Technical Assessment Report

In Support of the Section 15 Approval (Tracking # 447383)
for the Sunrise Expansion Program - Huntingdon Loop

Stantec

Prepared for:
Westcoast Energy Limited Partnership

April 30, 2026

Prepared by:
Stantec Consulting Ltd.

Project/File:
123317055

Stantec Consulting Ltd.

Limitations and Sign-off

This document entitled Technical Assessment Report – In Support of the Section 15 Approval (Tracking # 447383) for the Sunrise Expansion Program - Huntingdon 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 # 447383) for the CS-9–Huntingdon pipeline loop (hereafter 'Huntingdon 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 Huntingdon Loop is currently planned to be an approximately 4.2 km long pipeline loop located between the MS-16 meter station in Huntingdon at the Canada/United States border and Arnold Slough, 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 Huntingdon Loop has eight PDLs which include the Sumas River, irrigation canals (Arnold Slough and Sumas Lake Canal), and agricultural ditches (unnamed tributaries to Saar Creek). A variety of fish species have the potential to be present within the PDL receiving environments, including salmonids, suckers, and minnows; however, suitable habitat within the agricultural ditches and irrigation canals is more limited for fish.

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 Huntingdon Loop are generally shallow (typically less than 2.5 metres below ground surface). It is anticipated that the total length of the Huntingdon Loop mainline pipeline trench will be subject to groundwater inflow during construction and will require groundwater management and dewatering. Mainline trench excavations are estimated to require dewatering rates of up to 125 litres per second (L/s). Smaller, localized excavations, such as crossover excavations and bore bays, are expected to require dewatering rates of less than 62 L/s. The highest dewatering rate is anticipated near Arnold Slough. Dewatering rates will decrease westward toward the Canada/United States border, to generally less than 10 L/s.

Dewatering rates are expected to change seasonally with higher dewatering rates during high groundwater level conditions (i.e., October to April), and lower rates under lower groundwater conditions (i.e., May to September). Groundwater recharge from precipitation will be a small fraction of groundwater dewatering rates but may still require management during excavation. For these reasons, pipeline construction is planned to avoid the wettest months.

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 Sumas River, irrigation canals (Arnold Slough and Sumas Lake Canal), and agricultural ditches (unnamed tributaries to Saar Creek). Surface water monitoring results indicated that the watercourses have several elevated parameters and existing WQG-FAL exceedances. For the Sumas River (PDL-H10), exceedances of the chronic WQG-FAL were observed for several metals and nutrients, including total chromium and nickel, with nickel exceedances occurring most frequently (up to 99% of observations). For unnamed tributaries to Saar Creek (PDL-H1, PDL-H2, PDL-H3, PDL-H7) and Arnold Slough (PDL-H8), nutrient concentrations were generally low, but total ammonia and nitrate exceeded WQG-FAL. Metals exceedances of the chronic WQG-FAL were observed for aluminum, copper, iron, mercury, and nickel, with some parameters (notably iron, copper, and mercury) exceeding guidelines by more than thirty-fold. Sumas Lake Canal (PDL-H9A and PDL-H9B) samples exceeded the chronic WQG-FAL for nickel, copper, and aluminum, though at lower magnitudes than the Arnold Slough sites.

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). 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 (i.e., WQG-FAL) 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
- the 95th percentile 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 Huntingdon Loop and Corresponding Basis for the Discharge Quality Criteria by Watershed (Proposed Discharge Location)

Parameter of Concern	**Basis of Discharge Quality Criteria**	
	Saar Creek Watershed (PDL-H1, PDL-H2, PDL-H3, PDL-H7, PDL-H8)	**Sumas River Watershed (PDL-H9A, PDL-H9B, PDL-H10)**
Fluoride	Chronic WQG-FAL	Chronic WQG-FAL
Nitrate (as N)	Background	Chronic WQG-FAL
Total Aluminum	Background	Background
Total Arsenic	Chronic WQG-FAL	Chronic WQG-FAL
Total Beryllium	Chronic WQG-FAL	Chronic WQG-FAL
Total Chromium	Background	Background
Total Iron	Background	Background
Total Mercury	Background	Background
Total Selenium	Chronic WQG-FAL	Chronic WQG-FAL
Dissolved Cobalt	Background	Chronic WQG-FAL
Dissolved Copper	Background	Background
Dissolved Iron	Background	Acute WQG-FAL
Dissolved Manganese	Background	Chronic WQG-FAL
Dissolved Nickel	Background	Background

Notes:

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

Unshaded cells indicate discharge limits are based on discharge quality criteria based on the 95th Percentile of background water quality.

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.

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 or pumps 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.1. 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.

Two of the eight PDLs considered for the Huntingdon Loop—Arnold Slough (PDL-H8) in the Saar Creek watershed and Sumas River (PDL-H10)—can each accommodate large volumes and are currently proposed as the primary and secondary discharge locations, respectively. Four PDLs associated with unnamed tributaries of Saar Creek (PDL-H1, PDL-H2, PDL-H3, and PDL-H7) are either irrigation ditches or small drainage features that have limited receiving capacity and would, therefore, be used as a back-up or in combination with other PDLs for low volume discharges. Locations in the Sumas Lake Canal (PDL-H9A and PDL-H9B) are considered contingency sites to accommodate large discharge volumes because water would need to be piped a greater distance from the pipeline loop to discharge at these locations.

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 watershed. Although maximum discharge rates requested for the Section 15 Approval are defined in Table ES.2, actual discharge rates vary for some PDLs by month and those monthly maximum discharge values will be used instead of the annual maximum, when applicable.

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.

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

Parameter (Units)	**Proposed Discharge Limit for End-of-Pipe**	
	Saar Creek Watershed (PDL-H1, PDL-H2, PDL-H3, PDL-H7, PDL-H8)	**Sumas River Watershed (PDL-H9A, PDL-H9B, PDL-H10)**
Maximum Discharge Rate (m^3/s)*	PDL-H1, PDL-H2, PDL-H3, PDL-H7 – 0.005 PDL-H8 – 0.284	0.284
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)	> 5	> 5
Fluoride (mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Nitrate (as N; mg/L)	3.11	Chronic WQG-FAL
Aluminum (T; mg/L)	1.04	0.397
Arsenic (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Beryllium (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Chromium (T; mg/L)	0.00282	0.0069
Iron (T; mg/L)	15.1	2.2
Mercury (T; mg/L)	0.00000488	0.00000594
Selenium (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Cobalt (D; mg/L)	0.000721	Chronic WQG-FAL
Copper (D; mg/L)	0.00389	0.00222
Iron (D; mg/L)	6.1	Acute WQG-FAL
Manganese (D; mg/L)	0.924	Chronic WQG-FAL
Nickel (D; mg/L)	0.0129	0.0149

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

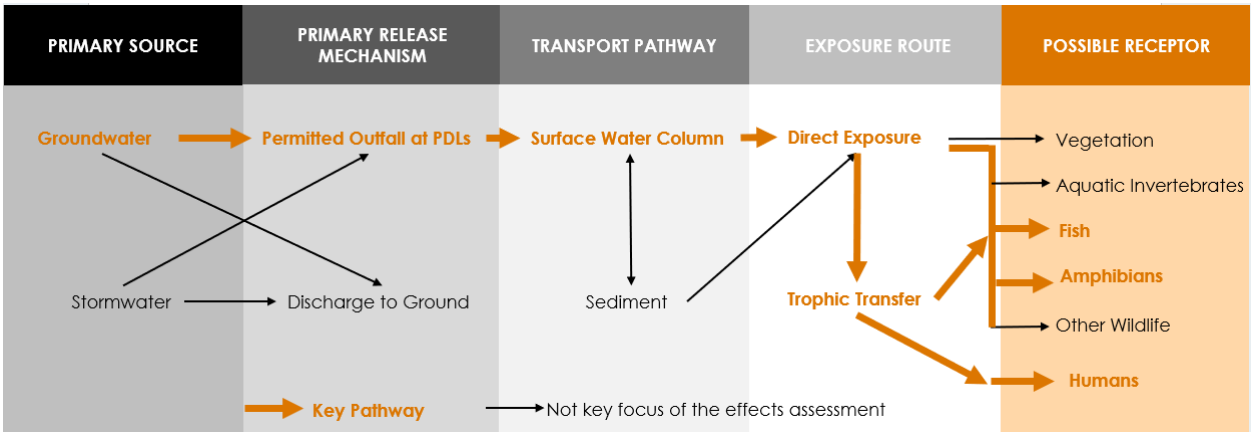
Unshaded cells indicate discharge limits are based on discharge quality criteria based on the 95th percentile of background water quality. Shaded cells indicate discharge quality criteria based on water quality guidelines which do not require defined discharge limits but will be monitored according to the applicable guideline values. 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.

* These are the maximum discharge rates requested for the Section 15 Approval; however, actual discharge rates vary by month for some PDLs as discussed in this TAR.

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 occur within the PDL receiving environments, with breeding confirmed for three species. 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 higher 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 the Saar Creek and Sumas River watersheds (i.e., fish, amphibians, or 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

Parameter	Method	Monitoring Frequency*	Monitoring Location(s)
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
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 # 447383) for the Huntingdon 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. The proposed discharge limits apply at the point of discharge, meaning concentrations meet the limits before any mixing or dilution occurs in the receiving environment, which represents an additional level of conservatism. 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).
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.
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.

Term	Definition
Best Achievable Technology	An assessment to evaluate water treatment technologies for treating the groundwater encountered during trench dewatering (see Appendix L). The Best Achievable Technology assessment was prepared in accordance with provincial guidance.
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
Discharge limits	The proposed Section 15 Approval discharge limits for flow, general construction parameters, and the identified parameters of concern.

Term	Definition
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	An 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).
Huntingdon Loop; CS-9–Huntingdon pipeline loop	An approximately 4.2 km long pipeline loop that located between the MS-16 meter station in Huntingdon at the Canada/United States border and Arnold Slough, adjacent to the existing Westcoast right of way.

Term	Definition
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 # 447383) was issued March 31, 2026.
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

Term	Definition
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).
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 8.5×10^6 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.

Term	Definition
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.
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.

Term	Definition
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.
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	50th percentile
90P	90th percentile
95P	95th 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 # 447383).

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

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).

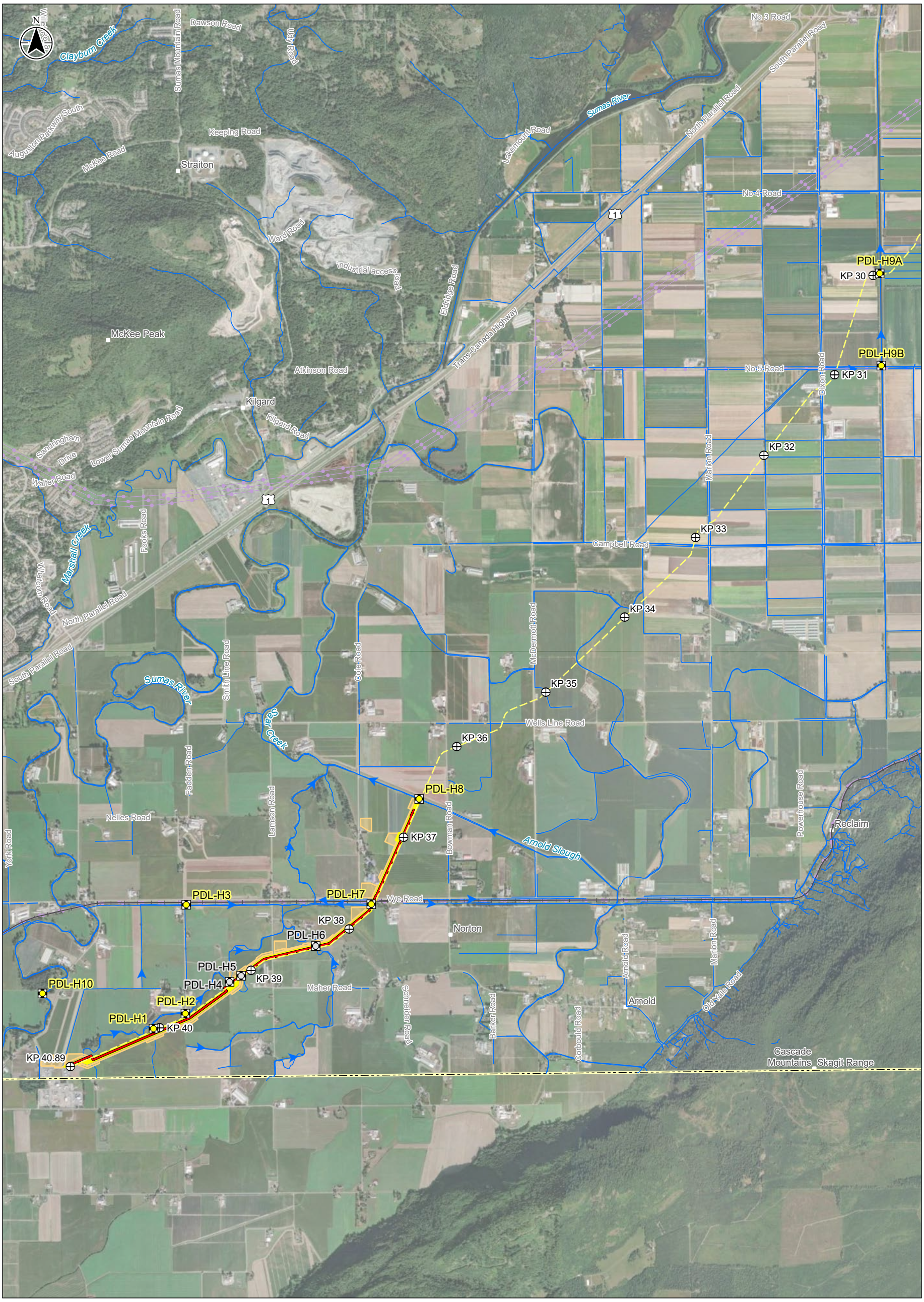
The Section 15 Approval Application and this TAR focus on the CS-9–Huntingdon pipeline loop (hereafter 'Huntingdon Loop'; Figure 1.2), one of the two pipeline loops in the Fraser Valley (see Section 1.1). The following subsections described the location of the Project, including the specific location of the Huntingdon Loop, and provide information on landownership and surrounding land use for the Huntingdon Loop component of the Project.

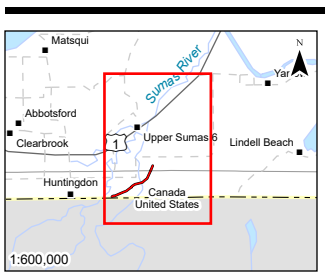
1.2.1 Project Location

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 Huntingdon Loop is currently planned to be approximately 4.2 km long between 49.02433°N,122.1769°W and 49.0036°N, 122.2206°W 49.0036°N (Figure 1.2). This pipeline loop will originate upstream of Huntingdon near Cole Road and traverse along the existing Westcoast system right-of-way (ROW) before terminating at the MS-16 meter station on the Canada/United States border, approximately 4.2 km east of the Huntingdon-Sumas border crossing. The Huntingdon Loop has eight 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.





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

- International Border
- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Proposed Right of Way
- Proposed Workspace

Proposed Discharge Locations
- Current
- Retired

0 350 700 1,050 1,400 m

1:35,000 (at original document size of 11x17)

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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.
1.2

Title
Overview of Pipeline Loop

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\12322\projects\123316894\figures\reports\TAR\loop_overviewsfig_123317055_sep_tar_loop_overview.aprx Revised: 2026-04-28 By: jpoucher

1.2.2 Landownership

The Huntingdon Loop crosses a variety of properties and includes provincial Crown land and private property at the discharge locations. The pipeline loop extends from Parcel Identification (PID) 007-340-699 to PID 018-779-441. 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.

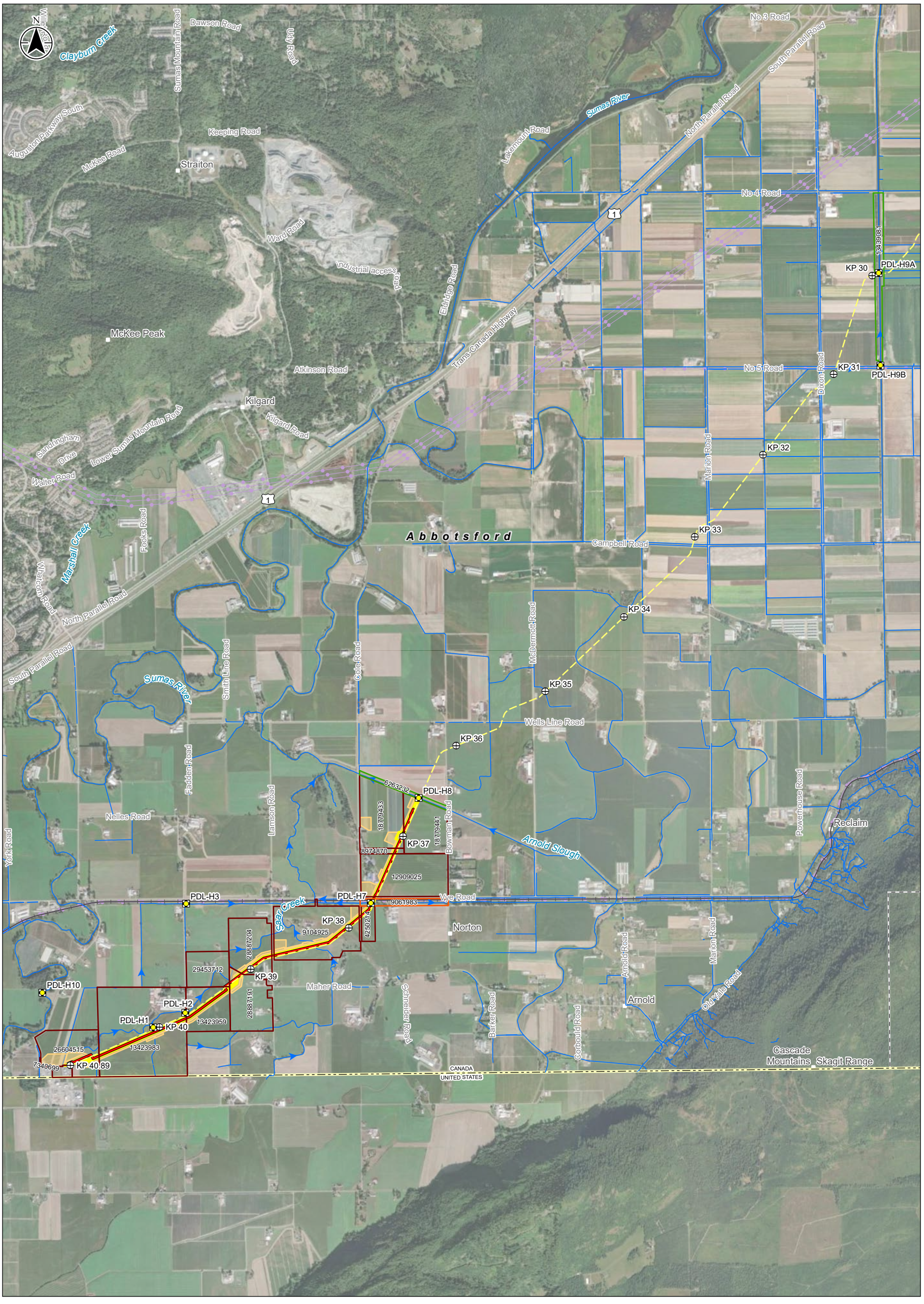
1.2.3 Surrounding Land Use

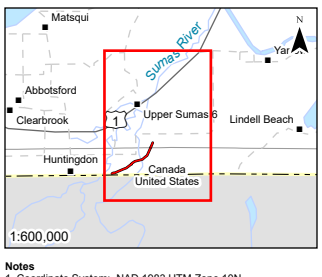
The Huntingdon Loop is within a pipeline utility ROW in Abbotsford, BC. The areas surrounding the loop are zoned as Agriculture 2 (City of Abbotsford 2025), which has been established to accommodate agricultural uses and complementary activities suitable in the Agricultural Land Use Designation. As such, most of the land use in the vicinity of the Huntingdon 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

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.





- International Border
- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Proposed Right of Way
- Proposed Workspace
- Proposed Discharge Location

Land Ownership

Owner Type

- Crown Agency
- Local Government
- Private

0 350 700 1,050 1,400 m

1:35,000 (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
Abbotsford, BC
NTS 50K Grid: 092G01

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.
1.3

Title
Landownership

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316894\figures\reports\TAR\land_ownership\fig_123317055_sep_tar_land_ownership.aprx Revised: 2026-04-28 By: jpoucher

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 A*ct 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.

Act, Regulation or Policy	Regulator*	Description
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
January 2025 – Westcoast and STSA jointly prepared and participated in a 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

Date, Form of Engagement, and Discussion Topics	Indigenous Groups Engaged
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
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.

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

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.

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). Westcoast recognizes that landowners along the Huntingdon Loop use water for irrigation and Westcoast will provide notification to landowners with identified permanent or temporary water intakes within 100 m of the PDLs.

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

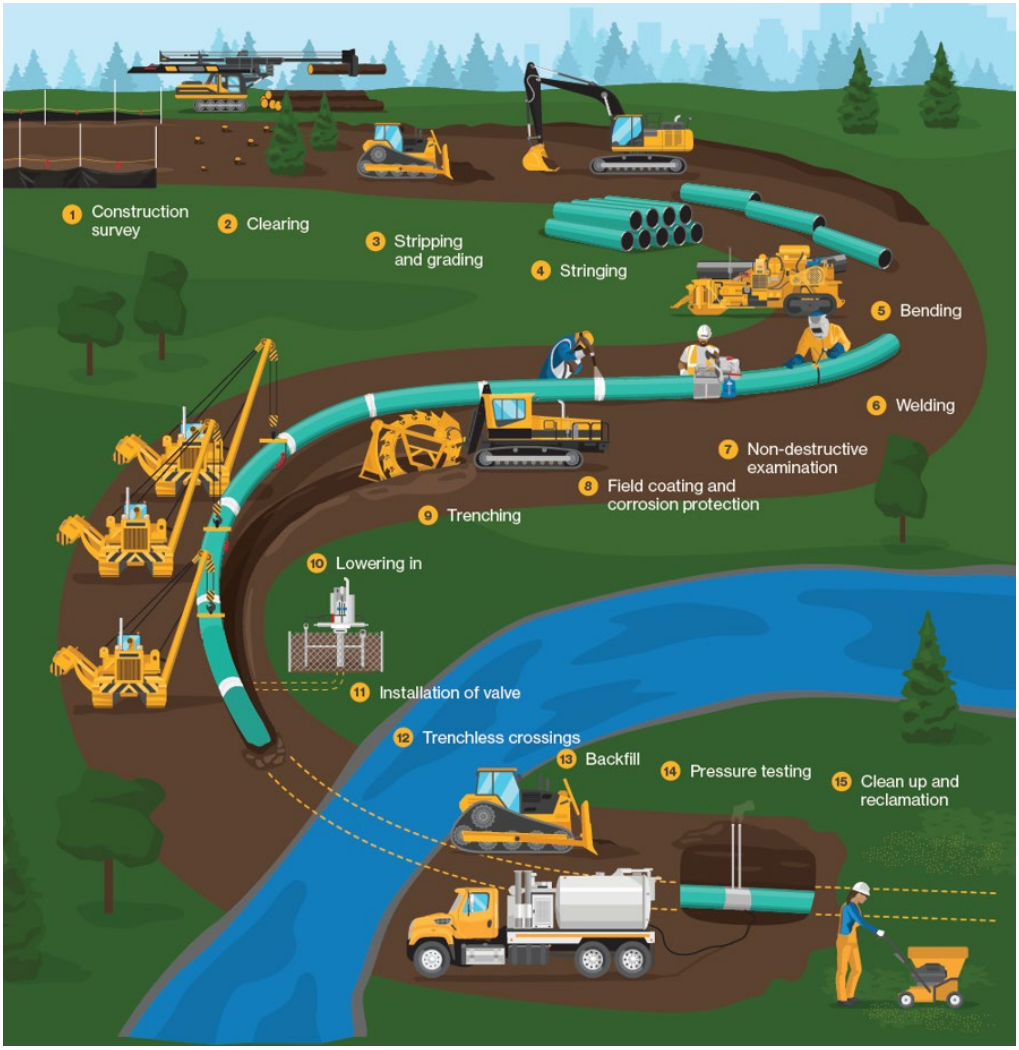
The pipeline will be designed and constructed in accordance with the industry standard, *CSA Z662:23 – Oil and Gas Pipeline Systems* (CSA Group 2023). The permanent ROW will be approximately 18 metres (m) wide. The temporary pipeline construction footprint will generally be 45 to 55 m wide, including 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

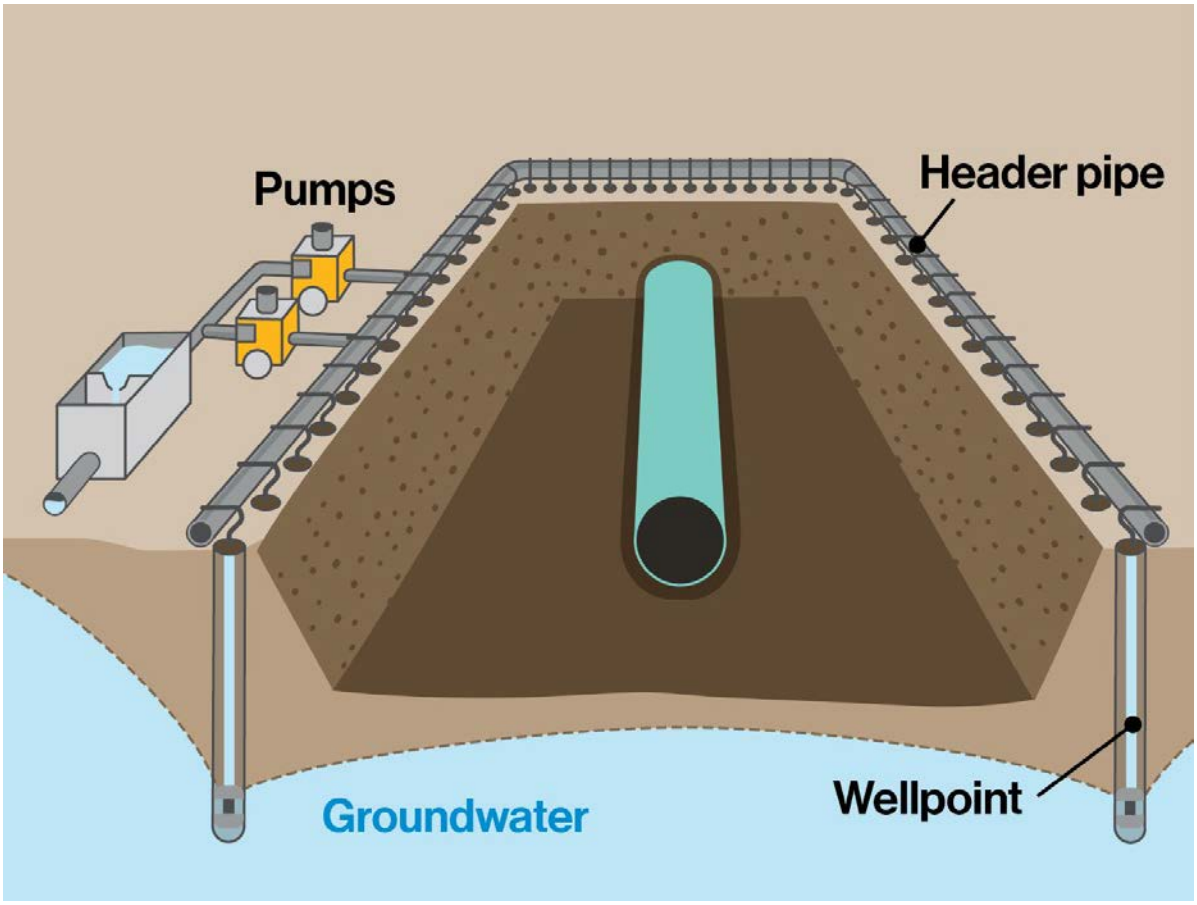
The Section 15 Approval is not applicable to Project closure and post-closure since trench dewatering and discharge will be temporary (no longer than 15 months) and confined to the initial construction phase.

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 eight 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 were the Sumas River (PDL-H10) and two locations on the Sumas Lake Canal (PDL-H9A and PDL-H9B). In second quarter (Q2) of 2025, three 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-H1	Unnamed tributary to Saar Creek	10U 557785 5428476	Assessed since August 2024	Location shifted slightly to avoid a cultural site.
PDL-H2	Unnamed tributary to Saar Creek	10U 558079 5428612	Assessed since August 2024	
PDL-H3	Unnamed tributary to Saar Creek	10U 558087 5429613	Assessed since August 2024	
PDL-H4	Unnamed tributary to Saar Creek	10U 558485 5428908	Removed in July 2025	Insufficient receiving capacity.
PDL-H5	Unnamed tributary to Saar Creek	10U 558592 5428963	Removed in July 2025	Insufficient receiving capacity.
PDL-H6	Saar Creek	10U 559276 5429233	Removed in July 2025	Insufficient receiving capacity.
PDL-H7	Unnamed tributary to Saar Creek	10U 559787 5429619	Assessed since August 2024	
PDL-H8	Arnold Slough	10U 560227 5430587	Assessed since 2024	
PDL-H9A	Sumas Lake Canal	10U 564459 5435417	Added in March 2025	Not within pipeline right-of-way but added because it has appropriate seasonal receiving capacity if alternative options are required.
PDL-H9B	Sumas Lake Canal	10U 564475 5434567	Added in March 2025	Not within pipeline right-of-way but added because it has appropriate seasonal receiving capacity if alternative options are required.
PDL-H10	Sumas River	10U 556765 5428797	Added in March 2025	Not within pipeline right-of-way but added as it is anticipated to have appropriate seasonal receiving capacity.

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 Huntingdon 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

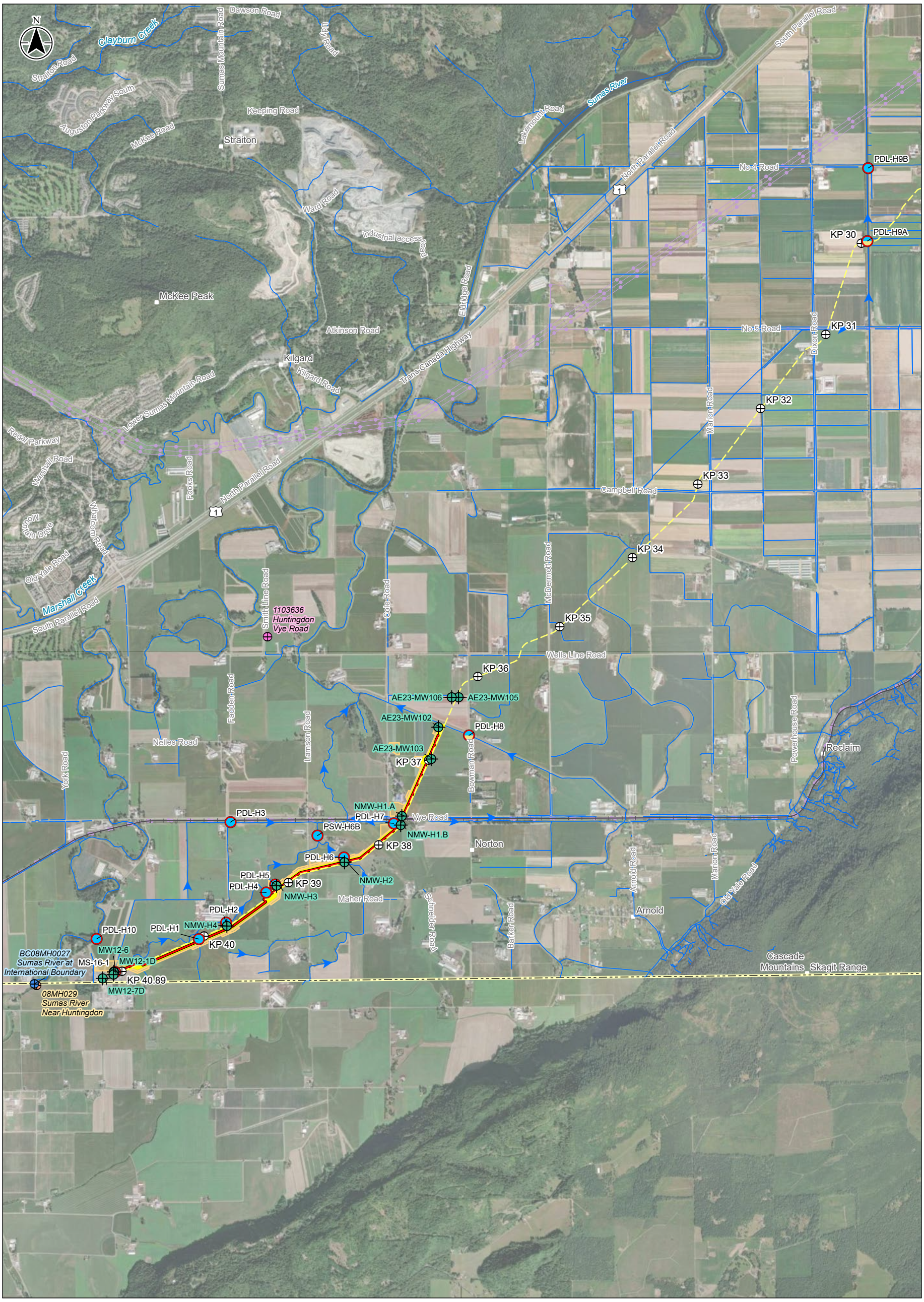
2 Environmental Settings

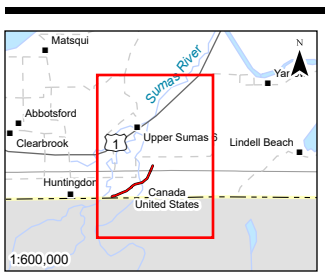
The following sections detail the environmental setting of the Huntingdon Loop, as it pertains to meteorology and climate, surface water hydrology, hydrogeology, surface water quality, freshwater aquatic life, and potential contaminated sites and acid rock drainage. Data related to the environmental 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.





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

- International Border
- Railway
- Transmission Line
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Proposed Right of Way
- 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
- Hydrometric Station
- Water Quality Station

0 380 760 1,140 1,520 m

1:38,000 (at original document size of 11x17)

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\ca0183-pbagf01\workgroup\12322projects\123316894\figures\reports\TAR\sampling_locations\fig_123317055_sep_tar_sampling_locations.aprx Revised: 2026-04-30 By: jpoucher

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 1100031 (Abbotsford A)
- ECCC Intensity-Duration-Frequency Data (1977–2001) for Climate Station 1100030 (Abbotsford A)
- ECCC Climate Normals Data (1981–2010) for Climate Station 1100030 (Abbotsford A)
- BC Agricultural Irrigation Scheduling Calculator

2.1.2 Results and Discussion

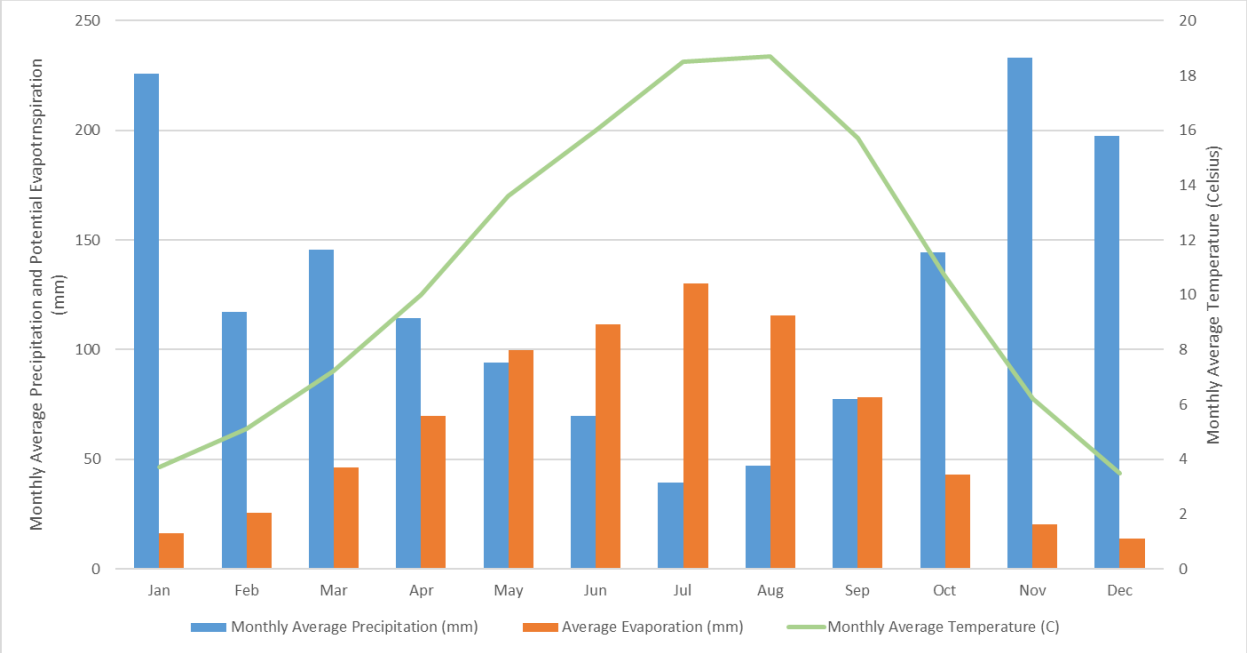
2.1.2.1 Historical Data

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

Canadian Climate Normals for precipitation, and temperature developed using data recorded from 1981 to 2010 at the Abbotsford A weather station (Climate ID: 1100030), located approximately 11 km east of the Huntingdon Loop at an elevation of 59 m, are presented in Figure 2.2 alongside evaporation data from the BC Agricultural Irrigation Scheduling Calculator.

Figure 2.2 Summary Climate Data for the Huntingdon 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 Huntingdon 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 Huntingdon Loop Area

Duration	**Rainfall (mm)**	
	5-Year Return Period	**100-Year Return Period**
5 min	5.0	8.4
10 min	7.8	14.5
15 min	9.5	17.4
30 min	13.3	23.4
1 hour	17.7	29.6
2 hours	23.8	39.1
6 hours	34.2	56.8
12 hours	57.9	83.5
24 hours	78.5	117.1

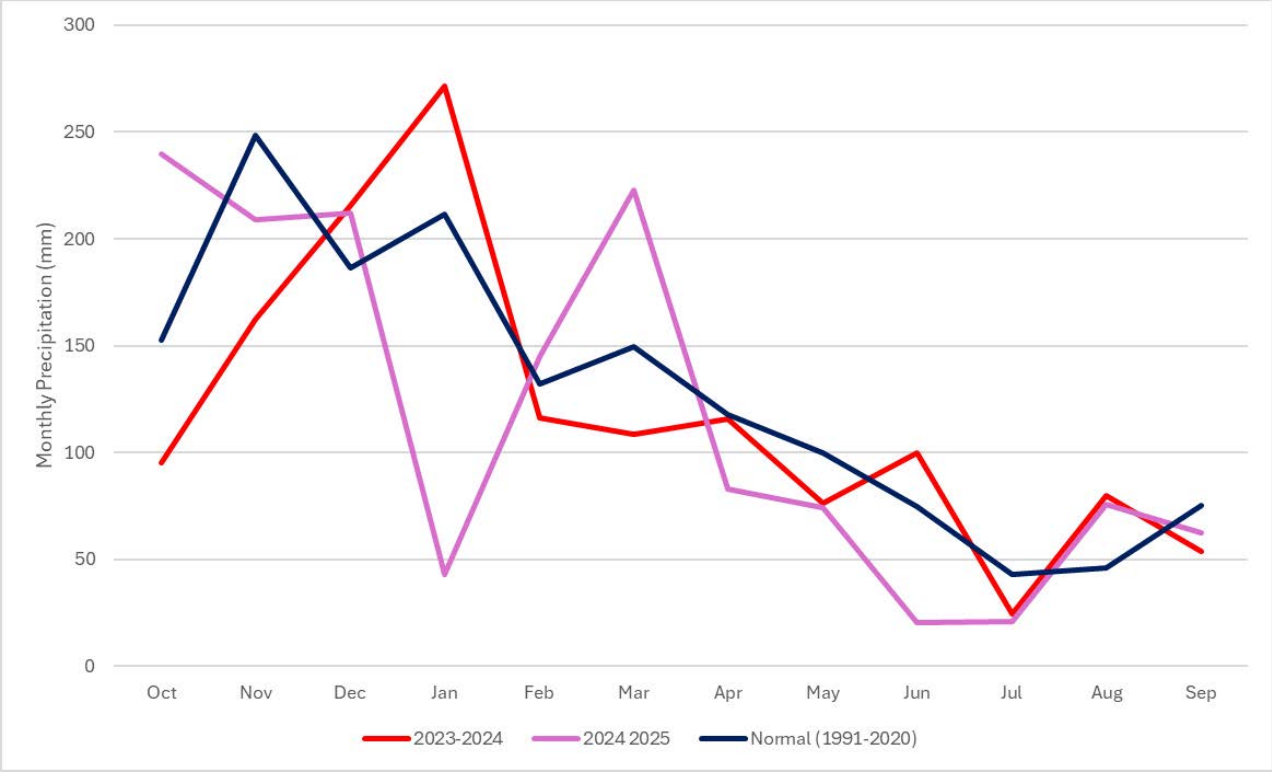
Note:
mm = millimetre

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 2.3, 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 Abbotsford A climate station and normal range derived from long-term averages from ECCC for the Abbotsford A climate station.

Figure 2.3 2023–2025 Precipitation Recorded at and Long-Term Average (Normal) Precipitation for the Abbotsford A Climate Station



For both the hydrologic years 2023–2024 and 2024–2025, precipitation recorded was approximately 10% less than an average year. Hydrologic year 2023–2024 received 10% less precipitation in the rainy season (i.e. October to March) and average precipitation from April to September. Hydrologic year 2024–2025 experienced average precipitation from October to March and 25% 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:

- Inventory of Streamflow in the South Coast and West Coast Regions, BC Ministry of Environment and Climate Change (October 2017)
- Westcoast's Huntingdon Loop field monitoring programs and surveys results and observations (2023–2025) included in Appendix E
- ECCC recorded hydrometric data (1953–2022) for Hydrometric Station 08MH029 (Sumas River Near Huntingdon)

2.2.2 Results and Discussion

2.2.2.1 Watershed Characteristics

The Huntingdon Loop PDLs are located either on the Sumas River or within the Sumas River watershed. The Sumas River watershed is in the Fraser River Lowland. The mainstem of the Sumas River originates in the coastal mountains in Whatcom County in Washington State and joins the Fraser River east of Abbotsford in BC. Agriculture occurs over more than 90% of the length of the Sumas River. The Sumas River passes through the Barrowtown Pump Station complex approximately 4.5 km upstream of its confluence with the Fraser River. Section 2.1.2 and Section 2.3.2 provide more information on the climate and geological setting of the Huntingdon Loop area.

Under normal conditions the Sumas River crosses the Barrowtown Pump Station complex through open flood gates. When the Fraser River is under high flow conditions, the flood gates are closed to prevent flooding along the Sumas River mainstem. Under these conditions, the Sumas River can be routed through the pump station to bypass the closed gates. The southern part of the catchment reaches the Barrowtown Pump Station complex through the Sumas Lake Canal. Surface runoff is retained in the canal through the summer months to support irrigation activities in the area. In the fall and winter, the water levels are lowered through the operation of the Barrowtown Pump Station to provide available storage for flood control in the area. A schematic of the system at the Barrowtown Pump Station complex is shown in Figure 2.4. The understanding of the system is based on personal communication between Westcoast and City of Abbotsford staff.

Figure 2.4 Barrowtown Pump Station Complex Schematic

2.2.2.2 Surface Runoff

Based on available data, mean monthly flows have been estimated for each Huntington Loop PDL. For PDLs within this loop, estimating flow by using regional equations for annual runoff and mean monthly runoff distribution from the BC Streamflow Inventory for Hydrologic Zone 27 was considered. However, due to the similarity (in location, aspect, and topography) of catchments draining into watercourses in this area with the catchment upstream of the ECCC hydrometric station 08MH029 (Sumas River Near Huntingdon), the estimates are based on the analysis of recorded monthly flows from 1953 to 2022 at the ECCC hydrometric station 08MH029 (Sumas River Near Huntingdon). These monthly estimates for the station have then been prorated by catchment area to develop estimates for all PDLs within the loop. The catchment area of each PDL was estimated using a digital elevation model based a combination of provincial and federal LiDAR data.

Mean monthly flows for each of the Huntingdon Loop PDLs are presented in Table 2.2. On average, streams within the Huntingdon Loop show higher flows in the winter months (December to February) and lower flows between July and September. While the monthly flow assessments assume that assessed waterbodies can operate as unregulated streams, the whole area of the Huntingdon Loop is managed by the City of Abbotsford for flood control and irrigation support (see Section 2.2.2.1). As such, water levels within the system are not always reflecting flow conditions.

Table 2.2 Mean Monthly Flow Estimates for Huntingdon 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-H1	Unnamed tributary of Saar Creek	0.016	0.016	0.013	0.010	0.007	0.005	0.003	0.002	0.003	0.004	0.013	0.016
PDL-H2	Unnamed tributary of Saar Creek	0.016	0.016	0.013	0.010	0.007	0.005	0.003	0.002	0.003	0.004	0.013	0.016
PDL-H3	Unnamed tributary of Saar Creek	0.008	0.008	0.006	0.005	0.003	0.003	0.002	0.001	0.001	0.002	0.006	0.008
PDL-H7	Unnamed tributary of Saar Creek	0.014	0.013	0.011	0.009	0.006	0.004	0.003	0.002	0.002	0.004	0.011	0.014
PDL-H8	Arnold Slough	0.901	0.796	0.655	0.518	0.349	0.258	0.165	0.126	0.132	0.228	0.645	0.804
PDL-H9A	Sumas Lake Canal	1.62	1.37	1.13	0.892	0.602	0.444	0.285	0.217	0.228	0.394	1.11	1.39
PDL-H9B	Sumas Lake Canal	1.62	1.37	1.13	0.892	0.602	0.444	0.285	0.217	0.228	0.394	1.11	1.39
PDL-H10	Sumas River	6.97	5.92	4.87	3.846	2.60	1.91	1.228	0.938	0.984	1.70	4.79	5.98

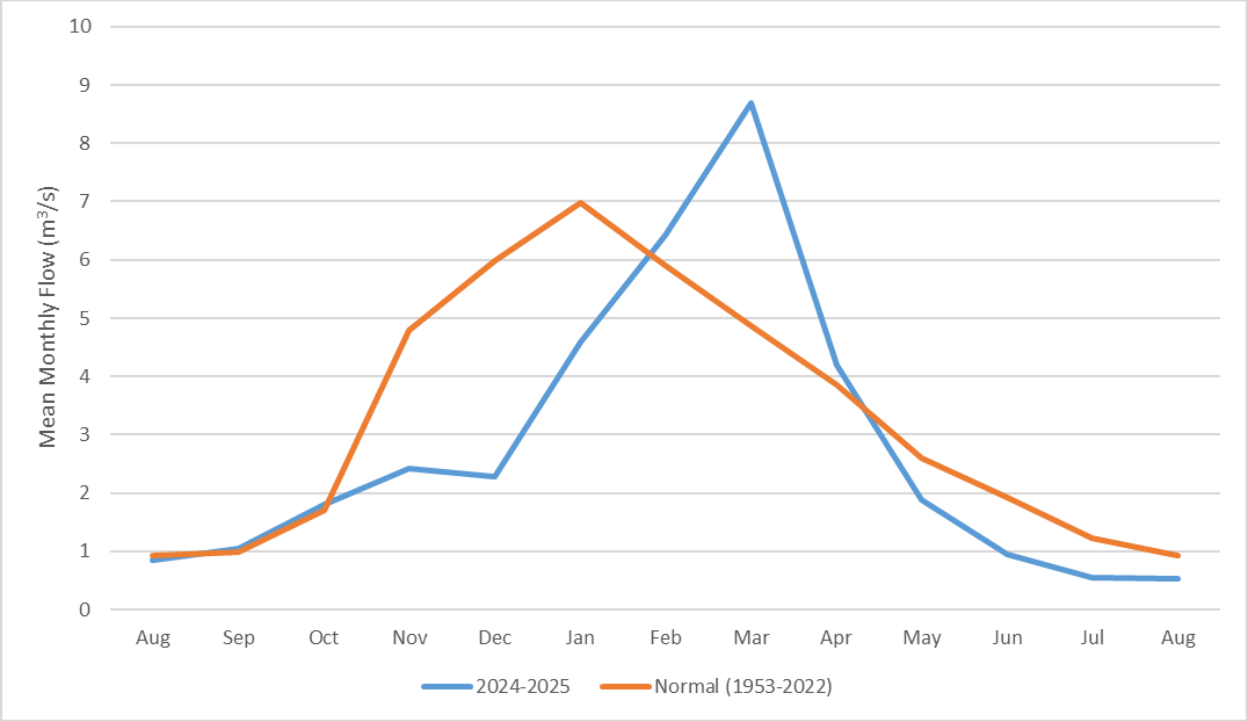
Note:
m^3/s = cubic metres per second

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 2.5 shows the comparison between average monthly flows and monthly flows recorded between August 2024 and August 2025 at the ECCC hydrometric station 08MH029 (Sumas River near Huntingdon). For the 2024–2025 monitoring period, flows in the Sumas River were approximately 15% less than normal (accounting for monthly fluctuations) with the biggest difference occurring between November and January and in June and July despite higher flow than normal between February and April.

Figure 2.5 2024–2025 Recorded and Historical Monthly Flows in Hydrometric Station 08MH029 (Sumas River near Huntingdon)



2.2.2.4 Channel Morphology

2.2.2.4.1 Unnamed Tributaries to Saar Creek

Saar Creek and the network of its tributaries appear to consist of multiple former natural water bodies that have been routed through man-made trapezoidal channels and ditches, typically showing well-vegetated banks and steep (approximately 1H:1V) side slopes. The channels are mostly straight or moderately sinuous and appear to be laterally stable, with limited evidence of localised bed or bank erosion. The channels have flat longitudinal slopes, and they were observed to be seasonally stagnant or dry. Typical conditions at PDL-H1, PDL-H2, PDL-H3, and PDL-H7 are shown in Photo 2.1, Photo 2.2, Photo 2.3, and Photo 2.4, respectively.

Photo 2.1 Unnamed Tributary to Saar Creek at PDL-H1 in October 2024 (Left) and April 2025 (Right) Looking Downstream

Photo 2.2 Unnamed Tributary to Saar Creek at PDL-H2 in October 2024 (Left) and May 2025 (Right) Looking Upstream

Photo 2.3 *Unnamed Tributary to Saar Creek at PDL-H3 in October 2024 (Left) and April 2025 (Right) Looking Downstream*

Photo 2.4 *Unnamed Tributary to Saar Creek at PDL-H7 in October 2024 (Left) and May 2025 (Right) Looking Downstream*

2.2.2.4.2 Arnold Slough

Arnold Slough, near PDL-H8, is a natural waterbody confined into a manmade trapezoidal canal. The canal has steep (1H:1V) vegetated banks and an approximately 2 m wide bed. The channel appears to be laterally stable and has a very flat longitudinal slope. Typical conditions at PDL-H8 are shown in Photo 2.5.

Photo 2.5 Arnold Slough at PDL-H8 in November 2024 (Left) and May 2025 (Right) Looking Downstream

2.2.2.4.3 Sumas Lake Canal

Sumas Lake Canal is a large (approximately 25 m width) manmade trapezoidal canal with vegetated banks and a relatively flat longitudinal slope. The canal is used for flood control (conveying surface runoff to the Barrowtown Pump Station) and to impound water for irrigation purpose. Two roadside ditches enter the canal from the east and west at PDL-H9B and a bridge is located immediately downstream of PDL H9B. Typical conditions at PDL-H9A and PDL-H9B are shown in Photo 2.6 and Photo 2.7, respectively.

Photo 2.6 Sumas Lake Canal at PDL-H9A in March 2025 (Left) and June 2025 (Right) Looking Downstream

Photo 2.7 Sumas Lake Canal at PDL-H9B in March 2025 (Left) and August 2025 (Right) Looking Downstream

2.2.2.4.4 Sumas River

The Sumas River near PDL-H10 is a natural waterbody with a meandering channel and steep, well vegetated banks. Some bank slumping was observed in the vicinity of the PDL. Woody debris was observed in the channel. Typical conditions at PDL-H10 are shown in Photo 2.8.

Photo 2.8 Sumas River at PDL-H10 in March 2025 (Left) and July 2025 (Right) Looking Across the Channel

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	
2023 Enbridge Lower Mainland Depth of Cover Groundwater Sampling Results for the Arensdale-Tolsma Site	McTavish 2023
Huntingdon Meter Station drilling program borehole logs, K-tests, and groundwater quality data	SNC-Lavalin 2012
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
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
City of Abbotsford WebMap Application	City of Abbotsford 2025
Aquifer #21 Fact Sheet	GOBC 2025d
Aquifer #21 Mapping Report	Hammond 2012
The Fraser Freshet Masterplan	BC MFLNRO 2011
Fraser Valley Groundwater Monitoring Program – Final Report	Carmichael et al. 1995
Surficial Geology, Chilliwack, BC, Geological Survey of Canada, Map 1487A	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 to build on legacy groundwater monitoring wells which included:

- Four wells near Arnold Slough (AE23-MW102 to AE23-MW106), previously installed by Active Earth Engineering Ltd. (McTavish 2023). Monitoring wells AE23-MW105 and AE23-MW106 are located outside the proposed pipeline alignment and are intended for broader site characterization.
- Three wells within the MS-16 meter station facility (BH-MS16-04, BH12-6, and BH12-7D), previously installed by SNC-Lavalin (2012).

The field programs were initiated to support subsurface characterization along the Huntingdon 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): Four monitoring were installed in September 2024 (NMW-H1.A, NMW-H1.B, NMW-H3, NMW-H4) to provide representative spatial coverage for the existing groundwater monitoring network (to supplement legacy wells). Table 2.4 presents the up-to-date groundwater monitoring well networks. Figure 2.1 provide an overview of the groundwater monitoring well locations. The legacy and new monitoring wells formed the basis for hydraulic conductivity testing, groundwater level monitoring, and groundwater quality monitoring programs.
- Geotechnical investigation (completed in July 2024): Three geotechnical boreholes (BH01, BH02, and BH03) were completed up to 15.6 metres below ground surface (mbgs) in 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 (undertaken from July 2024 to February 2025): Test pits were completed 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 3.7 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 Huntingdon Loop Groundwater Monitoring Well Network

Well ID	UTM Coordinates[a]		Elevations		Screened Interval (mbgs)	Screened Lithology
	Northing (m)	Easting (m)	Top of Casing (masl)[b]	Ground Elevation (masl)[b]		
NMW-H1.A	5429693.7	559872.8	7.2	7.6	4.3–5.8	Fine to medium sand with silt
NMW-H1.B	5429588.5	559819.1	4.2	4.51	3.0–4.5	Medium sand with gravel
NMW-H2	5429195.4	559281.9	4.96	5.32	3.0–4.5	Fine to medium sand, trace silt
NMW-H3	5428980.1	558601.2	6.41	6.79	6.1–7.6	Coarse sand with gravel
NMW-H4	5428560.9	558073.4	7.56	7.91	3.0–4.5	Lean clay, trace sand
AE23-MW102	5430577.5	560227.1	3.30	3.47	2.2–3.7	Fine to coarse sand, silty; some fine gravel lenses
AE23-MW103	5430279.1	560121.5	3.87	4.15	2.1–3.6	Fine to coarse sand, silty
AE23-MW105	5430885.4	560391.1	3.62	3.92	1.8–3.3	Fine to coarse sand with silt and fine gravel
AE23-MW106	5430885.2	560367.7	3.58	3.85	2.2–3.7	Fine to coarse sand with silt and fine gravel
BH-MS16-04	5428071.4	557030.7	9.09[c]	8.19[c]	1.9–3.4	Silt to clayey silt
MW12-6	5428096.7	556963.8	8.27[c]	8.34[c]	1.2–2.2	Gravel, crushed rock
MW12-7D	5428059.4	556855.9	8.35[c]	8.46[c]	4.4–5.9	Silty-fine sand (coarsening with depth)

Notes:

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

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

[b] Elevations referenced to NAD83; surveyed by GeoVerra (November 2024)

[c] Elevation was not surveyed during the field program; elevations was extracted from LidarBC (GOBC 2016; LiDAR DEM Index 1:20,000)

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

All wells constructed of 51 mm (2-inch) polyvinyl chloride pipe 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 July 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

Groundwater quality samples collected along the Huntingdon Loop (from May 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

2.3.1.5.1 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 Freshwater Aquatic Life (CWQG-AL) were applied (CCME 2026). Federal Environmental Quality Guidelines (FEQGs) developed by Environment and Climate Change Canada (ECCC 2024) 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 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 (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 sites within the Huntingdon Loop (PDL-H1, PDL-H2, PDL-H3, PDL-H7, PDL-H8, PDL-H9, Sumas River). 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 the Huntingdon Loop in (Table 2.5).

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

Parameter	Chronic WQG-FAL (mg/L)[1]			Acute WQG-FAL (mg/L)[1]		
	Min	25P[2]	Max	25P[2]	Min	Max[2]
Ammonia (as N)	0.762	1.22	1.24	5.74	12	23.8
Chloride	150	150	150	600	600	600
Fluoride	0.12	0.12	0.12	1.04	1.4	1.94
Nitrate (as N)	3	3	3	32.8	32.8	32.8
Nitrite (as N)	0.02	0.08	0.2	0.06	0.24	0.6
Sulphate	218	309	429	-	-	-
Aluminum (T)	0.0934	0.2015	0.576	-	-	-
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	-	-	-

Parameter	Chronic WQG-FAL (mg/L)[1]			Acute WQG-FAL (mg/L)[1]		
	Min	25P[2]	Max	25P[2]	Min	Max[2]
Uranium (T)	0.0075	0.0075	0.0075	0.0165	0.0165	0.0165
Vanadium (T)	0.06	0.06	0.06	-	-	-
Cadmium (D)	0.000122	0.00024	0.000457	0.000274	0.000704	0.00278
Cobalt (D)	0.00039	0.000548	0.0009	-	-	-
Copper (D)	0.0002	0.0009	0.0092	0.0012	0.0053	0.054
Iron (D)	-	-	-	0.35	0.35	0.35
Lead (D)	0.00286	0.00444	0.0168	-	-	-
Manganese (D)	0.37	0.56	1	-	-	-
Nickel (D)	0.001	0.0024	0.0136	0.0181	0.040075	0.189
Strontium (D)	1.25	1.25	1.25	-	-	-
Zinc (D)	0.0084	0.020425	0.164	0.0296	0.066375	0.167

Notes:

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

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

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

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.

2.3.1.5.2 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 Huntingdon Loop. The Huntingdon Loop was subdivided into three assessment areas based on sample size and spatial coverage considerations. Each assessment area is represented by at least three monitoring wells to characterize groundwater conditions within that portion of the pipeline loop as follows (Figure 2.1):

- Near Arnold Slough: AE23-MW102, AE23-MW103, AE23-MW105, AE23-MW106
- Center of the Loop: NMW-H1.A, NMWH1.B, NMW-H2, NMW-H3
- MS-16 Meter Station: MW12-6, MW12-7D, BH-MS16-04

Summary statistics were calculated for each assessment area, including the median (50th percentile [50P]) and the 90th percentile (90P) to represent typical and upper-range groundwater quality conditions. These 50P and 90P values were compared to applicable guidelines (Section 2.3.1.5.1) 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 21 (Sumas Prairie) underlies the Huntingdon Loop and extends across the Sumas Prairie area between Abbotsford and Chilliwack. Provincial mapping indicates that Aquifer 21 covers an area of approximately 98 square kilometres, bounded by Sumas Mountain to the north, the Canada/United States border to the south, and Vedder Mountain to the east (GOBC 2025b).

The aquifer is predominantly unconfined and composed of Fraser River Sediments, including sand, gravel, and interbedded silt and clay. It is potentially hydraulically connected to nearby surface water features, including the Sumas River and associated drainage canals. GWELLS records indicate aquifer thickness of greater than 10 m, with static water levels typically less than 6 mbgs. The aquifer remains unconfined across most of the area, though localized semi-confined conditions may occur where fine-grained lacustrine layers overlie coarser channel deposits.

Provincial Aquifer 21 is classified as IIB (moderately developed, moderate vulnerability) under the BC Aquifer Classification System. Aquifer productivity is considered moderate, with reported well yield ranging between 0.01 and 25 litres per second (L/s) (median reported well yield of 2.1 L/s; GOBC 2025b). Groundwater demand is considered moderate based on domestic well density and the presence of water supply and irrigation wells, as well as numerous large-diameter well installations. Regional iron issues have been reported in groundwater within Aquifer 21 (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.

Provincial Aquifer 21 has a provincial ranking score of 12. 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 21 is considered lower-moderate priority.

There are 197 wells correlated to Aquifer 21 within the provincial database, and an additional 93 uncorrelated wells located within the mapped aquifer extent. These uncorrelated wells may potentially be completed within Aquifer 21 or within isolated and unmapped water-bearing zones that occur within interbedded sand and gravel lenses.

2.3.2.1.2 Geological Setting

The Huntingdon Loop lies within the Fraser River floodplain bounded by Sumas Mountain to the north, Vedder Mountain to the east, and the Canada/United States border to the south. The area occupies the former Sumas Lake basin and is characterized by extensive agricultural lands and a network of sloughs and river channels. Local topography is generally flat, with ground surface elevations typically below 10 masl, and rise sharply near the mountains to elevations up to 900 masl.

Sumas Lake was drained in the 1920s for agricultural reclamation and flood control. A series of canals (e.g., Sumas Lake Canal) and pump stations (e.g., Barrowtown Pump Station) were built to divert inflows to the lake and allow access to reclaimed floodplain.

2.3.2.1.3 Surficial Geology

Regional surficial geology in the area has been mapped at a 1:50,000 scale by Armstrong (1980) and consist primarily of post-glacial lacustrine and fluvial deposits. The uppermost sediments along the ROW comprise fine-grained lacustrine silt and clay, generally less than 5 m thick, in places overlying sand to sandy loam or comprise Fraser River sediments consisting of fine to medium sand (up to 8 m thick) and forming beach and spit deposits.

Localized minor surficial deposits include stream and overbank sediments such as channel fill, floodplain, and alluvial deposits, as well as bog, swamp, and shallow lake deposits composed of peat, organic silt loam, and silty clay loam (ranging from 0.3 to over 10 m thick), overlying Fraser River Sediments or Salish lacustrine deposits.

Given the thickness of 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 44 well records were identified within the search area (as of October 2025; Appendix F.2.1), of which 31 are screened in Aquifer 21 (13 have no aquifer specified). Well records for the identified groundwater users are provided in Appendix F.2.2, and associated water use categories are summarized in Figure 2.6.

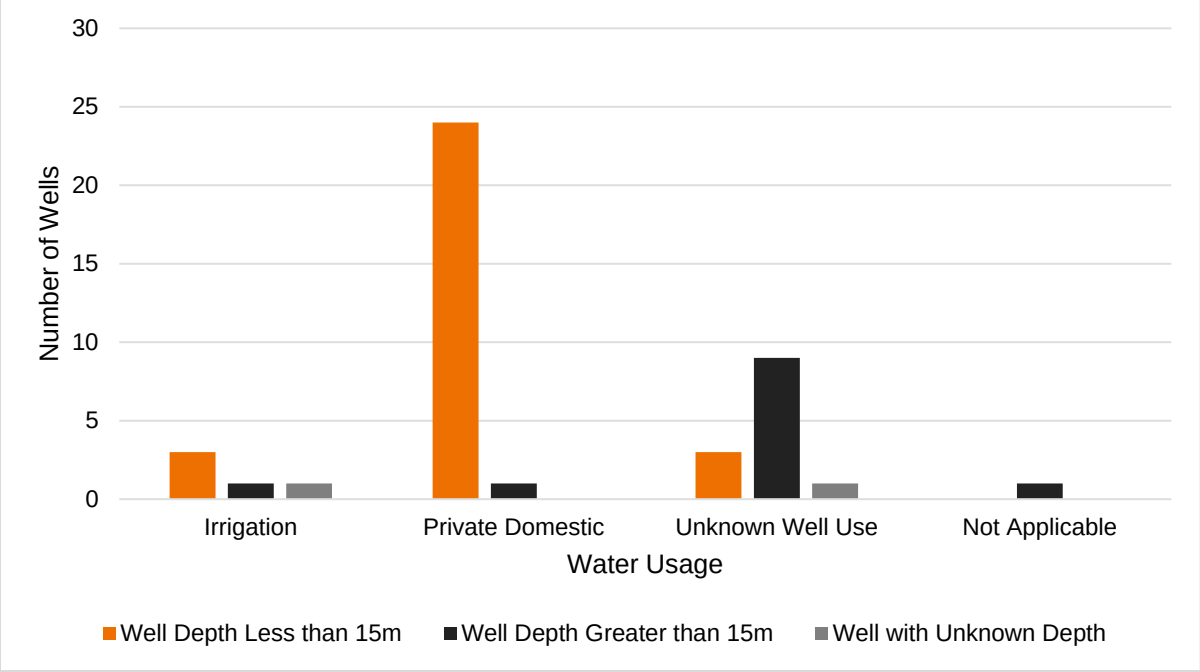


Figure 2.6 Water Well Use Summary in the Huntingdon Area

Figure 2.6 provides a snapshot of the groundwater users associated with the wells installed within 1 km of the Huntingdon Loop ROW. Of the 44 wells identified, 25 are listed as Private Domestic use, and 24 of these Private Domestic Use wells are installed at less than 15 mbgs. Thirteen wells (30%) 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 some of these wells are also private domestic use wells. One well was a ‘not specified’ use type record (i.e., shown as ‘Not Applicable’ in Figure 2.6); this likely corresponds to older well without well use information. The five remaining wells are listed as Irrigation use.

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

No licensed groundwater users or groundwater use applications are currently reported within 1 km of the Huntingdon Loop ROW (BC MWLRS 2025; as of October 2025).

2.3.2.2 Site Hydrogeological Conditions

2.3.2.2.1 Hydrostratigraphic Units

Site hydrogeological conditions along the Huntingdon 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 Huntingdon Loop were grouped into three HSUs:

- Clay to Silty Clay: Low-permeability deposits that restrict vertical groundwater movement. This unit is commonly encountered west of NMW-H3, locally beneath the silt to silty clay and sand with silt and clay units.
- Silt to Silty Clay: Fine-grained sediments with low hydraulic conductivity. This unit generally forms the uppermost layer and includes the organic topsoil unit along the pipeline loop.
- Sand with Silt and Clay: A heterogeneous unit composed primarily of sand with variable silt and clay content. This unit is typically encountered beneath the silt to silty clay layer and above the underlying sand unit and locally occurs between the clay to silty clay unit in the western portion of the pipeline loop.
- Fine to Medium Sand: High-permeability sand deposits forming the primary aquifer along the pipeline loop, with thickness greater than 10 m.

The distribution and thickness of these HSUs vary along the Huntingdon Loop (Appendix F.3). From Arnold Slough to Saar Creek, subsurface conditions (above 5 mbgs) are predominantly characterized by sand with silt and clay lenses. From Saar Creek to monitoring well NMW-H3, the upper stratigraphy typically consists of silt to silty clay and sand with silt/clay units, underlain by a lower clay to silty clay unit. This lower fine-grained unit may be laterally continuous in places and may partially separate the deeper sand unit from overlying materials. From NMW-H3 to the MS-16 meter station, subsurface conditions are characterized by increased presence of clay to silty clay, which may restrict groundwater flow.

Bedrock has not been encountered in the available subsurface investigations (e.g., to depths of up to approximately 15 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 completed in eight monitoring wells screened within the saturated portion of the HSUs along the Huntingdon Loop. The monitoring wells were screened at depth of less than 7.6 mbgs, with groundwater table observed at depths ranging from near ground surface to approximately 4.5 mbgs.

Most monitoring wells are screened within the primary aquifer units, including lower sand with silt/clay and/or fine to medium sand HSUs. Slug test results indicate that hydraulic conductivity within these units ranges from 9.8×10^{-6} metres per second (m/s) at MW12-1D to 3.2×10^{-3} m/s at NMW-H1.B. Slug test result from NMW-H4, screened within the clay to silty clay unit, indicates a hydraulic conductivity of 7.6×10^{-7} m/s. These values are generally consistent with ranges reported in the literature for similar materials (e.g., Domenico and Schwartz 1990).

Across the Huntingdon Loop, hydraulic conductivity values generally decrease from eastern portion of the loop toward the southern and western portions. This spatial trend is consistent with the observed hydrostratigraphic conditions, with clay to silty clay unit become more prevalent at shallow depth (e.g., above 5 mbgs) toward the western end of the pipeline loop, which may limit local groundwater flow.

Table 2.6 Single Well Response Test Summary

Area	Monitoring Well ID	Screen Depth (mbgs)	Screened Lithology	Geomean Hydraulic Conductivity (m/s)
Eastern Portion of the Loop	AE23-MW102	2.2–3.7	Fine to coarse sand, silty; some fine gravel lenses	9.3×10^{-4}
	AE23-MW103	2.1–3.6	Fine to coarse sand, silty	4.5×10^{-4}
	AE23-MW105	1.8–3.3	Fine to coarse sand with silt and fine gravel	3.0×10^{-4}
	AE23-MW106	2.2–3.7	Fine to coarse sand with silt and fine gravel	5.6×10^{-4}
	NMW-H1.B	3.0–4.5	Medium sand with gravel	3.2×10^{-3}
	NMW-H2	3.0–4.5	Fine to medium sand, trace silt	2.4×10^{-3}
Western Portion of the Loop	NMW-H3	6.1–7.6	Coarse sand with gravel	9.8×10^{-5}
	NMW-H4	3.0–4.5	Lean clay, trace sand	7.6×10^{-7}
	MW12-1D	4.2–5.7	Sand, silty, fine grained, trace clay	9.8×10^{-6}

Notes:

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

MW12-1D (approximately 25 m north of MW12-6) is part of the current groundwater monitoring network. Slug test result from MW12-1D is included to represent hydraulic conductivity conditions at the MS-16 meter station.

Representative hydraulic conductivity values were assigned to each HSU based on slug test results, grain-size information obtained from soil samples collected during hydrogeological investigations (Section 2.3.1.2), professional judgement, and relevant literature values (e.g., Domenico and Schwartz 1990). These values are summarized as follows:

- Clay to Silty Clay: less than 7.0×10^{-6} m/s
- Silt to Silty Clay: les than 6.0×10^{-5} m/s
- Sand with Silt and Clay: less than 2.5×10^{-4} m/s
- Fine to Medium Sand: less than 8.5×10^{-4} m/s

2.3.2.2.3 Groundwater Levels and Elevations

Groundwater levels along the Huntingdon Loop were monitored at 12 monitoring wells (Table 2.4), extending from Arnold Slough in the northeast to the MS-16 meter station to the southwest (Figure 2.1). Manual groundwater level measurements collected from June 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 June 2024 and August 2025, groundwater elevations along the Huntingdon Loop ranged from 2.05 masl at AE23-MW103 (May 9, 2024) to 8.34 masl at MW12-7D (November 5, 2024). Depth to groundwater ranged from 0.07 meter above ground surface (mags) at BH-MS16-04 (November 5, 2024) to 4.38 mbgs at NMW-H1.A (August 14, 2025). Depth to groundwater at NMW-H1.A were consistently greater than 3 mbgs. NMW-H1.A is located adjacent to the Vye Road in an area slightly elevated (a shore dune from Sumas Lake) to the surrounding low-lying agricultural lands (ground elevation is approximately 3.1 m higher than nearby NMW-H1.B). Excluding NMW-H1.A, groundwater depths across the low-lying monitoring wells were less than 2.5 mbgs (Appendix F.4.1).

In general, groundwater levels were higher in the western portion of the loop near the MS-16 meter station (e.g., MW12-6 and MW12-7D) and lower in the eastern portion near Arnold Slough (e.g., AE23-MW102 and AE23-MW103). Groundwater elevations decrease progressively from southwest to northeast, generally following surface topography and indicating a low horizontal hydraulic gradient of approximately 0.002 m/m toward Arnold Slough.

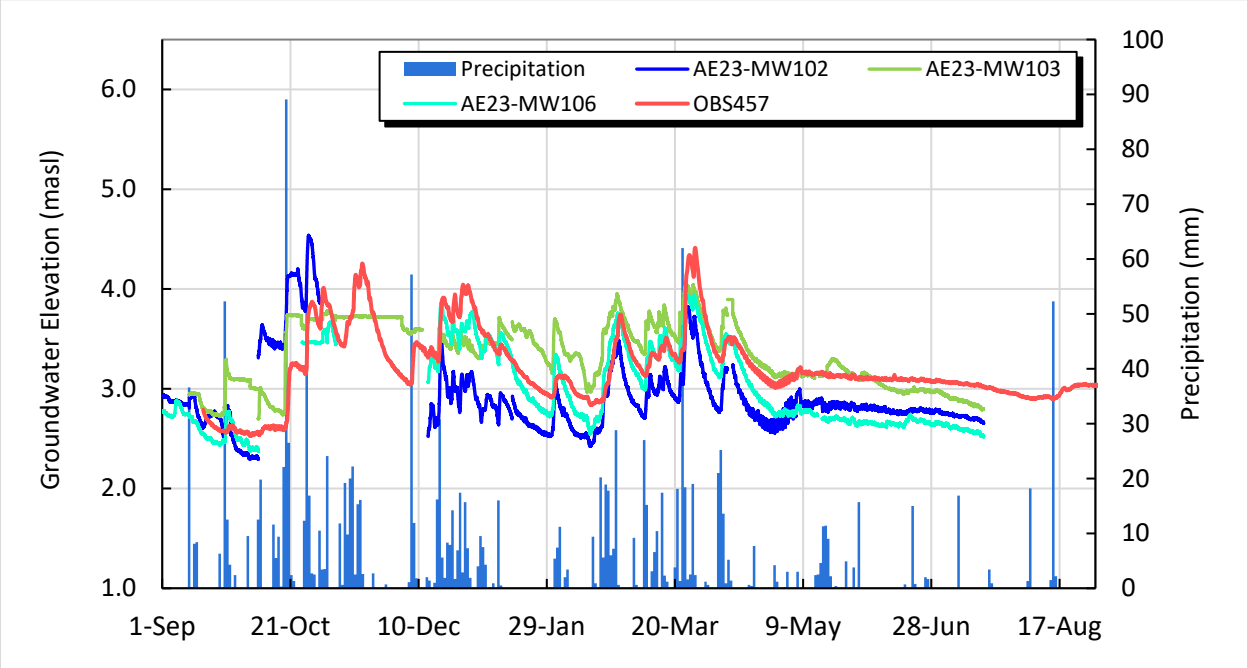
A groundwater hydrograph is presented for Provincial Observation Well 457 (OBS457) and selected nearby monitoring wells (AE23-MW102, AE23-MW103 and AE23-MW106, located approximately 1.45 km southeast of OBS457; Figure 2.7). Groundwater elevation recorded at the Arnold Slough monitoring wells show similar patterns to those observed at OBS457 (i.e., seasonal rises and declines), with seasonal groundwater elevation differences less than 2 m.

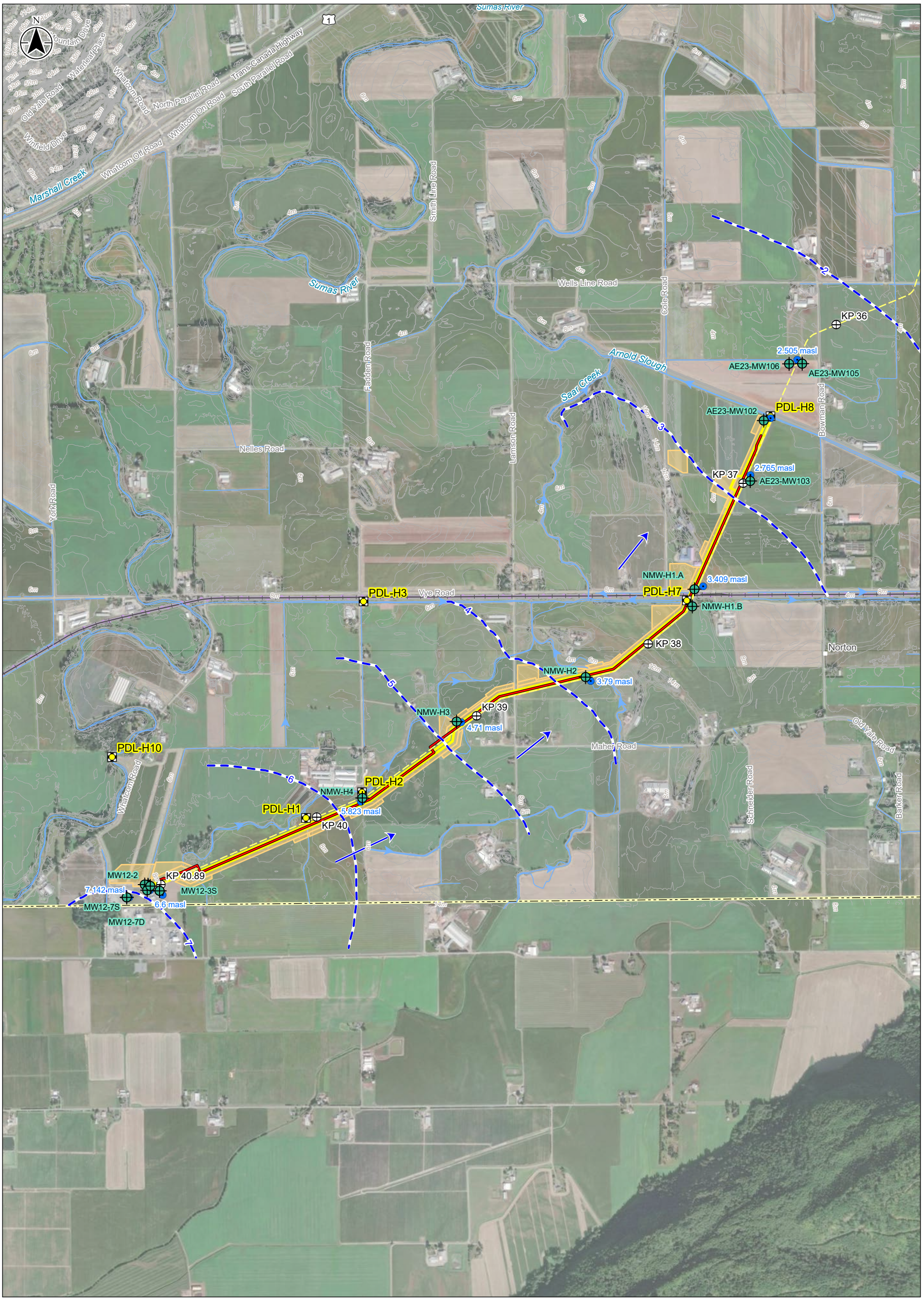
Seasonal variations were observed across the monitoring well network along the Huntingdon Loop (Appendix F.4.2). Groundwater elevations generally increase during winter months (December 2024 to March 2025), consistent with the typically wet winter season observed across the Lower Mainland of BC. Persistent precipitation events during the fall and winter months contribute to a rapid rise in shallow groundwater elevations as shown in the hydrographs (Appendix F.4.2). Groundwater levels in the

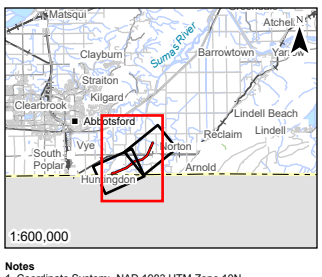
Sumas Prairie area are controlled by the Sumas Lake drainage system and are maintained at a relatively steady level via Barrowtown Pump Station and the filling of sloughs during the summer for more efficient irrigation access.

A groundwater contour map was developed using July 2025 data (Figure 2.8). 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 Huntingdon Loop (from northeast to southwest). Seasonal variations are not expected to alter the overall groundwater flow pattern.

Figure 2.7 OBS457 Groundwater Elevation Hydrograph – Precipitation data obtained from Abbotsford A Weather Station (Climate ID: 1100031)







- International Border
- Railway
- Transmission Line
- Topographic Contour
- Flow Direction
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Proposed Right of Way
- Proposed Workspace
- Proposed Discharge Location
- Monitoring Well
- Groundwater Contour (July 2025)
- Groundwater Elevation (July 2025)
- Interpreted Groundwater Flow Direction

0 200 400 600 800 m

1:20,000 (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
Abbotsford, BC
NTS 50K Grid: 092G01

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.
2.8

Title
Groundwater Flow Contour (July 2025)

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316894\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 Huntingdon Loop is summarized as follows:

- Groundwater is primarily derived from precipitation recharge, with additional contribution from lateral inflow from surrounding uplands (e.g., Vedder Mountain).
- Groundwater levels in Sumas Prairie are actively controlled through an engineered surface water drainage system consisting of Arnold Slough, the Sumas Lake Canal, and associated pump stations (e.g., Barrowtown Pump Station). Groundwater levels are maintained via a series of sloughs that feed into the Sumas Lake Canal that report to the Barrowtown Pump Station. Pumping rates are adjusted seasonally: groundwater levels are typically kept lower during the wet season for flood protection. Pumping is reduced in the spring (e.g., April), allowing groundwater levels to rise, and increasing groundwater availability for agricultural irrigation during the summer growing season.
- The subsurface along the Huntingdon Loop consists of clay to silty clay, silt to silty clay, sand with silt/clay, and deeper sand layers. Groundwater in the region is shallow and occurs within multiple HSUs. The deeper sand layer constitutes 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).
- Recharge to Aquifer 21 was estimated based on recharge studies (Scibek and Allen 2006; Forstner et al. 2018) conducted for the adjacent Abbotsford-Sumas Aquifer (Aquifer 15). Reported recharge estimates for Aquifer 15 range from approximately 40% to 67% of mean annual precipitation. Given the similar climatic setting and general hydrogeologic context between Aquifer 15 and Aquifer 21, a recharge rate of 40% to 67% of mean annual precipitation was adopted for Aquifer 21 (i.e., 615 to 1,030 millimetres per year).
- Using a recharge rate of 40% to 67% of mean annual precipitation, the estimated annual groundwater recharge via precipitation is approximately 3,321 to 5,562 cubic metres per year (m^3/yr) (0.11 to 0.18 L/s) per 300 m trench segment (approximately 5,400 square metres of area).
- Based on 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 toward the Arnold Slough (e.g., from southwest to northeast), which is expected to act as the primary discharge boundary for the local flow system (Figure 2.8). Localized groundwater discharge may also occur to other surface water features along the pipeline loop alignment, such as tributaries to Saar Creek.

- Groundwater elevations indicate a low horizontal hydraulic gradient of approximately 0.001 m/m across the Huntingdon Loop in the direction of the Arnold Slough (from southwest to northeast), calculated over approximately 4.2 km between MW12-7D to AE23-MW102. This shallow gradient reflects a flat groundwater table with slow lateral groundwater movement.
- The estimated groundwater flow velocity through the primary water bearing unit (fine to medium sand unit) toward the Arnold Slough (from southwest to northeast) is approximately 0.18 metres per day, calculated based on a geometric mean hydraulic conductivity of 8.5×10^{-4} m/s (Section 2.3.2.2.2), an effective porosity of 40%, and a horizontal hydraulic gradient of 0.001.

2.3.2.3 Groundwater Quality

Detailed exceedances of the WQG-FAL by groundwater assessment area 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).

Near Arnold Slough (AE23-MW102, AE23-MW103, AE23-MW105, AE23-MW106)

Table 2.7 provides the groundwater screening results for groundwater monitoring wells AE23-MW102, AE23-MW103, AE23-MW105 and AE23-MW106 based on exceedances of the WQG-FAL. Total aluminum, total and dissolved iron, total mercury, and dissolved nickel frequently exceeded the WQG-FAL (more than 60% samples exceeded) established for the pooled PDLs. Total aluminum and total mercury exceeded the WQG-FAL (chronic) with 90P concentrations of 940.8 µg/L and 0.00644 µg/L, respectively. Total iron and dissolved nickel exceeded the WQG-FAL (chronic and acute) with 90P concentrations of 25,040 µg/L and 92.1 µg/L, respectively. Dissolved iron exceeded the WQG-FAL (acute) with a 90P concentration of 21,560 µg/L.

Fluoride, total arsenic, total chromium, dissolved copper, dissolved cobalt and dissolved manganese showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 60% samples exceeded). Five samples are available for dissolved cobalt. 2 of these exceeded the WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 4.564 µg/L.

The remaining parameters (ammonia and nitrate) showed isolated exceedances, with 90P concentrations less than the WQG-FAL established for the pooled PDLs.

Table 2.7 Groundwater Screening Results Based on Water Quality Guidelines – Near Arnold Slough (KP36.7 to KP37.6)

Parameter	WQG-FAL	Groundwater Screening Results			
		# of Exceedances[a]	50th Percentile	90th Percentile	Maximum
Fluoride (mg/L)	0.12; 1.1	4 of 27	0.093	0.13	0.15
Ammonia (mg/L)	1.11; 5.74	3 of 26	0.17	1.025	1.5
Nitrate (mg/L)	3; 32.8	1 of 27	<0.2	0.368	4.7
Aluminum (T)	193.5	19 of 27	345	940.8	1,720
Arsenic (T)	5	8 of 27	3.1	7.892	18.2
Chromium (T)	2.5	5 of 27	1.8	2.92	10.3
Iron (T)	300; 1,000	27 of 27	8,970	25,040	28,200
Mercury (T)	0.00125	17 of 27	0.0029	0.00644	0.0201
Copper (D)	0.8; 1.2	14 of 26	1.255	8.565	17.1
Cobalt (D)	1.03	2 of 5	0.67	4.564	6.34
Iron (D)	350_{AC}	25 of 27	7,580	21,560	29,400
Manganese (D)	410	4 of 27	231	488.2	548
Nickel (D)	2; 18.1	22 of 26	12.8	92.1	99

Notes:

Units are in micrograms per litre (µg/L) except for fluoride, ammonia, and nitrate 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

Center of the Loop (NMW-H1.A, NMWH1.B, NMW-H2, NMW-H3)

Table 2.8 provides the groundwater screening results for groundwater monitoring wells NMW-H1.A, NMW-H1.B, NMW-H2 and NMW-H3 based on exceedances of the WQG-FAL. Total aluminum, total and dissolved iron, dissolved manganese and dissolved nickel frequently exceeded the WQG-FAL (more than 60% samples exceeded) established for the pooled PDLs. Total aluminum and dissolved manganese exceeded the WQG-FAL (chronic) with 90P concentrations of 873 µg/L and 1,346 µg/L, respectively. Total iron and dissolved nickel exceeded the WQG-FAL (chronic and acute) with 90P concentrations of 18,640 µg/L and 19.92 µg/L, respectively. Dissolved iron exceeded the WQG-FAL (acute) with a 90P concentration of 21,000 µg/L.

Fluoride, nitrate, nitrite, total manganese, total mercury, and dissolved cobalt showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 60% samples exceeded). Four samples are available for dissolved cobalt; three of these exceeded the WQG-FAL (chronic) for PDL-A6, with a 90P concentration of 4.564 µg/L.

The remaining parameters (total beryllium, total chromium, total selenium, dissolved copper, and dissolved zinc) showed isolated exceedances, with 90P concentrations below the WQG-FAL established for the pooled PDLs.

Table 2.8 Groundwater Screening Results Based on Pooled Water Quality Guidelines – Centre of the Huntingdon Loop (KP37.6 to KP40.0)

Parameter	WQG-FAL	Groundwater Screening Results			
		# of Exceedances[a]	50th Percentile	90th Percentile	Maximum
Fluoride (mg/L)	0.12; 1.1	7 of 13	0.13	0.158	0.25
Nitrate (mg/L)	3; 32.8	4 of 13	0.01	7.24	61.2
Nitrite (mg/L)	0.08; 0.06	2 of 13	0.0025	0.304	2.1
Aluminum (T)	193.5	8 of 13	2,85	873	5,980
Beryllium (T)	0.13	1 of 13	<0.1	0.1	0.17
Chromium (T)	2.5	1 of 13	1.0	2.2	13.6
Iron (T)	300; 1,000	12 of 13	7,090	18,640	23,100
Manganese (T)	1,062.5; 1,150	3 of 13	650	1,278	1,350
Mercury (T)	0.00125	3 of 13	<0.0019	0.00258	0.003
Selenium (T)	2	1 of 13	0.1	1.752	2.03
Copper (D)	0.8; 1.2	1 of 13	0.2	0.672	1.18
Cobalt (D)	1.03	3 of 4	2.64	3.912	3.93
Iron (D)	350_{AC}	9 of 13	4,100	21,000	22,700
Manganese (D)	410	9 of 13	683	1,346	1,390
Nickel (D)	2; 18.1	11 of 13	7.4	19.92	24.7
Zinc (D)	16.925; 29.6	1 of 13	2.5	10.76	18

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 2.3.1.5.1; 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

MS-16 Meter Station (MW12-6, MW12-7D, BH-MS16-04)

Table 2.9 provides the groundwater screening results for groundwater monitoring wells MW12-6, MW12-7D and BH-MS16-04 based on exceedances of the WQG-FAL. Fluoride and total iron frequently exceeded WQG-FAL (more than 60% samples exceeded). Fluoride exceeded the WQG-FAL (chronic) with a 90P concentration of 0.286 µg/L. Total iron exceeded the WQG-FAL (chronic and acute) with a 90P concentration of 19,200 µg/L.

Table 2.9 Groundwater Screening Results Based on Pooled Water Quality Guidelines – near MS 16 Meter Station (KP40.0 to KP40.9)

Parameter	WQG-FAL	Groundwater Screening Guidelines			
		# of Exceedances[a]	50th Percentile	90th Percentile	Maximum
Fluoride (mg/L)	0.12; 1.1	27 of 35	0.16	0.286	0.42
Ammonia (mg/L)	1.11; 5.74	5 of 35	0.52	1.2	1.2
Aluminum (T)	193.5	13 of 35	108	655.6	1410
Arsenic (T)	5	5 of 35	1.24	5.944	9.03
Iron (T)	300; 1,000	23 of 35	3,470	19,200	20,500
Mercury (T)	0.00125	13 of 35	<0.0019	0.00908	0.0408
Selenium (T)	2	6 of 35	0.2	2.136	2.87
Cadmium (D)	0.217; 0.321	1 of 35	0.014	0.1112	0.273
Copper (D)	0.8; 1.2	7 of 35	0.3	2.85	15.8
Iron (D)	350_{AC}	19 of 35	698	1,9640	25,100
Lead (D)	3.99	1 of 35	<0.4	<0.4	16.4
Manganese (D)	410	12 of 35	152	821	1,050
Nickel (D)	2; 18.1	7 of 35	1	4.1	8.7

Notes:

Units are in micrograms per litre (µg/L) except for fluoride and ammonia 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

Ammonia, total aluminum, total arsenic, total mercury, total selenium, dissolved copper, dissolved iron, dissolved manganese, and dissolved nickel showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 60% samples exceeded). Ammonia and dissolved nickel exceedances (chronic) were limited to monitoring well MW12-7D. Total selenium exceedances (chronic) were limited to MW12-6 and were observed between January and June 2025. Dissolved iron and dissolved manganese exceedances were limited to BH-MS16-04 and MW12-7D.

The remaining parameters (dissolved cadmium and dissolved lead) showed isolated exceedances, with 90P concentrations below the WQG-FAL established for the pooled PDLs.

Across the Huntingdon Loop, a total of 20 parameters exceeded the WQG-FAL for the Huntingdon Loop PDLs (Table 2.10). Two of these parameters (total and dissolved iron) showed frequent exceedances with more than 70% samples exceeding the WQG-FAL (exceedances observed in all assessment areas). The 90P concentrations for total and dissolved iron were 20,040 and 20,320 µg/L, respectively. Three parameters had exceedances in more than 50% of the samples (but less than 70%) and exceedances were observed in all assessment areas. These parameters include fluoride, total aluminum, and dissolved nickel. 90P concentrations for these parameters are 0.192 mg/L, 799.6 µg/L, and 62.51 µg/L, accordingly.

Six parameters (ammonia, total arsenic, total mercury, dissolved cobalt, dissolved copper and dissolved manganese) showed 90P concentrations exceeding the WQG-FAL but with less frequent exceedances (less than 50% samples exceeded). Three of which (ammonia, total arsenic, dissolved cobalt) are generally localized and occur discretely along the Huntingdon Loop.

The remaining nine parameters (nitrate, nitrite, total beryllium, total chromium, total manganese, total selenium, dissolved cadmium, dissolved lead and dissolved zinc) showed 90P concentrations below the WQG-FAL, 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 generally below the applicable Protocol 9 values (Sub-Region 1; Table 2.10), indicating that observed metal concentrations are within the expected background groundwater conditions. Total aluminum exceeded CSR Protocol 9 (330 µg/L), with a 90P concentration of 799.6 µg/L. This exceedance may be influenced by anthropogenic activities.

Table 2.10 Groundwater Screening Results – Huntingdon Loop

Parameters	Water Quality Guidelines			Groundwater Screening Results					
	CSR Protocol 9	WQG-FAL (chronic)	WQG-FAL (acute)	# of Samples Exceeded WQG-FAL [a]	% of Sample Exceeded WQG-FAL [a]	# of Assessment Area Exceeded WQG-FAL [a]	50th Percentile	90th Percentile	Maximum
Fluoride (mg/L)		0.12	1.1	38 of 75	51	3	0.13	0.192	0.42
Ammonia (mg/L)	-	1.11	5.74	8 of 74	11	2	0.245	1.17	1.5
Nitrate (mg/L)	-	3	32.8	5 of 75	7	2	0.1	1.446	61.2
Nitrite (mg/L)	-	0.08	0.06	2 of 75	3	1	0.0025	0.025	2.1
Aluminum (T)	330	193.5	-	40 of 75	53	3	251	799.6	5,980
Arsenic (T)	38	5	-	13 of 75	17	2	2.41	6.824	18.2
Beryllium (T)	0.56	0.13	-	1 of 75	1	1	0.1	0.1	0.25
Chromium (T)	12	2.5	-	6 of 75	8	2	1	2.46	13.6
Iron (T)	290,000	300	1000	62 of 75	83	3	6,440	20,040	28,200
Manganese (T)	26,000	1,062.5	1150	3 of 75	4	1	264	783	1350
Mercury (T)	0.49	0.00125	-	33 of 75	44	3	0.00095	0.00666	0.0408
Selenium (T)	4.4	2	-	7 of 75	9	2	0.24	1.98	2.87
Cadmium (D)	0.97	0.217	0.321	1 of 75	1	1	0.011	0.0868	0.273
Cobalt (D)	62	1.03	-	5 of 14	36	2	0.205	3.912	6.34
Copper (D)	14	0.8	1.2	22 of 74	30	3	0.305	6.165	17.1
Iron (D)	290,000	-	350	53 of 75	71	3	4,160	20,320	29,400
Lead (D)	2.1	3.99	-	1 of 75	1	1	0.2	0.2	16.4
Manganese (D)	26,000	410	-	52 of 75	33	3	249	821	1,390
Nickel (D)	110	2	18.1	40 of 74	54	3	2.9	62.51	99
Zinc (D)	44	16.925	29.6	1 of 75	1	1	5	7.92	18

Notes:

Units are in micrograms per litre (µg/L) except for fluoride, ammonia, 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 the pooled PDLs (chronic and/or short-term). Variable guidelines are represented by the 25th percentile (chronic) and minimum (short-term) values derived for the pooled PDLs

[a] Indicates number of samples, % of samples, and number of assessment area exceeding the minimum guideline established

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 Huntingdon Loop is located in close proximity to multiple surface water features, including the Fraser River, sloughs, drainage canals, and creeks. 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 May 2024 through September 2025, with an additional single sampling event completed in July 2023. 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 Huntingdon Loop were unnamed tributaries to Saar Creek (PDL-H1, PDL-H2, PDL-H3, PDL-H7), Arnold Slough (PDL-H8), the Sumas Lake Canal (PDL-H9), and Sumas River (PDL-H10; Figure 2.1). PDL-H8 is represented by pooled data from Arnold Slough sampling at stations AT1, AT2, AT3, and PDL-H8 which were within 1.5 km. Sumas Lake Canal (PDL-H9) is represented by pooled data from stations PDL-H9A and PDL-H9B which are located within 1 km of each other. Sumas River is represented by pooled data from PDL-H10 and ECCC station BC08MH0027 which is located approximately 1 km downstream of PDL-H10 at the Canada/United States border (Figure 2.1). Environmental monitoring data from the ECCC station on the Sumas River were not collected specifically for this TAR. These data comprise monthly or biweekly measurements—depending on seasonal monitoring frequency—for general water quality parameters, major anions, nutrients, and total and dissolved metals. For the purposes of this TAR, ECCC records from January 2020 through January 2025 were incorporated into the assessment.

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 BC WQG-FAL, and CWQG-AL were applied where corresponding WQG-FAL do not exist (Table 2.11). 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.

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 2.11; 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).

Table 2.11 Water Quality Guidelines Used to Characterize Existing Conditions

Parameter	**Units**	**Water Quality Guidelines**	
		Chronic BC WQG-FAL	**Acute BC WQG-FAL**
pH	pH units	6.5 – 9.0	-
TSS	mg/L	Background	
Turbidity	NTU	Background	
Temperature	°C	Life stage & species dependent	
Dissolved Oxygen	mg/L	Life stage & species dependent	
Ammonia, total (as N)	mg/L	Variable	Variable
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
Sulfate (as SO_4)	mg/L	Variable	-
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]

Parameter	Units	Water Quality Guidelines	
		Chronic BC WQG-FAL	Acute BC WQG-FAL
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
Vanadium, total	mg/L	0.06	-
Zinc, total	mg/L	-	0.075
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.

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 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.

Parameter	Units	Water Quality Guidelines	
		Chronic BC WQG-FAL	**Acute BC WQG-FAL**
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) long-term (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)			
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 20th percentile values for pH, DOC, and hardness.			
Lead (dissolved) chronic (mg/L): e^((0.514*(ln(DOC))) + (0.214*(ln(hardness))) + 0.4354)/2000			
Manganese (dissolved) long-term (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 20th 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			

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 2.11 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 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 WQG-FAL under background conditions, results for a broader list of key parameters are presented as box plots and time-series plots for each monitoring station (Appendix G.1 and G.2).

2.4.1.3 Anomalous Data

Anomalous data were not identified, except for a single sampling event at station PDL-H2 on August 7, 2024. In the August 2024 monitoring report, McTavish noted that the PDL-H2 sample was collected from an area with almost no water and indicated that the sample was very muddy and difficult to filter, with the potential for conditions to affect results (Appendix E.1.1). Laboratory analysis of this sample showed extremely high values consistent with elevated concentrations of suspended solids and associated metals, likely influenced by the atypical sampling conditions. Therefore, this sample was excluded from the analysis as it was deemed to be not representative of surface water quality conditions at PDL-H2.

2.4.2 Results and Discussion

2.4.2.1 General Parameters

2.4.2.1.1 Conductivity

Conductivity values varied across sites. Conductivity at PDL-H1 ranged from 211 microsiemens per centimeter (µS/cm) in November to 634 µS/cm in October, with high readings also in April (481 µS/cm) and October (634 µS/cm). Conductivity at PDL-H2 ranged from 235 µS/cm to 509 µS/cm, highest in January. PDL-H3 showed a broader range, from 222 µS/cm in March to 1,430 µS/cm in September. PDL-H8 had a narrower range (200 µS/cm to 350 µS/cm), while PDL-H9 ranged from 149 µS/cm to 456 µS/cm. Sumas River values were between 112 µS/cm and 315 µS/cm (Table 2.12).

Table 2.12 Monthly Conductivity (µS/cm)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	8	299	242	277	481	245	-	-	-	-	634	211	405
PDL-H2	7	509	337	235	235	481	-	-	-	-	-	362	336
PDL-H3	13	338	351	222	347	357	334 (2)	327	382	1,430	275	282	278
PDL-H7	3	-	272	278	-	-	-	-	-	403	-	-	-
PDL-H8	33	200	207	207	286	222 (4)	256 (5)	314 (7)	350 (4)	314 (3)	222 (3)	215 (2)	250
PDL-H9	14	-	-	149 (2)	172 (2)	456 (2)	260 (4)	298 (2)	267 (2)	-	-	-	-
Sumas River	7	-	-	226	239	112	303 (2)	315	203	-	-	-	-

Notes:

µS/cm = microsiemens per centimeter

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10

2.4.2.1.2 Total Suspended Solids

TSS at PDL-H1 ranged from 3.6 mg/L in December to 98.0 mg/L in October, with high values also in April (45 mg/L) and May (53 mg/L) during months of moderate flow. TSS at PDL-H2 ranged from 3.6 mg/L in December (during high seasonal flows) to 170 mg/L in May (during low seasonal flows). PDL-H3 ranged from 10 mg/L in November to 104 mg/L in December. PDL-H8 showed variability (8.95–65 mg/L), with peaks in April and July; values for TSS (1.86–37.9 mg/L) were generally lower than the other sites, decreasing as mean monthly flow declined through summer (Table 2.13).

Table 2.13 Monthly Concentrations of Total Suspended Solids (mg/L)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	9	4.40	15.0	13.0	45.0	53.0	92.0	-	-	-	98.0	6.40	3.60
PDL-H2	7	14.0	17.0	21.0	49.0	170	-	-	-	-	-	7.60	3.60
PDL-H3	12	49.0	23.0	27.0	-	51.0	28.0	16.0	10.0	26.0	37.0	10.0	104 (2)
PDL-H7	3	-	8.80	47.0	-	-	-	-	-	-	-	-	110
PDL-H8	33	16.0	22.0	15.0	65.0	45.1 (4)	8.95 (4)	43.1 (7)	11.0 (4)	34.0	29.3 (3)	7.80 (2)	41.2 (4)
PDL-H9	14	-	-	22.5 (2)	26.0 (2)	5.35 (2)	5.40 (2)	8.30 (2)	6.80 (2)	4.60 (2)	-	-	-
Sumas R.	89	28.8 (10)	15.6 (7)	37.9 (9)	16.6 (5)	12.4 (7)	20.0 (8)	5.92 (8)	3.11 (7)	1.88 (9)	1.86 (7)	10.4 (6)	20.0 (6)

Notes:

mg/L = milligrams per litre

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10 and the ECCC sampling location.

2.4.2.1.3 Turbidity

Turbidity at PDL-H1 ranged from 10.1 NTU in January to 83 NTU in April, with elevated values in spring when mean monthly flows were moderate. PDL-H2 peaked at 94.1 NTU in March and remained above 68 NTU through May. PDL-H3 ranged from 11.1 NTU in December to 80.5 NTU in June. PDL-H8 showed peaks in April (96.5 NTU) and August (55.2 NTU). Sumas River values were lower overall (2.69–23.1 NTU) compared to the other sites, decreasing as mean monthly flow declined in summer (Table 2.14).

Table 2.14 Monthly Turbidity (NTU)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	8	10.1	48.9	55.8	83.0	20.9	-	-	-	-	31.3	31.2	16.8
PDL-H2	7	20.4	40.8	94.1	76.1	68.0	-	-	-	-	-	33.3	13.6
PDL-H3	12	32.9	41.9	74.3	68.8	56.1	80.5 (2)	41.5	39.0	-	26.7	13.2	11.1
PDL-H7	3	-	23.4	100	-	-	-	-	-	48.8	-	-	-
PDL-H8	33	14.3	34.3	65.8	96.5	12.8 (4)	12.5 (5)	27.0 (7)	55.2 (4)	31.1 (3)	26.0 (3)	23.6 (2)	14.9
PDL-H9	14	-	-	60.4 (2)	46.4 (2)	8.64 (2)	7.40 (4)	5.00 (2)	5.26 (2)	-	-	-	-
Sumas River	89	22.6 (10)	9.79 (7)	23.1 (9)	14.7 (5)	7.45 (7)	12.1 (9)	6.38 (8)	4.02 (7)	3.08 (8)	2.69 (7)	8.96 (6)	18.6 (6)

Notes:

NTU = Nephelometric Turbidity Unit

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10 and the ECCC sampling location.

2.4.2.1.4 Water Temperature

Temperature increased seasonally at all sites. PDL-H1 ranged from 6°C in February to 13.7°C in May. PDL-H3 showed the largest variation, from 6.7°C in February to 24.1°C in July. PDL-H8 ranged from 4.6°C in December to 18.6°C in July. Sumas River ranged from 4.9°C in January to 18°C in July (Table 2.15).

Table 2.15 Monthly Water Temperature (°C)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	8	6.9	6.0	8.3	9.4	13.7	-	-	-	-	12.2	12.1	8.9
PDL-H2	7	6.3	6.6	7.5	9.7	14.0	-	-	-	-	-	10.6	7.2
PDL-H3	13	8.0	6.7	8.0	15.0	13.6	23.0 (2)	24.1	17.7	17.3	12.3	9.6	7.0
PDL-H7	3	-	6.9	7.5	-	-	-	-	-	18.0	-	-	-
PDL-H8	33	6.0	7.3	9.9	9.5	13.6 (4)	18.1 (5)	18.6 (7)	18.2 (4)	16.8 (3)	11.6 (3)	8.4 (2)	4.6
PDL-H9	14	-	-	12.7 (2)	9.5 (2)	13.2 (2)	24.3 (4)	25.0 (2)	21.0 (2)	-	-	-	-
Sumas River	89	4.9 (10)	6.4 (7)	8.9 (9)	9.6 (5)	13.6 (7)	16.1 (9)	18.0 (8)	18.0 (7)	14.6 (8)	11.1 (7)	6.7 (6)	6.4 (6)

Notes:

°C = degrees Celsius

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10 and the ECCC sampling location.

Most sites exhibited gradual warming through spring, showing sharp increases in June and July where data are available, followed by cooling into fall. While WQG-FAL provide species- and life-stage-specific thresholds—often below observed summer maxima—these values should be treated as context rather than strict compliance criteria. Applicability depends on documented presence and timing of sensitive species such salmonids (Section 2.5). Where these species occur, elevated summer temperatures may represent periods of thermal stress; however, interpretation should consider background conditions and seasonal flow regimes rather than isolated guideline exceedances.

2.4.2.1.5 Dissolved Oxygen

Dissolved oxygen at PDL-H1 ranged from 4.78 mg/L in May to 9.87 mg/L in January. PDL-H2 ranged from 3.56 mg/L in May to 10.1 mg/L in February. PDL-H3 decreased from 8.11 mg/L in January to 1.37 mg/L in August, with the lowest values occurring during months when temperatures exceeded 17°C. PDL-H8 showed a similar pattern, dropping from 11 mg/L in January to 1.72 mg/L in August as temperatures rose above 18°C. Sumas River DO levels remained higher overall (6.9–10.4 mg/L), with less seasonal variation (Table 2.16).

Table 2.16 Monthly Concentrations of Dissolved Oxygen (mg/L)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	8	9.87	9.72	6.63	7.46	4.78	-	-	-	-	6.78	7.20	8.57
PDL-H2	7	6.45	10.1	7.76	4.26	3.56	-	-	-	-	-	4.71	5.86
PDL-H3	13	8.11	6.86	7.56	4.80	4.77	4.37 (2)	5.16	1.37	2.05	6.21	5.33	6.40
PDL-H7	3	-	8.37	4.65	-	-	-	-	-	4.17	-	-	-
PDL-H8	33	11.0	8.38	6.35	6.20	5.74 (4)	5.17 (5)	2.82 (7)	1.72 (4)	2.86 (3)	4.32 (3)	8.06 (2)	8.97
PDL-H9	14	-	-	7.66 (2)	7.22 (2)	7.28 (2)	6.12 (4)	7.56 (2)	4.38 (2)	-	-	-	-
Sumas R.	87	10.4 (8)	10.2 (7)	9.81 (9)	8.99 (5)	8.65 (7)	6.90 (9)	7.97 (8)	6.98 (7)	7.86 (8)	8.52 (7)	9.29 (6)	9.58 (6)

Notes:

mg/L = milligrams per litre

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10 and the ECCC sampling location.

2.4.2.1.6 pH (Field Measured)

Monthly values for units of acidity (pH) generally remained within the WQG-FAL (6.5–9.0) across most monitored sites. Values typically ranged from 6.7 to 7.7, with early-year readings (January–April) slightly lower and mid- to late-summer values at some sites (e.g., PDL-H8, PDL-H9, Sumas River) reaching the upper range (up to 7.88). Two exceptions were observed: PDL-H7 in February (6.00) and PDL-H8 in March (6.22), both falling below the WQG-FAL minimum. pH values fluctuated modestly from month to month without a consistent seasonal signature, and overall conditions remain near-neutral and acceptable for aquatic life aside from the noted low-pH events (Table 2.17).

Table 2.17 Monthly pH Values (pH Units)

Site ID	n	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PDL-H1	8	6.89	6.92	7.26	6.90	7.15	-	-	-	-	7.29	6.75	6.73
PDL-H2	7	6.91	6.98	7.16	6.90	7.16	-	-	-	-	-	6.70	6.84
PDL-H3	13	6.92	6.82	7.10	6.89	6.97	6.82 (2)	7.04	6.98	7.64	7.30	6.53	6.63
PDL-H7	3	-	6.00	6.55	-	-	-	-	-	7.10	-	-	-
PDL-H8	33	6.89	7.02	6.22	7.08	7.17 (4)	7.12 (5)	7.66 (7)	7.23 (4)	7.19 (3)	7.15 (3)	6.78 (2)	6.91
PDL-H9	14	-	-	6.85 (2)	7.14 (2)	7.43 (2)	7.64 (4)	7.88 (2)	7.32 (2)	-	-	-	-
Sumas River	7	-	-	6.80	7.46	7.65	7.21 (2)	7.63	7.88	-	-	-	-

Notes:

pH units = units of acidity

Each row uses its own blue–white–red gradient (blue = low, white = mid, red = high). Brackets show sample count when more than one sample contributed to the monthly mean.

Sumas River = PDL-H10

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 Huntingdon Loop. Parameters exceeding the chronic WQG-FAL included total ammonia, nitrate, aluminum, chromium, cobalt, copper, mercury, and nickel. Acute exceedances were recorded for total ammonia, nitrate, copper, iron (dissolved and total), and nickel. These exceedances varied in magnitude and frequency, with some parameters exceeding guidelines by more than thirtyfold. Seasonal patterns were evident for some analytes, while others showed no clear trend across sites. Detailed site-specific results are provided in Table 2.18, 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:

- **Total Ammonia (as Nitrogen[N})**: Concentrations ranged from 0.0025 mg/L to 33 mg/L (maximum at PDL-H3, Dec-2024). The greatest exceedance was 27 times the long-term WQG-FAL at PDL-H3; the highest frequency of exceedances was 33% at PDL-H3. Acute guideline exceedance occurred in December (1.72 times the short-term WQG-FAL). Across sites, exceedances were concentrated in winter and spring.
- **Nitrate (as N)**: Concentrations ranged from 0.0025 mg/L to 33.3 mg/L (maximum at PDL-H1, Oct-2024). The largest exceedance was 11.1 times the long-term WQG-FAL at PDL-H1; the highest frequency was 86% at PDL-H2. Acute guideline exceedance occurred in October. Across sites, exceedances were most frequent in winter and early spring, with additional occurrences in late fall.
- **Fluoride**: Concentrations ranged from 0.025 mg/L to 0.22 mg/L across the Huntingdon Loop, with the maximum at PDL-H1 (Oct-2024). Exceedance frequencies of the chronic CWQG-AL were highest at PDL-H2 (100%), followed by PDL-H1 (89%) and PDL-H3 (50%). The greatest magnitude of exceedance was 1.83 times the CWQG-AL at PDL-H1. Exceedances occurred at most sites but were limited or absent at PDL-H8, PDL-H9, and Sumas River. Clear seasonal patterns were not identified, though most exceedances occurred in fall and early winter.
- **Aluminum (total)**: Concentrations ranged from 0.003 mg/L to 1.8 mg/L (maximum at PDL-H1, Jun-2025). The greatest exceedance was 19.3 times the long-term WQG-FAL at PDL-H1; the highest frequency was 86% at PDL-H2. Across sites, exceedances occurred in winter, spring, and fall, with no clear summer trend.
- **Chromium (total)**: Concentrations ranged from 0.00021 mg/L to 0.0479 mg/L (maximum in Sumas River, Mar-2022). The largest exceedance was 19.2 times the long-term WQG-FAL for hexavalent chromium (and 5.4 times the WQG-FAL for trivalent chromium) in Sumas River; the highest frequency was 47% at PDL-SR. A clear seasonal trend was not observed across sites.
- **Cobalt (dissolved):** Concentrations ranged from 0.000022 to 0.004 mg/L (maximum at PDL-H3, Dec-2024). The greatest exceedance was 4.65 times the chronic WQG-FAL at PDL-H3, and the highest exceedance frequency was 86% at PDL-H2. Exceedances were concentrated in winter to late spring, with most recent events occurring February to May.

- **Copper (dissolved)**: Concentrations ranged from 0.000015 mg/L to 0.0804 mg/L (maximum at PDL-H3, Dec-2024). The largest exceedance was 39 times the long-term WQG-FAL at PDL-H7; the highest frequency was 89% at PDL-H1. Acute guideline exceedances occurred in Feb–Mar and Nov–Dec (up to 9.08 times the short-term WQG-FAL). Generally, exceedances at each site were distributed across winter, spring, and fall; no single dominant seasonal pattern was evident.
- **Iron (dissolved)**: Concentrations ranged from 0.00025 mg/L to 12.5 mg/L (maximum at PDL-H3, Jun-2025). The greatest exceedance was 35.7 times the short-term WQG-FAL at PDL-H3; the highest frequency was 92% at PDL-H3. Across sites, exceedances were concentrated in spring and summer.
- **Iron (total)**: Concentrations ranged from 0.175 mg/L to 25.7 mg/L, with the maximum at PDL-H8 (Oct-2024). Exceedance frequencies of the chronic CWQG-AL were consistently very high: 100% at PDL-H2, PDL-H3, PDL-H7, PDL-H8, and PDL-H9, and 99% in Sumas River. The largest exceedance was 85.7 times the chronic CWQG-AL at PDL-H8, while the maximum exceedance of the Acute WQG-FAL was 25.7 times at the same site. Exceedances occurred year-round, with many maxima observed in May and October, but a single dominant seasonal trend was not identified.
- **Manganese (dissolved):** Concentrations ranged from 0.00002 mg/L to 1.41 mg/L, with the maximum at PDL-H8 (Aug-2025). Exceedance frequencies of the chronic CWQG-AL were highest at PDL-H3 (25%) and PDL-H8 (12%), with other sites showing no exceedances. The largest exceedance was 3.52 times the chronic guideline at PDL-H8. Exceedances were sporadic and occurred mainly in late summer and early winter. A consistent seasonal pattern across sites was not identified.
- **Mercury (total)**: Concentrations ranged from 9.5×10^{-7} mg/L to 6.09×10^{-5} mg/L (maximum at PDL-H3, Dec-2024). The greatest exceedance was 48.7 times the long-term WQG-FAL at PDL-H3; the highest frequency was 100% at PDL-H1 and PDL-H2. Across sites, exceedances occurred mainly in winter and spring.
- **Nickel (dissolved)**: Concentrations ranged from 0.000005 mg/L to 0.0449 mg/L (maximum at PDL-H7, Feb-2025). The largest exceedance was 18.7 times the long-term WQG-FAL at PDL-H7; the highest frequency was 99% at PDL-SR. A single acute exceedance occurred in February at PDL-H7. No clear seasonal trend was observed across sites.

Table 2.18 Metal Concentrations and Water Quality Guideline Exceedances in Surface Water along the Huntingdon Loop

Parameter	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	Short-Term	Chronic	Short-Term
Total Ammonia (as N)	PDL-H1	1.22	1.23	15.1	21.5	9	0.0075	0.504	3.7	Apr-2025	1 (11%)	-	3.03	-
	PDL-H2	1.22	1.23	16.5	22.4	7	0.048	0.901	3.7	Apr-2025	1 (14%)	-	3.03	-
	PDL-H3	1.22	1.23	15.1	23.2	12	0.36	3.92	33	Dec-2024	4 (33%)	1 (8%)	27	1.72
	PDL-H7	1.22	1.22	23.2	23.8	3	0.037	0.0753	0.15	Dec-2024	-	-	-	-
	PDL-H8	0.762	1.23	5.74	23.8	21	0.019	0.474	2.9	Apr-2025	1 (5%)	-	2.36	-
	PDL-H9	1.07	1.23	7.82	20.4	14	0.0075	0.326	1.4	Apr-2025	1 (7%)	-	1.14	-
	Sumas River[1]	0.904	1.24	6.64	21.5	83	0.0025	0.0607	0.41	Apr-2025	-	-	-	-
Nitrate (as N)	PDL-H1	3	3	32.8	32.8	9	0.01	11.6	33.3	Oct-2024	7 (78%)	1 (11%)	11.1	1.02
	PDL-H2	3	3	32.8	32.8	7	0.069	8.95	17.9	Nov-2024	6 (86%)	-	5.97	-
	PDL-H3	3	3	32.8	32.8	12	0.148	1.17	5.05	Feb-2025	1 (8%)	-	1.68	-
	PDL-H7	3	3	32.8	32.8	3	0.1	1.27	2.25	Feb-2025	-	-	-	-
	PDL-H8	3	3	32.8	32.8	33	0.0025	0.838	3.41	Jun-2024	2 (6%)	-	1.14	-
	PDL-H9	3	3	32.8	32.8	14	0.01	0.533	1.63	Mar-2025	-	-	-	-
	Sumas River[1]	3	3	32.8	32.8	89	1.15	2.17	3.87	Nov-2022	9 (10%)	-	1.29	-
Fluoride	PDL-H1	0.12	0.12	1.1	1.74	9	0.025	0.148	0.22	Oct-2024	8 (88.9%)	-	1.83	-
	PDL-H2	0.12	0.12	1.5	1.62	7	0.13	0.139	0.15	Nov-2024	7 (100%)	-	1.25	-
	PDL-H3	0.12	0.12	1.43	1.84	12	0.078	0.124	0.16	Dec-2024	6 (50%)	-	1.33	-
	PDL-H7	0.12	0.12	1.34	1.54	3	0.071	0.094	0.13	Dec-2024	1 (33.3%)	-	1.08	-
	PDL-H8	0.12	0.12	1.28	1.52	33	0.025	0.0722	0.116	Jul-2023	-	-	-	-
	PDL-H9	0.12	0.12	1.25	1.46	14	0.025	0.0594	0.087	Sep-2025	-	-	-	-
	Sumas River[1]	0.12	0.12	1.19	1.57	89	0.025	0.049	0.065	Jan-2020	-	-	-	-
Aluminum (total)	PDL-H1	0.0934	0.493	-	-	9	0.109	0.807	1.8	Jun-2025	6 (67%)	-	19.3	-
	PDL-H2	0.244	0.439	-	-	7	0.23	0.747	1.28	Apr-2025	6 (86%)	-	3.49	-
	PDL-H3	0.165	0.459	-	-	12	0.003	0.414	1.34	Sep-2025	5 (42%)	-	5.08	-
	PDL-H7	0.178	0.301	-	-	3	0.023	0.787	1.56	Mar-2025	2 (67%)	-	6.32	-
	PDL-H8	0.127	0.515	-	-	33	0.008	0.325	1.67	Apr-2025	17 (52%)	-	6.71	-
	PDL-H9	0.174	0.365	-	-	14	0.0046	0.178	0.675	Mar-2025	4 (29%)	-	3.88	-
	Sumas River[1]	0.147	0.371	-	-	86	0.0131	0.229	1.68	Mar-2022	22 (26%)	-	6.25	-

Parameter	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	Short-Term	Chronic	Short-Term
Chromium (total)	PDL-H1	0.0025	0.0025	-	-	9	0.0005	0.00186	0.0031	Jun-2025	3 (33%)	-	1.24	-
	PDL-H2	0.0025	0.0025	-	-	7	0.0012	0.00199	0.0032	Apr-2025	1 (14%)	-	1.28	-
	PDL-H3	0.0025	0.0025	-	-	12	0.0005	0.00128	0.0032	Sep-2025	1 (8%)	-	1.28	-
	PDL-H7	0.0025	0.0025	-	-	3	0.0016	0.00347	0.0051	Mar-2025	2 (67%)	-	2.04	-
	PDL-H8	0.0025	0.0025	-	-	33	0.0005	0.00111	0.0036	Apr-2025	3 (9%)	-	1.44	-
	PDL-H9	0.0025	0.0025	-	-	14	0.0005	0.00075	0.0016	Mar-2025	-	-	-	-
	Sumas River[1]	0.0025	0.0025	-	-	86	0.00021	0.0043	0.0479	Mar-2022	40 (47%)	-	19.2	-
Cobalt (dissolved)	PDL-H1	0.0004	0.000773	-	-	9	0.0001	0.000834	0.00188	May-2025	6 (66.7%)	-	2.77	-
	PDL-H2	0.000603	0.000685	-	-	7	0.00047	0.000933	0.00157	Apr-2025	6 (85.7%)	-	2.46	-
	PDL-H3	0.000563	0.000861	-	-	12	0.0002	0.00101	0.004	Dec-2024	9 (75%)	-	4.65	-
	PDL-H7	0.000512	0.000629	-	-	3	0.00062	0.00173	0.00233	Feb-2025	2 (66.7%)	-	4.4	-
	PDL-H8	0.000481	0.000619	-	-	33	0.00005	0.000412	0.00124	Apr-2025	10 (30.3%)	-	2.37	-
	PDL-H9	0.00047	0.000581	-	-	14	0.0001	0.000241	0.00066	Mar-2025	4 (28.6%)	-	1.4	-
	Sumas River[1]	0.000438	0.000653	-	-	85	0.000022	0.000271	0.000523	Jan-2020	2 (2.35%)	-	1.14	-
Copper (dissolved)	PDL-H1	0.0002	0.0047	0.0015	0.0283	9	0.00126	0.00726	0.0111	Jan-2025	8 (89%)	2 (22%)	10.1	1.59
	PDL-H2	0.0011	0.0039	0.0068	0.0235	7	0.00037	0.00495	0.0085	Nov-2024	6 (86%)	-	6.54	1
	PDL-H3	0.0005	0.0041	0.0013	0.0249	12	0.0002	0.00887	0.0804	Dec-2024	8 (67%)	2 (17%)	19.6	3.46
	PDL-H7	0.0003	0.0016	0.0013	0.0024	3	0.00042	0.00797	0.0118	Mar-2025	2 (67%)	2 (67%)	39	9.08
	PDL-H8	0.0002	0.0048	0.0012	0.0278	33	0.0001	0.00135	0.00469	Apr-2025	13 (39%)	2 (6%)	8.1	1.35
	PDL-H9	0.0007	0.0026	0.0044	0.0156	14	0.0001	0.00127	0.00244	Mar-2025	5 (36%)	-	3.49	-
	Sumas River[1]	0.0005	0.0027	0.0031	0.0161	84	0.000015	0.00124	0.00444	Jan-2024	22 (26%)	-	3.15	-
Iron (dissolved)	PDL-H1	-	-	0.35	0.35	9	0.0265	0.18	0.77	May-2025	-	1 (11%)	-	2.2
	PDL-H2	-	-	0.35	0.35	7	0.148	0.528	1.14	Apr-2025	-	4 (57%)	-	3.26
	PDL-H3	-	-	0.35	0.35	12	0.341	5.49	12.5	Jun-2025	-	11 (92%)	-	35.7
	PDL-H7	-	-	0.35	0.35	3	0.188	1.26	3.37	Dec-2024	-	1 (33%)	-	9.63
	PDL-H8	-	-	0.35	0.35	33	0.131	1.54	10	Oct-2024	-	24 (73%)	-	28.6
	PDL-H9	-	-	0.35	0.35	14	0.0683	0.422	1.72	Mar-2025	-	4 (29%)	-	4.91
	Sumas River[1]	-	-	0.35	0.35	85	0.00025	0.193	0.433	Jun-2022	-	1 (1%)	-	1.24
Iron (total)	PDL-H1	0.3	0.3	1	1	9	0.175	1.89	6.84	May-2025	8 (89%)	6 (67%)	22.8	6.84
	PDL-H2	0.3	0.3	1	1	7	0.766	2.93	6.52	May-2025	7 (100%)	6 (86%)	21.7	6.52
	PDL-H3	0.3	0.3	1	1	12	3.03	8.74	17.8	May-2025	12 (100%)	12 (100%)	59.3	17.8
	PDL-H7	0.3	0.3	1	1	3	0.709	8.95	24.4	Dec-2024	3 (100%)	2 (67%)	81.3	24.4
	PDL-H8	0.3	0.3	1	1	33	0.6	5.45	25.7	Oct-2024	33 (100%)	32 (97%)	85.7	25.7
	PDL-H9	0.3	0.3	1	1	14	0.654	1.85	4.43	Mar-2025	14 (100%)	9 (64%)	14.8	4.43
	Sumas River[1]	0.3	0.3	1	1	86	0.202	1.25	8.71	Mar-2022	85 (99%)	41 (48%)	29	8.71

Parameter	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	Short-Term	Chronic	Short-Term
Manganese (dissolved)	PDL-H1	0.49	0.89	-	-	9	0.004	0.126	0.583	May-2025	-	-	0.799	-
	PDL-H2	0.73	0.84	-	-	7	0.0235	0.269	0.713	May-2025	-	-	0.938	-
	PDL-H3	0.57	1	-	-	12	0.0947	0.516	1.1	Dec-2024	3 (25%)	-	1.37	-
	PDL-H7	0.55	0.77	-	-	3	0.045	0.239	0.624	Dec-2024	-	-	0.81	-
	PDL-H8	0.39	0.73	-	-	33	0.00937	0.29	1.41	Aug-2025	4 (12.1%)	-	3.52	-
	PDL-H9	0.37	0.61	-	-	14	0.0059	0.0807	0.202	Apr-2025	-	-	0.331	-
	Sumas River[1]	0.39	0.62	-	-	85	0.00002	0.0657	0.17	Jul-2023	-	-	0.283	-
Mercury (total)	PDL-H1	0.00000125	0.00000125	-	-	9	0.0000039	0.00000916	0.0000194	Apr-2025	9 (100%)	-	15.5	-
	PDL-H2	0.00000125	0.00000125	-	-	7	0.0000032	0.0000089	0.0000176	Apr-2025	7 (100%)	-	14.1	-
	PDL-H3	0.00000125	0.00000125	-	-	12	0.00000095	0.00000934	0.0000609	Dec-2024	8 (67%)	-	48.7	-
	PDL-H7	0.00000125	0.00000125	-	-	3	0.0000024	0.0000205	0.0000304	Feb-2025	3 (100%)	-	24.3	-
	PDL-H8	0.00000125	0.00000125	-	-	33	0.00000095	0.00000237	0.0000105	Apr-2025	19 (58%)	-	8.4	-
	PDL-H9	0.00000125	0.00000125	-	-	14	0.00000095	0.00000217	0.0000055	Multiple	4 (29%)	-	4.4	-
	Sumas River	0.00000125	0.00000125	-	-	7	0.00000095	0.00000246	0.0000063	Apr-2025	3 (43%)	-	5.04	-
Nickel (dissolved)	PDL-H1	0.001	0.0059	0.0181	0.101	9	0.0005	0.0146	0.0187	Jan-2025	8 (89%)	-	5.8	0.304
	PDL-H2	0.003	0.0051	0.0551	0.0864	7	0.0099	0.0141	0.0153	Nov-2024	7 (100%)	-	5.1	0.269
	PDL-H3	0.0024	0.0078	0.0436	0.142	12	0.0039	0.0104	0.0291	Dec-2024	12 (100%)	-	4.67	0.249
	PDL-H7	0.0024	0.0039	0.0446	0.0753	3	0.0037	0.0305	0.0449	Feb-2025	2 (67%)	1 (33%)	18.7	1.01
	PDL-H8	0.0016	0.0044	0.0276	0.0586	33	0.0018	0.00741	0.0157	Nov-2024	30 (91%)	-	7.85	0.419
	PDL-H9	0.0017	0.0028	0.0305	0.0418	14	0.0025	0.00521	0.011	Mar-2025	14 (100%)	-	6.47	0.361
	Sumas River[1]	0.0017	0.0036	0.0305	0.0584	85	0.000005	0.0129	0.0215	Nov-2023	84 (99%)	-	8.32	0.537

Notes:
WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life. The guidelines are British Columba WQG-FAL except; the chronic CWQG-AL for fluoride was adopted from the CCME due to no corresponding BC WQG-FAL.
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).
[1] Sumas River = PDL-H10 and the ECCC sampling location pooled.
The chronic guideline for hexavalent chromium (0.0025 mg/L) was used to screen total chromium concentrations.
"–" indicates not applicable

2.4.2.3 Summary

Conductivity ranged widely across unnamed tributaries to Saar Creek (PDL-H1, PDL-H2, PDL-H3, PDL-H7) and Arnold Slough (PDL-H8), from ~200 µS/cm at PDL-H8 to 1,430 µS/cm at PDL-H3. Turbidity and TSS were generally higher in spring and early summer, with notable peaks at PDL-H1 (TSS up to 98 mg/L, turbidity 83 NTU) and PDL-H3 (TSS up to 104 mg/L, turbidity 80.5 NTU). Temperatures increased into summer, reaching 24 °C at PDL-H3 and ~18 °C at PDL-H8, while dissolved oxygen declined to as low as 1.4–1.7 mg/L at PDL-H3 and PDL-H8 during August. pH remained mostly within guideline ranges, except for one low value (6.22) at PDL-H8 in March. Nutrient concentrations were generally low, but exceedances of the chronic WQG-FAL occurred for total ammonia and nitrate (the acute WQG-FAL was exceeded once for ammonia at PDL-H3 and nitrate at PDL-H1). For metals, exceedances of the chronic WQG-FAL were observed for aluminum, copper, iron, mercury, and nickel, with some parameters (notably iron, copper, and mercury) exceeding guidelines by 30-fold or greater. Exceedances occurred across multiple monitoring periods, with timing and magnitude varying among parameters and sites.

Sumas River (PDL-H10 and the ECCC Sumas River sampling location) exhibited lower conductivity (112–315 µS/cm) and generally lower turbidity and TSS compared to Arnold Slough sites, with values decreasing through summer. Water temperature ranged from ~4.9 °C in winter to ~18 °C in July, and dissolved oxygen remained relatively stable (6.9–10.4 mg/L). pH was within guideline limits. Exceedances of chronic WQG-FAL were observed for several metals and nutrients, including chromium and nickel, with nickel exceedances the most frequent (up to 99% of observations). Sumas Lake Canal (PDL-H9) showed intermediate conditions: conductivity up to 456 µS/cm, low turbidity and TSS, and seasonal temperature changes. Exceedances of the chronic WQG-FAL for nickel, copper, and aluminum were identified, though at lower magnitudes than Arnold Slough sites.

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 (there were sites where water levels were so low that sampling was not possible [e.g., PDL-H7]).
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-9–Huntingdon 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 Huntingdon Loop PDLs from 2024 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 field 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):

- American barn owl call playback survey (2024 and 2025) and critical habitat biophysical attribute review (2025)
- Fixed radius breeding bird survey (point count) (2024)
- Time-constrained amphibian search (2024 and 2025)
- Painted turtle survey (2025) and critical habitat biophysical attribute review (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 eight watercourses associated with the PDLs along the Huntingdon Loop are within the Chilliwack River watershed group (GOBC 2025e). The Chilliwack River watershed group encompasses several subbasins that flow into the Fraser River including the Sumas River subbasin, which encompasses all the PDLs for the Huntingdon Loop (GOBC 2025e). Sumas River (watershed code 100-065700) originates in the United States and flows north through agricultural areas in Abbotsford in the Fraser River lowlands before discharging into the Fraser River.

The following subsections describe fish species and aquatic habitat present around each of the PDLs. See Section 2.2.2 and Section 2.3.2 for more information on the hydrology and geological setting of the area. Additional fish and fish habitat details for each PDL, as well as the area assessed around each PDL 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 Chilliwack River watershed group are listed in Table 2.19. Table 2.19 also summarizes the fish species documented in watercourses with PDLs, where data were available. No fish have been previously documented at PDL-H1, PDL-H3, or PDL-H7 (GOBC 2025e). Five species at risk (i.e., those listed under Schedule 1 of SARA, by the Committee on the Status of Endangered Wildlife in Canada [COSEWIC], or that are provincially red or blue-listed) have been previously documented within the Chilliwack River watershed group including sturgeon, which is assumed to be a white sturgeon (*Acipenser transmontanus*) observation, brassy minnow – Pacific group (*Hybognathus hankinsoni*), coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) Salish sucker (*Catostomus* sp. 4), and bull trout – South Coast BC populations (*Salvelinus confluentus*). Of these, brassy minnow, coastal cutthroat trout, and white sturgeon have been documented in watercourses that have proposed discharge locations.

Barrowtown Pump Station, located downstream of the PDLs, is used to control water levels in the Sumas River and Sumas Lake Canal (see Section 2.2.2.1). The pump station may impact fish migration and fish presence at all the PDLs in the summer months as the pump station impounds water during this period, which would restrict fish access (e.g., migrating adult salmon) through the pump station.

Table 2.19 Fish Species Documented within the Chilliwack 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]	Documented Fish Presence by Proposed Discharge Location[d]			
							Unnamed Tributary to Saar Creek (PDL-H2)	Arnold Slough (PDL-H8)	Sumas Lake Canal (PDL-H9A and PDL-H9B)	Sumas River (PDL- H10)
Acipenseridae	White sturgeon – Lower Fraser River population	*Acipenser transmontanus*	-	Threatened	Red	Yes	-	-	-	-
	Sturgeon (general)	*Acipenser* sp.	-	-	-	Yes	-	-	-	X
Catostomidae	Bridgelip sucker	*Catostomus columbianus*	-	-	Yellow	Yes	-	-	-	-
	Largescale sucker	*Catostomus macrocheilus*	-	-	Yellow	Yes	-	-	-	X
	Longnose sucker	*Catostomus catostomus*	-	-	Yellow	Yes	-	-	-	-
	Salish sucker	*Catostomus* sp. 4	Threatened	Endangered	Red	Yes	-	-	-	-
	Sucker (general)	*Catostomus* sp.	-	-	-	No	-	X	-	X
Centrarchidae	Black crappie	*Pomoxis nigromaculatus*	-	-	Exotic	Yes	-	-	-	X
	Bluegill	*Lepomis macrochirus*	-	-	Exotic	No	-	X	-	-
	Largemouth bass	*Micropterus salmoides*	-	-	Exotic	Yes	-	X	-	X
	Pumpkinseed	*Lepomis gibbosus*	-	-	Exotic	No	-	X	-	X
	Smallmouth bass	*Micropterus dolomieu*	-	-	Exotic	Yes	-	-	-	-
Clupeidae	American shad	*Alosa sapidissima*	-	-	Exotic	No	-	-	-	X
Cottidae	Coastrange sculpin	*Cottus alutaceus*	-	-	Yellow	Yes	-	-	-	-
	Prickly sculpin	*Cottus asper*	-	-	Yellow	Yes	-	-	X	X
	Sculpin (general)	*Cottus* sp.	-	-	-	No	-	-	-	X
Cyprinidae	Brassy minnow – Pacific group	*Hybognathus hankinsoni*	-	Special concern	Blue	No	-	X	-	X
	Common carp	*Cyprinus carpio*	-	-	Exotic	No	-	X	-	X
	Fathead minnow	*Pimephales promelas*	-	-	Exotic	No	-	-	-	-
	Goldfish	*Carassius auratus*	-	-	Exotic	No	-	-	-	-
	Leopard dace	*Rhinichthys falcatus*	-	Not at risk	Yellow	Yes	-	-	-	-
	Longnose dace	*Rhynichthys cataractae*	-	-	Yellow	Yes	-	-	-	-
	Northern pikeminnow	*Ptychocheilus oregonensis*	-	-	Yellow	Yes	-	X	-	X
	Peamouth	*Mylocheilus caurinus*	-	-	Yellow	Yes	-	-	-	X
	Redside shiner	*Richardsonius balteatus*	-	-	Yellow	Yes	-	X	X	X
	Chub (general)	-	-	-	-	No	-	-	-	X
	Dace (general)	*Rhynichthys* sp.; *Phoxinus* sp.	-	-	-	No	-	-	-	X

Family	Common Name	Scientific Name	SARA Status[a]	COSEWIC Status[a]	BC Status[b]	Species of Importance to Indigenous Groups[c]	Documented Fish Presence by Proposed Discharge Location[d]			
							Unnamed Tributary to Saar Creek (PDL-H2)	Arnold Slough (PDL-H8)	Sumas Lake Canal (PDL-H9A and PDL-H9B)	Sumas River (PDL- H10)
Gasterosteidae	Threespine stickleback	*Gasterosteus aculeatus*	-	-	Yellow	No	X	X	X	X
Ictaluridae	Brown catfish	*Ameiurus nebulosus*	-	-	Exotic	Yes	-	X	-	X
	Yellow bullhead	*Ameiurus natalis*	-	-	Exotic	No	-	-	-	-
	Bullhead (general)	*Ameiurus* sp.	-	-	-	No	-	X	-	X
Petromyzontidae	Pacific lamprey	*Entosphenus tridentatus*	-	-	Yellow	Yes	-	-	-	-
	River lamprey	*Lampetra ayresii*	-	-	Yellow	No	-	-	-	-
	Western brook lamprey	*Lampetra richardsoni*	-	-	Yellow	No	-	-	-	-
	Lamprey (general)	*Lampetra* sp.	-	-	-	No	-	-	-	X
Salmonidae	Atlantic salmon	*Salmo salar*	-	-	Exotic	No	-	-	-	-
	Brook trout	*Salvelinus fontinalis*	-	-	Exotic	No	-	-	-	-
Salmonidae cont.	Bull trout – South Coast British Columbia populations	*Salvelinus confluentus*	Special concern	Special concern	Blue	Yes	-	-	-	-
	Chinook salmon	*Oncorhynchus tshawytscha*	-	-	-	Yes	-	-	-	X
	Chum salmon	*Oncorhynchus keta*	-	-	-	Yes	-	-	X	X
	Coastal cutthroat trout	*Oncorhynchus clarkii clarkii*	-	-	Blue	Yes	-	X	-	X
	Coho salmon	*Oncorhynchus kisutch*	-	-	-	Yes	-	X	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

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

[d] HabitatWizard (GOBC 2025e), Appendix H.1

White Sturgeon

Sturgeon, presumably white sturgeon based on sturgeon species known to be present in this area of the Fraser River watershed, have been documented near the mouth of the Sumas River (GOBC 2025e, 2025f); the Sumas River is associated with PDL-H10. 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). They are primarily found in river mainstems, large tributaries, reservoirs, and large lakes (McPhail 2007) and as such, are not expected to be found in proximity to PDL-H10, as the Sumas River is a relatively narrow watercourse (14.2 m wide) at this PDL compared to the size of watercourses white sturgeon are typically found in. Likewise, they are not expected to be present at the other PDLs.

Brassy Minnow

Brassy minnow has been documented in Arnold Slough and Sumas River, which are associated with PDL-H8 and PDL-H10, respectively (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 Sumas River watershed including in Arnold Slough upstream of PDL-H8 and the mainstem of Sumas River in proximity to PDL-H10 (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, though fry are generally found in shallower water with lower velocities than adults (McPhail 2007). Brassy minnow spawn in mid-May to early June in the lower Fraser Valley, when water temperatures reach approximately 14ºC and spawning occurs over vegetation (McPhail 2007).

Based on their habitat requirements, brassy minnow have the potential to be present at PDL-H8, PDL-H10, and the other PDLs associated with the Huntingdon Loop. Spawning has the potential to occur at PDLs where instream vegetation is present such as PDL-H8, PDL-H9A, and PDL-H9B.

Coastal Cutthroat Trout

Coastal cutthroat trout have been documented in Arnold Slough and Sumas River, which are associated with PDL-H8 and PDL-H10, respectively (GOBC 2025e, 2025f). They are provincially blue listed (BC CDC 2025a). Coastal cutthroat trout have been documented sporadically throughout the Sumas River watershed including approximately 900 m downstream of PDL-H8 (GOBC 2025e).

Coastal cutthroat trout are found in a wide variety of cool-water habitat (typically <18ºC; McPhail 2007). Adults can be found in 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*), the trout juveniles 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 to spawn in streams less than 1 m wide with a low gradient and gravel substrates and usually spawn in the tail-outs of pools where water depths are 0.15 to 0.45 m (McPhail 2007).

Based on their habitat requirements, coastal cutthroat trout have the potential to be present at PDL-H8, PDL-H10, and the other PDLs associated with the Huntingdon Loop. Spawning by coastal cutthroat trout is unlikely at the PDLs, as substrates are primarily fines and organics, which are unsuitable for spawning.

Salish Sucker

Salish sucker has not been documented in watercourses associated with Huntingdon Loop PDLs but have been documented within the Chilliwack River watershed group (GOBC 2025e, 2025f). They are listed as threatened under Schedule 1 of SARA, endangered by COSEWIC, and are provincially red listed (Government of Canada 2025; BC CDC 2025a). Within the Chilliwack River watershed group, Salish sucker has primarily been documented in the Chilliwack Creek watershed, Hope Slough watershed, and Vedder River, which are not in close proximity to the Huntingdon Loop (Government of BC 2025a). Additionally, they are only known from 11 watersheds in Canada, and the Huntingdon 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 any of the PDLs associated with the Huntingdon Loop.

Bull Trout

Bull trout have not been documented in watercourses associated with the Huntingdon Loop PDLs but have been documented within the Chilliwack River watershed group (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). Within the Chilliwack River watershed group, bull trout have primarily been documented in more mountainous terrain in the Chilliwack River watershed (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 it prefers high gradient, unproductive waters (Roberge et al. 2002; McPhail 2007). Given that the PDLs are located in a low-gradient area with higher water temperatures and given the lack bull trout observations in proximity to the Huntingdon Loop, it is considered unlikely that they would be present at any of the PDLs in this area.

2.5.2.1.2 Fish Habitat

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

Unnamed Tributaries to Saar Creek

There are four PDLs in unnamed tributaries to Saar Creek: PDL-H1, PDL-H2, PDL-H3, and PDL-H7 (Appendix H.2). PDL-H1, PDL-H3, and PDL-H7 are agricultural drainage ditches while PDL-H2 is a small stream (Appendix H.1). All have a riparian class of S3 and range from 3.7 m to 4.9 m wide (Appendix H.1). Habitat in PDL-H1, PDL-H2, and PDL-H7 was primarily flat in gradient, while PDL-H3 was run habitat with some pools (Appendix H.1). Substrates at all four PDLs were dominated by organics and/or fines, and cover was made up of instream and overhanging vegetation (Appendix H.1). PDL-H1 and PDL-H2 were dry during the August 2023 assessment but had moderate flow during a supplemental survey in spring 2024 (Appendix H.1). A beaver dam was present in proximity to PDL-H3 (Appendix H.1).

Banks at all the PDLs ranged from sloping to vertical and were stable and consist of fines and organics (Appendix H.1). Functional riparian width was less than 5 m at all the PDLs except for PDL-H7, where average width ranged from 8 to 18 m (Appendix H.1). Riparian vegetation was predominantly grasses and shrubs and the watercourses were surrounded by agricultural fields (Appendix H.1). Wetland vegetation was present around PDL-H7 (Appendix H.1).

Spawning habitat for salmonids was rated as unsuitable at the PDLs due to the lack of coarse substrates and dense instream vegetation and, in some cases, the presence of low seasonal flow (PDL-H1 and PDL-H2) and poor water quality (PDL-H7; Appendix H.1). Spawning habitat for coarse fish species was marginal (Appendix H.1). Rearing and overwintering habitat for all fish species is marginal at the PDLs except for PDL-H3, which had unsuitable overwintering habitat for salmonids (Appendix H.1). Migration and adult habitat ratings are unsuitable for salmonids and marginal for coarse fish species at the PDLs except for PDL-H7, which had unsuitable migration habitat for coarse fish species (Appendix H.1). With respect to species of management concern, brassy minnow and coastal cutthroat trout have the potential to be present.

Arnold Slough

PDL-H8 is the only PDL located in Arnold Slough, which is a linear drainage canal that flows into Saar Creek approximately 900 m downstream (northwest) of the PDL (Appendix H.2). It has a riparian class of S2 with a mean channel width of 14.9 m (Appendix H.1). The canal has flat habitat with substrates dominated by organics with a small amount of fines (Appendix H.1). Instream cover includes instream and overhanging vegetation (Appendix H.1). Overall, there is limited cover diversity and a lack of complexity in the channel (Appendix H.1).

The left bank is sloping and the right bank is vertical and associated with the Arnold Slough Dike (Appendix H.1). Banks are comprised of fines and organics and were in stable condition during the 2025 assessment (Appendix H.1). Functional riparian width is less than 4 m and riparian vegetation is made up of grasses (Appendix H.1). Agricultural fields surround the slough.

At PDL-H8, Arnold Slough provides important spawning habitat for coarse fish species that depend on vegetation for spawning such as brassy minnow, which have been documented in the canal, and other cyprinids and provides unsuitable habitat for other species, such as salmonids that require gravels for spawning (Appendix H.1). Overwintering, rearing, and migration habitat is also rated as important for species such as brassy minnow and other cyprinids (Appendix H.1). Overwintering, rearing, and migration habitat is rated as marginal for salmonids and larger coarse fish species due to low flows and a lack of coarse substrate (Appendix H.1). Adult habitat suitability is also marginal for all fish species. With respect to species of management concern, brassy minnow, and coastal cutthroat trout have the potential to be present (Appendix H.1).

Sumas Lake Canal

There are two PDLs in Sumas Lake Canal: PDL-H9A and PDL-H9B (Appendix H.2). Sumas Lake Canal is a linear canal in an agricultural area that flows north into Sumas River (Appendix H.2). It has a riparian class of S1B at both PDLs, with an average width of 20 to 25 m (Appendix H.1). The canal has flat habitat with substrates that are dominated by fines, with organics and cobble subdominant (Appendix H.1). Instream cover is primarily provided by depth as well as instream and overhanging vegetation (Appendix H.1).

The banks at PDL-H9A and PDL-H9B are sloping and stable and composed of fines and organics (Appendix H.1). Functional riparian width is less than 4 m at both PDLs, and riparian vegetation is made up of shrubs and grasses (Appendix H.1). Agricultural fields surround the canal (Appendix H.1).

Sumas Lake Canal provides important spawning habitat for coarse fish species that depend on vegetation for spawning such as redside shiner, which has been documented in the canal, and other cyprinids (e.g., brassy minnow) and provides unsuitable habitat for other species such as salmonids that require gravels for spawning (Appendix H.1). Overwintering, rearing, migration, and adult habitat ranges from marginal to important for cyprinid species (Appendix H.1). Overwintering, rearing, and migration habitat is rated as marginal for salmonids and larger coarse fish species due to lack of coarse substrate, low flows, and poor water quality (Appendix H.1). Adult habitat suitability is also marginal for salmonids and larger coarse fish species (Appendix H.1). With respect to species of management concern, brassy minnow and coastal cutthroat trout have the potential to be present.

Sumas River

PDL-H10 is the only PDL located in the Sumas River and is located near the Canada/United States border (Appendix H.2). It has a riparian class of S2 and a mean channel width of 14.2 m (Appendix H.1). The channel has flat habitat with substrates dominated by organics and with a small amount of fines (Appendix H.1). Instream cover is primarily provided by overhanging vegetation with lesser amounts of instream vegetation and woody debris (Appendix H.1).

At PDL-H10, the banks are moderately stable and comprised of organics, with the left bank sloping and the right bank vertical (Appendix H.1). Functional riparian width ranges from 15 to 50 m (Appendix H.1). The left bank has mature forest comprised of deciduous trees, shrubs, and grasses and the right bank is in the shrub stage and comprised of shrubs, grasses, and some deciduous trees (Appendix H.1). The riparian area is surrounded by agricultural fields.

At PDL-H10, Sumas River provides unsuitable spawning habitat for salmonid species due to lack of coarse substrates and provides marginal spawning habitat for coarse fish species such as threespine stickleback and cyprinid species (Appendix H.1). Overwintering, rearing, and adult habitat for salmonids is marginal, though it is an important migration corridor for salmon (Appendix H.1). There is also important overwintering, rearing, migration, and adult habitat for threespine stickleback and cyprinid species (Appendix H.1). With respect to species of management concern, brassy minnow and coastal cutthroat trout have the potential to be present.

2.5.2.2 Wildlife and Wildlife Habitat

The Huntingdon 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 are present, including 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 Sumas Prairie area of the Fraser delta (Appendix H.2), which is predominated by agricultural development. Table 2.20 summarizes the wildlife and wildlife habitat characteristics of the PDLs. The PDLs have been grouped based on the general characteristics of their receiving environments; that is, agricultural ditches (PDL-H1, PDL-H3, PDL-H7), a small stream in an agricultural setting (PDL-H2), Arnold Slough (PDL-H8), a section of the Sumas River with a relatively natural riparian area (PDL-H10), and Sumas Lake Canal (PDL-H9A and PDL-H9B). The PDLs are in the Municipality of Abbotsford, which supports a diversity of wildlife, including 77 vertebrate species of conservation concern that may occur in the Coastal Western Hemlock biogeoclimatic zone[1,2] (12 mammals, 57 birds, 5 amphibians, 3 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-H10 and PDL-H9A are within federally designated critical habitat polygons for painted turtle and American barn owl (Table 2.20; 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 Huntingdon Loop PDLs are in the Eastern Very Dry Maritime variant of the Coastal Western Hemlock biogeoclimatic zone

Table 2.20 Summary of Wildlife and Wildlife Habitat Characteristics of Potential Discharge Locations for Huntingdon 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)[1,2]
PDL-H1	Unnamed tributary to Saar Creek	• PDL is on an agricultural drainage ditch (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Irrigation canal between two cultivated fields, with grasses dominating both banks; little to no flow.	Suitable predominantly for amphibians (breeding), waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging). Confirmed breeding by northern red-legged frog in 2024 and 2025.	No	Birds: 94 species (see Appendix I.2), including the following species reported in Appendix I.1: American kestrel, Canada goose, European starling (introduced), mallard, northern harrier, ring-necked pheasant (introduced), white-crowned sparrow Amphibians: Pacific treefrog (*Pseudacris regilla*), northern red-legged frog (*Rana aurora*; Blue List and Special Concern under Schedule 1 of SARA) Mammals: None Terrestrial invertebrates: None
PDL-H2	Unnamed tributary to Saar Creek	• PDL is on a small stream (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Meandering natural but disturbed watercourse surrounded by cultivated lands with a farmyard to the north; surrounding habitat is dominated by grasses with patches of horsetails (*Equisetum* sp.).	Suitable predominantly for amphibians (breeding), waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging). Confirmed breeding by northern red-legged frog in 2025.	No	Birds: 94 species (see Appendix I.2), including the following species reported in Appendix I.1: American kestrel, American robin, American barn owl, barn swallow, Canada goose, European starling (introduced), mallard, northern harrier, ring-necked pheasant (introduced), white-crowned sparrow Mammals: None Amphibians: Pacific treefrog, northern red-legged frog Reptiles: None Terrestrial invertebrates: None
PDL-H3	Unnamed tributary to Saar Creek	• PDL is on an agricultural drainage ditch (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Irrigation canal with low flow and banks dominated by grasses and Himalayan blackberry (*Rubus armeniacus*), surrounded by cultivated lands	Suitable predominantly for waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging); potentially suitable for native amphibians.	No	Birds: 94 species (see Appendix I.2), including the following species reported in Appendix I.1: American crow, American robin, bald eagle, European starling (introduced), mallard, wood duck Mammals: Coyote (*Canis latrans*), small mammal, beaver (*Castor canadensis*) dam in vicinity (see Section 2.5.2.1) Amphibians: None[3] Reptiles: None Terrestrial invertebrates: None
PDL-H7	Unnamed tributary to Saar Creek	• PDL is on an agricultural drainage ditch (Appendix H.2) with wetland vegetation present around the PDL; see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Graminoid marsh, dominated by reed canarygrass (*Phalaris arundinacea*), sedges (*Carex* sp.), and bulrushes (*Scirpus* sp.), surrounded by cultivated lands	Suitable predominantly for amphibians (breeding), waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging). Confirmed breeding by Pacific treefrog and northwestern salamander in 2024.	No	Birds: 106 species (see Appendix I.2), including the following species reported in Appendix I.1: Common yellowthroat, mourning dove, white-crowned sparrow Mammals: None Amphibians: Pacific treefrog, northwestern salamander (*Ambystoma gracile*) Reptiles: Common gartersnake (*Thamnophis sirtalis*) Terrestrial invertebrates: None

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)[1,2]
PDL-H8	Arnold Slough	• PDL is on a drainage canal that flows into Saar Creek (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Wide, linear slough with water depth of approximately 1 m, minimal emergent vegetation, minimally undercut banks that are dominated by grasses, surrounded by cultivated lands.	Suitable predominantly for amphibians (breeding), waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging). Confirmed breeding by northwestern salamander in 2025.	No	Birds: 106 species (see Appendix I.2), including the following species reported in Appendix I.1: Canada goose, mallard, white-crowned sparrow Mammals: None Amphibians: Pacific treefrog, northwestern salamander Reptiles: None Terrestrial invertebrates: None
PDL-H10	Sumas River	• PDL is on the Sumas River, approximately 140 m west of Whatcom Road (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • PDL is in a treed riparian area with cultivated lands to west and east and a larger patch of trees to north. Vegetation cover includes mature black cottonwood (*Populus trichocarpa*), young paper birch (*Betula papyrifera*), and red-osier dogwood (*Cornus sericea*); banks are densely vegetated with grasses and areas of Himalayan blackberry.	Suitable predominantly for songbirds (breeding and foraging), raptors (breeding and foraging), furbearers (foraging, travel), and bats (foraging); potentially suitable for amphibians and painted turtle.	Yes, for painted turtle (*Chrysemys picta*; Red List and Threatened under Schedule 1 of SARA]) (Appendix H.2; see text for further information).	Birds: 49 species (see Appendix I.2), including the following species reported in Appendix I.1: American crow, American robin, black-capped chickadee, brown creeper, downy woodpecker, European starling (introduced), osprey, ring-necked pheasant (introduced), white-throated sparrow Mammals: None Amphibians: None[4] Reptiles: None Terrestrial invertebrates: None
PDL-H9A[5]	Sumas Lake Canal	• PDL is on a wide, linear canal between No. 4 Road and No. 5 Road and located approximately 850 m north of H9B (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Minimal aquatic vegetation, with a mix of reed canarygrass and Himalayan blackberry on the banks, surrounded by cultivated fields and treed hedgerows.	Suitable predominantly for waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging); potentially suitable for native amphibians and painted turtle.	Yes, for 1) for painted turtle, and 2) American barn owl (*Tyto furcata*; Blue List and Threatened under Schedule 1 of SARA) (Appendix H.2; see text for further information).	Birds: 64 species (see Appendix I.2), including the following species reported in Appendix I.1 and by McTavish (see Appendix E.1.11): American robin, bald eagle, barn swallow, Barrow's goldeneye, bufflehead, common yellowthroat, Eurasian collared-dove (introduced), European starling (introduced), green-winged teal, hooded merganser, mallard, red-breasted merganser, red-tailed hawk, ringed-neck duck, savannah sparrow. Mammals: American mink (*Neovison vison*), North American river otter (*Lontra canadensis*) Amphibians: American bullfrog (*Lithobates catesbeianus*; introduced), green frog (*L. clamitans*; introduced) Reptiles: None Terrestrial invertebrates: None
PDL-H9B[5]	Sumas Lake Canal	• PDL is on a wide, linear canal between No. 4 Road and No. 5 Road and located approximately 850 m south of H9A (Appendix H.2); see Section 2.2.2 and Section 2.5.2.1 for detailed descriptions of this receiving environment. • Minimal aquatic vegetation, with a mix of reed canarygrass and Himalayan blackberry on the banks, surrounded by cultivated fields and treed hedgerows.	Suitable predominantly for waterbirds (breeding and foraging), non-forest songbirds (breeding and foraging), raptors (foraging), furbearers (foraging, travel), and bats (foraging); potentially suitable for native amphibians.	No	

Notes:

[1] In past 10 years (i.e., 2016–2025)

[2] Species of conservation concern are underlined; see Appendix I.2 for scientific names and conservation status for birds.

[3] Amphibian survey completed, no amphibians detected.

[4] Amphibian survey not undertaken due to poor searchability conditions; no incidental observations of amphibians.

[5] Because of their proximity (850 m apart), connectivity (two locations on the same canal), and similar habitat characteristics, the wildlife occurrence records for PDL-H9A and PDL-H9B are combined.

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 Municipality of Abbotsford. There are confirmed occurrence records for 133 species within 1 km of the Huntingdon 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, 13 are species of conservation concern: brant (*Branta bernicla*), tundra swan (*Cygnus columbianus*), whimbrel (*Numenius phaeopus*), short-billed dowitcher (*Limnodromus griseus*), lesser yellowlegs (*Tringa flavipes*), Baird's sandpiper (*Calidris bairdii*), California gull (*Larus californicus*), great blue heron (*Ardea herodias*), American barn owl (*Tyto furcata*), short-eared owl (*Asio flammeus*), 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 Huntingdon Loop PDLs, Appendix I.1 reported detections of nine waterfowl species (Canada goose [*Branta canadensis*], mallard [*Anas platyrhynchos*], wood duck [*Aix sponsa*], Barrow's goldeneye [*Bucephala islandica*], bufflehead [*B. albeola*], green-winged teal [*Anas crecca*], hooded merganser [*Lophodytes cucullatus*], red-breasted merganser [*Mergus serrator*], ring-necked duck [*Aythya collaris*]), no shorebird species, two terrestrial species that forage directly in water (bald eagle [*Haliaeetus leucocephalus*], osprey [*Pandion haliaetus*]), and one aerial insectivore species (barn swallow) (also see Table 2.20).

There are no active great blue heron nest colonies in the vicinity of the Huntingdon Loop PDLs; the closest colony to have been active in the last ten years is 6 km northeast of PDL-H9A and was last recorded as active in 2017 (CMN 2025a). An active bald eagle nest was detected 140 m southeast of PDL-H9A in spring 2025 (Appendix I.1), which is approximately 720 m north of PDL-H9B. McTavish (see Appendix E.1.11) reported an active barn swallow nest in June 2025, located under the No. 4 Road bridge over the Sumas Lake Canal, downstream from PDL-H9A.

PDL-H9A is within a federally designated critical habitat polygon for American barn owl (Table 2.20; Appendix H.2) and PDL-H7 and PDL-H8 are approximately 140 m and approximately 150 m from American barn owl critical habitat, respectively (Appendix H.2). The area around PDL-H9A was assessed as having five of the seven biophysical attributes of American barn owl critical habitat (Appendix I.1). American barn owls are uncommon in the Lower Mainland (COSEWIC 2010; ECCC 2022); there was one publicly available occurrence record in 2024 and an observation by Jacobs in 2025 within 1 km of PDL-H1, PDL-H2, and PDL-H3 and one publicly available occurrence record in 2025 within 1 km of PDL-H9A and PDL-H9B (Appendix I.2; Table 2.20; Birds Canada 2025). American barn owls would not interact directly with the PDL receiving environments but may hunt along the edges.

2.5.2.2.2 Mammals

Mammal species known or likely to be present around the PDLs include black-tailed deer (*Odocoileus hemionus*), coyote (*Canis latrans*), 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 are assumed to forage around the 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).

[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)

Five amphibian species were identified during surveys associated with the Huntingdon Loop PDLs in 2024 and 2025: Pacific treefrog, northern red-legged frog, northwestern salamander, American bullfrog, and green frog (Table 2.20). Breeding was confirmed for Pacific treefrog, 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, and western red-backed salamander are unlikely to be present in any of the Huntingdon Loop PDL receiving environments, while long-toed salamander and rough-skinned newt may be present (ECCC 2020; TRU and BC MOE 2021b; iNaturalist 2025).

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 painted turtle, red-eared slider, common gartersnake, and western terrestrial gartersnake are likely to interact with the PDL receiving environments (TRU and BC MOE 2021c). There are no publicly available painted turtle or red-eared slider occurrence records for Sumas Prairie (ECCC 2021; iNaturalist 2025); however, gartersnakes are expected to be common.

PDL-H9A and PDL-H10 are within federally designated critical habitat polygons for painted turtle (Table 2.20; Appendix H.2). PDL-H9A and PDL-H10 were assessed as having six and eight of the nine biophysical attributes of painted turtle critical habitat, respectively (Appendix I.1). No painted turtles were found during the species-specific surveys completed at PDL-H9A and PDL-H10 in April 2025 (Appendix I.1). Both PDLs are more than 2 km from the painted turtle population units around which the critical habitat was defined (ECCC 2021; BC CDC 2025b).

2.5.2.2.5 Terrestrial Invertebrates

Many terrestrial invertebrate species are known or likely to be present in the Municipality of Abbotsford, including 32 species of conservation concern (BC CDC 2025a). Groups that are closely associated with stream or agricultural ditch habitat, particularly for reproduction, are most likely to interact with the PDL receiving environments (e.g., caddisflies, mayflies, mosquitos, damselflies).

[4] Synonymous with western painted turtle (BC CDC 2025c)
[5] Red List = extirpated, endangered or threatened (BC CDC 2025a)

2.5.3 Data Gaps and Uncertainties

The information available for the characterization of existing conditions for fish and fish habitat and wildlife and wildlife habitat as it pertains to the Huntingdon 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 fish and fish habitat and 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). One site (Site ID 1191) was identified within the 250 m of the centreline of the Huntingdon Loop from the BC ENV Site Registry database. Site ID 1191 is located approximately 100 m southwest of the southern end of the Huntingdon Loop. The detailed report for the Site ID 1191 identified a previous mercury soils impact that was remediated in 1993. No sites were identified within 250 m of the centreline of the Huntingdon Loop from the Federal Contaminated Sites Inventory database.

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.

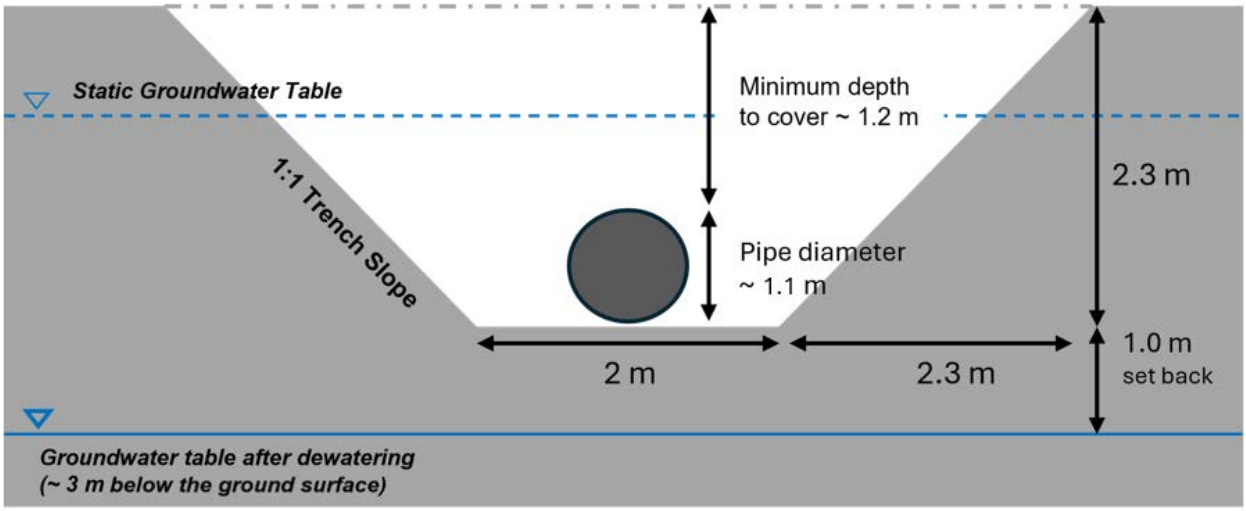
3.1.1 Construction Activities and Groundwater Management

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. The BC Railway/Vye Road crossing is anticipated to use the DSPT crossing approach. The Lamson Road crossing is an example of a location requiring bore crossing.

3.1.2 Groundwater Discharge Estimates

Groundwater inflow to trench excavation within the Huntingdon Loop were estimated using GeoStudio SEEP/W, a finite element numerical modeling software that simulates groundwater flow through saturated and unsaturated porous media. Two-dimensional cross-sections were used to simulate groundwater flow toward the trench, including lateral flow along the trench length and radial flow toward the trench ends. Monthly groundwater levels measured in monitoring wells were used to define baseline conditions. The modeled hydrostratigraphy is informed from the conceptual hydrostratigraphic model developed in Leapfrog Works (Section 2.3.2.2.1). Hydraulic properties assigned to each HSU were based on available site-specific data supplemented by literature values (Section 2.3.2.2.2).

Groundwater inflow estimates 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 is expected to occur during the early stage of dewatering (e.g., first seven days), when water is released from aquifer storage within the pumping zone of influence and groundwater levels stabilize at the base of excavation. After this period, discharge rates are expected to decrease by approximately 10%, as the contribution from aquifer storage decreases and the radius of influence stabilizes. 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 and Table 3.2 presents the estimated range of peak groundwater discharge rates for the mainline trench excavations (trench invert at 3.0 mbgs) and short isolated excavations (trench invert at 3.4 to 4.5 mbgs), respectively. Short, isolated excavations include pipeline crossovers, small surface water crossings, bore bays, and access shafts. The ranges are based on manual groundwater level measurements representing high (April 2025) and low (July to August 2025) groundwater conditions collected as part of the baseline groundwater monitoring program.

Along the Huntingdon Loop, groundwater levels were consistently above the trench invert throughout the monitoring period (June 2024 to August 2025; <2.5 mbgs; Section 2.3.2.2.3). Estimated peak discharge rates were less than 125 L/s for mainline trench excavations and less than 70 L/s for short, isolated excavations (Table 3.1; Table 3.2).

The highest peak discharge rates for mainline trench excavations occur near Arnold Slough (KP36.70 to KP38.30), ranging from 104 to 125 L/s (Table 3.1). Peak discharge rates decrease westward toward the MS-16 meter station (KP39.28 to KP40.91), where rates are less than 10 L/s (Table 3.1). This decrease in discharge towards the south corresponds to changes in subsurface conditions along the pipeline loop alignment. Deposits near Arnold Slough are dominated by sand to sand with silt/clay, which have relatively high hydraulic conductivity and, therefore, allow greater groundwater inflow to the excavation. Towards the MS-16 meter station, proceeding southwesterly, the subsurface transitions to finer-grained silt and clay deposits with lower hydraulic conductivity, resulting in reduced groundwater inflow and lower estimated discharge rates.

Estimated peak discharge rates vary seasonally in response to changes in groundwater levels relative to the trench invert. Higher groundwater levels during wetter periods (i.e., October to April) are expected to result in higher discharge rates, whereas lower groundwater levels during drier periods (i.e., May to September) are expected to result in lower discharge rates.

Table 3.1 Estimated Range of Peak Discharge Rate for Mainline Trench Excavations (June 2024 to August 2025)

KP Range	Segment Length	Peak Discharge Rates (L/s) for Active Segment Length
36.70 to 37.14	440	104–125
37.16 to 37.54	380	104–125
37.66 to 38.30	640	104–125
38.33 to 38.68	350	60–119
38.73 to 39.05	320	60–119
39.07 to 39.27	200	41–81
39.28 to 40.05	770	4–9
40.06 to 40.68	620	4–9
40.69 to 40.91	220	3–7

Notes:

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

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.

Table 3.2 Estimated Range of Peak Discharge Rate for Isolated Trench Excavations (June 2024 to August 2025)

KP Range	Crossing Name	Peak Discharge Rates (L/s)
37.14 to 37.16	Irrigation Ditch Crossing	27-33
37.54 to 37.57	Access Shaft (Vye Road)	54-62
38.30 to 38.33	Sarr Creek Crossing	31-37
38.68 to 38.71	Bore Bay (Lamson Road)	30-45
39.05 to 39.07	Irrigation Ditch Crossing	8-16
39.27 to 39.28	Westcoast Crossover	19-30
40.05 to 40.06	Irrigation Ditch Crossing	1-2
40.68 to 40.69	Westcoast Crossover	1-2

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 Huntingdon 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 Huntingdon Loop (at the excavation trenches) is summarized as follows:

- 2.26 to 2.99 m for mainline trench sections; and
- 1.46 to 3.99 m for deeper, isolated excavations associated with surface water crossings, pipeline crossings, bore bays, and access shafts

Along the Huntingdon loop, the estimated ZOI is generally less than 200 m for mainline trench sections. A localized higher ZOI of less than 230 m is estimated near Arnold Slough. For deeper isolated excavations (e.g., bore bays), the estimated ZOI is less than 300 m. Figures in Appendix K presents the estimated ZOI along the Huntingdon loop. Mainline trench sections (trench invert of 3.0 mbgs) generally have smaller ZOI extents compared to shorter, isolated excavations (trench invert from 3.4 to 4.5 mbgs).

3.1.3.1 Groundwater Users Within the Estimated ZOI

In total, 4 unlicensed well users (Private Domestic) are located within the estimated ZOI extent of the Huntingdon Loop (Figures in Appendix K; Table 3.3). There is no licensed well user within the estimated ZOI extent of the Huntingdon Loop. Well Tag Number 6769 is situated within 5 m of the excavation (exact distance to be confirmed) and has a reported well depth of 9.1 mbgs (Table 3.3).

Table 3.3 Well Users within the Estimated ZOI

Well Tag Number	Usage	License Status	Distance from Excavation[1] (m)	Finishing Well Depth (mbgs)
6769	Private Domestic	Unlicensed	<5	9.1
6532	Private Domestic	Unlicensed	140	6.1
16363	Private Domestic	Unlicensed	230	7.6
6448	Private Domestic	Unlicensed	147	6.1

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

3.1.3.2 Surface Water Users Within the Estimated ZOI

There are no surface water licenses located within the ZOI along the Huntingdon Loop (Appendix K).

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 Huntingdon Loop Area

Duration	**Volume (cubic metres)**	
	5-Year Return Period	**100-Year Return Period**
5 min	10	17
10 min	15	29
15 min	19	34
30 min	26	46
1 hour	35	59
2 hours	47	77
6 hours	68	112
12 hours	115	165
24 hours	155	232

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).

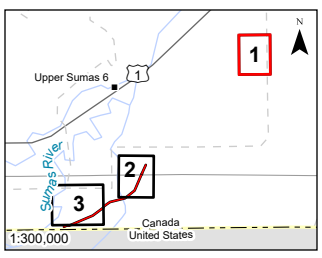
The collected water released to surface water will undergo water treatment prior to discharge. Treatment may include a combination of sediment removal, clarification, filtration, and aeration/oxidation to address turbidity and naturally elevated metal concentrations depending on the groundwater quality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

Eight PDLs are being considered for the Huntingdon Loop (Figure 3.2). Two of these PDLs, PDL-H8 (Arnold Slough) and PDL-H10 (Sumas River), can each accommodate large volumes (Section 3.2.2) and are currently proposed as the primary and secondary discharge locations, respectively. Four PDLs (PDL-H1, PDL-H2, PDL-H3, and PDL-H7) that are either irrigation ditches or small drainage features (i.e., unnamed tributaries to Saar Creek) have more limited receiving capacity and would, therefore, be used as a back-up or in combination with other PDLs for low volume discharges. Sumas Lake Canal (PDL-H9A and PDL-H9B) is considered contingency because water would need to be piped a greater distance from the pipeline loop to discharge at this location.

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).



Flow Direction
Transmission Line
Watercourse

Kilometer Post
Existing Pipeline
Proposed Right of Way
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
Abbotsford, BC
NTS 50K Grid: 092G01

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

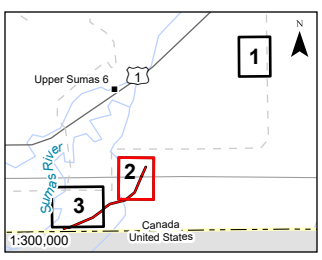
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
3.2

Title
Site Plan

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\ca0183-pbagf01\workgroup\1232projects\123316694l\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
Proposed Right of Way
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
Abbotsford, BC
NTS 50K Grid: 092G01

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

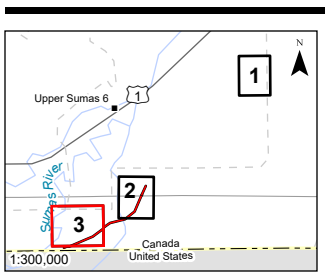
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
3.2

Title
Site Plan

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\ca0183-pbsgf01\workgroup\1232projects\123316694\figures\reports\TAR\site_plan\fig_123317055_sep_tar_site_plan.aprx Revised: 2026-04-30 By: jpoucher



Flow Direction
International Border
Railway
Transmission Line
Watercourse

Kilometer Post
Existing Pipeline
Proposed Pipeline
Proposed Right of Way
Proposed Workspace

Proposed Discharge Location (PDL) Buffer (~250 m)

0 90 180 270 360 m
1:9,000 (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
Abbotsford, BC
NTS 50K Grid: 092G01

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.
3.2 **Page 3 of 3**

Title
Site Plan

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\ca0183-pbagf01\workgroup\1232\projects\123316694\figures\reports\TARsite_plan\fig_123317055_sep_tar_site_plan.aprx Revised: 2026-04-30 By: jboucher

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.

Five treatment categories were evaluated:

1. bulk removal of TSS
2. metals removal
3. nitrogen species removal
4. fluoride removal
5. 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, describes the PDL receiving capacity assessment results, and presents the rationale for proposed discharge rates as they pertain to discharge quantity for the Huntingdon 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 Section 2.3.2. A summary of the dewatering requirements is provided as follows:

- Groundwater levels along the Huntingdon Loop are generally shallow (typically <2.5 mbgs) and remain above the trench invert (3.0 to 4.5 mbgs). It is anticipated that the total length of the Huntingdon Loop trench will be subject to groundwater inflow during construction and will require groundwater management and dewatering.
- Mainline trench excavations are estimated to require dewatering rates of up to 125 L/s, while short, isolated excavations (crossovers and bore bays) are expected to require less than 62 L/s.
- The highest dewatering rate is anticipated near Arnold Slough (KP36.7 to KP38.30). Dewatering rates decrease westward toward the MS-16 meter station (KP39.28 to KP40.91), where estimated discharge is generally less than 10 L/s.
- Higher discharge rates are expected under higher groundwater conditions (i.e., October to April), and lower rates under lower groundwater conditions (i.e., May to September).
- The inflow rate per metre of open trench section will increase as the saturated thickness of the excavation increases (i.e., deeper trenches will have higher inflows).
- Groundwater recharge from precipitation to the open cut trench footprint is estimated at 3,321 to 5,562 m^3/yr (0.18 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 preliminarily selected to be no more than 10% of the estimated monthly flows showed 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. The maximum monthly receiving capacity based on the 10% of the natural mean monthly flows is presented in Table 3.5.

Table 3.5 Preliminary Monthly Receiving Capacity for the Huntingdon Loop Proposed Discharge Locations

PDL		Preliminary Maximum Receiving Capacity[1] (m^3/s)											
Number	**Watercourse**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
PDL-H1	Unnamed	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.002
PDL-H2	Unnamed	0.002	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.002
PDL-H3	Unnamed	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
PDL-H7	Unnamed	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001
PDL-H8	Arnold Slough	0.088	0.078	0.064	0.051	0.034	0.025	0.016	0.012	0.013	0.022	0.063	0.079
PDL-H9A	Sumas Lake Canal	0.162	0.137	0.113	0.089	0.060	0.044	0.028	0.022	0.023	0.039	0.111	0.139
PDL-H9B	Sumas Lake Canal	0.162	0.137	0.113	0.089	0.060	0.044	0.028	0.022	0.023	0.039	0.111	0.139
PDL-H10	Sumas River	0.697	0.591	0.487	0.385	0.260	0.191	0.123	0.094	0.098	0.170	0.479	0.598

Notes:

[1] 10%% of mean monthly flow

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

However, the maximum discharge capacities for the Huntingdon Loop PDLs were adjusted to account for the extensive management of water in the catchment for agricultural use as discussed in the following paragraphs and in Section 3.2.3.

The Sumas River watershed is in the Fraser River Lowland in Washington State and BC. The mainstem of the river originates in the coastal mountains in Whatcom County in the United States and joins the Fraser River east of Abbotsford in BC. Agriculture occurs over more than 90% of the length of the Sumas River. Approximately 4.5 km upstream of where the Sumas River joins the Fraser River, the Sumas River passes through the Barrowtown Pump Station complex. Under normal or low flow conditions the Sumas River crosses the complex through open flood gates. When the Fraser River is under high flow conditions, the flood gates are closed to prevent flooding along the Sumas River

mainstem. Under these conditions, the Sumas River can bypass the gates being routed through the pump station. However, the pump station's main function is to drain the site of the former Sumas Prairie Lake by lifting water from the Sumas Lake Canal into the Sumas River. A schematic of the system at the Barrowtown Pump Station is shown in Figure 2.6.

Sumas River floods are not governed by freshet but by winter storm events. Frequent flooding of the area possibly indicates that the river has inadequate conveyance capacity and substandard dikes (GOBC 2025h). Sediment accumulations also can restrict flood conveyance (GOBC 2025h).
The catchment typically sees high flow conditions during the winter months, with lower flows between April and October.

Surface runoff within the entire Sumas River watershed, including Arnold Slough and the Sumas Lake Canal, is heavily used for irrigation purposes. Based on communication with the City of Abbotsford, it is understood that Barrowtown Pump station is shut to retain all surface runoff within the Sumas Lake Canal basins, during the irrigation season. Conversely, water levels in the system are kept as low a possible during the flood season to provide storage volume for potential flood control.

Historically, dredging of most of the tributaries and maintenance of sediment traps appears to have occurred regularly within the catchment (DFO 1999).

Additionally, the small channel and ditches that discharge into the main water bodies in the system (Sumas River, Arnold Slough and Saar Creek) appeared (during the monthly monitoring conducted by Westcoast between 2024 and 2025; Appendix E.1) to be mostly stagnant or dry, with detectable flows occurring only after a precipitation event.

3.2.3 Proposed Discharge Rates Rationale

The following factors were considered for refining the monthly receiving capacities for PDLs in the Huntingdon Loop:

- The lower Sumas River watershed is extensively affected by agricultural and flood control activities (e.g., water diversion, erosion and sedimentation from adjacent farmland, dredging, sediment trap maintenance).
- The Sumas River is an important salmon migration corridor.
- The Sumas River retains a semi-natural channel morphology that provides suitable habitat for multiple species of fish.
- Arnold Slough is a human-made channel.
- Although Arnold Slough provides suitable fish habitat, the lack of cover and channel complexity limit habitat suitability.
- Due to the extremely flat drainage and associated low velocities, channel shape, lack of cover and agricultural influence, Arnold Slough can be considered environmentally more similar to an irrigation canal than a natural channel.

- Smaller channel and ditches are typically dry or stagnant, with visible flow occurring only after precipitation events.
- The Sumas Lake Canal works primarily as an irrigation canal, and its hydrologic regime is controlled entirely by the operation of the Barrowtown Pump Station complex

Based on the above considerations, the following approach is proposed for selecting the maximum receiving capacity:

- The monthly maximum receiving capacity of the Sumas River (PDL-H10) and smaller natural ditches (PDL-H1/H2/H3/H7) is kept at 10% of the corresponding estimated mean monthly flow.
- The maximum receiving capacity of Arnold Slough (PDL-H8) is set at 0.284 cubic metres per second (m^3/s) between June and October, and 10% of the corresponding estimated mean monthly flow between November and April.
- The maximum receiving capacity of the Sumas Lake Canal (PDL-H9A/9B) is set at 0.284 m^3/s between June and October, and 10% of the corresponding estimated mean monthly flow between November and April.
- The maximum receiving capacity for typically stagnant ditches and channel is proposed to be set at 0.005 m^3/s. This value is based on the understanding that these channels can typically convey higher short-term flows and that they will be used only as back-up discharge locations.
- Discharging in the Sumas River is stopped when flows recorded at the nearby real-time ECCC hydrometric station, Sumas River near Huntingdon (08MH029), exceed 25.1 m^3/s (estimated 1 in 2 years peak flow).
- The other PDLs in this loop are contingency locations. Discharging to these PDLs would be reduced or temporarily suspended, as applicable, when the precipitation forecast shows a potential for more than 78.5 mm (1 in 5 years 24-hour precipitation) of rain in the following 24 hours.

Based on the above considerations, 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 Huntingdon Loop Proposed Discharge Locations

Proposed Discharge Location Name	Watercourse	Maximum Proposed Discharge Rate	Discharge Use
PDL-H1	Unnamed	0.005 m^3/s	Back-up/secondary discharge
PDL-H2	Unnamed	0.005 m^3/s	Back-up/secondary discharge
PDL-H3	Unnamed	0.005 m^3/s	Back-up/secondary discharge
PDL-H7	Unnamed	0.005 m^3/s	Back-up/secondary discharge
PDL-H8	Arnold Slough	0.284 m^3/s	Each location could be a single discharge location for entire loop or back-up/secondary discharge option
PDL-H9A	Sumas Lake Canal	0.284 m^3/s	
PDL-H9B	Sumas Lake Canal	0.284 m^3/s	
PDL-H10	Sumas 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 the Huntingdon Loop Proposed Discharge Locations

PDL		Monthly Proposed Discharge Rate (m^3/s)											
Number	**Watercourse**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
PDL-H1	Unnamed	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
PDL-H2	Unnamed	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
PDL-H3	Unnamed	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
PDL-H7	Unnamed	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
PDL-H8	Arnold Slough	0.013	0.013	0.013	0.013	0.013	0.284	0.284	0.284	0.284	0.284	0.013	0.013
PDL-H9A	Sumas Lake Canal	0.010	0.010	0.010	0.010	0.050	0.284	0.284	0.284	0.050	0.010	0.010	0.010
PDL-H9B	Sumas Lake Canal	0.010	0.010	0.010	0.010	0.050	0.284	0.284	0.284	0.050	0.010	0.010	0.010
PDL-H10	Sumas River	0.284	0.284	0.284	0.284	0.189	0.050	0.050	0.050	0.050	0.050	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 Huntingdon Loop Proposed Discharge Locations

PDL		Monthly Dilution Rate
Number	**Watercourse**	
PDL-H1	Unnamed	10:1 during wet periods
PDL-H2	Unnamed	10:1 during wet periods
PDL-H3	Unnamed	10:1 during wet periods
PDL-H7	Unnamed	10:1 during wet periods
PDL-H8	Arnold Slough	0.4:1 irrigation season 10:1 or higher flood season
PDL-H9A	Sumas Lake Canal	1:1 Irrigation Season 30:1 or higher flood season
PDL-H9B	Sumas Lake Canal	1:1 Irrigation Season 30:1 or higher flood season
PDL-H10	Sumas River	10:1 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, 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.

  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
    - the 95P of the background receiving environment surface water concentration.

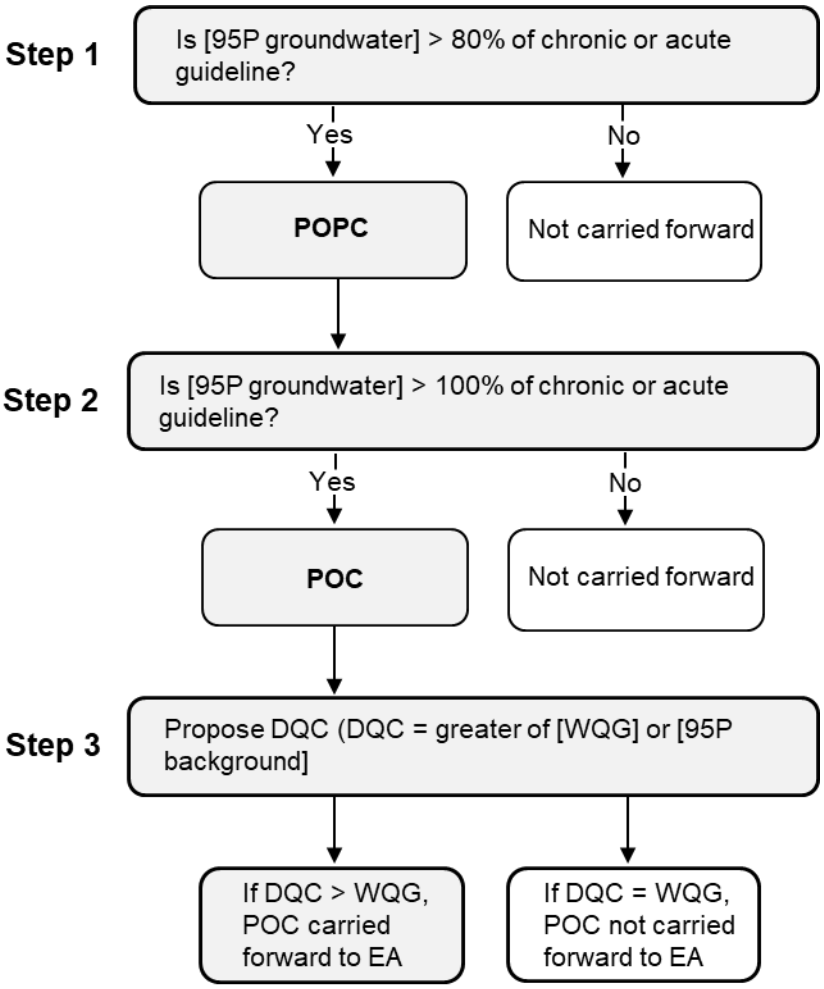
This approach aligns proposed DQCs with natural background conditions where background concentrations exceed guideline values and with applicable WQG-FAL values where background concentrations are lower. Note that standard general parameters (TSS, turbidity, pH, DO, and temperature) were automatically carried forward for the development of DQC, as described in Section 3.3.2.2.

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.

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. In this section of the application, which focuses on key PDLs within the Huntingdon Loop, variable WQG-FAL were calculated using surface water chemistry from Arnold Slough (PDL-H8) and the Sumas River (PDL-H10 and the ECCC monitoring station), which represent the primary and secondary discharge locations, respectively.

Other potential discharge locations within the Saar Creek watershed (PDL-H1, PDL-H2, PDL-H3, and PDL-H7) are back-up discharge points, with more limited proposed discharge volumes (see Section 3.2.2). The PDLs on Sumas Lake Canal are a contingency and were identified later in the Project planning process, resulting in fewer available water quality samples during the timeframe for data included in this report. Accordingly, Arnold Slough and the Sumas River were selected as representative proxy locations for the other discharge locations within the loop, as they provide the most robust and representative surface water chemistry data for the receiving environment. The use of the 95P for characterizing groundwater quality and background surface water quality is described in Sections 3.3.1.2 and 3.3.1.3, respectively, and the development of the 95P for water quality datasets containing censored data (i.e., results below the detection limit) is described in Section 3.3.1.4.

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)



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. 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.

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.

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.

3.3.1.4.1 Seasonal Comparison Analysis

Seasonal differences in surface water quality were evaluated to determine whether concentrations from drier months (i.e., 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 metals, anions, and nutrients identified as parameters of potential concern (POPCs; Step 1, based on screening against 80% of the corresponding WQG-FAL) and parameters of concern (POCs; Step 2, based on screening against 100% of the corresponding WQG-FAL) in groundwater are summarized in Table 3.9 (Arnold Slough) and Table 3.10 (Sumas River). 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 3.3.2.2.2.

Table 3.9 Identified Parameters of Potential Concern and Parameters of Concern for Groundwater Discharging to Arnold Slough

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)	1.2	0.976	4.59	Yes	1.22	5.74	-
Chloride	43.9	120	480	-	150	600	-
Fluoride	0.258	0.096	1.02	Yes	0.12	1.28	Yes
Nitrate (as N)	4.15	2.4	26.2	Yes	3	32.8	Yes
Nitrite (as N)	0.0261	0.16	0.192	-	0.2	0.24	-
Sulphate	110	247	-	-	309	-	-
Aluminum (T)	1.14	0.158	-	Yes	0.198	-	Yes
Antimony (T)	0.00066	0.0592	0.2	-	0.074	0.25	-
Arsenic (T)	0.0086	0.004	-	Yes	0.005	-	Yes
Barium (T)	0.166	0.8	-	-	1	-	-
Beryllium (T)	0.00017	0.000104	-	Yes	0.00013	-	Yes
Boron (T)	0.1	0.96	0.232	-	1.2	0.29	-
Chromium (T)	0.00289	0.002	-	Yes	0.0025	-	Yes
Iron (T)	23.6	0.24	0.8	Yes	0.3	1	Yes
Mercury (T)	0.0000125	0.000001	-	Yes	0.00000125	-	Yes
Molybdenum (T)	0.0038	6.08	36.8	-	7.6	46	-
Selenium (T)	0.00212	0.0016	-	Yes	0.002	-	Yes
Silver (T)	0.000035	0.000096	-	-	0.00012	-	-
Thallium (T)	0.0000214	0.00064	-	-	0.0008	-	-
Uranium (T)	0.00037	0.006	0.0132	-	0.0075	0.0165	-
Vanadium (T)	0.01	0.048	-	-	0.06	-	-
Cadmium (D)	0.000136	0.000182	0.000406	-	0.000228	0.000508	-
Cobalt (D)	0.00477	0.000424	-	Yes	0.00053	-	Yes
Copper (D)	0.00852	0.00064	0.00096	Yes	0.0008	0.0012	Yes
Iron (D)	23.2	-	0.28	Yes	-	0.35	Yes
Lead (D)	0.0004	0.0041	-	-	0.00513	-	-
Manganese (D)	1.1	0.44	-	Yes	0.55	-	Yes
Nickel (D)	0.0839	0.0016	0.0221	Yes	0.002	0.0276	Yes
Strontium (D)	0.21	1	-	-	1.25	-	-
Zinc (D)	0.0106	0.0165	0.039	-	0.0206	0.0488	-

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

Table 3.10 Identified Parameters of Potential Concern and Parameters of Concern for Groundwater Discharging to Sumas River

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)	1.2	0.984	5.31	Yes	1.23	6.64	-
Chloride	43.9	120	480	-	150	600	-
Fluoride	0.258	0.096	0.952	Yes	0.12	1.19	Yes
Nitrate (as N)	4.15	2.4	26.2	Yes	3	32.8	Yes
Nitrite (as N)	0.0261	0.064	0.144	-	0.08	0.18	-
Sulphate	110	247	-	-	309	-	-
Aluminum (T)	1.14	0.155	-	Yes	0.194	-	Yes
Antimony (T)	0.00066	0.0592	0.2	-	0.074	0.25	-
Arsenic (T)	0.0086	0.004	-	Yes	0.005	-	Yes
Barium (T)	0.166	0.8	-	-	1	-	-
Beryllium (T)	0.00017	0.000104	-	Yes	0.00013	-	Yes
Boron (T)	0.1	0.96	0.232	-	1.2	0.29	-
Chromium (T)	0.00289	0.002	-	Yes	0.0025	-	Yes
Iron (T)	23.6	0.24	0.8	Yes	0.3	1	Yes
Mercury (T)	0.0000125	0.000001	-	Yes	0.00000125	-	Yes
Molybdenum (T)	0.0038	6.08	36.8	-	7.6	46	-
Selenium (T)	0.00212	0.0016	-	Yes	0.002	-	Yes
Silver (T)	0.000035	0.000096	-	-	0.00012	-	-
Thallium (T)	0.0000214	0.00064	-	-	0.0008	-	-
Uranium (T)	0.00037	0.006	0.0132	-	0.0075	0.0165	-
Vanadium (T)	0.01	0.048	-	-	0.06	-	-
Cadmium (D)	0.000136	0.000206	0.000322	-	0.000257	0.000402	-
Cobalt (D)	0.00477	0.000456	-	Yes	0.000570	-	Yes
Copper (D)	0.00852	0.00078	0.00248	Yes	0.000975	0.0031	Yes
Iron (D)	23.2	-	0.28	Yes	-	0.35	Yes
Lead (D)	0.0004	0.00319	-	-	0.00399	-	-
Manganese (D)	1.1	0.456	-	Yes	0.57	-	Yes
Nickel (D)	0.0839	0.00192	0.0244	Yes	0.0024	0.0305	Yes
Strontium (D)	0.21	1	-	-	1.25	-	-
Zinc (D)	0.0106	0.0162	0.037	-	0.0203	0.0463	-

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

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 DQCs, consistent with the screening framework described in Section 3.3.1.1. The resulting proposed DQCs are summarized in Table 3.11 (Arnold Slough) and Table 3.12 (Sumas River).

Statistically significant seasonal differences were identified for dissolved cobalt and dissolved iron at Arnold Slough, and for nitrate, total aluminum, chromium, total iron, dissolved copper, and dissolved nickel in Sumas River, with concentrations April to October (likely discharge period) lower than those observed November to March; Appendix N). Accordingly, the proposed DQCs for these parameters were calculated using 95P concentrations derived from background surface water quality during the likely discharge period (April-October) which is more conservative than using the annual 95P values.

Table 3.11 Proposed Discharge Quality Criteria for Groundwater Discharges to Arnold Slough

Parameter	95P Groundwater (mg/L)	WQG-FAL (mg/L)		95P Surface Water (mg/L)	Proposed DQCs (mg/L)	Basis of DQC
		Chronic	Acute			
Fluoride	0.259	0.12	1.28	0.102	0.12	Chronic WQG-FAL
Nitrate (as N)	4.15	3	32.8	3.11	3.11	Background
Aluminum (T)	1.14	0.198	-	1.04	1.04	Background
Arsenic (T)	0.008603	0.005	-	0.002842	0.005	Chronic WQG-FAL
Beryllium (T)	0.00017	0.00013	-	0.0001	0.00013	Chronic WQG-FAL
Chromium (T)	0.00289	0.0025	-	0.00282	0.00282	Background
Iron (T)	23.6	0.3	1	15.1	15.1	Background
Mercury (T)	0.0000125	0.00000125	-	0.00000488	0.00000488	Background
Selenium (T)	0.00212	0.002	-	0.000333	0.002	Chronic WQG-FAL
Cobalt (D)	0.00477	0.00053	-	0.000721*	0.000721	Background
Copper (D)	0.00852	0.0008	0.0012	0.00389	0.00389	Background
Iron (D)	23.2	-	0.35	6.10*	6.10	Background
Manganese (D)	1.1	0.55	-	0.924	0.924	Background
Nickel (D)	0.0839	0.002	0.0276	0.0129	0.0129	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

* 95P was calculated using discharge-period data only (April–October), as statistically significant differences were identified between discharge and non-discharge periods.

Table 3.12 Proposed Discharge Quality Criteria for Groundwater Discharges to Sumas River

Parameter	95P Groundwater (mg/L)	WQG-FAL (mg/L)		95P Surface Water (mg/L)	Proposed DQCs (mg/L)	Basis of DQC
		Chronic	Acute			
Fluoride	0.259	0.12	1.19	0.0606	0.12	Chronic WQG-FAL
Nitrate (as N)	4.15	3	32.8	2.37*	3	Chronic WQG-FAL
Aluminum (T)	1.14	0.194	-	0.397*	0.397	Background
Arsenic (T)	0.0086	0.005	-	0.00155	0.005	Chronic WQG-FAL
Beryllium (T)	0.00017	0.00013	-	0.00002	0.00013	Chronic WQG-FAL
Chromium (T)	0.00289	0.0025	-	0.0069	0.0069	Background
Iron (T)	23.6	0.3	1	2.2*	2.2	Background
Mercury (T)	0.0000125	0.00000125	-	0.00000594	0.00000594	Background
Selenium (T)	0.00212	0.002	-	0.00028	0.002	Chronic WQG-FAL
Cobalt (D)	0.00477	0.00057	-	0.000442	0.00057	Chronic WQG-FAL
Copper (D)	0.00852	0.000975	0.0031	0.00222*	0.00222	Background
Iron (D)	23.2	-	0.35	0.310*	0.35	Acute WQG-FAL
Manganese (D)	1.1	0.57	-	0.123	0.57	Chronic WQG-FAL
Nickel (D)	0.0839	0.0024	0.0305	0.0149*	0.0149	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

* 95P was calculated using data April to October (likely discharge period) only, as statistically significant differences were identified for April to October and rest of the year.

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.

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 ranged among the Huntingdon Loop PDLs and varied by season. For example, TSS at Arnold Slough (PDL-H8) ranged from 8.95 to 65 mg/L, with peaks in April and July. TSS values in the Sumas River and Sumas Lake Canal (PDL-H9A and PDL-H9B) ranged from 1.86 to 37.9 mg/L and from 4.60 to 26.2 mg/L, respectively. TSS levels at the PDLs decreased as mean monthly flow declined through summer (Section 2.4.2.1). The TSS in the smaller tributaries had a higher upper range (i.e., PDL-H1 was 98.0 mg/L in October; PDL-H2 was 170 mg/L in May; PDL-H3 was 104 mg/L in December).

Maximum TSS of discharged water is proposed to be 25 mg/L or background, whichever is greater. 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 City of Abbotsford does not have a bylaw that outlines TSS requirements for water discharge. However, 25 mg/L is also consistent with or exceeds the requirement of other municipalities in the Fraser Valley and Metro Vancouver which do have TSS requirements; for example, <25 mg/L during dry weather and <75mg/L in wet weather or a significant rain event in the City of Maple Ridge and City of Port Moody and <75 mg/L in the City of New Westminster and City of Surrey (City of Maple Ridge 2006; City of New Westminster 2016; City of Port Moody 2023; City of Surrey 2024).

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.

At the larger watercourses (i.e., Arnold Slough [PDL-H8], Sumas Lake Canal [PDL-H9], and Sumas River [Sumas River]), pH values generally ranged from 6.7 to 7.7, with January–April having slightly lower pH values and mid- to late-summer pH values reaching the upper end of this range. One value was outside

WQG-FAL (minimum of 6.5); a value of 6.22 was recorded in Arnold Slough in March. In the smaller tributaries (PDL-H1, PDL-H2, PDL-H3, and PDL-H7), pH typically ranged from 6.5 to 7.6 except at PDL-H7 in February, where a value of 6.00 was recorded. The smaller tributaries typically had the lowest pH values in late fall and winter.

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 for the Huntingdon Loop PDLs generally had higher levels of DO from mid-fall to winter/early spring and lower levels from spring to mid-fall. At the larger watercourses (i.e., Arnold Slough [PDL-H8], Sumas Lake Canal [PDL-H9], Sumas River [Sumas River]) there were elevated DO levels over a longer period; DO ranged from 6.20 mg/L to 11.00 mg/L between November and April and 1.72 mg/L to 8.65 between May and October. In the smaller tributaries (PDL-H1, PDL-H2, PDL-H3, and PDL-H7), higher levels of DO were recorded over a shorter period; DO ranged from 4.65 mg/L to 10.1 mg/L between December and March and from 1.37 mg/L to 7.46 mg/L between April and November.

The proposed discharge limit for DO is >5 mg/L at the end-of-pipe. This value is derived from the instantaneous minimum 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 (BC MEP 2025), it is similar to DO level recorded in the Huntingdon Loop PDLs during the proposed discharged period (April to October; between 1.37 and 8.99 mg/L). In addition, mixing at the discharge outfall structures is expected to increase DO in the discharged water.

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 a discharge limit and will be monitored during construction.

Water temperatures increased during the summer months at all PDLs monitored, with the highest temperatures being recorded in July. Temperatures ranged from 9.4°C to 25.0°C from April to October and 4.6°C to 12.7°C from November to March. The coldest water temperatures were recorded in January.

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. The proposed DQCs for all PDLs within the pipeline loop are not based on anticipated mixing downstream of the PDL; therefore, a mixing assessment based on a mass balance approach only was used for all PDLs to assess potential concentrations in the receiving environment downstream of the PDLs with the procedure used for the two priority PDLs (PDL-H8 and PDL-H10) described herein. Due to the relatively small dimensions of the channels for both PDLs, 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 dilutions at any time of the year are 0.4 and 10 downstream of PDL-H8 is and PDL-H10 respectively as previously shown in Table 3.8 (Section 3.2.3).

Based on the estimated volumetric dilution, an estimate of the concentration of POCs based on a mass balance approach (BC MECCS 2019) was developed for all PDLs. Table 3.13 and Table 3.14 present the PDL outlet (end-of-pipe) concentration and typical background conditions in the Arnold Slough (PDL-H8) and Sumas River (PDL-H10) and the concentration once full mixing has occurred, using three POCs as examples.

Table 3.13 Relevant Concentrations Estimate Downstream of PDL-H8 for Example Parameters of Concern

Example Parameters of Concern	**Concentration Estimates for PDL-H8**		
	DQC End-of-Pipe Concentration (mg/L)	**95P Background Surface Water Concentration (mg/L)**	**Mixed Concentration (mg/L)**
Nitrate (as N)	3.11*	3.11	3.11
Iron (D)	6.10*	6.10	6.10
Nickel (D)	0.0129*	0.0129	0.0129

Notes:

95 = 95th percentile; PDL = proposed discharge location; WQG-FAL = Water Quality Guidelines for the Protection of Freshwater Aquatic Life; DQC = 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

Table 3.14 Relevant Concentration Estimates Downstream of PDL-H10 for Example Parameters of Concern

Example Parameters of Concern	**Concentration Estimates for PDL-H10**		
	DQCs End-of-Pipe Concentration (mg/L)	**95P Background Surface Water Concentration (mg/L)**	**Mixed Concentration (mg/L)**
Nitrate (as N)	3.00	2.37	2.243
Iron (D)	0.350	0.310	0.314
Nickel (D)	0.0149*	0.0149	0.0149

Notes:

95P = 95th 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

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 PDL-H1, PDL-H2, PDL-H3, PDL-H7, and PDL-H10 in the Huntington Loop discharge rates will be no more than 10% of the estimated mean monthly flow of each PDL. For Arnold Slough (PDL-H8) and Sumas Lake Canal (PDL-H9A, PDL-H9B), discharge rates will be no more than 10% of the estimated mean monthly flow of each PDL during higher flood season. During irrigation season, discharge rates in Arnold Slough and Sumas Lake Canal will be up to 250% and 100% of the estimated mean monthly flow of each PDL, respectively. 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. Though the discharge rates at Arnold Slough and Sumas Lake Canal are proposed to be high during irrigation season, these watercourses are relatively large (S2 and S1B, respectively) irrigation canals and a decrease or stoppage of water discharge is not expected to cause stranding due to their channel morphology (e.g., sloping banks) and width. 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 3.15. 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 3.15 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.
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.

3.5.2.1 Considerations for Painted Turtle Critical Habitat

As described in Section 2.5.2.2, PDL-H9A and PDL-H10 are within federally designated critical habitat polygons for painted turtle and were assessed as having six and eight of the nine biophysical attributes of painted turtle critical habitat, respectively. However, both PDLs are more than 2 km from the painted turtle population units around which the critical habitat was defined; no painted turtles were found during the species-specific surveys completed at PDL-H9A and PDL-H10 in April 2025; and there are no publicly available turtle records for Sumas Prairie (see Section 2.5.2.2).

Based on the federal recovery strategy for painted turtle (Pacific coast population) (ECCC 2021), considerations for painted turtle critical habitat mitigation are to:

- Maintain the presence of critical habitat biophysical attributes within the waterbody, including:
    - Presence of emergent vegetation, floating vegetation and vegetative mats
    - Bottom substrates of organic material such as decaying vegetation and detritus, partially organic silt or sand, mud
    - Submerged or emergent logs or large woody debris; rocks
    - Warm shallow water margins
- Maintain the presence of critical habitat biophysical attributes along the adjacent terrestrial habitat, including:
    - Areas with exposed soil and little to no vegetation (e.g., beaches, shoreline, sandy/loamy riparian edges or banks, natural islands, rocky bluffs, canopy gaps in forested habitats), where features include either of the following attributes:
        - Flat or gently sloping ground (no pooling water)
        - Sand, gravel, or silt substrates; low organic content

With these considerations, the following mitigation measures will be implemented where relevant:

- Ensure the temperature of the discharge water is consistent with the existing water temperature of the waterbody
- Ensure the discharge rate is slow enough to prevent change to water levels or flow in the waterbody, or scouring within the waterbody
- Ensure the discharge hose output is placed to avoid disturbing floating/emergent vegetation and vegetative mats, and away from submerged/emergent logs or woody debris
- Avoid disturbing the bottom substrate of the waterbody and causing turbidity
- Ensure the discharge hose and discharge structures are placed to minimally disturb the adjacent terrestrial habitat, and avoid any areas with exposed soil and little to no vegetation
- A qualified Resource Specialist should be engaged to identify site-specific habitat features in the waterbody and in the adjacent terrestrial habitat that should be avoided

- Minimize disturbance to the banks and riparian area while accessing the waterbody
- Ensure the discharge hosing are in good condition with no leaks, to avoid associated pooling water in the adjacent terrestrial habitat

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

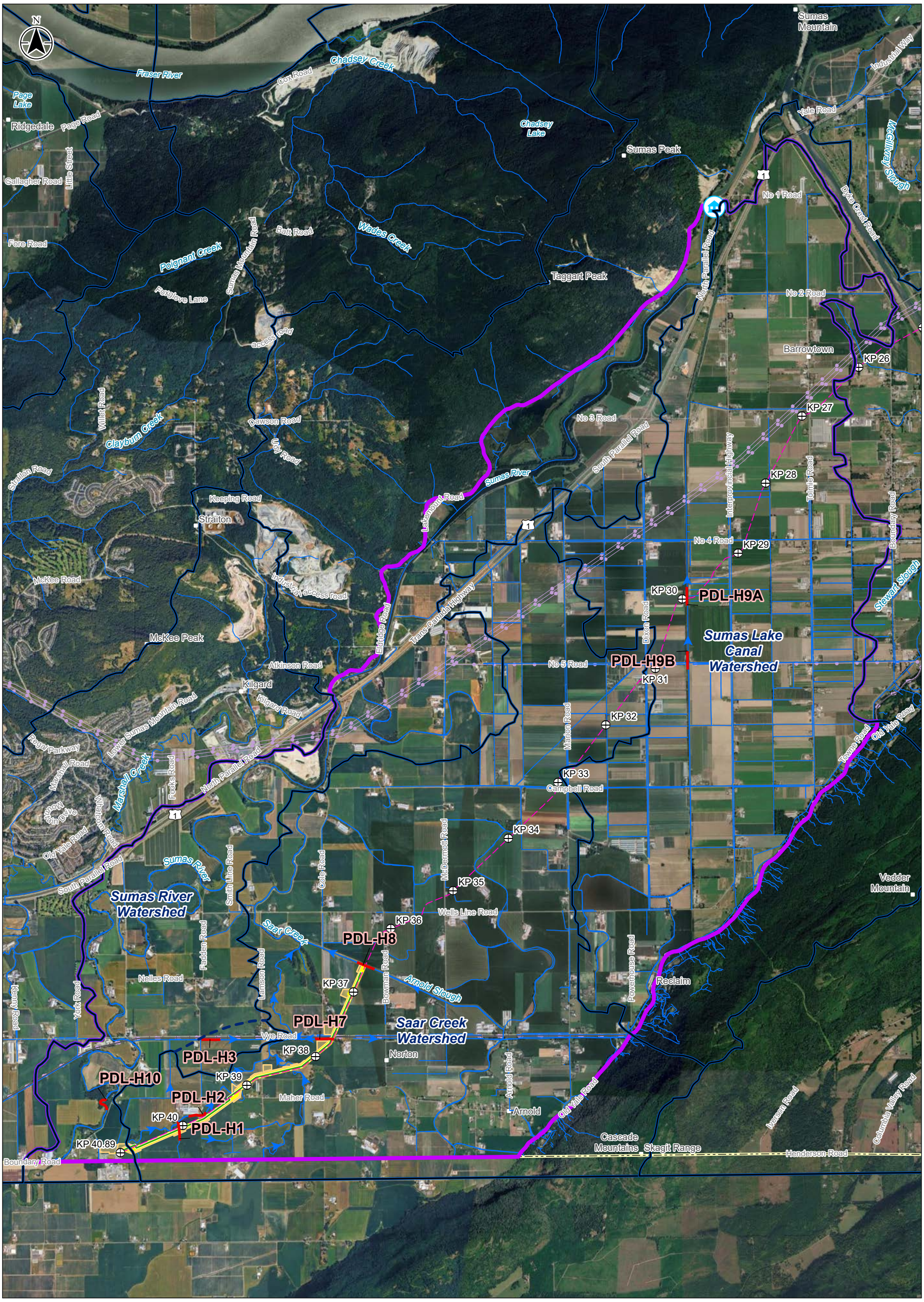
The aquatic wildlife presence has been assessed for the receiving environment for each PDL (see Section 2.5.2.2 for more details). If wildlife species at risk, site-specific habitat, or a wildlife habitat feature is discovered before or during construction activities, the discovery will be assessed to 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:

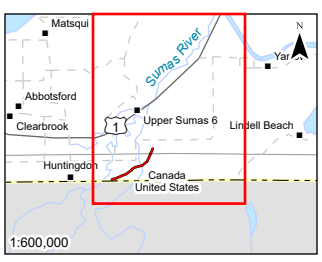
- location of the wildlife or habitat feature relative to Project activities
- type, scope, and timing of Project activities
- surrounding habitat type, quality, and presence of existing buffers or barriers
- the species and habitat feature type, life stage, sensitivity, legal protections, best management 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).





International Border
Railway
Transmission Line
Flow Direction
Watercourse

Kilometer Post
Existing Pipeline
Proposed Pipeline
Proposed Right of Way
Proposed Workspace

Barrowtown Pump Station
PDL Buffer (~250 m)
Assessment Area

Freshwater Atlas Assessment Watershed
Field Verified Watershed Boundary

0 500 1,000 1,500 2,000 m
1:50,000 (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
Abbotsford, BC
NTS 50K Grid: 092G01

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

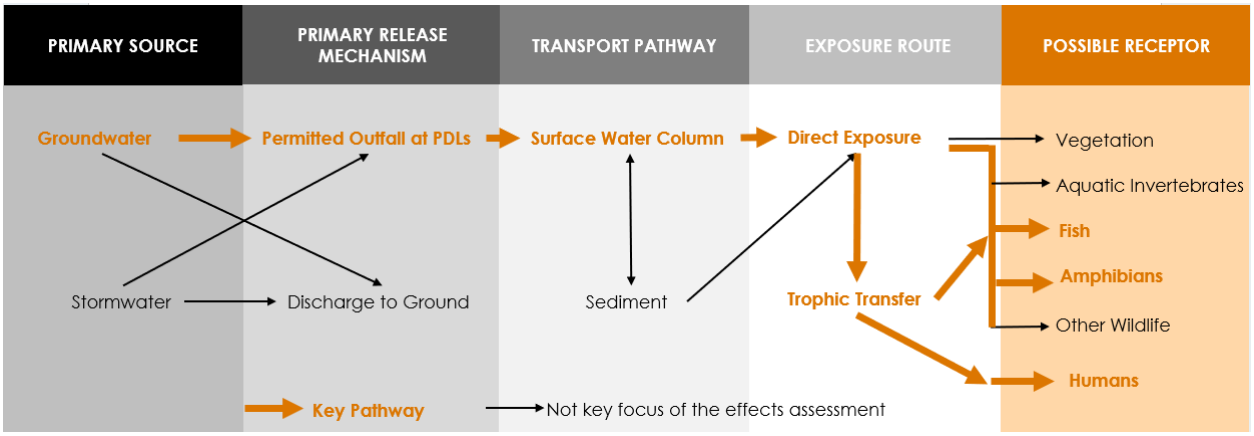
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\can0183-pbag\f01\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 Huntingdon 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 or pumps 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.

Eight PDLs are being considered along the Huntingdon Loop. Two of these, PDL-H8 (Arnold Slough) and PDL-H10 (Sumas River), can each accommodate large discharge volumes (Section 3.2.2) and are currently proposed as the primary and secondary discharge locations, respectively. The remaining PDLs (PDL-H1, PDL-H2, PDL-H3, and PDL-H7), which consist of irrigation ditches and small drainage features (unnamed tributaries to Saar Creek) have more limited receiving capacity and would, therefore, be used as a contingency or in combination with other sites for low-volume discharges. Sumas Lake Canal (PDL-H9A and PDL-H9B) is also considered a contingency because water would need to be piped a greater distance from the pipeline to discharge at this location.

As indicated in Section 3.2.2, the maximum increase in discharge will be limited to 10% of average monthly flows within each PDL. These discharge rates are 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. However, this approach is not proposed for PDL-H8 (Arnold Slough), and PDL-H9A and H9B (Sumas Lake Canal), as these waterbodies are capable of handling higher discharge rates through the year.

The receiving environment at PDL-H8 is a manmade channel that is used as an irrigation canal in dry months and as a surface runoff drainage channel in wet months, with limited aquatic habitat complexity. Further, the Sumas River gates at Barrowtown Pump Station are shut almost every year during the Fraser River spring freshet, resulting in stagnant water in Arnold Slough, which is upstream of the pump station. Since the receiving environment is managed as an irrigation canal during the irrigation season, a discharge rate comparable to the average monthly flow for this location is considered acceptable as the channel will be effectively working as a stagnant water body with storage available for the additional volume (see Section 3.2.3 for more details). The Project-related increased flows into Arnold Slough would be less noticeable farther downstream in areas that provide fish habitat, where flows from Saar Creek and Sumas River join the flows from Arnold Slough (Figure 4.1).

At PDL-H9A and H9B, the Sumas Lake Canal is managed as an irrigation canal with surface water retained as much as possible in the canal for irrigation support during the spring and summer months. Following Westcoast's communications with the City of Abbotsford, it is also understood that the maximum discharge rate of 284 L/s could be received in the canal during the irrigation season, and no negative effect is anticipated as the canal will be effectively working as a standing water body with extensive storage available to accommodate the additional volume.

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:

6. 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.
7. 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.
8. 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 Huntingdon Loop PDLs (e.g., agronomic grasses, black cottonwood [*Populus trichocarpa*], paper birch [*Betula papyrifera*], red-osier dogwood [*Cornus sericea*], and Himalayan blackberry [*Rubus armeniacus*]; see Table 2.20) 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 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 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.

[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).

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

For the Huntingdon Loop PDLs, amphibians are considered a key receptor 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 Huntingdon Loop PDL receiving environments are Pacific treefrog, northern red-legged frog, and northwestern salamander, but long-toed salamander and rough-skinned newt may also be present (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, long-toed salamander, and rough-skinned newt at low elevation in the Pacific Northwest (i.e., comparable to the Huntingdon Loop PDLs' receiving environments) are January to September (per BC MFLNRO 2014b, 2016).

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, salamander larvae) (TRU and BC MOE 2021b; AmphibiaWeb 2020; AmphibiaWeb 2025; CHS 2025a, 2025b, 2025c).

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

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).

As described in Section 2.5.2.2, PDL-H9A and PDL-H10 are within federally designated critical habitat polygons for painted turtle and were assessed as having six and eight of the nine biophysical attributes of painted turtle critical habitat, respectively. However, both PDLs are more than 2 km from the painted turtle population units around which the critical habitat was defined; no painted turtles were found during the species-specific surveys completed at PDL-H9A and PDL-H10 in April 2025; and there are no publicly available turtle records for Sumas Prairie (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 may consume fish taken in proximity to the Huntingdon Loop PDLs, most likely from the larger watercourses; recreational fish catches have been documented in Sumas River (PDL-H10) and Arnold Slough (PDL-H8) (Fish Brain n.d.; FishingAngler n.d.). 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 Huntingdon Loop. However, water quality changes to drinking water 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 Huntingdon Loop. 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 many 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 baseline characterization, POC screening, and development of DQCs are presented in Sections 2 and 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-H1, PDL-H2, PDL-H3, PDL-H7 (unnamed tributaries to Saar Creek) – approximately 250 m PDL buffer extent, plus the Saar Creek watershed from the United States border to where it discharges into Sumas River (Figure 4.1)
- PDL-H8 (Arnold Slough) – approximately 250 m PDL buffer extent, plus the Saar Creek watershed and Sumas River watershed from the United States border to Barrowtown Pump Station within lower elevations of the watersheds (Figure 4.1)
- PDL-H9A, PDL-H9B (Sumas Lake Canal) – approximately 250 m PDL buffer extent, plus the lower elevation sections of the Sumas Lake Canal watershed to Barrowtown Pump Station (Figure 4.1)
- PDL-H10 (Sumas River) – approximately 250 m PDL buffer extent, plus the lower elevation sections of the Sumas River watershed from the United States border to Barrowtown Pump Station (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 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 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 DQC 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.

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.

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 during the anticipated discharge period. As discussed in Section 3.3.2.2, statistically significant seasonal differences were identified for dissolved cobalt and dissolved iron at Arnold Slough, and for nitrate, total aluminum, chromium, total iron, dissolved copper, and dissolved nickel in the Sumas River, with concentrations during the anticipated discharge period (April–October) lower than those observed during the rest of the year (November–March; Appendix N). Accordingly, background surface water quality for these POCs is conservatively characterized using discharge-period upper-bound (95P) concentrations, which provide representative benchmarks for evaluating potential Project-related effects during periods most likely to be associated with active discharge.

4.2.1.3 Initial Dilution Zone Assessment

An IDZ-based assessment was not completed for PDLs within the Huntingdon Loop. Proposed discharges in the Huntingdon Loop occur to small, low-order watercourses and managed drainage features (e.g., Saar Creek, Sumas Lake Canal, and associated tributaries). These receiving environments have relatively limited flow, constrained channel geometry, and, in some cases, regulated or managed hydrology, resulting in minimal and spatially restricted mixing potential (Section 2.2).

As such, DQCs for Huntingdon Loop PDLs were developed without assuming dilution at the point of discharge rather than relying on an IDZ-based mixing assessment (Section 3.2 presents the development of the DQCs). This approach is conservative and consistent with BC ENV guidance, which indicates that IDZs are generally applicable to large, high-energy receiving waters where rapid and substantial mixing can be demonstrated (BC MECCS 2019).

Given the nature of the Huntingdon Loop receiving environments and the conservative basis used to develop DQC, the application of an IDZ was not considered appropriate or necessary for the Huntingdon 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 Saar Creek Watershed (Section 4.2.2.1) and the Sumas River Watershed (Section 4.2.2.2). Neither receiving environment includes an IDZ; therefore, potential effects in the receiving environment are evaluated at the point of discharge based on DQC, without assuming dilution (Section 4.2.1.3).

4.2.2.1 Saar Creek Watershed

For the various PDLs within Saar Creek watershed (i.e., PDL-H1, PDL-H2, PDL-H3, PDL-H7, PDL-H8), 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 (see Section 3.3 which presents the development of the DQCs). This approach provides a conservative basis for effects characterization in the absence of an applicable IDZ.

For parameters with proposed DQCs derived from long-term aquatic life water quality guidelines, including fluoride, total arsenic, total beryllium, and total selenium, 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 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 the Saar Creek watershed for these parameters.

For the remaining parameters of concern, including nitrate (as N), total aluminum, total chromium, total iron, total mercury, dissolved cobalt, dissolved copper, dissolved iron, dissolved manganese, and dissolved nickel, the applicable DQCs are derived from the upper range of observed background surface water quality (95th percentile) in Arnold Slough (PDL-H8) (see Section 3.3.1.1 and Table 3.11). For these parameters, effects are characterized relative to existing ambient conditions rather than guideline thresholds. Statistically significant seasonal differences were identified for dissolved cobalt and dissolved iron, with lower background concentrations during the anticipated discharge period (April–October); this seasonal pattern is retained in the 95P background concentration used for the effects assessment. Overall, Project-related discharges are not anticipated to extend beyond the range represented by background conditions in Saar Creek watershed, and Project-related effects to surface water quality or aquatic receptors are not anticipated for these parameters.

Table 4.2 summarizes the proposed DQCs for the Saar Creek watershed, corresponding background surface water quality (95P) in Arnold Slough, applicable aquatic life water quality guidelines, and contextual ratios illustrating the relative magnitude of DQCs compared to guideline values and existing conditions.

Table 4.2 Comparison of Proposed Discharge Quality Criteria to Guidelines and Background Conditions: Saar Creek Watershed

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)		
Fluoride	0.259	0.12	0.12	1.28	0.102	[DQC] = [Chronic WQG-FAL]
Nitrate (as N)	4.15	3.11	3	32.8	3.11	[DQC] = [Background]
Aluminum (T)	1.14	1.04	0.198	-	1.04	[DQC] = [Background]
Arsenic (T)	0.0086	0.005	0.005	-	0.00284	[DQC] = [Chronic WQG-FAL]
Beryllium (T)	0.00017	0.00013	0.00013	-	0.0001	[DQC] = [Chronic WQG-FAL]
Chromium (T)	0.00289	0.00282	0.0025	-	0.00282	[DQC] = [Background]
Iron (T)	23.6	15.1	0.3	1	15.1	[DQC] = [Background]
Mercury (T)	1.25×10^{-5}	4.88×10^{-6}	1.25×10^{-6}	-	4.88×10^{-6}	[DQC] = [Background]
Selenium (T)	0.00212	0.002	0.002	-	0.000333	[DQC] = [Chronic WQG-FAL]
Cobalt (D)	0.00477	0.000766	0.00053	-	0.000766 [b]	[DQC] = [Background]
Copper (D)	0.00852	0.00389	0.0008	0.0012	0.00389	[DQC] = [Background]
Iron (D)	23.2	5.92	-	0.35	5.92 b	[DQC] = [Background]
Manganese (D)	1.1	0.924	0.55	-	0.924	[DQC] = [Background]
Nickel (D)	0.0839	0.0129	0.002	0.0276	0.0129	[DQC] = [Background]

Notes:

[a] Untreated discharge will be treated to meet DQCs prior to discharge (Section 3.1.8)

[b] 95P background concentrations are based on April–October data due to statistically significant seasonal differences relative to November–March); values are based on Arnold Slough as a proxy as discussed in Section 3.3.1.1.

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 the Saar Creek watershed 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 (15.1 mg/L), derived from existing background surface water quality, exceeds the drinking-water aesthetic objective (0.3 mg/L) and the wildlife, livestock watering, and irrigation guidelines (each 5 mg/L); because the DQCs represents 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 Saar Creek watershed 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.

4.2.2.2 Sumas River Watershed

For the PDLs in the Sumas River/Sumas Lake Canal watershed (i.e., PDL-H10, PDL-H9A, PDL-H9B), potential effects to surface water quality are evaluated at the point of discharge using an end-of-pipe DQC framework, without assuming dilution in the receiving environment (see Section 3.3 which presents the development of the DQCs).

For parameters with proposed DQCs derived from long-term aquatic life water quality guidelines, including fluoride, total arsenic, total beryllium, total selenium, dissolved cobalt, dissolved iron, and dissolved manganese, 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 DQCs; accordingly, Project-related discharges are not anticipated to result in adverse effects to surface water quality or aquatic receptors in the Sumas River watershed for these parameters.

For the remaining parameters of concern, including nitrate (as N), total aluminum, total chromium, total iron, total mercury, dissolved cobalt, dissolved copper, dissolved iron, dissolved manganese, and dissolved nickel, the applicable DQCs are derived from the upper range of observed background surface water quality (95th percentile) in the Sumas River. For these parameters, effects are characterized relative to existing ambient conditions rather than guideline thresholds. Statistically significant seasonal differences were identified for this group of parameters, except total mercury, with background concentrations during the anticipated discharge period (April–October) lower than those observed during the non-discharge period. Overall, 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.

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 the Sumas River watershed, 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 Comparison of Proposed Discharge Quality Criteria to Guidelines and Background Conditions: Sumas River Watershed

Parameter of Concern	95P Untreated Wastewater (mg/L)[a]	DQC; End-of-Pipe Discharge 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)		
Fluoride	0.259	0.12	0.12	1.19	0.0606	[DQC] = [Chronic WQG-FAL]
Nitrate (as N)	4.15	3.11	3	32.8	3.11 [b]	[DQC] = [Background]
Aluminum (T)	1.14	0.835	0.194	-	0.835 [b]	[DQC] = [Background]
Arsenic (T)	0.0086	0.005	0.005	-	0.00155	[DQC] = [Chronic WQG-FAL]
Beryllium (T)	0.00017	0.00013	0.00013	-	0.00002	[DQC] = [Chronic WQG-FAL]
Chromium (T)	0.00289	0.0148	0.0025	-	0.0148 [b]	[DQC] = [Background]
Iron (T)	23.6	2.75	0.3	1	2.75 [b]	[DQC] = [Background]
Mercury (T)	1.25×10^{-5}	5.94×10^{-6}	1.25×10^{-6}	-	5.94×10^{-6}	[DQC] = [Background]
Selenium (T)	0.00212	0.002	0.002	-	0.00028	[DQC] = [Chronic WQG-FAL]
Cobalt (D)	0.00477	0.00057	0.00057	-	0.000442 [b]	[DQC] = [Chronic WQG-FAL]
Copper (D)	0.00852	0.00287	0.000975	0.0031	0.00287 [b]	[DQC] = [Background]
Iron (D)	23.2	0.35	-	0.35	0.302 [b]	[DQC] = [Chronic WQG-FAL]
Manganese (D)	1.1	0.57	0.57	-	0.123 [b]	[DQC] = [Chronic WQG-FAL]
Nickel (D)	0.0839	0.0181	0.0024	0.0305	0.0181 [b]	[DQC] = [Background]

Notes:

[a] Untreated discharge will be treated to meet DQCs at end-of-pipe (Section 3.1.8).

[b] 95P background concentrations are based on Sumas River April–October data due to statistically significant seasonal differences relative to November–March.

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 the Sumas 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 DQCs (2.75 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 the Sumas River watershed 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]). Accordingly, the potential for Project-related mercury and selenium bioaccumulation is considered for the Saar Creek and Sumas River watersheds.

In these watersheds, mercury is evaluated using DQCs derived from background surface water quality, while selenium is evaluated relative to the long-term WQG-FAL. Under the assessed discharge conditions, effluent concentrations of mercury and selenium are not anticipated to exceed the applicable background- or guideline-based DQCs and remain comparable to existing surface water quality conditions.

Given that Project-related discharges are not expected to increase mercury or selenium concentrations beyond existing background variability (for mercury) or the long-term aquatic life guideline (for selenium), Project-related changes to exposure conditions at the base of the aquatic food web are not anticipated. Accordingly, Project-related increases in the potential for mercury or selenium bioaccumulation or biomagnification in aquatic receptors are not anticipated for the Saar Creek or Sumas River watersheds.

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 >5 mg/L for the Huntingdon loop. This criterion is consistent with existing background variability and 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 at the point of discharge (where an IDZ is not defined). 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

For the PDLs in the Saar Creek and Sumas River watersheds, IDZs were 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 the Saar Creek and Sumas River watersheds are expected to occur intermittently during periods of active discharge. Seasonal differences in ambient surface water quality between the anticipated discharge period (April–October) and the rest of the year (November–March) were identified for certain parameters in the Saar Creek watershed and for most parameters in the Sumas River watershed. To address this seasonality within an end-of-pipe assessment framework, background-based DQCs were derived using ambient concentrations representative of the anticipated discharge period, providing a conservative basis for characterizing potential effects.

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 the Saar Creek and Sumas River watersheds. 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 episodic nature of 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 are expected to be reversible following cessation of discharge. Residual effects to surface water quality are not anticipated in the Saar Creek and Sumas River watersheds under the assessed discharge assumptions.

Overall, potential Project-related effects 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 Saar Creek and Sumas River (i.e., fish, amphibians, or humans via trophic transfer).

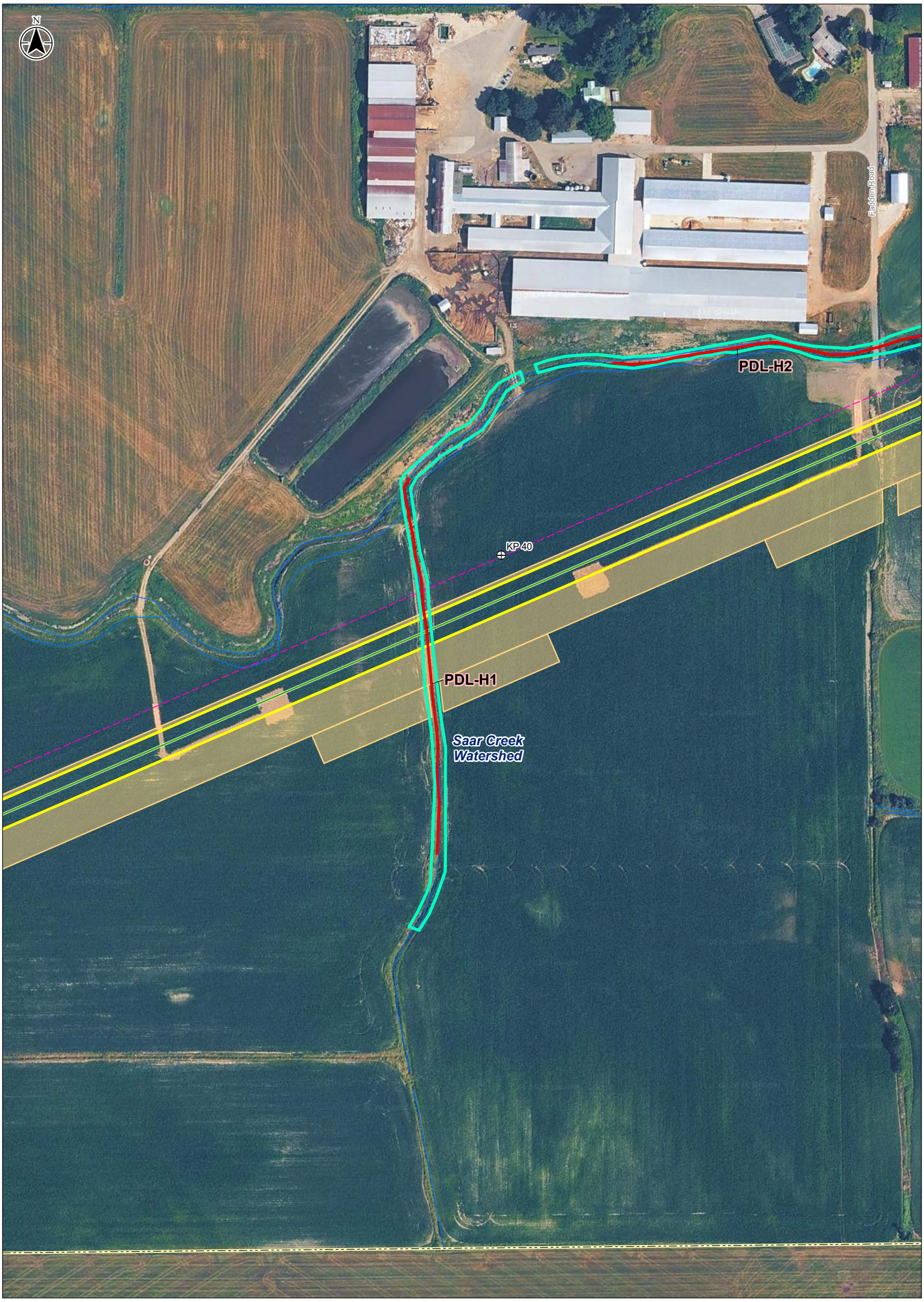
Consistent with the residual effects assessment approach described in Section 4.2.1.6, a project-specific risk management matrix was not developed for the Saar Creek watershed and Sumas River.

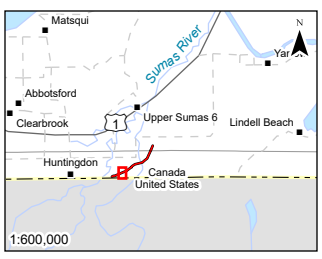
5 Monitoring Plans

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 watershed. 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). Although maximum discharge rates requested for the Section 15 Approval are defined in Table 5.1, actual monthly discharge rates vary for some PDLs by month as shown in Table 5.2.





- International Border
- Watercourse
- Kilometer Post
- Existing Pipeline
- Proposed Pipeline
- Proposed Right of Way
- Proposed Workspace
- PDL Buffer (~250 m)
- Approximate Monitoring Location

0 25 50 75 100 m

1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

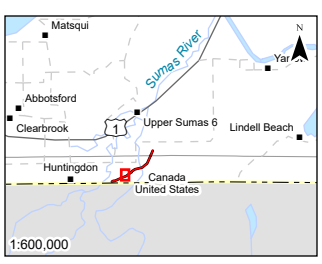
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H1

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316804\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



Flow Direction
Watercourse
Kilometer Post
Existing Pipeline
Proposed Pipeline
Proposed Right of Way
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

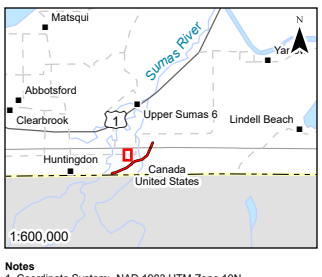
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H2

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316804\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



Railway
Transmission Line
Flow Direction
Watercourse
Proposed Right of Way
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

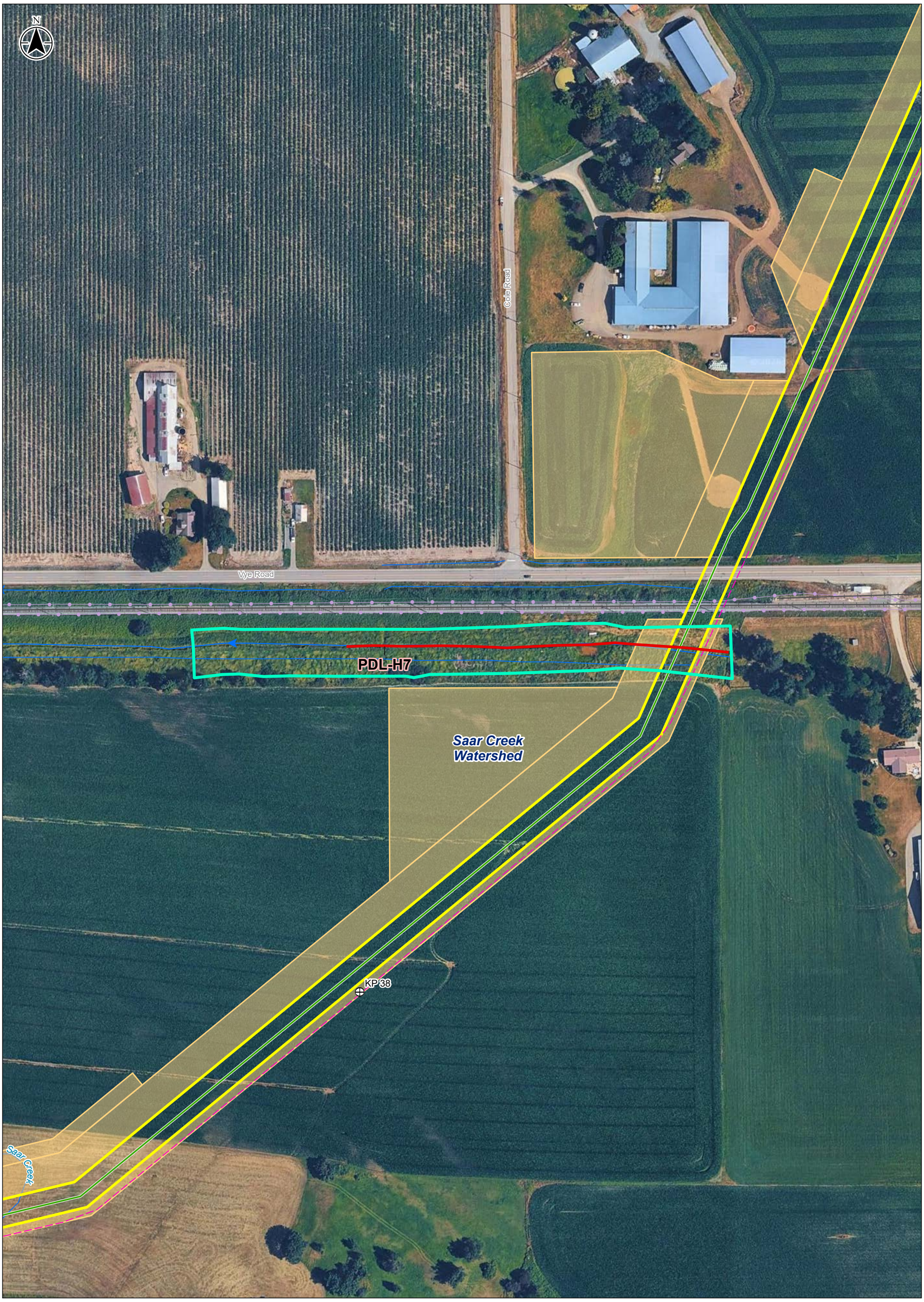
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

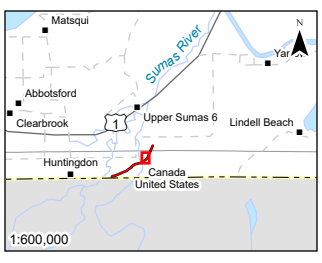
Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H3

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316894\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher





Railway
Transmission Line
Flow Direction
Watercourse

Kilometer Post
Existing Pipeline
Proposed Pipeline
Proposed Right of Way
Proposed Workspace

PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

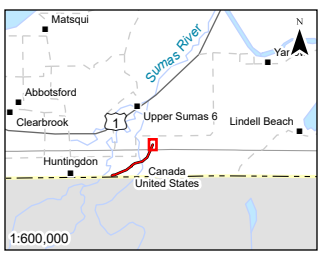
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H7

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\12323\projects\123316894\(gures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



Watercourse
Kilometer Post
Existing Pipeline
Proposed Pipeline
Proposed Right of Way
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

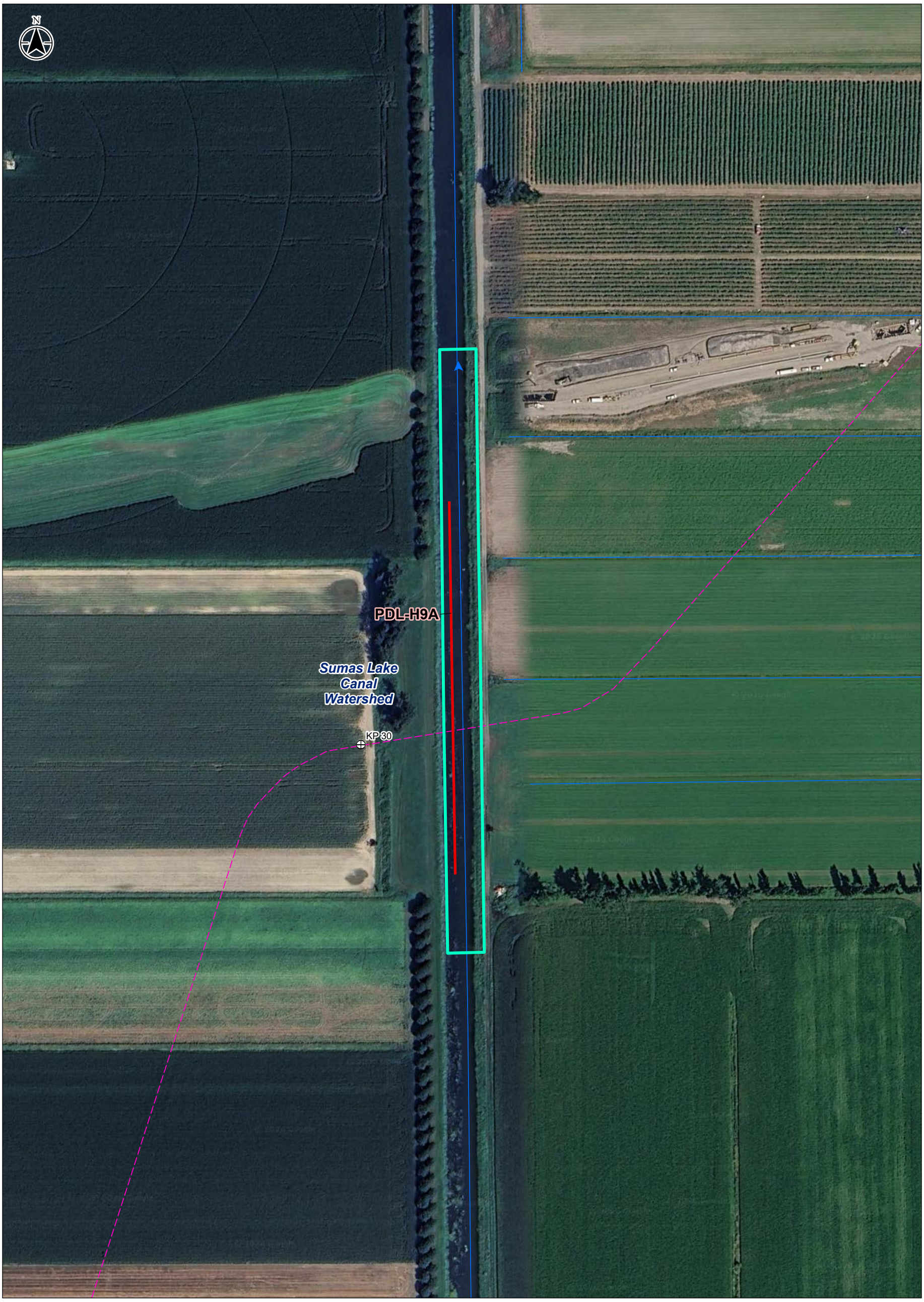
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

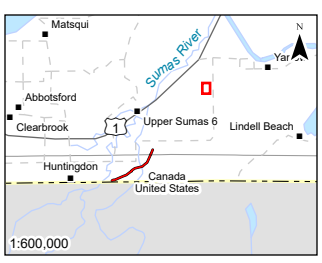
Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H8

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316694\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher





Flow Direction
Watercourse
Kilometer Post
Existing Pipeline
Proposed Right of Way
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

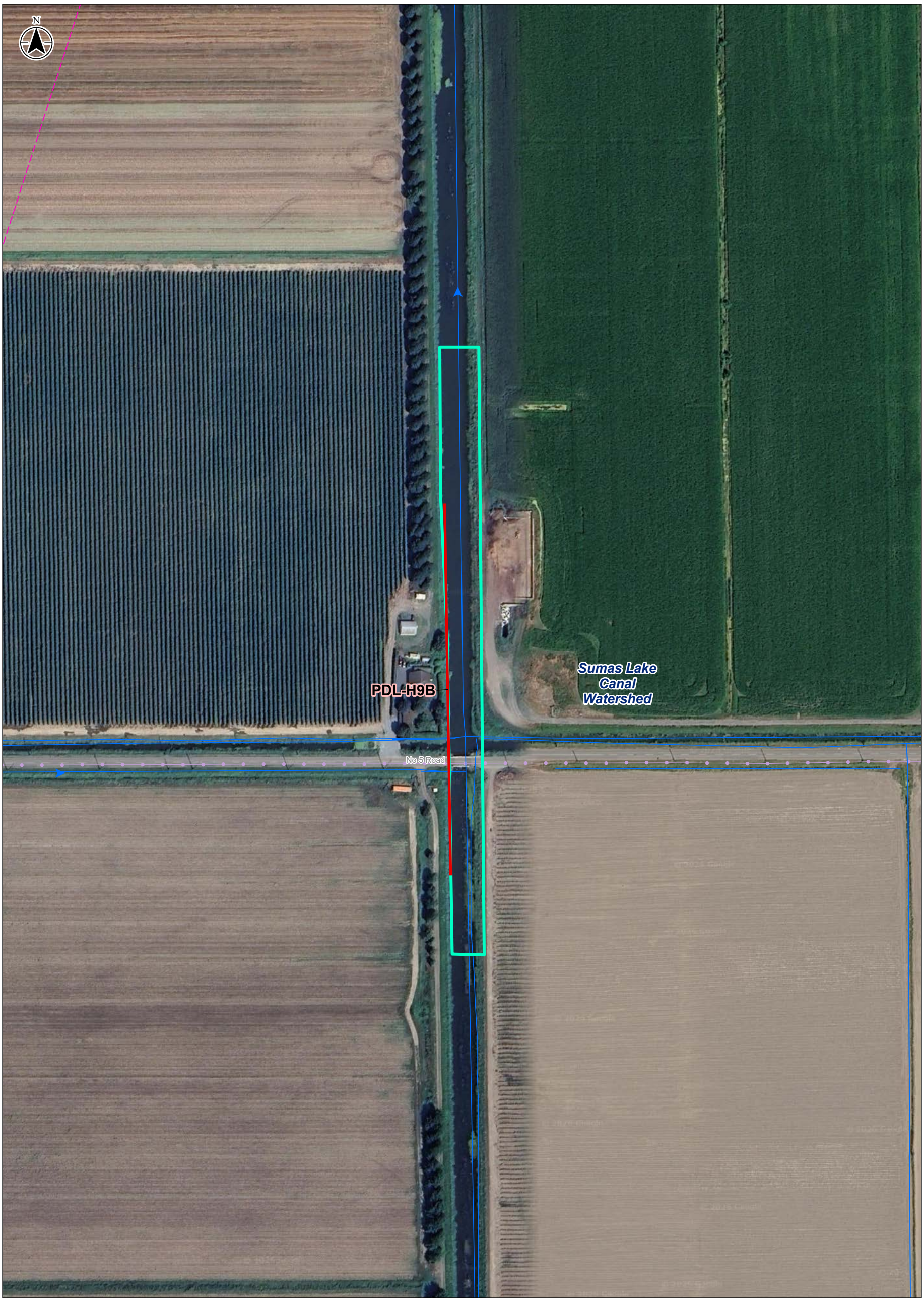
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

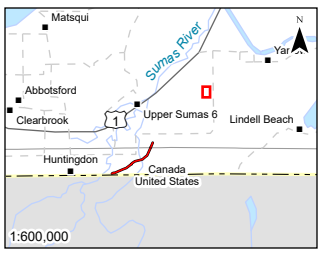
Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H9A

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316894\figure\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher





Transmission Line
Flow Direction
Watercourse
Existing Pipeline
Proposed Right of Way
Proposed Workspace
PDL Buffer (~250 m)
Approximate Monitoring Location

0 25 50 75 100 m
1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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

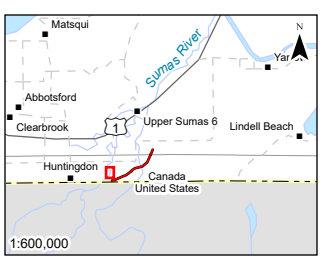
Client/Project/Report
Westcoast Pipeline
Sunrise Expansion Project
Technical Assessment Report

Figure No.
5.1

Title
Approximate Surface Water Monitoring Locations - PDL-H9B

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\12322\projects\123316894\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher



Watercourse

Proposed Right of Way

Proposed Workspace

PDL Buffer (~250 m)

Approximate Monitoring Location

0 25 50 75 100 m

1:2,500 (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

Stantec

Project Location
Abbotsford, BC
NTS 50K Grid: 092G01

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-H10

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

\\CA0183-PBAGF01\Workgroup\1232\projects\123316894\figures\reports\TAR\watersheds\fig_123317055_sep_tar_watersheds.aprx Revised: 2026-04-28 By: jpoucher

Table 5.1 Summary of Proposed Discharge Limit for Flow, General Construction Parameters, and Identified Parameters of Concern Corresponding Proposed Discharge Quality Criteria by Watershed (Proposed Discharge Location)

Parameter (Units)	**Proposed Discharge Limit**	
	Saar Creek Watershed (PDL-H1, PDL-H2, PDL-H3, PDL-H7, PDL-H8)	**Sumas River Watershed (PDL-H9A, PDL-H9B, PDL-H10)**
Maximum Discharge Rate (m^3/s)*	PDL-H1, PDL-H2, PDL-H3, PDL-H7 – 0.005 PDL-H8 – 0.284	0.284
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)	> 5	> 5
Fluoride (mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Nitrate (as N; mg/L)	3.11	Chronic WQG-FAL
Aluminum (T; mg/L)	1.04	0.397
Arsenic (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Beryllium (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Chromium (T; mg/L)	0.00282	0.0069
Iron (T; mg/L)	15.1	2.2
Mercury (T; mg/L)	0.00000488	0.00000594
Selenium (T; mg/L)	Chronic WQG-FAL	Chronic WQG-FAL
Cobalt (D; mg/L)	0.000721	Chronic WQG-FAL
Copper (D; mg/L)	0.00389	0.00222
Iron (D; mg/L)	6.1	Acute WQG-FAL
Manganese (D; mg/L)	0.924	Chronic WQG-FAL
Nickel (D; mg/L)	0.0129	0.0149

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.

* This is the maximum discharge rate requested for the Section 15 Approval; however, actual proposed monthly discharge rates vary by month for some PDLs as shown in Table 5.2

Table 5.2 Monthly Proposed Discharge Rates the Huntingdon Loop Proposed Discharge Locations

PDL		Monthly Proposed Discharge Rate (m^3/s)											
Number	**Watercourse**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
PDL-H1	Unnamed	0.005											
PDL-H2	Unnamed	0.005											
PDL-H3	Unnamed	0.005											
PDL-H7	Unnamed	0.005											
PDL-H8	Arnold Slough	0.013					0.284					0.013	
PDL-H9A	Sumas Lake Canal	0.010				0.050	0.284			0.050	0.010		
PDL-H9B	Sumas Lake Canal	0.010				0.050	0.284			0.050	0.010		
PDL-H10	Sumas River	0.284				0.189	0.050					0.284	

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 5.2.

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 5.3 outlines the monitoring parameters, sampling methods, and monitoring frequency. Monitoring will only be required during active dewatering and discharging periods.

Table 5.3 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

Proposed daily end of pipe field-measured parameters will include turbidity, conductivity, pH, temperature, and visible sheen (Table 5.3). The field measurements will be taken using handheld meters or sondes (i.e., automated data loggers). 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 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.

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 5.4. 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 5.4 *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 ENV 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	Varies by PDL and month see Table 5.2	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	>5 mg/L	6 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	5.5 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	5.2 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, Chilliwack, British Columbia. Geological Survey of Canada, Map 1487A, 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). 2019. Technical Guidance 11. Development and Use of Initial Dilution Zones in Effluent Discharge Authorizations. Version 1.0.

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 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. Species Information: Western Long-toed Salamander. Available at: https://www.canadianherpetology.ca/species/species_page.html?cname=Western%20Long-toed%20Salamander. Accessed December 2025.

CHS. 2025c. 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 Abbotsford. 2025. WebMap Application. Available at: https://www.abbotsford.ca/city-services/mapping-data-analytics/webmap. Accessed December 2025

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 New Westminster. 2016. Erosion and Sediment Control Bylaw No. 7754, 2016. Available at: https://www.newwestcity.ca/database/files/library/7754ESC.pdf. Accessed February 2026.

City of Port Moody. 2023. City of Port Moody Stream and Drainage Bylaw, 2023 No. 3426. Available at: https://api.ghdcdn.com/portmoody-edocs/v1/eDocs/Get?docnumber=624408. 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. 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 (Fisheries and Oceans Canada). 1999. Lower Fraser River Valley Streams Strategic Review. Fraser River Action Plan. Vancouver, 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.

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. 2022. Recovery Strategy for the Barn Owl *(Tyto alba*), Western Population, in Canada. *Species at Risk Act* Recovery Strategy Series. Environment and Climate Change Canada, Ottawa, ON. 2 parts, 24 pp. + 30 pp.

ECCC. 2024. 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. 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.

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://fraserstурgeon.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.

Fish Brain. n.d. Arnold Slough Fishing Reports. Available at: https://fishbrain.com/fishing-waters/9teg9DBJ/arnold-slough. Accessed December 2025.

FishingAngler. n.d. Fishing in Sumas River. Available at: https://www.fishangler.com/fishing-waters/ca/british-columbia/sumas-river/28212629. Accessed December 2025.

Forstner, T., T. Gleeson, L. Borrett, D.M. Allen, M. Wei, and A. Baye. 2018. Mapping Aquifer Stress, Groundwater Recharge, Groundwater Use, and the Contribution of Groundwater to Environment Flows for Unconfined Aquifers across British Columbia. Water Science Series, WSS2018-04. Province of British Columbia, Victoria, BC.

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. 2016. LidarBC LiDAR-derived Digital Elevation Model, LiDAR DEM Index 1:20,000. LidarBC Open LiDAR Data Portal. Available at: https://lidar.gov.bc.ca/. Accessed April 2026.

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 21 Fact Sheet. Available at https://s3.ca-central-1.amazonaws.com/aquifer-docs/00000/AQ_00021_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.

Hammond, Z. 2012. Aquifer 21 Mapping Report. Available at https://s3.ca-central-1.amazonaws.com/aquifer-docs/00000/AQ_00021_Aquifer_Mapping_Report.pdf. Accessed September 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-9–Huntingdon 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://fraserstурgeon.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

McTavish (McTavish Resource & Management Consultants Ltd). 2023. 2023 Enbridge Lower Mainland Depth of Cover Groundwater Sampling Results for the Arensdale-Tolsma Site (No. 231127).

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.

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

Scibek, J., and D.M. Allen. 2006. Comparing modelled responses of two high-permeability, unconfined aquifers to predicted climate change. Global and Planetary Change 50: 50–62.

Seequent. 2024. Leapfrog Works Version 2024.1. Seequent, The Bentley Subsurface Company.

SNC-Lavalin (SNC-Lavalin Environment). 2012. Huntingdon Meter Station drilling program borehole logs, K-tests, and groundwater quality data. Provided by client.

Stantec (Stantec Consulting Ltd.). 2024. Technical Memorandum – Enbridge SEP Preliminary Hydrogeology Desktop Assessment. Draft report prepared for Westcoast Energy Inc. May 13, 2024.

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.

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.