Stantec Consulting Ltd.

Technical Assessment Report

In Support of the Section 15 Approval (Tracking # 447386)
for the Sunrise Expansion Program - Agassiz Loop

Stantec

Prepared for:
Westcoast Energy Limited Partnership

April 30, 2026

Prepared by:
Stantec Consulting Ltd.

Project/File:
123317055

Limitations and Sign-off

This document entitled Technical Assessment Report – In Support of the Section 15 Approval (Tracking # 447386) for the Sunrise Expansion Program - Agassiz Loop (the “Report”) was prepared by Stantec Consulting Ltd. (“Stantec”) for the account of Westcoast Energy Limited Partnership (the “Client”). to support the *Environmental Management Act* Section 15 application (the “Application”). In connection therewith, this document may be reviewed and used by the British Columbia Ministry of Environment and Parks participating in the review process in the normal course of its duties. Except as set forth in the previous sentence, any reliance on this document by any other party or use of it for any other purpose is strictly prohibited. The material in it reflects Stantec’s professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The information and conclusions in the document are based on the conditions existing at the time the document was published and does not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by the Client or others, unless expressly stated otherwise in the document. Any use which another party makes of this document is the responsibility and risk of such party. Such party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other party as a result of decisions made or actions taken based on this document.

This document has been prepared by a team of Qualified Professionals (QP)[1] from Stantec. See Appendix A for the list of QPs who have contributed to this Report and signed Conflict of Interest & Declaration of Competency forms.

[1] Per the Application Instruction Document, Qualified Professional means a person who: (a) Is an engineer, scientist or technologist specializing in a particular applied science or technology; (b) Is registered in BC with a professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization; (c) Through suitable education, experience, accreditation and knowledge, may reasonably be relied upon to provide advice within his or her area of expertise and to carry out duties or functions in those areas; and if applicable, (d) Provides the completed Declaration of Competency and Conflict of Interest Disclosure Statements.

Executive Summary

Westcoast Energy GP Inc., general partner of Westcoast Energy Limited Partnership (Westcoast), owns and operates the Westcoast system, a natural gas transmission system that extends from points in Alberta and northern British Columbia (BC) to a point near the international boundary between Canada and the United States near Huntingdon, BC. As part of this system, Westcoast is proposing the Sunrise Expansion Program (the Project), which will include the installation of up to 139 kilometres (km) of nominal pipe size 42 pipeline (1,067 millimetre outside diameter) comprised of 11 pipeline loops.

Discharge permitting under the *Environmental Management Act* is proposed for the two pipeline loops located within the Fraser Valley where high groundwater volumes are anticipated during pipeline construction. Westcoast is applying to the BC Ministry of Environment and Parks for an *Environmental Management Act* Section 15 approval (hereafter 'Section 15 Approval') to allow for short-term discharge (i.e., up to a maximum of 15 months) of groundwater into watercourses.

This Technical Assessment Report (TAR) has been prepared to support Westcoast's application for a Section 15 Approval (Tracking #447386) for the CS-8B–CS9 pipeline loop (hereafter 'Agassiz Loop'). This TAR was prepared and reviewed by a team of Qualified Professionals; it is intended to meet the requirements of the Information Requirements Table issued by the BC Ministry of Environment and Parks on March 31, 2026. Per the requirements, this TAR includes a project description, environmental setting and baseline information, discussion of mitigation and management, effects assessment, and monitoring plans.

The Agassiz Loop is an approximately 13.4 km long pipeline loop located east of Agassiz, BC and runs north of the Fraser River to just north of Hicks Creek, mainly adjacent to the existing Westcoast right of way. During the construction of this loop, groundwater will be discharged to surface water at one or more proposed discharge locations (PDLs). The Agassiz Loop has four PDLs which include three Fraser River locations and one Hicks Creek location. A wide variety of fish species have the potential to be present within the PDL receiving environments, including white sturgeon, salmonids (e.g., salmon, trout, char, whitefish), suckers, minnows, sculpins, and lamprey.

Pipeline construction involves digging a trench as the pipeline is buried underground. The active work area must be dewatered if an accumulation of water (i.e., groundwater, precipitation, runoff) is present. Management of groundwater is a short-term and temporary construction activity needed to support safe and efficient work. Limited sections of the trench (e.g., 300 m) may be open at a time, while the construction crew works through the pipeline installation process of digging the trench, installing the pipe, covering sequential segments of pipe, and backfilling the trench using the original excavated soil material. For most of the Project pipeline loops, groundwater in the trench is limited and, if present, the groundwater can be discharged to the surrounding land. However, in the Fraser Valley, groundwater management is anticipated to be challenging due to the high groundwater table, anticipated dewatering volumes, and background groundwater quality.

Anticipated pipeline construction and associated trench dewatering relevant to this Section 15 Approval application is tentatively scheduled to commence April 2027, pending regulatory approvals. The Section 15 Approval is up to a maximum of 15 months, and pending approval is assumed to be valid from approximately April 2027 to June 2028.

To support construction planning and this TAR, Westcoast established: 1) groundwater monitoring wells to estimate potential groundwater volumes and groundwater quality; and 2) surface water sampling locations to understand receiving capacity, hydrology, and surface water quality for the PDLs. Groundwater and surface water sampling results presented in the TAR typically cover monthly sampling between August 2024 and August 2025. Fish and wildlife habitat field surveys were also completed, between 2023 to 2025, for the area that includes each PDL. In addition to the surveys and sampling specific to this Section 15 Approval application, publicly available databases and historical information for the region was compiled to characterize the environmental settings for the pipeline loop. This TAR details the environmental setting as it pertains to meteorology and climate, surface water hydrology, hydrogeology, surface water quality, freshwater aquatic life, potential contaminated sites, and acid rock drainage/metal leaching potential.

Estimated Dewatering Rates and Groundwater Quality

Groundwater levels along the Agassiz Loop vary. Mainline trench excavations within the northern 1 km segment of the loop are estimated to require up to 104 litres per second (L/s) for dewatering rates. Smaller, localized excavations, such as crossover excavations and bore bays, are expected to require dewatering rates of generally less than 40 L/s, with a maximum of 54 L/s near the Cheam Slough crossing. For the remainder of the pipeline loop, groundwater levels are generally anticipated to be below the trench excavation; however, dewatering may be required under seasonally higher groundwater level conditions (i.e., May to July), with estimated rates generally less than 140 L/s but up to 231 L/s south of Seabird Island. Groundwater recharge from precipitation will be a small fraction of groundwater dewatering rates but may still require management during excavation.

Monitoring results indicated that groundwater has elevated parameters that are within the expected local background concentration range (as compared to provincial guidance, Protocol 9). As discussed further in subsequent sections, water quality data from the groundwater monitoring wells were also compared to surface water quality guidelines for freshwater aquatic life (WQG-FAL), which are considered more relevant for discharge of groundwater into the PDL receiving environments.

The WQG-FAL include BC water quality guidelines, and where BC guidelines are not available, Canadian Water Quality Guidelines developed by the Canadian Council of Ministers of the Environment. A WQG-FAL is a science-based benchmark concentration for a parameter that is intended to protect freshwater aquatic life. WQG-FAL include chronic (long-term) values, intended to protect aquatic organisms from sublethal effects associated with prolonged exposure, and acute (short-term) values, intended to protect against lethal or severe effects resulting from brief or infrequent exposures. Exceedances of chronic or acute WQG-FAL do not necessarily indicate that adverse effects are expected or will occur but rather serve as screening tools to help identify conditions that may warrant further evaluation in the context of site-specific exposure, duration, and receiving environment characteristics.

Surface Water Quality Existing Conditions

Proposed receiving watercourses for groundwater discharges to surface water include the Fraser River and Hicks Creek. Surface water monitoring results indicated that the watercourses have several elevated parameters and existing WQG-FAL exceedances. All three Fraser River locations (PDL-A1, PDL-A8, and PDL-SBI9) had metals (including aluminum, copper, iron, mercury, and zinc) exceeding the chronic WQG-FAL guidelines, with aluminum showing the highest frequency and magnitude of exceedance. Acute WQG-FAL exceedances were noted for iron and copper during some months. For Hicks Creek (PDL-A6) exceedances of metal guidelines—particularly for copper, iron, mercury, and zinc—were common, with some concentrations surpassing WQG-FAL by more than tenfold. Less frequently, concentrations of copper, iron, and zinc were also above the acute WQG-FAL in some months. Peak metal concentrations generally occurred in late summer (August) at Hicks Creek and in late spring to mid-summer (April–July) at Fraser River sites, depending on the metal.

Discharge Quality Criteria

Discharge quality criteria were developed where screening of groundwater quality indicated groundwater concentrations exceeding applicable surface water quality guidelines (i.e., WQG-FAL) or Lower Fraser River water quality objectives (WQOs). Discharge quality criteria were derived for a focused set of parameters referred to as Parameters of Concern, which were identified in accordance with provincial guidance. Parameters of Concern were identified based on screening of groundwater quality results using representative upper-bound concentrations (95th percentile). Parameters with groundwater concentrations exceeding applicable surface water quality guidelines or objectives (i.e., WQG-FAL or WQOs) were identified as Parameters of Concern.

For each Parameter of Concern, a site-specific discharge quality criterion was established to provide an end-of-pipe discharge target for treatment of groundwater discharges. The discharge quality criterion for each Parameter of Concern was set as the greater of the following:

- the applicable chronic WQG-FAL or Lower Fraser River WQO, or
- the 95thpercentile of background receiving-environment surface water concentrations.

This approach allows discharge quality criteria to align with guideline values where background concentrations are lower than applicable guidelines, while reflecting existing ambient conditions where background concentrations exceed applicable WQG-FAL; this is consistent with provincial guidance for protecting existing water quality where generic guideline values are exceeded. The list of identified Parameters of Concern by watercourse and the basis of the corresponding proposed discharge quality criteria are summarized in Table ES.1.

Table ES.1 Parameter of Concerns in Groundwater for the Agassiz Loop and Corresponding Basis for the Discharge Quality Criteria for the Fraser River and Hicks Creek

Parameter of Concern	Basis of Discharge Quality Criteria	
	Fraser River (PDL-A1, PDL-A8, PDL-SBI9)	**Hicks Creek (PDL-A6)**
Nitrate (as N)	Acute WQG-FAL	Chronic WQG-FAL
Nitrite (as N)	Acute WQG-FAL	Background
Total Aluminum	*	Background
Total Iron	Background	Background
Total Mercury	*	Background
Dissolved Cadmium	Acute WQG-FAL	Chronic WQG-FAL
Dissolved Cobalt	*	Background
Dissolved Copper	Background	Background
Dissolved Iron	Acute WQG-FAL	Background
Dissolved Manganese	*	Chronic WQG-FAL
Dissolved Nickel	Acute WQG-FAL	Background

Notes:

WQG-FAL= Water Quality Guidelines for the Protection of Freshwater Aquatic Life; PDL = proposed discharge location

Unshaded cells indicate permit limits are based on discharge quality criteria derived from background water quality (defined as the 95th and 90th percentile for Fraser River and Hicks Creek, respectively).

* Discharge quality criteria are currently not proposed for Fraser River discharge(s) because no acute WQG-FAL exists; chronic WQG-FAL or background will be met at the edge of an initial dilution zone consistent with provincial guidance. These parameters of concern were evaluated in the effect assessment where the potential for adverse effects to aquatic life in the receiving environment is discussed.

The Fraser River represents a special case for the development of discharge quality criteria due to its large size, high flows, and substantial assimilative capacity relative to other receiving environments considered in this assessment. Unlike smaller watercourses such as Hicks Creek, the Fraser River provides rapid near-field mixing and dilution of treated discharges. Therefore, the concept of an initial dilution zone was applied for the Fraser River. An initial dilution zone is a defined area of the receiving environment immediately downstream of a discharge point where initial mixing and dilution occur before water quality conditions are evaluated against applicable WQG-FAL.

Where an initial dilution zone is applied, different guideline types are relevant at different locations in the receiving environment. In general, chronic WQG-FAL represent long-term exposure thresholds and are used to evaluate water quality after mixing has occurred in the receiving environment. Acute WQG-FAL represent short-term exposure thresholds and may be used to inform evaluation of water quality conditions within the near-field mixing area of the initial dilution zone.

Based on these characteristics, an initial dilution zone was considered appropriate for the Fraser River but was not applied to smaller receiving environment watercourses where baseline flows are more limited. For the Fraser River, the proposed discharge quality criteria are based on acute WQG-FAL where available. Predicted post-mixing concentrations were evaluated such that chronic WQG-FAL or background concentrations are met at the edge of the initial dilution zone following mixing.

Parameters of Concern for which discharge quality criteria are set equal to applicable chronic WQG-FAL were not carried forward to the effects assessment, as discharge concentrations meeting these criteria are not anticipated to exceed guideline values in the receiving environment. Where discharge quality criteria are based on background concentrations that exceed applicable chronic WQG-FAL, these parameters were carried forward to the effects assessment for further evaluation of potential effects on the receiving environment. In the case of the Fraser River, where an initial dilution zone was applied, parameters with discharge criteria informed by acute WQG-FAL were also carried forward to the effects assessment to support evaluation of predicted post-mixing concentrations in the receiving environment.

The discharge quality criteria described in Table ES.1 will be achieved through the implementation of mitigation measures related to groundwater collection, treatment, and discharge, as outlined in the following sections. The proposed numerical discharge quality criteria developed for each PDL are summarized thereafter.

Groundwater Collection, Treatment and Release

Stormwater and groundwater intercepted during trench dewatering will be collected along the pipeline footprint. Groundwater will be extracted from soil around the mainline trench and excavations through wellpoint systems installed along sections where excavation extends below the water table. Extracted groundwater will then be conveyed to treatment through above-ground temporary piping.

The collected groundwater released to surface water will undergo water treatment prior to discharge to meet the discharge quality criteria as noted in Table ES.2. Treatment may include a combination of sediment removal, clarification, filtration, and aeration/oxidation to address turbidity and naturally elevated metal concentrations depending on the groundwater quality and the site-specific discharge water quality requirements. This TAR includes a Best Achievable Technology assessment to evaluate technologies for treating the anticipated groundwater quality encountered during trench dewatering.

Where dewatering rates and ground conditions are favourable, discharge to ground will be employed. Where dewatering rates exceed infiltration capacity for controlled discharge to ground, the excess dewatering discharge will be directed to a PDL. Based on modelled groundwater inflow rates, it is anticipated that surface water discharge to the PDLs will remain the primary method.

Three of the PDLs (PDL-A1, PDL-A8, PDL-SB19) would discharge directly to the Fraser River, which has a large receiving capacity. PDL-A6 is Hicks Creek, which has a limited receiving capacity and would be used in combination or as a back-up to the Fraser River PDLs for low volume discharges.

Treated groundwater will be routed to the designated PDLs through temporary piping for discharge to surface water. Two approaches Westcoast is currently considering for controlling the release of water discharge into the PDLs includes: 1) an instream floating discharge structure consisting of a perforated pipe discharging water directly into the receiving water body and 2) the use of a perforated pipe placed at the top of a bank which releases water down the bank slope over an impermeable liner. Both approaches are focused on reducing the potential for localised erosion associated with the discharge structure while also avoiding disturbance of the channel bed and banks and aquatic species or habitat, as discussed more in the next section.

Additional Mitigation and Management

Westcoast is requesting a 250 m linear extent at each PDL for flexibility in placing the discharge structure to: 1) limit the impact on existing vegetation at the top of bank of each PDL; 2) allow adequate operating space for each discharge structure (which could extend up to approximately 50 m in linear length); and 3) allow room to relocate a discharge structure within approved areas if monitoring indicates a need to modify, enhance, or relocate discharge at a particular location.

Proposed discharge rates are PDL-specific and were developed so that discharge is unlikely to have an adverse effect on aquatic habitat such as lead to erosion of bed and banks when flows are increased or fish stranding when flows are reduced. However, when flows are reduced, an Environmental Inspector or designate will assess potential for fish stranding, extent of potential stranding, and conduct monitoring at locations where potential for fish stranding exists due to reduced or halted flow.

Site-specific mitigation measures for groundwater discharge management relevant to the Section 15 Approval for the pipeline loop will be implemented. In addition, Westcoast has prepared an Environmental Protection Plan for the Project that will be implemented during the pipeline loop construction activities and will be applied to water management and discharge-related activities, as applicable. Generally, construction will be completed in a manner that avoids or reduces adverse effects on residents in the area, nearby land users, and socio-economic and environmental features.

In addition to general construction mitigation measures, the Pipeline Environmental Protection Plan has several management and contingency plans that may be applicable to activities conducted under the Section 15 Approval including:

- Erosion and Sediment Control Management Plan
- Sedimentation of Watercourses and Wetlands Contingency Plan
- Soil Erosion Contingency Plan
- Fuels and Hazardous Materials Spill Contingency Plan
- Contamination Discovery Contingency Plan
- Wildlife and Habitat Feature Discovery Contingency Plan

Summary of Proposed Discharge Limits

Table ES.2 provides a summary of the Section 15 Approval proposed discharge limits at end-of-pipe for discharge rate, general construction parameters, and the identified Parameters of Concern by watercourse.

Proposed water quality limits are based on the discharge quality criteria, which incorporate the detailed characterization of baseline conditions and Parameter of Concern screening. For Parameters of Concerns where the corresponding discharge quality criteria are based on water quality guidelines, defined discharge limits are not required for the Section 15 Approval because the applicable water quality guidelines represent established effects benchmarks used under the *Environmental Management Act* to evaluate the potential for adverse effects to aquatic life. Nevertheless, these Parameters of Concern will be monitored with reference to the applicable guideline values. Acute WQG-FAL are proposed for Fraser River to reflect the proposed initial dilution zone and anticipated mixing in the receiving environment, while chronic WQG-FAL are proposed for Hicks Creek where no initial dilution zone is assumed (Table ES.2).

Table ES.2 Summary of Proposed Discharge Limits for Discharge Rate, General Construction Parameters, and Identified Parameters of Concern by Watercourse (Proposed Discharge Location)

Parameter (Units)	**Proposed Discharge Limit for End-of-Pipe**	
	Fraser River (PDL-A1, PDL-A8, PDL-SBI9)	**Hicks Creek (PDL-A6)**
Maximum Discharge Rate (m^3/s)	0.284	May 1 to August 31 – 0.050 September 1 to April 31 – 0.013
TSS (mg/L)	25 or background TSS concentration, whichever is greater	25 or background TSS concentration, whichever is greater
pH (pH units)	6.5–8.5	6.5–8.5
DO (mg/L)	≥ 8	≥ 8
Nitrate (as N; mg/L)	Acute WQG-FAL	Chronic WQG
Nitrite (as N; mg/L)	Acute WQG-FAL	0.0304
Total Aluminum (mg/L)	*	0.175
Total Iron (mg/L)	2.97	2.01
Total Mercury (mg/L)	*	0.00000344
Dissolved Cadmium (mg/L)	Acute WQG-FAL	Chronic WQG-FAL
Dissolved Cobalt (mg/L)	*	0.000896
Dissolved Copper (mg/L)	0.00151	0.00173

Parameter (Units)	Proposed Discharge Limit for End-of-Pipe	
	Fraser River (PDL-A1, PDL-A8, PDL-SBI9)	**Hicks Creek (PDL-A6)**
Dissolved Iron (mg/L)	Acute WQG-FAL	1.13
Dissolved Manganese (mg/L)	*	Chronic WQG-FAL
Dissolved Nickel (mg/L)	Acute WQG-FAL	0.0031

Notes:

WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; PDL = proposed discharge location; N = nitrogen, T = Total, D = Dissolved; TSS = Total Suspended Solids; DO = dissolved oxygen; pH = unit of acidity; m^3/s = cubic meters per second; mg/L = milligrams per litre

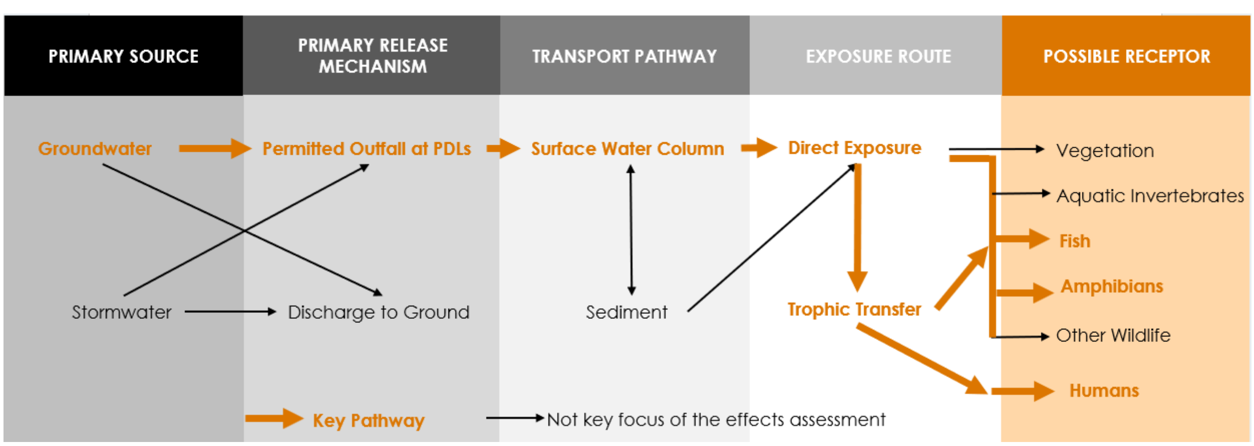
Unshaded cells indicate permit limits are based on discharge quality criteria derived from the 95th and 90th Percentile of background water quality for Fraser River and Hicks Creek, respectively. Shaded cells indicate discharge quality criteria based on WQGs which do not require defined permit limits but will be monitored and screened according to the applicable WQG-FAL. Exceedance for parameters with discharge quality criteria that are below acute WQG-FAL (i.e., discharge quality criteria based on chronic WQGs or background concentrations) will be identified based on monthly rolling averages from 4 weekly samples.

* Discharge quality criterion are currently not proposed for Fraser River discharge(s) because no acute WQG-FAL exists; chronic WQG-FAL or background will be met at the edge of the initial dilution zone consistent with provincial guidance.

Environmental Effects Assessment

Discharges from the pipeline construction dewatering have the potential to impact receptors in the PDL receiving environments. The conceptual site model, showing pathways of effects between pipeline dewatering activities and possible receptors in the receiving environments is presented in Figure ES.1. The impact assessment focuses on potential changes in surface water quality that may lead to adverse effects for the possible receptors in the receiving environment, from direct exposure (i.e., absorption of water) and/or indirect exposure (i.e., trophic transfer through diet).

Figure ES.1 Conceptual Site Model



In the conceptual site model, exposure routes associated with pipeline dewatering discharges during construction are direct exposure to changes in physical condition (e.g., water temperature) or water chemistry (e.g., pH or concentrations of DO), and indirect exposure to contaminants via the ingestion of food or prey. The conceptual site model considers direct exposure to changes in physical conditions and surface water chemistry as the key pathway for changes in water quality to affect possible receptors.

This TAR identifies six possible receptor groups (i.e., vegetation, aquatic invertebrates, fish, amphibians, other wildlife, and humans) for the receiving environments of the PDLs. As noted previously, a variety of fish species have potential to be present at each PDL. Amphibians are known to be present in Hicks Creek, with breeding confirmed for two species. The Fraser River receiving environment is not amphibian habitat. Mammals, birds, and reptiles may interact directly, but not continuously, with the PDL receiving environments when foraging, hunting, drinking, travelling, nesting, basking, and overwintering (turtles).

As fish and amphibians have the potential for direct exposure to changes in water quality, including changes to parameters that are critical for their habitat (temperature, DO, turbidity, TSS), the potential for adverse effects to fish and amphibians are the key focus of the effects assessment. Humans are also considered a key receptor, given the potential for consumption of fish and the use of water from around the PDLs for crops and livestock.

Change in Surface Water Quality

Where discharge quality criteria are derived from chronic WQG-FAL, discharge concentrations corresponding to the proposed discharge quality criteria are intended to be protective of aquatic life under continuous exposure conditions. Where discharge quality criteria are derived from background surface water quality, discharge concentrations are anticipated to remain within the upper range of observed existing conditions and, therefore, are not expected to result in a measurable change relative to ambient variability.

The evaluation of potential toxicity to surface water quality is based on a weight-of-evidence approach, including: (1) the derivation of discharge quality criteria from applicable water quality guidelines and/or background concentrations, and (2) the temporary (up to maximum of 15 months) and episodic nature of construction-related discharges, which limits the potential for prolonged Project-related effects. Under the assessed discharge assumptions, Project-related discharges are not indicative of conditions associated with acute or chronic toxicity during discharge periods.

Overall, potential Project-related effects on surface water quality are characterized as low in magnitude, localized in extent, short-term, intermittent, and reversible; accordingly, overall risk is considered low. As a result, adverse effects are not anticipated for the key receptors identified for Fraser River and Hicks Creek (i.e., fish, amphibians, and humans via trophic transfer).

Monitoring

The following sections provides an overview of the discharge and receiving environment monitoring programs proposed during the discharge to the surface water receiving environment. The discharge and receiving environment monitoring programs were developed in context of environmental baseline information, discharge mitigation and management, and the effects assessment. The approximate surface water quantity and quality monitoring location relative to each PDL and associated receiving environment when actively discharging are presented in Table ES.3.

Table ES.3 Proposed Water Quality Monitoring Parameters, Locations and Frequency when Discharging at a Given Proposed Discharge Location

Parameter	Method	Monitoring Frequency*	Monitoring Location(s)
Maximum Discharge Rate	Inline monitoring	Continuous (e.g., 15-minute intervals)	End-of-pipe
TSS	Grab Sample	Weekly	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location
Turbidity	Field-measured	Daily	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location
Conductivity	Field-measured	Daily	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location
pH	Field-measured	Daily	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location
DO	Field-measured	Daily	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location
Temperature	Field-measured	Daily	End-of-pipe
		Continuous (e.g., 15-minute interval)	Approximately 50 m upstream and 100 m downstream of discharge location
Visible sheen	Visual and Olfactory Assessment	Daily	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location

Parameter	Method	Monitoring Frequency*	Monitoring Location(s)
Rainbow trout 96-hour Acute Toxicity Test** (≥ 80% survival)	Grab Sample	Following the establishment of new water treatment units/processes and prior to initial discharge of water to the environment	End-of-pipe
Total and Dissolved Metals, Anions, and Nutrients	Grab Sample	Weekly	End-of-pipe Approximately 50 m upstream and 100 m downstream of discharge location

Notes:

TSS=Total Suspended Solids; DO = dissolved oxygen; pH=unit of acidity; m=metres

* Monitoring frequency will be increased to address site-specific conditions as noted in the Trigger and Response Plan

** 96-hour acute toxicity tests in rainbow trout (*Oncorhynchus mykiss*) using undiluted test water (i.e., single-concentration pass/fail tests)

Proposed daily field-measured parameters will include turbidity, conductivity, pH, DO, temperature, and visible sheen (Table ES.3). Conductivity does not have a proposed discharge limit but will be monitored because conductivity measurements, particularly substantial changes in conductivity over a short period of time, may be used as a rapid field-measured indicator for potential issues with other water quality parameters (i.e., nutrients, metals), and it can be used to initiate additional monitoring as noted in the Trigger and Response Plan. Similarly, field-measured turbidity will be used as a field-measured proxy for TSS and additional turbidity/TSS monitoring would be initiated if turbidity values are elevated beyond the Trigger and Response Plan monitoring thresholds.

Grab samples collected for weekly laboratory analysis will include TSS, total and dissolved metals, anions and nutrients. Following the initial establishment of a new water treatment unit/process, Westcoast is also proposing to undertake an acute toxicity test to check discharge water quality and assess for potential impacts on aquatic life prior to discharge into the receiving environment.

Conclusion

Westcoast is applying for a Section 15 Approval to allow for short-term discharge (i.e., up to a maximum of 15 months) of groundwater to surface water for pipeline trench dewatering within the Fraser Valley where high groundwater volumes are anticipated during construction of the Sunrise Expansion Program. This TAR has been prepared and reviewed by a team of Qualified Professionals to support Westcoast's application for a Section 15 Approval (Tracking #447386) for the Agassiz Loop.

This TAR provides a summary of Westcoast's plan for managing groundwater dewatering during pipeline construction in the Fraser Valley and protecting the receiving environment. Mitigation measures include treatment of groundwater to meet applicable water quality guidelines or background conditions prior to discharge to surface waters. Where proposed discharge limits are derived from chronic WQG-FAL, discharge concentrations corresponding to the proposed values are intended to be protective of aquatic life under continuous exposure conditions. Where proposed discharge limits are derived from background surface water quality, discharge concentrations are anticipated to remain within the range of observed existing conditions and, therefore, are not expected to result in a measurable change relative to ambient variability. Overall, potential Project-related effects on surface water quality are characterized as low in magnitude, localized in extent, short-term, intermittent, and reversible; accordingly, overall risk to identified receptors is considered low.

Table of Contents

List of Tables

List of Figures

List of Photos

List of Appendices

Appendices found under separate covers

Glossary

Term	Definition
Acute toxicity	A toxic effect (severe biological harm or death) produced in an organism by exposure to a substance or mixture of substances over a short period of time, typically 96 hours or less. In regulatory contexts, acute toxicity is evaluated using standardized acute toxicity tests conducted in undiluted discharge water. Acute toxicity is indicated when an effluent sample fails such a test, defined as test organism mortality exceeding 20% over the specified exposure period (e.g., the rainbow trout [*Oncorhynchus mykiss*] 96-hour acute toxicity test for freshwater).
Acute guideline	Acute water quality guidelines are intended to protect against severe effects such as lethality to the most sensitive species and life stage over a defined acute (short-term) exposure period (for example, 96 hours).
Agassiz Loop; CS-8B–CS9 pipeline loop	An approximately 13.4 km long pipeline loop located east of Agassiz, BC and runs north of the Fraser River to just north of Hicks Creek, mainly adjacent to the existing Westcoast right-of-way.
Background (water quality)	Water quality conditions representative of existing ambient conditions in groundwater or surface water, characterized using site-specific monitoring data collected outside the influence of Project-related activities and prior to Project implementation. Background water quality is used to describe baseline conditions and, where relevant, to inform the development of site-specific discharge quality criteria.
Best Achievable Technology	An assessment to evaluate water treatment technologies for treating the groundwater encountered during trench dewatering (Appendix L). The Best Achievable Technology assessment was prepared in accordance with provincial guidance.

Term	Definition
Benchmark	Numerical water quality values used in the effects assessment to evaluate potential Project-related effects on surface water quality. Benchmarks include applicable aquatic life water quality guidelines (i.e., chronic and acute WQG-FAL) and upper-bound background surface water quality. Where guidelines are dependent on site-specific toxicity-modifying factors, benchmark values are conservatively derived to represent protective conditions across potential receiving environments. Benchmarks represent the full set of reference values used in the assessment; project-specific discharge quality criteria (DQCs) are subsequently derived from these benchmarks and represent selected benchmark values applied to Project discharges.
Bioaccumulation	The process by which chemical substances are accumulated by organisms from exposure to water, sediments, or soil directly or through consumption of food containing the chemicals.
Biomagnification	The increase in tissue concentrations of accumulated chemicals from one trophic level to the next (i.e., organisms contain higher concentrations of the substance than their food sources).
Compressor Station (CS-X)	Existing compressor stations along the Westcoast system. For the Project, existing compressor stations are identified in numerical order from north to south (i.e., CS-1, CS-2, etc.). The work proposed at the MS-16 meter station is also included in this grouping.
Chronic guideline	Chronic water quality guidelines are intended to protect the most sensitive species and life stages against sub-lethal and lethal effects for chronic (long-term) exposures.
Conceptual site model (CSM)	A schematic depiction of the pathways connecting the sources of discharge water to potential receptors in the receiving environment.
Constituent	A chemical, physical, or biological component or attribute of water that may be measured as a water quality parameter. In this report, the terms ‘parameter’ and ‘constituent’ are used interchangeably to refer to measured aspects of water quality, and no distinction in meaning is intended unless otherwise specified.
Detection limit	The smallest concentration or amount of a substance that can be reported as present in a sample with a specified degree of certainty by a definite, complete analytical procedure

Term	Definition
Discharge limits	The proposed Section 15 Approval discharge limits for flow, general construction parameters, and the identified parameters of concern.
Discharge quality criteria	Site-specific concentration criteria developed for select parameters of concern identified in groundwater quality. Discharge quality criteria are derived based on applicable water quality guidelines or objectives, or background water quality where existing ambient conditions exceed generic guideline values. Discharge quality criteria are used to inform the design and operation of treatment and mitigation measures and, where applicable, the establishment of end-of-pipe discharge limits for Project-related discharges.
Dissolved parameter	The fraction of a parameter (e.g., a metal) measured in a water sample that will pass through a 0.45 micrometre membrane filter.
End-of-pipe	The point of discharge to the receiving environment, following treatment (where applicable) and prior to mixing with the receiving environment.
Environmental protection plan	A Environmental Protection Plan and its associated management and contingency plans have been developed for the pipeline component of the Project as part of the Project's Section 183 application under the *Canadian Energy Regulator Act* and it will be implemented for the pipeline loop construction. The EPP and its associated plans are provided in Appendix M.
Exposure pathway	The mechanism or route by which a chemical constituent or physical parameter moves from its source to a receptor; thereby, describing how a biological receptor may interact with a potential contaminant (for example). An exposure pathway comprises a primary source (e.g., groundwater), a primary release mechanism (e.g., discharge to receiving environment), a transport pathway (e.g., surface water), an exposure route (e.g., direct biological uptake via ingestion), and a possible receptor (e.g., aquatic life).
Information Requirements Table	A table that defines the technical aspects to be included in a waste discharge application under the *Environmental Management Act*. The Information Requirements Table is issued by the British Columbia Ministry of Environment and Parks to the applicant. The Information Requirements Table for this application (Tracking #447386) was issued March 31, 2026.

Term	Definition
Initial Dilution Zone	The 3-dimensional zone around a point of discharge where mixing of the effluent and the receiving environment water occurs.
Intensity-Duration-Frequency	Data that indicate the amount of precipitation estimated to fall over a specific duration (minutes, hours) for a specific return period (years); these data can be used to estimate the amount of stormwater accumulation.
Interested Parties	The collective term for groups that Westcoast is engaging with that may be potentially affected by the Project including Indigenous groups, landowners, regulatory agencies, and other stakeholders.
Key receptors	A subset of the potential ecological or human receptors identified through the conceptual site model. Key receptors are the primary focus of the effects assessment and are selected based on their presence in the receiving environment and their potential for direct exposure to changes in water quality or indirect exposure through trophic transfer pathways.
Parameter of Concern	A subset of ‘parameters of potential concern’ that are retained following further screening and evaluation and are considered relevant to the assessment of potential Project-related effects or the development of mitigation measures.
Parameter of Potential Concern	Chemical constituents identified through an initial, conservative screening of groundwater or surface water quality data based on comparisons to applicable water quality guidelines or objectives. Parameters of potential concern are carried forward for further evaluation to determine their relevance to the assessment of Project-related effects.
Pipeline loop	A pipeline segment constructed parallel and connected to the existing system between two compressor stations. Each pipeline loop for the Project is named for the two compressor stations it lies between
Potential receptor	An organism that has the potential to experience adverse effects from exposure to media either directly (e.g., through contact) or indirectly (e.g., through food chain transfer).

Term	Definition
Qualified Professional	A person who: (a) is an engineer, scientist or technologist specializing in a particular applied science or technology; (b) is registered in British Columbia with a professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization; (c) through suitable education, experience, accreditation and knowledge, may reasonably be relied upon to provide advice within his or her area of expertise and to carry out duties or functions in those areas; and if applicable, (d) provides the completed Declaration of Competency and Conflict of Interest Disclosure Statements.
Receiving capacity	Maximum discharge rate that could be released into a stream without resulting in adverse effects on aquatic habitat.
Residual effects assessment	The evaluation of potential environmental impacts in the receiving environment after proposed mitigation measures, treatment technologies, and best management practices have been applied.
Sunrise Expansion Program; the Project	Westcoast is proposing the Sunrise Expansion Program to expand its T-South system and add 300 million cubic feet per day or 8.5 x 10^6 cubic metres per day of additional service capacity through the installation of looping segments of nominal pipe size 42 pipelines, new compressor units, and powerlines to support electric motor drives at some compressor stations
Technical Assessment Report	This document which was prepared and reviewed by a team of Qualified Professionals from Stantec to support Westcoast's application for the Section 15 Approval and meet the technical requirements of the Information Requirements Table issued by the BC Ministry of Environment on March 31, 2026.
Toxicity	The inherent potential or capacity of a material to cause adverse effects in a living organism.
Toxicity modifying factor	A physical, chemical, or biological characteristic of water that influences the bioavailability and toxicity of a substance to aquatic organisms. Toxicity modifying factors affect the extent to which a substance causes adverse effects by altering chemical speciation, uptake, or organism sensitivity. Common toxicity modifying factors include water hardness, pH, dissolved organic carbon, and temperature, and are often explicitly accounted for in the derivation and application of water quality guidelines and toxicity benchmarks.

Term	Definition
Toxicity test	The means by which the toxicity of a chemical or other material is determined. Toxicity tests are used to measure the degree of response produced by exposure to a specific level of stimulus or concentration of chemical.
Trigger and Response Plan	A plan that documents the proactive steps that will be used to evaluate end-of-pipe monitoring data and to manage and respond to changing conditions relating to water discharge.
Uptake	A process by which substances are absorbed and incorporated into a living organism.
Water quality objective	A site-specific, provincially approved numeric value or narrative statement that establishes water quality conditions considered appropriate for protecting identified values and uses in a particular waterbody. Water quality objectives are developed to guide water management decisions at specific locations and may be derived from, adapted from, or differ from generic provincial water quality guidelines to reflect local conditions and management goals.
Water quality guidelines for the protection of freshwater aquatic life	For the purposes of this Technical Assessment Report, water quality guidelines for the protection of freshwater aquatic life (WQG-FAL) include BC water quality guidelines, and where BC guidelines are not available, Canadian Water Quality Guidelines developed by the Canadian Council of Ministers of the Environment. A WQG-FAL is a science-based benchmark concentration for a parameter that is intended to protect freshwater aquatic life. WQG-FAL include chronic (long-term) values, intended to protect aquatic organisms from sublethal effects associated with prolonged exposure, and acute (short-term) values, intended to protect against lethal or severe effects resulting from brief or infrequent exposures. Exceedances of chronic or acute WQG-FAL do not necessarily indicate that adverse effects are expected or will occur but rather serve as screening tools to help identify conditions that may warrant further evaluation in the context of site-specific exposure, duration, and receiving environment characteristics.
Westcoast	Westcoast Energy GP Inc., general partner of Westcoast Energy Limited Partnership (Westcoast), an Enbridge Employee Services Canada Inc. affiliate, owns and operates a natural gas transmission system known as the Westcoast system and is the proponent for the Sunrise Expansion Program.

Term	Definition
Zone of influence	A zone that represents the lateral extent of groundwater level decline caused by trench dewatering; that is, it defines the horizontal distance from the excavation trenches over which measurable drawdown may occur (i.e., groundwater decline > 0.1 m).

Acronyms / Abbreviations

°C	degrees Celsius
BAT	Best Achievable Technology
BC	British Columbia
BC ENV	British Columbia Ministry of Environment and Parks
BCER	British Columbia Energy Regulator
BC WQG-FAL	British Columbia Water Quality Guidelines for the Protection of Freshwater Aquatic Life
CER	Canada Energy Regulator
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSM	conceptual site model
CWQG-AL	Canadian Water Quality Guidelines for the Protection of Aquatic Life
DO	dissolved oxygen
DQC(s)	discharge quality criterion(criteria)
DSPT	direct steerable pipe thrusting
DU	designatable unit
ECCC	Environment and Climate Change Canada
EI	Environmental Inspector
EPP	Environmental Protection Plan
ESC	erosion and sediment control
FEQGs	Federal Environmental Quality Guidelines
GWELLS	BC Groundwater Wells and Aquifers Database
HSU	hydrostratigraphic unit
IDZ	initial dilution zone
RT	Information Requirements Table
Jacobs	Jacobs Consultancy Canada Inc.
km	kilometre
KM	Kaplan–Meier
KP	kilometre post
L/s	litres per second

m	metre
mm	millimetre
m^3/s	cubic metres per second
m^3/yr	cubic metres per year
masl	metres above sea level
mbgs	metres below ground surface
m/s	metres per second
mg/L	milligrams per litre
McTavish	McTavish Resource & Management Consultants Inc.
NTU	nephelometric turbidity units
PDL	proposed discharge location
PGOWN	Provincial Groundwater Observation Well Network
PID	Parcel Identification
Pinchin	Pinchin Ltd.
pH	units of acidity
POC(s)	parameter(s) of concern
POPC(s)	parameter(s) of potential concern
(the) Project	Sunrise Expansion Program
QP	Qualified Professional
ROS	Regression on Order Statistics
ROW	right-of-way
SARA	*Species at Risk Act*
sp.	species
Stantec	Stantec Consulting Ltd.
TAR	Technical Assessment Report
TMF	toxicity modifying factor
TSS	total suspended solids
UCL95	95^{th} upper confidence limit
Westcoast	Westcoast Energy GP Inc., general partner of Westcoast Energy Limited Partnership
WQG-FAL	Water Quality Guidelines for the Protection of Freshwater Aquatic Life
WQO(s)	Water Quality Objective(s)

WSP	WSP Canada Ltd.
ZOI	zone of influence
50P	50^{th} percentile
90P	90^{th} percentile
95P	95^{th} percentile
µg/L	micrograms per litre
µS/cm	microsiemens per centimeter

1 Project Description

1.1 Introduction

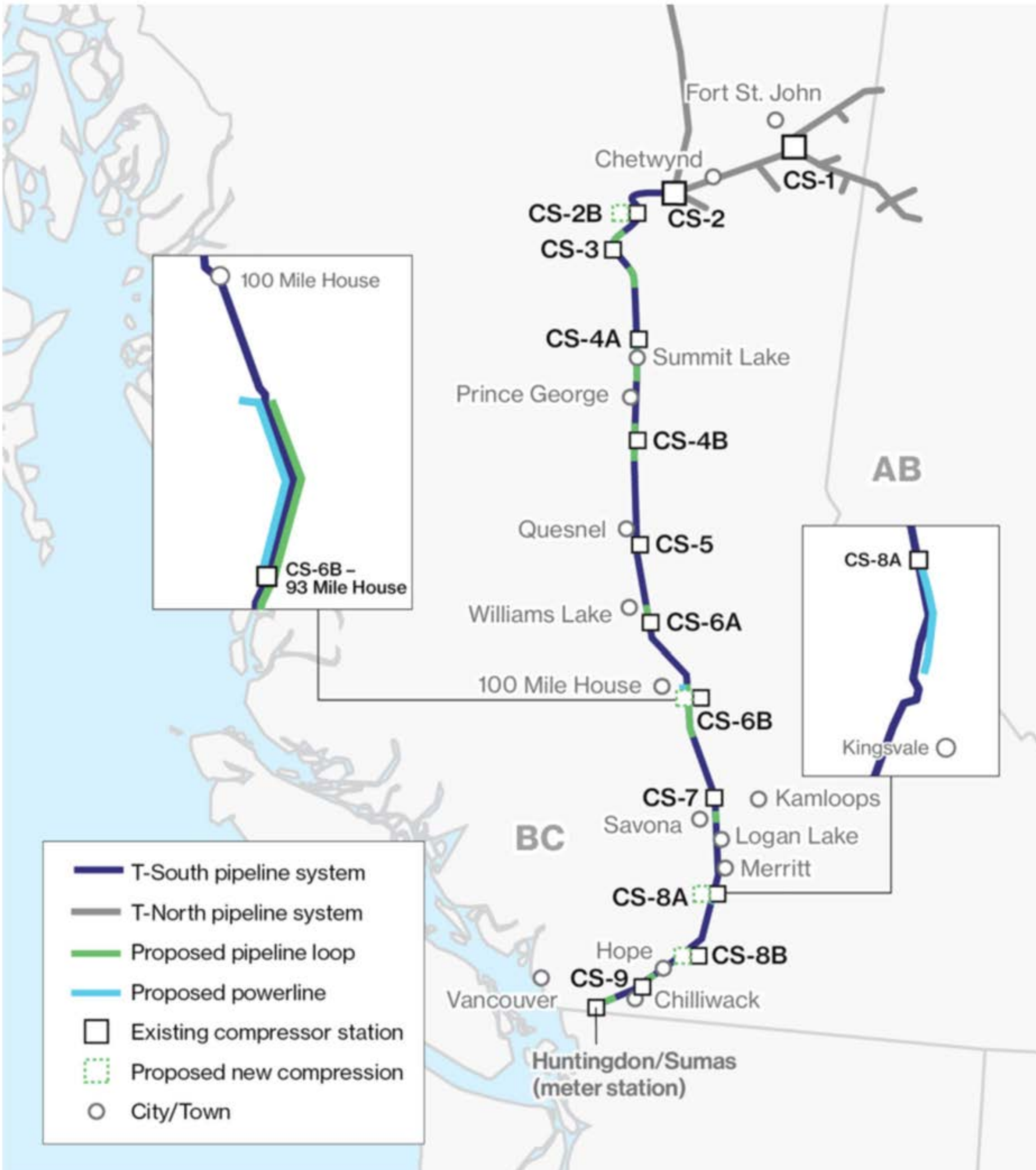
Westcoast Energy GP Inc., general partner of Westcoast Energy Limited Partnership (Westcoast), an Enbridge Employee Services Canada Inc. affiliate, owns and operates a natural gas transmission system known as the Westcoast system, which extends from points in Alberta and northern British Columbia (BC) to a point near the international boundary between Canada and the United States near Huntingdon, BC. As part of this system, Westcoast is proposing the Sunrise Expansion Program (the Project), which will include the installation of up to 139 kilometres (km) of nominal pipe size 42 pipeline (1,067 millimetre [mm] outside diameter) comprised of 11 pipeline loops (Figure 1.1).

Discharge permitting under the *Environmental Management Act* is proposed for the two pipeline loops located within the Fraser Valley where high groundwater volumes are anticipated during pipeline construction. Westcoast is applying to the BC Ministry of Environment and Parks (BC ENV) for an *Environmental Management Act* Section 15 approval (hereafter 'Section 15 Approval') to allow for short-term discharge (i.e., up to a maximum of 15 months) of groundwater to watercourses (Tracking #447386).

Westcoast engaged Stantec Consulting Ltd. (Stantec) to support the planning and permitting related to groundwater management in the Fraser Valley for the Project. Stantec prepared this Technical Assessment Report (TAR) to support Westcoast's application for the Section 15 Approval; it is intended to meet the requirements of the Information Requirements Table (IRT) issued by BC ENV on March 31, 2026, which forms part of the Application Instruction Document. This TAR was prepared and reviewed by a team of Qualified Professionals (QPs).[1] Appendix A provides the completed Declaration of Competency and Conflict of Interest Disclosure statements for these QPs.

[1] Per the AID, Qualified Professional means a person who: (a) is an engineer, scientist or technologist specializing in a particular applied science or technology; (b) is registered in BC with a professional organization, is acting under that organization's code of ethics and is subject to disciplinary action by that organization; (c) through suitable education, experience, accreditation and knowledge, may reasonably be relied upon to provide advice within his or her area of expertise and to carry out duties or functions in those areas; and if applicable, (d) provides the completed Declaration of Competency and Conflict of Interest Disclosure Statements.

Figure 1.1 Sunrise Expansion Program Overview



Map is for illustrative purposes only and not to scale. Project design is under development and configuration of pipeline loops, compressor units, additional compressor station modifications, and powerlines are subject to change.

1.2 Pipeline Loop Description

The Westcoast system consists of two divisions for regulatory and commercial purposes.[2] These divisions are identified as T-North and T-South. Westcoast is proposing the Project to expand its T-South system and add 300 million cubic feet per day or 8.5 x 10^6 cubic metres per day of additional service capacity through the installation of looping segments of nominal pipe size 42 pipelines, new compressor units, and powerlines to support electric motor drives at some compressor stations (Figure 1.1).

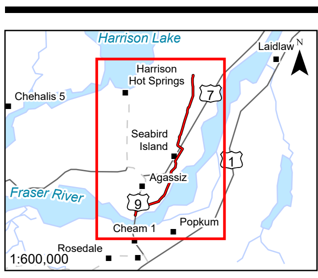
The Section 15 Approval application and this TAR focus on the CS-8B–CS-9 pipeline loop (hereafter ‘Agassiz Loop’; Figure 1.2), one of the two pipeline loops in the Fraser Valley (see Section 1.1). The following subsections describe the location of the Project, including the specific location of the Agassiz Loop, and provide information on land ownership and surrounding land use for the Agassiz Loop component of the Project.

1.2.1 Project Location

The Project originates approximately 100 km west of Chetwynd, BC in the Peace River Regional District, at Westcoast’s CS-2B Compressor Station, with proposed looping near McLeod Lake, and generally parallels the John Hart Highway south through the Regional District of Fraser-Fort George with proposed looping near Summit Lake, Salmon Valley, and Hixon (Figure 1.1). The Project continues south through the Cariboo Regional District, at times paralleling the Cariboo Highway, with proposed looping near 150 Mile House, 94 Mile House, and 70 Mile House and modifications or upgrades at CS-6B compressor station, near 93 Mile House. Heading south, the Project traverses through the Thompson-Nicola Regional District with proposed looping north of Logan Lake, and upgrades or modifications at the CS-8A compressor station. The Project then enters the Fraser Valley Regional District at the CS-8B compressor station near Hope, with proposed looping near Agassiz, and a final proposed loop terminating at the Huntingdon meter stations southwest of Chilliwack, BC.

Specific to this Section 15 Approval application, the Agassiz Loop is currently planned to be approximately 13.4 km long between 49.3119°N, 121.7087°W and 49.2130°N, 121.7745°W (Figure 1.2). This pipeline loop will originate upstream of the CS-9 compressor station near Hicks Creek (north of the Fraser River) and traverse along the Westcoast system right-of-way (ROW) before terminating at the CS-9 compressor station. The Agassiz Loop has four potential proposed discharge locations (PDLs) identified; these PDLs are described in Section 1.7.

[2] The legacy Westcoast system also included raw gas gathering and processing assets. Those assets were sold to Sukunka Natural Resources Inc. and NorthRiver Midstream Operations LP in separate transactions that closed in May and December 2019, respectively.



- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace

Proposed Discharge Locations

- Current
- Retired

0 420 840 1,260 1,680 m

1:42,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20251230
Requested by RKEELER on 20251216

NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
1.2

Title
Overview of Pipeline Loop

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\loop_overviews\fig_123317055_sep_tar_loop_overview.aprx Revised: 2026-04-28 By: jpoucher

1.2.2 Landownership

The Agassiz Loop crosses a variety of properties and includes provincial Crown land, federal reserve land, and private property. The pipeline loop extends from Parcel Identification (PID) 013-217-712 to PID 000-584-720. The landownership information is shown in Figure 1.3.

The BC Energy Regulator (BCER) has authority under the *Energy Resources Activity Act* to issue Crown land approvals under the *Land Act* for energy resource projects, such as the Project. BCER is authorized to grant land and issue Crown land tenures in the form of leases, licences, permits and ROW, and Westcoast will obtain the applicable permissions for use of Crown land. Westcoast will also obtain pipeline statutory rights-of-way approvals and associated land use agreements with private landowners for the pipeline loop, including the PDLs, prior to construction. Westcoast is having on-going discussions with landowners as described in Section 1.4.3

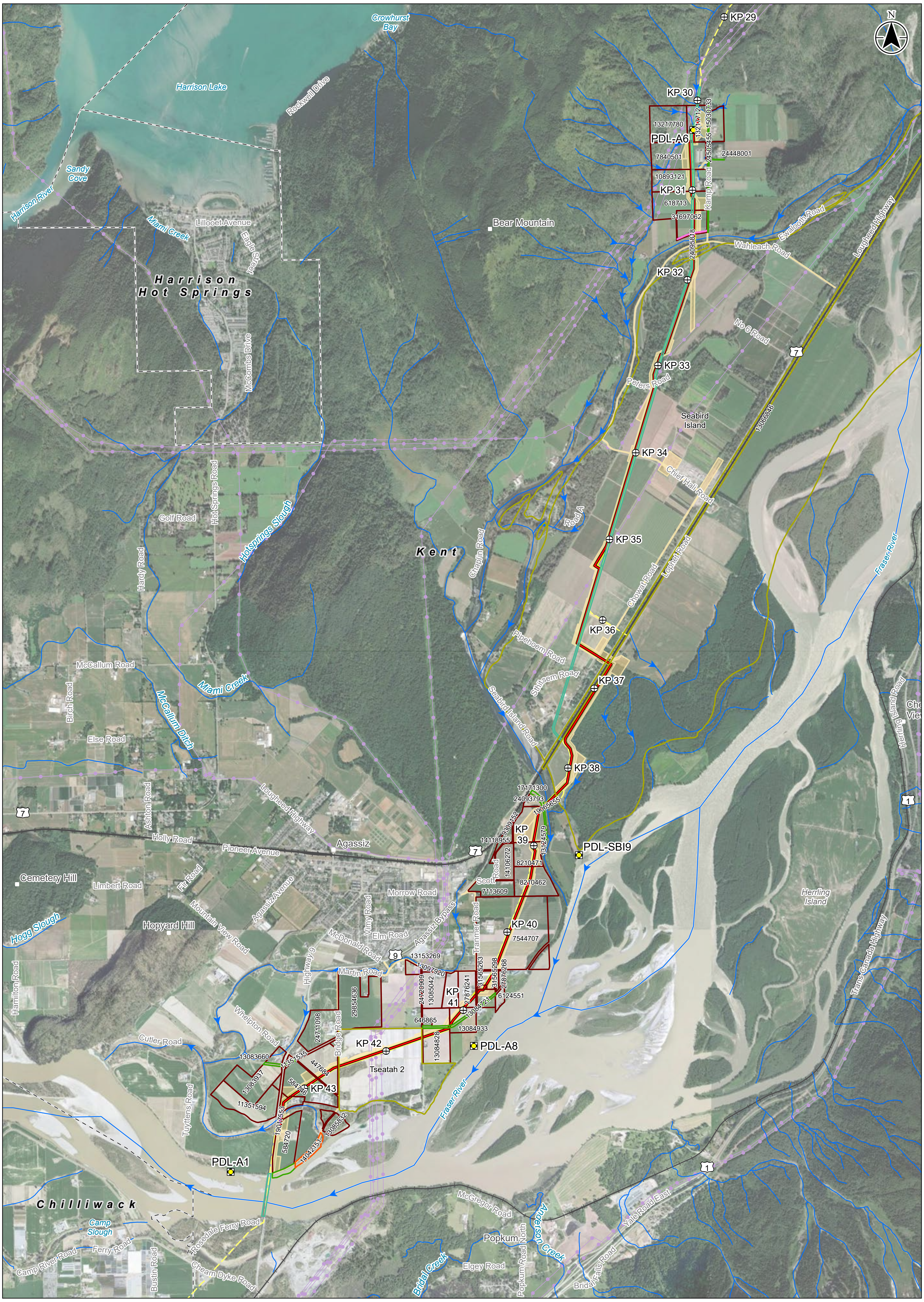
1.2.3 Surrounding Land Use

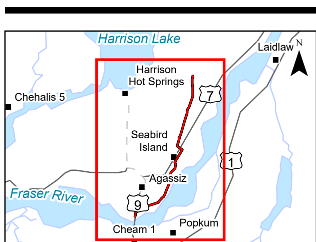
The Agassiz Loop is in the District of Kent and intersects provincial Crown land and federal reserve lands established under the *Indian Act*. The loop spans Seabird Island (Sq'éwqel) Indian Reserve and intersects Tseatah 2 Indian Reserve (Figure 1.3).

The areas surrounding the Agassiz Loop are within the Agricultural Land Reserve. The areas located within provincial jurisdiction are zoned as Agricultural Land (GOBC 2025e), a designation that provides for agricultural and related rural development and protects the agricultural integrity of the land within the Agricultural Land Reserve. As such, most of the land use in the vicinity of the Agassiz Loop relates to agricultural activities.

The distance to various specified features, required for the Discharge Factors Application Form, is summarized in Appendix B along with methods and data sources used for determining which feature was closest to each PDL. As required by the form, specified features include:

- Water well
- Reservoir
- Dwelling
- Serviced lot
- Recreational area
- Residential or health care facility
- Park or protected area
- School or daycare
- Surface water





Railway
Transmission Line
Flow Direction
Watercourse

Kilometer Post
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace

Proposed Discharge Location

Land Ownership

Owner Type

- Crown Agency
- Crown Provincial
- Federal
- Local Government
- Private
- Unclassified
- Untitled Provincial

0 420 840 1,260 1,680 m

1:42,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20251230
Requested by RKEELER on 20251216

NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
1.3

Title
Landownership

Westcoast is having on-going discussions with landowners, local government agencies and stakeholders as described in Section 1.4. Details about groundwater aquifers, groundwater users, surface water licence holders, and public water supply are provided in Section 2.3.2.

1.3 Regulatory Setting

The following sections describe the federal and provincial regulatory setting for the Project.

1.3.1 Federal

Table 1.1 summarizes the federal environmental acts, regulations, and policies that may be applicable or relevant to the Project. The Project is subject to federal jurisdiction and will require certificate approval from the Canada Energy Regulator (CER) pursuant to Section 183 of the *Canadian Energy Regulator Act*. As part of the Section 183 application materials submitted on May 20, 2024, Westcoast has completed an Environmental and Socio-economic Assessment (Jacobs 2024a)[3] and prepared an Environmental Protection Plan (EPP; Jacobs 2026; Appendix M)[4] for the Project. These documents are publicly available on the CER website[5] and will be updated as needed; information from these documents have been incorporated into this TAR, where applicable.

The Westcoast system is subject to federal jurisdiction and regulation, and the CER assesses potential impacts and regulatory requirements for the Project. The Project is not a designated project under the *Impact Assessment Act,* as it is not one of the physical activities set out in the schedule of the Physical Activities Regulations (i.e., the Project does not require 75 km or more of new ROW).

3 https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/130635/4457533/C29824-22_Appendix_8-1_-_Environmental_and_Socio-Economic_Assessment_Report_%28Part_1_of_8%29_-_A8Y4T3.pdf?nodeid=4457651&vernum=-2
4 https://apps.cer-rec.gc.ca/REGDOCS/Item/View/4657576
5 CER – Westcoast Energy Inc. – Sunrise Expansion Program

Table 1.1 Sunrise Expansion Program Federal Regulatory Setting

Act, Regulation or Policy	Regulator*	Description
*Canadian Energy Regulator Act (*CERA)	CER	Under the CERA, the CER is responsible for assessing the environmental and socio-economic effects of energy projects within its jurisdiction.
Onshore Pipeline Regulations (OPR)	CER	Under the CERA, the OPR are established to manage safety, security, and environmental protection throughout the entire life cycle (i.e., design, construction, operation, and abandonment) of facilities.
Species At Risk Act (SARA)	DFO/ECCC	SARA protects species at risk in Canada; this protection applies to species (including aquatic species) listed under Schedule 1 of SARA, and their critical habitat and residences (where applicable), as defined in recovery strategies and action plans. Under SARA, it is prohibited to destroy critical habitat (section 58), to kill, harm, harass, capture, or take individuals listed as extirpated, endangered, and threatened under Schedule 1 (section 32), and to damage or destroy the residences of those individuals (section 33) on federally-regulated lands and on all lands if the listed species is aquatic or a migratory bird protected under the *Migratory Birds Convention Act*. Otherwise, on non-federal lands, SARA largely relies upon ‘good stewardship’, primarily looking to the provinces and territories to protect at-risk species and critical habitat. DFO is responsible for aquatic species at risk under SARA, and ECCC is responsible for all other species at risk under SARA.
Migratory Birds Convention Act (MBCA) Migratory Birds Regulations	ECCC	The MBCA and Migratory Birds Regulations protect migratory birds, eggs, and nests. Section 5.0 of the MBCA prohibits possession of migratory birds and their nests or eggs. Section 5.1 of the MBCA prohibits the deposition of a substance that is harmful to migratory birds in waters or an area frequented by migratory birds or in a place from which the substance may enter such waters.
Fisheries Act	CER/DFO	The *Fisheries Act* prohibits activities that result in the death of fish by means other than fishing per Subsection 34.4(1), or that result in Harmful Alteration, Disruption or Destruction (HADD), per Subsection 35(1). Subsection 34.3 makes provisions for the maintenance of flows and fish passage, and Subsection 36(3) prohibits the introduction of unauthorized deleterious substances into waters frequented by fish. Through a memorandum of understanding between CER and DFO (CER 2023), the CER reviews CER application to determine likelihood of HADD of fish habitat, and DFO considers authorizations under the *Fisheries Act* for pipelines subject to the CERA.

Act, Regulation or Policy	Regulator*	Description
Canadian Navigable Waters Act	CER	The *Canadian Navigable Waters Act* protects navigation on scheduled waters, as well as navigable waters that are not listed in Schedule 1 of the Act. The *Canadian Navigable Waters Ac*t introduces a process to notify the public and to help resolve conflicts related to works on navigable waters that are not on the schedule. Proponents will receive an approval before construction for proposed major works in any navigable water, scheduled or otherwise. The CER is responsible for reviewing projects with respect to navigation and navigation safety, per the memorandum of understanding between Transport Canada and the CER (CER 2022).

Note:

* CER = Canadian Energy Regulator; DFO = Fisheries and Oceans Canada;
ECCC = Environment and Climate Change Canada

1.3.2 Provincial

Table 1.2 summarizes the provincial environmental acts, regulations, and policies that may be applicable or relevant to the Project. Under the *Energy Resources Activities Act*, BCER is the main provincial regulator for multiple provincial acts and regulations, although Section 8 and 9 of the *Energy Resource Activities Act* limits the authority of the BCER when a project is federally regulated. BC ENV retains the provincial authority to review this Section 15 Application for the Project.

The Project will be applying for applicable provincial permits prior to construction (see Section 1.8 for the Project schedule).

Table 1.2 Sunrise Expansion Program Provincial Regulatory Setting

Act, Regulation or Policy	Regulator*	Description
Environmental Management Act (EMA)	BC ENV	The EMA is the principal legislation governing environmental protection and waste management in BC. It establishes a regulatory framework for introduction of effluent into the environment and aims to protect air, land and water quality. A Section 15 Approval allows for temporary discharge of effluent into the environment for a maximum of 15 months. This document has been prepared to support a Section 15 Approval application under EMA.
Energy Resources Activities Act Environmental Protection Management Regulation (EPMR)	BCER	The EPMR under the *Energy Resources Activities Act* establishes the Government of BC's environmental obligations as they apply to Crown land and energy resource activities. The EPMR describes legal requirements for environmental protection and management and defines the government's objectives for environmental protection. By policy, the BCER applies the tests and principles of the EPMR to applications for provincial authorizations for Canada Energy Regulator (CER) regulated projects.
Water Sustainability Act (WSA) Water Sustainability Regulations (WSR)	BCER	The WSA is principal legislation for managing the diversion and use of water resources in BC. Under the WSA, the WSR sets out the statutory requirements for the issuance of licenses or approvals for the diversion, use, or storage of surface water or groundwater, and for making changes in and about a stream. For CER projects, the BCER has authority under the *Energy Resources Activities Act* to issue an approval for changes in and about a stream (including wetlands and lakes) in accordance with Section 11 of the WSA. The BCER also grants authorizations for short-term surface water or groundwater use under Section 10 of the WSA.
Land Act	BCER	The *Land Act* is used by the government to convey land to the public for community, industrial, and business use. It allows the granting of land, and the issuance of Crown land tenure in the form of leases, licences, permits, and rights-of-way.
Heritage Conservation Act	Archaeology Branch (BC MOF)	The *Heritage Conservation Act* protects and conserves heritage property in BC. Permits under this act are required if archaeological resources cannot be avoided.
Wildlife Act	BC MWLRS	The *Wildlife Act* protects certain vertebrate wildlife species (i.e., mammals, birds, amphibians, and reptiles) from direct harm, except as allowed under regulation (e.g., salvage during construction). A species may be designated as endangered or threatened under the *Wildlife Act.*

Note:

* BC ENV = British Columbia Ministry of Environment and Parks; BCER = British Columbia Energy Regulator; BC MOF = British Columbia Ministry of Forests; BC MWLRS = British Columbia Ministry of Water, Land and Resource Stewardship

1.4 Engagement

Westcoast began early engagement with potentially affected Indigenous groups, landowners, regulatory agencies, and other stakeholders (collectively referred to as 'Interested Parties') in January 2023 to understand interests and identify concerns relating to the Project prior to submission of the *Canadian Energy Regulator Act* Section 183 application. Engagement specific this Section 15 Approval application started in January 2025.

The goals of this early engagement included the following:

- identifying surface and groundwater-related knowledge and experiences held by Interested Parties
- soliciting specific feedback and insights into each PDL and its associated valued environmental components and sensitive features, including cultural values around water
- reviewing and considering the applicability of strategies that have been used to manage water during excavation activities in the past
- gauging perceptions and assessing the receptivity of residents in the area to conceptual and proposed water management options, including treatment and discharge

Input from early engagement has been integrated into the planning of the pipeline trench dewatering and throughout this TAR. As an example, Section 1.7 explains how input from engagement with Interested Parties was considered in the site selection process for the PDLs.

Westcoast has sought inputs from numerous Interested Parties and will continue and expand these interactions in 2026 following the submission of this TAR.

1.4.1 Indigenous Engagement

Table 1.3 summarizes Westcoast's engagement with potentially affected Indigenous groups who expressed an interest in the details relevant to the Section 15 Approval component of the Project.

Table 1.3 Summary of Engagement with Indigenous Groups Relevant to the Section 15 Approval

Date, Form of Engagement, and Discussion Topics	Indigenous Groups Engaged
March 2025 to present – Westcoast held introductory meetings with each group that included a presentation about water conditions in the Fraser Valley and Sumas Prairie, new pipeline construction phases and dewatering needs, Westcoast's water-related field studies, potential water discharge locations, the Section 15 Approval process, map review, and discussion. The meetings also included discussion of fieldwork training, community participation opportunities, and employment opportunities.	• Kwantlen First Nation • Leq'á:mel First Nation • Peters First Nation • Pópkw?em First Nation

Date, Form of Engagement, and Discussion Topics	Indigenous Groups Engaged
January 2025 – Westcoast and STSA jointly prepared and participated in an 1-day in-person workshop to engage in information sharing about water values and water management, construction methods, project schedule, Section 15 Approval application process and timeline, two-way sharing of interests and areas of concern, and ways to develop mitigation.	• S'ólh Téméxw Stewardship Alliance (STSA) • Stó:lō Research and Resource Management Centre (SRRMC)
Q2 2024 to present – Field surface water and groundwater baseline program development and delivery (see Section 2; Appendix E)	• McTavish Resource & Management Consultants Ltd. working with Leq'á:mel First Nation (Leq'á:mel Development Corporation)
Q2 2025 to present – Field groundwater well installation and monthly sampling support (see Section 2.3; Appendix F)	• Seabird Island Band and West Earth Sciences Ltd.
September 2025 – Westcoast and STSA held a half-day in-person workshop to review the water management program purpose and updates to the program, to discuss groundwater and surface water assessments, and to talk about the approach to preparing the Technical Assessment Report and fulfilling the Section 15 Approval application requirements.	• STSA
October and November 2025 – The STSA Dewatering Technical Working Group issued a technical information request to Westcoast in October 2025. Topics included questions about surface water quality monitoring, surface water quantity and take away capacity, proposed discharge location site selection methods, and general questions. In mid-November, Westcoast returned a written response to STSA, and an online (Zoom) Workshop was held to walk through each response. The session also provided an opportunity for dialogue.	• STSA Dewatering Technical Working Group
November 2025 – Westcoast shared the draft Information Requirements Table, when requested by the STSA Dewatering Technical Working Group.	• STSA Dewatering Technical Working Group
November 2025 to present – Westcoast and the STSA Dewatering Technical Working Group established a 'Parking Lot', which is a shared access, self-serve SharePoint spreadsheet where questions are posted by either the STSA Dewatering Technical Working Group or Westcoast and a response is posted by the responding party.	• STSA, SRRMC, STSA Dewatering Technical Working Group
January 2026 – Guidelines, guidance documents and reports related to water quality were provided by the STSA Dewatering Technical Working Group to Westcoast for consideration in preparing the Technical Assessment Report and Section 15 Approval application.	• STSA, SRRMC, STSA Dewatering Technical Working Group
November 2025 – A targeted in-person dialogue session on management plan development, including the Water Management Program. The Water Management Fact Sheet was issued by Westcoast in support of this session (Appendix C).	• Seabird Island Band
February to April 2026 – Westcoast presented an overview and/or provided a fact sheet about the proposed 2026 water management pilot program (Appendix C) that included descriptions of the three scopes to be tested in-field in summer 2026, on a small scale prior to construction (i.e., wellpoint system, water treatment, and ground infiltration trials)	• STSA • Seabird Island Band

Date, Form of Engagement, and Discussion Topics	Indigenous Groups Engaged
March 2026 – Tripartite Meeting 'Next Steps for Water' convened by STSA online with Westcoast and various provincial government agencies. The meeting purpose was to share information and establish common understanding among all parties on issues and options pertaining to water quality and water crossings for the Project. Topics included importance of water to Sto:lo, STSA lessons learned, Project activities and permitting timelines, role of collaborative work with STSA, potential discharge locations, and the 2026 water management pilot program.	• STSA
Regular weekly online technical meetings and monthly in-person general meetings.	• STSA, SRRMC • Seabird Island Band

Westcoast will continue to engage with Indigenous groups following submission of the TAR and will continue to incorporate input throughout the water management phase of construction.

1.4.2 Government Agencies

Westcoast has met multiple times with BC ENV to discuss the preparation of this TAR. In addition, Westcoast has also engaged with other provincial agencies and local governments on the Section 15 Approval as summarized in Table 1.4.

Following the submission of the TAR, Westcoast will complete regulatory engagement that is specific to the Section 15 Approval application, as required in the Application Instruction Document and anticipates providing notice of the application to the following agencies:

- Regional Health Authority
- Ministry of Agriculture and Food
- Ministry of Water, Land and Resource Stewardship
- Ministry of Transportation and Transit
- Ministry of Energy and Climate Solutions
- Ministry of Forests
- BCER
- Local governments, including City of Abbotsford, City of Chilliwack, Fraser Valley Regional District, and District of Kent, as applicable

A summary of this regulatory engagement will be provided to BC ENV separately from this TAR.

Table 1.4 Summary of Engagement with Government Agencies Relevant to the Section 15 Approval

Date, Form of Engagement and Discussion Topics	Government Agency Engaged
April 2025 to present – Westcoast held in-person introductory meetings that included a presentation about water conditions in the Fraser Valley and Sumas Prairie, new pipeline construction phases and dewatering needs, Westcoast's water-related field studies, potential water discharge locations, the Section 15 approval process, map review, and discussion.	• City of Abbotsford • City of Chilliwack • Fraser Valley Regional District • District of Kent
April 2025 to present – On-going quarterly meeting series. Key topics of discussion include construction approach and dewatering needs, proposed water discharge quantities, and seasonal timing. Much of the meeting discussion and email communication centers around understanding how the hydrology of the area works. This includes irrigation system operations and drainage controls, Barrowtown pump station operations and seasonality, proposed discharge locations seasonal receiving capacity, water hose routing and road crossings, and the 2026 water management pilot program (i.e., wellpoint system, water treatment, and ground infiltration trials). Westcoast construction and technical personnel have met in the field with City of Abbotsford field personnel to discuss site-specific topics.	• City of Abbotsford
March 2026 – Tripartite Meeting 'Next Steps for Water' convened by STSA online with Westcoast and various provincial government agencies. The meeting purpose was to share information and establish common understanding among all parties on issues and options pertaining to water quality and water crossings for the Project. Topics included importance of water to Sto:lo, STSA lessons learned, Project activities and permitting timelines, role of collaborative work with STSA, potential discharge locations, and the 2026 water management pilot program.	• Ministry of Energy and Climate Solutions • Ministry of Environment and Parks • BC Energy Regulator • BC Ministry of Forests

1.4.3 Landowners and Other Stakeholders

Westcoast has been engaging with potentially affected landowners as part of the CER application process and construction planning for the Project. Specific to the Section 15 Approval, Westcoast will provide notice to landowners with the potential to be directly impacted by the water discharge activities (i.e., a proposed discharge location is accessed via the property or hosing runs along the property).

Through engagement on the Project, Westcoast has identified community associations and special interest groups who may have interest in the Section 15 Approval application. The following groups will be notified of the Section 15 Approval application:

- BC Trappers Association
- BC Community Forest Association
- Guide Outfitters Association
- Sumas Prairie Flood Mitigation Committee.

Westcoast plans to notify general members of the public by posting information about the Section 15 Approval application on websites and newspapers. More targeted notice and engagement will be completed for landowners and stakeholders identified through the CER process as noted in the bulleted list above.

A summary of the public, landowner, and stakeholder engagement will be provided to BC ENV separately from this TAR.

1.5 Major Activities and Infrastructure

This section provides general information about the Project's major activities and infrastructure, primarily as they pertain to the dewatering component that is relevant to the Section 15 Approval application.

1.5.1 Project Footprint and Infrastructure

The pipeline will be designed and constructed in accordance with the industry standard, *CSA Z662:23 – Oil and Gas Pipeline Systems* (CSA Group 2023). The permanent ROW will be approximately 18 metres (m) wide. The temporary pipeline construction footprint will generally be 45 to 55 m wide, including approximately 27 m of temporary workspace. The actual width of the temporary footprint at a given location will reflect pipeline component design (such as bends, valves, crossovers, inspection assemblies), construction execution workspace requirements (including soil storage area), safety requirements, site-specific features and site-specific conditions. Existing access roads are expected to be used, where practical; however, access requirements will be determined during detailed design. Aboveground permanent infrastructure (such as crossovers, isolation and tie-in valves, in-line inspection assemblies, and launching and receiving traps) will be limited to the tie-in points with the existing T-South pipeline (see Section 3.1 for more construction details).

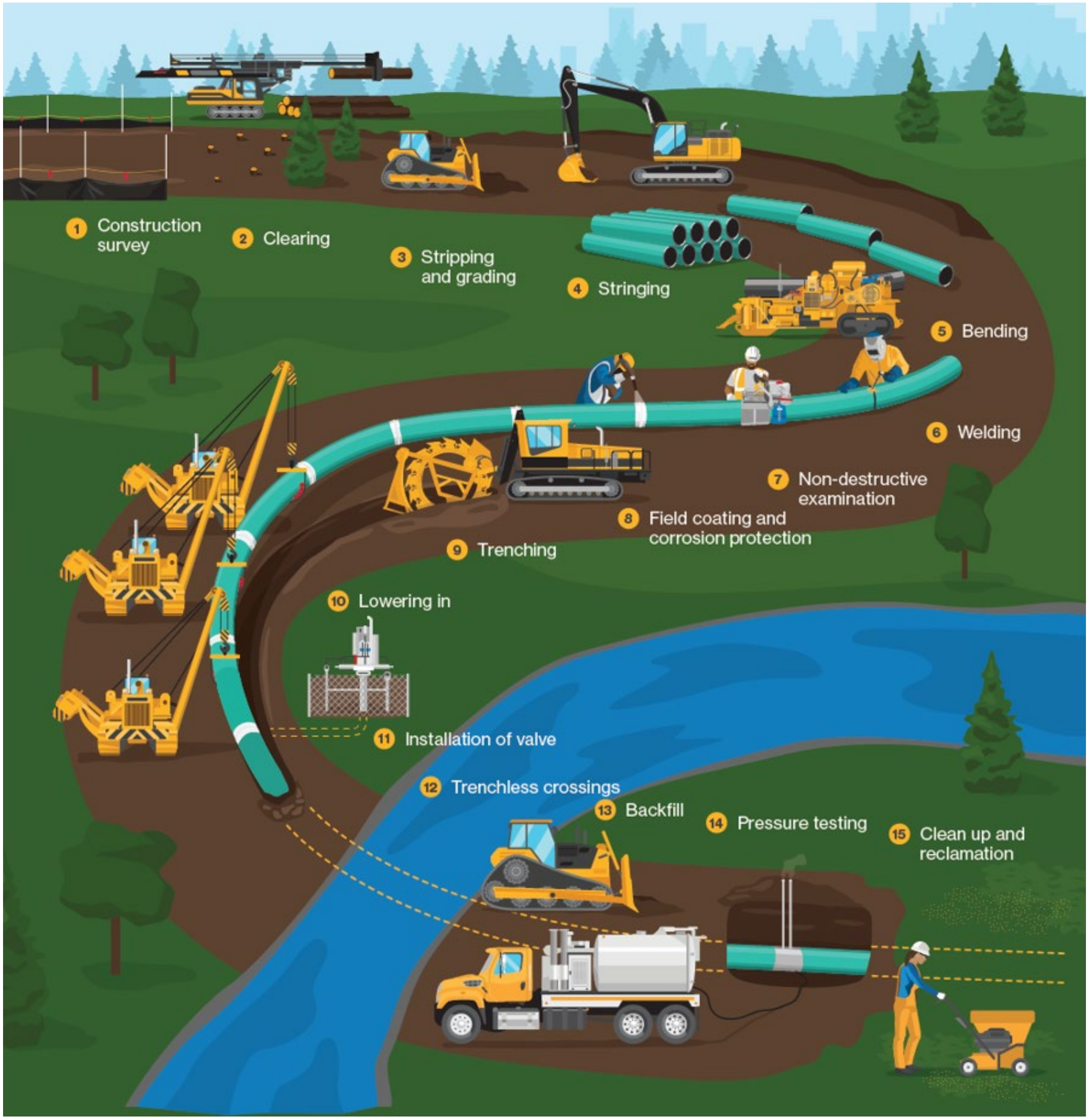
1.5.2 Site Preparation and Construction Activities

General pipeline construction sequencing steps are shown in Figure 1.4. Pipeline construction activities generally proceed in a linear fashion and includes the following:

- Field survey and marking the route with stakes
- Preparing the workspace, including tree clearing where necessary
- Stripping topsoil and storing for replacement following construction, grading
- Laying out sections of pipe (stringing)
- Bending and welding pipe into long segments
- Inspecting welds and field join coating (the pipe arrives on site facility-coated to prevent corrosion)
- Digging the trench
- Trench dewatering, where necessary
- Lowering the pipe into trench within the prepared trench bottom

- Backfilling the trench with subsoil
- Hydrostatic testing of the pipeline prior to operations
- Site cleanup and reclamation

Figure 1.4 Sunrise Expansion Program General Pipeline Construction Sequencing Steps



1.5.3 Operations

The Section 15 Approval is not applicable to Project operations since trench dewatering and discharge will be temporary (no longer than 15 months) and confined to the initial construction phase.

1.5.4 Closure and Post-closure

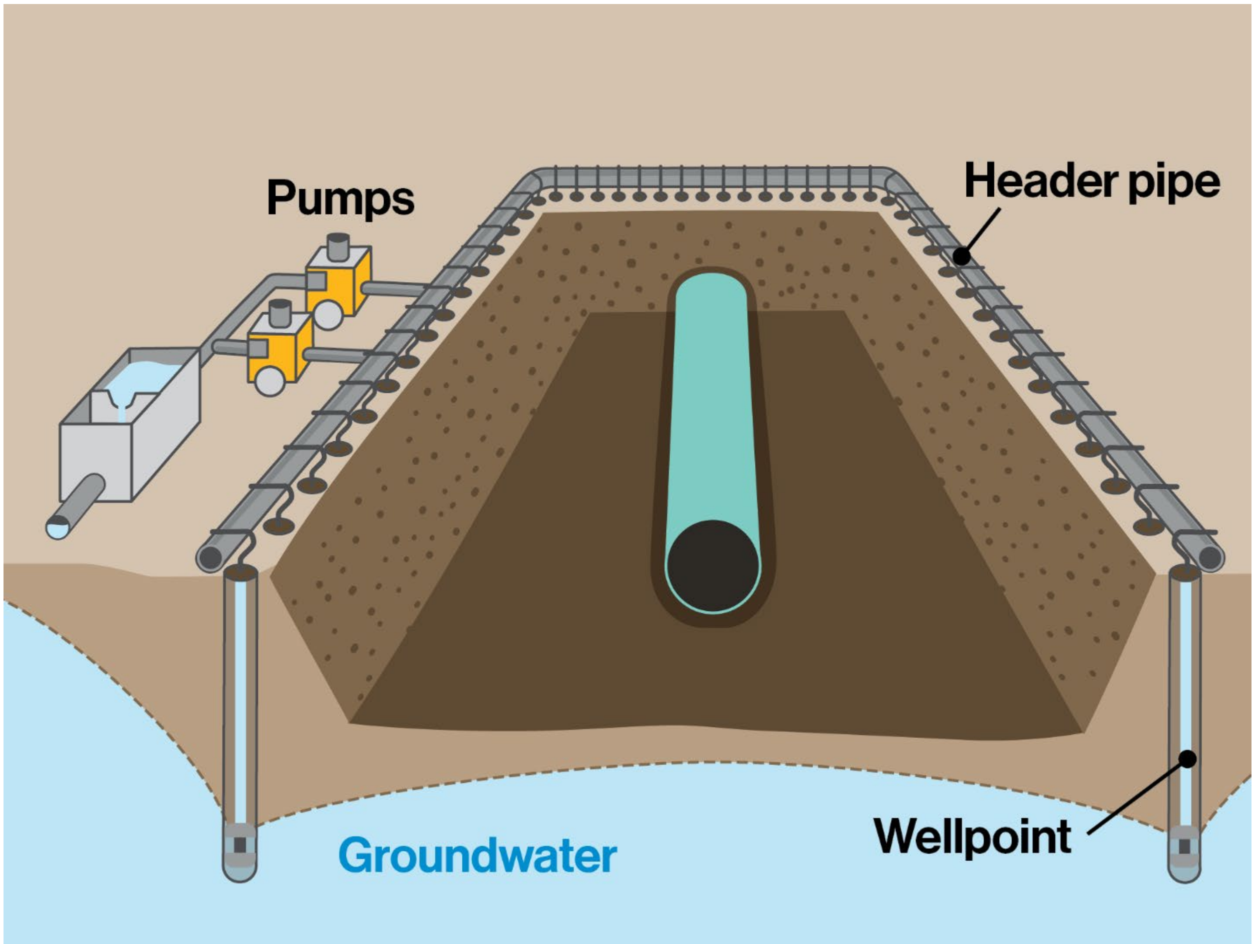
The Section 15 Approval is not applicable to Project closure and post-closure since trench dewatering and discharge will be temporary (no longer than 15 months) and confined to the initial construction phase.

1.6 Groundwater Management and Proposed Discharge

Pipeline installation involves digging a trench to facilitate the installation of the pipe as discussed in described in Section 1.5.2. This active work area must be dewatered if an accumulation of water (e.g., groundwater, precipitation, runoff) is present. Management of groundwater is a short term and temporary construction activity needed to maintain a safe and efficient work area. Limited sections of the trench (e.g., 300 m) may be open at a time, while the construction crew works through the pipeline installation process of digging the trench, installing the pipe and then covering sequential segments of pipe and backfilling the trench using the original excavated soil material (Figure 1.4, steps 9–13).
For most of the Project pipeline loops, groundwater in the trench is limited and, if present, the groundwater can be discharged to the surrounding land. However, for the Agassiz Loop and the Huntingdon Loop, the water table is expected to be high, and the inflow of groundwater management is anticipated to be challenging. Groundwater challenges in the Fraser Valley include a high groundwater table, as noted, high density of water users and existing elevated levels of some metals in groundwater.

Westcoast is looking at various ways to manage the groundwater in the Huntingdon and Agassiz loop areas, including collecting the groundwater via well points around the trench (Figure 1.5) and releasing groundwater to local streams, rivers, and sloughs (see Section 1.7 for PDLs and the related site selection process). The anticipated volumes and quality of the groundwater that is anticipated to be encountered along the pipeline loops has been assessed by Stantec and is discussed in Section 2.2.2. The discharge will also include stormwater encountered during construction, and anticipated volumes are discussed in Section 2.1.2 and discharges, mitigation and groundwater management are discussed in more detail in Section 3.

Figure 1.5 Sunrise Expansion Program Typical Pipeline Trench Well Point Dewatering



1.7 Proposed Discharge Locations and Site Selection

In 2024, Westcoast selected seven PDLs along the pipeline loop (Figure 1.2; Table 1.5). The locations were initially selected for discharge due to proximity to the ROW, easy access, and presence of a defined channel. Baseline data assessments and sampling for surface water receiving capacity and background water quality were initiated in 2024 at these locations where access/conditions permitted (see Sections 2.2, and 2.4, respectively). Fish and wildlife desktop review and field studies were also completed (Section 2.5) at the PDLs. In addition, Westcoast discussed these PDLs with Interested Parties. Field data and input from Interested Parties were considered iteratively to assess PDLs and site selection was an on-going process in 2024 and 2025.

In March 2025, additional sites were added to the list of PDLs, and these were selected based on the potential capacity to receive relatively large volumes of water (Table 1.5). The PDLs added in 2025 For the Agassiz Loop, additional PDLs on the Fraser River (PDL-A8 and PDL-SBI9) were added and a crossing of Maria Slough (PDL-SBI4) was removed because there were on-going issues with access. In second quarter (Q2) of 2025, five PDLs were removed from the list due to constraints related to receiving site capacity, cultural sites, species at risk critical habitat, and important habitat features (see Table 1.5).

Table 1.5 Proposed Discharge Locations Status

Proposed Discharge Location	Watercourse	Location (UTM: zone, easting, northing	Status	Rationale/Comments
PDL-A1	Fraser River	10U 588701 5451330	Assessed since August 2024	
PDL-A2	Cheam Slough	10U 589275 5452013	Removed in July 2025	Salish sucker (*Catostomus sp. cf. Catostomus*) critical habitat concerns
PDL-A6	Hicks Creek	10U 593804 5462814	Assessed since August 2024	
PDL-A7	Hicks Creek	10U 593915 5463032	Removed in July 2025	Known salmon spawning channel
PDL-A8	Fraser River	10U 591384 5452719	Added in March 2025	
PDL-SBI3	Maria Slough	10U 592182 5455342	Removed in July 2025	Oregon spotted frog (*Rana pretiosa*) critical habitat concerns
PDL- SBI4	Maria Slough	10U 591956 5457956	Removed in March 2025	Access not available for baseline sampling; Oregon spotted frog critical habitat concerns
PDL- SBI5	Maria Slough	10U 593791 5461604	Removed in July 2025	Oregon spotted frog critical habitat concerns
PDL- SBI9	Fraser River	10U 592543 5454821	Added in March 2025	

Notes:

PDL = Proposed Discharge Location; gray shading indicates PDLs that are no longer included on the list of discharge locations proposed by Westcoast and addressed in this TAR; UTM = Universal Transverse Mercator

1.8 Schedule

Subject to the receipt of regulatory approvals, Project construction activities described in Section 1.5.2 could commence certain construction activities as early as Q2 of 2026 subject to receiving regulatory approval, with a target in-service date of November 2028. Depending on local conditions and contractor availability, construction may commence under either frozen or nonfrozen ground conditions. Cleanup and reclamation of disturbed portions of the Project footprint will be completed following construction as weather, ground, and seasonal conditions allow.

The Project schedule for general pipeline construction is as follows:

- Pre-construction activities: Q2 2022–Q2 2026
- Construction start: Q2 2026
- In-service: Q4 2028
- Cleanup and reclamation: Q2–Q4 2029
- Post-construction monitoring: to be determined

The Project schedule accounts for regional timing windows (such as migratory bird nesting periods and provincial aquatic reduced risk work windows). Project scheduling is subject to revision Project planning advances.

The following are schedule details relevant to this Section 15 Approval application:

- Biophysical and archaeological programs were started in 2023 and are on-going
- Ground and surface water monitoring programs were initiated in 2024 and will continue until 2026
- Pipeline construction and associated trench dewatering for the Agassiz Loop is planned to commence April 2027, pending regulatory approvals
- Section 15 Approval is up to a maximum of 15 months, and pending approval is assumed to be valid from approximately April 2027 to June 2028

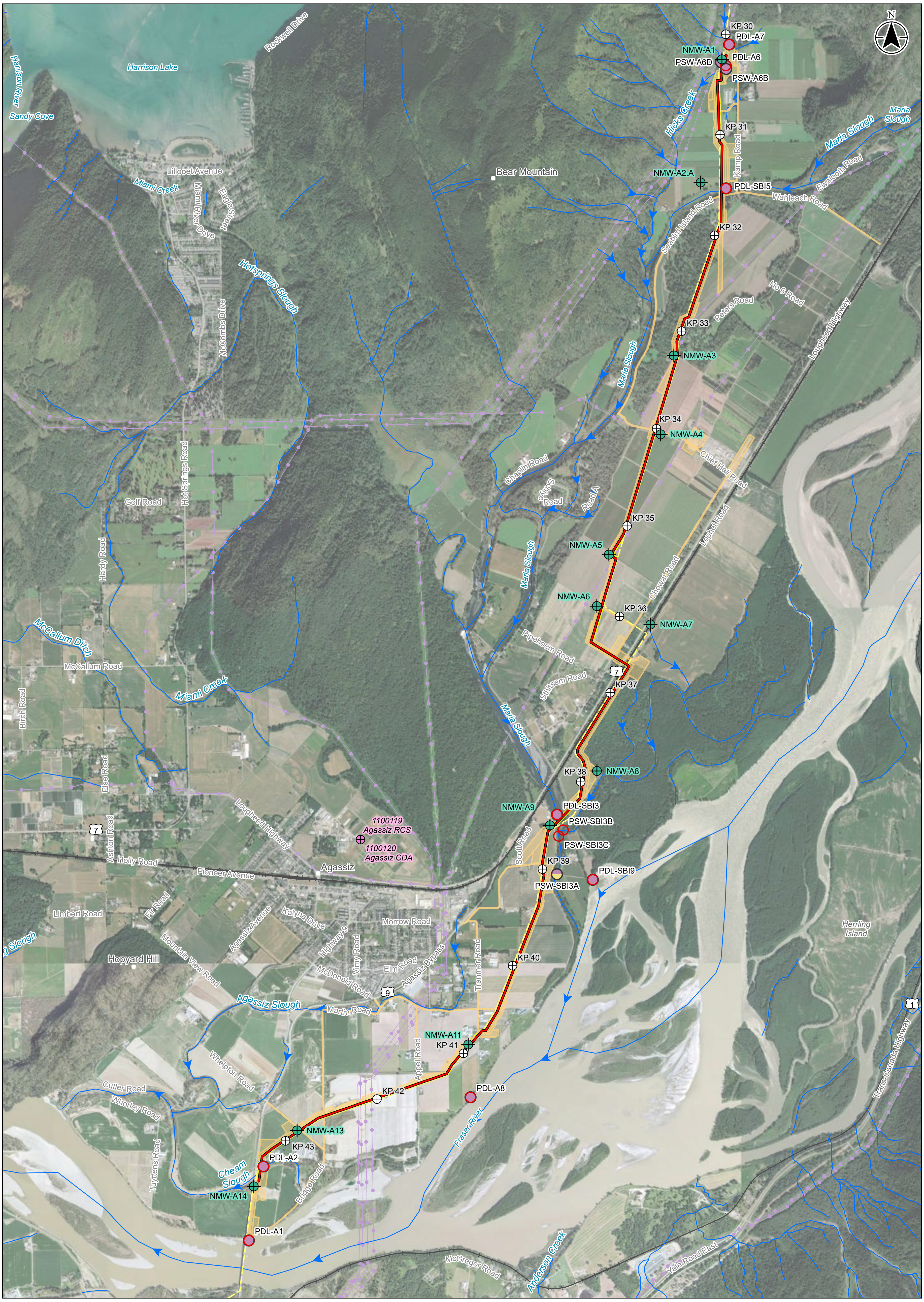
2 Environmental Settings

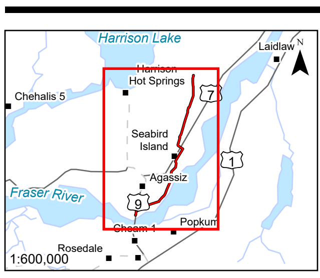
The following sections detail the environmental setting of the Agassiz Loop, as it pertains to meteorology and climate, surface water hydrology, hydrogeology, surface water quality, freshwater aquatic life, and potential contaminated sites and acid rock drainage. Data related to the environmental setting can also be found in the following appendices:

- Climate data – Appendix D
- Surface water monitoring – Appendix E
- Hydrogeology – Appendix F
- Surface water quality data – Appendix G
- Aquatic data – Appendix H
- Wildlife data – Appendix I
- Potential contaminated sites and acid rock drainage reporting – Appendix J

The review of the environmental setting for pipeline dewatering requirements started with a hydrogeological desktop assessment (Stantec 2024) in May 2024 to identify and assess risks associated with the potential construction dewatering required for the pipeline installation. The desktop assessment recommended installation of groundwater monitoring wells along the pipeline loop to allow for the collection of groundwater level and quality data, and surface water quality sampling at select locations related to potential discharge locations to inform dewatering decisions and support Section 15 Approval application data requirements.

Westcoast established groundwater monitoring wells and surface water sampling locations based on the desktop assessment recommendation, as shown in Figure 2.1, starting in May 2024. Monitoring reports for monthly surface water and groundwater sampling are provided in Appendix E and Appendix F, respectively, and summarized in the following sections: surface water hydrology (Section 2.2), hydrogeology (Section 2.3), and surface water quality (Section 2.4). Fish and wildlife habitat field surveys were also completed for the area that includes each PDL from 2023 to 2025; this reporting is included in Appendix H.1 and Appendix I.1, respectively, and summarized in Section 2.5. In addition to this Section 15 Approval application-specific sampling, existing information from the Environmental and Socio-economic Assessment (Jacobs 2024a), publicly available databases, and historical information for the region was compiled to characterize the environmental settings for the pipeline loop.





- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace

Sampling Locations
- Monitoring Well
- Surface Water Quality

Surface Water Hydrology Sampling
- Qualitative Assessment
- Hydrometric Stations

Environment and Climate Change Canada Stations
- Climate Station

0 375 750 1,125 1,500 m
1:37,500 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Project Location
Kent, BC
NTS 50K Grid: 092H05/092H04

Project Number: 123317055
Prepared by JPOUCHER on 20251230
Requested by RKEELER on 20251216

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
2.1

Title
Groundwater and Surface Water Sampling Locations

2.1 Meteorology and Climate

The following sections describe the methods, present the results and discussion, and identify data gaps and uncertainties as they pertain to the description of existing conditions for meteorology and climate. Although this section is not a requirement of the IRT, it is included in this report to provide specific inputs supporting the assessment of the stormwater volumes that will be considered as part of the construction trench dewatering requirements.

2.1.1 Methods

The meteorology and climate setting for the pipeline loop was described based on historical data available for regional Environment and Climate Change Canada (ECCC) climate stations; the dataset used is provided in Appendix D. Specifically, the following information was used:

- ECCC recorded climate data (2023–2025) for Climate Station 1100119 (Agassiz RCS)
- ECCC Intensity-Duration-Frequency Data (1955–2021) for Climate Station 1100119 (Agassiz RCS)
- ECCC Climate Normals Data (1991–2020) combined for Climate Stations 1100120 (Agassiz CDA) and 1100119 (Agassiz RCS)
- BC Agricultural Irrigation Scheduling Calculator

2.1.2 Results and Discussion

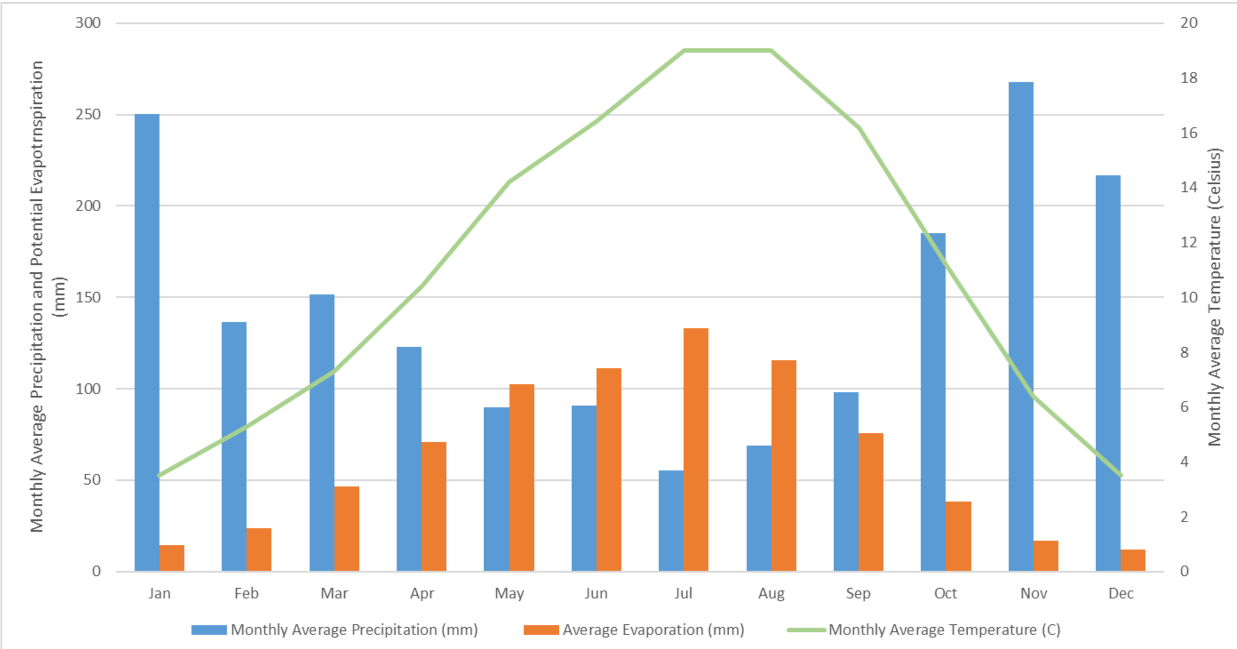
2.1.2.1 Historical Data

The climate in the pipeline loop area can be described as humid, and precipitation exceeds potential evapotranspiration. As shown in the sections below, there is a distinct seasonality with respect to precipitation and evapotranspiration that results in wet falls and winters (70% of annual precipitation typically occurs from October to March) and relatively dry springs and summers (30% of annual precipitation occurs from April to September).

2.1.2.1.1 Climate Data Summary

Combined Canadian Climate Normals for precipitation and temperature developed using data recorded from 1991 to 2020 at the Agassiz CDA weather station (Climate ID: 1100120) and Agassiz RCS weather station (Climate ID: 1100119), located approximately 2 km east of the site at elevations of 15 m and 19 m, respectively, are presented in Figure 2.2 alongside evaporation data from the BC Agricultural Irrigation Scheduling Calculator.

Figure 2.2 Summary of Climate Data for the Agassiz Loop Area



2.1.2.1.2 Extreme Precipitation Data

Historical Intensity-Duration-Frequency data for 5-year and 100-year return periods in the Agassiz Loop area are summarized in Table 2.1. The Intensity-Duration-Frequency data presented in Table 2.1 indicate the amount of precipitation estimated to fall in the time shown in the 'Duration' column for specific return period and can be used to estimate the amount of stormwater that could accumulate within the pipeline trench excavation.

Table 2.1 Historical Intensity-Duration-Frequency Data for 5-Year and 100-Year Return Periods for the Agassiz Loop Area

Duration	**Rainfall (mm)**	
	5-Year Return Period	**100-Year Return Period**
5 min	7.2	16.4
10 min	9.8	21.6
15 min	11.1	23.9
30 min	13.6	27.2
1 hour	16.3	28.8
2 hours	22.1	34.9
6 hours	39.7	56.1
12 hours	60.6	85
24 hours	91.8	139.5

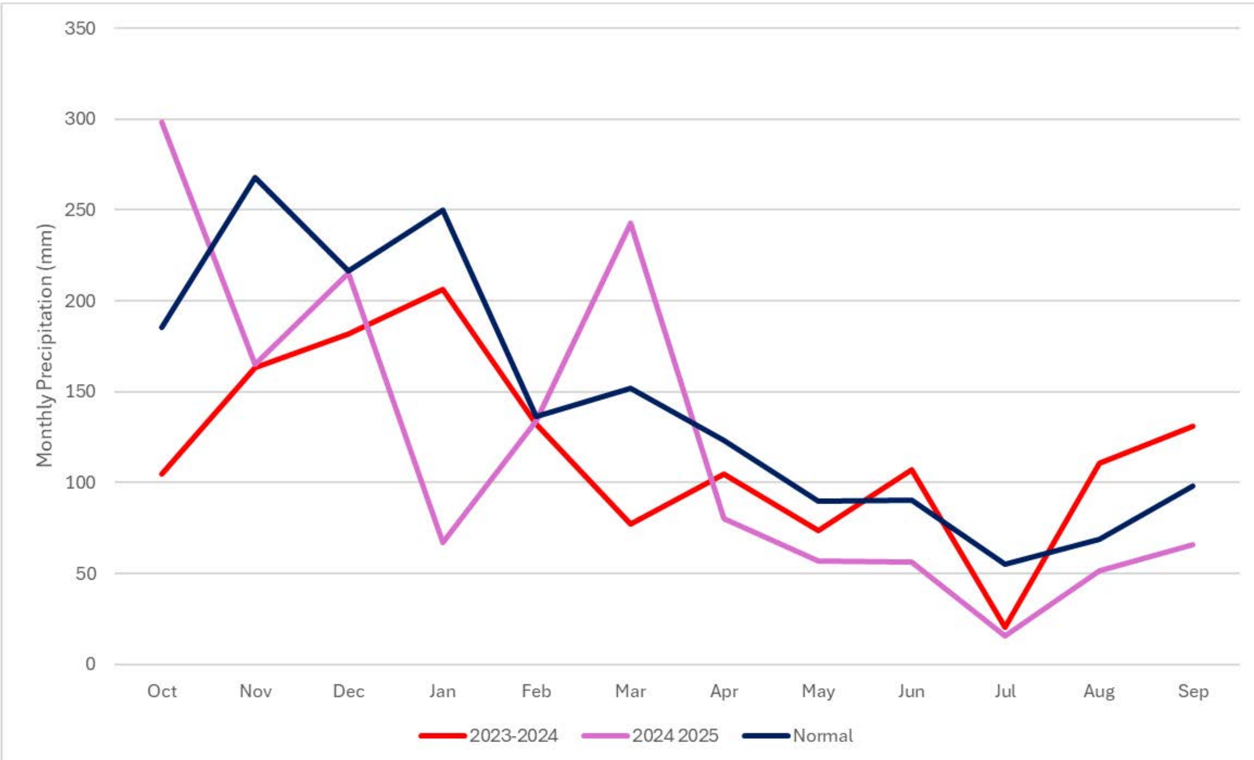
Note:
mm = millimetre

2.1.2.2 October 2023 to September 2025 Precipitation Conditions

Baseline conditions for surface water and groundwater are based on monitoring in the pipeline loop area from approximately August 2024 to August 2025 (see Sections 2.2 and 2.2.3, respectively). To determine if this monitoring period was characterized by average, wet, or dry climate conditions, precipitation data recorded by ECCC during the monitoring timeframe was compared to long-term averages for the pipeline loop area. In areas where summer groundwater conditions can be strongly influenced by recharge due to the fall-winter precipitation season preceding the summer under consideration, it is important to consider all precipitation that could have influenced the results of the monitoring program. Therefore, to capture more accurately the relationship between observed conditions and the long-term averages, the comparison was completed for ‘hydrologic years’ that start on October 1 and end on September 30, so precipitation data from October 2023 (the fall prior to the start of the monitoring program) were used.

Figure 2.3 shows the comparison between monthly precipitation recorded from October 2023 to September 2025 at the Agassiz RCS climate station and the normal range derived from long-term averages from ECCC for the Agassiz RCS and Agassiz CDA climate stations, combined.

Figure 2.3 2023–2025 Precipitation Recorded at Agassiz RCS Climate Station and Long-Term Average (Normal) Precipitation for the Agassiz RCS and Agassiz CDA Climate Stations



For both the hydrologic years 2023–2024 and 2024–2025, precipitation recorded was approximately 15 to 20% less than an average year. Hydrologic year 2023–2024 received 30% less precipitation in the rainy season (i.e., October to March) and average precipitation from April to September. Hydrologic year 2024–2025 experienced 10% less than average precipitation in the rainy season and 40% less than average precipitation from April to September.

2.1.3 Data Gaps and Uncertainties

The available meteorology and climate data are considered adequate to use for planning purposes for the short-term discharge and consideration of anticipated stormwater volumes for this TAR.

2.2 Surface Water Hydrology

The following sections describe the methods, present the results and discussion, and identify data gaps and uncertainties as they pertain to the description of existing conditions for surface water hydrology. Per the requirements of the IRT, this section uses regional and desktop methods to provide baseline hydrologic assessment to provide specific inputs supporting the assessment of the maximum receiving capacity of each PDL.

2.2.1 Methods

The baseline surface water hydrology conditions for the pipeline loop area were assessed using a combination of historical hydrometric data available for regional ECCC hydrometric stations, regional equations developed as part of the BC Regional Streamflow Inventory (the dataset is provided in Appendix E.3 and Ahmed [2017]), and field observations and water level data gathered by the Westcoast's surface water monitoring programs. As part of these monitoring programs, a qualitative assessment was completed monthly or quarterly at the PDLs. This includes recording site observations and collecting photos of channel geometry and physical characteristics to assess how the channel changes under varying flow conditions. A more detailed hydrotechnical assessment was completed at select PDLs with consistent presence of water and flow to understand the seasonal water level changes at the sites compared to regional averages. Specifically, the following information was used:

- ECCC recorded hydrometric data (1912–2022) for Hydrometric Station 08MF005 (Fraser River Near Hope)
- Inventory of Streamflow in the South Coast and West Coast Regions, BC Ministry of Environment and Climate Change (October 2017)
- Westcoast's Agassiz Loop field monitoring programs and surveys results and observations (2023–2025) included in Appendix E

2.2.2 Results and Discussion

2.2.2.1 Watershed Characteristics

The Agassiz Loop PDLs are located within the Fraser River watershed. The PDLs are located either directly on the Fraser River or on Hicks Creek (a tributary to Maria Slough, a former side channel of the Fraser River disconnected at the upstream end by the Canadian Pacific Railway construction). Water levels in the Fraser River are associated with snowmelt and precipitation occurring in central BC while water levels within Hicks Creek are expected to be dependant almost entirely on local precipitation. Section 2.1.2 and Section 2.3.2 provide more information on the climate and geological setting of the Agassiz Loop area.

2.2.2.2 Surface Runoff

Based on available data, mean monthly flows have been estimated for each Agassiz Loop PDL. For PDLs on the Fraser River (PDL-A1, PDL-A8, PDL-SBI9), the estimates are based on the analysis of recorded monthly flows from 1912 to 2022 from ECCC hydrometric station 08MF005 (Fraser River Near Hope). It has been assumed that the same monthly flows can be used for all three of the PDLs along the Fraser River.

For the PDL located on Hicks Creek (PDL-A6), mean monthly flows have been estimated by using regional equations for annual runoff and mean monthly runoff distribution from the BC Streamflow Inventory for Hydrologic Zone 26. The BC streamflow inventory provides estimates for annual runoff and monthly runoff distribution within the year.

Mean monthly flows for each of the Agassiz Loop PDLs are presented in Table 2.2 Both the Fraser River and Hicks Creek show a seasonal regime with high monthly flows between May and August (peaking typically in June) and low flow conditions in winter between December and March.

Table 2.2 Mean Monthly Flow Estimates for Agassiz Loop Proposed Discharge Locations

Proposed Discharge Location	Watercourse Name	Mean Monthly Flow (m^3/s)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	Fraser River	955	899	900	1,880	5,020	7,000	5,520	3,470	2,320	1,930	1,640	1,140
PDL-A6	Hicks Creek	0.346	0.283	0.292	0.409	0.813	1.07	0.922	0.615	0.429	0.480	0.536	0.332
PDL-A8	Fraser River	955	899	900	1,880	5,020	7,000	5,520	3,470	2,320	1,930	1,640	1,140
PDL-SBI9	Fraser River	955	899	900	1,880	5,020	7,000	5,520	3,470	2,320	1,930	1,640	1,140

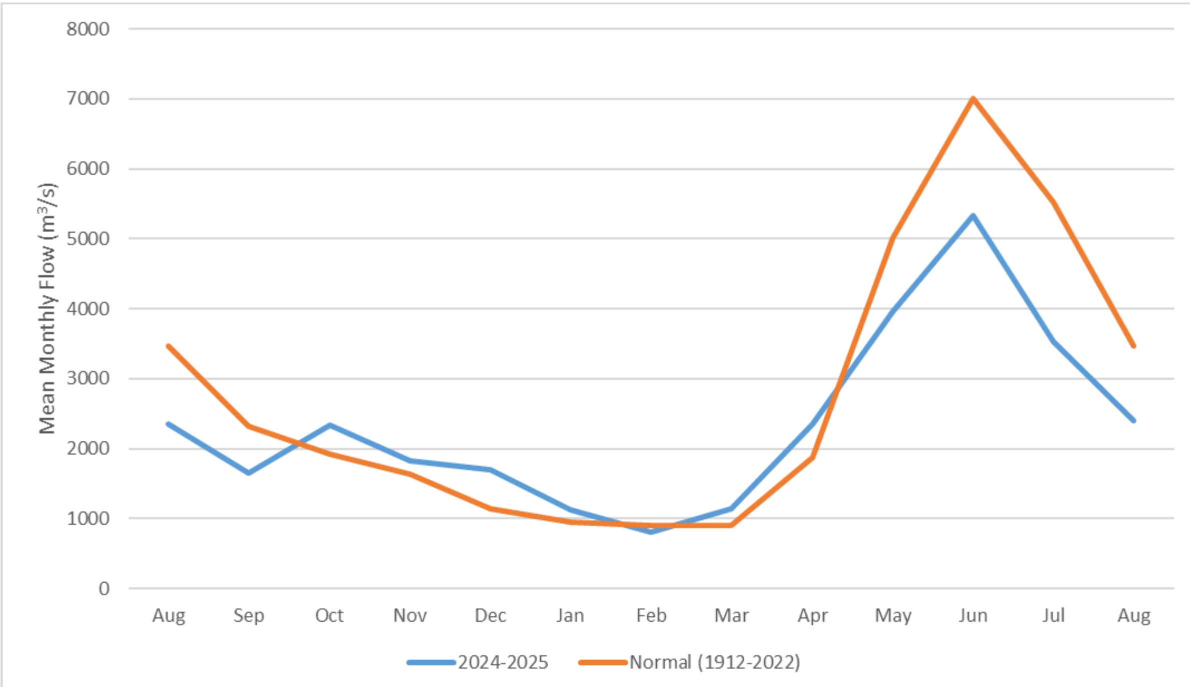
Note:
m^3/s = cubic metres per second

2.2.2.3 Monitoring Window Runoff Conditions

Surface water and groundwater monitoring data collected from the pipeline loop between August 2024 and August 2025 have been included in this report. To determine the type of flow regime at the PDLs during that timeframe, when compared to normal conditions, monthly hydrometric data recorded by ECCC during the monitoring timeframe were compared to long-term averages for the representative station.

Figure 2.4 shows the comparison between average monthly flows and monthly flows recorded between August 2024 and August 2025 at the ECCC hydrometric station 08MF005 (Fraser River Near Hope). During the 2024–2025 monitoring period, flows in the Fraser River were approximately 15% less than normal (accounting for monthly fluctuations), with the biggest difference occurring between May and July.

Figure 2.4 2024–2025 Recorded and Historical Monthly Flows at Hydrometric Station 08MF005 (Fraser River Near Hope)



2.2.2.4 Channel Morphology

2.2.2.4.1 Hicks Creek

Hicks Creek, near PDL-A6, is a small natural waterbody that appears to have been potentially routed through a mixed natural/man-made channel. A relatively large drainage enters the channel from the south directly upstream of PDL-A6. Multiple flood gates were observed in the banks near PDL-A6, controlling flow in the adjacent drainages. The banks of the channel appear predominantly well-vegetated with no obvious signs of erosion. The channel is generally sinuous near PDL-A6, but no sharp bend was observed nearby. The channel appears to be laterally stable with a very flat longitudinal slope. Debris accumulation was observed during monthly monitoring of the site (Appendix E.1). There is also anecdotal evidence of the creek occasionally having been almost entirely dry (Appendix E.1). Typical conditions at PDL-A6 are shown in Photo 2.1.

Photo 2.1 Hicks Creek at PDL-A6 in October 2024 (Left) and March 2025 (Right) Looking Upstream at the Existing Bridge

2.2.2.4.2 Fraser River

The Fraser River near the Agassiz Loop is a major river with a defined main channel, multiple side channels, and islands. PDL-SBI9 is located on the bank of a side channel, while PDL-A8 and PDL-A1 are on the north bank of the main river channel. The riverbank at both PDL-SBI9 and PDL-A8 is armoured with riprap. Typical conditions at PDL-A1, PDL-A8, and PDL-SBI9 are shown in Photo 2.2, Photo 2.3, and Photo 2.4, respectively.

Photo 2.2 Fraser River at PDL-A1 in August 2024 (Left) and October 2024 (Right) Looking Downstream

Photo 2.3 Fraser River at PDL-A8 in June 2025 (Left) and August 2025 (Right) Looking Across the Channel

Photo 2.4 Fraser River at PDL-SBI9 in June 2025 (Left) and August 2025 (Right) Looking Upstream

2.2.3 Data Gaps and Uncertainties

The available surface water hydrology data are considered adequate to use for planning purposes for the short-term discharge and considering receiving environment flows and capacity.

2.3 Hydrogeology

The following sections describe the methods, present the results and discussion, and identify data gaps and uncertainties as they pertain to the description of existing hydrogeological conditions.

2.3.1 Methods

This section describes the methods used to support the baseline hydrogeological assessment and consists of the following key components:

- A desktop review of existing geological, aquifer, and water use information
- Hydrogeological site investigations and baseline data collection activities to characterize subsurface and groundwater conditions
- Development of a conceptual hydrostratigraphic model to describe hydrostratigraphic units and groundwater levels in relation to the proposed trench excavations
- Groundwater quality assessment to evaluate groundwater quality

The following sections provide a detailed description of the methods, including information sources, field activities, modelling approaches, and groundwater quality data guideline and screening criteria.

2.3.1.1 Desktop Review

Public database information pertinent to geology, hydrogeology, water use, and water balance in the pipeline loop area was compiled and reviewed to establish the baseline hydrogeological setting. The information sources used in this desktop review are provided in Table 2.3.

The BC Data Catalogue, the Groundwater Wells and Aquifers Database (GWELLS), and the Provincial Groundwater Observation Well Network database (Table 2.3) were the primary sources for this desktop review. The BC Data Catalogue is a government repository for provincial datasets, including geology, mapped aquifers, surface water features, water licenses, landownership, administrative boundaries, and contour information. This information can be viewed spatially via the provincial webmap tools iMapBC and the BC Water Resources Atlas.

Table 2.3 Information Sources

Dataset or Report	Author/Source
Private Dataset or Report	
Hydrotechnical Support Maria Slough Anomaly at 8BL1 KP31.5 Background Climatology & Hydrology	MMA 2019
Public Dataset or Report	
British Columbia Data Catalogue	GOBC Gov 2025a
Groundwater Wells and Aquifers Database	GOBC 2025b
Provincial Groundwater Observation Well Network	GOBC 2025c
Ministry of Water, Land, and Resource Stewardship Water Rights Database	BC MWLRS 2025
District of Kent WebMap Application	District of Kent n.d.
Environment and Climate Change Canada Canadian Climate Normals & Averages Database	ECCC 2025a
Environment and Climate Change Canada Historical Hydrometric Data	ECCC 2025b
Project Notification – Westcoast Energy Inc. Sunrise Expansion Program	Westcoast 2024
Aquifer #4 Fact Sheet	GOBC 2025d
The Fraser Freshet Masterplan	BC MFLNRO 2011
Aquifer #4 Mapping Report	Park 2007
Fraser Valley Groundwater Monitoring Program – Final Report	Carmichael et al. 1995
Surficial Geology, Mission, BC, Geological Survey of Canada, Map 1485A	Armstrong 1980

GWELLS is a provincial database containing groundwater well and aquifer information. Well information includes data extracted from well installation logs that drilling contractors are required to upload upon completion of a well. Typical data in a well installation log include well location, stratigraphy encountered, well construction, water level and well yield estimates, and date of completion. Aquifer information includes mapping reports, vulnerability assessments, and statistical summaries of well information correlated to each aquifer. Information in GWELLS database can be viewed via iMapBC or the BC Water Resources Atlas and can be downloaded and used for specific applications.

The Provincial Groundwater Observation Well Network database contains groundwater level and quality information from a network of monitoring wells operated by the province.

2.3.1.2 Field Programs

A series of field programs were initiated in Q3 2024 and Q2 2025 to support subsurface characterization along the Agassiz Loop and to establish a groundwater monitoring network for ongoing baseline groundwater monitoring. These field programs were as follows:

- Monitoring well installations (completed in October 2024): Seven (7) monitoring wells were installed in October 2024 (NMW-A1, NMW-A2.A, NMW-A9, NMW-A10, NMW-A11, NMW-A13, and NMW-A14), and an additional six monitoring wells were installed on the Seabird Island in May 2025 (NMW-A3, NMW-A4, NMW-A5, NMW-A6, NMW-A7, NMW-A8). These monitoring wells formed the basis for hydraulic conductivity testing, groundwater level monitoring, and groundwater quality monitoring programs. Table 2.4 presents the existing groundwater monitoring well networks. Figure 2.1 provide an overview of the groundwater monitoring well locations.
- Geotechnical investigation (completed in July 2024): Four geotechnical boreholes (BH01, BH10, BH11, and BH14) were completed up to 55 metres below ground surface (mbgs) for subsurface investigation. Soil samples obtained during drilling were collected for laboratory sieve analysis, and observation of groundwater presence were recorded to support hydrogeological characterization.
- Archaeology test pit program (ongoing since June 2025): Test pit excavation was conducted as part of the archaeology assessment for the Project to support pipeline construction. Test pits were advanced approximately every 20 m to depths of up to 3.5 mbgs. Soil conditions encountered in the test pits were documented, soil sample collected from the excavated materials were submitted for sieve analysis, and the presence of groundwater was documented to support hydrogeological characterization.

Table 2.4 Agassiz Loop Groundwater Monitoring Well Network

Well ID	UTM Coordinates[b]		Elevations		Screened Interval (mbgs)	Screened Lithology
	Northing (m)	Easting (m)	Top of Casing (masl)[a]	Ground Elevation (masl)[a]		
NMW-A1	5462897.4	593852.2	24.44	23.55	3.7–5.2	Fine to medium sand, trace silt
NMW-A2.A	5461676.7	593639.9	23.16	22.39	4.4–5.9	Gravel with sand, frequent cobbles
NMW-A3	5459989.6	593365.1	23.4	22.6	3.1–6.1	Gravel with sand to sand with gravel, frequent cobbles
NMW-A4	5459343.9	593124.5	22.1	22.5	3.1–6.1	Sand with gravel to gravel with sand, frequent cobbles
NMW-A5	5458020.8	592724.6	21.1	21.5	3.1–6.1	Sand with gravel, some cobbles
NMW-A6	5457509.8	592598.9	20.5	20.8	3.1–6.1	Gravel with sand, some cobbles
NMW-A7	5457330.7	593149.9	19.6	20.0	2.6–5.6	Gravel with sand, occasional cobbles
NMW-A8	5455876.0	592645.6	20.7	20.0	3.1–6.1	Sand with silt and gravel with sand, occasional cobbles
NMW-A9	5455323.5	592123.0	20.28	19.37	6.1–7.6	Gravel with sand, frequent cobbles
NMW-A11	5453237.9	591341.5	19.04	18.22	6.1–7.6	Gravel with sand, frequent cobbles
NMW-A13	5452358.5	589652.1	16.39	16.76	6.1–7.6	Graded gravel with sand, trace cobble
NMW-A14	5451810.3	589236.0	15.61	16.12	4.6–6.1	Gravel with sand, frequent cobbles

Notes:

m = metre; masl = metres above sea level; mbgs = metres below ground surface.

[a] Elevations referenced to NAD83; surveyed by GeoVerra (November 2024 and June 2025).

[b] Universal Transverse Mercator (UTM) coordinates in Zone 10U.

All wells constructed of 51 mm (2-inch) PVC with 10-slot (0.25 mm) screen and sand-pack plus bentonite seal per installation guidance.

2.3.1.3 Baseline Groundwater Monitoring

Monitoring well development, hydraulic conductivity testing, and monthly groundwater monitoring was completed by Pinchin Ltd. (Pinchin), a third-party consultant subcontracted by McTavish Resource & Management Consultants Inc. (McTavish), who was contracted by Westcoast. Pinchin was responsible for the monthly groundwater quality and groundwater level data collection, including the collection of groundwater quality assurance and quality control samples (i.e., blanks, duplicates), and completion of related data quality calculations (i.e., relative percent difference, anion/cation ratio) in accordance with the BC Field Sampling Manual for groundwater (BC MECCS 2021a). Pinchin was supported by Seabird Island Band technical staff for sampling on Seabird Island. Groundwater level data from pressure transducers were processed using barometric corrections following standard hydrogeological practice.

Details of the monthly groundwater monitoring activities (e.g., methods and results) completed from October 2024 to August 2025 are provided in Pinchin's letter reports, included in Appendix F.1.

2.3.1.4 Conceptual Hydrostratigraphic Model

A three-dimensional (3D) conceptual hydrogeological model was developed for the pipeline loop to support interpretation of subsurface conditions along the pipeline loop alignment. The model was constructed using 3D geological modelling software (Leapfrog Works 2024.1 [Seequent 2024]) and incorporated data obtained from the baseline data collection program (Section 2.3.1.3) and other supporting programs (i.e. archaeology [test pits], geotechnical [boreholes]). Lithological data from test pits, boreholes, and monitoring wells were complied and interpreted within the 3D environment to define the distribution and continuity of unconsolidated sediment units along the alignment. Groundwater level measurements from test pits and monitoring wells were used to inform the position of the groundwater table. These datasets were integrated to produce a simplified 3D visualization of the hydrostratigraphy along the pipeline loop.

2.3.1.5 Groundwater Quality

2.3.1.5.1 Parameters Analyzed

Groundwater quality samples collected along the Agassiz Loop (from October 2024 to August 2025) were sent to Bureau Veritas and the following parameters were analyzed:

- pH, hardness, total dissolved solids, and total suspended solids (TSS)
- Anions (chloride, fluoride)
- Ammonia, total phosphorus, total nitrogen, nitrate, nitrite, total organic carbon, dissolved organic carbon, and sulphate
- Total and dissolved metals

2.3.1.5.2 Water Quality Guidelines and Screening Criteria

Groundwater quality data were screened against the Chronic and Acute BC Water Quality Guidelines for the Protection of Freshwater Aquatic Life (BC WQG-FAL) (BC MWLRS 2026). When no corresponding BC WQG-FAL existed for a parameter, the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-AL) were applied (CCME 2026). Groundwater was also screened against the Water Quality Objectives (WQOs) for the Lower Fraser River, as applied in the 2024 WQO Attainment Report (BC MEP 2025). Federal Environmental Quality Guidelines (FEQGs) developed by Environment and Climate Change Canada (ECCC 2024a) were considered during the screening of monitoring results. However, BC WQG-FAL have been developed for each metal parameter with a corresponding FEQG, and several of the most recent BC WQG-FAL, including those for total aluminum, dissolved lead, strontium, and vanadium, are directly adopted from the FEQGs (BC MWLRS 2026). In adopting these FEQG-based values, the BC Ministry of Water, Land, and Resource Sustainability (BC MWLRS) applied an uncertainty factor that reduces the FEQG values by approximately two- to three-fold depending on the parameter, resulting in provincial guidelines that are more stringent than the FEQGs. For these reasons, FEQGs were not used. Unless otherwise noted, the guidelines used in this application are collectively referred to as ‘WQG-FAL’ and include the BC WQG-FAL and, in a limited number of cases where BC WQG-FAL do not exist, the CWQG-AL (a detailed list of the WQG-FAL used in this TAR is provided in Section 2.4.1.

The WQG-FAL are science-based benchmark concentrations that are intended to protect freshwater aquatic life. The WQG-FAL include chronic (long-term) values, intended to protect aquatic organisms from sublethal effects associated with prolonged exposure, and acute (short-term) values, intended to protect against lethal or severe effects resulting from brief or infrequent exposures (BC MWLRS 2026). Exceedances of chronic or acute WQG-FAL do not necessarily indicate that adverse effects are expected or will occur but rather serve as screening tools to help identify conditions that may warrant further evaluation in the context of site-specific exposure, duration, and receiving environment characteristics (BC MWLRS 2026).

For parameters with variable guidelines, guideline values were calculated using site-specific water chemistry for toxicity modifying factors (TMFs) in surface water—including pH, dissolved organic carbon, hardness expressed as calcium carbonate and chloride. Surface water chemistry data used for guideline calculations were compiled from pooled Fraser River sites (PDL-A1, PDL-A8, PDL-SBI9) and from Hicks Creek (PDL-A6). TMFs were applied to each surface water sample individually to generate corresponding guideline values (i.e., on a sample-by-sample basis) in accordance with established provincial procedures (BC MWLRS 2026).

To establish conservative chronic screening criteria for groundwater, the 25th percentile of calculated chronic guideline values was determined for each sampling location. The 25th percentile was selected because chronic guidelines are intended to apply to a 30-day mean concentration (BC MWLRS 2026); using an instantaneous minimum value would imply that the most restrictive water-chemistry condition persists for the entire chronic averaging period, which is not scientifically realistic. The 25th percentile avoids this issue while still representing the protective end of each location’s guideline distribution (i.e., 75% of calculated guideline values at that location are higher). To develop a single chronic screening value for groundwater, the lowest of the location-specific 25th percentiles was then selected, providing protection under the most sensitive conditions observed across the pipeline loop area. This approach yields a deliberately conservative chronic screening value that reflects both temporal averaging considerations and spatial variability in water chemistry.

In contrast, Acute screening criteria were established by selecting the minimum calculated acute guideline for each surface water location. Unlike chronic guidelines, acute guidelines are designed to protect against brief, episodic exposures and do not incorporate temporal averaging (BC MWLRS 2026). Acute effects can occur during short-duration peak concentrations under the most sensitive water chemistry conditions observed at any single point in time. For this reason, the minimum calculated acute guideline was adopted as the short-term screening value, providing protection during conditions in which acute toxicity is most likely to occur.

Summary statistics for the calculated minimum, 25th percentile, and maximum chronic and acute guideline values are provided for Fraser River (Table 2.5) and Hicks Creek (Table 2.6).

Table 2.5 Summary of Calculated Guideline Statistics (Minimum, 25th Percentile, Maximum) Used to Derive Groundwater Screening Criteria for Fraser River

Parameter	Chronic WQG-FAL (mg/L)[a]			Acute WQG-FAL (mg/L)[a]		
	Min	25P[b]	Max	Min[b]	25P	Max
Ammonia (as N)	0.611	0.904	1.24	4.49	6.64	23.8
Chloride	150	150	150	600	600	600
Fluoride	0.12	0.12	0.12	1.09	1.1	1.37
Nitrate (as N)	3	3	3	32.8	32.8	32.8
Nitrite (as N)	0.02	0.02	0.02	0.06	0.06	0.06
Sulphate	218	218	309	-	-	-
Aluminum (T)	0.0559	0.167	0.395	-	-	-
Antimony (T)	0.074	0.074	0.074	0.25	0.25	0.25
Arsenic (T)	0.005	0.005	0.005	-	-	-
Barium (T)	1	1	1	-	-	-
Beryllium (T)	0.00013	0.00013	0.00013	-	-	-
Boron (T)	1.2	1.2	1.2	0.29	0.29	0.29
Chromium (T)	0.0025	0.0025	0.0025	-	-	-
Iron (T)	0.3	0.3	0.3	1	1	1
Mercury (T)	0.00000125	0.00000125	0.00000125	-	-	-
Molybdenum (T)	7.6	7.6	7.6	46	46	46
Selenium (T)	0.002	0.002	0.002	-	-	-
Silver (T)	0.00012	0.00012	0.00012	-	-	-

Parameter	Chronic WQG-FAL (mg/L)[a]			Acute WQG-FAL (mg/L)[a]		
	Min	25P[b]	Max	Min[b]	25P	Max
Thallium (T)	0.0008	0.0008	0.0008	-	-	-
Uranium (T)	0.0075	0.0075	0.0075	0.0165	0.0165	0.0165
Vanadium (T)	0.06	0.06	0.06	-	-	-
Cadmium (D)	0.000135	0.000139	0.000225	0.000312	0.000326	0.000643
Cobalt (D)	0.000395	0.000402	0.000528	-	-	-
Copper (D)	0.0002	0.0007	0.0025	0.0006	0.0041	0.0147
Iron (D)	-	-	-	0.35	0.35	0.35
Lead (D)	0.00241	0.0027875	0.00483	-	-	-
Manganese (D)	0.22	0.32	0.56	-	-	-
Nickel (D)	0.001	0.0011	0.0025	0.0167	0.0174	0.0321
Strontium (D)	1.25	1.25	1.25	-	-	-
Zinc (D)	0.00476	0.00584	0.0208	0.0276	0.0299	0.0503

Notes:

Min = Minimum, 25P = 25th Percentile, Max = Maximum; T = Total; D = Dissolved; N = as Nitrogen; Dashes = no corresponding guideline.

[a] Chronic values for fluoride, total iron, and dissolved manganese, and the acute value for boron are CWQG-AL adopted from the Canadian Council of Ministers of the Environment.

[b] The 25P Chronic and minimum Acute guideline values were adopted as the screening criteria for groundwater.

The variable guideline equations are shown in Table 2.17 (Section 2.4.1.2).

Note that the acute CWQG-AL for boron (0.29 mg/L) is lower than the chronic BC WQG-FAL (1.2 mg/L). In addition, the minimum acute BC WQG-FAL for dissolved copper (0.0006 mg/L) was lower than the site-specific 25P chronic value (0.0007 mg/L). These ‘inversions’ reflect differences in how acute and chronic values are derived (boron) or selected (minimum acute vs. 25P chronic; copper) and do not affect screening results, as acute and chronic comparisons were both conducted independently. This note is provided to clarify why the acute value may appear more restrictive than the chronic value for these parameters.

Table 2.6 Summary of Calculated Guideline Statistics (Minimum, 25th Percentile, Maximum) Used to Derive Groundwater Screening Criteria for Hicks Creek

Parameter	Chronic WQG-FAL (mg/L)[a]			Acute WQG-FAL (mg/L)[a]		
	Min	25P[b]	Min	25P[b]	Min	25P[b]
Ammonia (as N)	0.611	1.22	1.23	4.49	18.225	23.8
Chloride	150	150	150	600	600	600
Fluoride	0.12	0.12	0.12	0.488	0.5295	0.846
Nitrate (as N)	3	3	3	32.8	32.8	32.8
Nitrite (as N)	0.02	0.02	0.04	0.06	0.06	0.12
Sulphate	128	128	128	-	-	-
Aluminum (T)	0.0502	0.07285	0.426	-	-	-
Antimony (T)	0.074	0.074	0.074	0.25	0.25	0.25
Arsenic (T)	0.005	0.005	0.005	-	-	-
Barium (T)	1	1	1	-	-	-
Beryllium (T)	0.00013	0.00013	0.00013	-	-	-
Boron (T)	1.2	1.2	1.2	0.29	0.29	0.29
Chromium (T)	0.0025	0.0025	0.0025	-	-	-
Iron (T)	0.3	0.3	0.3	1	1	1
Mercury (T)	1.25E-06	1.25E-06	1.25E-06	-	-	-
Molybdenum (T)	7.6	7.6	7.6	46	46	46
Selenium (T)	0.002	0.002	0.002	-	-	-
Silver (T)	0.00012	0.00012	0.00012	-	-	-
Thallium (T)	0.0008	0.0008	0.0008	-	-	-
Uranium (T)	0.0075	0.0075	0.0075	0.0165	0.0165	0.0165
Vanadium (T)	0.06	0.06	0.06	-	-	-
Cadmium (D)	0.000045	4.85E-05	8.65E-05	6.74E-05	7.5E-05	0.000168
Cobalt (D)	0.00039	0.00039	0.00039	-	-	-
Copper (D)	0.0002	0.0002	0.0021	0.0006	0.0013	0.0123
Iron (D)	-	-	-	0.35	0.35	0.35
Lead (D)	0.00193	0.002423	0.00509	-	-	-
Manganese (D)	0.2	0.32	0.38	-	-	-
Nickel (D)	0.0006	0.0007	0.0019	0.0095	0.0114	0.0216

Parameter	**Chronic WQG-FAL (mg/L)[a]**			**Acute WQG-FAL (mg/L)[a]**		
	Min	**25P[b]**	**Min**	**25P[b]**	**Min**	**25P[b]**
Strontium (D)	1.25	1.25	1.25	-	-	-
Zinc (D)	0.00214	0.005195	0.0117	0.00956	0.010275	0.0207

Notes:

Min = Minimum; 25P = 25^{th} Percentile; Max = Maximum; T = Total; D = Dissolved; N = as Nitrogen; Dashes = no corresponding guideline.

[a] Chronic values for fluoride, total iron, and dissolved manganese, and the acute value for boron are CWQG-AL adopted from the Canadian Council of Ministers of the Environment.

[b] The 25P chronic and minimum Acute guideline values were adopted as the screening criteria for groundwater.

The variable guideline equations are shown in Table 2.17 (Section 2.4.1.2).

Note that the acute CWQG-AL for boron (0.29 mg/L) is lower than the chronic BC WQG-FAL (1.2 mg/L); this reflects differences in derivation and does not affect results, as both the acute and chronic guidelines were applied.

2.3.1.5.3 Groundwater Quality Data Analysis

Groundwater sample data were screened prior to comparison with the WQG-FAL established for the PDLs. Samples with TSS concentrations greater than or equal to 50 mg/L were excluded from the dataset to minimize potential bias, since the presence of excessive suspended solids can result in inaccurate and imprecise metal concentrations (BC MECCS 2021a).

Laboratory analytical results were assessed on an area basis to identify localized exceedances of the WQG-FAL along the Agassiz Loop. For reporting purposes, monitoring wells were organized by general kilometre post (KP) ranges to reflect spatial coverage along the pipeline loop alignment as follows (Figure 2.1):

- KP30.0 to KP30.5: NMW-A1
- KP30.5 to KP31.5: NMW-A2.A
- KP31.5 to KP38.5: NMW-A3, NMW-A4, NMW-A5, NMW-A6, NMW-A7, NMW-A8
- KP38.5 to KP40.0: NMW-A9
- KP40.0 to KP42.0: NMW-A11
- KP42.0 to KP43.5: NMW-A13, NMW-A14

Summary statistics were calculated for each KP range, including the median (50^{th} percentile [50P]) and the 90^{th} percentile (90P) to represent typical and upper-range groundwater quality conditions. These 50P and 90P values were compared to applicable guidelines (Section 2.3.1.5.2) to assess guideline exceedances. Time series plots (individual monitoring wells) were generated for parameters exceeding applicable guidelines using Python-based plotting scripts, with concentrations plotted against corresponding TSS values and applicable guidelines to illustrate temporal variability and trends along the pipeline Loop.

2.3.2 Results and Discussion

2.3.2.1 Desktop Review

2.3.2.1.1 Provincial Aquifer

Provincial Aquifer 4 (Agassiz-Seabird Island) is located downgradient and under the Agassiz Loop. The aquifer extends across much of the District of Kent and consists primarily of Fraser River sediments. Provincial mapping identifies Aquifer 4 as the principal groundwater-bearing unit in the region (GOBC 2025b), occupying an area of approximately 63 square kilometres. Aquifer 4 is bounded to the south and east by the Fraser River, and to the north and west by Harrison Lake and the Coast Mountains (e.g., Mount Agassiz and Mount Woodside).

The aquifer is characterized as an unconfined sand and gravel, large river system aquifer. Provincial mapping and GWELLS records indicate an aquifer thickness greater than 10 m, with static groundwater levels typically ranging between 1 and 6 mbgs (GOBC 2025b). Assuming groundwater flow generally follows local topography, the flow direction within Aquifer 4 is likely toward the southwest, toward the Fraser River.

Aquifer 4 is classified as IIIA (lightly developed, high vulnerability) under the BC Aquifer Classification System and is characterized by high productivity (median reported well yield of 6.3 litres per second [L/s]; GOBC 2025b). Localized water quality issues pertaining to iron have been reported within the aquifer as an aesthetic concern. Iron is recognized under Protocol 9 of the BC Contaminated Sites Regulation as a parameter that may be naturally elevated due to background geochemical conditions. No groundwater quantity concerns have been documented for Aquifer 4 in the aquifer mapping report.

The aquifer has a provincial ranking score of 15. The ranking system is used to prioritize aquifers for protection and management decisions. The ranking grades aquifers between 5 and 21, with 5 as the lowest priority and 21 as the highest. Aquifer 4 is considered high priority.

There are 95 wells correlated to Aquifer 4 within the provincial database, and an additional 405 uncorrelated wells located within the mapped aquifer extent. These uncorrelated wells may be completed within Aquifer 4 or within isolated and unmapped water-bearing zones that occur within interbedded sand and gravel lenses.

2.3.2.1.2 Geological Setting

The Agassiz Loop lies within the Fraser River floodplain bounded by the Coast Mountains to the north and the Cascade foothills to the south. The Fraser River flows westward along the southern boundary of the district, while Harrison Lake lies approximately 10 km to the north. Local topography is characterized by low-lying floodplain (less than 25 masl) that gently rises toward surrounding mountain slopes, which include prominent peaks such as Mount Cheam to the southeast (approximately 2,100 masl).

2.3.2.1.3 Surficial Geology

Regional surficial geology west of Apple Road has been mapped at a 1:50,000 scale by Armstrong (1980) and consists entirely of Fraser River sediments, composed of recent channel and overbank deposits of sandy loam, loamy sand, and minor silt loam and silt (i.e., alluvial sediments). GWELLS records indicate that surficial deposits consist primarily of sand and gravel to depths of approximately 20 to 25 mbgs, underlain by clay (GOBC 2025b). East of Apple Road, soil descriptions from GWELLS records indicate surficial materials that are similar to those mapped west of Apple Road by Armstrong (1980), consisting predominantly of alluvial sand and gravel with localized silt and clay.

Given the thickness of the unconsolidated materials and the relatively shallow depth of planned excavations (3.1 to 4.5 mbgs), bedrock geology is not considered relevant to this assessment and is not discussed herein.

2.3.2.1.4 Public Well Record Search

A public well record search was completed using the GWELLS database (GOBC 2025b). The search area extended 1 km from the pipeline loop ROW. A total of 111 well records were identified within the search area (as of October 2025; Appendix F.2.1), of which 27 are screened in Aquifer 4 (84 have no aquifer specified). Well records for the identified groundwater users are presented visually in Appendix F.2.2. Associated water use categories are summarized in Figure 2.5.

Figure 2.5 Water Well Use Summary in the Agassiz Area

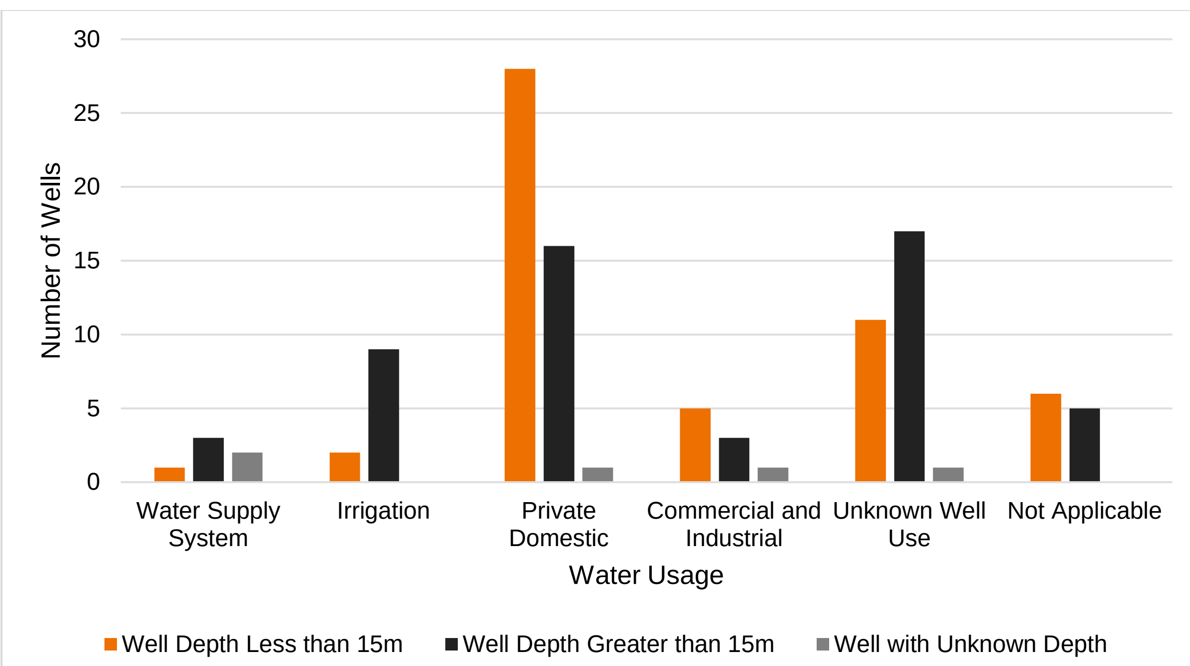


Figure 2.5 provides a snapshot of the groundwater users associated with the wells installed within 1 km of the Agassiz Loop ROW. Of the 111 wells identified, 45 are listed as Private Domestic use, and 28 of these are installed at less than 15 mbgs. Twenty-nine wells (26%) are listed as Unknown well use, which means that the drilling contractor who uploaded the well record to GWELLS was not aware of the purpose of the well or did not fill in the field on the report. It is likely many of these wells are also private domestic use wells. Eleven wells (10%) were 'not specified' use type records (i.e., shown as 'Not Applicable' in Figure 2.5); these likely correspond to older well records without well use information. The 26 remaining wells are listed as Commercial and Industrial, Irrigation, or Water Supply use. Water Supply use wells supply a water utility (GOBC 2025b).

The number of wells identified in the GWELLS database will be less than the actual number of wells near the pipeline loop ROW, since many wells, especially older installations, will not have had records uploaded to the database.

2.3.2.1.5 Existing Licensed Users and Applications

A total of 12 groundwater use licences and 8 groundwater use applications are recorded in the BC Water Rights database within 1 km of the Agassiz Loop ROW (BC MWLRS 2025; as of October 2025). A complete list of existing groundwater licensed users is summarised in Table 2.7. Licensed groundwater users including domestic, irrigation, industrial and agricultural water supply (Table 2.7). Current groundwater use applications are visually presented in Appendix F.2.2. These include well tag number 117085 for private irrigation purposes (7 applications; application number: 20023275).

Table 2.7 Existing License Users

System ID	License Number	Well Tag Number	Water Usage	Quantity (m^3/yr)
63358	115849	503017	Livestock & Animal	2,480
111540	101061	505626	Livestock & Animal	9,490
104744	115483	500568	Camps & Public Facilities	2,191
67046	125292	507133	Irrigation: Private	53,220
67045	125292	507133	Irrigation: Private	53,220
64837	94184	507542	Livestock & Animal	2,370
64838	94184	507542	Livestock & Animal	2,370
112154	114999	505526	Livestock & Animal	4,020
67015	72157	503868	Industrial Waste Management	33,237
67014	87903	503868	Industrial Waste Management	33,237
15910	113287	503881	Waterworks: Local Provider	724,000
15909	113298	503881	Waterworks: Local Provider	724,000

Note:
m^3/yr = cubic meter per year

2.3.2.1.6 Public Water Supply

Public use water providers outlined in Fraser Health Authority Drinking Water Reports (Fraser Health 2025) within 1 km of the pipeline ROW are summarized in Table 2.8 (as of October 2025). Public use water providers supply water for public consumption. The size or number of public connections refers to the number of facilities or buildings supplied by the source (i.e., number of homes) and are grouped by size (i.e., small system 2 to 14; medium system 15 to 300; large system 301 to 10,000). Each public use water provider listed in Table 2.8 uses groundwater as a water resource via water supply wells. The locations of these water providers are illustrated in Appendix F.2.2.

Table 2.8 Summary of Public Use Water Providers in the Agassiz Area

Name	Address	Size (Number of Public Connections)	Distance to Pipeline Loop Right-of-Way (m)
Agassiz Christian School WS	7571 Morrow Rd	1	955
Agassiz Wastewater Treatment Plant	1088 Tranmer Rd	1	134
District of Kent Water System	7170 Cheam Ave	301–10,000	240
Fraser River Lodge WS	7984 McDonald Rd	2–14	242
Homestead Cider	6046 Kamp Rd	2–14	257
Scott’s Meats Ltd	2310 Scott Rd	1	182

The Agassiz townsite uses groundwater for municipal water supply. The municipal water supply system uses wells along the Fraser River near municipal address 7984 McDonald Avenue.

2.3.2.2 Site Hydrogeological Conditions

2.3.2.2.1 Hydrostratigraphic Units

Site hydrogeological conditions along the Agassiz Loop were interpreted based on data obtained from hydrogeological site investigations (Section 2.3.1.2) and baseline groundwater monitoring (Section 2.3.1.3). These data were used to characterize subsurface and groundwater conditions across the site. A conceptual hydrostratigraphic model developed in Leapfrog Works was used to support visualization of spatial distribution of hydrostratigraphic units (HSUs) (Section 2.3.1.4). Representative cross-sections generated from the model are provided in Appendix F.3.

Based on the available bore logs and test pit observations, unconsolidated sediments encountered along the Agassiz Loop were grouped into three HSUs:

- Clay to Silty Clay/Silt: A low-permeability clay to silty clay/silt unit containing trace sand, rootlets, and organic material. This unit occurs intermittently as the upmost layer along the pipeline loop.
- Sand with Silt/Clay: A moderately permeable sand unit containing variable silt and clay content. This unit forms the upper layer along much of the loop, overlying the saturated gravel with sand unit.
- Gravel with Sand: A relatively high-permeability gravel unit with occasional interbedded sand layers. This unit represents the primary saturated HSU and forms the main groundwater bearing zone (thickness greater than 10 m).

Bedrock has not been encountered in the available subsurface investigations (e.g., to depths of up to approximately 55 mbgs). Given the shallow depth of planned trench excavation (e.g., less than 5 mbgs), bedrock is not expected to influence site hydrogeological conditions during construction and is therefore, not discussed further herein.

2.3.2.2.2 Hydraulic Conductivity

Single well response tests (slug tests) were conducted in eight monitoring wells screened within the primary water bearing unit (saturated gravel with sand) along the Agassiz Loop. The monitoring wells were screened at depths of less than 7 mbgs, with groundwater table observed at depths of approximately 2 to 5 mbgs.

Slug test results indicate that hydraulic conductivity of the gravel with sand unit ranges from 4.2×10^{5} metres per second (m/s) at NMW-A4 to 1.1×10^{-3} m/s at NMW-A8 (Table 2.9; geometric mean of 2×10^{-4} m/s). These values fall within the range reported in the literature for similar materials (e.g., Domenico and Schwartz 1990; 2×10^{-7} m/s to 3×10^{-2} m/s). Grain-size information obtained from soil samples collected during hydrogeological site investigations (Section 2.3.1.2) was also reviewed to provide a qualitative check on the slug test results. Hydraulic conductivity estimates based on grain-size analyses (gravel with sand) are generally consistent with the range indicated by the slug test results.

Hydraulic conductivity for the clay to silty clay/silt and the silt to silty clay HSUs was estimated based on grain-size observations, professional judgement, and ranges reported in literature for similar materials (e.g., Domenico and Schwartz 1990). Hydraulic conductivities for these HSUs are expected to be less than 2×10^{-5} m/s.

Table 2.9 Single Well Response Test Summary

Monitoring Well ID	Screen Depth (mbgs)	Screened Lithology	Geomean Hydraulic Conductivity (m/s)
NMW-A4	3.05–6.1	Sand with gravel to gravel with sand, frequent cobbles	4.2×10^{-5}
NMW-A5	3.05–6.1	Sand with gravel, some cobbles	3.6×10^{-4}
NMW-A7	3.05–6.1	Gravel with sand, occasional cobbles	4.9×10^{-5}
NMW-A8	3.05–6.1	Sand with silt and gravel, occasional cobbles	1.1×10^{-3}
NMW-A9	6.1–7.6	Gravel with sand, frequent cobbles	2.8×10^{-4}
NMW-A11	6.1–7.6	Gravel with sand, frequent cobbles	3.1×10^{-4}

Note:
mbgs = metres below ground surface; m/s = metres per second

2.3.2.2.3 Groundwater Levels and Elevations

Groundwater levels along the Agassiz Loop were monitored at 12 monitoring wells (Table 2.4), extending from north of Seabird Island to south of Agassiz near the Fraser River (Figure 2.1). Manual groundwater level measurements collected from October 2024 to August 2025 are provided in Appendix F.4.1. Continuous groundwater elevation from the instrumented monitoring well is illustrated as hydrographs in Appendix F.4.2.

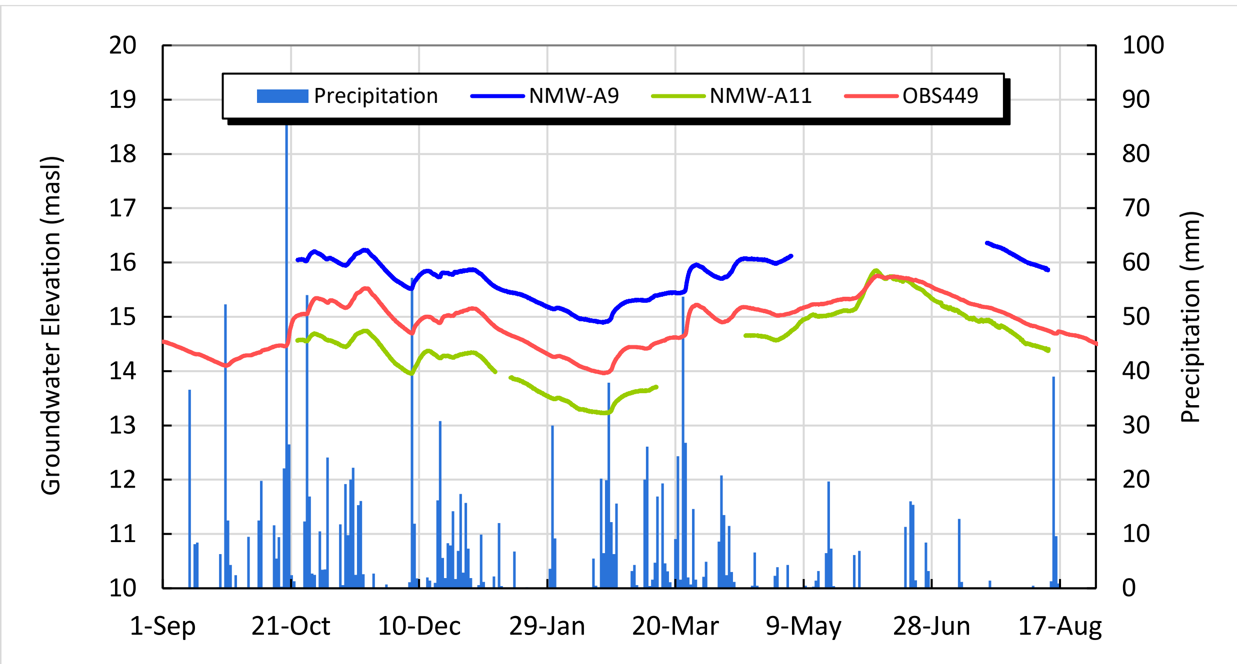
Between October 2024 and August 2025, groundwater elevations along the Agassiz Loop ranged from 12.16 masl at NMW-A14 (March 12, 2025) to 21.76 masl at NMW-A1 (November 5, 2024). Depths to groundwater ranged from 1.66 mbgs at NMW-A14 (June 11, 2025) to 5.01 mbgs at NMW-A11 (February 11, 2025) (Appendix F.4.2). In general, groundwater elevations along the Agassiz Loop were higher in the northern portion (e.g., NMW-A1 and NMW-A2.A) and lower in the southern portion near Cheam Slough (e.g., NMW-A13 and NMW-A14). Groundwater elevation decreases progressively from northeast to southwest, generally following surface topography and indicating a gentle hydraulic gradient toward the Fraser River.

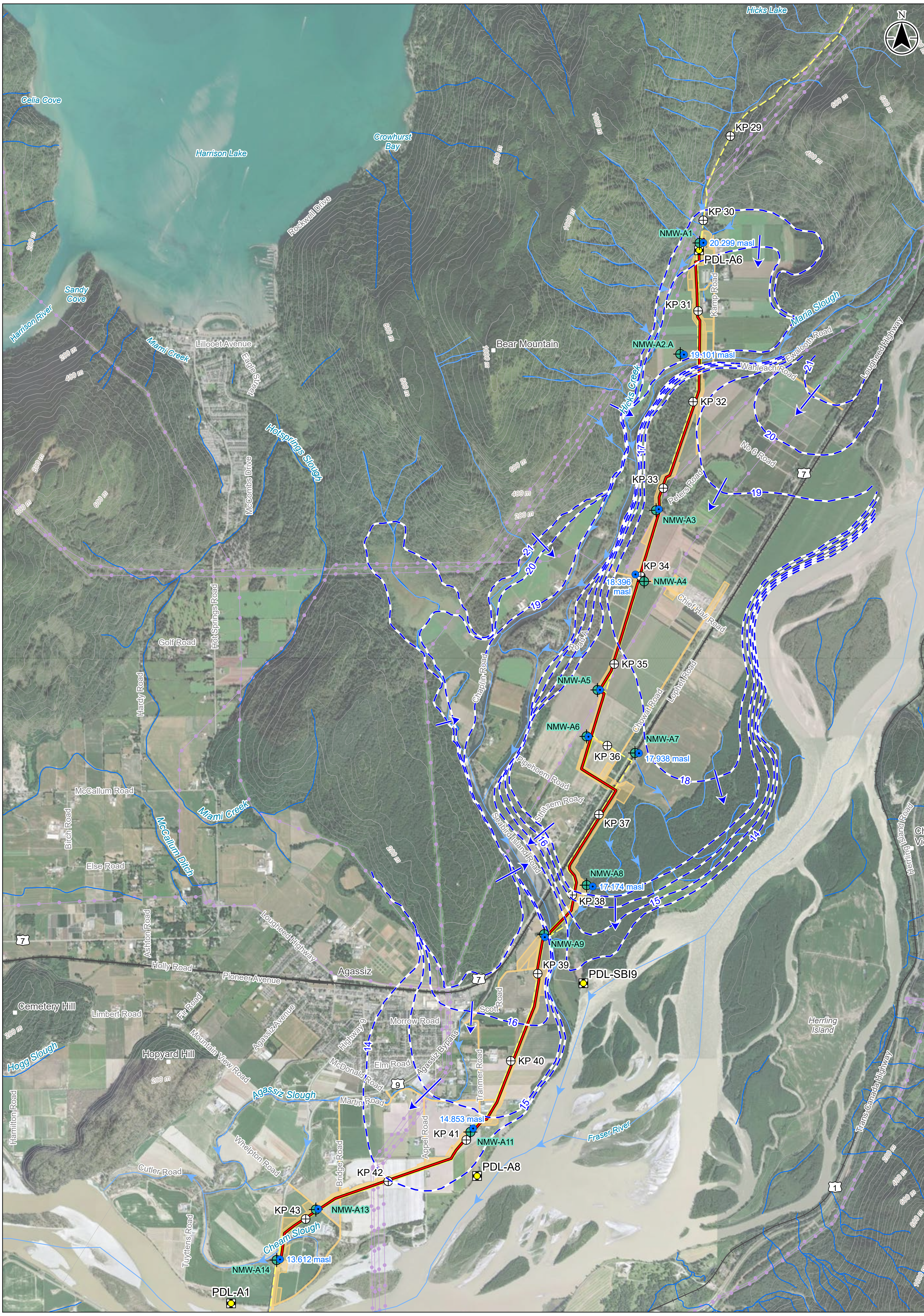
A groundwater hydrograph is presented for Provincial Observation Well 449 (OBS449) and selected nearby monitoring wells (NMW-A9 and NMW-A11, located approximately 1.37 km northeast and 1.13 km south of OBS449, respectively; Figure 2.6). Groundwater elevation recorded at the Agassiz Loop monitoring wells show similar patterns to those observed at OBS449 with the highest groundwater levels typically observed during winter and late spring in tandem with the Fraser River freshet period. Seasonal groundwater fluctuations are typically on the order of 2 m to 3 m.

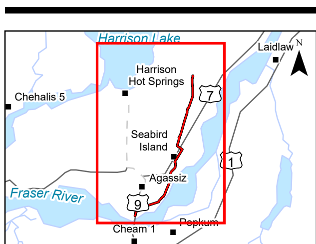
Monitoring well data indicate that groundwater elevations generally increase from February to June 2025 and from October to December corresponding to increased precipitation, snowmelt and Fraser River stage. Groundwater elevations generally decrease from June to August 2025 likely corresponding to seasonal recession of Fraser River flows (Figure 2.6; Appendix F.4.2).

A groundwater contour map was developed using July 2025 data (Figure 2.7). In areas with limited data coverage, contours were inferred based on surface topography. Local variations in groundwater elevations may occur due to site-specific factors (e.g., proximity to surface water features, localized recharge or discharge conditions). The groundwater contour map is intended to illustrate general groundwater flow directions along the Agassiz Loop (from northeast to southwest). Seasonal variations are not expected to alter the overall groundwater flow pattern.

Figure 2.6 OBS449 Groundwater Elevation Hydrograph – Precipitation data obtained from Agassiz RCS Weather Station (Climate ID: 1100119)







Railway
Transmission Line
Topographic Contour
Flow Direction
Watercourse

Kilometer Post
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace

Proposed Discharge Location
Monitoring Well
Groundwater Elevation (July 2025)
Groundwater Contour (July 2025)
Interpreted Groundwater Flow Direction

0 420 840 1,260 1,680 m

1:42,000 (at original document size of 11x17)

• Local variations in groundwater elevations may occur due to site-specific factors (e.g., proximity to surface water features, localized recharge, or discharge conditions). The groundwater contour map is intended to illustrate general groundwater flow directions.

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20251230
Requested by RKEELER on 20251216

NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
2.7

Title
Groundwater Flow Contour (July 2025)

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\hydrogeology\fig_123317055_sep_tar_hydrogeology.aprx Revised: 2026-04-28 By: jpoucher

2.3.2.2.4 Conceptual Groundwater Flow and Water Balance

The local conceptual groundwater flow and water balance along the Agassiz Loop is summarized below:

- Groundwater is derived from a combination of precipitation recharge through infiltration, lateral groundwater inflow from surrounding uplands (Coast Mountains), and hydraulic interaction with the Fraser River. The direction of groundwater-river exchange varies seasonally, with groundwater likely discharging to the Fraser River during periods of low river stage (typically from August to March) and the river potentially contributing localized recharge during periods of elevated stage (typically from April to June).
- The subsurface along the Agassiz Loop consists of clay to silty clay/silt, sand with silt/clay, and gravel with sand. The gravel with sand unit forms the primary water-bearing interval. Storativity for the aquifer is represented by specific yield under unconfined conditions; a value of 0.2 was adopted based on the observed aquifer material (Powers et al., 2007).
- Groundwater recharge of Aquifer 4 was conservatively assumed to be 40% of mean annual precipitation (i.e., 702 mm per year). The estimated annual groundwater recharge via precipitation is approximately 3,791 cubic metres per year (m^3/yr) (0.12 L/s) per 300 m trench segment (approximately 5,400 square metres of area).
- Based on a conceptual understanding of recharge processes and site conditions, vertical gradients are interpreted to be predominantly downward.
- Local groundwater flow within the unconsolidated sediments is interpreted to occur from higher inland areas (e.g., Bear Mountain) toward lower elevation surface water features (e.g., Maria Slough and Fraser River). The Fraser River is expected to act as the primary regional discharge boundary for the local flow system (Figure 2.7). Along Seabird Island, groundwater flow is generally from northeast to southwest; however, a local groundwater divide is interpreted to be present such that groundwater may discharge to either Maria Slough or the Fraser River depending on local hydraulic gradients. Localized groundwater discharge may occur to other surface water features, such as Hicks Creek.
- Groundwater elevations indicate a low horizontal hydraulic gradient of approximately 0.0007 m/m across the Agassiz Loop from northeast to southwest, calculated over approximately 12 km between NMW-A1 and NMW-A14. This shallow gradient reflects a flat groundwater table with slow lateral groundwater movement.
- The estimated groundwater flow velocity through the gravel with sand unit (primary water bearing unit; from northeast to southwest) is approximately 0.03 metres per day, calculated based on a hydraulic conductivity of 2.0×10^{-4} m/s (Section 2.3.2.2.2), an effective porosity of 40%, and a horizontal hydraulic gradient of 0.0007.

2.3.2.3 Groundwater Quality

Detailed exceedances of the WQG-FAL by KP ranges are discussed in the following sections. Groundwater sample data were screened prior to comparison with the WQG-FAL. Samples with TSS concentrations greater than or equal to 50 mg/L were excluded from the dataset to reduce potential bias (Section 2.3.1.5). The laboratory analytical results (prior to screening) are provided in Appendix F.5.1. Time series plots for parameters exceeding the WQG-FAL are provided for each monitoring well in Appendix F.5.2. Laboratory certificates and relative percent difference/data quality objective summaries for each sampling event are included in Pinchin's monthly groundwater monitoring reports updates (Appendix F.1).

KP30.0 to KP30.5 (NMW-A1)

Table 2.10 provides the groundwater screening results for groundwater monitoring well NWM-A1 based on exceedances of the WQG-FAL. Dissolved cadmium and dissolved copper consistently exceeded the WQG-FAL (chronic and acute; 13 of 13 samples exceeded). These exceedances apply to the WQG-FAL established for both Fraser River and Hicks Creek (PDL-A6). The 90th percentile (90P) concentrations of dissolved cadmium and dissolved copper in the groundwater well NMW-A1 were 0.3974 µg/L and 0.808 µg/L, respectively.

Table 2.10 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP30.0 to KP30.5

Parameter	WQG-FAL		Groundwater Screening Results			
	Fraser River PDLs	Hicks Creek (PDL-A6)	# of Exceedances [a]	50th Percentile	90th Percentile	Maximum
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	3 of 13	2.33	3.99	4.25
Aluminum (T)	167	72.85	1 of 13	20.60	37.66	462
Iron (T)	300; 1,000	300; 1,000	1 of 13	29.00	48.60	529
Mercury (T)	0.00125	0.00125	1 of 13	<0.0019	<0.0019	0.002
Cadmium (D)	0.139; 0.312	0.0485; 0.0674	13 of 13	0.344	0.3974	0.442
Copper (D)	0.7; 0.6	0.2; 0.6	13 of 13	0.59	0.808	1.8
Nickel (D)	1.1; 16.7	0.7; 9.5	3 of 13	<1.0	1.0	1.0

Notes:

Units are in micrograms per litre (µg/L) except for nitrate which is in milligrams per liter (mg/L), as specified

T = total; D = dissolved

Guideline values shown as 'x; y' represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

Nitrate and dissolved nickel had 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (3 of 13 samples exceeded). Nitrate in the groundwater well NMW-A1 exceeded the WQG-FAL (chronic) for both Fraser River and PDL-A6, with a 90P concentration of 3.99 mg/L. Dissolved nickel exceeded the WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 1.0 µg/L.

The remaining parameters (total aluminum, total iron, and total mercury) showed isolated exceedances, with 90P concentrations below the WQG-FAL established for both Fraser River and PDL-A6.

KP30.5 to KP31.5 (NMW-A2.A)

Table 2.11 provides the groundwater screening results for groundwater monitoring well NWM-A2.A based on exceedances of the WQG-FAL. Nitrate, nitrite, dissolved copper, dissolved manganese, and dissolved nickel frequently exceeded the WQG-FAL for both Fraser River and PDL-A6 (more than 60% of samples exceeded). Nitrate, dissolved manganese, and dissolved nickel exceeded the WQG-FAL (chronic) with 90P concentrations of 6.628 mg/L, 2,726 µg/L, and 3.92 µg/L, respectively. Nitrite and dissolved copper exceeded the WQG-FAL (chronic and acute) with 90P concentrations of 0.142 mg/L and 1.996 mg/L, respectively.

Table 2.11 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP30.5 to KP31.5

Parameter	WQG-FAL		Groundwater Screening Results			
	Fraser River PDLs	Hicks Creek (PDL-A6)	# of Exceedances [a]	50th Percentile	90th Percentile	Maximum
Ammonia (mg/L)	0.904; 4.49	1.22; 4.49	1 of 15	0.13	0.536	0.94
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	13 of 15	5.31	6.628	7.06
Nitrite (mg/L)	0.02; 0.06	0.02; 0.06	15 of 15	0.079	0.142	0.165
Aluminum (T)	167	72.85	6 of 15	50.7	124.2	392
Iron (T)	300; 1,000	300; 1,000	1 of 15	108	289	610
Manganese (T)	853; 1,140	768; 816	4 of 15	311	2,680	2,910
Mercury (T)	0.00125	0.00125	5 of 15	<0.0019	0.003	0.0053
Copper (D)	0.7; 0.6	0.2; 0.6	15 of 15	0.65	1.996	3.57
Cobalt (D)	0.804	0.39	2 of 3	0.43	0.638	0.69
Manganese (D)	320	320	10 of 15	433	2,726	2,930
Nickel (D)	1.1; 16.7	0.7; 9.5	15 of 15	2.3	3.92	4
Zinc (D)	5.84; 27.6	5.195; 9.56	2 of 15	2.5	8.98	27.1

Notes:

Units are in micrograms per litre (µg/L) except for ammonia, nitrate, and nitrite, which are in milligrams per litre (mg/L), as specified

T = total; D = dissolved

Guideline values shown as “x; y” represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

Total aluminum, total manganese, total mercury, dissolved cobalt, and dissolved zinc showed 90P concentrations exceeding the WQG-FAL (Fraser River and/or PDL-A6) but with less frequent exceedances (less than 60% samples exceeded). Three samples are available for dissolved cobalt, two of these exceeded the WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 0.638 µg/L.

The remaining parameters (total ammonia and total iron) showed isolated exceedances, with 90P concentrations less than the WQG-FAL established for both Fraser River and PDL-A6.

KP31.5 to KP38.5 (NMW-A3, NMW-A4, NMW-A5, NMW-A6, NMW-A7 and NMW-A8)

Table 2.12 provides the groundwater screening results for groundwater monitoring wells NWM-A3 through NMW-A8 based on exceedances of the WQG-FAL. Nitrate, total aluminum, total mercury, dissolved copper, dissolved manganese, and dissolved nickel frequently exceeded the WQG-FAL for both Fraser River and PDL-A6 (more than 60% of sample exceeded). Nitrate, total aluminum, and total mercury exceeded the WQG-FAL (chronic) with 90P concentrations of 24.46 mg/L, 394.9 µg/L and 0.01303 µg/L, accordingly. Dissolved copper, dissolved nickel and dissolved nickel exceeded the WQG-FAL (chronic and acute) with 90P concentrations of 0.997 µg/L, 8504 µg/L, and 30.1 µg/L, accordingly.

Nitrite, total and dissolved iron, total manganese, dissolved cadmium, and dissolved cobalt showed 90P concentrations exceeding the WQG-FAL (Fraser River and/or PDL-A6) but with less frequent exceedances (less than 60% samples exceeded). Exceedances of nitrate, total and dissolved iron, and total manganese were limited to monitoring wells NMW-A4 through NMW-A7, while dissolved cadmium exceedances were limited to monitoring wells NMW-A3 through NMW-A5. Four samples are available for dissolved cobalt; three of these exceeded the WQG-FAL (chronic) for both Fraser River and PDL-A6, with a 90P concentration of 2.801 µg/L.

The remaining parameters (total ammonia, total arsenic and total chromium) showed isolated exceedances, with 90P concentrations less than the WQG-FAL established for both Fraser River and PDL-A6.

Table 2.12 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP31.5 to KP38.5

Parameter	**WQG-FAL**		**Groundwater Screening Results**			
	Fraser River PDLs	**Hicks Creek (PDL-A6)**	**# of Exceedances[a]**	**50th Percentile**	**90th Percentile**	**Maximum**
Ammonia (mg/L)	0.904; 4.49	1.22; 4.49	1 of 12	0.10875	0.609	0.96
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	9 of 12	5.655	24.46	25.9
Nitrite (mg/L)	0.02; 0.06	0.02; 0.06	5 of 12	0.01345	0.3624	0.369
Aluminum (T)	167	72.85	11 of 12	147.5	394.9	996
Arsenic (T)	5	5	1 of 12	0.52	3.509	9.35
Chromium (T)	2.5	2.5	1 of 12	0.5	2.26	3.7
Iron (T)	300; 1,000	300; 1,000	7 of 12	501.5	6,576	20,800
Manganese (T)	853; 1,140	768; 816	6 of 12	1,458	8,111	14,100
Mercury (T)	0.00125	0.00125	8 of 12	0.0025	0.01303	0.0445
Cadmium (D)	0.139; 0.312	0.0485; 0.0674	7 of 12	0.0515	0.1129	0.224
Copper (D)	0.7; 0.6	0.2; 0.6	11 of 12	0.495	0.997	3.02
Cobalt (D)	0.804	0.39	3 of 4	2.13	2.801	2.81
Iron (D)	350_{ST}	350_{ST}	4 of 12	17.25	6,813	19,200
Manganese (D)	320	320	8 of 12	1,497.5	8,504	12,800
Nickel (D)	1.1; 16.7	0.7; 9.5	12 of 12	11.6	30.1	43.9

Notes:

Units are in micrograms per litre (µg/L) except for ammonia, nitrate, and nitrite which are in milligrams per liter (mg/L), as specified

T = total; D = dissolved

Guideline values shown as ‘x; y’ represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies; Values annotated with ‘$_{ST}$’ indicate the acute WQG-FAL

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

KP38.5 to KP40.0 (NMW-A9)

Table 2.13 provides the groundwater screening results for groundwater monitoring well NWM-A9 based on exceedances of the WQG-FAL. Nitrate, dissolved copper, and dissolved nickel consistently exceeded the WQG-FAL for Fraser River and/or PDL-A6 (12 of 12 samples). Nitrate and dissolved copper exceeded the WQG-FAL (chronic and acute) for Fraser River and PDL-A6 with a 90P concentration of 44.88 mg/L and 1.628 µg/L, respectively. Dissolved nickel exceeded the WQG-FAL for Fraser River (chronic) and PDL-A6 (chronic and acute), with a 90P concentration of 10.91 µg/L.

Table 2.13 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP38.5 to KP40.0

Parameter	WQG-FAL		Groundwater Screening Results			
	Fraser River PDLs	Hicks Creek (PDL-A6)	# of Exceedances[a]	50th Percentile	90th Percentile	Maximum
Fluoride (mg/L)	0.12; 1.09	0.12; 0.488	1 of 12	0.0715	0.0856	0.13
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	12 of 12	29.65	44.88	45.3
Nitrite (mg/L)	0.02; 0.06	0.02; 0.06	3 of 12	<0.005	0.126	0.344
Aluminum (T)	167	72.85	3 of 12	30.95	281.27	311
Iron (T)	300; 1,000	300; 1,000	2 of 12	63.5	418	458
Manganese (T)	853; 1,140	768; 816	1 of 12	99.6	635.3	935
Cadmium (D)	0.139; 0.312	0.0485; 0.0674	6 of 12	0.0455	0.0831	0.089
Copper (D)	0.7; 0.6	0.2; 0.6	12 of 12	1.145	1.628	1.9
Cobalt (D)	0.804	0.39	2 of 3	0.41	3.018	3.67
Manganese (D)	320	320	3 of 12	106.25	848.7	1,010
Nickel (D)	1.1; 16.7	0.7; 9.5	12 of 12	5.55	10.91	16

Notes:

Units are in micrograms per litre (µg/L) except for fluoride, nitrate, and nitrite which are in milligrams per liter (mg/L), as specified

T = total; D = dissolved

Guideline values shown as “x; y” represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

Nitrite, total aluminum, total iron, dissolved cadmium, dissolved cobalt, and dissolved manganese showed 90P concentrations exceeding the WQG-FAL (Fraser River and/or PDL-A6) but with less frequent exceedances (less than 50% of samples exceeded). Exceedances of nitrite and dissolved manganese were limited in 2024 (October to December 2024). Nitrite concentrations were less than detection limit (<0.005 µg/L) from February to August 2025. Dissolved cadmium exceedances were limited between November 2024 and April 2025 (concentration below 0.042 µg/L during other periods). Three samples are available for dissolved cobalt; two of which exceeded WQG-FAL (chronic) for both Fraser River and PDL-A6, with a 90P concentration of 3.018 µg/L.

The remaining parameters (fluoride, total manganese) showed isolated exceedances, with 90P concentrations less than the WQG-FAL for both Fraser River and PDL-A6.

KP40.0 to KP42.0 (NMW-A11)

Table 2.14 provides the groundwater screening results for groundwater monitoring well NWM-A11 based on exceedances of the WQG-FAL. Nitrate and dissolved copper consistently exceeded the WQG-FAL for Fraser River and/or PDL-A6 (15 of 15 samples). Nitrate exceeded the WQG-FAL (chronic) for both Fraser River and PDL-A6, with a 90P concentration of 4.936 mg/L. Dissolved copper exceeded WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 0.59 µg/L.

Nitrite, total aluminum, total iron, dissolved cobalt, dissolved manganese, and dissolved nickel showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 50% samples exceeded). Exceedances of nitrite and dissolved manganese were limited in 2024 (October to December 2024). Nitrate concentrations were less than detection limit (<0.005 µg/L) from March to August 2025. In 2025, dissolved manganese concentrations were less than 40 µg/L. Four samples are available for dissolved cobalt; one of these exceeded the WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 0.772 µg/L.

The remaining parameters (total chromium, total mercury, dissolved cadmium and dissolved zinc) showed isolated exceedances, with 90P concentrations below the WQG-FAL established for both Fraser River and PDL-A6.

Table 2.14 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP40.0 to KP42.0

Parameter	WQG-FAL		Groundwater Screening Results			
	Fraser River PDLs	Hicks Creek (PDL-A6)	# of Exceedances[a]	50th Percentile	90th Percentile	Maximum
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	15 of 15	4.39	4.936	4.98
Nitrite (mg/L)	0.02; 0.06	0.02; 0.06	2 of 15	0.0025	0.0303	0.098
Aluminum (T)	167	72.85	6 of 15	34.5	213.4	259
Chromium (T)	2.5	2.5	1 of 15	<1.0	1.68	3.0
Iron (T)	300; 1,000	300; 1,000	4 of 15	74	425	450
Mercury (T)	0.00125	0.0012	1 of 15	<0.0019	<0.0019	0.0021
Cadmium (D)	0.139; 0.312	0.0485; 0.0674	1 of 15	0.018	0.0406	0.049
Copper (D)	0.7; 0.6	0.2; 0.6	15 of 15	0.47	0.59	0.74
Cobalt (D)	0.804	0.39	1 of 4	0.1	0.772	1.06
Manganese (D)	320	320	2 of 15	4.7	357.84	760
Nickel (D)	1.1; 16.7	0.7; 9.5	7 of 15	<1.0	2.76	5.5
Zinc (D)	5.84; 27.6	5.195; 9.56	1 of 15	<5.0	<5.0	6

Notes:

Units are in micrograms per litre (µg/L) except for nitrate and nitrite which are in milligrams per liter (mg/L), as specified

T = total; D = dissolved

Guideline values shown as “x; y” represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

KP42.0 to KP43.5 (NMW-A13 and NMW-A14)

Table 2.15 provides the groundwater screening results for groundwater monitoring well NWM-A13 and NMW-A14 based on exceedances of the WQG-FAL. Nitrate, total aluminum, dissolved copper, and dissolved nickel frequently exceeded the WQG-FAL for both Fraser River and PDL-A6 (more than 80% samples). Nitrate and total aluminum exceeded the WQG-FAL (chronic) with 90P concentrations of 13.2 mg/L and 729.4 µg/L, respectively. Dissolved copper exceeded the WQG-FAL (chronic and acute) with a 90P concentration of 2.374 µg/L. Dissolved nickel exceeded the WQG-FAL for Fraser River (chronic) and PDL-A6 (chronic and acute) with a 90P concentration of 9.9 µg/L.

Table 2.15 Groundwater Screening Results Based on Fraser River and Hicks Creek Water Quality Guidelines – KP42.0 to KP43.5

Parameter	**WQG-FAL**		**Groundwater Screening Results**			
	Fraser River PDLs	**Hicks Creek (PDL-A6)**	**# of Exceedances[a]**	**50th Percentile**	**90th Percentile**	**Maximum**
Nitrate (mg/L)	3.0; 32.8	3.0; 32.8	27 of 27	11.1	13.2	13.4
Nitrite (mg/L)	0.02; 0.06	0.02; 0.06	13 of 27	0.018	0.1114	0.404
Aluminum (T)	167	72.85	22 of 27	161	729.4	937
Chromium (T)	2.5	2.5	1 of 27	0.5	2.14	4.5
Iron (T)	300; 1,000	300; 1,000	16 of 27	333	1252	1700
Manganese (T)	853; 1140	768; 816	1 of 27	92.9	617.4	1030
Mercury (T)	0.00125	0.00125	8 of 27	<0.0019	0.00376	0.0129
Cadmium (D)	0.139; 0.312	0.0485; 0.0674	13 of 27	0.041	0.1038	0.241
Copper (D)	0.7; 0.6	0.2; 0.6	27 of 27	1.96	2.374	5.33
Cobalt (D)	0.804	0.39	3 of 6	0.43	1.735	2.63
Iron (D)	350$_{AC}$	350$_{AC}$	2 of 27	24.1	300.8	1680
Manganese (D)	320	320	7 of 27	71.6	785.2	1230
Nickel (D)	1.1; 16.7	0.7; 9.5	27 of 27	4.2	9.9	15.3

Notes:

Units are in micrograms per litre (µg/L) except for nitrate and nitrite which are in milligrams per liter (mg/L), as specified

T = total; D = dissolved

Guideline values shown as “x; y” represent the chronic and acute WQG-FAL values as defined in Section 2.3.1.5.2; where a single guideline value is shown, only the chronic WQG-FAL applies; values annotated with “$_{AC}$” indicate the acute WQG-FAL

[a] Indicates number of samples exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

Nitrite, total iron, total mercury, dissolved cadmium, dissolved cobalt, and dissolved manganese showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 60% of samples exceeded). Six samples are available for dissolved cobalt; three of these exceeded the WQG-FAL (chronic) for both Fraser River and PDL-A6, with a 90P concentration of 1.735 µg/L.

The remaining parameters (total chromium, total manganese, and dissolved iron) showed isolated exceedances, with 90P concentrations below the WQG-FAL established for both Fraser River and PDL-A6.

Across the Agassiz Loop, a total of 17 parameters exceeded the WQG-FAL for Fraser River and/or Hicks Creek (PDL-A6; Table 2.16). Three of these parameters showed frequent exceedances with more than 80% samples exceeding the WQG-FAL (exceedances observed in all KP ranges). These parameters include nitrate, dissolved copper, and dissolved nickel. The 90P concentrations for nitrate and dissolved copper were 26.67 µg/L and 2.157 µg/L, respectively, exceeding the WQG-FAL (chronic) for both Fraser River and PDL-A6. The 90P concentration for dissolved nickel was 10.98 µg/L, exceeding the WQG-FAL for Fraser River (chronic) and PDL-A6 (chronic and acute).

Eight parameters (nitrite, total aluminum, total iron, total manganese, total mercury, dissolved cadmium, dissolved cobalt, and dissolved manganese) showed 90P concentrations exceeding the WQG-FAL (Fraser River and/or PDL-A6) but with less frequent exceedances (less than 60% samples exceeded). These exceedances are generally localized and discretely distributed along the Agassiz Loop.

The remaining six parameters (fluoride, ammonia, total arsenic, total chromium, dissolved iron, and dissolved zinc) have 90P concentrations below the WQG-FAL for both Fraser River and PDL-A6, with low exceedance frequencies (less than 10% of samples exceeded).

Groundwater quality results were also compared against the BC Contaminated Sites Regulation Protocol 9, which outlines local background concentrations in groundwater for inorganic substances (BC MECCS 2023a). 90P concentrations for metal results were below the applicable Protocol 9 values (Sub-Region 1; Table 2.16), indicating that observed metal concentrations are within the expected background groundwater conditions.

Table 2.16 Groundwater Screening Results – Agassiz Loop

Parameters	**Water Quality Guidelines**					**Groundwater Screening Results**					
	CSR Protocol 9 (Sub-Region 1)	**WQG-FAL Fraser River PDLs (Chronic)**	**WQG-FAL Fraser River PDLs (Acute)**	**WQG-FAL Hicks Creek (PDL-A6) (Chronic)**	**WQG-FAL Hicks Creek (PDL-A6) (Acute)**	**# of WQG-FAL Exceedances [a]**	**% of Samples Exceeding WQG-FAL [a]**	**# of KP Ranges Exceeding WQG-FAL [a]**	**50th Percentile**	**90th Percentile**	**Maximum**
Fluoride (mg/L)	-	0.12	1.09	0.12	0.488	1 of 94	1	1	0.025	0.079	0.13
Ammonia (mg/L)	-	0.904	4.49	1.22	4.49	2 of 94	2	2	0.0075	0.494	0.96
Nitrate (mg/L)	-	3.0	32.8	3.0	32.8	79 of 94	84	6	5.91	26.67	45.3
Nitrite (mg/L)	-	0.02	0.06	0.02	0.06	38 of 94	40	5	0.00595	0.1156	0.404
Aluminum (T)	330	167	-	72.85	-	49 of 94	52	6	74.45	308.9	996
Arsenic (T)	38	5	-	5	-	1 of 94	1	1	0.31	0.908	9.35
Chromium (T)	12	2.5	-	2.5	-	3 of 94	3	3	0.5	1.71	4.5
Iron (T)	290,000	300	1,000	300	1,000	31 of 94	33	6	163.5	900.4	20,800
Manganese (T)	26,000	853	1140	768	816	12 of 94	13	4	79.75	1,004.5	14,100
Mercury (T)	0.49	0.00125	-	0.00125	-	23 of 94	24	5	0.00095	0.00297	0.0445
Cadmium (D)	0.97	0.139	0.312	0.0485	0.0674	40 of 94	43	5	0.037	0.2642	0.442
Cobalt (D)	62	0.7	0.6	0.2	0.6	11 of 23	48	5	0.33	2.75	3.67
Copper (D)	14	0.804	-	0.39	-	94 of 94	100	6	0.79	2.157	5.33
Iron (D)	290,000	-	350	-	350	6 of 94	6	2	9.9	168.8	19,200
Manganese (D)	26,000	320	-	320	-	30 of 94	32	5	65.4	1,164	12,800
Nickel (D)	110	1.1	16.7	0.7	9.5	76 of 94	81	6	2.8	10.98	43.9
Zinc (D)	44	5.84	27.6	5.195	9.56	3 of 94	3	2	2.5	2.5	27.1

Notes:

Units are in micrograms per litre (µg/L) except for fluoride, nitrate, and nitrite which are in milligrams per liter (mg/L), as specified

T = total; D = dissolved

CSR Protocol 9 (Sub-Region 1) – Regional Estimates for Local Background Concentrations in Groundwater for Inorganic Substances (Table 1 in BC MECCS 2023a)

# of sample, % of sample, and # of assessment area exceeded WQG-FAL were calculated for exceedances applicable for either Fraser River or PDL-A6 (long-term and/or short-term). Variable guidelines are represented by the 25th percentile (chronic) and minimum (short-term) values derived for the Fraser River and PDL-A6

[a] Indicates number of samples, % of samples, and number of KP ranges exceeding the minimum guideline established (i.e., the lower of Fraser River or Hicks Creek)

2.3.3 Data Gaps and Uncertainties

This hydrogeological assessment was completed using a combination of desktop review, field investigations, baseline groundwater monitoring, and interpretation of public and private datasets. While the data collected are considered adequate to characterize baseline hydrogeological conditions along the pipeline loop, the following data gaps and uncertainties should be considered:

- Public Well and Water Use Information: Public well record and groundwater use information derived from provincial databases are subject to limitations related to data quality and completeness. The number of groundwater users identified from public databases is expected to be biased low, particularly in the Fraser Valley floodplain, where older and unreported private wells are common. Public well and water use information was used to support a regional, screening-level understanding rather than a comprehensive inventory of groundwater use.
- Spatial Coverage and Resolution of Data: Subsurface geological interpretations are based on a limited number of boreholes, monitoring wells, and test pits distributed along the pipeline ROW. The thickness, continuity, and lateral extent of hydrostratigraphic units may vary between investigation locations. The conceptual hydrostratigraphic model represents a simplified interpretation of subsurface conditions and is intended for qualitative understanding rather than detailed prediction of localized hydrogeological condition.
- Hydraulic Conductivity Estimates: Hydraulic conductivity values were derived primarily from slug tests conducted in selected monitoring wells and supplemented by grain-size analysis and literature values. Slug test results provide point-scale estimates and may not fully represent spatial variability or anisotropy within heterogeneous sediments. Hydraulic conductivity values assigned to fine-grained hydrostratigraphic units are based largely on qualitative observations, professional judgement, and literature ranges rather than direct field testing. These values should be considered approximate for conceptual interpretation.
- Groundwater and Surface Water Interaction: The Agassiz Loop is located in close proximity to multiple surface water features, including the Fraser River, and Hicks Creek. Interpretation of groundwater-surface water interactions is based on groundwater level data, site observations, and professional judgement. While detailed quantitative analyses were not undertaken, the available information is sufficient to support a qualitative understanding of groundwater-surface water interaction for the purposes of this assessment.

2.4 Surface Water Quality

The following sections describe the methods, present results and discussion, and identify data gaps and uncertainties associated with the characterization of existing surface water quality conditions. Herein, the term "background surface water quality" is used to describe existing conditions representative of ambient surface water quality in the absence of Project-related influences. Background conditions are characterized using measured water quality data collected from monitoring locations not influenced by Project-related activities, and from periods prior to Project construction where available. This definition is intended to reflect spatial and temporal variability associated with regional hydrology, geology, seasonality, and prevailing land use.

2.4.1 Methods

2.4.1.1 Data Sources and Processing

Surface water quality data were collected monthly by McTavish from August 2024 to September 2025. Detailed descriptions of sampling procedures, field measurement methods, and laboratory analytical protocols (conducted by BV Labs) are provided in the routine monitoring reports prepared by McTavish (Appendix E.2.1, Appendix E.2.2). Compiled data for the complete monitoring period are provided in Excel format (Appendix E.1).

Surface water quality data included field-measured parameters (conductivity, turbidity, pH, temperature, dissolved oxygen) and laboratory-analyzed parameters (total suspended solids, anions, nutrients, and total/dissolved metals).

Selected monitoring locations to characterize background conditions relevant to the Agassiz Loop were Fraser River sites PDL-A1, PDL-A8, and PDL-SBI9, and Hicks Creek site PDL-A6 (Figure 2.1).

2.4.1.2 Data Analysis

Data obtained from McTavish were compiled into a dataset using the R programming language (R Core Team 2026). Data were screened against the chronic and acute WQG-FAL; CCWQG-AL were applied where corresponding WQG-FAL do not exist. Water quality results from Fraser River sites were also screened against the WQOs for the Lower Fraser River, as applied in the 2024 WQO Attainment Report (BC MEP 2025), in addition to the applicable BC Water Quality Guidelines (Table 2.17).
Unless otherwise noted, the guidelines used in this application are collectively referred to as 'WQG-FAL' and include the BC WQG-FAL and, in a limited number of cases where BC WQG-FAL do not exist, the CWQG-AL.

Table 2.17 Water Quality Guidelines and Objectives Used to Characterize Existing Conditions

Parameter	Units	Water Quality Guidelines/Objectives		
		Chronic BC WQG-FAL	Acute BC WQG-FAL	WQO for Lower Fraser River
General				
pH	pH units	6.5 – 9.0	-	6.5 – 8.5
TSS	mg/L	Background		-
Turbidity	NTU	Background		-
Temperature	°C	Life stage & species dependent		BC-WQG-FAL
Dissolved Oxygen	mg/L	Life stage & species dependent		BC-WQG-FAL
Nutrients and Anions				
Ammonia, total (as N)	mg/L	Variable	Variable	BC-WQG-FAL
Chloride	mg/L	150	600	-
Fluoride	mg/L	0.12[a]	Variable	-
Nitrate (as N)	mg/L	3	32.8	-
Nitrite (as N)	mg/L	Variable	Variable	BC-WQG-FAL
Sulfate (as SO_4)	mg/L	Variable	-	-
Metals (Total)				
Aluminum, total	mg/L	Variable	-	-
Antimony, total	mg/L	0.074	0.25	-
Arsenic, total	mg/L	0.005	-	-
Barium, total	mg/L	1	-	-
Beryllium, total	mg/L	0.00013	-	-
Boron, total	mg/L	1.2	29 [a]	-
Chromium, total	mg/L	0.0025	-	-
Iron, total	mg/L	0.3 [a]	1	-
Mercury, total	µg/L	0.00125 [b]	-	-
Molybdenum, total	mg/L	7.6	46	-
Selenium, total	mg/L	0.002	-	-
Silver, total	mg/L	Variable	Variable	-
Strontium, total	mg/L	1.25	-	-
Thallium, total	mg/L	0.00003	-	-
Uranium, total	mg/L	0.0075	0.0165	-

Parameter	Units	Water Quality Guidelines/Objectives		
		Chronic BC WQG-FAL	Acute BC WQG-FAL	WQO for Lower Fraser River
Vanadium, total	mg/L	0.06	-	-
Zinc, total	mg/L	-	0.075	-
Metals (dissolved)				
Cadmium, dissolved	mg/L	Variable	Variable	-
Cobalt, dissolved	mg/L	Variable	Variable	
Copper, dissolved	mg/L	BLM	BLM	-
Iron, dissolved	mg/L	-	0.35	-
Lead, dissolved	mg/L	Variable	-	-
Manganese, dissolved	mg/L	Variable	Variable	-
Nickel, dissolved	mg/L	BLM	BLM	-
Strontium, dissolved	mg/L	1.25	-	-
Zinc, dissolved	mg/L	Variable	Variable	-

Notes:

BC WQG-FAL = British Columbia Water Quality Guidelines for the Protection of Freshwater Aquatic Life.

WQO = Water Quality Objective for the Lower Fraser River (BC MEP 2025).

BLM = Biotic Ligand Model (variable guideline based on site-specific temperature, pH, dissolved organic carbon, and water hardness).

[a] Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-AL) adopted from Canadian Council of Ministers of the Environment where no equivalent BC WQG-FAL exists.

[b] The BC WQG-FAL for total mercury is dependent on percent methylmercury (BC MWLRS 2026). The selected value of 0.00125 µg/L is based on 8% methylmercury.

Variable guidelines listed below are BC WQG-FAL unless noted otherwise.

The BC WQG-FAL for TSS and turbidity are based on changes from background conditions.

The BC WQG-FAL for temperature and dissolved oxygen are life-stage and species-dependent.

Nutrients and Anions:

Ammonia chronic and short-term: pH and temperature dependent (look-up table)

Fluoride short-term (mg/L): if hardness >10 mg/L, -51.73 + 92.57 x log10(hardness)) /100; if hardness <10 mg/L, 0.4

Nitrite (as N) chronic (mg/L): if chloride (Cl) ≤2, 0.02; if Cl ≤4, 0.04; if Cl ≤6, 0.06; if Cl ≤8, 0.08; if Cl ≤10, 0.1; if CL >10, 0.2

Nitrite (as N) short-term (mg/L): if chloride (Cl) ≤ 2, 0.06; if Cl ≤ 4, 0.12; if Cl ≤ 6, 0.18; if Cl ≤ 8, 0.24; if Cl ≤10, 0.3; if CL > 10, 0.6

Sulphate (mg/L): 128 (hardness < 30 mg/L), 218 (hardness 31-75 mg/L), 309 (hardness 76-180 mg/L), 429 (hardness 181-250 mg/L)

Parameter	Units	Water Quality Guidelines/Objectives		
		Chronic BC WQG-FAL	Acute BC WQG-FAL	WQO for Lower Fraser River
Total Metals:				
Aluminum (total) mg/L: e^((0.645 x ln(DOC)) + (2.255 x ln(hardness)) + (1.995 x pH) +(-0.284 x (ln(hardness) x pH)) -9.898))/3,000				
Silver (total) chronic (mg/L): if hardness ≤ 100, 0.00005; if hardness >100, 0.0015				
Silver (total) short-term (mg/L): if hardness ≤ 100, 0.0001; if hardness >100, 0.003				
Dissolved Metals:				
Cadmium (dissolved) chronic (mg/L): e^[0.736 × ln(hardness) – 4.943] /1000				
Cadmium (dissolved) short-term (mg/L): e^[1.03 × ln(hardness) – 5.274] /1000				
Cobalt (dissolved) chronic (mg/L): e^[(0.414[ln(hardness)] – 1.887]/2000				
Copper (dissolved) BLM based on water temperature of 15°C and 20^{th} percentile values for pH, DOC, and hardness.				
Lead (dissolved) long-term (mg/L): e^((0.514*(ln(DOC))) + (0.214*(ln(hardness))) + 0.4354)/2000				
Manganese (dissolved) chronic (mg/L): look-up table				
Manganese (dissolved) short-term (mg/L): e^(0.878[ln(hardness)]+4.76)/2000				
Nickel (dissolved) BLM based on water temperature of 15°C and 20^{th} percentile values for pH, DOC, and hardness.				
Zinc (dissolved) chronic (mg/L): e^(0.947[ln(hardness)] - 0.815[pH] + 0.398[ln(DOC)] + 4.625) /2000				
Zinc (dissolved) short-term (mg/L): e^(0.833[ln(hardness)] + 0.240[ln(DOC)] + 0.526) /2000				

The WQG-FAL are science-based benchmark concentrations for parameters that are intended to protect freshwater aquatic life. The WQG-FAL include chronic (long-term) values, intended to protect aquatic organisms from sublethal effects associated with prolonged exposure, and acute (short-term) values, intended to protect against lethal or severe effects resulting from brief or infrequent exposures (Table 2.17; BC MWLRS 2026). Exceedances of chronic or acute WQG-FAL do not necessarily indicate that adverse effects are expected or will occur, but rather serve as screening tools to help identify conditions that may warrant further evaluation in the context of site-specific exposure, duration, and receiving environment characteristics (BC MWLRS 2026).

Variable water quality guidelines that are dependent on TMFs (e.g., water hardness, pH, DOC, chloride, and temperature) were calculated for each site on a sample-by-sample basis. Federal Environmental Quality Guidelines (FEQGs) developed by ECCC were considered in the screening of monitoring results. However, BC WQG-FAL have been developed for each metal parameter that has a corresponding FEQG. In addition, some of the most recently developed BC WQG-FAL (e.g., total aluminum, dissolved lead, strontium, and vanadium) are based on the corresponding FEQGs (BC MWLRS 2026). Further, BC WQG-FAL s incorporate an ‘uncertainty factor’ which lowers the WQG-FAL by a factor of 2 to 3, depending on the parameter, resulting in more stringent guidelines than the corresponding FEQGs. Therefore, FEQGs were not used to identify parameters of concern (POCs). Unless otherwise noted, the guidelines listed in Table 2.17 are collectively referred to as WQG-FAL and include the BC WQG-FAL and, in a limited number of cases where BC WQG-FAL do not exist, the CWQG-AL.

Results below analytical detection limits were assigned a value of half the detection limit. Variable guidelines incorporating TMFs were calculated on a sample-by-sample basis using site-specific data. If measured TMF values fell outside a guideline's applicable range, the guideline was calculated using the lower bound value when below the range or the upper bound value when above the range.

Monthly results for general parameters (e.g., conductivity, pH, temperature) are presented as monthly averages when more than one sample was collected in the same calendar month. For nutrients and metals, parameters with more than one exceedance of the WQG-FAL are summarized in detail, including summary statistics and magnitude and frequency of exceedances. While the results section focuses on general parameters and nutrients/metals exceeding the WQG-FAL under background conditions, results for a broader list of key parameters are presented as box plots and time-series plots for Fraser River and Hicks Creek (Appendix G.1 and G.2).

2.4.1.3 Anomalous Data

Anomalous data were not identified, except for a single dissolved oxygen (DO) result at station PDL-A6 on June 12, 2025. McTavish initially reported a DO concentration of 60.1 mg/L; however, McTavish confirmed that this value was incorrect and had been presented as percent saturation rather than mg/L. The corrected DO concentration at station PDL-A6 for June 2025 is 5.77 mg/L.

2.4.2 Results and Discussion

2.4.2.1 General Parameters

2.4.2.1.1 Conductivity

Conductivity at PDL-A1 ranged from 89.1 microsiemens per centimeter (µS/cm) in June to 327 µS/cm in September, with elevated values in May (312 µS/cm) and September (Table 2.18). Data for PDL-A8 and PDL-SBI9 were available for March through August, with values between 86.7 and 354 µS/cm. PDL-A6 (Hicks Creek) showed lower conductivity overall (28.5–161 µS/cm) relative to the Fraser River, with the highest result occurring in August (161 µS/cm).

Table 2.18 Monthly Conductivity (µS/cm)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	13	163	193	146	168	312	89.1	140	141*	327	208	95.6	157
PDL-A8	6	-	-	156	128	340	96.3	100	102	-	-	-	-
PDL-SBI9	6	-	-	156	195	354	86.7	100	104	-	-	-	-
PDL-A6	13	52.1	49.2	89.6	31.8	28.5	39.9	52.4	161*	70.4	51	75.6	28.6

Notes:

µS/cm = microsiemens per centimeter

Each row (site) has its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the average of two samples collected in the same month but from different years (2024 and 2025).

2.4.2.1.2 Total Suspended Solids and Turbidity

TSS at PDL-A1 ranged from 13 mg/L in November to 150 mg/L in December, with elevated values in March (45 mg/L) and July (43 mg/L) during months of moderate to high flow (Table 2.19). PDL-A8 and PDL-SBI9 showed higher readings in spring and summer, up to 95 mg/L, coinciding with periods of high mean monthly flow. Variability was observed across Fraser River sites (PDL-A1, PDL-A8, PDL-SBI9), with seasonal elevations during spring (March–May) and summer (June–August) and evidence of spatial heterogeneity during these periods. Concentrations of TSS at PDL-A6 (Hicks Creek) were generally low (0.5–5.2 mg/L) except for August (37.3 mg/L), when mean monthly flow was low (0.615 m³/s).

Table 2.19 Monthly Concentrations of Total Suspended Solids (mg/L)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	12	14	16	45	-	30	-	43	46.8*	28*	37	13	150
PDL-A8	7	-	-	58	85	38	92	76	18	23	-	-	-
PDL-SBI9	7	-	-	15	14	52	95	68	11	18	-	-	-
PDL-A6	14	2.4	2	0.5	1.2	4	1.2	3.6	37.3*	5.2*	1.6	4.4	0.5

Notes:

mg/L = milligram per litre

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the average of two samples collected in the same month but from different years (2024 and 2025).

Turbidity at PDL-A1 ranged from 15.1 nephelometric turbidity units (NTU) in January to 108 NTU in June, with peaks in March and April (100 NTU) during increasing flows (Table 2.20). PDL-A8 and PDL-SBI9 recorded higher turbidity in spring and summer, up to 103 NTU, during months of high mean monthly flow. Turbidity at PDL-A6 was mostly below 10 NTU except for July (100 NTU) when mean monthly flow was relatively high (0.922 m³/s).

Table 2.20 Monthly Turbidity (NTU)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	12	15.1	66.1	100	100	41.7	108	55.2	43.6*	47.8	42	15.6	-
PDL-A8	6	-	-	100	67.5	62.6	97.5	69.3	35.9	-	-	-	-
PDL-SBI9	6	-	-	80.3	25.9	56.6	103	61.9	28.5	-	-	-	-
PDL-A6	12	2.53	5.9	2.56	1.54	1.97	2.4	100	5.55	5.24	27	9.65	2.31

Notes:

NTU = nephelometric turbidity units

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the average of two samples collected in the same month but from different years (2024 and 2025).

The TSS and turbidity data collected at Fraser River sites near Agassiz are generally consistent with known seasonal patterns, showing elevated concentrations during the spring freshet and lower levels in fall and winter. Seasonal variability in TSS and turbidity is a well-documented feature of the Fraser River, with peak values typically occurring during the spring freshet (April–June) when snowmelt-driven discharge mobilizes large volumes of sediment (Voss et al. 2015). Elevated turbidity often persists into summer before declining through autumn and winter (ECCC 2025c). These patterns reflect hydrologic cycles and sediment transport dynamics throughout the river system. Because the Fraser River sites are located near Agassiz, well upstream of the tidal estuary and dredging zones in the lower Fraser River, observed variability is driven by natural seasonal processes and local watershed factors such as tributary inputs and bank erosion, rather than tidal mixing or dredging.

2.4.2.1.3 Water Temperature

In the Fraser River, temperature at PDL-A1 ranged from 4.5°C in December to 21.3°C in August. PDL-A8 and PDL-SBI9 showed similar seasonal patterns, with summer temperatures above 19°C. In Hicks Creek, temperature at PDL-A6 was observed to be as low as 7.0°C in February and peaked at 22.8°C in July (Table 2.21).

Table 2.21 Monthly Water Temperature (°C)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	13	6.9	6.7	6.3	8.3	13.5	14.9	19.6	21.3*	18.1	13.4	7.3	4.5
PDL-A8	6	-	-	6.7	7.6	16	17.2	19.3	21.3	-	-	-	-
PDL-SBI9	6	-	-	7.1	8.9	16.2	16.5	20.1	21.6	-	-	-	-
PDL-A6	13	8.6	7.0	8.1	11.7	17.8	17.4	22.8	22.5*	15.9	13.4	9.9	8.4

Note:
Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the average of two samples collected in the same month but from different years (2024 and 2025).

Seasonal temperature patterns at PDL sites reflect natural variability typical of the Fraser River and small streams (e.g., Hicks Creek) in the region, with winter lows around 4 to 7 °C and summer highs exceeding 22 °C (DFO 2025a). While the WQG-FAL provide species- and life-stage-specific thresholds for fish—often below observed summer maxima—these values are best considered as context rather than strict pass/fail criteria. The guideline's applicability depends on documented presence and timing of sensitive species such as salmonids and sturgeon (Section 2.5). Where these species occur, elevated summer temperatures may represent periods of thermal stress; however, interpretation should account for background conditions and seasonal flow regimes rather than isolated guideline exceedances.

2.4.2.1.4 Dissolved Oxygen

In the Fraser River, dissolved oxygen (DO) at PDL-A1 decreased from 17.8 mg/L in January to 5.93 mg/L in August, corresponding with an increase in water temperature from 6.9°C to 21.3°C. PDL-A8 and PDL-SBI9 values for March through August were generally between 6.69 and 12 mg/L, during months when temperatures were above 16°C (Table 2.22). In Hicks Creek, DO at site PDL-A6 ranged from 4.67 mg/L to 12.8 mg/L.

Table 2.22 Monthly Concentrations of Dissolved Oxygen (mg/L)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-A1	13	17.8	10	9.65	10.8	9.12	12.4	6.02	5.93*	6.52	8.09	11.8	14.6
PDL-A8	6	-	-	9.11	10.8	9.03	8.26	6.69	6.92	-	-	-	-
PDL-SBI9	6	-	-	9.03	12	8.98	7.95	7.39	10.6	-	-	-	-
PDL-A6	13	12.8	11	10.1	10	8.8	5.77	4.71	6.3*	4.67	6.63	7.2	9.85

Notes:

mg/L = milligrams per litre

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the average of two samples collected in the same month but from different years (2024 and 2025).

Measured DO concentrations across Fraser River sites and Hicks Creek show seasonal variability typical of both large river and small stream systems in the region, with winter highs exceeding 14 mg/L and summer lows dropping below 6 mg/L at some locations (e.g., PDL-A6 in July and September; ECCC 2025c). The WQG-FAL for fish sets life-stage-dependent minimum thresholds for DO—generally higher for early life stages such as egg incubation and fry emergence—but these values should be treated as context rather than rigid criteria. Observed values below 9 mg/L may indicate conditions that could cause stress during the buried embryo or alevin life stage, particularly during prolonged warm periods. Interpretation should consider natural background conditions, seasonal flow regimes, and temperature interactions rather than isolated exceedances. As water temperature increases, dissolved oxygen levels naturally decrease due to reduced solubility, which explains the lower DO values observed during warm, low-flow summer periods.

Measured values at the Fraser River sites were above the acute dissolved oxygen WQOs (5 mg/L May to October; 9 mg/L November to April), while several summer measurements were below the chronic WQOs (8 mg/L May to October; 11 mg/L November to April), which is consistent with the naturally lower concentrations of DO typical of warm, low-flow periods.

2.4.2.1.5 pH (Field Measured)

Field-measured pH at PDL-A1 ranged from 7.04 in December to 7.88 in September (Table 2.23). PDL-A6 values were between 6.48 and 8.04, with the lowest in June (6.48). PDL-A8 and PDL-SBI9 were generally between 7.25 and 8.0. Therefore, pH remained within the WQG-FAL range of 6.5 to 9.0 and within the WQO range of 6.5 to 8.5 for the lower Fraser River. No clear seasonal trend was observed.

Table 2.23 Monthly pH Values (pH Units)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL_A1	13	7.76	7.63	7.63	7.8	7.49	7.83	7.67	7.22	7.88	7.65	7.44	7.04
PDL_A8	6	-	-	7.65	8	7.25	7.87	7.87	7.96	-	-	-	-
PDL_SBI9	6	-	-	7.78	7.54	7.82	7.83	7.91	7.87	-	-	-	-
PDL_A6	13	7.14	6.93	8.04	6.98	7.01	6.48	6.94	7.22	6.8	6.73	6.8	6.82

Note:

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Asterisks (*) indicate months where the value is the arithmetic mean of two samples collected in the same month but from different years; this corresponds to the geometric mean of hydrogen ion concentrations.

2.4.2.2 Nutrients and Metals

During the monitoring period, exceedances of the WQG-FAL were observed for several parameters across sites within the Agassiz Loop. Parameters exceeding the chronic WQG-FAL included aluminum, chromium, cobalt, copper, mercury, and zinc. Acute guideline exceedances were recorded for copper, iron (dissolved and total), and zinc. These exceedances varied in magnitude and frequency, with some parameters (e.g., aluminum and copper) exceeding guidelines by more than tenfold. Nutrients (ammonia, nitrate, and nitrite) did not exceed the WQG-FAL in surface water during the monitoring period. At the Fraser River sites and in Hicks Creek, the WQO for ammonia and nitrite were not observed to be exceeded, consistent with recent provincial WQO attainment reporting for the lower Fraser River (BC MEP 2025).

Seasonal patterns were evident for some analytes, while others showed no clear seasonal trend across sites. Detailed site-specific results are provided in Table 2.24, with supporting box plots in Appendix G.1 and time-series plots in Appendix G.2. A summary of exceedance magnitudes, frequencies, and seasonality is provided below:

- **Aluminum (total)**: Concentrations were greater in Fraser River compared to Hicks Creek. Overall, concentrations ranged from 0.0534 mg/L to 2.81 mg/L (maximum at PDL-A1, Dec-2024). The greatest exceedance was 37.7 times the long-term WQG-FAL at PDL-A1, and the highest frequency of exceedance was 100% of samples collected at PDL-A1, PDL-A8, and PDL-SBI9. Across sites, exceedances occurred throughout the year, with peaks in winter (December) and late summer (August).

- **Chromium (total)**: Concentrations were generally greater in Fraser River compared to Hicks Creek. Overall, concentrations ranged from 0.0005 mg/L to 0.0068 mg/L (maximum at PDL-A1, Dec-2024). The largest exceedance was 2.72 times the long-term WQG-FAL for hexavalent chromium (0.0025 mg/L) at PDL-A1; the highest frequency was 57% of samples collected at PDL-A8. No clear seasonal trend observed across sites.
- **Cobalt (dissolved)**: Concentrations were mostly below detection limits; the maximum was 0.00426 mg/L (at PDL-A6, Aug-2024). The greatest exceedance was 10.9 times the long-term WQG-FAL at PDL-A6, which also had the highest frequency of guideline exceedances (21% of samples). Across sites, guideline exceedances occurred only in summer (July–September).
- **Copper (dissolved)**: Concentrations ranged from 0.00024 mg/L to 0.00288 mg/L (maximum in Hicks Creeks at site PDL-A6, Aug-2024). The largest exceedance was 14.4 times the long-term WQG-FAL at PDL-A6, and the highest frequency of exceedances also occurred at PDL-A6 (79% of samples). Single exceedances of the acute guideline occurred at PDL-A6 (3.2 times the acute guideline) and in the Fraser River at site PDL-A1 (1.9 times the acute guideline). Exceedances at each site were generally distributed across winter, summer, and fall, with no single dominant seasonal pattern.
- **Iron (dissolved)**: Concentrations were generally greater in Hicks Creek compared to Fraser River. Overall, concentrations ranged from 0.0025 mg/L to 1.9 mg/L (maximum at PDL-A6, Aug-2024). The greatest exceedance was 5.43 times the short-term WQG-FAL at PDL-A6, which also had the highest frequency for exceedance of the acute WQG-FAL (50% of samples). Across sites, exceedances occurred mainly in summer and early fall (June–October).
- **Iron (total)**: In contrast to dissolved iron, concentrations of total iron were generally greater in Fraser River compared to Hicks Creek. Overall, concentrations ranged from 0.107 mg/L to 10.5 mg/L (maximum at PDL-A6, Aug-2024). The largest guideline exceedances were 35 times the chronic CWQG-AL and 10.5 times the short-term WQG-FAL at PDL-A6; the highest frequency for exceedance of the acute WQG-FAL occurred at PDL-A8 (86% of samples). Across sites, exceedances were frequent in spring and summer, extending into fall.
- **Mercury (total):** Concentrations were generally greater in Fraser River compared to Hicks Creek. Overall, concentrations ranged from 0.00095 µg/L to 0.0131 µg/L (maximum at PDL-A6, Aug-2024). The greatest exceedance was 10.5 times the long-term WQG-FAL of 0.00125 µg/L (assuming 8% methylmercury) at PDL-A6; the highest frequency of guideline exceedance was at site PDL-A8 (86% of samples). No clear seasonal trend observed across sites.
- **Zinc (dissolved)**: Concentrations were generally greater in Hicks Creek compared to Fraser River. Overall, concentrations ranged from 0.0025 mg/L to 0.0216 mg/L (maximum at PDL-A6, Jul-2025). The largest exceedance was 3.02 times the long-term WQG-FAL at PDL-A6, which also had the highest frequency of guideline exceedance (43% of samples). Acute guideline exceedance occurred in July (1.3 times short-term WQG-FAL). Across sites, exceedances occurred mainly in spring and summer.

Table 2.24 Metal Concentrations and Water Quality Guideline Exceedances in Surface Water along the Agassiz Loop

Parameter	Location	Site ID	WQG-FAL				Summary Statistics					Number (and percent) Observations Above WQG-FAL		Max Magnitude Above WQG-FAL	
			Chronic		Acute										
			Min (mg/L)	Max (mg/L)	Min (mg/L)	Max (mg/L)	N	Min (mg/L)	Mean (mg/L)	Max (mg/L)	Max Month	Chronic	Acute	Chronic	Acute
Aluminum (total)	Fraser River	PDL-A1	0.0559	0.267	-	-	12	0.301	1.08	2.81	Dec-24	12 (100%)	-	37.7	-
		PDL-A8	0.142	0.395	-	-	7	0.545	1.34	1.82	Jun-25	7 (100%)	-	10.3	-
		PDL-SBI9	0.142	0.395	-	-	7	0.273	0.938	2.03	Jun-25	7 (100%)	-	9.11	-
	Hicks Creek	PDL-A6	0.0502	0.426	-	-	14	0.0534	0.179	1.19	Aug-24	7 (50%)	-	16.2	-
Chromium (total)	Fraser River	PDL-A1	0.0025	0.0025	-	-	12	0.0005	0.00207	0.0068	Dec-24	4 (33%)	-	2.72	-
		PDL-A8	0.0025	0.0025	-	-	7	0.0005	0.00253	0.0035	Apr-25	4 (57%)	-	1.4	-
		PDL-SBI9	0.0025	0.0025	-	-	7	0.0005	0.00156	0.0035	Jun-25	2 (29%)	-	1.4	-
	Hicks Creek	PDL-A6	0.0025	0.0025	-	-	14	0.0005	0.000621	0.0022	Aug-24	-	-	-	-
Cobalt (dissolved)	Fraser River	PDL-A1	0.000395	0.000528	-	-	12	0.0001	0.0001	0.0001	NA (<DL)	-	-	-	-
		PDL-A8	0.000396	0.000528	-	-	7	0.0001	0.0001	0.0001	NA (<DL)	-	-	-	-
		PDL-SBI9	0.000396	0.000528	-	-	7	0.0001	0.0001	0.0001	NA (<DL)	-	-	-	-
	Hicks Creek	PDL-A6	0.00039	0.00039	-	-	14	0.0001	0.000517	0.00426	Aug-24	3 (21%)	-	10.9	-
Copper (dissolved)	Fraser River	PDL-A1	0.0002	0.0015	0.0006	0.0092	12	0.00062	0.000958	0.00164	Dec-24	6 (50%)	1 (8%)	5.7	1.9
		PDL-A8	0.0005	0.0025	0.0029	0.0147	7	0.00062	0.00107	0.00156	Apr-25	3 (43%)	-	2.7	-
		PDL-SBI9	0.0005	0.0025	0.0029	0.0147	7	0.00049	0.000841	0.00117	Jul-25	2 (29%)	-	1.67	-
	Hicks Creek	PDL-A6	0.0002	0.0021	0.0006	0.0123	14	0.00024	0.000921	0.00288	Aug-24	11 (79%)	1 (7%)	14.4	3.2
Iron (dissolved)	Fraser River	PDL-A1	-	-	0.35	0.35	12	0.0025	0.0433	0.281	Dec-24	-	-	-	-
		PDL-A8	-	-	0.35	0.35	7	0.0133	0.0483	0.0918	Apr-25	-	-	-	-
		PDL-SBI9	-	-	0.35	0.35	7	0.0059	0.0266	0.0691	Jul-25	-	-	-	-
	Hicks Creek	PDL-A6	-	-	0.35	0.35	14	0.0726	0.465	1.9	Aug-24	-	7 (50%)	-	5.43
Iron (total)	Fraser River	PDL_A1	0.3	0.3	1	1	12	0.489	1.66	4.96	Dec-24	12 (100%)	7 (58%)	16.5	4.96
		PDL_A8	0.3	0.3	1	1	7	0.8	2.05	2.59	Jul-25	7 (100%)	6 (86%)	8.63	2.59
		PDL_SBI9	0.3	0.3	1	1	7	0.548	1.43	2.99	Jun-25	7 (100%)	3 (43%)	9.97	2.99
	Hicks Creek	PDL_A6	0.3	0.3	1	1	14	0.107	1.44	10.5	Aug-24	8 (57%)	5 (36%)	35	10.5

Parameter	Location	Site ID	WQG-FAL				Summary Statistics					Number (and percent) Observations Above WQG-FAL		Max Magnitude Above WQG-FAL	
			Chronic		Acute										
			Min (mg/L)	Max (mg/L)	Min (mg/L)	Max (mg/L)	N	Min (mg/L)	Mean (mg/L)	Max (mg/L)	Max Month	Chronic	Acute	Chronic	Acute
Mercury (total)	Fraser River	PDL-A1	0.00000125	0.00000125	-	-	12	0.00000095	0.0000032	0.0000085	Dec-24	7 (58%)	-	6.8	-
		PDL-A8	0.00000125	0.00000125	-	-	7	0.00000095	0.00000516	0.0000086	Apr-25	6 (86%)	-	6.88	-
		PDL-SBI9	0.00000125	0.00000125	-	-	7	0.00000095	0.00000383	0.0000087	Jun-25	5 (71%)	-	6.96	-
	Hicks Creek	PDL-A6	0.00000125	0.00000125	-	-	14	0.00000095	0.00000285	0.0000131	Aug-24	9 (64%)	-	10.5	-
Zinc (dissolved)	Fraser River	PDL-A1	0.00476	0.0208	0.0276	0.0503	12	0.0025	0.0025	0.0025	NA (<DL)	-	-	-	-
		PDL-A8	0.00476	0.0116	0.0276	0.0503	7	0.0025	0.0025	0.0025	NA (<DL)	-	-	-	-
		PDL-SBI9	0.00476	0.0116	0.0276	0.0503	7	0.0025	0.00289	0.0052	Mar-25	-	-	-	-
	Hicks Creek	PDL-A6	0.00214	0.0117	0.00956	0.0207	14	0.0025	0.00611	0.0216	Jul-25	6 (43%)	1 (7%)	3.02	1.3

Notes:

WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life. The guidelines are British Columba WQG-FAL except the chronic guidelines for total iron and dissolved manganese are adopted from the Canadian Council of Ministers of the Environment due to no corresponding BC WQG-FAL.

"–" indicates not applicable

Max Month = The month and year corresponding to the maximum observed concentration.

Bold values denote results below the detection limit (reported as ½ the detection limit).

The chronic guideline for hexavalent chromium (0.0025 mg/L) was used to screen total chromium concentrations.

2.4.2.3 Summary

Across the Fraser River locations (PDL-A1, PDL-A8, and PDL-SBI9), temperature ranged from winter lows near 6–7 °C to summer highs above 21 °C, with dissolved oxygen generally declining during warmer months. Conductivity varied between approximately 87 and 354 µS/cm, with higher values observed in late spring and early fall. Turbidity and TSS were elevated during spring and summer sampling events, coinciding with periods of higher flow, and pH remained within a narrow circumneutral range (approximately 7.2–8.0). Nutrient concentrations were below WQG-FAL thresholds. Metals including aluminum, copper, iron, mercury, and zinc exceeded long-term guidelines at all three sites, with aluminum showing the highest frequency and magnitude of exceedance. Short-term exceedances were noted for iron and copper during select months.

Water quality conditions observed at the Fraser River monitoring locations (PDL-A1, PDL-A8, and PDL-SBI9) are generally consistent with recent provincial WQO attainment monitoring (BC MEP 2025), which characterizes the Lower Fraser River mainstem as generally meeting applicable WQOs, with seasonal variability and exceedances of the WQG-FAL for some metals (e.g., aluminum, iron, and copper) identified in provincial monitoring and attributed primarily to natural suspended sediment conditions and site-specific water chemistry (BC MEP 2025).

Hicks Creek (PDL-A6) exhibited lower conductivity overall (28.5–161 µS/cm) compared to Fraser River sites, and turbidity was generally low (<10 NTU) except for a single July spike (100 NTU). TSS was typically minimal (≤5 mg/L) but increased sharply in August under low-flow conditions. Temperature ranged from approximately 7 °C in winter to 22.8 °C in July, with dissolved oxygen decreasing during warmer months. Values for pH were slightly more variable than at Fraser River sites, ranging from 6.48 to 8.04. Nutrients remained below guideline levels. Exceedances of metal guidelines—particularly for copper, iron, mercury, and zinc—were common, with some concentrations surpassing chronic WQG-FAL by more than tenfold. Less frequently, concentrations of copper, iron, and zinc were also above the acute WQG-FAL in some months. Peak metal concentrations generally occurred in late summer (August) at Hicks Creek and in late spring to mid-summer (April–July) at Fraser River sites, depending on the metal.

2.4.3 Data Gaps and Uncertainties

The monitoring program for the characterization of existing conditions provides broad coverage across the core suite of water quality parameters, with data that support interpretation of spatial patterns and seasonal variability across the pipeline loop area. However, some limitations are expected in a program of this duration. For example, some sites have incomplete monthly records, with certain periods—most often mid-winter and mid-summer—not sampled at all locations. Sampling frequency also varied among stations, resulting in fewer observations for some sites and reduced comparability for select parameters. In several instances, monthly results are based on low sample counts, which introduces some uncertainty in capturing short-term variability or isolated events. The existing conditions monitoring program did not include a '5-in-30' study (i.e., five weekly samples collected over a 30-day period) to characterize short-term variability in surface water quality during hydrologically relevant periods (e.g., freshet). This data gap will be addressed through implementation of a 5-in-30 study during the 2026 freshet period. Data collected through this study will complement the existing dataset and inform future monitoring and evaluations, as applicable. Additionally, while the program includes comprehensive analysis of standard water quality indicators, other parameter classes (e.g., organics) were not part of the monitoring scope.

Despite these considerations, the dataset is considered adequate for characterizing background water quality conditions and for supporting interpretation of potential effects associated with short-term groundwater discharges related to the pipeline loop dewatering. The spatial coverage, parameter suite, and temporal extent of the monitoring program provide a sufficient basis for evaluating existing conditions within the pipeline loop area for the purposes of this assessment. Monthly monitoring reports summarizing surface water quality results are provided in Appendix E.1.

2.5 Freshwater Aquatic Life

The following sections describe the methods, present the results and discussion, and identify data gaps and uncertainties as they pertain to the description of existing conditions for the key aquatic life receptors identified for this TAR, that is, fish and fish habitat, as well as wildlife and wildlife habitats that are closely associated with freshwater aquatic environments.

2.5.1 Methods

2.5.1.1 Fish and Fish Habitat

Existing information from the following sources was compiled to characterize fish and fish habitat in the PDL receiving environments:

- Aquatic Species at Risk Map (DFO 2025b)
- BC Conservation Data Centre Species and Ecosystems Explorer (BC CDC 2025a)
- Species at Risk Public Registry (Government of Canada 2025)
- HabitatWizard (GOBC 2025e)
- Fish Inventories Data Queries (GOBC 2025f)
- EcoCat: The Ecological Reports Catalogue (GOBC 2025g)
- Guidelines for Reduced Risk Instream Work Windows Ministry of Environment, Lower Mainland Region (BC MOE 2006)
- Site photos taken by McTavish for surface water monitoring and sampling results summary reports from 2024–2025
- Government reports, non-government organization reports, and scientific literature
- Applicable recovery strategies, status reports, and management plans for species of conservation concern

Field surveys were completed for the area that includes each PDL between 2023 and 2025 (Appendix H.2) by Jacobs Consultancy Canada Inc. (Jacobs), which are summarized in the Fish and Fish Habitat Technical Data Report (Appendix H.1). To assess fish and fish habitat, Jacobs used field survey methods adapted from the following provincial guidelines and protocols:

- Environmental Protection and Management Guideline (BCER 2025)
- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (Province of British Columbia 2001)
- Fish Collection Methods and Standards (BC MELP 1997)
- Fish-stream Crossing Guidebook (BC MFLRNO and BC MOE 2012)
- Field-stream Identification Guidebook (GOBC 1998)
- Field Assessment for Determining Fish Passage Status of Closed Bottom Structures (BC MOE 2011)

Waterbodies with PDLs were classified in accordance with the Environmental Protection and Management Guideline (BCER 2025). Data collected at six cross-channel transects at each PDL were: channel width, wetted width, water depth, water quality, ordinary highwater mark, channel gradient, substrate composition, embeddedness, bank and channel characteristics, habitat unit type, cover, riparian characteristics, and flow. Information on unique channel features (e.g., barriers, beaver activity, existing crossings) was also collected. A fish habitat quality rating (i.e., unsuitable, marginal, important, or essential) was assigned to each PDL based on the stream characteristics and fish species potentially present. Fish sampling was also completed at some PDLs to inform fish presence and species composition. More details on methods for this fish and fish habitat assessment can be found in the Fish and Fish Habitat Technical Data Report (Appendix H.1).

Quality assurance and quality control procedures were implemented for desktop and field studies (Appendix H.1) including:

- Desktop and field studies were completed using the standard guidelines and protocols outlined above
- Trained crews were used to conduct fieldwork
- Data collection was completed using standardized digital forms with validation checks. Data were also reviewed after fieldwork for consistency, data gaps, and errors
- Fish habitat ratings were peer reviewed by a QP
- The report (Appendix H.1) was prepared under the direction of, and reviewed by, qualified professionals
- Fish and fish habitat components of this TAR were prepared and reviewed by qualified professionals (see Appendix A).

2.5.1.2 Wildlife and Wildlife Habitat

Existing information from the following sources was compiled to characterize wildlife and wildlife habitat in the PDL receiving environments:

- Wildlife Technical Data Report: CS-8B–CS-9 Potential Discharge Locations (Appendix I.1)
- Spatial data for wildlife observations collected by Jacobs from 2024 to 2025 (Jacobs 2025)
- Site photos taken by McTavish for surface water monitoring and sampling results summary reports from 2024–2025 (Appendix E.1)
- BC Conservation Data Centre Species and Ecosystems Explorer (BC CDC 2025a)
- CDC iMap (BC CDC 2025b)
- NatureCounts (Birds Canada 2025; eBird and iNaturalist queries for 1 km buffers around PDLs)
- eBird ‘Species Maps’ web application (eBird 2025)
- iNaturalist ‘Observations’ web application (iNaturalist 2025)
- e-Fauna BC (Klinkenberg 2023)
- BC Great Blue Heron Atlas (CMN 2025a)
- Wildlife Tree Stewardship Atlas (CMN 2025b)
- Species at Risk Public Registry (Government of Canada 2025)
- Government reports and databases, non-government organization reports, and scientific literature
- Applicable recovery strategies, status reports, and management plans for species of conservation concern

Field surveys were completed at, or within 1,000 m of, the Agassiz Loop PDLs from 2023 to 2025 (Appendix H.2) and the results are reported in Appendix I.1. Survey methods are described briefly in Appendix I.1 and in detail in Jacobs (2024b). The following surveys were completed at one or more of the PDLs, depending on site characteristics and other considerations (e.g., location of PDL relative to federally designated critical habitat):

- Bat acoustic survey (2024 and 2025)
- Fixed radius breeding bird survey (point count) (2024)
- Unlimited radius breeding bird survey (point count) (2024 and 2025)
- Oregon spotted frog time-constrained survey (2024 and 2025) and critical habitat biophysical attribute review (2023)
- Time-constrained amphibian search (2024 and 2025)

Quality assurance and quality control procedures were implemented for wildlife desktop and field surveys, as follows:

- Wildlife components of this TAR were prepared and reviewed by qualified professionals (see Appendix A).
- Appendix I.1 was prepared under the direction of, and reviewed by, qualified professionals
- Field surveys were completed under the direction of qualified professionals using accepted guidelines and protocols (see Jacobs 2024b and Appendix I.1)

2.5.2 Results and Discussion

2.5.2.1 Fish and Fish Habitat

The two watercourses associated with the PDLs along the Agassiz Loop are within the Harrison River watershed group, which includes the Fraser River between Hope and Mission (GOBC 2025e). The Agassiz Loop is located within the Fraser River lowlands in the southeast portion of the Harrison River watershed group (GOBC 2025e). See Section 2.2.2 and Section 2.3.2 for more information on the hydrology and geological setting of the area. The following subsections describe aquatic habitat present around each of the PDLs. Additional fish and fish habitat details for each PDL, as well as the area assessed around each can be found in the Fish and Fish Habitat Technical Data Report (Appendix H.1).

2.5.2.1.1 Fish Presence

Fish species and species groups documented in the Harrison River watershed group are listed in Table 2.25. Table 2.25 also summarizes the fish species documented in watercourses with PDLs. In the Harrison River watershed group, the following 13 species and populations at risk (i.e., those listed under Schedule 1 of SARA, by the Committee on the Status of Endangered Wildlife in Canada [COSEWIC], or are provincially red or blue-listed) have been previously documented:

- White sturgeon (*Acipenser transmontanus*)
- Cordilleran sucker (*Pantosteus bondi*; formerly mountain sucker)
- Salish sucker (*Catostomus sp. cf. catostomus*)
- Brassy minnow – Pacific group
- Pygmy longfin smelt (*Spirinchus* sp. 1)
- Bull trout – South Coast BC populations (*Salvelinus confluentus*)
- Chinook salmon (*Oncorhynchus tshawytscha*)
  - Lower Fraser, Ocean, Fall (DU2) population
  - Lower Fraser, Stream, Summer (DU5) population
  - Lower Fraser, Ocean, Summer (DU6) population
- Coastal cutthroat trout (*Oncorhynchus clarkii clarkii*)

- Sockeye salmon (*Oncorhynchus nerka*)
    - Harrison (downstream) – Late (DU9) population
    - Harrison (upstream) – Late (DU10) population

Of these, white sturgeon, Cordilleran sucker (mountain sucker), brassy minnow, bull trout, and coastal cutthroat trout have been documented in the Fraser River around PDL-A1, PDL-A8, and SBI9.
No species at risk have been documented in Hicks Creek. Though Fish Inventories Data Queries indicate that eulachon (*Thaleichthys pacificus*) and longfin smelt (*Spirinchus thaleichthys*) have been documented in the Harrison River watershed group, these observations are from near the mouth of the Fraser River and these species have not been documented within this watershed group (GOBC 2025e, 2025f).

Table 2.25 Fish Species Documented within the Harrison River Watershed Group and in Watercourses with PDLs

Family	Common Name	Scientific Name	SARA Status[a]	COSEWIC Status[a]	BC Status[b]	Species of Importance to Indigenous Groups[c]	Watercourse within Harrison River Watershed Group[d]	
							Fraser River (PDL-A1, A8, and SBI9)	Hicks Creek (PDL-A6)
Acipenseridae	White sturgeon – Lower Fraser River population[e]	*Acipenser transmontanus*	-	Threatened	Red	Yes	X	-
Catostomidae	Bridgelip sucker	*Catostomus columbianus*	-	-	Yellow	Yes	X	-
	Cordilleran sucker (formerly mountain sucker)	*Pantosteus bondi* (formerly *Catostomus platyrhynchus*)	Special concern (mountain sucker)	Threatened	Blue	Yes	X	-
	Largescale sucker	*Catostomus macrocheilus*	-	-	Yellow	Yes	X	-
	Longnose sucker	*Catostomus catostomus*	-	-	Yellow	Yes	X	-
	Salish sucker	*Catostomus sp. cf. catostomus*	Threatened	Endangered	Red	Yes	-	-
	Sucker (general)	*Catostomus* sp.	-	-	-	No	X	-
Centrarchidae	Black crappie	*Pomoxis nigromaculatus*	-	-	Exotic	Yes	X	-
	Bluegill	*Lepomis macrochirus*	-	-	Exotic	No	X	-
	Largemouth bass	*Micropterus salmoides*	-	-	Exotic	Yes	X	-
	Pumpkinseed	*Lepomis gibbosus*	-	-	Exotic	No	X	-
	Smallmouth bass	*Micropterus dolomieu*	-	-	Exotic	Yes	X	-
Clupeidae	American shad	*Alosa sapidissima*	-	-	Exotic	No	X	-
Cottidae	Coastrange sculpin	*Cottus alutaceus*	-	-	Yellow	Yes	X	-
	Prickly sculpin	*Cottus asper*	-	-	Yellow	Yes	X	-
	Sculpin (general)	*Cottus* sp.	-	-	-	No	X	-
Cyprinidae	Brassy minnow – Pacific group	*Hybognathus hankinsoni*	-	Special concern	Blue	No	X	-
	Common carp	*Cyprinus carpio*	-	-	Exotic	No	X	-
	Fathead minnow	*Pimephales promelas*	-	-	Exotic	No	X	-
	Goldfish	*Carassius auratus*	-	-	Exotic	No	X	-
	Leopard dace	*Rhinichthys falcatus*	-	Not at risk	Yellow	Yes	X	-
	Longnose dace	*Rhynichthys cataractae*	-	-	Yellow	Yes	X	-
	Northern pikeminnow	*Ptychocheilus oregonensis*	-	-	Yellow	Yes	X	-
	Peamouth	*Mylocheilus caurinus*	-	-	Yellow	Yes	X	-
	Redside shiner	*Richardsonius balteatus*	-	-	Yellow	Yes	X	-
	Chub (general)	-	-	-	-	No	X	-
	Dace (general)	*Rhynichthys* sp.; *Phoxinus* sp.	-	-	-	No	X	-
Gadidae	Burbot	*Lota lota*	-	-	Yellow	Yes	X	-
Gasterosteidae	Threespine stickleback	*Gasterosteus aculeatus*	-	-	Yellow	No	X	-
Ictaluridae	Brown catfish	*Ameiurus nebulosus*	-	-	Exotic	Yes	X	-

Family	Common Name	Scientific Name	SARA Status[a]	COSEWIC Status[a]	BC Status[b]	Species of Importance to Indigenous Groups[c]	Watercourse within Harrison River Watershed Group[d]	
							Fraser River (PDL-A1, A8, and SBI9)	Hicks Creek (PDL-A6)
Osmeridae	Pygmy longfin smelt	*Spirinchus* sp. 1	-	Data deficient	Red	No	-	-
Petromyzontidae	Pacific lamprey	*Entosphenus tridentatus*	-	-	Yellow	Yes	X	-
Petromyzontidae cont.	River lamprey	*Lampetra ayresii*	-	-	Yellow	Yes	X	-
	Western brook lamprey	*Lampetra richardsoni*	-	-	Yellow	No	-	-
	Lamprey (general)	*Lampetra* sp.	-	-	-	No	X	-
Salmonidae	Atlantic salmon	*Salmo salar*	-	-	Exotic	No	-	-
	Bull trout – South Coast British Columbia populations	*Salvelinus confluentus*	Special concern	Special concern	Blue	Yes	X	-
	Chinook salmon	*Oncorhynchus tshawytscha*	-	-	-	Yes	X	-
	Chinook salmon - Lower Fraser, Ocean, Fall (DU2)	*Oncorhynchus tshawytscha*	-	Threatened	-	Yes	-	-
	Chinook salmon - Lower Fraser, Stream, Summer (DU5)	*Oncorhynchus tshawytscha*	-	Threatened	-	Yes	-	-
	Chinook salmon - Lower Fraser, Ocean, Summer (DU6)	*Oncorhynchus tshawytscha*	-	Endangered	-	Yes	-	-
	Chum salmon	*Oncorhynchus keta*	-	-	-	Yes	X	X
	Coastal cutthroat trout	*Oncorhynchus clarkii clarkii*	-	-	Blue	Yes	X	-
	Coho salmon	*Oncorhynchus kisutch*	-	-	-	Yes	X	X
	Dolly Varden	*Salvelinus malma*	-	-	Yellow	Yes	X	-
	Kokanee	*Oncorhynchus nerka*	-	-	-	Yes	X	-
	Mountain whitefish	*Prosopium williamsoni*	-	-	Yellow	Yes	X	-
	Pink salmon	*Oncorhynchus gorbuscha*	-	-	-	Yes	X	-
	Rainbow trout and steelhead	*Oncorhynchus mykiss*	-	-	Yellow	Yes	X	-
	Sockeye salmon	*Oncorhynchus nerka*	-	-	-	Yes	X	-
	Sockeye salmon – Harrison (downstream)-Late (DU9)	*Oncorhynchus nerka*	-	Special concern	-	Yes	-	-
	Sockeye salmon – Harrison (upstream)-Late (DU10)	*Oncorhynchus nerka*	-	Endangered	-	Yes	-	-
	Sockeye salmon - Harrison - (River-Type) (DU23)	*Oncorhynchus nerka*	-	Not at Risk	-	Yes	-	-
	Whitefish (general)	*Prosopium* sp; *Coregonus* sp; *Stenodus* sp.	-	-	-	No	X	-

Notes:

“X” Species is present

“-” Species has not been documented (GOBC 2025e, 2025f, Appendix H.1)

[a] Government of Canada 2025; SARA = *Species at Risk Act*; COSEWIC = Committee on the Status of Endangered Wildlife in Canada

[b] British Columbia Conservation Data Centre listing (BC CDC 2025a; Yellow = species that are at the least risk of being lost; Blue = any species that is of special concern; Red = any species that is at risk of being lost (extirpated, endangered or threatened); Exotic = Introduced species

[c] Appendix H.1 or recent engagement activities

[d] HabitatWizard (GOBC 2025e)

[e] Sturgeon (general) have also been documented; however, as white sturgeon are the only sturgeon species whose range overlaps the Harrison River Watershed Group, it is assumed to be white sturgeon

White Sturgeon

White sturgeon have been documented in the Fraser River in proximity to PDL-A1, PDL-A8, and PDL-SBI9 (GOBC 2025e, 2025f). The lower Fraser River population of white sturgeon is listed as threatened by COSEWIC and is provincially red listed (Government of Canada 2025; BC CDC 2025a).

White sturgeon are primarily found in river mainstems, large tributaries, reservoirs, and large lakes (McPhail 2007). In the lower Fraser River, they are present throughout the main river channel throughout the year (McPhail 2007). Adult sturgeon have lower activity between October and March and prefer deep low-velocity habitat (McPhail 2007). Juveniles in the lower Fraser River use mainstem habitat and off-channel habitat such as sloughs and backwaters and are most prevalent in warm, turbid low-velocity areas and at depths of more than 5 m (McPhail 2007). Juvenile holding habitat has been documented in a Fraser River side channel on the south bank of the river approximately 4.5 km downstream of PDL-A1 and in the mainstem of the Fraser River approximately 2 km upstream of PDL-SBI9, but none has been documented in proximity to the PDLs (English et al. 2021).

Spawning typically occurs after peak freshet. In the lower Fraser River, sturgeon eggs have been collected between mid-June and late July, primarily from side-channel habitat at depths between 3.0 and 4.5 m where substrates were a mix of sand and gravel (McPhail 2007). In the lower Fraser River, 14 spawning areas have been documented, none of which are in proximity to the three PDLs (English et al. 2021). The closest documented spawning locations are Hamilton Bar, which is adjacent to the north bank of the river in a side channel approximately 4.5 km downstream of PDL-A1, and Herrling Island Side Channel, which is a side channel across the river and approximately 2.5 km away from PDL-A8 and 3 km away from PDL-SBI9 (English et al. 2021, LGL Limited 2016).

Based on their habitat requirements and previously observations, white sturgeon have the potential to be present at PDL-A1, PDL-A8, and PDL-SBI9 in the Fraser River but are unlikely to be present in Hicks Creek (PDL-A6). Adults and juveniles are the life stages most likely be present and in deeper waters around the PDLs; spawning is unlikely around the PDLs, so eggs are unlikely to be present.

Cordilleran Sucker

Cordilleran sucker (formerly referred to as the Pacific populations of mountain sucker) has been documented sporadically in the Fraser River in proximity to PDL-A1, PDL-A8, and PDL-SBI9 (GOBC 2025e, 2025f). This species is listed as threatened by COSEWIC and is provincially blue listed (Government of Canada 2025; BC CDC 2025a). Cordilleran sucker is not listed under Schedule 1 of SARA but is under consideration for addition (Government of Canada 2025). Mountain sucker – Pacific populations are listed as special concern (Government of Canada 2025).

The distribution of Cordilleran sucker in proximity to the Agassiz Loop is limited to the lower Fraser River downstream of Hope and upstream of the Sumas River mouth (McPhail 2007; COSEWIC 2022). There is limited information on the life history of this species. In the Fraser River, Cordilleran suckers (both adults and juveniles) occupy channels along gravel bars, often on the sheltered (lee) side in late summer and fall, deeper pools in winter, and areas adjacent to pools in moderate current in spring (COSEWIC 2022). Adults are typically in less than 1.5 m of water with velocities less than 0.7 m/s while juveniles are in less than 1.0 m of water with velocities less than 0.5 m/s (COSEWIC 2022). Young-of-year are generally found in embayments and blind channels in mid-river gravel bars; they are rare in similar habitat along the edge of the river (COSEWIC 2022).

Cordilleran sucker spawning occurs in the spring when water temperatures reach 10ºC (McPhail 2007). Spawning locations in the Fraser River are unknown, but they likely spawning in June (McPhail 2007). There is also limited information on spawning habitat preferences in the Fraser River, but generally adults move into riffle areas to spawn (COSEWIC 2022).

Based on their habitat requirements, adult and juvenile Cordilleran sucker have the potential to be present around PDL-A1, PDL-A8, and PDL-SBI9 in the Fraser River but are unlikely to be present in Hicks Creek (PDL-A6).

Salish Sucker

Salish sucker has not been documented in watercourses associated with current Agassiz Loop PDLs but have been documented within the Harrison River watershed group (GOBC 2025e, 2025f). Salish sucker is listed as threatened under Schedule 1 of SARA, endangered by COSEWIC, and red-listed by the province (Government of Canada 2025; BC CDC 2025a). Within the Harrison River watershed group, Salish sucker has primarily been documented in the Cheam Slough, Mountain Slough, and Miami Creek watersheds, which are areas of critical habitat for the species (GOBC 2025e, DFO 2025b). PDL-A1, PDL-A8, and PDL-SBI9 do not over lap with critical habitat for Salish sucker; PDL-A2 was located within Cheam Slough and in critical habitat of Salish sucker, which was the key reason it was removed from the PDL (see Section 1.7). Salish sucker is only known from 11 watersheds in Canada, and the Agassiz Loop PDLs are not within any of them (COSEWIC 2012). Based on the known distribution of Salish sucker in Canada, it is considered unlikely that they would be present at PDL-A1, PDL-A8, and PDL-SBI9 in the Fraser River or Hicks Creek (PDL-A6).

Brassy Minnow

Brassy minnow has been documented in side channels of the Fraser River such as Maria Slough, but not in the mainstem of the river within the Harrison River watershed group (GOBC 2025e, 2025f). They are listed as special concern by COSEWIC and are provincially blue listed (Government of Canada 2025; BC CDC 2025a). Brassy minnow has been documented sporadically throughout the Harrison River watershed group, primarily in smaller watercourses such as Agassiz Slough and Miami Creek (GOBC 2025e).

Brassy minnows are typically found in small, slow-moving streams, beaver ponds, and drainage ditches and remain close to vegetation (McPhail 2007). Their presence in flowing water can be variable; at some sites they are sometimes abundant seasonally every year, while in others they may only occasionally appear in large numbers (McPhail 2007). They are often not documented at sites between July and September/October and then reappear, indicating migration and schooling behaviours (McPhail 2007). In streams, adults are associated with vegetation and low water velocities (less than 0.5 m/s; McPhail 2007). Juvenile habitat is similar, although fry are generally found in shallower water with lower velocities than adults (McPhail 2007). Brassy minnow spawn over vegetation in mid-May to early June in the lower Fraser Valley, when water temperatures reach approximately 14ºC (McPhail 2007).

Based on their habitat requirements, brassy minnow have the potential to be present at PDL-A6 in Hicks Creek but are unlikely to be present at PDLs within the Fraser River (PDL-A1, PDL-A8, and PDL-SBI9). Spawning has the potential to occur at PDL-A6 as instream vegetation is present.

Pygmy Longfin Smelt

Pygmy longfin smelt is a lake-resident population of longfin smelt that occurs in one lake (Harrison Lake) within the Harrison River watershed group (McPhail 2007; GOBC 2025e, 2025f). It is provincially red listed (BC CDC 2025a). As none of the PDLs are in lakes where the pygmy longfin smelt is known to occur, it is unlikely that this species would be encountered in Agassiz Loop.

Bull Trout

Bull trout have been documented sporadically in the Fraser River, which is associated with PDL-A1, PDL-A8, and PDL-SBI9 (GOBC 2025e, 2025f). They are listed as special concern under Schedule 1 of SARA and by COSEWIC and are provincially blue listed (Government of Canada 2025; BC CDC 2025a). Elsewhere within the Harrison River watershed group, bull trout have been documented sporadically in tributaries of Harrison Lake (GOBC 2025e).

Bull trout is a cold-water species which is rarely found in waters where temperatures exceed 15ºC for long periods of time and prefers high gradient, unproductive waters (Roberge et al. 2002; McPhail 2007). In larger rivers such as the Fraser River, adults are typically found in tail-outs of pools close to overhead cover (McPhail 2007). In streams, adult bull trout prefer pool habitat near cover (McPhail 2007). In areas where bull trout and Dolly Varden both occur, such as the Harrison River watershed group, bull trout are typically riverine or adfluvial while Dolly Varden inhabit small streams (McPhail 2007). Juvenile bull trout rear in pools and deep side channels of streams and are unlikely to be found in rivers at this life stage (McPhail 2007). Young-of-year are usually found in shallow, slow-moving water at stream edges in water less than 5 cm deep with gravel substrates interspersed with boulders (McPhail 2007).

Bull trout spawn in the fall, typically migrating from rivers into smaller watercourses in August with spawning occurring when water temperatures fall to less than 9ºC, which is between mid-September and late October in southern populations (Roberge et al. 2002; McPhail 2007). Spawning occurs in small rivers and tributary streams with higher gradients over gravel and rubble substrates near cover (Roberge et al. 2002). Spawning commonly occurs in areas with groundwater upwellings (Roberge et al. 2002; McPhail 2007).

Based on their habitat requirements, adult bull trout may be present at PDLs within the Fraser River (PDL-A1, PDL-A8, and PDL-SBI9) but are unlikely to be present in in Hicks Creek (PDL-A6). Eggs and juvenile bull trout are unlikely to be present at either the Fraser River PDLs or in Hicks Creek (PDL-A6), as spawning is unlikely to occur in these areas.

Chinook Salmon

Chinook salmon have been documented in the Fraser River, which is associated with PDL-A1, PDL-A8, and PDL-SBI9, but not in Hicks Creek (PDL-A6; GOBC 2025e, 2025f). In addition, there are three designatable units (DUs) of Chinook salmon within the Harrison River watershed group (Pacific Salmon Federation 2024). The Lower Fraser, Ocean, Fall (DU2) and Lower Fraser, Stream, Summer (DU5) populations are listed as threatened and the Lower Fraser, Ocean, Summer population (DU6) is listed as endangered by COSEWIC (Government of Canada 2025). The range of these DUs does not overlap any of the Fraser River PDLs; however, DU6, overlaps with Hicks Creek (PDL-A6), though the species has not been documented in the watercourse (Brown and Musgrave 1979; Pacific Salmon Federation 2024). DU6 is associated with Chinook salmon spawning specifically in Maria Slough, which is downstream of Hicks Creek (COSEWIC 2020). Coho and chum salmon have been documented spawning in Hicks Creek; Chinook have been absent from historical spawning records, indicating they are unlikely to spawn in the watercourse (Brown and Musgrave 1979).

Chinook salmon is an anadromous species that spends most of its lifecycle in the ocean. Depending on the life history type, juveniles either migrate to the ocean in their first year (ocean-type) or after spending one to two years in freshwater (stream-type; McPhail 2007). Migration to sea usually occurs in the spring with both types of Chinook salmon (McPhail 2007). Stream-type fry primarily inhabit stream and rivers and are initially associated with shallow edge habitats (e.g., channel edges, sloughs, backwaters, off-channel habitat) with low velocities and move to deeper, faster areas as they grow (McPhail 2007). They overwinter in areas close to the bottom with abundant cover (e.g., boulders, woody debris), which typically involves migrating from tributary streams to large rivers (McPhail 2007).

Adult Chinook salmon migrate from the ocean into freshwater to spawn. In the Fraser River, Chinook migration peaks twice: once in July and again in September to October; Chinook salmon from DU6, which overlaps with Hicks Creek, typically enter freshwater in late July and August (McPhail 2007; Pacific Salmon Federation 2024). They typically spawn in larger rivers and their side channels but also spawn in streams that are 2 to 3 m wide (McPhail 2007). They prefer to spawn in tail-outs of pools, above riffles, or in upwelling sites; factors such as water depth, velocity, and substrate size are less critical (McPhail 2007).

Though the range of the Chinook salmon DUs of management concern does not overlap any of the Fraser River PDLs; the river is used as a migratory corridor for adult salmon returning to spawning grounds and the outmigration of juveniles in the Fraser River watershed. As there is no DU associated with the section of the Fraser River with PDLs, it is unlikely that Chinook salmon use this area substantially for spawning; however, the PDLs could potentially provide rearing habitat for juvenile Chinook salmon (e.g., those the migrate downstream from Maria Slough in DU6 [Pacific Salmon Federation 2024]).

Hicks Creek (PDL-A6) is within the boundaries of Chinook salmon DU6; however, Chinook salmon have not been previously documented in it and thus, Chinook salmon are unlikely to spawn in the creek. Fry are also unlikely to use Hicks Creek for rearing habitat.

Coastal Cutthroat Trout

Coastal cutthroat trout have been documented in the Fraser River, which is associated with PDL-A1, PDL-A8, and PDL-SBI9 (GOBC 2025e, 2025f). They are provincially blue listed (BC CDC 2025a). Coastal cutthroat trout have been documented throughout the Harrison River watershed group, primarily in streams, but not in rivers or lakes (GOBC 2025e).

Coastal cutthroat trout are found in a wide variety of cool-water habitats (typically <18ºC; McPhail 2007). Adults can be found in a range of habitat, including small headwater streams, lowland sloughs, and backwaters of large rivers, while juveniles are associated with small streams with a channel width of <5 m, particularly those with low gradients and gravel substrates (McPhail 2007). Where coastal cutthroat trout coexist with coho salmon (*Oncorhynchus kisutch*), juvenile trout prefer riffle and glide habitat with faster water (McPhail 2007).

Coastal cutthroat trout can spawn as early as late October but spawning usually peaks in February and extends into spring (McPhail 2007). They prefer streams less than 1 m wide with a low gradient and gravel substrates for spawning (McPhail 2007). Spawning usually occurs in the tail-outs of pools where water depths are 0.15 to 0.45 m (McPhail 2007).

Based on their habitat requirements, adult coastal cutthroat trout have the potential to be present at all the PDLs associated with Agassiz Loop. Juveniles have the potential to occur at PDL-A6 in Hicks Creek, as spawning has the potential to occur in the watercourse, though it is unlikely to occur specifically at PDL-A6 as habitat characteristics are unsuitable. Similarly, spawning at the Fraser River PDLs (PDL-A1, PDL-A8, and PDL-SBI9) is unlikely so the presence of coastal cutthroat trout juveniles and eggs are unlikely at these PDLs.

Sockeye Salmon

Sockeye salmon have been sporadically documented in the Fraser River in proximity to PDL-A1, PDL-A8, and PDL-SBI9, though the Fraser River is an important migration corridor for the species (GOBC 2025e, 2025f). They have also been documented in Maria Slough, downstream of Hicks Creek (PDL-A6; GOBC 2025e, 2025f). In addition, there are two DUs of sockeye salmon within the Harrison River watershed group (Pacific Salmon Federation 2024). The Harrison (downstream) – Late population (DU9) is listed as special concern, and the Harrison (upstream) – Late population (DU10) is listed as endangered by COSEWIC (Government of Canada 2025). The range of these DUs does not overlap any of the Agassiz Loop PDLs.

Sockeye salmon is an anadromous species that spends the majority of is lifecycle in the ocean. Juveniles typically spend one to two years in freshwater before migrating to the ocean; most rear in lakes during this phase, but some rear in streams and rivers (McPhail 2007). In rivers and streams, juvenile sockeye initially inhabit river margins in low-velocity water, sloughs, backwaters, and off-channel habitat (McPhail 2007).

Adult sockeye salmon migrate from the ocean to freshwater to spawn. In the Fraser River watershed, sockeye salmon enter freshwater between July and September to migrate to their spawning grounds (Pacific Salmon Federation 2024). Populations DU9 and DU10 migrate from early August to mid-September and late July to late September, respectively (Pacific Salmon Federation 2024). Spawning occurs between August and November, typically in lakes as well as small tributaries and side channels with sub-gravel water flow or upwelling of water (McPhail 2007).

Though the range of sockeye salmon DUs of management concern do no overlap any of the Agassiz Loop PDLs, the Fraser River is used as a migratory corridor for adult salmon returning to spawning grounds and the outmigration of juveniles in the Fraser River watershed. As there is no DU associated with the Agassiz Loop PDLs or areas immediately upstream in the Fraser River, it is unlikely that sockeye salmon use these areas substantially for spawning or rearing.

2.5.2.1.2 Fish Habitat

The sections below describe fish and fish habitat values watercourses with PDLs on the Agassiz Loop. Hydrological information on these watercourses can be found in Section 2.2.2.

Fraser River

PDL-A1, PDL-A8, and PDL-SBI9 are located on the north (right) bank of the Fraser River in the Agassiz area (Appendix H.2). The channel width in this area is greater than 100 m, which corresponds to a riparian class of S1A (Appendix H.1). The channel in proximity to PDL-A8 and PDL-SBI9 is braided with multiple islands within the river. PDL-A1 is located downstream of the braiding, where the river is relatively narrow. Based on aerial imagery, the area upstream of PDL-SBI9 may disconnect from the Fraser River during low flow periods but still connected downstream, making the area a temporary backwater. The Fraser River around the PDLs was made up of riffle and run habitat dominated by boulders and fines when assessed in spring 2025 (Appendix H.1). Lesser amounts of large gravel, cobble, and organics were also present (Appendix H.1). Water depth provided the primary form of cover, though PDL-SBI9 also had overhanging vegetation, boulders, and undercut banks along the shoreline (Appendix H.1).

There was a low gradient shelf bordering the shoreline at PDL-A1 before the channel dropped off to deeper water, when the site was assessed in spring 2025 (Appendix H.1). Riverbanks at the Fraser River PDLs ranged from stable to moderately stable and sloping to vertical (Appendix H.1). They were made up of fines and small gravel (Appendix H.1). Functional riparian width did not exceed 16 m wide on the right bank at any of the sites where PDLs will be located, as agricultural fields extended to near the edge of the river (Appendix H.1). Where present, riparian vegetation was made up of mature, deciduous forest (Appendix H.1).

Spawning, overwintering, and rearing habitat in this section of the Fraser River was rated as important for species such as salmonids (Appendix H.1). It was also rated as important migration for fish (Appendix H.1), and all salmon migrating to upstream areas of the Fraser River would pass by these PDLs. When PDL-SBI9 is cut off from the Fraser River upstream in low flow periods and provides backwater habitat, it is also likely to provide good overwintering and rearing habitat for many species of fish, particularly juveniles, which prefer slower flowing water.

Hicks Creek

PDL-A6 is located on Hicks Creek approximately 2.5 km upstream (northeast) of its confluence with Maria Slough (Appendix H.2). It has a mean channel width of 4.0 m, which corresponds to a riparian class of S3 (Appendix H.1). Hicks Creek was observed to have a seasonal flow pattern; it was dry during the August 2023 assessment under drought conditions and was observed to be flowing in April and November 2024 (Appendix H.1). Surface water monitoring reports indicate it had stagnant conditions during the August and September 2024 monitoring visits (Appendix E.1). Flow information for the creek is described in Section 2.2.2. The channel bed at PDL-A6 was flat, dominated by fines, with organics subdominant (Appendix H.1). Depths were generally less than 0.5 m (Appendix H.1). Cover was dominated by instream and overhanging vegetation that had limited function, along with trace amounts of woody debris (Appendix H.1).

Banks of Hicks Creek at PDL-A6 were moderately stable and sloping (Appendix H.1). They were made of up fines and organics (Appendix H.1). Functional riparian width was 6 m on average and riparian vegetation was made up of shrubs and mixed coniferous and deciduous vegetation in the shrub stage (Appendix H.1).

Spawning, overwintering, rearing, and adult habitat at PDL-A6 was rated as marginal due to lack of suitable substrates and seasonal flow patterns. It provides important migration habitat for salmonids, particularly chum and coho salmon, to access upstream spawning areas. Migrating, holding, and staging chum and coho salmon were observed in proximity to PDL-A6 during November 2024 spawning surveys and one redd was observed approximately 240 m upstream of PDL-A6 (Appendix H.1). Juvenile and young-of-year fish, including salmon, were also observed in proximity to PDL-A6 in spring and early summer 2025 surveys (Appendix H.1). With respect to species of management concern, brassy minnow and coastal cutthroat trout have the potential to be present in the watercourse when flows are adequate.

2.5.2.2 Wildlife and Wildlife Habitat

The Agassiz Loop PDLs are in the Fraser Lowland ecosection, which consists of the Fraser delta, estuary, lowlands, and associated uplands (Demarchi 2011). In addition to the Fraser River, other large watercourses in the ecosection are the Harrison, Stave, Pitt, Coquitlam, Chilliwack, Sumas, Serpentine, and Nooksack rivers (Demarchi 2011). There are no extant large lakes in the ecosection; Sumas Prairie approximates the location of historical Sumas Lake, which was drained for farmland in the 1920s (Demarchi 2011; Chan 2021). Urban, rural, transportation, commercial, industrial, and agricultural development is extensive. There are remnant forested areas, predominantly in parks and protected areas. Floodplain and wetland habitat loss has been well documented in the Fraser Lowland ecosection (Finn et al. 2021; Pacific Birds Habitat Joint Venture 2025).

The PDLs are in the lowlands upstream of the Fraser delta, with PDL-A6 adjacent to steep, forested slopes (Appendix H.2). Table 2.26 summarizes the wildlife and wildlife habitat characteristics of the PDLs. The three Fraser River PDLs (PDL-A1, PDL-A8, PDL-SBI9) are within 5.2 km of each other and have similar receiving environment and surrounding habitat characteristics and wildlife habitat suitability.
The Hicks Creek PDL (PDL-A6) is approximately 2.5 km inland from the Fraser River and distinct from the Fraser River PDLs with respect to its wildlife habitat characteristics. The PDLs are in the District of Kent, which supports a diversity of wildlife, including 79 vertebrate species of conservation concern that may occur in the Coastal Western Hemlock biogeoclimatic zone[1,2] (12 mammals, 58 birds, 5 amphibians, 4 reptiles [BC CDC 2025a]). None of the PDLs are within provincially designated wildlife areas (i.e., ungulate winter range polygons, Wildlife Habitat Areas) (Appendix I.1). PDL-A6 is within a federally designated critical habitat polygon for Oregon spotted frog (Table 2.26; Appendix H.2).

[1] Species of conservation concern are defined as species on the provincial blue or red lists or species listed under Schedule 1 of SARA
[2] The Agassiz Loop PDLs are in the Dry Maritime subzone of the Coastal Western Hemlock biogeoclimatic zone

Table 2.26 Summary of Wildlife and Wildlife Habitat Characteristics of Potential Discharge Locations for Agassiz Loop

Potential Discharge Location	Receiving Environment	Description of Receiving Environment and Surrounding Habitat	Wildlife Habitat Suitability	PDL within a Federally Designated Critical Habitat Polygon?	Confirmed Species Occurrence Records within 1 km of PDL Location (Except as Noted)[a,b]
PDL-A1[c]	Fraser River	• PDL is on the north bank (riparian zone) of the main channel of the Fraser River (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Adjacent to Tuyttens Road and cultivated lands, west of Highway 9; sparsely treed fringe along Fraser River • Vegetation cover along upper bank includes black cottonwood (*Populus trichocarpa*), willow (*Salix* sp.), horsetail (*Equisetum* sp.), and reed canarygrass (*Phalaris arundinacea*); beach present at low water.	Suitable predominantly for waterbirds (foraging), songbirds (foraging), raptors (foraging), furbearers (foraging), and bats (foraging). Receiving environment is not suitable for amphibians.	No	Birds: 115 species (see Appendix I.2), including the following species reported in Appendix I.1: American crow, American robin, barn swallow, cliff swallow, great blue heron, mallard, tree swallow Mammals: Raccoon (*Procyon lotor*) Amphibians: None[d] Reptiles: None Terrestrial invertebrates: None
PDL-A8	Fraser River	• PDL is on the north bank (riparian zone) of the main channel of the Fraser River (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Adjacent to unnamed access road and cultivated lands; sparsely treed fringe along Fraser River. • Vegetation cover along upper bank includes bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and Himalayan blackberry (*Rubus armeniacus*); bank is steep and armoured with riprap.	Suitable predominantly for waterbirds (foraging), songbirds (foraging), raptors (foraging), furbearers (foraging), and bats (foraging). Receiving environment is not suitable for amphibians.	No	Birds: 48 species (see Appendix I.2), including the following species reported in Appendix I.1: bald eagle, dark-eyed junco, great blue heron, northern harrier Mammals: None Amphibians: None[d] Reptiles: None Terrestrial invertebrates: None
PDL-SBI9[e]	Fraser River	• PDL is on the north bank (riparian zone) of a back channel of the Fraser River (Appendix H.2) that may be isolated at low water; see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • At end of Cuthbert Road; forest and cultivated land mix, treed fringe more substantive than the other two Fraser River PDLs. • Vegetation cover along upper bank includes bigleaf maple, red alder, black cottonwood shrubs, thimbleberry (*Rubus parviflorus*), spirea (*Spiraea* sp.), and large patches of Himalayan blackberry; bank is steep and armoured with riprap.	Suitable predominantly for waterbirds (foraging), songbirds (foraging), raptors (foraging), furbearers (foraging), and bats (foraging). Receiving environment is not suitable for amphibians.	No	Birds: 120 species (see Appendix I.2), including the following species reported in Appendix I.1: belted kingfisher Mammals: American mink (*Neovison vison*) Amphibians: None[d] Reptiles: None Terrestrial invertebrates: None
PDL-A6[f]	Hicks Creek	• PDL is on Hicks Creek (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Inland from Fraser River and at foot of steep forested slope; riparian fringe surrounded by disturbed lands (transmission line, cleared areas, cultivated lands). • Natural watercourse but has been excavated by landowner; steep banks. • Vegetation cover along stream banks includes western red cedar (*Thuja plicata*) and birch (*Betula* sp.) with red-osier dogwood (*Cornus sericea*), snowberry (*Symphoricarpos* sp.), and Himalayan blackberry in understorey and reed canarygrass in channel.	Suitable predominantly for amphibians (breeding), songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), Oregon forestsnail (year-round living), and bats (foraging). Confirmed breeding by northern red-legged frog and northwestern salamander in 2025.	Yes, for Oregon spotted frog (*Rana pretiosa*; Red List and Endangered under Schedule 1 of SARA) (Appendix H.2; see text for further information).	Birds: 24 species (see Appendix I.2), including the following species reported in Appendix I.1: American dipper, American goldfinch, American robin, barn swallow, great blue heron, mallard, song sparrow, spotted towhee, Steller's jay, Swainson's thrush, turkey vulture, varied thrush, violet-green swallow, warbling vireo, Wilson's warbler, yellow warbler Mammals: Small mammal; bats (acoustic detections) Amphibians: American bullfrog (*Lithobates catesbeianus*; introduced), green frog (*L. clamitans*; introduced), Pacific treefrog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*; Blue List and Special Concern under Schedule 1 of SARA), northwestern salamander (*Ambystoma gracile*) Reptiles: None Terrestrial invertebrates: Oregon forestsnail (*Allogona townsendiana*; Red List and Endangered under Schedule 1 of SARA)

Notes:
[a] In past 10 years (i.e., 2016–2025)
[b] Species of conservation concern are underlined; see Appendix I.2 for scientific names and conservation status for birds.
[c] Excludes Appendix I.1 wildlife field observations from Cheam Slough (PDL-A2 [see Table 1.5]), which are within 1 km of PDL-A1 but not in habitat comparable to banks of Fraser River
[d] Amphibian survey not undertaken due to lack of suitable habitat; no incidental observations of amphibians.
[e] Excludes Appendix I.1 wildlife field observations from Maria Slough (PDL-SBI3 [see Table 1.5]), which are within 1 km of PDL-SBI9 but not in habitat comparable to banks of Fraser River
[f] Includes Appendix I.1 wildlife field observations collected for PDL-A7 (see Table 1.5), which is on Hicks Creek, upstream and within 1 km of PDL-A6
Sources: Appendix I.1; Appendix I.2; Birds Canada 2025; BC CDC 2025a, 2025b; eBird 2025; iNaturalist 2025; McTavish surface water monitoring and sampling results summary reports from 2024–2025

The description of the existing conditions for wildlife for the PDLs is focused on five groups that are known or likely to interact with the PDL receiving environments year-round or seasonally: 1) birds, 2) mammals, 3) amphibians, 4) reptiles, and 5) terrestrial invertebrates. The existing conditions for the five groups are presented in the following sections.

2.5.2.2.1 Birds

There are 337 bird species known to occur in the Fraser Valley checklist area (per eBird 2025), a large, ecologically diverse area that includes the District of Kent. More specifically, there are confirmed occurrence records for 143 species within 1 km of the Agassiz Loop PDLs (Appendix I.2). These confirmed species include local breeders, year-round residents, and spring and fall migrants. Of the confirmed species, 84 have some degree of association with riparian, stream, riverine, and wetland habitats (see Appendix I.2). Of these 84 species, ten are species of conservation concern: tundra swan (*Cygnus columbianus*), black swift (*Cypseloides niger*), California gull (*Larus californicus*), western grebe (*Aechmophorus occidentalis*), double-crested cormorant (*Nannopterum auritum*), great blue heron (*Ardea herodias*), American barn owl (*Tyto furcata*), peregrine falcon (*Falco peregrinus anatum*), bank swallow (*Riparia riparia*), and barn swallow (*Hirundo rustica*) (see Appendix I.2). Species groups most likely to interact directly with the PDL receiving environments are waterfowl, shorebirds, terrestrial birds that forage directly in water, and aerial insectivores (e.g., swallows). Collectively for the Agassiz Loop PDLs, Appendix I.1 reports detections of one waterfowl species (mallard [*Anas platyrhynchos*]), one shorebird species (great blue heron), three terrestrial species that forage directly in water (bald eagle [*Haliaeetus leucocephalus*], belted kingfisher [*Megaceryle alcyon*], American dipper [*Cinclus mexicanus*]), and four aerial insectivore species (barn swallow, cliff swallow [*Petrochelidon pyrrhonota*], tree swallow [*Tachycineta bicolor*], violet-green swallow [*T. thalassina*]) (also see Table 2.26).

There are no active great blue heron nest colonies in the vicinity of the PDLs; the closest colony to have been active in the past ten years is 9.8 km southwest of PDL-A1 and was last recorded as active in 2018 (CMN 2025a). Two active bald eagle nests were detected approximately 3 km north of PDL-SBI9 in March 2025 (i.e., at PDL-SBI4 [see Table 1.5]; Appendix I.1) and, in 2023, an active bald eagle nest was documented within 1 km of PDL-A1 (eBird 2025). An active cliff swallow colony was detected under the Highway 9 Bridge approximately 400 m east of PDL-A1 in March 2025 (Appendix I.1).

2.5.2.2.2 Mammals

Mammal species known or likely to be present around the PDLs include black-tailed deer (*Odocoileus hemionus*), black bear (*Ursus americanus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), North American river otter (*Lontra canadensis*), American mink (*Neovison vison*), raccoon (*Procyon lotor*), small mammals (e.g., Townsend’s vole [*Microtus townsendii*], North American deermouse [*Peromyscus maniculatus*]), and bats (Klinkenberg 2023; iNaturalist 2025; Appendix I.1). These species may use the PDL receiving environments and their surrounding habitats for periodic travel, hunting and foraging, and drinking, and some small mammals may be resident. Except for some bat species, none of these species are species of conservation concern.

Eleven bat species are likely to be present in the Lower Mainland and Fraser Valley (Lausen et al. 2022), of which seven are species of conservation concern: little brown myotis (*Myotis lucifugus*; Blue List and Endangered under Schedule 1 of SARA), Yuma myotis (*M. yumanensis*; Blue List), fringed myotis (*M. thysanodes*; Blue List), western small-footed myotis[1] (*M. ciliolabrum*; Blue List), Townsend's big-eared bat (*Corynorhinus townsendii*; Blue List), hoary bat (*Lasiurus cinereus*; Blue List and under consideration for Schedule 1 of SARA as Endangered), and silver-haired bat (*Lasionycteris noctivagans*; under consideration for Schedule 1 of SARA as Endangered) (BC CDC 2025a; Government of Canada 2025).[2] Bat species in BC forage on insects over a variety of habitats including fields, forest clearings, wetlands, ponds, streams, lakes, rivers, and riparian corridors (Lausen et al. 2022). For drinking, bats likely avoid water that is moving too fast or is turbulent (Lausen et al. 2022). Slow flying, more manoeuvrable bats (e.g., *Myotis* sp.) may drink from small areas of water rather than an open lake, which is more likely to be used by fast flying, less manoeuvrable bats (e.g., hoary bat) (Lausen et al. 2022). Bats were confirmed to be present around PDL-A6 based on an acoustic survey in 2025 (Appendix I.1) and are assumed to also forage around the other PDLs.

2.5.2.2.3 Amphibians

Eleven native amphibian species may occur around the PDLs based on range: coastal tailed frog (*Ascaphus truei*), northern red-legged frog (*Rana aurora*), Oregon spotted frog (*R. pretiosa*), Pacific treefrog (*Pseudacris regilla*), western toad (*Anaxyrus boreas*), coastal giant salamander (*Dicamptodon tenebrosus*), ensatina (*Ensatina eschscholtzii*), rough-skinned newt (*Taricha granulosa*), northwestern salamander (*Ambystoma gracile*), long-toed salamander (*A. macrodactylum*), and western red-backed salamander (*Plethodon vehiculum*) (TRU and BC MOE 2021a). Of these, five are species of conservation concern: coastal tailed frog (Special Concern under Schedule 1 of SARA), northern red-legged frog (Blue List and Special Concern under Schedule 1 of SARA), Oregon spotted frog (Red List and Endangered under Schedule 1 of SARA), western toad (Special Concern under Schedule 1 of SARA), and coastal giant salamander (Blue List and Threatened under Schedule 1 of SARA) (BC CDC 2025a).[3] In addition, two introduced species (American bullfrog [*Lithobates catesbeianus*] and green frog [*L. clamitans*]) have the potential to occur (TRU and BC MOE 2021b; iNaturalist 2025).

Hicks Creek is encompassed by a federally designated critical habitat polygon for Oregon spotted frog (Environment Canada 2015; BC CDC 2025b; Appendix H.2). However, a 2023 field assessment of the biophysical attributes of Oregon spotted frog critical habitat (as defined in Environment Canada 2015) at PDL-A6 and upstream at PDL-A7 (see Table 1.5) determined that none of the required biophysical attributes were present (Appendix I.1). No Oregon spotted frogs were found during the species-specific surveys completed in March 2024 and 2025 (Appendix I.1).

The Fraser River receiving environment is not amphibian habitat, although adult amphibians of some species (e.g., western toad) may be present in the terrestrial environment adjacent to the Fraser River PDLs. Five amphibian species were identified during surveys associated with the Hicks Creek PDLs (PDL-A6 and upstream at PDL-A7 [see Table 1.5]) in 2025: Pacific treefrog, northern red-legged frog,

---

1 Lausen et al. (2022) identify this species as dark-nosed small-footed myotis (*M. melanorhinus*)
2 Blue List = special concern (BC CDC 2025a)
3 Blue List = special concern; Red List = extirpated, endangered or threatened (BC CDC 2025a)

northwestern salamander, American bullfrog, and green frog (Table 2.26). Breeding was confirmed for northern red-legged frog and northwestern salamander during those surveys (Appendix I.1). Based on publicly available records and habitat preferences, coastal tailed frog, Oregon spotted frog, western toad, coastal giant salamander, ensatina, long-toed salamander, and western red-backed salamander are unlikely to be present in the Hicks Creek receiving environment, while rough-skinned newt may be present (ECCC 2020; TRU and BC MOE 2021b; iNaturalist 2025; Appendix I.1).

2.5.2.2.4 Reptiles

Six native reptile species may occur around the PDLs based on range: common gartersnake (*Thamnophis sirtalis*), northwestern gartersnake (*T. ordinoides*), western terrestrial gartersnake (*T. elegans*), northern rubber boa (*Charina bottae*), northern alligator lizard (*Elgaria coerulea*), and painted turtle (*Chrysemys picta belli*)[4] (TRU and BC MOE 2021a). Of these, two are species of conservation concern: northern rubber boa (Special Concern under Schedule 1 of SARA) and painted turtle (Red List and Threatened under Schedule 1 of SARA) (BC CDC 2025a).[5] In addition, two introduced species (red-eared slider [*Trachemys scripta elegans*] and common wall lizard [*Podacris muralis*]) have the potential to occur (TRU and BC MOE 2021a; iNaturalist 2025). Based on habitat preferences, only western terrestrial gartersnake is likely to interact with the Fraser River receiving environment and painted turtle, red-eared slider, common gartersnake, and western terrestrial gartersnake could interact with the Hicks Creek receiving environment (TRU and BC MOE 2021c). There are few publicly available turtle records around Agassiz (ECCC 2021; iNaturalist 2025), but gartersnakes are expected to be common.

2.5.2.2.5 Terrestrial Invertebrates

Many terrestrial invertebrate species are known or likely to be present in the District of Kent, including 46 species of conservation concern (BC CDC 2025a). Groups that are closely associated with stream and riverine habitat, particularly for reproduction, are most likely to interact with the PDL receiving environments (e.g., caddisflies, mayflies, damselflies).

One Oregon forestsnail (*Allogona townsendiana*), a species of conservation concern (Red List and Endangered under Schedule 1 of SARA), was found approximately 350 m upstream of PDL-A6 in 2025 (Appendix I.1). This is the only confirmed occurrence of a terrestrial invertebrate within 1 km of a PDL (Table 2.26), although many species are assumed to be present. Although PDL-A6 is not within a federally designated critical habitat polygon for Oregon forestsnail[6] (Appendix H.2), the area where the individual was found was assessed as having all four of the biophysical attributes of Oregon forestsnail critical habitat (Appendix I.1), and there is federally designated Oregon forestsnail critical habitat as close as approximately 115 m from PDL-A6 (BC CDC 2025b; Appendix H.2). As a land snail, Oregon forestsnail would not interact directly with the waters of Hicks Creek but could occur in the creek's riparian zone (COSEWIC 2013).

---

[4] Synonymous with western painted turtle (BC CDC 2025c)
[5] Red List = extirpated, endangered or threatened (BC CDC 2025a)
[6] Oregon forestsnail critical habitat polygons are considered 'proposed' until the Amended Recovery Strategy (ECCC 2024b) is finalized.

2.5.3 Data Gaps and Uncertainties

The information available for the characterization of existing conditions for fish and fish habitat as it pertains to the Agassiz Loop PDLs is sufficient to support the environmental effects predictions and impact assessment for this aquatic life receptor. Though the assessment of the Fraser River PDLs was based on a high-level visual assessment due to width, depth, and water clarity constraints related to the river's size, the data collected was sufficient to determine potential effects.

The information available for the characterization of existing conditions for wildlife and wildlife habitat as it pertains to the Agassiz Loop PDLs is sufficient to support the environmental effects predictions and impact assessment for this aquatic life receptor. No information gaps have been identified for wildlife and wildlife habitat.

2.6 Contaminated Sites and Acid Rock Drainage/ Metal Leaching Potential

The IRT indicates that a search for potential contaminated sites along the pipeline loop should be completed using the contaminated sites database. In addition, the IRT also requested that the potential for acid rock drainage be assessed as part of the baseline studies. WSP Canada Inc (WSP) was retained by Westcoast to undertake these desktop reviews, which are reported in detail in Appendix J and summarized in the following sections.

2.6.1 Contaminated Sites

WSP completed desktop reviews for potential contaminated sites within 250 m of the pipeline loop centreline in the Environmental Risk Information Services (ERIS) and Federal Contaminated Sites Inventory databases (Appendix J). No sites were identified within 250 m of the centreline of the Agassiz Loop from the BC ENV Site Registry database. Six sites were identified within 250 m of the centerline of the Agassiz Loop from the Federal Contaminated Sites Inventory database. Of these six sites, WSP concluded that Site ID 00008279 and Site ID 05085001 were of potential concern to dewatering activities along the Agassiz Loop due to their proximity and inferred groundwater flow direction. As such, Westcoast will be considering further assessments of these sites to evaluate the potential for contamination to be present in the groundwater along the footprint in the vicinity of these two sites.

2.6.2 Acid Rock Drainage/Metal Leaching Potential

WSP completed a desktop level hazard assessment of acid rock drainage and metal leaching potential of bedrock along the proposed pipeline route (Appendix J). The surficial soils along the proposed pipeline route are anticipated to comprise granular Fraser River Sediment based on surficial geological mapping of the area and information from the BC Groundwater Well Database. The proposed pipeline construction works are understood to comprise typical trench installation with trenchless crossings of selected watercourse locations, with depths of excavation up to a maximum of 10 m below ground surface. Based on available mapping, the BC Groundwater Well database information, and WSP’s local experience, bedrock is not anticipated to be excavated as part of pipeline construction works. Therefore, WSP concluded that acid rock drainage and metal leaching and hazards associated with excavated bedrock are not anticipated for the pipeline loop.

3 Discharges, Mitigation, and Management

This section provides details about the water that will be intercepted and discharged during pipeline installation including discharge sources and flow, the anticipated discharge quantity and quality, and discharge mixing within the receiving environment. Additionally, mitigation measures to protect the receiving environment during discharge and a summary of Westcoast's general construction phase monitoring activities, where relevant, are presented in this section. Monitoring plans specific to the Section 15 Approval are described in Section 5.

3.1 Discharge Sources and Flow

Pipeline installation involves trenching to achieve the minimal cover depth requirements and facilitate the installation of the below ground pipeline. Trenching is typically completed in sections as the construction crew works through the pipeline installation process of digging the trench, installing the pipe, and then covering the pipe and backfilling the trench (Figure 1.4). Groundwater must be managed within the trench to provide a dry working area, and this is typically achieved through dewatering.

Trench dewatering is a short-term and temporary construction activity needed to maintain stable trench conditions and dry work area. During initial stages of dewatering, groundwater pumped from the excavation may contain elevated suspended solids due to the mobilization of fine-grained sediments from aquifer pore spaces under transient flow conditions. As dewatering progresses and groundwater flow condition stabilize, suspended solids concentrations are expected to decrease as the system approaches steady-state conditions. Where required, groundwater removed during dewatering will be treated prior to discharge to manage suspended solids.

Discharge will be made up predominantly of the groundwater captured during trench dewatering activities as described in detail in subsequent subsections; surface water run off may also be intercepted during construction as discussed in Section 3.1.6.

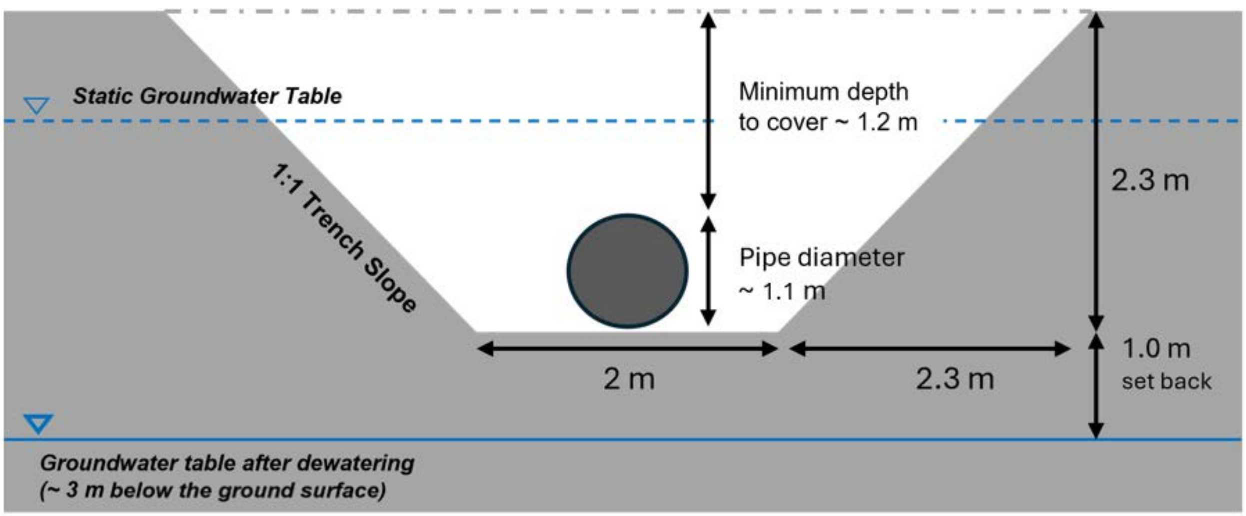
3.1.1 Construction Activities and Groundwater Management

Westcoast will complete pipeline installation using a combination of open cut trench and trenchless (boring) methods. Open cut trenching as described in Section 3.1.1.1 is planned for over 90% of the pipeline loop. Trenchless methods as described in Section 3.1.1.2 are typically restricted to railway crossings, road crossings, archeological sites, and major watercourse crossings.

3.1.1.1 Open Cut Trench Sections

Figure 3.1 illustrates the conceptual profile of an open cut trench section of mainline pipeline, which is the long pipeline lengths spanning kilometres between compressor stations, crossovers, and other specialized sections. The minimum open cut trench depth is determined by the design depth of pipeline cover, the pipe diameter, and work area clearance under the pipeline. For this Project, the trench invert depth to accommodate the pipeline installation will be a minimum of 3.0 mbgs to accommodate the 1,067 mm diameter pipe, using a minimum cover depth requirement of between 0.9 mbgs and 1.5 mbgs and a working area clearance minimum requirement of approximately 1.0 m below the pipeline to allow pipe fitting/coupling and to maintain a dry and firm excavation bottom.

Figure 3.1 Open Cut Trench Conceptual Profile



In contrast with mainline pipeline sections, a series of short (i.e., < 50 m) isolated excavations will be required along the pipeline loop alignment to accommodate the construction of site-specific pipeline design components, for pipeline crossovers, small surface water body crossings, and access shafts or bore bays to facilitate trenchless crossing works (see Section 3.1.1.2). At open-cut watercourse crossings, minimum trench depths of 3.4 mbgs are anticipated. At the Westcoast pipeline crossover (or private pipeline crossover), the new pipe will be installed below the existing line at an estimated depth of 4.5 mbgs.

As-built open cut trench depth will be ‘field fitted’ to actual ground surface conditions and may exceed the planned minimum trench depths.

For the purposes of the groundwater discharge analysis, open cut trench width was estimated assuming a flat bottom width of 2 m and a 1:1 average trench slope. Sheet piles resulting in a narrower excavation and vertical trench walls may also be used in places. Conversely the trench slope may also flatter depending on soil conditions. Where the trench depth is below the static groundwater table, the trench will need to be dewatered to remove groundwater inflow.

3.1.1.2 Trenchless Sections

The trenchless crossings will require an access shaft or bore bay on each side (for auger bores) or an entry pit (for direct steerable pipe thrusting [DSPT] installations) to advance the trenchless crossing equipment. It is assumed that each bore bay will have plan dimensions of 4 m by 30 m and a depth of 4 m. Dewatering of the bore bays is assumed to be required to a depth of approximately 4.5 mbgs.

While dewatering depth requirements for DSPT entry pits are typically less demanding than for auger bore access shafts or bore bays; for the purposes of groundwater discharge analysis, they have conservatively been considered equivalent. Maria Slough watercourse crossings are anticipated to use the DSPT crossing approach. Locations requiring bore crossings include Lougheed Highway and other roads (e.g., Peters Road, Cuthbert Road, Whelpton Road).

3.1.2 Groundwater Discharge Estimates

Groundwater inflow to trench excavations was estimated using an analytical solution for a long, narrow dewatering system as described by Powers et al. (2007). The trench was conceptualized as a linear excavation receiving groundwater inflow laterally along its length and radially at its ends. The method is based on the Dupuit-Forchheimer assumptions for unconfined, steady state flow in a homogeneous, isotropic aquifer. Groundwater inflow was calculated as a function of trench length (assumed to be 300 m for the purposes of this analysis), hydraulic conductivity, saturated thickness contributing to excavation inflow (i.e., the vertical distance between the static groundwater level and the trench invert), and an estimated radius of influence.

Calculated groundwater inflow rates are presented as the pumping discharge needed to maintain dewatered trench conditions (i.e., inflow is offset by pumping), and the values reported in this section correspond to the estimated peak discharge rate during excavation. Peak discharge generally occurs during the early stage of dewatering (e.g., first seven days), when water is released from aquifer storage as groundwater levels decline toward the base of excavation. After this period, discharge rates are expected to decrease by approximately 10%, as the short-term contribution from groundwater storage near the excavation declines and inflow approaches more stable conditions. The magnitude and duration of this reduction may vary depending on site-specific hydrogeologic conditions and boundary influences (e.g., proximity to surface water features).

Table 3.1 presents the estimated peak discharge rates for the mainline trench excavations (October 2024 to August 2025). These estimates were calculated using monthly manual groundwater level measurements representing pre-construction (pre-dewatering) conditions, obtained as part of the baseline groundwater monitoring program (Section 2.3.1.3).

Groundwater levels along the Agassiz Loop were typically below the trench invert depth (3.0 mbgs) throughout the monitoring period between September 2024 and December 2025. During the May to July 2025 period, groundwater levels rose above the trench invert in tandem with spring freshet period and the rising Fraser River stage level. Estimated peak discharge rates during this period were less than 231 L/s (Table 3.1).

Table 3.1 Estimated Peak Discharge Rates for Mainline Trench Excavations, October 2024 to August 2025

KP Range	Segment Length (m)	Peak Discharge Rate (L/s) for Active Segment Length										
		Oct-24	Nov-24	Dec-24	Jan-25	Feb-25	Mar-25	Apr-25	May-25	Jun-25	Jul-25	Aug-25
30.00 to 30.12	120	27	28	26	25	WL < Invert	25	26	22	22	WL < Invert	WL < Invert
30.13 to 30.27	140	29	30	28	27	WL < Invert	27	28	25	25	WL < Invert	WL < Invert
30.28 to 30.91	630	59	60	57	55	WL < Invert	56	58	54	54	WL < Invert	WL < Invert
30.94 to 31.17	230	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	77	WL < Invert	WL < Invert
31.70 to 32.69	990	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	104	WL < Invert	WL < Invert
32.71 to 33.03	320	No Data (Seabird Island) – Monitoring Well Not Installed until June 2025									WL < Invert	WL < Invert
33.09 to 33.84	750										WL < Invert	WL < Invert
33.89 to 36.34	2,450										WL < Invert	WL < Invert
36.55 to 38.02	1,470										231	WL < Invert
38.45 to 38.49	40	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	22	23	22	WL < Invert
38.52 to 38.75	230	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	86	89	86	WL < Invert
38.86 to 38.89	30	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	18	20	18	WL < Invert
38.92 to 40.28	1,360	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	108	112	108	WL < Invert
40.34 to 40.58	240	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	95	WL < Invert	WL < Invert
40.60 to 40.62	20	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	11	WL < Invert	WL < Invert
40.67 to 41.09	420	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	115	WL < Invert	WL < Invert
41.14 to 41.43	290	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	113	WL < Invert	WL < Invert
41.70 to 42.40	700	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	113	WL < Invert	WL < Invert
42.49 to 42.66	170	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	74	66	WL < Invert
42.74 to 43.19	440	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	116	109	WL < Invert
43.21 to 43.31	100	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	WL < Invert	43	39	WL < Invert
43.33 to 43.41	80	66	WL < Invert	WL < Invert	WL < Invert	No Data	WL < Invert	WL < Invert	76	94	74	WL < Invert

Notes:

KP = kilometre posting; m = metre; L/s = litres per second

'WL < Invert' indicates inflow not calculated, water level below the trench invert depth (3.0 mbgs)

Mainline trench peak discharge rates are estimated based on the active segment length (use 300 m for segments > 300 m). A trench width of 6.6 m and depth of 3.0 m were assumed.

A localized exception occurs between KP30 and KP30.91 (north of Seabird Island), where groundwater levels are persistently above the trench invert (October 2024 to January 2025, and March 2025 to June 2025). In this area, estimated peak discharge rates were less than 60 L/s (Table 3.1).

Limited data are available for the Seabird Island segments (KP32.71 to KP38.02), as monitoring wells were not installed until July 2025. July 2025 estimates indicate peak discharge rates of approximately 231 L/s between KP36.55 and KP38.02. Groundwater levels were below the trench invert between KP35.55 to KP38.02 in August 2025, and between KP32.71 and KP36.34 in July 2025 (Table 3.1).

Table 3.2 presents the range of estimated peak discharge rates isolated excavations, including pipeline crossovers, small surface water crossings, bore bays, and access shafts. For these excavations, groundwater levels were typically above the trench invert (3.4 to 4.5 mbgs) during the monitoring period (October 2024 to August 2025). Estimated peak discharge rates are generally less than 40 L/s, with higher rates of 54 L/s at the Cheam Slough crossing.

Table 3.2 Estimated Peak Discharge Rates for Isolated Trench Excavations, October 2024 to August 2025

KP Range	Excavation Name	Peak Discharge Rate (L/s)
30.12 to 30.13	Hicks Creek Crossing	3–5
30.27 to 30.28	Westcoast Crossover	4–7
30.91 to 30.94	Westcoast Crossover	8–12
31.14 to 31.17	Access Shaft (Maria Slough)	16–24
32.69 to 32.71	Westcoast Crossover	10
33.03 to 33.06	Bore Bay (Peters Road)	10–11
33.84 to 33.87	Bore Bay (Chief Hali Road)	6
36.34 to 36.37	Bore Bay (Lougheed Hwy)	10–15
38.45 to 38.48	Access Shaft (Maria Slough)	15–23
38.49 to 38.52	Westcoast Crossover	17–24
38.75 to 38.78	Bore Bay (Cuthbert Road)	15–23
38.89 to 38.92	Westcoast Crossover	17–24
40.28 to 40.31	Bore Bay (McDonald Road)	15–23
40.58 to 40.60	Westcoast Crossover	14–19
40.62 to 40.65	Bore Bay (Tranmer Road)	13–21
41.09 to 41.12	Bore Bay (Fraser Dyke)	13–21
41.43 to 41.46	Bore Bay (Apple Road)	13–21
42.40 to 42.43	Bore Bay (Bridge Road)	13–21
42.66 to 42.69	Bore Bay (Whelpton Road)	14–25
42.72 to 42.74	Private Pipeline Crossover	13–36
43.19 to 43.21	Westcoast Crossover	13–22
43.31 to 43.33	Cheam Slough Crossing	31–54

Note:
KP = kilometre post; L/s = litres per second

3.1.3 Dewatering Zone of Influence

The zone of influence (ZOI) represents the lateral extent of groundwater level decline caused by trench dewatering. It defines the horizontal distance from the excavation trenches over which measurable drawdown may occur (i.e., groundwater decline > 0.1 m). Within the ZOI, groundwater gradients are temporarily altered, and groundwater flows toward the dewatering system installed along the excavation (e.g., wellpoints or pumps). During pumping, drawdown is greatest at the centre of the excavation and decreases progressively with increasing distance away from the excavation.

The ZOI along the Agassiz Loop was estimated using the empirical Sichardt equation (Powers et al. 2007), based on the maximum anticipated drawdown required to lower groundwater below the trench invert and representative hydraulic conductivity values for the soil and subsurface units expected along the excavation profile. The maximum anticipated drawdown was defined as the difference between the highest manual groundwater level measurements and the trench invert elevation. A pilot dewatering testing program is planned for 2026 to better quantify the ZOI and improve understanding of site-specific groundwater responses to trench dewatering under field conditions.

Calculated maximum drawdown along the Agassiz Loop (at the excavation trenches) is summarized as follows:

- 0.1 to 1.5 m for mainline trench sections; and
- 0.1 to 2.5 m for deeper, isolated excavations associated with surface water crossings, pipeline crossings, bore bays, and access shafts

The estimated ZOI along the Agassiz Loop range from 8 to 147 m for mainline trench sections and from 8 to 176 m for deeper, isolated excavations. Although the extent of groundwater drawdown may vary locally depending on hydrogeologic conditions and proximity to hydraulic boundaries (e.g., surface water features), the maximum estimated ZOI distances (rounded to the nearest 10 m) are adopted for conservatism when assessing potential interactions with nearby receptors (150 m for mainline pipeline trench sections and 180 m for deeper, isolated excavations). Figures in Appendix K presents the ZOI adopted for the Agassiz loop.

3.1.3.1 Groundwater Users Within the Estimated ZOI

In total, 27 well users are located within the ZOI extent of the Agassiz loop. Reported use include Private Domestic (13 of 27), Commercial and Industrial (3 of 27), Irrigation (5 of 27), Water Supply systems (2 of 27), and unknown or not applicable (8 of 27; Table 3.3). Three wells within the estimated ZOI hold active groundwater licenses (Table 3.3). Licensed groundwater users include:

- Well Tag No. 114999 (Livestock & Animal); withdrawal quantity of 4,020 m^3/yr
- Well Tag No. 72157 (Industrial Waste Management); withdrawal quantity of 33,237 m^3/yr
- Well Tag No. 87903 (Industrial Waste Management); withdrawal quantity of 33,237 m^3/yr

Table 3.3 Well Users within the Estimated ZOI

Well Tag Number	Usage	License Status	Distance from Excavation[1] (m)	Finishing Well Depth (mbgs)
120321	Commercial and Industrial	Unlicensed	75	10.7
55862	Private Domestic	Unlicensed	130	19.0
116299	Unknown Well Use	Unlicensed	91	35.1
126350	Private Domestic	Unlicensed	87	10.7
94159	Private Domestic	Unlicensed	68	29.3
114999	Private Domestic	Licensed	41	11.3
112390	Unknown Well Use	Unlicensed	41	9.1
117085	Irrigation	Unlicensed	51	16.8
108455	Unknown Well Use	Unlicensed	90	19.5
101234	Commercial and Industrial	Unlicensed	99	Not Reported
72157	Not Applicable	Licensed	130	11.6
107135	Private Domestic	Unlicensed	91	16.6
87903	Water Supply System	Licensed	168	23.8
122943	Irrigation	Unlicensed	107	17.1
124041	Unknown Well Use	Unlicensed	133	23.2
72500	Unknown Well Use	Unlicensed	138	19.5
99799	Private Domestic	Unlicensed	145	28.7
849	Private Domestic	Unlicensed	85	11.9
122410	Private Domestic	Unlicensed	162	12.2
119214	Irrigation	Unlicensed	52	16.8
119766 (Closed)	Water Supply System	Unlicensed	106	Not Reported
56342	Private Domestic	Unlicensed	43	15.8
47759	Unknown Well Use	Unlicensed	178	11.9
94948	Unknown Well Use	Unlicensed	123	21.3
116156	Irrigation	Unlicensed	160	21.6
112811	Private Domestic	Unlicensed	151	10.7
115057	Irrigation	Unlicensed	132	19.7

Notes:

"m" = metres; "mbgs" = metres below ground surface

Information obtained from GWELLS database (GOBC 2025b)

[1] Well location not surveyed, exact distance from the excavation to be confirmed

Current groundwater license applications include Well Tag No. 117085 (application number 20023275), for private irrigation purposes.

One public use water provider is located within the ZOI. This facility is the Agassiz Wastewater Treatment Plant, located at 1088 Tranmer Road (134 m to the ROW).

3.1.3.2 Surface Water Users Within the Estimated ZOI

Two surface water licenses associated with Maria Slough are located within the ZOI along the Agassiz loop (Appendix K). These include License No. F041025 (private irrigation) located north of Seabird Island with a withdrawal quantity of 71541.84 m^3/yr, and License No. C057491 (private irrigation), located south of Seabird Island, which is currently inactive (abandoned).

3.1.4 Backfilled Excavations

Backfilling the pipeline trench along the pipeline loop is not expected to result in measurable or long-term changes to local groundwater flow or groundwater use. The trench will be backfilled following construction using native material placed in compacted lifts, matching pre-construction stratigraphy to the extent practicable. This approach limits the potential for the trench to either act as a preferential pathway for groundwater flow or to create hydraulic barriers.

Groundwater levels along the pipeline loop alignment are strongly controlled by regional conditions, and accordingly, temporary excavations (e.g., 6.6 m x 300 m trenches) are not expected to alter these broader hydraulic drivers. No changes to groundwater availability, flow direction, or user access are anticipated once the trench is backfilled.

3.1.5 Pipe Materials

Installation of the pipe involves trenching and lowering the pipeline into the trench. The pipe will only carry natural gas after 1) the dewatering of the trench during construction has concluded; 2) the pipe has been tested; and 3) natural gas transmission begins (Figure 1.4).

Pipe segments used during construction will arrive on site coated with Fusion Bond Epoxy. Additionally, pipe segments that are designated for bores, or trenchless crossings, will arrive on site with an additional layer of abrasive resistant coating to prevent potential damage from surrounding substrate (including gravel and bedrock) when the welded pipe section is pulled through the trenchless crossing bore during installation. The Fusion Bond Epoxy coating system is a thermosetting resin, applied in the form of a dry powder at thicknesses of 400–600 microns onto the heated surface of the steel. Once applied and cured, the epoxy film exhibits an extremely hard surface with excellent adhesion to the steel surface. Fusion Bond Epoxy is applied at the coating facility and not on the construction site. Consequently, no chemical interactions with groundwater are anticipated from the typical pipe coating.

Pipe segments are welded together, and these joints need to have a coating added to prevent corrosion. Field joint coating (i.e., the only coating applied in the field) is expected to be stabilized (chemically inert) in a matter of hours. Westcoast's approach to applying coating and mitigating potential effects during the field joint coating process is described in the Environmental Protection Plan (EPP; Appendix M) as follows:

- Place tarps, drip trays, or other impermeable material on the ground to catch drippings and overspray for spray or paint-on coating application at weld joints and areas where repairs to the coating are made. Dispose of spilled coating at an approved waste disposal facility. [PLC-15]
- Do not perform concrete coating activities near a watercourse or wetland unless suitable isolation from surface drainage and the water body is in place. [WCX-68]

The potential for coating to enter the receiving environment from trench dewatering is unlikely as coating does not take place with water present in the trench. As has been discussed in Section 1.6, the goal during construction will be to keep the open cut trench free from accumulations of water while pipe installation activities are occurring. Given the necessary dry conditions for pipe installation, and coating, Westcoast does not expect to have an interaction between uncured coating material and groundwater or surface water.

During application and storage, in the unlikely event that field coating material is released on unprotected ground, the coating and any impacted soils would be cleaned up as part of the Fuels and Hazardous Material Spill Contingency Plan (Section C6 of the Pipeline EPP; also see Section 3.5.3).

3.1.6 Stormwater Discharge Estimates

It is anticipated that most of the water discharge will be related to groundwater intercepted from the pipeline trench; however, it will also include rain falling directly into the pipeline trench during precipitation events. The climate setting, seasonal precipitation trends, and anticipated precipitation volumes associated with extreme rainfall events are discussed in detail in Section 2.1.2 and summarized as follows:

- Generally, the climate in the area can be described as humid, and precipitation exceeds potential evapotranspiration.
- There is a distinct seasonality with respect to precipitation and evapotranspiration that results in wet falls and winters (70% of annual precipitation typically occurs between October and March) and relatively dry springs and summers (30% of annual precipitation occurs between April and September).

Pipeline construction activities are planned to avoid the wetter months, which is anticipated to help limit the amount of precipitation and surface water runoff that will be intercepted. Stormwater, and the potential for erosion and sediment issues will be managed through typical pipeline construction mitigation measures and the Project's EPP (see Section 3.5), as will overland flow resulting from precipitation falling in the construction area, but outside of the construction trench.

The Intensity-Duration-Frequency data presented in Section 2.1.2.1.2 indicate the amount of precipitation estimated to fall in 24 hours for a specific return period and can be used to estimate the amount of stormwater that would need to be pumped out of the pipeline trench excavation. The estimated volume of stormwater to be pumped out of the trench associated with each precipitation amount shown in Section 2.1.2.1.2 is presented in Table 3.4 for a 300 m long section of trench.

Table 3.4 Estimated Stormwater Volume to be Pumped Out of 300 m of Trench for the Agassiz Loop Area

Duration	**Volume (cubic metres)**	
	5-Year Return Period	**100-Year Return Period**
5 min	14	32
10 min	19	43
15 min	22	47
30 min	27	54
1 hour	32	57
2 hours	44	69
6 hours	79	111
12 hours	120	168
24 hours	182	276

3.1.7 Discharge Collection and Release

Stormwater and groundwater intercepted during trench dewatering will be collected along the pipeline footprint. Groundwater will be extracted through wellpoint systems (Figure 1.5) or pumps installed along sections where excavation extends below the water table. Extracted groundwater will be conveyed through above-ground temporary piping (e.g., high-density polyethylene pipe or lay-flat hose).

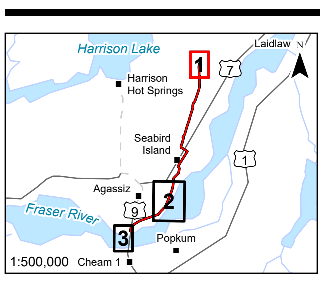
The collected water released to surface water will undergo water treatment prior to discharge. Treatment may include a combination of sediment removal, clarification, filtration, and aeration/oxidation to address turbidity and naturally elevated metal concentrations depending on the groundwater quality and the site-specific discharge water quality requirements (Section 3.3.2).

Where dewatering rates and ground conditions are favourable, discharge to ground will be employed. Where dewatering rates exceed infiltration capacity for controlled discharge to ground, the excess dewatering discharge will be directed to a PDL. It is anticipated that surface water discharge to the PDLs will remain the primary method due to the modelled groundwater inflow rates. A pilot dewatering testing program is planned for 2026 to assess the feasibility of the discharge to ground-option, including monitoring infiltration capacity and potential groundwater mounding effects.

Four PDLs are being considered for the Agassiz Loop (Figure 3.2). Three of these PDLs (PDL-A1, PDL-A8, PDL-SBI9) would discharge directly to the Fraser River, which has a large receiving capacity (Section 3.2.2). PDL-A6 is Hicks Creek, which has a limited receiving capacity and would be used in combination or as a back-up to the Fraser River PDLs for low volume discharges (Section 3.2.2).

Treated water will be routed from the water treatment units to the designated PDLs through temporary piping and will be discharged through stabilized outfalls with erosion protection and flow dissipation measures to avoid scour and habitat disturbance. Two approaches Westcoast is currently considering for controlling the release of water discharge into the PDLs includes an instream floating discharge structure consisting of a perforated pipe discharging water directly into the receiving water body. A second approach involves the use of a perforated pipe placed at the top of a bank and releasing water down the bank slope over an impermeable liner. Both approaches are focused on reducing potential localised erosion associated with the discharge structure while also avoiding disturbance of the channel bed and banks.

Designs for the discharge structure to be used at each PDL are currently being developed. Westcoast is applying for an extent of 250 m for placing the discharge structure at each PDL (Figure 3.2) to: 1) limit the impact on existing vegetation at the top of bank of each PDL; 2) allow adequate operating space for each discharge structure (which could extend up to approximately 50 m in linear length); and 3) allow room to relocate a discharge structure if monitoring indicates there is a need to, modify, enhance, or relocate mitigation measures at a particular location (see Section 3.4).



Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

- Flow Direction
- Transmission Line
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- Proposed Discharge Location (PDL) Buffer (~250 m)

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

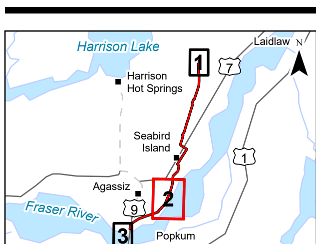
NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
3.2

Title
Site Plan

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\site_plan\fig_123317055_sep_tar_site_plan.aprx Revised: 2026-04-30 By: jpoucher



- Flow Direction
- Railway
- Transmission Line
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- Proposed Discharge Location (PDL) Buffer (~250 m)

0 80 160 240 320 m
1:8,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

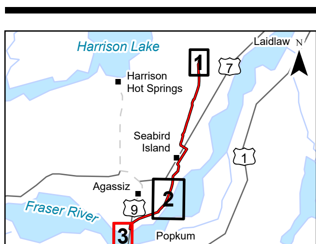
NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
3.2

Title
Site Plan

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\site_plan\fig_123317055_sep_tar_site_plan.aprx Revised: 2026-04-30 By: jpoucher



Flow Direction
Railway
Watercourse
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace
Proposed Discharge Location (PDL) Buffer (~250 m)

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
3.2

Title
Site Plan

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\site_plan\fig_123317055_sep_tar_site_plan.aprx Revised: 2026-04-30 By: jpoucher

3.1.8 Proposed Approach to Treatment

Westcoast engaged Stantec to prepare a Best Achievable Technology (BAT) assessment to evaluate treatment technologies for treating the groundwater encountered during trench dewatering (see Appendix L). The BAT assessment was prepared in accordance with provincial guidance (BC MECCS 2021b) and is based on the groundwater quality from the monitoring wells as discussed in Section 2.3.2.3. The purpose of the BAT assessment was to evaluate and recommend site-specific, feasible, and effective water treatment technologies for managing groundwater during construction.

Four treatment categories were evaluated:

1. bulk removal of TSS
2. metals removal
3. nitrogen species removal
4. removal for trace constituents (i.e., low level concentrations of residual constituents).

Several technologies were reviewed for each category, which were then evaluated in scoring tables using established evaluation criteria, as outlined by the provincial guidance (BC MECCS 2021b); the evaluation criteria are feasibility, reliability, control-effectiveness, environmental impacts, and cost-effectiveness. The BAT assessment summarizes the technologies that are demonstrated to be best suited for the pipeline dewatering activities. Use of flocculants is discussed for the bulk removal of TSS treatment category. By-product production and management is discussed for the four treatment categories, as applicable.

Several treatment scenarios were prepared ranging from least complex, where only one or two treatment categories are implemented to the most complex where all mentioned treatment categories are implemented. The treatment process can be modified for different inlet characteristics or discharge standards.

Based on the outcome of the technology screening, it is anticipated that one or more water treatment units with an appropriate treatment process will be established to address relevant constituent types by integrating the most suitable technologies. The specific technologies and layout of the water treatment units are still under consideration and will be selected with reference to the possible technologies recommended as part of the BAT assessment (Appendix L). It is likely that different technologies will be used throughout construction to manage changes in groundwater quantity (e.g., technologies will be adapted to volumes that need to be treated). The selected contractors/vendors will also be responsible for developing and implementing commissioning processes prior to construction that demonstrate their system is consistently treating water as required to meet the applicable water quality guidelines. Westcoast is in the process of developing a pilot test of water treatment systems in mid-2026 to support this pre-construction planning. Results of the pilot test will evaluate and support confirmation of treatment capacity, retention times, by-product production, management requirements, and input and output of water quantity and quality.

3.2 Discharge Quantity

This section provides a summary of dewatering rates and describes the PDL receiving capacity assessment results as they pertain to discharge quantity for the Agassiz Loop.

3.2.1 Summary of Dewatering Rates

Dewatering rates and the need for dewatering is expected to vary along the pipeline loop. A detailed range of predicted inflow rates in specific areas has been developed based on the groundwater monitoring program as discussed in Sections 2.3.2.2. A summary of the dewatering requirements is provided as follows:

- Mainline trench dewatering along the northern 0.9 km segment (KP30.0 to KP30.94) is estimated at up to 104 L/s. Short, isolated excavations (crossovers and bore bays) are expected to require dewatering of generally less than 40 L/s, with a maximum of 54 L/s at the Cheam Slough crossing.
- From KP30.94 to KP43.41, groundwater levels are generally below the trench invert of the mainline trench sections. Dewatering may be required under higher groundwater conditions (e.g., May to July), with estimated rates generally less than 140 L/s (up to 231 L/s south of Seabird Island).
- Groundwater recharge from precipitation to the open cut trench footprint is estimated at 3,791 m^3/yr (0.12 L/s) per 300 m trench segment (Section 2.3.2.2.4). This represents a minor inflow compared to groundwater dewatering rates but may still require management during excavation.
- A wellpoint system is currently anticipated; however, alternative methods may also be suitable depending on site-specific conditions.

Regardless of the trench dewatering volumes, Westcoast is not proposing to discharge beyond the receiving capacity of a given PDL, as discussed in Section 3.2.2.

3.2.2 PDL Receiving Capacity Assessment

The monthly receiving capacity of each PDL was selected to be no more than 10% of the estimated monthly flows shown in Section 2.2.2.2. These limits were selected on the basis that, for a natural waterbody, a 10% change is typically considered the limit for not having adverse effects on aquatic habitat. As a result of this approach, the maximum receiving capacity of each PDL can vary significantly throughout a calendar year. Based on this approach, the monthly maximum receiving capacities, defined as 10% mean monthly flows, for the PDLs located in the Agassiz Loop are presented in Table 3.5.

Table 3.5 Monthly Maximum Receiving Capacity for the Agassiz Loop Proposed Discharge Locations

PDL		**Monthly Maximum Receiving Capacity[1] (m^3/s)**											
Number	**Watercourse**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
PDL-A1	Fraser River	95.50	89.88	90.04	188.3	501.5	700.5	551.9	346.7	231.7	192.8	163.7	113.5
PDL-A6	Hicks Creek	0.035	0.028	0.029	0.041	0.081	0.107	0.092	0.062	0.043	0.048	0.054	0.033
PDL-A8	Fraser River	95.50	89.88	90.04	188.3	501.5	700.5	551.9	346.7	231.7	192.8	163.7	113.5
PDL-SBI9	Fraser River	95.50	89.88	90.04	188.3	501.5	700.5	551.9	346.7	231.7	192.8	163.7	113.5

Notes:

[1] 10%% of mean monthly flow

PDL = Proposed Discharge Location; m^3/s = cubic metres per second

Based on the numbers shown in Table 3.5, the maximum proposed discharge rate (at any point of a calendar year) for each PDL is presented in Table 3.6, while the proposed monthly discharge rate is included in Table 3.7.

Table 3.6 Proposed Maximum Discharge for the Agassiz Loop Proposed Discharge Locations

Proposed Discharge Location Name	**Watercourse**	**Maximum Proposed Discharge Rate**	**Discharge Use**
PDL-A1	Fraser River	0.284 m^3/s	Location could be a single discharge location for entire loop or back-up/secondary discharge option
PDL-A6	Hicks Creek	0.050 m^3/s	Back-up/secondary discharge
PDL-A8	Fraser River	0.284 m^3/s	Both locations could be a single discharge location for entire loop or back-up/secondary discharge option
PDL- SBI9	Fraser River	0.284 m^3/s	

Notes:

PDL = Proposed Discharge Location; m^3/s = cubic metres per second

Table 3.7 Monthly Proposed Discharge Rates for the Agassiz Loop Proposed Discharge Locations

PDL		**Monthly Proposed Discharge Rates (m^3/s)**											
Number	**Watercourse**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
PDL-A1	Fraser River	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284
PDL-A6	Hicks Creek	0.013	0.013	0.013	0.013	0.050	0.050	0.050	0.05	0.013	0.013	0.013	0.013
PDL-A8	Fraser River	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284
PDL-SBI9	Fraser River	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284	0.284

Notes:

PDL = Proposed Discharge Location; m3/s = cubic metres per second

The dilution rate at each PDL is defined as the ratio between the monthly flow in the waterbody and the proposed maximum discharge rate for a specific month, the dilution factors for each PDL are shown in Table 3.8.

Table 3.8 Dilution Factors for the Agassiz Loop Proposed Discharge Locations

PDL		**Monthly Dilution Rate**
Number	**Watercourse**	
PDL-A1	Fraser River	3,100:1 or higher year-round
PDL-A6	Hicks Creek	10:1 year-round
PDL-A8	Fraser River	3,100:1 or higher year-round
PDL-SBI9	Fraser River	3,100:1 or higher year-round

Note:

PDL = Proposed Discharge Location

3.3 Discharge Quality

This section provides the methods and results as they pertain to proposed discharge quality criteria for the pipeline loop. Specifically, the methods describe the development of discharge quality criteria (DQCs); the use of the 95th percentile (95P) for the groundwater and background surface water quality; the development of 95P statistics; and the surface water quality seasonal comparison analysis. The results identify the parameters of potential concern (POPCs) and POCs and the proposed DQCs for POCs (i.e., metals, anions, nutrients) and standard general parameters (i.e., TSS, pH, DO, and water temperature).

For clarity on how background conditions are applied in this section, background surface water quality is treated as an acceptable representation of existing ambient conditions for the purpose of evaluating Project-related change, with the assessment focused on preventing measurable degradation beyond existing variability rather than on requiring improvement relative to background concentrations.

3.3.1 Methods

3.3.1.1 Development of Discharge Quality Criteria

In this application, DQCs are defined as parameter- and site-specific numeric concentrations developed for effluent discharges and proposed for inclusion as discharge limits in the Section 15 Approval. DQCs represent end-of-pipe discharge concentrations during routine dewatering operations that form the basis for evaluating discharge quality compliance.

This section describes the stepwise process (Steps 1 to 3) used to identify parameters requiring DQCs and to determine which parameters were carried forward for assessment of potential effects on the receiving environment (Section 4). The approach follows the Parameters of Concern Factsheet (Defining Parameters of Concern for Effluent Discharge Authorization Applications; BC MECCS 2024a) and integrates guideline-based screening, background receiving-environment conditions, and the intended role of DQCs as Section 15 Approval discharge limits. Steps 1 to 3 are summarized in Figure 3.3 and described as follows:

- **Step 1**: Measured groundwater concentrations were initially screened against applicable chronic or acute WQG-FAL and water quality objectives (WQO), as appropriate for the receiving environment and parameter. For each parameter, the 95P groundwater concentration was compared to the applicable guideline value.

  Parameters for which the 95P groundwater concentration exceeded 80% of the applicable guideline were identified as POPCs and carried forward for further evaluation. Parameters with 95P groundwater concentrations less than or equal to 80% of the applicable WQG-FAL or WQO were not carried forward.

This step was conservatively included to identify parameters approaching applicable thresholds that warrant consideration prior to determining the need for discharge quality criteria. Identification of POPCs supports transparency in the screening process and documents the rationale for excluding parameters from further consideration where appropriate.

- **Step 2**: POPCs were further evaluated to identify POCs. For each POPC, the 95P groundwater concentration was compared to 100% of the applicable chronic or acute WQG-FAL or WQO.

  Parameters for which the 95P groundwater concentration exceeded the applicable guideline were identified as POCs. Parameters that did not exceed the guideline were not carried forward for the development of DQCs or effects assessment.

  Due to their bioaccumulation and biomagnification potential, selenium and mercury are carried forward to the effects assessment (Section 4) as POCs regardless of whether they exceed the WQG-FAL (BC MECCS 2024a). However, development of DQCs for these parameters follows the same decision logic as for other parameters. Accordingly, if the 95P of groundwater quality does not exceed the applicable WQG-FAL, a DQC is not proposed.

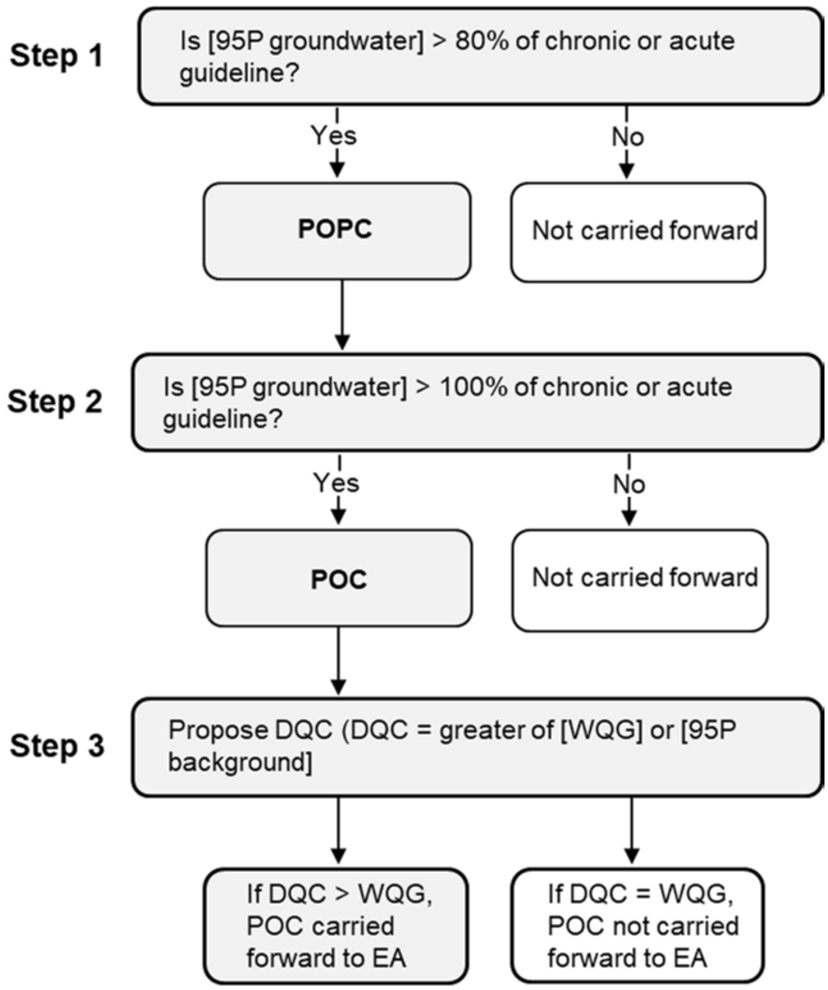
- **Step 3**: DQCs were developed for the POCs as numeric values proposed for inclusion as Section 15 approval discharge limits. For each POC, the DQC was established as the greater of:
  - the applicable WQG-FAL or WQO, or
  - the 95P of the background receiving environment surface water concentration.

This approach aligns proposed DQCs with natural background conditions where background concentrations exceed guideline values and with applicable WQG-FAL and WQO values where background concentrations are lower. Note that standard general parameters (TSS, turbidity, pH, DO, and temperature) were automatically carried forward for the development of DQC, as described in Section 3.3.2.2.2.

An exception to the general DQCs derivation approach was applied for the Fraser River. Discharges to the Fraser River will occur within an initial dilution zone (IDZ; Section 3.4) where mixing occurs within the immediate receiving environment. As a result, DQCs for the Fraser River were based on applicable acute WQG-FAL where such guidelines exist, recognizing that exceedances of chronic WQG-FAL may occur within the IDZ. Following initial mixing, discharge concentrations are anticipated to remain well below the chronic WQG-FAL at the edge of the IDZ, reflecting the substantial assimilative capacity of the Fraser River.

The use of background concentrations as DQCs where background levels exceed guideline values is consistent with provincial policy for the development of site-specific water quality objectives, which allows the upper range of natural background concentrations to be adopted where generic guideline values are not representative of ambient conditions (BC MOE 2013). This approach recognizes that discharge criteria are intended to manage incremental changes attributable to Project-related discharges, rather than to require reductions below existing background water quality conditions.

Figure 3.3 Stepwise Approach for the Identification of Parameters of Concern and the Development of Proposed Discharge Quality Criteria per BC ENV Guidance (BC MECCS 2024a)



The approach used to apply and calculate variable WQG-FAL (i.e., WQG-FAL dependent on TMFs such as pH, water hardness, and dissolved organic carbon) for identifying POPCs and POCs followed the methods described in Section 2.3.1.5. The use of the 95P for characterizing groundwater quality and background surface water quality is discussed in Sections 3.3.1.2 and 3.3.1.3, respectively.
The development of the 95P for water quality data containing censored data (i.e., results below the detection limit) is described in Section 3.3.1.4.

3.3.1.2 Use of 95th Percentile for Groundwater Quality

The 95P of groundwater concentrations was used to screen potential discharge quality against WQG-FAL or Water Quality Objectives (WQOs). Although the pipeline loop area is not a contaminated site and is not subject to the BC Contaminated Sites Regulation, the statistical rationale provided in Protocol 9 is directly applicable (BC MECCS 2023a). Protocol 9 specifies that representative upper-bound groundwater concentrations should be characterized using the 95P rather than the maximum because maximum values often reflect anomalous or non-representative events. While developed for contaminated sites, this guidance articulates a widely accepted statistical principle in environmental assessment—that upper-percentile metrics provide a more stable and representative high-end estimate of groundwater quality than maxima. Accordingly, use of the 95P draws on this conceptual foundation and provides a scientifically defensible basis for comparing groundwater quality to aquatic life guidelines and objectives.

This approach aligns with established environmental statistical practice; Helsel (2012) demonstrates that percentiles derived using censored-data methods (e.g., ROS, KM, see Section 3.3.1.4) are the appropriate statistics for censored datasets, whereas maximum values are statistically unstable and tend to be dominated by outliers or sampling artefacts. This approach is also consistent with United States EPA guidance, which recommends using upper-percentile or upper confidence-bound statistics—not maxima—for environmental comparisons and decision-making (U.S. EPA 2002, 2009). Accordingly, use of the 95P provides a scientifically defensible, regulator-aligned estimate of realistic high-end groundwater quality for screening against aquatic life guidelines.

3.3.1.3 Use of 95th Percentile for Background Surface Water Quality

When evaluating whether potential discharge (groundwater) concentrations may exceed not only provincial water quality guidelines but also existing background conditions in the receiving environment, the 95P of background surface-water quality was used as the comparison value. This approach is consistent with BC MOE (2013), which explicitly defines the upper limit of natural background concentrations as the 95P of relevant data.

The 95P provides a realistic representation of the upper portion of natural variability in receiving waters—variability that can arise from seasonal hydrology, geochemical conditions, and inter-annual fluctuations. In contrast, maxima tend to be statistically unstable and overly influenced by rare events, a point emphasized in environmental statistical literature (Helsel 2012) and United States EPA guidance, which recommends using upper percentiles or upper-confidence-bound statistics—not maxima—for environmental comparisons and/or background characterization (U.S. EPA 2002, 2015).

The use of the 95P to characterize the upper range of background conditions is well supported in CCME (2007) and BC MOE (2013), which identify upper-percentile statistics as appropriate for defining background ‘thresholds’ and for deriving background-based water quality objectives. Collectively, these considerations support the use of the 95P as a regulator aligned and scientifically defensible benchmark for comparing groundwater concentrations with the upper range of observed background conditions. For Hicks Creek, the 90th percentile (90P) was used instead of the 95P due to the smaller number of background samples, which limited the reliability of higher-order percentile estimates.

3.3.1.4 Development of 95th Percentile Statistics

The 95P values were calculated using statistical methods developed specifically for censored environmental datasets—those containing results reported below analytical detection limits. To account for censored data, the 95P values were developed using the NADA2 package in R (Lee 2025; Helsel and Lee 2025). Importantly, the statistical approaches used to calculate the 95P do not require assuming a global distribution (e.g., normal or lognormal); Regression on Order Statistics (ROS) relies only on a linear relationship between detected values and their probability plotting positions.

When detection limits vary or when censored values dominate the dataset, the R workflow applies a structured hierarchy consistent with best practice recommendations (Antweiler and Taylor 2008; Helsel 2012; BC MWLRS 2026). First, the workflow hierarchy uses two established approaches from the censored-data literature: ROS and the Kaplan–Meier (KM) estimator (Antweiler and Taylor 2008; Helsel 2012). ROS is applied only when ≥20% of the observations for a single parameter are detected, so that the regression model is sufficiently anchored by observed values; this criterion is consistent with guidance presented in Helsel (2012) and the NADA2 documentation. When the detect-frequency criterion is met, ROS fits a regression between detected concentrations and their plotting-position normal scores, then uses this model to estimate censored values (Lee and Helsel 2005). When more than 80% of values are below the detection limit for a given parameter, the workflow instead uses the non-parametric KM estimator, which constructs an empirical survival curve incorporating censored observations without imposing distributional assumptions (Antweiler and Taylor 2008; Helsel 2012). In both approaches, the 95P is obtained directly from the resulting empirical or semi-parametric distribution, and at no point is a normal or lognormal distribution assumed.

If either the ROS or KM methods failed—due to extreme censoring or an unstable model fit—a modeled 95th upper confidence limit (UCL95) was used instead. Following recommended practices for uncertainty estimation in censored datasets (Helsel 2012), a bootstrap approach was used to repeatedly resample the dataset (400 times) and calculate 95P estimates. For each bootstrap resample, the same censored-data method used in the primary analysis (i.e., ROS via the NADA2 package when ≥20% of values were detected, or the KM estimator via NADA2 when <20% were detected) was applied to generate a bootstrap 95P. The UCL95 was then defined as the 95P of this distribution of bootstrap-derived 95P values. If the bootstrap replicates fail the ROS or KM criteria and no valid UCL95 is obtained, a fallback estimate of the 95P is calculated as the 95P of the detection limits, capped at the maximum observed value (i.e., the ‘DL-proxy’). Therefore, the final reported 95P value follows a transparent hierarchy: modeled 95P (ROS or KM) → UCL95 → DL-proxy, such that the selected estimate is both statistically defensible and reproducible.

The same analytical framework and censored-data methods were applied to Fraser River and Hicks Creek. However, due to the smaller number of observations for Hicks Creek (n = 14), the 90P was calculated for Hicks Creek instead of the 95P, to serve as a more conservative summary statistic.

3.3.1.4.1 Seasonal Comparison Analysis

Seasonal differences in surface water quality were evaluated to determine whether concentrations from the drier months (April to October) differed from those observed November to March. This grouping was selected to reflect likely operational discharge conditions rather than climatological seasons; therefore, the analysis assesses differences between periods when discharge is more likely and the rest of the year.

For each discharge location and POC, concentrations from the two periods were compared using a Wilcoxon rank-sum test (Mann-Whitney U test). This non-parametric test was selected because water quality data commonly exhibit skewed distributions, unequal sample sizes between periods, and values below the analytical detection limit. The test evaluates whether concentrations measured during the discharge period tend to be systematically higher or lower than those observed during the non-discharge period, based on the relative ranking of observations. Statistical tests were conducted only where both periods contained a minimum of five observations (n = 5), to provide adequate representation of each period and to reduce uncertainty associated with small sample sizes. Statistical significance was evaluated at $\alpha = 0.05$, and p-values were used to determine whether differences between periods were statistically significant.

The outcome of the seasonal comparison was used to guide the calculation of percentiles (e.g., 95P) for the development of DQCs based on background concentrations (see Step 3). Where a statistically significant difference between periods was identified ($p < 0.05$) and concentrations during the proposed discharge period (April–October) were lower than those observed during the potential non-discharge period, the percentile was calculated using discharge-period (i.e., lower concentration) data only, consistent with the period of potential Project influence. Where no statistically significant difference was detected ($p \geq 0.05$), data from all available months were combined to increase sample size and improve the robustness of the percentile estimate. This approach informs the selection of percentiles that are representative of operational conditions, while avoiding unnecessary restriction of the dataset where differences between periods are not evident.

3.3.2 Results

3.3.2.1 Parameters of Potential Concern and Parameters of Concern

The parameters identified as POPCs (Step 1, based on screening against 80% of the corresponding WQG-FAL) and POCs (Step 2, based on screening against 100% of the corresponding WQG-FAL) in groundwater are summarized in Table 3.9 for the Fraser River and Table 3.10 for Hicks Creek. In addition, standard general parameters (TSS, turbidity, pH, DO, temperature, and hydrocarbons) were automatically carried forward for the development of DQC, as described in Section 3.3.2.2.

Table 3.9 Parameters of Potential Concern (Step 1) and Parameters of Concern (Step 2) for Discharges to Fraser River Initial Dilution Zone

Parameter	95P Groundwater (mg/L)	80% WQG-FAL (mg/L)		Step1: POPC?	100% WQG-FAL (mg/L)		Step 2: POC?
		Chronic	Acute		Chronic	Acute	
Ammonia (as N)	0.587	0.723	3.59	-	0.904	4.49	-
Chloride	18	120	480	-	150	600	-
Fluoride	0.095	0.096	0.872	-	0.12	1.09	-
Nitrate (as N)	31.6	2.4	26.2	Yes	3	32.8	Yes
Nitrite (as N)	0.226	0.016	0.048	Yes	0.02	0.06	Yes
Sulphate	40	174	-	-	218	-	-
Aluminum (T)	0.636	0.134	-	Yes	0.167	-	Yes
Antimony (T)	0.0005	0.0592	0.2	-	0.074	0.25	-
Arsenic (T)	0.00142	0.004	-	-	0.005	-	-
Barium (T)	0.126	0.8	-	-	1	-	-
Beryllium (T)	0.0001	0.000104	-	-	0.00013	-	-
Boron (T)	0.05	0.96	0.232	-	1.2	0.29	-
Chromium (T)	0.001	0.002	-	-	0.0025	-	-
Iron (T)	1.73	0.24	0.8	Yes	0.3	1	Yes
Mercury (T)	0.00000524	0.000001	-	Yes	0.00000125	-	Yes
Molybdenum (T)	0.00853	6.08	36.8	-	7.6	46	-
Selenium (T)	0.00156	0.0016	-	Yes*	0.002	-	Yes*
Silver (T)	0.00002	0.000096	-	-	0.00012	-	-
Thallium (T)	0.0000317	0.00064	-	-	0.0008	-	-
Uranium (T)	0.00107	0.006	0.0132	-	0.0075	0.0165	-
Vanadium (T)	0.005	0.048	-	-	0.06	-	-

Parameter	95P Groundwater (mg/L)	80% WQG-FAL (mg/L)		Step1: POPC?	100% WQG-FAL (mg/L)		Step 2: POC?
		Chronic	Acute		Chronic	Acute	
Cadmium (D)	0.000386	0.000111	0.00025	Yes	0.000139	0.000312	Yes
Cobalt (D)	0.00281	0.000322	-	Yes	0.000402	-	Yes
Copper (D)	0.00242	0.00056	0.00048	Yes	0.0007	0.0006	Yes
Iron (D)	1.65	-	0.28	Yes	-	0.35	Yes
Lead (D)	0.0002	0.00223	-	-	0.00279	-	-
Manganese (D)	2.92	0.256	-	Yes	0.32	-	Yes
Nickel (D)	0.0155	0.00088	0.0134	Yes	0.0011	0.0167	Yes
Strontium (D)	0.348	1	-	-	1.25	-	-
Zinc (D)	0.005	0.00467	0.0221	Yes	0.00584	0.0276	-

Notes:

95P = 95th percentile; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; N = nitrogen, T = total, D = Dissolved

POPC = Parameter of Potential Concern; POC = Parameter of Concern

Grey shading = identified POPC or POC

Asterisk: Identified as a POPC and POC due to bioaccumulation potential rather than 95P concentration in groundwater per BC ENV guidance (BC MECCS 2024a).

Table 3.10 Identified Parameters of Potential Concern and Parameters of Concern for Groundwater Discharging to Hicks Creek

Parameter	95P Groundwater (mg/L)	80% WQG-FAL (mg/L)		Step1: POPC?	100% WQG-FAL (mg/L)		Step 2: POC?
		Chronic	Acute		Chronic	Acute	
Ammonia (as N)	0.587	0.976	3.59	-	1.22	4.49	-
Chloride	18	120	480	-	150	600	-
Fluoride	0.095	0.096	0.39	-	0.12	0.488	-
Nitrate (as N)	31.6	2.4	26.2	Yes	3	32.8	Yes
Nitrite (as N)	0.226	0.016	0.048	Yes	0.02	0.06	Yes
Sulphate	40	102	-	-	128	-	-
Aluminum (T)	0.636	0.0583	-	Yes	0.0729	-	Yes
Antimony (T)	0.0005	0.0592	0.2	-	0.074	0.25	-
Arsenic (T)	0.00142	0.004	-	-	0.005	-	-
Barium (T)	0.126	0.8	-	-	1	-	-

Parameter	95P Groundwater (mg/L)	80% WQG-FAL (mg/L)		Step1: POPC?	100% WQG-FAL (mg/L)		Step 2: POC?
		Chronic	Acute		Chronic	Acute	
Beryllium (T)	0.0001	0.000104	-	-	0.00013	-	-
Boron (T)	0.05	0.96	0.232	-	1.2	0.29	-
Chromium (T)	0.001	0.002	-	-	0.0025	-	-
Iron (T)	1.73	0.24	0.8	Yes	0.3	1	Yes
Mercury (T)	0.00000524	0.00000125	-	Yes	0.00000125	-	Yes
Molybdenum (T)	0.00853	6.08	36.8	-	7.6	46	-
Selenium (T)	0.00156	0.0016	-	Yes*	0.002	-	Yes*
Silver (T)	0.00002	0.000096	-	-	0.00012	-	-
Thallium (T)	0.0000317	0.00064	-	-	0.0008	-	-
Uranium (T)	0.00107	0.006	0.0132	-	0.0075	0.0165	-
Vanadium (T)	0.005	0.048	-	-	0.06	-	-
Cadmium (D)	0.000386	0.0000388	0.0000539	Yes	0.0000485	0.0000674	Yes
Cobalt (D)	0.00281	0.000312	-	Yes	0.00039	-	Yes
Copper (D)	0.00242	0.00016	0.00048	Yes	0.0002	0.0006	Yes
Iron (D)	1.65	-	0.28	Yes	-	0.35	Yes
Lead (D)	0.0002	0.00194	-	-	0.00242	-	-
Manganese (D)	2.92	0.256	-	Yes	0.32	-	Yes
Nickel (D)	0.0155	0.00056	0.0076	Yes	0.0007	0.0095	Yes
Strontium (D)	0.348	1	-	-	1.25	-	-
Zinc (D)	0.005	0.00416	0.00765	Yes	0.0052	0.00956	-

Notes:

95P = 95th percentile; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; N = nitrogen, T = total, D = Dissolved

POPC = Parameter of Potential Concern; POC = Parameter of Concern

Grey shading = identified POPC or POC

Asterisk: Identified as a POPC and POC due to bioaccumulation potential rather than 95P concentration in groundwater per BC ENV guidance (BC MECCS 2024a).

3.3.2.2 Proposed Discharge Quality Criteria

3.3.2.2.1 Metals, Anions, and Nutrients

The POCs identified through Steps 1 and 2 were carried forward to Step 3 for the development of proposed DQC, consistent with the screening framework described in Section 3.3.1.1. The resulting proposed DQCs are summarized in Table 3.11 (Fraser River) and Table 3.12 (Hicks Creek).

Seasonal comparisons did not identify statistically significant differences in concentrations from April to October (likely discharge period) and November to March at the Fraser River and Hicks Creek (Appendix N); therefore, the proposed DQCs were informed by the overall 95P (Fraser River) and 90P (Hicks Creek), where background concentrations were used in DQCs development.

Table 3.11 Proposed Discharge Quality Criteria for Groundwater Discharges to Fraser River Initial Dilution Zone

Parameter	95P Groundwater (mg/L)	WQG-FAL (mg/L)		95P Surface Water (mg/L)	Proposed DQCs (mg/L)	Basis of DQC
		Chronic	Acute			
Nitrate (as N)	31.6	3	32.8	0.289	32.8	Acute WQG-FAL
Nitrite (as N)	0.226	0.02	0.06	0.005	0.06	Acute WQG-FAL
Aluminum (T)	0.636	0.167	-	2.09	*	*
Iron (T)	1.73	0.3	1	2.97	2.97	Background
Mercury (T)	5.24×10^{-6}	1.25×10^{-6}	-	8.58×10^{-6}	*	*
Cadmium (D)	0.000386	0.000139	0.000312	1.88×10^{-5}	0.000312	Acute WQG-FAL
Cobalt (D)	0.00281	0.000402	-	0.0002	*	*
Copper (D)	0.00242	0.0007	0.0006	0.00151	0.00151	Background
Iron (D)	1.65	-	0.35	0.0915	0.35	Acute WQG-FAL
Manganese (D)	2.92	0.32	-	0.0829	*	*
Nickel (D)	0.0155	0.0011	0.0167	0.0013	0.0167	Acute WQG-FAL

Notes:

95P = 95th percentile; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; DQCs = Discharge Quality Criteria; N = nitrogen, T = total, D = Dissolved

Shaded rows indicate DQCs based on WQG-FAL

* DQC is currently not proposed because no acute WQG-FAL exists; chronic WQG-FAL or background will be met at edge of IDZ consistent with *Technical Guidance 11: Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations* (BC MECCS 2019a). These POCs are carried forward to Section 4 where the potential for adverse effects to aquatic life in the receiving environment is discussed.

Table 3.12 Proposed Discharge Quality Criteria for Groundwater Discharges to Hicks Creek

Parameter	95P Groundwater (mg/L)	WQG-FAL (mg/L)		90P Surface Water (mg/L)	Proposed DQCs (mg/L)	Basis of DQC
		Chronic	Acute			
Nitrate (as N)	31.6	3	32.8	0.614	3	Chronic WQG-FAL
Nitrite (as N)	0.226	0.02	0.06	0.0304	0.0304	Background
Aluminum (T)	0.636	0.0729	-	0.175	0.175	Background
Iron (T)	1.73	0.3	1	2.01	2.01	Background
Mercury (T)	0.00000524	0.00000125	-	0.00000344	0.00000344	Background
Cadmium (D)	0.000386	0.0000485	0.0000674	0.000021	0.0000485	Chronic WQG-FAL
Cobalt (D)	0.00281	0.00039	-	0.000896	0.000896	Background
Copper (D)	0.00242	0.0002	0.0006	0.00173	0.00173	Background
Iron (D)	1.65	-	0.35	1.13	1.13	Background
Manganese (D)	2.92	0.32	-	0.207	0.32	Chronic WQG-FAL
Nickel (D)	0.0155	0.0007	0.0095	0.0031	0.0031	Background

Notes:

95P = 95th percentile; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; DQCs = Discharge Quality Criteria; N = nitrogen, T = total, D = Dissolved

Shaded rows indicate DQCs based on WQG-FAL

POC for which DQCs are set equal to the applicable Chronic WQG-FAL are not expected to exceed guideline values in the receiving environment; therefore, they are not carried forward to the effects assessment in Section 4. Where DQCs are based on background concentrations that exceed the applicable chronic WQG-FAL, these parameters are carried forward to the effects assessment for further evaluation of potential effects on the receiving environment.

For the Fraser River, where an IDZ is applicable (See Section 3.4), certain POCs have proposed DQCs based on short-term (acute) water quality guidelines. Acute WQG-FAL may be exceeded in effluent, whereas long-term (chronic) WQG-FAL (where they exist) or background conditions are required to be met at the edge of the IDZ following mixing. For parameters for which only short-term (acute) water quality guidelines are available, compliance is evaluated against acute WQG-FAL at the edge of the IDZ. Accordingly, parameters with DQCs based on acute WQG-FAL are carried forward to the effects assessment (Section 4) for evaluation of predicted concentrations at and beyond the IDZ boundary.

3.3.2.2.2 General Parameters

General parameters include TSS, pH, dissolved oxygen, and temperature. Proposed discharge criteria for these parameters are outlined in the sections below.

Total Suspended Solids

Soil disturbance is one of the primary potential effects of pipeline construction. If not adequately mitigated, erosion and sedimentation issues have the potential to adversely affect surface water and aquatic life. Therefore, TSS is being proposed as a general parameter that will have a discharge limit and will be monitored during construction.

The TSS data collected at Fraser River sites near Agassiz are generally consistent with known seasonal patterns, showing elevated concentrations during the spring freshet and lower levels in fall and winter. Seasonal variability in TSS is a well-documented feature of the Fraser River, with peak values typically occurring during the spring freshet (April–June) when snowmelt-driven discharge mobilizes large volumes of sediment. Per Section 2.4.2.1, TSS at the Fraser River sites ranged from 13 mg/L in November to 150 mg/L in December, with elevated values coinciding with periods of high mean monthly flow. Concentrations of TSS at Hicks Creek (PDL-A6) were generally low (0.5 to 5.2 mg/L) except for August (37.3 mg/L).

Maximum TSS of discharged water is proposed to be 25 mg/L or background, whichever is greater. This proposed limit is based on the short-term CWQG-AL and WQG-FAL for TSS, which is a change from background of 25 mg/L (CCME 2026; BC MWLRS 2026).

The District of Kent does not have a bylaw that outlines TSS requirements for water discharge. However, 25 mg/L for TSS and 25 NTU for turbidity is consistent with or exceeds the requirement of most other municipalities in the Fraser Valley and Metro Vancouver that do have these requirements; for example, 25 NTU during dry conditions and 100 NTU when rainfall exceeds 25 mm in 24 hours in City of Mission, City of Abbotsford, City of Langley, and Township of Langley; <25 mg/L during dry weather and <75 mg/L in wet weather or a significant rain event in the City of Maple Ridge; <75 mg/L in the City of Surrey (City of Maple Ridge 2006; City of Mission 2009; City of Abbotsford 2020; City of Langley 2021; City of Surrey 2024; Township of Langley 2024). The exception to the turbidity requirements is in the City of Maple Ridge, which indicates turbidity must not be greater than 20 NTU (City of Maple Ridge 2006).

pH

Treatment of the water to be discharged may impact its pH. If not adequately mitigated, high or low pH has the potential to adversely affect surface water quality and aquatic life. Therefore, pH is proposed as a general parameter that will have discharge limits and will be monitored during construction.

The pH data collected collected at Fraser River PDLs near Agassiz were consistent over time and ranged from 7.04 to 8.00. Values at Hicks Creek (PDL-A6) ranged between 6.48 to 7.22 for all months monitored except February, where it measured 8.04.

The range of pH of water discharge is proposed to be 6.5 to 8.5. These values are derived from the *Lower Fraser River – Hope to Kanaka Creek Water Quality Objectives Attainment Summary Report* (BC MEP 2025) and are more stringent than WQG-FAL, which are 6.5 to 9.0. Therefore, this range is not expected to have adverse effects on surface water quality or freshwater aquatic life and is not carried forward into the environmental effects predictions and impact assessment in Section 4 but will be monitored as discussed in Section 5.

Dissolved Oxygen

Groundwater can have low levels of DO due to a lack of exposure to the atmosphere, decomposition of organic matter, or other chemical processes. If not adequately mitigated, low levels of DO in water discharge have the potential to adversely affect surface water quality and aquatic life. Therefore, DO is proposed as a general parameter that will have discharge limits and will be monitored during construction.

Data collected at Fraser River PDLs generally showed high levels of DO between November and May (8.98 mg/L to 17.8 mg/L) and lower levels between June and October (5.93 mg/L to 12.4 mg/L). Hicks Creek (PDL-A6) showed a similar pattern with high levels of DO between December and May (8.8 mg/L to 12.8 mg/L) and lower levels between June and November (4.67 mg/L and 7.2 mg/L).

The proposed discharge limit for DO is ≥8 mg/L. This value is derived from the chronic guideline in the *Lower Fraser River – Hope to Kanaka Creek Water Quality Objectives Attainment Summary Report* (BC MEP 2025) for May to October (discharge is expected between April in October) and is the same as the chronic WQG-FAL for all life stages other than buried embryo/alevin. Though this value does not meet the chronic DO objective for the lower Fraser River in April (11 mg/L; BC MEP 2025), the Fraser River sites are expected to have sufficient mixing to meet this guideline downstream of the discharge point. In addition, a bubbler or dissipator designed to increase aeration/turbulence may be used to increase DO at the discharge point. Data indicate that Hicks Creek (PDL-A6) also does not meet the 11 mg/L chronic DO objective for the lower Fraser River in April (BC MEP 2025), and there is expected to be mixing at that location as well.

Temperature

Groundwater temperatures will vary from surface water temperatures and are anticipated to be colder than surface water in the summer and warmer than surface water in the winter. Water ready for discharge may increase in temperature after going through the water treatment process due to factors such as being processed in tanks exposed to the sun during hot weather. If not adequately mitigated, the discharge of higher-than-receiving environment water temperatures have the potential to adversely affect surface water quality and aquatic life. The discharge of colder-than-receiving environment water is expected to be a less likely issue, as dewatering activities are primarily scheduled for warmer months (April to October). Therefore, temperature is proposed as a general parameter that will have discharge limits and will be monitored during construction.

Water temperature increased during the summer months at all PDLs monitored. In the Fraser River, temperature ranged from 13.4ºC to 21.6º from May to October and 4.5ºC to 8.9ºC from November to April. The highest temperatures were recorded in August. Hicks Creek (PDL-A6) showed a similar pattern but was slightly warmer, with temperatures ranging from 15.9ºC to 22.8ºC between May and October to 7.0°C to 11.7ºC from November to April. The highest temperature in Hicks Creek was recorded in July.

An hourly temperature change of no more than 1°C is proposed for discharge. This is consistent with the hourly rate of temperature change in the WQG-FAL for streams with unknown fish distribution. Therefore, this range is not expected to have adverse effects on surface water quality or freshwater aquatic life and is not carried forward into the environmental effects predictions and impact assessment in Section 4 but will be monitored as discussed in Section 5.

Hydrocarbons

Hydrocarbons are not anticipated to be a POC associated with new pipeline installation because the groundwater discharged during trench excavation and pipe installation will only be in contact with pipe segments that are newly manufactured and do not contain product (i.e., natural gas or liquid hydrocarbons). Per Section 2.6.1, limited interactions with contaminated sites are anticipated based on registry and inventory database searches but undocumented contamination discovery is possible. If Westcoast encounters an area of potential existing hydrocarbon contaminated soil or water in the footprint via visual or olfactory indicators, on-site personnel will implement the Contamination Discovery Contingency Plan which is part of the EPP (Appendix C1 of the Pipeline EPP [Appendix M]) and discussed in Section 3.5.3. Accidental releases of hydrocarbons are also possible during construction. Vehicles and equipment are to arrive clean, leak-free, and maintained in good working conditions, and to be regularly inspected. In the event of a suspected or actual vehicle or equipment leak or spill, Westcoast will implement the Fuels and Hazardous Materials Spill Contingency Plan found in Appendix C.6 of the Pipeline EPP (Appendix M).

3.4 Discharge Water Mixing within the Receiving Environment

A preliminary assessment of the potential volumetric mixing of the discharged water within the receiving environment was conservatively developed, using a mass balance approach, comparing the discharge rates and DQCs for the discharged water with the corresponding average monthly flows and background concentrations for the POCs. For PDLs where the proposed DQCs are based on the assumption that mixing will occur downstream of the discharge, the assessment has been expanded to a simplified IDZ assessment.

Hicks Creek (PDL-A6) is the only PDL within the loop where the proposed DQCs are not based on anticipated mixing downstream of the PDL, therefore a mixing assessment based on a mass balance approach was used to assess potential concentrations in the receiving environment downstream of the PDL for illustrative purposes only. Due to the relatively small dimensions of the channel, it was assumed that the full ambient flow of the receiving environment would be within the discharge water plume downstream of the PDL, therefore, the lowest estimated volumetric dilution at any time of the year downstream of PDL-A6 is 10:1 as previously shown in Section 3.2.2.

Based on the estimated volumetric dilution, an estimate of the concentration of select POCs based on a mass balance approach (BC MECCS 2019a) was developed for PDL-A6. Table 3.13 present the PDL outlet (end-of-pipe) concentration, typical background conditions in the Hicks Creek, and concentration once full mixing has occurred, using three POCs as examples.

Table 3.13 Relevant Concentration Estimates Downstream of PDL-A6 for Example Parameters of Concern

Example Parameters of Concern	Concentration Estimates for PDL-A6		
	DQCs End-of-Pipe Concentration (mg/L)	90P Background Surface Water Concentration (mg/L)	Mixed Concentration (mg/L)
Nitrate (as N)	3.00	0.614	0.831
Iron (D)	1.13*	1.13	1.13
Nickel (D)	0.003*	0.003	0.003

Notes:

90P = 90th percentile; PDL = proposed discharge location; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; DQCs = Discharge Quality Criteria; mg/L = milligram per litre; N = nitrogen, T = total, D = Dissolved

* indicate DQCs based on background while the others are based on WQG-FAL

The proposed DQCs for the Fraser River PDLs (PDL-A1, PDL-A8 and PDL-SBI9) are based on anticipated mixing in the Fraser River downstream of each PDL. Therefore, a high-level assessment of the IDZ was completed for those three PDLs. The IDZ is the 3-dimensional zone around a point of discharge where mixing of the effluent and the receiving environment water occurs (BC MECCS 2019a). An IDZ does not encompass the entire extent where all mixing occurs, since the discharge plume may extend beyond the edge of an IDZ before the plume is fully mixed with the receiving environment. At the edge of an IDZ, the effluent should not cause chronic toxicity in the receiving environment.

The IDZ assessment was based on conservative assumptions for each Fraser River PDL to determine the hydraulic conditions in the receiving environment using analytical calculations based on a simple mass balance equation using dilution factors. The IDZ assessment was based on February and March mean monthly flows in the river as they represent the lowest monthly flow condition historically observed in the Fraser River (approximately 900 cubic metres per second [m^3/s]) and, therefore, the lowest potential for mixing and dilution at each PDL. As the Fraser River is split in multiple channels, the proportion of flow that would be conveyed in each channel in relation to the full flow in the river was estimated for each PDL based on an analysis of publicly available aerial photography. The Fraser River flow percentage in the channel adjacent to each PDL assumed as part of the IDZ assessment is shown in Table 3.14.

Table 3.14 Percentage of Fraser River Flow in Channel Adjacent to Proposed Discharge Locations

Proposed Discharge Location	Percentage of Fraser River Flow in Channel Adjacent to Proposed Discharge Location
PDL-A1	100%
PDL-A8	66%
PDL-SBI9	5%

Based on the assumed percentage of flow shown in Table 3.14 and using information for channel slope and roughness from the Fraser River model update (BC MFLRNO 2014a), the mean channel velocity, flow depth, and top channel width at each PDL were estimated for the receiving environment by developing a single section hydraulic assessment. The results of this assessment for each PDL are shown in Table 3.15

Table 3.15 Hydraulic Parameters at Fraser River Proposed Discharge Locations

Proposed Discharge Location	Estimated Hydraulic Parameters for March Mean Monthly Flow in the Fraser River			
	Flow (m^3/s)	Average Water Depth (m)	Average Channel Velocity (m/s)	Top Channel Width (m)
PDL-A1	900	2.5	0.618	575
PDL-A8	600	3.1	0.703	276
PDL-SBI9	45	1.3	0.849	43

Notes:

m = metre; m^3/s = cubic metres per second; m/s = metres per second

Using the parameters presented in Table 3.15 and methods presented in the Technical Guidance for Development and Use of Initial Dilution Zones (BC MECCS 2019a), the potential volumetric dilution (amount of mixing of the discharge and the receiving environment), for typical February–March flow conditions in the Fraser River has been estimated for each PDL as shown in Table 3.16.

Table 3.16 Potential Volumetric Dilution Estimates

Proposed Discharge Location	Potential Volumetric Dilution
PDL-A1	318
PDL-A8	318
PDL-SBI9	112

Based on the estimated volumetric dilution shown in Table 3.16, an estimate of the concentration of POCs at the edge of the IDZ was developed based on as mass balance approach (BC MECCS 2019a). Table 3.17 present the PDL outlet (end-of-pipe) concentration, typical background conditions in the Fraser River and concentration at the edge of the IDZ, and percentage reduction using nitrate as an example. IDZ concentrations for each POC are provided in Section 4.2.2.1.

Table 3.17. Relevant Concentrations Estimate within Initial Dilution Zone – Nitrate Example

Proposed Discharge Location	PDL, Background, and IDZ Concentrations (using Nitrate as example parameter)			
	DQCs End-of-Pipe Concentration (mg/L)	95P Background Surface Water Concentration (mg/L)	Mixed Concentration (mg/L)	% Reduction from PDL to Edge of IDZ
PDL-A1	32.8	0.289	0.391	99%
PDL-A8	32.8	0.289	0.391	99%
PDL-SBI9	32.8	0.289	0.572	98%

Notes:
95P = 95th percentile; PDL = proposed discharge location; IDZ = initial dilution zone; mg/L = milligram per litre

3.5 Mitigation Measures

A Pipeline EPP and its associated management and contingency plans have been developed for the Project and will be implemented for the pipeline loop. The EPP and its associated plans are provided in Appendix M. The Pipeline EPP is a living document and may be updated as Project details are refined and additional management/mitigation plans are developed (e.g., to meet conditions provided by the CER). Construction activities associated with the pipeline loop will implement the most recent version of the Pipeline EPP and its management/mitigation plans. Key information from the Pipeline EPP (Appendix M) that are applicable to water management and discharge, and the Section 15 Approval are outlined in the following sections.

3.5.1 Environmental Roles and Responsibilities During Construction

Section 3.5 of the Pipeline EPP (Appendix M) outlines the roles and responsibilities for environmental personnel involved in the Project who will support environmental regulatory compliance and protection of the receiving environment throughout construction. The following environmental personnel will work collaboratively to monitor general pipeline construction activities, including water management and discharge relevant to the Section 15 Approval.

Environmental Advisor:

- Supports timely integration of environmental requirements in Project design, contracting agreements, Project approvals, and permitting and construction plans.
- Communicates environmental requirements to the Project team and the Contractor. Advises on the Project-specific environmental commitments and applicable laws and regulations during construction planning and execution.
- Supervises environmental coordinators and inspectors working in the field; is responsible for maintaining effective communication protocols, compliance, and Project-specific environmental requirements.
- Liaises with identified stakeholders concerning environmental issues.
- Confirms pertinent environmental information is accessible to Project personnel.

Environmental Inspector (EI):

- Provides input to Construction Management during routing, planning, and execution phases.
- Has the authority to temporarily pause work if warranted to avoid or mitigate potential environmental impacts.
- Supports and consults with the Construction Manager or designate during construction when there is a need to implement contingency plans, including conditions where a pause or temporary suspension of activities is required.
- Attends the daily construction meeting with the other inspectors and the Contractor to coordinate environmental inspection activities with construction activities.
- Issues a daily EI Reports documenting compliance with the environmental conditions/permit requirements for their area of responsibility.
- Participates in evaluating the Contractor’s environmental performance. Promotes alignment with Project environmental requirements and communicates performance feedback to the Contractor’s management team when changes are required.
- Oversees implementation of regulatory compliance and mitigation measures including corrective measures; documentation of non-compliance issues; oversees resolution for non-compliances identified during construction and reclamation phases.

- Coordinates environmental survey work with the QP or Resource Specialist; assists in preparation of permits, drawings, and reports related to environmental activities.
- Coordinates responses to inadvertent events, such as spills or inadvertent drilling fluid releases, or discoveries, such as potential cultural resources, species of concern, or historical soil contamination.
- Advises others when conditions (such as wet weather) warrant restriction of construction activities to avoid soil losses or damage (e.g., excessive rutting), referencing the applicable contingency plan.

Qualified Professional (QP)

- Possesses a professional designation (as defined by the BC *Professional Governance Act*) or substantial experience to be described as a subject matter expert related to a particular discipline (such as aquatics, wildlife, vegetation, heritage resources, geology, or soils).
- Assists Westcoast in maintaining regulatory compliance and makes recommendations to align activities with Project environmental requirements.
- Directs the Resource Specialist crews, in conjunction with the EI, based on the site-specific Westcoast needs identified by the EI.
- Communicates issues to the EI as soon as possible if they have the potential to result in a construction delay or an impact to the environment, if unchecked.
- Support the training of EIs, where required.

Resource Specialist

- Knowledgeable of and competent in the practice of a particular discipline but may not possess a professional designation.
- Works under the Environmental Inspector, or the Environmental Inspector may operate as the Resource Specialist.
- Receives technical guidance for field tasks from a QP. Completes reporting deliverables for submission to the QP.
- Conducts specific environmental surveys and collects data related to aquatics, wetlands, wildlife, vegetation, soil, archaeology, reclamation, remediation, or other specialty, as needed by Westcoast.
- Produces end deliverables, when requested, to summarize the collected data (i.e., a summary report or memorandum).

Indigenous Monitor

- An individual with an understanding of their traditional territory or a desire to learn more about the interactions of the Project with the biophysical and cultural setting.
- Works with Westcoast's construction management team and liaises with the EI team.

- Communicates to Westcoast their insights and awareness into portions of the Project footprint or adjacent areas where environmental, cultural, and archaeological values and features may be present.
- Observes construction activities and the implementation of mitigation and environmental protection measures (including contingency and management plans), as described in the Project EPPs. Provides input and comments to help Westcoast construct the Project in a culturally appropriate way that respects Indigenous traditions, values, and beliefs.
- Supports heritage or cultural resource discovery assessments alongside the Heritage Resource Specialist.

3.5.2 Discharge Management

Treated water will be routed from the water treatment units to the designated PDLs through temporary piping and will be discharged through stabilized outfalls with erosion protection and flow dissipation measures to avoid scour and habitat disturbance.

Westcoast is applying for an extent of 250 m for placing the discharge structure at each PDL (Figure 3.2) to: 1) limit the impact on existing vegetation at the top of bank of each PDL; 2) allow adequate operating space for each discharge structure (which could extend up to approximately 50 m in linear length); and 3) allow room to relocate a discharge structure if monitoring indicates there is a need to, modify, enhance, or relocate mitigation measures at a particular location.

Discharge outfall structure design will be site-specific and is currently under development, with a focus on design that will allow for the protection of the bed and banks of the watercourses given the discharge volumes anticipated. Westcoast is currently focusing on two potential approaches for controlling the release of water discharge into the PDLs: 1) a floating discharge structure consisting of a perforated pipe discharging water directly into the receiving water body and 2) a perforated pipe placed at the top of a bank and releasing water down the bank slope over an impermeable liner. Both approaches are focused on reducing potential localised erosion associated with the discharge structure while also avoiding disturbance of the channel bed and banks.

Instream floating discharge structures and a perforated pipes placed at the top of watercourse banks have the potential to be used as discharge outfalls. Floating discharge structures are the preferred approach as they limit the potential for bank erosions by avoiding direct interaction with the bank (with the exception of the anchoring points and the pipe conveying the treated water to the discharge structure); however, these structures can have limitations where water is relatively shallow (due to the risk of disturbing the receiving water body bed substrate), where water velocity can be high, or where boats or other navigation vessels could interact with the discharge structure. Floating discharge structures would be tethered/anchored and therefore, be relatively stationary within the watercourse. They will not have pinch points or potential for fish impingement. Perforated pipes at the top of watercourse banks will be used in locations where floating discharge structures are unsuitable. Where perforated pipes are used, an impermeable liner will be placed on the bank slope down to the water level to limit erosion.

Water discharge quantity is discussed in Section 3.2; proposed discharge limits are PDL-specific and were developed so that discharge is unlikely to have an adverse effect on aquatic habitat (e.g., lead to erosion of bed and banks when flows are increased or fish stranding when flows are reduced). For PDLs in the Agassiz Loop, discharge rates will be no more than 10% of the estimated mean monthly flow of each PDL. When discharge activities decrease or stop, this reduction of flow is unlikely to affect the watercourses to an extent where stranding of fish will be a risk. However, an EI or designate will assess potential for fish stranding, extent of potential stranding, and conduct monitoring at locations where potential for fish stranding exists due to reduced or halted flows.

Site-specific mitigation measures will be applied to dewatering activities associated with pipeline loop construction. Mitigation measures specific to groundwater discharge management relevant to the Section 15 Approval for the pipeline loop will be implemented and are summarized in Table 3.18. General dewatering mitigation measures can be found in Appendix D.2 (Dewatering Management Plan) of the Pipeline EPP (Appendix M) and will be applied to water management and discharge-related activities, as applicable.

Table 3.18 Mitigation Measures for Water Discharge Management for the Pipeline Loop

Activity / Concern	Mitigation Measures
Erosion and Sediment Control	Situate PDLs within the 250 m buffer extent where they will limit impacts to stream water quality, riparian vegetation, stream channel, and fish and wildlife habitat. Avoid areas of unstable banks, steep slopes, alluvial fans, and meander bends.
	Inspect the PDLs frequently and after high stream flow events to assess: • Physical condition of the PDL • Slope/bank stability • Erosion and sediment control measures
	Shift the outfall location within the 250 m buffer extent if monitoring indicates there is a need to, modify, enhance, or relocate the PDL and/or mitigation measures at a particular location
	Inspect hoses frequently and address any leak as soon as identified
Discharge Rate	Keep discharge rates consistent, where possible. Increase and decrease flow rates gradually to reduce the risk of a sudden increase in flow causing damage to the stream or a sudden decrease causing stranding or other adverse effects on fish and other aquatic organisms.
	Decrease flows gradually, and with increased monitoring frequency, when ceasing water discharge at a PDL to reduce the potential for fish stranding. The EI or designate will assess potential for fish stranding, extent of potential stranding, and conduct monitoring at locations where potential for fish stranding exists due to reduced or halted flows. If required, flow reduction will be temporarily paused so that a QP can relocate the fish to the main channel of the watercourse.

Activity / Concern	Mitigation Measures
Discharge Structure (top of bank)	Establish impermeable liner over the bank and other flow and erosion and sediment control (ESC) control measures, as required, prior to the start of discharge.
	Inspect the liner under the discharge structure and over the bank for damage or signs of tear frequently. Repair or replace as needed.
	Check the stability of the anchoring system frequently.
	Inspect frequently the connection between the discharge line and discharge structure for leaks or damage.
Discharge Structure (floating)	Inspect toe of banks in the vicinity of structure for any sign of localised erosion.
	Monitor water levels and impacts of the discharge structure to channel substrates. If the discharge structure is impacting substrates (e.g., through erosion), considering moving the location of the structure to deeper water or changing the structure to one that discharges from the top-of-bank.
	Check the stability of the discharge structure anchoring system frequently.
	Monitor the connection between the discharge line and discharge structure for leaks or damage frequently.

3.5.3 General Construction Measures

Construction will be completed in a manner that avoids or reduces adverse effects on residents in the area, nearby land users, and socio-economic and environmental features. To accomplish this, mitigation measures will be applied to avoid or reduce adverse environmental effects associated with construction activities. Mitigation measures for general construction activities can be found in Section 7 of the Pipeline EPP (Appendix M); these measures will be applied to water management and discharge-related activities, as applicable.

In addition to general construction mitigation measures, the Pipeline EPP (Appendix M) has several management and contingency plans that may be applicable to activities conducted under the Section 15 Approval. They include:

- *Contamination Discovery Contingency Plan* (Appendix C.1. of the Pipeline EPP)
- *Fish Species of Concern Discovery Contingency Plan* (Appendix C.4. of the Pipeline EPP)
- *Vegetation Species and Communities of Concern Discovery Contingency Plan* (Appendix C.15. of the Pipeline EPP)
- *Biosecurity and Vegetation Management Plan* (Appendix D.1. of the Pipeline EPP)
- *Wildlife and Wildlife Habitat Management Plan* (Appendix D.7. of the Pipeline EPP)

These management and contingency plans will be implemented, where applicable.

3.5.3.1 Erosion and Sediment Control

Erosion and sediment control (ESC) measures will be implemented where erosion and/or sedimentation is anticipated or observed during construction. For water management and discharge-related activities, this may include areas disturbed for the installation of the water treatment units and associated infrastructure, the length of hoses and/or pipes used to move water, and the end of the discharge pipe. Mitigation measures must be implemented to reduce potential effects on fish and fish habitat and water quality, and to reduce the potential for loss of topsoil or soil productivity. The Westcoast Environmental Advisor and EI, in consultation with a QP as required, will determine appropriate procedures to be implemented to control soil erosion and sedimentation. Specific mitigation measures for ESC control during discharge are identified in Section 3.5.2. General ESC measures are described in the Pipeline EPP (Appendix M) and its associated plans including:

- *Erosion and Sediment Control Management Plan* (Appendix D.4. of the Pipeline EPP)
- *Sedimentation of Watercourses and Wetlands Contingency Plan* (Appendix C.10. of the Pipeline EPP)
- *Soil Erosion Contingency Plan* (Appendix C.11. of the Pipeline EPP)
- Typical Drawings 6 to 11 that detail the installation of erosion control measures in Appendix E of the Pipeline EPP

Applicable ESC measures from these plans will be implemented for water management and discharge-related activities.

3.5.3.2 Spill Prevention and Management

Spills are unplanned incidents that have a negative impact or the potential for a negative impact on the environment. The Pipeline EPP (Appendix M) identifies mitigation measures to address spills and potential trench water contamination, should previously unidentified historical spills or contamination be encountered during construction. The measures are designed to prevent hydrocarbons from being conveyed from the Project footprint to the receiving environment. A wellpoint system is expected to remove most, if not all, of the groundwater before it enters the trench, and a potential spill or leak in the pipeline trench would be identified and contained through the implementation of the Pipeline EPP mitigation measures and would not be expected to enter the wellpoint system.

Key spill prevention and management mitigation measures that will be applied to water management and discharge-related activities are provided in Section 7 of the Pipeline EPP (Appendix M). The EPP spill prevention measures are intended to describe preventative measures that the Contractor will be held to, with the Westcoast environmental inspection being a part of every day of the construction activity. Regular inspection includes confirmation of vehicle and equipment condition and maintenance, spill prevention/ management, and proper waste management and disposal.

In the event of an issue, the EIs are responsible for identifying, initiating response, documenting spills and environmental events, and guiding the appropriate course of further corrective action, in cooperation with the Environmental Advisor and Construction Manager. If a spill is reportable to external parties (e.g., a regulatory agency or Indigenous group), Westcoast will be responsible for making the applicable notifications. Spill response and reporting details are outlined in the *Fuels and Hazardous Materials Spill Contingency Plan* found in Appendix C6 of the Pipeline EPP (Appendix M).

3.5.4 Construction Environmental Inspection Program

An environmental inspection program will be implemented for the Project. The purpose of the Westcoast Environmental Inspection Program is to:

- evaluate the status of compliance with applicable environmental legislation
- assess the effectiveness of the Project's preventative and mitigative controls in the areas of identified environmental risk
- identify positive practices that may serve as a learning tool for communication and application across Project work areas and activities
- evaluate permit compliance

Environmental inspections will be undertaken to maintain compliance with the Project environmental mitigations, site-specific plans and management plans, and to identify non-compliances and non-conformances. As part of the environmental inspection program, the following activities, which are either directly related to water or may be relevant to water, will be implemented:

- field-measured water quality monitoring
- ESC monitoring
- spill response
- monitoring for potential contaminant discovery
- fish species of concern discovery
- wildlife species of concern discovery

See Section 3 of the EPP (Appendix M) for more information on the environmental inspection program (Section 3.4 of EPP), environmental events and deficiencies (Section 3.7 of EPP), and environmental change management during construction (Section 3.8 of EPP).

3.5.4.1 Field Measured Water Quality Monitoring

A detailed discussion of proposed water quantity and quality monitoring related to end-of-pipe water discharge is provided in Section 5 and the trigger and response plan for preventing potential exceedances of water quantity and quality parameters are discussed in Section 6.7 and will not be discussed further in this section. For field-measured water quality monitoring related to ESC, the Appendix D.6 (*Water Quality Monitoring and Fish Salvage Plan*) of the Pipeline EPP (Appendix M) provides Project-wide guidance for field-measured water quality monitoring for the Project.

3.5.4.2 Erosion and Sediment Control Monitoring

Specific mitigation measures for ESC control during discharge are identified in Section 3.5.2. General ESC measures are described in the Pipeline EPP (Appendix M) and its associated plans. The installed ESC measures require regular monitoring, as ESC measures are only effective when they are installed correctly, maintained, and modified when necessary. Weather forecasts should be consulted daily during site preparation and, in the event of a forecasted precipitation event in excess of 25 mm in 24 hours, ESC measures will be inspected in the field by the EI or contractor's trained ESC professional and preventative maintenance will be carried out by the contractor in advance of a storm. Additional ESC inspections will be completed after every rainfall event with precipitation of more than 25 mm in 24 hours.

Monitoring will be undertaken for active construction areas to assess the effectiveness of the ESC plan and compliance with regulatory requirements. For dewatering activities, locations that will require regular ESC monitoring will likely include:

- The PDL to check for potential erosion of the bed and banks of the watercourse due to the water discharge
- The banks of the watercourse in proximity to the PDL and hose/piping from the pipeline trench to the PDL(s) to check for erosion-related issues
- Watercourses at and downstream of the PDL for signs of sedimentation or elevated turbidity (see Section 5 for receiving environment water quality monitoring requirements)
- Areas of exposed soil and ESC measures installed as part of dewatering activities to check that measures are intact and functioning as intended
- The perimeter of temporary workspaces associated with dewatering activities to check for offsite migration of stormwater or trench water as well as erosion/sedimentation issues
- The length of hose/piping from the pipeline trench to the PDL(s) to check the condition of the hose or pipe, the functioning of the connection points, checking for leaks in the hose/pipe and water treatment system as well as erosion or sedimentation issues if any unintended water release has occurred

Daily environmental inspection reports will describe what environmental mitigation measures were applied, and whether there were issues or deficiencies in meeting Project environmental commitments. See Sections 3.4.1 (Environmental Inspection Documentation and Reporting) and 3.7 (Environmental Events and Deficiencies) of the Pipeline EPP for more information (Appendix M). Appropriate follow up will be conducted on any deficiencies noted during the monitoring events, and maintenance of all noted issues will be completed as soon as is possible, but prior to the next rainfall event. Field records will be kept of all activities that affect ESC on this Project to demonstrate due diligence to the regulatory agencies.

3.5.4.3 Spill Response

Spills of hazardous materials (excluding stains or spot spills) have the potential to affect environmental resources including soil, wetlands, vegetation, wildlife habitat, and aquatic ecosystems. In the event of a hydrocarbon spill or discovery, the EPP's corrective actions (Contingency Plans) are triggered, specifically the *Fuels and Hazardous Materials Spill Contingency Plan* found in Appendix C.6 of the Pipeline EPP (Appendix M). These actions kick-off with a spill or leak being observed based on visual or olfactory identification and associated construction activities being paused (if it is safe).

3.5.4.4 Monitoring and Response for Contamination Discovery

Construction activities may involve excavating and handling previously unidentified contamination. Soils are considered contaminated if free product is present, the soil is a notably different colour than the surrounding soil (e.g., black, shades of grey, blue, and green) or hydrocarbon odours are present. Surface water and groundwater are considered contaminated if hydrocarbon or other odours are present or there is sheen or discolouration in the water. Contaminated groundwater and surface water are of particular concern for water management and discharge activities for the pipeline loop. Per Section 2.6.1, limited interactions with contaminated sites are anticipated based on registry and inventory database searches but undocumented contamination discovery is possible and covered by Appendix C1 (*Contamination Discovery Contingency Plan*) of the Pipeline EPP (Appendix M). The EI will check the pipeline trench and areas where water has collected for potential contamination as part of their monitoring activities.

When suspected contamination is encountered, the Contractor will notify the EI, pause soil handling activities, and secure the site. The EI will assess the situation. If free product is visible, work will be temporarily paused in the affected area. Signage, flagging, and a provisional buffer zone will be established around the area of suspected contamination to alert workers to its presence and prevent inadvertent entry into the impacted zone or disturbance of the find. Westcoast will be responsible for characterization of the unknown contaminated site and development of a site-specific plan for construction, if warranted.

In the event previously unidentified contaminated soils or water is encountered during construction, Westcoast Environment, in consultation with a QP, will consider options for characterization and mitigation of the site. A QP may be retained to conduct sampling and determine contamination mitigation response and remediation, when required.

Additional details and mitigation measures can be found in Appendix C1 the Pipeline EPP (Appendix M).

3.5.4.5 Fish Species of Concern Discovery

The fish presence has been assessed for the receiving environment for each PDL (see Section 2.5.2.1 for more details). However, if previously unidentified fish species of concern or sensitive fish habitats are discovered during construction, a supplemental fish and fish habitat survey will be undertaken to evaluate the potential effects of construction activities on the fish species of concern and their habitat and inform the development of site--specific mitigation measures. The discovery will be assessed by a QP based on the following criteria:

- the fish species present and their sensitivity to disturbance
- location of the fish habitat features
- the timing of construction activities versus the timing constraints for the fish species
- the potential for modification of construction activities to reduce disturbance

Once the assessment is completed, the appropriate regulatory authority will be notified if warranted (e.g., Fisheries and Oceans Canada if a SARA permit is required), and site-specific mitigation options discussed, if necessary. Additional details and mitigation measures can be found in Appendix C4 (*Fish Species of Concern Discovery Contingency Plan*) of the Pipeline EPP (Appendix M).

3.5.4.6 Wildlife and Habitat Feature Discovery Contingency Plan

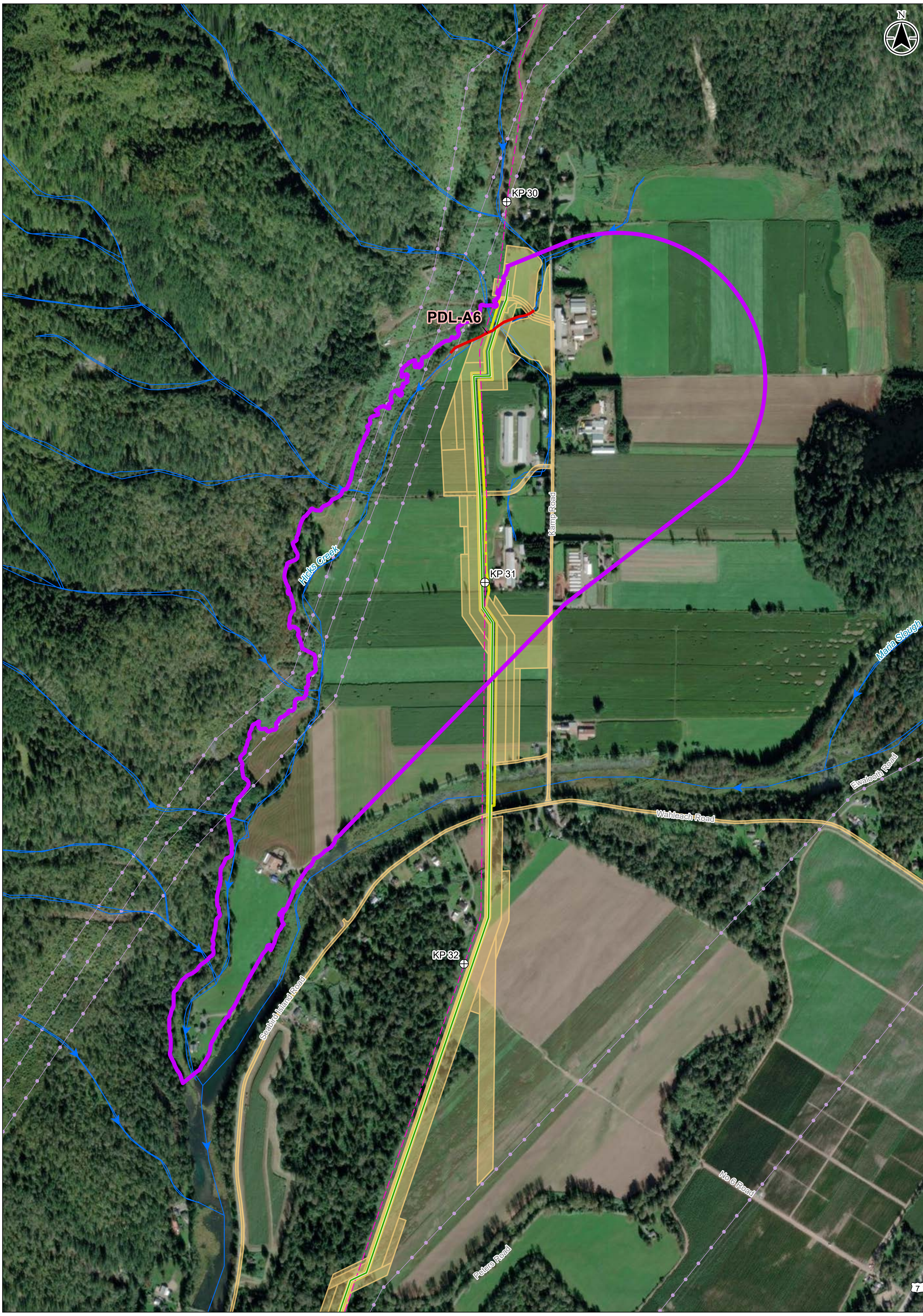
The aquatic wildlife presence has been assessed for the receiving environment for each PDL (see Section 2.5.2.2 for more details). If wildlife species at risk, site-specific habitat, or a wildlife habitat feature is discovered before or during construction activities, the discovery will be assessed to evaluate the potential effects of construction on the species or habitat and inform the development of site-specific mitigation measures. Site-specific mitigation will be developed, considering the following criteria:

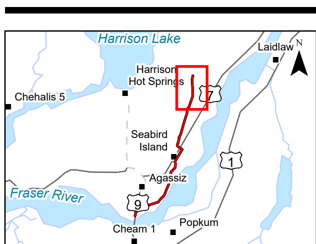
- location of the wildlife or habitat feature relative to Project activities
- type, scope, and timing of Project activities
- surrounding habitat type, quality, and presence of existing buffers or barriers
- the species and habitat feature type, life stage, sensitivity, legal protections, best management practices and guidelines, such as suitable setbacks and sensitive timing windows.

Additional details and mitigation measures can be found in Appendix D7 of the Pipeline EPP (Appendix M).

4 Environmental Effects Predictions and Effects Assessment

Discharges from the pipeline construction dewatering have the potential to impact receptors in the PDL receiving environments. The area where effects are assessed, referred to as the Assessment Area, is defined in Section 4.2.1 and shown in Figure 4.1. The conceptual site model (CSM), showing pathways of effects between pipeline dewatering activities and possible receptors in the receiving environments, is described in Section 4.1. The impact assessment (Section 4.2) focuses on potential changes in surface water quality that may lead to adverse effects for the possible receptors in the receiving environment, from direct exposure (i.e., absorption of water) and/or indirect exposure (i.e., trophic transfer through diet).





- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- PDL Buffer (~250 m)
- Assessment Area

0 100 200 300 400 m
1:10,000 (at original document size of 11x17)

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by MPENNER on 20260311

NTS 50K Grid: 092H05/092H04

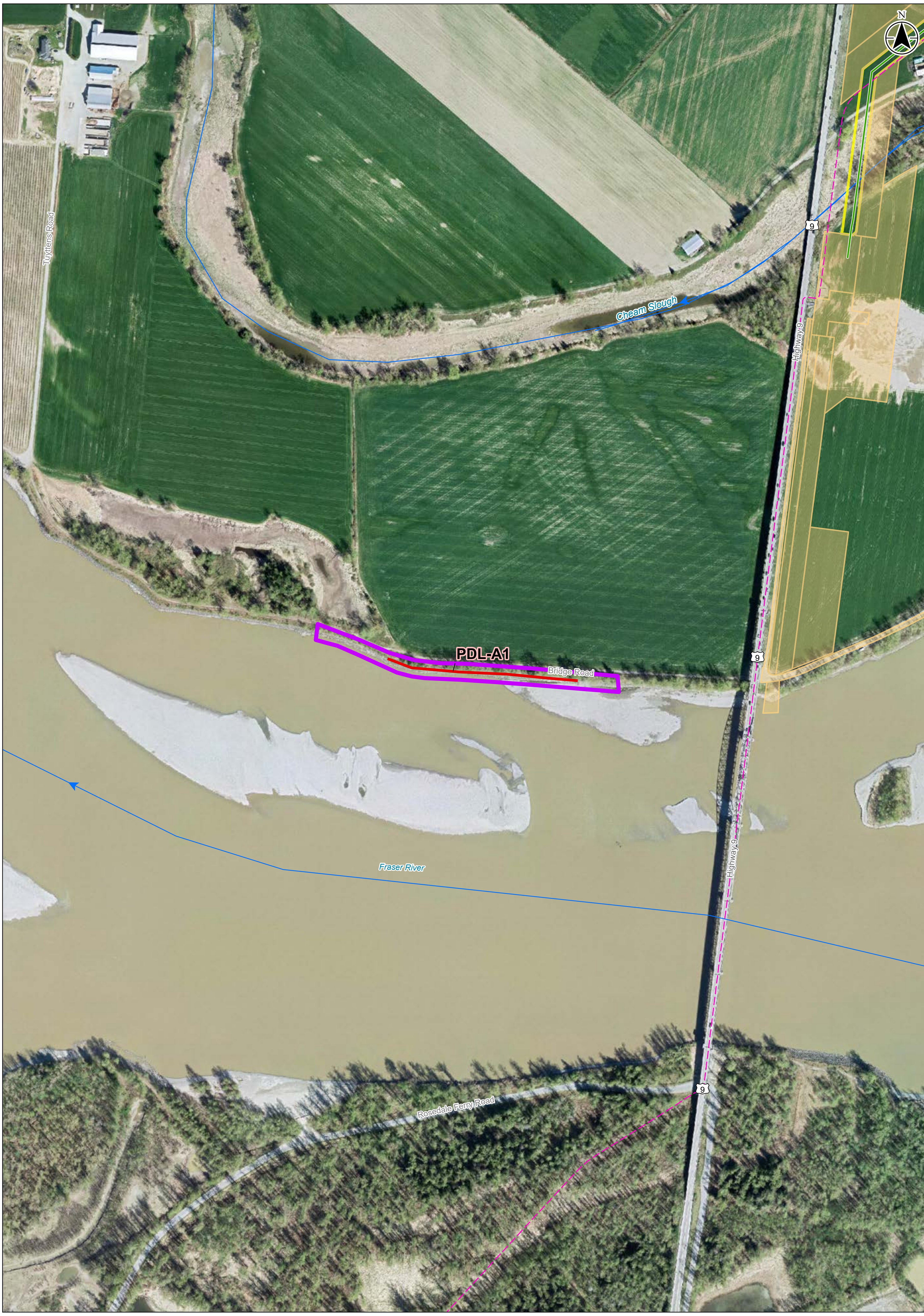
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

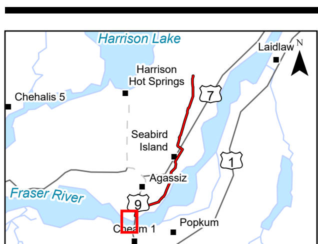
Figure No.
4.1

Title
Assessment Area - PDL-A6

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-30 By: jpoucher





Flow Direction
Watercourse
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace
PDL Buffer (~250 m)
Assessment Area

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

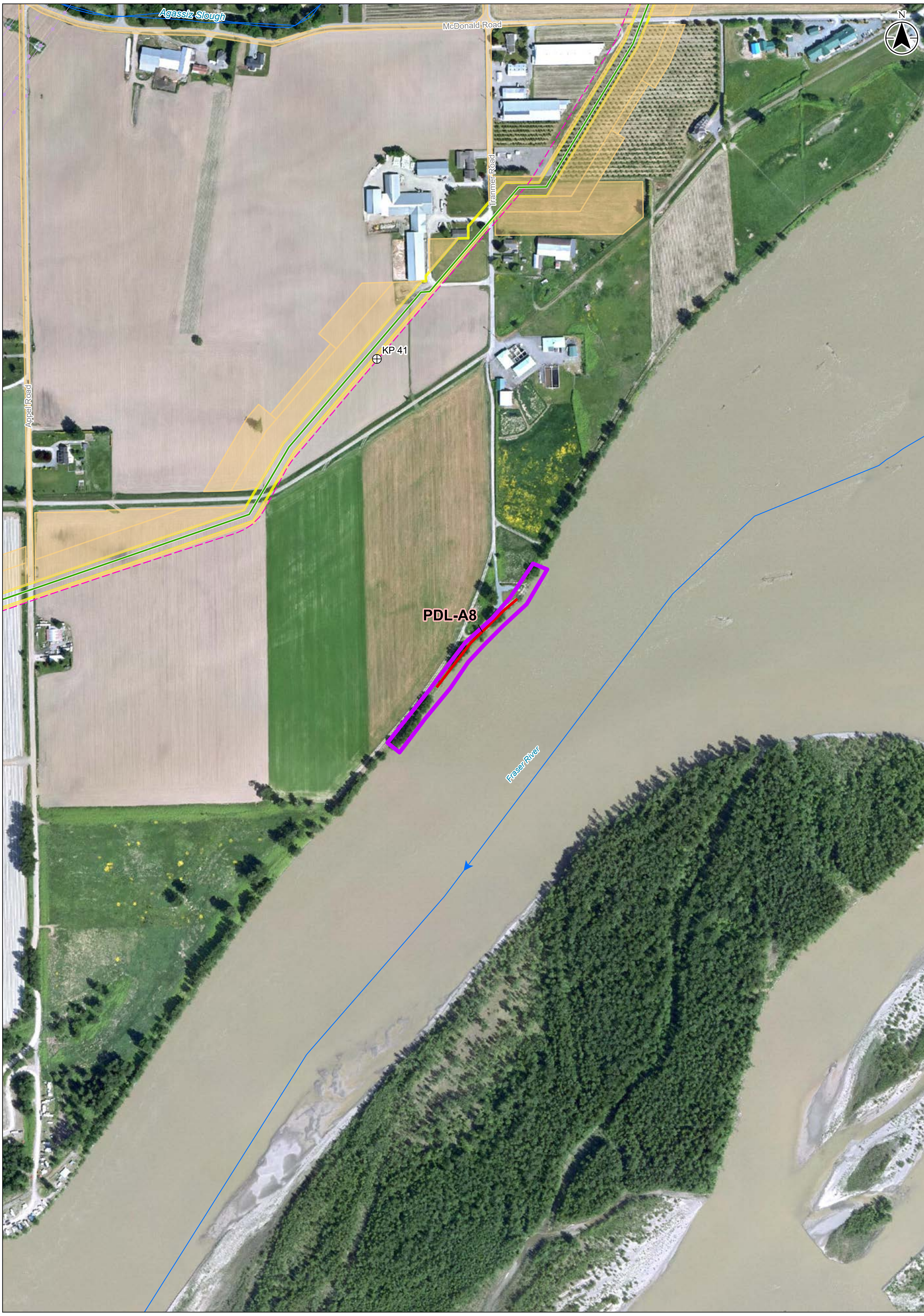
Project Location
Kent, BC
NTS 50K Grid: 092H05/092H04

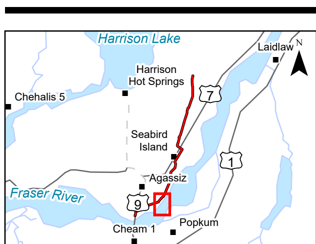
Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by MPENNER on 20260311

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
4.1

Title
Assessment Area - PDL-A1





Transmission Line
Flow Direction
Watercourse
Kilometer Post
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace
PDL Buffer (~250 m)
Assessment Area

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by MPENNER on 20260311

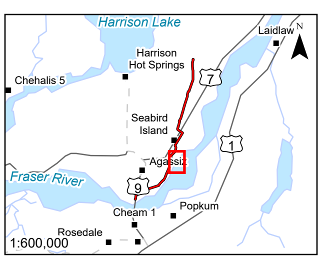
NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
4.1

Title
Assessment Area - PDL-A8

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-30 By: jpoucher



Railway
Flow Direction
Watercourse
Kilometer Post
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace
PDL Buffer (~250 m)
Assessment Area

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Project Location
Kent, BC
NTS 50K Grid: 092H05/092H04

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by MPENNER on 20260311

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
4.1

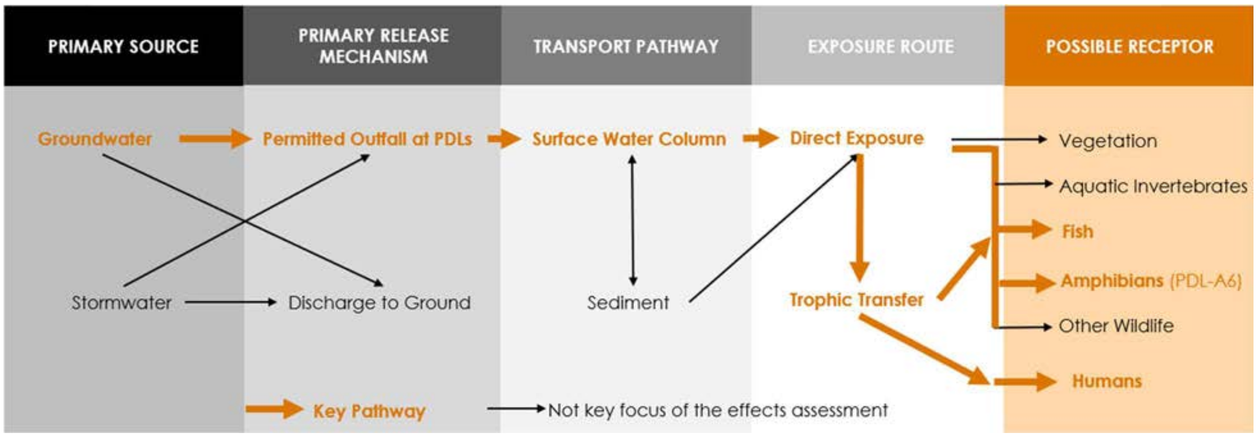
Title
Assessment Area - PDL-SBI9

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-30 By: jpoucher

4.1 Conceptual Site Model

A schematic depiction of the pathways connecting the sources of discharge water to potential receptors in the receiving environment is provided in the CSM (Figure 4.2). Each of the five components of the CSM (i.e., primary source, primary release mechanism, transport pathway, exposure route, possible receptor) is described in the following subsections.

Figure 4.2 Conceptual Site Model for Agassiz Loop



4.1.1 Primary Sources

It is anticipated that most of the water discharged via the permitted PDLs will be related to groundwater intercepted from the pipeline trench, so this is considered the key pathway within the CSM and discussed in detail in this assessment. However, discharge will also include stormwater intercepted during precipitation events. Pipeline construction activities are planned to avoid the wetter months, to the extent possible; this approach is anticipated to help limit the amount of precipitation and surface water runoff that will be intercepted. Stormwater, and potential sediment issues, will be managed through typical pipeline construction mitigation measures and the Project's EPP, as discussed in detail in Section 3.5.3.1 and Section 6.6.

Stormwater and groundwater intercepted during trench dewatering along the pipeline loop will be collected along the pipeline footprint. Groundwater will be extracted through wellpoint systems installed along sections where the depth of pipeline excavation extends below the water table.

4.1.2 Primary Release Mechanism

The collected groundwater released to surface water will undergo water treatment prior to discharge at a PDL. Treatment may include a combination of sediment removal, clarification, filtration, and aeration/oxidation to address turbidity and naturally elevated metal concentrations, depending on the groundwater quality and the site-specific discharge water quality requirements (Section 3.1.8).

The outfalls at the PDLs are the primary release mechanisms and these will be requested as the permitted discharge locations in the Section 15 Approval.

Four PDLs are being considered along the Agassiz Loop alignment. Three of these (PDL-A1, PDL-A8, and PDL-SBI9) would discharge directly to the Fraser River, which has a large receiving capacity (Section 3.2.2). PDL-A6 is Hicks Creek, which has a limited receiving capacity and is being considered for use in combination or as a back-up to the Fraser River PDLs for low discharge rates (Section 3.2.2).

As indicated in Section 3.2.2, the maximum increase in discharge will be limited to 10% of average monthly flows for Hicks Creek. The processed discharge rate is expected to avoid or limit the potential for negative impact on the aquatic habitat in the receiving environment, such as erosion of the bed and banks. For the Fraser River PDLs, a maximum of 10% of monthly flow in the Fraser River would vastly exceed the maximum discharge rate that Westcoast is requesting (284 L/s) so the actual increase in flow at PDL-A1, PDL-A8 and PDL-SBI9 will be substantially less than 10% of average monthly flows in the river.

Where dewatering rates and ground conditions are favourable, discharge to ground will be employed. Where dewatering rates exceed infiltration capacity for controlled discharge to ground, the excess dewatering discharge will be directed to a PDL. Based on the modelled groundwater inflow rates, it is anticipated that surface water discharge to the PDLs will remain the primary release mechanism.

Discharge to ground is not considered as a key pathway within the CSM (Figure 4.2) and is not discussed further in the effects assessment for the following reasons:

1. Per the IRT, dewatering and discharge to ground is part of general pipeline construction activities assessed for the Project by the CER, and the Section 15 Approval is focused on discharge to surface waters.
2. Dewatering involves temporary localized removal of groundwater to maintain dry excavation conditions. Groundwater quality is not expected to change because of construction dewatering or associated discharge activities.
3. Where discharge to ground occurs, it will generally involve returning the infiltration of groundwater removed during dewatering back to the shallow subsurface groundwater table at nearby locations.

A pilot dewatering testing program is planned for 2026 to assess the feasibility of the discharge to ground-option, including monitoring infiltration capacity and potential groundwater mounding effects.

Construction activities, including trench excavation, temporary dewatering, and subsequent backfilling, are not expected to result in measurable or long-term changes to the regional groundwater flow regime. Following pipeline installation, the trench will be backfilled with soil, using native material placed in compacted lifts, matching pre-construction soil stratigraphy to the extent practicable. This approach limits the potential for the trench to either act as a preferential pathway for groundwater flow or to create hydraulic barriers. Groundwater levels along the pipeline loop alignment are primarily controlled by regional recharge conditions and hydraulic gradients within the aquifer system. No measurable changes to groundwater flow direction, groundwater availability, or groundwater use are anticipated once the trench is restored.

4.1.3 Transport Pathway

The CSM considers two pathways between the permitted outfalls and the receptors: 1) water mixing in the PDL's surface water column, and 2) addition or change in sediment. Treated water will be routed from water treatment to the designated PDLs through temporary piping and will be discharged through stabilized outfalls with erosion protection and flow dissipation measures to avoid scour and habitat disturbance.

Two approaches that Westcoast is currently considering for controlling the release of water discharge into the PDLs are 1) an instream floating discharge structure consisting of a perforated pipe discharging water directly into the receiving waterbody, and 2) the use of a perforated pipe placed at the top of a bank and releasing water down the bank slope over an impermeable liner.

Both options are focused on reducing potential for localised erosion associated with the discharge structure while also avoiding disturbance of the channel bed; consequently, introduction of sediment is not considered a key pathway.

4.1.4 Exposure Routes

In the CSM, exposure routes associated with pipeline dewatering discharges during construction are direct exposure to changes in physical condition (e.g., water temperature) or water chemistry (e.g., concentrations of DO or pH), and indirect exposure to constituents via the ingestion of food or prey. More generally, routes of exposure include air, water, soil, sediments, food, and other media to which the organism may be exposed. The CSM considers direct exposure to changes in physical conditions and surface water chemistry as the key pathway for changes in water quality to affect possible receptors.

Generally, aquatic vegetation, aquatic invertebrates, fish, and wildlife have direct uptake when exposed to parameters in sediment and water present in both dissolved and particulate forms, with uptake occurring from sediment porewater, overlying surface water, the ingestion of prey, and the ingestion of sediments. Changes in water quality (e.g., DO, turbidity, and TSS levels) have the potential to cause ecologically relevant effects to the development, growth, and survival of aquatic life (e.g., Schürings et al. 2025).

Higher trophic level receptors (e.g., carnivorous fish, amphibians, piscivorous wildlife, humans) have the potential for trophic transfer from consuming lower trophic level receptors (e.g., aquatic vegetation, aquatic invertebrates, and lower trophic level fish) that have direct uptake. As fish and amphibians have the potential for direct exposure to changes in water quality, including changes to parameters that are critical for their habitat (temperature, DO, turbidity, and TSS), the potential for adverse effects to fish and amphibians are the key focus of the effects assessment. Humans are also considered as a key higher trophic level receptor, given the potential for consumption of fish and the use of water from around the PDLs for crops and livestock. The possible receptors are discussed further in Section 4.1.5.

4.1.5 Possible Receptors

This section provides information on possible receptors in the receiving environment. Figure 4.2 identifies six possible receptors (i.e., vegetation, aquatic invertebrates, fish, amphibians, other wildlife, humans) for the receiving environments of the PDLs. This section also provide a rationale for the identification of the 'key receptors' (i.e., fish, amphibians, humans; see Figure 4.2) that are carried forward as the focus of the effects assessment (Section 4.2).

4.1.5.1 Vegetation

Vegetation is a possible receptor for the direct exposure pathway through exposure to the surface water column. Aquatic macrophytes, including sedges (*Carex* sp.), rushes (*Juncus* sp.), bulrushes (*Scirpus* sp.), horsetail (*Equisetum* sp.), and reed canarygrass (*Phalaris arundinacea*) will interact with the PDL receiving environments.[1] Additionally, algae are present in the PDL receiving environments. Terrestrial vegetation within the riparian areas adjacent to the Fraser River and Hicks Creek PDLs (e.g., black cottonwood [*Populus trichocarpa*], bigleaf maple [*Acer macrophyllum*], western redcedar [*Thuja plicata*], red alder [*Alnus rubra*], willow [*Salix* sp.], red-osier dogwood [*Cornus sericea*], spirea [*Spiraea* sp.], thimbleberry [*Rubus parviflorus*], snowberry [*Symphoricarpos* sp.], and Himalayan blackberry [*Rubus armeniacus*]; see Table 2.26) is not expected to interact directly with the PDL receiving environments. While not a key receptor, aquatic vegetation is a lower-level component of the trophic transfer pathway to the upper trophic level key receptors (i.e., fish, amphibians, humans) (see Section 4.1.4).

4.1.5.2 Aquatic Invertebrates

Aquatic invertebrates are a possible receptor for the direct exposure pathway and the trophic transfer pathway via consumption of aquatic vegetation and aquatic invertebrates. Aquatic invertebrates, particularly species that are sessile or less mobile (e.g., freshwater bivalves) and those that feed directly on substrates (e.g., mosquito and caddisfly larvae, freshwater snails), are susceptible to effects from changes in habitat quality due to changes in water and sediment quality. Aquatic invertebrates are exposed to water and sediment quality parameters present in both dissolved and particulate forms, with uptake occurring from sediment porewater, overlying surface water, the ingestion of prey and forage items, and the ingestion of sediments. Changes in water and sediment quality (e.g., via introduction or

1 Aquatic macrophytes are macroscopic plants with life cycles that take place completely or periodically in the aquatic environment; this group includes species that are emergent, submerged, or floating (Lesiv et al. 2020).

redispersal of constituents) have the potential to affect aquatic invertebrate reproduction, development, growth, and survival (e.g., Banerjee et al. 2023; Schürings et al. 2025). While not a key receptor, aquatic invertebrates are a lower-level component of the trophic transfer pathway to the upper trophic level key receptors (i.e., fish, amphibians, humans) (see Section 4.1.4).

4.1.5.3 Fish

Fish are considered a key receptor for the direct exposure pathway as they are anticipated to be present in the aquatic habitats that are part of the PDL receiving environment. A wide variety of fish species have the potential to be present around the PDLs including white sturgeon, salmonid species (e.g., salmon, trout, char, and whitefish species), bait fish species (e.g., minnows), and other fish species (e.g., suckers, sculpin, lamprey). Life histories and diets of fish species potentially present in PDL receiving environments vary. Some fish species are stream-resident while others are anadromous. Diets also vary greatly and include plankton, copepods, invertebrates, fish, and small amphibians (e.g., tadpoles). See Section 2.5.2.1 for more details about the species, habitat and life histories of fish in the vicinity of each PDL receiving environment.

Fish are also considered a key receptor through the trophic transfer via the consumption of aquatic vegetation, aquatic invertebrates, smaller fish, and amphibians. Potential constituents (e.g., metals) can be transferred into the bodies of fish from prey or food and can accumulate in tissue if the fish does not have a method to break them down or remove them (Saidon et al. 2024). Concentrations of constituents that cannot be broken down move up the aquatic food web, so predators and piscivorous fish can have higher concentrations than those at lower trophic levels and thus, can be more impacted by their effects (Saidon et al. 2024). Bioaccumulation of constituents in fish can vary widely between fish species depending on factors such as feeding habits and detoxification mechanisms and can also be affected by the growth stage, age, sex, and body condition of fish (Saidon et al. 2024).

4.1.5.4 Amphibians

Amphibians are not possible receptors for the Fraser River PDLs because this large watercourse is not amphibian habitat (see Section 2.5.2.2). For PDL-A6 (Hicks Creek), amphibians are considered key receptors for the direct exposure pathway and the trophic transfer pathway via consumption of aquatic vegetation and aquatic invertebrates (Figure 4.2). Native amphibian species[2] that are most likely to interact with the PDL-A6 receiving environment are Pacific treefrog, northern red-legged frog, and northwestern salamander, but rough-skinned newt may also be present (see Section 2.5.2.2). While the adults of these species can readily leave the water and may spend considerable time in the terrestrial environment, their eggs and larvae are aquatic (TRU and BC MOE 2021b). Collectively, the approximate timing of the aquatic life stages of Pacific treefrog, northern red-legged frog, northwestern salamander, and rough-skinned newt at low elevation in the Pacific Northwest (i.e., comparable to the PDL-A6 receiving environment) is January to September (per BC MFLNRO 2014b, 2016).

---

[2] Introduced (exotic) species (i.e., American bullfrog, green frog) are excluded from consideration in the effects assessment.

With respect to the trophic transfer pathway, like fish (see Section 4.1.5.3), potential constituents, including bioaccumulators (e.g., mercury, selenium), can be ingested by amphibians when their diet is aquatic based. The adult diets of the amphibian species likely to be present consist predominantly of terrestrial invertebrates, although adult rough-skinned newts will also feed on aquatic invertebrates and amphibian eggs and larvae (AmphibiaWeb 2020; TRU and BC MOE 2021b; AmphibiaWeb 2023a, 2023b; AmphibiaWeb 2025; CHS 2025a, 2025b). Larvae and juveniles have aquatic-based diets that are, depending on the species, either herbivorous (feeding on algae, organic detritus) or carnivorous (feeding on zooplankton, insect larvae, small crustaceans, tadpoles) (TRU and BC MOE 2021b; AmphibiaWeb 2020; AmphibiaWeb 2025; CHS 2025a, 2025b).

4.1.5.5 Other Wildlife

Mammals, birds, and reptiles, collectively referred to in this TAR as ‘other wildlife’, are possible receptors for the direct exposure pathway and the trophic transfer pathway via consumption of aquatic vegetation, aquatic invertebrates, fish, and amphibians. ‘Other wildlife’ in the context of this assessment are defined as wildlife species that do not have life stages that are wholly aquatic in the same manner as fish and amphibian eggs and larvae. Mammals, birds, and reptiles may interact directly, but not continuously, with the PDL receiving environments when foraging, hunting, drinking, travelling, nesting, basking, and overwintering (turtles).

Turtles are the ‘other wildlife’ group most likely to interact directly with the PDL receiving environments. Painted turtle (Pacific Coast population), a species of conservation concern (see Section 2.5.2.2), moves between terrestrial and freshwater habitats and lays its eggs on land (ECCC 2021). The species prefers to forage in warm, shallow, slow-moving or stagnant water with emergent and floating vegetation (ECCC 2021). Adult diet includes insects, snails, earthworms, frogs, tadpoles, algae, aquatic plants, and carrion; juveniles are more carnivorous than adults (TRU and BC MOE 2021c). During the winter, individuals hibernate underwater, buried in the bottom of ponds or under submerged undercut banks, for a prolonged period (TRU and BC MOE 2021c). The hibernation period for painted turtle in the Lower Mainland and Fraser Valley is November to February (ECCC 2021).

Based on habitat preferences, painted turtle would not be associated with the Fraser River. Although their critical habitat does not interact directly with the Project’s pipeline footprint, there remains a possibility that painted turtle may be present within the area, and for the purposes of this assessment they are considered to have some potential to interact with the broader Hicks Creek receiving environment; however, there are few publicly available turtle records around Agassiz (see Section 2.5.2.2). Red-eared slider has similar habitat requirements to painted turtle, but it is an introduced species, poses a threat to amphibians, and may compete with painted turtle (TRU and BC MOE 2021c).

‘Other wildlife’ are not considered a key receptor because, as defined above, their direct interactions with the PDL receiving environments are spatially and temporally limited. Further, in the case of the painted turtle, evidence suggests that this species is unlikely to be present in the PDL receiving environments.

4.1.5.6 Humans

Humans are considered a key receptor based on their potential for trophic transfer via consumption of crops, livestock, and fish. Humans are likely to consume fish taken in proximity to the PDLs. There are several locations used for fishing documented near the Fraser River PDLs (PDL-A1, PDL-A8, and PDL-SBI9; see Fish ‘n BC 2018). Trophic transfer may also occur through use of water from the PDL receiving environments for watering crops and livestock that will ultimately be consumed by humans (see Section 4.1.4).

The direct exposure pathway for humans pertaining to changes in groundwater and surface water quantity and quality was considered because there is use of surface water and groundwater by humans in proximity to the Agassiz Loop. However, water quality changes to groundwater wells are not anticipated and direct consumption of surface water is considered unlikely. As discussed in Section 2.3.2.1.5, there are numerous water licences, water use applications, and well records within 1 km of the Agassiz Loop that use both surface water and groundwater. Surface water licences within this area are used for irrigation and domestic uses. There are no documented points of diversion for drinking water sources, and some serviced lots have municipal sources of drinking water or groundwater wells in the area, so humans are not likely directly consuming surface water in proximity to the PDLs (GOBC 2023).

4.2 Effects Assessment

This section evaluates potential effects related to changes in surface water quality associated with construction dewatering and Project-related discharges. The assessment is focused on potential changes to surface water quality conditions that could occur during the construction phase.

Potential effects to aquatic and human receptors are considered in the context of the CSM presented in Section 4.1. The potential receptors identified in the CSM may be exposed through direct contact with surface water or through indirect pathways associated with water use. Consistent with the CSM, potential effects to receptors are evaluated through consideration of surface water quality, as changes in water quality represent the primary pathway by which Project-related discharges could affect these receptors.

The surface water quality effects assessment is presented as a residual effects assessment, meaning it evaluates potential changes in the receiving environment after proposed mitigation measures, treatment technologies, and best management practices have been applied. Accordingly, the assessment assumes implementation of the mitigation measures described in Sections 3 and 6, including compliance with site-specific DQC, and considers whether Project-related discharges have the potential to alter receiving environment water quality in a manner that could result in adverse effects to surface water quality or key receptors.

Section 4.2.1 describes the methods, assumptions, assessment boundaries, and criteria used to assess potential surface water quality effects. Section 4.2.2 presents the results of the surface water quality assessment and the interpretation of potential effects to water quality and receptors. Section 4.2.3 discusses effluent loading considerations, and Section 4.2.4 summarizes the effects assessment and characterizes residual effects.

4.2.1 Effects Assessment Methods

This section describes the methods used to assess the potential effects related to changes in surface water quality. Detailed characterization of existing conditions (i.e., background) is presented in Section 2; POC screening and the development of DQCs are presented in Section 3.3.

The surface water quality effects assessment evaluates whether Project-related discharges during construction could result in changes to surface water quality or effects to receptors identified in the CSM. The assessment focuses on POCs and general water quality parameters relevant to construction dewatering and associated discharges identified in Section 3.3.

4.2.1.1 Temporal and Spatial Boundaries

The Section 15 Approval duration is a maximum of 15 months and pending approval is assumed to be valid approximately April 2027 to June 2028. Therefore, this period defines the temporal boundary with a focus on the anticipated construction discharge period during the drier months (i.e., April to October 2027). The spatial boundary for water quality effects predictions is defined separately for each receiving water and associated PDLs. The PDLs and assessment boundaries for the loop are:

- PDL-A1, PDL-A8, and PDL-SBI9 (Fraser River) - approximately 250 m PDL buffer extent, plus 50 m upstream and 100 m downstream of the buffer extent with approximately 20 m from top of bank into the Fraser River channel of each PDL (Figure 4.1)
- PDL-A6 (Hicks Creek) - approximately 250 m PDL buffer extent, plus the Hicks Creek watershed to where it discharges to Maria Slough (Figure 4.1)

These spatial boundaries define the extent of the receiving environments over which potential water quality effects are assessed for each PDL, as described in the following sections.

4.2.1.2 Benchmarks

For the purposes of this assessment, benchmarks refer to the numerical water quality values used to evaluate potential Project-related effects on surface water quality, including applicable WQGs (i.e., chronic and acute WQG-FAL and WQOs) and background surface water quality. Where WQGs are dependent on site-specific toxicity modifying factors (TMFs), benchmark values were conservatively derived to represent protective conditions across the receiving environments considered, consistent with the intended application of chronic and acute guidelines.

The benchmarks defined above are used to evaluate potential effects related to changes in surface water quality by informing the derivation of Project-specific discharge quality criteria (DQC) and characterizing potential Project-related effects to the receptors identified in the CSM (Section 4.1). For the purposes of this assessment, the DQCs represent end-of-pipe concentrations following implementation of the proposed treatment measures (Section 3.1.8).

Benchmark selection is based on the protection of aquatic life within the receiving environment. Accordingly, aquatic life water quality guidelines (i.e., chronic and acute WQG-FAL and WQO) and 95P background surface water quality are used as the primary benchmarks for the development of DQCs and evaluating potential Project-related effects. In general, aquatic life guidelines are more stringent than guidelines developed for other water uses and are, therefore, considered protective of those uses in most cases.

Other water uses identified at a conceptual level in the CSM (e.g., human use) do not define the applicable benchmarks for this assessment. However, proposed DQCs are compared to drinking water, recreational, wildlife, livestock watering, and irrigation guidelines for context only; these guidelines are not used to define effects or benchmarks for the surface water quality assessment.

Where background surface water concentrations exceed applicable aquatic life water quality guideline values, including both long-term (chronic) and short-term (acute) benchmarks, the assessment focuses on whether Project-related discharges could increase receiving water concentrations beyond the range of background variability. As discussed in Section 3.3.2.2, statistically significant seasonal differences (April to October versus November to March) were not identified for the Fraser River or Hicks Creek (Appendix N); therefore, background concentrations were pooled across seasons to support derivation of representative upper-bound (95P) background benchmarks used in the effects assessment.

For parameters with variable aquatic life guidelines (i.e., those dependent on TMFs such as pH, hardness, and dissolved organic carbon), benchmark values were derived using site-specific water chemistry, consistent with the methods described in Section 2.3.1.5. Chronic benchmarks are conservatively defined as the lower-quartile of site-specific guideline values calculated across potential receiving environments, consistent with the intended application of chronic guidelines to temporally averaged concentrations. Acute benchmarks are defined as the most restrictive (i.e., minimum) variable guideline values calculated across potential receiving environments, consistent with the intent of acute guidelines to protect against brief, episodic exposures.

For receiving environments where an IDZ applies (i.e., the Fraser River), benchmark comparisons are based on predicted receiving-water concentrations following initial mixing (Section 4.2.1.4). Where an IDZ is not applicable (i.e., Hicks Creek), benchmark comparisons are based on concentrations at the point of discharge.

4.2.1.3 Initial Dilution Zone Assessment

An IDZ assessment was considered appropriate for the Fraser River proposed discharge locations (PDL-A1, PDL-A8, and PDL-SBI9) based on the physical and hydrological characteristics of the receiving environment. The Fraser River is a large river system with substantial flow, well-defined channel morphology, and a capacity for rapid and predictable mixing under typical flow conditions. As a result, the application of an IDZ-based approach for the Fraser River aligns with provincial guidance indicating that IDZs are applicable in large receiving environments where mixing processes can be reasonably characterized (BC MECCS 2019a).

For the Fraser River PDLs, DQCs were therefore developed with consideration of anticipated mixing and dilution within an IDZ, rather than assuming limited dilution at the point of discharge. A conservative IDZ assessment was completed to support this approach, using low-flow conditions to represent a reasonable lower bound for dilution potential (Section 3.2.2). Within this effects assessment, the IDZ provides an appropriate framework for evaluating potential effects in the receiving environments of the Fraser River PDLs.

An IDZ-based assessment was not completed for the Hicks Creek proposed discharge location (PDL-A6). Hicks Creek is a small, low-order watercourse with limited flow, a flat longitudinal slope, and a mixed natural/human-made channel configuration in the vicinity of PDL-A6. Flow conditions in Hicks Creek are influenced by local drainage inputs and managed features, including flood gates, and there is evidence that the creek may experience very low or intermittent flow conditions (Section 2.2). As a result, the potential for rapid or substantial mixing is limited relative to a large river system such as the Fraser River.

Given these characteristics, DQCs for Hicks Creek were developed using a conservative approach that does not rely on an IDZ-based mixing assumption and instead assumes limited dilution at the point of discharge (Section 3.3 presents the development of the DQCs). This approach is consistent with BC ENV guidance, which indicates that IDZs are most applicable to large, high-energy receiving environments where predictable and rapid mixing can be demonstrated (BC MECCS 2019a). Accordingly, an IDZ was not considered appropriate or necessary for the Hicks Creek PDL as part of the Agassiz Loop effects assessment.

4.2.1.4 Parameters Evaluated

The assessment evaluates parameters relevant to construction dewatering and associated discharges and the POCs identified through the screening process described in Section 3.3.1.

Parameters evaluated include the POCs carried forward from Section 3.3.2 (i.e., nutrients, anions, and metals) and general water quality parameters (e.g., turbidity, TSS, and DO). Due to their bioaccumulation and biomagnification potential, selenium and mercury were also carried forward to the effects assessment as POCs regardless of whether they exceed the WQG-FAL (per POC Fact Sheet [BC MECCS 2024a]).

4.2.1.5 Effects Characterization

Potential effects to surface water quality and key receptors (i.e., freshwater aquatic life, and humans; Section 4.1.5) are characterized using a standard set of effects criteria, including magnitude, geographic extent, duration, frequency, and reversibility (Table 4.1). These criteria are applied to interpret the nature and relative importance of potential Project-related changes under the assessed discharge assumptions and in relation to existing surface water quality conditions.

Table 4.1 Effects Characterization Criteria and Categories

Criterion	Definition	Category
Magnitude	Magnitude describes the degree of Project-related change in surface water quality relative to existing background conditions and applicable assessment benchmarks. Where DQCs are derived from background concentrations, the magnitude of change is inherently constrained by the range of observed existing conditions. Where DQCs are derived from applicable WQG-FAL, the magnitude of change is characterized relative to DQCs rather than background conditions.	**Negligible**: No measurable change relative to background conditions; concentrations remain indistinguishable from background variability. **Low**: Project-related conditions remain within the range of background variability or do not exceed applicable DQC. **Moderate**: A measurable change that exceeds background variability or applicable DQCs but remains localized and limited in extent. **High**: A large change that substantially exceeds background conditions or applicable DQCs and represents a clear departure from existing conditions and the potential for adverse effects to aquatic receptors.
Geographic Extent	Geographic extent describes the spatial area over which Project-related changes in surface water quality may occur.	In this assessment, geographic extent is defined by the applicable assessment framework for each receiving environment. Where an initial dilution zone (IDZ) applies, potential effects are evaluated within the near-field mixing area used for post-mixing predictions. Where an IDZ is not defined, potential effects are evaluated at the point of discharge using an end-of-pipe DQCs framework, without assuming dilution in the receiving environment. Accordingly, potential Project-related effects are expected to be spatially limited and confined to the immediate receiving environment associated with each discharge location.
Duration	Duration describes the length of time over which Project-related changes in surface water quality may persist.	**Short-term**: Effects occurring only during periods of active discharge associated with construction activities. **Medium-term**: Effects that persist for a limited period following the end of construction activities (generally on the order of a few months) and diminish as discharge ceases and receiving-environment conditions stabilize. **Long-term**: Effects persisting beyond construction and not expected to recover in the near term.

Criterion	Definition	Category
Frequency	Frequency describes how often Project-related changes in surface water quality may occur.	**Single event**: One-time occurrence. **Intermittent**: Occurring periodically during active discharge periods, with discharges separated by periods of no discharge over the construction phase; periods of continuous discharge up to weeks or months may occur. **Continuous**: Occurring on an ongoing basis throughout the Section 15 Approval (within 15 month) period.
Reversibility	Reversibility describes the extent to which surface water quality is expected to return to baseline or background conditions following cessation of Project-related discharges.	**Reversible**: Surface water quality is expected to return to baseline or background conditions following cessation of discharge. **Partially reversible**: Recovery is expected, but residual changes may persist. **Irreversible**: Recovery to baseline conditions is not expected.

The effects characterization criteria are applied in Section 4.2.2 to interpret potential Project-related effects to surface water quality and key receptors. Effects conclusions are based on the relationship between discharge concentrations, DQC, background surface water quality, and applicable aquatic life benchmarks.

4.2.1.6 Risk Management Matrix

As part of the residual effects assessment approach, the need for a project-specific risk management matrix was evaluated. A matrix would be warranted where residual effects are predicted to be moderate or high in magnitude, persistent beyond the construction phase, associated with sustained exposure pathways, exceed applicable water quality guidelines by a substantial margin relative to background variability, or where there is uncertainty regarding effect reversibility.

Where residual effects are characterized as low magnitude, localized, short-term, intermittent, and reversible, and where predicted changes are small relative to background variability and generally within applicable guideline ranges, a project-specific risk management matrix is not required because the overall level of risk is low and the effects pathways are adequately addressed through the residual effects characterization.

4.2.2 Potential Effects on Surface Water Quality and Receptors

The water quality effects assessment evaluates whether Project-related discharges could result in adverse effects to surface water quality or associated receptors by applying the assessment benchmarks and evaluation approach described in Section 4.2.1.

Potential effects to surface water quality are evaluated for the Fraser River and Hicks Creek.
The Fraser River includes an IDZ in the receiving environment; therefore, potential effects are assessed based on predicted receiving-water concentrations following initial mixing (Section 4.2.2.1). The methods used to calculate post-mixing concentrations at the Fraser River discharge locations are provided in Section 4.2.1.3. Hicks Creek does not include an IDZ; accordingly, potential effects in the receiving environment are evaluated at the point of discharge based on DQC, without assuming dilution (Section 4.2.2.2).

4.2.2.1 Fraser River

Predicted post-mixing concentrations in the receiving environment are below the applicable long-term WQG-FAL and/or comparable to the 95P of background surface water quality. The proposed DQCs, background water quality conditions, and estimated post-mixing concentrations in the Fraser River are summarized in Table 4.2 (see Section 3.3 where the development of the DQCs is presented).

For nitrate (as N) at the Fraser River discharge locations (PDL-A1, PDL-A8, PDL-SBI9), predicted post-mixing concentrations in the receiving environment are below the applicable long-term WQG-FAL, indicating that guideline exceedances are not expected following initial mixing. Similarly, for nitrite (as N), predicted receiving-water concentrations are below the long-term guideline and closely aligned with background surface water quality, supporting the conclusion that Project-related increases beyond the range observed for existing conditions are not anticipated.

For several metals, including total aluminum, total iron, and total mercury, predicted discharge concentrations are below background surface water concentrations. As a result, predicted post-mixing concentrations in the receiving environment remain comparable to background conditions, indicating no Project-related change following initial mixing. This same rationale applies to dissolved copper, where predicted receiving-water concentrations are effectively indistinguishable from background surface water quality.

For other parameters, including total selenium, dissolved cadmium, dissolved cobalt, dissolved iron, and dissolved manganese, predicted post-mixing concentrations in the receiving environment are below the applicable long-term WQG-FAL (or in the case of dissolved iron, below the short-term CWQG-AL) and closely aligned with background surface water quality. In these cases, although discharge concentrations may be higher than background, initial mixing results in receiving-water concentrations remain within the upper range of background variability and below guideline values, indicating no anticipated Project-related effects.

Dissolved nickel is the only parameter for which predicted post-mixing concentrations marginally exceed the long-term WQG-FAL at the edge of the IDZ. However, predicted receiving water concentrations of nickel are closely aligned with the 95P background concentration at each Fraser River discharge location, with only a small magnitude of change relative to background conditions (i.e., at most ~1.1 times background). The long-term WQG-FAL for dissolved nickel is conservatively derived using lower-bound chronic toxicity endpoints and an assessment factor of 2 applied to the HC5 (i.e., the hazard concentration corresponding to the 5^{th} percentile of species sensitivity; BC MECCS 2019b). The most sensitive taxa contributing to the nickel Biotic Ligand Model (BLM) dataset (i.e., *Lymnaea stagnalis, Ceriodaphnia dubia, and Hyalella azteca*) are associated with stagnant or low-velocity, depositional habitats (e.g., ponds, wetlands, and sloughs) and are therefore, not considered representative of the high-energy Fraser River mainstem. For organisms likely to be present in the Fraser River mainstem, the lowest nickel effect concentration underpinning the guideline is approximately 9 µg/L, based on chronic growth effects in the mayfly *Neocloeon triangulifer*. When normalized to site-specific conditions, the BLM results indicate that effect concentrations (i.e., toxicity thresholds) for this species range from approximately 9 to 30 µg/L based on sample-by-sample water chemistry for pH, water hardness, and dissolved organic carbon. As predicted nickel concentrations are approximately within the range of background variability and below biologically meaningful effect levels for mainstem aquatic taxa, adverse Project-related effects to aquatic life are not anticipated for nickel.

For context, the DQCs for the Fraser River were also compared to BC guidelines for drinking water, wildlife, livestock watering, and irrigation. Exceedances were not identified except for total iron, for which the DQC (2.97 mg/L), derived from existing background surface water quality, exceeds the drinking-water aesthetic objective (0.3 mg/L). As aesthetic objectives relate to water appearance rather than health-based effects, and the DQCs reflects background conditions rather than a Project-related increase, Project-related changes or effects are not anticipated.

Overall, the combined evaluation of post-mixing concentrations relative to water quality guidelines, background surface water quality, and discharge concentrations supports the conclusion that Project-related discharges are not expected to result in adverse effects to surface water quality or aquatic receptors in the Fraser River following initial mixing.

Temporal and spatial variability in background surface water quality for Fraser River is summarized in Appendices G.1 and G.2 (box-plots and time-series plots for existing conditions), Appendix N (seasonal box-plots), and Appendix O (box-plots for background-based DQCs). These data provide context for the derivation of background-based DQCs and support the characterization of potential effects presented above.

Table 4.2 Comparison of Proposed Discharge Quality Criteria to Guidelines, Background Conditions, and Post-Mixing Concentration in the Fraser River

Fraser River Discharge Location	Parameter of Concern	95P Untreated Discharge Concentration (mg/L) [a]	Discharge Quality Criterion (mg/L)	Water Quality Guideline		95P Background Surface Water Concentration (mg/L)	Post-Mixing Condition Within IDZ			Rationale for Project-Related Effects Not Being Anticipated After Initial Mixing
				Chronic (mg/L)	Acute (mg/L)		Mixed Concentration Within IDZ (mg/L)	Magnitude Relative to Chronic WQG-FAL (mg/L)	Magnitude Change Relative to 95P Background	
PDL-A1, PDL-A8	Nitrate (as N)	31.6	32.8	3	32.8	0.289	0.391	0.13	1.35	[Mixed] < [Chronic WQG-FAL]
PDL-A1, PDL-A8	Nitrite (as N)	0.226	0.06	0.02	0.06	0.005	0.00517	0.26	1.03	[Mixed] < [Chronic WQG-FAL] and [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Aluminum (T)	0.636	*	0.167	-	2.09	2.09	12.5	1.00	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Iron (T)	1.73	2.97	0.3	1	2.97	2.97	9.90	1.00	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Mercury (T)	0.00000524	*	0.00000125	-	0.00000858	0.00000857	6.86	0.99	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Selenium (T)	0.00156	*	0.002	-	0.00017	0.000174	0.09	1.02	[Discharge] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Cadmium (D)	0.000386	0.000312	0.000139	0.000326	0.0000188	0.0000197	0.14	1.05	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Cobalt (D)	0.00281	*	0.000402	-	0.0002	0.000208	0.52	1.04	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Copper (D)	0.00242	0.00151	0.0007	0.0041	0.00151	0.00151	2.16	1.00	[Mixed] ≈ [Background]
PDL-A1, PDL-A8	Iron (D)	1.65	0.35	-	0.35	0.0915	0.0923	0.26	1.01	[Mixed] < [WQG-FAL]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Manganese (D)	2.92	*	0.32	-	0.0829	0.0878	0.27	1.06	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-A1, PDL-A8	Nickel (D)	0.0155	0.0167	0.0011	0.0174	0.0013	0.00135	1.23	1.04	[Mixed] ≈ [Background]; see text.
PDL-SBI9	Nitrate (as N)	31.6	32.8	3	32.8	0.289	0.579	0.19	2.00	[Mixed] < [Chronic WQG-FAL]
PDL-SBI9	Nitrite (as N)	0.226	0.06	0.02	0.06	0.005	0.00549	0.27	1.10	[Mixed] < [Chronic WQG-FAL] and [Mixed] ≈ [Background]
PDL-SBI9	Aluminum (T)	0.636	*	0.167	-	2.09	2.08	12.5	1.00	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-SBI9	Iron (T)	1.73	2.97	0.3	1	2.97	2.97	9.87	1.00	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-SBI9	Mercury (T)	0.00000524	*	0.00000125	-	0.00000858	0.00000855	6.84	1.00	[Discharge] < [Background]; [Mixed] ≈ [Background]
PDL-SBI9	Selenium (T)	0.00156	*	0.002	-	0.00017	0.000182	0.09	1.07	[Discharge] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-SBI9	Cadmium (D)	0.000386	0.000312	0.000139	0.000326	0.0000188	0.0000214	0.15	1.14	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-SBI9	Cobalt (D)	0.00281	*	0.000402	-	0.0002	0.000223	0.55	1.11	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-SBI9	Copper (D)	0.00242	0.00151	0.0007	0.0041	0.00151	0.00151	2.14	1.00	[Mixed] ≈ [Background]
PDL-SBI9	Iron (D)	1.65	0.35	-	0.35	0.0915	0.0938	0.27	1.03	[Mixed] < [WQG-FAL]; [Mixed] ≈ [Background]
PDL-SBI9	Manganese (D)	2.92	*	0.32	-	0.0829	0.0969	0.30	1.17	[Mixed] < [Chronic WQG-FAL]; [Mixed] ≈ [Background]
PDL-SBI9	Nickel (D)	0.0155	0.0167	0.0011	0.0174	0.0013	0.00144	1.31	1.11	[Mixed] ≈ [Background]; see text.

Notes:

[a] Untreated discharge will be treated to meet DQCs prior to discharge (Section 3.1.8).

DQCs = Discharge Quality Criteria; 95P = 95th percentile; T = total; D = dissolved; IDZ = Initial Dilution Zone

Asterisk = no proposed DQCs due to untreated discharge concentration below acute WQG-FAL or no acute WQG-FAL exists; for each of these POC, chronic WQG-FAL will be met after mixing within the IDZ in Fraser River.

The 95P untreated discharge concentration is based on pooled groundwater samples across the Agassiz Loop. The 95P background surface water concentration is pooled across Fraser River sites PDL-A1, PDL-A8, and PDL-SBI9.

[Mixed] = post-mixing concentration; [Discharge] = concentration of discharge (regardless of treatment); [Chronic WQG-FAL] = chronic guideline concentration; [Background] = concentration of 95P background surface water.

4.2.2.2 Hicks Creek

For Hicks Creek, potential effects to surface water quality are evaluated at the point of discharge using an end-of-pipe DQCs framework, without assuming dilution in the receiving environment (Section 3.3 presents the development of the DQCs). This approach reflects the absence of an applicable IDZ for this watercourse and provides a conservative basis for effects characterization.

For parameters with proposed DQCs derived from long-term aquatic life water quality guidelines, including nitrate (as N), dissolved cadmium, and dissolved manganese, potential effects in the receiving environment are evaluated at the point of discharge without assuming dilution. For these parameters, the effects characterization focuses on whether discharge concentrations corresponding to the proposed DQCs are indicative of conditions associated with chronic exposure effects, rather than on incremental change relative to existing background concentrations. Although the guideline-based DQCs for some parameters exceed typical background concentrations, these criteria are intended to be protective of aquatic life under long-term (chronic) exposure conditions. Under the assessed discharge assumptions, end-of-pipe concentrations are anticipated to remain within the applicable guideline-based DQC; accordingly, Project-related discharges are not anticipated to result in adverse effects to surface water quality or aquatic receptors in Hicks Creek for these parameters.

For the remaining POCs, including nitrite (as N), total aluminum, total iron, total mercury, total selenium, dissolved cobalt, dissolved copper, dissolved iron, and dissolved nickel, the applicable DQCs are derived from the upper range of observed background surface water quality (95P). For these parameters, potential effects are evaluated relative to existing ambient conditions rather than guideline thresholds. On this basis, Project-related discharges are not anticipated to extend beyond the range represented by background conditions, and Project-related effects to surface water quality or aquatic receptors are not anticipated for these parameters.

Selenium is carried forward as a POC due to its potential to biomagnify in aquatic food webs; however, untreated discharge concentrations are below the applicable chronic water quality guideline, and therefore, a DQC is not proposed for selenium. Mercury and selenium are discussed separately in Section 4.2.2.3, reflecting their distinct exposure pathways and bioaccumulation considerations.

Table 4.3 summarizes the proposed DQCs for Hicks Creek, corresponding background surface water quality (95th percentile), applicable aquatic life water quality guidelines, and contextual ratios illustrating the relative magnitude of DQCs compared to guideline values and existing conditions.

Table 4.3 Proposed Discharge Quality Criteria, Guidelines, and Background Conditions: Hicks Creek

Parameter of Concern	95P Untreated Wastewater (mg/L)[a]	DQC; End-of-Pipe Water Quality (mg/L)	Water Quality Guideline (WQG-FAL)		95P Background Receiving Environment (mg/L)	Rationale for Project-Related Effects Not Being Anticipated
			Chronic (mg/L)	Acute (mg/L)		
Nitrate (as N)	31.6	3	3	32.8	0.614	[DQC] = [Chronic WQG-FAL]
Nitrite (as N)	0.226	0.0304	0.02	0.06	0.0304	[DQC] = [Background]
Aluminum (T)	0.636	0.175	0.0729	-	0.175	[DQC] = [Background]
Iron (T)	1.73	2.01	0.3	1	2.01	[DQC] = [Background]
Mercury (T)	5.24×10^{-6}	3.44×10^{-6}	1.25×10^{-6}	-	3.44×10^{-6}	[DQC] = [Background]
Selenium (T)	0.00156	-	0.002	-	0.000248	[DQC] = [Background]
Cadmium (D)	3.86×10^{-4}	4.85×10^{-5}	4.85×10^{-5}	6.74×10^{-5}	2.10×10^{-5}	[DQC] = [Chronic WQG-FAL]
Cobalt (D)	0.00281	0.000896	0.00039	-	0.000896	[DQC] = [Background]
Copper (D)	0.00242	0.00173	0.0002	0.0006	0.00173	[DQC] = [Background]
Iron (D)	1.65	1.13	-	0.35	1.13	[DQC] = [Background]
Manganese (D)	2.92	0.32	0.32	-	0.207	[DQC] = [Chronic WQG-FAL]
Nickel (D)	0.0155	0.0031	0.0007	0.0095	0.0031	[DQC] = [Background]

Notes:

[a] Untreated discharge will be treated to meet DQCs prior to discharge (Section 3.1.8).

DQCs = Discharge Quality Criteria; 95P = 95th percentile; T = total D = dissolved; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life

For context, the DQCs for Hicks Creek were also compared to BC guidelines for drinking water, wildlife, livestock watering, and irrigation. Exceedances were not identified except for total iron, for which the DQCs (2.01 mg/L), derived from existing background surface water quality, exceeds the drinking-water aesthetic objective (0.3 mg/L). As aesthetic objectives relate to water appearance rather than health-based effects, and the DQCs reflects background conditions rather than a Project-related increase, Project-related changes or effects are not anticipated.

Temporal and spatial variability in background surface water quality for Hicks Creek is summarized in Appendices G.1 and G.2 (box-plots and time-series plots for existing conditions), Appendix N (seasonal box-plots), and Appendix O (box-plots and background-based DQCs). These data provide context for the derivation of background-based DQCs and support the characterization of potential effects presented above.

4.2.2.3 Special Case Parameters

Due to their potential to bioaccumulate and biomagnify in aquatic food webs, mercury and selenium were carried forward to the effects assessment regardless of whether predicted discharge concentrations exceed the WQG-FAL (per BC ENV guidance [BC MECCS 2024a]). The potential for Project-related mercury and selenium bioaccumulation is evaluated for the Fraser River and Hicks Creek in the following sections.

4.2.2.3.1 Fraser River

Mercury and selenium are recognized for their potential to bioaccumulate and biomagnify under certain environmental conditions. In the Fraser River, predicted post-mixing concentrations of total mercury and total selenium are comparable to background surface water quality and remain within the range of existing baseline variability. As a result, Project-related discharges are not expected to result in sustained increases in mercury or selenium concentrations beyond existing receiving-environment conditions.

Given the high-flow, high-energy nature of the Fraser River mainstem and short residence times following discharge, predicted post-mixing concentrations limit the potential for Project-related changes to mercury or selenium exposure at the base of the aquatic food web. Accordingly, Project-related increases in the potential for mercury or selenium bioaccumulation or biomagnification are not anticipated.

4.2.2.3.2 Hicks Creek

In Hicks Creek, potential effects related to mercury and selenium bioaccumulation are evaluated at the point of discharge without assuming dilution, consistent with the absence of an IDZ. The DQC for total mercury is derived from the 95P of background surface water quality, while a DQC for selenium is not proposed because concentrations in untreated discharge are below the WQG-FAL and within the range of background concentrations.

Because discharge concentrations for mercury and selenium are consistent with existing surface water quality conditions, Project-related changes to exposure conditions relevant to bioaccumulation and biomagnification are not anticipated. Accordingly, Project-related increases in the potential for mercury or selenium bioaccumulation or biomagnification in Hicks Creek aquatic receptors are not anticipated.

4.2.2.4 General Parameters

General water quality parameters, including pH, TSS, DO, and temperature, are managed through DQCs described in Section 3.3.2.2 and monitoring requirements outlined in Section 5 for Fraser River and Hicks Creek.

For TSS, the DQC is defined as 25 mg/L or background surface water concentrations, whichever is higher (described in Section 3.3.2.2). This approach accounts for existing background variability and is intended to limit Project-related increases above existing conditions. With application of this DQC, Project-related changes to TSS in the receiving environment are expected to be low in magnitude and are not anticipated to result in adverse effects to aquatic life.

For pH, the applicable DQCs is the range of 6.5 to 8.5. As this range is aligned with the WQO for Fraser River, and is applied at the point of discharge, potential effects related to pH are not anticipated.

The DQC for DO is established at ≥ 8 mg/L for the Agassiz loop. This criterion is consistent with the WQG-FAL and is intended to limit the potential for Project-related oxygen depletion in receiving waters. With application of the DQC, adverse effects related to DO are not anticipated.

For temperature, the DQC is based on adherence to the rate-of-change criteria (± 1 °C per hour) per the WQG-FAL (BC MOE 2001). As temperature effects are managed through compliance with this DQC, potential effects related to temperature are not anticipated.

Considerations related to field-measured monitoring and verification of compliance are addressed in Section 5.

4.2.3 Effluent Loading Considerations

This section provides additional context on effluent loading considerations that support the effects predictions summarized in Section 4.2.4.

Discharge loading represents the mass of a constituent released over time and is determined by the combination of effluent concentration and discharge volume. In this assessment, potential effects are evaluated using concentration-based DQCs applied either at the point of discharge (where an IDZ is not defined) or following initial mixing (where an IDZ applies). By establishing upper bounds on effluent concentrations under the assessed conditions, this framework places an inherent constraint on the potential mass loading associated with discharges.

Discharges considered in this effects assessment are associated with construction-related dewatering activities and are evaluated within the short-term Section 15 Approval temporal boundary applied for assessment purposes, as described in Section 4.2.1.1. At the Project scale, discharges are intermittent; however, during active dewatering at individual PDLs, discharge may occur on a continuous basis for limited periods (weeks to months), with discharge activity shifting spatially as construction progresses. Accordingly, potential discharge loading is limited in duration and frequency and does not represent a sustained or ongoing source of constituent loading to the receiving environment. For metals, discharge loading may include both dissolved and particulate-associated fractions, as metals can be present in solution or associated with suspended solids depending on source water characteristics. Where suspended solids are present in groundwater-derived contact water or discharge, the particulate-associated fraction contributes to total metal loading. Accordingly, control of turbidity and suspended solids in treated effluent limits the contribution of particulate-associated metals to overall discharge loading.

When considered together, the (1) use of concentration-based DQCs to bound discharge concentrations, (2) construction-phase discharge timing evaluated in this assessment, including intermittent Project-scale discharge with locally sustained discharge periods at individual PDLs, and (3) control of suspended solids and turbidity, the potential for Project-related discharge loading is constrained in magnitude, spatial extent, and duration. Accordingly, consideration of discharge loading does not alter the effect predictions summarized in Section 4.2.4.

On this basis, effluent quality requirements derived using concentration-based DQCs are considered appropriate in the context of discharge loading and discharge timing evaluated in this assessment.

4.2.4 Summary of Potential Effects

4.2.4.1 Fraser River

Based on evaluation of predicted post-mixing surface water concentrations within the mixing zone used for this assessment, the magnitude of potential Project-related changes to surface water quality in the Fraser River is characterized as low. For most POCs, predicted post-mixing concentrations are below applicable long-term (i.e., chronic) water quality guidelines and/or are closely aligned with the upper range of background surface water quality. Where marginal exceedances of long-term guidelines are predicted (e.g., dissolved nickel), the magnitude of exceedance relative to existing conditions is small and occurs within the range of observed background variability, indicating limited incremental change relative to existing conditions.

Potential Project-related changes to surface water quality in the Fraser River are expected to occur during periods of active discharge associated with construction dewatering activities. Operational seasonality was evaluated by comparing surface water quality during periods when discharge is likely to occur (April–October) to the rest of the year (November–March). This comparison did not identify statistically significant differences in surface water quality between periods, supporting the interpretation that predicted post-mixing concentrations during anticipated discharge periods are representative of conditions relevant to the effects assessment. Given the Fraser River's large assimilative capacity and high-energy environment, mixing following discharge is expected to occur rapidly in the near field, and sustained concentrations above background are not indicated by the post-mixing predictions.

The evaluation of potential adverse effects to aquatic life is based on a weight-of-evidence approach that considers: (1) predicted post-mixing concentrations within the mixing zone used for the assessment, (2) comparison of those concentrations to applicable short-term and long-term aquatic life water quality guidelines, and (3) the relationship of predicted concentrations to observed background variability. On this basis, predicted post-mixing concentrations are not indicative of conditions associated with acute toxicity in the immediate receiving environment, nor of conditions associated with acute or chronic toxicity beyond the mixing zone.

Given the low magnitude of predicted incremental change relative to existing conditions and temporary, construction-related discharges, Project-related changes to surface water quality in the Fraser River are expected to be reversible following cessation of discharge, with concentrations expected to return to baseline conditions once discharges end. Residual effects to surface water quality are not anticipated in the Fraser River under the assessed discharge assumptions.

Overall, potential Project-related effects on surface water quality in the Fraser River are characterized as low in magnitude, localized in extent, short-term, intermittent, and reversible; accordingly, overall risk is considered low. As a result, adverse effects are not anticipated for the key receptors identified for the Fraser River (i.e., fish or humans via trophic transfer).

Consistent with the residual effects assessment approach described in Section 4.2.1.6, a project-specific risk management matrix was not developed for the Fraser River receiving environment.

4.2.4.2 Hicks Creek

For Hicks Creek, an IDZ was not defined for this TAR. Accordingly, the assessment of potential effects to surface water quality is based on an end-of-pipe DQCs framework, assuming that discharge concentrations meet the proposed DQCs at the point of discharge. Under this framework, the magnitude of potential Project-related changes to surface water quality is characterized as low.

Where DQCs are derived from long-term aquatic life water quality guidelines, discharge concentrations corresponding to the proposed DQCs are intended to be protective of aquatic life under continuous exposure conditions. Where DQCs are derived from background surface water quality, discharge concentrations are anticipated to remain within the upper range of observed existing conditions and, therefore, are not expected to result in a measurable change relative to ambient variability.

Potential Project-related changes in surface water quality associated with discharges to Hicks Creek are expected to occur during periods of active discharge associated with construction activities rather than on a continuous basis. Operational seasonality was evaluated by comparing surface water quality during periods when the majority of discharge is likely to occur (April–October) to the rest of the year (November–March); this comparison did not identify statistically significant differences in surface water quality between periods. As a result, predicted discharge-period concentrations are considered representative of conditions relevant to the effects assessment.

Incremental change relative to existing surface water quality is evaluated using the end-of-pipe DQCs framework, which forms the basis of the effects assessment for Hicks Creek. Within this framework, both background-based and guideline-based DQCs provide a conservative basis for effects characterization, with background-based DQCs reflecting existing ambient conditions and guideline-based DQCs reflecting established aquatic life benchmarks.

The evaluation of potential toxicity to surface water quality is based on a weight-of-evidence approach, including: (1) the derivation of DQCs from applicable water quality guidelines and/or background concentrations, and (2) the temporary and episodic nature of construction-related discharges, which limits the potential for prolonged Project-related exposure. Under the assessed discharge assumptions, Project-related discharges are not indicative of conditions associated with acute or chronic toxicity during discharge periods.

Given the anticipated low magnitude of incremental change relative to existing conditions and the temporary, construction-related nature of discharges, Project-related changes to surface water quality in Hicks Creek are expected to be reversible following cessation of discharge. Residual effects to surface water quality are not anticipated in Hicks Creek under the assessed discharge assumptions.

Overall, potential Project-related effects on surface water quality in Hicks Creek are characterized as low in magnitude, localized in extent, short-term, intermittent, and reversible; accordingly, overall risk is considered low. As a result, adverse effects are not anticipated for the key receptors identified for Hicks Creek (i.e., fish, amphibians, or humans via trophic transfer).

Consistent with the residual effects assessment approach described in Section 4.2.1.6, a project-specific risk management matrix was not developed for the Hicks Creek receiving environment.

5 Monitoring Plans

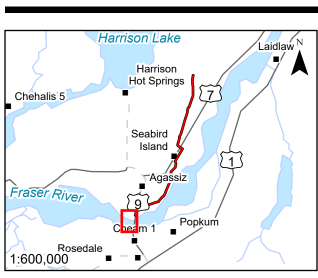
The following sections detail the discharge and receiving environment monitoring programs proposed during the discharge of groundwater and stormwater intercepted during pipeline construction dewatering to the surface water receiving environment. The discharge and receiving environment monitoring programs are presented in context of environmental baseline information (Section 2), discharge mitigation and management (Section 3), and the effects assessment (Section 4). The approximate surface water quantity and quality monitoring locations for each PDL and the receiving environment are presented in Figure 5.1.

5.1 Summary of Proposed Discharge Limits

Table 5.1 provides a summary of the proposed Section 15 Approval discharge limits for flow, general construction parameters, and the identified POCs by watercourse. Proposed limits are based on the DQCs presented in Section 3.3, which incorporate the detailed characterization of baseline conditions from Section 2 and POC screening. For POCs where the corresponding DQCs is based on water quality guidelines, defined discharge limits are not required because the applicable water quality guidelines represent established effects benchmarks used under the *Environmental Management Act* to evaluate the potential for adverse effects to aquatic life. Nevertheless, these POCs will be monitored with reference to the applicable guideline values (Section 3.3.2.2). Acute WQG-FAL are proposed for Fraser River to reflect the proposed IDZ while chronic WQG-FAL are proposed for Hicks Creek where no IDZ is assumed (Table 5.1).

Flow Direction
Watercourse
Existing Pipeline
Proposed Pipeline
Pipeline ROW
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)



Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Project Location
Kent, BC
NTS 50K Grid: 092H05/092H04

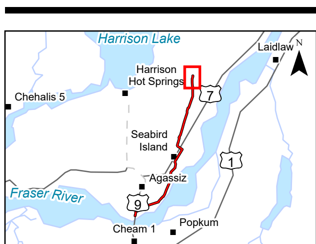
Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-A1

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- PDL Buffer (~250 m)
- Approximate Monitoring Location

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

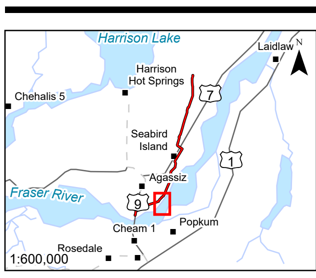
Project Location Kent, BC NTS 50K Grid: 092H05/092H04	Project Number: 123317055 Prepared by JPOUCHER on 20260316 Requested by RKEELER on 20260311

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-A6

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- PDL Buffer (~250 m)
- Approximate Monitoring Location

0 50 100 150 200 m

1:5,000 (at original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

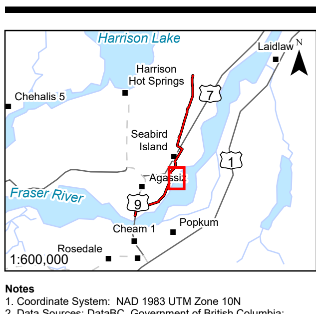
NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-A8

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



- Railway
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Pipeline ROW
- Proposed Workspace
- PDL Buffer (~250 m)
- Approximate Monitoring Location

0 50 100 150 200 m
1:5,000 (at original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
3. Imagery: ESRI World Imagery

Stantec

Project Location
Kent, BC

Project Number: 123317055
Prepared by JPOUCHER on 20260316
Requested by RKEELER on 20260311

NTS 50K Grid: 092H05/092H04

Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-SBI9

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher

Table 5.1 Summary of Proposed Discharge Limits for Flow, General Construction Parameters, and Identified Parameters of Concern Corresponding Proposed Discharge Quality Criteria by Watercourse (Proposed Discharge Location)

Parameter (Units)	**Proposed Discharge Limit**	
	Fraser River (PDL-A1, PDL-A8, PDL-SBI9)	**Hicks Creek (PDL-A6)**
Maximum Discharge Rate (m^3/s)	0.284	May 1 to August 31 - 0.050 September 1 to April 31 - 0.013
TSS (mg/L)	25 or background TSS concentration, whichever is greater	25 or background TSS concentration, whichever is greater
pH (pH units)	6.5–8.5	6.5–8.5
DO (mg/L)	≥ 8	≥ 8
Nitrate (as N; mg/L)	Acute WQG-FAL	Chronic WQG-FAL
Nitrite (as N; mg/L)	Acute WQG-FAL	0.0304
Aluminum (T; mg/L)	*	0.175
Iron (T; mg/L)	2.97	2.01
Mercury (T; mg/L)	*	0.00000344
Cadmium (D; mg/L)	Acute WQG-FAL	Chronic WQG-FAL
Cobalt (D; mg/L)	*	0.000896
Copper (D; mg/L)	0.00151	0.00173
Iron (D; mg/L)	Acute WQG-FAL	1.13
Manganese (D; mg/L)	*	Chronic WQG-FAL
Nickel (D; mg/L)	Acute WQG-FAL	0.0031

Notes:

WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; PDL = proposed discharge location; N = nitrogen, T = Total, D = Dissolved; TSS = Total Suspended Solids; DO = dissolved oxygen; pH = unit of acidity; m^3/d = cubic metres per day; mg/L = milligrams per litre

Unshaded cells indicate discharge limits are based on discharge quality criteria (DQCs) derived from the 95th and 90th percentiles of background water quality for Fraser River and Hicks Creek, respectively (see Section 3.3.1.3). Shaded cells indicate DQCs based on WQG-FAL s which do not require defined discharge limits but will be monitored and screened according to the applicable WQG-FAL. Exceedance for parameters with DQCs that are below acute WQG-FAL (i.e., DQCs based on chronic WQG-FAL s or background concentrations) will be identified based on monthly rolling averages from 4 weekly samples.

* DQCs is currently not proposed for Fraser River discharge(s) because no acute WQG-FAL exists; chronic WQG-FAL or background will be met at edge of IDZ consistent with *Technical Guidance 11: Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations* (BC MECCS 2019a). These POCs were evaluated in Section 4 where the potential for adverse effects to aquatic life in the receiving environment is discussed.

5.2 Discharge Monitoring Program

The discharge monitoring program consists of water quantity and water quality monitoring as described in the following sections.

5.2.1 Water Quantity Monitoring

Monitoring of the discharge water quantity will occur consistent with the Section 15 Approval conditions. The objective of the proposed water quantity monitoring is to check that the volumes of water released do not exceed maximum discharge rates for each PDL as shown in Table 5.1.

Westcoast will use an inline flow meter to record the discharged rate, in frequent increments (e.g., every 15 minutes) and the total volume per PDL over a 24-hour period, during active discharge periods, to check for compliance with the permitted discharge rate for each PDL (and as shown in Table 5.1). The flow instrumentation will be calibrated according to manufacturer specifications. Westcoast's water treatment vendor/contractor(s) and/or EI will perform visual inspections of the instrumentation and arrange for maintenance, as required. Should issues with the flow measuring device be identified, they will be addressed as soon as practical.

5.2.2 Discharge Water Quality Monitoring

Monitoring of the end-of-pipe discharge water quality will occur at the end of the water treatment process. The objective of the proposed water quality monitoring is to verify that treated discharge water is not in exceedance of applicable WQG-FAL or parameter-specific maximum discharge concentrations, as defined in Table 5.1. Table 5.2 outlines the monitoring parameters, sampling methods, and monitoring frequency. Monitoring will only be required during active dewatering and discharging periods.

Proposed daily end of pipe field-measured parameters will include turbidity, conductivity, pH, temperature, and visible sheen (Table 5.2). The field measurements will be taken using handheld meters or sondes (i.e., automated data loggers). Conductivity does not have a proposed permit limit but will be monitored because conductivity measurements, particularly substantial changes in conductivity over a short period of time, may be used as a rapid field-measured indicator for potential issues with other water quality parameters (i.e., nutrients, metals) and initiate additional monitoring as noted in the Trigger and Response Plan (Section 6.7). Similarly, field-measured turbidity will be used as a field-measured proxy for TSS and additional turbidity/TSS monitoring would be initiated if turbidity values are elevated beyond the Trigger and Response Plan monitoring thresholds (see Section 6.7). Site-specific turbidity and TSS relationships will be assumed to be 1:1 unless site-specific relationships are determined based on baseline monitoring data prior to construction. Temperature at end-of-pipe does not have a set discharge limit but will be considered in relation to the receiving environment monitoring (Table 5.3) with the objective that the hourly rate of change does not to exceed 1 degree per hour in the receiving environment.

Table 5.2 Proposed Water Quality Monitoring Parameters and Frequency when Discharging

Parameter	Method	Monitoring Frequency
TSS	Grab Sample	Weekly
Turbidity	Field-measured	Daily
Conductivity	Field-measured	Daily
pH	Field-measured	Daily
DO	Field-measured	Daily
Temperature	Field-measured	Daily
Visible sheen	Visual and Olfactory Assessment	Daily
Rainbow trout 96-hour Acute Toxicity Test (≥ 80% survival)	Grab Sample	Following the establishment of new water treatment units/processes and prior to initial discharge of water to the environment
Total and Dissolved Metals, Anions, and Nutrients	Grab Sample	Weekly

Note:
TSS = Total Suspended Solids; DO = dissolved oxygen; pH = unit of acidity

Grab samples collected for weekly laboratory analysis will include TSS, total and dissolved metals, anions and nutrients. Westcoast is also proposing to conduct a 96-hour tests for acute toxicity to rainbow trout (*Oncorhynchus mykiss*) using undiluted test water (i.e., single-concentration pass/fail tests) to check discharge water quality following the establishment of a new water treatment unit/process to assess for potential impacts on aquatic life prior to discharge into the receiving environment. Failure of a toxicity test will be reported if less than 80% survival is observed. Failure of the toxicity test and/or identified exceedances for nutrients, anions, or metals may initiate additional toxicity testing within 24 hours as noted in the Trigger and Response Plan (Section 6.7).

Hydrocarbons are not anticipated to be a POC associated with new pipeline installation because the groundwater discharged during trench excavation and pipe installation will only be in contact with pipe segments that are newly manufactured and do not contain product (i.e., no gas or liquid hydrocarbon). Accidental releases of hydrocarbons are possible during construction. If a vehicle or equipment leak or spill is suspected, Westcoast will implement the Fuels and Hazardous Materials Spill Contingency Plan (Section 3.5.4.3). Water quality monitoring will include daily visual inspection for sheens or olfactory indicators of hydrocarbons.

Equipment used to take field measurements will be maintained and calibrated according to manufacturer specifications. Proper care will be taken in sampling, storing, and transporting grab samples to adequately control temperature and avoid contamination and breakage. Monitoring will be carried out in accordance with procedures described in the BC Field Sampling Manual (BC MECCS 2024b) or by alternative procedures, as approved by BC ENV. Grab samples will be submitted to a Canadian Association for Laboratory Accreditation Inc. accredited laboratory that uses methods for laboratory analyses that are recognized by BC ENV and in accordance with the British Columbia Environmental Laboratory Manual (BC MECCS 2023b).

5.3 Receiving Environment Monitoring Program

A receiving environment monitoring program will be implemented to assess potential changes in physical and chemical parameters that could lead to adverse effects on receptors in the receiving environment. The receiving environment monitoring program is consistent with the potential pathways, receptors, and the potential effects to these receptors, as described in Section 4. The water quality assessment focuses on potential changes in physical and chemical parameters that may lead to adverse effects in ecological receptors in the receiving environment.

General construction monitoring (e.g., monitoring for ESC, spill prevention, and wildlife) for the receiving environment is discussed in Section 3 and water quality monitoring specific to the Section 15 Approval is discussed in this section. Additional receiving environment water quality monitoring requirements and follow-up based on monitoring results are discussed as part of the Trigger and Response Plan (Section 6.7).

Monitoring locations will include a reference location upstream of the PDL(s) to determine background conditions as well as a location downstream of the PDL(s) as shown in Figure 5.1. Monitoring will occur approximately 50 m upstream and 100 m downstream from the PDL when water is being actively discharged; sampling locations may vary depending on the location of the PDL outfall as it relates to site conditions, access restrictions, and safety considerations. Additional sampling and monitoring locations may be added downstream of the PDL in the event of exceedances of monitoring result thresholds as discussed in the Trigger and Response Plan (Section 6.7).

A summary of the proposed approach to monitoring the receiving environment is provided in Table 5.3. Field-measured parameters (i.e., temperature, DO, pH, conductivity, turbidity, visible sheen) will be monitored daily upstream and downstream of the outfall during active discharge at a given PDL. These field measurements will be taken using handheld meters or sondes (i.e., automated data loggers). Grab samples for TSS, nutrients, and total and dissolved metals will be collected weekly upstream and downstream of the outfall during active discharge at a given PDL.

Table 5.3 *Proposed Monitoring Locations and Approach for the Receiving Environment* when Discharging at a Given Proposed Discharge Location

Parameter	Locations*	Method	Monitoring Frequency
TSS	Approximately 50 m upstream and 100 m downstream of discharge location	Grab Sample	Weekly
Turbidity	Approximately 50 m upstream and 100 m downstream of discharge location	Field-measured (in situ)	Daily
Conductivity	Approximately 50 m upstream and 100 m downstream of discharge location	Field-measured (in situ)	Daily
pH	Approximately 50 m upstream and 100 m downstream of discharge location	Field-measured (in situ)	Daily
DO	Approximately 50 m upstream and 100 m downstream of discharge location	Field-measured (in situ)	Daily
Temperature	Approximately 50 m upstream and 100 m downstream of discharge location	Inline monitoring	Continuous (e.g., 15-minute intervals)
Visible sheen	Approximately 50 m upstream and 100 m downstream of discharge location	Visible and olfactory assessment	Daily
Total and Dissolved Metals, Anions and Nutrients	Approximately 50 m upstream and 100 m downstream of discharge location	Grab Sample	Weekly

Notes:

TSS = Total Suspended Solids; DO = dissolved oxygen; pH = unit of acidity

* In the event of limited flow within a given proposed discharge location, alternative monitoring locations within the receiving environment will be recommended by a Qualified Environmental Professional

5.4 Groundwater Monitoring

As part of Westcoast's pipeline EPP (Section 5 of Appendix M) pre-construction and post-construction at selected water wells near the Project footprint (for example, within 100 m) to monitor for changes in water quality and quantity associated with construction.

5.5 Quality Assurance and Quality Controls

Monitoring samples will be submitted to one or more qualified analytical laboratories, as defined under the Environmental Data Quality Assurance Regulation. Westcoast or its delegate will obtain from the analytical laboratory the precision, accuracy, and blank data for each sample set submitted. Westcoast or its delegate will also obtain an evaluation of the data acceptability, based on the criteria set by the laboratory. In accordance with the BC Field Sampling Manual (BC MECCS 2024b), quality control samples will be collected, prepared, and submitted for analysis to the analytical laboratory for each parameter in the Section 15 Approval. At a minimum, the number of duplicate samples will be 10% of all samples collected. Quality control samples will include duplicate, field, and trip blank samples for each parameter.

Quality controls for toxicity tests will include exposure and control groups, the measurement and recording of physical parameters in test and control water (e.g., temperature, DO, pH, conductivity), and the recording of exposure conditions (e.g., photoperiods, aeration rates, vessel volumes, number of organisms).

5.6 Reporting and Notifications

Westcoast will report to BC ENV on permit compliance and results of the discharge and receiving environment monitoring programs 90 days following the end of Section 15 Approval discharges. All reports submitted to BC ENV will be prepared and signed by QPs, who will include Declaration of Professional Competency and a Conflict of Interest Disclosure statements.

BC ENV will be notified in writing of a permit non-compliance. Non-compliances for field measured parameters will be reported following checks for accuracy (e.g., calibration or alternative methods) and 3 follow-up measurements showing exceedances in the same day. Lab exceedances for parameters with DQCs that are below acute WQG-FAL (i.e., DQCs based on chronic WQG-FAL s or background concentrations) will be identified based on monthly rolling averages from 4 weekly samples. Lab exceedances will trigger follow-up as noted in Section 6.7.2. When an exceedance is noted, BC ENV will be provided with a follow-up report summarizing test results (including raw laboratory reports) related to the non-compliance, potential causes of the non-compliance, corrective actions planned or taken, subsequent follow-up tests, and the effluent quality results of samples collected as part of corrective actions.

In the event of a spill to the environment (as defined in the Spill Reporting Regulation) during construction, the spill will be responded to per Westcoast's spill response (see Section 3.5 for details) and reported, as soon as practical, in accordance with the Spill Reporting Regulation.

6 Management Plans

This section describes the management practices and plans related to water treatment and water discharge activities, as required by the IRT. Additionally, a high-level trigger and response plan is presented in Section 6.7.

6.1 Operations, Maintenance, and Inspection of Water Treatment Units

As described in Section 3.1.8, an appropriate water treatment process will be established to address relevant constituent types by integrating the most suitable technologies as detailed in the BAT assessment (Appendix L). The specific technologies and layout of the water treatment unit(s) are under consideration.

Westcoast is in the process of developing a pilot test of water treatment systems in mid-2026 to support pre-construction planning. Results of the pilot test will evaluate and support confirmation of treatment capacity, retention times, by-product production, management requirements, and input and output of water quantity and quality. The pilot test has the potential to provide insight about inspection and maintenance requirements, such as anticipated inventory materials and replacement parts required for the water treatment unit(s).

The selected water treatment contractors/vendors will be responsible for the following:

- Developing and implementing commissioning processes prior to the start of dewatering activities that demonstrate their system is consistently treating water as required to meet the applicable water quality guidelines.
- Implementing on-going testing of their water treatment unit(s) to check that they continue to meet applicable water quality guidelines throughout operations.
- Documenting the maintenance and inspection schedule, with oversight by Westcoast's environmental team.

Monitoring related to discharge and the receiving environment will be undertaken as outlined in Section 5.

6.2 Operator Training and Qualifications

An Environmental Training Program will be developed for the Project as outlined in Section 3.3 of the Pipeline EPP (Appendix M). The Environmental Training Program will provide individuals involved in Project construction an understanding of the environmental requirements and their role and responsibilities to meet those requirements. The Environmental Training Program will be implemented across multiple levels commensurate with individual role(s) and responsibilities (e.g., a higher level of environmental training will be required for construction managers and EIs). The Environmental Training

Program is designed to employ a standardized means of sharing critical information regarding environmental protection, mitigation, and compliance requirements, and providing focused training and development of resources targeted to role-specific needs.

Further to the Environmental Training Program, issue-specific or site-specific training, or refresher training (e.g., site-specific wildlife mitigation) will also be conducted as warranted for the Project. Depending on role, multiple environmental training sessions are expected to be conducted, as warranted. to address construction over varying seasons, scopes of work, locations (e.g., different pipeline loops), and phases of construction.

Qualifications of Project personnel will depend on their role. Project QPs are required to possess a professional designation or have substantial experience to be described as a subject matter expert for a particular discipline. Section 3.5.1 and the Pipeline EPP (Appendix M) further outline training requirements, qualifications, and roles and responsibilities for the Project.

6.3 Emergency Response

As outlined in Appendix C.3 (*Fire Contingency Plan*) of the Pipeline EPP (Appendix M), the general construction contractor is responsible for developing an Emergency Response Plan for their work area that will include plans such as a Fire Contingency Plan and Fire Prevention Plan. Section 3.7 of the Pipeline EPP (Appendix M) describes the process for identifying and addressing environmental events and/or deficiencies. Further, contractors will be required to follow the Pipeline EPP spill prevention and spill response requirements as summarized in Sections 3.5.3.2 and 3.5.4.3, respectively.

Environmental emergency response procedures will also be covered in the Environmental Training Program discussed in Section 6.2. Emergency contacts for the Project are outlined in Appendix A of the Pipeline EPP (Appendix M) and will be used in an emergency response scenario, as required.

Automated systems and emergency response for the water treatment process will be determined and completed by the contractor/vendor responsible for the water treatment operation as needed, with input from Westcoast

6.4 Management of Chemicals

Management of chemicals used in the water treatment process will be handled and documented by the contractor/vendors responsible for the water treatment operation, in compliance with the Pipeline EPP (Appendix M) and with oversight from Westcoast.

Hazardous materials chemicals will be transported, handled, used, and disposed of in accordance with Section 7 (General Environmental Protection Measures) of the Pipeline EPP (Appendix M) for general construction activities.

Contractors will be required to follow the Pipeline EPP's spill prevention and spill response requirements.

6.5 Contingency Plan

The Pipeline EPP (Appendix M) has multiple contingency plans applicable to the pipeline loop that, depending on the specific circumstances, will be implemented if required during dewatering activities, including:

- Fuels and Hazardous Materials Spill Contingency Plan (Appendix C.6 of the Pipeline EPP) – procedures that will be implemented if there is a spill of hazardous material, including spills to a waterbody or wetland.
- Contamination Discovery Contingency Plan (Appendix C.1 of the Pipeline EPP) – procedures that will be implemented if the presence of contamination in soil or water is suspected.
- Fish Species of Concern Discovery Contingency Plan (Appendix C.4 of the Pipeline EPP) – despite the biophysical assessments conducted to date, these procedures will be implemented if sensitive fish habitats or fish species of concern area discovered during construction.
- Wildlife and Habitat Feature Discovery Contingency Plan (Section 9 of Appendix D.7 of the Pipeline EPP) – despite the biophysical assessments conducted to date, these procedures will be implemented if a wildlife species of concern, species at risk, or habitat feature is discovered.
- Sedimentation of Watercourses and Wetlands Contingency Plan (Appendix D.10 of the Pipeline EPP) – procedures that will be implemented if sedimentation of a watercourse or wetland occurs.
- Soil Erosion Contingency Plan (Appendix D.11 of the Pipeline EPP) – procedures that will be implemented if soil erosion occurs due to the action of wind or water.
- Vegetation Species and Communities of Concern Discovery Contingency Plan (Appendix C.15 of the Pipeline EPP) –despite the biophysical assessments conducted to date, these procedures will be implemented if vegetation species or communities of concern are discovered prior to or during construction.

6.6 Erosion and Sediment Control Plan

The Pipeline EPP (Appendix M) includes ESC measures in Appendix D.4 (Erosion and Sediment Control Management Plan), which will be implemented for the pipeline loop. Key mitigation measures for ESC related to discharge management are outlined in Section 3.5.2 and Section 3.5.4.2 summarizes the environmental monitoring that will be undertaken with respect to ESC.

6.7 Trigger and Response Plan

A trigger and response plan has been developed to document proactive steps that will be taken to manage and respond to changing conditions relating to water discharge to avoid or control exceedances of proposed discharge limits. Monitoring will occur as described in Section 5. Water discharge quality criteria exceedances of lab-based testing will be managed as noted in Section 6.7.2. The trigger and response plan for real-time monitoring of in field-measured parameters is described in Section 6.7.1.

6.7.1 Field-Measured Parameters

The trigger and response plan documents the proactive steps that will be used to evaluate end-of-pipe monitoring data and to manage and respond to changing conditions relating to water discharge. General parameters (i.e., maximum discharge rate values, turbidity, pH, DO, and temperature) will be monitored daily at the PDLs as discussed in Section 5. These field measurements will enable real time management of the discharge conditions and implementation of contingency plans and additional mitigation measures, if indicated. The quantity of water discharged will be recorded continuously (e.g., 15-minute increments) while discharging at each PDL, as outlined in Section 5.2.1. Turbidity, pH, DO, and temperature will be monitored daily, as outlined in Section 5.3. The trigger and response plan for each of these parameters, based on the end-of-pipe monitoring results is provided in Table 6.1. The responses outlined in this plan are initiated if the trigger thresholds are recorded as part of the PDL end-of-pipe results and trigger responses have escalating mitigation measures as the values near the proposed discharge limits.

Table 6.1 Trigger and Response Plan for Field-Measured Parameters

Parameter	Proposed Discharge Limit	Level 1 Trigger	Level 1 Response	Level 2 Trigger	Level 2 Response	Level 3 Trigger	Level 3 Response
Maximum discharge rate	PDL-A1, PDL-A8, PDL-SBI9 – 0.0284 m^3/d PDL-A6 – 0.050 m^3/s (May 1 – Aug 31) 0.013 m^3/s (Sept. 1 – April 31)	80% of maximum discharge rate per PDL	• Monitor discharge rates • Consider weather forecast and probability of precipitation or additional sources of water • Assess options to hold water or discharge at a different PDL	85% of maximum discharge rate per PDL	• Monitor discharge rates • Consider weather forecast and probability of precipitation or additional sources of water • Assess options to hold water or discharge at a different PDL	95% of maximum discharge rate per PDL	• Monitor discharge rates • Consider weather forecast and probability of precipitation or additional sources of water • Start implementing options to hold water or discharge at a different PDL
Turbidity (as a proxy for TSS)	25 mg/L TSS or background TSS concentration, whichever is higher	End-of-pipe monitoring results indicate an anomalous observation or a trend of increasing turbidity outside of normal water treatment and/or observation of turbid water at a PDL	• Check if background is elevated. If not: • Increase frequency of turbidity monitoring • Investigate the source of increased turbidity • Assess options for mitigation measures such as changes to the water treatment process or implementation of ESC measures	20 NTU or 80% of background, whichever is higher	• Check if background is elevated. If not: • Investigate the source of increased turbidity • Increase frequency of turbidity monitoring • Assess options for mitigation measures such as implementation of ESC measures • Assess options to hold water or adjust water treatment process to allow for settling/removal of more sediment	22 NTU or 90% of background, whichever is higher	• Check if background is elevated. If not: • Investigate the source of increased turbidity • Increase frequency of turbidity monitoring • Assess options for mitigation measures such as implementation of ESC measures • Assess options to hold water or adjust water treatment process to allow for settling/removal of more sediment • Take a water samples to the lab to check for potential exceedance of TSS discharge limits • If feasible, do not discharge water until monitoring indicates TSS is stable and below discharge limit (< 25 mg/l or below background levels)
pH	6.5 – 8.5	End-of-pipe monitoring results indicate an anomalous observation or a trend of increasing/ decreasing pH outside of normal water treatment operating range	• Investigate potential causes of pH changes • Assess options for mitigation measures to address pH levels if trend is concerning	< 6.7 or > 8.3	• Increase frequency of pH monitoring • Investigate potential causes of pH changes • Assess options for mitigation measures to address pH levels • Assess options to hold water in water treatment unit(s)	< 6.6 or > 8.4	• Increase frequency of pH monitoring • Investigate potential causes of pH changes • If feasible, implement mitigation measures to address pH levels • If feasible, do not discharge water until monitoring indicates pH is stable and within proposed discharge limit
DO	≥8 mg/L	9 mg/L	• Investigate potential causes for reduction of DO • Assess options for mitigation measures to address low DO (e.g., aeration options at the end of pipe), if required	8.5 mg/L	• Increase frequency of DO monitoring • Investigate potential causes for reduction of DO • Start implementation of options for mitigation measures to address low DO e.g., aeration device at the end of pipe	8.2 mg/L	• Increase frequency of DO monitoring • Investigate potential causes for reduction of DO • Start implementing mitigation measures to address low DO (e.g., aeration device at the end of pipe) • If feasible, do not discharge water until monitoring indicates DO is stable and below discharge limit

Parameter	Proposed Discharge Limit	Level 1 Trigger	Level 1 Response	Level 2 Trigger	Level 2 Response	Level 3 Trigger	Level 3 Response
Temperature	Hourly rate of change not to exceed 1 degree/hour in the receiving environment	End-of-pipe monitoring results show change in temperature that differs from background or a period of extreme weather is in the forecast	• Increase frequency of temperature monitoring	+/- 0.8℃ per hour	• Increase frequency of temperature monitoring • Assess options for mitigation measures to address temperatures differences • Hold meeting to discuss options for water management	+/- 0.9 ℃ per hour	• Increase frequency of temperature monitoring • Start implementing mitigation measures to address water temperatures differences • If feasible, do not discharge water until monitoring indicates temperature is stable and close to background
Conductivity	Not applicable**	End-of-pipe monitoring results indicate an anomalous observation or a trend of increasing conductivity above typical values	• Increase frequency of conductivity monitoring	Dependant on spike or rate of increase above typical range (e.g., 50% change)	• Increase frequency of conductivity monitoring • Investigate potential causes of conductivity changes and potential mitigation measures	Dependant on spike or rate of increase above typical range (e.g., 100% change)	• Increase frequency of conductivity monitoring • Investigate potential causes of conductivity changes and potential mitigation measures • Take samples for submission to lab for analysis to check for changes in nutrients and metals.

Notes:

* Site-specific turbidity and TSS relationships will be assumed to be 1:1 unless site-specific relationships are determined based on baseline monitoring data prior to construction; if a relationship is developed, trigger values will be updated.**Conductivity does not have a discharge limit but will be monitored because conductivity measurements, particularly substantial changes in conductivity over a short period of time, may be used as an indicator for potential issues with other water quality parameters (i.e., nutrients, metals)

PDL = proposed discharge location; TSS = total suspended solids; ESC = erosion and sediment control; m^3/d = cubic metres per day; mg/L = milligrams per litre; NTU = nephelometric turbidity units; pH = unit of acidity; DO = dissolved oxygen; ℃ = degrees Celsius

6.7.2 Lab Analysis Exceedances

Lab exceedances for parameters with DQCs that are below acute WQG-FAL (i.e., DQCs based on chronic WQG-FAL s or background concentrations) will be identified based on monthly rolling averages from 4 weekly samples. In the event of a DQC exceedance analysing will be repeated within 24 hours of receiving the results and weekly thereafter, until two consecutive lab tests indicate that applicable guidelines are being met. An exceedance of metal and/or nutrient parameters above both background and acute WQG-FAL s would also trigger a 96-hour test for acute toxicity to rainbow trout using undiluted test water (i.e., single-concentration pass/fail tests) to check discharge water quality for potential impacts on aquatic life. Failure of a toxicity test will be indicated if less than 80% survival is observed.

If two consecutive lab analysis indicate exceedances of proposed discharge limits (i.e., DQCs) or applicable guidelines, Westcoast and its contractors/vendors will initiate the following procedure to determine the nature and cause of the exceedance and implement corrective measures, as required:

- Water treatment contractor/vendor and EI will investigate the source of the issue.
- Water treatment contractor/vendor and EI will investigate the corrective measures required to meet water quality guidelines or Section 15 Approval conditions (e.g., recirculating, reducing volumes, addition of further water treatment units).
- A QP (e.g., water treatment engineer) will be engaged to assess and provide recommendations to Westcoast...
- Westcoast will report to BC ENV on progress of the investigation weekly.
- Westcoast will resolve the issue of permit maximum discharge concentration/parameter exceedance as soon as practical and return to normal monitoring.

Within 30 days of resolving the exceedance and returning to normal operations and monitoring, Westcoast will submit a summary to BC ENV that includes the following:

- Relevant test results related to the exceedance event
- An explanation of the most probable cause of the exceedance
- A description of the remedial actions planned and taken to prevent similar exceedances in the future.

6.8 Closure Plan

After trench dewatering discharge activities under the Section 15 Approval are complete, infrastructure related to water treatment and discharge (e.g., hoses, treatment and discharge structures) will be decommissioned and removed from site. Specific decommissioning procedures for the water treatment units will be determined by the contractors/vendors responsible for the water treatment operation.
After removal of infrastructure, temporary workspaces, such as laydown areas for water treatment unit(s), will undergo cleanup and reclamation, as required according to site-specific Project plans, using guidance outlined in Section 13 of the Pipeline EPP (Appendix M) The objectives of cleanup and reclamation of the temporary workspaces are to:

- Remove construction debris and material.
- Reclaim the area to a stable condition, including re-establishing the grade, as applicable, and replacing topsoil.
- Effectively use reclamation techniques that prevent surface material loss due to wind and water erosion.
- Establish vegetative cover compatible with surrounding vegetation and land uses and to deter the proliferation of weeds of concern, as applicable.
- Establish an equivalent land capability, where appropriate, such that the land can be used in a similar manner as prior to construction (Appendix M).

7 References

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

AmphibiaWeb. 2020. *Rana aurora*: Northern Red-legged Frog. University of California, Berkeley, CA. Available at: https://amphibiaweb.org/species/4987. Accessed December 2025.

AmphibiaWeb. 2023a. *Ambystoma gracile*: Northwestern Salamander. University of California, Berkeley, CA. Available at: https://amphibiaweb.org/species/3833. Accessed December 2025.

AmphibiaWeb. 2023b. *Taricha granulosa*: Rough-skinned Newt. University of California, Berkeley, CA. Available at: https://amphibiaweb.org/species/4288. Accessed December 2025.

AmphibiaWeb. 2025. *Pseudacris regilla*: Pacific Treefrog. University of California, Berkeley, CA. Available at: https://amphibiaweb.org/species/929. Accessed December 2025.

Antweiler, R.C., and H.E. Taylor. 2008. Evaluation of statistical treatments of left-censored environmental data using coincident uncensored data sets. Environmental Science & Technology 42: 3732–3738.

Armstrong, J.E. 1980. Surficial Geology, Mission, British Columbia. Geological Survey of Canada, Map 1485A, scale 1:50,000.

Banerjee, P., P. Garai, N.C. Saha, S. Saha, P. Sharma, and A.K. Maiti. 2023. A critical review on the effect of nitrate pollution in aquatic invertebrates and fish. Water Air Soil Pollution 234: 333. https://doi.org/10.1007/s11270-023-06260-5

BC CDC (Conservation Data Centre). 2025a. Species and Ecosystem Explorer. Available at: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/species-and-ecosystems-explorer. Accessed October 2025.

BC CDC. 2025b. CDC iMap. Available at: https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/known-locations-of-species-and-ecosystems-at-risk/cdc-imap-theme. Accessed October 2025.

BC CDC. 2025c. Species Summary: *Chrysemys picta* pop. 1. Painted Turtle – Pacific Coast Population. Available at: https://a100.gov.bc.ca/pub/eswp/speciesSummary.do?id=24166. Accessed October 2025.

BC MELP (British Columbia Ministry of Environment, Land and Parks). 1997. Fish Collection Methods and Standards. Version 4.0. Prepared for the Aquatic Ecosystems Task Force, Resources Inventory Committee. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/fishml04.pdf. Accessed October 2025.

BC MECCS (British Columbia Ministry of Environment and Climate Change Strategy). 2019a. Technical Guidance 11. Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations. Version 1.0.

BC MECCS. 2019b. Copper Water Quality Guideline for the Protection of Freshwater Aquatic Life- Technical Report. Water Quality Guideline Series, WQG-03-1. Prov. B.C., Victoria B.C.

BC MECCS. 2021a. The British Columbia Field Sampling Manual. Part E2 Groundwater. Available at: https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/monitoring/emre/manuals/field-sampling-manual/sops/part_e2_groundwater.pdf. Accessed October 2025.

BC MECCS. 2021b. Best Achievable Technology Assessment to Inform Waste Discharge Standards Handout. https://www2.gov.bc.ca/assets/gov/environment/waste-management/waste-discharge-authorization/guides/bat_assessment_steps.pdf. Accessed December 2025.

BC MECCS. 2023a. Protocol 9 for Contaminated Sites. Establishing Local Background Concentrations in Groundwater. Version 4. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol09.pdf. Accessed April 2026.

BC MECCS. 2023b. British Columbia Environmental Laboratory Manual. Available at: https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-environmental-laboratory-manual. Accessed April 2026.

BC MECCS. 2024a. Defining Parameters of Concern for Effluent Discharge Authorization Applications. Fact Sheet. Available at: https://www2.gov.bc.ca/assets/gov/environment/waste-management/industrial-waste/industrial-waste/mining-smelt-energy/guidance-documents/parameter_of_concern_fs.pdf. Accessed March 2026.

BC MECCS. 2024b. British Columbia Field Sampling Manual. Available at: https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/laboratory-standards-quality-assurance/bc-field-sampling-manual. Accessed April 2026.

BC MEP (British Columbia Ministry of Environment and Parks). 2025. 2024 Lower Fraser River – Hope to Kanaka Creek Water Quality Objectives Attainment Summary Report. May 2025. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-objectives/wqo-attainment-reports/wqoattainfraser2024.pdf. Accessed January 2026.

BC MFLNRO (British Columbia Ministry of Forests, Lands and Natural Resource Operations). 2011. The Fraser Freshet Master Plan. Available at https://www.env.gov.bc.ca/wsd/public_safety/flood/pdfs_word/fraser_freshet_masterplan.pdf. Accessed September 2025.

BC MFLNRO. 2014a. Fraser River Design Flood Level Update – Hope to Mission. Final Report.

BC MFLNRO. 2014b. Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (2014). Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices. Accessed November 2025.

BC MFLNRO. 2016. Best Management Practices for Amphibian and Reptile Salvages in British Columbia. Version 1.0. Available at: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices. Accessed November 2025.

BC MFLNRO and BC MOE (British Columbia Ministry of Forests, Lands and Natural Resource Operations and British Columbia Ministry of Environment). 2012. Fish-stream Crossing Guidebook. Revised Edition. Available at: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/resource-roads/fish-stream_crossing_web.pdf. Accessed October 2025.

BC MOE (British Columbia Ministry of Environment). 2001. Ambient Water Quality Guidelines for Temperature: Overview Report. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division, Province of British Columbia, Victoria, BC. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/waterquality/water-quality-guidelines/approved-wqgs/temperature-or.pdf. Accessed April 2026.

BC MOE. 2006. Guidelines for Reduced Risk Instream Work Windows Ministry of Environment, Lower Mainland Region. Available at: https://www2.gov.bc.ca/assets/gov/environment/air-land-water/water/working-around-water/work_windows_low_main.pdf. Accessed October 2025.

BC MOE. 2011. Field Assessment for Determining Fish Passage Status of Closed Bottom Structures. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/land-based-investment/forests-for-tomorrow/field-assessment-for-determining-fish-passage-status-of-cbs.pdf. Accessed October 2025.

BC MOE. 2013. Guidance for the Derivation and Application of Water Quality Objectives in British Columbia. Water Protection & Sustainability Branch, Victoria, BC.

BC MWLRS (British Columbia Ministry of Water, Land, and Resource Stewardship). 2024. Nickel Water Quality Guideline for the Protection of Freshwater Aquatic Life-Technical Report. Water Quality Guideline Series, WQG-FAL -22-1. Victoria BC.

BC MWLRS. 2025. Water Rights Database. Available at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-licensing-rights/water-licences-approvals/water-rights-databases. Accessed October 2025.

BC MWLRS. 2026. British Columbia Water Quality Guidelines for the Protection of Freshwater Aquatic Life. Available at: https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/water-quality/water-quality-guidelines. Accessed October 2025.

BCER (BC Energy Regulator). 2025. Environmental Protection and Management Guideline. Version 3.2. Available at: https://www.bc-er.ca/files/operations-documentation/Environmental-Management/Environmental-Protection-and-Management-Guideline.pdf. Accessed October 2025.

Birds Canada. 2025. NatureCounts. Available at: https://naturecounts.ca/nc/default/main.jsp. Accessed October 2025.

Brown, R.F., and M.M. Musgrave. Preliminary Catalogue of Salmon Streams and Spawning Escapements of Mission-Harrison Sub-District. Fisheries & Marine Service Data Report No. 133. Available at: https://waves-vagues.dfo-mpo.gc.ca/Library/37860.pdf. Accessed October 2025.

Carmichael, V., M. Wei, and L. Ringham. 1995. Fraser Valley Groundwater Monitoring Program – Final Report. Prepared for the Government of British Columbia.

CCME (Canadian Council of Ministers of the Environment). 2007. A Protocol for the Derivation of Water Quality Guidelines for the Protection of Aquatic Life. Canadian Environmental Quality Guidelines, Winnipeg, MB. Available at: https://ccme.ca/en/res/protocol-for-the-derivation-of-water-quality-guidelines-for-the-protection-of-aquatic-life-2007-en.pdf. Accessed March 2026.

CCME. 2026. Water Quality Guidelines for the Protection of Aquatic Life. Available at: https://ccme.ca/en/resources/water-aquatic-life. Accessed December 2025.

CER (Canada Energy Regulator). 2022. Memorandum of Understanding between the Canada Energy Regulator and Transport Canada. November. Available at: https://www.cer-rec.gc.ca/en/about/acts-regulations/other-acts/cooperative-agreements/memorandum-of-understanding-between-canada-energy-regulator-and-transport-canada.html. Accessed December 2025.

CER. 2023. Memorandum of Understanding for the Cooperation and Administration of the Fisheries Act and the *Species at Risk Act* Related to Regulating Energy Infrastructure. Between Fisheries and Oceans Canada and Canada Energy Regulator. March. Available at: http://neb.gc.ca/en/about/acts-regulations/other-acts/cooperative-agreements/memorandum-understanding-between-fisheries-oceans-canada-canada-energy-regulator-fisheries-act-species-risk-act- energy-infrastructure.pdf. Accessed December 2025.

Chan, K. 2021. What is Sumas Lake? 100 years ago, Abbotsford had a 134 sq km lake (PHOTOS). DailyHive on-line article, November 17, 2021. Available at: https://dailyhive.com/vancouver/sumas-lake-sumas-prairie-barrowtown-pump-station-abbotsford-flooding. Accessed October 2025.

CHS (Canadian Herpetological Society). 2025a. Northwestern Salamander *Ambystoma gracile*. Available at: https://www.canadianherpetology.ca/species/species_page.html?cname=Northwestern%20Salamander. Accessed December 2025.

CHS. 2025b. Rough-skinned Newt *Taricha granulosa*. Available at: https://www.canadianherpetology.ca/species/species_page.html?cname=Rough-skinned%20Newt. Accessed December 2025.

City of Abbotsford. 2020. Erosion and Sediment Control Bylaw, 2010. Bylaw 1989-2010. Last amended August 31, 2020. Available at: https://laws.abbotsford.ca/civix/document/id/coa/coabylaws/2010b1989. Accessed January 2026.

City of Langley. 2021. Watercourse Protection Bylaw No. 3152. Available at: https://www.langleycity.ca/media/file/water-course-protection-bylaw-3152-consolidated-oct-2021-0. Accessed February 2026.

City of Maple Ridge. 2006. Maple Ridge Watercourse Protection Bylaw No. 6410 - 2006. Bylaw No. 6410-2006. Available at: https://www.mapleridge.ca/media/file/watercourse-protection-bylaw-no-6410-2006. Accessed February 2026.

City of Mission. 2009. District of Mission Sewer Bylaw 5033-2009. Available at: https://www.mission.ca/media/file/sewer-bylaw-5033-2009pdf-0. Accessed February 2026.

City of Surrey. 2024. Bylaw No. 21181. Available at: https://www.surrey.ca/sites/default/files/bylaws/BYL_21181.pdf. Accessed February 2026.

CMN (Community Mapping Network). 2025a. British Columbia Great Blue Herons Atlas. Available at: https://cmnmaps.ca/gbhe_gomap/. Accessed October 2025.

CMN. 2025b. Wildlife Tree Stewardship Atlas. Available at: https://cmnmaps.ca/WITS_gomap/. Accessed October 2025.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2010. COSEWIC assessment and status report on the Barn Owl *Tyto alba* (Eastern population and Western population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. vii + 11 pp.

COSEWIC. 2012. COSEWIC assessment and status report on the Salish Sucker *Catostomus* sp. cf. *catostomus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xi + 36 pp.

COSEWIC. 2013. COSEWIC assessment and status report on the Oregon Forestsnail *Allogona townsendiana* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON, ON. xii + 87 pp.

COSEWIC. 2020. COSEWIC assessment and status report on the Chinook Salmon *Oncorhynchus tshawytscha*, Designatable Units in Southern British Columbia (Part Two – Designatable Units with High Levels of Artificial Releases in the Last 12 Years), in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. xxxv + 203 pp. Available at: https://ecprccsarstacct.z9.web.core.windows.net/files/SARAFiles/legacy/cosewic/sr%20Chinook%20Salmon%202020_e.pdf. Accessed October 2025.

COSEWIC. 2022. COSEWIC assessment and status report on the Plains Sucker *Pantosteus jordani*, Saskatchewan-Nelson River population and Missouri population and the Cordilleran Sucker *Pantosteus bondi* in Canada. Ottawa, ON. xxii + 68 pp. Available at: https://ecprccsarstacct.z9.web.core.windows.net/files/SARAFiles/legacy/cosewic/sr-PlainsCordilleranSuckers-v00-2022-eng.pdf. Accessed October 2025.

CSA Group. 2023. CSA Z662:23 – Oil and gas pipeline systems.

Demarchi, D.A. 2011. An Introduction to the Ecoregions of British Columbia. Third Edition. Ecosystem Information Section, British Ministry of Environment. Victoria, BC.

DFO. 2025a. Fraser River Environmental Watch: Water temperature monitoring and forecasts. Pacific Region. Available at: https://www.pac.dfo-mpo.gc.ca/science/habitat/frw-rfo/index-eng.html. Accessed December 2025.

DFO. 2025b. Aquatic Species at Risk Map. Available at: https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html. Accessed October 2025.

District of Kent. n.d. WebMap Application. Available at https://www.kentbc.ca/en/living-here/mapping-and-gis.aspx. Accessed September 2025.

Domenico, P.A., and F.W. Schwartz. 1990. Physical and Chemical Hydrogeology. John Wiley & Sons, New York, NY. 824 pp.

eBird. 2025. Species Maps. Cornell Lab of Ornithology, Ithaca, NY. Available at: https://ebird.org/map. Accessed October 2025.

ECCC (Environment and Climate Change Canada). 2020. Management Plan for the Western Toad (*Anaxyrus boreas*), Calling and Non-calling Populations, in Canada. *Species at Risk Act* Management Plan Series. Environment and Climate Change Canada, Ottawa, ON. v + 39 pp.

ECCC. 2021. Recovery Strategy for the Western Painted Turtle (*Chrysemys picta bellii*) Pacific Coast Population in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa, ON. 2 parts, 31 pp. + 59 pp.

ECCC. 2024a. Federal Environmental Quality Guidelines (FEQGs). Available at: https://www.canada.ca/en/health-canada/services/chemical-substances/fact-sheets/federal-environmental-quality-guidelines.html. Accessed March 2026.

ECCC. 2024b. Amended Recovery Strategy for the Oregon Forestsnail (*Allogona townsendiana*) in Canada (Proposed). *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa, ON. vii + 62 pp.

ECCC. 2025a. Canadian Climate Normals & Averages Database. Available at: https://climate.weather.gc.ca/. Accessed September 2025.

ECCC. 2025b. Historical Hydrometric Data. Available at: https://wateroffice.ec.gc.ca. Accessed September 2025.

ECCC. 2025c. Fraser River Long-term Water Quality Monitoring Data. DataStream. Available at: https://datastream.org/en-ca/dataset/a66534c3-30b6-4895-bdb4-305a22e3c385. Accessed February 2026.

English, K.K., W. Challenger, D. Robichaud, and J. Korman. 2021. Recovery Potential Assessment for Lower Fraser River White Sturgeon (*Acipenser transmontanus*). Fisheries and Oceans Canada. Canadian Science Advisory Secretariat Research Document 2021/064. vii + 85 pp. Available at: https://frasersturgeon.com/wp-content/uploads/2022/11/Recovery_Potential_Assessment_for_LowerFraserWhiteSturgeon2021.pdf. Accessed November 2025.

Environment Canada. 2015. Recovery Strategy for the Oregon Spotted Frog (*Rana pretiosa*) in Canada. *Species at Risk Act* Recovery Strategy Series. Environment Canada, Ottawa, ON. 23 pp. + Annex.

Finn, R.J.R., L. Chalifour, S.E. Gergel, S.G. Hinch, D.C. Scott, and T.G. Martin. 2021. Quantifying lost and inaccessible habitat for Pacific salmon in Canada's Lower Fraser River. Ecosphere 12(7) https://doi.org/10.1002/ecs2.3646

Fish 'n BC. 2018. BC Fishing Spot Database. Available at: https://www.fishnbc.com/locations/fishingspots.php. Accessed December 2025.

Fraser Health (Fraser Health Authority). 2025. Drinking Water Inspection Reports and Violation Tickets. Available at https://www.healthspace.ca/Clients/FHA/FHA_Website.nsf/Water-Drinking?OpenPage&amp. Accessed October 2025.

GOBC (Government of British Columbia). 1998. Field-stream Identification Guidebook. Second edition. Version 2.1. Available at: https://www.for.gov.bc.ca/hfd/library/ffip/BCMoF1998.pdf. Accessed October 2025.

GOBC. 2023. Data Catalogue – Drinking Water Sources (Surface Water PODs). Available at: https://catalogue.data.gov.bc.ca/dataset/bd3566ed-1101-473b-a3ec-5daefa1fe2c1. Accessed April 2026.

GOBC. 2025a. Data Catalogue. Available at https://apps.nrs.gov.bc.ca/gwells/groundwater-information. Accessed September 2025.

GOBC. 2025b. Groundwater Wells and Aquifers Database. Available at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers. Accessed September 2025.

GOBC. 2025c. Provincial Groundwater Observation Well Network (PGOWN). Available at https://www2.gov.bc.ca/gov/content/environment/air-land-water/water/groundwater-wells-aquifers/groundwater-observation-well-network. Accessed September 2025.

GOBC. 2025d. Aquifer 4 Fact Sheet. Available at https://s3.ca-central-1.amazonaws.com/aquifer-docs/00000/AQ_00004_Aquifer_Factsheet.pdf. Accessed September 2025

GOBC. 2025e. HabitatWizard. Available at: https://maps.gov.bc.ca/ess/hm/habwiz/. Accessed October 2025.

GOBC. 2025f. Fish Inventories Data Queries. Available at: https://a100.gov.bc.ca/pub/fidq/searchSingleWaterbody.do. Accessed October 2025.

GOBC. 2025g. EcoCat: The Ecological Reports Catalogue. Available at: https://a100.gov.bc.ca/pub/acat/public/welcome.do. Accessed October 2025.

GOBC. 2025h. Flood Debris Management – Sumas River and Canal. Available at: https://www2.gov.bc.ca/gov/content/environment/flood-projects/sumas-river-and-canal. Accessed October 2025.

Government of Canada. 2025. Species at Risk Public Registry. Available at: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html. Accessed October 2025.

Helsel, D.R. 2012. Statistics for Censored Environmental Data Using Minitab and R (2nd edition). John Wiley & Sons, Hoboken, NJ.

Helsel, D.R., and L. Lee. 2025. Statistical Methods in Water Resources. 3rd Edition. U.S. Geological Survey, Reston, VI.

iNaturalist. 2025. Observations. Available at: https://www.inaturalist.org/observations. Accessed October 2025.

Jacobs (Jacobs Consultancy Canada Inc). 2024a. Environmental and Socio-Economic Assessment Report. Prepared for Westcoast Energy Inc.

Jacobs. 2024b. Sunrise Expansion Program. Section 183 Application. Appendix 8-1 – Appendix K5 Wildlife and Wildlife Habitat Technical Data Report. Prepared for Westcoast Energy Inc.

Jacobs. 2025. Spatial data from 2024–2025 wildlife field surveys for CS-8B–CS9 potential discharge locations. Unpublished.

Jacobs. 2026. Pipeline Environmental Protection Plan. Prepared for Westcoast Energy Inc. Available at: https://apps.cer-rec.gc.ca/REGDOCS/Item/View/4657576. Accessed April 2026.

Klinkenberg, B. (editor). 2023. E-Fauna BC: Electronic Atlas of the Wildlife of British Columbia. Available at: https://linnet.geog.ubc.ca/biodiversity/efauna/introduction.html. Accessed November 2025.

Lausen, C.L., D.W. Nagorsen, R.M. Brigham, and J. Hobbs. 2022. Bats of British Columbia. 2nd edition. Royal BC Museum Handbook. Victoria, BC.

Lee, L. 2025. NADA: Nondetects and Data Analysis for Environmental Data. R Package Version 1.6-1.2. Available at: https://CRAN.R-project.org/package=NADA. Accessed February 2026.

Lee, R.L., and D.R. Helsel. 2005. Statistical analysis of environmental data containing multiple detection limits: software for regression on order statistics. Computers & Geosciences 31: 1241–1248.

Lesiv, M.S., A.I. Polishchuk, and H.L. Antonyak. 2020. Aquatic macrophytes: ecological features and functions. Studia Biologica 14: 79–94.

LGL Limited. 2016. Side-scan Sonar Surveys of Potential White Sturgeon (*Acipenser transmontanus*) Spawning Areas in the Lower Fraser River, 2016. Prepared for Habitat Conservation Trust Fund. Available at: https://frasersturgeon.com/wp-content/uploads/2019/01/Fraser-River-Sidescan-Sonar-Report2016_22Jan2017_final_26Jan2017_2220_dk-4.pdf. Accessed October 2025.

McPhail, J.D. 2007. The Freshwater Fishes of British Columbia. University of Alberta Press. 620 pp

MMA (M. Miles and Associates Ltd). 2019. Hydrotechnical Support Maria Slough Anomaly at 8BL1 KP31.5 Background Climatology & Hydrology.

Pacific Birds Habitat Joint Venture. 2025. Fraser Lowland Wetland Inventory Data Report: Assessment of Wetland Loss 1989 to 2019 and Priority 1 Wetland Protection 1992 to 2024. Available at https://pacificbirds.org/resource_categories/coastal-wetlands-conservation-priority/. Accessed October 2025.

Pacific Salmon Federation. 2024. Pacific Salmon Explorer. Available at: https://www.salmonexplorer.ca/. Accessed October 2025.

Park, E. 2007. Aquifer 4 Mapping Report. Available at: https://s3.ca-central-1.amazonaws.com/aquifer-docs/00000/AQ_00004_Aquifer_Mapping_Report.pdf. Accessed September 2025.

Powers, J.P., A.B. Corwin, P.C. Schmall, and W.E. Kaeck. 2007. Construction Dewatering and Groundwater Control. John Wiley & Sons Inc., Hoboken, NJ.

Province of British Columbia. 2001. Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures. Version 2.0. Prepared for the Resources Inventory Committee. Available at: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/recce2c.pdf. Accessed October 2025.

R Core Team. 2026. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: https://www.R-project.org/. Accessed March 2026.

Roberge, M., J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life History Characteristics of Freshwater Fishes Occurring in British Columbia and the Yukon, with Major Emphasis on Stream Habitat Characteristics. Fisheries and Oceans Canada. Canadian Manuscript Report of Fisheries and Aquatic Science 2611. 262 pp.

Saidon, N.B., R. Szabó, P. Budai, and J. Lehel. 2024. Trophic transfer and biomagnification potential of environmental contaminants (heavy metals) in aquatic ecosystems. Environmental Pollution 340: Part 1, 2024.

Schürings, C., W. Kaijser, S.M. Gillmann, J. Kiesel, H.H. Nguyen, K. Peters, P. Rolauffs, P. Haase, A.W. Lorenz, and D. Hering. 2025. Drivers of recovery and degradation of riverine benthic invertebrate communities: a Germany-wide analysis. Ecological Process 14: 30. https://doi.org/10.1186/s13717-025-00593-1

Seequent. 2024. Leapfrog Works Version 2024.1. Seequent, The Bentley Subsurface Company.

Stantec (Stantec Consulting Ltd.). 2024. Technical Memorandum – Enbridge SEP Preliminary Hydrogeology Desktop Assessment. Draft report prepared for Westcoast Energy Inc. May 13, 2024.

Township of Langley. 2024. Erosion and Sediment Control Bylaw 2006 No. 4381. Available at: https://www.tol.ca/en/services/resources/bylaw-services/bylaws/Development-Bylaws/Erosion-and-Sediment-Control-Bylaw-(No.-4381).pdf. Accessed February 2026.

TRU and BC MOE (Thompson Rivers University and British Columbia Ministry of Environment). 2021a. British Columbia reptile and amphibian range maps. Available at: https://bcreptilesandamphibians.ca/range-maps/. Accessed October 2025.

TRU and BC MOE. 2021b. British Columbia amphibian species accounts. Available at: https://bcreptilesandamphibians.ca/amphibian-species-accounts/. Accessed October 2025.

TRU and BC MOE. 2021c. British Columbia reptile species accounts. Available at: https://bcreptilesandamphibians.ca/reptile-species-accounts/. Accessed October 2025.

U.S. EPA (United States Environmental Protection Agency). 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10. Washington, DC.

U.S. EPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. EPA/530/R-09/007. Washington, DC.

U.S. EPA. 2015. ProUCL Version 5.1 Technical Guide. EPA/600/R-07/041. Washington, DC.

Voss, B.M., B. Peucker-Ehrenbrink, T.I. Eglinton, R.G.M. Spencer, E. Bulygina, V. Galy, C.H. Lamborg, P.M. Ganguli, D.B. Montluçon, S. Marsh, S.L. Gillies, J. Fanslau, A. Epp, and R. Luymes. 2015. Seasonal hydrology drives rapid shifts in the flux and composition of dissolved and particulate organic carbon in the Fraser River. Biogeosciences 12: 5597–5618. https://doi.org/10.5194/bg-12-5597-2015

Westcoast (Westcoast Energy Inc). 2024. Project Notification – Westcoast Energy Inc. Sunrise Expansion Program. Available at: https://docs2.cer-rec.gc.ca/ll-eng/llisapi.dll/fetch/2000/90464/90550/90718/4430166/4456083/4435255/4433079/C28231%2D2_Sunrise_Expansion_Program_%2D_Project_Notification_%2D_A8W0R3.pdf?nodeid=4433280&vernum=-2. Accessed March 2026.

Appendices

Appendices found under separate covers

Contact BCProjects@enbridge.com to request for the Appendices.