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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
October 2023

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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 Sḵwx̲wú7mesh (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 Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) through Sḵwx̲wú7mesh 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, Sḵwx̲wú7mesh 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 Stak̲w (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 Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) Certificate of Project Approval.	Entire plan
SNEAA 4.6 – Condition #6	This 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.	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 will 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 will 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 will 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 will 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 will, 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 will 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 will 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 will, 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 will 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 will 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

1.1.1.1.1 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.

2.1.1.1.1 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"):

a. Woodfibre LNG's explanation of how the mitigation measure is being followed;

b. 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);

c. 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.

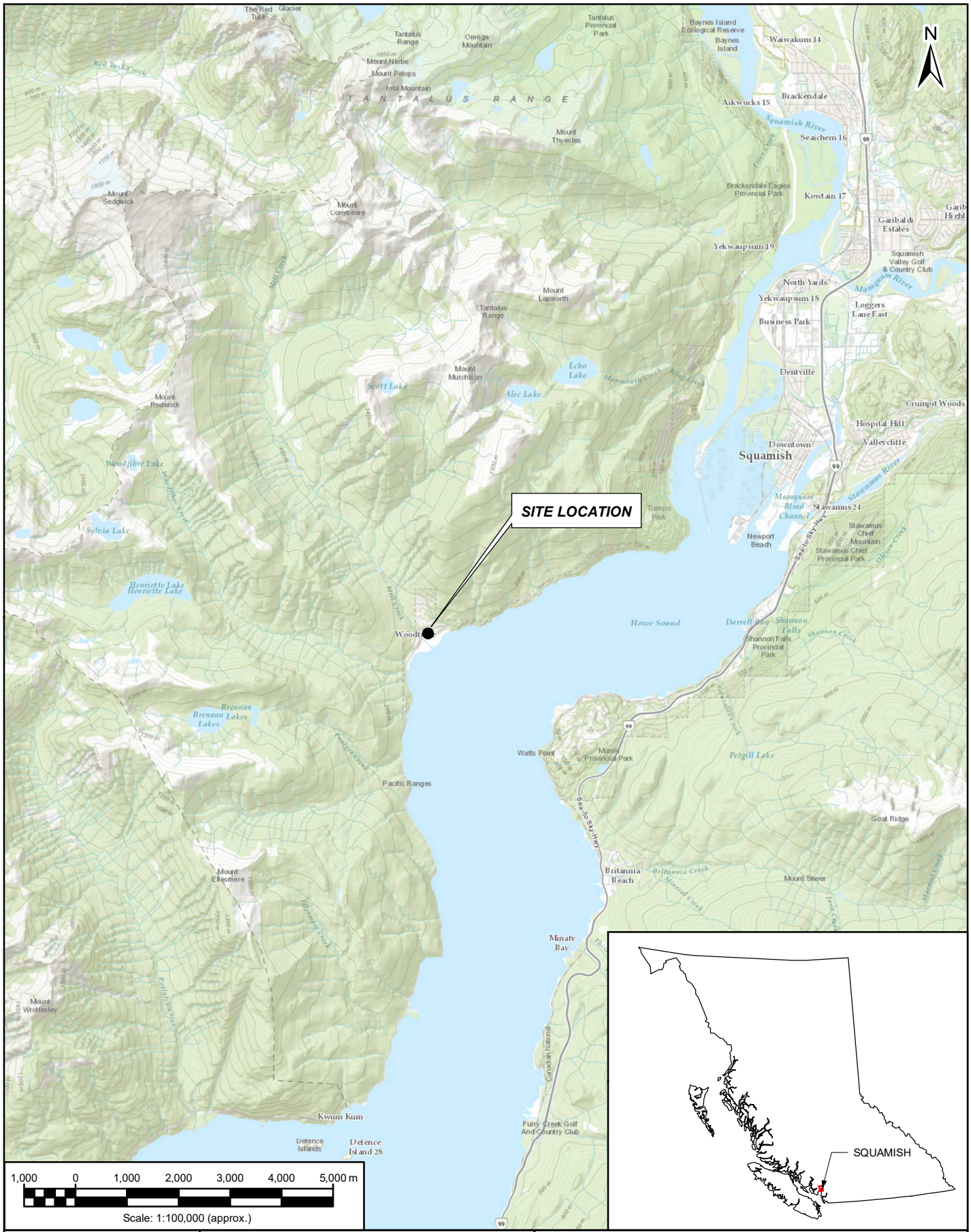
(d) Should Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) not be satisfied with the Response, then the Sḵwx̲wú7mesh Úxwumixw (Squamish Nation) may submit the matter to the dispute resolution process set out in section 8.1 and if the reasonableness of the Response is at issue the expert or expert panel shall 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

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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 Átlḵ'a7tsem (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

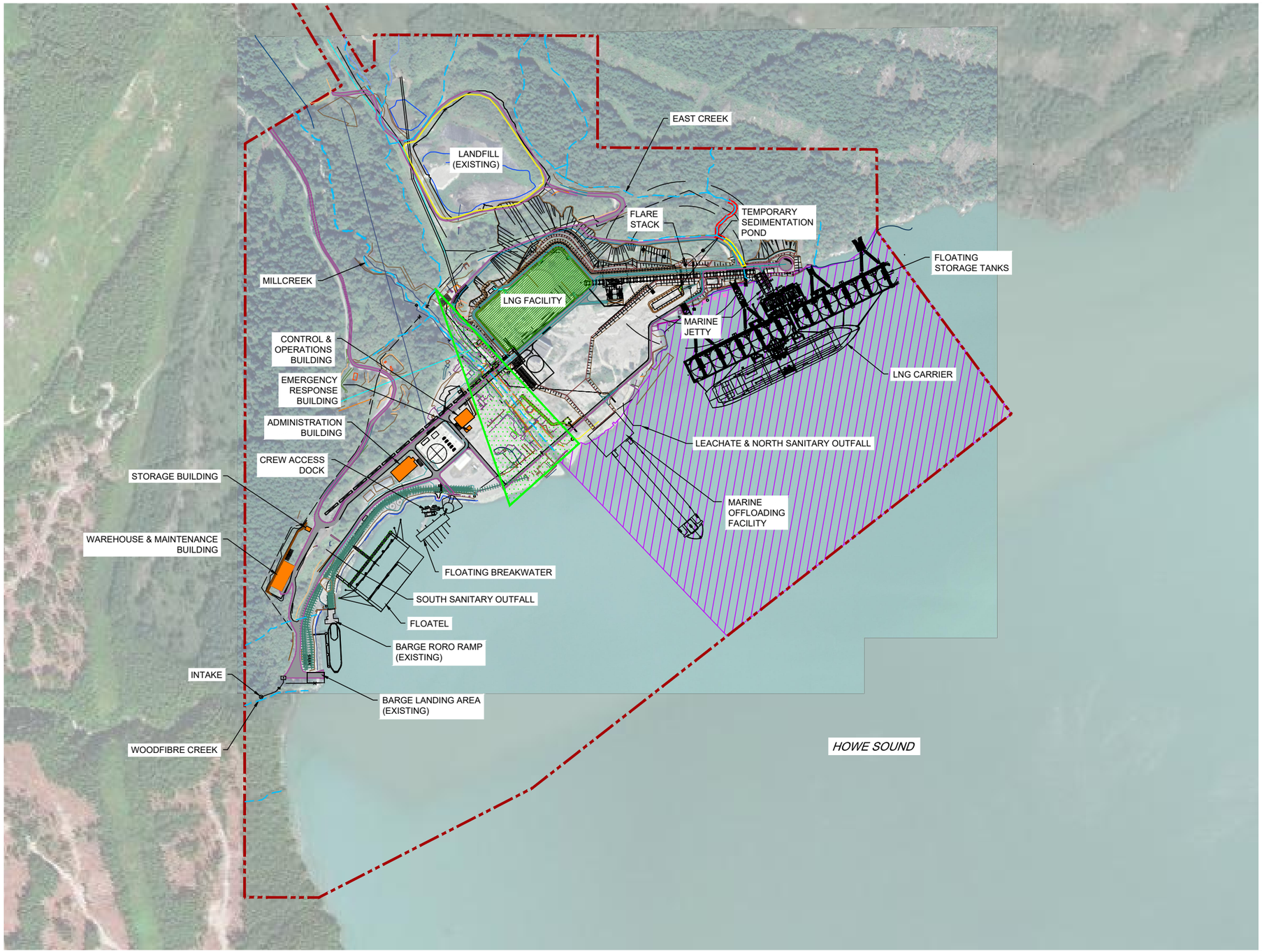
The Project is located at the former Woodfibre Pulp and Paper Mill, approximately seven (7) kilometres (km) southwest of Skwxwú7mesh (Squamish), British Columbia (BC) within the District of Skwxwú7mesh (Squamish) municipal boundaries (the Site) (**Figure 1-1**). The Project location, layout, and Certified 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 Sḵwx̱wú7mesh 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 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 responsible Qualified Environmental Professional (QEP) implementing the Plan. See Section 8.5 for guidance on determining which QEP will be responsible for each task.

Table 2-3 Report Version History

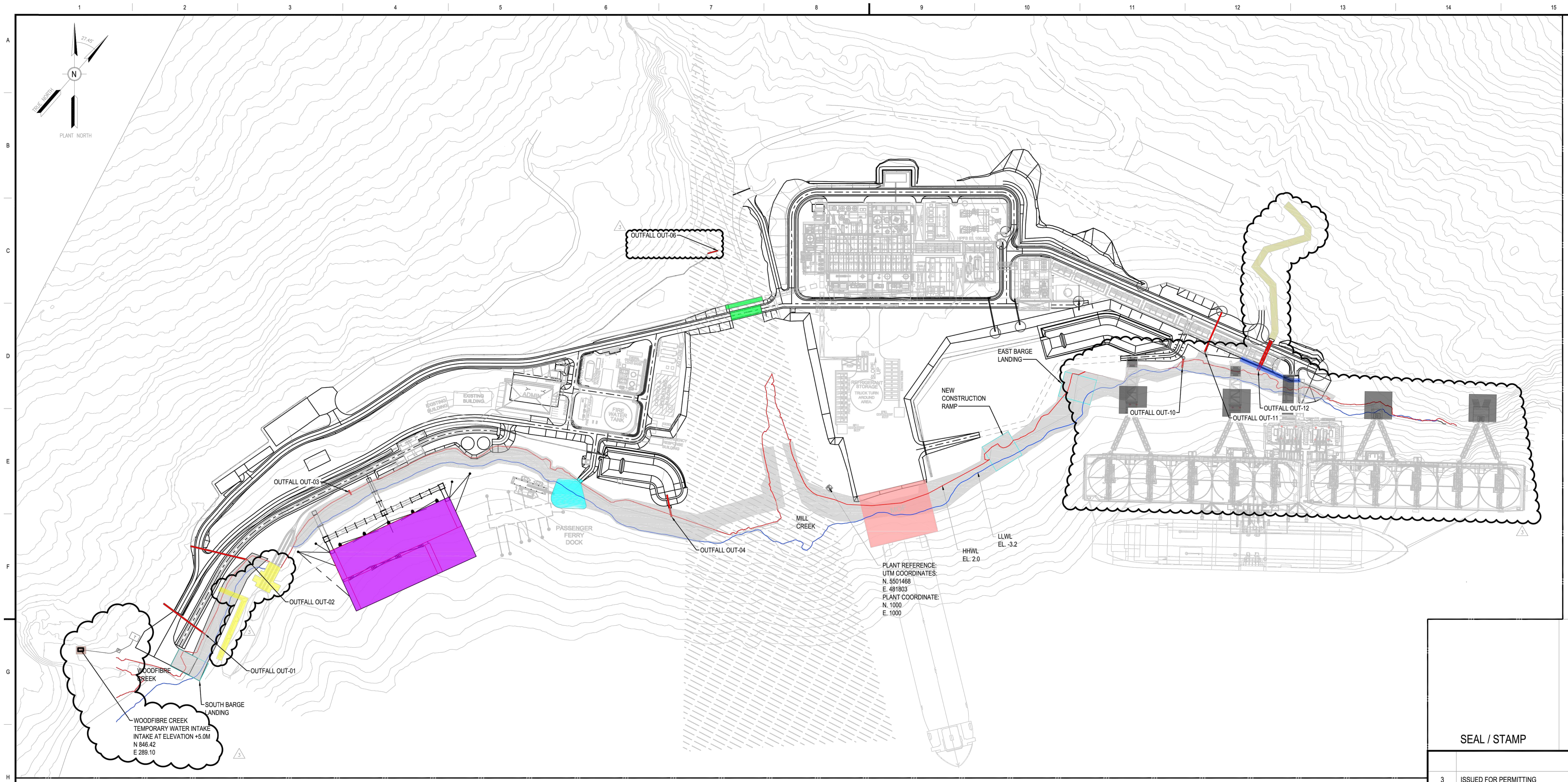
Version	Date Issued	Distribution	Purpose
0.1	May 2019	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation)	Draft for comment
0.2	August 2019	Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) Tsleil-Waututh Nation Fisheries and Oceans Canada Oil and Gas Commission	Draft for comment responding to Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) comments from May 2019
0.3	June 2023	Sḵwx̱wú7mesh 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 Stak̲w (water) Sustainability Regulation.
Culverts and Outfalls	Within Shoreline Armour Footprint	Stormwater outfall culverts will be installed above the higher high stak̲w (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.
Stak̲w (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	APPD	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

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: 350106 | DWG NO: 350106-PER-002001.04 | REV: 3

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 staq̓w (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-staq̓w (water) mark will be installed from a marine piling barge, and piles above the current high-staq̓w (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. The driving of sheet piles will be completed using a vibratory hammer unless another method is required to achieve engineering requirements, as determined by an appropriately qualified engineer. If necessary and with the approval of the responsible QEP, 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.

The23ccesss 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 (as determined by the Contractor) 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 responsible 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-stak̲w (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 staq̓w (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 to the bed of the creek using methods such as driven steel dowels, tee posts, and precast concrete lock blocks. 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 staq̓w (water) line route and will be minimized to facilitate pump access and above ground staq̓w (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 will be performed by construction personnel throughout the operations of the temporary intake. After completion of construction activities, the temporary raw staq̓w (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
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

Component	Start	Finish	In-Stak̲w (water) Works within Least Risk Window
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 Stak̲w (water) Intakes	01-Sep-23	Through construction 01-Mar-26	Yes
Marine Terminal			
Blasting	01-Nov-23	31-Jan-24	No in-stak̲w (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. Specific to this management plan, Woodfibre environment representatives (including the Woodfibre Environmental Monitor) will work together with the Contractor Environment Manager and Environmental Monitors to coordinate adaptive management resources and QEP recommendations resulting from on-going monitoring results being reported and consolidated throughout the construction phase of the project. 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 and activity 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.
Woodfibre Environmental Monitor (Section 3.2.1.1. of CEMP)	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 Monitors 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.
Contractor (Section 3.2.2. of CEMP)	The Contractor (s) is responsible for the development of Contractor Implementation Tools, which must outline the management measures included in this report. Activity-specific 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.

Participant	Specific Work Activity
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.
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. • 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. • 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 inspections. • 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 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) such as 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.

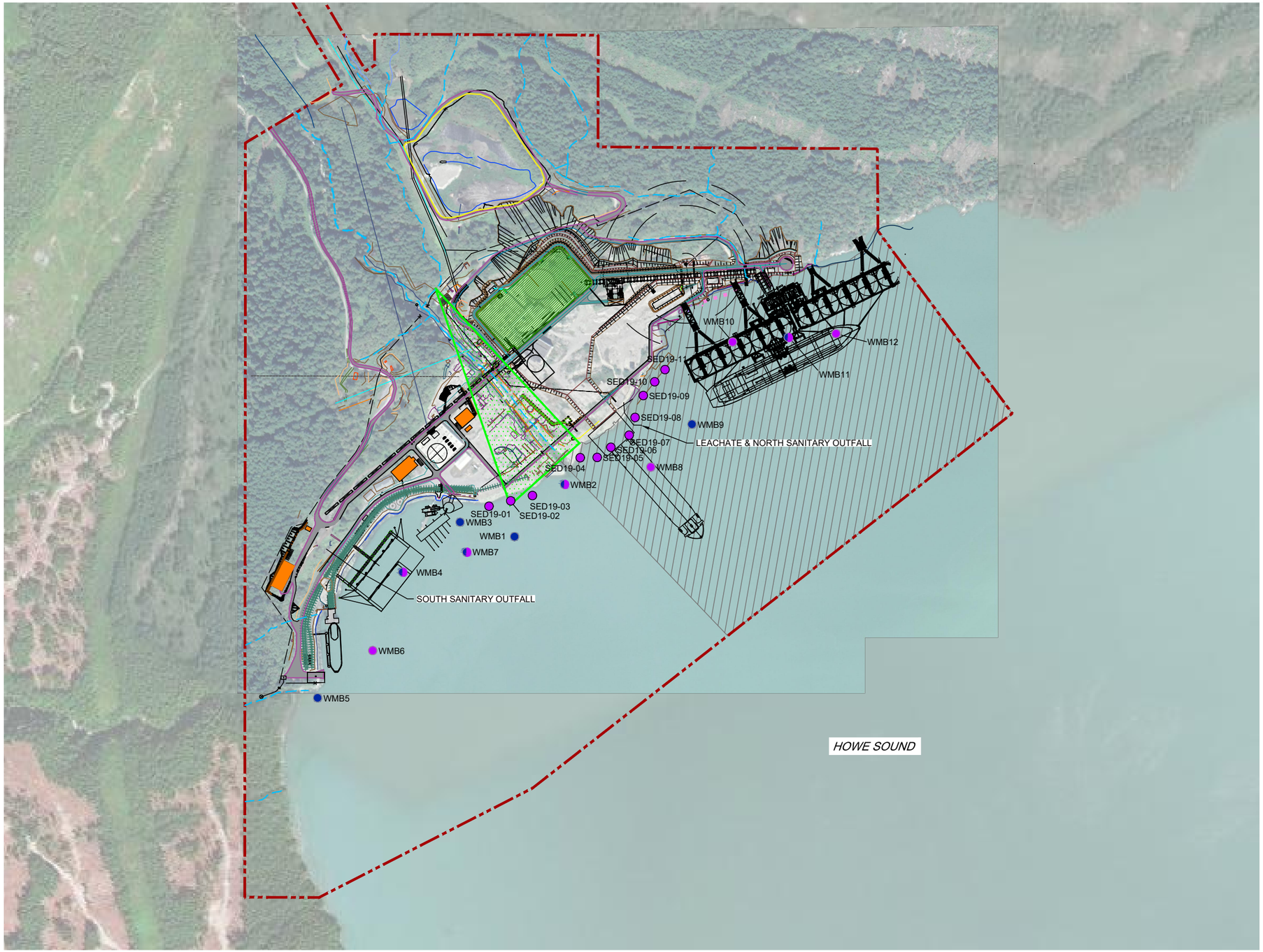
Figure 6-1 and **Figure 6-2** summarize the 2014 baseline sampling program. Of the analysed parameters, total boron, copper, and zinc had elevated concentrations above the BC WQG for marine aquatic life. The average total copper and zinc concentrations were less than the BC WQG for marine aquatic life. 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.)

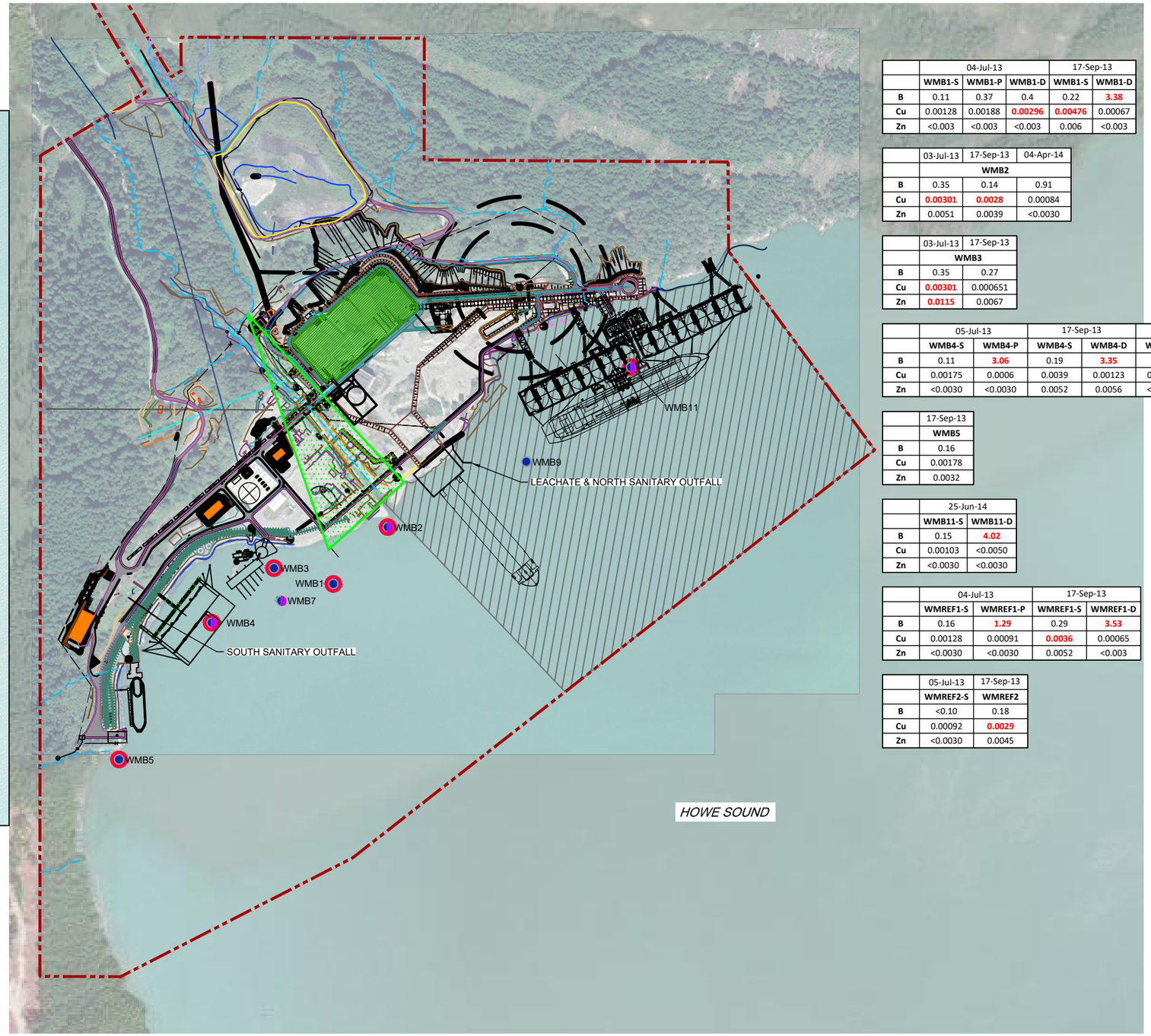
Squamish Pulp Mill (Woodfibre)
Squamish, B C
Woodfibre LNG Limited

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, Sḵiẃx̲ (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 stak̲w (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*

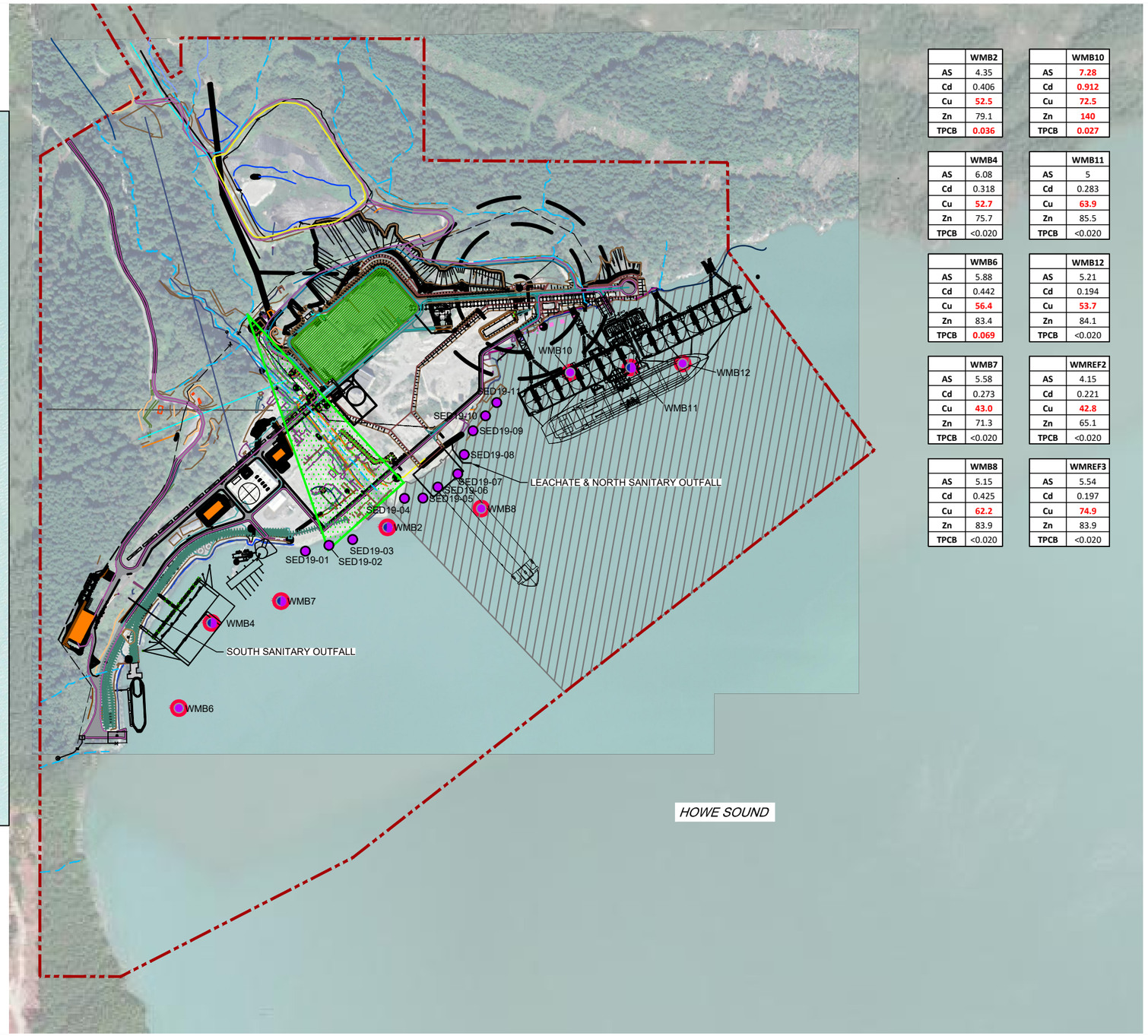
Notes:
ISQG – CCME & BC ENV Interim Sediment Quality Guidelines
CEPA DAS – *Canadian Environmental Protection Act, 1999, Disposal at Sea Regulations*
PEL – CCME & BC ENV Probable Effect Level guidelines
CSR Sed – BC Contaminated Sites Regulation for sediments
TEQ – Toxic equivalency
- Shaded text indicates 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

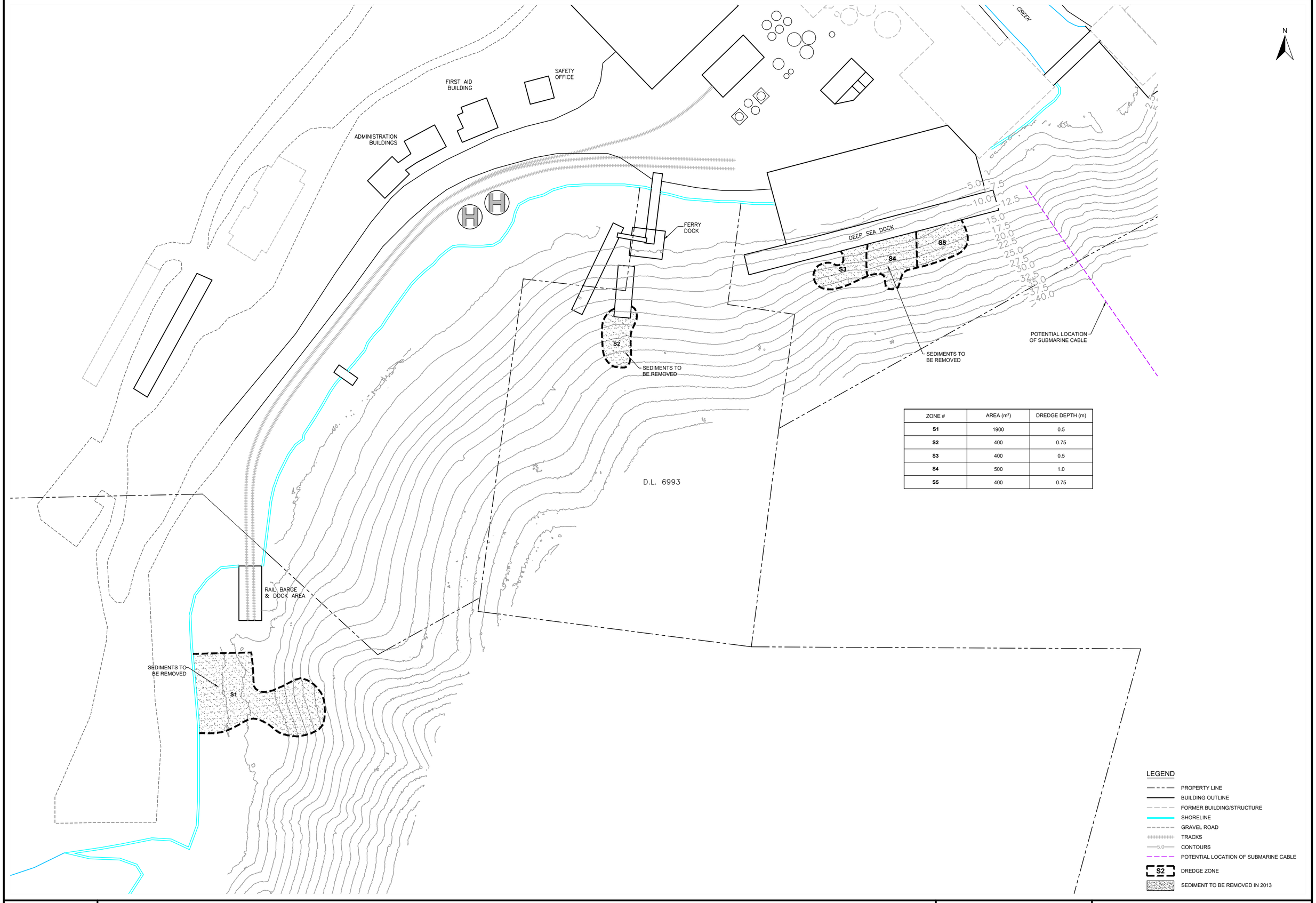
Intrusive environmental investigations identified regulated substances in media at concentrations greater than British Columbia Contaminated Sites Regulation (CSR) standards. Risk assessments were undertaken to evaluate whether the identified regulated substances in environmental media pose unacceptable 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 stak̲w (water) lot relative to the "fishable" portion of Howe Sound). The approach taken is likely conservative due to several factors. Firstly, the area of stak̲w (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 will 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 will 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 stak̲w (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 Lhémk̲w'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 Átlk̲'a7tsem (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 stak̲w (water) quality were not significant:

> *No Project-related changes in marine stak̲w (water) quality beyond natural variability and exceeding stak̲w (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 Stak̲w (water) Quality'. Mitigation ID relates to the unique ID assigned to mitigations in the Environmental Assessment Application.

Table 7-1 Marine Stak̲w (water) Quality Mitigations for the Construction Phase

Summary of Potential Effect	Project Design Measure / Mitigation	Mitigation ID
Potential change in marine stak̲w (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 stak̲w (water) quality due to seabed disturbance and siltation during marine construction	Marine Works Management Plan	M5.10-1
Potential change in marine stak̲w (water) quality due to release of cementitious material during cast in place works	Concrete Works Management Plan	M5.10-2
Potential change in marine stak̲w (water) quality from creosote during removal of old piles	Minimize the Effects of Creosote Pile Removal	M5.10-3
Potential change in marine stak̲w (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. Stak̲w (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 stak̲w (water) column before reaching the seafloor.

7.2 General Marine Works Management and Timing Windows

The following mitigation measures for marine stak̲w (water) quality effects will be adhered to during marine construction works:

- Construction activities will be monitored by the Contractor 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-stak̲w (water) works (as determined by the responsible QEP) and at all times when construction is to occur outside the timing work window.
- Where there is potential for Sts'úkwi7 (fish) to be harmed by changes in stak̲w (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 responsible QEP with the Contractor and submitted for review and approval by Woodfibre LNG prior to works commencing and will meet requirements in salvage permits.
- 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) or otherwise approved by the responsible QEP if not possible for another reason.
- Shore based equipment maintenance and fuelling will be conducted at a distance of greater than 30 m from marine stak̲w (water) and freshwater environmental features, or as approved by the Environmental Monitor.
- Grounding of stak̲w (water) borne equipment will be avoided in order to minimize disturbance of the seabed and resuspension of sediment.
- Works will be conducted in a manner to prevent the discharge or introduction, either direct or indirect, of soil, sediment, or sediment-laden stak̲w (water), turbid stak̲w (water), or any other deleterious substance into aquatic environments. All discharges from construction activities will meet BC WQG or CCME stak̲w (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 stak̲w (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 will 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. Based on the results of water quality monitoring as determined by a QEP, additional mitigation will be required to minimize resuspension of marine sediments resulting from seabed scouring (**Section 7.7**).
- Stak̲w (water)-based equipment (i.e., boats and barges) will 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 will 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;
- 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 stak̲w (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 the responsible QEP based on the results of stak̲w (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 stak̲w (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 an 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 by the contractor QEP determines that the work will not cause serious harm to fish or their habitat, and that assessment is provide to Woodfibre LNG Similarly, should any residual single piles need to be removed, the responsible QEP will conduct an assessment and piles will be as accordingly.
- Works within intertidal zones will be scheduled during low tide periods to the extent feasible as determined by the responsible 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.
- Pile removal via vibratory extraction is the preferred method of pile removal and will be employed first unless the pile is too decayed or short for the vibratory hammer to grip, or there is a risk of greater disturbance of sediments as determined by the responsible QEP. In the event that vibratory removal is not possible, as determined by a QEP in discussion with the Contractor, other alternative methods including direct cable pulls, clamshell bucket removal or other methods may be used (WDNR, 2017).

- If pile removal is completed using a clamshell bucket, the bucket size will be minimized to reduce turbidity during piling removal and must free of material before it is lowered into the water (WDNR, 2017).
- 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.
- Broken off creosote piles may only remain below the biologically active zone (EAC commitment 5.10-3).
- Upon removal from substrate, the pile will be removed expeditiously from the water into the containment basin. The pile will not be shaken, hosed-off, left hanging to drip or any other action intended to clean or remove adhering material from the pile (WDNR, 2017).
- 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.
- The work surface on barge deck or pier, or upland staging area will include a containment basin for all treated materials and any sediment removed during pulling. The containment basin will be constructed of durable plastic sheeting with continuous sidewalls supported by hay bales, ecology blocks, other non-contaminated materials, or support structure to contain all sediment and creosote. The containment basin will be lined with oil absorbent boom (WDNR, 2017).
- Creosote will be prevented from re-entering the water. Uncontaminated water run-off can return to the waterway (WDNR, 2017).
- Absorbent booms will be used around areas where creosote piles are removed (Hutton and Samis 2000). The boom will be located at a sufficient distance from all sides of the structure or piles that are being removed to ensure that contaminated materials are captured. The booms will remain in place until any sheen present from removed pilings has been absorbed by the boom (WDNR, 2017).
- Promptly collect any cut wood, chips, sawdust or debris that enters the aquatic environment (Hutton and Samis 2000).
- To the extent possible, as determined by a QEP through discussion with the Contractor, sawdust will be prevented from contacting the intertidal zone, marine or fresh water bodies. For example, sawdust on top of decking will be removed immediately after sawing operations (WDNR, 2017).
- A sediment containment system (e.g., silt curtains) may be installed as appropriate (as determined by the responsible QEP) during piling removal to prevent the dispersion of suspended sediments and/or debris.
- Cut up piling, sediments, absorbent pads/boom, construction residue and plastic sheeting from containment basin will be disposed of on temíxw (land) in an appropriate waste management facility (Hutton and Samis 2000). Creosote treated materials will not be reused (WDNR, 2017).
- Creosote timber removed from site will be tracked by the Contractor.

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 *Stak̲w (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 stak̲w (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 Woodfibre environmental representatives, including the 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 stak̲w (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 Stak̲w (water) Quality Guidelines, or the work areas and activities contributing to these conditions will be isolated from tidal and flowing stak̲w (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 stak̲w (waters) and reduce the deposition of sand and silt to adjacent areas. Silt curtains will 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 will be deployed around the placement area or rig and around scows where material is deposited.
- When used, the silt curtain will 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 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).
- 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) or otherwise approved by the responsible QEP if not possible for another reason.
- 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 will 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 the responsible 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.
- Recyclable materials will be separated from general waste 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 stak̲w (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 stak̲w (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 additional measures (e.g., temporary debris nets anchored to the rock face and/ or blasting mats) as adaptive management.

8. MARINE STAḴW (WATER) QUALITY ÍNEXWANTAS (MONITORING) AND FOLLOW-UP PLANS

ínexwantas (monitoring) is proposed to verify the accuracy of the environmental assessment, to determine the effectiveness of mitigation measures related to Construction, and to inform the application of adaptive management The following subsections describe the Project stak̲w (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 stak̲w (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 stak̲w (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 stak̲w (water) quality and human health. The marine stak̲w (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

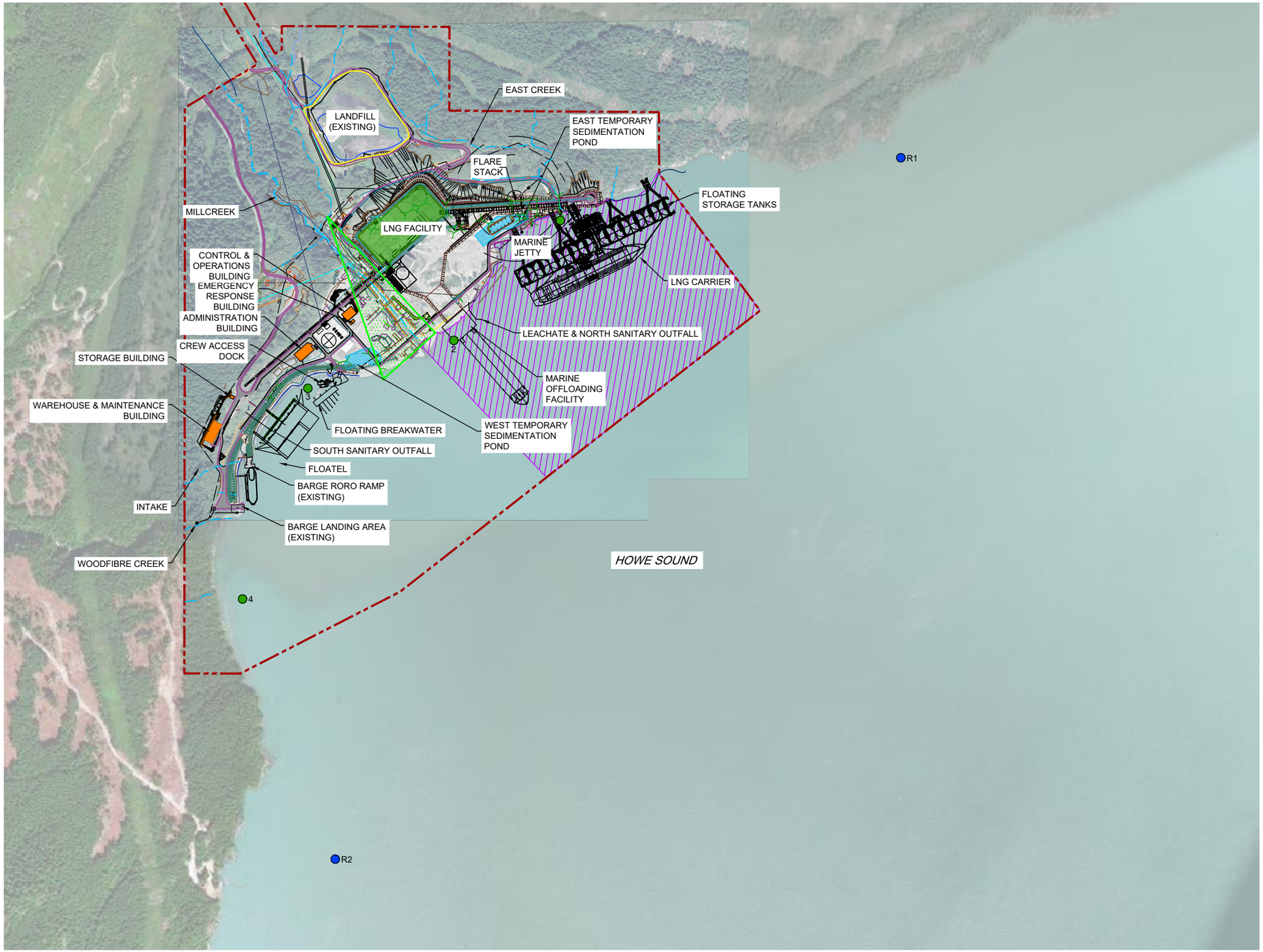
Stak̲w (water) quality ínexwantas (monitoring) will consist of in-situ/ analytical baseline establishment, routine in-situ, routine analytical, and non-routine (exceedance) analytical. Each of these ínexwantas (monitoring) requirements are described in detail below.

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. The Woodfibre QEP will establish the correlation between in-situ turbidity and analytical parameters for non-soluble constituents prior to construction activities commencing that may adversely affect water quality. The correlation work includes marine sediment sampling from the initial marine work areas, including the floatel infrastructure and the material offloading facility. Subsequent analytical work on marine sediment slurries, representing gradations of TSS concentration, will be completed to establish the correlation. On-going routine sampling, as outlined in section 8.2.3, will support the on-going calibration of the turbidity correlation, and provide project-level compliance data.

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 the responsible 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, tributyltin, 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

Activity specific Stak̲w (water) quality ínexwantas (monitoring) will be measured by an Environmental Monitor, overseen by the Contractor QEP, 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.

Stak̲w (water) quality ínexwantas (monitoring) will be conducted during works with the potential to impact marine stak̲w (water) quality as determined by the Contractor QEP in consultation with Woodfibre LNG (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 the responsible QEP.
- If conditions are within stak̲w (water) quality guidelines, ínexwantas (monitoring) frequency may be reduced at the discretion of the responsible QEP and as reported to Woodfibre LNG.

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 preconstruction 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 QEP responsible for establishing and adjusting the correlative relationship.

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 and overseen by the Contractor QEP. 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 Contractor QEP will advise and provide recommendations to the Contractor and Woodfibre LNG to initiate adaptive management as described in section 8.5, 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 Contractor QEP will initiate an order to cease work and will notify Woodfibre LNG. Adaptive measures to the Contractor and Woodfibre LNG to 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 responsible QEP has observed implementation of, or repair to, adaptive mitigation measures.

As a proactive measure, 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 immediately 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 or confirms a trend towards an exceedence, the Contractor QEP will advise the Contractor and Woodfibre LNG andprovide recommendations to coordinate the deployment of additional measures to limit potential increases in the parameter of concern. In situ ínexwantas (monitoring) will increase in frequency, as recommended by the Contractor QEP, 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 Contractor QEP. The Contractor and Woodfibre QEP both have the authority to stop works based on stak̲w (water) quality observations if required to prevent exceedances and will report the stop work order to Woodfibre LNG.

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 Contractor QEP will issue a cease work order and provide recommendations to the Contractor and Woodfibre LNG to coordinate the deployment of additional mitigation and/or monitoring measures.

Additional measures will be implemented to address the exceedance (e.g., slowing down dredging operations, installing additional containment). Once confirmed by the Contractor QEP that stak̲w (water) quality is consistent with guidelines, notification will be provided to the Contractor and Woodfibre LNG that work may restart and in-situ ínexwantas (monitoring) will be implemented at an increased frequency, as determined by the Contractor QEP, 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 the Woodfibre Environmental Monitor (or designated QEP). 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) 500 m North and 500 m South of CPA	R1, R2	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
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 Woodfibre Environmental Monitor or designated Woodfibre QEP.

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 Will 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 Will 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 Stak̲w (water) Quality Guideline (2012) and the BC Recreational Stak̲w (water) Quality Guidelines (2019), both recommend beach stak̲w (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 stak̲w (water) quality sampling required by this plan, context may be provided with ínexwantas (monitoring) reports.

8.2.6 Construction Stak̲w (water) Discharge

Construction stak̲w (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 Stak̲w (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 stak̲w (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 stak̲w (water) quality ínexwantas (monitoring) program. The Environmental Monitor will be audited by the responsible QEP as at frequency determined by the responsible 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 excavation or dredging is required as part of the shoreline protection activity, sampling will be conducted prior to the activity 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**.

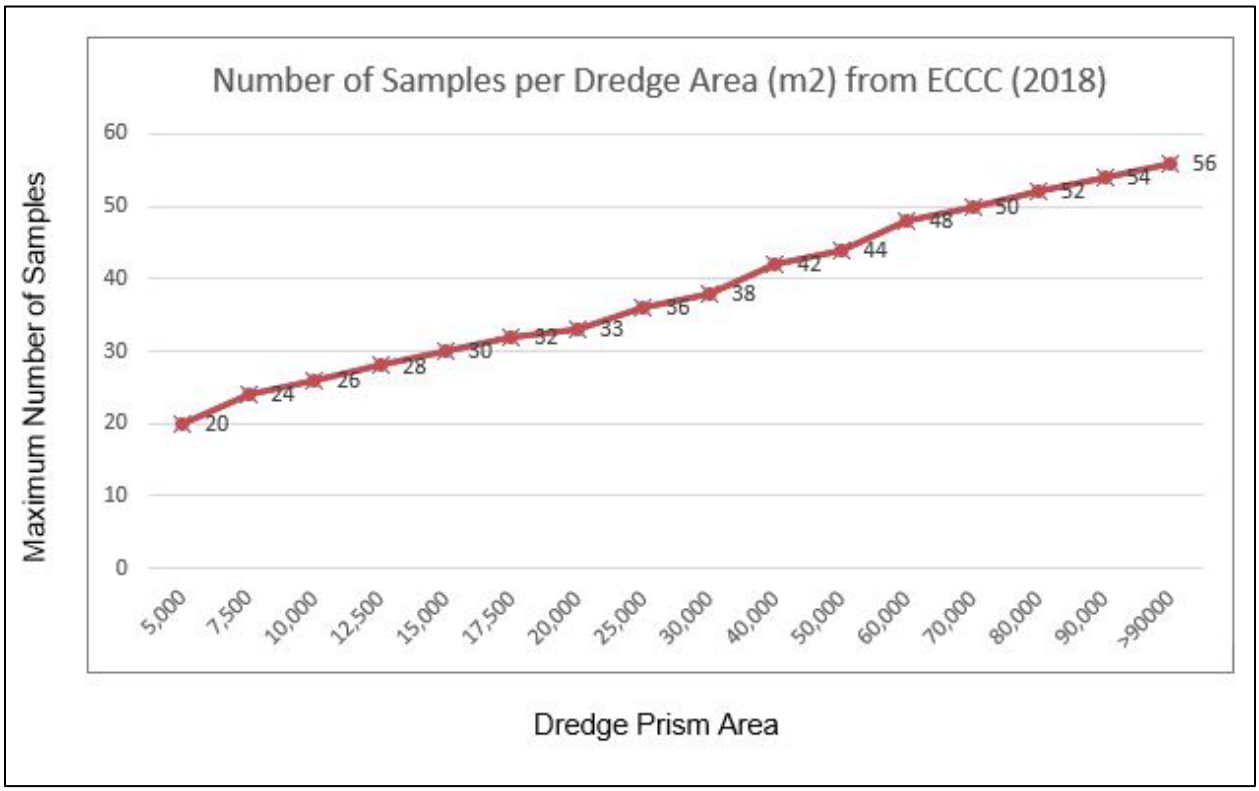


Figure 8-2 Number of Samples per Area (ECCC 2018)

During dredging, the Contractor will be responsible for maintaining environmental control systems such as silt curtains for compliance with permit conditions and stak̲w (water) quality requirements. They will remove debris from the seabed, perform sediment removal using mechanical excavation techniques, dewater the excavated sediment, and transport it along with any debris to the onshore offloading area. Surveys will be conducted during excavation and 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.

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.

[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.

In the event of a stak̲w (water) quality exceedance or upon completion of the excavation 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-existing 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 Lhémk̲w'a (sole), *Parophys vetulus*) Crab (Aẏ̓x (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 stak̲w (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 stak̲w (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, as summarized below, requires that measures are implemented and purposefully evaluated and adjusted in order to achieve objectives. This MWQMMP is a living document and may be revised, as needed based on results of the ínexwantas (monitoring) program.

Adaptive management will be triggered by complementary monitoring tasks that will be deployed as coordinated by the site environmental management team (SEMT). This team consists of the Contractor QEP of record who reports to the Contractor environment manager, and the Woodfibre QEP of record who reports to the Woodfibre LNG. The complementary monitoring task include:

1. The establishment of correlation between in-situ turbidity and analytical parameters for non-soluble constituents including PAHs, hydrocarbons, and total metals.
2. Routine sampling for monthly verification at four (4) per-selected locations within the certified project area (CPA) and two (2) reference locations outside of the CPA. The subsequent data collection will be conducted in-situ and analytically by an accredited laboratory.
3. Activity-specific in-situ field turbidity (NTU) and pH measurements.
4. Non-routine sampling where in-situ measurements for a given activity exceed the acceptable criteria. Rush laboratory analyses will be requested.

The Woodfibre QEP of record will establish the correlation between in-situ turbidity and analytical parameters for non-soluble constituents that may adversely affect water quality. The initial correlation work involves marine sediment sampling from the initial marine work areas, including the floatel infrastructure

and the material offloading facility. Subsequent analytical work on marine sediment slurries, representing gradations of TSS concentration, will be completed to establish the correlation. On-going routine sampling, as outlined in section 8.2.3, will support the on-going calibration of the turbidity correlation, and provide project-level compliance data.

The Contractor QEP of record is responsible for activity specific in-situ monitoring and reporting results to the Contractor site environment manager and to Woodfibre LNG. The Contractor QEP is responsible for determination of activity specific risk to water quality and deployment of mitigation measures prior to activity commencing.

Warning stations and compliance stations will be established around marine activity work areas. Exceedances measured at a warning station will immediately trigger the Contractor QEP to notify the Contractor environment manager and Woodfibre LNG and determine increased sampling frequency and/or additional activity specific measures to be prepared for subsequent deployment. Exceedances measured at compliance stations will trigger an immediate stop work order by the Contractor QEP. Marine work activity cannot re-commence until water quality returns to below the criteria outlined in Table 8-4 and confirmation of additional mitigation measures being deployed to the satisfaction of the SEMT.

Non-routine sampling will be initiated where in-situ measurements for a given activity exceed the acceptable criteria at a compliance station (e.g., NTU). Woodfibre LNG will deploy the QEP when non-routine sampling is required. Samples will be submitted to an analytical laboratory for analysis and comparison to the stak̲w (water) quality criteria outlined in Table 8-6 Rush analysis will be requested and increased sampling frequency will be initiated as determined by the QEP.

If analytical results are above the thresholds listed in Table 8-6, the QEP will compare and report results from historical baseline data, to established background sites, and to current in-situ monitoring results, and will make recommendations for adaptative management to the SEMT to action. Note that the SEMT acts to coordinate resources and does not provide approval for QEP recommendations. Marine works being undertaken at the time will be reviewed and where required revised mitigation will be applied as outlined in the QEP report as described here. Additional stak̲w (water) quality ínexwantas (monitoring) may be conducted, at the discretion of the QEP. The QEP has the authority to stop works based on stak̲w (water) quality observations if required to prevent exceedances.

Further, consistent with EAC condition 6, this plan supports the management of outcomes during the Project Construction phase for marine stak̲w (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, through 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.

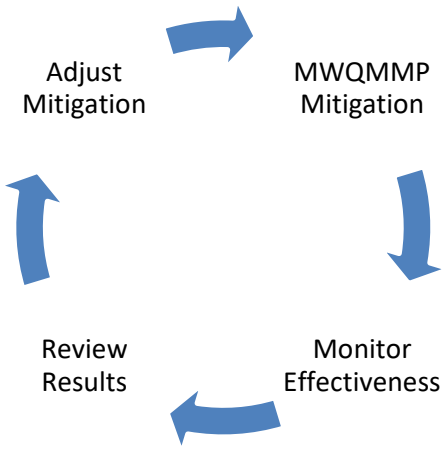


Figure 8-3 MWQMMP Adaptive Management Cycle

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 the responsible 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 Sḵwx̲wú7mesh 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 stak̲w (water) quality, including spills or release of deleterious substances. The Contractor will immediately notify the Environmental Monitor when safe to do so following any environmental incident. The Environmental Monitor will notify the responsible 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, 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 Stak̲w (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.

October 27, 2023
Date

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Warren Appleton, R.P.Bio.
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