoustic impacts on marine mammals by sharing its noise monitoring data and marine mammal monitoring data collected in respect of the Project, where and when such data are requested by qualified and reputable researchers. Woodfibre LNG also agrees to adopt in its adaptive management framework progressive strategies to minimize cumulative impacts on underwater noise on marine mammals. Woodfibre LNG's funding commitment for this work will be as set out in the IBA.

Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) is not an author of the MMMMP, nor does Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) hold any liability for implementation of this plan as it relates to more general marine navigation and commercial or recreational activities. In respect of the MMMMP being a Regulated Environmental Management Plan, and in accordance with Condition 6 of the SNEAA, a draft of the MMMMP was reviewed by a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Working Group representative. That draft review clarified Sḵwx̱wú7mesh Úxwumixw (Squamish Nation's) expectations for final approval of this plan. A key condition of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation's) approval of the MMMMP is the living nature of this document; it is anticipated that through the construction period, unforeseen conflicts may occur between Project marine traffic and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) members' marine activities. The protocols included in this MMMMP are intended to identify and respond to evolving or unforeseen concerns.

1.4 APPLICATION TABLE 22-1 COMMITMENTS

A concordance table that cross-references the sections of this MMMMP to the construction-related marine mammal commitments in Table 22-1 of the Application[3] is provided in Table 3. The mitigation measures in Table 3 are provided as proposed in Table 22-1 of the Application; further detail on how these mitigation measures will be implemented is described in the respective MMMMP sections referred to in the table.

Table 3: Marine Mammal Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the MMMMP
M5.17-6	**Underwater Noise Management Plan** Woodfibre LNG Limited will prepare and implement an Underwater Noise Management Plan as a component of the Marine Works Management Plan (M5.10-1) to mitigate potential mortality and behavioural changes to birds, fish and marine mammals. The plan will reference DFO's BMP for Pile Driving and Related Operations (BCMPDCA and DFO 2003), and will contain the following measures: Pile Driving and Related Activities: • Multiple underwater noise generating activities will be minimized when practicable (e.g., avoid multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced to minimize construction duration. • Works in the marine environment will be conducted during the least risk fisheries work window specified by DFO for the region unless otherwise agreed upon by DFO. The prescribed work window for Howe Sound is August 16–January 31 (DFO 2014b).	Section 5.1 Section 5.2 Section 7.0

[3] At the time the Application, including Table 22-1 was submitted, the company name was Woodfibre LNG Limited but it is now Woodfibre LNG General Partner Inc. The commitments as written and presented herein remain unchanged from the Application.

Table 3: Marine Mammal Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the MMMMP
M5.17-6 (cont'd.)	• Where possible, pile driving activities will avoid impacting hard substrates to prevent disturbance to fish habitat. • The use of vibrational pile driving will be used where practical and feasible as impact pile driving is associated with louder sound pressure levels underwater. The use of vibro-hammers for pile installation minimizes the effects on fish by decreasing the anticipated noise levels. • A ramp up or soft start technique will be used. Where equipment allows, power will be built up slowly from a low energy start-up to give adequate time for marine wildlife to leave the vicinity before exposure to the maximum sound pressure level. There will be a soft start every time pile driving is resumed following an interval of no pile driving. • Underwater noise from pile driving activities will be monitored in accordance with the following: – Sound will not exceed 30 kPa at a distance of 1 m to 2 m from pilings; or – If the sound exceeds 30 kPa at a distance of 1 m to 2 m from pilings, measures will be taken to reduce either the intensity of the sound generated or the level of sound propagation through the water column. – The appropriate measures will be chosen based on practicality to the Project and effectiveness and may include: • Silt curtains around pile driving activities • Bubble curtains around pile driving activities • A vibratory hammer in place of an impact hammer for pile driving. Prior to pile driving, the perimeter of the pile driving area will be identified, so that work occurs within the confines of the pile driving area. Monitoring: The Environmental Monitor will be responsible for monitoring underwater noise and potential effects to wildlife, and implementing corrective mitigation measures if necessary (e.g., establishing safety zones in the event underwater noise levels exceed injury thresholds).	Section 5.1 Section 5.2 Section 7.0
M5.19-1	**Avoidance of Pile Driving on Hard Substrates** In addition to the mitigation measures described in M5.17-6, Woodfibre LNG will prevent pile driving activities from impacting hard substrates, where possible. During impact pile-driving activities, a qualified specialist marine mammal observer will monitor for marine mammals and will communicate presence or absence to the Contractor.	Section 7.1

Table 3: Marine Mammal Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the MMMMP
M5.19-2	**Marine Mammal Management Plan** Woodfibre LNG Limited will produce a Marine Mammal Management Plan for the Project. This plan will include vessel speed reductions and avoidance of marine mammals: • LNG carrier and other deep-sea vessel speeds will be kept at a maximum of 8 to 10 knots when operating in the LAA [Local Assessment Area, per the Application]. • All Project vessels will follow established shipping lanes/navigational routes typically used in the area. • All Project vessels will maintain a constant course and constant speed, to the extent practical, when operating in the RAA [Regional Assessment Area, per the Application]. • Under no circumstances, other than in the case of an emergency, will vessels approach within 200 m of any marine mammal. • If marine mammals approach within 200 m of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal. If it is not possible for a vessel to move away from or detour around a stationary marine mammal or group of marine mammals, the vessel will reduce its speed and wait until the animal(s) moves at least 200 m from the vessel prior to resuming speed. • During impact pile driving activities, a qualified specialist marine mammal observer will monitor for marine mammals and will communicate presence/absence to the Contractor.	Section 5.1 Section 5.4
M5.19-3	**Planning for Future Marine Traffic** Woodfibre LNG Limited will undertake additional passage planning concerning the interaction of future traffic in studies as part of the Technical Review Process under TERMPOL Code of Recommended Standards for the safety and Prevention of Pollution for Marine Transportation Systems and Related Assessment Procedures.	Section 5.4.1

2.0 REGULATORY FRAMEWORK

2.1 REGULATORY REQUIREMENTS

Regulation and management of marine mammals occurs primarily through the Marine Mammal Regulations (SOR/93-56) of the *Fisheries Act*, R.S.C. 1985, c. F-14, and SARA, S.C. 2002, c. 29. These Acts are administered by Fisheries and Oceans Canada (DFO) in partnership with other federal departments and are the main federal statutes that pertain to the conservation and protection of marine mammals.

2.2 FEDERAL REGULATIONS

2.2.1 Marine Mammal Regulations (SOR/93-56) of the Fisheries Act

Regulation and management of marine mammals in Canada occurs primarily through the *Fisheries Act*, R.S.C. 1985, c. F-14 (under which marine mammals are classified as 'fish' for regulatory purposes), and the associated Marine Mammal Regulations (SOR/93-56). Section 7 of the Marine Mammal Regulations prohibits disturbance of marine mammals, except under a limited number of circumstances (e.g., when fishing for them under the authority of the Regulations; when carrying out authorized activities under the *Fisheries Act*; or, when acting in a manner authorized under SARA).

2.2.2 Species at Risk Act

The *Species at Risk Act* is a federal Act that applies to certain sek̲w'ek̲w'inexw (wildlife) species in Canada. Species listed on Schedule 1 as extirpated, endangered, or threatened are afforded protection under SARA. Species listed as special concern on Schedule 1 are managed to prevent them from becoming extirpated, endangered, or threatened. It is prohibited to kill, harm, harass, capture, or take an individual of those Schedule 1 species. It is also prohibited to damage or cause destruction to any part of the designated critical habitat of any listed endangered, threatened, or extirpated (if its reintroduction was recommended) species (Government of Canada, 2002). The conservation status of marine mammal species in Átl'k̲a7tsem (Howe Sound) is presented in Section 4.0 (Table 4). The federal government is required to develop a recovery strategy for those Schedule 1 species. Recovery strategies identify critical habitat and SARA prohibits the destruction of critical habitat on federal land. Recovery strategies that apply to this Project are listed in Section 5.1.

3.0 ROLES AND RESPONSIBILITIES

The Construction Environmental Management Plan (CEMP) outlines the roles and responsibilities of the Environmental Manager, Contractor, Qualified Professional (QP), and Environmental Monitor. Specific to the MMMMP, the QP is responsible for:

- developing the MMMMP and supervising its implementation
- providing discipline-specific expertise in underwater noise and marine mammals
- determining the most effective implementation of the Marine Mammal Observers (MMOs)
- supporting Woodfibre LNG representatives in annual review and, where required, updating the MMMMP
- reviewing results of the underwater noise verification program and identifying additional mitigation measures, if required
- supporting training of contractors, MMOs, and vessel operators

4.0 MARINE MAMMAL SETTING

A comprehensive literature review (desktop study) was completed to characterize existing marine mammal baseline conditions in the CPA, with an emphasis on seasonal residency/abundance and habitat use patterns (see Application Appendix 5.10-1 Marine Resources Baseline Study).

4.1 MARINE MAMMALS

Many marine mammal species are commonly sighted in Átl'ka7tsem (Howe Sound), including (Golder Associates, 2014):

- kw'únut' (any of: harbour porpoise [*Phocoena phocoena*]; Pacific white-sided dolphin [*Lagenorhynchus obliquidens*]; Dall's porpoise [*Phocoenoides dalli*])
- yéwyews (killer whale [*Orcinus orca*]; northern and southern residents, Bigg's [transient], and offshore ecotypes)
- skwúmechn (humpback whale [*Megaptera novaeangliae*])
- kwenís (minke whale [*Balaenoptera acutorostrata*])
- asxw (harbour seal [*Phoca vitulina richardsi*])
- kwexnís (either of: California sea lions [*Zalophus californianus*] or Steller [Loughlin's northern] sea lion [*Eumetopias jubatus monteriensis*])
- sea otter (*Enhydra lutris*)

Less commonly sighted whales have also been observed in the general regional area, including:

- false killer whale (*Pseudorca crassidens*)
- kwenís (grey whale [*Eschrichtius robustus*])
- pilot whale (*Globicephala macrorhynchus*)

Several species are listed as being of conservation concern on either a provincial or national level (Table 4). Marine mammals are important to Skwxwú7mesh Úxwumixw (Squamish Nation) and coastal Indigenous groups in the CPA. The most common marine mammal species reported in the upper reaches of Átl'ka7tsem (Howe Sound) near the CPA are asxw (harbour seals), kw'únut' (Pacific white-sided dolphins), and yéwyews (killer whale).

No critical habitat for marine mammals is designated in Átl'ka7tsem (Howe Sound); however, critical habitat for the endangered population of yéwyews (southern resident killer whales) has been designated approximately 11.5 km south of the entrance to Átl'ka7tsem (Howe Sound), near the mouth of the Fraser River, and extending through the Salish Sea to west coast of Vancouver Island (DFO, 2018; Figure 3).

Of the marine mammal species known to frequent Átl'ka7tsem (Howe Sound), asxw (harbour seals) were the only species observed to establish predictable haulout sites, typically located on nearshore islands, islets, reefs, or sandbars (Miller et al., 2020). Asxw (harbour seal) haulout sites have been studied since 1973 to better understand site location, general abundance, and population variations within

Átl'ḵa7tsem (Howe Sound) (Miller et al., 2020). Multiple sites have been observed along the shipping routes south of the Project, ranging as far as Burrard Inlet. In 2019, three main haulout sites; South Watts Point, Watts Point Logbooms, and Northwest St'a7mes (Squamish Harbour), were observed to be in close proximity to the Project. Haulouts in these locations ranged from 1 to 25 individuals (Miller et al., 2020).

Marine mammals at the species level vary greatly in their seasonal occurrence in Átl'ḵa7tsem (Howe Sound) (Table 4; Figure 3). Marine mammal sightings data from the British Columbia Cetacean Sightings Network (BCCSN) shows the use of habitats in Átl'ḵa7tsem (Howe Sound) by cetaceans to change seasonally, and the number of observations declines with distance from the Strait of Georgia. Asxw (harbour seal) are year-round residents in Átl'ḵa7tsem (Howe Sound), while ḵwex̱nís (California and Steller sea lions) and kw'únut' (harbour and Dall's porpoises) are considered occasional visitors throughout the year. Other cetacean species have generally been absent from Átl'ḵa7tsem (Howe Sound) over the last few decades until recently, with sightings of kw'únut' (Pacific white-sided dolphin), yéwyews (killer whale), ḵwenís (grey whale), and sḵwúmechn (humpback whale) notably increasing since 2009 (BCCSN 2022, pers. comm.). The recent rise in cetacean sightings in Átl'ḵa7tsem (Howe Sound) has been linked with improved water quality in the area and associated return in prey sts'úḵwi7 (fish) numbers, including slhawt' (herring) and cháyilhen (salmonids). K̲wenís (minke whale) and false killer whales are historically rare in Átl'ḵa7tsem (Howe Sound) and would be considered vagrant sightings in this area. A detailed overview of each species is provided in the Application Appendix 5.10-1 Marine Resources Baseline Study.

Table 4: Marine Mammal Species Potentially Occurring in Átl'ḵa7tsem (Howe Sound)

Common Name	Seasonal Occurrence	Conservation Status	
		SARA Schedule 1	BC
Killer whale (*Orcinus orca*)—Southern Resident	Year-round	EN	Red
Killer whale (*Orcinus orca*)—Northern Resident	Year-round	TH	Red
Killer whale (*Orcinus orca*)—Transient	Year-round	TH	Red
Killer whale (*Orcinus orca*)—Offshore	Year-round	TH	Red
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	Year-round	N/A	Yellow
Dall's porpoise (*Phocoenoides dalli*)	Year-round	N/A	Yellow
Harbour porpoise (*Phocoena phocoena*)	Year-round	SC	Blue
Humpback whale (*Megaptera novaeangliae*)	Year-round	SC	Blue
Grey whale (*Eschrichtius robustus*) - Pacific Coast Feeding Group population	Spring, summer, fall	EN	Red
Minke whale (*Balaenoptera acutorostrata*)	Spring, summer	N/A	Yellow
Steller sea lion (*Eumetopias jubatus monteriensis*)	Year-round	SC	Blue
California sea lion (*Zalophus californianus*)	Year-round	N/A	Yellow
Harbour seal (*Phoca vitulina*)	Year-round	N/A	Yellow

Notes:
EN—endangered; SC—special concern; TH—threatened.
"N/A" Denotes no SARA Schedule 1 status

4.2 UNDERWATER NOISE

Ambient underwater noise levels were measured near the CPA in Átl'ka7tsem (Howe Sound) on July 5, 2013, to inform the environmental assessment. This information served as a baseline for comparison to anticipated underwater noise levels from proposed Project activities (e.g., pile installation, vessel operations). Broadband ambient noise levels ranged from 112.0 decibels (dB) to 126.8 dB re 1 µPa (micropascal[4]), with a median (50th percentile) of 116 dB re 1 µPa. A detailed summary of the ambient underwater noise assessment is provided in the Application Appendix 5.10-1 Marine Resources Baseline Study.

The JASCO Applied Sciences Woodfibre LNG Marine Acoustic Baseline Monitoring study was conducted in 2022 to better understand marine mammal presence, seasonality, and variability at the terminal site within St'a7mes (Squamish Harbour) (Lawrence et al. 2022). The program spanned one year and comprised two six-month deployments. The soundscape data retrieved was analyzed to distinguish between natural ambient sounds, anthropogenic noises, and marine mammal presence. Results from the study indicate that the main contributor of acoustic noise was from marine vessel and construction activities; however, several marine mammal species were detected amongst the data sets. Species detected along with their acoustic characteristics, behavioural attributes, and other physiological tendencies supporting the detection and confirming presence is summarized below.

Yéwyews (Bigg's killer whales), one of the four distinct transient population which frequents the Strait of Georgia and Howe Sound, was sporadically detected throughout the recording period. Similarly, kw'únut' (harbour porpoises), distinguishable by narrowband high-frequency clicks, were also frequently detected throughout the period. Kw'únut' (harbour seals) and kwexnís (California sea lions) were less frequently detected; however, acoustic detection was confirmed through vocalizations associated with mating and seasonal migratory behaviours respectively. Other species known to have previously visited the general area, such as kwexnís (Steller sea lions), kwenís (grey whales, minke whales), yéwyews (southern resident killer whale), kw'únut' (Dall's porpoises, or Pacific white-sided dolphins) were not detected amongst the data. Marine mammal vocalizations mainly from kwexnís (California sea lions) coincided with sounds that suggested skwúmechn (humpback whale) presence, but confirmation was nullified because of overlapping acoustic patterns.

4.3 VESSEL TRAFFIC LEVELS

Approximately 80 deep-sea vessels call at the Squamish Terminal per year. An additional three BC Ferries' routes from Horseshoe Bay provide daily large vessel activities in the region (Application Figure 5.19 1). BC Ferries accounts for nearly 75 percent of large vessel marine traffic in Átl'ka7tsem (Howe Sound). Tugs and barges also transit the route, although tug and barge traffic density in Montagu Channel is 13 percent of that in Thornbrough Channel. According to anecdotal reports, there are approximately 10 water taxi movements to the CPA per day (WFP 2014a,b, pers. comm.). Additional details regarding shipping are presented in the Application, Section 7.3 Marine Transport.

[4] An international system of units (SI) unit of pressure and stress equal to 10−6 pascals (using one-third octave percentile band levels of the 5th to 95th percentile, respectively).

5.0 MARINE MAMMAL MITIGATION MEASURES

This section describes the marine mammal mitigation measures that are applicable to the construction and operations phases of the Project. The mitigation measures are based on Project conditions of approval, Project commitments, and industry and government BMPs and guidelines. In addition to the CEMP, other management plans relevant to marine mammals include the Water Management Plan, the Marine Transport Management Plan, and the Marine Fish and Fish Habitat Management and Monitoring Plan. The CEMP and Emergency Response Plan include spill prevention and mitigation measures.

The mitigation of adverse project effects on marine mammals outlined in the MMMMP will be achieved through adherence to best practices and guidelines, project design, site-specific mitigation measures, and environmental training/education. Details are provided in the following sections.

The BC EAO environmental assessment report concluded that unmitigated underwater noise generated during Project construction may potentially injure marine mammals or result in behavioural disturbance. The approval also concluded that unmitigated transit of Project vessels during construction and operations could result in injury or mortality to marine mammals. Mitigation measures were proposed to reduce adverse effects.

The following sections:

- summarize the conclusions of the Application regarding the potential effects of underwater noise and vessel strikes from the Project on marine mammals
- provide relevant background information describing effects of underwater noise and vessel strikes on marine mammals
- describe mitigation measures to be implemented during Project construction and operations to reduce or eliminate potential effects of underwater noise and vessel strikes on marine mammals

5.1 BEST MANAGEMENT PRACTICES AND GUIDELINES

5.1.1 Acoustic Thresholds

Canada does not currently have formal regulatory acoustic thresholds for underwater sound levels that should not be exceeded, nor are there standardized national or provincial guidelines outlining mitigation measures or protocols to protect marine mammals exposed to noise from in-water pile installation (impact, vibratory, rotary drilling) or other marine construction activities. Environmental assessments and management plans in Canada therefore frequently rely on regulatory thresholds and guidance in place in the United States, which are provided by the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration (NOAA Fisheries). NOAA Fisheries provides guidance for assessing the potential for underwater sound levels to injure or disturb marine mammals. This guidance includes the provision of thresholds that can be used to assess both behavioural disruption and injury (where onset of permanent threshold shift is used as the threshold for injury). With respect to behavioural disruption, NOAA Fisheries has historical (2005) interim guidance that sets thresholds for broadband underwater

root mean square (rms) sound pressure levels[5] (SPLs) predicted to cause behavioural disruption (NOAA, 2022). NOAA Fisheries has released updated regulatory guidance for assessing the potential for underwater noise to cause injury (i.e., permanent threshold shift) (NOAA Fisheries, 2018); however, these more recent recommendations do not update the (2005) interim guidance for disturbance (NOAA, 2022). In the absence of formal Canadian thresholds, and based on recent guidance on other Canadian projects on the west coast (e.g., Pacific Northwest LNG [CEA Agency, 2016], Aurora LNG [Aurora LNG, 2016]), and as required in FDS condition 3.8, an rms SPL threshold of 160 dB re 1 µPa will be used to establish the area encompassing potential injury and sensory disturbance to cetaceans relevant to Project construction activities and the geographic size of the area where mitigation measures will be implemented. Woodfibre LNG will also establish and maintain a separate pinniped-specific exclusion area a (set at the greater of either a 150-m radius from underwater noise producing activities, or 190 dB re 1 µPa) to avoid injury to pinnipeds. The 150-m boundary is conservative based on two facts:

- Woodfibre LNG will be required to meet an underwater noise threshold of 207 dB re 1 µPa at approximately 10 m from the pile installation to prevent injury or mortality of sts'úḵwi7 (fish)—this is necessary to be compliant with paragraph 34.4(1) of the *Fisheries Act*. Ínexwantas (Monitoring) is required to demonstrate that mitigation measures for attenuation of underwater noise from pile installation (e.g., bubble curtains) achieves this threshold.
- The scientific and United States' regulatory standard peak thresholds for injury are 218 dB re 1 µPa for seals and 232 dB re 1 µPa for sea lions, for impulsive sounds from activities such as pile installation (NOAA Fisheries, 2018).

Since the underwater peak sound level threshold to protect sts'úḵwi7 (fish) is well below the injury level for pinnipeds, the proposed 150-m boundary (verified as being below 190 dB re 1 µPa) is protective of injury to pinnipeds from both underwater noise and from any potential direct interactions with construction activities.

5.1.2 In-Water and Near-shore Land-Based Blasting

DFO has developed a policy document—*Guidelines for the use of explosives in or near Canadian fisheries waters* (Wright and Hopky, 1998)—that outlines methods and practices for the conservation and protection of sts'úḵwi7 (fish), marine mammals, and fish habitat from the potential effects arising from the destructive forces of explosives. Among these guidelines is the directive that no explosive is to be knowingly detonated within 500 m of a marine mammal (or no visual contact from an MMO using 7 x 35-power binoculars). The ultimate spatial extent of the Project in-water and near-shore land-based blasting exclusion zone will be verified in the field but will not be less than 500 m. Project-specific blasting mitigation measures are detailed in Table 5.

[5] Sound pressure level: a metric, measured in dB units that is commonly used to describe the magnitude of sound.

5.1.3 Pile Installation

The BC Marine and Pile Driving Contractors Association and DFO have developed a policy document—*Best Management Practices for Pile Driving and Related Operations*—that identifies the BMPs for pile installation activities that occur on the water in BC (BC Marine and Pile Driving Contractors Association, 2003). These include recommended practices for installing piles of varying materials, styles, and sizes, and using a variety of methods (e.g., drop, impact, or vibratory hammer). While these guidelines were designed primarily to prevent sts'úḵwi7 (fish) mortality (predicted to occur at underwater pressure levels in excess of 30 kPa [kiloPascals])[6], they provide a basis point from which to prioritize activities that may require mitigation for marine mammals as well.

Vibratory installation of steel piles is not explicitly identified in the BC BMPs as an activity requiring mitigation or ínexwantas (monitoring); this method of pile installation is frequently selected over impact pile installation as a mitigation measure in itself, as it does not produce the high impulse sound signatures of impact pile driving that can result in hearing injury to marine mammals. In contrast, the BC BMPs recommend that impact pile installation of steel pipe piles with a diameter greater than 24 inches requires ínexwantas (monitoring) and mitigation measures, such as bubble curtains.

While noise levels produced during pile installation are highly situation-specific, on average, use of a vibratory driver produces sound pressure levels (peak and rms) that are lower than those produced by an impact hammer in a comparable setting (California Department of Transportation, 2020; McCauley and Salgado Kent, 2008). The Project's preferred pile installation method is therefore vibratory driver, and these will be used wherever such methods are possible based on local substrate composition.

5.2 GENERAL MITIGATION MEASURES

Mitigation measures in Table 5 are designed to reduce displacement and direct mortality of marine mammals. The measures are intended to fulfill project conditions and commitments relating to marine mammals, as described in Section 1.0. If recommended setbacks cannot be followed, a QP will be engaged to determine setback adjustments or to outline additional mitigation measures, as needed.

During near-shore and in-water construction activities that generate underwater noise, Woodfibre LNG will adopt a precautionary approach for exclusion zones until otherwise confirmed through continuous Project-specific sound source verification measurements. Woodfibre LNG will set the initial exclusion zone at 1,000 m for cetaceans and at 500 m for pinnipeds. Continuous underwater noise measurements at both of these distances will determine whether the initial exclusion zones can be modified. If noise level measurements are greater than 160 dB SPLrms at 1,000 m (for cetaceans) or are greater than 190 dB at 500 m (for pinnipeds), the exclusion zones will be increased accordingly to reflect the measured distances. Conversely, if the distances to the respective noise thresholds are less than the planned initial distances referred to above, the exclusion zones may be reduced accordingly as determined by the QP. This approach will limit the potential effect of underwater noise on cetaceans and pinnipeds until such time that replicate sound source verification data is available to the QP. The QP will review the sound source verification information and, as required, recommend appropriate adaptive exclusion zones or

[6] Equivalent to 206 peak decibels (dB_{peak}).

additional mitigation measures to comply with the thresholds. The verification and adaptation processes described above are also replicated when construction activities change and/or the location or number of work fronts change. The change in activity will also reset the initial exclusion zones described above until the sound source verification is complete.

General mitigation measures outlined in Table 5 apply to all underwater noise generating activities, which Woodfibre LNG understands to be the following, based on Project-specific modelling (Kanu and Quijano, 2023):

- General shoreline works
- Pile installation
- In-water blasting
- Near-shore land-based blasting
- In-water or near-water drilling

Vessel movements, marine infilling and other activities in or near the marine environment are not expected to individually produce underwater noise to a level that requires management. The continuous underwater sound source verification will identify if these noise sources cumulatively generate underwater noise above the thresholds identified above.

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
Underwater Noise		
General	• Multiple underwater noise-generating activities will be limited, when practical (e.g., avoid multiple pile installation activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced to limit construction duration, if practical, with exclusion zones confirmed and adjusted based on monitoring data (see Section 7.1.1). • Transiting vessels will follow Fisheries and Oceans Canada's guidance (DFO 2023) for minimum distance between a vessel and yéwyews (killer whale), i.e., 400 m, when possible to do so while maintaining safe transit. • 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. • A ramp up or soft start technique will be used. Where equipment allows, power will be built up slowly from a low energy start-up to give adequate time for marine sek̲w'ek̲w'inexw (wildlife) to leave the vicinity before exposure to the maximum sound pressure level. There will be a ramp up or soft start every time pile installation is resumed following an interval of no pile installation.	M5.17-6

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
General (cont'd.)	• Where technically feasible, given topographical and hydrological conditions (i.e., water depth, current speed, and wave climate), bubble curtains (or other feasible sound attenuation method) will be used in conjunction with in-water blasting and in-water impact pile installation activities to attenuate SPLs. Bubble curtains (or other feasible sound attenuation methods) will be regularly inspected by the Contractor to verify the equipment is functioning properly. Bubble curtains reduce SPLs and pressure waves and, therefore, reduce the radius around the source within which injury or behavioural disturbance can occur. Exclusion zone radii (based on 160 dB re 1 µPa rms for cetaceans and set at 150-m/190 dB re 1 µPa for pinnipeds) will be appropriate, whether or not bubble curtains are employed; larger exclusion zones will be monitored for the presence of cetaceans when bubble curtains are not feasible, again based on the results of underwater noise ínexwantas (monitoring). • 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 or until Woodfibre LNG and the QP can reduce the scope following analysis of replicate sound source verification data. The MMMMP incorporates the use of MMOs to maintain a visual watch of the exclusion zones during in-water blasting and pile installation activities and implement shutdown procedures in the event of a cetacean sighting within the 160 dB re 1 µPa rms exclusion zone or a pinniped sighting within the 150-m/190 dB re 1 µPa rms exclusion zone (minimum 500 m for in-water blasting). An MMO will be a QP that has undergone training in marine mammal observation methods and protocols and is specifically trained in: sighting and identifying local marine mammal species, recording and reporting observations, and implementing the correct procedures in the event of sightings. The QP will have the discretion to identify the number and locations of MMOs required to perform the visual Ínexwantas (monitoring), and this number will be dependent on multiple factors, including the scope of construction activities, viewing conditions, and the presence of viewing obstructions (e.g., vessels and barges) within the cetacean and pinniped exclusion zones. The designated and qualified MMOs will be responsible for ínexwantas (monitoring) the cetacean and pinniped exclusion zones and will work with the Woodfibre LNG Construction Manager and/or the Woodfibre LNG Environmental Representative during all activities requiring ínexwantas (monitoring). Detailed ínexwantas (monitoring) procedures are outlined below (Section 7.0).	

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number

General (cont'd.)	Prior to in-water construction activities and near-shore blasting, MMOs will implement the following protocols in relation to enforcement of the exclusion zones:
	• The entire cetacean and pinniped exclusion zones will be visually monitored with binoculars and naked eye for 30 minutes prior to commencement of in-water blasting or in-water pile installation (referred to herein as the pre-scan).
	• The visual ínexwantas (monitoring) of the exclusion zones during the 30-minute pre-scan will only be completed when the full extent of the exclusion zones can be surveyed by one or more MMOs and when visibility is sufficient for detecting marine mammals (i.e., must be completed during daylight hours, when the Beaufort sea state [a standard, semi-quantitative method for describing sea conditions] is 3 or less, and with no prohibitively thick fog or heavy rain impeding ínexwantas (monitoring) of the exclusion zone).
	• If visibility becomes compromised during the 30-minute pre-scan, the activity must be delayed until visibility increases and the exclusion zones can be fully monitored for a continuous 30-minute period.
	• If a cetacean or pinniped is detected within an exclusion zone during the 30-minute pre-scan, MMOs will:
	  • Notify the Woodfibre LNG Environmental Representative and/or Woodfibre LNG Construction Manager to delay start-up of the activity.
	  • Continue to monitor the exclusion zone until the sighted cetacean or pinniped has been observed to leave its exclusion zone and the initial 30-minute pre-scan period has been completed without additional sightings of any marine mammal, or,
	  • The cetacean or pinniped has not been re-sighted within its exclusion zone and a full additional 30 minutes has elapsed following the last sighting.
	• Once the exclusion zones have been deemed clear of marine mammals as per the directives above, the MMO will communicate to the Woodfibre LNG Environmental Representative and/or Woodfibre LNG Construction Manager (depending on who is on site) using an agreed and clear communication signal to indicate whether the relevant activity may proceed.
	• The number and location of ínexwantas (monitoring) stations will be selected by the QP to provide the best practical vantage point to observe the exclusion zones, considering safety limitations. Stations may be located on land, a small vessel, or on a barge in proximity to the noise-producing activity being monitored. A minimum of 3 boats will be used at the outset of ínexwantas (monitoring) to allow coverage of the entire exclusion zone; this may be modified, as required, following in-field hydrophone verification.
	• The pinniped exclusion zone is specific to the marine area and does not apply to pinnipeds that are hauled-out (i.e., out of the water) within a similar distance from the sound source. That said, Woodfibre LNG expects that hauled-out pinnipeds may retreat to the water to avoid shore-based activity associated with construction.
	• The construction activity shall only proceed upon positive confirmation with the MMO and following the activity-specific procedures outlined below.	

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
Pile Installation	Prior to pile installation (impact, vibratory, rotary drilling), MMOs will follow the pre-scan protocol outlined above. Specific mitigation measures and protocols during pile installation activities include the following: • Pile installation will follow the BMPs developed by DFO and the BC Marine and Pile Driving Contractors Association (BC Marine and Pile Driving Contractors Association, 2003). • For pile installation, following the 30-minute pre-scan (detailed above) and where equipment allows, underwater acoustic energy output should commence from a lower energy level and build steadily and gradually to full output. This ramp-up period is designed to reduce risk to any marine mammals that may not have been identified by the MMO, prior to the generation of peak pressure and noise levels for pile installation. • As long as pile installation has been initiated under the appropriate conditions (i.e., following the complete 30-minute pre-scan), then it may continue throughout daylight hours and into the night provided adequate monitoring for marine mammals can continue as per QP recommendations (e.g., weather conditions are favourable, thermal imagery equipment is deployed, passive acoustic monitoring is deployed). If pile installation ceases during the daylight hours for a period longer than 30 minutes, piling activity may resume when needed following the pre-scan protocol being completed. MMOs will stop the activity in question if: • a cetacean is observed in the cetacean exclusion zone where underwater noise levels exceed 160 dB re 1 µPa rms or • a seal or sea lion is observed in the pinniped exclusion zone, set at a minimum of 150-m/190 dB re 1 µPa rms.	M5.17-6 M5.19-1

Near-shore Land-Based Blasting	Prior to near-shore land-based blasting, MMOs will follow the same pre-scan protocol outlined above. Specific mitigation measures and protocols during land-based blasting include the following:
	• Near-shore blasting will be phased such that areas further from shore are blasted first as a precautionary principle, allowing site-specific field measures to inform adaptive measures for subsequent works.
	• Charges should not exceed 3.17 kg TNT equivalent charge
	• Blasting mats will be used, as required, to control fly-rock.
	• During the initial blast, the exclusion zone will be set to 1,000 m.
	• Two hydrophones will be installed prior to near-shore blasting, one at 1,000 m and one at 500 m from the source, to directly measure or back-calculate the exact location of the exclusion zones. The zones will then be adjusted accordingly but will not be less than 500 m.
	• Underwater noise ínexwantas (monitoring) will be conducted at the commencement of land-based blasting activities, as directed by the QP, to verify that underwater pressure levels do not result in adverse effects to marine mammals. Similar to pile installation (as described above), MMOs will stop land-based blasting if:
	  • a cetacean is observed in the cetacean exclusion zone where underwater noise levels exceed 160 dB re 1 µPa rms or a minimum of 500 m
	  • a seal or sea lion is observed within the 500 m pinniped exclusion zone.
		M5.17-6

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
Near-shore Land-Based Blasting (cont'd)	• Noisemakers (e.g., bangers, air horns) may be used prior to detonation to deter marine mammals from occurring in the "blast zone" and to prevent harm. Noisemakers will be used sparingly and only after a visual scan is used to confirm that marine mammals are present. • The hydrophones will also be used to passively monitor for marine mammal presence. • Prior to any available on-site noise data becoming available during the initial blasting, a bubble curtain will be deployed around the immediate blasting area and at 5 m below the water level. Once peak pressure levels are confirmed, the bubble curtain may be discontinued at the discretion of the QP. Land-based nearshore blasting can only be undertaken during daylight and in conditions of good visibility and sightability (as defined above).	
Dredging	The following mitigation measures only apply to suction dredging or other non-clamshell or non-backhoe dredging methods. No mitigations are required for clamshell or backhoe dredging. Prior to dredging, MMOs will follow the pre-scan protocol outlined above. If, during non-clamshell or non-backhoe dredging, a cetacean or pinniped is observed within 100 m of the dredging, work will not be started or work will be stopped. Dredging activities may only start or resume once the marine mammal has been confirmed by the MMO to have left the 100-m zone or has not been sighted by the MMO for 30 minutes. If pinnipeds cause regular delays to start of dredging or regular shutdown of dredging activity, Woodfibre LNG will work with DFO and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) to develop alternative protocols to allow work to continue while providing appropriate protection to marine mammals.	M5.17-6
Operations within Átl'ḵa7tsem (Howe Sound)	The MMMMP will be implemented during the construction phase and continued in the operations phase. Additional measures that will be required during operations include the following (EAC Condition 13.2.3.8): • To the extent possible, vessel engines and propellers will be shut down while moored at the floating storage and offloading (FSO) jetty to reduce unnecessary underwater noise during LNG transfer operations. • Subject to safety considerations, machine-based equipment, engines, and propellers will be turned off when not in use to minimize unnecessary noise. • All Project vessels will follow established shipping lanes typically used in the area. • All Project vessels will maintain a constant course and constant speed, to the extent practical, when operating in Átl'ḵa7tsem (Howe Sound). • Other than in the case of an emergency, vessels will not intentionally approach within 200 m of a cetacean. • If a cetacean approaches within 200 m of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal. If it is not possible for a vessel to move away from or detour around a stationary cetacean or group of cetaceans, the vessel will reduce its speed and wait until the animal(s) moves at least 200 m from the vessel prior to resuming speed.	M5.19-2

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
Above Water Noise		
General	Hauled out marine mammals will be exposed to construction generated noise. The following mitigation measures will be applied to limit potential effects of this exposure. • The MMO will confirm there are not hauled out marine mammals within 500 m of loud and impulsive noise generating activities (e.g., blasting or impact pile driving). Work will temporarily stop and resume only after being cleared to proceed by the QP or the marine mammals have left the area. • If kwexnís (Steller sea lion(s)) are observed above water within 500 m of construction noise, work will temporarily stop and resume only after being cleared to proceed by the QP with the application of modified work activity, noise reduction, or monitoring for behavioural disturbance. Work may also resume if the kwexnís (Steller sea lion(s)) have left the area.	N/A
Vessel Strikes		

	The geographic area within which the movement of construction-related vessels could result in injury or mortality to marine mammals is adjacent to the construction area and along Woodfibre LNG vessel transit areas in the LAA, as defined in the Application. Similarly, direct contact to a marine mammal may occur during dredging. Both of these activities (i.e., vessel strike or direct contact with a marine mammal during dredging) will be mitigated in the same way.
	• Other than in the case of an emergency,
	  • Vessels will not intentionally approach within 200 m of a cetacean, or within 400 m of a yéwyews (killer whale).
	  • If a cetacean approaches within 200 m of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal.
	  • If it is not possible for a vessel to move away from or detour around a stationary cetacean or group of cetaceans, the vessel will reduce its speed and wait until the animal(s) moves at least 200 m from the vessel prior to resuming speed.
	  • Marine vessel operators during construction activities will practice caution when cetaceans are observed within the Project Area, including reducing boat speed to minimize wake/wash and not intentionally approaching cetaceans.
	• The Contractor will provide marine mammal observation and identification training to vessel operators employed by the Contractor or who provide recurring vessel service to the Contractor. The Contractor will maintain records of staff and sub-contractors who have taken this training.
	• During the Project's marine construction phase, vessel operators will practice caution when pinnipeds (seals and sea lions) are observed by vessel operator within the CPA, including reducing boat speed to minimize wake/wash and not intentionally approaching pinnipeds.
		M5.19-2

Table 5: Mitigation Measures for Marine Mammals During Construction and Operations

Category	Mitigations	Application Mitigation Number
Operations within Átl'ka7tsem (Howe Sound)	Woodfibre LNG committed to implementing the recommendations from TERMPOL as they become available, as per EAC commitment M5.19-3. TERMPOL is a process for marine terminal or transshipment facilities operations phase and, in the case of Woodfibre LNG, relating to LNG carriers travelling to/from the Project Area. The TERMPOL technical review process appraises the safety of vessels, the transit route to/from the entrance of Juan de Fuca Strait (J Buoy) to its berth, and the cargo transfer operations. Woodfibre LNG submitted its TERMPOL report at the end of 2015 and is currently in the review phase. Woodfibre LNG will make public and comply with the technical review process findings and recommendations and incorporate them into applicable management plans. This is expected to include the development of a Port Information and Terminal Operations Manual to be reviewed by TERMPOL at least six months prior to start of operations. The MMMMP will be continued in the operations phase. Mitigation measures that will be required during operations include the following: • All Project vessels will follow established shipping lanes typically used in the area.	M5.19-2 M5.19-3
Operations within Átl'ka7tsem (Howe Sound) (cont'd.)	• All Project vessels will maintain a constant course and constant speed, to the extent practical, when operating in Átl'ka7tsem (Howe Sound). • Deep-sea Project vessels (vessels >65 m, excluding barges) and LNG carriers will travel at a maximum speed of 10 knots when operating in the Átl'ka7tsem (Howe Sound) marine corridor and will be directed not to exceed 6 knots within the CPA, unless the vessel operator determines that this speed limit poses a safety risk. • Other than in the case of an emergency, vessels will not intentionally approach within 200 m of any cetacean. • If cetaceans approach within 200 m of a vessel, the vessel will reduce its speed and, if possible, cautiously move away from the animal. If it is not possible for a vessel to move away from or detour around a stationary cetacean or group of cetaceans, the vessel will reduce its speed and wait until the animal(s) moves at least 200 m from the vessel prior to resuming speed. LNG carriers will respect speed profiles applicable to the operations, subject to navigational safety, to prevent or reduce the risks of collisions between LNG vessels and cetaceans. Project LNG vessels and tugs will report collisions with cetaceans in Átl'ka7tsem (Howe Sound) to the Canadian Coast Guard and DFO within two hours of a collision occurrence, and Woodfibre LNG will notify Indigenous groups in writing.	

5.3 UNDERWATER NOISE

5.3.1 Importance of Sound to Marine Mammals

Marine mammals use sound to communicate, forage, orient, and respond to perceived threats (Ketten, 1998; Southall et al., 2007; Ellison et al., 2012). Baleen whales (e.g., sḵwúmechn [humpback whale], ḵwenís [grey whale]) use sounds primarily for social functions, including reproductive behaviours and maintaining contact over great distances (hundreds of kilometres). Toothed whales (e.g., yéwyews [killer whale], kw'únut' [porpoise, dolphin]) communicate primarily over middle to short distances (tens of kilometres) and use specialized clicks (echolocation) to detect prey and navigate. Pinnipeds (e.g., asxw [seals] and ḵwex̱nís [sea lions]) also produce sounds but predominantly in social functions and during reproductive behaviours. As asxw (seals) and ḵwex̱nís (sea lions) spend time on land and at sea, they are sensitive to sound both in air and in water, but generally are not as susceptible to disturbance as cetaceans.

Given the importance of a functional acoustic environment to most marine mammal life functions, the introduction of anthropogenic underwater noise, if unmitigated, can result in behavioural disturbance. Disturbance can range from overt and visually observable responses such as displacement or avoidance behaviours and changes in activity state (e.g., swim speed or direction, surfacing interval) to less obvious changes such as increases in stress hormones. Behavioural disturbance in response to underwater noise depends on a number of variables, including the magnitude, duration, and wavelength of the noise, distance of the animal from the sound source, species, and the context (e.g., activity of the animal at the time). Amidst the additional anthropogenic background noise, relevant biological sound signals may also become undetectable (i.e., masked) to marine mammals (Ketten 1998). Marine mammals subject to high intensity SPLs, such as in-water blasting and impact pile installation, may experience a temporary or permanent decreased hearing sensitivity (i.e., temporary or permanent threshold shift) (Richardson et al., 1995; Southall et al., 2007; Popper and Hawkins, 2012).

5.3.2 Environmental Assessment Effects Summary

Most in-water marine Project construction activities produce underwater noise[7]; however, SPLs for most Project activities are unlikely to injure marine mammals. The Application considered that underwater noise effects from pile installation could occur during the construction of the FSO (i.e., floating storage tank) jetty, including pile installation and shoreline modifications to accommodate structural infrastructure, and possibly during dredging and permanent mooring of the FSO, and carried this Project interaction forward to determine mitigation measures and residual effects. Vibratory methods will be the preferred method (over impact methods) to install piles and sheet-piles and will be used wherever such methods are practical and feasible based on local substrate composition and construction requirements. Use of vibratory installation techniques is expected to reduce sound levels below those capable of causing injury.

[7] Effects to marine mammals from in-air noise were determined to be negligible in the Application given the absence of established asxw (seal) or ḵwex̱nís (sea lion) haulout sites proximal to the CPA.

While efforts will be made to reduce the need for and scale of marine blasting and in-water impact pile installation to the extent feasible, mitigation measures and ínexwantas (monitoring) protocols for these activities are addressed in Table 5 and Section 7.1. Mitigation measures to limit effects of marine construction are also detailed in the CEMP. The MMMMP details those mitigation measures for potential effects that are specific to marine mammals.

The Application concluded that marine mammal behavioural disturbance could occur due to underwater noise during pile installation during construction and from underwater noise associated with vessel operations. These activities were predicted to be short-term and localized, and any associated disturbance effects are expected to be reversed when construction stops. Mitigation measures to reduce potential for sensory disturbance to marine mammals are summarized in Table 5.

The Application also concluded that during Project operations, underwater noise could result in behavioural disturbance from the following activities: mooring of LNG carriers at the FSO for LNG transfer; marine shipping within Átl'ka7tsem (Howe Sound) (approximately 40 LNG carriers per year) in established shipping lanes; patrolling of Control Zone around LNG facility, FSO, and LNG carriers; and transport of employees through private passenger ferry terminal, transport of supplies using barges, site administration, safety facilities, and emergency transportation via helicopter. Mitigation measures to reduce potential effects on marine mammals during project operations are summarized in Table 5.

5.3.3 Underwater Acoustic Noise Modelling

An underwater acoustic modelling study was conducted for potential noise-producing activities associated with the construction of the Project (Kanu and Quijano, 2023). The goal of the study was to predict the potential extent of underwater noise exposure to marine mammals and sts'úkwi7 (fish) during construction of the terminal, materials offloading facility (MOF), floatel mooring infrastructure, and FSO facilities. The model considered installation of piles through impact and vibratory piling (with mitigation), land-based near-water rock blasting at the FSO, and rock coring using a rotary/cluster drill (down-the-hole). Conservative ranges for the extent of ensonification were calculated from the model to define exclusion zones to limit potential effects on marine mammals during construction of the Project. The following 10 scenarios were considered in the modelling study:

1. Six scenarios for impact and vibratory piling (i.e., both methodologies at the terminal, floatel, and FSO locations)
2. Three scenarios for rock coring (i.e., one at each of the MOF, terminal, and FSO locations)
3. One scenario for rock blasting at the east end of the modelling area

The geographical and environmental conditions were conservatively selected for the underwater noise model (e.g., water depths were modelled at the higher high water level, which is the most conservative depth). Construction activities were also conservatively modelled for the worst-case scenario of underwater noise production. For example, blasting was modelled at a 3.17 TNT charge, 1.5 m below the surface, and 5.4 m inland from the bedrock face; however, the actual blast locations will be 3 m above the high water mark and 23 m inland, with an actual vertical distance from the nearest water blast to low tide of 8.7 m (Keystone, 2023). These supporting noise modelling studies are available upon request.

The resulting distances for marine mammal disturbance threshold criteria based on the underwater noise model are summarized in Table 6.

Table 6: Construction Activity-based Estimated Distances To SPL Threshold Criteria

Construction Activity	SPL_{rms} Threshold (dB re 1µPa)	Ranges (km)
Impact pile installation with noise mitigation (confined bubble curtains)	160	Floatel: 1.11 All three locations (terminal, floatel, and FST): 0.64–1.11
Vibratory pile installation with noise mitigation (confined bubble curtains)	120	Terminal: 12.14 All three locations (terminal, floatel, and FST): 10.85–12.14
Land-based rock blasting	-	~13 (land-limited)
Rock coring	120	~14 (land-limited)

Note:
Kanu and Quijano (2023) used FST for the floating storage tank, which is referred to as the FSO in this MMMMP.

Source: Kanu and Quijano, 2023 (available upon request)

Mitigation measures to reduce potential effects on marine mammals are summarized in Table 5. Additional contingency measures may be implemented based on the underwater noise ínexwantas (monitoring) results; options include the following:

- Land-based rock blasting would be scheduled to occur during lower tides, when the tide is within 2 m of the lowest tide.
- Additional bubble curtains would be installed to further limit potential effects of underwater noise. Curtains would be installed at least 2 m apart to spread out the bubbles. The first curtain would be installed 5 m below the water, and the second would be around 6 m below the water.
- Amounts of charge in blast holes would be reduced.

5.4 VESSEL STRIKES

Records of vessel–collisions from the late 1800s to 1998 compiled by Laist et al. (2001) demonstrate that vessel strikes typically involve large baleen whales (Mysticetes). Toothed whales (Odontocetes) and pinnipeds (seals) are more agile and smaller and therefore rarely struck by vessels (Laist et al., 2001). However, DFO has recently identified vessel strikes as an emerging threat to yéwyews (killer whale) due to reported injuries and mortalities of both southern and northern resident yéwyews (killer whale) (DFO, 2017, 2018). Sḵwúmechn (humpback whale) are particularly sensitive to effects from vessel strikes (DFO, 2013), with a moderate risk to individuals and a low risk to the population. The Humpback Whale Recovery Strategy (DFO, 2013) indicates some high-risk potential, but further studies are required to clarify uncertainties. In BC waters, sḵwúmechn (humpback whale) is the most common cetacean struck by vessels, with 21 reports between 2001 and 2008; the rate of mortality from vessel strikes in BC waters, however, is largely unknown.

5.4.1 Environmental Assessment Effects Summary

An increase in the number of vessels operating in the proposed Woodfibre LNG carrier route, as well as project vessels operating between St'a7mes (Squamish Harbour) and the CPA, may cause a change in the health and mortality risk for marine mammals. All Project vessels during construction, operations, and decommissioning have potential for a collision with cetaceans. The BC EAO concluded in its environmental assessment report that in consideration of the mitigation measures proposed in the Application, the likelihood of a fatality or injury of a cetacean from an accidental vessel strike would be rare and the long-term viability of marine mammal populations in Átl'ka7tsem (Howe Sound) would unlikely be affected (BC EAO, 2015).

The Application stated that low vessel speeds (less than 14 knots) have been found to greatly reduce the likelihood of ship strikes on cetaceans by providing time for these animals to avoid oncoming vessels, as well as time for crew to detect and avoid cetaceans during transits. Furthermore, the potential for a vessel-cetacean collision would be limited to the proposed Woodfibre LNG carrier route.

6.0 MARINE SHIPPING ASSOCIATED WITH THE PROJECT OUTSIDE OF ÁTL'ḴA7TSEM (HOWE SOUND)

Woodfibre LNG will explore voluntary participation in regional initiatives to address potential effects of marine shipping on cetaceans from vessels associated with the Project (i.e., the Salish Sea from Buoy J to the mouth of Átl'ḵa7tsem [Howe Sound]). Woodfibre LNG is exploring participation in initiatives related to the programs, such as the federal Oceans Protection Plan and the Vancouver Fraser Port Authority Enhancing Cetacean Habitat and Observation (ECHO) Program. Woodfibre LNG is also committed to working collaboratively with Indigenous groups to determine ways to understand and reduce potential effects of marine shipping on cetaceans. Addressing the cumulative effects of marine shipping in the Salish Sea is a regional, multi-stakeholder, and multi-jurisdictional issue, with multiple contributors required to collaborate in the effort to effectively address the issue. Potential initiatives that Woodfibre LNG may participate in include:

Education and Awareness

- Woodfibre LNG carrier captain or designated personnel complete *Whales in Our Waters*[8] tutorial developed by the Vancouver Fraser Port Authority ECHO Program, BC Ferries, and Ocean Wise
- Woodfibre LNG carriers have *Mariner's Guide to Whales, Dolphins, Porpoises of Western Canada*[9] on the bridge

Regional Vessel Strike Risk Reduction

- Woodfibre LNG carriers will utilize the WhaleReport Alert System[10] developed for commercial ship operators to receive real-time notifications when whales are in range of vessel to take corrective action to avoid vessel strikes

Ongoing Research and Ínexwantas (Monitoring)

- Contribution of cetacean sightings to the BCCSN[11] to help build understanding of baseline conditions
- Potential collaboration with industry and Indigenous groups on marine mammal studies and initiatives

Participation in Regional Underwater Noise Reduction Initiatives

- Woodfibre LNG participation in Vancouver Fraser Port Authority ECHO Program[12] initiatives in the southern waters of BC (e.g., voluntary ship slowdowns, voluntary shipping lane route modifications, measuring underwater noise levels of individual ships at ECHO Listening Station)
- Consideration of offering incentives to Woodfibre LNG carriers/or encouraging that they meet Green Marine[13] or other underwater noise reduction criteria

[8] https://echolearn.portvancouver.com/
[9] https://www.portvancouver.com/wp-content/uploads/2017/07/Mariners-Guide-to-Whales-Dolphins-Porpoises-of-Western-Canada.pdf
[10] https://wildwhales.org/wras/
[11] https://wildwhales.org/
[12] https://www.portvancouver.com/environment/water-land-wildlife/echo-program/
[13] https://green-marine.org/certification/

7.0 MARINE MAMMAL ÍNEXWANTAS (MONITORING) AND ADAPTIVE MANAGEMENT

Marine mammal and underwater noise ínexwantas (monitoring) data collected will be used to inform and adaptively refine the mitigation measures described in the MMMMP with input from DFO and Indigenous groups. If additional mitigation measures are required and implemented, ínexwantas (monitoring) will be conducted to confirm their effectiveness and to verify the conclusions of the environmental assessment. Furthermore, in agreement with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), ínexwantas (monitoring) will contribute to the understanding of marine mammal distributions and underwater noise levels in Átl'ḵa7tsem (Howe Sound).

7.1 ÍNEXWANTAS (MONITORING)

7.1.1 Pile Installation and Blasting

Underwater noise ínexwantas (monitoring) will be conducted at the commencement of marine pile installation and near-shore blasting to inform mitigation measures, primarily by defining the boundary of the cetacean exclusion zone, which will be set at the radial extent where sound levels dissipate to 160 dB re 1 µPa rms. A component of this acoustic field verification will be to confirm the predicted sound levels presented in Woodfibre LNG's environmental assessment (Section 5.19.3.2; Table 5.19-12) for underwater blasting and pile installation. Resulting data will be used on-site to verify that the initial exclusion zones are appropriate for these activities under site-specific conditions (i.e., that received sound levels within the cetacean exclusion areas are below 160 dB re 1 µPa rms). Should measured hydroacoustic data indicate that sound levels extend further than predicted by modelling, the size of the cetacean exclusion zones and any ínexwantas (monitoring) techniques applied therein will be adjusted to reflect the site-specific data obtained during the field trial. Similarly, if underwater noise levels at this distance are below the 160 dB re 1 µPa rms cetacean threshold, then the cetacean exclusion zone radius may be reduced. Results of acoustic field verification and updated cetacean exclusion zones (as needed) will be provided to BC EAO and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and can be provided to Indigenous groups upon request.

Underwater noise will be monitored continuously during pile installation and blasting activities where those activities or combination of activities have not been previously monitored, or where Project-specific monitoring data has identified that the specific activities and combination of activities generate underwater noise levels greater than 160 dB rms and 190 dB rms at a reference pressure of one micropascal (FDS Condition 3.8.1 and 3.8.7). Continuous monitoring will provide information to better understand if changes in concurrent activities, near-shore activities (e.g., blasting), pile installation methods (e.g., change in equipment, additional rig, change in pile diameter, change in pile material) and/or environmental conditions (e.g., water depth, water temperature, substrate type) at the noise source

influence the established cetacean and/or pinniped exclusion zone boundaries. If necessary, the exclusion zones may be modified under the direction of the QP.

Underwater noise levels during land-based blasting will also be monitored at the anticipated boundary of the exclusion zones. The location of ínexwantas (monitoring) and distance for the blast and from the shore will be recorded by the Environmental Monitor, as well as the results of ínexwantas (monitoring). Ínexwantas (monitoring) for marine mammals will commence 30 minutes prior to the blast. If cetacean thresholds are exceeded, underwater noise ínexwantas (monitoring) will continue for land-based blasting and additional mitigation will be applied (e.g., change in the blast design), until confirmed by the QP that underwater noise ínexwantas (monitoring) is no longer needed.

A quality assurance and quality control program will be implemented to evaluate the precision of underwater noise measurements (e.g., hydrophones) and verify instrument calibration and field procedures. This program will include instrument inspections and calibrations, collection of multiple readings at each sampling location, and inclusion of reference site measurements.

7.1.2 Shoreline Revetment Work

Underwater noise will be monitored continuously during shoreline revetment work and dredging activities to establish and modify, if necessary, the boundary of the 160 dB re 1 µPa rms cetacean exclusion zone. If underwater noise levels are consistently below the 160 dB re 1 µPa rms threshold for either shoreline work and/ or dredging activities, underwater noise ínexwantas (monitoring) may no longer be required for these activities (FDS Condition 3.8.1 and 3.8.7), at the discretion of the QP. As described in the mitigation measures, the sound source verification process will be replicated for these activities and will support adaptive management of potential effects to marine mammals.

7.1.3 Project Operations

Ínexwantas (monitoring) during the operations phase will be undertaken by shipping contractors during all Project-related shipping activities to avoid interactions with marine mammals. Ínexwantas (monitoring) programs related to underwater noise during operations (e.g., during transit of the LNG carriers and associated tugs within Átl'ka7tsem (Howe Sound) will be discussed and developed as appropriate by Woodfibre LNG in collaboration with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and Tsleil-Waututh Nation.

7.1.4 Adaptive Management

To meet Condition 10 of the SNEAA, Woodfibre LNG will use an adaptive management process to evaluate performance objectives and to guide management actions. The adaptive management process comprises seven steps: assess, design, implement, monitor, evaluate, adapt, and update the MMMMP. These steps are described as follows:

1. Assess: This consists of an assessment of the potential effects of the Project on marine mammals and the identification of mitigation measures. This was completed through the federal, provincial, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes.
2. Design: This consists of the development of the mitigation and ínexwantas (monitoring) plans for construction, engineering design of the Project, and scheduling of construction activities. The MMMMP is a core element of this step.
3. Implement: This consists of implementing the MMMMP during construction and operations.
4. Monitor: This consists of implementing the Ínexwantas (monitoring) programs described in Section 7.1.
5. Evaluate: Results of ínexwantas (monitoring) will be reviewed to inform whether mitigation measures are functioning as intended and if additional mitigations are required. Woodfibre LNG will develop, in consultation with a QP, ínexwantas (monitoring) performance measures (e.g., targets, thresholds, and site objectives) to evaluate effectiveness of mitigations during construction and operations.
6. Adapt: If marine mammal conflicts and interactions occur, or if mitigations implemented are shown to be ineffective (i.e., where there is evidence of harm or a strong behavioural reaction [e.g., violent lobtailing, flipper slapping, irregular jumping out of the water, etc.] observed during construction activities), adaptive management measures will be identified and implemented. A QP will work with the Woodfibre LNG Environmental Representative and construction team to improve the mitigations and reduce the number of incidents. If compensation and offsetting are warranted, Woodfibre LNG will work with Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) to determine appropriate measures.
7. Update MMMMP: When adaptive management strategies necessitate an update to this MMMMP, Woodfibre LNG will prepare a red-line version of the document that identifies what triggered the need for improvement (i.e., which target, threshold, or site objective was not met) and the changes that were made to address a concern. The red-line version will be issued to Indigenous groups and regulatory agencies for a 30-day review and comment period. During this review period, the QP, Woodfibre LNG Environmental Representative, and MMOs or other relevant personnel will be responsible for working with the applicable contractor(s) to implement appropriate measures that continue to limit potential effects to marine mammals. After comments are received, the document will be updated and issued as the next revision.

8.0 REPORTING AND COMMUNICATIONS

8.1 ÍNEXWANTAS (MONITORING) REPORTS

Woodfibre LNG MMOs will actively monitor the in-water blasting and in-water pile installation exclusion zones to support implementation of mitigation measures (e.g., shutdowns). Sightings of pinnipeds and cetaceans will be documented, and cetacean sightings will be reported to the BCCSN for research purposes. Example underwater noise data sheets and marine mammal observation forms are presented in Appendices A and B, respectively.

The following information will be collected during ínexwantas (monitoring) periods:

- date and time that construction activity starts and ends
- weather and sea conditions
- date and time of marine mammal sighting, species, the number of individuals, location, orientation, and the time at which the individual(s) entered and left the exclusion zone (if applicable)
- the marine mammal(s)' behaviour at time of sighting (e.g., resting, foraging, travelling or surface-active behaviour [breaching, tail-slapping, etc.])
- any mitigation measures enacted (i.e., if there is a delayed start or stop in the activity)
- estimated distance of marine mammal from MMO and from construction activity when first sighted
- other human activity in the area, such as other vessel activity, including fishing
- underwater noise measurements using the form provided in Appendix A**,** or a similar form that provides the equivalent information
- the MMO will record marine mammal sightings using the form provided in Appendix B**,** or a similar form that provides equivalent information.
- monthly reporting during construction regarding compliance with EAC conditions

Annual reporting to BC EAO and the Impact Assessment Agency of Canada will be submitted on or before March 31 for the previous calendar year and posted on the Woodfibre LNG website, and will include:

- activities undertaken to be compliant with the FDS, fulfilled FDS condition 2.1, results of consultation (where required)
- results of follow-up programs
- reports of any additional mitigation measures applied
- as part of the FDS, annual report of marine observations and collisions

This information will be collated into ínexwantas (monitoring) reports, which will be sent to DFO, BC EAO, the Impact Assessment Agency of Canada, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and Tsleil-Waututh Nation upon completion of construction. Woodfibre LNG will provide a copy of these ínexwantas (monitoring) reports to other Indigenous groups, upon request.

Records of cetacean sightings will be provided to the BCCSN (www.wildwhales.org) to help inform their research programs, and to Indigenous groups upon request, upon completion of construction.

For the duration of construction, the Construction Monitors from respective Indigenous groups will, while working alongside Woodfibre LNG Environmental Monitors, have the opportunity to observe construction activities and report back to their community on the implementation and success of mitigation measures from the MMMMP.

Woodfibre LNG will report observations and sightings of marine mammals in annual FDS compliance reports and, if determined necessary by a QP (based on trends, frequency, timing or location of observations, and/or vessel-whale collisions), apply additional mitigation measures. Any additional mitigation measures will include consideration of marine safety and navigation and will be monitored for effectiveness.

8.2 ENVIRONMENTAL INCIDENT REPORTS

MMOs will immediately report any observations of injured, sick, or dead marine mammals to the Woodfibre LNG Environmental Representative or Woodfibre LNG Construction Manager (depending on who is on site), who will in turn contact the whale emergency hotline (1-800-465-4336), operated by DFO's BC Marine Mammal Response Program.

Project LNG vessels and tugs will report collisions with marine mammals in Átl'ka7tsem (Howe Sound) to the Canadian Coast Guard within two hours of a collision occurrence and to Woodfibre LNG. Woodfibre LNG will notify all ten Indigenous groups (as defined by FDS) in writing. Woodfibre LNG will also notify Indigenous groups of any incident of injury of significance with a marine mammal.

Any non-compliance with the EAC, as amended, will be reported by Woodfibre LNG within 72 hours of becoming aware of any such non-compliance, or immediately for any non-compliance that may cause a significant adverse effect.

8.3 RECORDS OF INFORMATION

Monthly ínexwantas (monitoring) reports completed during construction to comply with the EAC will be retained through the construction phase and for five years after commencing operations. Woodfibre LNG will maintain a record of information related to the implementation of the conditions set out in the most current Decision Statement issued under Section 54 of the *Canadian Environmental Assessment Act, 2012*, and the results of all associated ínexwantas (monitoring).

This information will be made available for 25 years following the end of operations or until the end of decommissioning of the Project, whichever comes first, and includes:

- training records retained by those providing training on this MMMMP; Woodfibre LNG and the Contractor
- records of consultation regarding the development of this MMMMP
- marine mammal observations and results of underwater noise ínexwantas (monitoring), including quality assurance / quality control results
- reports of cetacean collisions and notifications to Indigenous groups

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APPENDIX A
UNDERWATER NOISE DATA SHEET

APPENDIX A UNDERWATER NOISE DATA SHEET

Acoustic Monitoring Log

Project:								
Date:		**Start time:**		**End Time:**		**Monitor:**		**Crew:**
Weather:								
Construction and Other Anthropogenic Activities Nearby:								
General Notes:								

Time	Monitoring Site No.	Depth (m)	Peak Sound Pressure Level (dB)	RMS Sound Pressure Level (dB)	Stop Works (Y/N; if Y, duration)	Photo (Y/N, number)	Noise Type	Notes

APPENDIX B

Marine Mammal Observation Form

Woodfibre LNG

APPENDIX B MARINE MAMMAL OBSERVATION FORM

MARINE MAMMAL OBSERVATION FORM

Date (dd/mm/yyyy)	**Observation Start Time** (hh:mm)	**Observation End Time** (hh:mm)	**Sighting no.**
Observer location		**Observer name** (full name)	
Initial sightings cue (blow, back, head, footprint, splash, behaviour, birds)			
Species (see list of options on back)		**Certainty of identification** (percentage)	
Reticle (yes or no)	**Distance (m)** determine using reticles or range finder.	**Location of sighting re: pile**	
Number of mammals sighted		**Travel direction** (unknown, no direction, N, NE, E, SE, S, SW, W, NW)	
Behaviour(s) (see list of options on back)		**Blow** (None seen, V-shaped, low blow, medium blow, high blow; answer N/A for pinniped sighting)	
Appearance (Black, grey, brown, spots, snout - short, narrow, bump on head, fluke - small, fluke - large, relative body size, other - provide details)		**Dorsal fin** (None, position - middle of back, closer to fluke, height - short, medium, tall, size - small, medium, large, shape - triangular, curved, pointy, etc.)	
Video taken (yes or no) Provide video Numbers:		**Photos taken (yes or no)** Provide Photo Numbers:	
Work delay or stoppage? Why or why not?			
Sightings Comments (notes on the sighting, more details on appearance or behaviours observed, whether sightings made at close intervals are thought to be of the same individual or not)			

Species

- Killer whale
- Harbour porpoise
- Dall's porpoise
- Unidentified porpoise
- Pacific white-sided dolphin
- Unidentified dolphin or porpoise
- Minke whale
- Grey whale
- Humpback whale
- Unidentified large whale
- Unidentified whale
- Harbour seal
- Unidentified seal
- Steller sea lion
- California sea lion
- Unidentified sea lion
- Unidentified pinniped
- Other (provide species name)

Behaviours

- Blow
- Bow or wake riding
- Breaching
- Diving
- Feeding
- Fluking
- Lobtailing
- Looking
- Milling
- Pectoral/flipper slaps
- Porpoising
- Resting/logging
- Sinking
- Socializing
- Spyhopping
- Thrashing
- Traveling – slow or fast
- Hauled out
- Other – explain

Appendix G Invasive Plant Management Plan

Invasive Plant Management Plan

Woodfibre LNG Project: WLNG-W0001-EV-EMP-0004 Rev 1

July 28, 2023

123221624EN-RPT0014

Woodfibre LNG

Preamble

The Woodfibre Liquefied Natural Gas Project (the Project) is a liquefied natural gas export facility being constructed on the former Woodfibre Pulp and Paper Mill site in Nexwnéwu7ts Átl'ka7tsem (Howe Sound), approximately seven kilometres south of Skwxwú7mesh (Squamish). The Project is on the historical location of a Skwxwú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Nexwnéwu7ts Átl'ka7tsem (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 General Partner Inc. seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Invasive Plant Management Plant is primarily written in English with important place names, species, phrases, and passages provided in the Squamish language.

Temíxwiẏikw chet wa naantem chet ti temíxw Swiẏát
Chet wa sméṅhemswit kwis ns7éyxnitas chet ti temíxw
We7ú chet kwis t'íchimwit iy íẇas chet ek' I tti.

Our ancient ancestors named this place Swiẏát
We, as their descendants safeguard these lands
We will continue to swim and fish in these clear waters.

Limitations and Signoff

This document entitled Invasive Plant Management Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Woodfibre LNG General Partner Inc. (the "Client").[1] Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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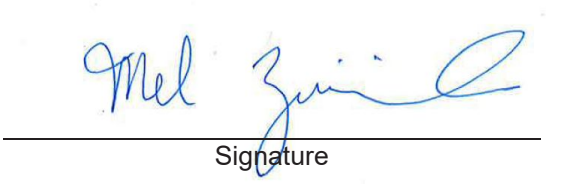


Signature

Chris Konchalski, M.Sc., RPF

Printed Name

Reviewed by:

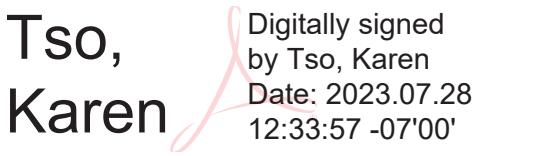


Signature

Mel Zwierink, RPF, P.Ag., CPESC, B.Sc.

Printed Name

Approved by:



Signature

Karen Tso, PMP, EP, B.Sc.

Printed Name

[1] A draft version of Invasive Plant Management Plan was prepared by Hemmera, a subsidiary of Ausenco. The draft version has been revised and updated by Stantec Consulting Limited (Stantec) at the request of Woodfibre LNG General Partner Inc.

Table of Contents

PREAMBLE ..... **I**

LIMITATIONS AND SIGNOFF ..... **II**

SQUAMISH-ENGLISH TRANSLATION ..... **V**

ABBREVIATIONS ..... **VI**

1.0 INTRODUCTION **1**
1.1 OBJECTIVE 4
1.2 PROJECT APPROVALS AND CONDITIONS 5
1.3 SḴWX̱WÚ7MESH ÚXWUMIXW (SQUAMISH NATION) ENVIRONMENTAL ASSESSMENT AGREEMENT 7

2.0 REGULATORY FRAMEWORK **9**
2.1 LEGISLATIVE REQUIREMENTS AND CRITERIA 9

3.0 ROLES AND RESPONSIBILITIES **12**

4.0 INVASIVE PLANT SPECIES SETTING **13**
4.1 AREAL EXTENTS OF INVASIVE SPECIES OCCURRENCES 17

5.0 INVASIVE PLANT MITIGATION **18**
5.1 BEST MANAGEMENT PRACTICES AND STANDARDS 18
5.2 CONSTRUCTION PHASE 19
5.2.1 Prevention Program 19
5.2.2 Control Program 21
5.2.3 Treatment Constraints 28
5.2.4 Management of Contaminated Soils and Contaminated Soils with Invasive Plants 28
5.3 OPERATIONS PHASE 29

6.0 INVASIVE PLANT SPECIES ÍNEXWANTAS (MONITORING) AND REPORTING **30**
6.1 CONSTRUCTION PHASE COMPLIANCE ÍNEXWANTAS (MONITORING) AND REPORTING 30
6.2 CONSTRUCTION PHASE EFFECTIVENESS ÍNEXWANTAS (MONITORING) AND REPORTING 30
6.3 ADAPTIVE MANAGEMENT 32
6.4 OPERATIONS PHASE ÍNEXWANTAS (MONITORING) AND REPORTING 32
6.5 PRE-CONSTRUCTION INVASIVE PLANT CONTROL 33

7.0 LITERATURE CITED **34**

LIST OF TABLES

Table 1 Conditions Relevant to the Invasive Plant Management Plan 6
Table 2 Regulatory Framework for the Invasive Plant Management Plan 11
Table 3 Invasive Plant Species Documented in the CPA from 2013 to 2021 15
Table 4 Areal Extents of Contiguous Invasive Plant Species Occurrences in the CPA 17
Table 5 Mitigation to Prevent the Spread of Invasive Plant Species during Construction 19
Table 6 Control and Disposal Methods for *Weed Control Act* Noxious Weeds within the CPA 22
Table 7 Control and Disposal Methods for Invasive Plant Species 25

LIST OF FIGURES

Figure 1 Location of the Woodfibre Liquefied Natural Gas Project 2
Figure 2 Certified Project Area and Key Project Components 3
Figure 3 Invasive Vegetation Occurrences in the Certified Project Area 14

LIST OF APPENDICES

APPENDIX A INVASIVE PLANT SPECIES PHOTO-LOG A.1

Squamish-English Translation

Squamish	English
Átl'ka7tsem	Howe Sound
ínexwantas	monitoring
K̲'íḵ'elxn	Port Mellon
Kwtsá7tsutsin	Darrell Bay
Shisháyu7ay	Britannia Beach
Skwxwú7mesh	Squamish
Sḵwx̲wú7mesh stélmexw	Squamish people
Sḵwx̲wú7mesh Úxwumixw	Squamish Nation
Swiy̓át	Woodfibre LNG site and historical Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) village location

Abbreviations

the Application	Woodfibre LNG's application for an Environmental Assessment Certificate
BC	British Columbia
BC EAO	BC Environmental Assessment Office
BCEAA	British Columbia *Environmental Assessment Act*
BCER	British Columbia Energy Regulator
CEAA	*Canadian Environmental Assessment Act*
CPA	Certified Project Area
EAC	Environmental Assessment Certificate
EM	Environmental Monitor
FLNR	Ministry of Forests, Lands and Natural Resource Operations
IPMA	*Integrated Pest Management Act*
IPMP	Invasive Plant Management Plan
ISCBC	Invasive Species Council of British Columbia
ISMA	Integrated Species Management Area
km	kilometre
LNG	liquefied natural gas
m	meters
m^3	cubic metre
MoF	Ministry of Forests
OGC	Oil and Gas Commission
OGAA	*Oil and Gas Activities Act*
the Project	Woodfibre Liquefied Natural Gas Project
QP	Qualified Professional
RISC	Resource Inventory Standards Committee
SLRD	Squamish – Lillooet Regional District
SNEAA	Squamish Nation Environmental Assessment Agreement
SSISC	Sea to Sky Invasive Species Council
Woodfibre LNG	Woodfibre LNG General Partner Inc.

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) (Figure 1). The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas, have a storage capacity of 250,000 cubic metres (m^3), and export the liquefied natural gas (LNG) via tankers.

The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- an environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the British Columbia *Environmental Assessment Act* (EAC #E15-02) in 2015;
- an environmental assessment approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015, and;
- a positive federal Decision Statement under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016.

Two EAC amendments were granted by the BC Environmental Assessment Office (EAO) in 2017 and 2019, and the federal Decision Statement was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address.

Most of the Project is on fee simple, industrially zoned, brownfield lands with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Átl'ḵa7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro, and gas will be supplied to the facility by Fortis BC .

The CPA and key project components are illustrated in Figure 2. Key project components are:

- land-based natural gas processing and liquefaction facilities
- a floating storage and offloading unit
- construction worker accommodation
- supporting infrastructure

The supporting infrastructure includes buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.

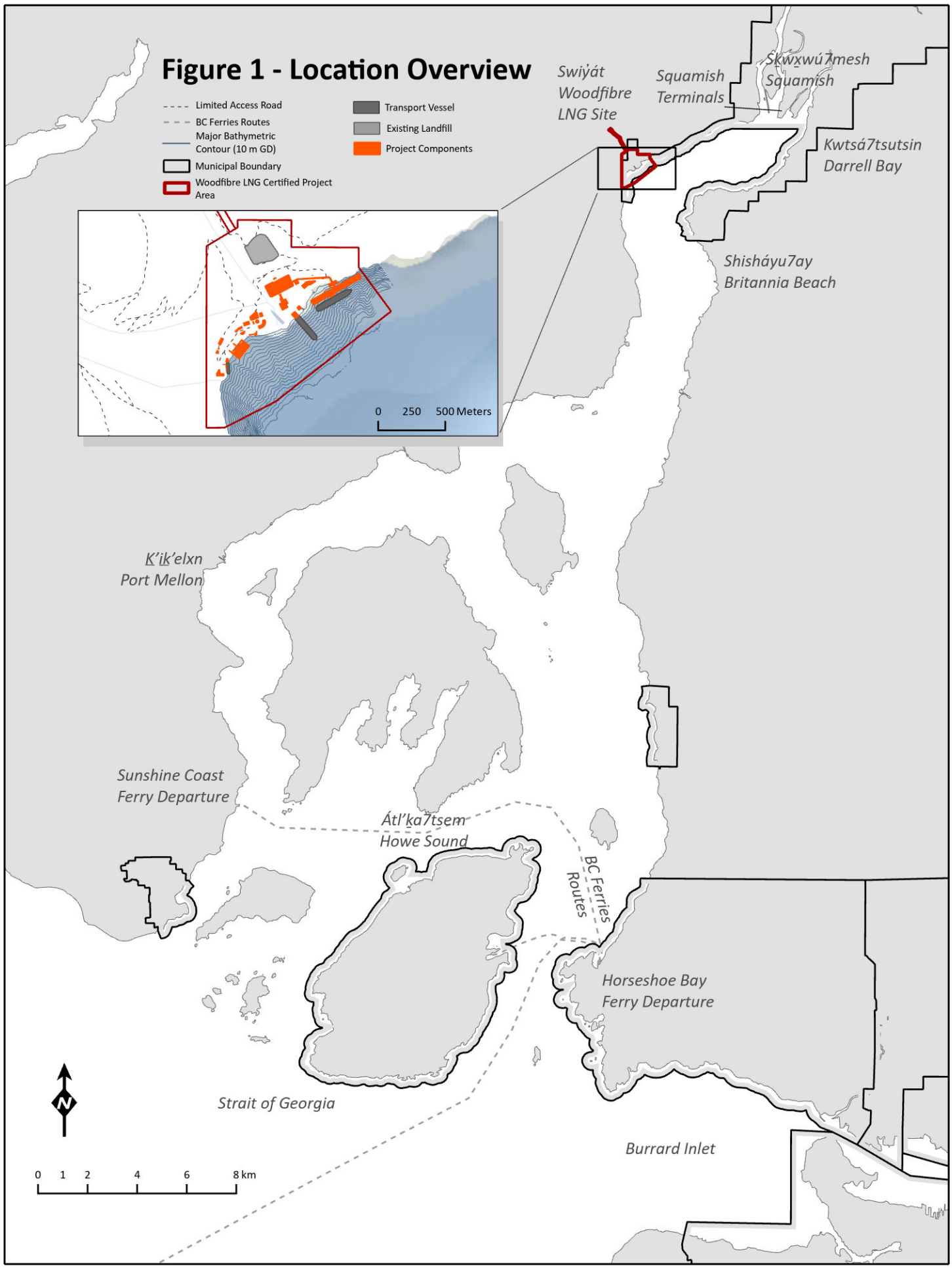
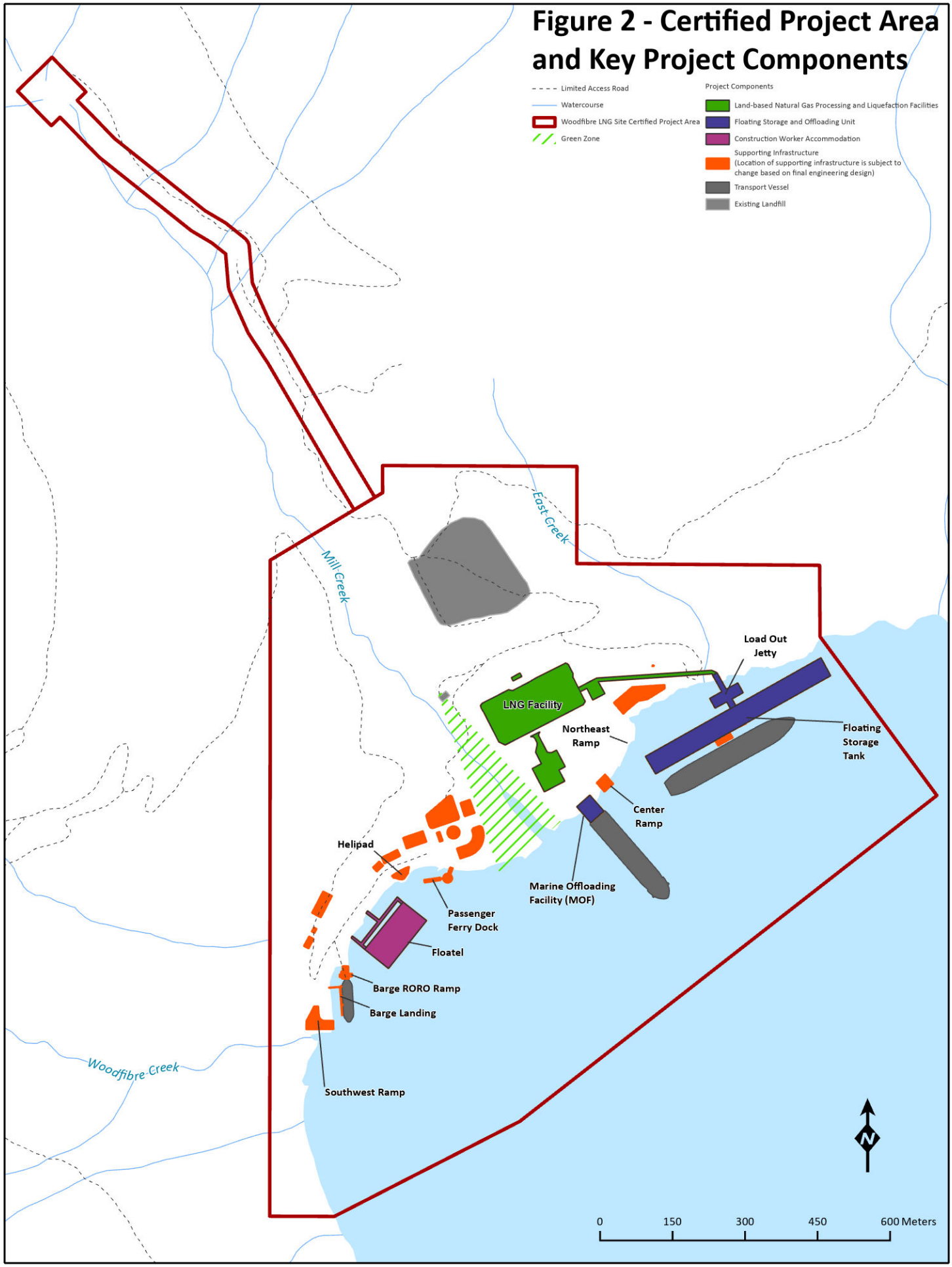

Figure 1 - Location Overview
Limited Access Road
BC Ferries Routes
Major Bathymetric Contour (10 m GD)
Municipal Boundary
Woodfibre LNG Certified Project Area
Transport Vessel
Existing Landfill
Project Components
0 250 500 Meters
Swiy̓át
Woodfibre
LNG Site
Squamish
Terminals
Sḵwx̱wú7mesh
Squamish
Kwtsá7tsutsin
Darrell Bay
Shishóyu7ay
Britannia Beach
K'ik'elxn
Port Mellon
Sunshine Coast
Ferry Departure
Át̓l'ka7tsem
Howe Sound
BC Ferries
Routes
Horseshoe Bay
Ferry Departure
Strait of Georgia
Burrard Inlet
N
0 1 2 4 6 8 km

Figure 2 - Certified Project Area and Key Project Components



The works and activities that will occur as part of construction include:

- marine early works (e.g., shoreline improvements and armoring, dock replacement or repairs), including improvements to the existing in-service (east and south) barge landing
- vegetation clearing and grubbing
- stripping and grading
- drilling and blasting, including excavation, crushing, screening, and hauling
- grouting and rock stabilization
- road, culvert, and bridge works
- construction of land-based natural gas processing and liquefaction facility
- construction support structures, services, and equipment
- construction of the floating storage and offloading unit
- marine facility construction of mooring dolphin supports and connecting trestles and gangways
- dredging, if required

1.1 OBJECTIVE

The purpose of the Invasive Plant Management Plan (IPMP) is to describe the measures to mitigate the establishment and spread of invasive plant species during construction of the Project and to monitor the effectiveness of these measures. An operational IPMP will be prepared after commissioning the LNG facility. For the purposes of this IPMP, invasive plants are defined as follows:

- Noxious weeds, as per Schedule A of the Weed Control Regulation under the *Weed Control Act*, including both Provincial Weeds listed on Part I and Regional Weeds in the Squamish-Lillooet Regional District (SLRD) listed on Part II. There are currently no regional weeds designated in the SLRD by the *Weed Control Act*.
- Priority invasive plant species listed on Schedule B of the Noxious Weeds Control Bylaw (Bylaw 1542) of the SLRD.
- Invasive species identified on the Sea to Sky Invasive Species Council (SSISC) Priority Species List. The IPMP was prepared based on the version of the SSISC Priority Species List last updated on April 16, 2022.

The objectives of the IPMP are to:

- Identify the regulatory and Project requirements for the prevention, ínexwantas (monitoring), and control of invasive plant species associated with Project activities.
- Describe measures that Woodfibre LNG will implement to meet the regulatory and Project requirements within the CPA, which includes the Project footprint and areas where construction activities will occur, as well as adjacent areas under Woodfibre LNG's control, during construction of the Project.
- Outline the ínexwantas (monitoring) that Woodfibre LNG will implement to verify that invasive species mitigation measures are implemented and verify the effectiveness of these mitigation measures.

This IPMP is a living document and revisions will be made if relevant new information becomes available through the progression of the detailed engineering design of the Project, changes in legislation, if performance objectives are not met, or as required by other regulatory approvals. If the IPMP requires updating, Woodfibre LNG will prepare a red-line version of the document that clearly identifies the changes that were made. The red-line version will be issued to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, and regulatory agencies for a 30-day review and comment period. After comments are received, the document will be updated and issued as a clean final revision for submittal to the BC EAO. The IPMP will continue to be implemented unless Woodfibre LNG is advised otherwise by the BC EAO.

1.2 PROJECT APPROVALS AND CONDITIONS

The requirements of Section 13.2 of Woodfibre LNG's application for an Environmental Assessment Certificate (the Application) (Woodfibre LNG, 2015) related to the IPMP are as follows:

- **Section 13.2.1.12:** The Proponent will develop methods to mitigate the introduction, transport, and extent expansion of invasive plant species (including noxious weeds) to and from the Project area during construction and operation. The objectives of this plan will be to detect, control (i.e., remove), and monitor invasive plant species in the Project footprint. Monitoring will be conducted to make sure that mitigation measures are properly implemented and are effective.
- **Section 13.2.3.7**: The Proponent will develop methods to mitigate the introduction, transport, and extent of expansion of invasive plant species (including noxious weeds) to and from the Project area. The plan developed during construction will be continued in the operation phase.

As referenced in Sections 13.2.2.12 and 13.2.3.7 of the Application, ínexwantas (monitoring) for invasive species will be as indicated in Section 13.3.6 of the Application, which commits to a Vegetation Monitoring Program as follows:

- **Section 13.3.6:** Monitoring is proposed to reduce potential effects to vegetation resources as a result of Project construction activities. Identification and mapping of invasive plant species will be monitored in and adjacent to the Project footprint in accordance with RISC standards. Follow-up monitoring of native plant landscaping efforts on the Project site will be needed to manage noxious weeds and invasive species to confirm that the objectives of the reclamation plan are achieved. In addition, thresholds or action levels at which control measures will be implemented will be identified.

The requirements outlined in the bullets above have been included in this plan. In addition, the requirements for the development of an IPMP (supported by the Construction Environmental Management Plan) are set out in EAC #15-02 (Table 1).

Table 1 Conditions Relevant to the Invasive Plant Management Plan

Condition Number	Condition	IPMP Reference
EAC Condition 10	The Holder must develop, in consultation with FLNR, OGC and Squamish Nation an invasive plant management plan that describes measures to prevent, monitor and control the establishment and spread of invasive plant species in the terrestrial portions of the Certified Project Area during Construction and Operations.	Entire plan
	A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, FLNR, OGC, and Squamish Nation 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.	Entire plan
EAC Condition 21	The Holder must develop, in consultation with FLNR, OGC and Aboriginal Groups, a construction environmental management plan and an operations environmental management plan in accordance with Section 13.2 of the Application.	Construction Environmental Management Plan
	A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the construction environmental management plan to EAO, FLNR, OGC and Aboriginal Groups no less than 30 days prior to the Holder's planned date to commence Construction. The Holder must provide the operation environmental management plan to EAO, FLNR, OGC and Aboriginal Groups no less than 60 days prior to the Holder's planned date to commence Operations. The Holder must develop and implement the plans to the satisfaction of EAO.	Construction Environmental Management Plan
SNEAA Condition 12	Making certain mitigation measures proposed in its EA application that are considered voluntary measures legally binding under a Squamish Nation Certificate of Project Approval.	Entire plan

Note:

The regulator names (i.e., FLNR and OGC) in the conditions reflect the names that were in place when the conditions were written. FLNR (Ministry of Forests, Lands and Natural Resources) is now split into Ministry of Forests and Ministry of Water, Land and Resource Stewardship and OGC (Oil and Gas Commission) is now BC Energy Regulator.

Comments received on the IPMP and Woodfibre LNG's responses to these comments are provided in a Consultation Record, as required by EAC Condition 2.

1.3 SḴWX̱WÚ7MESH ÚXWUMIXW (SQUAMISH NATION) ENVIRONMENTAL ASSESSMENT AGREEMENT

The Sḵwx̱wú7mesh Úxwumixw (Squamish Nation's) environmental assessment process for the Project was designed to parallel the federal and provincial environmental assessment processes, whereby Project effects on the Sḵwx̱wú7mesh stélmexw (Squamish people's) rights and title interests are identified, understood, and properly avoided or mitigated. The process for the Project ultimately resulted in the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) issuing an environmental assessment certificate (#2015-001), which includes conditions described in the SNEAA that was issued on October 14, 2015. Per SNEAA, "*Squamish Nation has agreed that Woodfibre may proceed with carrying out the Project, subject to Woodfibre LNG meeting, and (as applicable) continuing to meet, the Squamish Nation Conditions as provided for in this Agreement*."

The SNEAA Condition 12, which has applicability to the IPMP, states

4.12 Binding Mitigation Measures - Squamish Condition #12

(a) Woodfibre LNG identifies approximately 119 distinct mitigation measures in Table 22-1 of Woodfibre LNG's EA application. If Squamish Nation determines that it wishes to monitor any of the mitigation measures, then Squamish Nation will issue a notice to Woodfibre LNG identifying which mitigation measures it intends to monitor ("Monitored Mitigation Measures") and the manner it proposes to undertake such monitoring.

(b) Where Squamish Nation is of the opinion that any Monitored Mitigation Measure is not being followed, it will notify Woodfibre LNG. Woodfibre LNG will respond to the notification with one of the following (the "'Response"):

(i) Woodfibre LNG's explanation of how the mitigation measure is being followed;

(ii) a written explanation why the mitigation measure is not being followed, and the measure that replaces it (with an explanation of how the new measure provides equal or greater levels of environmental protection);

(iii) A written explanation of why the mitigation measure is not being followed, with justification for:

a. why it has not been replaced with another measure, or

b. why it has been replaced with a measure that provides less levels of environmental protection

(c) Woodfibre LNG will develop a Monitored Mitigation Measures plan with the Squamish Nation that will include the frequency of guided tours for the Squamish Nation during construction and operations and a budget to implement the plan, which plan will be fully funded by Woodfibre LNG.

(d) *Should Squamish Nation not be satisfied with the Response, then the Squamish Nation may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the Response is at issue the expert or expert panel shall consider the following when making its decision: whether the mitigation measure has a material impact on constructability, cost, operability, safety, environment, or schedule; whether the mitigation measure creates unacceptable risk or legal liability for the Project; whether the mitigation measure conflicts with any legal, regulatory, or pre-existing contractual obligations of Woodfibre LNG; whether the Woodfibre LNG response to the proposed mitigation measure(s) conforms to Good Industry Practice; and any other information the expert or expert panel considers relevant.*

The following mitigation measure (M5.11-1) from the Application[2] is enabled by condition 12 of the SNEAA and is addressed by the IPMP:

- Woodfibre LNG General Partner Inc. Limited will develop an Invasive Plant Management Plan to mitigate the introduction, transport, and extent expansion of invasive plant species (including noxious weeds) to and from the Project area during construction and operation. The objectives of this plan will be to detect, control (i.e., remove), and monitor invasive plant species in the Project footprint area. Part of this plan will include mapping invasive plant extent and tracking this extent over the life of the Project to record invasive species proliferation. Monitoring will be conducted to make sure that mitigation measures are properly implemented and effective.

[2] At the time the Application was submitted, the company name was Woodfibre LNG Limited but it is now Woodfibre LNG General Partner Inc. The commitments as written and presented herein remain unchanged from the Application.

2.0 REGULATORY FRAMEWORK

The Project is to be designed, constructed, and operated in alignment with the requirements of the provincial, federal, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes, including:

- EAC #E15-02 issued on October 26, 2015 and amendments issued on July 12, 2017 and July 19, 2019
- Decision Statement issued under section 54 of the *Canadian Environmental Assessment Act,* 2012 (CEAA, 2012) on March 18, 2016 and a revised Decision Statement on March 7, 2018
- SNEAA certificate issued on October 14, 2015
- Permits, licenses, and authorizations issued for the Project
- Regulatory requirements of federal and provincial legislation and regulations
- SLRD bylaws
- District of Squamish bylaws
- Best management practices regarding reducing the introduction and proliferation of invasive plants

Information applicable to this IPMP is provided in the following sections.

2.1 LEGISLATIVE REQUIREMENTS AND CRITERIA

Management of invasive plant species for the Project is regulated provincially under the *Weed Control Act* and *Oil and Gas Activities Act* (OGAA), which are administered by Ministry of Forests (MoF) and the BC Energy Regulator (BCER), respectively. The *Weed Control Act* applies to all provincial Crown and private land in BC; it requires landowners or occupiers to control the spread of noxious weeds, as listed in Schedule A of the Weed Control Regulation. Woodfibre LNG is responsible for compliance with the requirements of the *Weed Control Act*. The Environmental Protection and Management Regulation under the OGAA requires persons carrying out an oil and gas activity on an operating area to make reasonable efforts to not transport invasive plants into the area and prevent invasive plants from becoming established. Amendments made to the OGAA in 2023 require that permit holders prepare and maintain an invasive plant compliance record (BCER 2023). Order M152, issued under section 33 of the Environmental Protection and Management Regulation, establishes plants listed in Schedule A, Part 1 of the Weed Control Regulations as invasive plants.

The *Integrated Pest Management Act* (IPMA) and Regulation establish conditions for the sale and use of pesticides in BC through a classification system and regulatory provisions for licenses, certification, permits, and ministry confirmations of receipt of pesticide use notices under Pest Management Plans. The Regulation also contains public notification, consultation, reporting, and record keeping provisions, as well as standards for use of Integrated Pest Management and for human health and environmental protection.

The SLRD, a local government federation that includes the District of Squamish, has enacted bylaws for the management of invasive species and movement of soil. Squamish-Lillooet Regional District Bylaw No. 1542 defines noxious weeds as all noxious weeds identified in Schedule A of the Weed Control Regulation under the *Weed Control Act*, as well as a list of invasive plant species presented in Schedule B of the Bylaw, which includes species identified as priorities by the SSISC or the Lillooet Regional Invasive Species Society. The bylaw prohibits planting noxious weeds, gives bylaw officers authority to provide written notices requiring control of the noxious weeds, and sets out provisions whereby the regional district can control noxious weeds at the expense of the owner or occupier of the property.

The District of Squamish has three bylaws regarding the management of invasive species: Bylaw No. 2786 (Invasive Species Management), Bylaw No. 2787 (Pesticide and Herbicide Use) and Bylaw No. 1868 (Unsightly Premises and Objectionable Situations). The Invasive Species Management Bylaw requires that property owners do not let invasive species grow or spread on their property. Treatment and disposal of invasive species is required to follow methods that are endorsed, published, or established by the SSISC, Invasive Species Council of BC, or under the direction of a Qualified Professional (QP) and accepted by District of Squamish environmental staff. The Pesticide and Herbicide Use bylaw states that pesticides are only allowed to be used under certain conditions. The Unsightly Premises and Objectionable Situations bylaw does not allow landowners to allow noxious weeds to grow on their property and states that noxious weeds must be removed from the property. The District of Squamish also maintains representation on the board of the regional SSISC and contributes annually to the organization; in turn, the SSISC works in cooperation with the District of Squamish to manage invasive species in the SLRD. The SSISC has issued a Priority Species List that categorizes provincially regulated and unregulated invasive plants into management categories (i.e., prevention watchlist, eradicate, contain, strategic control, no action, and insufficient information) (SSISC, 2020a). The Project occurs in Integrated Species Management Area (ISMA) 1 as defined by the SSISC.

The regulatory framework for the IPMP is summarized in Table 2.

Table 2 Regulatory Framework for the Invasive Plant Management Plan

Name	Jurisdiction	Description
Weed Control Act	Provincial	Requires that the occupier of land must control noxious weeds on their property. It is an offense to knowingly contravene this Act or to refuse to comply with an order to control noxious weeds.
Weed Control Regulation	Provincial	Prevents the accidental and deliberate spread of noxious species. Supports the *Weed Control Act* by defining noxious weeds.
Environmental Protection and Management Regulation	Provincial	Requires a person undertaking an oil and gas activity to make reasonable efforts not to establish or spread invasive plants.
OGAA	Provincial	Requires permit holders to prepare and maintain an invasive plant compliance record.
OGAA (Order M152)	Provincial	Order M152 is made under the Environmental Protection and Management Regulation, whereby the species of plants listed in Schedule A, Part I – Provincial Weeds of the Weed Control Regulation are established as invasive plants.
IPMA	Provincial	Outlines specific requirements for pesticide (herbicide) use for management of noxious weeds and invasive plants.
IPMA	Provincial	Specifies licensing around pesticide use and provides requirements around public notification of pesticide use.
Pest Control Products Act	Federal	Specifies required measures to prevent unacceptable risks to individuals and the environment from the use of pest control products
SLRD Invasive Species Management and Control Service Establishment (Bylaw No. 1541)	Regional	The Regional Board of the SLRD may enter into contracts with external parties to provide invasive species management and control within the service area.
Noxious Weeds Control Bylaw (Bylaw No. 1542)	Regional	Prohibits the growth of noxious weeds on private property. The definition of noxious weeds under the bylaw includes those listed on the provincial *Weed Control Act*, as well as species identified as priorities by the SSISC or the Lillooet Regional Invasive Species Society.
Deposit and Removal of Soil (Bylaw No. 1423)	Regional	Regulates deposit and removal of soil that specifies weeds to be controlled at all times by mechanical or chemical means.
Invasive Species Management (Bylaw No. 2786, 2020)	Municipal (Squamish)	Regulates invasive species and management within the District. Outlines certain conditions required for treatment and disposal of invasive species.
Pesticide and Herbicide Use (Bylaw No. 2787, 2020)	Municipal (Squamish)	Outlines when and where pesticides can be applied.
Unsightly Premises and Objectionable Situations (Bylaw No. 1868, 2005)	Municipal (Squamish)	Requires that noxious weeds do not accumulate and are removed from the property, among other conditions.
Soils Management (Bylaw No. 2641, 2018)	Municipal (Squamish)	Requires a permit for deposit and removal of more than 30 m^3 of soil or other material during a 12-month period.

3.0 ROLES AND RESPONSIBILITIES

The Construction Environmental Management Plan describes the roles and responsibilities of the Environmental Manager, Contractor, QP, and Environmental Monitor (EM). Specific to the IPMP, the QP is responsible for:

- Preparing the IPMP
- Preparing and maintaining the invasive plant compliance record required by the BCER
- Providing discipline-specific expertise in management of invasive plants
- Completing an annual review of the priority species list provided by the SSISC and the regulations listed in Table 2
- Providing training to the EM and Contractor on the recognition of invasive plant species and mitigation measures in the Construction Environmental Management Plan
    - This training will include a description of how to report invasive species. Any potential new occurrences of invasive species will be reviewed by the QP prior to being uploaded into the Invasive Alien Plant Program (IAPP) or the InvasivesBC database.
    - It will be made clear that incidental observation of any invasive species or suspected invasive species will be sent to the EM and/or QP for review.
- Supervising surveys to refine mapping of the spatial extent of invasive species after implementation of the IPMP (see Section 6.2)
- Supervising Contractors who are completing invasive plant control treatments
- Supporting development of an Integrated Pest Management Plan for the operations phase
- 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 invasive species and will be either a registered professional or an accredited practitioner.

4.0 INVASIVE PLANT SPECIES SETTING

Five invasive plant surveys have been conducted within the CPA between 2013 and 2021 to address environmental assessment and EAC conditions requirements. These are summarized below.

In support of the environmental assessment process and based on the historical use and disturbed nature of Swĺyat, an invasive species survey was carried in 2013. A total of 26 invasive plant species were observed during the 2013 field program, including three provincially noxious weed species, as defined under the *Weed Control Act*: Canada thistle (*Cirsium arvense*), Japanese knotweed (*Fallopia japonica*/*Reynoutria japonica*), and perennial sow-thistle species (*Sonchus arvensis*) (Golder, 2014).

Additional invasive plant surveys were conducted in 2017, 2018, 2019, and 2021, in accordance with the guidelines provided by the Invasive Alien Plant Program at the time of each survey (Ministry of Forest and Range, 2010; FLNRORD, 2019). While Section 13.3.6 of the Application specified that Resource Inventory Standards Committee (RISC) standards are to be used for the identification and mapping of invasive plant species, a review of the Province of British Columbia's inventory standards website shows there are no guidance documents for field surveys or mapping of invasive plant species. As such, the Invasive Alien Plant Program Reference guidelines (Ministry of Forests and Range, 2010) are the most applicable for identification and mapping of invasive plant species. The surveys were conducted by biologists who surveyed the CPA by foot and vehicle. The surveys focused on regularly disturbed areas, particularly those being used during existing site activities (i.e., previously disturbed areas, access roads, and the transmission line corridor within the fee simple boundaries). When a single site supported multiple invasive plant species, all species associated with a point or polygon were documented (Hemmera, 2017, 2018, 2019).

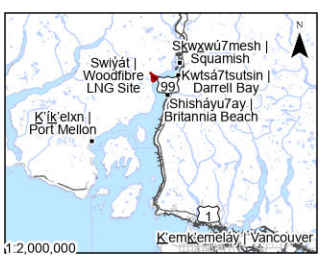
A total of 16 invasive plant species were documented during the 2017 survey (Figure 3; Hemmera, 2017), including provincially regulated noxious plants and other unregulated invasive species of concern (Table 3). Japanese knotweed, thistle (*Cirsium* spp.), and sow-thistle (*Sonchus* spp.) were the only noxious weed species identified in the survey area that are regulated by the *Weed Control Act*.

Surveys were repeated in 2018 and 16 invasive plant species were again observed. Common burdock (*Arctium minus*) was observed but common periwinkle (*Vinca major*) was not as the sites where it had been previously documented were not resurveyed due to time constraints (Hemmera, 2018).

Surveys in 2019 identified 20 invasive plant species. Species not documented in 2017 or 2018 included: common foxglove (*Digitalis purpurea*), common St. John's-wort (*Hypericum perforatum*), creeping bellflower (*Campanula rapunculoides*), orange hawkweed (*Hieracium aurantiacum*), and white sweet-clover (*Melilotus alba*; Hemmera, 2019). Cherry-laurel (*Prunus laurocerasus*) and oxeye daisy (*Leucanthemum vulgare)* were not observed in the 2019 survey (Hemmera, 2019).

The survey completed by Stantec in 2021 detected 21 invasive species within the CPA (Table 3). A survey of areas of the Certified Project Area that are not disturbed by construction will occur in 2024.





Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. World Imagery: District of Squamish, Maxar

- Invasive Plant Species Occurrence
- Invasive Plant Flagging October 2021
- 2019 Invasive Plant Species Inventory- Areas of Contiguous Species Occurrences
- Knotweed
- Knotweed and other invasive species
- Knotweed, thistle, and other invasive species
- Thistle and other invasive species
- Thistle species
- Other invasive species
- Transmission Line
- Road
- Biogeoclimatic Ecosystem Classification Zone
- Existing Watercourse
- Watercourse
- Topographic Contour
- Waterbody
- Green Zone
- Crown Land Rights-of-way
- Woodfibre LNG Site Certified Project Area
- Existing Landfill
- Transport Vessel
- Project Components

0 100 200 300 400 m

1:8,000 (at original document size of 11x17)

Stantec

Project Location: Swiýát
Project Number: 123221624
Prepared by EHERTZMAN on 20220506
Requested by CLION on 20220506

Client/Project/Report
Woodfibre LNG Limited
Woodfibre LNG Project

Figure No.
3

Title
Invasive Vegetation Occurrences in the Certified Project Area

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Figure 3 shows the conditions in the CPA based on the 2019 invasive species surveys, including specific information regarding the location of noxious weeds (Japanese knotweed and thistle species). Table 3 provides an aggregated list of the invasive species identified in all four surveys and identifies the SSISC management category for each species documented during surveys (SSISC, 2020a). A photo log of the observed species is provided in Appendix A.

Table 3 Invasive Plant Species Documented in the CPA from 2013 to 2021

Common Name(s)	Latin Name	*Weed Control Act*	DOS Bylaw No. 2786[1]	SLRD Bylaw 1542[2]	SSISC Management Category[3]	Years Documented				
						2013	2017	2018	2019	2021
big-leaf periwinkle	*Vinca major*	-	-	Yes	Prevention Watchlist	x			x	
bladder campion; maidenstears	*Silene vulgaris (cucubalus)*	-	-	-	Prevention Watchlist	x				
traveler's joy; wild Clematis	*Clematis vitalba*	-	-	Yes	Prevention Watchlist	x	x	x	x	x
butterfly-bush	*Buddleja davidii*	-	-	Yes	Contain	x	x	x	x	x
English holly	*Ilex aquifolium*	-	-	Yes	Contain	x	x	x	x	x
English ivy	*Hedera helix*	-	Yes	Yes	Contain	x	x	x	x	x
Japanese knotweed	*Fallopia japonica Reynoutria japonica*	Noxious	Yes	Yes	Contain	x	x	x	x	x
common burdock; lesser burdock	*Arctium minus*	-	-	-	Strategic Control	x		x	x	x
common periwinkle	*Vinca minor*	-	-	Yes	Strategic Control		x		x	x
common St. John's-wort	*Hypericum perforatum*	-	Yes	Yes	Strategic Control	x			x	x
common tansy	*Tanacetum vulgare*	-	-	-	Strategic Control	x	x	x	x	x
common foxglove; purple foxglove	*Digitalis purpurea*	-	-	-	Strategic Control	x			x	x
Himalayan blackberry	*Rubus armeniacus*	-	Yes	Yes	Strategic Control	x	x	x	x	x
orange hawkweed	*Hieracium aurantiacum*	-	-	Yes	Strategic Control	x			x	x
oxeye daisy	*Leucanthemum vulgare*	-	-	-	Strategic Control		x	x		x
policeman's helmet; ornamental jewelweed; Himalayan balsam	*Impatiens glandulifera*	-	Yes	Yes	Strategic Control		x	x	x	x

Table 3 Invasive Plant Species Documented in the CPA from 2013 to 2021

Common Name(s)	Latin Name	*Weed Control Act*	DOS Bylaw No. 2786[1]	SLRD Bylaw 1542[2]	SSISC Management Category[3]	Years Documented				
						2013	2017	2018	2019	2021
Scotch broom	*Cytisus scoparius*	-	Yes	Yes	Contain	x	x	x	x	x
sow-thistle species[4]	*Sonchus* spp.	Noxious	Yes	-	Strategic Control		x	x	x	
prickly sow-thistle	*Sonchus asper*	-	Yes	-	Insufficient Information				x	x
perennial sow-thistle	*Sonchus arvensis*	Noxious	Yes	-	Strategic Control	x				
thistle species[5]	*Cirsium* or *Silybum* spp.	Noxious	Yes	Yes	Prevention Watchlist / Strategic Control		x	x	x	
Canada thistle	*Cirsium arvense*	Noxious	Yes	-	Strategic Control	x				
common dandelion	*Taraxacum officinale*	-	-	-	No Action	x				
common plantain	*Plantago major*	-	-	-	No Action	x				
creeping buttercup	*Ranunculus repens*	-	-	Yes	No Action	x				x
curled dock; curly dock	*Rumex crispus*	-	-	-	No Action	x				
field bindweed; morning glory	*Convolvulus arvensis*	-	-	-	No Action	x	x	x	x	x
great mullein; common mullein	*Verbascum thapsus*	-	-	-	No Action	x	x	x	x	
narrow-leaved plantain; ribwort plantain	*Plantago lanceolata*	-	-	-	No Action	x				
yellow salsify; western goat's beard	*Tragopogon dubius*	-	Yes	-	No Action	x				
white sweet-clover	*Melilotus alba*	-	-	-	No Action				x	x
yellow sweet-clover	*Melilotus officinalis*	-	-	-	No Action	x				x
European bittersweet; climbing nightshade; blue bindweed	*Solanum dulcamara*	-	-	-	-					x
cherry-laurel	*Prunus laurocerasus*	-	-	-	Insufficient Information		x	x		

Table 3 Invasive Plant Species Documented in the CPA from 2013 to 2021

Common Name(s)	Latin Name	*Weed Control Act*	DOS Bylaw No. 2786[1]	SLRD Bylaw 1542[2]	SSISC Management Category[3]	Years Documented				
						2013	2017	2018	2019	2021
creeping bellflower; rampion bellflower	*Campanula rapunculoides*	-	-	-	Insufficient information				x	
reed canarygrass	*Phalaris arundinacea*	-	Yes	-	Insufficient Information	x				

Notes:

[1] District of Squamish Invasive Plants identified in Bylaw No. 2786 (from the *Spheres of Concurrent Jurisdiction – Environment and Wildlife Regulation*)

[2] SLRD noxious weeds identified in Bylaw 1542 (2018)

[3] Management categories for Priority Species in ISMA 1 defined as follows (SSISC, 2020a):

- Prevention Watchlist = not yet known in the ISMA; prevent species from entering the region and eradicate immediately if detected following Early Detection Rapid Response protocol
- Contain = abundant in portions of ISMA; apply control measures to keep the species from spreading
- Strategic Control = widespread species beyond landscape-level control and/or with relatively low impact; apply control measures in high priority areas only (e.g., wildlife habitat, agricultural land)
- Insufficient Information = not enough information to assign a management category. Monitor known locations and/or access more information from other regions.

[4] In 2013, perennial sow-thistle *(Sonchus arvensis)* was recorded; in 2019, prickly sow-thistle (*Sonchus asper*) was recorded. Surveys in 2017 and 2018 were unable to identify the sow-thistle plants to species.

[5] In 2013, Canada thistle was recorded on site. Subsequent surveys were not able to identify the thistles to species.

4.1 AREAL EXTENTS OF INVASIVE SPECIES OCCURRENCES

A total of 46.64 hectares of invasive plant species occurrences have been recorded to date. In addition to the polygon occurrences reported in Table 4 there are 125 point-occurrences of invasive plant species that occur in the CPA; the majority occur within the mapped invasive plant occurrences.

Table 4 Areal Extents of Contiguous Invasive Plant Species Occurrences in the CPA

Invasive Plant Species (common names)	Hectares
Knotweed	3.67
Knotweed and other invasive species	16.50
Knotweed and Himalayan Blackberry	14.42
Other invasive species	7.72
Prickly sow thistle (invasive) and other invasive species	3.22
Thistle and other invasive species	0.29
Thistle species	0.82
Total	***46.64***

5.0 INVASIVE PLANT MITIGATION

The measures to prevent and control the establishment and spread of invasive plant species in the terrestrial and riparian portions of the CPA during construction and operations are described in the following subsections. The ínexwantas (monitoring) and reporting program, including the approach to adaptive management, is described in Section 6.3.

5.1 BEST MANAGEMENT PRACTICES AND STANDARDS

Governments and industry bodies have published several best practices, guidelines, and codes of practice applicable to the management of invasive plants. These documents contain management techniques that are acceptable to regulators and contribute to the corporate due diligence in environmental protection. The following documents were considered in the development of this Plan:

- The Field Guide to Noxious Weeds and Other Selected Invasive Plants of British Columbia (Province of British Columbia, 2021)
- Invasive Alien Plant Program Reference Guide (Ministry of Forests and Range, 2010)
- A Guide to Weeds in British Columbia (MAFF, 2002)
- Invasive Alien Plants in Canada Technical Report (Canadian Food Inspection Agency, 2008)
- Sea to Sky Corridor Invasive Plants: A Guide to Identification & Management (SSISC, 2012)
- Best Practices for Managing Invasive Plants on Roadsides (ISCBC, 2019)
- Best Practices for Managing Invasive Species on Utility Operations (ISCBC, 2014)
- Pest Management Plan for Invasive Alien Plant and Noxious Weed Control on Provincial Crown Lands within South Coastal Mainland of British Columbia (Province of British Columbia, 2011)
- Best Management Practices for Knotweed Species in the Metro Vancouver Region (Metro Vancouver, 2021a)
- Best Management Practices for English and Irish Ivies in the Metro Vancouver Region (Metro Vancouver, 2021b)
- Best Management Practices for English Holly in the Metro Vancouver Region (Metro Vancouver, 2021c)
- Best Management Practices for Himalayan Balsam in the Metro Vancouver Region (Metro Vancouver, 2021d)
- Best Management Practices for Himalayan Blackberry in the Metro Vancouver Region (Metro Vancouver, 2021e)
- Best Management Practices for Scotch Broom in the Metro Vancouver Region (Metro Vancouver, 2021f)
- Best Management Practices for Reed Canarygrass in the Metro Vancouver Region (Metro Vancouver, 2021g)

- Targeted Invasive Plant Solutions 16 – Invasive Knotweeds (IPCBC, 2008)
- Invasive Japanese Knotweed (*Fallopia japonica* (Houtt.)) Best Management Practices in Ontario (OIPC and Anderson, 2012)

5.2 CONSTRUCTION PHASE

5.2.1 Prevention Program

Table 5 lists the Project activities that may result in the introduction or spread of invasive plant species and the associated potential effect, and describes mitigations to prevent such introduction or spread during the Project construction phase.

Table 5 Mitigation to Prevent the Spread of Invasive Plant Species during Construction

Project Activity	Potential Activity Effect	Mitigation
Vehicle and Machinery Access	Vehicles and machinery are the most common ways invasive plants infest new areas	• The Contractor will establish wash and inspection stations where vehicles and construction equipment arriving and departing the site will be cleaned and inspected to prevent the spread of invasive plants. Wash stations involve the use of water to remove accumulations of dirt, debris, and weed matter from vehicles and construction equipment (USDA, 2005). If the inspection determines a vehicle or piece of construction equipment is not clean upon arrival to the CPA, the Contractor will wash it prior to use. The Contractor will also wash vehicles and construction equipment prior to barging offsite. When washing, special attention will be paid to wheel wells, tire treads, tracks, and undercarriages where mud, roots, and seeds may be lodged. The use of these wash stations will be documented by the Contractor's EM. Wash stations will require containment of run-off and sediment to prevent further distribution of invasive plants or seeds via wash water or soil. Accumulated sediment will be stockpiled near wash stations and monitored for growth of invasive plants. Treatment of any invasives that establish in stockpiled accumulated sediment will follow the Soil Management and Grading Project Activity in this table (Table 5). Erosion and sediment control and treatment of potentially contaminated soil in accumulated sediment stockpiles will follow the methods in Table 6 and Section 5.2.4. • Vehicle and equipment movement within the CPA will be concentrated within designated roads, travel corridors, and development areas (including clearing and grubbing outside of designated roads). Designated roads, travel corridors, and development areas will be identified by the Contractor; they will be responsible for conveying this information to equipment operators either through signage within the CPA or maps presented as part of the environmental orientation program detailed in the Construction Environmental Management Plan (CEMP). • Disturbed areas which have exposed, unvegetated ground/soil surfaces will be revegetated with a vegetation seed mix in order to establish a vegetation cover that will control invasive plant establishment and surface erosion (seed mix details provided under Vegetation Clearing activity).

Table 5 Mitigation to Prevent the Spread of Invasive Plant Species during Construction

Project Activity	Potential Activity Effect	Mitigation
Vegetation Clearing	If areas that are currently vegetated are cleared for temporary use, those areas will be revegetated by the Contractor once the area is no longer required. Cleared vegetation could contain invasive plant propagules or seeds and exposed soil could promote invasive plant establishment if not revegetated with native species in a timely manner.	• Areas to be cleared will be flagged to limit the risk of over clearing of vegetation. • Clearing within 20 m of known locations of noxious weeds will be monitored by the EM to confirm that mitigation measures are being followed. • The QP will provide an erosion control or reclamation seed mix specification (e.g., custom native seed mix, Coastal Revegetation Mix, or Ministry of Highways Vancouver Island/Coast mix) and application rate that the Contractor will use to reseed disturbed areas[1]. • Seed grade will be Common No. 1 Forage or better, as determined by QP[1]. • Practices for clearing and grubbing will be proposed by the Contractor and approved by the EM.
Soil Management and Grading	There is potential that soil being moved between areas within the CPA or imported as fill will introduce or spread invasive plant species.	• Any soil or fill brought to the CPA for use during construction will be obtained from reputable suppliers that meet the requirements of the District of Squamish Soils Management Bylaw No. 2641 (DOS, 2018), as applicable. • Within the CPA, soil from areas with invasive plant species present will only be reused or stockpiled within that specific site or areas where the invasive plant species are already present and subject to control measures (Figure 3). • Invasive plant infestations will be treated prior to clearing to reduce the potential for invasive plants to spread once clearing has started. • After moving soil from areas that contain invasive propagules, vehicles, tools, and other equipment will be cleaned to avoid spreading invasive plant parts around the CPA. • Soil containing any invasive plant parts that will be buried will be buried to a minimum depth of 5 m • Disturbed areas which have exposed, unvegetated ground/soil surfaces will be revegetated with a vegetation seed mix in order to establish a vegetation cover that will control invasive plant establishment and surface erosion (seed mix details provided under Vegetation Clearing activity).
Shared Land Use	Introduction or spread of invasive species via use of Forest Service Roads located within the CPA	• Woodfibre LNG is working with the forest tenure holders and other land tenure holders to identify opportunities for ongoing access through construction and operations. • Woodfibre LNG will communicate with other tenure holders where invasive plant species occur to mitigate the spread of invasive plant species.

Note:

[1] Seed mix will not contain clover (*Trifolium* spp.)

5.2.2 Control Program

The control program is based on the control and disposal methods listed in Table 6 and Table 7. The program will address control of existing invasive plant species listed under the *Weed Control Act* and SLRD Noxious Weeds Control Bylaw (Bylaw No. 1542), as well as species on the SSISC Priority Species List (2020a) with management category of Prevention Watchlist, Contain, or Control, in areas where vegetation is cleared to support Project activities. As summarized in Table 3, these management categories are associated with the following approaches to control:

- **Prevention Watchlist:** invasive species not yet known in the ISMA. Prevent the invasive species from entering the region and eradicate immediately if detected following Early Detection Rapid Response protocol. Three invasive plant species with management category Prevention Watchlist were identified in the CPA, though two of them have not been observed since 2013.
- **Contain:** invasive species abundant in portions of ISMA. Apply control measures to limit the spread of the invasive species. Four invasive plant species with this management category have been identified in the CPA, including the noxious weed Japanese knotweed.
- **Strategic Control:** widespread invasive species beyond landscape-level control and/or with relatively low impact; apply control measures in high priority areas only. Twelve invasive plant species with this management category were identified in the CPA, including two noxious species: thistle species (*Cirsium* spp.) and sow-thistle species (*Sonchus* spp.). The Green Zone and riparian areas are the high priority areas within the CPA (see Figure 1). The Green Zone is an area adjacent to Mill Creek where riparian habitat will be protected and enhanced following Project construction. In compliance with the Certified Project Description, the Green Zone will be planted with suitable native vegetation and will not contain any permanent Project buildings.
- **Insufficient Information**: Complete an inventory for these species if needed; monitor known locations. There are three invasive plant species identified within the CPA in the management category of Insufficient Information.

Site preparation for the Project footprint will generally consist of clearing of debris and vegetation, removal of topsoil and soil containing organic materials (i.e., soil salvage), and disposal and/or stockpiling of materials. Cleared and salvaged soil materials will be categorized according to the presence of invasive species (e.g., clean, general organic, containing noxious weeds), with prevention and control measures applied accordingly. Materials containing invasive plants (or propagules) will be stockpiled and/or disposed of properly (Table 6 and Table 7). Stockpiling will only occur in areas approved by Woodfibre LNG and will follow the measures outlined in Table 5 (Soil Management and Grading) and Section 5.2.4. Stockpiled soils will be a minimum of 30 m from a watercourse, and at least 50 m away from a watercourse where feasible.

In addition to the broad management of vegetation and soil materials containing invasive species that will occur during site preparation activities in the Project footprint, targeted control measures may be required for individual occurrences of invasive species. Table 6 provides a suite of targeted control and disposal methods for noxious weeds listed on the *Weed Control Act* that have been identified in the CPA. These methods were developed through discussions with invasive plant specialists from the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) working group and MoF. Recommended measures for targeted control of other invasive plant species known to occur within the CPA are presented in Table 7.

Table 6 Control and Disposal Methods for *Weed Control Act* Noxious Weeds within the CPA

Common Name	Control and Disposal Methods
knotweed[1]	• Areas infested with knotweed (as per Figure 3) will be georeferenced, flagged, signed, treated, bermed where feasible, and monitored prior to any earthworks to prevent further infestation. • Where clearing is planned outside of the growing season (i.e., late fall and winter), knotweed areas will be flagged during the previous growing season (i.e., spring, summer, or early fall). • Infested or potentially infested soil, plant, or knotweed material (Figure 3) will remain onsite for disposal. Contaminated soils that also contain invasive plant parts will be handled in a manner consistent with Contaminated Sites Regulation requirements for contaminated soils, as applicable (see Section 5.2.4). • Salvaged/disturbed soil, vegetation, or material containing, or potentially containing, knotweed plant parts will be stockpiled in a predetermined area where there is a known knotweed infestation prior to its disposal. The stockpile will be subject to appropriate erosion and sediment control (e.g., tarping during winter months and extreme weather events) to prevent erosion and following disposal this area will be reviewed by a QP bi-weekly, treated, and managed, as necessary during the growing season. • Potential spread of knotweed from the knotweed infested soil stockpile will be controlled by covering the stockpile. Knotweed in this area will be treated with herbicide in-situ in this area, if required. This area will be bermed where feasible, clearly marked, signed and monitored bi-weekly during the growing season to make sure plant parts are not observed outside of the contained area and to monitor effectiveness of herbicide treatment. • Knotweed areas disturbed by construction will be treated and managed to control the spread of knotweed or introduction of other invasive species. • As per the specifications of the weed control contract developed by Woodfibre LNG, chemical treatment will be applied, as needed, to infected areas. The use of herbicides will be discussed with District of Squamish or SLRD staff and provided to Squamish Nation prior to treatment. Herbicide application permits, as required by regulatory agencies such as the BC Ministry of Environment, will be obtained prior to application. The licensed weed management professional must be certified, have a valid pesticide license, and have at least three years of experience treating and successfully managing knotweed infestations. • Knotweed located within the waterbody or within 30 m of a waterbody may be treated using stem injections or foliar herbicides approved for use within riparian areas. Only herbicides that are approved by the Government of Canada for use near water will be used within 30 m of a water course. Prior to the use of any herbicide WLNG will consult with IG and relevant government agencies. • No herbicides will be used within the herbicide-free zone (1 m away from the high-water mark) unless approved by the appropriate entities described in Section 1.0 and Section 2.0. • Chemical treatment will be conducted annually in the spring, early summer, and late summer or fall for follow-up treatments – Follow up treatments will be based on the monitoring observations recorded during quality inspection • Mechanical removal will be used where herbicide use is not considered acceptable by a QP. In this case, applicable agencies (e.g., Fisheries and Oceans Canada, BCER) will be consulted in advance and works will be monitored.

Table 6 Control and Disposal Methods for *Weed Control Act* Noxious Weeds within the CPA

Common Name	Control and Disposal Methods
knotweed[1] (cont'd)	• Live stems can be hand-cut, tarped, bagged, and disposed of by deep burial at a minimum depth of 5 m (ISCBC, 2017; Metro Vancouver, 2021a). Cutting of plants should be done before plants go to seed (late spring or early summer). The burial area will be monitored during the growing season to verify that knotweed does not become established. Any regrowth of knotweed will be chemically treated where appropriate (e.g., not within 30 m of waterbody, unless treated using stem injections). • If contaminated soils infested with knotweed need to be disposed of offsite, all material should be bagged, sealed, and securely strapped to a vehicle. Facilities that accept knotweed infested soils can be found in Best Management Practices for Knotweed Species in the Metro Vancouver Region (Metro Vancouver, 2021a). Knotweed canes will not be transported off site. Areas where knotweed has been removed that are outside of the Project footprint (i.e., not subject to development) will be revegetated using a seed mix approved by the QP to prevent further invasive plant establishment. • As knotweed should not be transported, if possible (Metro Vancouver, 2021a), where feasible knotweed may be disposed of by completely incinerating the plants onsite (ISCBC, 2008; OIPC and Anderson, 2012) using an appropriate burning device (e.g., an air curtain burner), that will attain high enough temperatures to render the rhizomes and other plant parts incapable of reproduction, re-rooting, or spread. A QP will observe the success of incineration and provide feedback to the incineration Contractor.

thistle or sow-thistle[2]	• Treatment will be undertaken during the growing season prior to start of construction in the vicinity of the occurrence.
	• Mechanical treatment will include the following, depending on the timing of the treatment:
	  ○ Mowing plants when buds are present (mid- to late-spring); or
	  ○ Digging up rosettes and leaving to decompose on site.
	  ○ Prior to flowering, plant parts will be left to decompose on site.
	  ○ However, if plants are cut after flowering, they will be disposed of in an on- or off-site landfill for deep burial.
	• Herbicide will be used if a QP determines that mechanical control is unlikely to be effective for the species. The use of herbicides will be discussed with District of Squamish or SLRD staff prior to treatment. Herbicide application permits, as required by regulatory agencies such as the BC Ministry of Environment, will be obtained prior to application. If feasible, treatment will occur at the growth stage stated on the herbicide label. More than one application may be required.

Notes:

[1] There are four species of knotweed that occur in southwestern BC: Japanese knotweed (*Fallopia japonica/Reynoutria japonica)*, giant knotweed (*Fallopia sachalinensis*), bohemian knotweed (*Fallopia x bohemica*), and Himalayan knotweed (*Polygonum polystachyum*) (ISCBC, 2017). Japanese knotweed is the only species of these four that has been documented in the CPA (Section 5.0). All knotweeds are designated as noxious under the *Weed Control Act* and they are similar in appearance. Control and disposal methods in this table are applicable to all four species.

[2] Several different thistle species (*Cirsium sp.* or *Sonchus sp*.) were identified during the surveys; however, specimens were not identified to the species level due to their poor condition. Until confirmatory surveys are undertaken to determine the species and the applicability of the *Weed Control Act*, all thistle species documented within the CPA will be treated as though noxious and regulated by the *Weed Control Act*.

To be most effective, targeted control methods will be tailored to the characteristics of the invasive plant species occurrence being controlled, based on information such as the target plant species, size of infestation and treatment type, and flowering period and seed production. This selection of control methods will be determined with input from the QP, EM, and/or licensed weed management professional and approved by Woodfibre LNG's Environmental Representative.

For invasive plant infestations, the following is the preferential order for treatment:

1. Infestations in high traffic areas and travel routes
2. Infestations in riparian and seasonally flooded or standing water areas
3. Infestations in areas of known soil containing invasive plants

The majority of the invasive occurrences on site will be controlled by removal of above ground plant parts during clearing and construction and then disposed of by incineration in an air curtain burner (Table 7). Soil containing invasive plant parts will be treated as per Table 6 for knotweed and sow-thistle and Table 5 for all other species. Table 7 provides methods for the targeted control and disposal of other invasive plant species (i.e., species listed under SLRD Bylaw 1542 and/or with SSISC Management Category of Prevention Watchlist, Contain, or Strategic Control that are not noxious weeds) that have been identified within the CPA. Appropriate control and disposal methods for known occurrences impacted by construction activities will be developed by a QP for implementation by the Contractor. In cases where removal and incineration are not feasible and the QP determines that targeted control is required, the location and extents of occurrences will be isolated and access controls (i.e., flagging and signage) will be implemented until the appropriate disposal method has been determined and implemented for that particular occurrence (Table 7; SSISC, 2012). The use of herbicides as a treatment method for invasive plants that are not noxious weeds will comply with any applicable legislation, including local bylaws. Herbicide application permits, as required by regulatory agencies such as the BC Ministry of Environment, will be obtained prior to application.

Table 7 Control and Disposal Methods for Invasive Plant Species

Common Name	Latin Name	SLRD Bylaw 1542	Control and Disposal Methods
All Categories			
All	*N/A*	N/A	Throughout the majority of the site, above ground invasive plant occurrences will be mechanically removed using an excavator during clearing and construction activities. Excavated invasive plant parts will be incinerated (e.g., air curtain burner) by a Contractor concurrent with the clearing and construction activities.
Prevention Watchlist			
traveler's joy; wild clematis	*Clematis vitalba*	Yes	Cut climbing vines at knee height and apply herbicide to cut vines. Treat vines when actively growing in late spring. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
big-leaf periwinkle	*Vinca major*	Yes	Small infestations and seedlings can be pulled or covered with a weed barrier (e.g., landscaping fabric) for 4-6 months. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
bladder campion; maidenstears	*Silene vulgaris (cucubalus)*	Yes	Manual treatment by removing the seed heads and plant. Herbicides effective but best applied early in season before seed production. Fall applications may also offer long-term control. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
Contain			
butterfly-bush	*Buddleja davidii*	Yes	Remove when flowering. Pull smaller plants and cut larger plants at the base of the stem. Dig up the root ball and cover with a fabric barrier, then mulch to prevent re-sprouting. Do not leave stems on the ground. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
English ivy	*Hedra helix*	Yes	Manually remove ivy at rooting nodes before seeds are produced. Bag plants and dispose of at a landfill. Will need to be repeated if herbicides are not used. Pulling vines out of trees can cause damage, so it is better to cut vines at chest height and remove everything below that. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill (Metro Vancouver, 2021b).
English holly	*Ilex aquifolium*	Yes	Cut down mature plants before berries are produced and brush stumps with herbicide. Young plants will be pulled. Roots should be removed as much as possible (Metro Vancouver, 2021c). Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.

Table 7 Control and Disposal Methods for Invasive Plant Species

Common Name	Latin Name	SLRD Bylaw 1542	Control and Disposal Methods
Strategic Control			
scotch broom	*Cytisus scoparius*	Yes	Larger plants must be cut below ground level and the stems injected or sprayed with herbicide, while smaller plants will be hand pulled (Metro Vancouver, 2021f). Plants must be cut or pulled prior to seed production and must be bagged and disposed of in a landfill.
orange hawkweed	*Hieracium aurantiacum*	Yes	Plants can be removed by digging up the rosette. Care must be taken not to break the roots and entire plant must be removed to prevent plant re-growth. If flowers are already present, plants should be carefully disposed of by placing them in a plastic bag or similar container so seeds cannot spread. Regular mowing before the flowers go to seed can reduce seed production. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
common St. John's wort	*Hypericum perforatum*	Yes	This species is considered under biological control, but some populations of the plant are out of phase with the chemical control measures. Combinations of 2,4-D and picloram, or 2,4-D and glyphosate have been used to control this plant in the US. Several biocontrol agents are available to control large infestations. Monitor sites to confirm chemical control measures are present and the plant is not dispersing. If any plant material is cut, it will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
policeman's helmet; ornamental jewelweed; Himalayan balsam	*Impatiens glandulifera*	Yes	Plants can be easily removed by hand-pulling but must be removed before seeds are produced, usually before flowering. For larger infestations, mowing can also be effective in non-riparian areas (Metro Vancouver, 2021d). Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
Himalayan blackberry	*Rubus armeniacus*	Yes	Cut back branches when flowering and before berries are produced. Dig up the root ball using machinery or by hand. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill (Metro Vancouver, 2021e).
common periwinkle	*Vinca minor*	Yes	Dig up plants by removing the plants and 60 cm of soil under and around the plants. Hand pull regrowth and repeat over two to three years for complete removal if herbicides are not used. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.

Table 7 Control and Disposal Methods for Invasive Plant Species

Common Name	Latin Name	SLRD Bylaw 1542	Control and Disposal Methods
Strategic Control (cont'd)			
common burdock	*Arctium minus*	-	Preventing the production of the burred seed is a key manner to prevent spread. Mowing or cutting is best done before flowering to eliminate seed production. To remove this problematic plant fully, the large taproot system that grows deep underground must be tilled. Re-seed bare soil where possible, and encourage desirable, competing vegetation. Most broadleaf herbicides are also useful for control. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
common foxglove; purple foxglove	*Digitalis purpurea*	-	Cut before seed set. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
common tansy	*Tanacetum vulgare*	-	Use a combination of mowing and herbicide to control large infestations. Hand pulling is effective for smaller patches. Gloves must be worn to prevent skin irritation from the sap. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill.
oxeye daisy	*Leucanthemum vulgare*	-	Herbicide may be applied to prevent regrowth. Plant material will be bagged, labelled as invasive plant material, and disposed of at an appropriate facility and/or landfill
No Action			
creeping buttercup	*Ranunculus repens*	Yes	Manual removal by digging out, removing runners, roots and growing points, is most effective from fall to spring when soil is moist. Plants resist mowing and re-sprout quickly when cut. Broadleaf herbicides can be effective and likely require two or three applications to eradicate because mature plants can recover and the seed bank persists. Plant material will be bagged, labelled as invasive plant material, and incinerated on site.
Insufficient Information			
cherry-laurel	*Prunus laurocerasus*	No	Small plants can be dug up while larger plants can be cut to the ground and the root ball dug out or an herbicide used on the stump (SSISC, 2020b).
creeping bellflower	*Campanula rapunculoides*	No	Hand-pulling or digging plants out before blooming will prevent seed production. Roots are likely to resprout, so as much root and rhizome material as possible must be removed (Alberta Invasive Species Council, 2014).
reed canarygrass	*Phalaris arundinacea*	No	Small patches can be removed by digging out the plant and all of the roots. Larger infestations can be smothered using clear or black plastic. Herbicides are also effective (Tu, 2004).

5.2.3 Treatment Constraints

Treatments may be completed at any time of the growing season for all species except knotweed, which needs to be treated at least twice with herbicide at specific times: once in late spring and then again two months later. Three invasive plant control field program scopes of work will be carried out in the spring, summer, and fall for this site. It is assumed that the majority of species will require treatment during more than one of the three programs.

Within 30 m of waterbodies, conventional foliar herbicides will not be used, but stem injections or manual removal are permitted. Within 1 m of waterbodies, no conventional herbicides will be applied; however, an herbicide designed for riparian applications is being explored for use subject to approval by the relevant entities (see below for more information). Broadcast spray application of herbicides is not recommended in natural undisturbed vegetated areas such as forests or shrubland areas to avoid herbicide injury to non-target species due to spray drift. Alternate herbicide application methods for areas such as forest or shrubland are recommended, including stem injection, stem painting, wipe on application, basal spray, or cut stump application. Mechanical or manual control treatments are also recommended for these areas (see NSW, 2022 and USDA, 2011).

Woodfibre LNG has applied for a permit to use Habitat® Aqua for riparian area herbicide applications, and is currently consulting with relevant groups and agencies. The effectiveness of Habitat® Aqua will be assessed during Quality Inspection of invasive treatments (see Section 6.0 for details on Quality Inspection). If approved for use in 2023, Habitat® Aqua will be used in the third treatment application (targeting September). The manufacturer, BASF, reports that Habitat® Aqua is a “low-volume herbicide that provides effective, long-lasting, post-emergent control of undesirable, invasive and emergent aquatic vegetation”, and is a “nonvolatile, water-soluble herbicide that will not bioaccumulate in aquatic organisms” (BASF 2021).

5.2.4 Management of Contaminated Soils and Contaminated Soils with Invasive Plants

Due to the historical industrial use of Swíyat, there is the potential for contaminated soils to also have invasive plant species present. In all cases, the requirements of the Contaminated Sites Regulation under the *Environmental Management Act* will take precedence over any guidance provided in this IPMP. To mitigate the spread of invasive plant species during contaminated soils management activities, the following mitigation measures will be applied:

- Soils that are, or suspected to be, contaminated and contain invasive plants (propagules) will be stockpiled in a contained area that is flagged and posted with appropriate signage. Mitigations for extreme weather events/erosion and sediment control will be provided (e.g., tarps and silt fencing).
- Woodfibre LNG is in the process of applying for an Approval in Principle from the Ministry of Environment to reuse contaminated soils on site as per conditions of the Approval in Principle (e.g., buried to a minimum of 1.5 m and capped with a road surface).

- Equipment transporting the contaminated soils on site will be cleaned prior to use for other purposes.
- Within the CPA, soils with contamination levels that allow for re-use on-site and from areas with invasive plant species present will only be reused within that specific site or areas where the same invasive plant species is already present. Soils will only be re-used after invasive plant management has occurred (i.e., mechanical or chemical treatment, if appropriate). Contaminated soils that contain invasive plant parts will only be re-used if they can be buried to the specifications of the BMPs found in Section 5.1 and as per the Agreement in Principle described above.

5.3 OPERATIONS PHASE

After commissioning the LNG facility, Woodfibre LNG will prepare an operational IPMP that will outline the approach to surveying and managing remaining invasive plants within the CPA. This is anticipated to build upon the learnings from the construction phase of the Project. As part of this process, Woodfibre LNG will review new information from the ISCBC, SSISC, and BC Inter-Ministry Invasive Species Working Group Priority Species list to identify any new or emerging noxious weed or invasive plant species of concern that have the potential to occur within the terrestrial portion of the CPA. It is anticipated that the extent of invasive plants within the terrestrial portion of the CPA will be substantially reduced by the end of construction and the intent of the operations phase IPMP will be to prevent, control, and monitor the establishment and spread of invasive plant species in the terrestrial portions of the CPA.

6.0 INVASIVE PLANT SPECIES ÍNEXWANTAS (MONITORING) AND REPORTING

The objectives of the ínexwantas (monitoring) program are to confirm implementation of the IPMP during construction, determine the effectiveness of the invasive plants control measures outlined in Section 5.2, and identify triggers and actions for treatment. The effectiveness component of the ínexwantas (monitoring) program will be used to inform subsequent control activities in the terrestrial portions of the CPA.

6.1 CONSTRUCTION PHASE COMPLIANCE ÍNEXWANTAS (MONITORING) AND REPORTING

During construction, the EM will be responsible for documenting compliance with the prevention measures described in Section 5.2. This will be documented in the monthly ínexwantas (monitoring) reports prepared by the EM and will be available for audit purposes.

As required by the *OGAA*, an invasive species compliance record is required. This record will be prepared and maintained by the QP and will include:

- A description of the monitoring activities used to determine whether invasive species have become established, are established, or have spread to new areas
- The location, presence/absence, and density/distribution of invasive plants observed
- Activities carried out to prevent transport and establishment of invasive plants
- Activities carried out to remove invasive plants
- Revegetation activities, including which species are planted

The invasive species compliance record will contain the dates, methods and equipment used for invasive plant activities (i.e., monitoring, activities carried out to prevent transport and establishment of invasive species, invasive species removal activities and revegetation activities). The qualifications of personnel completing and/or supervising the activities will be included in the compliance report.

6.2 CONSTRUCTION PHASE EFFECTIVENESS ÍNEXWANTAS (MONITORING) AND REPORTING

Woodfibre LNG will undertake an effectiveness ínexwantas (monitoring) program in years 2 and 3 of construction and at the end of construction, prior to the start of operations. The schedule for these surveys has been selected as the initial invasive plants control activities will be implemented by Woodfibre LNG's Contractor(s) in years 1 and 2, with earth works (i.e., stripping and grading) underway in year 1 as well.

As part of this ínexwantas (monitoring) program, invasive plant surveys will be completed in the terrestrial portion of the CPA and 100 m buffer around terrestrial portions of the CPA, where safe and feasible to access, with particular focus on areas of recent Project activities. Surveys will follow the guidelines provided by the Invasive Alien Plant Program at the time of each survey. These surveys will be overseen by a QP and will be used to:

- Monitor the effectiveness of the prevention program by identifying and delineating any new infestations
    - Quality inspections will be completed within approximately two weeks of each treatment, and the results of these surveys will be used to inform future treatments.
- Monitor the effectiveness of the control program by documenting:
    - the presence/absence and density/distribution and vigour of invasive plants in areas that have been treated
    - delineating areas containing invasive plants that have not yet been subject to the control program
    - delineating areas where regrowth has occurred
- Inform recommendations for additional treatments (Section 5.2.2)

Triggers for additional treatment will be based on the results of surveys. The following triggers will be taken into consideration by the QP in providing recommendations for additional treatment:

- Identification of a new invasive species in the CPA
- Spread of invasive species beyond bounds previously mapped
- Changes to applicable legislation or guidance requiring control of species found in the CPA (e.g., addition of a new species to the Weed Control Regulation under the *Weed Control Act*, or a change in management category by the SSISC*)*

The results of each survey will be documented in a short technical report that summarizes the control program implemented in the previous year, the results of the current survey, and recommendations for further implementation of the control program (i.e., treatment prescriptions). This report will describe any adaptive measures that were taken and followed up on. This report will be signed by a QP. Copies of these reports will be available to the relevant parties, currently identified as the BC EAO, MoF, BCER, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and Tsleil-Waututh Nation, upon request.

Two weeks after each invasive plant control treatment, a quality inspection survey will be completed that will document the effectiveness of the treatment and provide input for the next round of treatments. In addition to this report, the treatment Contractor will provide documentation of every treatment indicating specifications, methodology, location, effectiveness, and updated spatial extents, and the results will also be considered in adaptive management.

6.3 ADAPTIVE MANAGEMENT

If the prevention or control methods specified in Sections 5.2.1 and 5.2.2 are not effective during construction, Woodfibre LNG will consult with the SSISC, ISCBC (or the regulating body if that association dissolves), and MoF Invasive Plant Specialists to discuss alternative prevention and treatment strategies, as new methods and technologies may be developed over time. The CPA will be surveyed for invasive plant species annually during Construction. New treatment strategies will be developed with the QP. Any information related to new treatment strategies will be updated in the IPMP and further clarification on treatment will be provided by a QP. If new invasive plant species occurrences, or new occurrences of previously documented species are encountered during treatment or monitoring activities, their location, distribution, and density will be described and incorporated into treatment plans. This IPMP will be updated by the Woodfibre LNG Environmental Representative to reflect any prevention or control measures added or removed as part of the adaptive management strategy, or new invasive species and occurrences encountered. If this occurs, Woodfibre LNG will prepare a red-line version of the Plan identifying the changes that were made. The red-line version will be issued to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), Tsleil-Waututh Nation, and regulatory agencies for a 30-day review and comment period. After comments are received, the updated IPMP will be finalized and issued to the BC EAO. During Project operations, Woodfibre LNG onsite environmental staff will determine an appropriate ínexwantas (monitoring) program and adaptive management approaches.

6.4 OPERATIONS PHASE ÍNEXWANTAS (MONITORING) AND REPORTING

Woodfibre LNG will conduct follow-up ínexwantas (monitoring) of native plant landscaping on the Project site that is implemented as part of post-construction reclamation efforts. Ínexwantas (Monitoring) will occur in the first two years of operations to determine the success of native plant revegetation efforts and overall condition of the site. The survival, growth, health, and vigour of planted native plants will be assessed, along with the presence and extent of invasive plant species.

Ínexwantas (Monitoring) of planted native plants and invasive plant species will occur once in the growing season each year for two years. Survival will be assessed either by conducting a complete census of nursery stock or assessed along a linear transect. Native and invasive plant species cover will be determined using at least three transects and the line-intercept method. Health and vigour will be qualitatively assessed on a scale from 1 to 4, where 1 = dead, 2 = low health and vigour, 3 = moderate health and vigour, and 4 = high health and vigour. Invasive plant species presence and extent will be assessed using the Invasive Alien Plant Program ínexwantas (monitoring) forms for the areas of native plant landscaping as a whole (MOFR, 2010). A summary report of survey findings will be produced following each ínexwantas (monitoring) year.

Native plant landscaping area(s) will be considered successful if ≥80% of the planted stock survive or planted stock plus natural recruitment yields at least one plant (tree or shrub) per square metre in the restoration area, at the end of the second growing season, and there is no increasing trend of invasive plant cover during the two-year ínexwantas (monitoring) period.

6.5 PRE-CONSTRUCTION INVASIVE PLANT CONTROL

Two invasive plant species control treatment programs were completed in 2022 (July 11 to 15 and July 18 to 21, and August 22 to 26 and August 29 to September 2), and a follow-up quality inspection was completed in November 2022 after the second treatment Approximately 40-59% mortality of invasive plants was observed on the treated areas (approximately 23.5 ha) The objectives of the quality inspection survey were to document the effectiveness of invasive plant species control measures using IAPP field forms (MOFR, 2010); and photo document invasive plant species occurrences using the IAPP photo log form. Details of the quality inspection survey can be found in the memo referenced as “November 2022 Invasive Plant Control Quality Inspection” (Stantec, 2022).

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APPENDIX A

Invasive Plant Species Photo-Log

Woodfibre LNG

Appendix A Invasive Plant Species Photo-Log

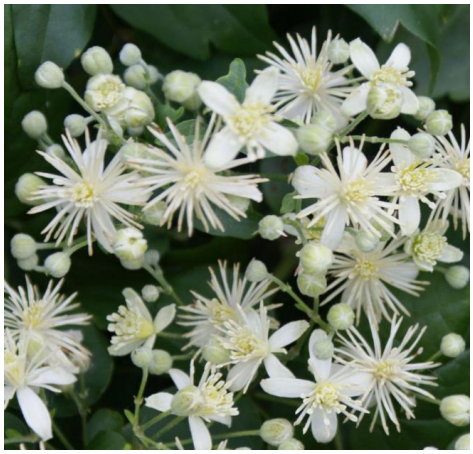
Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 1 **Name:** Common burdock (*Arctium minus*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 2 **Name:** Butterfly-bush (*Buddleja davidii*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Contain	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).

Client: Woodfibre LNG

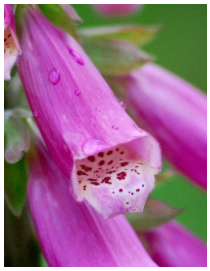
Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 3 **Name:** Thistle species[1] (*Cirsium* spp.). Noxious. **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 4 **Name:** Traveler's joy (*Clematis vitalba*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Prevention Watchlist.	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Clematis%20vitalba Accessed November 2021).
Photograph ID: 5 **Name:** Field bindweed (*Convolvulus arvensis).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Convolvulus%20arvensis Accessed November 2021).

[1] Canada thistle (*Cirsium arvense*) or milk thistle (*Silybum marianum*) were not identified to species as both are listed as noxious.

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 6 **Name:** Scotch broom (*Cytisus scoparius*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 7 **Name:** Foxglove (*Digitalis purpurea).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Strategic Control	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Digitalis%20purpurea Accessed November 2021).
Photograph ID: 8 **Name:** Policeman's helmet (*Impatiens glandulifera*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 9 **Name:** Knotweed species[2] (*Fallopia spp.).* Noxious. **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Contain	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 10 **Name:** English ivy (*Hedra helix*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Contain	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 11 **Name:** Orange hawkweed (*Hieracium aurantiacum).* **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).

[2] Japanese knotweed includes scientific synonyms *Reynoutria japonica* var. *japonica* or *Polygonum cuspidatum*.

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 12 **Name:** Common St. John's wort (*Hypericum perforatum*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 13 **Name:** English holly (*Ilex aquifolium).* **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Contain.	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 14 **Name:** Yellow sweet-clover (*Melilotus officinalis*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Melilotus%20officinalis Accessed November 2021).
Photograph ID: 15 **Name:** Reed canary grass (*Phalaris arundinacea).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Insufficient Information	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Phalaris%20arundinacea Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 16 **Name:** Narrow-leaved plantain (*Plantago lanceolata*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Plantago%20lanceolata Accessed November 2021).
Photograph ID: 17 **Name:** Common plantain (*Plantago major).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Plantago%20major Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 18 **Name:** Creeping buttercup (*Ranunculus repens*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Ranunculus%20repens Accessed November 2021).
Photograph ID: 19 **Name:** Himalayan blackberry (*Rubus armeniacus).* **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Northwest Invasive Plant Council (Available at: http://nwipc.org/plants/himalayan-blackberry Accessed November 2021)
Photograph ID: 20 **Name:** Curled dock (*Rumex crispus*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Rumex%20crispus Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 21 **Name:** Bladder campion (*Silene cucubalus).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Prevention Watchlist	  Reference: Northwest Invasive Plant Council (Available at: http://nwipc.org/plants/bladder-campion Accessed November 2021)
Photograph ID: 22 **Name:** White sweetclover (*Melilotus alba*) **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Melilotus%20albus Accessed November 2021).

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 23 **Name:** European bittersweet; climbing nightshade; blue bindweed *(Solanum dulcamara)* **SLRD Bylaw 1542:** N/A	 
SSISC Management Category: Insufficient Information	Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/ShowDBImage/gallery.aspx?page=0&specrep=0&latinName=Solanum%20dulcamara) Accessed May 2022.
Photograph ID: 24 **Name:** Sow-thistle species[3] (*Sonchus* spp.*)*. Noxious. **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Alberta Invasive Species Council (Available at: https://abinvasives.ca/fact-sheet/sow-thistle-perennial/ Accessed November 2021).
Photograph ID: 25 **Name:** Common tansy (*Tanacetum vulgare*). **SLRD Bylaw 1542:** N/A	

[3] Annual sow thistle (*Sonchus oleraceus*) or perennial sow thistle (*Sonchus arvensis*) were not identified to species as both are listed as noxious.

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

SSISC Management Category: Strategic Control	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Photograph ID: 26 **Name:** Common dandelion (*Taraxacum officinale).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Taraxacum%20officinale&redblue=Both&lifeform=7 Accessed November 2021).
Photograph ID: 27 **Name:** Western goat's beard (*Tragopogon dubius*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** No Action	  Reference: Northwest Invasive Plant Council (Available at: http://nwipc.org/plants/mead-goats-beard November 2021)

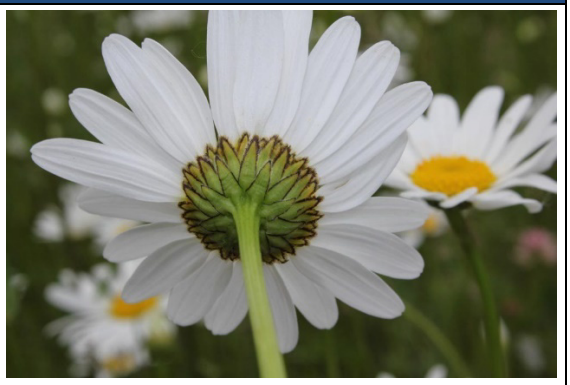
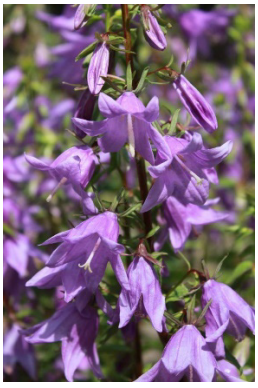
Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 28	  Reference: Alberta Invasive Species Council (Available at: https://abinvasives.ca/fact-sheet/mullein-common/ Accessed November 2021).
Name: Mullein (*Verbascum thapsus).*	
SLRD Bylaw 1542: N/A	
SSISC Management Category: No Action	
Photograph ID: 29	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Vinca%20major&redblue=Both&lifeform=7 Accessed November 2021).
Name: Big-leaf periwinkle (*Vinca major*).	
SLRD Bylaw 1542: Yes	
SSISC Management Category: Prevention Watchlist	
Photograph ID: 30	  Reference: Invasive Species Council of BC (Available at: https://bcinvasives.ca/ Accessed November 2021).
Name: Common periwinkle (*Vinca minor*).	
SLRD Bylaw 1542: N/A	
SSISC Management Category: Strategic Control	

Client: Woodfibre LNG

Project: WLNG-W0001-EV-EMP-0004: Invasive Plant Management Plan

Photograph ID: 31 **Name:** Oxeye daisy (*Leucanthemum vulgare*). **SLRD Bylaw 1542:** Yes **SSISC Management Category:** Strategic Control	  Reference: Alberta Invasive Species Council (Available at: https://abinvasives.ca/fact-sheet/oxeye-daisy/ Accessed November 2021).
Photograph ID: 32 **Name:** Cherry-laurel (*Prunus laurocerasus).* **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Insufficient Information	  Reference: E-Flora BC (Available at: https://linnet.geog.ubc.ca/Atlas/Atlas.aspx?sciname=Prunus%20laurocerasus Accessed November 2021).
Photograph ID: 33 **Name:** Creeping bellflower (*Campanula rapunculoides*). **SLRD Bylaw 1542:** N/A **SSISC Management Category:** Insufficient Information.	  Reference: Alberta Invasive Species Council (Available at: https://abinvasives.ca/fact-sheet/creeping-bellflower/ Accessed November 2021).

Appendix H Wildlife Management and Monitoring Plan – Construction Phase

Wildlife Management and Monitoring Plan

–

Construction Phase

Woodfibre LNG Project
Rev 1

August 16, 2023

WLNG-W0001-EV-EMP-0013 Rev 1

Woodfibre LNG

Preamble

The Woodfibre Liquefied Natural Gas Project (the Project) is a liquefied natural gas export facility being constructed on the former Woodfibre Pulp and Paper Mill site in Átl'ḵa7tsem (Howe Sound), approximately seven kilometres south of Sḵwx̱wú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiy̓át. Swiy̓át and Átl'ḵa7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) members, their ancestors, and their descendants, and to other Indigenous groups as defined in the Project's Environmental Assessment Certificates. The Project is also operating within the traditional, ancestral, and unceded territory of the səlilwətaɬ (Tsleil-Waututh) Nation. Woodfibre LNG General Partner Inc. recognizes the importance of these areas to the Sḵwx̱wú7mesh stélmexw (Squamish People), and other Indigenous groups. Woodfibre General Partner Inc. seeks to construct and operate the Project in a manner that is respectful of Indigenous values. This Estéteýwilhs iy Ínexwantas ta Sekw'ekw'inexw (Wildlife Management and Monitoring Plan) is primarily written in English with important place names, species, phrases, and passages provided in Sḵwx̱wú7mesh sníchim (the 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 lands
We will continue to swim and fish in these clear waters.

Limitations and Sign-off

This document entitled Wildlife Management and Monitoring Plan was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Woodfibre LNG General Partner Inc. (the "Client").[1] Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Qualified Professional sign-off: _____

Signature

Joanna Preston B.Sc., R.P.Bio.

Printed Name

[1] A draft version of this Estéteýwilhs iy Ínexwantas ta Sekw'ekw'inexw (Wildlife Management and Monitoring Plan) was prepared by Hemmera, a subsidiary of Ausenco. The draft version has been revised and updated by Stantec Consulting Ltd. (Stantec) at the request of Woodfibre LNG General Partner Inc.

Table of Contents

SQUAMISH-ENGLISH TRANSLATION ..... **V**

ABBREVIATIONS ..... **VI**

1.0 INTRODUCTION **1**
1.1 OBJECTIVE 4
1.2 PROJECT APPROVALS AND CONDITIONS 5
1.3 SḴWX̱WÚ7MESH ÚXWUMIXW (SQUAMISH NATION) ENVIRONMENTAL ASSESSMENT AGREEMENT (SNEAA) 7
1.4 APPLICATION TABLE 22-1 COMMITMENTS 8

2.0 REGULATORY FRAMEWORK **18**
2.1 REGULATORY REQUIREMENTS 18
2.2 FEDERAL REGULATIONS 18
2.2.1 Species at Risk Act 18
2.2.2 Migratory Birds Convention Act 18
2.3 PROVINCIAL REGULATIONS 19
2.3.1 Wildlife Act 19
2.3.2 Oil and Gas Activities Act 19

3.0 ROLES AND RESPONSIBILITIES **20**

4.0 SEḴW'EḴW'INEXW (WILDLIFE) SETTING **21**
4.1 TERRESTRIAL BIRDS 21
4.1.1 Nsx̱ípim (Northern Goshawk) 22
4.1.2 Shá7yu (Western Screech-Owl) 22
4.1.3 Sp'áḵw'us (Bald Eagle) 22
4.1.4 Kw'eḵw'íḵw'ehatl' (Barn Swallow) 23
4.1.5 Nsex̱á7x̱em (Band-tailed Pigeon) 23
4.1.6 Pileated Woodpecker Tsíptspí7lhtn (Nest) 23
4.2 SEḴW'EḴW'INEXW TL'A SHKWEN (MARINE BIRDS) 24
4.2.1 Piyís (Marbled Murrelet) 25
4.3 SḴÁP'ḴAP'TSAYLH (BATS) 26
4.4 AMPHIBIANS AND REPTILES 28
4.5 TERRESTRIAL MAMMALS 31

5.0 SEḴW'EḴW'INEXW (WILDLIFE) MITIGATION MEASURES **32**
5.1 BEST MANAGEMENT PRACTICES AND GUIDELINES 32
5.2 PROJECT DESIGN MEASURES 33
5.2.1 Green Zone 33
5.2.2 Lighting 34
5.2.3 Bird Strikes on Buildings 34
5.2.4 Bird Electrocution Potential from Powerlines 34
5.3 GENERAL MITIGATION MEASURES 35
5.4 HABITAT LOSS MITIGATION MEASURES 49

5.5 ENVIRONMENTAL TRAINING AND ORIENTATION 53
5.6 COORDINATION AND INFORMATION SHARING 53

6.0 SEK̲W'EK̲W'INEXW (WILDLIFE) ÍNEXWANTAS (MONITORING) AND ADAPTIVE MANAGEMENT 55
6.1 ÍNEXWANTAS (MONITORING) 55
6.1.1 Compliance 55
6.1.2 Ínexwantas (Monitoring) and Follow-up Programs 55
6.2 ADAPTIVE MANAGEMENT 59

7.0 REPORTING 61

8.0 REFERENCES 62
8.1 LITERATURE CITED 62
8.2 PERSONAL OBSERVATIONS 69

LIST OF TABLES

Table 1: EAC Conditions Relevant to the Construction Wildlife Management and Monitoring Plan 5
Table 2: FDS Conditions Relevant to the Construction Wildlife Management and Monitoring Plan 6
Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application 9
Table 4: Sḵáp'ḵap'tsaylh (Bat) Species Known or Likely to Occur in the Certified Project Area 27
Table 5: General Mitigation Measures for Sek̲w'ek̲w'inexw (Wildlife) During Construction 36
Table 6: Sensitive Periods for Sek̲w'ek̲w'inexw (Wildlife) 47
Table 7: Habitat Loss Mitigation Measures for Sek̲w'ek̲w'inexw (Wildlife) During Construction 50

LIST OF FIGURES

Figure 1: Location Overview 2
Figure 2: Certified Project Area and Key Project Components 3
Figure 3: Sensitive Habitats and Habitat Features for Birds, Amphibians, and Reptiles in the Certified Project Area 29
Figure 4: Sensitive Habitats and Habitat Features for Bats in the Certified Project Area 30

LIST OF APPENDICES

APPENDIX A WILDLIFE OBSERVATION AND INCIDENT REPORTING FORM A.1

Squamish-English Translation

Squamish	English
Átl'ka̲7tsem	Howe Sound
ch'áatl'am	hunting
cháyilhen	salmon
élhk̲aẏ	snake
Estéteýwilhs iy Ínexwantas ta Sek̲w'ek̲w'inexw	Wildlife Management and Monitoring Plan
ínexwantas	monitoring
kw'áxwa7s tl'a shá7yu	western screech-owl nest boxes
k̲wáẏtsay	hemlock tree
kw'ek̲w'ík̲w'ehatl'	barn swallow
lams tl'a kw'ek̲w'ík̲w'ehatl'	barn swallow nest/nest cups
nsex̲á7x̲em	band-tailed pigeon
nsx̲ípim	northern goshawk
piyís	marbled murrelet
sek̲w'ek̲w'inexw	wildlife
sek̲w'ek̲w'inexw tl'a shkwen	marine bird
səlilwətaɬ	Tsleil-Waututh
shá7yu	western screech-owl
sk̲áp'k̲ap'tsaylh	bat
sk̲el̓áẇ	beaver
Skwelwíl̓em	Skwelwilem Wildlife Management Area
Sk̲wx̲wú7mesh	Squamish
Sk̲wx̲wú7mesh sníchim	Squamish language
Sk̲wx̲wú7mesh stélmexw	Squamish people
Sk̲wx̲wú7mesh Úxwumixw	Squamish Nation
slhawt̓	herring
smek̲w'á7	great blue heron
sp'ák̲w'us	bald eagle
stak̲w	water
sts'úk̲wi7	fish
Swiẏát	historic Squamish Nation village located at Woodfibre Site
temíxw	land
tsíptspí7lhtn	bird nest

Abbreviations

the Application	Application for an Environmental Assessment Certificate
BC	British Columbia
BC EAO	BC Environmental Assessment Office
BMP	Best Management Practice
CDC	BC Conservation Data Centre
CEAA 2012	*Canadian Environmental Assessment Act, 2012*
CEMP	Construction Environmental Management Plan
CPA	Certified Project Area
DFO	Fisheries and Oceans Canada
EAC	Environmental Assessment Certificate
EC	Environment Canada
ECCC	Environment and Climate Change Canada
EM	Environmental Monitor
EMP	Environmental Management Plan
FDS	Federal Decision Statement
FLNR	Ministry of Forests, Lands, Natural Resource Operations
IFR	Instream flow release
km	kilometre
LAA	Local assessment area
LNG	Liquefied Natural Gas
m	metre
m^3	cubic metre
MBMP	Marine Bird Management Plan
OGC	Oil and Gas Commission
Project	Woodfibre LNG Project
QP	Qualified Professional
RAA	Regional assessment area
SARA	*Species at Risk Act*
SNEAA	Squamish Nation Environmental Assessment Agreement
SOMC	Species of management concern
Woodfibre LNG	Woodfibre LNG General Partner Inc.
WMMP	Wildlife Management and Monitoring Plan

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Sḵwx̱wú7mesh (Squamish), British Columbia (BC) (Figure 1). The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas and a storage capacity of 250,000 cubic metres (m^3) and will export the liquefied natural gas (LNG) via tankers.

The Project underwent a comprehensive environmental assessment process from 2013 to 2015 and Woodfibre LNG received:

- an environmental assessment approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) through the Squamish Nation Environmental Assessment Agreement (SNEAA) in 2015
- an environmental assessment certificate (EAC) for the Certified Project Area (CPA) under the BC *Environmental Assessment Act* (EAC #E15-02) in 2015
- a positive Federal Decision Statement (FDS) under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) in 2016

Two EAC amendments were granted by the BC Environmental Assessment Office (BC EAO) in 2017 and 2019, and the FDS was reissued in 2018 in response to changes to the Designated Project. Woodfibre LNG also received an extension on EAC#15-02 from the BC EAO in October 2020. The provincial, Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), and federal environmental assessment processes have each yielded conditions of approval that Woodfibre LNG must address.

Most of the Project is on fee simple, industrially zoned, brownfield lands with more than 100 years of industrial use. There is no road access to the CPA, and all personnel, equipment, and supplies for the Project will be brought in by vessel via Átl'ḵa7tsem (Howe Sound). The Project will use electrical power sourced from BC Hydro and gas will be supplied to the facility by Fortis BC.

The CPA and key project components are illustrated in Figure 2. Key project components are:

- land-based natural gas processing and liquefaction facilities
- a floating storage and offloading unit
- construction worker accommodation
- supporting infrastructure

The supporting infrastructure includes buildings (e.g., administration, control rooms, maintenance, dry storage and chemical, fire house, first aid, safety and guardhouse), fencing (temporary and permanent), material storage and laydown areas, utility and loading lines, and boil off gas vapour lines.

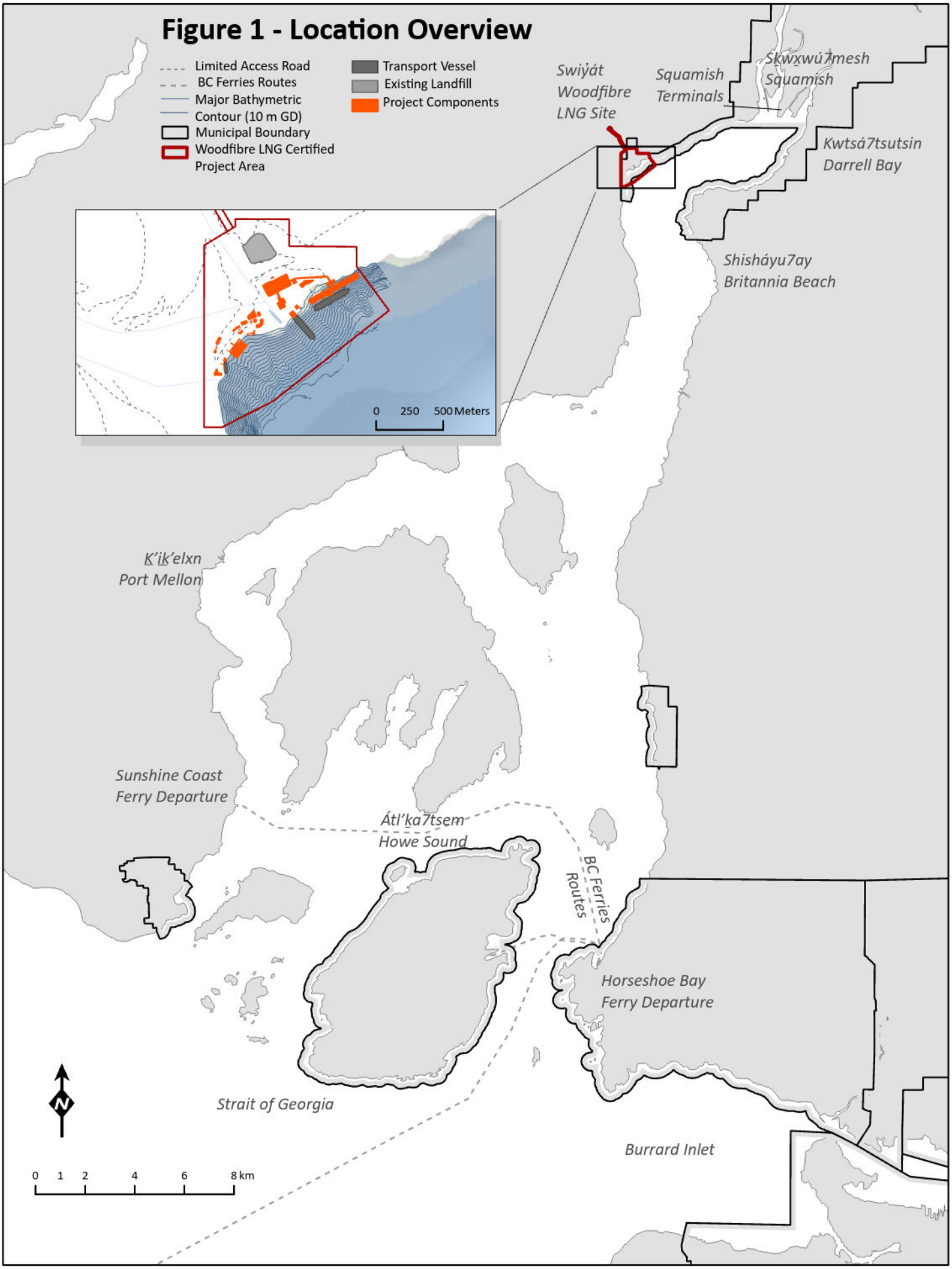
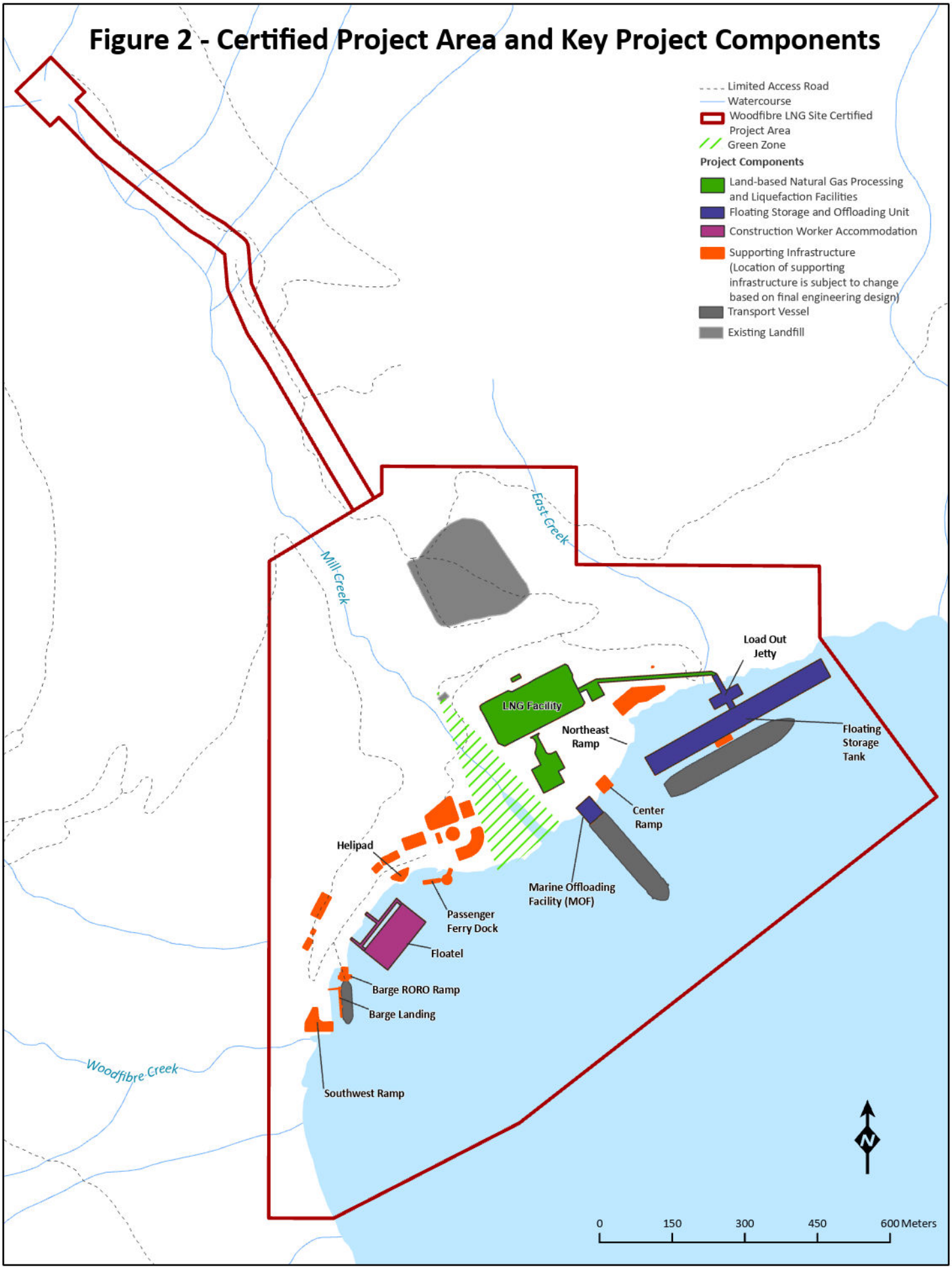

Figure 1 - Location Overview
Limited Access Road
BC Ferries Routes
Major Bathymetric Contour (10 m GD)
Municipal Boundary
Woodfibre LNG Certified Project Area
Transport Vessel
Existing Landfill
Project Components
Swiy̓át
Woodfibre LNG Site
Squamish Terminals
Sḵwx̱wú7mesh Squamish
Kwtsá7tsutsin Darrell Bay
Shishá̱yu7ay Britannia Beach
0 250 500 Meters
K'ik'elxn Port Mellon
Sunshine Coast Ferry Departure
Átl'ka7tsem Howe Sound
BC Ferries Routes
Horseshoe Bay Ferry Departure
Strait of Georgia
Burrard Inlet
N
0 1 2 4 6 8 km

Figure 2 - Certified Project Area and Key Project Components



The works and activities that will occur as part of construction include, but are not limited to:

- marine early works (e.g., shoreline improvements and armoring, dock replacement or repairs), including improvements to the existing in-service (east and south) barge landing
- vegetation clearing and grubbing[2]
- stripping and grading[3]
- drilling and blasting, including excavation, crushing, screening, and hauling
- grouting and rock stabilization
- road, culvert, and bridge works
- construction of land-based natural gas processing and liquefaction facility
- construction support structures, services, and equipment
- construction of the floating storage and offloading unit
- marine facility construction of mooring dolphin supports and connecting trestles and gangways
- dredging, if required

1.1 OBJECTIVE

The objective of this Construction Estéteýwilhs iy Ínexwantas ta Sek̲w'ek̲w'inexw (Wildlife Management and Monitoring Plan; Construction WMMP) is to satisfy approval conditions and commitments by describing measures that will be implemented to mitigate potential effects on sek̲w'ek̲w'inexw (wildlife) during construction of the Project. This includes information on requirements for:

- Best management practices (BMPs) and mitigation measures identified in the environmental assessment that were selected to reduce or avoid potential effects on sek̲w'ek̲w'inexw (wildlife)
- Approaches that support mitigation, such as sek̲w'ek̲w'inexw (wildlife) surveys
- Ínexwantas (monitoring) activities, including procedures for reporting project interactions with sek̲w'ek̲w'inexw (wildlife), including potential sek̲w'ek̲w'inexw (wildlife) mortality.

This Construction WMMP is a living document and revisions will be made if relevant new information becomes available through the progression of the detailed engineering design of the Project, changes in legislation or regulation, if performance objectives are not met, or as required by Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), səlilwətaɬ (Tsleil-Waututh) Nation, and/or regulatory agencies. If the Construction WMMP requires updating, Woodfibre LNG will prepare a red-line version identifying the changes that are made. The red-line version will be issued to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), səlilwətaɬ (Tsleil-Waututh Nation), and regulatory agencies for a 30-day review and comment period. After comments are received, the document will be updated and issued as a clean final revision

[2] Clearing vegetation refers to cutting and/or mowing vegetation, which could include trees, shrubs, and/or herbs. Grubbing refers to removal of roots from the soil using machinery and follows clearing.

[3] Stripping refers to removal of soil, including vegetation, if present. Soil refers to the organic topsoil, mineral soil (i.e., A and B horizons), and overburden (i.e., C horizon, or "subsoil"). Grading refers to adjusting the slope and elevation of soil and/or rock; generally, vegetation has been removed prior to grading.

for approval by Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and for submittal to the BC EAO. As standard practice, the latest version of the Construction WMMP will be implemented.

Annual tracking of updates to the status of listed species identified by the BC Conservation Data Centre (CDC), Committee on the Status of Endangered Wildlife in Canada, or the federal Species at Risk Public Registry will be completed by Woodfibre LNG. Updates to the status of listed species will be included in annual ínexwantas (monitoring) reports. If needed, additional BMPs or mitigation measures may be necessary to reduce or avoid effects of the Project on the affected species in accordance with species recovery plans, should the status of a listed species change during construction.

1.2 PROJECT APPROVALS AND CONDITIONS

The following are the sek̓w'ek̓w'inexw (wildlife)-related conditions:

- EAC #15-02 Condition 11 (Wildlife – Construction)
- *Canadian Environmental Assessment Act*, *2012* (CEAA 2012) Decision Statement Conditions 4.1 and 4.3 (Migratory birds), and 9.1, 9.2, and 9.3 (Listed species at risk)
- Mitigation measures enabled by Condition 12 of the SNEAA

Concordance tables that cross-reference the sections of this Construction WMMP to the specific conditions are provided for each of the provincial (Table 1) and federal (Table 2) environmental assessment decisions. The Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) decision and conditions are described in Section 1.3. Comments received during consultation on the development of this Construction WMMP, and Woodfibre LNG's responses, are provided separately in a Consultation Record as required by EAC Condition 2.

Table 1: EAC Conditions Relevant to the Construction Wildlife Management and Monitoring Plan

Condition Number	Condition	Construction WMMP Reference
EAC Condition 11	The Holder must develop, in consultation with EC, FLNR, OGC and Aboriginal Groups, a wildlife management and monitoring plan for Construction that must at a minimum:	Entire plan
	• Set out the means by which the wildlife mitigation measures related to Construction in the Application Table 22-1 (sections 5.12 - 5.14 and 5.17) will be implemented;	Table 3 Section 5.0
	• Include results of completed marbled murrelet presence and habitat surveys, plans for additional presence surveys, and specify mitigation to avoid or reduce adverse effects of the Project on birds, including marbled murrelets and marbled murrelet habitat, to the satisfaction of a Qualified Professional;	Section 4.2.1 Section 5.2 Section 5.3 Section 6.0
	• Include mitigation measures to avoid or reduce human-wildlife conflicts and to avoid or reduce direct and indirect wildlife mortality;	Section 5.2 Section 5.3 Section 6.0

Table 1: EAC Conditions Relevant to the Construction Wildlife Management and Monitoring Plan

Condition Number	Condition	Construction WMMP Reference
Eac Condition 11 (cont'd)	• Specify the mitigation measures that will be implemented for the protection of wildlife habitat features that are encountered within the terrestrial portions of the Certified Project Area;	Section 5.2 Section 5.3
	• Specify mitigation measures to identify and avoid clearing high-value nesting habitat for western screech-owl;	Section 5.3 Section 5.4
	• Specify the consideration of migratory bird timing windows when scheduling planned flaring events, where feasible from a technical and safety perspective to the satisfaction of a Qualified Professional, to minimise the risk of mortality and injury to birds during Commissioning; and	Addressed in the Operation WMMP
	• Design a monitoring and follow-up program with respect to impacts to wildlife within the terrestrial portions of the Certified Project Area during Construction.	Section 6.0
	A Qualified Professional must develop the plan and supervise the implementation of the plan. The Holder must provide the plan to EAO, EC, FLNR, OGC and Aboriginal 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. Marbled murrelet survey results must be provided to EC and FLNR prior to site clearing.	Section 3.0 Section 4.2.1

Note:

The regulator names (i.e., FLNR, OGC, EC) in the conditions reflect the names that were in place when the conditions were written. FLNR is now split into Ministry of Forests and Ministry of Water, Land and Resource Stewardship, OGC is now BC Energy Regulator, and EC is now Environment and Climate Change Canada.

Table 2: FDS Conditions Relevant to the Construction Wildlife Management and Monitoring Plan

Condition Number	Condition	Construction WMMP Reference
FDS Condition 4.1	The Proponent shall carry out all phases of the Designated Project in a manner that protects migratory birds and avoids harming, killing or disturbing migratory birds or destroying, disturbing or taking their nests or eggs. In this regard, the Proponent shall take into account Environment and Climate Change Canada's *Avoidance Guidelines*. The Proponent's actions in applying the *Avoidance Guidelines* shall be in compliance with the *Migratory Birds Convention Act*, *1994* and with the *Species at Risk* Act.	Section 5.0
FDS Condition 4.3	The Proponent shall develop, prior to construction and in consultation with Aboriginal groups, and implement, during all phases of the Designated Project, a follow-up program to verify the accuracy of the environmental assessment as it pertains to the environmental effects of the air cooling system on migratory birds and to determine the effectiveness of the mitigation measures used to avoid harm to migratory birds, their eggs and nests, including the measures used to comply with conditions 4.1 and 4.2.	Section 6.0

Table 2: FDS Conditions Relevant to the Construction Wildlife Management and Monitoring Plan

Condition Number	Condition	Construction WMMP Reference
FDS Condition 9.1	The Proponent shall conduct pre-clearing surveys to determine the distribution of little brown myotis (*Myotis lucifugus*), and establish, in consultation with relevant government authorities, buffer zones around active hibernacula and active roosts.	Section 4.3 Section 5.3
FDS Condition 9.2	The Proponent shall, prior to construction and throughout all phases of the Designated Project, install and maintain roosting structures to offset any loss of little brown myotis (*Myotis lucifugus*) roosting habitat.	Section 5.4 Table 7
FDS Condition 9.3	The Proponent shall develop and implement a follow-up program to monitor the little brown myotis (*Myotis lucifugus*) usage of buffer zones and roosting structures to determine the effectiveness of the mitigation measures throughout all phases of the Designated Project and to verify the accuracy of the environmental assessment as it pertains to the environmental effects of the air cooling system on little brown myotis (*Myotis lucifugus*)[4].	Section 6.0

Note:

FDS Condition 4.2 is related to operation and not construction; therefore, it is not included in this Construction WMMP.

1.3 SḴWX̱WÚ7MESH ÚXWUMIXW (SQUAMISH NATION) ENVIRONMENTAL ASSESSMENT AGREEMENT (SNEAA)

The Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment process for the Project was designed to parallel the federal and provincial environmental assessment processes, whereby project effects on the Sḵwx̱wú7mesh stélmexw (Squamish people's) rights and title interests are identified, understood, and properly avoided or mitigated. The process for the Project ultimately resulted in the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) issuing an environmental assessment certificate (#2015-001), which includes conditions described in the SNEAA that was issued on October 14, 2015. Per SNEAA, "*Squamish Nation has agreed that Woodfibre may proceed with carrying out the Project, subject to Woodfibre LNG meeting, and (as applicable) continuing to meet, the Squamish Nation Conditions as provided for in this Agreement*."

The SNEAA Condition 12, which has applicability to the Construction WMMP, states

4.12 Binding Mitigation Measures - Squamish Condition #12

(a) Woodfibre LNG identifies approximately 119 distinct mitigation measures in Table 22-1 of Woodfibre LNG's EA application. If Squamish Nation determines that it wishes to monitor any of the mitigation measures, then Squamish Nation will issue a notice to Woodfibre LNG identifying which mitigation measures it intends to monitor ("Monitored Mitigation Measures") and the manner it proposes to undertake such monitoring.

[4] The follow-up monitoring related to the air-cooling system is presented in the Operation WMMP as it relates to the operation of the LNG facility.

(b) Where Squamish Nation is of the opinion that any Monitored Mitigation Measure is not being followed, it will notify Woodfibre LNG. Woodfibre LNG will respond to the notification with one of the following (the "'Response"):

(i) Woodfibre LNG's explanation of how the mitigation measure is being followed;

(ii) a written explanation why the mitigation measure is not being followed, and the measure that replaces it (with an explanation of how the new measure provides equal or greater levels of environmental protection);

(iii) A written explanation of why the mitigation measure is not being followed, with justification for:

a. why it has not been replaced with another measure, or

b. why it has been replaced with a measure that provides less levels of environmental protection

(c) Woodfibre LNG will develop a Monitored Mitigation Measures plan with the Squamish Nation that will include the frequency of guided tours for the Squamish Nation during construction and operations and a budget to implement the plan, which plan will be fully funded by Woodfibre LNG.

(d) Should Squamish Nation not be satisfied with the Response, then the Squamish Nation may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the Response is at issue the expert or expert panel shall consider the following when making its decision: whether the mitigation measure has a material impact on constructability, cost, operability, safety, environment, or schedule; whether the mitigation measure creates unacceptable risk or legal liability for the Project; whether the mitigation measure conflicts with any legal, regulatory, or pre-existing contractual obligations of Woodfibre LNG; whether the Woodfibre LNG response to the proposed mitigation measure(s) conforms to Good Industry Practice; and any other information the expert or expert panel considers relevant.

Per Condition 6 (Section 4.6) of the SNEAA, the Construction WMMP is considered a Regulated Environmental Management Plan (EMP), meaning that it is an EMP requiring approval from Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) in accordance with Section 4.6(e) of the SNEAA.

1.4 APPLICATION TABLE 22-1 COMMITMENTS

A concordance table that cross-references the sections of this Construction WMMP to the construction-related sek̲w'ek̲w'inexw (wildlife) commitments in Table 22-1 of the Application for an Environmental Assessment Certificate (the Application) is provided in Table 3. The mitigation measures in Table 3 are provided as proposed in Table 22-1 of the Application[5]; further detail on how these mitigation measures will be implemented is described in the respective Construction WMMP sections referred to in the table. Mitigation measures in Table 3 that relate to operation are addressed in the Operation WMMP.

[5] At the time the Application, including Table 22-1, was submitted the company name was Woodfibre LNG Limited but it is now Woodfibre LNG General Partner Inc. The commitments as written in Table 22-1 and presented in Table 3 of this Construction WMMP remain unchanged from the Application.

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
5.12 Avifauna (Birds)		
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 minimum amount required to accommodate the Project footprint will reduce the direct loss of vegetation communities and wildlife habitat. Monitoring will be conducted to ensure that mitigation measures are properly implemented and effective.	Section 5.2.1 Section 5.3
M5.12-1	**Wildlife Management Plan** Woodfibre LNG Limited will develop and implement a Wildlife Management Plan prior to initiation of the construction phase of the project. The Wildlife Management Plan will provide the following information: • details regarding any required pre-construction surveys and wildlife monitoring: – call-playback surveys prior to clearing that specifically focus on western screech-owl at night to ensure the cleared areas are not being used as post-fledgling areas – pre-construction surveys to assess potential western screech-owl nesting habitat in the potential corridors for the gas and water pipeline ROWs, and avoidance of such habitat in the final design for the Project – surveys will also be conducted in areas to be cleared to confirm that natural mineral sites (i.e., mineral water springs) that may be used by band-tailed pigeon are not impacted by the Project • information on how to report and record wildlife conflicts, including wildlife mortality due to vehicles and equipment. A database of wildlife mortality associated with construction and operation of the project should be maintained through the construction and operation phases. Observations of Red and Blue-listed species will be conveyed to the CDC. • limit speed on roadways within the Project area to 30 km/h • measures to identify amphibian crossings (if any) • details regarding posting signage and educating workers to ensure vigilance for amphibians during peak movement periods (i.e., rainy nights in April and September)	Section 4.1.2 Section 4.1.5 Section 5.3 Section 5.6 Section 6.1.2 Section 6.2 Section 7.0
M5.12-2	**Retain Snags and Wildlife Trees** Woodfibre LNG Limited will retain wildlife habitat features, including those for avifauna and bats, such as snags and wildlife trees (mature trees are included in M5.9-2) wherever possible and safe to do so. Prior to site clearing, wildlife habitat features to be retained will be demarcated with no-go fencing and signage. Habitat features to be field identified and retained will be included on Project Environmental Management Plan mapping.	Section 4.1.2 Section 5.0

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
M5.12-3	**Establish and Retain Vegetative Buffers Around Raptor Nests** Woodfibre LNG Limited will establish and retain vegetative buffers around raptor nests to mitigate sensory disturbance in accordance with *Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia* (MOE 2013). These guidelines suggest that a 100-m vegetated buffer be retained around osprey and bald eagle nests and a 200-m vegetated buffer be retained around western screech-owl nests. An additional 100-m no-disturbance buffer for each species nests is recommended during the nesting season.	Section 5.0 Section 5.3
M5.12-4	**Avoid Clearing During Bird Nesting Season** Where possible, Woodfibre LNG Limited will avoid vegetation clearing during the nesting season for bald eagles, osprey and western screech-owl in accordance with MOE (2013). The least risk periods for development outlined in MOE's Develop with Care 2014 guidelines (MOE 2014) are identified as follows: • bald eagle – September 1 to December 31 • osprey – September 15 to March 31 • other raptors – October 1 to February 28 Woodfibre LNG Limited will avoid clearing during nesting season for passerines in accordance with least risk development windows to passerines (September 1 to February 28) provided in MOE (2014).[6] Pre-clearing bird nest surveys will be undertaken if the aforementioned least risk windows cannot be maintained. Appropriate, species-specific setback buffers will be established and maintained around any confirmed or suspected active nests that are detected.	Section 5.0 Section 5.3 Table 6
M5.12-5	**Light Management** Subject to safety and operational requirements, Woodfibre LNG Limited will use blue or green lighting rather than red or white lighting in order to reduce attractiveness to birds.	Section 5.2.2 Section 5.2.3 Section 6.1.2

[6] Correction: This least risk window (September 1 to February 28) and reference cited (i.e., MOE, 2014) applies to raptors, and not passerines as suggested. Table 6 in Section 5.3 provides the least risk windows for wildlife, including passerines.

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
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 marine birds. 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).[7] 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)[8]. 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)[9].	Section 5.3
M5.12-7	**Reduce Electrocution Potential** Woodfibre LNG Limited will design powerlines and conductor layout to reduce potential bird strikes. The new powerlines will be small extension to the Project area with short spans of lines between poles and are expected to be visible to birds. If larger spans of line are installed, conductors will be placed far apart to avoid electrocution, and powerlines will be marked to enhance visibility for avian VCs.	Section 5.2.4 Section 6.1.2
M5.12-8	**Install Nesting Structures** Woodfibre LNG Limited will install western screech-owl and barn swallow nesting structures at suitable locations in the LAA once construction is complete to compensate for the removal of (possible) nesting habitat during construction. Artificial nest structures for barn swallows include nesting shelves or nesting cups attached to an appropriate surface.	Section 4.1.2 Section 4.1.4 Section 5.3 Section 5.4
M5.12-9	**Design Buildings to Reduce Bird Strikes** Woodfibre LNG Limited will design building facilities to reduce the potential for bird strikes and bird mortality. Design features will include minimizing the amount of glass and applying tints or facades where glass is required to provide visual cues.	Section 5.2.3 Section 5.3 Section 6.1.2
M5.12-10	**Work With BC Hydro and FortisBC to Minimize Effects to Wildlife** Woodfibre LNG Limited will meet with BC Hydro (i.e., Woodfibre Substation project) and FortisBC (i.e., Eagle Mountain – Woodfibre Gas Pipeline Project) to identify further measures to minimize potential adverse cumulative effects on wildlife.	Section 5.6

[7] Wright, D.G. and G.E. Hopky. 1998. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107. Available at: Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (publications.gc.ca).

[8] Cooper, J. 1982. Methods of reducing mortality of seabirds caused by underwater blasting. *Marine Ornithology* 10: 109-114.

[9] Demarchi, M.W. and M.D. Bentley. 2004. Effects of natural and human-caused disturbances on marine birds and pinnipeds at Race Rocks, British Columbia. Prepared for Department of National Defence, Canadian Forces Base Esquimalt and Public Works and Government Services Canada.

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
M5.14-2	**Identify Sensitive Habitat** Prior to initiation of the construction phase of the Project, Woodfibre LNG will identify important habitat to be retained by including it in construction plans and by field-identified with no-go fencing.	Section 4.1.2 Section 4.3 Section 5.3
5.13 At-risk Bat Species		
M5.9-2	**Minimize Vegetation Clearing** See description for M5.9-2 above.	Section 5.2 Section 5.3
M5.11-2	**Minimize Clearing of Sensitive and Important Ecosystems** Woodfibre LNG Limited will, where possible, design the Project to avoid the riparian area along Mill Creek (outside of the Green Zone) and the mature forest adjacent to the Creek.	Section 4.3 Section 5.2.1
M5.12-1	**Wildlife Management Plan** See description for M5.12-1 above.	Section 4.3 Section 5.3 Section 5.6 Section 6.1.2 Section 6.2 Section 7.0
M5.12-2	**Retain Snags and Wildlife Trees** See description for M5.12-2 above.	Section 4.3 Section 5.0
M5.12-10	**Work With BC Hydro and FortisBC to Minimize Effects to Wildlife** See description for M5.12-10 above.	Section 5.6
M5.13-1	**Avoid Clearing During Bat Maternity Season** Woodfibre LNG Limited will avoid clearing when maternity roosts are likely to be active. The least risk season for bats in the Project Area (i.e., when females are not heavily pregnant nor when juvenile bats are present and unable to fly) is expected to occur between September 1 to May 15, therefore clearing will be avoided when possible between May 16 and August 31. Pre-clearing maternity roost surveys will be undertaken if the least-risk windows cannot be maintained. Acceptable non-disturbance buffers will be established around active maternity roosts.	Section 4.3 Section 5.3
M5.13-2	**Minimize the Amount of Ultraviolet Light** Woodfibre LNG Limited will, where possible, use lighting technology that minimizes the amount of ultraviolet light generated, thereby minimizing its attractiveness to insects.	Section 5.0 Section 5.2.2
M5.13-3	**Installation of Bat Boxes** Woodfibre LNG Limited will construct and install bat boxes away from potential sources of mortality (e.g., roads) to provide additional roosting habitat for bats.	Section 4.3 Section 5.4
M5.14-2	**Identify Sensitive Habitat** See description for M5.14-2 above.	Section 4.3 Section 5.3

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
5.14 Amphibians		
M5.8-1	**Erosion Prevention and Sediment Control Plan** See description in the CEMP.	CEMP
M5.8-5	**Develop and Implement a Water Quality Monitoring Program** Woodfibre LNG Limited will develop and implement a water quality 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.	CEMP
M5.9-2	**Minimize Vegetation Clearing** See description of M5.9-2 above.	Section 5.0 Section 5.3
M5.12-1	**Wildlife Management Plan** See description of M5.12-1 above.	Section 4.4 Section 5.3 Section 5.6 Section 6.1.2 Section 6.2 Section 7.0
M5.12-10	**Work With BC Hydro and FortisBC to Minimize Effects to Wildlife** See description of M5.12-10 above.	Section 5.6
M5.14-1	**Avoid Falling Trees into Watercourses** Where safe to do so, Woodfibre LNG will avoid falling trees into the watercourse where clearing is necessary adjacent to a watercourse (e.g., Mill Creek).	Section 5.3
M5.14-2	**Identify Sensitive Habitat** See description of M5.14-2 above.	Section 4.4 Section 5.3
M5.14-3	**Salvage and Replace Coarse Woody Debris** Woodfibre LNG Limited will salvage coarse woody debris that has been removed in upland areas to facilitate Project construction and will relocate it along linear features and within the Green Zone upon completion of the construction phase.	Section 5.3
M5.14-4	**Develop an Environmental Protection Plan for Works in and About Mill Creek** Woodfibre LNG Limited will develop and implement an Environmental Protection Plan specific to works required in and around Mill Creek. The Plan will be developed prior to the initiation of instream works. This plan will require coastal tailed frog salvage for instream construction.	Section 5.2.1 Section 5.3

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
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 streamflows 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). Monitoring will be a requirement of the Water Management Plan to confirm that the plan is effective in protecting fish and fish habitat. Effective monitoring will include a combination of compliance monitoring and biotic response monitoring and the definition of program objectives. Design of a monitoring program will consider program objectives, scope of effort, timing, and duration. Typical designs include, though are not limited to, the following: • continuous streamflow monitoring downstream of point of withdrawal • intermittent monitoring of biotic variables (e.g., fish abundance or density) • random IFR compliance audits	Section 5.3
5.17 Marine Birds		
M5.12-1	**Wildlife Management Plan** See description of M5.12-1 above.	Section 4.2 Section 5.3 Section 5.6 Section 6.1.2 Section 6.2 Section 7.0
M5.12-10	**Work With BC Hydro and FortisBC to Minimize Effects to Wildlife** See description of M5.12-10 above.	Section 5.6

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
M5.17-1	**Avoid Clearing During Marine Bird Breeding Season** Woodfibre LNG Limited will follow guidelines for restricted activity periods to protect nesting marine birds to comply with the federal *Migratory Birds Convention Act* and the provincial *Wildlife Act*. The site is located within the A1 bird nesting zone in Canada, which has a regional nesting period of March 19 to August 17 (EC 2014);[10] however, the breeding season for colonial waterbirds extends from March into September (EC 2013a). Based on the locations of recorded colonial waterbird nesting habitat, colonial waterbirds are unlikely to be affected by clearing activities associated with the Project; therefore, the A1 bird nesting zone period (March 19 to August 17) will be followed and the clearing activities will be avoided during the nesting season where feasible. When clearing is required during the nesting season, pre-clearing surveys for nesting birds will be conducted and appropriate, species-specific setback buffers will be established and maintained around any confirmed or suspected active nests to reduce potential mortality. This mitigation measure is predicted to be effective in reducing potential marine bird mortality.	Section 5.3 Table 6
M5.17-2	**Establish and Maintain Bird Nest Setbacks** Project activities will maintain a minimum 30 m setback distance from active marine bird nests identified in the Project area. Larger setbacks may be established for listed species and will be considered on a species-by-species case.	Section 5.3
M5.17-3	**Establish and Maintain Marine Bird Breeding Colony Setbacks** Woodfibre LNG Limited will comply or require its contractors to comply with the recommended 300 m minimum setback from waterbird colonies (see Figure 5.17-2) for Project – related marine vessel traffic, and subject to safety concerns, refrain from blowing horns or whistles and maintain constant engine noise while passing near the colonies (EC 2013a).	Section 5.3
M5.17-4	**Implement Marine Vessel Speed Restrictions** During inbound travel, LNG carriers will be moving at a maximum speed of 8 to 10 knots at the south end of Passage Island (entrance to Howe Sound and the RAA) until they reach the immediate vicinity surrounding the Project area (LAA) where speeds will be reduced to 6 knots. To the extent practical, all other Project vessels will limit their speed while travelling within the RAA.	Section 5.3
M5.17-5	**Minimize the Duration of Activities in Intertidal Zone** Woodfibre LNG Limited will minimize the duration of necessary activities, including both dismantling and construction of structures, that must occur within the intertidal zone to the extent possible to reduce the disturbance of marine birds and marine bird habitat. Where practicable, activities will be scheduled during low tide.	Section 5.3
M5.17-6	**Underwater Noise Management Plan** Woodfibre LNG Limited will prepare and implement an Underwater Noise Management Plan as a component of the Marine Works Management Plan (M5.10-1) to mitigate potential mortality and behavioural changes to birds, fish	Section 5.3 CEMP

[10] The nesting period for the A1 bird nesting zone has been updated since the commitment in Table 22-1 of the Application was prepared. The updated window is March 26 to August 16 (ECCC, 2018a).

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
	and marine mammals. The plan will reference DFO's *BMP for Pile Driving and Related Operations* (BCMPDCA and DFO 2003), and will contain the following measures: Pile Driving and Related Activities: Multiple underwater noise generating activities will be minimized when practicable (e.g., avoid multiple pile driving activities at the same time). Where multiple underwater noise generating activities are planned, they will be sequenced to minimize construction duration. • Works in the marine environment will be conducted during the least risk fisheries work window specified by DFO for the region unless otherwise agreed upon by DFO. The prescribed work window for Howe Sound is August 16–January 31 (DFO 2014b). • Where possible, pile driving activities will avoid impacting hard substrates to prevent disturbance to fish habitat. • The use of vibrational pile driving will be used where practical and feasible as impact pile driving is associated with louder sound pressure levels underwater. The use of vibro-hammers for pile installation minimizes the effects on fish by decreasing the anticipated noise levels. • A ramp up or soft start technique will be used. Where equipment allows, power will be built up slowly from a low energy start-up to give adequate time for marine wildlife to leave the vicinity before exposure to the maximum sound pressure level. There will be a soft start every time pile driving is resumed following an interval of no pile driving.	
M5.17-6 (cont'd.)	• Underwater noise from pile driving activities will be monitored in accordance with the following: – Sound will not exceed 30 kPa at a distance of 1 m to 2 m from pilings; or – If the sound exceeds 30 kPa at a distance of 1 m to 2 m from pilings, measures will be taken to reduce either the intensity of the sound generated or the level of sound propagation through the water column. The appropriate measures will be chosen based on practicality to the Project and effectiveness and may include: o silt curtains around pile driving activities o bubble curtains around pile driving activities o a vibratory hammer in place of an impact hammer for pile driving • Prior to pile driving, the perimeter of the pile driving area will be identified, so that work occurs within the confines of the pile driving area. Monitoring: The Environmental Monitor will be responsible for monitoring underwater noise and potential effects to wildlife, and implementing corrective mitigation measures if necessary [e.g., establishing safety zones in the event underwater noise levels exceed injury thresholds (180 and 190dB re 1 µPa)].	Section 5.3 CEMP

Table 3: Wildlife Mitigation Measures Related to Construction in Table 22-1 of the Application

Mitigation Number	Mitigation Name and Proposed Mitigation	Concordance with the Construction WMMP
M5.17-8	**Development of a Marine Bird Management Plan** Woodfibre LNG Limited will develop and implement a Marine Bird Management Plan (MBMP) prior to the initiation of the construction phase of the Project. This MBMP will be part of an overall Wildlife Management Plan document. This plan will include: • Pre-construction surveys within mapped (but not field-verified) marbled murrelet critical nesting habitat to be cleared as part of the Project will be undertaken following appropriate standards developed by the Resource Information Standards Committee for marbled murrelet inventory (MELP 2001). These surveys will determine if marbled murrelets are currently nesting in these areas (if timing of Project construction allows for these surveys to be conducted during nesting season), or if these areas provide suitable nesting habitat (if timing of Project construction prevents surveys of during active nesting activity). • Provision of information and training to all workers (contractors, staff, and employees) on how to report and record marine bird conflicts in the Project area, specifically vessel strikes (bird species, location of carcass on vessel, weather conditions) in a database during construction, operation and decommissioning. • Should regular review of the database identify areas of persistent conflict or mortality rates that would affect populations, the Project operations will be reviewed to identify potential mitigation measures.	Section 4.2 Section 5.0 Section 6.1.2
M5.17-8 (cont'd.)	Pre- and post-construction (operation-phase) monitoring of marine birds in the Project area. If the monitoring identifies high levels of marine bird attraction and collision related mortality associated with the Project on-shore infrastructure, lighting, weather or migration periods, additional mitigation measures will be explored, including: turning off unnecessary lights (exterior and interior), especially during periods of high marine bird migratory flight activity in the area, wider light shut-down periods during migratory periods and inclement weather events (overcast, cloudy and/or hazy and foggy conditions), avoidance of continuous red or flashing red incandescent lights, use of blue jelly-jar LED lights on suspension cables and rectangular blue LED lights on bridge decks (Golder et al. 2010[11]). Survey methods may include stand watches during migratory periods (spring and fall) in an adaptive management approach.	Section 4.2 Section 5.0 Section 6.1.2
M5.17-9	**Coordinate with BURNCO to Share Information from Marine Bird Monitoring Studies** Woodfibre LNG Limited will coordinate with BURNCO to mutually share results of marine bird monitoring studies to contribute to the knowledge base for marine bird interactions.	Section 5.6

[11] Golder Associates Ltd., ABR, Inc., and Rolf Bergman Consulting. 2010. Literature Review, Synthesis, and Design of Monitoring of Ambient Artificial Light Intensity on the OCS Regarding Potential Effects on Resident Marine Fauna. Prepared for: US Department of the Interior, Minerals Management Service, Anchorage, AK. Golder Associates Inc., Mount Laurel, NJ, ABR, Inc. Environmental Research & Services, Fairbanks, AK, and Rolf Bergman Consulting, Cleveland Heights, OH. 93 pp.

2.0 REGULATORY FRAMEWORK

2.1 REGULATORY REQUIREMENTS

Legislation and regulations that apply to the management of sek̲w'ek̲w'inexw (wildlife) include the federal *Species at Risk Act* (SARA), *Migratory Birds Convention Act* and Migratory Birds Regulations (Section 2.2), and the provincial *Wildlife Act* and *Oil and Gas Activities Act* (Section 2.3). Woodfibre LNG is responsible for abiding by all applicable legislation, regulations, permits, and authorizations while undertaking work for the Project.

2.2 FEDERAL REGULATIONS

2.2.1 Species at Risk Act

The SARA is a federal Act that applies to certain sek̲w'ek̲w'inexw (wildlife) species in Canada. Species listed on Schedule 1 as extirpated, endangered, or threatened are afforded protection under SARA. Species listed as special concern on Schedule 1 are managed to prevent them from becoming extirpated, endangered, or threatened. It is prohibited to kill, harm, harass, capture, or take an individual of those Schedule 1 species. It is also prohibited to damage or cause destruction to the residence (e.g., nest or den) of species listed as extirpated, endangered, or threatened on Schedule 1. The federal government is required to develop a recovery strategy for those Schedule 1 species and identify critical habitat. Recovery strategies that apply to this Project are listed in Section 5.1.

2.2.2 Migratory Birds Convention Act

The federal *Migratory Birds Convention Act* and the Migratory Birds Regulations, 2022 (updated July 30, 2022) provide protection for migratory birds identified in the *Act* on federal, provincial, and private lands. These protections include a prohibition on depositing harmful substances in areas frequented by migratory birds, and a prohibition on disturbing, destroying, taking, or possessing migratory birds, their nests, and eggs.

Under the updated Migratory Birds Regulations, 2022, the nests of certain species, identified in Schedule 1 of the Migratory Birds Regulations, will be protected year-round for a period since they were last used (e.g., 12, 24, or 36 months), whether those nests are active or not. Pileated woodpecker (*Dryocopus pileatus*) nests are likely within the CPA; these nests have a 36-month waiting period. The nests of most species, however, can be removed without a permit provided those nests do not contain a live bird or viable egg or are protected as a residence under SARA.

2.3 PROVINCIAL REGULATIONS

2.3.1 Wildlife Act

The provincial *Wildlife Act* prohibits intentional feeding or attempting to feed dangerous sek̲w'ek̲w'inexw (wildlife). Further, it is prohibited to leave an attractant out that may attract dangerous sek̲w'ek̲w'inexw (wildlife). Birds, occupied nests, or eggs may not be possessed, taken, injured, molested, or destroyed.

The nest of an eagle, peregrine falcon (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), osprey (*Pandion haliaetus*), and heron are protected year-round regardless of the status of the nest (i.e., occupied or unoccupied).

Disturbing, molesting or destroying sḵeĺáẇ (beaver) lodges and dams and muskrat houses or dens is prohibited under the *Wildlife Act* without permits. The attempted capture and handling of sek̲w'ek̲w'inexw (wildlife) (e.g., amphibians) requires a permit under the *Wildlife Act*.

2.3.2 Oil and Gas Activities Act

The Environmental Protection and Management Regulation of the *Oil and Gas Activities Act* provides the statutory authority to the BC OGC for the management and protection of environmental values. Oil and gas activities are required to be planned and undertaken in a manner where the activities do not damage or make a wildlife habitat feature ineffective.

Wildlife habitat features include high priority wildlife dens and nests of birds exhibiting nest fidelity, and significant mineral licks and wallows (see OGC's Environmental Protection and Management Guidelines, 2021).

3.0 ROLES AND RESPONSIBILITIES

The CEMP describes the roles and responsibilities of the Environmental Manager, Contractor, Qualified Professional (QP) and Environmental Monitor (EM). Specific to the Construction WMMP, the QP is responsible for:

- Providing discipline-specific expertise (e.g., amphibians, shá7yu [western screech-owl])
- Undertaking surveys requiring a QP and preparing reporting as required by the Construction WMMP
- Annual review of CDC/SARA registry to identify changes to the conservation status of sek̲w'ek̲w'inexw (wildlife) species that may occur in the Project area. Providing updates and recommending mitigations, as applicable, to the Woodfibre LNG Environmental Representative based on the findings of the review.
- Quarterly review of Wildlife Observation Forms to determine if a species of management concern (i.e., sek̲w'ek̲w'inexw [wildlife] species listed provincially on the Red- or Blue-list or on Schedule 1 of SARA) not previously detected in the Project area was detected during construction. Reporting detections of Red- or Blue-listed species or species at risk on Schedule 1 of SARA to the BC CDC.
- Supervising the implementation of the Construction WMMP.

4.0 SEK̲W'EK̲W'INEXW (WILDLIFE) SETTING

Baseline information on the sek̲w'ek̲w'inexw (wildlife) that use the temíxw (land) and stak̲w (water) in the vicinity of the Project was presented in Woodfibre LNG's Application for an EAC in January 2015. Information in the Application was used to assess potential effects on sek̲w'ek̲w'inexw (wildlife) and identify mitigation measures to avoid or reduce the potential effects. Sek̲w'ek̲w'inexw (wildlife) included species of management concern (SOMC).[12]

The baseline information presented in the Application has since been supplemented with additional pre-construction field surveys based on commitments made by Woodfibre LNG or as required by environmental assessment approval conditions. The pre-construction surveys are specific to certain species or species groups identified in project conditions; the purpose of those surveys was to improve the understanding of the occurrence and distribution of those species within the CPA and to determine whether additional mitigation measures are needed to avoid or reduce adverse effects. The results of studies completed up to December 2022 are summarized below. This Construction WMMP builds on the mitigation measures identified in the Application and findings of the pre-construction surveys.

4.1 TERRESTRIAL BIRDS

The Project area provides habitat for a variety of breeding, migrating, and overwintering raptors and owls, gamebirds, and songbirds. Suitable nesting and foraging habitat for diurnal raptors (hawks, falcons, vultures, eagles) and nocturnal and diurnal owls occur in the area surrounding the Project.
Two subcomponents of the avifauna valued component in the Application are 1) platform and cavity-nesting birds (e.g., sp'ák̲w'us [bald eagle; *Haliaeetus leucocephalus*], osprey [*Pandion haliaetus*], shá7yu [western screech-owl; *Megascops kennicottii kennicottii*]), and 2) passerines (e.g., swallows, flycatchers, songbirds), and Columbiformes (e.g., pigeons).

Bird SOMC include:

- sooty grouse (*Dendragapus fuliginosus*; confirmed)
- smek̲w'á7 (great blue heron [*Ardea herodias fannini;* confirmed])
- nsx̲ípim (northern goshawk [*Accipiter gentilis laingi*; possible])
- shá7yu (western screech-owl [possible])
- nsex̲á7x̲em (band-tailed pigeon [*Patagioenas fasciata*; confirmed])
- kw'ek̲w'íḵw'ehatl' (barn swallow [*Hirundo rustica*; confirmed])
- olive-sided flycatcher (*Contopus cooperi*; confirmed)
- common nighthawk (*Chordeiles minor*; possible)
- pileated woodpecker (*Dryocopus pileatus*; confirmed).

[12] SOMC are species listed as red or blue in BC, listed on Schedule 1 of SARA, and species of interest to Sḵwx̲wú7mesh Úxwumixw (Squamish Nation)

The proposed clearing area includes suitable habitat for ground-nesting bird species (e.g., killdeer [*Charadrius vociferus*], spotted sandpiper [*Actitis macularius*]) that use substrates such as gravel for their nests. A killdeer nest was observed in the CPA during baseline surveys (Golder, 2014b) and pre-demolition surveys in 2021 (Stantec, 2023a), and killdeer and spotted sandpiper nests were observed during the pre-demolition surveys in 2023 (Stantec, 2023b).

The following sections describe SOMC-specific surveys that were completed post-Application up to July 2023.

4.1.1 Nsx̱ípim (Northern Goshawk)

Nsx̱ípim (northern goshawk) uses large tracts of mature forest for nesting and hunting (COSEWIC, 2013). Mature forest within the CPA is highly fragmented and restricted to patches adjacent to the marine foreshore south and east of the CPA, adjacent to Mill Creek (WLNG 2015). Standard call-playback surveys (i.e., RISC, 2001) for nsx̱ípim (northern goshawk) were undertaken in June and July 2015 in mature forest areas to determine if the species was present within the CPA (Hemmera, 2015a). There were 20 stations surveyed twice and two stations surveyed once; the surveys for nsx̱ípim (northern goshawk) resulted in no detections (Hemmera, 2015a).

4.1.2 Shá7yu (Western Screech-Owl)

Standard call-playback surveys for shá7yu (western screech-owl) were undertaken in June and July 2015 (Hemmera, 2015b). These surveys resulted in the detection of one adult male at the northern end of the CPA, on adjacent Crown temíxw (land). Three sets of call-playback surveys were completed at 11 call-playback stations in April 2019 (Hemmera, 2019). An autonomous recording unit was also deployed in 2019 at the location where the owl in 2015 was detected; no shá7yu (western screech-owl) were detected during the 2019 surveys (Hemmera, 2019). In March 2023 Fortis BC completed sha7yu (western screech-owl) surveys using call-playback methods within the CPA; no western screech-owls were detected.

Forest habitat greater than 80 years of age was mapped in the CPA in 2019 (Hemmera, 2019) and habitat assessments in mature forested areas within the CPA were completed in June 2021 to assess nesting habitat suitability. Assessment methods followed Wildlife Habitat Rating Standards (RIC 1999), habitat description in RISC (2006), and site assessments developed by Tripp and Welstead (2019). Trees and snags with potential to support a sha7yu (western screech-owl) nest were identified and recorded at this time (Stantec, 2023a). Findings are presented in Figure 3. Suitable sites contained mature second growth forest with wildlife trees (i.e., snags with one or more suitable cavities to support nesting) and an open flyway with security cover available. Moderate and high suitability habitat was identified within the CPA but primarily outside the proposed clearing area. Trees and snags with potential to support a sha7yu (western screech-owl) nest are located within 100 m of the proposed clearing area, including one site in the western portion at the edge of the proposed clearing area; see Figure 3).

4.1.3 Sp’ák̲w’us (Bald Eagle)

One sp’ák̲w’us (bald eagle) nest is in a Douglas-fir tree on the north side of Woodfibre Creek, approximately 150 m upstream from where it flows into Átl’k̲a7tsem (Howe Sound) (Figure 3). Surveys in

2019, 2020, 2021, and 2022 confirmed that the nest was active in each of those years (Hemmera, 2020; Stantec, 2023a). No other raptor nests were found during surveys in 2021.

4.1.4 Kw'ekw'íkw'ehatl' (Barn Swallow)

A kw'ekw'íkw'ehatl' (barn swallow) pair count and nest survey was completed in June 2021 by a QP experienced with swallows (Stantec, 2023a). Kw'ekw'íkw'ehatl' (barn swallow) was confirmed nesting inside and on buildings planned for demolition (Figure 3). These include the warehouse, pumphouse, and leachate buildings on beams, in rafters of the ceiling, and on cement walls. Approximately 15 pairs were observed in early June 2021 prospecting for nest sites, collecting nest materials, and building nests. A thorough search of nests inside of buildings was not completed because of safety risks associated with entering derelict buildings; the QP concluded, however, that each building likely supports several nesting kw'ekw'íkw'ehatl' (barn swallow) pairs. Nests were not found on or under bridges within the CPA over Mill Creek, the QP determined that the bridges do not provide adequate supporting structures for swallows to attach their nests. A survey of the buildings in the existing industrial site was completed in November and December 2022; a total of 37 kw'ekw'íkw'ehatl' (barn swallow) nests in various condition (from fully intact, partially intact, to only a mud outline) were found in or on buildings (see Figure 3 for general locations of nests) (Stantec, 2022). A barn swallow compensation structure with artificial nest cups was installed in April 2023 near the existing landfill (Figure 3) (see Section 5.4 for further details).

4.1.5 Nsexá7xem (Band-tailed Pigeon)

A QP surveyed the CPA for potential mineral sites for nsexá7xem (band-tailed pigeon) in June 2021 (Stantec, 2023a). Characteristics of potential mineral sites in a coastal environment, that is, presence of mineralized soils and streams, upwelling water, mineral residue (COSEWIC 2008; ECCC 2019b) were determined to be lacking within the CPA. One potential mineral site was identified along a tributary of Mill Creek where at least 20 pigeons were present. This site is at the perimeter of the CPA and outside of proposed clearing areas (Figure 3).

4.1.6 Pileated Woodpecker Tsíptspí7lhtn (Nest)

Surveys for pileated woodpecker tsíptspí7lhtn (nest) cavities were completed by a qualified and experienced biologist in July 2023. Trees within the proposed clearing area (see Figure 3) were visually searched for evidence of pileated woodpecker use. Use was determined using the Pileated Woodpecker Cavity Identification Guide (ECCC, 2023b) and cavities were documented as feeding, roosting, or nesting. In summary, there is evidence of pileated woodpecker feeding and potentially roosting activity: feeding cavities were observed within the eastern and southwestern portion of the proposed clearing area and a tree with potential roosting cavities was observed in the southwest portion just outside the proposed clearing area. No tsíptspí7lhtn (nest) cavities were observed. Pileated woodpeckers were detected by bird specialists during other wildlife surveys in June 2021 and June 2023, which further indicates use of the area by this species. Tsíptspí7lhtn (nest) cavities are likely present elsewhere within the CPA but outside the proposed clearing area.

4.2 SEK̲W'EK̲W'INEXW TL'A SHKWEN (MARINE BIRDS)

Sek̲w'ek̲w'inexw tl'a shkwen (Marine birds) are species that depend on marine and coastal habitat for one or more of their life requisites. Seventy species of sek̲w'ek̲w'inexw tl'a shkwen (marine bird) are known to occur in the upper Átl'k̲a7tsem (Howe Sound) (Badzinski et al., 2008; Ricker and Turner, 2017; BC CDC, 2023; eBird, 2023) and are known or likely to occur within the CPA marine environment. Species include gulls, alcids (murres, murrelets, auklets), cormorants, diving ducks, loons, grebes, geese, swans, and shorebirds.

Based on habitat characteristics, the CPA marine environment provides foraging habitat for gulls, diving ducks, loons, grebes, geese, and swans (Golder, 2014a; Stantec, 2023b). The rocky shoreline provides foraging habitat for killdeer, spotted sandpiper (*Actitis macularius*), and smek̲w'á7 (great blue heron); however, the deep bathymetry of the marine environment does not supply high value shorebird foraging habitat such as shallow mudflats (Golder, 2014a). Killdeer and spotted sandpiper nest in the CPA (Stantec, 2023a,b; Stantec biologists, pers. obs., 2023). Other birds that use or potentially use the CPA marine environment for foraging include (Ricker and Turner, 2017; Stantec, 2023a; eBird, 2023): raptors, kingfisher, swallows, purple martin (*Progne subis*), American dipper (*Cinclus mexicanus*), and common nighthawk.

There are no federal or provincial protected areas located near the CPA; however, the Skwelwíl̓em (Squamish Estuary Wildlife Management Area) is located on the Squamish estuary, which provides wintering, migration, feeding, and breeding habitats for waterfowl and shorebirds, as well as for raptors, passerines, and other species (Golder, 2014a).

There are no sek̲w'ek̲w'inexw tl'a shkwen (marine bird) colonies in the CPA or within 300 m of the Project-related vessel traffic route (Golder, 2014a). Sek̲w'ek̲w'inexw tl'a shkwen (Marine birds) likely forage in the CPA marine environment and along the vessel traffic route during the breeding season. Sek̲w'ek̲w'inexw tl'a shkwen (Marine birds) occur in Átl'k̲a7tsem (Howe Sound) throughout the year but are most abundant during the spring (March–May) and fall (September–November) migration and winter months (December–February) (Badzinski et al., 2008; Ricker and Turner, 2017). In the spring, the slhawt' (herring) spawn in intertidal and shallow subtidal waters can attract many sek̲w'ek̲w'inexw tl'a shkwen (marine birds), mostly gulls (*Larus* spp.), sea ducks, and other diving species. In the fall, cháyilhen (salmon) migrating to spawning streams (e.g., Squamish River watershed) attract marine wildlife, including birds. In early November 2022, hundreds of gulls were observed resting and feeding at night and pre-dawn in large flocks along the water taxi route between Sḵwx̱wú7mesh (Squamish) and the Project site (Stantec, 2023b).

Mitigation M5.17-8 from Table 22-1 of the Application requires the development of a MBMP, which is provided in Section 5.3. Woodfibre LNG completed pre-construction ínexwantas (monitoring) of sek̲w'ek̲w'inexw tl'a shkwen (marine birds) in the CPA in 2022 to understand potential bird collision risk and to inform mitigation measures. Sek̲w'ek̲w'inexw tl'a shkwen (Marine bird) data was collected in February, March, April, August, November, and December 2022 (Stantec, 2023). Sek̲w'ek̲w'inexw tl'a shkwen (Marine birds) detected in the CPA marine environment included (Stantec, 2023): gulls (*Larus* spp.), cormorants, goldeneye (*Bucephala* spp.), mergansers (*Mergus* spp.), loons (*Gavia* spp.), grebes (*Podiceps* spp.), surf scoter (*Melanitta perspicillata*), harlequin duck (*Histrionicus histrionicus*), and

trumpeter swan (*Cygnus buccinator*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos*), killdeer, spotted sandpiper, smek̲w'á7 (great blue heron), and American dipper.

The highest numbers of sek̲w'ek̲w'inexw tl'a shkwen (marine birds) were present in spring, while summer had the fewest individuals recorded. Gulls were present year-round but with highest numbers in winter, sea ducks were present primarily in spring, and geese and swans were absent during fall and winter. There is limited shorebird habitat within the CPA, which is consistent with low detections of shorebirds (Stantec, 2023b).

4.2.1 Piyís (Marbled Murrelet)

Piyís (Marbled murrelet [*Brachyramphus marmoratus*]) is provincially Blue-listed and federally designated as threatened on Schedule 1 of SARA. There are terrestrial geographic location polygons that could contain critical habitat for piyís (marbled murrelet) nesting in the watersheds of Mill and Woodfibre Creeks within the CPA; however, no polygons overlap the proposed clearing areas (Figure 3; ECCC, 2023c). Provincial suitable habitat, as identified in the Marbled Murrelet Order (FLNRORD, 2021) does not overlap the CPA; however, the Ministry of Water, Land and Resource Stewardship re-surveyed the Lower Squamish landscape unit in spring 2023 and identified two areas of suitable habitat within 1 km of the CPA: one is approximately 815 m east of the CPA and the other is approximately 720 m north of the CPA (MWLRS, 2023a). Historical forest harvesting practices and other land developments have limited the availability of old forest habitat used by piyís (marbled murrelet) in the Lower Squamish landscape unit where the Project occurs (FLNRORD, 2018a).

Piyís (Marbled murrelet) has been detected in upper Átl'k̲a7tsem (Howe Sound) (Ricker and Turner, 2017; eBird, 2023) and occurrence is considered irruptive (fluctuations in numbers from year to year) in winter, low in spring and fall, and medium in summer (Ricker and Turner, 2017; Birds Canada, 2023). Piyís (Marbled murrelet) was not observed within the CPA marine environment during baseline surveys (Golder, 2014a; Hemmera, 2015c) or during pre-construction sek̲w'ek̲w'inexw tl'a shkwen (marine bird) surveys completed in 2022 (Stantec, 2023). Helicopter-based, low-level aerial assessments have indicated that nesting habitat is limited within the Mill Creek and Woodfibre Creek watersheds (WLNG, 2015). There were no confirmed observations during the 2015 radar survey, suggesting that nesting does not occur or is low use, and nest commuting behaviour in the CPA is likely low (Hemmera, 2015c).

Additional habitat suitability assessments were completed in 2021 within the CPA following Environment and Climate Change Canada's (ECCC's) methods for ground plot habitat assessments (Manning et al., 2018). Data collected included site- and landscape-level biophysical attributes of nesting critical habitat consistent with the Recovery Strategy (ECCC, 2023c). Survey results identified the presence of site-level biophysical attributes, such as mature k̲wáy̓tsay (hemlock) and cedar trees, with suitable platforms at some plots within the CPA at a microhabitat scale (Stantec, 2023a). However, in the context of landscape-level habitat requirements for piyís (marbled murrelet), the forested areas within the CPA are considered low suitability because biophysical attributes that are present are non-uniformly distributed, the size of forest patches is small and within a fragmented landscape influenced by forestry activities, predation risk is high due to presence of corvids (crows, ravens, jays), and the forest patches are within 400 m of the coastline Ih is typically not used by piyís (marbled murrelets) due to increased predation and inadequate forest structures (Burger et al., 2000; Rodway and Regehr, 2002). Given this,

and that the nearest provincially-mapped suitable habitat polygons are approximately 720 m north of the CPA and approximately 815 m east of the CPA (MWLRS 2023a), the potential for adverse effects on piyís (marbled murrelet) from construction activities is low and limited to sensory disturbance during the nesting season.

4.3 SḴÁP'ḴAP'TSAYLH (BATS)

Based on range and habitat preferences, there are nine sḵáp'ḵap'tsaylh (bat) species known or likely to occur in the CPA, including two SOMC: Townsend's big-eared bat (*Corynorhinus townsendii*) is provincially Blue-listed, and little brown myotis (*Myotis lucifugus*) is listed as endangered on Schedule 1 of SARA (Table 7). While Townsend's big-eared bat was not recorded in the Project area during baseline studies, little brown myotis was confirmed as present; this species is the subject of FDS condition 9 (see Table 2) and is the focal species for sḵáp'ḵap'tsaylh (bat) management within the Construction WMMP.

Sḵáp'ḵap'tsaylh (Bat) roosting habitat assessments were completed in May 2020 within areas to be cleared (Hemmera, 2020). Surveys identified four sites with habitat attributes considered moderate to high suitability for roosting (Hemmera, 2020). An additional sḵáp'ḵap'tsaylh (bat) roosting habitat assessment was completed in 2021 to identify potential roost sites within the areas to be cleared and inform mitigation measures, such as avoidance, setbacks, and potential habitat loss mitigation measures (Stantec, 2023a). Sites included trees with cavities or sloughing bark, rock walls with crevices, and buildings planned for demolition. Potential roost sites and a potential hibernation site are shown on Figure 4 and details are provided in Stantec (2023a). The powerhouse was identified as a site that could support hibernating and maternity-roosting sḵáp'ḵap'tsaylh (bats) (Stantec, 2023a).

Sḵáp'ḵap'tsaylh (Bat) surveys were completed between October and December 2022 to determine the use of buildings by sḵáp'ḵap'tsaylh (bats) (Stantec, 2022). Swarming, exit count, acoustic, and hibernacula surveys were undertaken. Acoustic sḵáp'ḵap'tsaylh (bat) activity was detected in the warehouse portion of the powerhouse & warehouse in November 2022. Acoustic analysis from ultrasonic acoustic recording units (uARUs) determined the sḵáp'ḵap'tsaylh (bats) were likely Californian myotis (*Myotis californicus*). UARUs remained active in the powerhouse & warehouse into December and no further activity was detected, indicating the sḵáp'ḵap'tsaylh (bats) had either left the building or had entered hibernation within the building. Swarming and exit count surveys in November detected no sḵáp'ḵap'tsaylh (bat) activity at the exterior of the buildings. Hibernacula surveys were performed with the assistance of a drone and two areas were identified in the warehouse portion of the powerhouse & warehouse as potential hibernacula. Surveys from November 2022 to April 2023 included building inspections for bats, guano collection, passive monitoring using uARUs, and a dusk emergence survey around the powerhouse & warehouse (Stantec, 2023c). Three, possibly four, species were identified foraging and flying in late March and early April 2023: silver-haired bat, possibly big brown bat, Yuma myotis, and California myotis (Stantec, 2023c). Guano samples collected from inside two buildings were inconclusive likely due to degradation of DNA in the old samples.

Table 4: Sḵáp'ḵap'tsaylh (Bat) Species Known or Likely to Occur in the Certified Project Area

Common Name	Scientific Name	BC List	Federal List	Maternity Roost Preference May – August	Winter Roost (Hibernacula) Preference November – March/April
Big brown bat	*Eptesicus fuscus*	Yellow	Not at risk	Trees (dead), rock crevices and outcrops, cliffs, buildings, bridges, bat boxes	Buildings, mines, rock crevices
Silver-haired bat	*Lasionycteris noctivagans*	Yellow	Not at risk[a]	Trees (on surface of bark, live trees)	Trees, mines, buildings, migrates
Hoary bat	*Lasiurus cinereus*	Blue	Not at risk[a]	Trees (dead, live) foliage, potentially bridges	Migrates
Townsend's big-eared bat	*Corynorhinus townsendii*	Blue	Not at risk	Trees, cliffs, mines, buildings, bat boxes	Mines, caves
Yuma myotis	*Myotis yumanensis*	Blue	Not at risk	Trees (dead), rock crevices and outcrops, mines, buildings, bridges, bat boxes	Mines, buildings
California myotis	*Myotis californicus*	Yellow	Not at risk	Trees (dead) behind bark, rock crevices and outcrops, mines, bridges, sometimes buildings, bat boxes	Buildings, mines, caves
Long-eared myotis	*Myotis evotis*	Yellow	Not at risk	Trees (dead), stumps, rock crevices and outcrops, cliffs, sometimes buildings, bat boxes	Mines, buildings, trees (dead), rock crevices
Little brown myotis	*Myotis lucifugus*	Blue	Endangered	Trees (dead) behind bark, in cavities, rock crevices and outcrops, cliffs, mines, buildings, bridges, bat boxes	Mines, caves, root wads, stumps
Long-legged myotis	*Myotis volans*	Yellow	Not at risk	Trees (dead), stumps, rock crevices and outcrops, cliffs, sometimes buildings	Mines, caves

Notes:

BC List: Red = endangered or threatened; Blue = special concern; Yellow= not at risk (BC CDC, 2023)

Federal List: Species at risk on Schedule 1 of the SARA (SRPR, 2023).

[a] Species has recently been assessed by COSEWIC as endangered (COSEWIC, 2023); however, the species is not yet listed on Schedule 1 of SARA

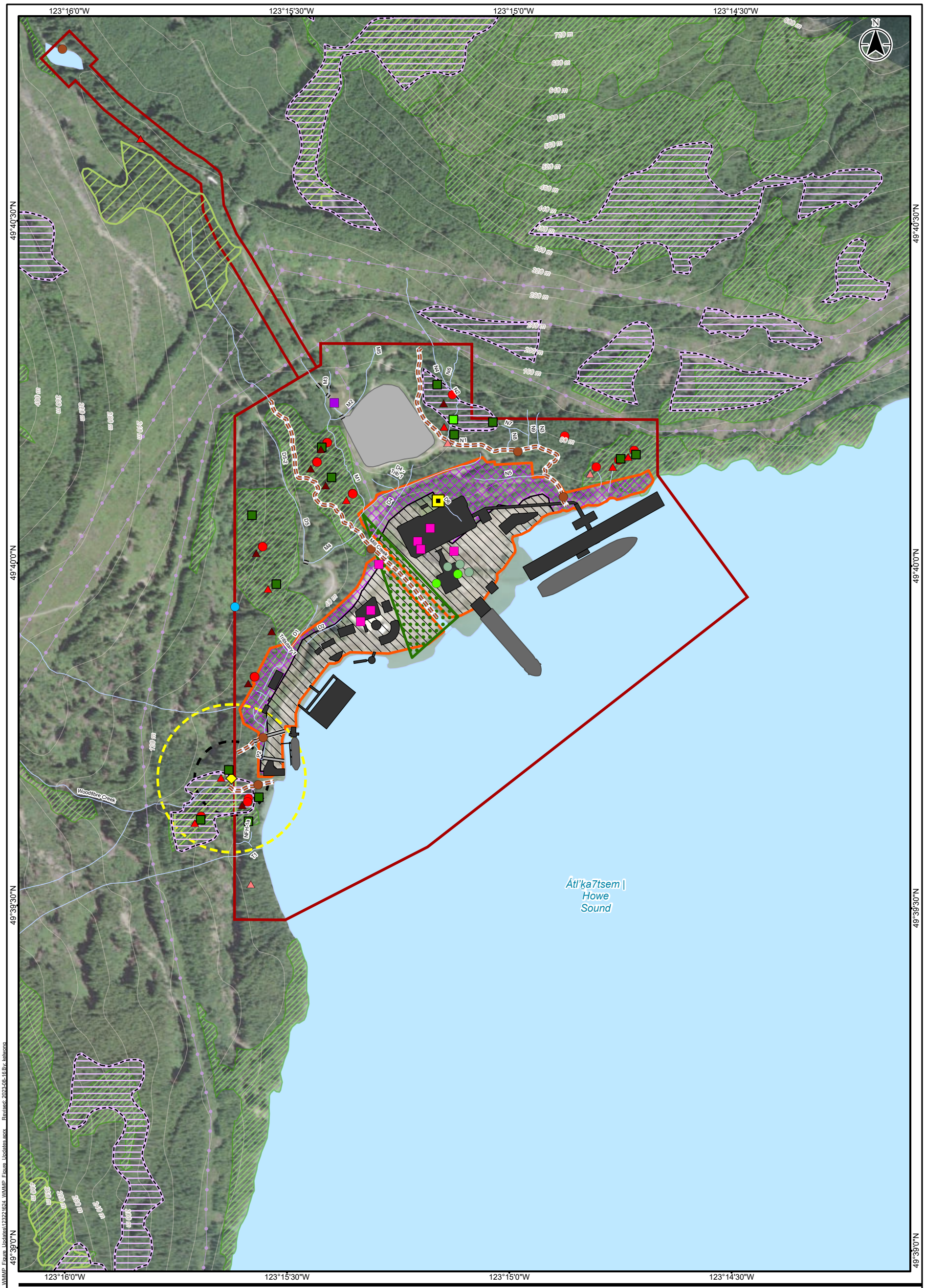
Roosting preference per Best Management Practices for Bats of British Columbia (MOE, 2016)

4.4 AMPHIBIANS AND REPTILES

There are nine amphibian species known or likely to occur in the CPA (Golder, 2014b). Of these, three are SOMC: coastal tailed frog (*Ascaphus truei*), northern red-legged frog (*Rana aurora*), and western toad (*Anaxyrus boreas*). Coastal tailed frog is federally listed as special concern on Schedule 1 of SARA and occurs in and near rocky, mountainous streams and has been confirmed as present in streams in the CPA (Figure 3). Where present, coastal tailed frog occurs year-round. Northern red-legged frog is federally listed as a species of special concern on Schedule 1 of SARA and is provincially Blue-listed. Western toad is federally listed as special concern on Schedule 1 of SARA.

The forested areas surrounding the Project may offer suitable upland habitat for adult northern red-legged frog and western toad. Both species require aquatic habitats for breeding, and this can be provided by human-made waterbodies such as ponds and ditches. Northern red-legged frog was not detected during visual searches and eDNA sampling (Golder, 2014b, Keystone, 2021). Western toad was detected using eDNA sampling (Keystone, 2021) and adult toads were detected in April and May 2023 during demolition activities, including pairs in amplexus ready to lay eggs (Stantec biologists and Woodfibre LNG Environmental Coordinator, pers. obs., 2023).

Reptiles known or likely to occur in the CPA include terrestrial gartersnake (*Thamnophis elegans*), northwestern gartersnake (*T. ordinoides*), common gartersnake (*T. sirtalis*), and northern alligator lizard (*Elgaria coerulea*). Gartersnakes and northern alligator lizard were detected in the northern section of the proposed clearing area in May 2023 (Stantec biologists and Woodfibre LNG Environmental Coordinator, pers. obs., 2023) (Figure 3). There is potential for a élhk̲aẏ (snake) hibernaculum within the CPA (Stantec biologists, pers. obs., 2023).



Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada

Amphibians and Reptiles
- Stream with Coastal tailed frog detected
- Western Toad, Northern Alligator Lizard, and Potential Snake Hibernaculum (2023)

Observation (prior to 2023)
- Coastal tailed frog
- Pacific Treefrog (Tadpole)
- Amphibian Breeding Site

Western Screech-Owl
- Suitable nesting habitat (Hemmera 2019)

Nesting Habitat Suitability Rating
- High (1)
- Moderate (2)
- Low (3)
- Potential Nest Site

Potential Mineral Source Site
- Band-tailed Pigeon

Barn Swallow
- Nest sites (prior to 2023)
- Nest Structure

Bald Eagle
- Nest (Protected Year Round)
- 100m Setback when Unoccupied
- 200m Setback when Occupied

Marbled Murrelet
- Geographic Location Polygon for Terrestrial Critical Habitat

Nesting Habitat Suitability Rating
- Moderate (2)
- Low (3)
- Watercourse
- Culvert
- Old Growth Management Areas

- Green Zone
- Certified Project Area
- Existing Landfill
- Transport Vessel
- Project Components

Clearing Areas
- Area for Clearing and Grubbing
- Area for Deforest, Clearing and Grubbing
- Proposed Clearing Area

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Stantec

Project Location
Swíyát

Project Number: 123221624
Prepared by KWONG on 20230816
Requested by JPRESTON on 20230816

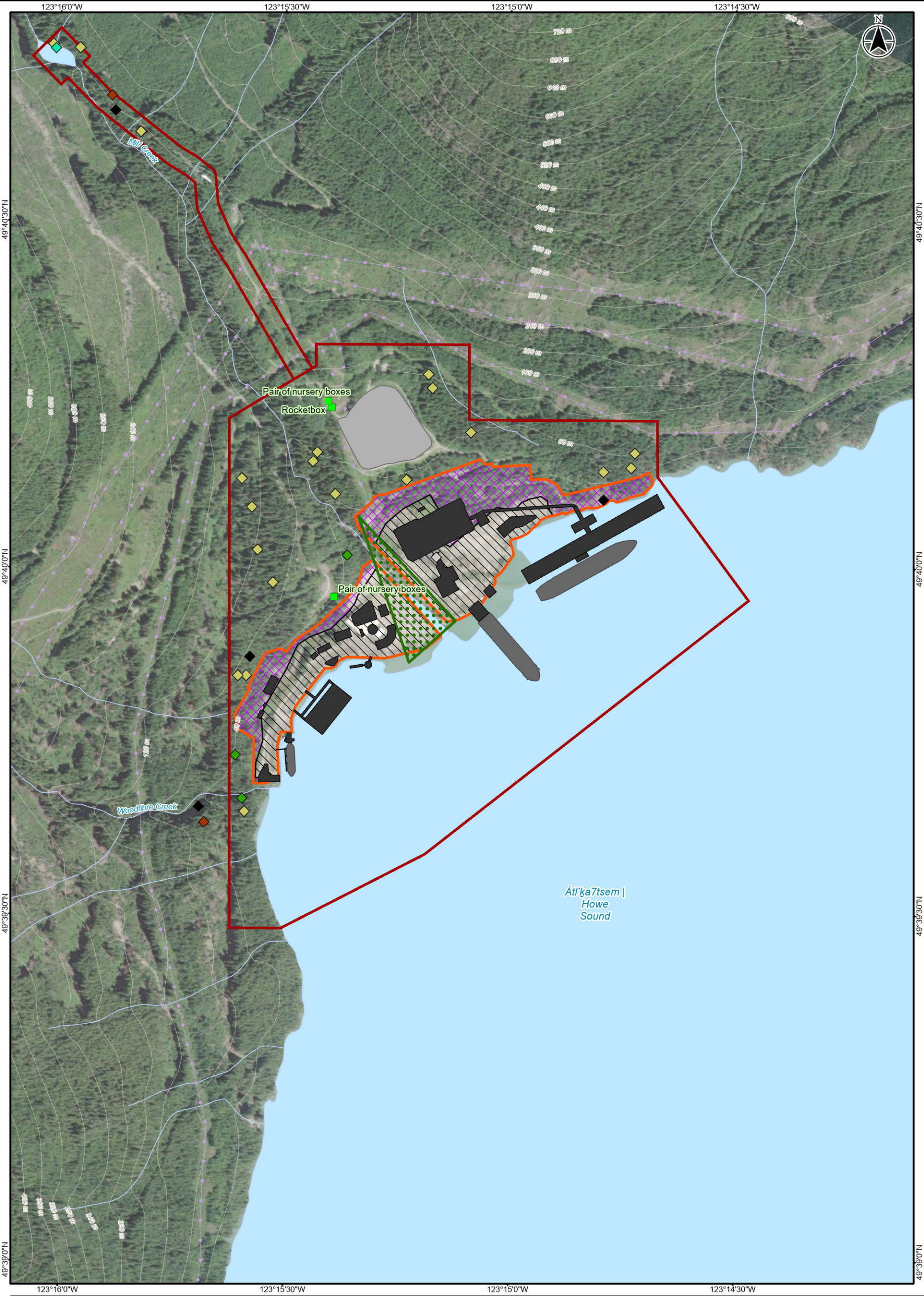
Client/Project/Report
Woodfibre LNG Limited
Woodfibre LNG Project
Wildlife Management and Monitoring Plan
- Construction Phase

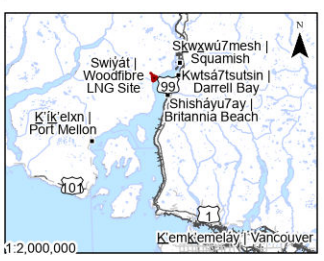
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3

Title
Sensitive Habitats and Habitat Features for Birds, Amphibians, and Reptiles in the Certified Project Area

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Potential Bat Roost Habitat Feature

- Live Tree
- Penstock
- Rock Face
- Snag
- Stump
- Potential Bat Hibernation Feature
- Bat Roosting Structures Installed
- Green Zone
- Certified Project Area
- Transmission Line
- Watercourse
- Topographic Contour
- Waterbody
- Existing Landfill
- Transport Vessel
- Project Components

Clearing Areas

- Area for Clearing and Grubbing
- Area for Deforest, Clearing and Grubbing
- Proposed Clearing Area

0 100 200 300 400 m

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Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada

Stantec

Project Location: Swíyát
Project Number: 123221624
Prepared by EHERTZMAN on 20230529
Requested by CLION on 20230527

Client/Project/Report
Woodfibre LNG Limited
Woodfibre LNG Project
Wildlife Management and Monitoring Plan
- Construction Phase

Figure No.
4

Title
Sensitive Habitats and Habitat Features for Bats in the Certified Project Area

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4.5 TERRESTRIAL MAMMALS

Based on a review of range maps and habitat types present in the Project area, several species of mammal, including carnivores, meso-carnivores, and ungulates, are known or likely to occur in the CPA.

Mammals known to occur in the CPA are:

- Black-tailed deer (*Odocoileus hemionus*)
- Black bear (*Ursus americanus*)
- Coyote (*Canis latrans*)
- River otter (*Lontra canadensis*)
- Wolf (*Canis lupus*)
- Mink (*Neovison vison*)
- Bobcat (*Lynx rufus*)

5.0 SEK̲W'EK̲W'INEXW (WILDLIFE) MITIGATION MEASURES

This section describes the sek̲w'ek̲w'inexw (wildlife) mitigation measures that are applicable to the construction phase of the Project. The mitigation measures are based on project conditions of approval, project commitments, and industry and government BMPs and guidelines. As indicated in the concordance tables in Section 1.0, the details of some mitigation measures are provided in the CEMP (e.g., Erosion Prevention and Sediment Control Plan) and, where relevant, a linkage to measures in the CEMP is provided below. In addition to the CEMP, other management plans relevant to sek̲w'ek̲w'inexw (wildlife) include the Invasive Plant Management Plan, Water Management Plan, Marine Transport Management Plan, and Marine Mammal Management and Monitoring Plan.

The mitigation of adverse Project effects on sek̲w'ek̲w'inexw (wildlife) outlined in the Construction WMMP will be achieved through adherence to best practices and guidelines, Project design, avoidance of sensitive areas and sensitive periods, site-specific and species-specific mitigation measures, compensation (i.e., habitat loss mitigation measures, such as bat boxes), and environmental training/education. Details are provided in the following sections.

5.1 BEST MANAGEMENT PRACTICES AND GUIDELINES

The Province of BC has published several environmental BMPs and guidelines applicable to sek̲w'ek̲w'inexw (wildlife) and the Project. These documents contain guidance that is considered acceptable to regulators and contributes to corporate due diligence in environmental protection. There are also federal recovery strategies for endangered or threatened species and management and/or action plans for species of special concern.

Key sek̲w'ek̲w'inexw (wildlife) guidance documents that were used to prepare the Construction WMMP:

- Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia (MOE, 2014a)
- Best Management Practices for Amphibian and Reptile Salvages in British Columbia (FLNRO, 2016)
- Guidelines for Amphibian and Reptile Conservation During Road Building and Management Activities in British Columbia (MECCS, 2020)
- Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (MOE, 2013a)
- Best Management Practices for Bats in British Columbia (MOE, 2016)
- Best Management Practices for Bat Boxes in British Columbia (BC Community Bat Program, 2019)
- Guidelines to Avoid Harm to Migratory Birds (ECCC, 2023a)
- Environmental Protection and Management Guideline (OGC, 2021)
- Identified Wildlife Management Strategy (MWLAP, 2004)
- Beneficial management practices for Barn Swallow (*Hirundo rustica*) (TBCSCP, 2014a)

- Implementation Plan for the Recovery of Marbled Murrelet in British Columbia (FLNRORD, 2018b)
- Amended Recovery Strategy for the Marbled Murrelet (*Brachyramphus marmoratus*) in Canada (ECCC, 2023c)
- Recovery Strategy for Little Brown Myotis (*Myotis lucifugus*), the Northern Myotis (*Myotis septentrionalis*), and the Tri-colored Bat (*Perimyotis subflavus*) in Canada (ECCC, 2018b)
- Recovery Strategy for the Common Nighthawk (*Chordeiles minor*) in Canada (EC, 2016a)
- Recovery Strategy for the Olive-sided Flycatcher (*Contopus cooperi*) in Canada (EC, 2016b)
- Recovery Strategy for the Northern Goshawk *laingi* subspecies (*Accipiter gentilis laingi*) in Canada (Parks Canada Agency, 2018)
- Recovery plan for the Western Screech-Owl, *kennicottii* subspecies (*Megascops kennicottii kennicottii*) in British Columbia (MOE, 2013b)
- Management Plan for the Great Blue Heron *fannini* subspecies (*Ardea herodias fannini*) in Canada (ECCC, 2020a)
- Management Plan for the Band-tailed Pigeon (*Patagioenas fasciata*) in Canada (ECCC, 2019a)
- Management Plan for the Western Toad (*Anaxyrus boreas*), Calling and Non-calling Populations, in Canada (ECCC, 2020b)
- Management Plan for the Northern Red-legged Frog (*Rana aurora*) in Canada (ECCC, 2017)
- Management Plan for the Coastal Tailed Frog (*Ascaphus truei*) in Canada (ECCC, 2018c)
- Guidelines for Amphibians and Reptile Conservation during Urban and Rural Land Development in British Columbia (FLNRO, 2014)
- Guidelines for Amphibian and Reptile Conservation during Road Building and Management Activities in British Columbia (MECCS, 2020)

5.2 PROJECT DESIGN MEASURES

Project design measures that are applicable to construction of the LNG facility are described in the following sections.

5.2.1 Green Zone

The first step of the provincial and federal mitigation hierarchy is to avoid adverse effects on environmental values (MOE, 2014b; Environment Canada, 2012). The establishment of the Green Zone avoids some effects on sekw'ekw'inexw (wildlife) by maintaining and enhancing a portion of the CPA.

Woodfibre LNG will establish the Green Zone (see Figure 4), which is an area adjacent to Mill Creek where riparian habitat will be protected (mitigation M5.14-4) and enhanced (mitigation M5.14-3) following Project construction. In compliance with the Certified Project Description, the Green Zone will be planted with suitable native vegetation upon completion of the construction phase. The Green Zone will not contain permanent Project buildings, but utilities, including power, process piping, communications cables, and roads and bridges, will be present within the Green Zone. The approach to planting the

Green Zone will be defined in the Green Zone Restoration Plan, which Woodfibre LNG will co-write with the Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) in accordance with the SNEAA.

5.2.2 Lighting

Woodfibre LNG has designed, and will install and maintain, temporary exterior lighting during construction of the Project and during operation of the floatel during construction. Light design will follow the *International Commission on Illumination's CIE 150:2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations* (Pollard et al., 2017) (or subsequent standards), but with consideration for meeting marine transportation and aviation safety requirements.

Design measures intended to reduce light trespass (i.e., light extending beyond a target) and skyglow (i.e., illumination of the night sky) are described in the Visual Quality Management Plan. Subject to safety and operational requirements, Woodfibre LNG will use blue and green lighting at night instead of red or white lighting and install directional lighting with shades to reduce attractiveness to birds (mitigation M5.12-5). This is consistent with the lighting standards in North America (e.g., Sustainable Development Code in the U.S. [Jarchow et al., 2021] and American Bird Conservancy's Bird-friendly Building Design [American Bird Conservancy 2019]). Woodfibre LNG will avoid the use of lighting that produces ultraviolet light to reduce the attractiveness of lights to insects, which could lead to the attraction of bats (mitigation M5.13-2).

5.2.3 Bird Strikes on Buildings

Woodfibre LNG will review the design of building facilities (including the floatel) with a QP experienced in avian biology and include mitigation measures to reduce the potential for bird strikes and bird mortality, where recommended by the QP (mitigation M5.12-9). Design approaches to reduce bird strikes on buildings include limiting the amount of glass and applying tints or façades to windows to provide visual cues and increase visibility of glass. Other measures include turning off lights in buildings at night when lights are not required. These measures are consistent with the lighting and building standards in North America (e.g., Sustainable Development Code in the U.S. [Jarchow et al., 2021)] and American Bird Conservancy's Bird-friendly Building Design [American Bird Conservancy, 2019]).

5.2.4 Bird Electrocution Potential from Powerlines

A QP experienced in avian biology will provide recommendations on mitigation measures in the design of the power line, including conductor layout, to reduce the potential for bird electrocution (mitigation M5.12-7). The QP will consider guidance in Bernardino et al. (2018) and APLIC (2012) when making recommendations to Woodfibre LNG's construction contractor.

5.3 GENERAL MITIGATION MEASURES

Mitigation measures in Table 5 are designed to reduce displacement and direct mortality of sek̲w'ek̲w'inexw (wildlife), and to limit human-sek̲w'ek̲w'inexw (wildlife) interactions. The measures are intended to fulfill project conditions and commitments relating to sek̲w'ek̲w'inexw (wildlife), as described in Section 1.0. Sek̲w'ek̲w'inexw (wildlife) sensitive periods and recommended setbacks are provided where relevant (Table 6). If recommended setbacks cannot be followed, a QP will be engaged, in consultation with appropriate regulatory authorities, when applicable, to determine alternative or additional mitigation measures, as needed.

Most vegetation clearing will occur outside of the primary nesting period for birds, which is the primary physical activity that could result in displacement and direct mortality to nesting birds (Table 6; mitigation M5.12-4 and M5.17-1). Grubbing, stripping, and grading activities, and mobile equipment operations may also be a risk to vulnerable sek̲w'ek̲w'inexw (wildlife) such as ground-nesting birds (e.g., killdeer), swallows that nest on equipment and infrastructure, habitat features (e.g., nsex̲á7x̲em [band-tailed pigeon] mineral sites), amphibians, reptiles, and mammals (during maternity denning period). It is likely that birds nest within the CPA and there is potential for amphibians and reptiles to enter the worksite during construction activities. Surveys of these 'simple' habitats will be undertaken to assess risk and to implement mitigation measures for vulnerable sek̲w'ek̲w'inexw (wildlife).

Table 5: General Mitigation Measures for Sekw'ekw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
General Sekw'ekw'inexw (Wildlife)		
Human-sekw'ekw'inexw (wildlife) interactions	• Workers will avoid direct interactions with sekw'ekw'inexw (wildlife) unless crew safety is at risk. • Project personnel and contractors will not feed, harass, or approach sekw'ekw'inexw (wildlife). • Human-sekw'ekw'inexw (wildlife) conflicts and incidents, including the use of deterrents, will be reported to the EM and documented. Sekw'ekw'inexw (wildlife) observations and incidents will be documented using the Wildlife Observation and Incident Reporting Form (Appendix A) and maintained in a database. Incident reports will be reviewed quarterly by a QP during construction to determine if additional mitigation or ínexwantas (monitoring) should be implemented. If additional mitigation or ínexwantas (monitoring) is required, this Construction WMMP will be updated to reflect those requirements. • In the case of imminent risk of sekw'ekw'inexw (wildlife) mortality or risk to sekw'ekw'inexw (wildlife) health, the EM will verbally report incidents or potential incidents to the Woodfibre LNG Environmental Representative as soon as possible. If required, input from a QP will be requested. • No ch'áatl'am (hunting), fishing, or gathering by Project personnel and contractors will be allowed in the immediate vicinity of Woodfibre CPA. • Workers will be required to report activities related to on-site sekw'ekw'inexw (wildlife) interactions. The EM will be responsible for documenting this information. • To reduce the likelihood or severity of potential vehicle-sekw'ekw'inexw (wildlife) interactions, the Contractor will implement maximum speed limits of 30 km per hour on roadways within the CPA.	M5.12-1
Waste management	• Food and stored garbage will be kept in bear-proof areas or bear-proof containers to limit attractants to sekw'ekw'inexw (wildlife); food waste will be transported to appropriate facilities. • Grease, oils, and fuels stored on-site will be stored in secured areas except where in use. The Waste Management Plan (see CEMP) will be followed.	M5.12-1
Spills	• Vehicles will be equipped with spill kits and fueled 30 m away from waterbodies (including creeks).	M5.12-1

Table 5: General Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Reporting mortalities	• If sḵw'eḵw'inexw (wildlife) mortality occurs within the CPA, the incident, and the suspected cause, will be tracked in a database by the EM and reported in the environmental ínexwantas (monitoring) report. Sḵw'eḵw'inexw (wildlife) mortalities will be documented using the Wildlife Observation and Incident Reporting Form (Appendix A) • If sḵw'eḵw'inexw (wildlife) mortality requires reporting to applicable agencies (i.e., a species listed on the BC Red list or Blue list, species at risk listed on Schedule 1 of SARA, migratory birds, dead bats), this will be done by Woodfibre LNG's Environmental Representative or QP. Species listed on the BC Red list or Blue List and species at risk on Schedule 1 of SARA will be reported to the BC CDC. BC Government website provides information for what to do if a sick, injured, or dead wildlife is found, including which agency to report to. Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh) Nation will be notified of wildlife mortality events and mortality risk concerns, and if wildlife mortalities are reported to the appropriate agency or authority. Appendix A provides contact information.	M5.12-1
Salvage of coarse woody debris	• Coarse woody debris that has been removed in upland areas will be salvaged and relocated along linear features and within the Green Zone upon completion of the construction phase.	M5.14-3

Table 5: General Mitigation Measures for Sek̲w'ek̲w'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Blasting	• Blasting operations will be completed in a manner that reduces disturbance of residences, businesses, and infrastructure and aquatic and terrestrial habitats from shock waves, noise, and vibration. • Blasting activities will conform to the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky, 1998). • Controlled blasting techniques will be applied to reduce the risk of impacts from fly-rock, vibration, and noise disturbance. • When blasting adjacent to environmentally sensitive areas, the contractor is to provide at least 24-hours' notice to agencies (e.g., BC Ministry of Forests, DFO) and to Woodfibre LNG. • Blasting activities will not be undertaken within 1 km of provincially-mapped marbled murrelet suitable habitat (MWLRS 2023b) during the marbled murrelet nesting season (late April to early September). • Noisemakers (e.g., bangers, air horns) may be used prior to detonation to deter birds from occurring in the 'blast zone' and to prevent harm. Noisemakers will be used sparingly and only after a visual scan is used to confirm that birds are present. • If other sek̲w'ek̲w'inexw (wildlife) are within the 'blast zone,' detonation will be delayed until they have moved away and to a safe distance. • Drills will be equipped with vacuums or screens to prevent distribution of dust during drilling. • Sediment control measures and retention ponds will be used to prevent siltation and pollution of wetlands, watercourses, and environmentally sensitive areas from drilling residues, oil, grease, and nitrate or nitrite blasting residues. • Ínexwantas (Monitoring) of effects to aquatic and terrestrial habitats will be incorporated into the blasting plan so that corrective mitigation measures can be undertaken, if necessary.	M5.12-6
Avifauna (Birds)		
General	• If clearing, ground disturbance, or construction activities must occur in the CPA during the nesting periods identified in Table 6, tsíptspí7lhtn (bird nest) surveys supervised by a QP will be undertaken beforehand to avoid Project-related incidental take of birds or their nests. There are currently no provincial or federal standards for undertaking pre-clearing tsíptspí7lhtn (bird nest) surveys, but common methods used during pre-construction surveys will be deployed as outlined below. – Surveys will be undertaken in the morning when birds are most active, but not during inclement weather (e.g., heavy rain, snow, or high wind). Surveys for shá7yu (western screech-owl) will be undertaken following provincial inventory standards (i.e., RISC, 2006), where feasible.	M5.12-1 M5.17-2

Table 5: General Mitigation Measures for Sel̲kw'el̲kw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
General (cont'd.)	– The level of effort will generally be about one hour per hectare, although simple habitats (e.g., existing industrial site) may be surveyed relatively quickly and more complex and denser habitat may require more effort. – Nest searches will include both passive surveys (e.g., point counts) and active nest searches. Point count surveys provide surveyors with an understanding of species and territories that occur in the area, particularly in complex habitats (e.g., mature forest) and for species with nests that are not conspicuous. The objective of passive surveys is to inform the search effort required for active surveys or to narrow down the location of a nest or nest area. Passive surveys are not needed for species with conspicuous nests, such as bald eagle, woodpeckers, and barn swallow. – Nesting will be determined through the detection of an actual nest or through cues that suggest a nest is present (i.e., suspected nest). An actual nest does not need to be found for the surveyor to determine with confidence that a nest is present to recommend mitigation. This reduces the need to spend a long time searching for the actual nest and potentially damaging it, when bird cues alone (e.g., adult seen bringing food to a shrub and leaving without food) can indicate that a nest is present. – Searches will include up to 30 m buffer of the direct area to be disturbed to detect nests that could be disturbed in the edge by construction activities. – Nest surveys of the buildings scheduled for demolition and the existing industrial site, including stationary equipment, will be completed by a QP; methods will be determined by the QP in consideration of species expected to be nesting in industrial site and on equipment. – An experienced QP will determine an appropriate setback for each nest that is discovered. Setbacks (mitigation M5.17-2) will be established around active nests and the setback perimeter will be flagged in the field; the nest will not be flagged. The QP will use ECCC's guidelines (ECCC, 2023a) on establishing buffer zones and setback distances and will consider site-specific conditions (e.g., type of disturbance, presence of security cover, species tolerance to disturbance) to determine an appropriate setback. Setbacks and buffers for raptor nests will consider the *Guidelines for Raptor Conservation during Urban and Rural Development in British Columbia* (MOE, 2013a). A minimum 30 m setback will be implemented for active marine tsíptspí7lhtn (bird nests) (mitigation M5.17-2). – Setbacks will be clearly marked in the field by the QP or EM. – No clearing activities will occur within established setbacks until after a QP has determined that the tsiptspÍ7lhtn (nest) status has changed from active to inactive (e.g., young have fledged and left the nest area).	M5.12-1 M5.17-2

Table 5: General Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
General (conti'd.)	– In areas that have been searched and no nests or nesting activity was confirmed, the clearing crew will have 48 hours to commence clearing activities and up to 7 days to complete clearing. If 7 days elapses and clearing is not complete, a new survey for nesting activity will be undertaken at the discretion of a QP. • If, at any time of year, an active tsíptspí7lhtn (bird nest) is discovered within or adjacent to construction activities that could pose a risk of disturbance or damage to that active nest, construction activities will stop and a QP will be consulted to determine and recommend a setback buffer. Woodfibre LNG will maintain a no-disturbance setback buffer for the duration that the nest is active. Woodfibre LNG will report the nest and setback in the Wildlife Observation and Incident Reporting Form (Appendix A). Flaring events will be scheduled outside of periods when migratory birds would be most at risk (e.g., during migration), to the extent feasible. Flaring scheduling will be refined in the Operation WMMP.	M5.12-1 M5.17-2
Pileated woodpecker tsiptspÍ7lhtn (nests)	• A survey for pileated woodpecker nest cavities was completed by a QP in July 2023; no nest cavities were found within the proposed clearing area. • If the nest of a pileated woodpecker is discovered, the nest will be checked by a QP to determine whether it is actively being used by a pileated woodpecker or another migratory bird. When the nest is inactive, and assuming the tree is scheduled to be cleared for construction, Woodfibre LNG will submit a notification to the Abandoned Nest Registry. The nest will not be disturbed, damaged, of destroyed for a period of at least 36 months after the nest is registered and on the provision that the nest remains inactive during that time. If Woodfibre cannot delay removal for a period of 36 months, Woodfibre LNG will consult with ECCC regarding options to remove or relocate the nest tree under a permit.	Not applicable
Sḵw'eḵw'inexw tl'a shkwen (Marine birds)	• Sḵw'eḵw'inexw tl'a shkwen (Marine bird) colonies have not been observed in or near the CPA but they occur within lower Howe Sound and the Salish Sea (WLNG, 2015; Stantec, 2023b). Prior to the start of construction, a QP will review data sources in Howe Sound to determine whether any marine bird colonies have been established since 2022 that could be affected by the Project. If a colony is identified and could be affected by construction activities, Woodfibre LNG will require its contractors of Project-related marine vessel traffic to maintain a setback of 300 m from that colony. Further, subject to safety concerns, if Project-related marine vessel traffic must pass with 1 km of a colony, contractors will be required to refrain from blowing horns or whistles and maintain a steady speed and constant engine noise while passing within 1 km (ECCC, 2018d). Vessel speed will be limited while traveling in the RAA. • Incidents involving sḵw'eḵw'inexw tl'a shkwen (marine bird) vessel strikes or strandings will be recorded on the Wildlife Observation and Incident Reporting Form (Appendix A) and maintained in a database; the species involved, location of bird, and weather conditions will be recorded.	M5.17-3 M5.17-4 M5.17-5 M5.17-6

Table 5: General Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Sḵw'eḵw'inexw tl'a shkwen (Marine birds) (cont'd.)	• Construction pile driving activities will follow DFO's BMP for Pile Driving and Related Operations (BCMPDCA and DFO, 2003). These include maintaining equipment in good working order to reduce the risk of harmful leaks into the marine environment, storing fuel and petroleum products following safe operating procedures, and maintaining emergency spill equipment on site to enable swift response should a spill occur in the marine environment. • Woodfibre LNG will avoid pile driving and marine construction activities during periods with high abundance of sḵw'eḵw'inexw tl'a shkwen (marine birds) (e.g., April), especially more sensitive species groups such as sea ducks, swans, loons, and grebes, within the CPA. • Woodfibre LNG will limit the duration of necessary activities, including both dismantling and construction of structures that must occur within the intertidal zone, to the extent possible to reduce disturbance of sḵw'eḵw'inexw tl'a shkwen (marine birds) and sḵw'eḵw'inexw tl'a shkwen (marine bird) habitat. • During inbound travel, Project vessels will be moving at a maximum speed of 8 to 10 knots at the south end of Passage Island (entrance to Átl'ḵa7tsem [Howe Sound] and the RAA) until they reach the immediate vicinity surrounding the Project area (LAA) where speeds will be reduced to 6 knots. To the extent practical, all other Project vessels will limit their speed to 8 to 10 knots while travelling within the RAA.	M5.17-3 M5.17-4 M5.17-5 M5.17-6
Lams tl'a kw'eḵw'íḵw'ehatl' (Barn swallow nests)	• Kw'eḵw'íḵw'ehatl' (Barn swallow) has been observed nesting inside and on buildings planned for demolition (Figure 3). Under SARA, lams tl'a kw'eḵw'íḵw'ehatl' (barn swallow nests) are considered a "residence" from May 1 or whenever birds are first seen building a nest, whichever is earlier, through August 31 or whenever a bird is last seen at a nest, whichever is later. Nests are considered residences regardless of whether they are occupied from May 1 to August 31 and therefore no lams tl'a kw'eḵw'íḵw'ehatl' (barn swallow nests) will be removed from the CPA during this period without a permit. Additional mitigation is summarized below: – A QP will determine appropriate setbacks around active lams tl'a kw'eḵw'íḵw'ehatl' (barn swallow nests), and additional measures may be taken (e.g., avoidance of noise or human traffic near the nest area) at the direction of the QP to protect the nests from disturbance. – If vegetation management is required around artificial nest cups as part of habitat creation and enhancement for kw'eḵw'íḵw'ehatl' (barn swallow), it will be managed outside of the kw'eḵw'íḵw'ehatl' (barn swallow) nesting period, preferably within a few weeks before the swallows arrive for the season, to avoid disturbance to nesting birds. – Woodfibre LNG was issued SARA permit (SARA-PYR-2023-0739) to manage barn swallow nests during the residence period during demolition activities. Mitigation measures will align with the terms and conditions of the SARA permit.	M5.12-1 M5.12-4 M5.12-8 M5.14-2

Table 5: General Mitigation Measures for Sel̲kw'el̲kw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Shá7yu (Western screech-owl)	• Woodfibre LNG will retain suitable shá7yu (western screech-owl) nesting habitat in the CPA that does not conflict with development plans (Figure 3), where possible. This includes the mature forest in the riparian area on Mill Creek. A 200 m setback around suitable nest sites will be maintained, where possible as recommended by provincial guidelines (MOE, 2013a). Suitable nesting habitat will not be cleared unless approved by the Woodfibre LNG Environmental Representative. • If tree clearing or construction activities that could directly or indirectly (i.e., within 300 m) affect suitable nesting habitat for shá7yu (western screech-owl) (Figure 3) is scheduled during the breeding season (March through August), a QP will undertake pre-construction surveys for shá7yu (western screech-owl) during the same season as the construction activities are set to occur, following provincial standards (RISC, 2006). Surveys will take place between March and the end of May when the probability of detecting nesting owls is highest (Cannings et al., 2020). Surveys will involve the use of call-playback, acoustic recorder units, and visual searches of potential nest sites within 300 m of the construction activities, where appropriate and as determined by the QP. • If a shá7yu (western screech-owl) nest is detected, an additional 100 m 'quiet buffer will be implemented during the breeding season (MOE, 2013a). Setbacks will be demarcated with no-go fencing and signage to identify them in the field.	M5. 9-2 M5.11-2 M5.12-2 M5.12-3
Piyís (Marbled murrelet)	• The Contractor will retain suitable piyís (marbled murrelet) nesting habitat in the CPA that does not conflict with development plans (Figure 3), where possible. No suitable nesting habitat is identified with the proposed clearing areas. • Woodfibre LNG will maintain a no-disturbance buffer of 100-m of provincially-mapped suitable habitat (MWLRS 2023b) during the piyís (marbled murrelet) nesting period (late April to early September). • Woodfibre LNG will limit noise (e.g., no blasting) within 1 km of provincially-mapped suitable habitat (MWLRS 2023b) during the piyís (marbled murrelet) nesting period (late April to early September).	M5.9-2 M5.11-2 M5.14-2 M5.17-8
Nsex̲á7x̲em (Band-tailed pigeon)	• Prior to ground or surface disturbance in areas with potential to provide a mineral source for nsex̲á7x̲em (band-tailed pigeons) (i.e., marine beaches, water springs, gravel roads), a QP with experience in nsex̲á7x̲em (band-tailed pigeon) habitats will undertake a field survey to assess the site for use by nsex̲á7x̲em (band-tailed pigeon). The QP will also review Wildlife Observation and Incident Reporting Forms for detections of nsex̲á7x̲em (band-tailed pigeon). • If mineral sites are determined to be present following the field survey or during construction, Woodfibre LNG will report the site to ECCC and will establish appropriate setbacks. Consideration for habitat loss mitigation measures is provided in Section 5.4.	M5.14-2

Table 5: General Mitigation Measures for Seḵw'eḵw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Sp'áḵw'us (Bald eagle)	• A known sp'áḵw'us (bald eagle) nest is southwest of the CPA, on the north side of Woodfibre Creek (Figure 3). The proposed clearing area and some supporting infrastructure overlaps with the 100 m year-round setback and 100 m 'quiet zone' (Figure 3). Woodfibre LNG will maintain, where possible, the 100 m 'quiet zone' during the breeding season (January 5 through August 31) (MOE, 2013b) or when the nest is active. • If clearing or construction activities are required within 100 m of a sp'áḵw'us (bald eagle) nest or within 200 m of the nest when it is active, Woodfibre LNG will consult with a QP to determine appropriate mitigation measures. • Project timing of construction, including clearing, site prep/blasting, and construction of project infrastructure within 200 m of a nest, will avoid the sp'áḵw'us (bald eagle) breeding season (see Table 6), to the extent practical. • If vegetation clearing or other construction activities are required within 200 m of a nest during the breeding season, Woodfibre LNG will implement the following mitigation measures: – Woodfibre LNG will consult a QP to determine appropriate measures to avoid disturbance to the eagles. This may include ínexwantas (monitoring) of nesting activity—the QP will develop a ínexwantas (monitoring) form and protocol for the EM to follow. – The EM will monitor (through a remote camera[13] or in-person with binoculars at a distance) the eagle nest and behaviour of the eagles during construction activities to assess level of stress or changes to bird behaviour (e.g., reduced food deliveries, increase time off nest, reduced time incubating or brooding). The EM will determine if Project activities need to be temporarily paused or modified to reduce disturbance to the nesting eagles. – If birds are showing signs of reduced nesting behaviour (off nest) during cold, windy, and/or wet (rain, snow) conditions, Project activities will be paused until weather conditions improve. Woodfibre LNG will consult a QP to determine appropriate temperature and weather conditions for Project activities to continue. – If blasting is scheduled to occur during the breeding season, the QP will review the blasting mitigation measures above and work with the Contractor to determine and implement additional mitigation measures and ínexwantas (monitoring), as required.	M5.12-3 M.5.12-6

[13] Camera installation at the eagle nest would require adherence to the timing restrictions and other guidelines outlined in the Raptor Webcam Guidelines (MOE, 2010)

Table 5: General Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Sḵáp'ḵap'tsaylh (Bats) and other Mammals		
Tree clearing	• The Contractor will avoid clearing potential bat roost habitat features (which includes those identified during sekw'ekw'inexw (wildlife) surveys shown on Figure 4) during the skap'kap'tsaylh (bat) maternity season when females and pups may be present (May 16 to August 31). If clearing in bat roost habitat is required during the maternity season, the following additional mitigation will be used: – If the Contractor determines that tree clearing must occur during the maternity season (i.e., between May 16 to August 31), large live, dead, or dying trees with hollows and cavities (trees with decay class 2 or greater; see Figure 4 for potential sites) will be visually inspected for skap'kap'tsaylh (bat) use (e.g., bat droppings) by a QP experienced with skap'kap'tsaylh (bats), prior to tree removal (MOE, 2016). If the QP considers appropriate, acoustic surveys will also be undertaken to determine use. • The QP will establish a suitable buffer in consultation with relevant government authorities, (depending on the location and number of suspected bats present) around an identified maternity site, and the tree will not be removed until after the maternity season ends, or bat use is no longer observed, whichever is later.	M5.13-1
Mammal dens	• Infrastructure and stationary equipment may provide denning areas for some mammals. Prior to removal of long-stationary equipment or infrastructure (e.g., holding tanks, disposal bins), the EM will inspect around and underneath the structure to check for signs of denning or burrowing animals that may be disturbed.	M5.12-1
Amphibians and Reptiles		
Mortality risk	• Woodfibre LNG is applying for a permit under the *Wildlife Act* to undertake incidental salvages prior to and during construction if reptiles or amphibians are at risk of entering the worksite during construction. • Sekw'ekw'inexw (wildlife) exclusion fencing will be installed at strategic locations in areas of potential concern to deter reptiles and amphibians from entering the worksite. • Prior to construction in an area of potential concern, a QP will visually inspect the worksite and surrounding vegetation and ground for reptiles and amphibians; if animals are detected, salvages will be undertaken in accordance with the *Wildlife Act* permit conditions.	M5.12-1
Mortality risk	• Woodfibre LNG's Erosion Prevention and Sediment Control Plan (see CEMP) describes the applicable permits, best management practices, and mitigation measures that will be used to avoid or reduce adverse effects on water quality that could affect amphibian mortality. • Woodfibre LNG will develop and implement a water quality ínexwantas (monitoring) program for Mill Creek and Woodfibre Creek that will include sample sites, frequency of sampling, and parameters to be monitored.	M5.8-1 M5.8-5 M5.14-1 M5.14-4 M5.15-2 FDS 4.3

Table 5: General Mitigation Measures for Sel̲kw'el̲kw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Mortality risk (cont'd.)	• Woodfibre LNG will develop a Water Management Plan for Mill Creek, which will afford protection of sts'úl̲kwi7 (fish) and fish habitat by prescribing the minimum instream flow releases. Although the focus of this plan is sts'úl̲kwi7 (fish) and fish habitat, this plan will also benefit amphibian and amphibian habitat. • Woodfibre LNG will develop an Environmental Protection Plan specific to works required in and around Mill Creek prior to the initiation of these works. • Prior to commencing instream work on Mill or Woodfibre creeks (e.g., installation of water intake structures), a QP experienced with amphibians will assess instream habitat to determine if an amphibian salvage and relocation program is required. • Prior to vegetation clearing within 30 m of Mill Creek or Woodfibre Creek, a QP experienced with amphibians will undertake a salvage to relocate amphibian species, if observed. Methods for detecting coastal tailed frog will follow RISC protocols (RISC, 2000). If amphibian salvage is required, a QP will undertake the salvages using methods consistent with provincial best practices (e.g., FLNRO, 2016). Terrestrial amphibian salvages will target rainy nights, if feasible, for effective capture and safe handling of amphibians. • When clearing vegetation adjacent to watercourses, and where safe to do so, Woodfibre LNG will avoid falling trees into the watercourse. • If clearing or instream works are planned for winter, salvage and relocation of coastal tailed frog will occur during non-winter conditions (i.e., water temperature above 5°C and snow-free conditions). • The EM will be responsible for ínexwantas (monitoring) areas of standing water for pond-dwelling amphibians that may be disturbed by construction. • Exclusion fencing will be installed in strategic locations to divert amphibians and snakes away from the worksite and roads. • During the amphibian active period (March to October; see Table 6), signage will be installed and maintained at strategic locations and workers reminded, at daily toolbox meetings, to maintain awareness of amphibians on roads, especially on rainy nights, and on site and allow amphibians the right of way. • During the reptile active period (April to October; see Table 6), signage will be installed and maintained at strategic locations and workers reminded, at daily toolbox meetings, to maintain awareness of snakes on roads and allow snakes the right of way.	M5.8-1 M5.8-5 M5.14-1 M5.14-4 M5.15-2 FDS 4.3

Table 5: General Mitigation Measures for Sekw'ekw'inexw (Wildlife) During Construction

Category	Mitigations	Application Mitigation Number
Mortality risk (cont'd.)	• If salvage and relocation is needed, a QP will prepare a provincial permit application and salvage plan consistent with provincial guidelines (i.e., FLNRO, 2016). The permit application and salvage plan will be submitted to the Province (through FrontCounter BC). Captured amphibians, including adults, tadpoles, neonates, larvae, or eggs, will be relocated to areas of suitable habitat in accordance with a sekw'ekw'inexw (wildlife) salvage permit, at the direction of a QP experienced with amphibians (FLNRO, 2016). The location(s) of suitable habitat for relocation will be identified by the QP in the sekw'ekw'inexw (wildlife) salvage permit application. • The EM will be responsible for documenting amphibian activity on site (e.g., aggregation, migration, or dispersal to a noticeable degree). If amphibians are expected and may be disturbed by construction (as determined by a QP experienced with amphibians), work in the immediate vicinity will be halted until mitigation measures are implemented. Mitigation structures for amphibians may include drift fences (to direct amphibians away from construction activities and towards safe habitat during migration or dispersal movements), exclusion fences (to prevent amphibians from entering a workspace), and culverts. Signage (e.g., stakes, flagging, or signs) will be used to identify locations where amphibians are present, at the discretion of the QP. These measures will be monitored for their effectiveness at avoiding amphibian mortality. Fencing will be removed after construction activities that could cause amphibian injury or mortality is complete.	M5.8-1 M5.8-5 M5.14-1 M5.14-4 M5.15-2 FDS 4.3

Table 6: Sensitive Periods for Sel̲kw'el̲kw'inexw (Wildlife)

Species or Species Group	Sensitive Period[a]	Dates	Reference
Migratory birds	Primary Nesting Period, zone A1	March 26 to August 16	ECCC, 2018a
	Nesting – wetland	March 26 to August 8	
	Nesting – open	March 30 to August 16	
	Nesting – forest	March 26 to August 9	
Kw'el̲kw'íl̲kw'ehatl' (Barn swallow)	Nesting (residence period)	May 1 or the date when adults are first seen building a nest, whichever is earlier to August 31 or the date when a bird is last seen at a nest, whichever is later	ECCC, 2019b
Seabird and water bird colonies	Breeding	March 17 to August 17	ECCC, 2018d
Piyís (Marbled murrelet)	Nesting (residence period)	Late April to early September	MWLRS, 2023a
Smel̲kw'á7 (Great blue heron)	Breeding	February 15 to August 31	MWLAP, 2004
	Colonies	November 1 to March 31	
Sp'ál̲kw'us (Bald eagle)	Courtship	January 5 to February 5	MOE, 2013a
	Eggs	February 5 to June 25	
	Young	April 1 to August 31	
Osprey	Courtship	March 21 to April 21	
	Eggs	April 21 to July 5	
	Young	May 25 to September 5	
Shá7yu (Western screech-owl)	Courtship	February 17 to March 17	
	Eggs	March 17 to June 1	
	Young	April 20 to August 25	
Nsx̲ípim (Northern goshawk)	Courtship	March 7 to April 7	
	Eggs	April 7 to June 10	
	Young	May 20 to August 21	
Sk̲áp'k̲ap'tsaylh (Bats)	Maternity season when females and pups may be present	May 16 to August 31	MOE, 2016

Table 6: Sensitive Periods for Sḵw'eḵw'inexw (Wildlife)

Species or Species Group	Sensitive Period[a]	Dates	Reference
Pond-dwelling amphibians	Breeding and movement periods	Active period: March to October	FLNRO, 2016 MECCS, 2020
Stream-dwelling amphibians (coastal tailed frog)	Year-round	Year-round	ECCC, 2018c
Elhḵaẏ̓ (Snakes) and lizards	Active period: spring emergence, breeding, returning to hibernacula Inactive period: hibernation	April to October (active period) October to March (hibernation period)	FLNRO, 2014 MECCS, 2020

Notes:

[a] Sensitive period for young birds includes nestling (i.e., in nest) and fledgling (i.e., young out of, but near, nest and not yet able to fly well) stages

5.4 HABITAT LOSS MITIGATION MEASURES

Habitat loss mitigation measures are used to compensate for the potential loss of certain wildlife habitat features during construction. Habitat loss mitigation measures will be implemented if Project construction requires the removal of a skap'kap'tsaylh (bat) roost, a shá7yu (western screech-owl) nest site, a kw'ekw'íkw'ehatl' (barn swallow) nest, or a nsexá7xem (band-tailed pigeon) mineral source site. Habitat loss mitigation measures include provision of skap'kap'tsaylh (bat) roosting structures, kw'áxwa7s tl'a shá7yu (western screech-owl nest boxes), lams tl'a kw'ekw'íkw'ehatl' (barn swallow nest cups), and, if needed, nsexá7xem (band-tailed pigeon) mineral sites.

Woodfibre LNG began to implement habitat loss mitigation measures pre-emptively by installing and skap'kap'tsaylh (bat) roosting structures within the CPA in 2022.

Table 7 summarizes wildlife habitat loss mitigation measures for the Project during the construction phase.

Table 7: Habitat Loss Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Habitat Loss Mitigation	Mitigation / Permit Number
Bats – artificial roosting structures (bat boxes)	• Artificial roosting structures will be installed to mitigate for loss of suitable roosting sites for skap'kap'tsaylh (bats). A QP experienced with skap'kap'tsaylh (bats) will determine the number, placement, and type of roosting structures following Best Management Practices for Bat Boxes in British Columbia (BC Community Bat Program, 2019). The number of structures to be installed will depend on the outcome of the bat surveys and site assessment to be completed prior to clearing and demolition of buildings. • Artificial roosts will be installed prior to habitat removal and located within suitable habitat selected by the QP. Results of the bat surveys and site assessment will inform the locations of artificial roosts. The QP will also review Wildlife Observation Forms for detections of skap'kap'tsaylh (bats). • Maintenance and ínexwantas (monitoring) of artificial roosts will be completed annually by inspections during construction by a QP experienced with bats. The QP will determine occupancy and confirm the artificial roosts are still functional and capable of supporting bats. If bat guano is present, the QP will collect samples per collection methods described in the BC Community Bat Project DNA Sampling Protocol (BC Community Bat Program, 2022) for analysis to determine species. If an artificial roost is deemed to be no longer functional it will be repaired or replaced prior to the onset of the next roosting season. Artificial roosting structures have been installed as described here: • Two bat boxes were installed on the external wall of the warehouse in 2020 to introduce bats in the area to artificial structures; the boxes were inspected in October 2020 for signs of bat use and bat sign was not observed at that time (Keystone, 2021). The boxes were removed in early 2021. • Woodfibre LNG purchased four 4-chamber nursery bat boxes and one 2-chamber rocket box following Best Management Practices for Bat Boxes in British Columbia (BC Community Bat Program, 2019) and A Guide for Bat Houses in British Columbia (BC Community Bat Program, 2018; Stantec, 2021). Under the supervision of a QP, Woodfibre LNG installed two nursery bat boxes back-to-back, and one rocket box, on the west side of the landfill (Figure4), and the other two nursery bat boxes behind the warehouse (Figure4) in March 2022. The bat boxes near the landfill were installed on wooden posts bolted to the cement block wall along the access road. The boxes behind the warehouse were installed on the existing, but disused, lamp post. Woodfibre LNG brushed and cleared a few shrubs and cedar saplings around the lamp post to limit opportunities for bird and mammal predators to perch or hunt near the bat boxes. Predator guards were installed on the posts to deter animals from climbing up.	M5.13-3 FDS 9.2 FDS 9.3

Table 7: Habitat Loss Mitigation Measures for Sek̲w'ek̲w'inexw (Wildlife) During Construction

Category	Habitat Loss Mitigation	Mitigation / Permit Number
Birds – ww'áxwa7s tl'a shá7yu (western screech-owl nest boxes)	• If suitable nesting sites will be removed, kw'áxwa7s tl'a shá7yu (western screech-owl nest boxes) will be installed as a mitigation measure following guidance from the *Owl Monitoring Group – Nest Box Protocol for the Coastal Western Screech-Owl (Megascops kennicottii kennicottii)* (Tripp and Welstead, 2019). • The number of nest boxes will be based on the quantity of suitable nesting cavities removed (those observed during the pre-clearing assessment enumerating cavity/sek̲w'ek̲w'inexw [wildlife] trees). • A QP experienced with shá7yu (western screech-owl) will identify suitable habitat(s) for nest box placement. The QP will also review Wildlife Observation Forms quarterly for detections of shá7yu (western screech-owl). • Kw'áxwa7s tl'a shá7yu (western screech-owl nest boxes) will be installed prior to the onset of the next breeding season (February), following clearing. • Unless determined otherwise by the QP, kw'áxwa7s tl'a shá7yu (western screech-owl nest boxes) will be placed from 3 m to 9 m above ground (NestWatch, 2019). • The nest boxes will be checked at the onset of each breeding season during each year of construction to confirm they are still functional (i.e., attached to the tree). A nest box that is deemed to no longer be functional will be repaired or replaced within 30 days of the initial inspection.	M5.12-8
Birds – lams tl'a kw'ek̲w'íḵw'ehatl' (barn swallow nest cups)	• Mitigation measures and monitoring will align with the terms and conditions of SARA Permit SARA-PYR-2023-0739. • Lams tl'a kw'ek̲w'íḵw'ehatl' (barn swallow nest cups) were installed on a compensation structure to mitigate the removal of nest locations associated with the demolition of old buildings. The number of nest cups installed was equivalent to the number of nests identified during a pre-demolition nest survey and in consideration of occupancy rates of artificial nest cups by swallows, such that the number of nest locations present before demolition is the same or higher after demolition. The QP will also review Wildlife Observation Forms quarterly for detections of kw'ek̲w'íḵw'ehatl' (barn swallow). The nest cup design was similar to those used successfully in other locations, following specifications developed in BC (e.g., TBCSCP, 2014b, 2015) and Ontario (OMNRF, 2016). • Woodfibre LNG constructed a nesting structure and installed nest cups on the structure near the existing landfill, which is within 1 km of where lams tl'a kw'ek̲w'íḵw'ehatl' (barn swallow nests) were located in the pre-demolition nest survey and within 300 m of foraging habitat. Nest cup and nesting structure design, planning, and implementation was determined by a QP experienced with kw'ek̲w'íḵw'ehatl' (barn swallow) in review of best practices (e.g., OMNRF, 2016) and in consultation with the Contractor and ECCC. This compensation forms part of the SARA Permit terms and conditions: SARA-PYR-2023-0739.	M5.12-8

Table 7: Habitat Loss Mitigation Measures for Sḵw'eḵw'inexw (Wildlife) During Construction

Category	Habitat Loss Mitigation	Mitigation / Permit Number
	• Nest cups were installed prior to May following the loss of nest sites.	
Birds - nsex̱á7x̱em (band-tailed pigeon) mineral site	• If disturbance to a mineral source for nsex̱á7x̱em (band-tailed pigeon) cannot be avoided, then mitigation measures for the potential loss of nsex̱á7x̱em (band-tailed pigeon) mineral sites will be implemented by creating an artificial mineral site (e.g., livestock salt block) in a location determined to be suitable by a QP experienced with nsex̱á7x̱em (band-tailed pigeons). The artificial mineral site will be monitored annually during construction by the QP to determine if the habitat loss mitigation is being used. The QP will also review Wildlife Observation Forms quarterly for detections of nsex̱á7x̱em (band-tailed pigeon).	M5.14-2

5.5 ENVIRONMENTAL TRAINING AND ORIENTATION

Sek̲w'ek̲w'inexw (wildlife) mitigation and management training will be included in the environmental orientation program that will be developed and implemented by the Contractor. The program will be reviewed and approved by Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) and the Woodfibre LNG Environmental Representative.

All workers (i.e., contractors, staff, and employees) will be informed of sek̲w'ek̲w'inexw (wildlife) concerns at the site and trained on how to record and report sek̲w'ek̲w'inexw (wildlife) conflicts/concerns (e.g., vehicle-sek̲w'ek̲w'inexw [wildlife] collisions, nuisance animals, sek̲w'ek̲w'inexw [wildlife]-human interactions). Information such as species involved, time and location of incident, and a description of what was observed will be documented. Conflicts will be reported based on the form in Appendix A. Workers will be informed of the need to be vigilant and obey appropriate signage (e.g., speed limits) and proper use of bear-proof waste disposal/storage procedures specified in the Waste Management Plan (see CEMP).

5.6 COORDINATION AND INFORMATION SHARING

The Woodfibre LNG Environmental Representative will contact FortisBC prior to construction of the Eagle Mountain—Woodfibre Gas Pipeline Project commencing between the Sḵwx̲wú7mesh ták̲w (Squamish River) estuary and the CPA (mitigation M5.12-10). The parties will discuss opportunities to reduce potential adverse effects on sek̲w'ek̲w'inexw (wildlife) through infrastructure sharing (e.g., laydown areas).

The Woodfibre LNG Environmental Representative will meet with BC Hydro regarding the Woodfibre Substation Project to identify measures to reduce potential adverse effects on sek̲w'ek̲w'inexw (wildlife) (mitigation M5.12-10).

If the BURNCO Aggregate Project begins mining operations, the Woodfibre LNG Environmental Representative will contact BURNCO to discuss sharing results of the sek̲w'ek̲w'inexw (wildlife) ínexwantas (monitoring) programs where it is determined that these results could enhance the other project's ínexwantas (monitoring) programs (mitigation M5.17-9). This information sharing will include the results of sek̲w'ek̲w'inexw tl'a shkwen (marine bird) ínexwantas (monitoring) studies to increase the knowledge base for sek̲w'ek̲w'inexw tl'a shkwen (marine bird) interactions.

Per mitigation measure M5.12-1 and Sections 13.2.2.17 and 13.3.5 of the Application, observations of provincially Red- or Blue-listed sek̲w'ek̲w'inexw (wildlife) species and sek̲w'ek̲w'inexw (wildlife) species listed in Schedule 1 of SARA that have not previously been documented within the CPA will be reported to the BC CDC by Woodfibre LNG.

In accordance with FDS Condition 13, records will be maintained of information relating to the implementation of conditions set out in the FDS and the results of associated ínexwantas (monitoring). This includes dates, locations, and times of ínexwantas (monitoring); the techniques, methods, or procedures used; and the names of the persons involved and documentation of their professional certifications. This information will be provided to the EM to prevent information loss.

Per mitigation measure M5.12-1, a database of sek̲w'ek̲w'inexw (wildlife) conflicts and mortality will be maintained throughout the construction phase. The sek̲w'ek̲w'inexw (wildlife) reporting process for all Project workers will be included in the Project's environmental training and orientation.

Environmental ínexwantas (monitoring) summary reports will be provided by the EM to the Woodfibre LNG Environmental Representative. Reporting frequency for environmental ínexwantas (monitoring) reports is outlined in the CEMP. These reports will include the results of the pre-construction sek̲w'ek̲w'inexw (wildlife) surveys and other mitigation measures and ínexwantas (monitoring), as well as incidental sek̲w'ek̲w'inexw (wildlife) observations from within the CPA.

Woodfibre LNG will provide marbled murrelet survey data to the Ministry of Water, Land and Resource Stewardship.

6.0 SEḴW'EḴW'INEXW (WILDLIFE) ÍNEXWANTAS (MONITORING) AND ADAPTIVE MANAGEMENT

Environmental ínexwantas (monitoring) is required to verify compliance with this Construction WMMP and applicable regulations and conditions and to document the effectiveness of implemented mitigation measures, document incidents and mortalities, and determine if adaptive management is required.

6.1 ÍNEXWANTAS (MONITORING)

Per EAC Condition 11, Woodfibre LNG has designed a ínexwantas (monitoring) and follow-up program with respect to impacts to seḵw'eḵw'inexw (wildlife) within the terrestrial portions of the CPA during construction. The following sections describe Woodfibre LNG's compliance and ínexwantas (monitoring) and follow-up programs for seḵw'eḵw'inexw (wildlife).

6.1.1 Compliance

To meet EAC Condition 1, Woodfibre LNG will retain the services of a QP as an EM to verify compliance with the Certificate, including the requirements of Section 13.3.5 of the Application for an EAC and this Construction WMMP. The EM will complete routine ínexwantas (monitoring) during construction to verify whether the mitigation measures outlined in this Construction WMMP are being implemented effectively or if adaptive management is required.

6.1.2 Ínexwantas (Monitoring) and Follow-up Programs

Woodfibre LNG has developed, in consultation with a QP, ínexwantas (monitoring) and follow-up programs, with defined performance measures such as targets, thresholds, and objectives. Ínexwantas (Monitoring) programs have specific objectives (e.g., ínexwantas [monitoring] lams tl'a kw'eḵw'íḵw'ehatl' [barn swallow nest cups] to determine occupancy), while follow-up programs are used to understand how new or unproven mitigation measures are functioning and to verify the accuracy of predicted potential effects, as stated in the Application. An outcome of ínexwantas (monitoring) and follow-up is to determine whether additional mitigations are required, which will be addressed through the application of adaptive management. A framework of seḵw'eḵw'inexw (wildlife) ínexwantas (monitoring) and follow-up programs is provided in the following sections.

6.1.2.1 Sḵáp'ḵap'tsaylh (Bat) Roosting Sites

Woodfibre LNG has developed a follow-up program to monitor little brown myotis usage of artificial roosting structures and of buffer zones to satisfy FDS Condition 9.3. The objective of ínexwantas (monitoring) is to determine the effectiveness of mitigation measures throughout all phases of the Project. The artificial roosting structures will be monitored and maintained on an annual basis by a QP experienced with sḵáp'ḵap'tsaylh (bats). The QP will determine occupancy and confirm if the artificial

roosts are functional and capable of supporting sḵáp'ḵap'tsaylh (bats); the target is that artificial roosts are occupied and functioning as intended. Artificial roosting structures will be inspected by a QP once per year prior to sḵáp'ḵap'tsaylh (bats) potentially occupying them and at least once per year when bats would be expected to be present. When sḵáp'ḵap'tsaylh (bats) are expected to be absent (November to March), the EM will check the roosting structures for wasp nests and remove them if they are present. During the maternity season, a QP will visually inspect the roosting structures from the ground for evidence of guano and urine to avoid disturbing sḵáp'ḵap'tsaylh (bats). If guano is present, the QP will collect samples per collection methods described in the BC Community Bat Project DNA Sampling Protocol (BC Community Bat Program, 2018) for analysis to determine species. If determined necessary by a QP, Woodfibre LNG may monitor the artificial roosting structures passively using uARUs and/or actively using roost emergence counts at dusk. If after two years the artificial roosts are not used (i.e., the threshold), ínexwantas (monitoring) will continue and an evaluation of potential limiting factors will be undertaken by the QP. Woodfibre LNG recognizes that it may take several years for bats to use or occupy artificial roosts. If corrective measures are necessary to improve the likelihood of occupancy, these will be implemented if they are reasonable and feasible.

If an active maternity roost site is detected (e.g., during pre-clearing survey prior to construction) and requires a non-disturbance buffer during operation, a QP will monitor the effectiveness of buffer zones. Ínexwantas (monitoring) methods will include visual inspections of the roost sites and, if considered necessary, passive and/or active acoustic surveys to determine usage. Surveys will be undertaken during the sḵáp'ḵap'tsaylh (bat) active season. If the QP determines that a passive acoustic survey is necessary, uARUs will be deployed in May through October when roost sites are expected to be occupied. If a suspected hibernaculum is identified it will be monitored with an uARU from early March to early November to cover the fall swarming period, per provincial inventory methods for bats (RISC, 2022). Additionally, the QP will consult with the appropriate regulatory authorities in the event an active roost is identified. Data from the uARUs will be analyzed using Kaleidoscope or a similar acoustic data analysis program and summarized in the annual report (see Section 7.0).

As part of compliance ínexwantas (monitoring), the EM will inspect buffer zones to confirm they have been implemented and maintained during construction, as appropriate and specified by the QP. As part of compliance ínexwantas (monitoring), the EM will inspect setbacks to confirm they have been implemented and maintained during tree clearing (i.e., the target), as appropriate and specified by the QP.

6.1.2.2 Migratory Birds

The focus of the follow-up program for migratory birds is on the effectiveness of mitigation measures used to protect migratory birds per FDS conditions 4.1 and 4.3.

Predictions made in the Application for an EAC for migratory birds state that Project-related effects can be reduced to an acceptable level during activities that may harm, kill, or disturb migratory birds. Woodfibre LNG recognizes that under the *Migratory Birds Convention Act*, there is no acceptable level of harm for migratory birds. Mitigation measures for migratory birds are described above and are focused on the use of nest surveys and the implementation of appropriate setbacks and buffers for a period until an active nest is no longer active (i.e., young have successfully fledged or left the nest area). The measure of effectiveness of the mitigation will be that the appropriate setback is maintained for the duration the

nest is active. Woodfibre LNG will implement the following follow-up program during construction to determine the effectiveness of mitigation measures used to protect migratory birds:

- If a tsíptspí7lhtn (bird nest) survey is deemed necessary (per mitigation measures described in the section above), Woodfibre LNG will confirm, through documentation, that each of ECCC's criteria for a nest survey are satisfied.
- If an active tsíptspí7lhtn (bird nest) is identified, an appropriate setback will be prescribed and established for the duration that the nest is active. Woodfibre LNG will confirm that the setback is maintained until the nest is complete.
- Woodfibre LNG will not undertake nest ínexwantas (monitoring) unless this can be done at a safe distance that does not cause the bird to change its nesting behaviour, cause pre-mature fledging, or draw the attention of predators to the nest.
- If a migratory bird, or its nest or egg, is accidentally disturbed, harmed, or destroyed, Woodfibre LNG will promptly report the incident to ECCC. Incident reporting will include the species, nest stage (e.g., nest-building, egg-laying, incubation, nestlings), location, setting and context, and Project activity that led to the incident. Woodfibre LNG will review the details of the incident and risk of recurrence with a QP and make necessary changes to project activities to reduce the future likelihood of a similar incident.
- Nest surveys completed, and mitigations implemented and their effectiveness, will be reported on per FDS Condition 2.6. If additional mitigations are determined to be required, these will be implemented and reported on per FDS Condition 2.4

6.1.2.3 Lams tl'a kw'ekw'íkw'ehatl' (Barn Swallow Nest Cups)

Woodfibre LNG is committed to ínexwantas (monitoring) the use and function of kw'ekw'íkw'ehatl' (barn swallow) compensation to determine if the compensation is functioning as intended and if adaptive management is required. Monitoring will align with the terms and conditions of SARA Permit SARA-PYR-2023-0739. A QP experienced with kw'ekw'íkw'ehatl' (barn swallows) will monitor kw'ekw'íkw'ehatl' (barn swallow) use and nesting activities on the compensation nesting structure in each breeding season for at least two years following installation of the compensation structures to determine nest occupancy. The measure of effectiveness of the mitigation will be the number of active barn swallow nests within a nesting season within the CPA. The target is the same number of barn swallow pairs nesting within the CPA following construction as the number of pairs that nested prior to construction.

The QP will undertake a survey in May (onset of nesting) and July (chick-rearing and potential second nesting attempts) of each year to count the number of pairs on site, number of nests, and to inspect the nesting structures and artificial nest cups to determine occupancy. The survey in May will determine kw'ekw'íkw'ehatl' (barn swallow) prospecting and nest building activities, including where the swallows go to find nest materials and number of pairs visiting the structures. The survey in July will determine nest cup occupancy and potential second or third nesting attempts. Nest cup occupancy will be considered affirmative if an adult kw'ekw'íkw'ehatl' (barn swallow) or its eggs or young is detected in an artificial or natural nest cup in the interior or exterior of the nesting structures. An end-of-season survey will be completed in late August or early September, no later than September 15, to determine the final nest count. If after two years the structures are not used (i.e., the threshold), ínexwantas (monitoring) will

continue and an evaluation of potential limiting factors will be undertaken by the QP. If corrective measures are necessary to improve the likelihood of nesting, these will be implemented if they are reasonable and feasible.

In addition, a wildlife camera will be installed in May at each nesting structure to monitor effectiveness of predator guards and other measures installed to deter predators. Data from the cameras will be reviewed monthly throughout the kw'ek̲w'íḵw'ehatl' (barn swallow) nesting season to determine potential predation events and if adaptive management is required.

6.1.2.4 Nsex̲á7x̲em (Band-tailed Pigeon) Mineral Sites

If Woodfibre LNG creates an artificial mineral site (e.g., provision of a livestock salt block) for nsex̲á7x̲em (band-tailed pigeon) as determined by a QP, the EM will monitor the site annually during construction to determine if it is being used. A survey will be completed annually when nsex̲á7x̲em (band-tailed pigeons) typically congregate at mineral source sites (i.e., late summer). If necessary, as determined by a QP, Woodfibre LNG may install a wildlife camera to monitor the use of the artificial mineral site. The measure of effectiveness of the mitigation will be use of the artificial mineral site by nsex̲á7x̲em (band-tailed pigeons).

6.1.2.5 Sp'áḵw'us (Bald Eagle) Nest

During construction activities in the vicinity (i.e., 200 m) of a sp'áḵw'us (bald eagle) nest during the nesting period, the EM will monitor daily, either with a remote camera or in-person with binoculars, the nest to watch for changes in behaviour. If needed, adaptive management measures (e.g., temporary stop work), will be implemented to manage disturbance to the nest. If blasting is scheduled to occur during the breeding season, additional ínexwantas (monitoring) may be required. The measure of effectiveness of the mitigation will be use of the nest site by bald eagles for nesting and raising young to fledging; the target is no changes in use of the nest site by bald eagles during construction activities.

6.1.2.6 Amphibian and Reptile Exclusion Measures

The EM will document amphibian and reptile activity on site (e.g., aggregation, migration, or dispersal to a noticeable degree). If amphibians or reptiles are expected and may be disturbed by construction activities (as determined by a QP experienced with amphibians and reptiles), work in the immediate vicinity will be halted until mitigation measures (e.g., exclusion, salvage, and relocation) are implemented. Exclusion measures could include drift fencing to direct amphibians and reptiles away from construction or continuous fencing around a site (e.g., waterbody) to exclude amphibians from the site. Where exclusion measures are implemented, the EM will monitor amphibian and reptile movements during construction activities for the duration the exclusion measures are installed. Ínexwantas (Monitoring) will determine the effectiveness of exclusion measures at avoiding amphibian and reptile mortalities during construction. The measure of effectiveness of the mitigation will be amphibian and reptile presence within the active construction site and Project-related mortalities. The target is no amphibians or reptiles are harmed during construction activities.

6.1.2.7 Sek̲w'ek̲w'inexw tl'a shkwen (Marine Birds)

Woodfibre LNG completed pre-construction surveys in 2022 as part of the MBMP; methods are described in Stantec (2023b). The objective of pre-construction sek̲w'ek̲w'inexw tl'a shkwen (marine bird) ínexwantas (monitoring) is to better understand seasonal presence of sek̲w'ek̲w'inexw tl'a shkwen (marine birds) within the CPA marine environment and to determine if new or revised mitigation measures are needed to manage collision risk potential. Post-construction ínexwantas (monitoring) will be completed during the operation phase and therefore, is described as part of the Operation WMMP.

Woodfibre LNG will also provide information and training to workers (contractors, staff, and employees) on how to report and record sek̲w'ek̲w'inexw tl'a shkwen (marine bird) conflicts during construction (see Section 5.5) (per mitigation M5.17-8). Reporting will be reviewed regularly (e.g., monthly) to identify areas of conflict or mortality of sek̲w'ek̲w'inexw tl'a shkwen (marine birds). Where conflict is identified and in the event of a sek̲w'ek̲w'inexw tl'a shkwen (marine bird) collision with Project infrastructure or vessels, construction activities will be reviewed by the EM in consultation with a QP to identify mitigation measures to reduce the risk of future conflicts or mortality events.

6.1.2.8 Record Keeping

Ínexwantas (Monitoring) during construction will include recording sek̲w'ek̲w'inexw (wildlife) observations, including incident and mortality events. Records will be made on a Wildlife Observation and Incident Reporting Form (Appendix A) and forms will be reviewed by the EM, with support from QPs as needed. The EM will review sek̲w'ek̲w'inexw (wildlife) records regularly with a QP to determine whether adaptive measures are required. Record keeping includes the following:

- Recording sek̲w'ek̲w'inexw (wildlife) incidents and mortality events (e.g., bird strikes on buildings, bird electrocutions, vehicle or equipment collisions), including identifying known or probable cause, species, and follow-up or corrective/adaptive management action (i.e., additional mitigations) implemented
- Recording detections of SOMC
- Follow-up ínexwantas (monitoring) of additional mitigations implemented under the adaptive management process

6.2 ADAPTIVE MANAGEMENT

Woodfibre LNG will use an adaptive management process to evaluate performance objectives and to guide management actions. The adaptive management process comprises seven steps: assess, design, implement, monitor, evaluate, adapt, and update the WMMP. These steps are described as follows:

1. Assess: This consists of an assessment of the potential effects of the Project on sek̲w'ek̲w'inexw (wildlife) and the identification of mitigation measures. This was completed through the federal, provincial, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes, and through pre-construction sek̲w'ek̲w'inexw (wildlife) surveys described in Section 4.0 (e.g., see Stantec, 2022, 2023a).

2. Design: This consists of the development of the mitigation and ínexwantas (monitoring) plans for construction, engineering design of the Project, and scheduling of construction activities. The Construction WMMP is a core element of this step.
3. Implement: This consists of implementing the Construction WMMP during construction.
4. Monitor: This consists of implementing the ínexwantas (monitoring) programs described in Section 6.1.
5. Evaluate: Results of ínexwantas (monitoring) will be reviewed to inform whether mitigation measures are functioning as intended and if additional mitigations are required. Woodfibre LNG will develop, in consultation with a QP, ínexwantas (monitoring) performance measures (e.g., targets, thresholds, and site objectives) to evaluate effectiveness of mitigations during construction and operation.
6. Adapt: If sek̲w'ek̲w'inexw (wildlife) conflicts and interactions occur, or if mitigations implemented are shown to be ineffective where targets, thresholds, or site objectives are not being met, a QP will work with the Woodfibre LNG Environmental Representative and construction team to improve the mitigations and reduce the number of incidents. The targets, thresholds, and/or site objectives for additional mitigations are linked to the significance determination framework used by the BC EAO in its Assessment Report for the original Application (BC EAO, 2015); if the magnitude, extent, or frequency of effects are expected to change, then adaptive management measures will be applied.
7. Update Construction WMMP: When adaptive management strategies necessitate an update to this Construction WMMP, Woodfibre LNG will prepare a red-line version of the document that identifies what triggered the need for improvement (i.e., which target, threshold, or site objective was not met) and the changes that were made to address a concern. The red-line version will be issued to Indigenous groups and regulatory agencies for a 30-day review and comment period. After comments are received, the document will be updated and issued as the next revision.

7.0 REPORTING

In accordance with FDS Condition 13, Woodfibre LNG's EM will maintain records of information related to the implementation of conditions set out in the FDS and the results of associated ínexwantas (monitoring) and adaptive management. This includes dates, locations, and times of ínexwantas (monitoring); the techniques, methods, or procedures used; sek̲w'ek̲w'inexw (wildlife) incidents and potential conflicts; and the names of the persons involved and documentation of their professional certifications.

As part of EAC Condition 1, Woodfibre LNG will prepare monthly and annual reports on compliance with EAC conditions. These reports will present summaries of the methods and results of ínexwantas (monitoring) completed, adaptive management measures implemented (if any), and the conclusions of the evaluation. Observations of sek̲w'ek̲w'inexw (wildlife) including incidents or potential conflicts and possible cause, and corrective actions implemented, will be included in the reports. Updates to the status of listed species will be included in annual ínexwantas (monitoring) reports. Reports will be provided to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), səlilwətaɬ (Tsleil-Waututh) Nation, and the BC EAO.

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APPENDIX A

Wildlife Observation and Incident Reporting Form

APPENDIX A WILDLIFE OBSERVATION AND INCIDENT REPORTING FORM

Woodfibre LNG – Wildlife Observation and Incident Reporting Form

Name of Observer(s):	Date:
Location:	Species (if unknown, describe size colour, etc.):
Behaviour of Animal (e.g., distressed, injured):	Description of Observation or Incident:
Action Taken (if needed, use a Wildlife Incident Response Kit available on site and follow the guidance sheet):	Follow-up (e.g., monitoring, additional mitigations):
Photos (include with form or identify where photos are located):	

Environmental Monitor or Environmental Representative Sign-off:

Name:	Signature:	Date:
Reported to appropriate agency, if applicable?	Agency:	Date:

The Environmental Representative is responsible for reporting to the appropriate agency or authority, if applicable. The following resources are:

BC Government information for what to do if you find a sick, injured, or dead wildlife.

For bats, if discovered flying during winter or early spring or found dead, please report it the B.C. Community Bat Program at 1-855-922-2287 or info@bcbats.ca.

For birds, call 1-866-431-BIRD (2473) and read The BC Interagency Wild Bird Mortality Investigation Protocol & the 2022 Avian Influenza Surveillance Program.

If a migratory bird, or its active nest or egg, is accidentally harmed or destroyed, report the incident to the Canadian Wildlife Service (IncidentalTake.PriseAccesoire@ec.gc.ca).

Appendix I Erosion and Sediment Control Plan

Appendix I
Erosion and Sediment Control Plan

Woodfibre LNG Project

July 18, 2023

Prepared By:
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Prepared For:
123221624EN-RPT0012

Woodfibre LNG

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 Skwxwú7mesh (Squamish). The Project is on the historical location of a Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát and Nexwnéwu7ts Átlḵ’a7tsem (Howe Sound) are tied to the cultural well-being of Sḵwx̱wú7mesh 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 Construction Environmental Management Plan is primarily written in English with important place names, species, phrases, and passages provided in the Squamish language.

Temíxwiẏiḵw chet wa naantem chet ti temíxw Swiẏát
Chet wa sméṅhemswit kwis ns7éyx̱nitas chet ti temíxw
We7ú chet kwis t’íchimwit iy íẇas chet ek̲’ I tti.

Our ancient ancestors named this place Swiẏát
We, as their descendants safeguard these lands
We will continue to swim and fish in these clear waters.

Document Revision History

	PREPARED BY	REVIEWED BY	APPROVED BY
Name:	Keith Bell, RPBio, RPF	Ashleigh Crompton	
Position:	Technical Director, Hatch		
Date: **(YYYY-MM-DD)**			
Signature	Signature to be provided upon approval		

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B	July 12, 2023	-	Updated from Client Comments
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Table of Contents

PREAMBLE ..... **I**

DOCUMENT REVISION HISTORY ..... **II**

SQUAMISH-ENGLISH TRANSLATION ..... **V**

ABBREVIATIONS ..... **VI**

1.0 INTRODUCTION **1**

2.0 OBJECTIVE **2**

3.0 REGULATORY CONSIDERATIONS **3**
3.1 APPLICABLE LEGISLATION, REGULATION, AND GUIDELINES 3
3.2 PROJECT SPECIFIC STANDARDS 4

4.0 POTENTIAL ENVIRONMENTAL EFFECTS **6**
4.1 POTENTIAL IMPACTS TO AQUATIC RESOURCES 6
4.2 POTENTIAL IMPACTS TO TERRESTRIAL RESOURCES 6

5.0 EROSION AND SEDIMENT MITIGATION MEASURES **7**
5.1 ESC STRATEGY 7
5.2 ESC HIERARCHY OF PREFERENCES 7
5.3 ENVIRONMENTAL WORK PLAN 8
5.4 MITIGATION MEASURES 8
5.5 BMP MAINTENANCE 20

6.0 MONITORING **21**
6.1 INSPECTIONS 21
6.2 WATER QUALITY 21
6.3 KEY PERFORMANCE INDICATORS 22

7.0 COMPLIANCE REPORTING **23**
7.1 WEEKLY ENVIRONMENTAL MONITORING REPORT 23
7.2 MONTHLY ENVIRONMENTAL REPORT 23

8.0 ROLES AND RESPONSIBILITIES **24**

LIST OF TABLES

Table 3-1: Summary of Water Quality Guidelines for Turbidity and Total Suspended Solids 4
Table 3-2: Summary of Quality Requirements - Waste Discharge Authorization #1239 5
Table 5-1: Suggested Wattle Spacing based on Slope Gradient..... 12
Table 5-2: Suggested Spacing for Check Dams..... 14
Table 5-3: Suggested Minimum Slope Drain Diameter Based on Contributing Area..... 15
Table 8-1: Roles and Responsibilities 24

Squamish-English Translation

Squamish	English
General Terms	
Sḵwx̱wú7mesh Sníchim	Squamish language
Sḵwx̱wú7mesh Úxwumixw	Squamish Nation
Sḵwx̱wú7mesh stélmexw	Squamish people
Locations	
Swiẏát	Historic Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village located at Woodfibre LNG site
Sḵwx̱wú7mesh	Squamish
Nexwnéwu7ts Átlḵ’a7tsem	Howe Sound

Abbreviations

the application	Woodfibre LNG's application for an Environmental Assessment Certificate
BC	British Columbia
BMP	Best Management Practice
CCME	Canadian Council of Ministers of the Environment
CEMP	Construction Environmental Management Plan
EAC	Environmental Assessment Certificate
ESCP	Erosion and Sediment Control Plan
ESC	Erosion and Sediment Control
EWP	Environmental Work Plan
LNG	Liquefied Natural Gas
MOE	Ministry of Environment and Climate Change Strategy
MOTI	Ministry of Transportation and Infrastructure
PAM	Polyacrylamides
QEP	Qualified Environmental Professional
RECP	Rolled Erosion Control Products
SDS	Safety Data Sheets
The Project	Woodfibre Liquified Natural Gas Project
TSS	Total Suspended Solids
Woodfibre LNG	Woodfibre LNG General Partner Inc.

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc. (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia (BC).The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas and a storage capacity of 250,000 cubic metres (m^3) and will export the liquefied natural gas (LNG) via tankers.

This Erosion and Sediment Control Plan (ESCP) has been prepared to outline appropriate mitigation measures that will be applied to mitigate soil erosion and to control sediment-laden flows to prevent sediment-laden water from entering watercourses. This ESCP will include spatial information, designed by a Qualified Environmental Professional (QEP) showing locations of site drainages, catch basins, settling ponds, stockpile areas and other controls (e.g., sediment fences).

Where appropriate, applicable elements from the following guidelines will be incorporated into this ESCP:

- Environmental Protection and Management Guide (OGC 2013)
- Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993)
- Develop with Care Environmental Guidelines for Urban and Rural Land Development in British Columbia (MOE 2014)
- Technical Assessment Report for the Woodfibre LNG Export Facility, Construction Phase Waste Discharge Authorisation
- Standards and Best Practices for Instream Works (MWLAP 2004)

The measures described in this ESCP will be incorporated into site-specific or activity-specific environmental work plans (EWPs) developed by the Contractor. The ESCP will also include a description of the environmental inspection program that will be implemented to monitor the effectiveness of the proposed measures.

This ESCP is intended for use during the Construction phase of the Project and should be read in conjunction with the following:

- Water Management Plan (Appendix C): Provides for protection of fish and fish habitat by prescribing the minimum allowable instream flow and water withdrawal rate from Mill and Woodfibre Creeks. The Water Management Plan requires a water quality monitoring program for Mill and Woodfibre Creeks to be established.
- Marine Water Quality Management and Monitoring Plan (Appendix D): Aims to reduce impact to water quality by preventing the runoff of deleterious materials to the ocean and minimize disturbance to the seabed. The Marine Water Quality Management and Monitoring Plan requires water quality monitoring (including marine water quality).

2.0 OBJECTIVE

The purpose of this ESCP is to outline proposed measures to be implemented to prevent and or minimise the potential erosion and sediment issues relating to construction. An adaptive management approach will be used whereby erosion and sediment control (ESC) measures that fail to prevent or mitigate ESC deficiencies will be promptly replaced by alternative and more effective ESC measures (this process will continue until ESC issues are successfully resolved). Lastly, the Plan provides a summary of the water quality monitoring program that will be used during construction of the Project.

This Plan identifies key regulatory requirements, mitigation strategies, and Best Management Practices (BMPs) for controlling erosion and sediment that is generated by construction activities. This Plan also provides a monitoring program and reporting framework for ESC issues to verify compliance with the applicable Project environmental requirements.

The objectives of this plan are to:

- Emphasize proactive planning, as reflected in an ESC hierarchy of preferences for selecting mitigation measures.
- Summarize general and specific construction practices and related potential adverse water quality effects due to erosion and sedimentation risks and impacts.
- Describe general ESC measures for the Project to reduce construction impacts and manage potential adverse water quality effects in site watercourses. Site-specific ESC measures will be outlined in contractor EWPs.
- Outline the ESC monitoring plan requirements that ensure effective erosion prevention and mitigation is being accomplished.
- Apply water quality guidelines and objectives in evaluating water quality data collected before, during, and after construction.
- Use adaptive management i.e., adjust BMPs in response to changing conditions and replace measures that fail with more effective measures to promptly correct environmental protection deficiencies.

3.0 REGULATORY CONSIDERATIONS

The Project is to be designed, constructed, and operated in alignment with the requirements of the provincial, federal, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes, including:

- Environmental Assessment Certificate (EAC or the application) #E15-02 issued on October 26, 2015 and amendments issued on July 12, 2017 and July 19, 2019
- Decision Statement issued under section 54 of the *Canadian Environmental Assessment Act, 2012* on March 18, 2016 and a revised Decision Statement on March 7, 2018
- Squamish Nation Environmental Certificate No. 2015-001.
- Permits, licenses, and authorizations issued for the Project
- Regulatory requirements of federal and provincial legislation and regulations
- Squamish-Lillooet Regional District bylaws
- District of Squamish DPA1 and bylaws 2373
- Best management practices for the management of erosion and sedimentation

Information applicable to this ESCP is provided in the following sections.

3.1 APPLICABLE LEGISLATION, REGULATION, AND GUIDELINES

Surface water quality and sediment control management activities must comply with applicable federal and provincial legislation, regulations, standards, and guidelines as outlined below.

Federal Requirements:

- *Fisheries Act*, RSC 1985, c.F-14 (DFO) – Section 35(2)(b) Authorization
- *Canadian Environmental Protection Act*, 1999 (SC 1999, c. 33)

Provincial Requirements:

- *Water Sustainability Act*, SBC 2014, c.15; Water Sustainability Regulation, BC Reg. 36/2016, Part 2 (MOF) – Section 11 Approval
- *Water Sustainability Act*, SBC 2014, c.15; Water Sustainability Regulation, BC Reg. 36/2016, Part 3 (MOF) – Section 11 Notification
- *Water Sustainability Act*, SBC 2014, c.15 (MOF) – Section 10 Approval
- BC *Environmental Management Act* (SBC 2003, c. 53)
- BC *Water Sustainability Act* (SBS 2014, c. 15) and regulations, including Protecting Water Resources
- BC *Riparian Areas Protection Act* (SBC 1997 c. 21)
- ENV Waste Discharge Authorization, Environmental Protection and Management Regulation (2017)

Municipal Requirements:

- District of Squamish Soils Management Bylaw No. 2641 (2018)
- District of Squamish DPA1 and bylaws 2373

Applicable Guidelines:

- Land Development Guidelines for the Protection of Aquatic Habitat (DFO 1993)
- Measures to Protect Fish and Fish Habitat (DFO 2019)
- BC Water Quality Guidelines (MOE 2009)
- Fish-stream crossing guidebook (BC MOF, BC MOE, DFO 2012)
- Guidelines for the use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998)
- Canadian Interim Sediment Quality Guidelines for the Protection of Aquatic Life (CCME 1999)
- Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 2011)
- Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia (BC MOE 2014)
- Requirements and Best Management Practices for Making Changes In and About a Stream in British Columbia. Version 2022.01. Government of British Columbia.
- Environmental Protection and Management Guide (BC OGC 2021)
- Riparian Areas Regulation Implementation Guidebook (BC MWLAP 2006)
- Standards and Best Practices for Instream Works (BC MWLAP 2004)

3.2 PROJECT SPECIFIC STANDARDS

Water quality standards related to monitoring the effectiveness of ESC are described below.

Watercourses

In accordance with proposed mitigation measure M5.10-1, provided in Table 22-1 of the Environmental Assessment Application; 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. Water Quality Guidelines for turbidity (NTU) and total suspended solids (TSS) are provided in Table 3-1.

If there are competing requirements between BC or Canadian Council of Ministers of the Environment (CCME), water quality criteria and permit requirements (i.e., Waste Discharge Authorization) activities will comply with project specific commitments and permit conditions.

Table 3-1: Summary of Water Quality Guidelines for Turbidity and Total Suspended Solids

Maximum Induced Turbidity (NTU) or % of Background	Maximum Induced Total Suspended Solids or % of Background
Change from background of 2 NTU when the background level is less than 8 NTU	Change from background of 5 mg/L when background is less than 25 mg/L

Maximum Induced Turbidity (NTU) or % of Background	Maximum Induced Total Suspended Solids or % of Background
Change from background of 5 NTU when background is 8 to 50 NTU	Change from background of 10 mg/L when background is 25 to 100 mg/L
Change from background of 10% when background is greater than 50 NTU	Change from background of 10% when background is greater than 100 mg/L

Marine Discharges

Discharges of leachate to marine waters will comply with the requirements of Table 3-2.

Table 3-2: Summary of Quality Requirements - Waste Discharge Authorization #1239

Treated Leachate Quality		
Total Suspended Solids	Maximum:	60 mg/L
Biochemical Oxygen Demand	Maximum:	45 mg/L
Rainbow Trout LT50	Minimum:	96 h
pH	Maximum:	8.5 pH units
pH	Minimum:	5.5 pH units
Dissolved Oxygen	Minimum:	2 mg/L

4.0 POTENTIAL ENVIRONMENTAL EFFECTS

Unmitigated erosion and the subsequent generation of sediment by construction activities could have potential adverse environmental effects. The following sections describe potential impacts to aquatic and terrestrial resources.

4.1 POTENTIAL IMPACTS TO AQUATIC RESOURCES

Introduction of sediment into the aquatic environment from construction activity (as measured by an increase in turbidity and TSS) can result in detrimental impacts to fish and associated habitats. Sediment laden water entering aquatic habitats can have the following effects.

- Excess sediment in the watercourse may degrade water quality and habitat quality.
- Excess sediment in fish-bearing water bodies could settle and cover stream bed gravels, eliminating habitat and reducing egg survival.
- Suspended sediment may also reduce the amount of light penetration into the water column, which can affect fish feeding and schooling practices and reduce aquatic plant life, a major source of food for aquatic invertebrates.
- Suspended sediment could potentially irritate or abrade the gills of fish which can compromise respiratory function and cause death (in high concentrations).
- Some aquatic invertebrates are filter feeders and sediment could clog their filter mechanisms.
- Suspended sediment could potentially destroy the protective mucous covering of fish, making them more susceptible to infection and disease.

4.2 POTENTIAL IMPACTS TO TERRESTRIAL RESOURCES

While sediment control is focused on mitigating impacts to aquatic environments, the following potential impacts can occur to the terrestrial environment as a result of uncontrolled erosion.

- Destabilizing effects on hillsides and structural components.
- Sediment accumulation that buries terrestrial vegetation and small mammal habitat.
- Degradation of terrestrial environments through the transport and deposition of contaminated sediment and unwanted plant species.
- Loss of topsoil resources that support vegetation which in turn stabilize slopes and reduce erosion.

5.0 EROSION AND SEDIMENT MITIGATION MEASURES

5.1 ESC STRATEGY

The overarching strategy for erosion and sediment control planning is:

- Emphasize proactive planning, as reflected in an ESC hierarchy of preferences for selecting mitigation measures.
- Identify all construction activities that may result in the exposure of surfaces.
- Prepare activity and location specific Environmental Work Plans (EWPs) to provide specific detail on ESC requirements (see **Section 5.3)**.
- Implement an ESC checklist as part of the Contractor's Environmental Monitoring Program.
- Apply provincial water quality guidelines and objectives in evaluating surface water quality data collected before, during and after construction.
- Use adaptive management i.e., adjust best management practices (BMPs) in response to changing conditions and replace measures that fail with more effective measures to promptly correct environmental protection deficiencies.

The selection and implementation of ESC best management practices will consider such factors as: the size of work sites; the potential impact of specific activities; proximity to environmentally sensitive features such as fish-bearing watercourses or a catch basin connecting to a watercourse; work site gradient; soil erodibility and erosion potential of exposed material; forecasted weather events and predicted run-off discharge volumes and flow rates.

5.2 ESC HIERARCHY OF PREFERENCES

The Project will follow an ESC hierarchy of preferences for selecting mitigation measures. The goal of the hierarchy is to limit the exposure of soils by emphasizing erosion prevention to reduce potential for creation of sediment-laden water. The hierarchy of preferences is as follows (beginning with most preferred):

1. Effective Environmental Planning and Construction Scheduling to avoid unnecessary disturbance and exposure of soils, minimize the amount of clearing and ground disturbance, and limit the duration of soil exposure (e.g., by reducing the duration of ground disturbance activities).
2. Erosion Prevention and Surface Water Management to prevent the creation of unconsolidated sediment and uncontrolled flow of sediment-laden water flows.
3. Sediment Control to capture unconsolidated sediment and prevent loss from site.
4. Water Treatment to meet applicable guidelines prior to discharge or offsite disposal.

The Contractor is responsible for reviewing and compliance with all environmental regulatory documents, permits, and approvals associated with works and implementing appropriate ESC measures to achieve

Project commitments and standards (e.g., water quality requirements for discharge to the receiving environment).

It is anticipated that a variety of ESC measures will be required during construction. ESC measures should be selected to complement one another and provide “back-up” in the event one measure fails or otherwise proves to be ineffective.

Guidance on the selection, implementation and maintenance of ESC measures will be provided by the Contractor’s Environmental Monitor, as overseen by the Environmental Manager.

BMPs following the ESC hierarchy of preferences are provided below.

5.3 ENVIRONMENTAL WORK PLAN

Environmental Work Plans (EWP) are required to provide site and/or activity specific environmental management measures. The EWPs supplement the overarching Construction Environmental Management Plan (CEMP) and accompanying Component Plans and will be prepared by the Contractor.

At a minimum the site-specific ESC plan, will include the following information:

- Specify the proposed BMPs.
- Environmental Mapping (see CEMP Section 5.3.2) including figure(s) illustrating the location of the proposed BMPs and locations of environmentally sensitive areas (e.g., watercourses). For longer duration activities (greater than 3 months), a series of phasing/staging figures may be required to show the progression of BMPs required throughout the various stages of construction.
- Provide the installation details/specifications for each specified BMP.
- Identify the maintenance requirements for the specified BMPs.
- Described the ESC inspection frequency, effectiveness monitoring and reporting requirements.

An EWP is required for:

- Project activities that will result in exposure of or disturbance of soils (that is not minor in nature).
- Vegetation clearance.
- Any works within the riparian management area (see BMP #3).
- Any other activity that has the potential to result in uncontrolled runoff of sediment-laden water from the site.

5.4 MITIGATION MEASURES

The following section outlines the best management practice (BMP) measures to be implemented for the management of erosion and sediment during construction activities. 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.

BMP #1 – Planning and Scheduling

Effective planning and scheduling of construction works is essential to limit the potential for erosion and sediment control impact. Effective planning also enables identification of fit-for-purpose measures early in the activity design and planning process.

- The size and type of each construction site (e.g., laydown, excavation, foundation, road fill) will be carefully considered, based on the functional and safety needs of the Project.
- Provide sufficient quantities of materials are available onsite to stabilize erodible surfaces (e.g., silt fence, seed mix, sandbags, erosion control blanketing, polyethylene sheeting, mulch, etc.).
- Plan sites to limit works in erosion prone and sensitive areas including riparian management areas and creek beds. Where possible, schedule significant ground disturbance activities during dry months.
- Design sites and plan activities to limit soil excavation and disturbance.
- Confine construction to regional least risk timing windows for fish and wildlife species and habitat, where feasible.
- Where practicable, schedule ground disturbance works to limit the volume of exposed surfaces and unconsolidated material at any given time.
- Install erosion and sediment control measures prior to commencing their respective ground disturbance activities. Ensure an Environmental Monitor inspects newly installed measures.
- Schedule works to enable progressive stabilization of disturbed surfaces, where possible.

BMP #2 – Preserve Existing Vegetation

- Minimize the amount of area cleared for construction purposes to restrict the amount of erosion and sediment source areas. Where possible, disturbance and re-stabilization of large areas will be staged to allow for ESC measures to be employed in a deliberate and timely manner.
- Disturbed areas adjacent to watercourses will be re-vegetated as soon as possible to prevent surface erosion or downstream water quality effects.
- Re-vegetate disturbed areas adjacent to watercourses as soon as possible.
- All sensitive areas will be delineated (e.g., flagging, signage, and fencing) to prevent accidental incursion by machinery or clearing of vegetation.
- Install signage and barriers to prevent access / harm to vegetation not approved from removal. Clearly demarcate vegetation to be removed. 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.
- Where possible, use vegetated buffer strips around water bodies and construction site perimeters to provide supplementary run-off filtering of sediment from surface run-off.
- Preferentially tie-back or trim vegetation rather than remove where possible.
- Where possible, clearing and grubbing should be scheduled when weather and terrain conditions are optimum to minimize erosion and sedimentation of the site.
- In areas where vegetation removal is necessary, but soil disturbance is not, use close-cutting techniques to maintain soil stabilizing root systems.

- Avoid clearing/grubbing work areas until just prior to construction if wet conditions are anticipated.

BMP #3 – Riparian Management Areas

- An EWP must be prepared and approved for the management of all works within a riparian management area.
- 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 within these areas.
- No refueling will occur within these areas.
- Avoid vegetation clearance within riparian management areas. If not possible, revegetate the area with native species as soon as reasonably practicable.
- If practicable, remove riparian vegetation by hand. If machinery must be used, operate machinery in a manner that minimizes disturbance to the banks of the watercourse.
- Do not stockpile erodible material in riparian management areas. All stockpiles must be stored >30 m from a watercourse and include erosion protection.

BMP #4 – Erosion Prevention

The following BMPs are associated with the control and prevention of erosion during construction. Control measures will be implemented where exposure of ground surfaces cannot be effectively avoided through planning and scheduling of works. Control measures for erosion prevention will be determined on a site / activity-specific basis taking into consideration the following:

- Erodibility of soils.
- The presence / absence of slopes and the slope's relative steepness and length.
- The duration an area is anticipated to be exposed.
- Proximity to a watercourse or other environmentally sensitive areas.
- The season in which an area is disturbed and forecasted weather events.

BMP #5 – Trafficked Areas

Trafficked areas including driveways, parking areas, laydown areas that will be used for longer than two (2) months will be stabilized to reduce erosion potential, where possible.

- Clearly demarcate trafficked areas to prevent unnecessary ground disturbance.
- Stabilize surfaces by paving or installing a geotextile fabric covered in aggregate (minimum 50 mm). Periodic top dressing with additional rock and repair / maintenance of any measures used to trap sediment may be required.
- Eliminate ponding in trafficked areas by maintaining flat surfaces.
- Sediment will be removed from roads by hand shoveling, bucket scraping, power broom/sweeper or pickup with a vacuum sweeper (see BMP #18). Removed sediment will be disposed of in an onsite soil storage or stockpile area.

BMP #6 – Hydroseed and Hydromulch

Hydroseeding can provide both temporary and permanent vegetation cover wherein root structure provides effective erosion control. Temporary vegetation cover is used on areas that will be disturbed in the future, but in the interim require erosion protection; temporary cover is an important component of "phased" construction activities. Permanent seeding is applied to exposed areas which have been graded to final contour and prepared with a growing medium (e.g., topsoil).

Hydraulically applied mulches form a continuous blanket on the soil surface, protecting the soil from raindrop impact and wind erosion, conserving soil moisture, reducing soil crusting, and increasing infiltration. This results in improved conditions for seed germination and plant growth.

The following guidance will be taken into consideration when applying temporary hydroseeding or hydromulching.

- Apply measures on suitable disturbed areas that will lie dormant for 30 days to one year, unless directed by the QEP.
- For soil that is compacted or hardened, the soil should be loosened (e.g., raking or harrowing) or machine-tracked prior to applying measures.
- Seed mixes for temporary or permanent erosion control will be determined by a Suitably Qualified Professional.
- All seed supplied either as individual species, or as a seed mix, shall comply with the requirements of the Federal *Seeds Act* and Seeds Regulations, the grade standards for that particular crop kind, and with Ministry of Transportation and Infrastructure (MOTI) Standards for the Vancouver Island / Coast Mix. Grass and legume seed shall meet or exceed Common No.1 grade prior to mixing with other species. Seed shall be free of propagules of plant species designated as noxious or invasive under the provincial *Weed Control Act* and Weed Control Regulation, any BC Proposed Prohibited Species, and any sweet clover/bear attractants.
- Apply hydromulch, including number of applications (passes) and application rate, as per the manufacturer's recommendations.
- Verify hydromulch and hydroseed applications meet specifications. Record materials used and keep all certification tags for inspection and records.
- Seeded areas should be inspected frequently, especially after a significant rain event. If the seeded area is damaged due to run-off, immediate repairs should be made, and additional stormwater control measures may be required.
- All permanent surfaces and areas that are in final form and are to be vegetated should be done as soon as practically possible (delays greater than 7 days, temporary slope and surface protection should be applied).
- Final graded area should have the surface roughened, topsoil spread, and the appropriate permanent surface protection or landscaping in place as soon as possible. Surface protection for final graded areas will typically be tackifier and hydroseeding.

BMP #7 – Slope Protection (Rolled Erosion Control Products)

Rolled erosion control products (RECPs) are machine-produced mats of organic, biodegradable mulch such as straw, curled wood fibre (excelsior), coconut fibre or a combination thereof, evenly distributed on

or between photodegradable polypropylene or biodegradable fibre netting. The following describes the use of RECPs to protect slopes.

- Ensure the slope is properly prepared before installing the blanket. The slope should be fine graded to a smooth profile and relatively free of weeds, clods, stones, debris, rills, and crusting. Fill any voids and make sure that the slope is lightly compacted.
- If required, seed the area prior to installing the RECPs.
- At the top of the slope, dig an anchor trench 150 mm deep by 150 mm wide. Ideally, set the anchor trench at least 1 m back from the crest of the slope (this will help prevent water from flowing under the blanket and causing erosion). Install the end of the blanket in the trench, providing 750 mm of excess blanket extended upslope of the trench. Staple the RECPs at 300 mm intervals within the trench.
- Backfill the anchor trench and compact the soil. Cover the compacted soil with the remaining 750 mm of the terminal end of the RECP. Staple or stake the terminal end of the RECP down slope of the anchor trench at 300 mm intervals.
- Starting at the crest of the slope, “walk” the blanket down the slope (unrolling of heavy rolls can be controlled using temporary stakes). Excess slack should be pulled out of the blanket every 6 to 7 m, taking care not to overstretch the blanket. Secure the blanket using staple types/sizes and placement patterns as recommended by the manufacturer. Follow the manufacturer’s recommended overlap when rolling out parallel sections of blanket. Secure the overlaps with staples at recommended intervals.
- If the blanket needs to be spliced in the middle of a slope, ensure the blanket is "shingled" with the upslope blanket overlapping the downslope blanket. There should be minimum 100 mm of overlap in a splice. Use a staple check slot to secure the overlap (place a row of staples 100 mm on center and then placing a second, staggered row of staples 100 mm on center.

BMP #8 – Slope Protection (Wattles or Rolls)

Straw/Fibre wattles or rolls consist of bundled straw (or other natural fibre) wrapped in photo-degradable open-weave plastic netting. Wattles are staked into the soil along slope contours using wood stakes or live willow stakes to provide a grade break. Wattles are typically used on long, exposed slopes to reduce slope length, reduce rilling and decrease run-off velocity. The following guidance will be followed when installing RECPs:

- Starting at the toe of the slope, excavate small trenches across the slope. Trenches should be deep and wide enough to accommodate half the thickness of the roll (typically 0.15 m x 0.15 m). It is critical that rolls are installed perpendicular to water movement, parallel to the slope contour.
- Space trenches at contour intervals, depending on steepness of slope. The steeper the slope, the closer the trench spacing. Guidance regarding the appropriate spacing of wattles based on slope gradient is provide in **Table 5-1**.

Table 5-1: Suggested Wattle Spacing based on Slope Gradient

Slope Gradient	Approximate Wattle Spacing (m)
>1:1	1.5
2:1 – 1:1	3.0

Slope Gradient	Approximate Wattle Spacing (m)
4:1 – 2:1	6.0
6:1 – 4:1	7.5
<6:1	15

- Place fibre rolls/wattles into the trench, ensuring continuous contact between the roll and soil.
- Overlap the ends of rolls at least 0.15 m by excavating additional trench at overlaps.
- Prior to placing wood stakes or live willow stakes, use a metal bar to drive pilot holes through the roll and into the soil. Stake spacing should not exceed 1.2 m. Ensure overlaps are well staked. Drive stakes through prepared holes into the soil. Leave only 25 - 50 mm of stake exposed above the roll.

BMP #9 Surface Water Management

The general approach to surface water management during construction will be in the context of water exposed to construction areas (contact water) and water not exposed to construction areas (non-contact water). All water in contact with construction areas will be kept separate from non-contact water.

Where possible, surface water drainage that has not been exposed to or in contact with construction areas will be collected or directed away from construction activities. Within the construction areas, contact water will be directed to a water treatment system, settling pond/tank, and/or through a series of BMPs (e.g., check dams). General requirements of surface water management are to:

- Divert overland flows from undisturbed areas away from or around construction areas.
- Divert surface runoff away from disturbed soil and stockpiles.
- Divert overland flows into erosion and sediment control measures.
- Install drainage (temporary and permanent) to be used as ESC (e.g., storm water and surface water conveyance) prior to or at the time of site clearing.

BMP #10 – Check Dams

Check dams reduce erosion by decreasing the velocity of run-off in a channel and if properly installed and maintained, also provide temporary water detention that allow the settling of coarse sediment. Check dams can be constructed from a variety of materials (including suitable rock, sandbags, straw bales, and synthetic permeable barriers). As there are several different products suited to different situations, the following information is provided as general guidance on the installation of check dams.

- Rock check dams should consist of clean, free-draining, well-graded aggregate, large enough to remain in place during high flow conditions. It is important that a mix of sufficient size rocks be used to ensure the stability of the structure. Where low flows are expected, mean rock diameter (D50) should range from 75 to 150 mm. For higher flows, larger diameter rock should be used, and the structures designed by a qualified professional.
- If constructing a series of check dams, the height and spacing between structures should be designed to reduce channel gradient to intervals of flatter gradient. Always ensure the bottom of the upstream check dam is the same elevation of the center of the top of the downstream check dam.

- Build up the structure by machine-placing and hand-placing rocks, ensuring that the structure extends a minimum of 450 mm laterally beyond the tops of the channel banks. The flowline (dam center) should be least 300 mm below the elevation of the dam edges (this will allow water to flow over the structure rather than around it).
- Guidance regarding the appropriate height and spacing of check dams is contained in **Table 5-2**.
- Regular inspection and maintenance of check dam is required to remove sediment accumulation and prevent accumulated sediment from becoming subsequently resuspended. Sediment behind check dams should be removed when it reaches on-third of the height of the center elevation or as needed to prevent damage to channel vegetation while maintaining the effectiveness of the structure.

Table 5-2: Suggested Spacing for Check Dams

Ditch Grade	Minimum Height of Center Elevation of Dam		
	150 mm	300 mm	450 mm
6%	Not Recommended	4.5 m	7.5 m
5%	Not Recommended	6.0 m	9.0 m
4%	Not Recommended	7.5 m	12.0 m
3%	4.5 m	10.5 m	15.0 m
<2%	7.5 m	15.0 m	24.0 m

BMP #11 – Temporary Diversion Ditch

Temporary diversion ditches will be designed in consultation with a qualified professional. In general, temporary diversion ditches (e.g., cut-off ditch) will be installed as follows:

- Prior to construction, install temporary diversion ditches to intercept non-contact water and/or divert it around or away from construction activity (e.g., disturbed areas, stockpiles, excavations).
- Within the construction areas, use temporary diversion ditches to direct contact water to an area for water treatment/sediment settlement (see BMP #20).
- Channels should be constructed with a parabolic or trapezoidal cross sections, with side slopes of 2H:1V or flatter for mixed, fine-grained soils that can be compacted and 3H:1V or flatter for coarse-grained soils.
- Where channel gradient exceeds two (2) percent, armour/line temporary diversion ditches to minimize erosion (e.g., erosion control blankets, rock armouring, check dams).
- Temporary diversion ditches should be of sufficient capacity to convey most if not all clean run-off to the intended location.
- Temporary ditches are to be continuous, have a positive grade and drain towards a stabilized outlet. Protect the outfalls of temporary diversion ditches to provide adequate energy dissipation (see BMP #9).

BMP #12 – Temporary Berms

Temporary berms will be constructed to divert or collect runoff away from sensitive areas such as exposed slopes or water bodies. Berms should be constructed of suitable material and adequately

compacted to prevent failure. Where the berm serves to divert run-off, flows should be directed to a stabilized outlet (see BMP #14). Temporary berms are often used as a perimeter control in association with a sediment trap or basin (see BMP #20).

To prevent erosion, temporary berms should be stabilized immediately following construction (see BMP #12).

BMP #13 – Temporary Slope Drains

A temporary slope drain is a flexible pipe, over-side drainpipe, or other conduit extending from the top to the bottom of a cut or fill slope. The drainage area may be used to provide indicative guidance regarding slope drain sizing. Indicative guidance regarding the minimum sizing for slope drains is contained in; however, it should be noted that temporary slope drains must be designed by a qualified professional.

If required, temporary slope drains will typically be installed as follows:

- Construct a temporary diversion ditch and berm along the top of the cut or fill slope to collect and direct run-off (see BMP #12) into the slope drain inlet. The top of the diversion berm should be a minimum of 0.3 m higher than the top of the slope drain inlet.
- Always extend the drain beyond the toe of a slope and install a suitable energy dissipater at the downslope outlet end of all slope drains (see BMP #13).
- Secure slope drains in place to prevent movement (e.g., steel anchor stakes, hold-down grommets or another QEP approved method), spacing anchors on each side of the slope drain at maximum intervals of 3 m.

Table 5-3: Suggested Minimum Slope Drain Diameter Based on Contributing Area[1]

Maximum Contributing Drainage Area (ha)	Minimum Slope Drain Diameter Based on Contributing Area (mm inside diameter)
0.2	300
0.6	450
1.0	530
1.4	600
2.0	750

BMP #14 – Energy Dissipater

Energy dissipaters are structures / armouring placed at pipe outlets, in channels, and immediately downstream of check structures to reduce the velocity and dissipate the energy of concentrated water flow, thereby minimizing erosion and scour potential. Energy dissipaters can reduce flow energy in a relatively small area. Energy dissipaters are not to be used in a stream or watercourse unless the required approval is obtained from the regulating agency(s). When constructing an energy dissipater, the following will be taken into consideration:

- Design the dissipater to accommodate a ten-year peak run-off event or the design discharge of the channel, whichever is greater.
- Riprap should be comprised of a well-graded mixture of hard, angular, weather resistant stone.

[1] Alberta Infrastructure and Transportation ESC Design Guidelines for Highways March 2011

- Ensure that the dissipater apron has zero grade and is installed so the surface is even with the surrounding ground (avoid any over fall).
- Dissipater thickness should be sufficient to control erosive energy (riprap dissipater thickness should be at least 1.5 times the thickness of the largest rock, with a minimum thickness of 0.3 m).
- To prevent erosion of fine material under a riprap dissipater, always install an underlay of heavy duty, non-woven geotextile fabric or a layer of well-graded sand and gravel (at least 100 mm thick).

BMP #15 – Sediment Detention Ponds

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.

The Contractor will design for and construct sediment ponds, and stormwater detention ponds, on a site-specific basis in a manner that conforms to the "Land Development Guidelines".

BMP #16 – Catch Basin Protection

Catch basin (storm drain) protection is used to prevent coarse sediment from entering an operational drainage system. Inlet protection is often the last opportunity to treat run-off prior to a discharge. The following guidance will be followed of the selection and use of catch basin protection:

- Install catch basin protection (e.g., catch basin inserts, filter socks, dandy-sacks, gravel berm bags) as per the manufacture’s specifications.
- Geotextile fabric installed under or over storm drains is not an acceptable practice.
- Catch basin inserts only provide a minimal level of treatment for discharges and, whenever feasible, should not be relied on as the sole method for minimizing sediment release.
- Catch basin inserts are to be inspected and maintained frequently (i.e., every three (3) days between October 16 and April 15 and after a significant rainfall event) to ensure they are not plugged and/or causing water to pond on a roadway.
- Inlet controls must be installed with overflow devices to accommodate high flows.

Sediment Control

The following BMPs are associated with the control of sediment generated during construction.

BMP #17 – Soil Stockpiles

If temporary stockpiles are constructed, appropriate erosion prevention and sediment control measures will be installed and regularly inspected for effectiveness and maintained until these stockpiles are decommissioned or seeded. Soil stockpiles, or any other substance potentially deleterious to riparian, aquatic, or marine habitat will be stored or disposed of in such a manner as to prevent entry into the riparian, aquatic, or marine areas.

- No soil stockpiles will be placed within 30 m of riparian management areas.
- Soil stockpiles will be kept a minimum of 30 m away from all watercourses unless the watercourse has been isolated. In the case of the latter, stockpiles remaining within 15 m of

watercourse, for longer than 24 hours or in advance of a significant rain event must be covered with secure polyethylene sheeting or tarp.

- No erodible material will be stockpiled within riparian management areas.
- Soil stockpiles to be left in place for three (3) or more days between October 16 to April 15 or seven (7) or more days between April 16 to October 15 will have no greater than 2:1 slope gradient and will be managed through one or a combination of the following measures:
  - covered with polyethylene sheeting or a tarp that is securely anchored so not to be blown away by the wind.
  - surrounded by wattles (see BMP #8), a temporary diversion berm (see BMP #11) or dike, or sediment fence (see BMP #19).
- If stockpiles are to be left idle for more than two (2) months, hydroseeding/hydromulching are the preferred stabilization methods, unless weather conditions preclude the establishment of vegetation (see BMP #6).
- Aggregate stockpiles that are free of fines and free draining (e.g., gravel) do not require erosion protection.

BMP #18 – Sweeping

For paved surfaces within the construction site, the following guidance will be followed for sweeping.

- Keep paved or hard surfaces clean to prevent buildup of fine sediments as well as other construction materials (e.g., concrete dust/powder, metal filings), especially during the rainy season when these materials can be washed into waterways without proper containment.
- Sweeping and/or vacuuming will be completed at a frequency that correlates to the volume of vehicle movements.
- Removed sediment will be disposed of in an onsite soil storage or stockpile area.

BMP #19 – Sediment Fence

The following guidelines should be noted when installing sediment fence:

- The run-off path length between other upslope erosion protection measures and a sediment fence will not exceed 30 m and is typically much less depending on the slope gradient.
- Maximum slope gradient upstream of a fence will not exceed about 2H:1V.
- Sediment fence will be installed at least 2 m downslope of the toe of a slope.
- Unless intended as a temporary diversion structure, sediment fence will be installed along the slope contour, with the ends pointed upslope to ensure sediment capture.
- Sediment fence installed around a construction site perimeter should have a suitable number of J-hooks installed so that contributing drainage area is limited to about 0.1 ha per 30 m of silt fence.
- Do not install sediment fence at locations where concentrated run-off occurs or may occur (i.e., in ditches or dedicated watercourses). Sediment fences are not designed to withstand high run-off velocities.

- Installation requirements for sediment fence include:
  - Sediment fence should be firmly entrenched and anchored into the soil.
  - Fence height should not exceed 0.9 m. However, the ponding height of water should not exceed 0.5 m (install stabilized overflow sections on long runs of fence).
  - Sediment fence should be firmly attached to posts (steel T-posts or 50 mm (2") diameter wood stakes), driven at least 600 mm into the ground, with a 2 m maximum post spacing, on the downstream side of the fabric.
  - Minimize joints by installing fence from a continuous roll. Where joints are required, construct at least a 0.4 m overlap and wrap the end posts together.
  - Bury at least 0.3 m of fabric in the trench on the upstream side of the posts.
  - Following sediment fence installation in the trench, backfill and compact soil within the trench (with boots and shovels).

BMP #20 – Sediment Traps

Sediment traps are sediment containment systems designed to contain and promote deposition of sediment laden run-off and to discharge water at a controlled rate. Traps can be installed at the site perimeter, as well as intermediate points, to retain concentrated, sediment-laden run-off. Perimeter sediment containment should be installed prior to commencement of site stripping, grading, and other earthwork activities. A sediment trap can vary from a small, excavated depression to a small sediment basin with a designed storage volume, settling depth and outlet. The following information is provided as general guidance on the installation of sediment traps.

- Sediment traps are used for disturbed drainage areas of 2.0 ha or less for up to one year, or until the contributing upstream area is stabilized.
- Sediment traps will be designed and constructed to provide two zones: A sediment storage zone (at least 0.3 m depth) and a sediment settling zone (at least 0.6 m depth).
- Install inlet and outlet protection to protect from scour (see BMP #14).
- Where practical, contributing drainage areas will be subdivided into smaller areas with multiple sediment traps installed.
- When sediment accumulation depth in the trap reaches one-third of its design depth it will be removed. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at a suitable location.

BMP #21 – Water Treatment and Disposal

Water treatment will comply with the requirements of the Waste Discharge Authorization (Ministry of Environment [MOE] Permit 1239) which includes stormwater management strategies for non-contaminated contact water and potentially contaminated water. If water is encountered that can not be treated in the onsite sedimentation ponds or the wastewater treatments systems, The water will be tested to determine the appropriate offsite disposal options. Disposal may be onto surrounding land or directly to Howe Sound (see **Section 6.0**). Disposal of water onto surrounding land may be adopted referring to the methodology described in BMP#22 below and ensuring appropriate sediment control is deployed to ensure no watercourses are impacted.

BMP #22 – Bio-infiltration

The term bio-infiltration encompasses the method of discharging excess water from a construction site into a vegetated area where the water can dissipate and infiltrate into the ground. The most common method is to pump water out of areas where it does not otherwise drain off (e.g., excavations, foundation footings sediment traps). The following information provides guidance on the use of bio-infiltration:

- Water must meet water quality requirements (see **Section 3.2**).
- Release sediment-laden water to existing vegetation in a controlled manner.
- Ensure water is released through or onto an energy dissipater to reduce the potential for erosion (see BMP #14).
- Where sediment load in released water is expected to be significant, a sediment bag will be used and maintained.
- Water that is being released in this manner will be routinely monitored to ensure that it is not causing erosion or flooding.
- Bio-infiltration will not be allowed for water that is known or suspected of being contaminated.
- Bio-infiltration will only occur on lands controlled by the Project.

BMP #23 – Chemical Treatment

Fine silt and clay-size particles typically carry a negative charge, causing particles to repel each other and further increasing particle settling time (due to their small size and repulsion, they are commonly referred to a colloids). Low dosage of chemicals known as flocculants and coagulants (containing highly charged polymer chains or ions) destabilizes negative charges on fine particles, allowing material to aggregate and settle. Two classes of flocculant and coagulant chemicals that are proposed for use on the Project to assist settlement are anionic polyacrylamides (PAM) and chitosan-based products.

Prior to using chemical treatment of sediment laden water on the Project, preliminary site-specific assessment (requiring basic soil and water sampling and analysis) will be required (to determine dosing rate, method, and maintenance requirements). In addition, any proposed chemical must be accompanied by a safety data sheet (SDS) and toxicity information from the manufacturer confirming that the product and any required additives cause no acute or chronic toxicity to aquatic biota.

Chemical water treatment to reduce sediment load will be used in active water treatment systems (i.e., injected by controlled dosage into a pipe or mixing chamber in the sedimentation tank). Set-up and monitoring of the active water treatment systems will require the expertise of a water treatment specialist. Sediment collected through settlement associated with active treatment will be disposed in accordance with applicable legislation (e.g., Contaminated Site Regulation). As required, samples of the sediment will be collected to assist with determining disposal options.

The use of active water treatment systems, including the use of chemical treatment, will be described in a site-specific ESC plan (see **Section 5.3**). At a minimum, the information will be provided in the site-specific ESC plan; location, point of discharge, installation details, safety data sheets for chemical treatments, monitoring and maintenance criteria.

5.5 BMP MAINTENANCE

As part of the Contractor's environmental monitoring program, ESC issues will be identified and documented, as specified below in **Section 6.0** 'Monitoring'. It will be the responsibility of the Contractor to address the issues identified by the Environmental Monitor.

For example, all sediment control measures that have accumulated sediment in or immediately around them will be cleaned once sediment build-up is one-third of the device's retention capacity. Maintenance will also occur immediately after problems are identified and will be done in a manner that will prevent further sediment migration. The Environmental Monitor is responsible for documenting and reporting on maintenance activities.

6.0 MONITORING

ESC monitoring will follow an adaptive management approach, consisting of a combination of ESC inspections and water quality monitoring to determine the effectiveness of this Plan. If during inspections control measures are determined to be ineffective, the Contractor must rectify the control measures as soon as practicable. The Environmental Monitor, in consultation with the Environmental Manager, may recommend additional control measures to be implemented. This adaptive process will be documented and tracked by a qualified Environmental Monitor.

6.1 INSPECTIONS

ESC measures must be inspected to ensure they remain effective. The effectiveness will be assessed visually and will also be supported by the water quality monitoring program.

- The CEMP outlines the routine environmental monitoring to be undertaken during construction and includes the following: Twenty-four (24) hours following installation of ESC measures to ensure correct installation methods and procedures are followed.
- Prior to, during, and following construction activities identified as having a high potential of resulting in erosion or sediment concerns. Activities with a high potential of resulting in erosion and sediment concerns will be identified in their respective EWP.
- Prior to, daily during, and 24 hours following a significant rainfall event. A rainfall event will be considered significant if it will result in overland flow of water within the construction site.
- Weekly during all other periods.

ESC Inspections will include but may not be limited to:

- Inspection of work areas to verify that all ESC measures have been implemented as required.
- Evaluation of mitigation devices and measures to verify correct installation effective erosion prevention and/or sediment control and maintenance has been conducted.
- Collection and testing of background and runoff water samples at the outlet point of the ESC system.
- Assessment of potential for future ESC issues and preventative measures that can be employed to mitigate issues identified.

6.2 WATER QUALITY

A water quality monitoring program is required to ensure water leaving the site / entering Mill Creek, Woodfibre Creek, and Howe Sound meet relevant water quality standards and waste discharge authorization discharge requirements (see **Section 3.2)**. The monitoring program is included within the CEMP and the Marine Water Quality Management and Monitoring Plan (Appendix D). Sample sites, frequency of sampling, and parameters to be monitored are included within these Plans.

6.3 KEY PERFORMANCE INDICATORS

The following Key Performance Indicators will be tracked monthly to demonstrate conformance to this ESC Plan.

- Percentage of ESC Inspections completed in accordance with the minimum inspection frequency and content requirements of **Section 7.1** of this Plan.
- The timeliness of addressing of ESC-related issues (e.g., effectiveness, completion of recommended maintenance).
- ESC-related surface water quality results that passed (or failed) applicable water quality standards.

7.0 COMPLIANCE REPORTING

The following compliance reports will be prepared by the Environmental Manager and incorporated into the Projects reporting requirements as outlined in section 4.1 of the CEMP.

7.1 WEEKLY ENVIRONMENTAL MONITORING REPORT

The Environmental Monitor will document results and status updates on ESC, including effectiveness of mitigation measures and recommendations to rectify noted deficiencies. This documentation will be provided in the Weekly Environmental Monitoring Reports.

7.2 MONTHLY ENVIRONMENTAL REPORT

The Environmental Manager will summarize the following in the Monthly Environmental Report:

- Important aspects of the weekly monitoring activities (e.g., implementation of corrective measures).
- Erosion and sediment control monitoring statistics and challenges.
- Documentation of the effectiveness of ESC best management practices; include the implementation of adaptive measures.

8.0 ROLES AND RESPONSIBILITIES

The organizational structure and overall roles and responsibilities are outlined in Section 3.2 of the CEMP. The position, and responsibilities of key personnel who will be involved throughout the Project, as related to erosion and sediment control issues is provided in **Table 8-1**. The Contractor will employ at least one (1) Certified Professional in Erosion and Sediment Control to oversee the implementation of this Plan. Contact information and reporting structure is provided in the CEMP.

Table 8-1: Roles and Responsibilities

Role	Responsibility
Environmental Manager	• Implement and manage the ESC program. • Ensure crews are trained in the installation and maintenance of ESC measures. • Maintain ESC monitoring records. • Document Project ESC management statistics in the Monthly Environmental Report.
Environmental Monitor(s)	• Conduct inspections of ESC measures, as assigned by the Environmental Manager. • Record and document data during ESC inspections. • Prepare daily and weekly ESC reports. • Report exceedances, non-compliances, and incidents to the Environmental Manager.

Appendix J Waste Management Plan

Waste Management Plan

Woodfibre LNG Project

October 4th, 2023

Prepared By:
Woodfibre LNG General Partner Inc., as General Partner on behalf of the Woodfibre LNG Limited Partnership
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Prepared For:

123221624EN-RPT0012

Woodfibre LNG

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 Skwxwú7mesh (Squamish). The Project is on the historical location of a Skwxwú7mesh Úxwumixw (Squamish Nation) village known as Swiẏát. Swiẏát 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 Construction Environmental Management Plan is primarily written in English with important place names, species, phrases, and passages provided in the Squamish language.

Temíxwiẏiḵw chet wa naantem chet ti temíxw Swiẏát

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 Swiẏát

We, as their descendants safeguard these lands

We will continue to swim and fish in these clear waters.

Squamish-English Translation

Squamish	English
General Terms	
Sḵwx̱wú7mesh Sníchim	Squamish language
Sḵwx̱wú7mesh Úxwumixw	Squamish Nation
Sḵwx̱wú7mesh stélmexw	Squamish people
Locations	
Swiy̓át	Historic Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) village located at Woodfibre LNG site
Sḵwx̱wú7mesh	Squamish
Nexwnéwu7ts Átlḵ̓a7tsem	Howe Sound

Abbreviations

the application	Woodfibre LNG's application for an Environmental Assessment Certificate
BC	British Columbia
BMP	Best Management Practice
CEMP	Construction Environmental Management Plan
EAC	Environmental Assessment Certificate
LNG	Liquified Natural Gas
SNEAA	Squamish Nation Environmental Assessment Agreement
The Project	Woodfibre Liquified Natural Gas Project
TDG	Transportation of Dangerous Goods
WMP	Waste Management Plan
Woodfibre LNG	Woodfibre LNG General Partner Inc.

Document Revision History

	PREPARED BY	REVIEWED BY	APPROVED BY
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Position:	Technical Director, Hatch		
Date: (YYYY-MM-DD)	2023-10-04		
Signature			

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B	July 18, 2023	-	For review and consultation
C	September 25, 2023	-	Updated from consultation comments
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Table of Contents

PREAMBLE ..... **I**
DOCUMENT REVISION HISTORY ..... **II**

1.0 INTRODUCTION **1**
2.0 OBJECTIVES **1**
3.0 REGULATORY CONSIDERATIONS **2**
3.1 PROJECT APPROVALS 2
3.2 REGULATORY FRAMEWORK 4
4.0 ROLES AND RESPONSIBILITIES **5**
5.0 BEST MANAGEMENT PRACTICES **6**
5.1 OVERVIEW OF KEY RISKS 7
5.2 GENERAL MANAGEMENT PRACTICES 7
5.3 WASTE CLASSIFICATION 8
5.4 WASTE HIERARCHY 10
5.5 STORAGE AND HANDLING 11
5.5.1 All Waste 11
5.5.2 Liquid Non-Hazardous Waste 11
5.5.3 Hazardous Waste 12
5.5.4 Sewage 12
5.5.5 TRANSFER OF WASTE TO BARGE 12
5.6 DISPOSAL 12
5.7 SPILLS 13
6.0 IMPLEMENTATION **13**
6.1 WASTE STREAMS 13
6.1.1 WASTE CLASSIFICATION 14
6.2 WASTE TRACKING 14
6.3 RECORD RENTENTION 14
7.0 MONITORING **15**
8.0 REPORTING **15**
8.1 MONTHLY ENVIRONMENTAL REPORT 15
9.0 LITERATURE CITED **16**

LIST OF TABLES

Table 3-1: Conditions Relevant to the Waste Management Plan 3
Table 3-2: Applicable Legislation and Regulations 4
Table 4-1: Roles and Responsibilities 5
Table 5-1: Waste Management Guidance 6
Table 5-2: Definition of Hazardous Waste (BC MOE 2016) 9
Table 5-3: Waste Reduction Opportunities 10
Table 6-1: Waste Classification Requirements 14

1.0 INTRODUCTION

Woodfibre LNG General Partner Inc., as General Partner on behalf of the Woodfibre LNG Limited Partnership (Woodfibre LNG) will construct and operate the Woodfibre Liquefied Natural Gas Project (the Project), which is located on the former Woodfibre Pulp Mill site approximately seven kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia (BC). The Project will have capacity to liquefy up to 2.1 million tonnes per year of natural gas and a storage capacity of 250,000 cubic metres (m^3) and will export the liquefied natural gas (LNG) via tankers.

This Waste Management Plan (WMP) describes the measures that will be implemented to minimize waste generation, and ensure waste is stored, contained, and disposed of appropriately. This WMP incorporates a general waste hierarchy of preferences for avoiding, reducing, reusing, recycling, and disposing of hazardous and non-hazardous wastes and the inspection and reporting framework that will be implemented to monitor the effectiveness of the mitigation measures and track waste disposal.

For the purpose of this WMP, hazardous waste is any waste that could harm human health or the environment if not properly handled and disposed of (e.g., poisons, corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or any other material that can endanger human health or wellbeing or the environment). Non-hazardous waste includes all wastes that are not considered to be hazardous waste.

Where appropriate, applicable elements from the following guideline will be incorporated into this WMP.

- Technical Assessment Report for the Woodfibre LNG Export Facility, Construction Phase Waste Discharge Authorization

The measures described in this WMP will be incorporated into a site-specific Environmental Protection Plan (EPP) to be developed by the Contractor. This EPP will include how the project will support objectives outlined in the WMP, site-specific waste management measures related to waste bin types, segregation procedures, wildlife-proof waste storage and disposal, criteria for waste storage locations, waste inspection equipment and frequencies, record keeping requirements and reporting frequencies. The EPP will also include information regarding waste storage areas, and waste management controls (e.g., bunding and covering). Activity specific Environmental Work Plans (EWPs) will be developed by the Contractor that will include details on how waste will be handled to comply with site waste requirements.

This WMP is a component plan of the Construction Environmental Management Plan (CEMP) for the Woodfibre LNG Project (“Project”) and is intended for use during the Construction phase of the Project.

2.0 OBJECTIVES

The objectives of this Plan are to:

- Identify and address all applicable legislation, regulations, and guidelines for waste management.
- Define the roles and responsibilities in relation to waste management.
- Identify Project activities that may generate hazardous and non-hazardous waste.
- Identify waste streams including quantities of wastes.
- Describe strategies for waste reduction, re-use, recycling, and disposal.

- Identify the key risks and detail the management practices for the storage, handling, and transport of wastes.
- Identify an inspection and reporting framework to evaluate and improve waste management measures.

3.0 REGULATORY CONSIDERATIONS

The Project is to be designed, constructed, and operated in alignment with the requirements of the provincial, federal, and Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) environmental assessment processes, including:

- EAC #E15-02 issued on October 26, 2015 and amendments issued on July 12, 2017 and July 19, 2019.
- Decision Statement issued under section 54 of the *Canadian Environmental Assessment Act, 2012* (CEAA, 2012) on March 18, 2016 and a revised Decision Statement on March 7, 2018.
- Squamish Nation Environmental Certificate No. 2015-001. Squamish Nation Environmental Assessment Agreement (SNEAA) certificate issued on October 14, 2015.
- Permits, licenses, and authorizations issued for the Project.
- Regulatory requirements of federal and provincial legislation and regulations.
- Squamish-Lillooet Regional District bylaws.
- District of Squamish bylaws.
- Best management practices for the management of waste.

Specific requirements applicable to this WMP is provided in the following sections.

3.1 PROJECT APPROVALS

The WMP has been prepared as a tool to ensure compliance and facilitate implementation of the conditions of approval during the construction phase of the Project in accordance with the conditions described in the:

- Federal Decision Statement for the Woodfibre LNG Project.
- Environmental Assessment Certificate (EAC) No. E15-02 (including amendment No. 1 and No. 2).
- Squamish National Environmental Certificate No. 2015-001.

A summary of the Project environmental approvals on which this WMP is based is provided in **Table 3-1**.

Table 3-1: Conditions Relevant to the Waste Management Plan

Condition Number	Condition	WMP Reference
EAC Application Table 22-1 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: o 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. o 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: o 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. o Whenever possible, the materials used in construction will be reused and recycled. Recyclable materials will be separated and transported off site. o Clearly labeled garbage bins with lids and recycling containers will be made available for food waste and recyclables. o Food waste will be stored in wildlife-proof bins.	Section 5.0 Section 6.0
M5.10-3 (relevant clauses)	Used / decommissioned creosote piles will be disposed of on land in an appropriate waste management facility.	Section 5.0
M5.10-1	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.	Section 5.0 Section 6.0
M5.8-1	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.	Section 5.0 Section 6.0

3.2 REGULATORY FRAMEWORK

Waste management activities must comply with applicable federal and provincial legislation and regulations as outlined in

Table 3-2.

Table 3-2*:* Applicable Legislation and Regulations

Name	Relevance
Federal Requirements	
Fisheries Act, RSC 1985, c.F-14 (DFO) – Section 35(2)(b) Authorization	Safeguards fish and fish habitat. It is also an offence for anyone to deposit or permit the deposit of deleterious substance in water frequented by fish without a permit or under a regulation.
Canadian Environmental Protection Act, 1999 (SC 1999, c. 33)	An Act aiming to prevent pollution and protect the environment and human health in order to contribute to sustainable development.
Canadian Environmental Assessment Act, 2012 (SC 2012 c. 19, s. 52)	Sets the responsibilities and procedures for environmental assessments of projects that require federal government decision making. The environmental assessment requires consideration of waste management, and that any potential negative impacts from waste are identified and mitigated.
Provincial Requirements	
BC *Health Act* Sanitary Regulations (BC Reg 147/59 O.C. 829/17), as amended	Outlines the requirements for the sanitary handling, disposal, and management of waste in order to protect public health and safety. It sets standards for the proper handling, storage, transportation, and disposal of waste.
BC *Environmental Management Act* (SBC 2003, c. 53), as amended.	The Environmental Management Act 2003 regulates the introduction of waste into the environment, including industrial and municipal waste discharge, pollution, hazardous waste, and contaminated site remediation.
BC Hazardous Waste Regulation (BC Reg 63/88 O.C. 268/88)	The Hazardous Waste Regulation addresses the identification, handling, transport, disposal and treatment of hazardous wastes.
BC Contaminated Sites Regulation (CSR), B.C. Reg. 375/96, as amended	Provides a framework for the identification, assessment, and remediation of contaminated sites. It specifies requirements for the management and disposal of hazardous waste to prevent contamination of the soil, groundwater, and surface water.
BC Waste Discharge Regulation (BC Reg 320/2004 O.C.723/2004), as amended.	Prescribes industries, trades, businesses, operations, or activities that are prohibited from discharging wastes and that must obtain ministry authorization to discharge waste into the environment.
BC *Wildlife Act* (RSBC 1996, c. 488), as amended	Protects wildlife, endangered species, and wildlife habitat. Prohibits feeding wildlife.
Occupational Health and Safety Regulation (OHSR), B.C. Reg. 296/97, as amended (relevant occupational health and safety requirements as outlined in WorkSafe BC).	Protects workers' health and safety. Requires the development and implementation of procedures for the safe handling, storage, transportation, and disposal of hazardous materials / wastes.
Municipal Requirements	
Greater Vancouver Sewerage and Drainage District Tipping Fee and Solid Waste Disposal Regulation Bylaw No. 306, 2017.	Sets the rules and fees for the disposal of solid waste in the district. It outlines the types of wastes accepted at the district's facilities and the procedures for handling and disposing of them.

Name	Relevance
District of Squamish Solid Waste Utility and Regulation Bylaw No. 2870, 2021	Construction and demolition waste is subject to this bylaw, which requires recyclables and organic waste to be separated from landfill waste (e.g., separating wood waste, metal, cardboard, plastic, etc.).
District of Squamish Demolition Waste Diversion Bylaw No. 2813, 2021	Applies to the diversion and disposal of waste generated by demolition activities (demolition, deconstruction or systematic disassembly of an existing building, structure or improvement regulated by the *Building Bylaw*).
District of Squamish Wildlife Attractant Bylaw No. 2781, 2020	This bylaw is intended to avoid human-wildlife conflicts. It outlines the following waste management requirements: have bear resistant bins for all food waste; keep barbeques on-site clean; store grease, antifreeze, paint or petroleum products so they are inaccessible to wildlife; and, keep food waste out of construction waste bins.
District of Squamish Zero Waste Strategy	The strategy established in 2017 set a target of 75% diversion of waste by 2020 and committed to a per capita target of 350kg by 2026 and zero by 2040. There are a number of Priority Initiatives to support the targets: Priority No. 1 – Implement an Organics Disposal Ban Priority No. 2 – Ensure Recycling and Organics Diversion Programs and Services are Available and Convenient for Everyone at Home, at Work and on the Go Priority No. 3 – Institute Construction and Demolition Waste Diversion Guidelines Priority #4 – Promote Waste Minimization Construction and Demolition Waste is subject to the Solid Waste Bylaw, which requires recyclables and organic waste to be separated from landfill waste. For most construction sites, this means separating wood waste, metal and drywall off cuts, and during the finishing stages separating cardboard and plastic overwrap from the garbage.

4.0 ROLES AND RESPONSIBILITIES

The organizational structure and overall roles and responsibilities are outlined in Section 3.2 of the CEMP. Key roles and their responsibilities for the Contractor to achieve compliance with the WMP during the Project are identified in **Table 4-1.**

Table 4-1: Roles and Responsibilities

Role	Responsibility
Environmental Manager	• Ensure effective implementation and monitoring of this WMP. • Ensure corrective actions are identified and completed in the event of non-conformance to the plan. • Ensure all requirements of the WMP are adequately addressed and that corrective and preventative actions are properly implemented. • Develop alternative mitigation measures if current measures are ineffective or may be improved. • Maintain waste disposal records. • Oversee the tracking and maintenance of the Waste Register. • Document key waste statistics in the Monthly Environmental Report.

Role	Responsibility
	• Vet proposed waste transport operators and disposal facilities. Review relevant permits, approvals, and licenses at least once per year. • Ensure all personnel is properly trained in waste management measures. • Ensure waste streams and quantities are identified. • Ensure hazardous wastes are appropriately handled, stored, transported and disposed of at an appropriate facility or location.
Environmental Monitor(s)	• Ensure construction activities proceed in an environmentally responsible manner meeting the requirements of the WMP. • Conduct daily site inspections to ensure waste materials are properly collected, stored, and handled. • Evaluate the effectiveness of waste mitigation measures and provide recommendations to modify or improve them. • Ensure any non-conformances and incidents are properly addressed and reported. • Update waste stream inventories at a minimum of once per month. • Ensure records of types and quantities of waste generated, stored, or removed from the Project site are maintained. • Ensure all relevant waste transport operators and disposal facilities are subject to an appropriate and diligently applied vetting process. • Collect waste disposal certification documents.
Construction Personnel	• Segregate waste streams to facilitate reuse, recycling or disposal. • Manage wastes in designated areas where appropriate or required, • Practice good housekeeping to minimize potential wildlife attractants.

5.0 BEST MANAGEMENT PRACTICES

Waste management measures to be considered during the Project are presented within **Section 5.0**. The following waste management guidance documents were reviewed to identify appropriate waste management measures (**Table 5-1**). The tools and processes for implementation of the identified management measures are provided in **Section 6.0**.

Table 5-1: Waste Management Guidance

Best Management Practice	Relevant Sections
A Best Practices Guide to Solid Waste Reduction (Canadian Construction Association, 2001).	• Section 2.0: Guidance on waste collection, handling, storage, removal / disposal, waste diversion and hazardous waste management • Section 3.0: Guidance on creating a waste audit – used to assist in waste planning including Waste Stream Profiles • Section 4.6: Guidance on separation of waste materials • Section 5.0: Guidance on effective establishment of sites and tracking waste.
Construction and Demolition Waste Reduction and Recycling Toolkit 2020	• Information on Hazardous Waste Management • Guidelines on Recycling and Waste Management Programs
Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia (MOE, 2014).	• Section 3: Site Development and Management

Best Management Practice	Relevant Sections
British Columbia Hazardous Waste Legislation Guide (MOE 2016).	• Chapter 3: Process adopted for classification of Waste Streams • Chapter 5: Requirements for Hazardous Waste Containers • Chapter 6: Transportation of Hazardous Waste • Chapter 7: Disposal options for Hazardous Waste • Chapter 10: Storage requirements for Hazardous Waste

5.1 OVERVIEW OF KEY RISKS

Poor or inappropriate management of waste materials may result in an adverse effect to the surrounding environment. The risks of poor or inappropriate waste management include, but are not limited to:

- Improper storage, handling, and transport of wastes resulting in loss of waste material from site causing degradation to the environment.
  - Runoff of waste materials (including leachates) into the adjacent marine environment is identified as a key Project risk.
  - Removal of waste and placement into barges presents additional risk of loss to the marine environment.
  - Adverse weather reducing collection frequency of waste barges, creating risk of insufficient storage space available and loss of material from site.
- Improper handling and disposal of wastes resulting in:
  - Risk to human health and safety (e.g., personnel exposed to hazardous waste materials).
  - Incorrect disposal location with associated environmental and liability risk.
  - Failure to comply with regulatory requirements.
- Attraction to wildlife including pests / wildlife interactions. Inadequate segregation of waste streams resulting in:
  - Disposal of material that may otherwise be reused or recycled.
  - Potential to increase volumes of hazardous waste.
- Hazardous pollution / contamination of the surrounding environment.

5.2 GENERAL MANAGEMENT PRACTICES

The following measures will be implemented to minimize potential adverse effects to the environment associated with waste generated by Construction activities.

- Project-specific orientation will be provided to all personnel in accordance with Section 3.3 of the CEMP, including training on waste management for collecting, handling, and storing waste.
- General site cleanliness will be maintained.
- All waste must be stored in designated locations.

- Identify any wastes onsite prior to commencing site works.
- Ensure waste management planning is undertaken in accordance with this WMP, including designation of a waste classification and Waste Stream Inventory (for all waste already onsite and expected to be produced during construction), determination of storage and handling facilities, determination of disposal requirements, and identification of waste transporters and disposal facilities prior to commencing works.
- Display the Site Layout - Waste onsite, so it is available to all workers for reference and guidance.
- If hazardous wastes are encountered unexpectedly, work shall be paused, taking any precautionary measures until the Environment Manager is notified and advises how to proceed.

5.3 WASTE CLASSIFICATION

Waste Classification is to be undertaken in accordance with the British Columbia Hazardous Waste Legislation Guide (MOE 2016), 'Chapter 3 When is a Waste a Hazardous Waste'. The Procedure provides an elimination-based process to determine if a waste is hazardous. An overview of the Procedure is provided below:

1. Starting Point – determine if the substance or stream is a waste.
2. Exclusions – identify if the waste is excluded from being hazardous by definition according to the British Columbia Hazardous Waste Legislation Guide (BC MOE 2016) shown in **Error! Reference source not found.** below.
3. Characterization – determine the properties of the waste and what it is comprised of by using analysis, calculations, or knowledge of the waste origin.
4. Dangerous Goods Check – determine if the waste is classified and regulated as a dangerous good if transported. A waste is classified as dangerous goods if it is in one or more classes defined by the Transportation of Dangerous Goods (TDG) Regulation (BC 1985).
5. Hazardous Waste Regulation Check – determine if the waste is one of the other types of hazardous waste.

Construction waste classifications include, but are not limited to:

- Wood Waste (e.g., heavy timber, pallets, dimensional lumber)
- Metal Waste (e.g., metal strapping, rebar, steel beams, pipes)
- Concrete Waste (e.g., bricks, blocks, excess structural concrete)
- Electrical Waste (e.g., electrical equipment and cables)
- Asphalt Waste (e.g., saw-cuttings, excess asphalt paving)
- Packaging materials

Domestic waste classifications include, but are not limited to:

- Office Waste (e.g., paper, cardboard, aluminum containers, electronics, glass containers, green waste, food waste)
- Liquid Waste (e.g., sewage from portable toilets, vehicle wash water)

Table 5-2: Definition of Hazardous Waste (BC MOE 2016)

Types of wastes defined as hazardous wastes	*Hazardous waste* means:
	• dangerous goods if they
	  ○ are no longer used for their original purpose, and
	  ○ meet the criteria for class 2, 3, 4, 5, 6, 8, or 9 of the Transportation of Dangerous Goods Regulations,
	including those that are recycled, treated, abandoned, stored or disposed of, intended for recycling, treatment, or disposal or in storage or transit before recycling, treatment, or disposal
	• PCB wastes
	• biomedical wastes
	• wastes containing dioxin
	• waste oil
	• waste asbestos
	• waste pest control product containers and wastes containing pest control products, including wastes produced in the production of treated wood products using pest control products
	• leachable toxic waste
	• waste containing tetrachloroethylene
	• wastes listed in Schedule 7
	• waste containing polycyclic aromatic hydrocarbon, or
	• on site media that is stored ex situ unless the on site media is stored for one of the following purposes:
	  ○ transport from the contaminated site within 60 days, or a different period approved by the director, from the date when the on site media was physically removed or excavated from where it originated
	  ○ remediation activities that involve the handling, management or treatment of contamination in accordance with the Contaminated Sites Regulation, or
	  ○ another approved purpose

Types of waste excluded from definition as hazardous waste	Hazardous waste does not include:
	• household refuse that is collected from residential premises
	• domestic sewage
	• dangerous goods that are defective, surplus, or otherwise not usable for their intended purpose and that are in the process of being returned directly to a manufacturer or supplier
	• asphalts and tars used in the manufacture of asphaltic concrete and roofing materials
	• waste wood products treated with wood preservatives or wood protection products registered under the *Pest Control Products Act* (Canada)
	• household hazardous waste that:
	  ○ is removed from a return collection facility in accordance with an authorization from the owner of the return collection facility and
	  ○ is to be reused for its originally intended purpose
	• wood ash, or pulp mill dregs and grit, that would be hazardous waste only because they are classified under the federal dangerous goods regulations as class 8
	• waste that
	  ○ has a pH greater than or equal to 2.0 and less than or equal to 12.5, and
	  ○ would be a hazardous waste only because it is classified under the federal dangerous goods regulations as class 8 because of pH, or
	• on site media

The Hazardous Waste Regulation addresses the proper handling and disposal of hazardous wastes under the Environmental Management Act. The Hazardous Waste Legislation Guide will be used for specific storage, handling, and disposal requirements of the different hazardous waste classes (BC MOE 2016). It is possible for waste to be in more than one class. If this is the case, the class that shows the most important hazard will take precedence. The classifications for hazardous wastes include, but are not limited to:

- Those described in Schedule 7 of the Hazardous Waste Regulation
- Asbestos Waste
- Hydrocarbon Wastes (e.g., PCBs, PAHs, dioxins, oils)
- Leachable Toxic Waste
- Pest Control Product Containers and Waste
- Dangerous Goods if they are no longer used for their original purpose including gases, flammable liquids, flammable solids, oxidizing substances and organic peroxides, toxic and infectious substances, corrosive substances, and miscellaneous dangerous goods.

5.4 WASTE HIERARCHY

Waste will be managed according to the following hierarchy:

- Avoid unnecessary resource consumption and by extension waste generation.
- Reduce quantity of waste generated during construction activities.
- Reuse potential waste resources where possible both on the Project and off the Project.
- Recycle (e.g., transporting excess materials to a recycling facility).
- Treat waste materials to enable reduction, reuse, or recycling (e.g., treatment of water to enable discharge from site).
- Dispose waste to a landfill.

Opportunities for avoidance, reduction, reuse, recycling, and treatment of waste materials in line with District of Squamish zero waste goals is provided in **Table 5-3**.

Table 5-3: Waste Reduction Opportunities

Management Process	Opportunities
Avoid and Reduce	• Minimize land clearance and retain vegetation. • Accurately measure and estimate material quantities – purchase only the necessary amounts of materials to meet Project requirements. • Use recycled and prefabricated materials where possible. • Wherever possible, require suppliers to reduce or take back plastic packaging and any damaged materials. • Purchase materials in bulk where possible to minimize packaging wastes. • Compost food scraps and other organic materials.
Reuse	• Store stripped topsoil for revegetation of site. • Save unused / excess materials for future use.

Management Process	Opportunities
Recycle and Treat	• Identify waste facilities that can receive the identified waste streams. Review transport and disposal costs to confirm disposal at waste facility is sustainable (i.e., economically feasible). • Process large trees as lumber or firewood. • Compost vegetation removed from site.

5.5 STORAGE AND HANDLING

Waste must be stored, handled, and disposed of in accordance with its classification.

The following provides management practices for the storage and handling of waste on the Project site. A layout for waste storage facilities will be developed and included in the EPP.

5.5.1 All Waste

- Plan for adequate storage / stockpiling locations that are on flat ground and outside of flood prone areas. Ensure waste is kept at least 30 m away from environmentally sensitive areas, including the marine environment, riparian protection zones, green zones, and watercourses or ditches that connect with watercourses.
- Determination of adequate size for waste storage areas must consider risk of waste not being collected from barges due to adverse weather conditions.
- Ensure waste storage areas are bunded and well maintained to prevent runoff.
- Ensure storage bins are an appropriate size and are bunded, covered, and in good condition (e.g., not leaking).
- Separate waste into different waste streams and store in properly labeled containers and bins to avoid contamination.
- Clearly labelled garbage bins with lids and recycling containers will be made available for food waste and recyclables.
- Food waste will be stored in wildlife-proof bins. Feeding wildlife directly or indirectly is strictly prohibited.
- Organic materials generated from vegetation clearing will be stored onsite where it will be stockpiled for beneficial use (e.g., stabilizing re-vegetated areas).

5.5.2 Liquid Non-Hazardous Waste

In addition to the previously described storage and handling practices, the following management measures should be implemented for liquid non-hazardous waste:

- Where connection to sewage infrastructure is not possible, portable toilets and hand washing stations should be equipped with closed holding tanks that are emptied into sewage tanker trucks or equivalent on a regular basis.
- Portable toilets will be located on flat ground at least 30 m from environmentally sensitive areas, including the marine environment, riparian protection zones, green zones, and watercourses or ditches that connect with watercourses.

- Portable toilets will be secured to avoid or minimize damage from vandalism (e.g., tipping over) and weather (e.g., wind).
- Provide sufficient back-up capacity for sewage barges in case of adverse weather.
- Other non-hazardous liquid wastes consist of waste waters and shall be managed according to the Water Management Plan.

5.5.3 Hazardous Waste

In addition to the previously mentioned storage and handling requirements, the following management measures must be implemented for hazardous waste:

- Containers must be labelled with the shipping name of the hazardous waste it contains and stored, handled, and transported in ways that avoid leakage or rupture.
- Hazardous wastes should be stored in a secure area with appropriate signage.
- Secondary containment will be used when storing liquid hazardous material.
- Repacking of hazardous wastes will be avoided except when essential (e.g., container is leaking) to reduce the chance of spills and exposure to hazardous chemicals.
- Proper protective clothing and equipment will be worn when handling hazardous wastes.
- No smoking, drinking, or eating is allowed when handling hazardous wastes.
- Wash and clean up is required after handling hazardous wastes.
- Containers of hazardous waste must be kept closed at all times during storage or transport except when being filled or emptied.
- Hazardous wastes will not be burned or buried onsite.

5.5.4 Sewage

If sewage generated on-site (excluding the floatel) exceed the allowable discharge volume of the existing discharge authorization, the excess quantity will be taken off-site for disposal at an approved facility.

5.5.5 TRANSFER OF WASTE TO BARGE

The floatel service provider has been selected and planning is underway and mitigations specific to the floatel will be outlined in a waste management plan specific to the vessel.

The waste management plan for the floatel will include mitigations that will ensure no discharge of sewage to Howe Sound.

5.6 DISPOSAL

- No construction or demolition waste will be sent to District of Squamish facilities. All waste will be diverted to approved facilities determined by the Contractor. This action will contribute to the achievement of the District of Squamish Zero Waste Strategy Targets.
- Any waste materials disposed of offsite will be at appropriately licensed facilities (see **Section 6.1**).

- Waste disposal will be tracked as described in **Section 6.2.**
- Waste will be removed from site regularly. At a minimum, waste will be scheduled for removal from site when facilities reach 80% capacity.
- Sanitary waste will not be discharged into a watercourse or to ground.
- Waste containers may only be reused for other shipments if they are in good condition and meet relevant requirements. When reusing containers compatibility of wastes and residues in the container will be considered prior to reuse.
- If reuse or recycle of waste containers is not practical, they may be disposed of at a permitted disposal facility if they no longer contain enough waste to qualify as hazardous waste or have been properly decontaminated with suitable solvent.
- Ensure on-site sewage disposal systems are properly installed and maintained.

5.7 SPILLS

Construction activities have the potential for spills and leaks of fuels, concrete, oils, and other hazardous chemicals, particularly in relation to their use, storage, and handling. Spill kits are to be kept onsite and staff trained in their use. In the event of any accidental spills or leaks, works in the affected area will cease immediately, the waste will be contained and cleaned up, and the incident will be reported. Further details on the management of spills and emergencies are described in Section 6.0 Incident Management of the CEMP and the standalone Emergency Response Plan. Incident Response covered in the CEMP includes requirements and guidance on spill prevention, spill response and spill reporting.

6.0 IMPLEMENTATION

The tools and processes for implementation of the identified management measures are provided in **Section 6.0**.

6.1 WASTE STREAMS

All waste will be classified within a Waste Stream Profile. The Waste Stream Profile will be recorded in an inventory, including the types of waste (classification) and source, the quantity of each waste type, and the intended disposal option. In addition, the Waste Stream Profile will be used by the Contractor to determine:

- The facilities required onsite including the location and size of storage areas, management controls to contain wastes (e.g., as described by Chapter 10 of the British Columbia Hazardous Waste Legislation Guide, MOE 2016).
- License requirements for waste transporters and disposal facilities (e.g., as described by Chapter 19 of the British Columbia Hazardous Waste Legislation Guide, MOE 2016).

The Waste Stream Profile will be completed by the Environmental Manager prior to commencement of construction works. The Environmental Monitor will update the Inventory at a minimum, once per month and prior to the commencement of a new Project stage.

Templates for the Waste Streams for non-hazardous and hazardous wastes are provided in **Appendix A** and **Appendix B**.

6.1.1 WASTE CLASSIFICATION

The following provides an overview of the classification requirements to be undertaken for identified waste streams.

Table 6-1: Waste Classification Requirements

Waste	Classification Requirements
Sewage (not including floatel)	• Wastewater sampling to be completed to determine water quality • Note - Floatel sewage is managed under the floatel waste management plan.
Contaminated Soils	• Sampling to confirm contaminants of concern and removal options

6.2 WASTE TRACKING

The Environmental Monitor will ensure records of the types and quantities of waste generated, stored, or removed from the Project site are maintained. A Waste Register will be used to track transport and disposal of waste generated on the Project site (**Appendix C0**).

The Waste Register will include:

- Site address and responsible person (for management of waste).
- Date waste was removed from site.
- Waste type (classification) and estimated quantity.
- Waste transporter (company name) and waste transporter vehicle registration.
- Intended waste disposal facility and licence number.
- Disposal docket (or similar) number and confirmed disposal volume.
- Intended waste facility and facility license/approval number.

The Environmental Monitor will cross check that the waste transporter and disposal facility have undergone the vetting process as described in **Section 6.3**.

6.3 RECORD RENTENTION

The Environmental Monitor is also responsible for collecting waste disposal certification documents. These records must be kept for at least two years in the form of paper or computer files.

The Environmental Manager is responsible for vetting all waste transport operators and disposal facilities prior to their engagement. This may be completed throughout the construction phase of the Project. The vetting process will include review of relevant documentation including permits, approvals, and licenses. Information received from the vetting process will be documented in the Waste Transporter and Disposal Facilities Manifest (**Appendix D**).

The Environmental Manager will review waste transport operators and disposal facilities relevant permits, approvals, and licenses at a minimum of once per year.

7.0 MONITORING

The monitoring of waste management during Project activities will be conducted as part of the Project's overall environmental monitoring program described in Section 7.0 of the CEMP. Specific monitoring of waste management will be conducted as follows:

- On-site inspections of management controls will be completed during the General Site Inspection (see Section 7.0 of the CEMP).

8.0 REPORTING

8.1 MONTHLY ENVIRONMENTAL REPORT

The Environmental Manager will document the following information regarding waste in the Monthly Environmental Report:

- Any non-compliance events identified during site inspections and implementation of corrective measures.
- Type and quantity of non-hazardous and hazardous waste generated during the reporting period.
- Amount of waste recycled / disposed of and the receiving location.
- Any reportable spill, including the effectiveness of cleanup measures.

9.0 LITERATURE CITED

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Woodfibre LNG. 2015. Application for an Environmental Assessment Certificate. Available at: https://projects.eao.gov.bc.ca/p/588511e1aaecd9001b8272e7/application

Appendix A Non-Hazardous Waste Stream Inventory

Table A-1: Non-Hazardous Waste Inventory

Waste Classification	Waste Description	Source(s)	Estimated waste (t)	Disposal Method(s)
Industrial / Construction Waste				
Domestic Waste				

Appendix B Hazardous Waste Stream Inventory

Table B-1: Hazardous Waste Stream Inventory

Waste Classification	Waste Description	Source(s)	Estimated waste (t)	Disposal Method(s)

Appendix C Offsite Waste Register Template

Table C-1: Waste Register

Date	Transporter[1] Company / Name	Waste Description	Check Appropriate Box[2]			Weight	Disposal Method	Disposal Facility / Destination	Disposal Certification Reference
			R	H	EW				

Received by: _____ On date: _____

[1] Include relevant information on the hauler (Company, Vehicle License/ Registration, etc)
[2] Recyclables (R) – Metal, paper, cartons, glass, precious metals, electric wires and cables, electronics, wood
Hazardous (H) – Chemical wastes (oil, acid, paints, adhesive sludge, inks, organic solvent, empty chemical containers, batteries), asbestos, fibers, fluorescent light bulbs
Exempted Waste (EW) – Garbage (domestic waste)

Appendix D Waste Transporter and Disposal Facilities Manifest

Table D-1: Waste Transporter and Disposal Facilities Manifest

Company Name	Facility / Transporter Name	License Number	License Date of Expiry (if applicable)	Approval Conditions	Date of Last Review

Appendix K Material Change Compliance Review Template

Material Change Compliance Review - Assessment			
Approved Activity			
Description of Change			
Justification for Change			
Assessment of Change			
Valued Component	Potential impact consistent from environmental assessment? (Y/N)	Description of change in impact OR justification as to why impact is not different	Description of required amendment to mitigation measures
Air quality			
Greenhouse gas management			
Freshwater sts'úkwi7 (fish) and sts'úkwi7 (fish) habitat			
Shx̱weṉ (Marine Water) quality and benthic habitat			
Marine sts'úkwi7 (fish) and mammals			
Vegetation communities			
Terrestrial sekw'ekw'inexw (wildlife) and sekw'ekw'inexw tl'a shkwen (marine birds)			
Labour market and sustainable economy			
Infrastructure and community services			
Temíxw (Land) and resource use			
Marine transport			
Visual quality			
Community health and well-being			
Heritage resource			
Human health			

Material Change Compliance Review - Summary			
Consistency	Yes	No	Commentary
Does the assessment in the above environmental impact table conclude:			
There are no new impacts?			
The change will have a similar, lesser, or positive impact compared with the approved impacts?			
The change can be managed without any new mitigation measures?			
There will be no new receptors affected by an impact who were not previously?			
Is the change consistent with the objectives in the Project Approvals?			
Is the change consistent with the Project description in the approved Project Approvals?			
Is the change consistent with all mitigation measures in the Project Approvals?			
Is an update to the Project CEMP or any Component Plan required (provide justification)?			