

1 **7 VALUED COMPONENTS EFFECTS ASSESSMENT**

2 **7.4 Surface Water**

3 As specified in Section 5.0 of the Application Information Requirements (**AIR**), Surface Water has been
4 identified as a valued component (**VC**) to be assessed for the Project. This section describes and assesses
5 the potential effects on Surface Water, including surface water quality and surface water quantity, from
6 the Project during all Project phases.

7 This assessment is linked to other VC assessments, either through integration of information from other
8 VCs into this assessment, or information from this assessment is incorporated into the assessment of
9 other VCs.

10 Components of this assessment integrate information from, or are integrated into the following VCs:

- 11 • Air Quality (Section 7.02) – provided sulphur and nitrogen deposition information which was used
12 in the acidification and eutrophication assessment
- 13 • Groundwater (Section 7.05) – informed by and provided information for the assessment for
14 groundwater interactions
- 15 • Vegetation and Wetlands (Section 7.06) – informed by the assessment of potential effects on
16 surface water quantity as they relate to effects on drainage and soil moisture and changed in
17 vegetation species composition
- 18 • Wildlife and Wildlife Habitat (Section 7.07) – informed by the assessment of the location of
19 freshwater waterbodies that may provide wildlife habitat
- 20 • Freshwater Fish and Fish Habitat (Section 7.08) – informed by the assessment of potential effects
21 on surface water quality and quantity as they relate to freshwater fish and fish habitat
- 22 • Marine Resources (Section 7.09) – provided information on the boundaries of higher high water
23 mean tide line to delineate the freshwater and marine interface
- 24 • Human Health (Section 7.14) – informed by information on surface water quality
- 25 • Summary of Biophysical Factors that Support Ecosystem Function (Section 20.0) – informed by
26 the assessment of potential effects on Surface Water that support ecosystem function

27 Information provided in this section is also used to inform the Indigenous assessments, Sections 11.0
28 to 19.0.

1 **7.4.1 Overview**

2 This section provides a brief summary of the Surface Water VC assessment.

3 From a surface water perspective, the Project is expected to interact with Site preparation and clearing,
4 construction of land-based infrastructure, natural gas pre-treatment, liquefaction, and storage, and
5 temporary on-Site power generation. The Project has the potential to result in the following effects on
6 surface water:

- 7 • Change in the chemical and physical composition of surface water
- 8 • Change in surface water flow

9 In assessing the potential effects of the Project on surface water, existing conditions within the Project
10 local assessment area (**LAA**) and regional assessment area (**RAA**) were considered. Primary and secondary
11 data indicates that:

- 12 • Watercourses in the LAA have acidic to neutral pH, low turbidity, and typically low conductivity
- 13 • Of the two lakes and three streams sampled for the acidification assessment, one lake (LK-02) has
14 a low buffering capacity and is sensitive to potential acid inputs/acidic
- 15 • Of the two lakes and three streams sampled for the eutrophication assessment, all are
16 oligotrophic
- 17 • All watercourses are classified as small streams (based on mean annual discharge)

18 To reduce or avoid adverse residual effects, the following have been identified as key mitigation measures:

- 19 • Develop and implement erosion prevention and sediment control measures using industry
20 standard management practices
- 21 • Develop and implement a Trigger Action Response Plan (**TARP**) for water and sediment control
22 management
- 23 • Planning and design will avoid impacts to identified watercourses, wetlands and riparian areas
24 within the proposed terrestrial Project footprint to the extent possible

25 In addition, power from British Columbia Power and Hydro Authority (**BC Hydro**) will ultimately be used
26 for the Project, rather than on-Site power generation, which will reduce the potential for acid and nitrogen
27 deposition.

28 With the implementation of the key mitigation measures identified above and development of a
29 construction environmental management plan (**CEMP**), adverse residual effects include an increase in
30 total suspended solids, turbidity, and specific conductance during construction, and an increase of sulphur
31 and nitrogen deposition during operation. These adverse residual effects on surface water quality are low
32 magnitude and reversible. The risk and uncertainty are low. During construction, water withdrawals may
33 reduce the quantity of water available. Adverse residual effects of surface water quantity are low in
34 magnitude and reversible. The risk and uncertainty are low.

1 The Westcoast Connector Gas Transmission Project (Enbridge Nasoga Compressor Station) has the
2 potential to interact cumulatively with the Project’s adverse residual effects on surface water, including
3 an increase of sulphur and nitrogen deposition due to industrial emissions. Overall, the risk to surface
4 water quality is low. The uncertainty related to this assessment is low. Residual effects will not interact
5 cumulatively with other projects. The TARP will use on-Site hydrometric monitoring data to define
6 appropriate withdrawals. Requirements for monitoring of total suspended solids and/or turbidity in
7 watercourses is expected. An acidification and eutrophication monitoring program is required.

8 **7.4.2 Relevant Statutes, Policies and Frameworks**

9 The management of Surface Water is subject to several statutes, policies, and frameworks. These are
10 identified in Section 7.4.1 of the AIR and in Section 6.1. A list of the key legislation, policies and regulatory
11 guidance documents applicable to the assessment of Surface Water is provided in Table 7.4–1, followed
12 by additional policy, and regulatory guidance applicable to the management of Surface Water.

Table 7.4–1 – Summary of Key Legislation, Policy, and Regulatory Guidance Documents for Surface Water

Regulation or Policy	Description
Federal	
<i>Fisheries Act</i>	Fisheries and Oceans Canada (DFO) administers section 34.4(1) of the <i>Fisheries Act</i> , which prohibits the death of fish by means other than fishing, and section 35(1), which prohibits the harmful alteration, disruption, or destruction of fish habitat. Project-related works, undertakings, or activities that would result in death to fish or harmful alteration, disruption, or destruction of fish habitat require an authorization under paragraph 34.4(2)(b) and paragraph 35(2)(b), respectively. Environment and Climate Change Canada (ECCC) administers section 36 of the <i>Fisheries Act</i> , which prohibits the unauthorized deposition of deleterious substance(s) into waters frequented by fish.
Provincial	
<i>Water Sustainability Act</i> and regulations	Changes in and about a stream may be made only with an approval under section 11 of the <i>Water Sustainability Act</i> and section 4 of the Water Sustainability Regulation, or through a notification, where applicable. Under the <i>Water Sustainability Act</i> , “changes in and about a stream” means “any modification to the nature of the stream, including any modification of the land, vegetation and natural environment of a stream or the flow of water in a stream, or any activity or construction within a stream channel that has or may have an impact on a stream or stream channel”. Section 10 of the <i>Water Sustainability Act</i> allows proponents to divert, store, and use surface water or groundwater for up to 24 months if approved by the British Columbia Energy Regulator (BCER). Section 9 of the <i>Water Sustainability Act</i> allows for the issuance of a licence authorizing the diversion or use of water by an owner.

Table 7.4–1 – Summary of Key Legislation, Policy, and Regulatory Guidance Documents for Surface Water

Regulation or Policy	Description
<i>Environmental Management Act</i>	The <i>Environmental Management Act</i> is administered by the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) and governs the discharge of waste to the air, terrestrial, and aquatic environments, such as air contaminants, effluent, litter, refuse, and hazardous waste. The <i>Environmental Management Act</i> prohibits discharge of pollution as defined under the Act. Permits issued under the <i>Environmental Management Act</i> authorize the quality and quantity of waste discharged to the environment.
<i>BC Environmental Flow Needs Policy</i>	The <i>BC Environmental Flow Needs Policy</i> (British Columbia Ministry of Forests, Lands, Natural Resource Operations and Rural Development [BC FLNRORD] and BC ENV 2022) describes the recommended procedure for evaluating the likelihood that water withdrawals would affect the environmental flow needs of the watercourse the water is being withdrawn from. Environmental flow needs are defined as the volume and timing of water flow required for the proper function of the aquatic ecosystem of the watercourse. Section 15 of the <i>Water Sustainability Act</i> requires the decision maker consider the environmental flow needs of a stream when deciding on an application for a water authorization.

- 1
- 2 Other policies, frameworks, and guidelines considered in this assessment are:
- 3
- 4 • British Columbia (**BC**) working and approved Water Quality Guidelines (BC ENV 2021a, 2023b)
 - 5 • BC Water Quality Guidelines are generic guidelines used to identify potential adverse effects.
 - 6 They have been developed for aquatic life, wildlife, drinking water, recreation, and irrigation
 - 7 water uses. This assessment uses BC Water Quality Guidelines for the protection of
 - 8 freshwater aquatic life (**WQG-FAL**), the most sensitive receptor for most of the parameters
 - 9 • Canadian Council of Ministers of the Environment (**CCME**) water quality guidelines for the
 - 10 protection of aquatic life (CCME WQG-FAL; CCME 2022)
 - 11 • These generic guidelines developed by the CCME have not been formally approved in BC. They
 - 12 have been used to inform characterization of the existing environment but are not included
 - 13 in the effects assessment
 - 14 • *Air Emissions Impact Assessment for Liquefied Natural Gas Export Terminal Facilities: Guidance for*
 - 15 *the Assessment of Acidification and Eutrophication of Aquatic Ecosystems* (British Columbia
 - 16 Ministry of Environment [**BC MOE**] 2015)
 - 17 • This document provides guidance how to assess potential impacts of acid deposition
 - 18 (acidification) and nitrogen deposition (eutrophication) on aquatic ecosystem health from
 - 19 air emissions related to liquefied natural gas (**LNG**) export terminal facilities. The guidance
 - 20 recommends analyzing surface water chemistry, describing anion composition, and predicting
 - aquatic critical loads exceedances to assess potential impacts

- 1 • *Environmental Flow Needs Policy* (BC FLNRORD and BC ENV 2022)
- 2 • *Manual of Standard Operation Procedures for Hydrometric Surveys in British Columbia*
- 3 (Resources Information Standards Committee [RISC] 2018)

4 **7.4.3 The Influence of Consultation and Engagement**

5 The development of the AIR and this assessment was influenced by consultation with Technical Advisors,
6 Indigenous groups, and the public. This section describes information and concerns related to
7 Surface Water shared through consultation with government agencies, stakeholders, Indigenous nations,
8 and community members.

9 A summary of the topics, key information, including Indigenous knowledge, and concerns that the
10 Proponent identified as part of its consultation and engagement efforts that relate to Surface Water, as
11 well as a summary of the influence that the outcomes of this consultation and engagement had on the
12 assessment, is provided in Table 7.4–2.

13 **7.4.3.1 Indigenous Knowledge**

14 Indigenous knowledge and land use has been included in the assessment when made available by
15 Indigenous nations through consultation, information gathering, and voluntary information sharing.

16 Sections 11.0 to 19.0 of this Application provide information regarding the alignment of the use of
17 knowledge shared by Indigenous nations with each nation’s respective policies and protocols, consent for
18 its use and public disclosure, and views regarding the characterization of Indigenous knowledge within
19 this section of the Application. Sections 11.0 to 19.0 also describe, as applicable, if no feedback regarding
20 the use, public disclosure, or characterization of Indigenous knowledge was provided by an Indigenous
21 nation. In this case and as applicable, the Application has considered publicly available information and
22 non-confidential outcomes of Project consultation activities to date.

23 Refer to Section 6.0 for detailed methods regarding the incorporation of Indigenous knowledge into the
24 Application.

25

Table 7.4–2 – Summary of Key Information, Indigenous Knowledge and Concerns for the Project Related to Surface Water

Topic	Key Information and Concerns	Influence on the Assessment
Surface Water Quality	<ul style="list-style-type: none"> ▪ Kitselas First Nation, and Kitsumkalum First Nation, and Gitxaala Nation identified concerns related to surface water quality ▪ Kitselas First Nation expressed concern for acidification and eutrophication of waterbodies ▪ Gitxaala Nation expressed concern for changes in the physical and chemical composition of surface water ▪ Nisga'a Social, Economic, Resource Use, and Cultural survey respondents expressed concerns around impacts of water pollution affecting waters, and fishing grounds, hunting grounds and disrupting sea life ▪ Gitxaala Nation expressed concerns about water and sediment quality. 	<ul style="list-style-type: none"> ▪ Project effects on surface water quality are assessed as part of the Surface Water VC and is described in Section 7.4.9.1. ▪ An acidification and eutrophication assessment was completed as part of the assessment of Project effects on surface water quality ▪ Management of solid and hazardous wastes during the construction and operation phases of the Project is described in Section 1.9.5.1. Where possible, non-hazardous wastes will be recycled or reused. Where reuse is not possible, waste will be stored at the Site and then shipped for disposal at a local landfill, other approved waste disposal facility, or a recycling facility in compliance with applicable legal requirements. No other means for waste management have been considered for the Project. Management of wastewater during the construction and operation phases of the Project is described in Section 1.9.5.2.
Surface Water Quantity	<ul style="list-style-type: none"> ▪ Nisga'a Nation identified concern relating to quantity of potable water and access ▪ Gitxaala Nation expressed concern for changes in surface water quantity 	<ul style="list-style-type: none"> ▪ Project effects on surface water quantity were assessed as part of the Surface Water VC and is described in Section 7.4.9.2.

1 7.4.4 Assessment Boundaries

2 The spatial, temporal, administrative, and technical boundaries for the assessment of effects on
3 Surface Water are described below.

4 7.4.4.1 Spatial Boundaries

5 Spatial boundaries for the assessment of potential effects to Surface Water considered the geographic
6 extent over which Project activities may affect freshwater surface water quantity and/or quality. These
7 boundaries are shown in Figure 7.4–1, Figure 7.4–2, Figure 7.4–3 and Figure 7.4–4. Due to differences in
8 the spatial extent of potential effects associated with land-based infrastructure and Project-related air
9 emissions, the following spatial boundaries have been defined:

10 The **Project footprint** is the physical footprint for the Project (i.e., the areal extent of planned terrestrial
11 clearing and marine infrastructure development at the Project Site [**Site**]). The Project footprint has been
12 defined conservatively to encompass the maximum extent, including both permanent and temporary
13 clearing and/or structures, for Project development for both land-based and marine-based Project
14 infrastructure and activities (see Figure 1.4 in Section 1.0). The initial assessment of impacts to Surface
15 Water from the road corridor to the overburden area was based on a 40-metre clearing area/corridor.
16 This assessment was conservative, as the actual clearing for this road is expected to be approximately 8 m
17 wide. Based on further planning related to the identification of fisheries offset options, it was
18 acknowledged that more flexibility with respect to the road corridor may be needed to allow for avoidance
19 of key environmental features (i.e., wetland and intertidal riparian area). As such, a variable width road
20 corridor has been identified (see Figure 7.4–1) within which the access road will be located. The width of
21 this amended corridor is 40 m for much of the proposed route (in line with what was originally presented)
22 and wider (up to approximately 160 m) in areas of greater uncertainty in final routing and where
23 avoidance of key environmental features may be required. The use of a corridor-based approach will allow
24 for greater flexibility for road placement so that design can be adjusted to address environmental,
25 engineering, geotechnical, Indigenous nation and other routing considerations. Overall, the effects of the
26 road corridor are expected to be much smaller than the initial assessment indicates, and the amended
27 corridor allows for route refinement for prioritizing considerations during final routing. The amended
28 corridor does not result in a change to the potential or residual effects presented for Surface Water as
29 they relate to the road corridor to the overburden area.

- 30
- For the potential effects associated with land-based infrastructure:
 - 31 • The **Surface Water LAA** corresponds to District Lot boundaries 5431 and 7235 (Figure 7.4–1).
32 The LAA encompasses the area within which Project potential effects on surface water quality
33 and quantity can be measured and would be of potential concern.
 - 34 • The **Surface Water RAA** includes the entirety of the watersheds intersected by the Site
35 (Figure 7.4–2). This RAA encompasses potential interactions with other past, present, or
36 future activities or projects that may affect surface water in the same watersheds that Project-
37 specific interactions with surface water may occur.

- 1 • For potential effects associated with Project-related air emissions:
- 2 • The **Surface Water Acidification and Eutrophication Study Area (AESA)** is the 40 kilometre
- 3 **(km)** by 40 km Air Quality Facility LAA defined in Section 7.02 (Figure 7.4–3). Although the
- 4 screening thresholds established by BC MOE (2015) use the larger area of the 100 equivalents
- 5 per hectare per year (**eq/ha/y**) sulphur (**S**) + nitrogen (**N**) isopleth deposition area or the
- 6 3 kilograms per hectare per year (**kg/ha/y**) N isopleth deposition area, the 100 eq/ha/y S+N
- 7 isopleth (the larger of the two isopleths) extends beyond the 40 km by 40 km deposition
- 8 model domain, so the Air Quality Facility LAA was used to define the AESA.
- 9 • The Surface Water Acidification and Eutrophication Assessment Area is the same as the AESA.
- 10 They are collectively referred to as the AESA.
- 11 • For the potential effects associated with the third-party transmission line:
- 12 • The transmission line assessment area (**TLAA**) has been defined as a broad area between the
- 13 Site and Nisga'a lands (as defined under the Nisga'a Treaty) within which a third-party
- 14 transmission line will be developed (Figure 7.4–4). The TLAA is defined to encompass the likely
- 15 scenarios for the transmission line, including necessary rights-of-way and associated
- 16 infrastructure. The portion of the transmission line within the TLAA will tie into to a
- 17 transmission line that will be developed on Nisga'a Lands, connecting to the BC Hydro grid.

18 As per Table 6.4-1 (Section 6.0) the Open Water Assessment Area is not applicable for this VC.

19 **7.4.4.2 Temporal Boundaries**

20 Temporal boundaries identify when an environmental effect is evaluated in relation to specific Project

21 phases and activities. Temporal boundaries are based on the timing and duration of Project activities and

22 the nature of the interactions with Surface Water.

23 Based on the current Project schedule, the temporal boundaries for the assessment are:

- 24 • **Construction:** approximately three to four years, commencing following receipt of necessary
- 25 regulatory approvals and the final investment decision for the Project
- 26 • **Operation:** a minimum of 30 years following completion of construction
- 27 • **Decommissioning:** approximately 12 months following the end of operation

28 **7.4.4.3 Administrative Boundaries**

29 Administrative boundaries describe limitations imposed on a project assessment by political, economic,

30 or social constraints. No specific administrative boundaries for Surface Water were identified.

31 **7.4.4.4 Technical Boundaries**

32 Technical boundaries describe limitations in information, data analyses, and data interpretation.

33 The following technical boundaries were defined for the Surface Water assessment:

- 34 • Baseline data was collected in 2021 and 2022 within specific areas of the LAA and in 2022 within
- 35 the AESA

- 1 • Project construction and design parameters – the Surface Water assessment has been prepared
2 based on the understanding of the preferred construction methods and project design at the time
3 of filing. However, detailed engineering studies are ongoing. Results of these studies may change
4 or refine the construction methods and/or project design during permitting, prior to construction
- 5 • BC MOE developed guidance for conducting acidification and eutrophication assessments in
6 surface waters (BC MOE 2015). The methods for conducting acidification and eutrophication
7 assessments followed the guidance with some changed according to Project-specific information,
8 or current best practices. The methods used included the following:
- 9 • Air quality modelling procedures met BC ENV guidance (see the *Technical Data Report –*
10 *Air Quality* [Appendix 7.02A: Stantec 2023a] for more details)
- 11 • S+N deposition was predicted to be 110 eq/ha/y throughout the deposition model domain in
12 the Baseline Case, which is greater than the 100 eq/ha/y S+N deposition isopleth
13 recommended by BC MOE to define the AESA. Therefore, the 40 km by 40 km deposition
14 model domain was used to define the AESA
- 15 • Interim air quality deposition model 100 eq/ha/y-1 S+N deposition isopleth results for the
16 Project-alone Case (On-Site Power Generation) were used to determine sampling locations,
17 as the final air quality deposition model had not been completed at the time of sampling
- 18 • Review of publicly available orthophotos and baseline data indicated there are no lakes within
19 the interim modeled 100 eq/ha/y acid deposition isopleth study area for the
20 Project-alone Case (On-Site Power Generation) (i.e., the Project-alone Case with higher
21 S+N deposition) and that mapped standing waters within this acid deposition isopleth are
22 wetlands or beaver impoundment areas. As a result, the two lakes nearest to the isopleth
23 were used in the assessment. Three streams were also selected for assessment. Based on
24 feedback from BC Ministry of Environment and Climate Change Strategy (BC ENV;
25 Gauthier 2022, pers. comms.), the Project used a higher ratio of streams to lakes in the
26 assessment than recommended in the BC MOE guidance (2015). This reflected the types of
27 waterbodies present in the AESA
- 28 • Methods for calculating watershed area and average annual runoff were based on the data
29 currently available using the Northwest Water Tool (**NWWT**) (BC FLNRORD and
30 Foundry Spatial 2022)
- 31 • The acidification assessment used the Steady-State Water Chemistry (**SSWC**) model described
32 in Henriksen *et al.* (1995), Henriksen and Posch (2001), and Henriksen *et al.* (2002) to estimate
33 critical loads of acidity (**CL_(A)**) and potential critical load exceedances in the identified lakes
34 and streams using water chemistry data
- 35 • An acid neutralizing capacity limit (**ANC_{limit}**) of 40 microequivalents per litre (**µeq/L**) was used
- 36 • Empirical critical loads were used to assess potential for eutrophication. Water quality data
37 were used to predict the trophic status of the lakes and streams for each modelling scenario

- 1 • Assessment of surface water values in the TLAA outside of areas that overlapped the LAA was
2 conducted through desktop review only. No fieldwork was completed in the TLAA.

3 **7.4.5 Existing Conditions**

4 This section summarizes the data sources and existing conditions for Surface Water in the
5 Project footprint, the LAA, the RAA, the AESA, and the TLAA.

6 **7.4.5.1 Methods**

7 Data and information sources used to characterize existing conditions were gathered through a review of
8 traditional knowledge and traditional use information, relevant literature, and field studies conducted
9 specifically for the Project.

10 Review of existing surface water quality data is broken into two parts: data reviewed in relation to the
11 LAA, RAA, and TLAA, and data reviewed for the AESA.

12 7.4.5.1.1 Surface Water Quality Public Data

13 7.4.5.1.1.1 LAA, RAA, and TLAA

14 Publicly available literature and data were reviewed for surface water quality information for
15 watercourses within the LAA, RAA, and TLAA. The Freshwater Atlas on Habitat Wizard (BC ENV 2023a) was
16 used to identify watercourses and waterbodies within these areas. Watercourses within the LAA were
17 classified into stream riparian classes according to the Environmental Protection and
18 Management Regulation (**EPMR**) based on data collected during field assessments for the Freshwater Fish
19 and Fish Habitat VC (see the *Freshwater Fish and Fish Habitat Technical Data Report* in Appendix 7.08A;
20 Stantec 2023b). The Ecological Reports Catalog (BC ENV 2022) and the Surface Water Quality Monitoring
21 Sites Interactive Map (Government of British Columbia 2023) were reviewed to determine if historical
22 data for surface water quality was present within the LAA, RAA, and TLAA. The NWWT (BC FLNRORD and
23 Foundry Spatial 2022) and Indigenous knowledge were used to determine if there were water use
24 licences, permits, or drinking water sources within the LAA, RAA, or TLAA.

25 7.4.5.1.1.2 AESA

26 The same methods as described in Section 7.4.5.1.1.1 were used to identify watercourses and
27 historical water quality information within the AESA. In addition, the NWWT (BC FLNRORD and
28 Foundry Spatial 2022) was used for the following information:

- 29 • Surface water allocations (i.e., water use and licences) used for drinking water within this AESA to
30 inform the selection of waterbodies for field sampling locations for the acidification and
31 eutrophication assessment
- 32 • Watershed area and mean annual discharge (**MAD**; cubic metres [m^3] per second) information for
33 waterbodies that were part of the acidification and eutrophication assessment

1 The MAD was converted to m^3 per year and then normalized (i.e., divided) by catchment area
2 (square metres [m^2]) to calculate the average annual catchment runoff (Q ; m/y). These average annual
3 catchment runoff values were used along with catchment area of the sites to calculate annual loads for
4 waterbodies sampled in the AESA for the acidification and eutrophication assessment.

5 7.4.5.1.2 Surface Water Quantity

6 Publicly available literature and data were reviewed for surface water quantity for information relating to
7 watercourses within the Surface Water LAA, RAA, and TLAA. The NWWT was used to retrieve monthly
8 average discharge, potential and existing allocations, information on watershed area, hypsometry and
9 physiography, and climate change projections (BC FLNRORD and Foundry Spatial 2022). Please refer to
10 the Surface Water Quantity Technical Data Report (**TDR**) for a more detailed description of methodologies
11 (Appendix 7.4).

12 7.4.5.1.3 Surface Water Quality Field Studies

13 Surface water quality field studies were conducted in both the LAA and the AESA and are described below.

14 7.4.5.1.3.1 Surface Water LAA

15 In situ water quality data in the LAA was collected in conjunction with the fish and fish habitat field surveys
16 conducted in June, August/September, and October 2021 and in April 2022; hydrology surveys conducted
17 in March and May 2022; and acidification and eutrophication surveys conducted in June and
18 September/October 2022. Water temperature, pH, dissolved oxygen (**DO**) concentration, specific
19 conductivity, and turbidity were measured in watercourses within the Surface Water LAA using
20 multiparameter meters. Where turbidity was not assessed with the turbidity meter in June 2021, it was
21 visually assessed as clear, brown/yellow, green/algae, cloudy, milky, or plume. In situ water quality data
22 was compared to the BC WQG-FAL (BC ENV 2021a, 2023b). Additional details on in situ water quality
23 sampling methods can be found in the *Freshwater Fish and Fish Habitat Technical Data Report* (Appendix
24 7.08A; Stantec 2023b).

25 7.4.5.1.3.2 Surface Water AESA

26 The *Guidance for the Assessment of Acidification and Eutrophication of Aquatic Ecosystems*
27 (BC MOE 2015) was used as a basis to plan the acidification and eutrophication field studies and
28 subsequent assessment. A workplan and study design was developed and reviewed by BC ENV based on
29 this guidance and BC ENV feedback was incorporated into the workplan and field studies. Selection of the
30 sampling sites for the field assessment focused on watercourses predicted to be within the Project-related
31 S+N 100 $\text{eq}/\text{ha}/\text{y}$ deposition isopleth. Selection of the sampling sites for the field assessment included the
32 following considerations:

- 33 • Lakes and streams representative of the AESA
- 34 • Lakes and streams with known fish and/or recreational values
- 35 • Lakes in potentially acid sensitive regions

36 Site selection also incorporated BC ENV guidance on the study design (Gauthier 2022, pers. comm.).

1 The criterion of selecting surface waterbodies used for drinking water was not applicable. No surface
2 waterbodies within the AESA used as a primary source of drinking water were identified based on a review
3 of the BC Water Portal (BC FLNRORD and BC OGC 2022), NWWT (BC FLNRORD and Foundry Spatial 2022),
4 and information provided by the Nisga'a Lisims Government Lands Manager on water sources for the
5 four Nisga'a villages in the region (Cassidy 2021, pers. comm.). The Gingolx River is used as an emergency
6 water supply for Gingolx (Cassidy 2021, pers. comm.). However, it is outside the area that has
7 Project-related S+N deposition greater than 100 eq/ha/y.

8 The number of surface water quality sampling sites included in the assessment was proportional to the
9 modeled sulphur dioxide (**SO₂**) and nitrogen oxide (**NO_x**) emissions at maximum build-out (BC MOE 2015).
10 The maximum combined SO₂ plus NO_x emissions from the Project is 3.59 tonnes (t)/day and occur as a
11 result of the on-Site power generation option (Project-alone Case (On-Site Power Generation)). This
12 emission rate is derived from Table 10 in Appendix 7.02A (Air Quality TDR), by adding total SO₂ and total
13 NO_x, then converting to tonnes/day. Using this worst-case emissions value and following BC MOE
14 guidance of proportionate sampling (i.e., 1 lake per 1 tonnes/day of S+N emissions and 1 stream per
15 4 tonnes/day of S+N emissions), water chemistry was sampled from five waterbodies for the purposes of
16 the assessment.

17 Potential waterbodies for sampling were identified using Freshwater Atlas information, fish observation
18 information, and aerial imagery in Habitat Wizard (BC ENV 2023a). There are no lakes within the area
19 where Project-related S+N depositions are predicted to be greater than 100 eq/ha/y. Mapped standing
20 waterbodies within this area are wetlands or beaver impoundment areas, based on inspection of publicly
21 available aerial imagery and baseline data. Therefore, two lakes and three streams within or in close
22 vicinity to the area where Project-related S+N depositions were greater than 100 eq/ha/y, within the AESA
23 were identified for surface water sampling (Table 7.4–3). This approach was suggested by BC ENV
24 (Gauthier 2022, pers. comm.).

25

Table 7.4–3 – Acidification and Eutrophication Assessment Surface Water Sampling Locations

Site ID	Watercourse Name	Waterbody Type	Watershed Code ^a	Lake Area (ha)	Catchment Area (km ²) ^c	UTM (Zone 9 N)	
						Easting	Northing
LK -01	Unnamed	Lake	910-971200	6.26	0.74	430199	6100418
LK-02	Unnamed	Lake	910-971500-71400	1.52	0.10	429636	6105496
STR-01	Dogfish Creek	Stream	910-971500	N/A	21.09	426989	6101430
STR-02 ^b	Unnamed	Stream	915-896000-55400	N/A	0.75	423984	6098260
STR-03 ^b	Unnamed	Stream	915-896000-52800	N/A	9.19	423005	6098167

NOTES:

N/A = not applicable

^a Habitat Wizard (BC ENV 2023a)^b STR-02 is the same watercourse as WC-02 and STR-03 is the same watercourse as WC-09 in Section 7.08 and in the *Fish and Fish Habitat Technical Data Report* (Stantec 2023b). Different naming conventions were used for naming the watercourses in the different assessments.^c Catchment area is defined as the drainage area upstream of the sampling site and determined from the NWWT reports (BC MOF and Foundry Spatial 2022). For lake sites, catchment areas were estimated at the lake outflows using the Freshwater Atlas Watershed layer and geographic information system (GIS) analysis.

1
2 Surface water sampling for the acidification and eutrophication assessment was completed in June and
3 September/October 2022 from the lake and stream sampling sites. The June sampling period was selected
4 to occur in the spring after winter storms, snow melt, and potential spring circulation (lake turnover). The
5 September/October sampling period was selected to occur in the fall when water temperature drops,
6 leading to turnover and maximum nutrient concentrations in the lakes, to facilitate stable conditions. A
7 single lake water chemistry sample collected in the fall has been found to be representative of average
8 annual water chemistry for sites with long-term data sets (Henriksen and Posh 2001). Hence, a $CL_{(A)}$
9 calculated using a single water chemistry sample collected in the fall can be considered representative of
10 a waterbody $CL_{(A)}$.

11 LK-01 has an area greater than 6.0 hectares (**ha**) and was sampled in three locations (inlet, outlet, and
12 middle) while the remaining lake and streams were sampled in one location. Sampling was completed a
13 wadable distance from shore at all lake locations in June and from a boat in October. In October, LK-01
14 samples were collected by boat from just below the surface and one metre from the bottom at the
15 deepest point using a Van Dorn water sampler. Stream samples were collected from just below the surface
16 while facing upstream.

17 In situ parameters (conductivity, DO, turbidity, and pH) were measured using a YSI water quality
18 multimeter. Dissolved metal and dissolved organic carbon (**DOC**) samples were filtered in the field using
19 a sterile syringe with a 45-micrometre filter to remove particulates. Samples were preserved in the field
20 immediately after collection (metals with nitric acid; nutrients and DOC with sulphuric acid). Water quality

1 samples were analyzed for general water chemistry parameters in the laboratory. These parameters were
2 hardness, conductivity, nutrients, anions, total organic carbon (**TOC**) and DOC, total and dissolved metals,
3 and full major ion chemistry.

4 Chlorophyll-*a* samples, as a measure of primary production, were collected from the lake sites in June and
5 September/October and the stream sites in September/October. Lake samples were collected in one litre
6 (L) bottles from just below the surface (~ 0.25 m deep). At each stream, five samples of periphyton were
7 collected to provide a measure of chlorophyll-*a*. Each sample was obtained from a rock large enough to
8 yield a composite of three fixed area scrapings (19.64 square centimeters).

9 Water chemistry data was used to calculate acid sensitivity and baseline trophic status of the lakes and
10 streams sampled. Acid sensitivity was determined through calculating the acid neutralizing capacity (**ANC**)
11 and $CL_{(A)}$ in each of the lakes and streams sampled. The ANC of an aquatic ecosystem is its capacity to
12 buffer changes in pH from acidification, while the $CL_{(A)}$ is an estimate of the amount of acid deposition
13 from emissions and inputs of SO_2 and NO_x that can occur within a body of water without having a
14 permanent adverse impact on the aquatic ecosystem. The SSWC model recommended by Environment
15 Canada (2004) and BC MOE (2015) was used to evaluate $CL_{(A)}$.

16 7.4.5.1.3.2.1 Critical Load

17 $CL_{(A)}$ is calculated using Equation 1. In Equation 1, the $CL_{(A)}$ is the difference between the sum of the
18 corrected¹ base cations concentration pre-acidification (**BC*₀**) and the acid neutralizing capacity critical
19 lower limit (ANC_{limit}) multiplied by the annual catchment runoff (Q). The lower the $CL_{(A)}$, the greater the
20 sensitivity of the waterbody to acid inputs.

21 **Equation 1** $CL_{(A)} = Q([BC^*]_0 - [ANC]_{limit})$

22 Where:

23 $CL_{(A)}$ = the critical load of acidity (milliequivalents per square metre per year [**meq/m²/y**])

24 Q = the annual catchment runoff (metres per year [m/y])

25 $[BC^*]_0$ = corrected pre-acidification base cations for a waterbody ($\mu\text{eq/L}$)

26 $[ANC]_{limit}$ = acid neutralizing capacity critical lower limit ($\mu\text{eq/L}$)

27 The ANC is a measure of the buffering capacity of surface water against acidification. The ANC_{limit} is a
28 critical lower limit of ANC that is protective of sensitive aquatic biota. Across Canada, a pH below 6.0 is
29 the threshold identified for when effects occur to aquatic biota (Henriksen et al. 2002). Derived ANC_{limit}
30 ranges between 20 $\mu\text{eq/L}$ and 40 $\mu\text{eq/L}$ when a pH of 6.0 is used. Previous studies have found an ANC_{limit}
31 of 8 to 50 $\mu\text{eq/L}$ to be protective, depending on the aquatic biota. Overall, a higher ANC_{limit} is more
32 conservative and offers increased ecosystem protection. Therefore, an ANC_{limit} threshold of 40 $\mu\text{eq/L}$ was
33 used based on Henriksen *et al.* (2002) and to provide a margin of safety.

¹ As described in the “Cation and Anion Correction” section below, base cation concentrations are corrected to account for the contribution of cations from marine aerosols (i.e., sea salt spray) to changes in cation concentrations in a waterbody from pre-acidification to present day.

1 Details for calculating Q and $[BC^*]_0$ are provided in the Surface Water Acidification and Eutrophication
2 TDR (Appendix 7.08b).

3 7.4.5.1.3.2.2 *Acid Sensitivity Assessment*

4 The $CL_{(A)}$ values were used to qualitatively assess acid sensitivity in surface water using the critical load
5 classification system presented in the Sulphur Dioxide Technical Assessment Report for the Rio Tinto
6 Kitimat Modernization Project (ESSA 2013). Table 7.4–4 shows the acid sensitivity classifications using
7 critical loads to identify acid sensitive waterbodies.

Table 7.4–4 – Acid Sensitivity Classifications Based on Critical Load of Acidity

Acid Sensitivity	Critical Load ($CL_{(A)}$) (meg/m ² /y)	Shading Colour
Acidic	<0	Red
High	0–20	Orange
Sensitive	20–40	Yellow
Moderate	40–60	Light Green
Low	60–100	Blue
Very Low	>100	White

Source: ESSA Technologies (2013)

8

9 7.4.5.1.3.2.3 *Trophic Status*

10 Eutrophication of aquatic systems occurs from excessive input of nutrients (i.e., phosphorus and nitrogen)
11 that may promote excessive algal growth. In turn, this excessive algal growth can support toxic
12 cyanobacterial growth, decrease diversity, and reduce the DO levels in aquatic systems. The baseline
13 trophic status of the lakes and streams was estimated using total nitrogen concentrations to classify the
14 lakes or streams as low (oligotrophic), moderate (mesotrophic), high (eutrophic), or very high nutrient
15 (hypertrophic) systems.

16 To evaluate the eutrophication potential for lakes and streams from atmospheric deposition of NO_x , the
17 baseline trophic status was estimated using nitrogen concentrations measured during the field sampling.
18 Baseline trophic status of lakes was estimated using the trophic state index (TSI). This method uses a
19 logarithmic calculation to produce values that range between 0 and 100 (Carlson and Simpson 1996):

- 20 • Oligotrophic: 0 – 40
- 21 • Mesotrophic: 41 – 50
- 22 • Eutrophic: 51 – 70
- 23 • Hypereutrophic: 71 – 100

1 The equation used to calculate the TSI is:

2 **Equation 2**

3
$$TSI(TN) = 54.45 + 14.43 \ln TN$$

4 This equation uses total nitrogen (**TN**), but the TSI can also be calculated using total phosphorous and
5 chlorophyll *a* independently (Carlson and Simpson 1996). TN was used in this case due to potential
6 nitrogen deposition and because coastal oligotrophic and dystrophic lakes have been identified as being
7 sensitive to nitrogen deposition and potential eutrophication (BC MOE 2015), although it is noted that
8 additions of phosphorus are also instrumental in creating eutrophic conditions (Wetzel 2001).

9 The baseline trophic status of the three stream sites within the AESA was estimated using the system of
10 Dodds et al. (1998), which defines trophic status according to the following range of TN concentrations:

- 11 • Oligotrophic: 0 to 0.7 mg TN/L
12 • Mesotrophic: 0.7 to 1.5 mg TN/L
13 • Eutrophic: > 1.5 mg TN/L

14 Detailed methods for the acidification and eutrophication assessment can be found in the *Technical Data*
15 *Report – Surface Water Acidification and Eutrophication* (Appendix 7.08B; Stantec 2023c).

16 7.4.5.1.4 Surface Water Quantity

17 Methods and results from surface water quantity monitoring in 2022 are presented in the Surface Water
18 Quantity TDR (Appendix 7.4A). To summarize, hydrology measurements were conducted at watercourse
19 (**WC**)-09, WC-04, and WC-02 on Pearse Island throughout 2022 (Table 7.4–5; Figure 7.4–1).
20 Water quantity field studies consisted of six field visits in 2022. Hydrometric stations were established at
21 WC-09 (late February) and WC-04 (May) 2022. Water level was continuously recorded at these stations.
22 Manually measured water level (stage) and discharge were used to establish stage-discharge relationships
23 (**SDR**; rating curves). Recorded water levels were passed through SDR to produce continuous records of
24 discharge. Data collection is ongoing at the stations at time of writing. Stage and discharge measurements
25 in 2023 will be used to update SDRs and extend discharge records for each site to September 2023.

26 Point measurements of discharge were periodically conducted at WC-02 during field visits spanning from
27 March 2022 to present. A continuously recording hydrometric station was established at this site in
28 November 2022 (Table 7.4–5) and measurements collected in 2023 will be used to develop an SDR and
29 discharge record for the station. Field measurements followed RISC guidelines (RISC 2018).

1 **Table 7.4–5 – Watercourses in the Local Assessment Area where Surface Water Quantity was Assessed**

Watercourse	UTM (m) ^a		Elevation (metres above sea level [masl])		Watershed Area (km ²) ^b	Hydrometric Station Established	Number of Flow Measurements ^d	Rating Curve Developed?
	Easting (m)	Northing (m)	Min	Max ^b				
WC-09	423,007	6,098,174	0	749	9.2	February 2022	9	y
WC-04	424,310	6,097,745	0	496	0.98	May 2022	9	y
WC-02	423,961	6,098,249	0	81	0.75	November 2022	4	Y

NOTES:

^a UTM Zone 9. Coordinates are near the mouth of each watercourse.

^b From the NWWT (BC FLNRORD and Foundry Spatial 2022).

^c Data collection is ongoing at each site. A rating curve will be developed at station WC-02 using data collected in 2023.

^d Flow measurements used in rating development

2

3 Publicly available literature and data were reviewed for surface water quantity information for
4 watercourses within the TLAA. The Environmental Flow Needs Policy (BC FLNRORD and BC ENV 2022) and
5 the Northwest Water Tool (BC FLNRORD and Foundry Spatial 2022) were used to determine general
6 stream size, and records of approvals or licenses.

7 **7.4.5.2 Overview of Existing Conditions**

8 7.4.5.2.1 Physiography

9 Pearse Island is located between the Portland Canal and Pearse Inlet, and approximately 15 km west of
10 the closest community of Gingolx, BC. It is in the northern coastal portion of the Kitimat Ranges
11 physiographic region (Church and Ryder 2010). The RAA is not glacierized but is mountainous, with the
12 highest elevations on the island—about 750 masl—occurring in the RAA headwaters (Table 7.4–5).
13 Elevations decrease to sea level from these headwaters to the LAA within an approximately 7 km straight-
14 line distance.

15 Regional and local climatic data are summarized in Table 7.4–6. This includes temperature, precipitation,
16 and evapotranspiration information based on data from nearby weather stations, from the on-Site
17 weather station, and from Site-specific modelled data (ECCC 2022; Wang et al. 2012; Wang 2022).
18 Regional and local climate data are also summarized in the Air Quality TDR, Appendix 7.02.

19 Unconsolidated deposits mapped across the RAA include glaciomarine sediments, colluvium, till, and
20 organics (McCuaig 2003). Deposit landforms are generally veneers: one to two metres thick, discontinuous
21 horizons with numerous areas of exposed bedrock. Bedrock underlying the north half of Pearse Island has
22 been mapped as early Tertiary granodiorite. Fresh, competent granodiorite is typically characterized with
23 low primary porosity (Freeze and Cherry 1979).

24 The vegetation cover of the RAA and LAA are dominated by upland forest communities and wetlands.
25 The topography is undulating with linear ridges running approximately north/south, interspersed with
26 low-lying wetlands. The LAA and RAA support a variety of upland, floodplain, wetland, and sparsely

1 vegetated communities. Both mineral and organic soils are found within the LAA and RAA, as are wetlands
2 that are freshwater, estuarine (brackish), and tidal water-influenced (Section 7.06).

3 Physiographic features potentially affecting hydrology in the RAA include steep slopes, particularly in
4 watershed headwaters (Figure 7.4–2), wetlands at lower elevations (Figure 7.4–1), forested land cover,
5 thin veneer of unconsolidated sediments, and relatively impervious bedrock.

6 7.4.5.2.2 Climate and Weather

7 Pearse Island is in the Coastal Mountains Hydrologic Zone, near the boundary of the northern and
8 southern subzones (Ahmed and Jackson 2013). The northern subzone is defined by higher precipitation
9 and more extensive glacierization compared to the southern subzone.

10 The region typically receives almost 3 m of precipitation annually, with the wettest months being October
11 and November (Table 7.4–6). At Wil Milit, about 3,200 millimetres (**mm**) of rain fell from February to
12 November 2022 (with most precipitation in December and January likely falling as snow).

13 Peak snow depth was about 1.5 m at Wil Milit in January 2022 (Table 7.4–6). Within the LAA, 411 mm of
14 precipitation typically falls as snow (or about 14% of annual total precipitation), but the fraction of
15 precipitation falling as snow would increase in the higher elevation headwaters of the RAA. From
16 qualitative field observations, snow accumulation is also dependent on surface cover, with deeper, more
17 extensive, and more persistent snowpack in forested areas compared to clearings.

18 About 16% of precipitation (470 mm) is lost through potential evapotranspiration annually. Most
19 evapotranspiration occurs from May through August (Table 7.4–6).

20 In 2021, mean daily air temperatures at Wil Milit dropped below freezing in early December and mostly
21 remained below freezing until the first week in January. Following this, air temperatures were above
22 freezing for the remainder of the year, except for brief periods in early and late February.

1 **Table 7.4–6 – Summary of Local and Regional Meteorological and Climate Data**

Month	Average Air Temperature				Total Rain		Total Precipitation			Snow		Evapotranspiration
	(°C)				(mm)		(mm)					(mm)
	Prince Rupert	Prince Rupert	ClimateBC	Pearse LAA	Prince Rupert	Pearse LAA	Prince Rupert	Prince Rupert	ClimateBC	Precipitation as Snow (mm), ClimateBC	Max. Snow Depth (m), Pearse LAA	ClimateBC
	(1981-2010)	(2021-2022)	(1991-2020)	(2021-2022)	(1981-2010)	(2021-2022)	(1981-2010)	(2021-2022)	(1991-2020)	(1991-2020)	(2021-2022)	(1991-2020)
Sep	11.5	12.4	12.3	11.2	266	604	266	497.4	279	7	n/d	40
Oct	8	n/d	7.8	6.3	373	477	374	269.2	340	5	n/d	19
Nov	4.3	n/d	3.9	3.5	307	672	317	370	348	35	0.31	8
Dec	2.7	-2.7	1.4	-4	272	n/d	294	131.1	295	41	0.74	4
Jan	2.4	2.6	0.6	-0.1	253	n/d	276	325.7	278	53	1.49	6
Feb	2.7	4.0	1.8	2	167	390	186	326.5	218	37	0.7	12
Mar	4.2	5.2	3.5	3.7	188	301	200	215.3	223	29	0.07	26
Apr	6.4	5.3	7	5.4	170	134	172	113.4	197	10	n/d	48
May	9	8.5	10.6	8.8	138	139	138	124.4	140	3	n/d	74
Jun	11.6	12.4	13	13.2	109	100	109	74.5	114	1	n/d	80
Jul	13.4	14.4	14.8	14.6	119	160	119	108.7	125	1	n/d	80
Aug	13.8	15.4	14.8	15.5	169	245	169	201.7	198	2	n/d	68
Average	7.5	n/d	7.6	6.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total	n/a	n/a	n/a	n/a	2,531	3,222	2,620	2,758	2,755	224	n/a	465

NOTES:

Data Sources

'Prince Rupert (1981-2010)' is climate normals data for the 'Prince Rupert A' ECCC meteorological station (climate ID: 1066481), located at 35 masl (ECCC 2022b).

'Prince Rupert (2021-2022)' is from ECCC station 'Prince Rupert' (climate ID: 1066482), located at 35 masl (ECCC 2022b).

'Pearse LAA (2021-2022)' is from the LAA weather stations at Wil Milit, from September 1, 2021, to August 31, 2022; station is at about 31 masl.

'ClimateBC (1991-2020)' is climate normals data for the approximate latitude, longitude, and elevation of the meteorological station in the LAA, retrieved using ClimateBC (Wang et al. 2012; Wang 2022).

Parameters

Air temperatures are monthly averages of daily average air temperature.

Rain data are not available from Wil Milit in December 2021 and January 2022 when snow and/or ice likely disabled the tipping bucket rain gauge.

Snow depths are monthly averages.

Evapotranspiration is Hargreaves potential evapotranspiration from ClimateBC (Wang et al. 2012; Wang 2022).

Other

Months are sorted from September to August to (a) align with Pearse Island LAA data availability at the time of writing (September 2021 to August 2022), while (b) presenting a single annual record of climate and weather conditions.

Where a data source is not included for a given parameter, it is not available from that source.

n/d = no data. n/a = not applicable

1 7.4.5.2.3 Surface Water Quality

2 An overview of surface water quality is broken into two parts: an overview of the LAA and an overview of
3 the AESA.

4 7.4.5.2.3.1 Surface Water LAA

5 Many smaller waterbodies and watercourses are present in the LAA. In total, 18 streams, 9 open-water
6 wetlands, and 42 non-classified drainages (NCDs) were identified in the LAA. Table 7.4–7 summarizes the
7 watercourse in the LAA and their associated classification under the EPMR. The location of these streams
8 is shown in Figure 7.4–1. Of the 18 streams, 10 streams flowed directly to the marine environment while
9 the remaining 8 were tributaries to these larger streams. Further information on the physical
10 characteristics of these waterbodies can be found in Section 7.08 and in the *Freshwater Fish and*
11 *Fish Habitat Technical Data Report* (Appendix 7.08A; Stantec 2023b).

12 **Table 7.4–7 – Watercourses Within the LAA**

Watercourse Type	Classification ^a	Number of Reaches	Associated Watercourse IDs
Stream	S2	4	WC-02 R3, WC-02 R4, WC-04 R2, WC-09
	S3	8	WC-02 R1, WC-02 R2, WC-03 R1, WC-03 R3, WC-04 R1, WC-04.1, WC-06, WC-08
	S4	11	WC-01 R1, WC-01 R2, WC-02.1, WC-02.6, WC-02.9, WC-03 R2, WC-03.1, WC-03.3, WC-03.4, WC-10, WC-10d
	S5	1	WC-04 R3
	S6	4	WC-04.3, WC-05 R1, WC-05 R2, WC-08 R2
Wetland	W1	9	WC-01 R3, WC-01-WET-a, b, c, and d, WET-01, WC-02-WET-a, b, and c
NCD	NCD	42	NCD-02.2, NCD-02.3, NCD-02.4, NCD-02.5, NCD-02.6.1.1, NCD-02.6.1, NCD-02.6.2, NCD-02.7, NCD-02.8, NCD-02.9, NCD-02.9.1, NCD-03.1, NCD-03.1.1, NCD-03.2, NCD-03.3, NCD-03.4, NCD-03.5, NCD-03.6, NCD-03a, NCD-04.1, NCD-04.2, NCD-05.1, NCD-05.1.1, NCD-05a, NCD-05a.1, NCD-06.1, NCD-06.1.1, NCD-06.2, NCD-06.3, NCD-06a, NCD-06b, NCD-08a, NCD-08a.1, NCD-08a.1.1, NCD-08.1, NCD-08b, NCD-10.1, NCD-10a, NCD-10b, NCD-10c, NCD-10d, NCD-10d.1

NOTES:

NCD = non-classified drainage^a Stream classes determined in accordance with the EPMR

13

14 The literature review did not identify any historical surface water quality data within the LAA or RAA. A
15 summary of in situ results by field visit in each watercourse and wetlands in the LAA are presented in
16 Table 7.4–8. In situ sampling measurements from each stream and wetland can be found in the
17 *Freshwater Fish and Fish Habitat Technical Data Report* (Appendix 7.08A; Stantec 2023b) and the
18 *Technical Data Report – Surface Water Acidification and Eutrophication* (Appendix 7.08B; Stantec 2023c).

19 No surface water licences, permits, or drinking water sources were identified within the LAA or RAA
20 (BC FLNRORD and Foundry Spatial 2022).

Table 7.4–8 – Summary of In Situ Water Quality Sampling by Watercourse Type

Watercourse Type	Measurement Timing	Number of Reaches Sampled ^a	In Situ Parameter Range					
			Temperature (°C)	pH	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	Turbidity (NTU)	Clarity
Stream	June 2021	14	5.7 – 15.5	4.80 – 6.57	1.87 – 11.80	10.3 – 235	ND	Clear & Brown/Yellow
	August / September 2021	10	11.2 – 15.1	5.29 – 6.46	7.80 – 10.6	0.2 – 56.1	1.64 – 4.70	Clear & Brown/Yellow
	October 2021	7	5.1 – 6.5	6.28 – 7.14	10.3 – 12.2	14.3 – 31.5	0.44 – 2.40	Clear
	March 2022	1	0.4	5.79	14.49	15.5	0.01	Clear
	April 2022	16	0.5 – 4.5	6.08 – 7.97	8.17 – 14.40	4.5 – 31.1	0 – 3.21	Clear
	May 2022	2	3.2 – 3.4	5.86 – 6.14	11.23 – 11.31	11.5 – 12.5	0 – 0.42	Clear
	June 2022	2	9.7 – 11.6	6.29 – 6.34	10.36 – 11.25	18.3 – 36.9	0.54 – 1.23	Clear
Wetland	June 2021	5	11.6 – 19.4	5.04 – 5.30	1.79 – 7.16	13.2 – 27.2	ND	Green/Algae & Brown/Yellow
	August / September 2021	7	15.7 – 24.2	4.60 – 5.54	4.30 – 8.10	9.8 – 24.1	3.28 – 3.84	Green/Algae & Brown/Yellow
	April 2022	3	6.4 – 8.4	6.21 – 6.53	11.00 – 11.40	7.2 – 10.0	0.15 – 0.88	Green/Algae & Brown/Yellow

NOTES:

°C = degrees Celsius; mg/L = milligrams per litre; µS/cm = microsiemens per centimetre; NTU = Nephelometric Turbidity Units; ND = no data

^a Not every reach was sampled; in most cases, only one reach of a given watercourse was sampled per site visit (i.e., the measurement timing column). Most of the watercourses were sampled at least twice, with measurements taken in different seasons.

1 Dissolved oxygen concentrations were typically above the WQG-FAL instantaneous minimum for all
2 life stages of fish (i.e., ≥ 9 mg/L) in larger mainstem streams (BC ENV 2023b). Open water wetlands and
3 beaver impoundments had lower DO concentrations than flowing streams and were less likely to meet
4 the WQG-FAL instantaneous minimum concentration for embryos/alevins (i.e., 9 mg/L) or the WQG-FAL
5 for all other salmonid life stages (i.e., 5 mg/L; BC ENV 2023b). Only wetlands and beaver impoundments
6 had DO concentrations that were < 5 mg/L.

7 Most watercourses in the LAA had at least one pH measurement below the WQG-FAL range of 6.5 to 9.0
8 (BC ENV 2023b). Wetlands, beaver impoundments, and streams that were fed by wetlands had the lowest
9 pH values, while larger streams that were not fed by wetlands had higher pH values. Where
10 Ph measurements were taken during multiple field assessments, measurements were more likely to be
11 low during spring and higher in summer and fall. Acidic conditions are common in high precipitation areas
12 of the west coast of BC (BC MOE 1991), so the observed results from watercourses and wetlands within
13 the LAA are not unexpected.

14 Turbidity was low in all streams and wetlands in the LAA. Water clarity was clear in most streams, while
15 the clarity was brown/yellow or green/algae in most wetlands. Conductivity measured < 40 $\mu\text{S}/\text{cm}$ in most
16 streams and wetlands in the LAA during all four surveys. Water temperatures were higher in wetlands and
17 beaver impoundments than in streams in all seasons.

18 Laboratory analysis was completed on water samples from the lakes and streams within the LAA as part
19 of the acidification and eutrophication study. Metal concentrations in the lakes and streams met the
20 BC WQG-FAL, except for aluminum, cadmium, and iron:

- 21 • Total aluminum concentrations ranged from 0.012 mg/L to 0.211 mg/L in June and from
22 0.017 mg/L to 0.257 mg/L in September/October 2022 for the lakes and streams. The total
23 aluminum concentrations at LK-01 inlet, LK-02, STR-01, STR-02 and STR-03 in June and LK-01
24 bottom, LK-02, STR-01, STR-02 and STR-03 in September/October were above the 2023 long-term
25 BC WQG-FAL. In addition, the total aluminum concentrations at LK-01 inlet, LK-02, STR-01, STR-02
26 and STR-03 in June and LK-02, STR-01, STR-02 and STR-03 in September/October were above
27 respective CCME WQG-FAL.
- 28 • In September/October 2022, total cadmium concentrations at LK-02 (0.00084 mg/L; total
29 hardness of 1.99 mg/L) was above the short-term CCME WQG-FAL (0.00004 mg/L when total
30 hardness < 17 mg/L) and long-term CCME WQG-FAL (0.00011 mg/L when hardness < 5.3 mg/L).
- 31 • Dissolved cadmium concentration ranged from below detection limit (0.000005 mg/L) to
32 0.00149 mg/L in June and September/October for the lakes and streams. The dissolved cadmium
33 concentration at LK-02 was above the short-term and long-term BC WQG-FAL.
- 34 • The dissolved iron concentration at STR-02 (0.360 mg/L) was above the BC WQG-FAL (0.35 mg/L
35 short term guideline).

1 7.4.5.2.3.2 Surface Water AESA

2 CL_(A) and predicted acid sensitivity for the two lakes and three streams sampled for the acidification
 3 assessment are summarized in Table 7.4–9. Results based on the water samples collected in June 2022
 4 and in September/October 2022 are presented for transparency, but only the results from
 5 September/October 2022 are considered representative for acidification assessments for the lakes. LK-02
 6 had a negative CL_(A) value based on water quality data from June 2022, which is an indication of the lake
 7 being acidic, and had a CL_(A) of 18 meq/m²/y based on water quality data from October 2022, which
 8 corresponds to the lake being highly sensitive to acid inputs. LK-01 and the three streams in this
 9 assessment had CL_(A) values over the 100 meq/m²/y cut-off and were placed in the very low sensitivity
 10 category.

Table 7.4–9 – Existing Acid Sensitivity Based on Critical Load Values

Site ID	Watercourse Name	Watercourse Type	Catchment Area (km ²) ^a	Catchment Runoff (Q) (m ³ /y/m ²)	BC ₀ (µeq/L)		Critical Load (CL _(A)) (meq/m ² /y)	
					June 2022	Sept./ Oct. 2022	June 2022	Sept./ Oct. 2022
LK -01 inlet	Unnamed	Lake	0.74	2.60	92	260	135	571
LK -01 middle	Unnamed	Lake	0.74	2.60	167	251	330	548
LK -01 outlet	Unnamed	Lake	0.74	2.60	170	253	337	553
LK-01 bottom	Unnamed	Lake	0.74	2.60	ND	386	ND	897
LK-02	Unnamed	Lake	0.10	2.31	37	48	-8	18
STR-01	Dogfish Creek	Stream	21.90	3.57	197	250	560	751
STR-02	Unnamed	Stream	0.75	2.35	186	146	344	248
STR-03	Unnamed	Stream	9.19	2.73	168	196	349	425

NOTES:

meq = milliequivalents; ND = no data

^a Catchment area was taken from NWWT for stream sites (BC FLNRORD and Foundry Spatial). For lake sites, catchment areas were estimated at the lake outflow using the Freshwater Atlas Watershed layer and geographic information system (GIS) analysis.

Acid sensitivity classifications are based on CL_(A) values in the following ranges.

	Acidic (< 0 meq/m ² /y) and an ANC _{0aa} value <0
	Highly sensitive (<0 to 20 meq/m ² /y)
	Sensitive (20 to 40 meq/m ² /y)
	Moderately Sensitive (40 to 60 meq/m ² /y)
	Low sensitivity (60 to 100 meq/m ² /y)
	Very low sensitivity (> 100 meq/m ² /y)

- 1 Baseline trophic status for the two lakes and three streams sampled for the eutrophication assessment
2 are summarized in Table 7.4–10. The lakes and streams sampled are classified as oligotrophic.

Table 7.4–10 – Baseline Trophic Status

Site ID	Watercourse Name	Sampling Date (2022)	Sampling Depth (m)	Total Nitrogen (mg/L)	Lake Trophic Status Index (TSI)	Trophic Status
LK -01 inlet	Unnamed	22-Jun-22	Surface	0.015	0	Oligotrophic
LK -01 inlet	Unnamed	7-Oct-22	Surface	0.111	23	Oligotrophic
LK -01 middle	Unnamed	22-Jun-22	Surface	0.074	17	Oligotrophic
LK -01 middle	Unnamed	7-Oct-22	Surface	0.101	22	Oligotrophic
LK -01 outlet	Unnamed	22-Jun-22	Surface	0.094	21	Oligotrophic
LK -01 outlet	Unnamed	7-Oct-22	Surface	0.095	21	Oligotrophic
LK-01 bottom	Unnamed	7-Oct-22	Bottom	0.249	34	Oligotrophic
LK-02	Unnamed	22-Jun-22	Surface	0.105	22	Oligotrophic
LK-02	Unnamed	5-Oct-22	Surface	0.31	38	Oligotrophic
STR-01	Dogfish Creek	20-Jun-22	Surface	0.07	N/A	Oligotrophic
STR-01	Dogfish Creek	29-Sep-22	Surface	0.123	N/A	Oligotrophic
STR-02	Unnamed	20-Jun-22	Surface	0.152	N/A	Oligotrophic
STR-02	Unnamed	29-Sep-22	Surface	0.162	N/A	Oligotrophic
STR-03	Unnamed	20-Jun-22	Surface	0.078	N/A	Oligotrophic
STR-03	Unnamed	29-Sep-22	Surface	0.121	N/A	Oligotrophic

NOTES:

N/A = not applicable

When total nitrogen was below detection limit, one-half the detection limit (i.e., 0.015) was used for calculation

- 3
4 [7.4.5.2.3.3 Surface Water TLAA](#)
5 Streams in the TLAA are coastal, generally steep, and flow directly to the marine environment. Named
6 watercourses in the TLAA include Chambers Creek, Flewin Creek (watershed code: 500-010700),
7 Masoga Gulf Creek (watershed code: 910-900800), and Matheson Creek (watershed code: 910-908300)
8 (BC ENV 2023a). Surface water information was limited within the TLAA and no surface water quality
9 monitoring sites were found (Government of British Columbia 2023). Fish habitat surveys conducted in
10 November and December 2000 in the Chambers Creek area recorded the stream being clear with
11 temperatures ranging from 2-4°C (FINS Consulting Ltd. 2001). Fish habitat surveys conducted in
12 September 2013 recoded temperatures between 9-16.6°C, pH between 5.70 and 8.50, and
13 dissolved oxygen between 7.54 and 12.36 mg/L in Flewin Creek, Chambers Creek, Masoga Gulf Creek, and
14 other unnamed tributaries in the Chambers Creek and Nasoga Gulf Creek watersheds
15 (Tera Environmental Consultants 2014).

1 7.4.5.2.4 Water Quantity

2 7.4.5.2.4.1 Regional and Local Hydrology

3 This section provides a high-level summary of regional and local hydrology. It focuses on modelled data
4 from NWWT (BC FLNRORD and Foundry Spatial 2022) to characterize long-term typical conditions. On-site
5 monitoring data are compared to data from NWWT in the Surface Water Quantity TDR (Appendix 7.4).
6 Please refer to the Surface Water Quantity TDR for a more detailed description of existing conditions.

7 Discharge and runoff on Pearse Island are characterized by two annual maxima and minima. Maxima occur
8 in May in response to snowmelt and in October in response to rainfall. Minima occur in February-March
9 when precipitation is stored as snow in headwaters, and again in summer through early fall when rainfall
10 is at its annual minimum (Table 7.4–6) and snowpack is largely exhausted. The extent to which
11 precipitation is stored as snow and the effects of storage on the timing and magnitude of runoff depends
12 on the extent to which local watersheds extend into high elevations in their headwaters.

13 Existing hydrologic conditions are assessed for three of the larger watercourses that drain within the
14 LAA and are near proposed Project infrastructure: WC-09, WC-04, and WC-02 (Table 7.4–5; Figure 7.4–1;
15 Figure 7.4–2).

16 Discharge, flow volumes, and runoff for watercourses WC-09, WC-04, and WC-02 are presented in
17 Table 7.4–11, Table 7.4–12 and Table 7.4–13, respectively (BC FLNRORD and Foundry Spatial 2022). All
18 watercourses are classified as small streams, i.e., MAD is less than 10 m³/s (BC FLNRORD and
19 BC ENV 2022). These tables also include potential water allocations, discussed in Section 7.4.9.2.5.1.

20 Total annual runoff ranges from about 2,400 to 2,700 mm. This is several hundred millimetres less than
21 total annual precipitation at Pearse Island (Table 7.4–6); evapotranspiration and infiltration could be
22 responsible for the difference between runoff and precipitation. Discharge and flow volumes scale with
23 watershed size. For the largest watercourse, WC-09, average monthly flows are up to about 1.2 m³/s, as
24 low as about 0.5 m³/s, and MAD is 0.8 m³/s. For the smallest watercourse, WC-02, average monthly flows
25 are up to about 0.09 m³/s, as low as about 0.01 m³/s, and MAD is 0.06 m³/s.

26 No records of short-term use approvals or long-term licenses were found for any of the assessed
27 watercourses (BC FLNRORD and Foundry Spatial 2022); no annual allocations are assumed to occur.

28 Based on field visits in late February early March 2022, the watercourses listed in Table 7.4–5 may not
29 freeze completely and could continue to flow in winter.

1 **Table 7.4–11 – Flow Statistics for Watercourse 9 (WC-09), Pearse Island (Watershed Area = 9.2 km²)**

Month	Northwest Water Tool Flow ^a				
	Discharge (m ³ /s)	% of Mean Annual Discharge	Daily Flow Volume (m ³ /d)	Monthly Flow Volume (m ³ /mon.)	Runoff (mm)
Jan	0.8	101	69,120	2,142,720	233
Feb	0.5	63	43,200	1,220,400	133
Mar	0.5	63	43,200	1,339,200	146
Apr	0.6	76	51,840	1,555,200	169
May	1.2	152	103,680	3,214,080	349
Jun	0.9	114	77,760	2,332,800	254
Jul	0.5	63	43,200	1,339,200	146
Aug	0.5	63	43,200	1,339,200	146
Sep	0.8	101	69,120	2,073,600	225
Oct	1.2	152	103,680	3,214,080	349
Nov	1.1	139	95,040	2,851,200	310
Dec	0.9	114	77,760	2,410,560	262
Annual average	0.8	n/a	68,400	2,086,020	227
Annual sum	n/a	n/a	n/a	25,032,240	2,721

NOTE:

^a BC FLNRORD and Foundry Spatial 2022

2

1 **Table 7.4–12 – Flow Statistics and Potential Allocations for Watercourse 4 (WC-04), Pearse Island**
 2 **(Watershed Area = 0.98 km²)**

Month	Northwest Water Tool Flow ^a					Northwest Water Tool Allocations			
	Discharge (m ³ /s)	% of Mean Annual Discharge	Daily Flow Volume (m ³ /d)	Monthly Flow Volume (m ³ /mon.)	Runoff (mm)	Potential Allocations (Risk Management Level 1)			
						(m ³ /s)	(m ³ /d)	(m ³ /mon.)	Flow Sensitivity
Jan	0.08	107	6,912	214,272	219	0.012	1,037	32,141	Low
Feb	0.06	80	5,184	146,448	149	0.009	778	21,967	Low
Mar	0.05	67	4,320	133,920	137	0.008	648	20,088	Low
Apr	0.07	93	6,048	181,440	185	0.011	907	27,216	Low
May	0.12	160	10,368	321,408	328	0.018	1,555	48,211	Low
Jun	0.07	93	6,048	181,440	185	0.011	907	27,216	Low
Jul	0.03	40	2,592	80,352	82	0.005	389	12,053	Low
Aug	0.03	40	2,592	80,352	82	0.005	389	12,053	Low
Sep	0.07	93	6,048	181,440	185	0.011	907	27,216	Low
Oct	0.12	160	10,368	321,408	328	0.018	1,555	48,211	Low
Nov	0.11	147	9,504	285,120	291	0.017	1,426	42,768	Low
Dec	0.09	120	7,776	241,056	246	0.014	1,166	36,158	Low
Annual average	0.08	n/a	6,480	197,388	201	0.011	972	29,608	n/a
Annual sum	n/a	n/a	n/a	2,368,656	2,417	n/a	n/a	355,298	n/a

NOTES:

^a BC FLNRORD and Foundry Spatial 2022

^b BC FLNRORD and BC ENV 2022. Described in Section 7.4.9.2.1.

3

1 **Table 7.4–13 – Flow Statistics and Potential Allocations for Watercourse 2 (WC-02), Pearse Island**
 2 **(Watershed Area = 0.75 km²)**

Month	Northwest Water Tool Flow ^a					Northwest Water Tool Allocations			
	Discharge (m ³ /s)	% of Mean Annual Discharge	Daily Flow Volume (m ³ /d)	Monthly Flow Volume (m ³ /mon.)	Runoff (mm)	Potential Allocations (Risk Management Level 1 ^a)			
						(m ³ /s)	(m ³ /d)	(m ³ /mon.)	Flow Sensitivity ^b
Jan	0.07	122	6,048	187,488	249	0.011	907	28,123	Low
Feb	0.05	87	4,320	122,040	162	0.008	648	18,306	Low
Mar	0.05	87	4,320	133,920	178	0.008	648	20,088	Low
Apr	0.06	104	5,184	155,520	207	0.009	778	23,328	Low
May	0.09	157	7,776	241,056	321	0.014	1,166	36,158	Low
Jun	0.04	70	3,456	103,680	138	0.006	518	15,552	Low
Jul	0.01	17	864	26,784	36	0.000	0	0	Moderate
Aug	0.01	17	864	26,784	36	0.000	0	0	Moderate
Sep	0.05	87	4,320	129,600	172	0.008	648	19,440	Low
Oct	0.09	157	7,776	241,056	321	0.014	1,166	36,158	Low
Nov	0.09	157	7,776	233,280	310	0.014	1,166	34,992	Low
Dec	0.08	139	6,912	214,272	285	0.012	1,037	32,141	Low
Annual average	0.06	n/a	4,968	151,290	201	0.008	724	22,024	n/a
Annual sum	n/a	n/a	n/a	1,815,480	2,414	n/a	n/a	264,287	n/a

NOTES:

^a BC FLNRORD and Foundry Spatial 2022

^b BC FLNRORD and BC ENV 2022. Described in Section 7.4.9.2.1.

3
 4 Streams within the TLAA are mixed rain and snowmelt dominated flow regimes typical of northern coastal
 5 environments. Generally, these streams are small in magnitude and drain steep terrain directly into the
 6 marine environment. All watercourses in the TLAA are considered small streams (MAD less than 10 m³/s)
 7 except for Chambers Creek, which has a MAD of 10 m³/s (BC FLNRORD and BC ENV 2022). Surface water
 8 information was limited within the TLAA and no hydrometric monitoring sites were found (Government of
 9 British Columbia 2023). No records of short-term use approvals or long-term licenses were found for any
 10 watercourses within the TLAA (BC FLNRORD and Foundry Spatial 2022); no annual allocations are assumed
 11 to occur.

12 A conceptual model for the hydrological environment, summarizing the information above, appropriate
 13 to describe baseline conditions for surface waters, is presented in Figure 7.4–5.

1 7.4.5.2.4.2 Conceptual Model for the Hydrological Environment

2 A conceptual model for the hydrological environment at Wil Milit has been developed for the Project and
3 is presented in Figure 7.4-5 (see Section 7.4.12).

4 7.4.5.2.4.3 Floods

5 Potential causes of floods and inundation within the LAA include:

- 6 • Inundation from storm waves, tsunamis, and earthquakes (NHC 2022)
- 7 • Inundation from tides in areas below the high tide mark. The tidal limit typically extends less than
8 several hundred metres upstream from watercourse mouths at the Portland and Pearse canals,
9 and is mapped in Section 7.09 (Section 7.09, Marine Vegetation Classification maps)
- 10 • floods within and near watercourse channels from large runoff events sourced from rainfall
11 and/or snowmelt, and
- 12 • floods in poorly drained areas such as wetlands following runoff events.

13 7.4.5.2.4.4 Climate Change and its Effects on Hydrology in the LAA and RAA

14 Climate change is defined as the long-term continuous increase or decrease of any statistical form of
15 climatic variables such as temperature and precipitation. The statistical form can be mean, variability, or
16 extreme (ECCC 2022a). Climate change projections of future climates are available from numerous global
17 climate models and emission scenarios. Climate change scenarios and projections for the area are
18 described in Section 8.0. Generally, air temperatures and precipitation are expected to increase
19 year-round. Despite increased precipitation, snowpack is expected to decrease due to increased air
20 temperatures, except in January. This section describes potential climate change effects on watershed
21 processes and surface water quantity.

22 Watershed processes potentially altered by climate change include increased evapotranspiration, altered
23 vegetation composition, decreased snow accumulation, accelerated snowmelt, altered timing and
24 magnitude of streamflows, altered groundwater storage and recharge, and changes in the frequency and
25 magnitude of hillslope and geomorphic processes (Pike et al. 2010).

26 The effects of these changing processes on water quantity and the timing and magnitude of flows will be
27 spatially variable and complex, even within the LAA and RAA. For example, hydrologic responses to varying
28 precipitation and air temperature will vary with elevation, affecting the timing and amount of storage in
29 snow at each elevation and the downstream routing of snowmelt. As a result, the hydrologic responses
30 (including flooding) to changing climate may differ in the lower elevation WC-02 compared to the higher
31 elevation headwaters of WC-09.

32 In a comparison of watersheds in differing hydrologic zones in BC, a coastal headwater system
33 (Campbell River) was found to respond more severely to changes in climate compared to interior systems.
34 Within 50-years, the modelled system fell outside of the range of natural variability, resulting in different
35 hydrologic conditions relative to the historic record (Bennett et al., 2012).

1 There are numerous sources of uncertainty with hydrologically important parameters from global climate
2 models, including uncertainties in greenhouse gas forcings and uncertainty relating to downscaling data
3 from large model grid cells to a region representative of the RAA.

4 **7.4.6 Selection of Potential Effects and Indicators/Measurable Parameters**

5 The potential of effects for Surface Water are identified in Table 7.4–14. For each effect in Table 7.4–14,
6 effect pathways and indicators/measurable parameters have been identified to facilitate the quantitative
7 or qualitative assessment of change in Project-specific and cumulative effects potentially caused by the
8 Project.

Table 7.4–14 – Potential Effects, Effects Pathways and Indicators/Measurable Parameters for Surface Water

Potential Effect	Effect Pathway	Indicator and/or Measurable Parameter(s) and Units of Measurement
Change in the chemical and physical composition of surface water	<ul style="list-style-type: none"> ▪ Construction of on-land infrastructure can increase erosion and lead to increased sediment loading in streams and wetlands ▪ Riparian clearing can increase water temperature in streams and wetlands ▪ Air emissions (i.e., NO_x and sulphur oxide compounds [SO_x]) have the potential to cause acidification in waterbodies within the Project’s airshed if the deposition of S+N exceeds the natural buffering capacity of the lakes ▪ Air emissions can increase nitrogen deposition and nutrient availability in waterbodies within the Project’s airshed potentially resulting in a change in trophic status 	<ul style="list-style-type: none"> ▪ Changes in water quality due to land disturbance, erosion, changes in flow, and dust fall: <ul style="list-style-type: none"> • TSS • turbidity • specific conductance • temperature ▪ Changes in water quality due to deposition of sulphur and nitrogen from the Project will be assessed following the Air Emissions Impact Assessment for Liquefied Natural Gas Export Terminal Facilities Guidance for the Assessment of Acidification and Eutrophication of Aquatic Ecosystems (BC MOE 2015). As per the guidance, changes in water quality will be assessed by identifying potential for acidification (exceedances of calculated critical loads of acid deposition) and eutrophication (changes in trophic status) in watercourses due to the Project.
Change in surface water quantity	<ul style="list-style-type: none"> ▪ water withdrawals ▪ reduction in watershed area ▪ changes to land cover 	<ul style="list-style-type: none"> ▪ Change in surface water flow (m³/s) through reduction in watershed area, direct surface water withdrawals, and changes to land cover.

9
10 Where possible, the assessment of potential effects on Surface Water used measurable parameters that
11 are quantifiable (e.g., exceedances of critical loads due to sulphur and nitrogen deposition from Project
12 emissions). However, not all effects pathways can be quantified (e.g., changes in total suspended solids
13 concentrations [TSS] in watercourses). Therefore, some effects are predicted qualitatively through use of
14 scientific literature, professional judgment, and project experience.

1 Spills also have the potential to affect Surface Water; however, effects and mitigation related to spills are
2 covered in Section 09.0 – Malfunctions and Accidents.

3 **7.4.7 Project Surface Water Interactions**

4 Table 6.3, Section 6.4, identifies the potential interactions between the Project’s components and physical
5 activities with Surface Water; these interactions are consistent with Table 6.3 of the AIR. Table 7.4–15
6 identifies the potential interactions between the Project’s components and potential effects on surface
7 water as defined in Table 7.4–14. Interactions that have been identified (ranked as 1 or 2) are carried
8 forward and assessed within this section. Each of the effects identified are discussed in detail, in the
9 context of effects pathways, mitigation/enhancement, and residual effects. Rationale for interactions
10 ranked as 0 is provided following Table 7.4–15.

Table 7.4–15 – Potential Project Interactions and Effects on Surface Water

Project Activities and Physical Works	Potential Project Effects	
	Change in the chemical and physical composition of surface water	Change in surface water quantity
Construction		
Procurement of labour, goods, and services	0	0
Site preparation and clearing	1	1
Construction of temporary and permanent land-based infrastructure (includes transmission line within the TLAA)	1	2
Construction of temporary and permanent marine-based infrastructure (includes transmission line within the TLAA)	0	0
Marine transport of workforce and construction materials to the Site	0	0
Land transportation of workforce and construction materials from Terrace to Gingolx or Prince Rupert (for marine transport to Site)	0	0
Waste management	0	0
Operation		
Procurement of labour, goods, and services	0	0
Natural gas pre-treatment, liquefaction, storage and offloading of LNG and natural gas liquid (NGL) products (condensate) at the floating liquefied natural gas (FLNG) production, storage and offloading facility barges (includes storage of NGLs)	1	0
LNG carrier and NGL product carrier loading	0	0
Marine shipping and transportation (includes tugs) to Site	0	0
Land transportation of workforce to Gingolx or Prince Rupert (for marine transport to Site)	0	0
Facility and infrastructure maintenance (includes transmission line within the TLAA)	1	1
Waste management	0	0
Temporary on-Site power generation on barges	1	0

Table 7.4–15 – Potential Project Interactions and Effects on Surface Water

Project Activities and Physical Works	Potential Project Effects	
	Change in the chemical and physical composition of surface water	Change in surface water quantity
Decommissioning		
Procurement of labour, goods, and services	0	0
Decommissioning or repurposing of land-based infrastructure	1	1
Decommissioning of marine-based infrastructure (includes transmission line within the TLAA)	0	0
Land transportation of workforce to Gingolx or Prince Rupert (for marine transport to Site)	0	0
Marine transport of decommissioned infrastructure	0	0
Waste management	0	0

Key:

0 = Negligible or no effect expected; no further consideration warranted.

1 = Potential adverse effect that warrants consideration, and requires mitigation through current legal or policy management, best management practice(s) and/or Project-specific mitigation.

2 = Potential adverse effect of particular importance or concern that warrants further detailed assessment.

+ = Potential positive effect that can be enhanced; warrants further consideration.

1

2 The following is justification for interactions ranked as 0 in Table 7.4–15:

- 3
- Procurement of labour, goods, and services in all phases do not interact with Surface Water
- 4
- Several activities will occur in the marine environment and are not anticipated to interact with surface water, as the Surface Water VC only includes the freshwater environment. These include:
- 5
- Construction of temporary and marine-based infrastructure
- 6
- Marine transport of workforce and construction materials to the Site
- 7
- LNG carrier and NGL product vessel loading
- 8
- Marine shipping and transportation from Prince Rupert and/or Gingolx to the Site
- 9
- Decommissioning of marine-based infrastructure
- 10
- Marine transport of decommissioned infrastructure
- 11

- 1 • There will be no LNG production or facility emissions during the construction and
2 decommissioning phases. It is these emissions that may cause acidification and eutrophication of
3 area lakes and streams. During operation, all other activities besides natural gas pre-treatment,
4 liquefaction, storage and offloading of LNG and NGL products, and temporary on-Site power
5 generation, do not result in facility-related emissions and, therefore, do not create a valid
6 pathway for potential acidification and eutrophication
- 7 • No water withdrawals from watercourses will occur during the operation or decommissioning
8 phase.
- 9 • Land transportation of the workforce and materials to Gingolx or Prince Rupert during all Project
10 phases is not anticipated to interact with Surface Water and will occur outside of the LAA
- 11 • Water discharges that will occur as part of waste management during all Project phases will be to
12 the marine environment and are not anticipated to interact with the Surface Water VC, which
13 only includes freshwater

14 With the exception of *'Construction of temporary and permanent land-based infrastructure'*, no key
15 interactions (i.e., interactions ranked as 2) between any Project activity or physical work and
16 Surface Water are anticipated to occur during any phase; all potential interactions are anticipated to be
17 lower risk interactions (ranked as 1 in Table 7.4–15) that can be managed through use of standard
18 operating procedures, best management practices (**BMP**), or other effective mitigation measures.

19 **7.4.8 Assessment Methods**

20 This section describes the residual effects characterization terms, the key residual effect threshold, and
21 the likelihood of residual effects categories. It is the framework for the assessment of the potential effects
22 on Surface Water.

23 The criteria and definitions of the quantitative or qualitative measures used to characterize adverse
24 residual effects on surface water from the Project are described below. Analytical assessment techniques
25 are discussed in Section 7.4.9.1 for each of the potential effects.

26 **7.4.8.1 Analytical Assessment Techniques**

27 Potential Project-related effects on surface water quality were assessed through the assessment of
28 change in water quality due to land disturbance, erosion and dust fall, plus the acidification and
29 eutrophication assessment.

1 **7.4.8.2 Residual Effects Characterization**

2 The Surface Water LAA, RAA, and TLAA are in relatively undisturbed areas with little to no anthropogenic
 3 development, little disturbance except for some historical logging activities, which maintained buffers
 4 around streams based on field assessments within the LAA and aerial imagery, and no known existing or
 5 historic water allocations or withdrawals. The AESA is also in a relatively undisturbed area with no major
 6 sources of emissions. In situ water quality measurements indicate that larger, mainstem streams sampled
 7 within the LAA and AESA generally meet WQG-FAL for the instantaneous minimum concentration for all
 8 life stages of fish for DO (≥ 9 mg/L; BC ENV 2023b) while open-water wetlands and beaver impoundments
 9 were less likely to meet this WQG-FAL (Appendix 7.08A & 7.08B; Stantec 2023b, c). The pH values for
 10 watercourses in the LAA and AESA were generally low (i.e., acidic); most watercourses in the LAA had at
 11 least one pH measurement below the WQG-FAL range of 6.5 to 9 (BC ENV 2023b). Wetlands,
 12 beaver impoundments, and streams that were fed by wetlands had the lowest pH values while larger
 13 streams that were not fed by wetlands had higher pH values (Appendix 7.08A & 7.08B; Stantec 2023b, c).
 14 Kitselas First Nation and Kitsumkalum First Nation identified concerns related to surface water quality.
 15 Table 7.4–16 presents definitions and criteria that are used to characterize the adverse residual effects
 16 on Surface Water.

Table 7.4–16 – Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Magnitude	The amount of change in measurable parameters or the valued component relative to existing conditions	<p><u>For Surface Water Quality</u></p> <p>No Measurable Change – no measurable change in the indicator or measurable parameter is expected to occur.</p> <p>Low – A measurable change detected but is within the variability of existing conditions, has no new $CL_{(A)}$ exceedance when compared to baseline (i.e., both Baseline Case and Application Cases have exceedances), or has no change in trophic status (eutrophication) and/or is within applicable guidelines (e.g., WQG-FAL).</p> <p>Moderate – a measurable change from baseline conditions that exceeds applicable guidelines, which results in a new $CL_{(A)}$ exceedance at sites which are considered acid sensitive or acidic at baseline (acidification), or a change in trophic status from oligotrophic to mesotrophic (eutrophication).</p> <p>High – a measurable change from baseline conditions that exceeds applicable guidelines, which results in a $CL_{(A)}$ exceedance at sites which are considered to have moderate to low acid sensitivity at baseline (acidification), or a change in trophic status to eutrophic (eutrophication).</p> <p><u>For Surface Water Quantity</u></p> <p>Residual effects are defined quantitatively for withdrawals and qualitatively for changes to the catchment and land surface type.</p>

Table 7.4–16 – Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
		<p>No Measurable Change – no measurable change in the indicator or measurable parameter is expected to occur.</p> <p>Low – For withdrawals, is defined to occur when less than 15% of mean monthly discharge is withdrawn and average monthly flow is greater than 20% of MAD (Section 7.4.9.2; BC FLNRORD and BC ENV 2022). For catchment and land surface types, is a change expected to have minor effects on infiltration and runoff.</p> <p>Moderate – For withdrawals, is defined to occur when less than 15% of mean monthly discharge is withdrawn and average monthly flow is greater than between 10 and 20% of MAD (Section 7.4.9.2; BC FLNRORD and BC ENV 2022). For catchment and land surface types, is a change expected to have intermediate effects on infiltration and runoff.</p> <p>High – For withdrawals, is defined to occur when less than 15% of mean monthly discharge is withdrawn and average monthly flow is less than 20% of MAD (Section 7.4.9.2; BC FLNRORD and BC ENV 2022). For catchment and land surface types, a change expected to have large effects on infiltration and runoff.</p>
Geographic Extent	The geographic area in which a residual effect occurs	<p>Project footprint – residual effects are restricted to the Project footprint</p> <p>LAA – residual effects extend into the LAA or AESA</p> <p>RAA – residual effects extend into the RAA</p>
Timing	Considers when the residual environmental effect is expected to occur. Timing considerations are noted in the evaluation of the residual environmental effect, where applicable or relevant.	<p>Not Applicable – seasonal aspects are unlikely to affect residual effects on Surface Water</p> <p>Applicable – seasonal aspects may affect residual environmental effect on Surface Water</p>
Duration	The time required until the measurable parameter or the valued component returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	<p>Short-term – the residual effect is restricted to no more than the duration of the construction phase (3 years)</p> <p>Medium-term – the residual effect extends through the operation phase (30 years)</p> <p>Long-term – the residual effect extends beyond the operation phase (> 30 years)</p>

Table 7.4–16 – Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories																																								
Reversibility	Pertains to whether a measurable parameter or the valued component can return to its existing condition after the Project activity ceases	<p>Reversible – the residual effect is likely to be reversed after activity completion and reclamation</p> <p>Partially reversible – the residual effect can be partially reversed</p> <p>Irreversible – the residual effect is unlikely to be reversed</p>																																								
Frequency	How often the residual effect occurs and how often during the Project or in a specific phase	<p>Single event - effect occurs once</p> <p>Multiple irregular event – occurs at no set schedule</p> <p>Multiple regular event – occurs at regular intervals</p> <p>Continuous – occurs continuously</p>																																								
Risk (likelihood and consequences)	Assesses the likelihood and consequences of the potential residual effect. Likelihood is the probability of the residual effect occurring and should consider many factors. Consequence is the potential outcome of the residual effect. Risk is the interaction between likelihood and consequence (see risk rating table)	<p>Consequences: are assessed as minor, moderate or major based primarily on a combination of Magnitude and Geographic Extent as:</p> <table border="1" data-bbox="743 840 1414 1203"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="2">Geographic Extent</th> </tr> <tr> <th>Project Footprint or LAA/AESA</th> <th>RAA</th> </tr> </thead> <tbody> <tr> <td rowspan="4" style="writing-mode: vertical-rl; transform: rotate(180deg);">Magnitude</td> <td>No Measurable Change</td> <td>Minor</td> <td>Minor</td> </tr> <tr> <td>Low</td> <td>Minor</td> <td>Minor or Moderate</td> </tr> <tr> <td>Moderate</td> <td>Minor or Moderate</td> <td>Moderate</td> </tr> <tr> <td>High</td> <td>Moderate or Major</td> <td>Major</td> </tr> </tbody> </table> <p>*Where relevant, Duration is also taken into consideration (e.g., a high Magnitude event within the LAA may be Moderate or Major in Consequence and Duration could be considered)</p> <p>Likelihood: as defined in the Risk table below</p> <p>Risk:</p> <p>Low: Low risk/uncertainty of effect prediction</p> <p>Moderate: Moderate risk/uncertainty of impact prediction</p> <p>High: High risk/uncertainty of impact prediction</p> <table border="1" data-bbox="743 1539 1414 1883"> <thead> <tr> <th colspan="2" rowspan="2"></th> <th colspan="3">Consequence</th> </tr> <tr> <th>Major</th> <th>Moderate</th> <th>Minor</th> </tr> </thead> <tbody> <tr> <td rowspan="3" style="writing-mode: vertical-rl; transform: rotate(180deg);">Likelihood</td> <td>High (>80% chance)</td> <td>High</td> <td>Moderate</td> <td>Low</td> </tr> <tr> <td>Medium (40-80% chance)</td> <td>High</td> <td>Moderate</td> <td>Low</td> </tr> <tr> <td>Low (<40% chance)</td> <td>Moderate</td> <td>Low</td> <td>Low</td> </tr> </tbody> </table>			Geographic Extent		Project Footprint or LAA/AESA	RAA	Magnitude	No Measurable Change	Minor	Minor	Low	Minor	Minor or Moderate	Moderate	Minor or Moderate	Moderate	High	Moderate or Major	Major			Consequence			Major	Moderate	Minor	Likelihood	High (>80% chance)	High	Moderate	Low	Medium (40-80% chance)	High	Moderate	Low	Low (<40% chance)	Moderate	Low	Low
		Geographic Extent																																								
		Project Footprint or LAA/AESA	RAA																																							
Magnitude	No Measurable Change	Minor	Minor																																							
	Low	Minor	Minor or Moderate																																							
	Moderate	Minor or Moderate	Moderate																																							
	High	Moderate or Major	Major																																							
		Consequence																																								
		Major	Moderate	Minor																																						
Likelihood	High (>80% chance)	High	Moderate	Low																																						
	Medium (40-80% chance)	High	Moderate	Low																																						
	Low (<40% chance)	Moderate	Low	Low																																						

Table 7.4–16 – Characterization of Residual Effects

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Uncertainty	The degree of uncertainty as assessed for the data and methods including potential effectiveness of mitigation measures that have been used in the assessment of effects	<p>Low – good understanding of the pathway to effect(s) on the VC due to the Project activities and/or physical works and sufficient data is available to support the assessment. Uncertainty associated with data and/or modelling is low. The effectiveness of the selected mitigation is expected to be moderate to high. Overall, uncertainty in the predicted residual effect is low.</p> <p>Moderate – potential uncertainty associated with the pathway to effect(s) on the VC due to the Project activities and/or physical works, e.g., due to unknown external variables or incomplete data. Potential for uncertainty associated with data and/or modelling. The effectiveness of mitigation is expected to be moderate to low. Uncertainty in the predicted residual effect is considered moderate.</p> <p>High – poor understanding of the pathway to effect(s) on the VC due to the Project activities and/or physical works. May be unknown external variables and/or data for the Project is incomplete. Modelling results may vary considerably with inputs. The effectiveness of the mitigation may be expected to be low or is unproven. Overall there is a high degree of uncertainty associated with the predicted residual effect.</p>

1

2 **7.4.9 Assessment of Residual Effects**

3 **7.4.9.1 Assessment of Change in the Chemical and Physical Composition of Surface Water Quality**

4 This section describes the analytical assessment techniques, effect pathways, mitigation measures,
 5 predicted residual effects, and likelihood of predicted residual effects as they pertain to change in the
 6 chemical and physical composition of surface water.

7 7.4.9.1.1 Change Due to Land Disturbance, Erosion, and Dust Fall

8 A qualitative assessment approach was used for the assessment of change in water quality due to land
 9 disturbance, erosion, and dust fall. Potential Project-related effects on surface water quality were
 10 assessed by:

- 11 1. Describing the effect mechanism(s) by which Project components or activities identified in
- 12 Table 7.4–15 may result in measurable changes in surface water quality
- 13 2. Evaluating the likely effectiveness of identified mitigation measures to reduce or eliminate the
- 14 potential effect
- 15 3. Characterizing the likely residual effect to surface water quality (i.e., after mitigation) based on
- 16 magnitude, duration, geographic extent, frequency, and reversibility

17 Mitigation of potential effects on surface water quality focused on the protection of water quality through
 18 Project design and implementation of BMPs (see Section 7.4.9.1.4).

1 7.4.9.1.2 Change Due to Acidification or Eutrophication

2 An acidification and eutrophication assessment of surface water was conducted following the guidance
3 provided by BC MOE (2015). For the assessment of Project effects, wet and dry deposition of sulphur and
4 nitrogen compounds were calculated to determine the acidic deposition patterns predicted from
5 emissions of SO₂ and NO_x from the Project. Details of the air quality modelling are presented in the
6 *Technical Data Report - Air Quality* (Appendix 7.02A: Stantec 2023a). Five modelling scenarios were used
7 to assess potential freshwater acidification and eutrophication for the Project:

- 8 • **Baseline Case:** Includes background concentrations defined from an air quality monitoring station
9 outside the modelling domain in Juneau, Alaska, given that there were no local monitoring
10 stations within the model domain. These background concentrations were considered
11 representative because the monitoring station was located in a similar location to the Project in
12 a remote coastal area with no nearby emission sources. The same Baseline Case deposition rate
13 is used throughout the AESA
- 14 • **Project-alone Case (BC Hydro):** Includes emission sources from the Project only, assuming power
15 is provided through BC Hydro
- 16 • **Project-alone Case (On-Site Power Generation):** Includes emission sources from the Project only,
17 assuming on-Site power generation
- 18 • **Application Case (BC Hydro):** Combines the Project-alone Case (BC Hydro) and Baseline Case
- 19 • **Application Case (On-Site Power Generation):** Combines the Project-alone Case (On-Site Power
20 Generation) and Baseline Case

21 Outputs from each of the scenario model runs were used to create isopleth concentration maps of S+N
22 and N deposition (Figure 7.4–3). Additional details for the air quality modelling are presented in the
23 *Technical Data Report - Air Quality* (Appendix 7.02A: Stantec 2023a).

24 Changes to surface water quality due to potential acidification of lakes and streams in the AESA were
25 assessed by calculating CL_(A) (i.e., the maximum amount of acid deposition that can occur within a
26 waterbody without permanently affecting the aquatic ecosystem) using the methods outlined in
27 Section 7.4.5.1.3.2. Total acid inputs for the Baseline Case and Application Cases were calculated and
28 compared to the CL_(A) to determine if any of the lakes and streams in the AESA were predicted to have an
29 acid input that could exceed the CL_(A) using the following equation:

30 **Equation 3**

$$31 \quad EX_a = S_{\text{dep}} + N_{\text{dep}} - CL_{(A)}$$

32 This formula calculates the difference between the combined deposited sulphur (**S_{dep}**; meq/m²/y) and
33 nitrogen (**N_{dep}**; meq/m²/y) and the CL_(A). EX_a values greater than zero indicate that inputs of sulphur and
34 nitrogen will exceed the waterbody's ability to buffer against increase in acidity, with a risk of acidity
35 declining below the ANC_{limit} and no longer being protective of aquatic biota.

1 If no acid input exceedance was predicted, changes to surface water are unlikely to occur. If acid input
2 exceedances were predicted, potential changes to surface water quality were assessed based on whether
3 there was a change in critical load status (i.e., whether there was a $CL_{(A)}$ exceedance for both the
4 Baseline Case and the Application Cases or whether there was no $CL_{(A)}$ exceedance for the Baseline Case
5 but a $CL_{(A)}$ exceedance for the Application Cases).

6 The methods used to determine the $CL_{(A)}$ exceedance are considered conservative due to the following
7 model inputs:

- 8 • The assessment deposition rates for each lake or stream site represents the maximum annual
9 average values derived from one-hour deposition rates modelled over the five-year model period.
10 This deposition rate does not reflect the fluctuations in deposition that will occur over the
11 five-year model period
- 12 • The assessment is based on maximum deposition rates applied to the entire catchment for an
13 assessment site which does not reflect the fluctuations in deposition over the catchment
- 14 • The assessment assumes that 100% of depositional sulphur and nitrogen are mobilized to surface
15 water. This assumption does not reflect the potential for depositional nitrogen to be retained in
16 the biomass and soil of vegetated areas within a catchment (Henrikson and Posch 2001;
17 Sutton et al., 2014, Gurmesa et al., 2022)

18 A detailed description of the how $CL_{(A)}$ and $CL_{(A)}$ exceedances were calculated for the acidification
19 assessment is provided in the *Technical Data Report - Acidification and Eutrophication* (Appendix 7.08;
20 Stantec 2023c).

21 The eutrophication assessment used modelled nitrogen deposition rates and empirical critical loads from
22 the literature to assess potential for eutrophication. Baseline nitrogen data were used to calculate
23 baseline trophic status and modelled deposition of Project-related nitrogen was used to conservatively
24 predict trophic status following deposition to further assess the potential for eutrophication using change
25 in trophic status as an indicator.

26 Empirical critical loads for nitrogen represent levels above which changes have been found to occur based
27 on field studies reported in the literature. Potential for eutrophication was assessed by comparing
28 predicted N deposition with empirical critical loads from the literature. Empirical critical loads for
29 N deposition for inland surface waters range from 3 to 10 (kg/ha/y N depending on the ecosystem type
30 (Bobbink and Hettelingh, 2010; de Wit and Lindholm, 2010; Baron *et al.*, 2011; CLRTAP 2017). Empirical
31 critical loads of 5 to 10 kg N/ha/y have been found to be reliable estimates for permanent oligotrophic
32 waters in temperate, boreal regions (CLRTAP 2017). Empirical critical loads of 3 to 5 kg N/ha/y are
33 considered reliable for permanent dystrophic lakes, ponds, and pools (CLRTAP 2017). The value of
34 3 kg/ha/y is consistent with the BC MOE (2015) recommended study area boundary.

1 The likelihood of eutrophication occurring in the lakes and streams sampled due to Project deposition of
2 NO_x was determined by calculating the predicted TN in these waterbodies as follows:

- 3 1. Calculate baseline flux of nitrogen (grams [g]/y) = TN (g/m³) x discharge (m/y) x watershed area
4 (m²)
- 5 2. Calculate Project flux of nitrogen (g/y) = 0.1 x N_{dep} (g/m²/y) x watershed area (m²)
- 6 3. Calculate increase in flux (%) = Project flux (2) / baseline flux (1) x 100%
- 7 4. Calculate increase in nitrogen (g/m³) = TN (g/m³) x (increase in flux rate (3) / 100)
- 8 5. Predicted nitrogen (g/m³) = TN (g/m³) + increase in TN (g/m³) (4)

9 Limitations and assumptions associated with using this approach are as follows:

- 10 • The assessment assumes that 100% of depositional nitrogen is mobilized to surface water. This
11 does not reflect the potential for depositional nitrogen to be retained in the biomass and soil of
12 vegetated areas within a catchment (Henrikson and Posch 2001; Sutton *et al.*, 2014,
13 Gurmesa et al., 2022)
- 14 • The assessment did not consider any ecosystem processes that could increase or decrease
15 nitrogen (i.e., nutrient cycling) in the calculation
- 16 • Nutrient inputs and outputs are considered equal in each waterbody
- 17 • Project activities will not interact with or change the regular lake and stream processes
- 18 • Baseline water chemistry data used for this evaluation captured both terrestrial watershed and
19 aquatic ecosystem processes
- 20 • An increase in the flux of nitrogen will eventually lead to a new steady state in the waterbody at
21 the higher concentration without considering the roles of water residence time and the size of
22 the aquatic systems
- 23 • The eutrophication assessment focuses on inputs of nitrogen and assumes that nitrogen is the
24 limiting nutrient for productivity and growth of phytoplankton and periphyton. Phosphorous is a
25 limiting nutrient for productivity but it is not predicted to change as a result of Project activities

26 A detailed description of the acidification and eutrophication assessment can be found in the
27 *Technical Data Report – Surface Water Acidification and Eutrophication* (Appendix 7.08B; Stantec 2023c).

28 7.4.9.1.3 Project Pathways

29 7.4.9.1.3.1 Land Disturbance, Erosion, and Dust Fall

30 Project activities during construction, operation, and decommissioning have the potential to change the
31 chemical and physical composition of surface water due to land disturbance, erosion, changes in flow, and
32 dust fall. Increased TSS concentrations (and increase in turbidity and specific conductance because of an
33 increase in TSS) are associated with Site preparation, clearing, and construction of land-based
34 infrastructure during the construction phase; facility and infrastructure maintenance during the operation
35 phase; and decommissioning of land-based infrastructure during the decommissioning phase. These

1 activities may result in erosion, and subsequently sedimentation, changes in flow, and dust fall in
2 watercourses and apply to both the LAA and TLAA. Increases in water temperature in waterbodies are
3 associated with riparian clearing as part of Site preparation and clearing during the construction phase,
4 and facility and infrastructure maintenance during the operation phase in both the LAA and TLAA.

5 7.4.9.1.3.2 Deposition of Sulphur and Nitrogen from Emissions

6 Changes in surface water quality may be caused by acidification or eutrophication of freshwater lakes and
7 streams due to increases in air-borne deposition of sulphur and nitrogen during operation of the
8 LNG facility. The potential sources of airborne emissions during the operation phase are: 1) natural gas
9 pre-treatment, liquefaction, storage, and offloading of LNG and NGL products at the FLNG barges; and
10 2) temporary on-Site power generation on barges.

11 Air emissions (i.e., NO_x and SO₂) have the potential to cause acidification of waterbodies, causing a
12 decrease in pH, if the quantity of sulphur and nitrogen deposition exceeds the natural buffering capacity
13 of the waterbody (acidification). Increases in nitrogen inputs (eutrophication) may promote algal growth
14 (e.g., phytoplankton in lakes, periphyton in streams) which can lead to increases in potentially toxic
15 cyanobacteria blooms, decreases in algal community diversity, changes in aquatic community
16 composition, and decreases in dissolved oxygen concentrations in affected waterbodies. Changes in
17 chlorophyll *a* in a lake or stream can indicate changes in phytoplankton and periphyton biomass,
18 respectively.

19 7.4.9.1.4 Mitigation and Enhancement Measures

20 Mitigation measures were selected based on provincial and federal regulations and policies, BMPs,
21 guidelines, and relevant peer-reviewed literature. These included mitigation measures pertaining to
22 surface water quality presented in Requirements and Best Management Practices for Making Changes In
23 and About a Stream in British Columbia (Government of British Columbia 2022) and Measures to Protect
24 Fish and Fish Habitat (DFO 2019), which will also be used to develop site-specific mitigation measures for
25 the CEMP.

26 Mitigation was selected to address Project interactions that affect the chemical and physical composition
27 of surface water during all Project phases. Table 7.4–17 provides a summary of the mitigation and
28 enhancement measures to avoid or reduce change in the chemical and physical composition of surface
29 water. These measures will be incorporated into a Project-specific CEMP. These mitigation measures
30 could also be used to avoid or reduce potential effects on surface water quality within the TLAA. No
31 enhancement measures have been identified.

32 If the potential for acid generating rock or metal leaching is identified as a concern through a
33 pre-construction geochemical characterization of the Site, it will be managed as required. It is expected
34 that should additional excavation be required during operation and/or decommissioning, a similar
35 assessment would be completed.

1 A hierarchical approach was followed to reduce potential changes to surface water. This hierarchy
2 involved implementing avoidance measures that eliminate the potential changes to surface water before
3 applying mitigation measures to reduce remaining effects. For example, as much as practical of the FLNG
4 infrastructure, temporary power barges, and accommodations was located in the marine environment,
5 thereby reducing many potential interactions with surface water. Furthermore, electric-driven
6 refrigeration processes were incorporated into the Project, which will reduce emissions that have the
7 potential to cause acidification or eutrophication to waterbodies within the AESA.

Table 7.4–17 – Mitigation Measures Proposed to Avoid or Reduce Change in the Chemical and Physical Composition of Surface Water

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Mitigation 7.04-1: Develop and implement erosion prevention and sediment control measures using industry standard management practices.</p> <p>Mitigation Mechanism: Managing erosion and sedimentation using industry best practices and Site-specific controls to prevent or reduce changes to water quality.</p>	<p>To prevent or limit change in water quality in the LAA</p>	<p>Expected Success: There is a moderate to high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is some uncertainty about the effectiveness of this mitigation measure because of the wet climate around the Project area. Continuous wet/rainy conditions can reduce the effectiveness of erosion prevention and sediment control measures if measures are not regularly monitored and adapted to address local conditions.</p>	<p>Project Phase: Construction Operation Decommissioning</p> <p>Effectiveness: This mitigation measure is expected to be effective in the short-term and long-term</p>	<p>CEMP</p>
<p>Mitigation 7.04-2: Develop and implement measures for water and stormwater management.</p> <p>Mitigation Mechanism: The Proponents are committed to meeting the BC Water Quality Guidelines for Freshwater Aquatic Life or being within 20% of background conditions as a component of stormwater management. Water and stormwater management methods are widely used and effective. Documentation and communication (e.g., education) of best practices</p>	<p>To prevent or limit change in water quality in the LAA</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is little uncertainty about the effectiveness of this mitigation.</p>	<p>Project Phase: Construction Operation Decommissioning</p> <p>Effectiveness: This mitigation measure is expected to be effective in the short-term and will begin functioning once measures associated with the water and stormwater management are installed. Educating construction personnel will also aid in the effectiveness of this measure.</p>	<p>CEMP</p>

Table 7.4–17 – Mitigation Measures Proposed to Avoid or Reduce Change in the Chemical and Physical Composition of Surface Water

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>during construction will enable personnel to effectively implement measures to reduce impacts on surface water related to stormwater entering waterbodies.</p>				
<p>Mitigation 7.04-3: Implement dust control measures (e.g., application of water) during dry or dusty conditions. Mitigation Mechanism: Watering roads and exposed surfaces will help to suppress dust and thus limit dust inputs into waterbodies within the LAA.</p>	<p>To prevent or limit change in water quality in the LAA.</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure. Risk and Uncertainty: There is little uncertainty of the effectiveness of this mitigation measure.</p>	<p>Project Phase: Construction Decommissioning Effectiveness: This mitigation measure is effective in the long-term and will function immediately upon application.</p>	<p>CEMP</p>
<p>Mitigation 7.04-5 Planning and design will avoid or reduce impacts to identified watercourses, wetlands and riparian areas within the proposed terrestrial Project footprint to the extent possible. Mitigation Mechanism: Proper understanding and the subsequent implementation of mitigation will reduce impacts on surface water quality related to stormwater entering waterbodies through education and accountability.</p>	<p>Stormwater management methods are widely used and effective</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure. Risk and Uncertainty: There is little uncertainty about the effectiveness of this mitigation measure because effectively communicating stormwater management practices will reduce sedimentation and reduce changes in surface water quality.</p>	<p>Project Phase: Construction Operation Decommissioning Effectiveness: This mitigation measure is expected to be effective in the short-term.</p>	<p>CEMP</p>

Table 7.4–17 – Mitigation Measures Proposed to Avoid or Reduce Change in the Chemical and Physical Composition of Surface Water

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Mitigation 7.04-6 Complete a geotechnical assessment of the Site including a geochemical characterization by a qualified professional of the potential for acid rock drainage/metal leaching (ARD/ML) during FEED. Should the need for geochemical management to mitigate potential effects to water quality and aquatic resources be identified, mitigation will be developed prior to construction activities that may result in ARD/ML to the environment and will be implemented while those activities are occurring.</p> <p>Mitigation Mechanism: Proper characterization of the potential for ARD/ML and the subsequent implementation of mitigation measures will reduce potential effects to water quality and aquatic resources.</p>	<p>To prevent or limit change in water quality in the LAA.</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is little uncertainty of the effectiveness of this mitigation measure.</p>	<p>Project Phase: Pre-Construction Construction Operation Decommissioning</p> <p>Effectiveness: This mitigation measure is expected to be effective in the short-term and the long-term.</p>	<p>CEMP</p>

Table 7.4–17 – Mitigation Measures Proposed to Avoid or Reduce Change in the Chemical and Physical Composition of Surface Water

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Mitigation 7.02-6: Implement industry standard practices for inspection and maintenance including regular maintenance of machinery and equipment, and completing annual emissions testing on power turbines, thermal oxidizer, and heaters to confirm emission levels.</p> <p>Mitigation Mechanism: Meeting the turbine NO_x limits outlined in the Guideline for the Reduction of Nitrogen Oxide Emissions from Natural Gas-fueled Stationary Combustion Turbine may limit NO_x emissions and N deposition into watercourses within the AESA.</p>	<p>To limit changes in water quality in the AESA.</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is little uncertainty of the effectiveness of this mitigation measure because these are best practices.</p>	<p>Project Phase: Operation</p> <p>Effectiveness: This mitigation measure is effective in the long-term.</p>	<p>N/A</p>

Table 7.4–17 – Mitigation Measures Proposed to Avoid or Reduce Change in the Chemical and Physical Composition of Surface Water

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Mitigation 7.08-3: Establish designated equipment refueling areas and develop a spill response plan. Maintain a designated area for refueling to reduce the likelihood and spatial extent of potential fuel spills to the environment.</p> <p>Mitigation Mechanism: Following the above guidelines reduces the potential for hydrocarbons to enter streams, wetlands, or lakes by removing them from being in proximity to these waterbodies, and allows measures to be implemented (e.g., spill kits) should leaks occur.</p>	<p>These guidelines are industry standard BMPs</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is little uncertainty about the effectiveness of this mitigation measure because it is industry standard practices, and the methods are well established and proven effective.</p>	<p>Project Phase: Construction Operation Decommissioning</p> <p>Effectiveness: This mitigation measure is effective in the short-term and long-term and effective immediately upon implementation.</p>	<p>CEMP</p>

1 7.4.9.1.5 Project Residual Effects

2 7.4.9.1.5.1 Changes in Water Quality Due to Land Disturbance, Erosion, and Dust Fall

3 Clear-span structures or open bottom culverts for watercourse crossings will be constructed over eight
4 watercourses (e.g., WC-02, WC-02.1, WC-02.9, WC-03, WC-03.3, WC-04, WC-05, and WC-06) and two
5 NCDs (NCD-05a and NCD-06a). These crossings will be constructed above the ordinary high water mark of
6 the watercourses therefore, except for the potential to ford the watercourse to facilitate construction, no
7 instream work is expected. Water intakes are planned to be placed within WC-02 and WC-04.
8 Watercourse crossing installation is also anticipated to be required in relation to transmission line
9 construction in the TLAA.

10 All mitigation measures that would be implemented to avoid or reduce potential effects to surface water
11 quality during construction, operation, and decommissioning of the Project are expected to be
12 moderately to highly effective. This is because these measures are industry standards used throughout
13 BC, including in north coast locations with similar conditions to those present in the LAA. In addition to
14 the mitigation measures in Table 7.4–17, instream works related to watercourse crossings construction in
15 the TLAA will be conducted in isolation of flowing water, which will reduce the potential for
16 sedimentation.

17 While there may be small unavoidable increases in TSS, turbidity, changes in flow, and specific
18 conductance (e.g., in relation to storm events or instream works related to watercourse crossing
19 installation, which may cause erosion and result in increased sedimentation in waterbodies), these
20 increases are expected to be infrequent, highly localized, and of short duration.

21 Residual effects to surface water quality will be managed through implementation of the CEMP. The CEMP
22 will include guidelines, BMPs, and mitigation measures to limit Project-related effects on surface water
23 quality. With implementation of mitigation measures and BMPs to reduce erosion and sedimentation
24 (e.g., sediment mobilization and runoff into watercourses) during Site preparation and while working in
25 areas of exposed soil during construction, operation, and decommissioning, surface water quality levels
26 are expected to remain within the BC WQG-FAL (BC ENV 2023b) for TSS and/or turbidity. BC WQG-FAL (BC
27 ENV 2023b) state that TSS should measure < 10 mg/L of change above background levels when
28 background is 25 to 100 mg/L during high flows or turbid waters or less than a 10% change above
29 background when background is > 100 mg/L.. BC WQG-FAL (BC ENV 2023b) specifies that TSS should
30 measure <25 mg/L of change from background at any one time for a duration of 24 hours in all waters
31 during clear flow or in clear waters and <5 mg/L of change in background at any one time for a duration
32 of 30 days in all waters during clear flows or in clear waters.

33 Changes in water temperature due to riparian clearing is anticipated to be negligible. Potential riparian
34 clearing in the riparian management area (**RMA**), as defined by the Environmental Protection and
35 Management Regulation, will be restricted to approximately 5.0 ha around the WC-02, WC-03, WC-04,
36 and WC-06 watersheds in relation to the Project footprint and watercourse crossing construction
37 (see Section 7.08 – Freshwater Fish and Fish Habitat for more details). Marking of sensitive features, such

1 as streams, will be completed prior to clearing activities in the construction and operation phases to avoid
2 clearing within the RMAs as much as possible.

3 Clearing in the RMA is also expected to be required in the TLAA for transmission line construction and
4 maintenance during operation. It is anticipated that clearing in the RMA would be limited, where possible,
5 by designing the transmission line to span watercourses and reduce the need for riparian clearing and
6 vegetation maintenance. In areas where riparian clearing is required, it is expected that shorter vegetation
7 (e.g., shrubs) that will reduce potential impacts to surface water quality. Residual effects are anticipated
8 to be low.

9 With the application of mitigation measures, changes in water quality due to dust fall are anticipated to
10 be negligible. Applying water to roads and other exposed surfaces is an effective way to suppress dust.

11 Residual effects to water quality with respect to land disturbance, erosion, changes in flow, and dust fall
12 are anticipated to be low in magnitude, limited to the LAA and TLAA, short-term in duration, occur as
13 multiple irregular events, and be reversible as vegetation is re-established in the Project footprint and
14 TLAA after decommissioning.

15 7.4.9.1.5.2 Acidification and Eutrophication

16 Figure 7.4–3 summarizes the 100 eq/ha/y S+N deposition isopleths for the acidification assessment. Only
17 Project-alone Case (BC Hydro) and Project-alone Case (On-Site Power Generation) are shown, as the
18 Baseline Case and, as a result, the application Cases exceed 100 eq/ha/y S+N deposition throughout the
19 AESA. The air quality modelling found that the S+N deposition Project-alone Case (BC Hydro) isopleth
20 within Canada is generally limited to the north side of Pearse Island and a small area on the southwest
21 side of Ashington Range, a peninsula on northeast of Pearse Island.

22 Results of the acidification assessment indicate that no $CL_{(A)}$ exceedances (i.e., the maximum acid input
23 level to protect aquatic biota) are predicted for any air quality model scenario in LK-01, STR-01, STR-02,
24 and STR-03 (80% of waterbodies sampled; Table 7.4–18) when using the June 2022 or
25 September/October 2022 baseline water quality data. These waterbodies all had very low acid
26 sensitivities. LK-02 was predicted to have $CL_{(A)}$ exceedances in all of the modelling scenarios, including the
27 Baseline Case using the June 2022 sampling data and no $CL_{(A)}$ exceedances in any scenario using the
28 October 2022 sampling data. The residual effects with respect to acidification are anticipated to be low
29 magnitude as there is no change in the number or location of $CL_{(A)}$ exceedances when the Application
30 Cases are compared to the Baseline Case.

1 **Table 7.4–18 – Residual Effects of Acidification Potential for the Baseline Case and Application Case**

Site ID	Waterbody	Water Quality Sample Date	BC ₀ (µeq/L)	Critical Load (CL _(A)) (meq/m ² /y)	EX _a (meq/m ² /y)		
					Baseline Case	Application Case (BC Hydro)	Application Case (On-Site Power Generation)
LK-01 inlet	Unnamed	June 2022	92	135	-124	-123	-122
		Oct. 2022	260	571	-560	-560	-559
LK-01 middle	Unnamed	June 2022	167	330	-319	-318	-317
		Oct. 2022	251	548	-537	-536	-535
LK-01 outlet	Unnamed	June 2022	170	337	-326	-326	-324
		Oct. 2022	253	553	-542	-542	-541
LK-01 bottom	Unnamed	Oct. 2022	386	897	-886	-886	-885
LK-02	Unnamed	June 2022	37	-8	19	20	24
		Oct. 2022	48	18	-7	-6	-3
STR-01	Dogfish Creek	June 2022	197	560	-549	-542	-530
		Sept. 2022	250	751	-740	-733	-721
STR-02	Unnamed	June 2022	186	344	-333	-318	-296
		Sept. 2022	146	248	-237	-222	-200
STR-03	Unnamed	June 2022	168	349	-338	-331	-317
		Sept. 2022	196	425	-415	-407	-393

NOTES:

meq/m²/y = milliequivalents per square metre per yearGray highlighting indicates critical load of acidity (CL_(A)) exceedance.

2
3 Empirical critical loads for N deposition for inland surface waters range from 3 to 10 kg/ha/y N depending
4 on the ecosystem type (e.g., temperate or boreal region, permanent oligotrophic waters) (Bobbink and
5 Hettelingh 2010; de Wit and Lindholm 2010; Baron *et al.*, 2011; CLRTAP 2017). Figure 7.4–3 summarizes
6 the 3 kg/ha/y N deposition isopleths for the eutrophication assessment. For cases related to on-Site power
7 generation, modelled /y N deposition isopleths over land are limited to the north end of Pearse Island and
8 a small area on Ashington Range near the mouth of STR-01 (Dogfish Creek). N deposition 3 kg/ha/y
9 isopleths for cases related to power supply by BC Hydro are limited to a small area on Pearse Island. Within
10 the modelled 3 kg/ha/y N deposition isopleth, potential eutrophication is expected with the addition of
11 nitrogen from deposition. Provided other conditions are favorable (e.g., temperature), the addition of
12 nitrogen from deposition into these lakes and streams could potentially impact them by resulting in a
13 change in algal community, an increase in algal productivity, and a shift from nitrogen to phosphorus
14 limiting the growth of primary producers as described in Bobbink and Hettelingh (2010).

15 The lakes and streams were further evaluated to identify whether the increase in N from deposition would
16 change their trophic status. No change in trophic status was predicted for the two lakes and three streams
17 sampled in the modelled scenarios (i.e., Baseline Case, Project-alone Case (BC Hydro), Project -alone Case
18 (On-Site Power Generation), Application Case (BC Hydro), and Application Case (On-Site Power

1 Generation)), as summarized in Table 7.4–19. All the lakes and streams assessed for eutrophication were
 2 oligotrophic in all the scenarios. Though no change in trophic status is predicted, increases in TN in the
 3 lakes and streams are predicted, with higher TN values associated with Application Case (On-Site Power
 4 Generation) when compared to Application Case (BC Hydro). The residual effects with respect to
 5 eutrophication are anticipated to be low magnitude as there is no change in trophic status when the
 6 Application Cases are compared to the Baseline Case.

7 Electrical power will ultimately be provided by BC Hydro (i.e., Application Case (BC Hydro)), which will
 8 lower emissions and sulphur and nitrogen deposition. However, if the connection to the BC Hydro grid is
 9 delayed, on-Site power generation may be required at Site for up to five years following the start of
 10 operation.

11 Residual effects to water quality with respect to acidification and eutrophication are anticipated to be low
 12 in magnitude, limited to the LAA (i.e., the AESA), medium term in duration, reversible following
 13 completion of operation, and continuous during Project operation. The likelihood of a change in the
 14 chemical and physical composition of surface water due to increases in TSS, turbidity, specific
 15 conductance, or temperature, or due to changes in pH or trophic status from acidifying or eutrophying
 16 emissions, is predicted to be low. Consequences will be minor and overall risk is low.

17 **Table 7.4–19 – Residual Effects of Trophic Status for the Baseline Case and Application Cases**

Site ID	Waterbody	Sample Date	Predicted Trophic Status		
			Baseline Case	Application Case (BC Hydro)	Application Case (On-Site Power Generation)
LK-01 inlet	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic
LK-01 middle	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic
LK-01 outlet	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic
LK-02	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic
STR-01	Dogfish Creek	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic
STR-02	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic
STR-03	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic

18

1 7.4.9.2 Assessment of Change in Surface Water Quantity

2 The assessment of change to surface water quantity resulting from water withdrawals was completed
3 quantitatively and is discussed below. Surface water sources at Wil Milit are being considered as a
4 potential source of water supply during the construction phase and will be limited to WC-02 or WC-04.

5 The assessment of change in surface water quantity due to reductions in watershed areas and changes to
6 land cover over the Project footprint and overburden storage areas was assessed semi-qualitatively; each
7 method is described below.

8 7.4.9.2.1 Quantitative assessment of change from surface water withdrawals

9 Mitigation of potential effects on surface water quantity focused on the preservation of water quantity
10 through Project design and implementation of best management practices.

11 While the specific volumes and rates of withdrawal have not been established, permissible withdrawal
12 rates will be identified through the *Water Sustainability Act* licencing process.

13 It is expected that the permitted withdrawal volumes and rates will be informed by:

- 14 • Environmental Flow Needs Policy (BC FLNRORD and BC ENV 2022, discussed below)
- 15 • Baseline data and hydrologic modelling (BC FLNRORD and Foundry Spatial 2022)
- 16 • Seasonal conditions
- 17 • Site-specific conditions

18 To characterize the magnitude of potential effects on Surface Water Quantity within the LAA,
19 BC environmental flow needs (EFN) guidelines for risk management level and flow sensitivity
20 (BC FLNRORD and BC ENV 2022) have been adopted.

21 Risk management levels are dependent on the quantity of water to be withdrawn and whether ‘sensitive
22 species or habitats’ are present. A Risk Management Level 1 “indicates that supplementary information
23 may not be required, unless the presence of sensitive species or habitats suggests the need for
24 Special Considerations”, and “there is sufficient water available to provide for EFN as well as for proposed
25 water diversion and use” (BC FLNRORD and BC ENV 2022). Less than 15% of mean monthly discharge can
26 be cumulatively withdrawn while maintaining EFN. Withdrawals from WC-02 and WC-04 are currently
27 intended to correspond to Risk Management Level 1 in periods of ‘low’ sensitivity, and potential
28 allocations are provided in Table 7.4–11, Table 7.4–12 and Table 7.4–13.

29 The sensitivity of streams to withdrawal are classified as low, moderate, or high (BC FLNRORD and
30 BC ENV 2022). Flow in a watercourse varies month-to-month and flow sensitivity is considered low if the
31 average monthly flow is greater than 20% of the MAD, moderate sensitivity if the average monthly flow
32 is 10 to 20% of the MAD, and high sensitivity if the average monthly flow is less than 10% of the MAD
33 (BC FLNRORD and BC ENV 2022). All monthly flow sensitivities are classified as ‘low’ under
34 Risk Management Level 1 for WC-04. At WC-02, all months are classified as ‘low’ except for July and
35 August, which are classified as ‘moderate’. (Table 7.4–11; Table 7.4–12; Table 7.4–13).

1 Definitions for residual effects classifications are summarized in Table 7.4–16 and are based on
2 Risk Management Level and flow sensitivity.

3 It is unknown at this time whether the third-party transmission line, within the TLAA, will require water
4 withdrawal during construction, and therefore it is not included in the quantitative assessment of change
5 from surface water withdrawals. It is assumed that if required, any potential environmental issues
6 regarding water withdrawal will be assessed and accounted for through a *Water Sustainability Act*
7 licencing process specific to the transmission line.

8 7.4.9.2.2 Qualitative Assessment of Change from Reduction in Watershed Area and Changes to 9 Land Cover

10 Anticipated terrestrial Project facilities were assessed semi-qualitatively for potential changes to runoff
11 patterns, surface type, evapotranspiration, and infiltration within the LAA based on the type of land
12 surface change and the area over which the change is proposed to occur.

13 7.4.9.2.3 Project Pathways

14 Water will likely be used for domestic and industrial purposes during construction. During operation
15 domestic and industrial water will be sourced primarily from desalination.. The volumes of water required
16 will be determined during front-end engineering and design (FEED). Components of water management
17 potentially affecting surface water quantity within the Site could include installation of a surface water
18 diversion structure, a pump, water pipeline and access road to the Site. Water management will occur
19 through development and implementation of a TARP for incorporation into the CEMP.

20 Changes in surface water flow, runoff, and drainage patterns could occur within the LAA through water
21 withdrawals, reduction in watershed area, and changes to land cover. Although details related to the
22 third-party transmission line are not available, it is assumed that similar changes may be applicable within
23 the TLAA.

24 7.4.9.2.3.1 Water Withdrawals

25 Any water withdrawals from water sources would reduce the quantity of water available for fish and
26 wildlife. As described in Section 1.9.5, the Project is considering various water supply options for domestic
27 and process water, including surface water.

28 7.4.9.2.3.2 Reduction in Watershed Area and Changes to Land Cover

29 Project activities relating to a reduction in watershed area and changes to land cover include Site
30 preparation and clearing, construction and decommissioning of land-based infrastructure, waste
31 management (e.g., storage of overburden, biomass, and wastewater management), and rainfall
32 catchment and storage (Stantec 2021b). These activities can change runoff patterns and the timing and
33 magnitude by changing the land type and hence evapotranspiration and infiltration and may occur within
34 the LAA. Although details related to the third-party transmission line are not available, it is assumed that
35 similar activities may be required during construction and decommissioning, and may similarly change
36 runoff patterns, timing, and magnitude within the TLAA.

1 7.4.9.2.3.3 Other Considered Pathways

2 Groundwater is inferred to flow from higher elevations in the RAA towards the LAA (Section 7.05).
 3 Groundwater is not considered as a pathway to effects or to be affected by changes in surface water
 4 quantity because:

- 5 • No groundwater withdrawals are planned
- 6 • Surface water withdrawals are not anticipated to affect groundwater recharge. Withdrawals are
 7 anticipated during the construction phase and will occur near the coast, i.e., near the mouths of
 8 watercourses

9 7.4.9.2.4 Mitigation and Enhancement Measures

10 Mitigation measures were selected based on provincial regulations and policies, management practices
 11 and guidelines, and relevant peer-reviewed literature. Table 7.4–20 provides a summary of the mitigation
 12 measures to avoid or reduce change to surface water quantity. These measures will be incorporated into
 13 a Project-specific CEMP. These mitigation measures could also be used to avoid or reduce potential effects
 14 on surface water quantity within the TLA. The actual mitigation measures for the transmission line will
 15 be determined once the third-party starts to design the route. The CEMP will be incorporated into
 16 appropriate construction-related contracts. No enhancement measures have been identified.

Table 7.4–20 – Mitigation and Enhancement Measures Proposed to Avoid or Reduce Changes to Surface Water Quantity

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Mitigation 7.04-4: Develop and implement a Trigger Action Response Plan (TARP) for water and sediment control management to align with licensing requirements as stipulated</p> <p>Mitigation Mechanisms: The TARP is a management tool to be used during monitoring of streamflow at water withdrawal sites in order to determine allowable volume for surface water withdrawals. Withdrawals will correspond to BC Environmental Flow</p>	<p>Mitigation is consistent with BC EFN guidance (BC FLNRORD and BC ENV 2022) designed to provide withdrawal volumes to maintain the proper functioning of the aquatic ecosystems of streams. The EFN protocol is widely applied and accepted.</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure.</p> <p>Risk and Uncertainty: There is little uncertainty about the effectiveness of this mitigation measure because withdrawals will be kept within Risk Level 1 and ‘low’ sensitivity levels.</p>	<p>Project Phase: Construction</p> <p>Effectiveness: This mitigation measure is expected to be effective for as long as withdrawals occur.</p>	<p>Develop and implement a TARP for incorporation into the CEMP</p>

Table 7.4–20 – Mitigation and Enhancement Measures Proposed to Avoid or Reduce Changes to Surface Water Quantity

Mitigation/Mitigation Mechanism	Rationale for Selection	Expected Success/Risks and Uncertainty	Timing	Management and/or Compensation Plans
<p>Needs (BC EFN) guidelines for Risk Level 1 and ‘low’ sensitivity (BC FLNRORD and BC ENV 2022). The TARP will include monitoring flows in real-time as withdrawals occur to ensure withdrawals comply with licensing requirements.</p>				
<p>Mitigation 7.04-5 Planning and design will avoid or reduce impacts to identified watercourses, wetlands and riparian areas within the proposed terrestrial Project footprint to the extent possible. Mitigation Mechanism: Proper understanding and the subsequent implementation of mitigation will reduce impacts on surface water related to stormwater entering waterbodies through education and accountability.</p>	<p>Stormwater management methods are widely used and effective</p>	<p>Expected Success: There is a high likelihood of success associated with this mitigation measure. Risk and Uncertainty: There is little uncertainty about the effectiveness of this mitigation measure because effectively communicating stormwater management practices will reduce sedimentation and reduce changes in surface water quantity.</p>	<p>Project Phase: Construction Operation Decommissioning Effectiveness: This mitigation measure is expected to be effective in the short-term.</p>	<p>CEMP</p>

1

2 7.4.9.2.5 Project Residual Effects

3 7.4.9.2.5.1 Water Withdrawals within the LAA

4 WC-02 and WC-04 are being considered for freshwater withdrawals during the construction and operation

5 phases. Both of these watercourses are fish-bearing. Potential effects of water withdrawal on fish and

6 fish habitat are discussed in Section 7.08 of the Application. Water withdrawals for the Project have not

7 yet been licensed and withdrawal volumes are not finalized. A preliminary assessment of water availability

8 and identification of minimum flow requirements for fish is conducted here based on modelled flow data

1 (BC FLNRORD and Foundry Spatial 2022) and BC EFN policy (BC FLNRORD and BC ENV 2022). For example,
2 minimum monthly allocations at WC-04 under Risk Management Level 1 and ‘low’ flow sensitivity are
3 about 12,000 m³ in July and August, and maximum monthly availability is about 48,000 m³ in May and
4 October (Table 7.4–12). The timing and magnitude of this residual effect will vary throughout the year,
5 depending on flow conditions and withdrawal volumes.

6 Prior to licensing, the timing and volume of withdrawals will be determined using volumes provided above
7 and results from on-Site monitoring (Appendix 7.4).

8 Mitigation will occur by incorporating a TARP for water management into the CEMP. The TARP will use
9 on-Site hydrometric monitoring data to define appropriate triggers, trigger thresholds, and responses for
10 withdrawals. For example, the TARP will include flow monitoring as withdrawals occur to confirm that
11 withdrawals comply with licensing requirements. Additionally, an adaptive management and monitoring
12 plan may need to be developed in support of provincial licence requirement, a component of which would
13 include the TARP.

14 As stated in Section 7.4.9.2.1 a quantitative assessment of change from surface water withdrawals within
15 the TLAA has not been completed.

16 7.4.9.2.5.2 Reduction in Watershed Area and Changes to Land Cover

17 Most of the Project’s terrestrial infrastructure will be on the eastern portion of District Lot 5431. The total
18 Project terrestrial footprint at Wil Milit is estimated at 37.75 ha (0.38 km²). This includes areas of waste
19 storage and overburden.

20 Most of the Project terrestrial footprint drains unchannelized hillslopes, does not intersect with larger
21 WC catchments (e.g., WC-02, WC-04, WC-09), and largely occurs in areas that drain catchment areas less
22 than 0.75 km². Interactions with the Project footprint would occur at the hillslope/plot scale. The
23 exception is a small portion of the WC-04 catchment near its mouth, where the watercourse drains into
24 Portland Canal (Figure 7.4–2). This area is 3.26 ha (0.033 km²), or 3% of the WC-04 watershed.
25 Modifications to drainage patterns, flow, and runoff at the catchment scale and scale where channelized
26 flow occurs will be limited to a relatively small area. In addition, withdrawals planned from WC-04 would
27 largely not interact with changes to land cover described below, since its watershed is largely outside of
28 the Project footprint. The timing and magnitude of this residual effect will vary throughout the year,
29 depending on flow conditions and withdrawal volumes.

30 Hydrological changes at the hillslope/plot scale can be assessed by examining current hydrologic
31 conditions in the Project footprint and expected changes to land cover.

1 Currently, losses to infiltration and evapotranspiration appear to be low at Wil Milit. For example,
2 potential evapotranspiration is about 16% of annual precipitation (Table 7.4–6); actual evapotranspiration
3 is likely less than potential. In addition, the LAA and RAA are underlain by unconsolidated deposits,
4 impervious bedrock geology, and steep slopes (Section 7.05, Groundwater). As a result, annual runoff
5 coefficients (the ratio of runoff to precipitation) for WC-02 and WC-04 range from 0.83 to 0.87
6 (using runoff data in Table 7.4–11, Table 7.4–12 and Table 7.4–13, and ClimateBC precipitation data from
7 Table 7.4–6). As expected, this range of runoff coefficients is at the higher end of maximum runoff
8 coefficient values for coastal type basins in BC and is characteristic of mountainous or moderate to steep
9 slopes with impervious or forested land cover (BC MOE 1991).

10 Some ecological communities are expected to decrease in areal extent as a result of Project activities.
11 For example, the areal extent of upland forests will decrease by 21% in the Vegetation and Wetlands LAA
12 and wetlands by 14% in the Vegetation and Wetlands RAA, while sparsely vegetated areas are expected
13 to increase (Section 7.06; Vegetation and Wetlands). Changes to terrestrial land cover will, for example,
14 consist of a helipad, buildings, roads, generators, and plants (Section 1.0 'Project Overview). These
15 changes would be expected to increase runoff coefficients at the plot scale. Maximum runoff coefficients
16 for impervious areas such as roofs and asphalt surfaces are typically about 0.95 (Brown et al. 2001).

17 There is uncertainty in whether runoff coefficients derived at the watershed scale are applicable to the
18 plot/hillslope scale in the Project footprint, and the extent to which these coefficients will change in
19 response to changing land surface type in the Project area. However, land surface types are expected to
20 occur over a small area (less than 38 ha) and over an area that is not hydrologically connected to
21 channelized watercourses. Therefore, hydrologic changes described above would have localized effects
22 on drainage patterns and soil moisture. These effects would be limited by developing and implementing
23 erosion prevention and sediment control measures using industry standard management practices
24 (Table 7.4–20).

25 Construction of the third-party transmission line could result in similar residual effects within the TLAA.
26 For example, installation of infrastructure (e.g., poles, towers) could result in modification to drainage
27 patterns and changes to ecological communities (through clearing) and changes to terrestrial land cover
28 could increase runoff coefficients.

29 Decommissioning and reclamation will move land cover types and surface water quantity characteristics
30 (e.g., flow magnitudes) towards pre-Project conditions within the LAA. Although details are not available,
31 the same is assumed to be applicable for the TLAA as well.

32 7.4.9.2.5.3 Other Pathways Relating to Surface Water Quantity

33 Potential sources of floods at the Site are described in Section 7.4.5.2.4.3. Flooding of infrastructure can
34 be avoided or limited by establishing Project infrastructure above the high tide and/or inundation marks
35 and mapped limits (NHC 2022). High water events within and near channels within the Project's terrestrial
36 footprint would be of concern only near the mouth of WC-04 (e.g., the bridge to be constructed over
37 the WC) (Figure 7.4–1). Expansion of poorly drained areas such as wetlands during floods would be of
38 concern only near the southeast portion of the LAA, where the eastern edge of the wetland near

1 WC-03-WET-a approaches a Project footprint component (Figure 7.4–1). Impacts from floods can be
2 avoided by implementing best practices during construction and implementing stormwater management
3 practices.

4 7.4.9.2.5.4 Summary of Residual Effects

5 Mitigation measures that will be implemented to avoid or reduce potential effects to surface water
6 quantity during construction, operation, and decommissioning of the Project are expected to be highly
7 effective. These measures are industry standards used throughout BC, including in north coast locations
8 with similar conditions as those present in the Surface Water LAA. While there may be small unavoidable
9 changes to water quantity, these are expected to be infrequent and highly localized.

10 Residual effects to surface water quantity will be managed through detailed Project design,
11 implementation of the CEMP, which will include guidelines, BMPs, and mitigation measures to limit
12 Project-related effects on surface water quantity.

13 Residual effects with respect to surface water quantity are anticipated to be low in magnitude, limited to
14 the LAA, short- to medium-term in duration, reversible following completion of operation, and continuous
15 during Project operation. Timing is applicable as withdrawal volumes will be variable depending on the
16 season and flow conditions. The likelihood of changes in surface water quantity that could affect EFN are
17 predicted to be low. Consequences will be minor and overall risk is low. It is expected that with
18 appropriate planning, permitting, and environmental management by the third-party, residual effects
19 associated with construction and operation of the third-party transmission line within the TLAA can be
20 adequately managed and that residual effects would be low magnitude.

21 7.4.9.3 Summary of Mitigation and Enhancement Measures

22 Table 7.4–20 provides mitigation measures for Surface Water, which are summarized in Table 7.4–21. In
23 conjunction with these measures, the Proponents will develop and implement a Project-specific CEMP
24 that captures the mitigation measures tied to Project-related activities and physical works associated with
25 construction.

26 While the mitigation measures are intended for the Proponent, Project contractors will be required to
27 implement these measures as applicable to their scope of work.

Table 7.4–21– Summary of Mitigation and Enhancement Measures for the Assessment of Surface Water

Mitigation Measure	Potential Effects	
	Change in the Chemical and Physical Composition of Surface Water	Change in Surface Water Quantity
Mitigation 7.04-1: Develop and implement erosion prevention and sediment control measures using industry standard management practices.	✓	✓
Mitigation 7.04-5: Planning and design will avoid or reduce impacts to identified watercourses, wetlands and riparian areas within the proposed terrestrial Project footprint to the extent possible.	✓	
Mitigation 7.04-2: Develop and implement measures for water and stormwater management.	✓	
Mitigation 7.04-3: Implement dust control measures (e.g., application of water) during dry or dusty conditions.	✓	
Mitigation 7.02-6: Implement industry standard practices for inspection and maintenance including regular maintenance of machinery and equipment, completing annual emissions testing on power turbines, thermal oxidizer, and boiler to confirm emission levels.	✓	
Mitigation 7.04-4: Develop and implement a Trigger Action Response Plan (TARP) for water and sediment control management to align with licensing requirements as stipulated		✓
Mitigation 7.04-6: Complete a geotechnical assessment of the Site including a geochemical characterization by a qualified professional of the potential for ARD/ML during FEED. Should the need for geochemical management to mitigate potential effects to water quality and aquatic resources be identified, mitigation will be developed prior to construction activities that may result in ARD/ML to the environment and will be implemented while those activities are occurring.	✓	

NOTE:

Check marks indicate the applicable effect to which the mitigation can be successfully applied.

- 1
- 2
- 3
- 4

7.4.9.4 Summary of Project Residual Effects

Table 7.4–22 summarizes Project residual effects on Surface Water.

Table 7.4–22 – Project Residual Effects on Surface Water

Project Phase	Proposed Mitigation and Enhancement Measures	Residual Effects Characterization Criteria								
		Magnitude	Geographic Extent	Timing	Duration	Reversibility	Frequency	Affected Sub-Populations	Risk (Likelihood and Consequences)	Uncertainty
Change in the Chemical and Physical Composition of Surface Water										
Construction	Table 7.4–17	L	LAA-TLAA	N/A	ST	R	MIR	N/A	L	L
Operation	Table 7.4–17	L	LAA*-TLAA	N/A	ST-MT	R	MIR-C	N/A	L	L
Decommissioning	Table 7.4–17	L	LAA-TLAA	N/A	ST	R	MIR	N/A	L	L
Residual Project effect for all phases	Table 7.4–17	L	LAA-TLAA	N/A	ST-MT	R	MIR-C	N/A	L	L
Change in Surface Water Quantity										
Construction	Table 7.4–21	L	LAA-TLAA	A	ST	R	MIR-C	N/A	L	L
Operation	Table 7.4–21	L	LAA-TLAA	A	MT	R	MIR-C	N/A	L	L
Decommissioning	Table 7.4–21	L	LAA-TLAA	A	ST	R	MIR-C	N/A	L	L
Residual Project effect for all phases	Table 7.4–21	L	LAA-TLAA	A	ST	R	MIR-C	N/A	L	L

KEY

See Table 7.4–16 for detailed definitions

Project Phase

- C: Construction
- O: Operation
- D: Decommissioning

Magnitude:

- NMC: No Measurable Change
- L: Low
- M: Moderate
- H: High

Geographic Extent:

- PF: Project Footprint
- LAA: Local Assessment Area
- RAA: Regional Assessment Area
- TLAA: Transmission Line Assessment Area
- *Refers to the LAA and the acidification and eutrophication LAA i.e., the AESA.

Timing:

- N/A: Not Applicable
- A: Applicable
- Duration:**
- ST: Short-term
- MT: Medium-term
- LT: Long-term
- N/A: Not applicable
- Reversibility:**
- R: Reversible
- PR: Partially reversible
- I: Irreversible

Frequency:

- S: Single event
- MIR: Multiple irregular event
- MR: Multiple regular event
- C: Continuous

Affected Sub-Populations:

- ED: Evenly distributed
- DD: Disproportionately distributed

Risk (Likelihood and Consequences)

- L: Low
- M: Moderate
- H: High

Uncertainty:

- L: Low
- M: Moderate
- H: High

1 7.4.9.4.1 Summary of Adverse Residual Effects

2 7.4.9.4.1.1 Surface Water Quality

3 The Project is anticipated to have low magnitude adverse residual effects on surface water quality
4 associated with the construction, operation and decommissioning of the land-based infrastructure and
5 Project emissions during operation. Clearing, grading, and construction, and subsequent removal of the
6 land-based infrastructure, is expected to have adverse residual effects on surface water quality due to
7 infrequent TSS releases that are low in magnitude, localized to the LAA and TLAA, short-term, multiple
8 irregular events during each Project phase. Potential adverse effects due to TSS releases will be reversible.

9 Deposition of sulphur and nitrogen compounds in lakes and streams from Project air emissions during
10 operation will have a low magnitude effect on surface water quality. With respect to acidification, one
11 (LK-02) of the five waterbodies sampled is predicted to have $CL_{(A)}$ exceedances based on one of the two
12 water quality sampling periods (i.e., in June 2022). LK-02 is also predicted to have a $CL_{(A)}$ exceedance in
13 the Baseline Case, so there are no changes in the number or location of $CL_{(A)}$ exceedances when the
14 Application Cases are compared to the Baseline Case. With respect to eutrophication, there are no
15 predicted changes in trophic status but measurable increases in TN in the waterbodies within the
16 3 kg/ha/y isopleth are predicted.

17 There is an overall low risk to surface water quality and the uncertainty related to this assessment is low.
18 The uncertainty related to this assessment causes the effects to be overestimated because conservative
19 assumptions were used in the quantitative assessments to address the uncertainty (e.g., on-site power
20 generation for the Project when the Project will ultimately be electrified by BC Hydro, and conservative
21 values used for the ANC_{limit} in the acidification assessment).

22 Many avoidance measures have been incorporated into the Project design that eliminate or reduce
23 potential adverse residual effects on the chemical and physical composition of surface water quality,
24 including:

- 25 • Siting Project infrastructure to avoid watercourses and wetlands
- 26 • Use of hydro-electric power in the refrigeration processes for the Project, which reduces potential
27 acidifying and eutrophying emissions

1 7.4.9.4.1.2 Surface Water Quantity

2 Two main pathways were identified for surface water quantity (1) withdrawals, and (2) changes to flows
3 due to a reduction in watershed area and changes to land cover. Effects from withdrawals on water
4 quantity will last only as long as withdrawals occur, during all phases.

5 Residual effects pertain to changing land use types within the Project footprint. Clearing, grading, and
6 construction, and subsequent removal of the land-based infrastructure, are expected to have adverse
7 residual effects on surface water quantity. However, residual effects will be reversible; the Project area
8 will be restored as per the applicable agreements with the Nisga'a Nation and as prescribed in operating
9 permits. While details on the third-party transmission are not available, similar adverse residual effects
10 may be expected within the TLAA. Restoration of the TLAA area following construction is expected to be
11 completed per applicable agreements with the Nisga'a Nation or as directed by regulatory authorities and
12 Indigenous nations in regard to the third-party transmission line.

13 The Project is anticipated to have low magnitude adverse residual effects on surface water quantity. The
14 timing of these residual effects will be associated with the construction, operation, and decommissioning
15 of the land-based infrastructure.

16 There is an overall low risk to surface water quantity and the uncertainty related to this assessment is low.
17 Many avoidance measures have been incorporated into the Project design that eliminate or reduce
18 potential adverse residual effects on surface water quantity, including:

- 19 • Withdrawals will follow BC EFN policy and be informed by on-Site monitoring at the time of
20 withdrawal
- 21 • Construction will occur over a relatively small area in a small portion of the WC-04 catchment and
22 will follow BMPs

23 7.4.9.4.2 Summary of Positive Residual Effects

24 No positive residual effects to Surface Water have been predicted, compared to existing conditions.

25 **7.4.10 Assessment of Cumulative Effects on Surface Water**

26 In accordance with the AIR, the assessment of cumulative effects on Surface Water was undertaken
27 because the following two conditions were met:

- 28 • The Project is assessed as having residual effects on Surface Water
- 29 • Residual effects could act cumulatively with residual effects of other past, present, or reasonably
30 foreseeable future physical activities

31 The Project residual effects described in Section 7.4.9.4 that are likely to interact cumulatively with
32 residual environmental effects from past, present, or reasonably foreseeable projects are identified in this
33 section and the resulting cumulative effects are assessed. This is followed by an analysis of the Project's
34 contribution to residual cumulative effects.

1 7.4.10.1 Project Residual Effects Likely to Interact Cumulatively

2 The Project residual effects identified in Section 7.4.9.4 with potential to act cumulatively with those past,
3 present and reasonably foreseeable future projects and activities (see Table 6.7-1 in Section 6.7.1 for more
4 information regarding the Projects and activities included in the Project and Physical Activities Inclusion
5 List) are listed in Table 7.4–23. Where residual effects from the Project act cumulatively with residual
6 effects from other projects and physical activities, a cumulative effects assessment is carried out. Effects
7 identified in Table 7.4–23 not likely to interact cumulatively with residual effects of other projects and
8 physical activities (no check mark) are not discussed further. The assessment of the cumulative effects
9 that are likely to result from the Project in combination with other projects and physical activities are
10 discussed in subsequent sections.

11 Residual effects have been identified for surface water quantity, but these effects will not interact
12 cumulatively with other projects and therefore will not be assessed further.

13 Since not all reasonably foreseeable projects and physical activities may proceed, the cumulative effects
14 assessment should be considered conservative.

Table 7.4–23 – Interactions with the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Effects	Potential Cumulative Effects
	Change in the Chemical and Physical Composition of Surface Water Quality
Past and Present Physical Activities and Resource Use	
Port of Prince Rupert (PRPA)	-
LNG Canada Export Terminal	-
Prince Rupert Airport	-
Northwest Regional Airport Terrace-Kitimat (YXT)	-
Swamp Point – Sand and Gravel	-
Stewart Bulk Terminal	-
Stewart World Port	-
Port of Hyder, Alaska	-
Kitsault Mine	-
True Grit Abrasives	-
All West Trading	-
Various Forestry Activities	-
Various Fishing and Aquaculture Activities	-
Marine Shipping Activities	-
Coastal Gaslink	-

Table 7.4–23 – Interactions with the Potential to Contribute to Cumulative Effects

Other Projects and Physical Activities with Potential for Cumulative Effects	Potential Cumulative Effects
	Change in the Chemical and Physical Composition of Surface Water Quality
Future Physical Activities	
Third-party Powerline	-
Port of Prince Rupert	-
Port Edward Small Scale LNG (Port Edward LNG)	-
Prince Rupert Gas Transmission Project (TransCanada Corp.)	-
Westcoast Connector Gas Transmission Project (Enbridge Inc.)	✓
Kinskuch Lake Hydro (Wind River Power Corporation)	-
Cedar LNG	-
Skeena LNG	-
Totem LNG	-
BC Hydro transmission line upgrades	-

NOTES:

✓ = Those “other projects and physical activities” whose effects are likely to interact cumulatively with the Project’s residual effects.

– = Interactions between the residual effects of other projects and residual effects of the Project are not expected.

1

2 **7.4.10.2 Change in the Chemical and Physical Composition of Surface Water Quality**

3 The only Project residual effect carried forward to the cumulative effects assessment is in relation to
 4 change in water quality due to deposition of S and N compounds from emissions potentially resulting in
 5 acidification and/or eutrophication. Changes associated with construction, operation, and
 6 decommissioning of the land-based infrastructure (e.g., increases in TSS) were not carried forward to the
 7 cumulative effects assessment because the magnitude, duration, and geographic extent of these residual
 8 effects were considered too small to result in any temporal or spatial overlap of Project-related changes
 9 with other past, present, or reasonably foreseeable future projects. For example, future projects may
 10 generate short-term changes in water quality (e.g., TSS) during physical activities, but it is expected that
 11 any projects would require use of similar mitigation measures and would be required to meet similar
 12 effluent permit conditions to protect fish and aquatic life.

13 7.4.10.2.1 Cumulative Effect Pathways

14 For the assessment of potential cumulative effects due to change in the chemical and physical
 15 composition of surface water quality, the spatial and temporal overlap with other projects with the
 16 potential to produce acidifying and eutrophying emissions during operation was assessed. One potential
 17 project, the Westcoast Connector Gas Transmission Project (Enbridge Nasoga Compressor Station), has
 18 the potential to produce S and N compounds in emissions that may act cumulatively with the Project.

1 7.4.10.2.2 Mitigation and Enhancement Measures for Cumulative Effects

2 No additional mitigation measures are proposed to address potential cumulative effects of acidification
3 or eutrophication on surface waters in the AESA.

4 7.4.10.2.3 Residual Cumulative Effects

5 Three modelling scenarios were used to assess the potential for acidification and eutrophication
6 cumulative effects to the chemical and physical composition in surface water quality in freshwater lakes
7 and streams in the AESA:

- 8 • **Baseline Case:** Includes background concentrations defined from an air quality monitoring station
9 outside the modelling domain in Juneau, Alaska, given that there were no local monitoring
10 stations within the model domain. These background concentrations were considered
11 representative because that monitoring station was located in a similar location to the Project in
12 a remote coastal location with no nearby emission sources
- 13 • **Cumulative Case (BC Hydro):** Combines the Project-alone Case (BC Hydro) results plus
14 Baseline Case and emissions from the Enbridge Nasoga Compressor Station (part of the Westcoast
15 Connector Gas Transmission Project)
- 16 • **Cumulative Case (On-Site Power Generation):** Combines the Project-alone Case (On-Site Power
17 Generation) results plus Baseline Case and emissions from the Enbridge Nasoga Compressor
18 Station (part of the Westcoast Connector Gas Transmission Project)

19 Results from the acidification assessment indicate no $CL_{(A)}$ exceedance (i.e., the maximum acid input level
20 to protect aquatic biota) in the Cumulative Case scenarios in LK-01, STR-01, STR-02, and STR-03
21 (Table 7.4–24). LK-02 also did not have predicted $CL_{(A)}$ exceedances across both Cumulative Case scenarios
22 as well as all the remaining of the scenarios, including Baseline Case based on data from the October 2022
23 sampling. Predicated changes to the chemical and physical composition of surface water quality with
24 respect to acidification are anticipated to be low in magnitude, as there are no predicted changes to the
25 number and location of $CL_{(A)}$ exceedances when compared to the Baseline Case.

26 Results from the eutrophication assessment indicate there will be an increase in N in waterbodies within
27 the 3 kg/ha/y N deposition isopleth. However, no change in trophic status is predicted in any of the lakes
28 and streams that were sampled; all are predicted to remain oligotrophic in the cumulative scenarios.
29 Figure 7.4–3 summarizes the 3 kg/ha/y N deposition isopleth for Cumulative Case (BC Hydro) and
30 Cumulative Case (On-Site Power Generation), which shows that deposition over land is limited to the
31 north end of Pearse Island. Because there is no change in trophic status predicted (Table 7.4–25,
32 cumulative effects on changes in chemical and physical composition of surface water quality are
33 anticipated to be low in magnitude.

1 Cumulative effects to water quality with respect to acidification and eutrophication are anticipated to be
2 low in magnitude, limited to the LAA (i.e., the AESA), medium-term in duration, reversible, and continuous
3 during Project operation. The likelihood of a change in the chemical and physical composition of surface
4 water due to changes in pH or trophic status from acidifying or eutrophying emissions, is predicted to be
5 low. Consequences will be minor and overall risk is low.

6 **7.4.10.3 Summary of Cumulative Effects**

7 Table 7.4–26 summarizes cumulative effects on Surface Water.

8 The residual cumulative effect of change in the chemical and physical composition of Surface Water is low
9 in magnitude both with and without the Project. In terms of acidification, there is no predicted change in
10 the number and location of critical load exceedances in any of the lakes and streams sampled. However,
11 the Project has a high proportional contribution to the cumulative residual effects when compared to
12 future activities (i.e., the Enbridge Nasoga Compressor Station portion of the Westcoast Connector Gas
13 Transmission Project); nitrogen and sulphur deposition from the Project contributes between 51% to 95%
14 of the deposition above baseline in the lakes and stream sampled for Cumulative Case (BC Hydro) and
15 between 75% and 98% for Cumulative Case (On-Site Power Generation).

16 With respect to eutrophication, nitrogen deposition related to emissions does not predict a change in
17 trophic status in any of the lakes and streams sampled. However, the Project has a high proportional
18 contribution to the cumulative residual effects when compared to future activities (i.e., the
19 Enbridge Nasoga Compressor Station portion of the Westcoast Connector Gas Transmission Project);
20 nitrogen deposition from the Project contributes between 36% to 92% of the deposition above baseline
21 in the lakes and streams sampled for Cumulative Case (BC Hydro) and between 72% and 98% for
22 Cumulative Case (On-Site Power Generation).

1 **Table 7.4–24 – Cumulative Effects on Acidification Potential (Critical Load of Acidity Exceedances)**

Site ID	Waterbody	Data Sample Date	Critical Load (CL _(A)) \ (meq/m ² /y)	EX _a (meq/m ² /y)				
				Baseline Case	Application Case (BC Hydro)	Cumulative Case (BC Hydro)	Application Case (On-Site Power Generation)	Cumulative Case (On-Site Power Generation)
LK-01 inlet	Unnamed	June 2022	135	-124	-123	-123	-122	-122
		Oct. 2022	571	-560	-560	-559	-559	-558
LK-01 middle	Unnamed	June 2022	330	-319	-318	-318	-317	-316
		Oct. 2022	548	-537	-536	-536	-535	-535
LK-01 outlet	Unnamed	June 2022	337	-326	-326	-325	-324	-324
		Oct. 2022	553	-542	-542	-541	-541	-540
LK-01 bottom	Unnamed	Oct. 2022	897	-886	-886	-885	-885	-884
LK-02	Unnamed	June 2022	-8	19	20	21	24	24
		Oct. 2022	18	-7	-6	-6	-3	-2
STR-01	Dogfish Creek	June 2022	560	-549	-542	-542	-530	-530
		Sept. 2022	751	-740	-733	-732	-721	-721
STR-02	Unnamed	June 2022	344	-333	-318	-318	-296	-295
		Sept. 2022	248	-237	-222	-222	-200	-199
STR-03	Unnamed	June 2022	349	-338	-331	-330	-317	-317
		Sept. 2022	425	-415	-407	-406	-393	-393

NOTE:

Gray highlighting shows predicted critical load exceedance.

1 **Table 7.4–25 – Cumulative Effects of Eutrophication on Trophic Status**

Site ID	Waterbody	Sample Date	Predicted Trophic Status			
			Application Case (BC Hydro)	Cumulative Case (BC Hydro)	Application Case (On-Site Power Generation)	Cumulative Case (On-Site Power Generation)
LK-01 inlet	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
LK-01 middle	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
LK-01 outlet	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
LK-02	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Oct. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
STR-01	Dogfish Creek	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
STR-02	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
STR-03	Unnamed	June 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic
		Sept. 2022	Oligotrophic	Oligotrophic	Oligotrophic	Oligotrophic

2

Table 7.4–26 – Summary of Residual Cumulative Effects on Surface Water

Residual Cumulative Effects	Proposed Mitigation and Enhancement Measures	Cumulative Effects Characterization Criteria								
		Magnitude	Geographic Extent	Timing	Duration	Reversibility	Frequency	Affected Sub-Populations	Risk (Likelihood and Consequences)	Uncertainty
Change in Chemical and Physical Composition of Water Quality										
Residual cumulative effect with the Project	N/A	L	LAA*	N/A	MT	R	C	N/A	L	L
Project contribution to residual cumulative effects	N/A	H	LAA*	N/A	MT	R	C	N/A	L	L

KEY

See Table 7.4–16 for detailed definitions

Project Phase

- C: Construction
- O: Operation
- D: Decommissioning

Magnitude:

- NMC: No Measurable Change
- L: Low
- M: Moderate
- H: High

Geographic Extent:

- PF: Project footprint
- LAA: Local Assessment Area
- RAA: Regional Assessment Area

*Refers to the acidification and eutrophication LAA (i.e., the AESA)

Timing:

- N/A: Not Applicable
- A: Applicable
- Duration:**
- ST: Short-term
- MT: Medium-term
- LT: Long-term
- N/A: Not applicable

Reversibility:

- R: Reversible
- PR: Partially reversible
- I: Irreversible

Frequency:

- S: Single event
- MIR: Multiple irregular event
- MR: Multiple regular event
- C: Continuous

Affected Sub-Populations:

- ED: Evenly distributed
- DD: Disproportionately distributed **Risk (Likelihood and Consequences)**

- L: Low
- M: Moderate
- H: High

Uncertainty:

- L: Low
- M: Moderate
- H: High

1 **7.4.10.4 Prediction Confidence**

2 The predication confidence in the conclusions for Project residual effects and residual cumulative effects
3 for Surface Water is high. This confidence is based on:

- 4 • Quality of baseline data
- 5 • Use of conservative assumptions in the acidification and eutrophication assessments
- 6 • Clear understanding of the effect mechanisms between Project works and activities and
7 Surface Water
- 8 • Confidence in the effectiveness of the proposed mitigation measures and BMPs to manage the
9 risk of adverse effects on Surface Water
- 10 • Professional judgment from prior experience assessing effects of similar LNG projects in the same
11 geographic area

12 The use of industry standard BMPs to avoid or mitigate residual effects is expected to further reduce the
13 risk of adverse effects on Surface Water.

14 **7.4.11 Follow-up Program**

15 To verify compliance of the Project with commitments in this Application and conditions of the
16 Environmental Assessment Certificate, the Proponents are committed to the development of an CEMP.
17 This CEMP will incorporate the mitigation measures included in this assessment to avoid or reduce effects
18 to surface water. The CEMP will describe mitigation measures that will be implemented during
19 construction and normal operation of the Project to avoid or reduce potential adverse effects of Project
20 activities on surface water. The CEMP will also outline environmental monitoring requirements, including
21 monitoring of surface water quality and quantity.

22 Monitoring will be conducted following procedures outlined in the British Columbia Field Sampling
23 Manual (BC MOE 2013) and the Manual of British Columbia Hydrometric Standards (RISC 2018). For
24 monitoring of surface water quality during construction, background levels of TSS and/or turbidity will be
25 undertaken in watercourses at locations upstream of Project works and results compared to TSS/turbidity
26 downstream of Project works before the watercourses enter the marine environment. Measurements will
27 be compared to the WQG-FAL (BC ENV 2023b). Surface water quality monitoring will focus on
28 watercourses within the vicinity of the Project footprint (i.e., WC-03, WC-03.1, WC-03.4, WC-04, WC-05)
29 and watercourse crossings (i.e., WC-02, WC-02.1, WC-02.9, WC-03, WC-03.3, WC-04, WC-05, and WC-06)
30 during construction. If WQG-FAL are exceeded for turbidity and/or TSS, the need for additional mitigation
31 measures will be assessed and implemented, if required.

1 The frequency of turbidity and/or TSS monitoring will depend on the potential risk of the activity or works
2 to cause sedimentation of watercourses, proximity of the activity or works to watercourses, and weather
3 conditions. If there is potential for Project activities or works to cause sedimentation of a watercourse,
4 monitoring will occur daily, though frequency may increase for higher risk work (e.g., watercourse
5 crossings construction). Frequency of monitoring will be further defined during pre-construction planning
6 (e.g., during development of the management plans).

7 Hydrometric monitoring stations previously established in WC-02, WC-04, and WC-09 will remain
8 operational to record streamflow at each station for comparison with baseline data. The timing of
9 sampling events will be scheduled to measure a range of flows in order to maintain the stage-discharge
10 relationships used to convert recorded water levels at each station into discharge.

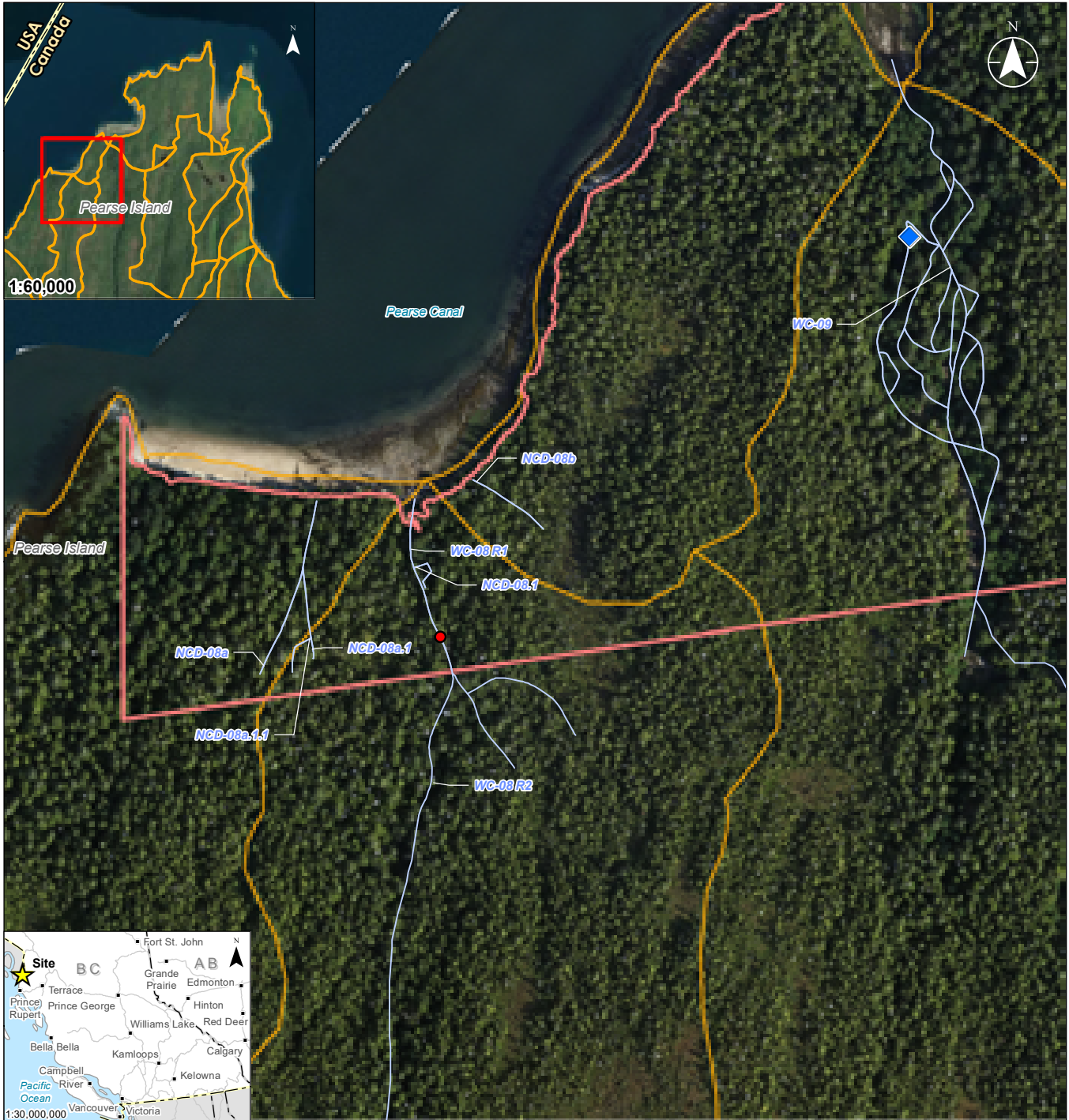
11 A follow-up acidification and eutrophication monitoring program will be developed in consultation with
12 regulatory bodies and Indigenous groups to monitor lakes and streams in the vicinity of the Project for
13 acidification and eutrophication (i.e., monitor for effects on pH, ANC, nutrients, trophic status, and aquatic
14 biota) during operation. It will include assessment of the five waterbodies sampled as part of the
15 acidification and eutrophication assessment to validate the predictions made by the assessment and other
16 waterbodies within the Application Case (On-Site Power Generation) 3 kg/ha/y N deposition isopleth if
17 and when on-Site power generation is used.

18 The acidification and eutrophication monitoring program will include baseline characterization for a
19 minimum of one year prior to operations and monitoring during operations. Baseline characterization of
20 the stream sites will include monthly sampling plus five samples collected over a 30-day period during a
21 biologically relevant period (i.e., during late summer maximum primary productivity). The lake sites will
22 be sampled seasonally during the open water season to assess variability, stratification, and turnover.
23 Parameters for stream and lake samples will include in situ parameter measurements (e.g., conductivity,
24 dissolved oxygen, turbidity, and pH) and collection of water quality samples, which will be analyzed for
25 general water chemistry parameters including hardness, conductivity, nutrients, anions, TOC and DOC,
26 total and dissolved metals, full major ion chemistry, and chlorophyll *a*. Water quality sampling will follow
27 the protocols described in *British Columbia Field Sampling Manual* (BC MOE 2013).

28

1 **7.4.12 Figures**

2



I:\CA0153-FBAGF01\Workgroup\123221820\figures\reports\EAS\SurfaceWater_Fish\fig_04_1_123221820_304_SurfaceWater_LAA.mxd - Refresh: 2024-05-20 By: ayiu



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Alnnon

- ◆ Hydrometric Station
- Reach Break
- Project Mapped Stream
- FWA – Watersheds – Outlined
- Surface Water Local Assessment Area



Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

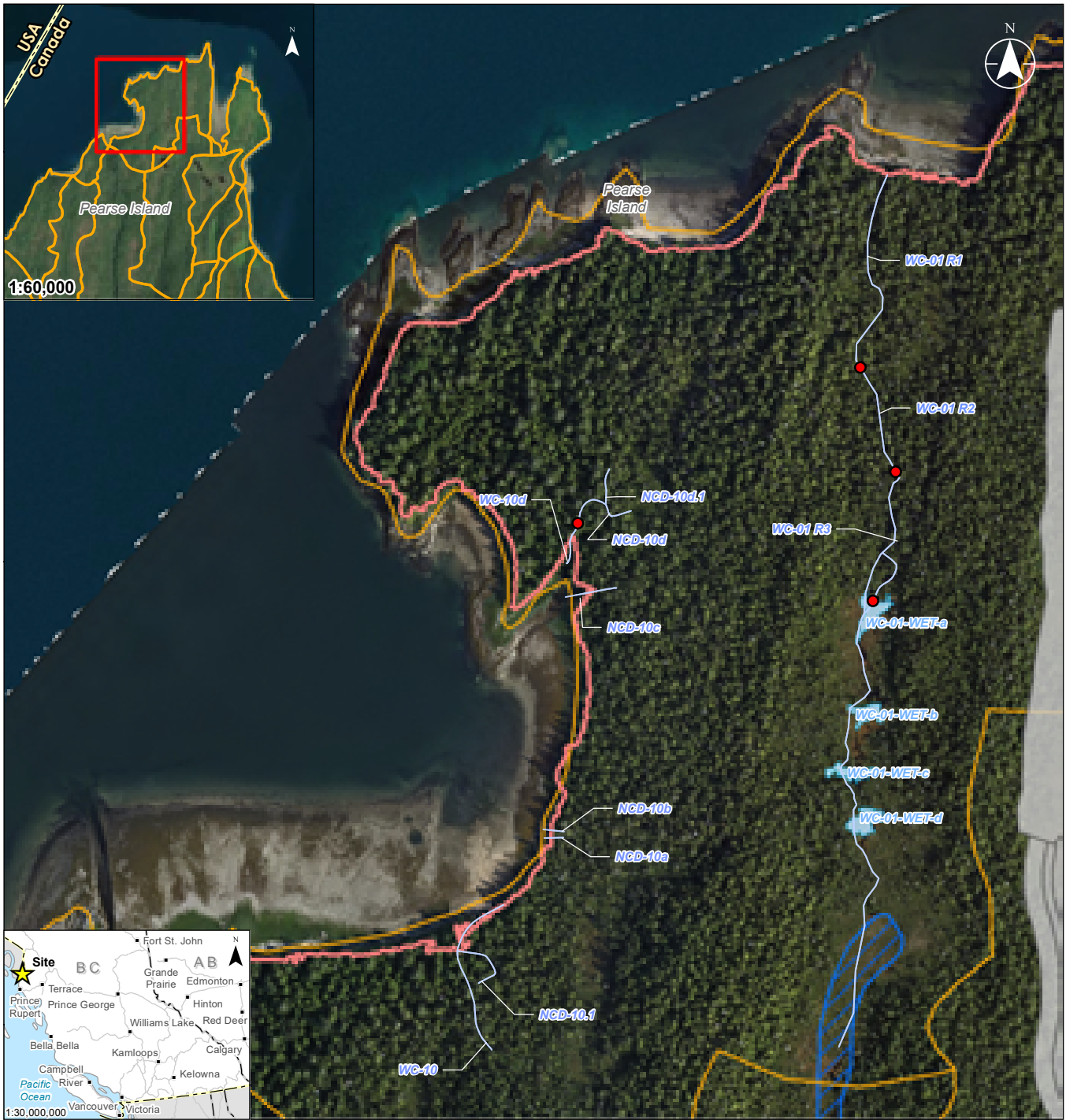
Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

Figure No. **7.04-1** Page 1 of 5

Title
Surface Water Local Assessment Area

NCD = non-classified drainage
 WC = watercourse

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.

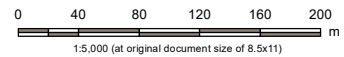


I:\CA0153-FBAGF01\Workgroup\123221820\figures\reports\EIS\SurfaceWater_Fish\fig_04_1_123221820_304_SurfaceWater_LAA.mxd Reviset: 2024-05-20 By: ayiu



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Alniron

- Reach Break
- FWA – Watersheds – Outlined
- Project Mapped Stream
- Footprint Component
- Surface Water Local Assessment Area
- Open Water Wetland or Pond
- Wetland Boundary



Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

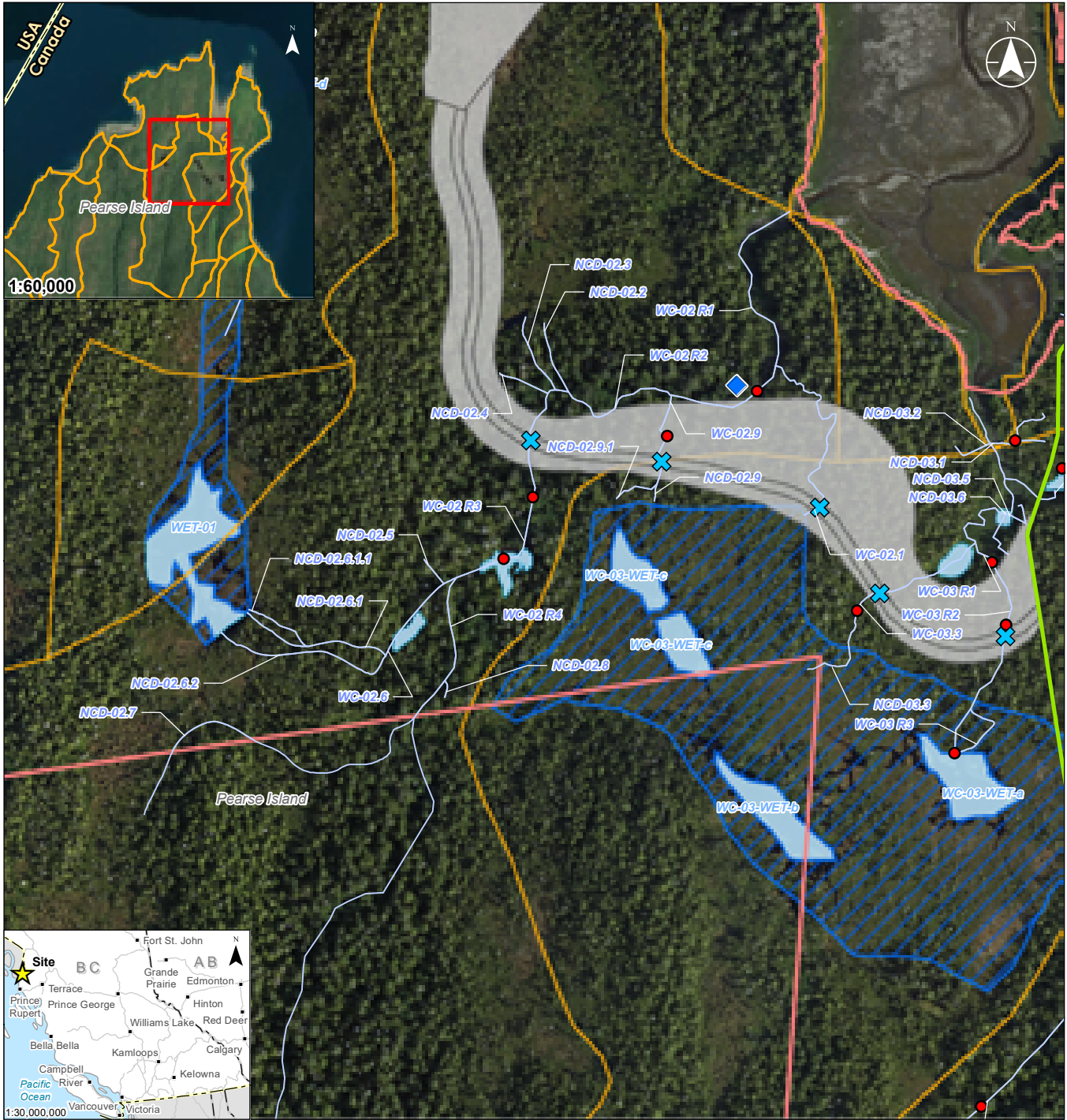
Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

Figure No. **7.04-1** Page 2 of 5

Title
Surface Water Local Assessment Area

NCD = non-classified drainage
 WC = watercourse

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.



I:\CA0153-FBAGF01\Workgroup\12321820\project\12321820\figures\reports\EIS\SurfaceWater_Fish\fig_04_1_12321820_304_SurfaceWater_LAA.mxd Reviset: 2024-05-20 By: ayfu



- ◆ Hydrometric Station
- Reach Break
- Potential Watercourse Crossing Classification**
- ✕ Fish Bearing (S3,S4)
- Proposed Access Road
- Project Mapped Stream
- FWA – Watersheds – Outlined
- Footprint Component
- Surface Water Local Assessment Area
- Project Terrestrial Footprint
- Open Water Wetland or Pond
- Wetland Boundary



Project Location: Pearse Island, BC
 Project Number: 12321820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

Figure No. **7.04-1**
 Title **Surface Water Local Assessment Area**
 Page 3 of 5

Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Imagery Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Alnorb

NCD = non-classified drainage
 WC = watercourse

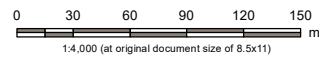
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in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



I:\CAD\153-FBAGF01\Workgroup\12321820\figures\reports\EIS\SurfaceWater_Fish\fig_04_1_12321820_304_Surface_Water_LAA.mxd - Refresh: 2024-05-20 By: ayfu



- ◆ Hydrometric Station
- Reach Break
- Potential Watercourse Crossing Classification**
- ✕ Fish Bearing (S3,S4)
- Proposed Access Road
- Project Mapped Stream
- FWA – Watersheds – Outlined
- Footprint Component
- Surface Water Local Assessment Area
- Project Terrestrial Footprint
- Open Water Wetland or Pond
- Wetland Boundary



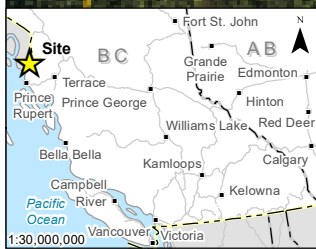
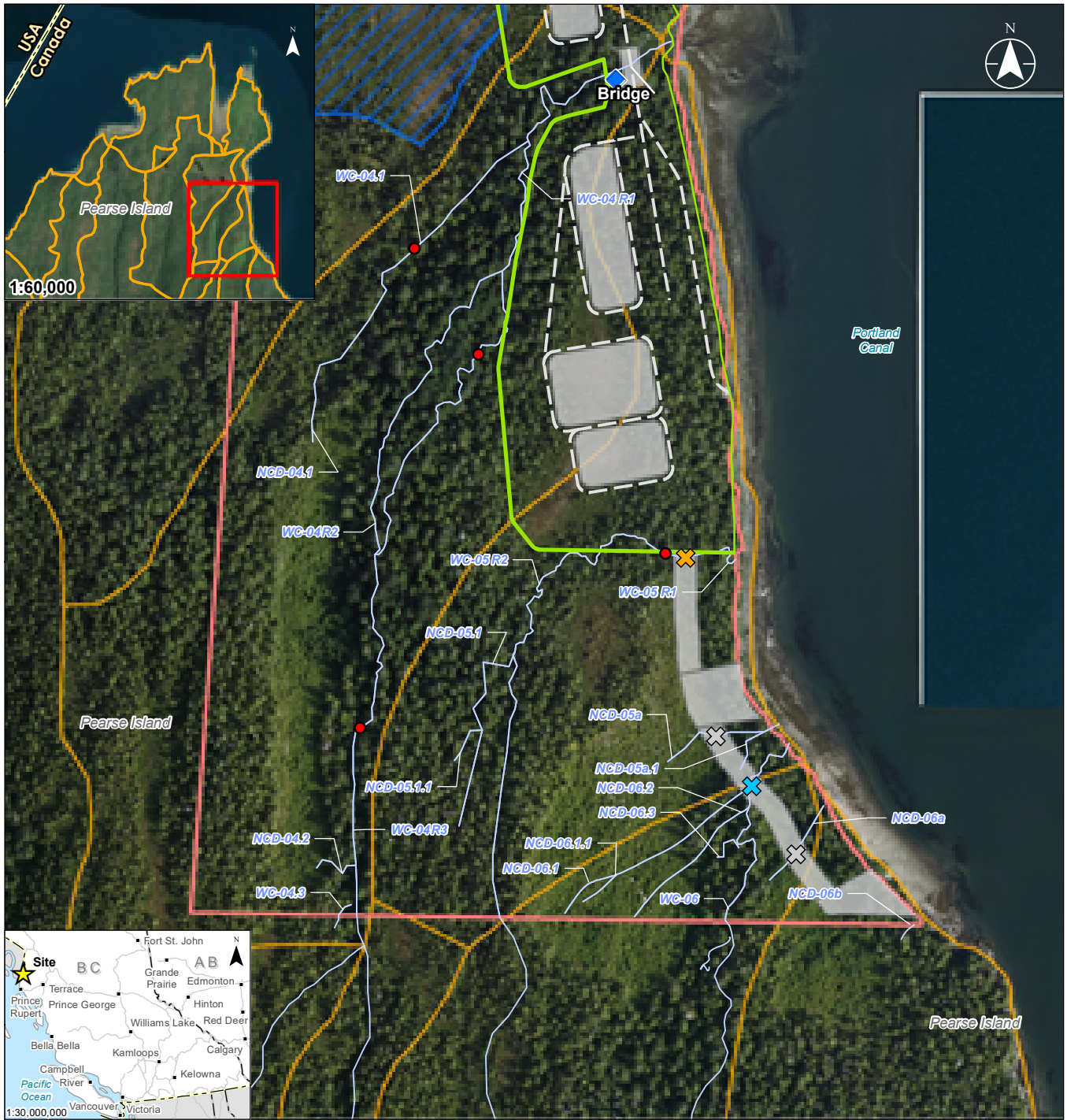
Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

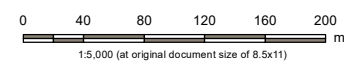
Figure No. **7.04-1** Page 4 of 5
 Title
Surface Water Local Assessment Area

NCD = non-classified drainage
 WC = watercourse

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.



- ◆ Hydrometric Station
- Reach Break
- Potential Watercourse Crossing Classification**
- X NCD
- X Fish Bearing (S3,S4)
- X Non Fish Bearing (S6)
- Proposed Access Road
- Project Mapped Stream
- FWA – Watersheds – Outlined
- Footprint Component
- Surface Water Local Assessment Area
- Project Terrestrial Footprint
- Open Water Wetland or Pond
- Wetland Boundary



Stantec

Project Location: Pearse Island, BC

Project Number: 123221820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

Client/Project/Report
Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

Figure No.
7.04-1

Title
Surface Water Local Assessment Area

Notes

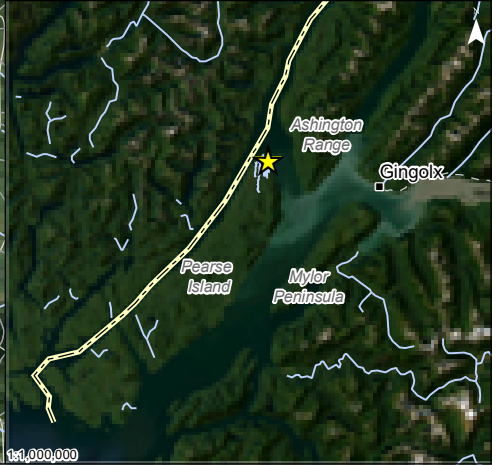
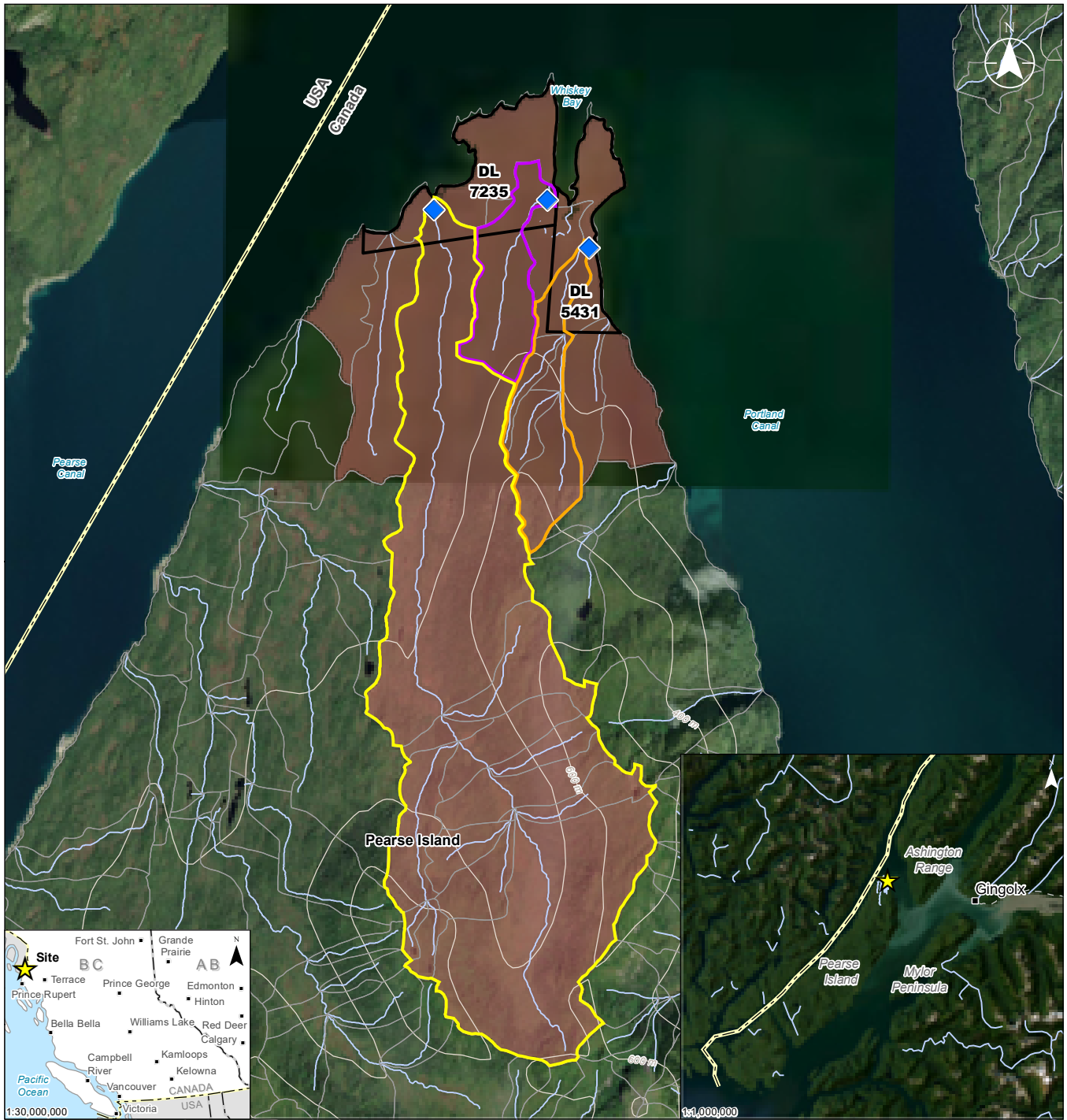
- Coordinate System: NAD 1983 UTM Zone 9N
- Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
- Imagery Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community; Alinorth

NCD = non-classified drainage
 WC = watercourse

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.

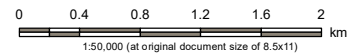
I:\CA0153-FBAGF01\Workgroup\123221820\figures\reports\EAS\SurfaceWater_Fish\fig_04_1_123221820_304_Surface_Water_LAA.mxd Reviset: 2024-05-29 By: ayiu

I:\CA0103\FBAGFD\Workgroup\123221820\figures\reports\EASurfaceWater_Files\Fig_04_2_123221820_Surface_Water_Regional_Assessment_Area.mxd Revised: 2023-09-08 By: tqulichini



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- ◆ Hydrometric Station
- ★ Site
- Boundaries of District Lots 7235 and 5431
- FWA – Watersheds – Outlined
- Surface Water Regional Assessment Area
- Freshwater Atlas Watershed Boundary**
- WC-02
- WC-04
- WC-09
- International Boundary
- Watercourse
- Topographic Contour

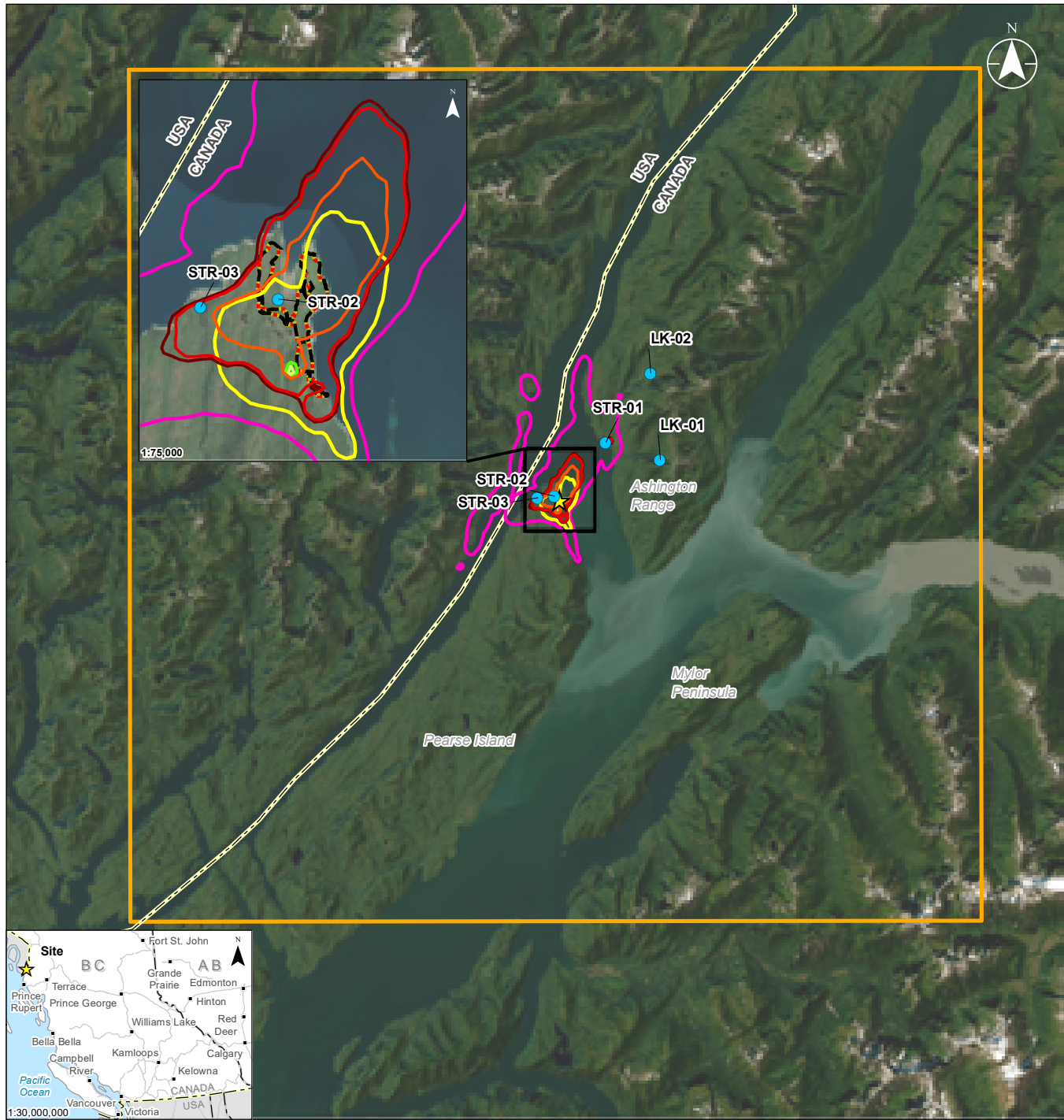


Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by SMOSS on 20230731
 Requested by MPENNER on 20230727
 Checked by TQULICHINI on 20230731

Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

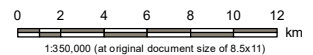
Figure No.
7.04-2
 Title
Surface Water Regional Assessment Area

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.



Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- ★ Site
- Surface Water Quality Sampling Site
- Predicted Nitrogen Deposition (3 kg/ha/yr)**
 - Application Case (BC Hydro)
 - Cumulative Case (BC Hydro)
 - Project-alone Case (On-Site Power Generation)
 - Application Case (On-Site Power Generation)
 - Cumulative Case (On-Site Power Generation)
- Predicted S + N Deposition (100 eq/ha/yr)**
 - Project-alone Case (BC Hydro)
 - Project-alone Case (On-Site Power Generation)
- ▭ Acidification and Eutrophication Study Area
- ▭ Project Footprint
- International Boundary



Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by AYIU on 20240529
 Requested by JFRIES on 20240529
 Checked by EFLORY on 20240529

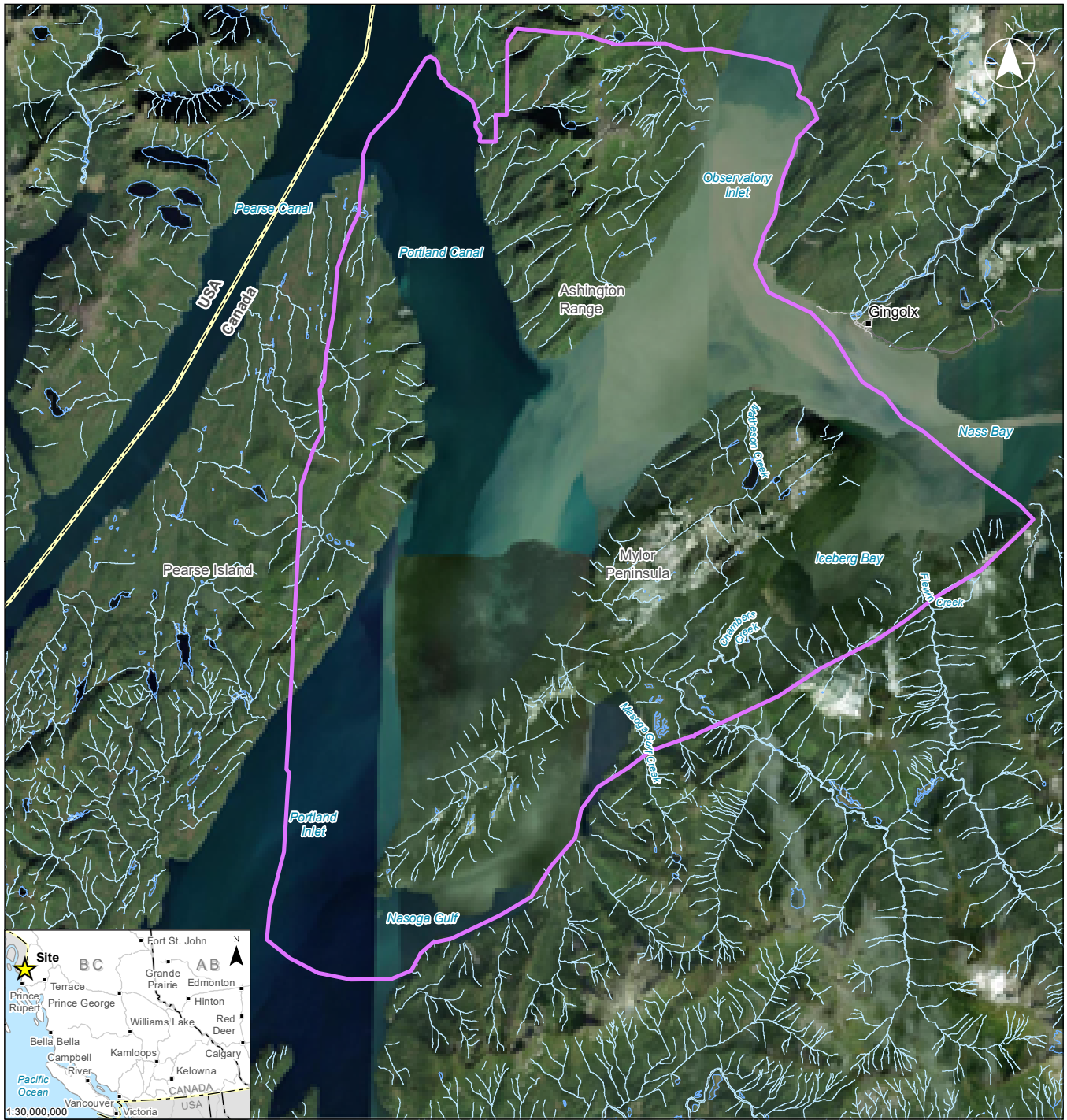
Client/Project/Report
 Ksi Lisims LNG
 Natural Gas Liquefaction and Marine Terminal
 Environmental Assessment - Impact Assessment

Figure No.
7.04-3

Title
Acidification and Eutrophication Study 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.

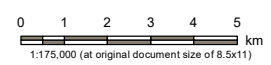
I:\CA0153-FBAGF01\Workgroup\123221820\figures\reports\EIA\SurfaceWater_Fish\fig_04_3_123221820_360_Surface_AE_study_areas.mxd Revised: 2024-05-29 By: ayiu



I:\CA0103\FBAGFD\Workgroup\123221820\figures\reports\EASurfaceWater_Fish_TLAA.mxd
 Revised: 2023-09-08 By: tqulichini



- Site
- Transmission Line Assessment Area
- International Boundary
- Road
- Local Street
- Resource Road
- TRIM Watercourse
- TRIM Waterbody

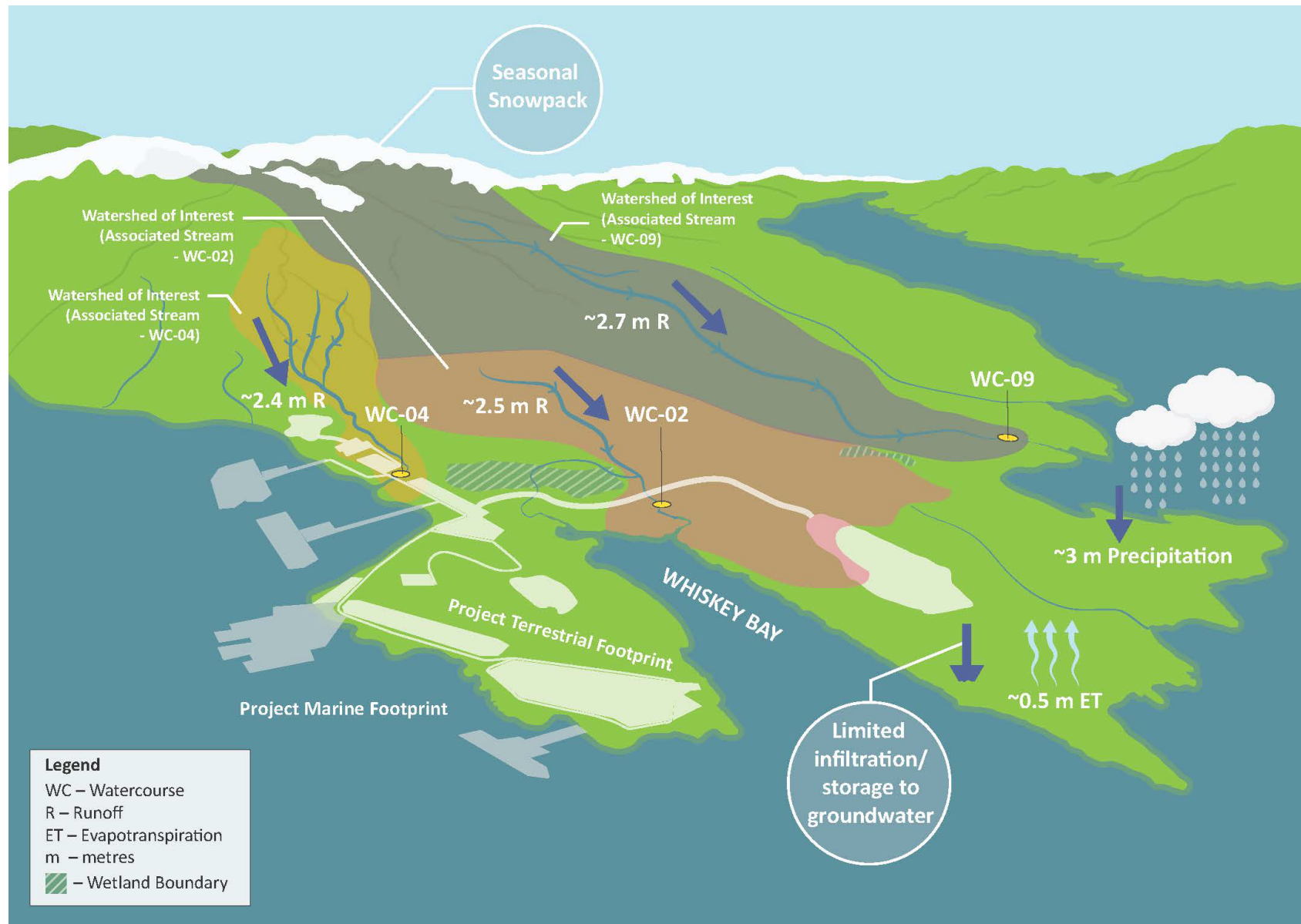


Project Location: Pearse Island, BC
 Project Number: 123221820
 Prepared by SMOSS on 20230728
 Requested by MPENNER on 20230727
 Checked by TQUILICHINI on 20230731

Client/Project/Report
Ksi Lisims LNG
Natural Gas Liquefaction and Marine Terminal
Environmental Assessment - Impact Assessment
 Figure No.
7.04-4
 Title
Transmission Line Assessment Area

Notes
 1. Coordinate System: NAD 1983 UTM Zone 9N
 2. Data Sources: DataBC, Government of British Columbia; Natural Resources Canada
 3. Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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.



1
2 **Figure 7.4–5 – Conceptual Model for the Hydrological Environment and Baseline Conditions**