Fisheries Act Authorization Supplemental Information Report

Fisheries and Oceans Canada

Partington Creek Conveyance and Off-channel Enhancement Habitat

June 2022

ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

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June 17, 2022

Our Reference: 32628

Fish and Fish Habitat Protection Program Triage and planning unit
Regional Office Ecosystem Management Branch
Fisheries and Oceans Canada
200 – 401 Burrard Street
Vancouver, BC V6C 3S4

Attention: Referrals Technician

Dear Sir/Madam:

Reference: City of Coquitlam – Partington Creek Conveyance and Off-Channel Habitat, Fisheries and Oceans Canada Authorization under the *Fisheries Act*

The CoQ is undertaking this major capital project as part of the Partington Creek Integrated Watershed Management Plan and to address safety and flooding conditions along Cedar Drive. Over the years, Cedar Drive has experienced severe flooding on a frequent basis when Partington Creek overtops its left bank. The impacts of this overtopping is:

- a hazardous situation for vehicles, pedestrians and cyclist travelling on Cedar Drive;
- causing property damage each time flooding occurs;
- Damaging the existing road structure and farmland; and,
- potential harm/death to fish, such as salmonid species due to flood flows carrying fish to unsuitable habitat in the farm field south of Partington Creek.

The Partington Creek Conveyance and Off-Channel Habitat project will provide a secondary off-channel habitat area that will divert high flows away from Partington creek to mitigate erosion within the creek and prevent flooding and washouts of Cedar Drive and provide off-channel fish habitat during all flow condition and provide instream and riparian restoration to enhance habitat functionality in the lower reaches of Partington Creek.

The enclosed supplemental information is formatted into the following key sections:

- Project Overview
- Project Background and Rationale
- Associated Permits
- Site Description and Aquatic Environmental Context
- Description of the Proposed Works
- Impacts to Other Affected Lands and People
- Stream and Stream Channel Impact Assessment

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1.0 Project Overview

ISL Engineering and Land Services Ltd. (ISL) has been retained by the City of Coquitlam (CoQ) to provide preliminary and detailed engineering design, hydraulic assessment, environmental impact assessment, environmental effects mitigation and regulatory application for submission of an Authorization per the *Fisheries Act* for the Partington Creek Conveyance and Off-Channel Habitat (PCCOH) project along lower Partington Creek (**Figure 1**).

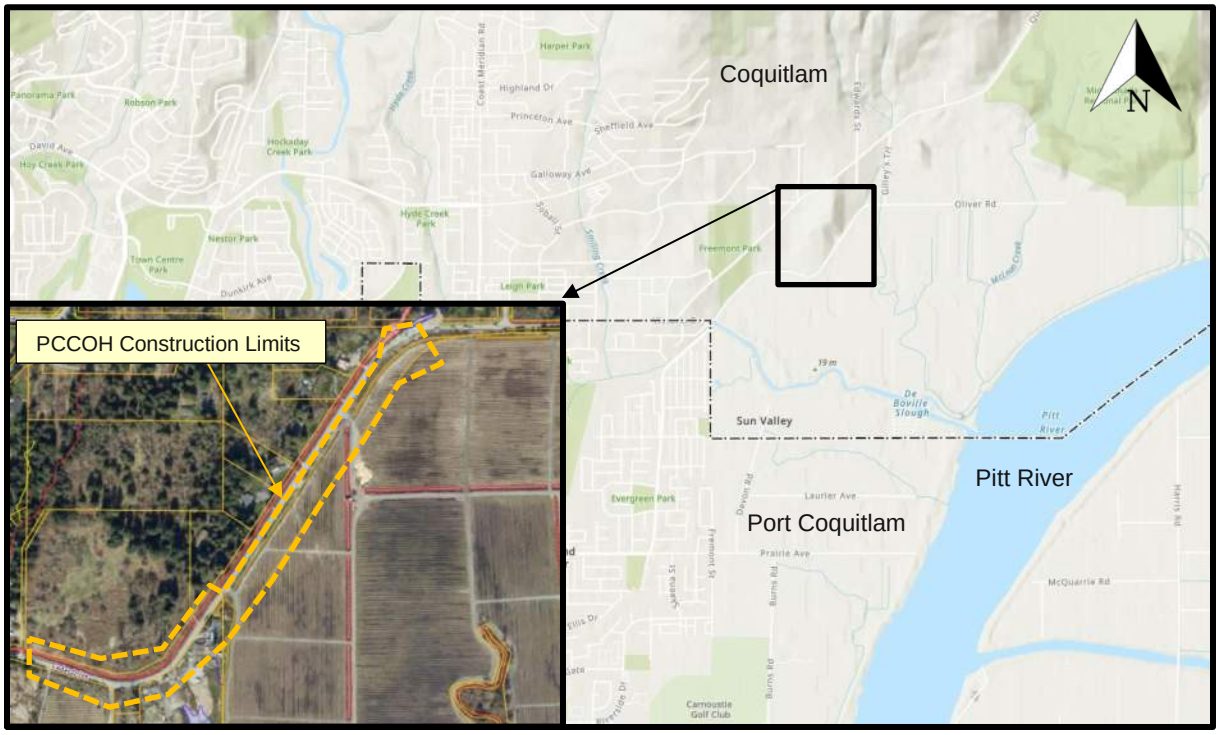

Figure 1. Key map showing the general project location of the PCCOH (Source: QtheMap 2021).

1.1 Project Location Information

Locational setting information pertaining to this project is provided in **Table 1**.

Table 1. Project location, setting, and stream information.

Primary Region	Lower Mainland	
General Location	Cedar Drive, Coquitlam, BC	
UTM	Between 10U 519940 m E 5459588 m N and 10U 520547 m E 5460066 m N	
Latitude / Longitude	Between 49.28871º, -122.72579º and 49.29300º, -122.71742º	
Land ownership	City owned municipal road right-of-way (ROW), City owned land.	
Legal description of lands	City owned municipal road	
Partington Creek	Partington Creek	Watershed Code: 100-026700-07200
Ditch 1	Unnamed Watercourse	No Watershed Code flows into: 100-026700-07300-18700
Ditch 2	Unnamed Watercourse	No Watershed Code flows into: 100-026700-07300-18700
Ditch 3	Unnamed Watercourse	No Watershed Code flows into: 100-026700-07300

1.2 Contact Information

ISL is acting as agent and consultant to the City of Coquitlam for this project. Contact information for the applicant (Owner) is provided in **Table 2**. The Owner's agent (consultant) information is provided in **Table 3**.

Table 2. Applicant's contact information.

Business Name	City of Coquitlam
Doing Business As	Local government
Contact Name	Nadeem Kazmi, P.Eng., Contact Administrator
Phone	604-927-3517
Email	nkazmi@coquitlam.ca
Mailing Address	3000 Guildford Way, Coquitlam, BC V3B 7N2

Table 3. Consultant contact information.

Business Name	ISL Engineering and Land Services Ltd.
Doing Business As	Consultant
Contact name	Nathan Discusso, B.Sc., BIT, Environmental Scientist
Phone	604-371-0091
Email	ndiscusso@islengineering.com
Mailing Address	#201 8506 200 Street, Langley BC V2Y 0M1

2.0 Project Background and Rationale

2.1 Project Background

Partington Creek is located north of Cedar Drive and runs parallel to the existing alignment. During periods of high flow, Partington Creek floods Cedar Drive. As part of the Partington Creek Integrated Watershed Management Plan (IWMP) through the realignment of Cedar Drive, the project will help to alleviate and prevent flooding via the construction of an off-channel flood conveyance area and fish restoration habitat (KWL, 2011). Design of the off-channel habitat and installation of the sediment ponds were based on the concept designs from Kerr Wood Leidel (KWL) that were to be incorporated into the detail design (KWL, 2015). The project consists of the installation of the new sanitary infrastructure, installation of a new water main and construction of an in-line sediment pond and channel widening that will require temporary diversion of Partington Creek. An off-channel habitat will also be constructed concurrent with the new road to accommodate high creek flows and prevent flooding. This off-channel will also provide additional salmonid habitat, and habitat restoration will replace the existing invasive vegetation found along the project area with native riparian plants. Nine (9) Culverts will be installed to facilitate variable flows and fish passage between the off-channel habitat and Partington Creek.

The existing properties south of Cedar Drive have ditches which facilitate drainage of the agricultural land. In their existing condition, these ditches are connected to DeBoville Slough B. The ditches do not provide fish habitat and will be infilled during the project to accommodate the new road alignment of Cedar Drive.

2.2 Project Rationale/Justification

The CoQ is undertaking this major capital project as part of the Partington Creek IWMP and to address safety and flooding conditions along Cedar Drive. A key component of the IWMP is to realign and raise Cedar Drive and to allow space for the off-channel and relieve flooding from Partington Creek (KWL, 2011). The CoQ has provided a Letter of Urgency to indicate the importance and prioritization of this work during regulatory review (**Appendix A**). Over the years, Cedar Drive has experienced severe flooding on a frequent basis when Partington Creek overtops its left bank. The impacts of this overtopping is:

- a hazardous situation for vehicles, pedestrians and cyclist travelling on Cedar Drive;
- causing property damage each time flooding occurs;
- Damaging the existing road structure and farmland; and,
- potential harm/death to fish, such as salmonid species due to flood flows carrying fish to unsuitable habitat in the farm field south of Partington Creek.

The PCCOH will provide a secondary off-channel habitat area that will divert high flows away from Partington creek to mitigate erosion within the creek and prevent flooding and washouts of Cedar Drive and provide off-channel fish habitat during all flow condition and provide instream and riparian restoration to enhance habitat functionality in the lower reaches of Partington Creek.

Alterations to the existing ditches will result in marginal effects to fish habitat, but the off-channel habitat will provide enhanced fish rearing habitat and enhanced riparian functioning habitat from the existing conditions of invasive species. Fish and amphibian salvage will be completed prior to works within Partington Creek and for alterations to the agricultural drainage ditches to prevent death of fish. Further mitigation measures for the project include installation of fish passable culverts in the off-channel habitat, riparian enhancement planting, and construction mitigation measures outlined in the Environmental Management Plan (**Appendix B**).

3.0 Associated Permits

A submission has been made to the Ministry of Forest, Land, Natural Resource Operations and Rural Development (FLNRORD) for Change Approval per Section 11 of the Water Sustainability Act under File number 2008929.

4.0 Site Description and Aquatic Environmental Context

An environmental assessment was undertaken by ISL to assess existing site conditions with regards to fish, wildlife, and vegetation resources, and identify potential environmental effects associated with the project. Both a desktop and field investigations were completed. Sources of environmental information for the desktop review included:

- Provincial mapping databases Habitat Wizard and iMapBC;
- Provincial Conservation Data Centre (BC CDC) databases;
- City of Coquitlam GIS (QtheMap);
- Fisheries Inventory Data Queries (FIDQ);
- Wildlife Tree Stewardship Atlas (WiTS);

- British Columbia Great Blue Heron Atlas (GBHE); and,
- Dillon Consulting (2013). DeBoville Slough and Pitt River dike assessment and watercourse classification. [Interim report, Project No. 13-7258]. Prepared for City of Coquitlam.

Field investigation of Partington Creek was conducted on December 2, 2020 by Nathan Discusso, B.Sc., B.I.T., and Larissa Darc, M.Sc., B.I.T., of ISL. Bankfull widths and depths were taken to establish baseline parameters for Partington Creek and to delineate reaches along the PCCOH.

A field investigation of the agricultural drainage ditches was conducted on February 24, 2021 by Nathan Discusso, B.I.T., B.Sc., and David Neufeld, R.P.Bio., B.Sc., of ISL. Water quality measurements, specifically Dissolved Oxygen (DO), and bankfull widths were taken to establish baseline parameters for the agricultural drainage ditches.

4.1 Aquatic Information

The aquatic area has been broken up into six sub-components including Partington Creek Reach 1, Reach 2 and Reach 3, and Ditch 1, Ditch 2 and Ditch 3 (**Figure 2**)

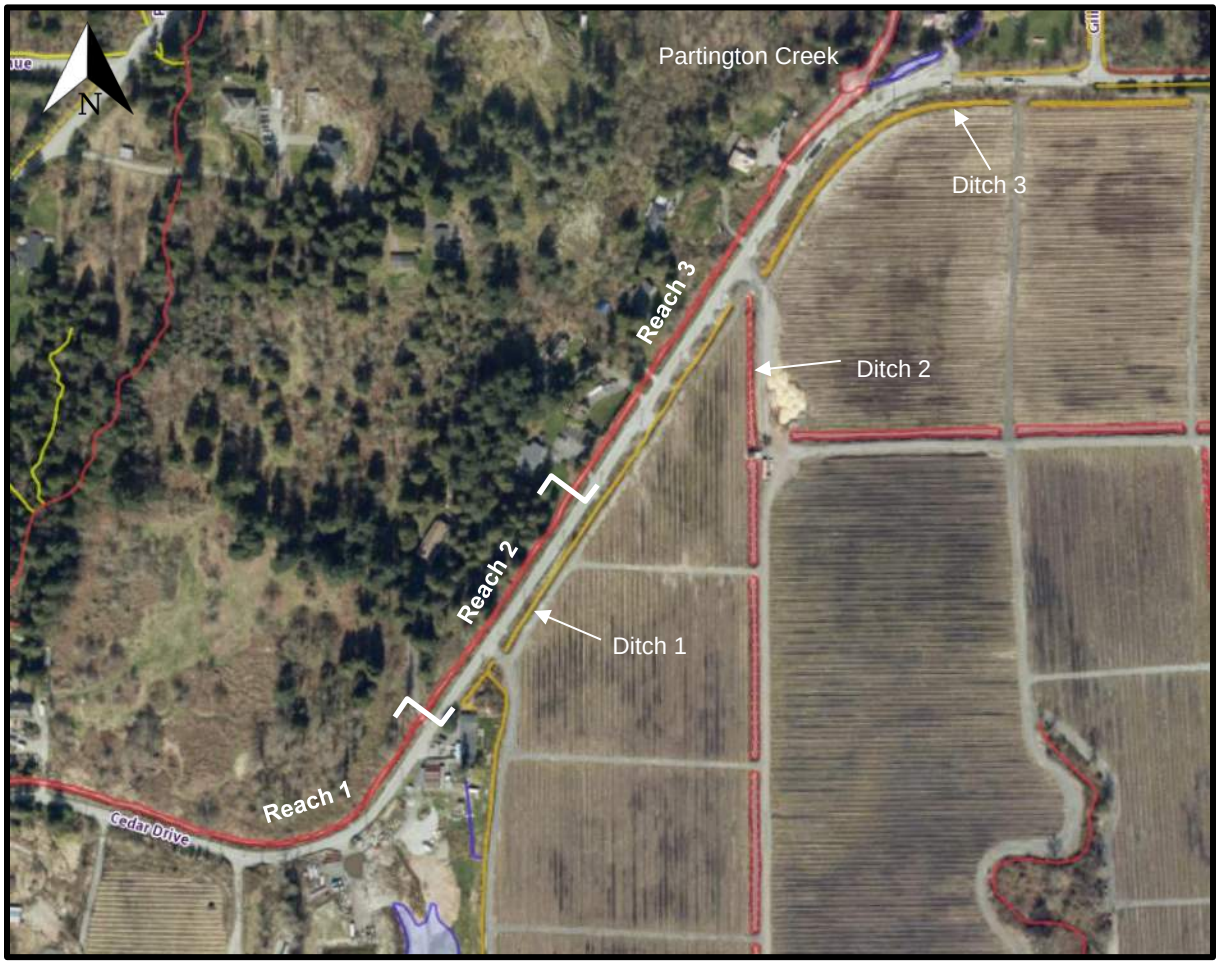

Figure 2. Map showing the assessed reaches in Partington Creek and the adjacent ditches.

4.1.1 Fish Populations

Partington Creek is classified by the CoQ as red coded. FIDQ records indicate that Partington Creek supports the following salmonid species:

- Chum Salmon (*Oncorhynchus keta*)
- Coho Salmon (*Oncorhynchus kisutch*)
- Cutthroat Trout (*Oncorhynchus clarki*)
- Rainbow Trout (*Oncorhynchus mykiss*)

Constructed Ditches 1, 2, and 3, are not mapped on Provincial databases and do not have associated watershed codes but are mapped on the CoQ QtheMap. Ditch 1 and 3 are orange coded, meaning there are no fish present, but water is permanent; and Ditch 2 is red dashed, meaning it is potentially fish bearing, however no captures were observed. Ditches 1, 2, and 3 ultimately drain into DeBoville Slough B and then into the Pitt River.

Aquatic habitat within the roadside ditches of this area as generally poor, but the riparian vegetation surrounding both Ditch 1 and Ditch 3 is cited to provide a source of food and nutrients to red coded constructed ditches that have confirmed fish/salmonid presence (Dillon, 2013). McElhanney, 2017, conducted fish sampling in downstream red coded ditches (salmonid presence) directly connecting Ditches 1, 2 and 3, and captured 14 threespine stickleback (*Gasterosteus aculeatus*) only. No salmonids were captured in the surrounding ditches during sampling.

4.1.2 Aquatic Species at Risk

There are no mapped occurrences of aquatic species at risk or mapped Critical Habitat (CH) for aquatic species at risk present within or surrounding the three constructed ditches.

4.1.3 Partington Creek Reach 1

Reach 1 had a glide/pool morphology with a bankfull width of 6.5 m. The bankfull depth was 0.50 m and wetted depth was 0.5 m. The streambed consisted of sand (60 %), gravel (30%), and cobble (10%) (**Figure 3**). Due to the lack of gravel and cobble there is no viable salmon spawning habitat in this reach. At the observed discharge, the reach consists of a deep glide habitat, suitable for rearing during low discharge periods. During high discharge conditions (i.e. late fall and winter) the reach offers sub-optimal rearing conditions due to the lack of off-channel areas or LWD which can be used by salmonids as refuges from high stream flows. The stream gradient was < 1% through this reach.

Figure 3. Downstream view of Reach 1

Streamside vegetation consisted of salmonberry (*Rubus spectabilis*), western redcedar (*Thuja plicata*), hardhack (*Spiraea douglasii*) and invasive Himalayan blackberry, Japanese knotweed and reed canary grass (*Phalaris arundinacea*). The south bank offers very low habitat potential for terrestrial wildlife and amphibians. The north bank riparian forest offers good (albeit somewhat fragmented habitat) for terrestrial and aquatic wildlife.

4.1.4 Partington Creek Reach 2

Reach 2 had a glide/pool morphology with a bankfull width of 8.3 m. The bankfull depth was 0.5 m and wetted depth was 0.5 m. The streambed consisted of sand (65 %), gravel (25%), and cobble (10%). There was no viable spawning habitat within this stream reach, due to the predominance of sand. The stream gradient was < 1% through this reach. The channel morphology consisted of a floodplain that extended up to 16 m into the adjacent swamp forest from the edge of the constructed channel (**Figure 4**).

Figure 4. Upstream view of Reach 2

Streamside vegetation consisted of western redcedar, Douglas-fir (*Pseudotsuga menziesii*), salmonberry, red alder (Alnus rubra), hardhack and invasive Himalayan blackberry, Japanese knotweed and reed canary grass.

4.1.5 Partington Creek Reach 3

Reach 3 had a glide/pool morphology with a bankfull width of 6.5 m. The bankfull depth was 0.5 m and wetted depth was 0.4 m. The streambed consisted of sand (60 %), gravel (30%), and cobble (10%). The stream gradient was < 1% through this reach. (**Figure 5**). Streamside vegetation is sparse and patchy owing to the adjacent residential development. It consisted of salmonberry, western redcedar, hardhack and invasive Japanese knotweed and reed canary grass.

Figure 5. Downstream view of Reach 3.

4.1.6 Ditch 1

Ditch 1 has an average bankfull width of 4.2 m. Water depth ranged from 5 cm to 31 cm. Instream DO levels were low, ranging from hypoxic to habitable with slight production impairment for adult fish (range: 1.04 mg/L to 6.69 mg/L). DO measurements were taken along a range of depths with higher reading observed near the surface of the water and Hypoxic conditions near the ditch bed. Riparian area was primarily Himalayan blackberry (50%) with reed canary grass (10%), grass (35%) and minimal seral stage trees (5%) (**Figure 6**). Riparian vegetation is only present on the northwest side of Ditch 1. Agricultural area to the southeast comprised of gravel pathways and blueberry fields that provide no functional riparian cover. No fish were observed in this ditch during site assessment or previous observation by others, and it is classified as orange coded with no fish presence (Dillon 2013).

Figure 6. Ditch 1 southeast of the existing Cedar Drive, note typical riparian condition.

4.1.7 Ditch 2

Ditch 2 was classified as potentially fish-bearing habitat by the CoQ and further confirmation by Dillon (2013). Ditch 2 had been dredged into a blueberry field presumably to improve site drainage. It had an average bankfull width of 7.0 m and variable depth of water, ranging from 12 cm to 109 cm. Instream DO levels were higher than Ditch 1 and Ditch 3, with a DO of 6.21 mg/L. Based on the observed DO levels, this Ditch could provide habitat for invertebrates and non-salmonid fish (all life stages). Embryo and larval stages of salmonids could not persist at these DO levels; however other life stages could persist with slight production impairment. Riparian area was primarily reed canary grass (80%) and other grasses (20%) (**Figure 7**). Riparian vegetation along Ditch 2 was comprised of gravel roadway and blueberry crops that provide no functional riparian cover, no leaf drop of allochthonous inputs, and no small woody debris or LWD. No fish were observed in this ditch during site assessment.

Figure 7. Ditch 2 typical riparian condition.

4.1.8 Ditch 3

Ditch 3 has an average bankfull width of 4.3 m and average water depth ranging from 10 cm to 41 cm. DO levels in the ditch were low ranging from 3.24 mg/L to 4.81 mg/L with elevated amounts of iron precipitate in the water (**Figure 8**). Riparian vegetation is only present on the northwest side of Ditch 3 and consisted of Himalayan blackberry (50%), reed canary grass (10%) and grass (40%). Agricultural area to the southeast comprised of gravel pathways and blueberry fields that provide no functional riparian cover. No fish were observed in this ditch during site assessment or previous observation by others, and it is classified as orange coded with no fish presence (Dillon 2013).

Figure 8. Ditch 3 south of Cedar Drive, note typical riparian condition and poor water quality.

4.2 Terrestrial Information

4.2.1 Vegetation Condition

The project site is in an area highly disturbed by agricultural land use activities. The project is located in the coastal western hemlock very dry maritime (CWHxm) biogeographical subzone. CWHxm occurs at low to mid elevations in southern coastal BC. Analysis of satellite images from Google Earth shows vast areas of farmland to the south, with areas of trees along the north edge of Partington Creek along Cedar Drive. Most treed areas are on the Northwest side of the project area and are within private property, with few trees within the southern riparian zone.

4.2.2 Wildlife

There were no mapped occurrences of Bald Eagle or Osprey nests within 1 km of the project site (WiTS, 2021). The GBHE (2021) showed two mapped but vacant Great Blue Heron colonies (DeBoville Slough 1 and 2) present at the junction of DeBoville Slough and Pitt River. Both of these colonies were marked first observed in 1992 and now as vacant in 1997.

4.2.3 Terrestrial Species and Ecosystems at Risk

Three terrestrial species at risk critical habitat or occurrence polygons overlap the PCCOH (**Table 4)**.

Table 4. Wildlife species at risk overlapping the project location.

Species Common Name	Specie Scientific Name	Provincial Status	Federal Status/Schedule 1 Y/N
Western painted turtle, Pacific coast pop.	*Chrysemys picta bellii*	Red	Threatened / Schedule 1
Green Heron	*Butorides virescens*	Blue	Not Listed
Marbled Murrelet	*Brachyramphus marmoratus*	Blue	Threatened / Schedule 1

Western Painted Turtle

The culvert crossing locations have been identified within a CH polygon for the for the Western painted turtle, Pacific Coast population (iMapBC, 2021). The CH polygon is centered within Partington Creek and extends 150 m inland, overlapping the project. To complete life history, this species requires both aquatic and terrestrial riparian areas with exposed sand for basking, emergent aquatic vegetation, large boulders and submerged large woody debris (LWD) (WPTRT, 2016).

At the PCCOH project location, our assessment of the site shows that there are several key habitat attributes that are missing, rendering the site unsuitable as Western painted turtle CH. These include:

- Increased farmland vehicle traffic and heavy dominance of Himalayan blackberry (*Rubus armeniacus*) and Japanese knotweed (*Reynoutria japonica*), reducing movement ability and nesting potential.
- Lack of submerged LWD needed for overwintering.
- Lack of stagnant or slow-moving water in Partington Creek.
- Lack of sufficient water depth required for overwintering (0.5-3.0 m).
- Steep banks present along the constructed ditches and along Partington Creek limit movement and distribution.

Marbled Murrelet

A CH polygon for Marbled Murrelet has been identified, centered in Partington Creek that overlaps the Ditch 1 location (iMapBC, 2021). This species requires both a marine ecosystem for foraging and a terrestrial ecosystem with tall trees for nesting and breeding (EC, 2014). Assessment of the site shows that there are no trees >30 m in height that are affected by the works and therefor, CH attributes required by this species are lacking.

Green Heron

An occurrence polygon for Green Heron is overlapped within the project sites. The last known observation of Green Heron was in July 1985 (BC CDC, 2021). Green Heron critical habitat is primarily associated with heavily-wooded wetlands to complete nesting and breeding life history traits. At the location of the PCCOH there is a lack of substantial trees to provide nesting and breeding habitat for Green Heron

4.3 Impacts to Land

The CoQ has acquired all the necessary property in order to complete this work such that there are no permission requests required for any land not owned by the applicant.

4.3.1 Existing Water License Holders

ISL utilized the iMapBC Tool, with 'points of diversion' layer to determine if there are any existing water licenses within 500 m of the project area. Existing water licenses include:

- License no. C108335; Licensee Owner: Johal Coquitlam Oliver Holdings Ltd. 148802. Point of Diversion is 720 m southeast of the culvert crossings within Irvine Creek.

The project would have no potential impacts on any licensees as the works do not connect by surface water to Irvine Creek. The project would also not impact any upstream Water License for Partington Creek and there are no Water Licenses present in the downstream reaches of Partington Creek or DeBoville Slough.

5.0 Description of Proposed Works

5.1 Description of the Proposed Activities/Works

The PCCOH will consist of realignment and widening of Cedar Drive, construction of in-line and off-line sediment ponds, widening and deepening of the main channel, construction of an off-channel habitat, and installation of culverts to facilitate water flow between these Partington Creek and the off-channel habitat. An engineering design drawing set for the project is included in **Appendix C**. Specifically, the design has the following elements:

- New alignment and multi-use path for Cedar Drive.
- Alterations of the agricultural ditches south of existing Cedar Drive
- Isolation and temporary bypass of Partington Creek.
- Construction of the in-line sediment pond and deepening and widening of the existing creek bed (Main channel Stn 0+005 – 0+270).
- Construction of an approximately 600m long x 20m wide off-channel habitat (Off-channel Stn. 0+020 – 0+605) that will provide enhanced rearing habitat for salmonids.
- Installation of 9 total concrete box culverts designed to facilitate fish passage and to connect flows of Partington Creek to the off-channel habitat (see section 8.1 Table 7 for detailed description of specifications)
- Installation of a 99.9m long 600mm diameter Reinforced Concrete Culvert for bypass during maintenance
- Restoration planting of native riparian vegetation surrounding the in-line sediment pond, off-channel and Cedar Drive once construction is complete. The small boulevard adjacent to the MUP will be treated with 150mm topsoil and sod.
- Installation of 375mm diameter PVC gravity main sanitary sewer beginning at southern project extent. Tie-in with existing Victoria Drive sanitary main to the north.
- Installation of proposed 450mm diameter PVC gravity sewer main to cross Partington Creek for the proposed development sanitary service connection at property #4189.
- Installation of a 450mm diameter HDPE sanitary forcemain to Victoria Drive

- At northern extent of project, at Gilley's Trail, install an outlet structure within the off-channel. The outlet structure will be connected to a new 600mm concrete storm main, which will tie-in with the existing storm main at Gilley's Trail.
- Construction of maintenance access roads for future maintenance within the in-line and off-line sediment ponds.

A total of 10 culverts are to be installed to facilitate the flow of water from Partington Creek to the off-channel enhancement habitat back into Partington Creek (**Table 5**). Culvert design specs and weir details can also be found in the engineering design drawing in **Appendix C**.

Table 5. Culvert location, specifications and weir details

Culvert Location	Culvert Specifications
North inlet to off-channel (3 total culverts)	Outside: 21.5m long 1.2 x2.1m Box Culvert with V-notch outlet weir and adjustable inlet weir.
	Middle: 20.2m long 0.9 x 2.1m Box Culvert.
	Outside: 20.2m long 0.9 x 2.1m Box Culvert.
Existing Cedar Drive road culverts in off-channel (3 total culverts)	Outside: 25.3m long 1.2 x 2.1m Box Culvert.
	Middle: 25.3m long 1.2 x 2.1m Box Culvert with V-notch weir.
	Outside: 25.3m long 1.2 x 2.1m Box Culvert.
South outlet to the off-channel (3 total culverts	Outside: 17.8m long 1.2 x 2.1m Box Culvert.
	Middle: 17.8m long 1.2 x 2.1m Box Culvert with V-notch weir.
	Outside: 17.8m long 1.2 x 2.1m Box Culvert.

5.2 Construction Equipment, Steps and Timeline

The number of crew and construction teams working on the project are dependent on the Contractor's approach. However, due to narrow instream work windows and project size, ISL envisions that the Contractor may have up to four crews. Crews could be comprised of 3-8 persons depending on construction stage. Anticipated materials to be deployed prior to the construction phase include: road granular base and sub-base and subsequent materials to construct road alignment and multi-use path; such as concrete, asphalt, lock block retaining walls, chain link fencing. Excavators, large haul trucks, dozers, and small rock trucks will be used to haul and move material to and within the site during the PCCOH.

Work will commence with tree, shrub and invasive clearing in areas along the alignment. Larger diameter trees may be required to be felled by a faller operating a chainsaw, while smaller trees and shrubs will be excavated from the earth with a track-mounted excavator.

Other equipment includes crew vehicles to allow workers to access the site, 1-ton flat deck trucks for hauling smaller loads. No exotic chemicals or products are required. No blasting is anticipated to be required for this project. An outline describing each construction activity and anticipated schedule to complete the work is outlined in **Table 6**.

Table 6. Description of proposed construction activity and anticipated schedule.

Project Activity	Anticipated Schedule
Pre-construction Baseline Monitoring	Spring 2023 – Spring 2024
Fish salvage (main channel in-line sediment pond)	August 1 – September 15, 2023 or, August 1 – September 15, 2024
Site isolation (main channel in-line sediment pond)	
Channel widening (Partington Creek)	
Construction/excavation of sediment pond	
Riparian vegetation and invasive species removal	Spring 2023 – Fall 2024
Ditch alterations	Fall 2022 – Spring 2023
Road, Utility and MUP construction	Fall 2023 – Fall 2025
Off-channel construction	Spring 2023 – Fall 2023
Fish salvage (off-line sediment pond and south outlet culverts from off-channel to Partington Creek)	August 1 – September 15, 2024
Site isolation (off-line sediment pond and south outlet culverts from off-channel to Partington Creek)	
Construction/excavation of north sediment pond	
Installation of south outlet culvert from off-channel to main channel	
Riparian planting for (per restoration plan)	Fall 2024
Post-construction effectiveness Monitoring	Fall 2025 – Fall 2029

5.3 Roles and Responsibilities of Qualified Professional Assisting with the Project

Environmental personnel deployed for the project will include at least one full-time Environmental Monitor, Environmental Coordinator, and several Fish Salvage Technicians. The anticipated roles for these individuals are outlined in **Table 7**.

Table 7. Environmental personnel required for the project.

CATEGORY	QUALIFICATIONS	REPORTS TO	ROLE
Environmental Coordinator	R.P. Bio; R.B. Tech.	MFLNRORD DFO CoQ Engineer of Record	Coordinates regulatory application and design to meet regulatory application requirements (i.e. fish passage). Completes Environmental Assessment, Environmental Effects Assessment and submits the application to the province. Provides sign-off on completed environmental design components, coordinates the environmental monitoring team.
Environmental Monitor	R.P. Bio., AScT; QEP; CESCL	Environmental Coordinator Engineering Inspector Contractor	Monitoring during instream works or other environmentally sensitive works, including presence of Japanese knotweed during excavation. Nesting bird surveys as required. Regular checks to ensure design elements are installed per design and will function as intended. Erosion and Sediment Control inspections.
Fish Salvage Technician	R.P. Bio; Dipl. Tech. QEP	Environmental Monitor	Installs isolation fish fencing. Completes fish salvage prior to instream works. On standby in case fish re-salvage efforts are needed

5.4 Long-term Maintenance Requirements

A sediment management plan for Partington creek was outlined within the IWMP (KWL, 2011; Page 112). Additional long-term maintenance requirements are set out in **Table 8**. The CoQ is requesting that these maintenance activities be added to the Change Approval as a multi-year maintenance program that is to be required to maintain stream functionality and reduce fine sediment deposit within the newly enhanced instream habitat.

Table 8. Long-term maintenance requirements for sediment removal in Partington Creek.

Maintenance Requirement	Mitigation measures implemented during maintenance
Annual sediment removal from in-line sediment pond. (August 1st – September 15th)	• Installation of 99.7m diversion culvert to divert flows around the worksite • Metre bag berm installation wrapped with polyethylene upstream and downstream to isolate flows • Fish salvage prior to instream works. • Works to occur in the dry during instream fish window. • Vehicles to work from dop of bank.
Annual sediment removal from off-line sediment pond. (August 1st – September 15th)	• Sandbag berms installation wrapped in polyethylene to divert flows. • Pump installation with fish screens to maintain flows into the off-channel habitat. • Fish salvage prior to instream works. • Works to occur in the dry during instream fish window.
Bi-annual off-channel sediment removal in 4 pools. (August 1st – September 15th)	• Sandbag berms installation wrapped in polyethylene to divert flows. • Pump with fish screen to divert flows around the worksite. • Fish salvage prior to instream works. • Works to occur in the dry during instream fish window.

5.5 Archeology

A Heritage Inspection Permit application has been made to the Archeology Branch under the Heritage Conservation Act (**Appendix D**). An Archeological/Heritage Permit application has also been made to the Katzie First Nations Katzie Development Limited Partnership (**Appendix E**). These applications have been made to complete an Archeological Impact Assessment (AIA) on the impacted area for the PCCOH project conducted by Antiquus Archeological Consultants Ltd. Based on an Archeological Overview Assessment completed by Archer in 2017 of the surrounding area, it was determined the project area possess potential for archeological sites. It is anticipated that if ground truthing during the AIA identifies archeologically important sites than an Archeological Branch Site Alteration Permit will need to be obtained prior to works commencing on the site.

6.0 Impacts to Other Affected Lands and People

As part of the approval process for the IWMP completed by KWL, extensive Stakeholder engagement and public input was provided with open forums being held between the CoQ, KWL, Fisheries and Oceans Canada, Ministry of Environment, Hyde Creek Watershed Society and others. A full list of attendees and comments is available in **Appendix F**.

7.0 Stream and Stream Channel Impact Assessment

The alteration and relocation of the existing roadside ditches will have minimal environmental effects owing to mitigation that was considered for both the design and construction planning for the project.

7.1 Culvert Fish Passage

Seven culverts within the off-channel habitat that intake low flow and base flow into the off-channel will be embedded and filled at varying depths of 0.3m to 0.5m with a coho gravel mix at the bottom of the culvert. Culvert installations along the project corridor have been designed to exceed the capacity of typical storm water flows through the area. The culvert gradients of the existing Cedar Drive road culverts and south outlet culverts will be at 0%. The gradient of the outside north inlet base/low flow culvert will have a gradient of 0.01%. Culverts have been designed to allow low flow and low tide water to be concentrated into one culvert along the channel thalweg so fish passage is maintained through the off-channel during all flow conditions. The inlet culvert to the off-channel habitat will have a flow control weir to allow flows to enter the off-channel so that they are split equally between the off-channel and main channel. This adjustable weir was designed primarily to consider future potential low flow conditions based on climate change and reduced water levels so that flows are maintained in both the off-channel and main channel at all times.

7.2 Riparian Enhancement Planting

A restoration plan has been developed for this project that includes riparian planting requirement (**Appendix G**). As the project will require the removal of noxious Japanese knotweed and Himalayan blackberry, an Invasive Species Management and Restoration has been developed by Diamond Head Consulting (**See EMP Schedule 2**). Implementation of Japanese knotweed chemical treatment started in fall 2021 and will continue until spring of 2022. As not all Japanese knotweed can be chemically treated due to the close proximity to the creak and with the heavy distribution of Himalayan blackberry, provisions for the contractor to develop an Invasive Species Removal, Disposal and Mitigation Plan has been incorporated into the Restoration Plan (**Appendix G**). Mitigation will include provision for the contractor to remove any invasive species within the restoration area for the term of the planting warranty period.

7.3 Construction Impact Mitigation

ISL has prepared an Environmental Management Plan for the project (**Appendix B**). The EMP represents the Owner and Designer's commitments to ensure appropriate construction impact mitigation is considered when the project is tendered. The EMP includes comprehensive provisions for:

- Vegetation clearing and noxious plant management.
- Environmental Monitoring.
- Environmental Reporting.
- Erosion and sediment control and water quality management.
- Nesting bird impact mitigation.
- Fish salvage.
- Wildlife mitigation and salvage.
- Worksite isolation.
- Stream bypass.
- Trash pumping.
- Grout and concrete management.
- Hazardous and non-hazardous waste management.

- Spill Response.
- Environmental Incident Reporting.

7.4 Assessment of Impacts on Environmental Values and Components

Effort for applying the four levels of the environmental mitigation hierarchy are outlined in **Table 9**.

Table 9. Mitigation options for the four levels of environmental hierarchy.

Environmental hierarchy	Mitigation options on environmental hierarchy level
Avoid	• Alignment of the road and off-channel habitat design could not deviate from KWL concept design drawings.
Minimize	• Off-channel habitat design opposed to 600m of deepening and widening of the main channel for flood conveyance.
Restore On-site	• Temporal riparian effects and invasive species control and removal. • Enhancement planting of native shrubs and trees with increased conifer density as outlined within the IWMP to achieve more historical site conditions.
Offset	• Off-channel habitat creation with deep pools, complex channel substrate, LWD root wads and enhanced native vegetation planting.

7.4.1 Project Impact Balance

The effects for the project have been assessed in the Annotated Effects Drawing in **Appendix H** and effects mitigated/offset in **Appendix G**, and the balance of the project effects and gain is summarized in the impact balance in **Table 10**. Setbacks were established using methodology for detailed assessment from the Riparian Area Protection regulation (RAPR) with Partington Creek getting a setback of 3 times the channel width at each reach location. Fish bearing ditches received a 10m setback where non fish bearing ditches received a 2m setback.

Table 10. Summary of project related footprint and impact balance on fish habitat.

Stream	Description of Works	Instream Impacts			Riparian Impacts		
		Effect	Gain	Net (Effect-Gain)	Effect	Gain	Net (Effect-Gain)
		(m^2)	(m^2)	(m^2)	(m^2)	(m^2)	(m^2)
Ditch 1	Ditch alteration	-1590[1]	0	-1590	-570[4]	0	-570
Ditch 2	Ditch alteration	-390[1]	0	-390	-680[4]	0	-680
Ditch 3	Ditch alteration	-755[1]	0	-755	-810[4]	0	-810
Partington Creek Reach 1	In-line Sediment Pond and creek deepening and widening	-2170[2]	+3075[3]	+905	-2630[4]	+3755[5]	+1125
Partington Creek Reach 2	Off-channel off-setting and mitigation	0	0	0	-1655[4]	+1840[5]	+185
Partington Creek Reach 3	Off-channel off-setting and off-line sediment pond	-315[2]	+60[3]	-255	-2590[4]	+1935[5]	-655
Off-channel to Partington Creek	Off-channel off-setting and mitigation	0	+5505[3]	+5505	0	+9550[5]	+9550
IMPACT TOTAL		**-5220**	**+8640**	**+3420**	**-8935**	**+17080**	**+8145**
PROJECT NET LOSS/GAIN		**INSTREAM:**		**+3420**	**RIPARIAN:**		**+8145**

[1] Effect of instream along surrounding agricultural ditches.
[2] Effect of Instream along Partington Creek mainstem
[3] Mitigation of instream effects through placement of 300mm deep coho gravel substrate.
[4] Effect of riparian vegetation along Partington Creek and the agricultural ditches, primarily riparian area associated with invasive plant species and blueberry fields.
[5] Restoration tree planting with native shrubs and trees along the off-channel habitat and north and south bank of Partington Creek.

7.4.2 Instream Effect Restoration

Partington Creek Reach 1, Reach 2 and Reach 3 consist of a uniform and consistent glide/pool morphology comprise predominantly of fines and lacks any cobble and boulder complexing. This habitat value is consistent within the entire lower section of Partington Creek due to historic realignment and channelization. The lower reaches of Partington Creek also lack LWD within the channel that would typically provide resting and cover for spawning/rearing salmonids. Complexing of the main channel and off-channel is to be completed through channel substrate treatment and installation of LWD clusters. An outline of the restoration habitat units for the main channel and off-channel is provided in **Table 11**.

Table 11. New habitat units created in Partington Creek Reach 1 and the off-channel habitat.

Site	Station	Habitat unit #	Habitat unit length (m)	Habitat Unit	Dominant channel Substrate	Subdominant channel substrate	Gravel depth (cm)	Area created (m^2)
Partington Creek Reach 1	0+005 – 0+135	1	130	Glide	Gravel	Cobble	30	1128
Partington Creek Reach 1	0+135 – 0+205	2	70	Deep Pool	Fines	Gravel	0	1300
Partington Creek Reach 1	0+205 – 0+270	3	65	Glide	Gravel	Cobble	30	560
Off-channel	0+020 – 0+080	4	60	Glide	Gravel	Cobble	30	565
Off-channel	0+100 – 0+115	5	15	Glide	Gravel	Cobble	30	165
Off-channel	0+115 – 0+150	6	35	Pool	Fines	Gravel	0	375
Off-channel	0+150 – 0+210	7	60	Glide	Gravel	Cobble	30	545
Off-channel	0+210 – 0+250	8	40	Pool	Fines	Gravel	0	400
Off-channel	0+250 – 0+257	9	7	Glide	Gravel	Cobble	30	50
Off-channel	0+257 – 0+295	10	38	Pool	Fines	Gravel	0	381
Off-channel	0+295 – 0+365	11	70	Glide	Gravel	Cobble	30	670
Off-channel	0+365 – 0+375	12	10	Riffle	Gravel	Cobble	30	85
Off-channel	0+375 – 0+400	13	25	Glide	Gravel	Cobble	30	240
Off-channel	0+400 – 0+428	14	28	Pool	Fines	Gravel	0	280
Off-channel	0+428 – 0+515	15	87	Glide	Gravel	Cobble	30	840
Off-channel	0+515- 0+543	16	28	Riffle	Gravel	Cobble	30	215
Off-channel	0+563 – 0+605	17	42	Deep Pool	Fines	Gravel	0	600

The main channel has incorporated a deep pool sediment trap as well as an enhanced glide habitat unit through the over excavation of the channel to allow for the substrate treatment with 300mm of coho gravel, boulders and river sand to fill interstitial space. Large woody debris clusters will also be installed within the glide units to further complex the stream and add high quality rearing habitat to Reach 1 of Partington Creek. The deep pool habitat unit comprised of the sediment pond cannot be treated with boulder or LWD due to future annual maintenance requirement for sediment removal. It is not anticipated that this will impact the quality of the pool habitat as the deep pool will provide relief from high velocity flows and will provide adequate depth coverage for rearing fish. Tree planting will be heavy along the south side of the sediment pond to provide adequate shade cover to prevent the large surface area of the pond from drastically increasing in temperature.

The off-channel has mainly incorporated glide and pool habitat units into the restoration design with 2 riffle habitat units at 2.0% gradient being added. The addition of riffle habitat is difficult along this stretch of Partington creek as the average slope of the main channel from Reach 3 to Reach 1 is 0.04%. Habitat units within the off-channel have been treated with the following measures:

- Over excavation of the main channel and off-channel and installation of 300mm of channel substrate comprised of:
  - 10% River sand;
  - 40% Gravel (10-100mm);
  - 30% (Cobble (100-300mm); and,
  - 20% Boulder (300-600mm).

- Installation of sixty-four (64) LWD clusters along riffle and glide habitats with rootwad installed perpendicular to the bank with the entire trunk keyed into the bank and fractured boulders cabled together.
  - LWD is to be keyed in at a depth that allows for planting above.
  - Each cluster is comprised of 4 trunks supported

7.4.3 Riparian Effect Restoration

Riparian restoration treatment to mitigate the loss provide exponentially higher quality habitat than previous conditions of Partington Creek and to include the following:

- Restoration planting as outlined in the restoration plan (**Appendix G**).
- Removal and mitigation planting of invasive/noxious plant species.
- Planting trees throughout the riparian area to provide increased shade to the channels.
- Planting of native conifers and small amounts of deciduous per the IWMP (KWL, 2011).
- Bench planting at two location with sedges and rushes
- Installation of eighteen (18) bat boxes within the riparian habitat.
- Installation of seventeen (17) standing tree snags for bird nesting with:
  - 300mm diameter at breast height (DPH);
  - two slabs removed and allowed out per tree with an augured access hole;
  - Hollowed slabs affixed with galvanized wood screws; and,
  - Predator guard wheel installed around and extended 300mm minimum from the base.
- Installation of eighteen (18) course woody debris structures with loosely stacked rock and interlocking logs and branches approximately 4.0m x 2.0m wide with 10 pieces of debris per pile for terrestrial habitat.

7.4.4 Hydraulic Effects

A hydraulic assessment has been completed for Partington Creek (Appendix I). The lower section of Partington Creek (Reach1, Reach 2 and Reach 3) are tidally influenced and fluctuate in elevation by 0.87m during spring baseflow and 1.05m during summer low flow conditions. As the majority of the off-channel habitat and all of the in-line sediment pond are tidally influenced it is difficult to make assumption on velocity and depth as they vary drastically throughout each day. As such, all velocity and depth measurements that have been provided for environmental assessment are based on low tide scenarios when the tide does not influence channel flows in Partington Creek.

The projected velocity measurement and depth were calculated within the main channel of Partington Creek and the off-channel habitat during 2 scenarios, the first being summer low flow conditions and the second being fall and spring conditions during Coho salmon, Chum salmon, Rainbow trout and Cutthroat trout spawning times. Historic runs for Chum and Coho salmon do not begin spawning until upstream of Reach 3 where gradients elevate to 1-3% with higher stream velocities and substrate is dominated by gravel and cobble.

Velocity and Depth

During summer low flow conditions projected velocities within the main channel of Partington Creek 60 m from the in-line sediment pond would be 0.12m/s. The off-channel will have a low flow velocity of 0.09m/s. Velocities during summer low flow conditions are below or equal to current maximum sustained swimming speeds for Coho, Cutthroat and Rainbow trout juveniles (50mm) allowing for adequate fish migration through the main channel and off-channel through to the upper reaches of Partington Creek (WRP, 1997).

During spawning period in October for Coho and Chum salmon projected velocities within the main channel of Partington creek south from the in-line sediment pond has a range from 0.24m/s – 0.47m/s. The off-channel has projected velocities ranging from 0.20m/s-0.40m/s. Velocity ranges were obtained by using the lowest flow and highest flow during the month of October as flow conditions vary drastically during the month with lower flows typical in early October and higher flows After mid-October during the first extending period of rain.

The range of projected water velocities and depths at the main channel (south of in-line sediment pond) and off-channel locations where flows are split between the main channel and off-channel during periods of spawning by salmon (fall) and trout (spring) is found in **Table 12**.

Table 12. Range of projected water velocities and depths in the main channel of Partington Creek and the off-channel during periods of spawning salmon (fall) and trout (winter)

Main Channel	Salmon spawning period			Trout spawning period		
	October	November	December	April	May	June
Average depth (m)[1]	0.26	0.32	0.43	0.18	0.17	0.20
Average velocity (m/s)[1]	0.25	0.28	0.33	0.20	0.19	0.21
Off-Channel						
Average depth (m)[1]	0.18	0.22	0.29	0.12	0.11	0.13
Average velocity (m/s)[1]	0.20	0.23	0.28	0.16	0.15	0.17

[1]These projected values are calculated using Mannings equation and the longest and shortest base width. The average discharge (m^3/s) for Partington Creek was from 2020 data taken from the Partington Creek flow meter located at Victoria Drive. These values do not consider tidal influence and are only based on low tide conditions. Typical increase in depth translates to a relative decrease in velocity based on the Manning equation.

The projected velocity range of the main channel and the off-channel is within range of typical prolonged swimming speed velocities of Coho, Cutthroat and Rainbow trout juveniles (50mm) allowing for accessible rearing fish movement through the main channel and off-channel to the upper reaches of Partington Creek (WRP, 1997).

The average proposed velocities within the main channel and off-channel are moderately lower and slightly lower than the recommended spawning velocity required for both Chum (0.46m/s) and Coho salmon (0.30m/s) respectively. Depth within the main channel and off-channel will vary dramatically

throughout the day due to the two typical tidal cycles, however, minimum projected depths during October of both the main channel and the off-channel based on no tidal influence will be an average of 0.26m and 0.18m respectively. These depths would be significantly higher based and tidal influence during high tide and would relatively be higher than the typical minimum depth required for Chum and Coho salmon of 0.18m (WRP, 1997).

Based on projected velocities and depths for the spring months, depths fall in line with typical minimum spawning depth requirements for Rainbow (0.18) and Cutthroat trout (0.06m). Rainbow trout project spawning velocities are lower than the typical minimum velocity requirements of 0.48m/s for spawning. The projected spawning velocities do fall within the velocity requirements for Cutthroat trout with a minimum of 0.11m/s (WRP, 1997).

Additionally, Reach 1 of Partington Creek (where in-line sediment pond and creek widening is taking place) and the off-channel habitat will have constructed riffles, glides, deep pools, large woody debris clusters and boulder clusters to provide varying velocities. This would help to improve rearing along the lower reaches of Partington Creek that are tidally influenced and impacted by higher flow velocities. Substrate size will vary with the main channel and off-channel and will be composed of 0.3m deep of coho gravel (10-100mm), cobble (100-300mm), boulders (300mm-600mm) and river sand (0.1-10mm) to fill interstitial spaces. It is not anticipated that spawning will occur within the off-channel. The primary purpose and design elements of the off-channel and main channel works is to provide high quality rearing habitat for both Coho salmon and resident trout species in Partington Creek.

7.4.5 Post-construction Effectiveness Monitoring

A 5-year Post Construction Effectiveness Monitoring Program will be required to be implemented for this project to assess the effectiveness of mitigation and offset measures developed for the project. A Post Construction Effectiveness Monitoring Plan has been proposed in **Table 13**. As part of the effectiveness monitoring program, pre-construction baseline monitoring is to be complete to compare results of the post-construction monitoring.

Table 13. Proposed pre- and post-construction and effectiveness monitoring program associated with the Partington Creek in-line sediment pond and channel widening and off-channel enhancement habitat.

MONITORING MEASURE	MONITORING QUESTION	APPROACH/TECHNIQUE	MONITORING LOCATIONS Instream / Riparian /Offsite	TIMING	DURATION/ FREQUENCY	MONITORING REPORTS TO AGENCIES
Fish utilization	What are fish densities and usage by life stage per habitat of the Off-channel habitat and main channel at in-line sediment pond? Pre-construction baseline sampling to be conducted in Partington Creek and surrounding agricultural ditches.	Pre-construction and Post-construction fish sampling/ catch-per-unit effort/catch per unit area, Including electrofishing	Instream	April, July	2024, 2025, 2027, 2029	December 31, 2025, 2027, 2029
Productivity capacity	Are benthic invertebrate assemblages within the off-channel habitat? Pre-construction baseline sampling to be conducted in Partington Creek and surrounding agricultural ditches.	Pre-construction and Post-construction benthic invertebrate sampling.	Three replicates within work zone and at control site	April, July, October	2024, 2025, 2027, 2028	December 31, 2025, 2027, 2029
Riparian cover	Has vegetation planted provided adequate shade cover? Pre-construction baseline sampling to be conducted in Partington Creek and surrounding agricultural ditches.	Pre-construction and Post-construction. Solar irradiation light metering.	Within entire length of disturbed riparian area	July	2024, 2025, 2026, 2027, 2028, 2029	December 31, 2025, 2027, 2029
Fish salvage	Is death of fish avoided?	Fish salvage prior to all instream activities, and prior to bypass	All instream areas	August 1 to September 15	2023, 2024	December 31, 2024 post-construction report
Construction environmental monitoring	Are the construction impact mitigation measures developed for the project and offset being implemented per Authorization, Approvals, Contract and the EMP	Full-time monitoring (that is an 8-hour day) during installation of site isolation and bypass and all instream work, followed by minimum twice weekly half day monitoring for all other activities.	All Instream and riparian activities	August 1 to September 15	2023, 2024	December 31, 2024 post-construction report
Stream gravel stability	Is the new stream channel substrate stable and accumulating to similar depth as existing channel? Do conditions match existing?	Assess gravel areas in the main channel and Off-channel.	Instream	April	2025, 2026, 2029	December 31, 2025, 2027, 2029
Pool & riffle stability	Are pools and riffles stable? Are the pools and riffles constructed in the relocated habitat persisting?	Pool count and pool depth measurement	Instream	April	2025, 2026, 2029	December 31, 2025, 2027, 2029
Riparian planting	Were the requisite plantings completed by Contractor in a manner that is consistent with the planting plan?	Plant counts, check plant species list from supplier, are plants appropriate size, planted depth.	Plot counts throughout disturbed riparian area and quantities check from the plant supplier	April, September	2024	December 31, 2024 post-construction report
Riparian plant survival	Are vegetation plantings reaching survival targets: 80% for trees; 80% for shrubs. Are plantings “free to grow” (growing above competing vegetation	Plant counts /flag and tally dead annually recommend replacement planting if necessary	Plot counts throughout entire length of disturbed riparian area	April, September	2025, 2026, 2027, 2028, 2029	December 31, 2025, 2027, 2029
Riparian plant health	Is removal of invasive species and maintenance of competing vegetation warranted and ongoing?	Visual inspection and removal of invasive plant species.	Within entire length of disturbed riparian area	April, September	2025, 2026, 2027, 2028, 2029	December 31, 2025, 2027, 2029
Water depth	Do post-construction depths align with those anticipated by design and are they similar to the preconstruction condition? Identify depths during spring freshet and summer low flows with varying tidal influences. Pre0construction baseline sampling to be conducted in Partington Creek.	Bankfull depth and wetted depth measurements	Instream	April, September	2025, 2026, 2029	December 31, 2025, 2027, 2029
Instream Velocity Monitoring	What are velocities during low flow and high flow conditions and how do conditions change through splitting the channel.	Velocity measurements pre construction compared to post construction velocities for both the main channel and off-channel	Instream	April, September	2025, 2026, 2029	December 31, 2025, 2027, 2029

7.5 Effects Statement

The Project will result in a net gain in instream effects of 3,420m2. Over half (2,735m2) of the instream effect is from the alteration of the agricultural drainage ditches located in the alignment of the new road and off-channel. Ditches 1 and 3 are not fish bearing and Ditch 2 is potentially fish bearing with all the constructed ditches providing marginal, at best, fish habitat to downstream fish bearing ditches. The instream gain achieved from the project will replace poor quality agricultural drainage ditches with high quality off-channel fish habitat to Partington Creek. It is debatable whether effects to the ditches would be classified as a harmful alteration/negative effect as the majority of area of the ditches is to be converted into the enhanced off-channel habitat. ISL considers impacts to instream habitat as low magnitude as most would be temporary effects during construction that are fully mitigated through enhancement of habitat features and substrate condition through Partington Creek.

The Project will result in a net gain in riparian effects of 8145m2. The majority of area constituting riparian effects comes from areas inundated with invasive/noxious species of Himalayan blackberry, reed canary grass and Japanese knotweed, as well as areas that currently provide no current riparian functionality but are assessed as riparian potential from the existing agricultural farmland to the southeast of the existing Cedar Drive. The riparian gain in functionality through restoration is far higher due to the quality of habitat that is to be restored within the riparian zones of the main channel and Off-channel habitats and therefore the riparian habitat balance is not reflective of the true net gain effect that is achieved from the restoration activities within the riparian areas.

8.0 References

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APPENDIX A
City of Coquitlam Letter of Urgency

Coquitlam

July 9, 2021
Our File: 11-5220-01/000/2021-1
Doc #: 4131334.v1

Front Counter BC

To Whom It May Concern:

Re: Cedar Drive/Partington Creek Project – Request for Prioritization of Project Review and Approval

The City of Coquitlam is undertaking a major capital project as part of the Partington Creek Integrated Watershed Management Plan (PCIWMP) implementation plan and to address safety and flooding conditions along Cedar Drive.

Over the years, Cedar Drive has experienced severe flooding on a frequent basis when Partington Creek overtops its left bank (which is Cedar Drive, see attached picture). The impact of this overtopping is:

- a hazardous situation for vehicles, pedestrians, and cyclists travelling on Cedar Drive;
- causing property damage each time flooding occurs, including damage to the road structure and farmland; and
- a hazard to fish, such as salmon, in Partington Creek.

The Cedar Drive/Partington Creek project will provide an overflow channel which will divert high flows away from Partington Creek to mitigate erosion within the creek and prevent flooding and washouts of Cedar Drive.

We respectfully request that the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development prioritize the review and approval of this culvert project, since it is a critical step in mitigating the flooding and erosion described above.

The Cedar Drive/Partington Creek project will also provide a number of other benefits which are very important to the City of Coquitlam, including the following:

- A large area of riparian and aquatic habitat is being created within the overflow channel. The channel is an important component of the PCIWMP;

City of Coquitlam
3000 Guildford Way
Coquitlam, BC Canada V3B 7N2
Reception Desk: 604-927-3000
coquitlam.ca

- The sanitary sewer system is being expanded; and
- A new safer roadway and pedestrian/cyclist corridor is being constructed.

Thank you for your consideration of prioritizing this important project.

If you have any questions, please contact Mark Zaborniak, P.Eng., Manager of Design and Construction at 604 927 3502.

Yours truly,

J Boan

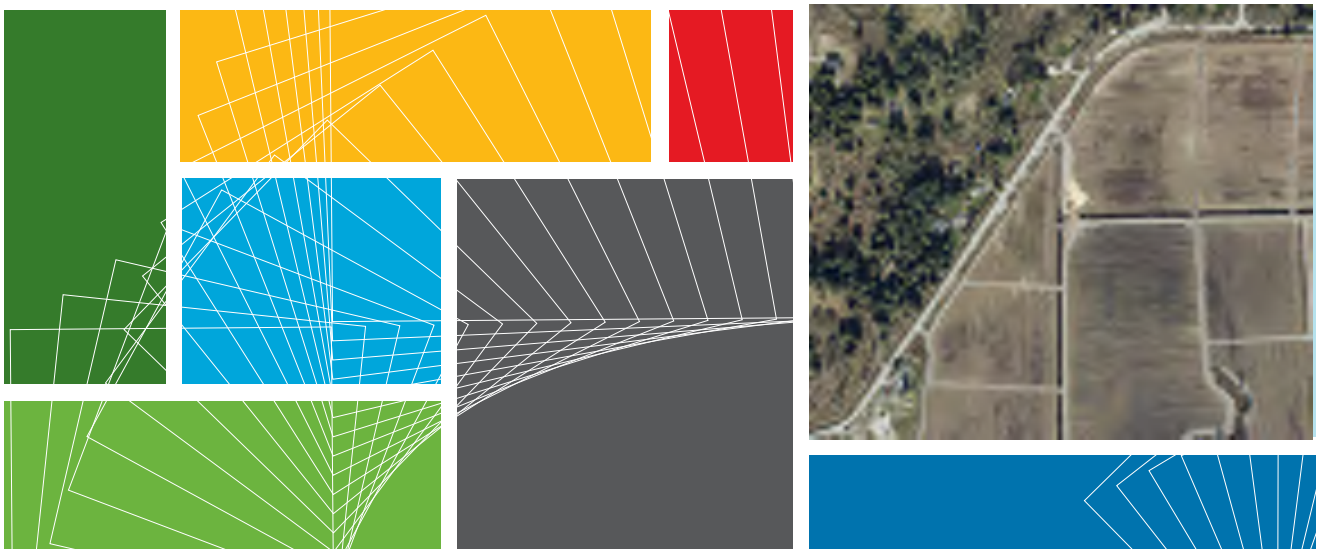
Jaime Boan, P.Eng.
General Manager Engineering and Public Works

Attachment

ATTACHMENT

PHOTO OF CEDAR DRIVE – FLOODING FROM PARTINGTON CREEK

APPENDIX B
Environmental Management Plan



ENVIRONMENTAL MANAGEMENT PLAN

City of Coquitlam

Cedar Drive/Partington Creek Upgrades and Off-Channel Enhancement Habitat

May 2022

ISL Engineering and Land Services Ltd. is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

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1.0 Environmental Management Plan Purpose

The enclosed Environmental Management Plan (EMP) has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use by the City of Coquitlam (CoQ) during the proposed Cedar Drive/Partington Creek Upgrades and Off-Channel Enhancement Habitat, located in Coquitlam, BC. This EMP represents the CoQ and ISL's environmental commitments to designing and tendering the project in a manner that avoids detrimental effects to the surrounding environment.

As the CoQ and ISL have committed to implement a design to avoid, minimize and mitigate harmful environmental effects, it will be necessary for the Contractor who will deliver and install the system to abide strictly to the conditions set out in this EMP. The EMP cites applicable Best Management Practices (BMPs) for mitigation of environmental effects and Environmental Regulatory Approval requirements that the Contractor must adopt as part of their practices. Fully implementing the BMP's set out in this EMP will help to avoid triggering project review, Stop Work Orders, and otherwise contravening the following environmental legislation:

- Provincial *Water Sustainability Act (*WSA*);*
- Provincial *Weed Control Act;*
- Provincial *Wildlife Act;*
- Provincial *Environmental Management Act;*
- Federal *Fisheries Act;*
- Federal *Species at Risk Act (*SARA*);* and,
- Federal *Migratory Birds Convention Act (*MBCA*).*

The provisions outlined in this EMP are Contractor's 'mandatories' and form part of contract documents for the project. Therefore, the Contractor must read and understand the environmental obligations contained within this EMP and, consequently, the Contract. Prospective Contractors are advised to carefully review this EMP prior to submitting responses to the Tender, to ensure that the environmental protection and effect mitigation requirements are adequately captured and accounted for.

If the Contractor does not have the appropriate environmental effects mitigation measures on site and the Environmental Monitor (EM) indicates that the Contractor cannot protect and mitigate effects to fish, fish habitat, wildlife and other project-specific environmental sensitivities requiring protection, delays and shutdowns may result in additional costs that are the Contractor's sole responsibilities.

2.0 Project Background

ISL Engineering and Land Services Ltd. (ISL) was retained by the CoQ to provide preliminary and detailed engineering design, hydraulic assessment, environmental impact assessment, environmental effects mitigation and regulatory application submission for the Cedar Drive/Partington Creek Upgrades and Off-Channel Enhancement Habitat project. Cedar Drive currently has low residential density, with the existing properties sanitary effluent being treated by individual septic systems. As part of CoQ's development strategy, a new sanitary collection system is required to aid future development along the corridor. The Cedar Drive/Partington Creek Upgrades and Off-Channel Enhancement Habitat are required for flood protection and riparian enhancement along the corridor.

The new sanitary collection system will consist of a sanitary gravity sewer and sanitary forcemain, connected to a proposed pump station. Road upgrades will include relocation, raising, and widening of Cedar Drive. The existing Cedar Drive will be kept in service to provide access to properties North of Partington Creek and to carry utilities.

Partington Creek is located north of Cedar Drive and runs parallel to the existing alignment. During periods of high flow, Partington Creek floods Cedar Drive. Through realignment of Cedar Drive, the project will help to alleviate and prevent flooding via the construction of an Off-channel flood conveyance area and fish restoration habitat. The project consists of the installation of the new sanitary infrastructure, installation of a new water main and construction of an in-line sediment pond and channel widening that will require temporary diversion of Partington Creek. An Off-channel habitat will also be constructed concurrent with the new road to accommodate high creek flows and prevent flooding. This Off-channel will also provide additional salmonid habitat, and habitat restoration will replace the existing invasive vegetation found along the project area with native riparian plants. Culverts will be installed to facilitate variable flows and fish passage between the Off-channel habitat and Partington Creek.

The existing properties south of Cedar Drive have ditches which facilitate drainage of the agricultural land. In their existing condition, these ditches are connected to DeBoville Slough B. The ditches do not provide fish habitat and will be infilled during the project to accommodate the new road alignment of Cedar Drive.

2.1 Project Location and Context

The project is in Coquitlam, BC and will be located at a 1.6 km portion of Cedar Drive between Victoria Drive and Gilley's Trail (**Figure 1**). Partington Creek exists north of Cedar Drive.

Figure 1. Key map of the project location (source: iMapBC; Google Earth, 2021).

2.2 Description of Project Activities

The project will consist of relocation of existing utilities; installation of new water and sanitary infrastructure; realignment and widening of Cedar Drive; construction of an in-line sediment pond and off-channel habitat; and installation of culverts to facilitate water flow between these two components. An engineering design drawing for the project is included in **Appendix C of the Supplemental Report**. Specifically, the design has the following elements:

- Removal of existing water and gas mains. Existing hydro poles will be supported during new main installation but will ultimately be relocated during road alignment.
- Cap and abandon any existing water mains on CoQ property. Private landowners' existing water services will be reconnected to new main.
- Site excavation and installation of new 200 mm diameter water main along project alignment.
- Installation of 60 mm diameter gas main along project alignment.
- Installation of 375 mm diameter PVC gravity main sanitary sewer beginning at southern project extent.
- Installation of pump station at southern project extent, the proposed 375 mm diameter sanitary gravity main from South and 450 mm diameter sanitary gravity main from North will merge into 600 mm main prior to connecting with the pump station.
- Installation of proposed 450 mm diameter HDPE sanitary forcemain. Tie in to existing forcemain at Victoria drive with 350 mm – 450 mm diameter HDPE reducer.

- At northern extent of project, at Gilley's Trail, install an outlet structure within the off-channel. The outlet structure will be connected to a new 600 mm concrete storm main, which will tie-in with the existing ditch at Gilley's Trail.
- Infill of excavation from utilities. Laydown of new road with two 3.3 m lanes and 3.5 m MUP. Tie-in of existing property driveways on the South to new road. Specific specifications for road and MUP infrastructure are as follows:
  - New road surface will consist of:
    - 50 mm top lift asphalt
    - 75 mm base lift
    - 150 mm of 19 mm minus granular base
    - 300 mm of 75 mm minus granular subbase
  - MUP and asphalt driveways:
    - 50 mm hot mix asphalt
    - 100 mm of 19 mm minus granular base
    - 250mm of 75 mm minus granular subbase
- At northern extent road tie-in locations, lane width reduces to 2 m at Oliver Road, and 3 m width at Gilley's Trail. MUP ends at Gilley's Trail. Asphalt curbs will be installed at northern extent.
- Infilling of agricultural ditches south of existing Cedar Drive
- Isolation and temporary bypass of Partington Creek.
- Construction of the in-line sediment pond through deepening and widening of the existing creek bed.
- Construction of the off-channel habitat.
- Installation of 9 total concrete box culverts designed to facilitate fish passage and to connect flows of Partington Creek to the Off-channel habitat (**Table** 1)
- Installation of a 99.9m long 600mm diameter Reinforced Concrete Culvert with an affixed flow gate adjacent to the in-line sediment pond to provide flow diversion during future maintenance activities of the sediment pond
- Restoration planting of native riparian vegetation surrounding the in-line sediment pond, Off-channel and Cedar Drive once construction is complete. The small boulevard adjacent to the MUP will be treated with 150mm topsoil and sod.

Table 1. Detailed culvert design specs and weir details.

Culvert Location	Culvert Specs	Culvert Weir Detail
North inlet to Off-channel (3 total culverts)	Outside: 21.5m long 1.2 x2.1m Box Culvert with V-notch outlet weir and adjustable inlet weir.	Inlet adjustable weir to inverts of 3.15m to 3.25m to adjust flows entering the Off-channel during varying flow conditions. Outlet V-notch weir set at invert of 3.05m.
	Middle: 20.2m long 0.9 x 2.1m Box Culvert.	Inlet weir set at invert of 3.50m no outlet weir as culvert designed to provide capacity to the Off-channel during storm events.
	Outside: 20.2m long 0.9 x 2.1m Box Culvert.	Inlet weir set at invert of 3.50m no outlet weir as culvert designed to provide capacity to the Off-channel during storm events.
Existing Cedar Drive road culverts in Off-channel (3 total culverts)	Outside: 25.3m long 1.2 x 2.1m Box Culvert.	Top of inlet weir and outlet weir at invert of 1.9m.
	Middle: 25.3m long 1.2 x 2.1m Box Culvert with V-notch weir.	V-notch at the inlet and the outlet set at invert of 1.8m to direct low summer flows into one culvert during low tide periods.
	Outside: 25.3m long 1.2 x 2.1m Box Culvert.	Top of inlet weir and outlet weir at invert of 1.95m.
South outlet to the Off-channel (3 total culverts	Outside: 17.8m long 1.2 x 2.1m Box Culvert.	Top of inlet weir and outlet weir at invert of 1.95m.
	Middle: 17.8m long 1.2 x 2.1m Box Culvert with V-notch weir.	V-notch at the inlet and the outlet set at invert of 1.8m to direct low summer flows into one culvert during low tide periods.
	Outside: 17.8m long 1.2 x 2.1m Box Culvert.	Top of inlet weir and outlet weir at invert of 1.95m.
Diversion culverts for creek by-pass during in-line sediment pond maintenance	99.93m long – 600mmØ Reinforced Concrete Culvert.	None. Diversion culvert will be affixed with a gate valve to allow flows to enter the culvert during maintenance activities.

2.3 Timing of the Proposed Works

Construction of the In-line sediment pond and Off-channel habitat will be conducted in two phases. As the In-line sediment pond is within the existing Partington Creek, construction associated with deepening and widening the creek along this section will be completed during the Reduced Risk Instream Window, from August 1st to September 15th, 2023 and August 1st to September 15th, 2024.

Construction of the Off-channel will begin in 2024. It is anticipated the construction of the off-channel will start when conditions are typically drier and creek flows are low (May/June). All instream works within Partington Creek, including the upstream and downstream culvert connections to the off-channel habitat and upstream sediment pond connection, will be completed during the Reduced Risk Instream Window from August 1st to September 15th, 2024.

Construction of the new alignment of Cedar Drive, multi-use path, utilities connections, and infilling of the agricultural ditches will be ongoing through 2023 and 2024. The existing agricultural ditches have no fish presence and do not provide adequate fish habitat; therefore, infilling can occur outside of the typical fish window as there is no risk to spawning or rearing fish. Mitigation measures can be implemented to prevent death of fish during infilling of the drainage ditches which include, fish salvage prior to infilling, erosion and sediment control measures and leak-free isolation and dewatering so work can be completed in the dry.

3.0 Environmental Regulatory Context

A Change Approval under Section 11 of the *Water Sustainability Act* will be submitted to the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRO).

A Fisheries and Oceans Canada (DFO) Request for Review will be submitted to see if the project will result in the death of fish and/or harmful alteration, disruption or destruction of fish habitat.

The Contractor is responsible for reviewing all environmental regulatory documents, permits, and approvals associated with the project to understand the environmental protection and mitigation commitments undertaken by responding to the Tender.

The Contractor is also responsible for following all conditions set out by regulatory documents for all project activities, as well as the BMPs described in this EMP. Should the Contractor need further clarification, they will contact ISL or the designated Environmental Monitor (EM).

3.1 Applicable Best Management Practices (BMPs)

The following Best Management Practices (BMPs) documents are applicable to the project and must be reviewed and understood by the Contractor and EM.

- **Land Development Guidelines for the Protection of Aquatic Habitat:** http://www.sxd.sala.ubc.ca/9_resources/fed_%20files/fed%20land%20development%20guidelines.pdf
- **Standards and Best Practices for Instream Works**: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/iswstdsbpsmarch2004.pdf
- **A User's Guide to Working in and Around Water:** https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/working_around_water.pdf

The documents listed above, the information within this EMP, and regulatory submissions outline the minimum mandatory mitigation measures for project-related impacts.

4.0 Environmental Monitoring

The project and associated activities requires works which require isolation from flowing water. These construction activities require the presence of an Environmental Monitor (EM) to ensure the activities are undertaken in conformance with this EMP. The EM will be provided by ISL for the project.

The EM must be a Qualified Environmental Professional (QEP). QEPs can conduct work required by this EMP as individuals or together with other qualified environmental professionals and will only be considered a suitable QEP for work that is within their area of expertise.

4.1 Environmental Orientation and Monitoring Frequency

- After project award, and prior to any work on-site, an office-based pre-construction kick-off meeting will be held amongst the EM, Project Manager, Engineering Inspector, and the Contractor to ensure an understanding of the applicable regulatory documents and mitigative BMPs outlined in this EMP.
- Prior to any works on-site, a second field pre-construction meeting will be held amongst the EM, Designer, Contractor's Site Supervisor (or Foreman) to conduct a site walk-through and identify site-specific risks, environmental constraints, and discuss the project schedule.
- The EM will complete a Contractor Environmental Orientation Record (**Schedule 1**) as part of the second field pre-construction meeting and submit that to the Contract Administrator.
- Environmental Monitoring will be full-time during instream works. Otherwise, additional inspections within 24 hours of a significant rain event are required. SRE's are defined as >24mm rain/24 hours.
- The EM will be notified a minimum of five (5) days prior to the start of project activities.

4.2 Environmental Monitoring Requirements

The EM will:

- Modify or halt any construction activity, if deemed necessary, for protection of organisms, habitat, or other environmental resources.
- Advise the Contractor on required protective or mitigatory measures to meet requirements of environmental regulatory advice, approvals and applicable BMPs as required by this EMP.
- Ensure that all project components are completed in conformance with this EMP.
- Ensure that the best management practices related to the nature of the construction work occurring are adopted to avoid contravening provincial or federal legislation.
- Require that the Contractor have all documentation regarding environmental mitigation and environmental approvals on-site, including this EMP.
- Report to the environmental regulatory agencies with jurisdiction, as required, by project Approvals or Authorizations.
- Report Environmental Incidents or non-compliances to the regulatory agencies with jurisdiction in the event of circumstances that would trigger a requirement for agency involvement.
- Report environmental non-compliance to the Site Supervisor, Engineering Inspector, and Contract Administrator.

- Prepare weekly inspection summary reports, including documented observations, photographs, compliance, and construction progress. Weekly summary reports will be provided to the Contract Administrator.
- At the completion of the project, complete and submit a copy of a post-construction report consistent with the recommended standard format to the relevant parties within 60 days of project completion. The report will document that construction has been completed and outline any difficulties encountered during the project.
- Not consider the project to be complete and in compliance with best practices for mitigating the works if there are any outstanding proposed mitigation measures.

5.0 Project Mitigation Measures

5.1 Erosion and Sediment Control Requirements

Effective Erosion and Sediment Control (ESC) measures must be utilized for the duration of the project to prevent erosion of soils and sedimentation into the CoQ drainage and fish habitat. The Contractor must abide by the ESC Requirements below:

- Prior to commencement of the work the Contractor must obtain sufficient quantities of materials to be used to stabilize erodible surfaces (for example, silt fence, native grass seed mix, sandbags, erosion control blanketing, polyethylene sheeting, mulch etc.).
- Ensure that ESC control materials and labour required to install the materials are on-site, and available for inspection and deployment prior to the commencement of any ground disturbance.
- Effective erosion and sediment control measures are to be installed before starting work.
- ESC measures will be regularly inspected by the EM during construction. Necessary repairs will be made by the Contractor immediately if any damage occurs such that erosion and sediment control is compromised.
- Construction must be completed in a manner that will prevent the release of sediment or sediment-laden waters to watercourses, ditches, storm sewers, and swales draining to fish habitat.
- Perimeter control measures will be installed to ensure deleterious materials are not released into any of the surrounding drainages.
- Leave undisturbed native vegetation wherever possible.
- Stabilize all disturbed slopes, watercourse banks and ground surfaces that may contribute sediment-laden water into sensitive fish habitats during precipitation events. Use biodegradable erosion and sediment control materials whenever possible.
- Complete work as quickly as possible once started.
- Maintain effective sediment and erosion control measures until revegetation of disturbed areas is achieved.
- Soil stockpiles are to be stabilized to prevent them from entering the watercourses by covering stockpiles with 6 mm polyethylene sheeting weighted down with sandbags. Sheeting must be overlapped by minimum of 30 mm.
- Soil stockpiles are to be 30 m from the top of bank of any watercourse.
- If paved surfaces are nominated for temporary soil stockpiling, stockpiles shall be placed on tarps and the toe will be surrounded by a berm of sandbags, siltsoxx or an approved equivalent.

- All ESC controls must be removed prior to vacating the worksite (i.e., removing all exposed non-biodegradable ESC materials once site is stabilized).

5.2 Water Quality Management

Water quality downstream of the work site must meet or exceed the discharge limits referenced in the City of Coquitlam Stream and Drainage Protection Bylaw No. 4403, 20313. Work practices on site should ensure water exiting the site meets the following criteria:

- Discharge turbidity levels must not exceed 25 Nephelometric Turbidity Units (NTU) under normal weather conditions.
- During and for 24 hours following an SRE, discharge turbidity levels must not exceed 100 NTU.
- Discharge pH values should not be outside the range of 6.5-8.0.

5.3 Fish Habitat Protection Requirements

Partington Creek provides habitat for salmonid and non-salmonid fishes. The Contractor will implement the following fish habitat protection measures for the duration of the project:

- Avoid stockpiling material on stream banks and in riparian zones.
- Limit disturbance to areas adjacent to waterbodies.
- Limit grubbing on watercourse banks to the area required for the footprint of the works, undertakings, or activities.
- Do not deposit any substances deleterious to fish or fish habitat directly or indirectly into the watercourse or downstream reaches of the watercourse.
- Prevent debris from entering ditches or streams that have not been isolated from flowing water. No debris is to remain below the high-water mark or placed into the stream.
- Develop and implement a response plan to avoid a spill of deleterious substances into the watercourse.

5.4 Instream Works Requirements

All instream works are to be completed in isolation of flowing water through implementation of isolation and a stream bypass system.

5.4.1 Site Isolation Requirements

The contractor is responsible for installing quality, functioning site isolation upstream and downstream of the worksite to prevent death of fish, permanent alteration of fish habitat, and deposition of deleterious substances.

- The site isolation technique utilized must be “substantially leak free”. ‘Substantially leak free’ will be defined as having water that is discharged from the isolated work site to fish habitat that is less than 25 Nephelometric Turbidity Units (NTU).

- If one or both parameters cannot be met, then the EM will have the authority to shut-down the works and direct the contractor to adjust the site isolation and/or treatment of sediment-laden water.
- Costs or delays associated with achieving the site isolation requirements will be solely borne by the contractor.
- Site isolation methods for Partington Creek may include:
  - Metre bag berm installation wrapped with polyethylene; or,
  - Metal road plate installed bank to bank
- Site isolation and bypass must remain in place for all instream works.

5.4.2 Stream Bypass Requirements

- A full stream bypass needs to be deployed by the Contractor and maintained for the duration of the instream works at each project location.
- Bypass directs clean water from around the worksite, discharging this same water to the stream channel immediately downstream of the isolated site.
- It is mandatory that water be returned to the stream channel immediately downstream of the lowest isolation fence, to prevent dewatering of potential downstream fish-bearing habitat.
- Bypass water must be discharged back into the watercourse onto non-erodible surfaces (natural bedrock, temporary rip rap placement, plastic sheeting, or through a diffuser.).
- The contractor's bypass system is to be submitted to the Contract Administrator for review prior to installation.
- Should the Contractor's bypass system fail and this loss of bypass functionality results in an environmental incident (discharge of turbid water, death of fish, alteration of downstream fish habitat) then the Contractor is solely responsible for all costs associated with assessing, cleaning, mitigating, and restoring that fish habitat, along with costs and penalties associated with DFO Director's Orders or Orders by a Fisheries Officer or provincial Conservation Officer.
- Under conditions of low flow or standing water and dependent on the nature of the work, an appropriately sized and properly deployed silt curtain may function as a suitable bypass structure, and work within the curtain would be considered isolated from flowing water.

5.4.3 Trash Pump Requirements

Subsurface water or water that leaks through the isolation wall will accumulate within the work zone. This water may need to be removed from the worksite before it floods the works. The water accumulating in the work site is usually very turbid and **cannot** be discharged to streams or ditches that provide fish habitat.

- A 'trash pump' may need to be deployed to draw this sediment-laden water from the work site and dispose of the sediment-laden water in a manner that prevents discharge of sediment laden water to fish habitat. The Contractor must plan and prepare a viable means of controlling and/or treating sediment laden trash water.
- Techniques for the effective control of sediment laden water from a trash-pump system may include:

- Pump sediment laden water to vegetated areas well away from fish habitat with permission from the landowners.
- Pump to a vacuum truck.
- Pump to a flocculant bag, within secondary containment/infiltration.
- Use of portable sediment treatment systems (i.e., Stormguard, Storm-tech, Filter-tech etc.),
- Construction of an appropriately sized sediment control basin

- Trash pump discharge points must be equipped with an energy dissipator to prevent sediment and erosion.
- The Contractor will be required to modify their trash-pump sediment control system if discharge to fish habitat exceeds discharge exceed parameters set out in Section 5.2 of this EMP. The delays and costs associated with shutdowns and addressing trash-pump discharge exceedances are the sole responsibility of the Contractor.
- Should turbid water from the trash-pump system exceed the CoQ Bylaw No. 4403, 2013 limits at its point of discharge to fish habitat, an Environment Incident (Section 5.10) will be deemed to have occurred.
  - Should such an Environmental Incident occur, the Incident will be reported to the Contract Administrator.
  - Environmental Incidents from a discharge of trash-pump water to fish habitat exceeding the BC WQGs will not be acceptable and will lead to the EM recommending to the Contract Administrator a local 'shut-down' for environmental non-compliance.
  - The Contractor will be required to modify their trash-pump sediment control system if discharge to fish habitat exceeds turbidity limits. Any schedule delays and costs associated with shutdowns and addressing trash-pump discharge exceedances are the sole responsibility of the Contractor.
  - The local shutdown will not be lifted until the trash-pump discharge is brought into conformance with the Contract and this EMP.

5.4.4 Fish Salvage Requirements

The project will require the services of a fish salvage crew to be deployed prior to conducting instream works.

- A fish salvage crew will be provided by the Contractor.
- The fish salvage crew must apply for requisite fish salvage permits in advance of the construction window.
- The Contractor will need to install isolation fish fencing upstream and downstream of instream work areas with direction from the EM before fish will be removed from the work area.
- The fish salvage team must be led by a QEP, and must use gee traps, seine nets and/or a backpack electrofisher to remove fish from the worksite.
- Fish salvage must be done in a sequential manner and utilize enough passes and techniques to ensure fish have been removed from the worksite.
- The fish salvage crew will issue a written report to the Owner indicating the fish species and numbers of fish 'salvaged' by their operations and outlining whether the fish salvage is complete.

- The Owner will forward that report to the EM. The EM will issue a Notice to Proceed with Site Isolation and Dewatering after reviewing the fish salvage report and inspecting the fish salvage area.
- The Contractor must not commence instream works until fish salvage is complete and the EM has issued the Notice to Proceed with Site Isolation and Dewatering.
- The Contractor must not undertake any work that will disturb this isolation fish fencing.
- Results of the fish salvage will be a mandatory deliverable. The results of the fish salvage will be forwarded to the Contract Administrator in a short technical memorandum.

5.5 Wildlife Protection Requirements

- All work will adhere to the BC *Wildlife Act, Species at Risk Act*, and the *Migratory Birds Protection Act* through following this EMP.
- If vegetation/tree clearing for the project will occur within the nesting bird window (late March – mid-August for this region), a QEP will be retained by the Contractor to conduct nesting bird surveys prior to any clearing activities.
- If the EM determines that a wildlife/amphibian salvage will be required prior to project work, the Contractor will retain a QEP to conduct the required salvage(s).
  - The Contractor's QEP will obtain all necessary wildlife permits to complete salvage work.
- The EM will be notified of any wildlife (i.e., rodents, reptiles, bears, coyote, beaver, etc.) that is encountered onsite during construction activities. If wildlife is encountered, works shall be suspended to allow for wildlife to safely pass.
- Any chance discoveries of bird nests, wildlife denning sites, and other areas of wildlife habitation during construction will be reported to the EM. It is the Contractor's responsibility to ensure their crew are aware of their wildlife reporting responsibilities.
- Pets will be prohibited from the construction site.
- The Contractor's crew **will not feed or handle wildlife**.

5.6 Non-Hazardous Waste Management

- Littering is prohibited and monitoring for this activity by the EM will be ongoing throughout the project.
- Food and food waste shall be stored in such a way that is not accessible by animals. Trash cans will be required with appropriate wildlife-proof lids for the disposal of crew-generated wastes.
- Trash cans must be removed from the site at the end of each day to avoid wildlife attraction.
- Disposal of solid wastes onto the site will not be permitted, including into watercourses, ditches, road edges, or private property.

5.7 Invasive Plant Management

Several invasive and noxious plants are present within the project site. Japanese knotweed (*Fallopia japonica*) is present throughout the project site and is classified as a noxious weed under the provincial *Weed Control Act*. Portions of the project will involve vegetation removal and restoration

planting. Project activities associated with vegetation removal and planting should adhere to the following to **prevent the spread of invasive plant species**:

- An Invasive Plant Management and Restoration Plan has been prepared by Diamond Head Consulting and is provided in **Schedule 2**. The Contractor is responsible for reviewing and implementing procedures recommended in this report and the EMP.
- All equipment that is being used for the construction of the project is required to be pressure washed prior to arriving onsite to remove any potential invasive plant material or seeds.
- Any soil and / or plant material that needs to be removed from the site will be isolated on polyethylene sheeting or a tarp and covered with polyethylene sheeting that is weighted with sandbags and disposed of at an appropriate landfill that accepts invasive plant material.
- All equipment that has come into contact with invasive plants will be thoroughly cleaned to remove any plant material prior to that equipment being removed from the site.
- Manage invasive plants consistent with the provincial *Weed Control Act*.
- Familiarize the construction crew with Japanese knotweed and other invasive plants on site. Information relating to the invasive species can be found on the Invasive Species Council of British Columbia, including identification and handling procedures.
- Place any material that needs to be temporarily stockpiled onsite on a non-permeable surface (i.e. tarpaulin or polyethylene sheeting) and protect/cover with a non-permeable surface that is weighted with sandbags.
- Clean all parts of equipment (i.e. excavator and trucks) including tracks, undercarriage, cabin, arm and bucket that has contact with noxious weeds, of soil containing noxious weeds, seeds, and stem fragments prior to demobilization off site or being utilized for another activity;
- The EM will inspect utilized equipment for soil and plant material prior to demobilization off-site;
- Ensure that invasive plants are not to be disturbed prior to an approval from EM.
- Should the works take place in August – September, many of the invasive plants will have developed seeds and removal or disturbance may release/mobilize the seeds. This can contribute to spreading the invasive plant to potentially non-invaded areas.

5.8 Hydrocarbon Wastes and Fuel Spill Mitigation Measures

A Reference Spill Response Plan is provided in **Schedule 3**. The Contractor will prepare their own Spill Response Plan and submit that plan to the Contract Administrator. The Contractor will use their Spill Response Plan in the event of release of deleterious substances occurs. The Spill Response Plan will include a Project Contact List (**Schedule 4**). The following measures must be taken to prevent deleterious substances such as oils, fuel, grease, or hydrocarbons from entering aquatic habitat:

- The Spill Response Plan must be posted on the board or near the refueling facility.
- In the event of a spill, the Spill Response Procedures will be implemented.
- Fuel and hydrocarbon-based lubricants must be stored in designated storage areas, such as a lockable metal cabinet. Alternatively, such material can be kept in trucks or utility vehicles during the works, with prior permission from the EM.
- Oil, grease, or any other substance deleterious to aquatic life will be prevented from entering any watercourse, ditch, or storm sewer.

- There will be no discharge of hydrocarbons (oils, fuel, grease, lubricants, anti-freeze), concrete, grouts, construction wastes, or other deleterious substances to fish habitat or to ground.
- Equipment and machines that are utilized onsite will be in good operating condition and free of leaks, excess oil, and grease.
- The Contractor will deploy spill trays beneath equipment operating within 30 m of any ocean, watercourse, ditch, or storm sewer.
- Hydraulic fluids utilized in the machines onsite shall be non-toxic to aquatic life and biodegradable.
- The Contractor will provide dedicated waste receptacles for hydrocarbons and lubricant fouled waste material, concrete, and other potentially deleterious wastes.
- An adequate number of spill containment booms must be available on-site in the case of a spill to the marine environment. The specs and quantity of booms will be approved by the Contract Administrator prior to the start of construction.
- Large spill kits will be available on site and will include, at a minimum 220 litre sorbent capacity, and the following:
  - 1 - 58 gal/220 L polyethylene container with lid and wheels
  - 100 Absorbent pads (Oil, Gas & Diesel)
  - 50 Universal Absorbent Pads (Antifreeze & Non-Haz)
  - 6 - 3" x 4’ Absorbent Socks (Oil, Gas & Diesel)
  - 4 -3" x 8’ Absorbent Socks (Oil, Gas & Diesel)
  - 1 – 36” x 36” Neoprene Drain Cover
  - 1 – 1lb Jar of Plug n Dike (Leak Stop)
  - Nitrile Gloves
  - HD Hazmat Disposal Bags

- In addition to the large spill kit, each machine utilized on-site for construction activities will be equipped with a small spill kit with a minimum sorbent capacity of 30 L and the following:
  - 20 Absorbent pads (Oil, Gas & Diesel)
  - 2 - 3" x 4’ Absorbent Socks (Oil, Gas & Diesel)
  - Hazmat disposal bags
  - Nitrile gloves
- Spill kits will be restocked within 48 hours of a spill.
- The spill kits will be inspected on a regular basis by the Contractor and the EM to ensure that enough spill response material is present.
- Machine or equipment refueling or machine maintenance will be strictly prohibited within 30 m of watercourses, ditches, or storm sewers.
- Oil/fuel absorbent pads will be wrapped and secured around all fittings during machine refueling to mitigate any spillage.
- The refueling attendant must maintain a hand on the refuelling hose at all time (may not lock the hose and attend to other matters while refueling operations are underway).
- Jerry cans will be stored in a plastic spill containment tray / secondary containment tray with 125% capacity and be stored away from construction equipment traffic or large open areas, to avoid potential damages.

- Machines shall be parked in a designated laydown area at the end of each day. The laydown area is to be located a minimum of 30 m away from any watercourses.
- Any contaminated material must be disposed of in an appropriate manner (i.e. designated disposal facility)
- Smoking is prohibited nearby the containment facility or near fuel storage. Designated smoking area must be established is smoking on site is permitted.
- Spills will be immediately reported to the EM who will determine the need for reporting to Emergency Management BC, 24-hour phone line at 1-800-663-3456.
- Call before you dig. BC One Call 1-800-474-6886.
- The Contractor is wholly responsible for costs associated with clean-up of spills originating from their equipment or work practices and with any regulatory penalties, orders or charges stemming from a spill originating from their equipment or work processes.

5.9 Archaeological Resource Protection

Archaeological sites are legally protected by the *Heritage Conservation Act* (HCA). All known and unknown archaeological sites are protected under the HCA. The project site is not a known archaeological site; however, artifacts have been found nearby at the Pitt River. Thus, the project site has a potential for encountering unknown heritage resources. It is important for the Contractor to be aware of this potential risk and to take appropriate action in the event archaeological resources are inadvertently encountered during construction; a “chance find”.

5.9.1 Chance Encounter Protocol

An example Chance Find Management Plan has been provided in **Schedule 5**. In the event a suspected archaeological site or artifact is encountered:

- All ground disturbing work will immediately cease.
- Do not disturb or collect the potential artifact.
- The Contractor will inform the Contract Administrator.
- The Contract Administrator will contact a Professional Archaeologist who will attend the site to ascertain whether the suspected artifact or archaeological site is protected by the HCA.
- If the Professional Archaeologist confirms that the object or site is an artifact protected by the HCA, the BC Archaeology Branch ((250) 953-3334) will be contacted immediately.
- Aboriginal groups with an interest in the area shall also be contacted.
- The archaeologist may identify areas to be avoided and work activities that can proceed.
- Work that poses a risk to the artifact or site will be suspended until the site has been assessed.
- No worker, monitor or administrator shall move, collect, destroy, excavate, or alter heritage resources.
- Only a qualified archaeologist can move, collect, excavate, or alter heritage resources and may only do so by obtaining heritage permits and securing approval from the Archaeological Branch.
- The location of identified sites relative to the final project plan shall be verified prior to construction and the sites shall be avoided where possible.
- The Chance Encounter Protocol is to be posted around the worksite.

- The EM will go over chance encounter protocol in the CEOR during the pre-construction meeting.

5.9.2 Discovery of Suspected Human Remains

If over the course of any project phase suspected human remains are discovered by chance, the following procedures shall apply to avoid or mitigate disturbance:

- Work shall stop immediately.
- The RCMP will be notified as soon as possible. The BC Archaeology Branch ((250) 953-3334) shall also be contacted immediately;
- If the impacted location is busy or is highly visible, an employee shall be assigned to stand watch until an RCMP representative arrives;
- The relevant government agency, in consultation with the appropriate cultural group(s), shall determine disposition of the remains; and
- Work shall not commence again until follow-up procedures for the remains have been agreed upon with First Nations group and the relevant government agency.

5.10 Environmental Incident Response

Effective communications regarding Environmental Incidents are important. The Contractor shall provide a list of project contacts with reference to external agencies related to potential incident reporting, similar to that provided in **Schedule 4.** For this project, Environmental Incidents will be defined as:

- Spill to lands exceeding reportable quantities outlined in Schedule 1 of the Spill Reporting Regulation of the BC *Environmental Management Act*.
- Spill to water or watercourse (any).
- Other environmental issues that considered together are deemed to represent a significant risk to the environment.

A reference Environmental Incident Response (EIR) is provided in **Schedule 3**. The Contractor's EM is responsible for preparing a project specific EIR plan.

If an Environmental Incident is observed by the EM:

- The EM will determine if a regulatory threshold has been crossed which requires reporting to senior government agencies.
- Construction activities will cease, and the EM and the Contractor will discuss immediate and longer-term contingencies to avoid reoccurrence.
- The EM will issue an interim incident report to the Contractor on the day the incident is observed.
- The EM will provide a follow-up EIR to the Contractor Administrator and Owner and within one business day of the observation of the incident.
- Repeated Environmental Incidents will lead to the EM recommending to the Contract Administrator a local 'shut-down' for environmental non-compliance.
- The local shutdown will not be lifted until the construction is brought into conformance with this EMP.

SCHEDULE 1
Contractor Environmental Orientation Record

ISL Environmental Management - Contractor Environmental Orientation Record

The Contractor Environmental Orientation Record (CEOR) shall be completed for all works involving an environmental component. The Environmental Monitor is responsible for ensuring that the environmental requirements of the work are reviewed with the Contractor before work is started, and that a record of the discussion is documented on the CEOR. The form must be signed by both the Environmental Monitor and the Contractor. By signing the CEOR, the Contractor indicates he/she has been advised of the environmental requirements of the project. The CEOR shall be filed with the Contract documents as required to confirm pay items, or to otherwise satisfy requirements of the contract.

	Date:		File No.
1	**Project Information**		
	Project Title		
	Project Description		
	Project Location		
2	**Contractor Information (if applicable)**		
	Company Name		
	Company Address		
	Site Contact/Representative Name		
	Tel. #	Fax #	E-mail

3	**Environmental Management Plan** Review the environmental issues and requirements of the work as specified in the Environmental Management Plan (EMP), Regulatory approvals or Best Management Practices (BMP)		
	Is there an EMP, CMP,BMP or Field Guide for the work?	❑ Yes	❑ NA
	Have the environmental requirements been reviewed with the Contractor and the Contractor's staff? (Use the checklist below to guide discussion)	❑ Yes	❑ NA

Environmental Issues	Environmental Management Plan Requirements	Discussed	NA
Fish and Aquatic - habitat alteration, disturbance or loss		❑	❑
Site isolation & Bypass		❑	❑
Instream footprint mitigation		❑	❑
Riparian footprint mitigation (Vegetation disturbance or removal and mitigation)		❑	❑
Noxious weed control		❑	❑
Wildlife and Bird - habitat alteration, disturbance or loss		❑	❑
Soil erosion/compaction Water quality - erosion and siltation		❑	❑
Disturbance to Heritage Resources/Archaeological Sites		❑	❑
Noise Concerns		❑	❑
Hazardous waste (garbage)		❑	❑

Environmental Issues	Environmental Protection Requirements	Discussed	NA
Air emissions/ dust generation/other		❑	❑
Generation and disposal of waste (litter, latrine)		❑	❑
Fuel and flammable storage		❑	❑
Fuel-Spill of Spill of hazardous substances		❑	❑
Generation and disposal of hazardous substances		❑	❑
Property Considerations		❑	❑
Do the tools and equipment meet the requirements?		❑	❑

	Permits and Approvals Information: Ensure the necessary environmental permits and approvals relating to the work have been obtained prior to starting work.		
	Are environmental notification, permits, licenses or approvals required?	❑ Yes	❑ NA
	List applicable regulatory requirements and permit reference numbers.		
	Have the permits, licenses and approvals obtained and/or checked?	❑ Yes	❑ NA
	Emergency Response Plan/Oil and Chemical Spill Response Plan		
	Has the Oil and Chemical Spill Response Plan been discussed?	❑ Yes	❑ NA
	Are there spill kits available on location?	❑ Yes	❑ NA
	Where are the spill kits located?	❑ Yes	❑ NA
	Does the contractor have an Emergency Response Plan? Has it been discussed?		
	Environmental Incident Reporting		
	Environmental Incident Reporting Procedures discussed?	❑ Yes	❑ NA

The undersigned has been briefed on the environmental requirements of the work as detailed above.

Signed: _____ Contractor Foreman Date: _____

Counter-signed: _____ Environmental Monitor Date: _____

Additional Comments:

_____

_____

_____

SCHEDULE 2

Invasive Plant Management and Restoration Plan

Invasive Plant Management and Restoration Plan

Partington Creek & Cedar Drive
Coquitlam, B.C.

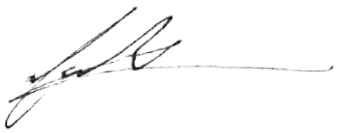
October 16, 2020

Submitted to:

Nadeem Kazmi
Engineering and Public Works
City of Coquitlam

DIAMOND HEAD
3559 Commercial Street
Vancouver, BC 604.733.4886

The following Diamond Head Consulting staff performed the site visit and prepared the report. All general and professional liability insurance and individual accreditations have been provided below for reference.



Matthew Morrish, R.B.Tech., M.Sc., M.A.
Restoration Biologist

Fiona Steele, R.P.Bio.
Senior Biologist, Principal

Contact Information

Phone: 604-733-4886
Fax: 604-733-4879
Email: matt@diamondheadconsulting.com, fiona@diamondheadconsulting.com
Website: www.diamondheadconsulting.com

Insurance Information

WCB:	# 657906 AQ (003)
General Liability:	Northbridge General Insurance Corporation - Policy #CBC1935506, $5,000,000
Errors & Omissions:	Lloyds Underwriters – Policy #1010615D, $1,000,000

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1.0 Introduction

The City of Coquitlam requested environmental consulting services for the development of an Invasive Species Management and Restoration Plan for a section of Partington Creek along Cedar Drive. Diamond Head Consulting (DHC) conducted a site visit on Wednesday, September 9th, 2020 to perform the initial mapping. DHC was asked to provide consultation to inform future restoration efforts in the area including an inventory of invasive species, management recommendations, and restoration planting information. The project assessment area was defined by the City of Coquitlam (figure 1).

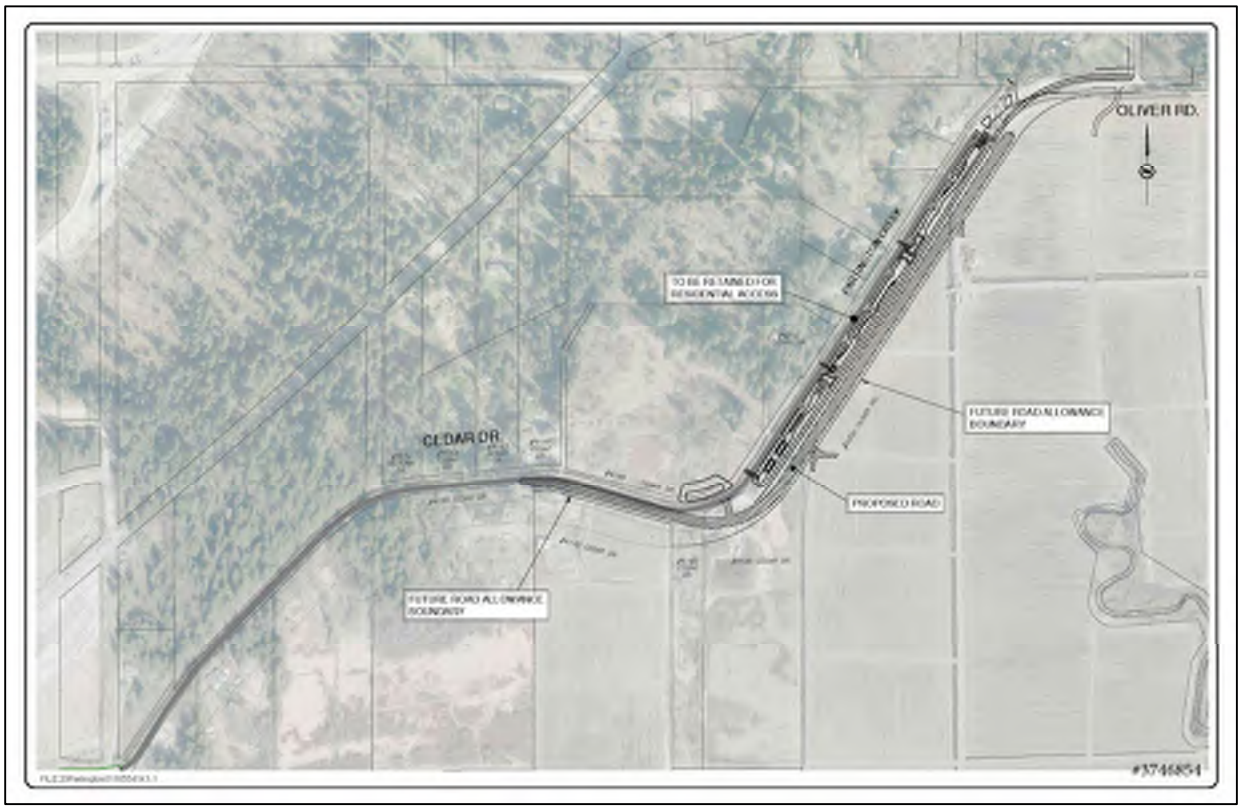


Figure 1. Project assessment area.

Invasive plant species have established throughout the Metro Vancouver region and are a major component of urbanization-related changes in parks and green spaces. These plants are rapidly spreading, non-native species that have become regionally common and locally abundant. They have the potential to cause significant changes to the composition, structure, and function of native ecosystems. They cause habitat loss for native species, modify ecological processes, and alter hydrology and aesthetics. In addition, they can pose human health risks, reduce access to natural areas, damage infrastructure, and increase costs for maintenance.

This invasive plant management and restoration plan provides guidance on the distribution of invasive plants on site and provides a framework for restoration actions. This survey can serve as a baseline with which to compare success of the restoration efforts as invasive plant management proceeds. The

restoration plan has been developed for the site to meet the City's specifications. Restoration actions on this site are predominantly focused on the removal and management of invasive vegetation and the replanting of native vegetation.

2.0 Invasive Inventory Methodology and Scope

2.1 Scope

A detailed ground survey was conducted in September 2020 to provide comprehensive mapping of the distribution and abundance of invasive plant species currently on site. Partington Creek and the associated riparian areas were mapped along Cedar Drive encompassing the project area scope defined by the City.

2.2 Methods

The field inventory was carried out using ESRI's ArcGIS Collector app loaded onto iPads. Data was stored and backed up on DHC's online ArcGIS account. Data cleanup and analysis was done using ArcGIS software.

Every species occurrence was denoted as a polygon or a point feature. All infestation area measurements are visual estimations. The smallest measured unit is one square meter. Area estimations are made as contiguous measurements of impacted square meters (i.e. if there are 10 knotweed stems within two contiguous square meters, the impacted area is recorded as two square meters). When an occurrence impacted an area greater than 20 m^2, a polygon feature was used to record the extent. Polygon features were also used to indicate areas with unique distribution patterns. Polygon features recorded the percent cover for the species indicated. Percent cover was defined as the percent of ground affected by the species.

2.3 Inventoried Plant Species

Thirty-one invasive plant species were included in the survey (Table 1). These species are all known to pose ecological, economic, and/or human health risks in the Metro Vancouver region. The survey also included provincial EDRR species and proposed prohibited noxious weeds, as well as new emergent non-native plant species with the potential to become invasive. Not all of the targeted species were observed at the survey site.

Table 1. Invasive plant species targeted during field inventory

Common Name	Scientific Name
Bamboo species	Various
Butterfly bush	*Buddleia davidii*
Cherry laurel (English laurel)	*Prunus laurocerasus* and related species
Clematis (old man's beard)	*Clematis vitalba*

Common Name	Scientific Name
Common comfrey	*Symphytum officinale*
Common hops	*Humulus lupulus*
Common tansy	*Tanacetum vulgare*
English holly	*Ilex aquifolium*
English ivy and Irish holly	*Hedera helix* and *Hedera hibernica*
Garlic mustard	*Alliaria petiolata*
Giant hogweed	*Heracleum mantegazzianum*
Gorse	*Ulex europaeus*
Goutweed (Bishop's weed)	*Aegopodium podgaria*
Hedge bindweed (morning glory)	*Calystegia sepium*
Himalayan balsam (policeman's helmet)	*Impatiens glandulifera*
Himalayan blackberry	*Rubus armeniacus*
Knotweed, bohemian/Japanese	*Fallopia japonica* and *Fallopia x bohemica*
Knotweed, giant	*Fallopia sachalinensis*
Knotweed, Himalayan	*Polygonum polystachyum* and *Persicaria wallichii*
Orange hawkweed	*Hieracium aurantiacum*
Parrot's feather	*Myriophyllum aquaticum*
Periwinkle	*Vinca minor*
Portuguese laurel	*Prunus lusitanica*
Purple loosestrife	*Lythrum salicaria*
Reed canary grass	*Phalaris arundinacea*
Scotch broom	*Cytisus scoparius*
Small flowered touch-me-not	*Impatiens parviflora*
Spurge laurel (daphne laurel)	*Daphne laureola*
Wild chervil	*Anthriscus sylvestris*
Yellow archangel (lamium)	*Lamiastrum galeobdolon*
Yellow flag-iris	*Iris pseudacorus*

2.4 Limitations

The timing of the inventory may contribute to an under-representation of specific species. Some species are difficult or impossible to detect during some seasonal conditions. The survey timing (September) is optimal to capture the largest number of invasive plants.

3.0 Inventory Results

3.1 Abundance and Distribution

In total, 104 invasive plant occurrences were recorded. This is inclusive of 75 polygons for larger occurrences (>20 m^2) and unusual distribution patterns. These occurrences represent approximately 31,154 m^2 of area impacted by invasive plant species in the project area (Figure 2). Table 2 shows the total impacted area surveyed by invasive plant species within the project boundaries.

Table 2. Total impacted area

Common Name	Total on Property (m^2)	Comments
Himalayan blackberry	20,499	Abundant in patches throughout the park, highest density on eastern perimeter.
Common tansy	8	Established throughout forested areas of the park.
Hedge bindweed	56	Established throughout forested areas of the park.
Himalayan balsam	2,983	Several established patches as ground cover, few climbing vines.
Knotweed, Japanese/bohemian	7,436	A few patches in forested areas.
Laurel, cherry	154	Scattered trees in forested areas.
Yellow archangel	18	One patch directly adjacent to the park. Not yet present in park.

Himalayan blackberry is the most abundant invasive plant on the property, followed by Japanese/bohemian knotweed and Himalayan balsam. Other species occurrences are relatively small and limited in distribution.

Figure 2 shows the extent of invasive species occurrences on site represented as points and polygons. Figures 3-5 show detailed views of (1) the SE section of the project area, (2) the central section of the project area, and (3) the NE section of the project area.

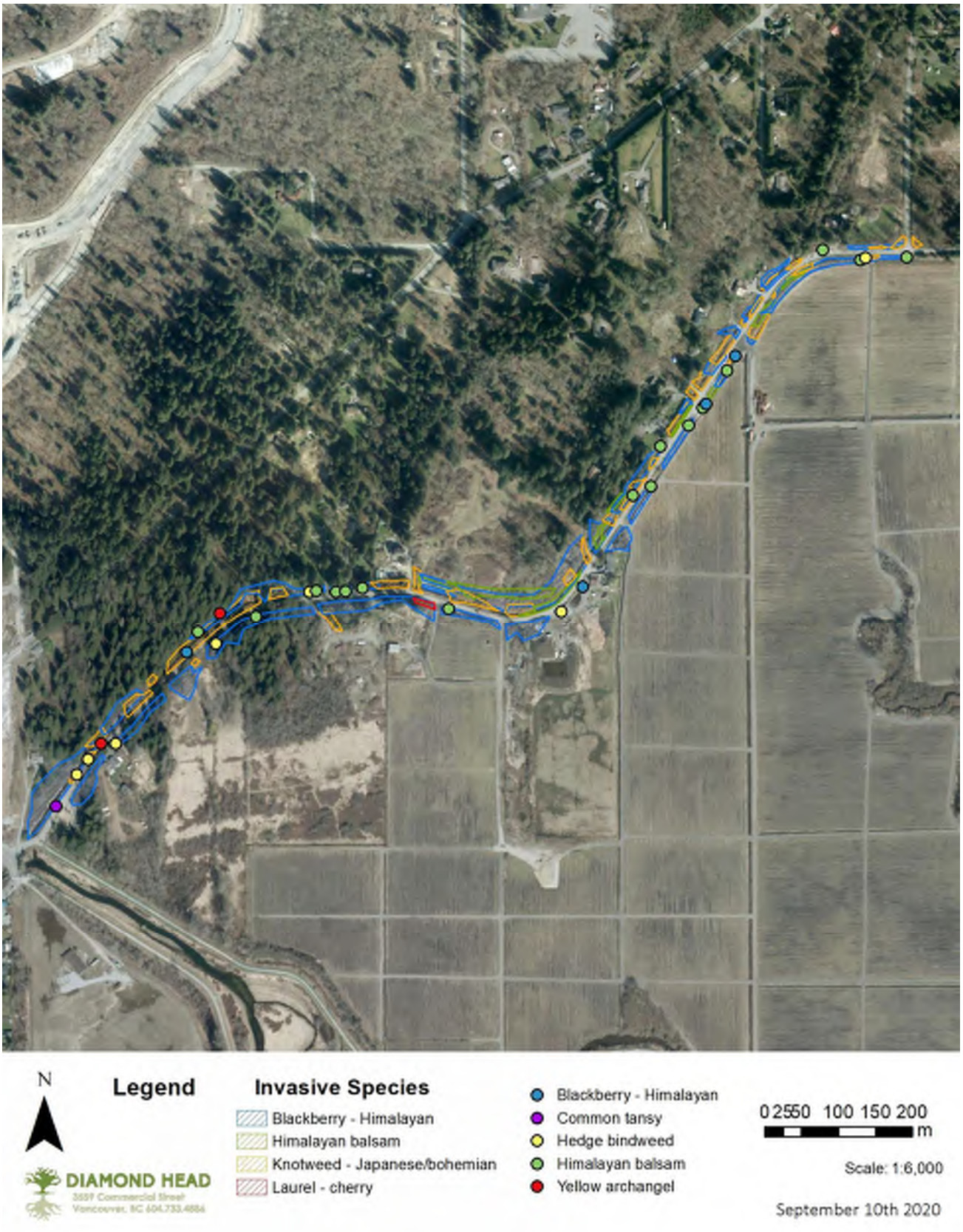


Figure 2. Invasive species documented on site. September 2020.

Figure 3. Detail: SW Partington Creek. Invasive species documented on site. September 2020.

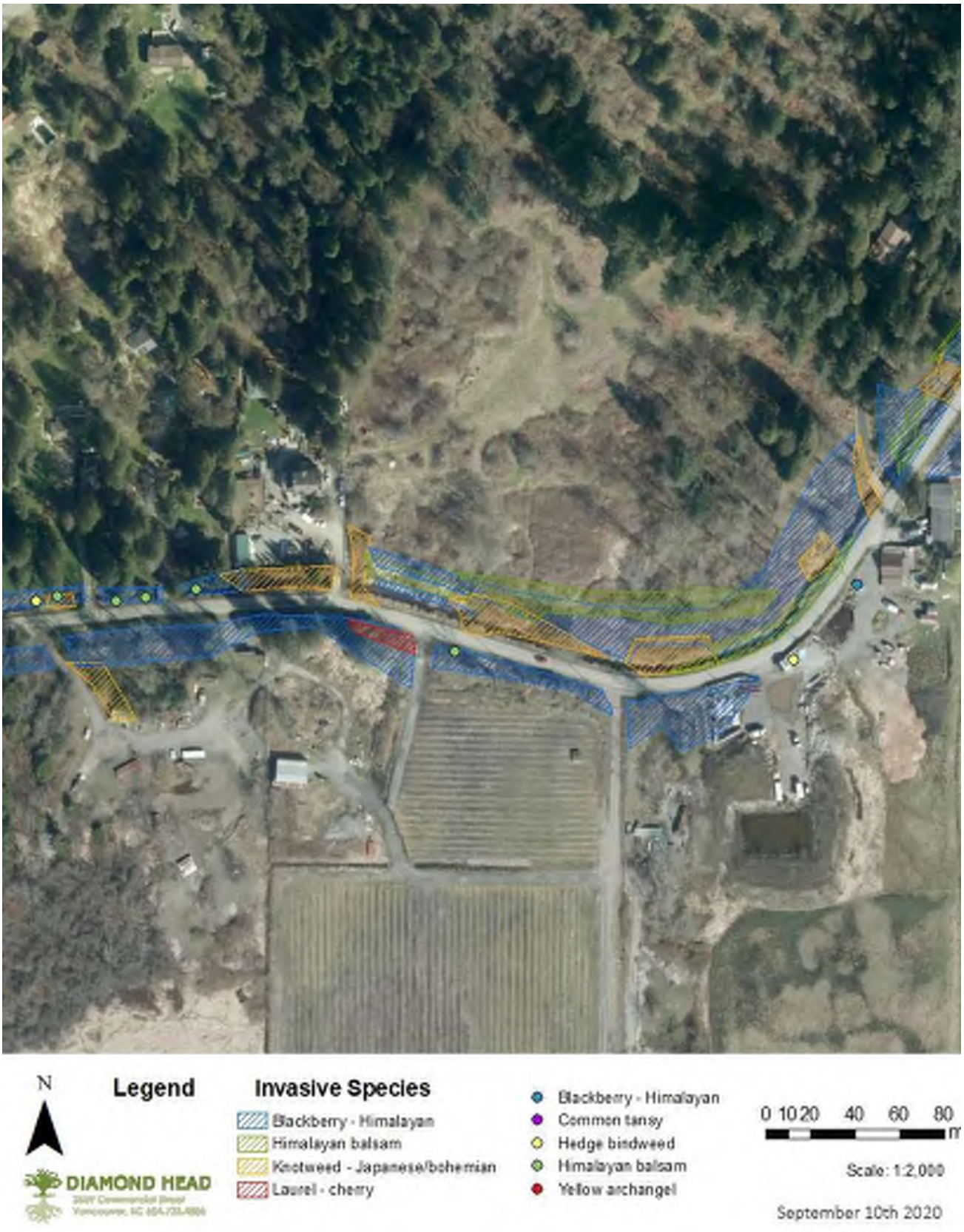


Figure 4. Detail: Central Partington Creek. Invasive species documented on site. September 2020.

Figure 5. Detail: NE Partington Creek. Invasive species documented on site. September 2020.

Japanese knotweed bordering the north side of Cedar Dr. (SW section)

Himalayan blackberry on the north side of Cedar Dr. (SW section)

Japanese knotweed growing over Partington Creek (central section)

Himalayan blackberry and Japanese knotweed along Partington Creek on north side of Cedar Dr. (central section)

Himalayan balsam and Himalayan blackberry along Partington Creek on north side of Cedar Dr. (NE section)

Himalayan blackberry and Himalayan balsam on south side of Cedar Dr. (NE section)

4.0 Invasive Species Management Recommendations

The City of Coquitlam has indicated that it requires guidance for future potential invasive plant management and restoration efforts in this area. It is recommended that invasive species from the site be removed or treated, if possible. Estimates for labour time and cost are dependant on treatment method employed and extent of removal required. Site-specific plans should be formulated for specific development areas as required. Due to provincial regulations regarding the use of herbicides adjacent to watercourses, treatment options are limited (particularly for knotweed).

The following provides a discussion of control methods for invasive plant species found on site.

4.1 Himalayan Blackberry

Himalayan blackberry can be controlled manually, however long-term success requires removal of all plant parts. Hand pulling of small seedlings can be effective provided the root crown is removed. Established plants can be controlled by digging/grubbing to remove root crowns and lateral roots. Care should be taken to ensure no root fragments remain, as these can sprout new plants. For large continuous patches, removal by machine (i.e. excavator) can be very effective, although manual clean-up will be required afterwards. Should any bird nests be identified in the patches prior to/during removal, these locations should be avoided until the end of nesting season (mid-March to September). Successful removal typically requires multiple years of monitoring for re-growth.

Metro Vancouver has developed best management practices for Himalayan blackberry control.

4.2 Common Tansy

Common tansy is an invasive plant often found on roadsides and other disturbed edge areas. It can be controlled both manually and chemically, with best results from a combination of the two. Mowing tansy before July can prevent seed production. The regrowth can then be treated with a foliar herbicide (a variety have been found to be effective). Hand pulling of plants can also be effective in areas where herbicide use is not feasible, although care must be taken to remove all root fragments. Due to the likely presence of a seed bank, treatments must often be repeated for several years.

For more information on common tansy spread and removal, refer to the Invasive Species Council of BC's factsheet.

4.3 Hedge Bindweed

Hedge bindweed or morning glory forms extensive and deep rhizomes which can easily regenerate. This plant spreads by seed and clonal offshoots and can smother native plant species. Newly planted restoration sites are particularly vulnerable. Control can be very difficult due to the extensive rhizomes, which fuel regrowth following treatment and long-lived seed banks. Control should focus on allowing

replanted species to establish rather than complete eradication. Hedge bindweed is a poor competitor in shady conditions and may be displaced by native vegetation over time. Manual control is recommended despite the difficulty in eradication. Plants and regrowth should be pulled annually (at minimum) to suppress growth while plants establish.

For more information on hedge bindweed visit the King County factsheet for hedge bindweed.

4.4 Himalayan Balsam

Manual control can be quite effective for Himalayan balsam. The plants are easy to remove when pulled, however removal must be completed before flowers and seedpods are present. Attempting to remove plants with seedpods present will likely result in further spread. All plant parts should be bagged and disposed off site. Several herbicides have been found to be effective for control of Himalayan balsam, however use is often limited due to the fact that it typically grows in wet areas. Due to the likely presence of a seedbank, annual monitoring and repeat treatments will be required to ensure adequate control.

For more information on Himalayan balsam spread and removal, refer to the Invasive Species Council of BC's factsheet.

4.5 Japanese/bohemian Knotweed

Japanese/bohemian knotweed is classified as a noxious weed under the BC *Weed Control Act*. Under this Act, "an occupier must control noxious weeds growing or located on land and premises, and on any other property located on land and premises, occupied by that person".

Chemical control is recommended for this species due to the difficulty of manual control methods. Manual control is not an effective treatment method unless extreme care and large quantities of soil are removed (a 20 m radius from the plant). Systemic herbicides are recommended and should be applied following Metro Vancouver's BMP for knotweed control by certified pesticide applicators. Glyphosate has been specifically approved for use up to 1 m of the high-water mark of watercourses on public land for knotweed control only. For all other species, a 10 m buffer is required from the high water mark of all watercourses for any herbicide application. Application is by foliar spray or stem injection. Stem injection is only used when knotweed is inter-mixed with desired vegetation. In Canada, herbicides must be specifically labelled for use by stem injection to be permitted.

Additional knotweed control information for contractors is included in Appendix B of this document.

4.6 Cherry Laurel

Cherry laurel is an invasive tree species that is often planted ornamentally and can spread rapidly into surrounding environments, typically via seed in bird droppings. These trees can be cut down; however, regrowth is likely if root systems are not also removed. Saplings and smaller plants can be dug up, however this may not be feasible for larger, more established trees. Cut stumps can be monitored for

regrowth and new stems cut to exhaust the root energy stores. This technique is labour intensive and will require prolonged treatment. Herbicides may be used following cutting to ensure control of the root system and prevent new shoots from emerging. Consider impacts to the surrounding environment before implementing chemical control. Pesticides are restricted by 10 m Pesticide Free Zones surrounding watercourses. Pesticides for invasive species control must be applied by a Certified Pesticide Applicator on public/private lands. All pesticide labels must be followed during application. If pursued, the cut stumps should be painted with pesticide immediately following cutting (typically within 15 minutes). Other methods such as stem injection or basal bark application can be used however all methods will require monitoring and possible follow-up treatments.

For more information on cherry laurel control, refer to Washington's King County factsheet for cherry laurel control.

4.7 Yellow Archangel

Yellow Archangel control is best achieved through manual pulling. This process is labour intensive and requires attention to detail to ensure no plant parts are left. Hand removal should be done in the fall-spring when soils are moist but not saturated. Larger infestations can be chemically treated, though pesticide free zones must be observed (within 10 meters of a watercourse). Smothering using cardboard or wood mulch may been effective, though this method requires monitoring and is less effective in areas with native vegetation as it will need to be applied around vegetation. This forms holes in the cover, throughout which yellow archangel can grow through.

Best management practices for yellow archangel control should be followed when removing this species to prevent further spread.

4.8 Disposal of Invasive Plant Material

Invasive species removal generates large amounts of green waste. As many of these species require complete removal of roots and rhizomes, offsite disposal is desirable to prevent reintroduction. Plant parts should be transported in tarps or heavy plastic bags and taken to an appropriate disposal or composting facility. Care should be taken to prevent spread of these plant parts during transport (tarps/bags). Refer to Metro Vancouver's invasive plant disposal options.

Soil that is excavated during invasive species removal or site construction will need to be disposed of off-site. Soils that contain knotweed plants or their root material must be treated separately from other soils on site. Knotweed soils should be stockpiled in an off-site location and monitored for 3-5 years. Soils should be tarped and fenced to prevent transfer of soil of plant material to the external environment. Any regrowth in the stockpile should be treated using herbicides as part of a regular treatment and monitoring program. Alternatively, contaminated knotweed soil can be brought to an approved location for disposal (see above link), although this option is often quite expensive.

5.0 Habitat Restoration Areas

5.1 Restoration Plan

Invasive plant species have established as a dense monoculture throughout the site, outcompeting native species. Once they are removed from the site, there will be little native plant cover remaining. The site would then be susceptible to the re-establishment of invasive plants and exposed mineral soil could be at risk of erosion. This poses a risk of sedimentation to Partington Creek if not properly managed. As an integral part of the invasive species mitigation program, sites that are denuded of native vegetation cover should be stabilized and re-vegetated with native plants.

Site-specific restoration planting plans throughout the site are not included in this report. Instead, a general list of suitable plant species is presented to guide restoration efforts following invasive species removal. Site specific plantings should be directed by a Qualified Environmental Professional (QEP) and should be implemented concurrent with future development. Plant communities are specific to climatic and soil characteristics. Restoration prescriptions are therefore based on the site series of the Biogeoclimatic Ecosystem Classification system of BC (BEC). Partington Creek is located in the CWHdm subzone. A plant list is provided below to suggest suitable species for the conditions found on site. The plant list labeled CWHdm, site series 05/07 is for sites with average (fresh) to moist soil moisture conditions. This plant list is intended to provide a general guideline for plant selection in restoration efforts. Site specific planting plans can be tailored to specific sites within the project area in consultation with an appropriately trained QEP.

5.2 CWHdm Subzone, Site Series 05/07 (average to moist soil moisture conditions)

The following plant list (Table 3) is a suggested list of species that are appropriate for the site moisture conditions along Partington Creek. This list is not exhaustive but can provide a good starting point for plant selection in areas undergoing restoration. Spacing guidelines are suggested.

Table 3. Plant list for CWHdm, Site Series 05/07

Soil Moisture: Fresh to Moist - **Soil Nutrients:** Rich		**Spacing**	**Space/Plant**
Botanical Name	**Common Name**	m	m^2
Tree Layer			
Acer macrophyllum	bigleaf maple	5	21.65
Alnus rubra	red alder	5	21.65
Populus balsamifera	black cottonwood	5	21.65
Pseudotsuga menziesii	Douglas-fir	5	21.65
Thuja plicata	western redcedar	5	21.65
Tsuga heterophylla	western hemlock	5	21.65
Shrub/Herb Layer			
Acer circinatum	vine maple	1	0.87
Cornus sericea	red osier dogwood	1	0.87
Corylus cornuta	beaked hazelnut	1	0.87

Oemleria cerasiformis	Indian plum	1	0.87
Ribes sanguineum	red-flowering currant	1	0.87
Rosa nutkana	Nootka rose	1	0.87
Rubus spectabilis	salmonberry	1	0.87
Sambucus racemosa	red elderberry	1	0.87
Spiraea douglasii	hardhack	1	0.87
Symphocarpos albus	snowberry	1	0.87

5.3 Planting Specifications

The success of planting is dependent on ecological suitability of the plants and the quality of the plants that are installed. All planted species should meet the standards of the BC Landscape Association. They should be well rooted in the container, but not root bound (plants should be inspected prior to placement). Plants should be healthy and free of disease or insect damage. All plants should be inspected when delivered and those not meeting the most recent Landscape Standards should be sent back to the delivering nursery.

In general, survival is related to the root to shoot ratio of the stock planted and the soil moisture and nutrient availability on site during the growing season. Larger stock plants have the advantage of having a large stem to obtain light; however, they often have a lower proportional root system. In addition, larger stock often requires a higher moisture availability to establish in the first two growing seasons.

Shrubs and ferns should be well established in #1 pots for restoration planting. Ferns should be at least 30 cm tall and shrubs should be at least 50 cm tall. Smaller containers are not recommended for most shrubs and ferns due to poor survival rates. Trees should be well established in #2 or #5 pots and be at least 50 cm tall. In areas that were occupied by dense infestations of Himalayan blackberry, it is recommended that only large stock (>1.5m tall) of aggressive trees or tall shrubs be planted at high densities. Watering is critical in highly exposed areas to ensure survival beyond the first summer season.

It is recommended that planting be completed at high densities to help prevent the re-establishment of invasive plant species and to reduce the risk of erosion. Fall planting is recommended for all planting stock. Planting should take place following the end of the last drought period (September to October). This allows for two periods of root growth (fall and early spring) before the flush of foliage.

6.0 Additional Recommendations

6.1 Erosion and Sediment Control Measures

For all sites, restoration should consider soil stabilization prior to planting. This is of particular concern in areas with steep slopes, and especially those associated with riparian areas and water systems. Specific thresholds and erosion control measures are difficult to prescribe until management plans are finalized. It is recommended that all sites be monitored for the risk of erosion while invasive species are being removed. Erosion and sediment control products (silt fences, waddles, mats, etc.) can be very effective for short term erosion control. Long term stability is best achieved through revegetation.

The following practices should be implemented for all restoration sites:

- Minimize the area of disturbed soil and retain existing native vegetation where possible.
- Avoid work during predictable periods of wet weather.
- Coordinate restoration planting activities to minimize the amount of time that soils are subject to erosion.

Surface erosion can be controlled quickly and effectively by the application of surface treatments, including the placement of straw and/or granular materials. Straw is widely available and frequently used as mulch that can be applied by hand over small areas. Although it has limited longevity, straw adds organic matter into the soil, provides a surface layer for moisture retention, and aids in germination. Straw should only be used as a temporary erosion control strategy until native plantings are established. Other surface treatment methods include the application of wood chips or wood fibre. Collectively, mulches protect the soil surface from rain impact, promote runoff infiltration, decrease runoff velocity, prevent soil compaction, and conserve soil moisture. Mulches also have the added benefit of suppressing the regrowth of undesired species in recently restored areas. 5 cm of wood mulch can be applied over areas of dense invasive coverage or in areas with steep slopes to aide in erosion control.

Silt fencing or straw waddles can also be used downslope of treated areas to minimize surface erosion runoff. This is particularly important if the removal is being done upslope of a waterway. Long-term planning should always include the removal of any non-biodegradable erosion control products (such as silt fencing).

Hydro-seeding can be used for temporary slope stabilization, however it is not recommended when the goal is the restoration of a native plant community. Establishment of native plants and associated temporary ESC controls will work to stabilize the slopes and avoids a number of potential problems that can come from hydro-seeding mixtures (i.e. accidental introduction of unintended invasive species, competition with native plantings, etc.). Even “native’ seed mixtures can contain unintended species that can complicate restoration efforts.

6.2 Monitoring and Maintenance

Monitoring and maintenance of restoration sites are critical components for ensuring long-term restoration success. This includes in-fill planting where high plant mortality has occurred, and the removal of invasive and competing vegetation. Regular inspections and maintenance are recommended at all sites for the first five years. Longer periods of monitoring/maintenance (10 years) will improve long term success of the project and are recommended when feasible. Sites should be inspected approximately one month following flushing of new vegetation in the spring. In-fill planting should be conducted to replace any mortality. Any invasive plant species detected in planted areas should be removed before they are able to re-establish.

6.3 Wildlife Habitat Features

Long-term restoration planning can include features to improve the availability of suitable habitat for local wildlife. Creation of additional artificial and natural habitat features wherever possible will improve overall biodiversity. Habitat enhancement recommendations include:

- Introduction of coarse woody debris;
- Installation of wildlife trees;
- Installation of nest boxes for cavity nesting birds;
- Installation of bat roosts;
- Planting of pollinator friendly species

Coarse Woody Debris

Larger tree trunks that have fallen are often called downed wood, large woody debris (LWD) or coarse woody debris (CWD). These features provide shelter, feeding sites, and movement pathways for wildlife. They also act as nurse logs for plants, add organic matter and nutrients to the soil, and help to stabilize slopes, reduce erosion, and control sediment runoff. As a critical restoration substrate, large wood should be retained and reintroduced wherever possible. In relatively undisturbed forested areas, naturally downed trees should be sufficient to fulfill this need.

Standing Wildlife Trees

Dead standing trees or ‘planted wildlife trees’ are important habitat features for birds, mammals, amphibians and other organisms. They provide forage, roosting and nesting sites for a diversity of bird species. They are also a source of organic nutrient inputs. Natural tree mortality can provide the required habitat in relatively undisturbed forested areas.

Nest Boxes

Raised nest boxes located on artificial posts or pilings provide secure habitat protected from terrestrial predators and human disturbance. Nest boxes should be designed for local cavity nesting birds. There are over 30 bird species that are known to use nest boxes, including raptors, waterfowl, and songbirds. Installation and maintenance of nest boxes should be coordinated with local stewardship groups. The Cornell Lab of Ornithology has developed a number of plans for construction of nesting boxes, specific

to BC. To avoid creating nesting habitat for invasive birds such as European starlings, entrance holes smaller than 3.8 cm are recommended when suitable for the desired species.

Bat Boxes

Natural bat roosts are declining, particularly in urban areas. Building bat boxes as part of a restoration project can be successful as there are usually numerous insects for feeding. Boxes could be installed high up on a wildlife tree or artificial post and be located near a water source in an area that receives ample sunshine.

6.4 Project Timing

Proper project timing can ensure a greater degree of success for ecological restoration projects. This includes seasonal timing such as scheduling invasive plant removals for periods outside of prolonged rain events to limit surface erosion (winter months) and scheduling plantings following the last drought period (fall). Order of works is also of importance; invasive plants should be removed prior to site preparation and replanting. Planting should be the final works (aside from monitoring and maintenance) completed. This timing limits trampling and allows the plants to better establish. The exception is if wood mulch (to prevent surface erosion) is to be spread over a site. Mulching should occur after planting is completed when possible as it makes planting more difficult. Chemical treatment of knotweed is recommended to take place twice annually: once in late Spring, and again in late Summer/early Fall. Recommended seasonal timing for the restoration works are outlined in Table 7. Yellow indicates a recommended timing, while hatched boxes are acceptable provided additional measures are in place (watering for plantings, ESC measures for invasive removal or soil amendments).

Table 4. Recommended seasonal timing of works

	Spring	Summer	Fall	Winter
Invasive Removal				
Knotweed Treatment (chemical)				
Soil amendments				
Planting				
Monitoring/Maintenance (ongoing)	*			

*Sites should be inspected one month after flushing to determine mortality

Tree Removal

If any tree removals are planned as part of the development plans for the area it is important to keep the following information in mind. Nesting season in Metro Vancouver for most birds occurs between March 1 and August 31, as directed by the BC Ministry of Environment in ***Develop with Care 2014: Environmental Guidelines for Urban and Rural Land Development in British Columbia***. Tree removal during this period may affect nests and nesting behavior of some birds. If tree removal or pruning is required to occur during this time period, bird nest surveys by a QEP will be required to determine if there are nesting birds in the trees prior to removal.

Appendix 1 Statement of Limitations

This document was prepared by Diamond Head Consulting Ltd. Should this report contain an error or omission then the liability, if any, of Diamond Head Consulting Ltd. should be limited to the fee received by Diamond Head Consulting Ltd. for the preparation of this document. Recommendations contained in this report reflect Diamond Head Consulting Ltd.'s judgment in light of information available at the time of study. The accuracy of information provided by Diamond Head Consulting Ltd. is not guaranteed. This report is valid for 6 months from the date of submission. Additional site visits and report revisions are required after this point to ensure accuracy of the report.

Neither all nor part of the contents of this report should be used by any party, other than the client, without the express written consent of Diamond Head Consulting Ltd. This report was prepared for the client for the client's own information and for presentation to the approving government agencies. The report may not be used or relied upon by any other person unless that person is specifically named by Diamond Head Consulting Ltd as a beneficiary of the report, in which case the report may be used by the additional beneficiary Diamond Head Consulting Ltd has named. If such consent is granted, a surcharge may be rendered. The client agrees to maintain the confidentiality of the report and reasonably protect the report from distribution to any other person. If the client directly or indirectly causes the report to be distributed to any other person, the client shall indemnify, defend and hold Diamond Head Consulting Ltd harmless if any third party brings a claim against Diamond Head Consulting Ltd relating to the report.

Appendix 2 Invasive Plant Management Information for Contractors

The following guidelines should be followed during all phases of the project:

- PREVENTION: Adherence to invasive plant spread prevention practices during all phases of construction:
    - Isolate invasive plants adjacent to site by fencing to avoid disturbance during construction, where feasible.
    - Employ procedures to maximize the likelihood that imported materials are free from invasive plant propagules.
    - Inspect and clean equipment of all visible soil and plant material before entering and leaving the project site. Staging areas should be selected or managed to be free of invasive plants to avoid spreading seeds and other visible plant parts. Acceptable methods of cleaning equipment include a portable wash station that contains runoff from washing equipment (containment must be in compliance with wastewater discharge regulations), high pressure air; and brush, broom, or other hand tools (used without water).
    - Train site operators and contractors during construction via toolbox talks that detail identification of invasive plants, practices to prevent further spread and location of historic knotweed sites.

- KNOTWEED MANAGEMENT:
    - Chemically treat all knotweed sites. Refer to Metro Vancouver's Best Management Practices for Knotweed Species for further information on knotweed control.
    - Monitor and treat re-growth twice annually (spring and summer) through the duration of the project. Monitoring should occur through the entire construction site, not just at historic locations. Continue to monitor until there are no signs of re-growth for five consecutive years.
    - If excavated: supervision of excavation by a QEP to ensure all roots are removed; disposal of plants and roots at a facility that accepts knotweed or stockpiled for 3-5 with regular monitoring and treatment of regrowth.
    - If not excavated: isolation fencing installed, and other necessary techniques, to sufficiently ensure roots are not disturbed during construction.

In addition, the following guidelines should be followed during all phases of the project:

- INVASIVE PLANT REMOVAL: For all areas with invasive plant infestations within the construction zone (whether part of planned clearing area or not): dispose above ground growth as green waste and remove roots as follows:
    - Grub out roots: Himalayan blackberry, bamboo, English holly, butterfly bush, cherry laurel
    - Remove 4 to 6 inches of soil: English ivy, lamium, small flowered touch-me-not, morning glory, common hops, common tansy

- GREEN WASTE AND SOIL DISPOSAL: No invasive plant green waste or contaminated soil should be stockpiled on-site.

- MONITORING: Invasive plant monitoring (after site clearing for the duration of the project):
    - Monitor construction site for invasive plant re-growth.
    - Mechanically remove re-growth except for knotweed which should be chemically treated.

SCHEDULE 3
Reference Spill/Incident Response Plan

REFERENCE SPILL RESPONSE PLAN

If a spill of fuel, oils, lubricants or other harmful substances occurs at the site, the following procedures will be implemented.

Spill Response Steps
1. **ENSURE SAFETY**
2. **STOP THE FLOW** (when possible)
3. **SECURE THE AREA**
4. **CONTAIN THE SPILL**
5. **NOTIFY/REPORT** (EMBC 1-800-663-3456)
6. **CLEAN-UP**

(Circumstances may dictate another sequence of events)

1. ENSURE SAFETY

- Ensure Personal, Public, and Environmental Safety
- Wear appropriate Personal Protective Equipment (PPE)
- Never rush in, always determine the product spilled before taking action
- Warn people in immediate vicinity
- Ensure **no ignition sources** if spill is of a flammable material

2. STOP THE FLOW (when possible)

- Act quickly to reduce the risk of environmental effects
- Close valves, shut off pumps or plug holes/leaks, set containers upright
- Stop the flow of the spill at its source

3. SECURE THE AREA

- Limit access to spill area
- Prevent unauthorized entry onto site

4. CONTAIN THE SPILL

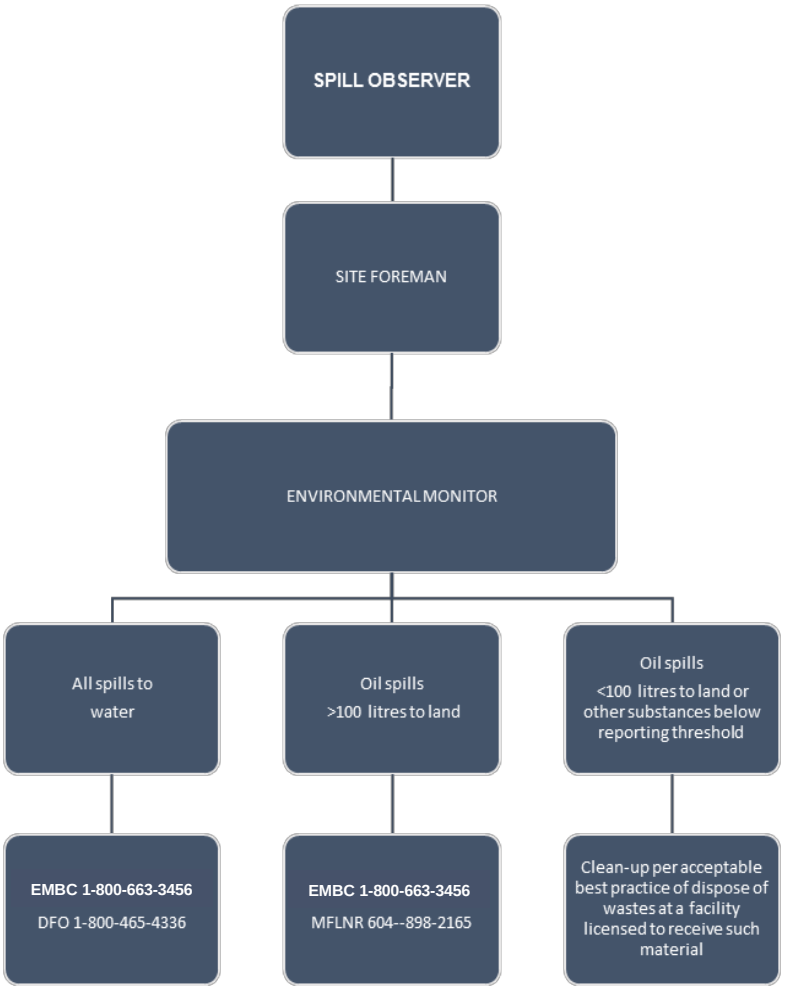
- Block off and protect ditches, drains and culverts
- Prevent spilled material from entering drainage structures (ditches, culverts, drains)
- Use spill sorbent material to contain spill
- If necessary, use a dike, berm or any other method to prevent any discharge off site
- Make every effort to minimize contamination
- Contain as close to the source as possible

5. NOTIFY/REPORT

- Notify Site Supervisor and EM (or alternate) of incident (provide spill details)
- When necessary, the first external call should be made to (see spill reporting requirements):

  Emergency Management BC (EMBC) 1-800-663-3456 (24 hours)
- Provide necessary spill details to other external agencies (see spill reporting requirements)

Spill Response/Incident Response Notification Chart



- In the event of a spill and Environmental Incident will have been deemed to occur.
- The EM if not already onsite, the Site Supervisor/Foreman will immediately call the EM to attend the site.
- The EM will prepare an Incident Response Report. The Incident Response Report will follow information requirements of the provincial Spill Reporting Regulation.
- The Incident Report will be submitted to the Owner's Environmental Monitor/Owner's Environmental Auditor who will report to the CA and CoQ Project Manager.

SPILL REPORTABLE QUANTITIES

Should there be a spill of materials or products that exceed the thresholds in the table below, the EM will report to Emergency Management BC per the Spill Reporting Regulation. An Environmental Incident will be deemed to have occurred and the EIR procedures will be instituted.

Substances as defined in the Federal Regulations or Hazardous Waste Regulation (HWR)	Quantity
Class 1, Explosives as defined in section 2.9	≤50 kg, if the substance poses a danger to public safety
Class 2.1, Flammable Gases, other than natural gas, as defined in section 2.14 (a)	10 kg
Class 2.2 Non-flammable and Non-toxic Gases as defined in section 2.14 (b)	10 kg
Class 2.3, Toxic Gases as defined in section 2.14(c)	5 kg
Class 3, Flammable Liquids as defined in section 2.18	100 L
Class 4, Flammable Solids as defined in section 2.20	25 kg
Class 5.1, Oxidizing Substances as defined in section 2.24 (a)	50 kg or 50 L
Class 5.2, Organic Peroxides as defined in section 2.24 (b)	1 kg or 1 L
Class 6.1, Toxic Substances as defined in section 2.27 (a)	5 kg or 5 L
Class 8, Corrosives as defined in section 2.40	5 kg or 5 L
Class 9, Miscellaneous Products, Substances or organisms as defined in section 2.43	25 kg or 25 L
Leachable toxic waste as defined in section 1 of the HWR	25 kg or 25 L
Waste containing PAH's as defined in section 1 of the HWR	5 kg or 5 L
Waste asbestos as defined in section 1 of the HWR	50 kg
Waste oil as defined in section 1 of the HWR	100 L
Waste that contains a pest control product as defined in section 1 of the WWR	5 kg or 5 L
PCB wastes as defined in section 1 of the HWR	25 kg or 25 L

**** Not-withstanding the reportable quantities list above, all spills to water are reportable. ****

SCHEDULE 4
Project Contact List

PROJECT CONTACT LIST - TO BE UPDATED PRIOR TO CONSTRUCTION

CONTACT	NAME	OFFICE #	CELL/PAGER #	24 HOUR #
Contractor	TBD	TBD	TBD	TBD
Contractor Project Manager	TBD	TBD	TBD	TBD
Contractor Site Supervisor/ Foreman	TBD	TBD	TBD	TBD
CoQ Project Manager	TBD	TBD	TBD	TBD
Project Manager	TBD	TBD	TBD	TBD
Contract Administrator	TBD	TBD	TBD	TBD
Environmental Lead	TBD	TBD	TBD	TBD
Environmental Monitor	TBD	TBD	TBD	TBD
Department of Fisheries and Oceans	-	-	-	**1-800-465-4336**
Ministry of Forests, Lands, & Natural Resource Operations	-	-	-	**1-800-663-7867**
Emergency Management BC	-	-	-	**1-800-663-3456**
TBD = To be determined after award				

SCHEDULE 5
Example Chance Find Management Plan





Chance Find Management Protocol
EXAMPLE

City of Coquitlam

May 2022

ISL Engineering and Land Services Ltd. Is an award-winning full-service consulting firm dedicated to working with all levels of government and the private sector to deliver planning and design solutions for transportation, water, and land projects.

Proudly certified as a leader in quality management under Engineers and Geoscientists BC's OQM Program from 2014 to 2021.

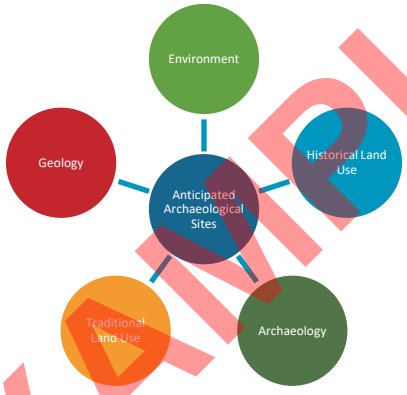
Table of Contents

APPENDICES

1.0 Introduction

On behalf of the _ (the City), ISL Engineering and Land Services Ltd. (ISL) is pleased to present this Chance Find Management Protocol developed for the _ Project (the Project), in _, BC. The purpose of this document is to provide protocols for responsible management of archaeological deposits in the event possible archaeological materials and/or features become exposed during project-related ground altering activities. It also aims to promote the preservation of archaeological data while minimizing delays and disruptions to the Project's schedule and activities.

Archaeological sites are an invaluable resource, protected for their historical, cultural, scientific and educational value to the Indigenous descendent and local communities and the general public. Archaeological sites within British Columbia, on Provincial Crown or private lands, are protected under the *Heritage Conservation Act* (HCA) and ground disturbing activities occurring during Project work have the potential to disturb these resources, where present. The discovery of archaeological materials and/or features, including human (ancestral) remains, during ground disturbing activities must be reported as soon as possible to minimize Project impacts and allow for proper documentation. Impacts to archaeological sites must be avoided or managed by development proponents.



2.0 Types of Archaeological Sites

A wide variety of archaeological materials (i.e., artifacts) and features (i.e., hearths, burials, depressions) represent the physical remains of Indigenous and historical peoples across British Columbia. Researching the Project's geological, environmental, historical, archaeological and traditional land use informs the anticipated site types that may be expected in the Project area.

Archaeological materials and/or features appear in all subsurface contexts from greenfield environments to disturbed imported fill layers. It is key to note, prior ground disturbance should does not influence the likelihood archaeological deposits will not be present.

A pictorial guide to the types of archaeological materials and features that may be identified within the Project area are summarized in Appendix A.

Potential Impacts to Archaeological Sites

Project activities that involve excavation, displacement and/or disturbance of soils has the potential to impact archaeological materials and features, if present. Activities such as, but not limited to geotechnical drilling, transportation and movement of equipment, land clearing, pre-loading, excavation and road removal and construction are all examples of activities that may adversely affect archaeological deposits.

3.0 Chance Find Procedure

Step-by-step procedures for managing chance finds of known or suspected archaeological deposits and human remains are provided below.

3.1 Archaeological Deposits

If you suspect the Project has encountered archaeological materials and/or features, either intact or from disturbed contexts, execute the following procedures immediately:

Step 1

- **STOP all ground disturbing activities** in the vicinity (approximately 30 m) of the find/feature.

Step 2

- Secure the area, making the workspace safe and prevent further impacts to the archaeological deposits.
- The soils associated with find/feature (i.e., immediately around the find/feature; the adjacent spoil material; the loaded sediments in a dump truck or hydrovac truck) should not be moved or disturbed further until cleared by an archaeologist.

Step 3

- Notify the Management team. Project-specific contact details are provided in Section 4.0 and general contacts have been included in Appendix C
- The Management team will notify a professional archaeologist who will determine the next steps based on a description of the find.
  - Be prepared to provide details of the archeological find and/or feature (e.g., shape, material type, dimensions) and the surrounding context (e.g., depth below surface, associated soil matrix).
  - **Do not** take photographs of any possible bones unless directed by an archaeologist.

Step 4

- The archaeologist will determine if a site visit and/or if further work (i.e., documentation, collection, monitoring, testing, detailed excavation and/or other mitigative strategies based on the type and density of the find[s]) is required.
- The archaeologist will notify involved Indigenous community representatives and the Archaeology Branch.

3.2 Human Remains

If suspected human remains are encountered from either intact or disturbed context, execute the below procedures immediately. The appropriate course of action may differ depending on whether the remains are found in an undisputed archaeological context. The Archaeology Branch's Found Human Remains Policy is included for review and reference in Appendix B.

Step 1

- **STOP ALL WORK** in the vicinity (approximately 30 m) of the remains.

Step 2

- Secure the area, making the workspace safe and to prevent further impacts.
- Do not moved or disturbed further the soils associated with remains (i.e., immediately around the find/feature; the adjacent spoil material; the loaded sediments in a dump truck or hydrovac truck) until cleared by an archaeologist.
- Do not allow photographs or videos and ensure the remains are treated with dignity and respect by all on site personnel.

Step 3

- Notify the Management team (Project-specific contact details are provided below; general contacts have been included in Appendix C). The Management team will notify a professional archaeologist who will contact the Archaeology Branch.

Step 4

- The archaeologist and/or a specialist trained in physical anthropology will conduct a site visit.
- If it is determined to be human remains (i.e., forensic) and not ancestral (i.e., archaeological) the local authorities (i.e., police and the Office of the Corner) will be contacted for further guidance.
- If it is determined to be ancestral, discussions between the Project team, local Indigenous communities, Archaeology Branch and the archaeologist will identify the appropriate next steps (i.e., avoidance, controlled respectful excavation and/or other cultural protocols).

4.0 Contact List

Project-specific contact details are provided below. General contacts are provided in Appendix C.

Contact Information				
Company	**Role**	**Name**	**Phone Number**	**Email**
_ **City**	Project Manager	TBD	TBD	TBD
ISL	Project Manager	TBD	TBD	TBD
	Senior Project Technologist	TBD	TBD	TBD
	Archaeologist, Lead	TBD	TBD	TBD
	Archaeologist	TBD	TBD	TBD
Archaeology Branch	Project Officer	TBD	TBD	TBD
	HCA Permit Application _			

APPENDIX A
Archaeological Site Identification Guide

Appendix A – Archaeological Site Identification Guide

A comprehensive pictorial guide of expected archaeological materials and features is provided herein.

Fire Cracked Rock (FCR)

Rocks fractured from being deliberately, rapidly heated and cooled from cultural use in fires during resource or food preparation (i.e., hearths [campfire], earth ovens, stone boiling pit)

Key Identifiers

- Concertation of fractured rock with crenulated interior surfaces ad jagged, angular edges
- Typically retains exterior or cortex of the cobble
- Rocks show evidence of being in a fire (pink to red and/or black staining)
- Soils around the rocks may also show signs of reddish to orange and/or black staining, often with charcoal lenses

A hearth feature and FCR exposed in an excavation trench.

Example of an excavated intact rocked lined hearth (campfire).

Collection of recovered FCR.

Shell Midden

Shell midden is created through the collection and processing of shellfish over time. Shell midden is known to contain a variety of artifacts like FCR, stone tools, antler and bone. Bone (mammal and ancestral) tend to preserve well in midden material due to the calcium counteracting soil acidity. Midden deposits can stand-out from surrounding non-midden layers as shown below.

Key Identifiers

- Concertation of layered shells (flecks/crushed and/or whole shells)
- Soils tend to be black and greasy to the touch
- Commonly associated with charcoal, FCR and bone

Exposed shell midden eroding out of a bank. Note the black soil, layered shell [crushed and complete] and FCR.

Shell midden exposed in an excavation trench during construction. Note the black soil, concentration of shell and FCR.

Stone Tools (Lithics)

Stone tools (lithics) can appear similar to broken rocks at first but once reviewed, they show evidence of thoughtful manipulation (flint knapping, grinding, shaping) to create a purposeful tool. Stone tools can include chipped or ground stone artifacts and come in a wide variety of material and complexity.

Key Identifiers

- Often small and thin stone fragments that appear out-of-place with the surrounding natural rocks
- Formed, often symmetrical or one-sided, in appearance
- Edges may be chipped or ground into a shape
- Material is typically fine-grained, with a matte to glassy finish. Exotic or imported materials are also common along to coast
- Stone flakes are sharp or appear to have a “working-edge”

Examples of stone cores. These were used to produce flakes for reforming into other tools (often referred to as blanks) or to obtain a sharp edge for immediate use.

Examples of chipped bifaces (projectile points).

A chipped biface on the left (projectile point) and a retouched flake on the right. A flake was further modified to maintain a sharp edge.

An example of an expedient cobble chopper (left) and an ear spool (ground stone artifact) on the right.

The left is an example of a drilled stone used either as a net weight or anchor stone and the right is a ground stone hand hammer (hand maul).

An example of a ground stone slate knife (left) and a ground stone adze (right)..

Faunal (bone)

Faunal elements recovered from archaeological contexts can consists of formed tools and the byproducts of producing such tools. As with stone tools, bone tools show evidence of thoughtful manipulation (grinding, shaping, chipping) to create a purposeful tool.

Faunal remains are also associated with resource processing and/or food preparation and can be historical or archaeological in nature based on the context of the finds and whether the remains were from a domesticated or non-domesticated animal.

Key Identifiers

TOOLS

- Edges are typically ground into a shape, but may also be chipped
- Formed, often symmetrical in appearance
- Bone has a smooth, polished finish

RESOURCE PROCESSING

- Concentration of highly fragment bones
- Typically, fragments are small and consist of compact (cortical) bone
- Edges are sharp, displaying evidence of fresh bone fractures

Important to note are bones with evidence of modern butchery practices (i.e., saw cut) as they indicate historical deposits. In addition, articulated or isolated bones (intact or fragmented) could be human. Caution should be taken when bones are identified in all contexts.

The left is a barbed harpoon, the center image is a bone bipoint, and the right shows a point with the base formed for attaching to a shaft.

Collection of unearthed fragmented mammal bones.

The left is picture of an intact wolfs paw inside a house pit and the right is an example of a ground and formed bone wedge

An example of proper chance find management being implemented for a bone found during construction. The team was able to identify the bone as being historical (i.e., non-archaeological) based on the butcher marks (band-saw cut) and work was able to proceed with minimal delay.

Wet Site (Organic)

Wet sites contain preserved organic material that has been preserved in low-oxygen environments (i.e., waterlogged) and generally are found in areas with stable ground water levels (i.e., intertidal areas). It's important to note, wet site materials (i.e., cordage/rope, stakes, baskets, other formed wood implements) have been identified below large amounts of fill.

Key Identifiers

- Fragments or complete buried baskets, rope, or shaped wood implements
- Odd arrangements of sticks or woven/weaved fibrous materials

These examples show formed and shaped organic wooden implements. The left image is a wood wedge, and the right shows a split prong.

An example of recover cordage or rope.

An example of a cleaned basket. Note the interwoven fibers.

APPENDIX B
Found Human Remains Policy

Appendix B – Found Human Remains Policy

Archaeology Branch

Issued: September 22, 1999

Please note, this policy is currently under review.

Purpose

The purpose of this directive on found human remains is to provide guidelines to Archaeology Branch staff, archaeologists, other agencies and the public as to branch procedures for handling human remains that may be protected under the *Heritage Conservation Act* (1996, RSBC, Chap. 187), and to facilitate the respectful treatment of these remains.

Mandate

Pursuant to section 13(2)(b) of the *Heritage Conservation Act*, a permit is required under section 12 or 14 before a person can undertake any actions affecting a burial place of historical or archaeological value, human remains or associated heritage objects.

Authority

The Director of the Archaeology Branch and the Manager, Permitting and Assessment Section, have been authorized to exercise the powers of the Minister to issue permits under sections 12(2) and 14(2), as well as ministerial orders under section 14(4) where necessary for emergency conservation purposes.

Policy statement

Upon notification of the discovery of human remains that are not of forensic concern, the Archaeology Branch will take steps to facilitate the respectful handling and disposition of those remains within the limits of existing funds and program priorities.

Procedures

The following procedures will normally apply in cases where human remains are discovered fortuitously through various land altering activities such as house renovations, road construction or natural erosion; or during archaeological studies conducted under a *Heritage Conservation Act* permit:

1. Fortuitous Discoveries

In cases where the branch has been notified that human remains have been discovered by chance, the following procedures should normally apply:

- the Coroner's Office and local policing authority should be notified as soon as possible.
- the Coroner's Office should determine whether the matter is of contemporary forensic concern. The branch may provide information and advice that may assist in this determination.

- if the Coroner's Office determines the reported remains are not of forensic concern, the branch will attempt to facilitate disposition of the remains.
- if a cultural affiliation for the remains can be reasonably determined, the branch will attempt to contact an organization representing that cultural group.
- if remains are determined to be of aboriginal ancestry, the branch will attempt to contact the relevant First Nation(s).
- generally, if remains are still interred and are under no immediate threat of further disturbance, they will not be excavated or removed.
- if the remains have been partially or completely removed, the branch will facilitate disposition.
- if removal of the remains is determined to be appropriate, they will be removed under authority of a permit issued pursuant to section 12 or 14, or an order under section 14 of the *Heritage Conservation Act*, respecting the expressed wishes of the cultural group(s) represented to the extent this may be known or feasible.
- if circumstances warrant, the branch may arrange for a qualified physical anthropologist or an archaeologist with training in human osteology to provide an assessment of the reported remains in order to implement appropriate conservation measures.
- analysis should be limited to basic recording and in-field observations until consultation between the branch and appropriate cultural group(s) has been concluded.

2. Permitted Archaeological Projects

In cases where human remains are encountered in the course of a permitted project, the Archaeology Branch should be contacted as soon as possible.

- the remains are to be handled in accordance with the methods specified in the permit, respecting the expressed wishes of the cultural group(s) represented, to the extent that these may be known or feasible.
- if the permit does not specify how remains are to be handled and if the cultural affiliation of the remains can be reasonably determined, the field director or permit-holder should attempt to contact an organization representing that group. The permit-holder or field director should advise the branch of the organization contacted, and any wishes expressed by that organization.
- the branch, in consultation with the appropriate cultural group(s), will determine disposition of the remains.
- analysis should be limited to basic recording and in-field observations, until consultation between the branch and appropriate cultural group(s) has been concluded.

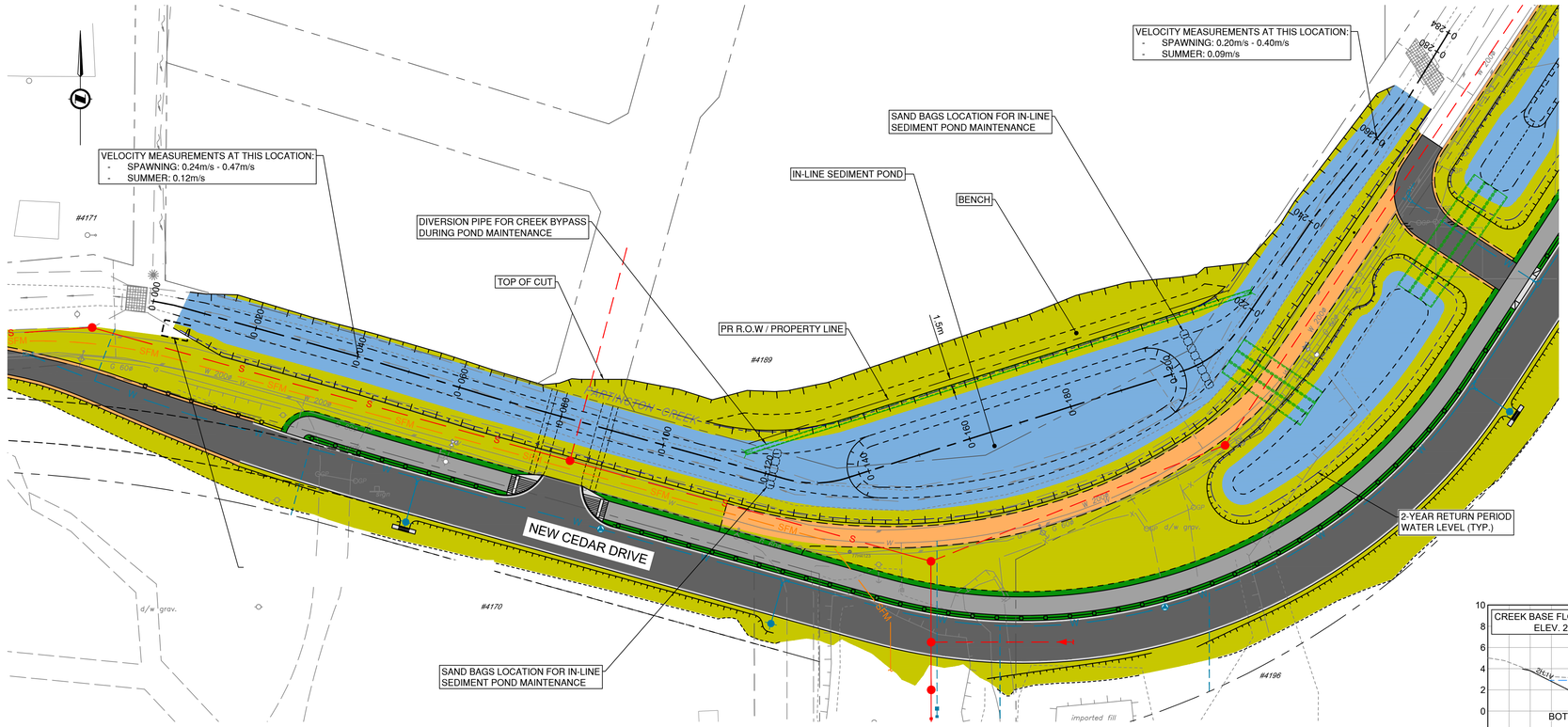
Available at: Bulletins and policies - Province of British Columbia (gov.bc.ca)

APPENDIX C
Project Contact List

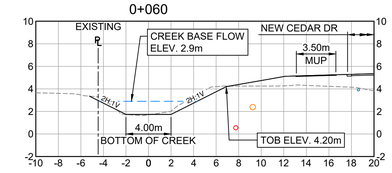
Appendix C – Contact List

Contact Information				
Company	**Role**	**Name**	**Phone Number**	**Email**
City of _	Project Manager	-	-	-
	Main Line:			
ISL	Project Manager	-	-	-
	Senior Project Technologist	-	-	-
	Archaeologist, Lead	-	-	-
	Archaeologist	-	-	-
	Main Line:			
Archaeology Branch	Project Officer	-	-	-
	HCA Permit Application _ | Main Line 250.953.3334			
	Supervisor	-	-	-
	Manager	-	-	-
Office of the Corner	-	-	250.561.8488 1.855.207.0637	-
	Main Line:			
RCMP Non-emergency	-	-	-	-

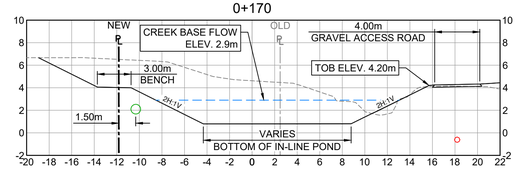
APPENDIX C
Engineering Design Drawings



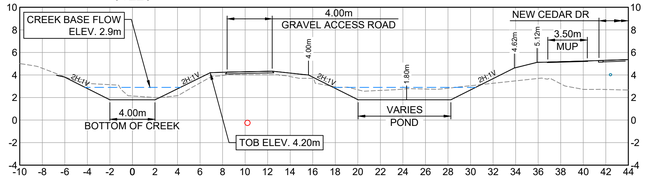
PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW
SCALE 1:500



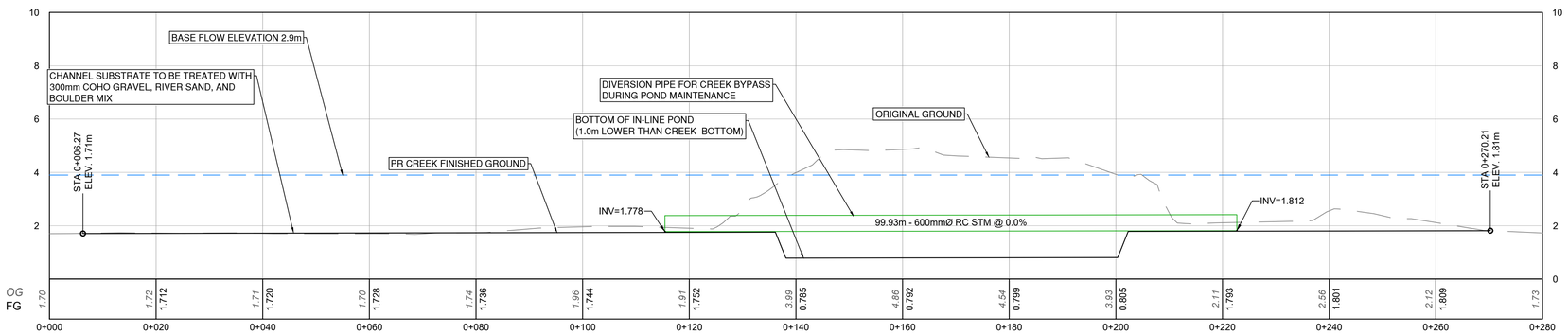
PARTINGTON CREEK IMPROVEMENT CROSS-SECTION
SCALE 1:250H / 1:250V



IN-LINE SEDIMENT POND - CROSS-SECTION
SCALE 1:250H / 1:250V



PARTINGTON CREEK IMPROVEMENT CROSS-SECTION
SCALE 1:250H / 1:250V



PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PROFILE VIEW
SCALE 1:500H / 1:100V

SURFACE TREATMENT

- ROAD SURFACE: SEE ROADWORK DRAWINGS FOR DETAILS
- MULTI-USE PATH / ASPHALT DRIVEWAY: SEE ROADWORK DRAWINGS FOR DETAILS
- GRAVEL DRIVEWAY / SHOULDER: SEE ROADWORK DRAWINGS FOR DETAILS
- BOULEVARD: - 150 mm OF TOPSOIL AND SOD
- 100mm TOPSOIL AND HYDROSEED
- CONCRETE
- RIPARIAN PLANTING
- PARTINGTON CREEK BASE FLOW WATER LEVEL

1:500 0 10 30m

PLOT DATE: July 15, 2021

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/15	GA	CJB/ND

Coquitlam
Engineering & Public Works
3000 Guildford Way, Coquitlam, B.C. V3B 7N2

PARTINGTON CREEK AND IN-LINE POND
CEDAR DRIVE UPGRADES

ISL Engineering and Land Services
#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2690 F: (604)629-2698

DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Apr-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT
			REV. B

DWG. NO. 34 OF 52

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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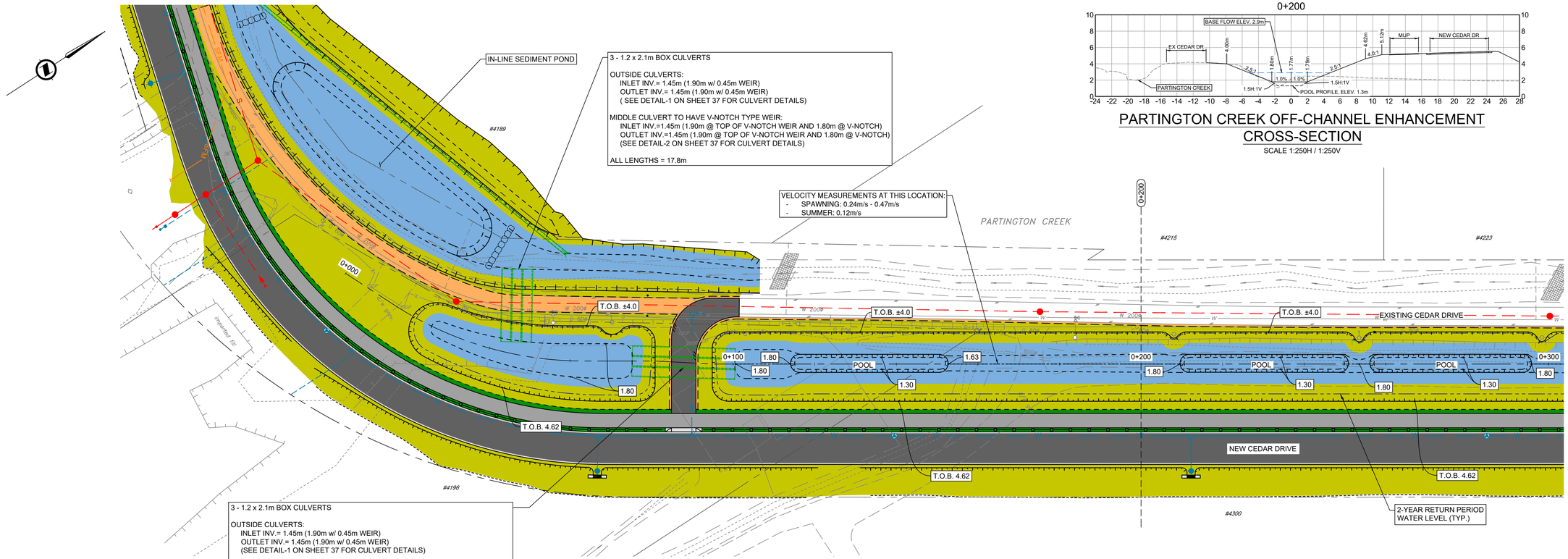

PARTINGTON CREEK OFF-CHANNEL ENHANCEMENT CROSS-SECTION

SCALE 1:250H / 1:250V

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT PLAN VIEW

SCALE 1:500

SURFACE TREATMENT

- ROAD SURFACE: SEE ROADWORK DRAWINGS FOR DETAILS
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- RIPARIAN PLANTING
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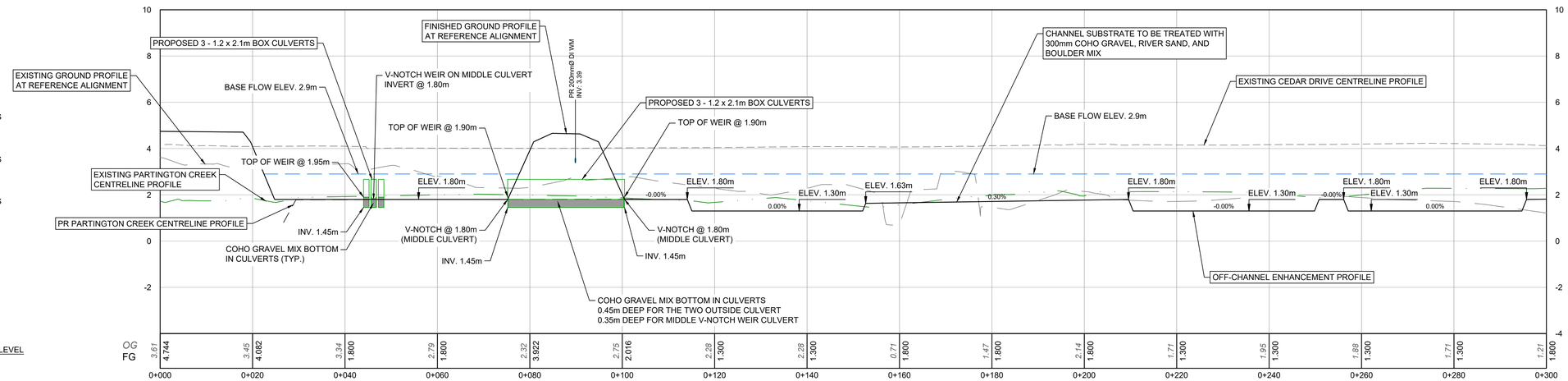

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT PROFILE VIEW

SCALE 1:500H / 1:100V

1:500 0 10 30m

DETAILED DESIGN DESIGN NO. 32628

PLOT DATE: July 15, 2021

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
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OFF-CHANNEL WORKS
CEDAR DRIVE UPGRADES

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#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2699 F: (604)629-2698

SCALE	AS SHOWN	DATE	Apr-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT

DWG. NO. 35 OF 52
REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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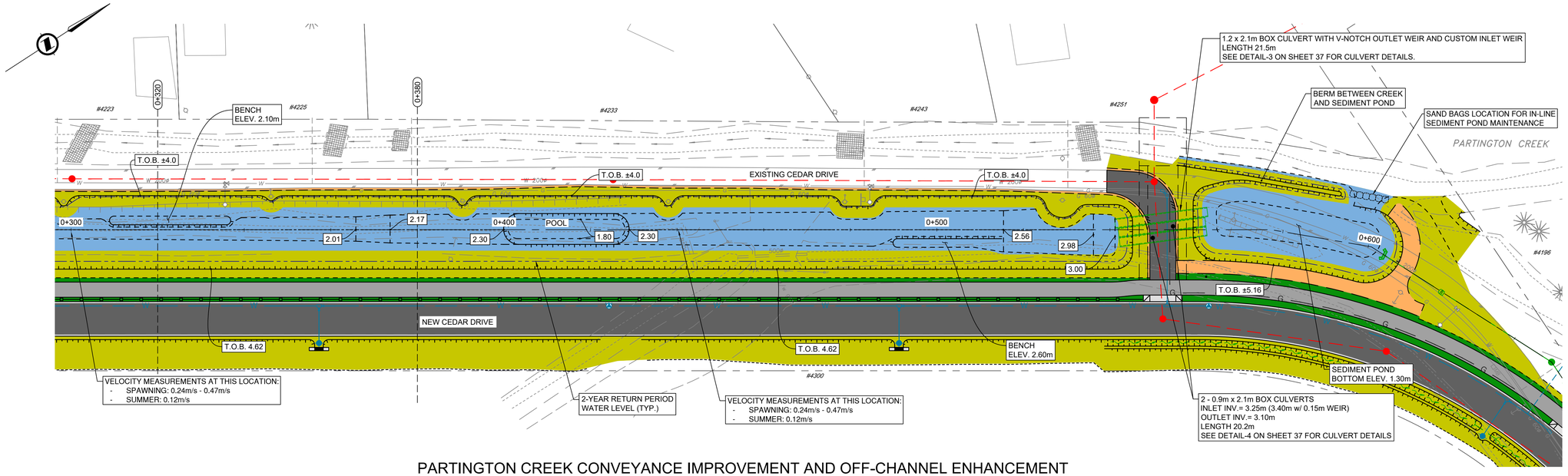
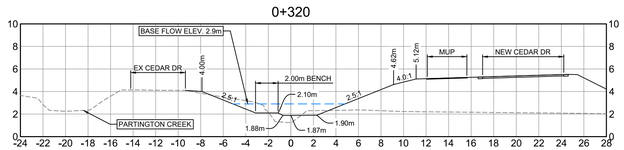


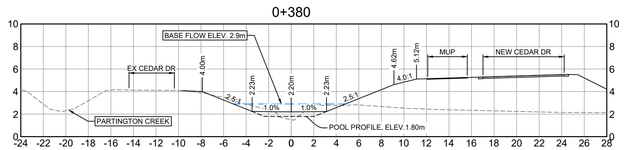
PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW

SCALE 1:500



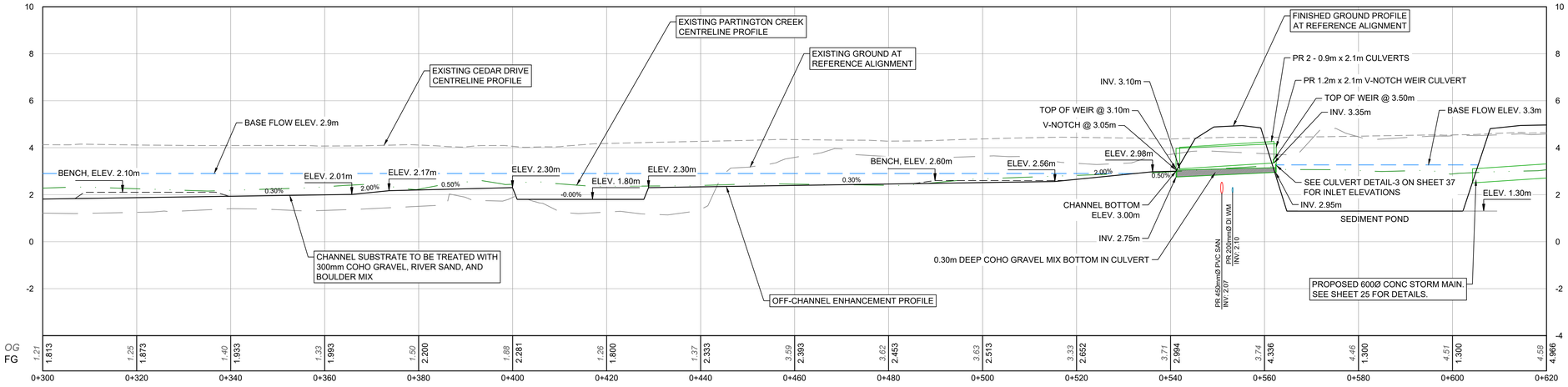
PARTINGTON CREEK OFF-CHANNEL ENHANCEMENT
CROSS-SECTION

SCALE 1:250H / 1:250V



PARTINGTON CREEK OFF-CHANNEL ENHANCEMENT
CROSS-SECTION

SCALE 1:250H / 1:250V



PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PROFILE VIEW

SCALE 1:500H / 1:100V

SURFACE TREATMENT

- ROAD SURFACE:
  SEE ROADWORK DRAWINGS FOR DETAILS
- MULTI-USE PATH / ASPHALT DRIVEWAY:
  SEE ROADWORK DRAWINGS FOR DETAILS
- GRAVEL DRIVEWAY / SHOULDER:
  SEE ROADWORK DRAWINGS FOR DETAILS
- BOULEVARD:
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1:500 0 10 30m

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OFF-CHANNEL WORKS
CEDAR DRIVE UPGRADES

ISL Engineering and Land Services
#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2696 F: (604)629-2698

DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Apr-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT

DWG. NO. 36 OF 52
REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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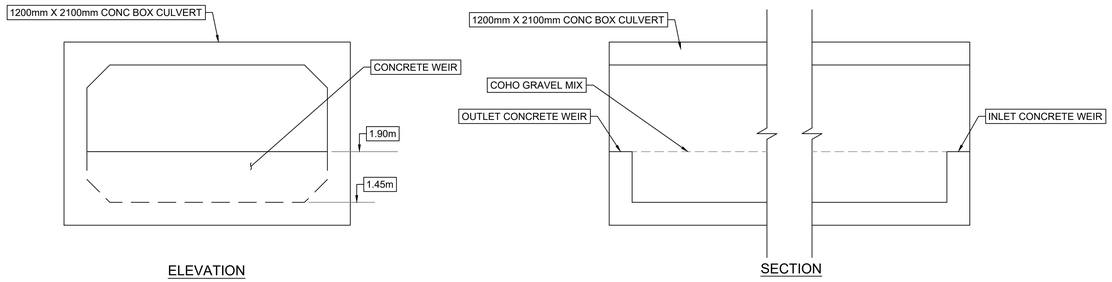
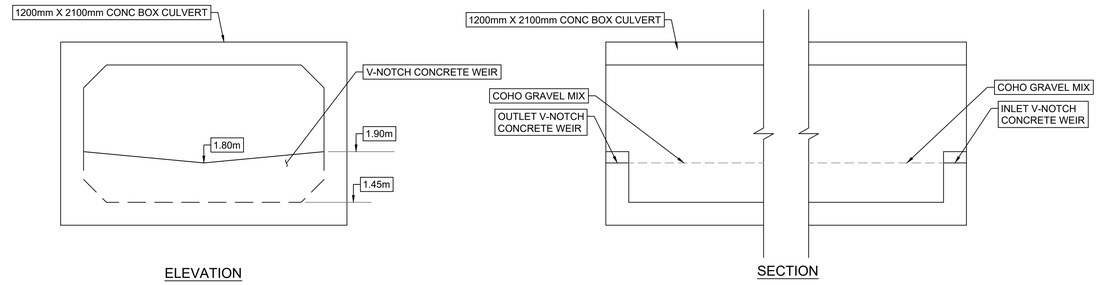


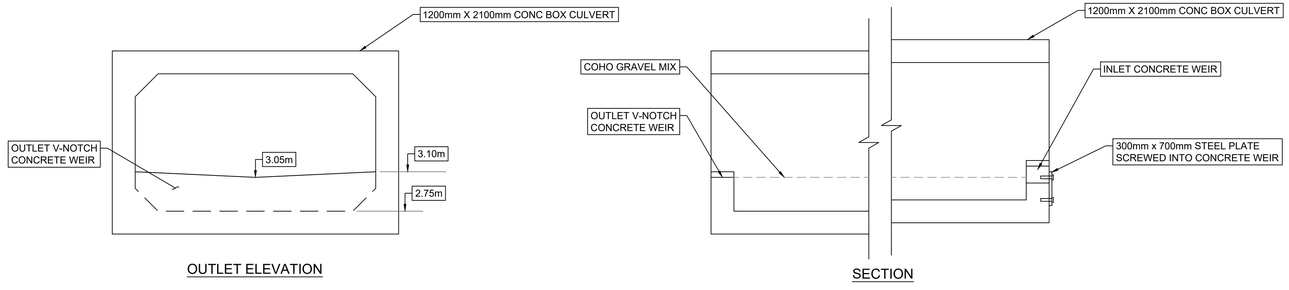
CULVERT DETAIL - 1

SCALE 1:25



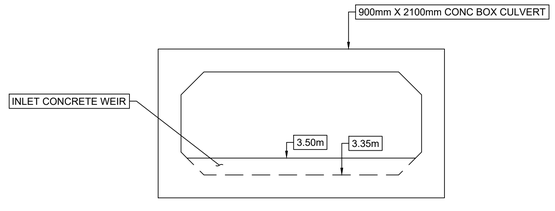
CULVERT DETAIL - 2

SCALE 1:25



CULVERT DETAIL - 3

SCALE 1:25



CULVERT DETAIL - 4

SCALE 1:25

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PLOT DATE: July 15, 2021

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/15	GA	CJB/ND

Coquitlam
Engineering & Public Works
3000 Guildford Way, Coquitlam, B.C. V3B 7N2

CULVERT DETAILS
CEDAR DRIVE UPGRADES

ISL Engineering and Land Services
#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2696 F: (604)629-2698

DETAILED DESIGN

DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Apr-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT

DWG. NO. 37 OF 52
REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

APPENDIX D
Heritage Inspection Permit Application

HERITAGE CONSERVATION ACT

APPLICATION FOR HERITAGE INSPECTION PERMIT

The undersigned hereby applies for a permit, under Section 12.2 of the Heritage Conservation Act, to carry out a Heritage Inspection in accordance with the terms and conditions, and information requested on the reverse of this form.

Name: Mike Rousseau	*Company:* Antiquus Archaeological Consultants
Address: 23021 132 Ave, Maple Ridge, B.C.	
Phone: 604-467-3497	*Fax or Email:* antiquus@shaw.ca

Permit expiry date:	04/15/2023
Permit deliverables due[1]:	04/15/2023

Financial responsibility for the assessment is assumed by the following proponent(s):

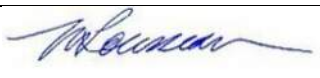
Name: Kevin Terness	*Company:* ISL Engineering and Land Services Ltd
Address: 4190 Lougheed Hwy #503, Burnaby, B.C. V5C 6A8	
Phone: 604-629-2696	*Fax or Email:* kterness@islengineering.com

☐ Other proponents may be added to this permit without an amendment, pending submission of a client certification and client endorsement, as appropriate, to the Archaeology Branch.

PERMIT APPLICANT'S CERTIFICATION

I certify that I am familiar with the provisions of the Heritage Conservation Act of British Columbia, and that I will abide by the terms and conditions listed herein, or any other conditions the Minister may impose, as empowered by said Act.

Permit Applicant's Certification

Date[2]: March 30 2021	*Permit Applicant Name:* Mike Rousseau	*Signature:* 

[1] Section 8 describes deliverables (i.e., report[s], site records, spatial data, repository acceptance)
[2] Each revision requires a new date

Briefly summarise the project: This permit is in support of proposed road upgrade project located near the Pitt River in eastern Coquitlam, BC. Kevin Turness, representing ISL Engineering, has proposed that Cedar Drive (between Victoria Drive to the south and Gilleys Trail to the north) be decomissioned and replaced with a new road directly to the east/south of the original route. The space between the original route and the new road will be occupied by a paved multi-use pathway (MUP) and a flood conveyance channel and off-channel habitat.

Choose applicable sector: Choose an item.

Application for S12.2 Heritage Inspection Permit

1. PERMIT INFORMATION

Applications and maps submitted to the Branch will comply with Provincial standards[3]. Spatial data will include shapefiles and kml/kmz files.

1.1. PROPOSED DEVELOPMENT(S) TO BE ASSESSED

Describe the proposed development(s) to be assessed. Describe the duration, extent, and magnitude of impacts from proposed activities, and how these impacts may affect archaeological resources: The proposed project encompasses a length of Cedar Drive approximately 1.5 kilometres long between Victoria Drive Gilleys trail. The project involves the replacement of the existing Cedar Drive with a new route, located just south and east of the existing road. The proposed project may involve the following development activities:

(1) Removal of surface vegetation ('grubbing') to facilitate the construction of the new road.

(2) Excavation of sediments and deposition of fill in various localities to the east and south of the existing road in order to form a level surface to facilitate the construction of the new route.

(3) Construction of a new road on the southern/eastern side of the existing Cedar Drive.

(4) Excavation to facilitate the installation of a flood conveyance channel/animal habitat.

(5) Construction of a new paved multi-use pathway (MUP) located on the north and west of the new route.

(6) Removal of existing culverts and other utilities from beneath the original Cedar Drive route.

[3] Mapping and Shapefiles as of January 2, 2020: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/mapping_shapefile_requirements.pdf ; more resources are forthcoming

(7) Excavation to facillitate the installation of new buried culverts and other utility services.

(8) Removal of existing buildings on both sides of the existing Cedar Drive.

(9) Construction of a foot bridge over the newly installed flood conveyance channel to provide access to the northern side of Cedar Drive from the proposed multi-use path.

(10) Removal of the concrete that forms the existing Cedar Drive.

(11) Construction of a new road surface, including deposition of sand and gravel road bed and paving along the entirety of the 1.5 kilometre route.

(12) Heavy machine traffic throughout the impact zone.

All of the above development activities could potentially pose a risk of negative impacts to any buried artifacts or features located within the proposed impact zone.

Is this a Multi-Assessment Permit (MAP)?

☒ No. All components are identified in this application. **Size of proposed permit area (ha):**

Additional comments:

☐ Yes. The Multi-Assessment Permit Policy[4] applies.

Define scope of MAP:

- Maximum number of individual assessments: ;
- Maximum size of assessment areas: ; and/or
- Other[5]. Describe:

[4] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/multi_assessment_permit_policy_18dec19.pdf
[5] E.g., maintenance or upgrades to existing infrastructure

Should proposed assessment areas exceed what is described above, the permit holder will contact the Branch. The Branch may provisionally authorise the proposed variance, but approval will ultimately consider First Nation responses to Notices of Intent.

Additional comments:

1.2. LOCATION

Table 1. Location of Permit Area

Jurisdiction/Tenure	Description
☐ **Private Property**	☐ *Municipal address including postal code* ☐ *Legal description including land title district* ☐ *Property Identification(s) (PID):*
☒ **Crown land**	*Tenure Type and Description; if surveyed land, include land title district and/or Parcel Identifier Number(s) [PIN] or Geographical information:* *LOT 1, SECTION 8, TOWNSHIP 40, EAST OF THE COAST MERIDIAN, NEW WESTMINSTER DISTRICT, PLAN EPP38098; NW1/4, SECTION 8, TOWNSHIP 40, EAST OF THE COAST MERIDIAN, NEW WESTMINSTER DISTRICT*
☐ **Other**	*Administrative Layer and/or Operating Areas as appropriate:*

Additional comments regarding permit area:

1.3. GOALS AND OBJECTIVES

The objective of this study is to collect data to inform next steps. **Intended goals and objectives are selected:**

☒ Identify and evaluate protected archaeological resources within the proposed development area subject to assessment;

☒ Interpret site function;

☒ Assess site significance;

☒ Identify the nature and magnitude of direct and indirect impacts that future proposed development may have on protected archaeological sites;

☒ Formulate management options for avoiding or mitigating the impacts to protected sites, which may include systematic data recovery;

☒ Collate the results of any previous investigations at the site, with consideration to regional information.

☐ Other objectives are proposed. **Describe:**

If any of the above are not selected, **provide a rationale:**

Additional comments:

1.4. RELATED STUDIES

The following studies are known to exist within or near the proposed permit area and have been provided to the Branch with this application:

☒ An Archaeological Overview Assessment (AOA)[6]:

☐ A GIS-based archaeological predictive model. **Details:**

☒ A desk-based assessment. **Details:** Archer carried out an archaeological overview assessment that included the project area in 2017. Archer determined the entire project area to possess high archaeological site potential.

☐ Field studies. **Details:**

☐ Other (e.g., ethnographic accounts, Traditional Use Studies). **Details:**

Where models exist, desktop AOA or AOA model-generated high potential areas will be displayed on the detailed survey map. The field director will assess areas of low potential, to aid in the ongoing evaluation of the AOA model. The amount of visual assessment in areas modelled as low potential will be determined by the field director and a rationale provided in the report.

Additional comments:

[6] Studies which incorporate information from First Nations may contain more comprehensive information relevant to adequately assessing potential.

Table 2. Previous Studies Relevant[7] to the Proposed Assessment(s)

Type of Study	Direct Overlap with Assessment Area? (Y/N)	Distance, Direction from Proposed Assessment Area	Year Assessed	HCA Permit #[8]	Comments Relevant to this Study
AOA	Y	0	2017	n/a	The proposed project area is considered to have high archaeological site potential.

Additional comments:

[7] For MAPs, it may be appropriate to list only those studies relevant to assessments known at the time of application; otherwise this information should be included in Notices of Intent
[8] If applicable

Is this related to any concurrent Heritage Conservation Act (HCA) permits?

☒ No.

☐ Yes. **Provide HCA application and/or permit number(s)**:

Describe how the HCA permits will work together:

If known, provide First Nation File numbers:

Additional comments:

1.5. ADDITIONAL DISCUSSION

This application requires further discussion not outlined elsewhere in this section of the application:

2. PERSONNEL

Roles will comply with Branch policy (e.g., Permit Personnel Policy[9]). The Archaeology Branch (the Branch) may approve the addition of field directors without an amendment to the permit.

Table 3. Field Directors

The Permit Area overlaps with these Culture Area(s)	Qualified Field Directors
☒ **Northwest Coast**	Mike Rousseau; Geoff Homel
☐ **Interior Plateau**	
☐ **Sub-Arctic / Boreal Forest**	

Additional Comments:

3. FIELD METHODS

The permit holder and field director(s) will consider and document comments and concerns from First Nations when making in-field decisions and developing management recommendations under this permit.

How will developments be selected for assessment? **Describe:** The entire proposed development will be assessed.

Prior to the initiation of field studies, all previously recorded sites near the project area (e.g., within 50 m) will be subject to detailed background review of available site records, permit reports, and site record updates on file with the Archaeology Branch.

[9] Forthcoming as of January 2020

Discrepancies in previously recorded site locations, site boundaries, or other site information will be addressed with Archaeology Branch prior to site visit(s). **Additional comments:**

3.1. ARCHAEOLOGICAL POTENTIAL

Areas with potential for archaeological resources will be considered when some of the following criteria are encountered. Reports will provide rationale behind in-field decisions:

- Geological, terrain, or microtopographical features
- Proximity to potable water
- Slope
- Aspect
- Elevation
- Forest cover
- Soil drainage
- Proximity to sheltered areas (from wind or rain);
- Proximity to areas of potential cultural significance
- Timber with potential for CMT sites
- Shore lines
- Proximity to cultural resources (e.g., trails; berry patches; fishing sites; travel corridors)
- Any of the above conditions that existed in the past that are not present today (e.g., paleolandscapes; landforms obscured by agricultural practices)
- Previously recorded archaeological or heritage sites
- Areas identified by First Nations or other interested parties
- Significant disturbance
- Other (e.g., GPR)

Additional comments:

3.2. FIELD RECORDING

Field notes will record in-field observations. Survey coverage and points of interest will be recorded (e.g., with a GPS or total station). A camera will be used to document in-field observations. When sites are identified, they will be mapped per Branch requirements[10].

Notes will document information provided by First Nations and observations to support the rationale behind in-field decisions regarding survey coverage, subsurface testing methods, and preliminary management recommendations for sites.

[10] Defining Archaeological Site Boundaries & Protection Status: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/defining_archaeological_site_boundaries_protection_status.pdf

Polygons of negative subsurface test locations and areas of potential will be created for submission to the Branch. Notes will sufficiently describe sites to include necessary information to complete a site form[11] to Provincial standards.

Additional comments:

3.3. SURVEY COVERAGE

The study area will be surveyed for archaeological features (e.g., cultural depressions, trees with modifications that may pre-date AD 1846), and areas exhibiting potential for archaeological resources (e.g., landforms and exposures). Surveyed terrain will be mapped in relation to the development footprint and described in the report.

Survey coverage will minimally address areas of anticipated archaeological potential identified by the AOA study (where they exist) and may be modified based on in-field observations. Areas of potential that are not surveyed will be mapped and rationale provided for why the area was not assessed and why it was evaluated to contain potential.

Select all that apply:

☒ Traverses or transects with crew members spaced at 10 m intervals or less in areas of high potential; at less than 25 m intervals in areas of moderate potential; at 10-40 m intervals in areas of low archaeological potential. **Additional details regarding approach:**

☐ The entire development will be surveyed with crew members spaced in less than 5 m intervals. **Additional details regarding approach:**

☒ Areas with high potential for surface artifacts will be surveyed with crew members spaced at 1-5 m intervals. **Additional details regarding approach:**

☐ Areas with terrain that has low potential for archaeological resources other than CMTs will be surveyed with crew members spaced at 5-50 m intervals. **Additional details regarding approach:**

☐ Areas of low archaeological potential may not be surveyed or will be surveyed en route to areas of high archaeological potential. **Additional details regarding approach:**

☐ **Other (provide details and rationale):**

Additional comments: :

[11] Notes and photos are required by repositories and may be recalled by the Branch

3.4. SUBSURFACE TESTING[12]

All Areas of Potential (AOPs) and negative Subsurface Test Locations (STLs) will be mapped and shapefiles will be provided to the Branch, per the Mapping and Shapefile Requirements (i.e., shown as polygons with the number of tests, or each individual test shown).

Stratigraphic and subsurface descriptions will be recorded in the field and summarized in the report(s). Special attention will be paid to significant results, variations, and/or changes.

Reports will describe why the Field Director determined the sediments are culturally sterile. When the depth of culturally sterile deposits in the test was not determined, a rationale must be provided in the report.

The effectiveness of testing at each STL will be determined by a quantitative and/or qualitative evaluation of research. Assumptions about the type, size and artifact density of potential target sites will be described in this evaluation.

While the Branch recommends subsurface testing Areas of Potential (AOPs), when AOPs are avoided by development and thereby not subjected to testing, reports will describe observations (e.g., microtopography, nearby drainages, vegetation); indicate how these characteristics affected the evaluation of potential; and provide management recommendations to avoid impacts to the AOPs until they can be fully assessed.

Select as appropriate:

☒ Tests will minimally measure 0.123 m^2 (e.g., 35 cm a side shovel test). Sediments will be screened through ¼" mesh or smaller. Tests will be excavated until culturally sterile sediments are confirmed (e.g., glacial till). **Additional details regarding approach:**

☒ Soils believed to contain cultural materials will remain within the site boundary[13] and described in the site form and report. **Additional details regarding approach:**

☒ STLs will be tested at 5 m intervals or less. The field director will provide a rationale in instances where a different interval of testing is employed. **Additional details regarding approach:**

☒ Soil probes may be used to confirm the presence of cultural deposits (e.g., midden; stratigraphy within cultural depressions). However, only mechanical augers or shovel testing can be used to demonstrate cultural deposits are not present to support site boundary definition. **Additional details regarding approach:**

[12] Including mechanical augers
[13] Cultural deposits must be kept within site boundary and permit area

☒ Mechanical augers may be employed. **Describe approach**: If a significant amount of fill or overburden is present or if cultural deposits are found to be at depths beyond shovel reach, mechanical augers may be employed at the discretion of the field director.

☐ Other methods will be followed. **Describe**:

Additional comments: :

3.4.1. Machine-Assisted Inspections

Would you like to include provision for mechanical excavation (i.e., backhoes)?

☐ No (delete rest of the text in this section and proceed to next section)

☒ Yes (see below).

Machine-assisted inspection will comply with appropriate WorkSafe BC Requirements.

Machine-assisted inspections will be directed by a qualified archaeologist (i.e., field director).

In the event ancestral remains are identified, methods are described in Section 6.

Select as appropriate:

☒ Toothed buckets may be used to remove obstructions (pavement, boulders, etc.) prior to reaching potentially culture-bearing sediments. **Additional details regarding approach:**

☐ Potentially culture-bearing sediments will be removed with a finishing bucket, in maximum cm vertical lifts, to allow the archaeologist to observe any exposed features or intact deposits and collect artifact provenience in the most precise manner possible. The horizontal extent of lifts will not exceed 3 m. **Additional details regarding approach:**

☐ The Field Director may use discretion to determine the amount of material to be processed; the report will include a summary of methods and the rationale behind in-field decisions. **Additional details regarding approach:**

☒ In the event intact archaeological deposits or features are identified, mechanical excavation will cease and excavation will proceed by hand or other methods in consultation with the Branch. **Additional details regarding approach:**

☐ When archaeological deposits are identified, of sediments will be excavated by hand. **Additional details regarding approach:**

☐ When greater than m^3 of archaeological deposits are identified, the Branch and First Nations will be contacted. Work may not proceed without Branch approval. **Rationale and additional details regarding approach:**

☐ Mechanically-displaced deposits will be inspected for cultural material (e.g., screening). **Describe methods:**

☐ Alternate methods. **Provide detail:**

☒ This section requires further discussion not outlined elsewhere in this section of the application. **Describe:** It is unlikely that machine-assisted investigation will be employed. In cases where major obstructions are encountered, machines may be employed to remove them at the discretion of the field director.

3.4.2. Winter Assessments

Will winter assessment be employed?

☒ No (delete rest of the text in this section and proceed to next subsection)

ADDITIONAL DISCUSSION

This application requires further discussion regarding archaeological methods not outlined in this template. **Describe:**

4. SITE RECORDING AND EVALUATION

Sites will be mapped using measuring tape, compass, GPS, total station, or similar. Archaeological features (e.g., cultural depressions) will be measured, mapped, and photographed. Sites and significant artifacts will be photographed in the field and detailed in a photo log.

Proposed site boundaries will comply with Branch policy[14] (observed, natural, etc.) Any variances will be discussed with Branch staff prior to the completion of fieldwork.

Select as Appropriate:

☒ When site extent is evaluated through subsurface testing, tests may be spaced 1-5 m apart on a grid, as appropriate. Additional testing may occur at the field director's discretion. Testing will continue until 15 m of negative tests are reached in each direction (e.g., cardinal or ordinal), unless other methods are approved. **Additional details regarding approach:**

☐ For larger sites, "back testing" may be applied. The specific methods will be described in the report. **Additional details regarding approach:**

☒ Where the site is comprised of one positive test, a minimum of four additional subsurface tests will be placed 1 m around the test. **Additional details regarding approach:**

☐ Other. **Describe:**

Additional comments:

[14] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/defining_archaeological_site_boundaries_protection_status.pdf

4.1. CMT SURVEY

Are CMTs anticipated?

☒ No. **Provide rationale:** `No trees pre-dating CE 1846 are located within the proposed study area.`

☐ Yes. Following Bulletin 27[15], CMT sites will be recorded and samples will be analysed in accordance with Branch standards[16]. Rationale and details regarding a sampling strategy[17] will be discussed in reports. The type and location of CMTs presumed to post-date AD 1846 will be recorded (i.e., a sample recorded to Level 1 standards).

Additional comments:

4.2. ROCK ART

If rock art is identified, it will be fully recorded (e.g., multiple overlapping photographs, sketches), whilst minimising damage, per Bulletin 26[18].

Additional comments:

4.3. WET SITES

Are wet sites anticipated?

☒ No. **Provide rationale:** `The proposed route is associated with a minor creek crossing, but is not close enough to the Pitt River to anticipate buried wet site deposits.`

☐ Yes. **Describe specific methods:**

Additional comments:

[15] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/bulletin_27_cmt_guidelines.pdf
[16] Defining Archaeological Site Boundaries; CMT Handbook
[17] I.e., Muir and Moon 2000
[18] https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/archaeology/guidance-policy-tools/bulletins

4.4. EVALUATIVE EXCAVATION

Describe under what circumstances evaluative units will be excavated: If intact and dense or particularly significant buried cultural deposits are identified, evaluative units may be dug at the discretion of the field director.

Select as appropriate:

☒ Evaluative units may be excavated in stratigraphic layers or arbitrary levels (5-10 cm). Features will be excavated by stratigraphic layer. Within thicker layers, 5-10 cm arbitrary levels will be excavated as appropriate.

☐ 3D provenience for features and artifacts found in situ will be recorded and cultural materials collected. For each unit, an illustrative representation to scale for two adjacent walls and floor plans will be prepared and labelled as appropriate. Photographs will be taken at the completion of each layer. Stratigraphy will be recorded.

☐ Other. **Describe:**

4.5. SITE FLAGGING

Will boundaries be flagged?

☐ No. **Provide rationale:**

☒ Yes. **Describe approach:** Site boundaries will be flagged using either flagging tape or spray-painted stakes, depending on the local environment and topography.

Additional comments:

4.6. ADDITIONAL DISCUSSION

This application requires further discussion regarding methods not outlined in this section. **Describe:**

5. COLLECTION AND ANALYSIS

Collection of materials from an archaeological site will be handled with sufficient care during excavation, recording, transport, cleaning, analysis and storage to ensure no additional damage or negative impacts occur to the collections during these processes per Bulletin 26.

The permit holder is responsible to ensure analysts are qualified. Analysts must be named in the report(s).

All collected materials from an archaeological context (e.g., artifacts, fauna) will be collected, analysed, reported, and curated with the designated repository/repositories.

Artifact collection and/or sampling strategies will consider First Nation comments where possible[19].

Artifacts and samples will only be sent out of the Province (even to other offices within the archaeological firm) following engagement with First Nations and approval from the Branch. The request to send artifacts out of the Province will include an artifact catalogue, photographs of tools and/or diagnostics, the reason for export, the destination and the length of time they will be out of Province.

All artifact assemblages will be analyzed with the intent of defining site function, activity areas and cultural chronology if possible[20]. All formed tools will be measured and illustrated or photographed, with technological attributes noted.

Faunal remains will be analysed to the most specific taxa possible by a trained individual with access to an appropriate comparative collection or reference materials. Faunal elements will be identified by taxa, element, and side if possible, and any relevant cultural modifications or natural taphonomic processes noted, with the aim of answering questions on site formation processes, subsistence strategies, environment, season of occupation, etc.

If materials are not collected, they will be recorded in detail and photographed in the field.

5.1. COLLECTION OF MATERIAL AND SAMPLING

With regards to collection of materials, select as appropriate:

☒ All materials from an archaeological context (e.g., artifacts, fauna) will be collected. **Additional details regarding approach:**

☐ For large lithic scatters (>100 artifacts), sampling may be employed in consultation with the Branch; diagnostic artifacts will be collected, as well as artifacts at risk from proposed development or unauthorized collection. **Rationale:**

☐ Formed or expedient tools, diagnostic artifacts, and artifacts which may provide opportunities for additional analysis (e.g., XRF; residue analysis) will be collected. At the request of First Nations, other artifacts may be left within the site, in a location unlikely to be harmed by unauthorised collection. Artifacts left in the field will be described, assigned basic analysis, and photographed. The location where artifacts are reburied will be recorded on maps and described in the report. Photographs will be of a sufficient quality to confirm an artifact's cultural origin. Photos must be date stamped. If the site consists of non-diagnostic debitage, a selection of artifacts should be photographed as evidence

[19] i.e., First Nations with overlapping territories may have different perspectives whether artifacts should be collected or left in situ
[20] E.g., Clark 2010; Mitchell 1971

of cultural modification prior to reburial. **Describe the reburial approach and rationale:**

☐ All artifacts removed from evaluative units will be collected. **Additional details regarding approach:**

Additional comments regarding collection of materials:

With regards to analysis of sampled material, select as appropriate:

☒ Micro debitage may be present. **Describe how it will be identified and assessed**: If micro debitage is suspected or observed, 1/8" screens may be employed at the discretion of the field director in order maximize the chances of retrieval.

☒ FAR (Fire Altered Rock) may be present. **Describe approach for collection and analysis**: FAR will be noted in the field notes and final report but will not be collected.

☐ Midden deposits are anticipated. **Describe how vertebrates and invertebrates will be sampled:**

☐ Other**. Describe:**

Additional comments regarding collection and analysis of sampled material:

With regards to additional sampling strategies, select as appropriate:

☒ If intact deposits are encountered, appropriate samples (e.g., radiocarbon, column, bulk samples) will be taken. The provenience of all samples will be recorded. Samples will be labeled appropriately. Description of methods and analysis will be provided in the report. **Additional details regarding approach:**

☒ Where wet sites are encountered, monolith and/or specialist samples may be taken and processed if the site cannot be avoided. **Additional details regarding approach:**

☒ Where wet screening is appropriate, all displaced deposits will be screened through an appropriate sized screen (e.g., 1/4” or smaller). Sediments will be placed in the screen and washed through using a hand-held hose with a variable control nozzle. Contextual information will be maintained to ensure that levels, layers, and features are separated within evaluative units or shovel tests and cultural material recovered in the screens will be bagged by level, layer, and unit/test. **Additional details regarding approach:**

☒ When column samples are taken, the volume from each stratigraphic component should be 1 L unless otherwise specified in the report. The samples will be dried and screened through nested geologic screens. The contents of the

screens will be sorted and weighed to the nearest 0.01 g. **Additional details regarding approach:**

☒ Samples will be processed by a qualified individual[21] before the report deliverables are due. Samples will be analysed in the lab using methods appropriate for geological, palaeobotanical, zooarchaeological, or micro debitage analysis, which will be described in the final report. **Additional details regarding approach:**

☒ When samples are not processed, they will be stabilized for long-term storage, and their lack of analysis rationalised in the associated report(s). **Additional details regarding approach:**

☐ Other**. Describe:**

Additional comments regarding additional sampling strategies:

5.2. ANALYSIS

Select as appropriate for analysis:

☒ Raw material sourcing analysis will be completed, where appropriate. **Additional details regarding approach:**

☒ The lab results from radiocarbon analysis will be appended to the report and site record(s) with calibrated and conventional/standard dates. Results will be submitted to the Canadian Archaeological Radiocarbon Database (CARD[22]). **Additional details regarding approach:**

☐ Other**. Describe:**

Additional comments regarding analysis:

5.3. SIGNIFICANCE AND IMPACTS

5.3.1. Significance Evaluation

Site significance will be evaluated following Section 3.5.2.2 and Appendix D of the Guidelines[23], and, where CMTs have been identified, the Significance and Management of CMTs[24].

Additional comments:

[21] Per Bulletin 26
[22] https://www.canadianarchaeology.ca/
[23] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/archaeological_impact_assessment_guidelines.pdf
[24] Eldridge 1997

5.3.2. Assessing Impacts

Assessing impacts to archaeological sites will follow Section 3.5.2.3 and Appendix F of the Guidelines.

Additional comments:

5.4. ADDITIONAL DISCUSSION

This application requires further discussion regarding archaeological methods not outlined in this template. **Describe:**

6. ANCESTRAL REMAINS AND BURIAL PLACES

When partial or complete ancestral remains, grave goods, and/or burial features (e.g., cairns and mounds) are identified in the field, all nearby ground disturbance will cease. Affected First Nations, the Branch, and other concerned parties will be immediately informed, and next steps will be determined.

Archaeologists will consult with First Nations prior to fieldwork to determine protocols in the event ancestral remains are anticipated.

Where human remains of suspected forensic interest are encountered, local law enforcement and/or the Coroners Service of BC will be notified.

Ancestral remains will not be subjected to destructive testing nor out-of-Province analysis without First Nation engagement and approval from the Branch.

Select as appropriate:

☒ This management plan is based on discussion with affected First Nations. **Additional comments**:

☒ Where burial features are believed to be present, the field director will describe the basis for their identification and cite the appropriate classification scheme(s)[25]. In addition to standard archaeological site recording, ancestral remains and burial features will be recorded to include, at minimum: horizontal and vertical extent, orientation and position, inventory of skeletal remains and grave inclusions, and integrity. **Additional comments:**

☒ Where possible, basic osteological data will be recorded (e.g., minimum number of individuals, sex, age, stature, and any evidence of trauma, disease and cultural modification). **Additional comments:**

☒ In consultation with all involved parties, efforts will be made to rebury the remains and associated grave goods following First Nations protocols, within the

[25] E.g., Mathews 2006

permit area, preferably within the archaeological site, in an area unlikely to be disturbed in the future. **Additional comments:**

☒ The reburial location is within or near the original archaeological site; it will be mapped and recorded on the site form under that Borden number. **Additional comments:**

☐ The proposed reburial location is not anticipated to be near the original archaeological site. **Describe:**

☐ If ancestral remains cannot be avoided in situ and consultation between First Nations, the Branch and other concerned parties determines that relocation or reburial is the most appropriate option, the remains will be respectfully recovered by an archaeologist with osteological expertise and placed in secure storage (i.e., the consultant's office unless otherwise specified below) with associated grave goods until ready for final disposition. **Additional comments:**

☐ Fragmentary or isolated ancestral remains identified during post-field analysis will be kept in secure storage pending final disposition. **Additional comments:**

☐ A location other than the consultant's office will be used as secure storage when ancestral remains are identified and cannot be immediately reinterred. **Specify:**

☐ Other. **Describe:**

Additional comments: If ancestral remains are encountered, all archaeological work will cease until stakeholder First Nations are consulted. All recovery, data collection, and reburial efforts will be guided by First Nation policy.

7. REPOSITORY AND CURATION

☐ The repository has been contacted and agrees to accept materials collected under the authority of this permit.

Table 4. Repository Information

Contact Name: **Dr. Genevieve Hill**	*Repository:* **Royal BC Museum**
Address: **675 Belleville St, Victoria, BC V8W 9W2**	
Phone: **250-356-7226**	*Email or Fax:* **reception@royalbcmuseum.bc.ca**

☐ More than one repository will be used. **Rationale and contact information:**

Materials to accompany the archaeological collection include:

- submission letter with box inventory;

- artifacts and digital catalogue;
    - catalogue numbers will be provided by the Province
    - The Province must be advised of the final catalogue number when cataloguing is complete
- field notes (original and/or digital copies, including maps and sketches);
- photographs and photo log (copies of prints, if any, and digital); and
- final permit report, with interims and specialised analyses appended (hardcopy and digital copy).

Cultural materials and supporting documentation must be transferred to the designated repository per their standards for packing and transport. The Branch must be provided confirmation that the repository has accepted artifacts, samples, and records prior to the expiration of the reporting period of this permit.

Additional comments:

8. PERMIT DELIVERABLES

Reports, maps, and site records will comply with Branch standards[26]. The permit report and site form(s) will identify the repository. Site information described in reports must precisely match the site records (e.g., boundaries, recovered materials).

Permit report citations in the References sections of reports will include the relevant HCA permit number. Reports will include a distribution list.

Permit deliverables include:

- Site records, including site forms, artifact catalogues, and other documentation;
- PDF[27] and hard copy of Final Report:
    - Interims (when applicable) will be appended to the electronic version – the hardcopy will not include interims;
    - Specialised analyses (e.g., radiocarbon dating) will be appended to the electronic and hardcopy versions of reports;
    - Summary of Notices of Intent (when applicable) will be appended to the electronic and hardcopy versions of reports
- Shapefiles (as polygons):
    - study areas;
    - negative subsurface test locations; and
    - areas of potential not subjected to subsurface testing.
- Confirmation of acceptance from the repository.

[26] E.g., Mapping and Shapefile Requirements; Bulletins 7 and 10
[27] Electronic versions of reports should be uploaded directly to APTS

8.1. SITE RECORDS

Site forms and all related documentation (e.g., maps, artifact catalogues) will comply with Branch requirements[28]. Site forms will be submitted within 6 weeks of the completion of site investigations.

Additional comments:

8.2. REPORTS

Management summaries and recommendations will clearly outline the proponent's responsibilities under the HCA. Interim Reports may be submitted under this permit.

Reports shall contain detailed descriptions of every part of each proposed development area assessed, in terms of the criteria used to evaluate archaeological potential. This includes all proposed development areas that are inspected in the field, as well as those development areas reviewed solely through map and document review if the permit would have authorized field inspection of those developments.

Reports will describe test locations in terms of size, stratigraphy, setting, and number of tests placed. The report will include an evaluation of research including an evaluation of the level of confidence that can be placed in the results of the assessment.

Reports will describe areas of low potential as assessed by an AOA model or desktop review. Rationales may include a summary of the model parameters, and supporting evidence (terrain maps, forest cover information, air photos, etc.).

Photographs of diagnostic artifacts, formed tools, and rock art will be included in the site record and permit report. Where sensitive information has been collected, the site record and report may be redacted prior to distribution via the Remote Access to Archaeological Data (RAAD) the Provincial Archaeological Report Library (PARL).

A summary description of each site recorded or revisited will be included in the report, including a synthesis of previous archaeological work relating to the site.

Additional comments:

8.3. SCHEDULE OF DELIVERABLES

Is the report due within two years of the anticipated permit issuance?

☒ Yes (delete rest of this section and proceed to the next section).

[28] E.g., Site Form Guide - https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/archaeology/forms-publications/archaeological_site_inventory_form_guide.pdf

Should the permit be amended to extend beyond two years, the permit holder is required to provide shapefiles and a summary report annually to the Branch.

9. APPLICANT

Applicant's current resume must be on file with the Archaeology Branch prior to review of this application.

Choose as appropriate:

☐ This is the applicant's first permit issued under the HCA.

The permit-holder will not be eligible to hold additional permits until the terms and conditions of this permit are met to the satisfaction of the Archaeology Branch.

The permit holder is expected to undertake the majority of fieldwork and reporting (including site records) in order to demonstrate their abilities under this permit.

For multi-assessment permits, no more than 15 developments can be assessed. This may be extended following acceptance of site forms and interim reports. The Branch will provide written authorisation to the permit holder.

☐ The applicant has successfully completed the following permits (n≤3):

The Branch may apply additional conditions to the permit based on the scope of the assessment and results of previous permitted work.

☒ The applicant has held and successfully completed more than three permits issued under the HCA.

Additional comments:

10. NOTICES[29]

10.1. COPYRIGHT

At the time of report production, the owner(s) of the report copyright will be asked to grant a non-exclusive license to the Province of British Columbia for the purpose of copying and distributing the report. The original copyright owner will retain copyright ownership. The granting of this license will facilitate access to the archaeological data contained within the report and will therefore contribute to the protection of heritage resources throughout the Province.

Copyright owners who refuse to grant a license to the Province may be restricted from accessing other licensed works on PARL and photocopying reports. Individuals working on behalf of a copyright owner who has refused to grant a license to the Province may

[29] Additional information available in Bulletin 3 - https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/archaeology/guidance-policy-tools/bulletins

also be restricted from accessing Branch records. Refusing to grant a license does not affect permit eligibility.

The Grant of License will be added to the first page of reports, and reads:

I _____ confirm that I am the copyright owner (or a copyright owner) of this permit report, and for good and valuable consideration I irrevocably grant a non-exclusive license to the Province of British Columbia, for a term equal to the life of the copyright commencing on the date of execution below, to make copies of the reports, including all appendices and photos, and to provide such copies to anyone, at the discretion of the Province, either at no charge or at the cost incurred by the Province in making and distributing the copies. All parties, except the party for whom the report was prepared, acknowledge that any use or interpretation of this report is at the sole risk and liability of the subsequent user(s).

Executed this ___ day of _____, 20XX, for Permit Number _____, by

_____ _____

Signature of Copyright Owner Affiliation

10.2. OTHER PERMITS

This application is for a permit, under the *Heritage Conservation Act* (HCA), to authorize the permit holder to carry out the inspections as described in the permit application. Please note that additional authorizations may be required to ensure compliance with all applicable laws.

11. REFERENCES

Andrefsky, W., Jr.
1998 Lithics: Macroscopic approaches to analysis. Cambridge University Press, Cambridge, UK.

Archaeology Branch
1998 British Columbia Archaeological Impact Assessment Guidelines. Electronic document, accessed April 8, '21.
1999 Found Human Remains. Electronic document, accessed April 8, '21.
2001 Culturally Modified Trees of British Columbia: A Handbook for the Identification and Recording of Culturally Modified Trees. Electronic document, accessed April 8, '21.
2017a Defining Archaeological Site Boundaries and Protection Status. Electronic document, accessed April 8, '21.
2017b Mapping and Shapefile Requirements. Electronic document, accessed April 8, '21.

2017c Information Bulletin Number 27: Cultural Modified Trees Guidelines. Electronic document, accessed April 8, '21.
2019a Information Bulletin Number 26: Treatment of Archaeological Materials. Electronic document, accessed April 8, '21.
2019b Multi-Assessment Permit Policy. Electronic document, accessed April 8, '21.

Clark, T.
2010 Rewriting Marpole: The Path to Cultural Complexity in the Gulf of Georgia. Unpublished Ph.D. dissertation, Department of Anthropology, University of Toronto, Toronto, ON.

Eldridge, M.
1997 The Significance and Management of Culturally Modified Trees. Final Report Prepared for Vancouver Forest Region and CMT Standards Steering Committee. Manuscript on file, Canadian Environmental Agency, Ottawa, ON. Electronic document, accessed April 8, '21..

Magne, M.P.R.
1983 Lithics and Livelihood: Stone Tool Technologies of Central and Southern Interior BC. Unpublished Ph.D. dissertation, Department of Anthropology, University of British Columbia, Vancouver, BC.

Mathews, D.
2006 Burial Cairn Taxonomy and the Mortuary Landscape of Rocky Point, British Columbia. Unpublished M.A. thesis, Department of Anthropology, University of Victoria, Victoria, BC.

Mitchell, D.
1971 Archaeology of the Gulf of Georgia, A Natural Region and its Cultural Types. Syesis Vol. 4, Supplement 1. British Columbia Provincial Museum, Victoria, BC.

Muir, R.J. and H. Moon
2000 Sampling Culturally Modified Tree Sites. British Columbia Ministry of Forests and Range, Aboriginal Affairs Branch. Electronic document, accessed April 8, '21.

12. CERTIFICATION AND CONSENT[30]

12.1. CLIENT CERTIFICATION

I certify that I have read and concur with the content of this permit application.

Client Certification.

Date:	*Client Name:*	*Client Affiliation:*	*Client Signature:*
April 13, 2021	Kevin Terness	ISL Engineering	

12.2. CONSENT TO THE USE OF PERSONAL INFORMATION

Permit applicants and their clients must consent to the use of personal information, as names, addresses, telephone numbers, and email addresses are included in permit applications, site inventory forms, and/or permit reports. The collection, management, and distribution of personal information is subject to the Freedom of Information and Protection of Privacy Act[31].

I consent to the Archaeology Branch's use of personal information contained in this application, as well as the personal information contained in the resulting site inventory form and permit report, for contact and verification purposes. I understand this information will be retained in the provincial archaeological site database and permit report. I also understand this information may be disclosed to researchers, consulting archaeologists and other users of the database and permit report. Database users must identify themselves and the purpose of their information request and are precluded from distribution of the information they obtain with unauthorised parties. The permit report will be available on the Provincial Archaeological Report Library (PARL) once it has been accepted as meeting permit terms and conditions.

Permit Applicant Consent to the Use of Personal Information

Date:	*Permit Applicant Name:*	*Signature:*
April 8, 2021	*Mike Rousseau*	

Client Consent to the Use of Personal Information

Date:	*Client Name:*	*Signature:*
April 13, 2021	Kevin Terness	

[30] Refer to Bulletin 3 for more information: https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/archaeology/guidance-policy-tools/bulletins
[31] http://www.bclaws.ca/Recon/document/ID/freeside/96165_00

12.3. CLIENT ENDORSEMENT

For applications where there are no recorded archaeological sites, or where assessment is not required by another agency or under a *Heritage Conservation Act* Ministerial Order:

I acknowledge I have not been ordered to conduct a heritage inspection under S.12 of the *Heritage Conservation Act* and that I have commissioned an archaeological impact assessment on my own accord to facilitate my proposal to undertake the developments described herein.

Client Endorsement

Name:	*Company:*
Address:	
Phone:	*Fax: or Email:*
Date:	*Client Signature:*

13. GENERAL TERMS AND CONDITIONS OF PERMIT

Additional conditions may be added to the permit, but at the time this template was created, here are the standard conditions applied to heritage Inspection permits issued under Section 12.2 of the *Heritage Conservation Act*, as administered by the Archaeology Branch:

1. Permits shall be valid for the term stipulated on the front of the permit unless otherwise suspended or cancelled. Extensions to the term of the permit, or other amendments, will be considered upon submission of an application to the Archaeology Branch at least 45 days prior to the expiry date of the permit.
2. The permit holder shall conduct the inspection as described in the permit application, unless otherwise specified in the permit .
3. A Heritage Inspection Permit issued under the Heritage Conservation Act does not authorize entry onto land or into a building without the permission of the owner or occupier.
4. Upon completion of any excavations, the permit holder shall make reasonable efforts to ensure all sites are restored as nearly as possible to their former condition.
5. The permit holder shall arrange for a secure repository to curate any materials recovered under authority of the permit. The permit holder shall conform to all requirements that may be imposed by the institution or organization named in the permit. Provisions with respect to the "Repository and Curation" section shall remain and continue in full force and effect in perpetuity, even if the permit is inactive or terminated.
6. Heritage objects and associated materials recovered under authority of the permit may not be sold or exchanged for financial gain. Any other transfer of heritage objects, materials and records, or changes to the conditions identified in the permit, may only be carried out with prior consent of the Minister.

7. The permit holder shall utilize any site recording forms, formats or systems required by the Minister. To fulfill this condition, the site form, mapping, and related documentation must comply with Archaeology Branch directives for site record submission. Failure to submit satisfactory site records or reports will be considered an outstanding obligation, thereby affecting the archaeologists' ability to hold additional permits.
8. The permit-holder shall provide the Archaeology Branch with one (1) bound copy if longer than ten (10) pages and one (1) electronic copy in PDF format of a written report, in accordance with the standards required by the Minister, outlining the work carried out under the terms of the permit. The title page of all reports must indicate the HCA permit number, and name(s) of the copyright owner(s) and, where agreed to, a Grant of License statement completed and signed by the copyright owner(s).
9. The permit holder shall submit spatial information in accordance with the standards required by the Minister of all study areas, areas of potential, and negative subsurface test locations that were the subject of in-field inspections.
10. The Branch may independently conduct quantitative analysis, using assumptions based on expected site type information (site area and artifact density) and test location information (tested area, individual test size, number of tests).
11. Where known, First Nation file numbers will be referenced in permit-related correspondence.
12. The permit holder shall provide affected First Nations with electronic copies of any site records and reports produced under the permit, unless the parties have agreed to alternate arrangements.
13. A person appointed by the Archaeology Branch may at any time inspect any aspect of a project conducted under the terms of this permit. To further their inspection, the appointee may request field data, or conduct excavations within the study area. Unless other arrangements are made, data must be made available to the Archaeology Branch within five (5) business days of their request. Notwithstanding the expiration or earlier termination of the term of the permit this provision will remain and continue in full force and effect.
14. Any other conditions that may be specified in the permit.

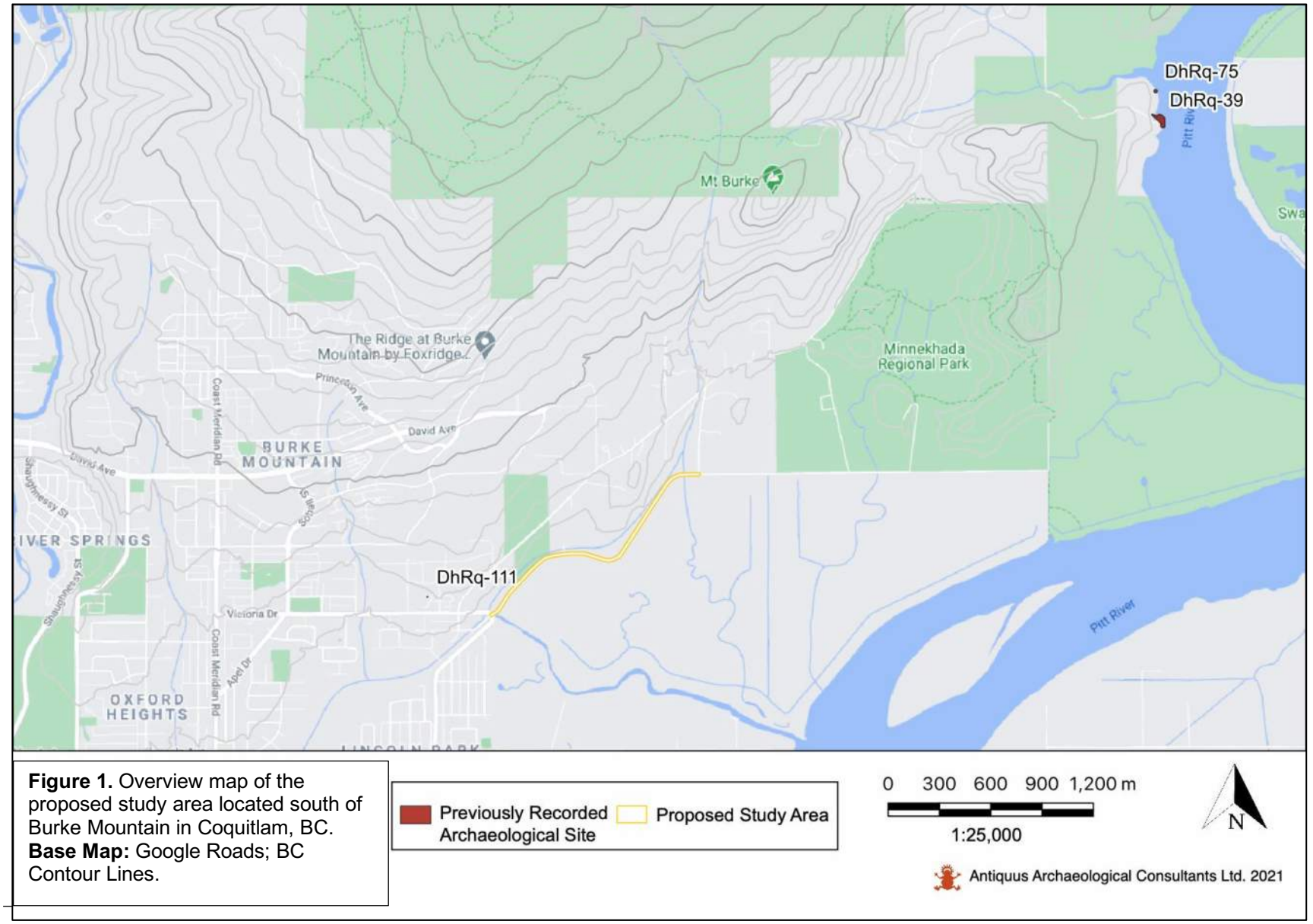


Figure 1. Overview map of the proposed study area located south of Burke Mountain in Coquitlam, BC. **Base Map:** Google Roads; BC Contour Lines.

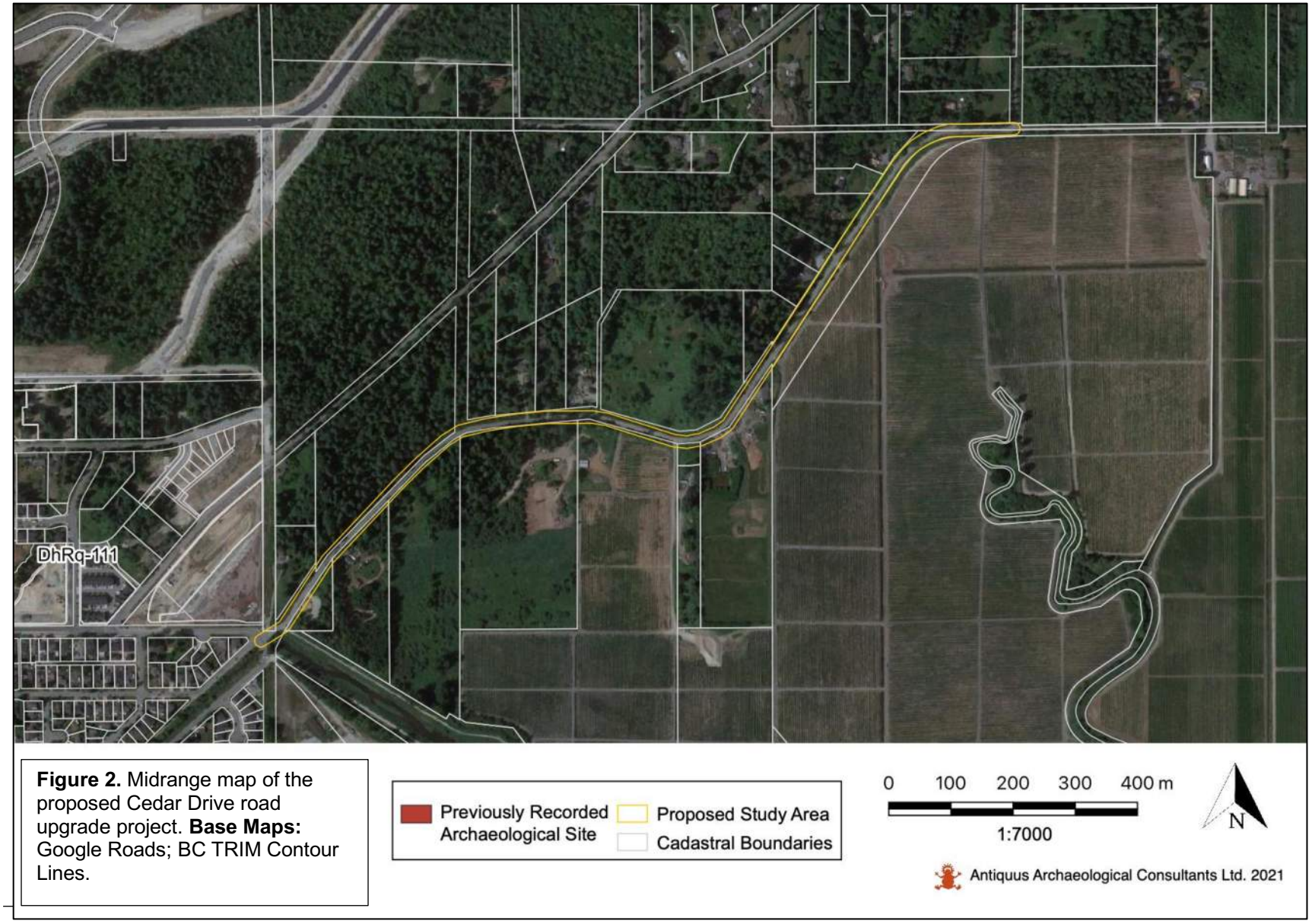
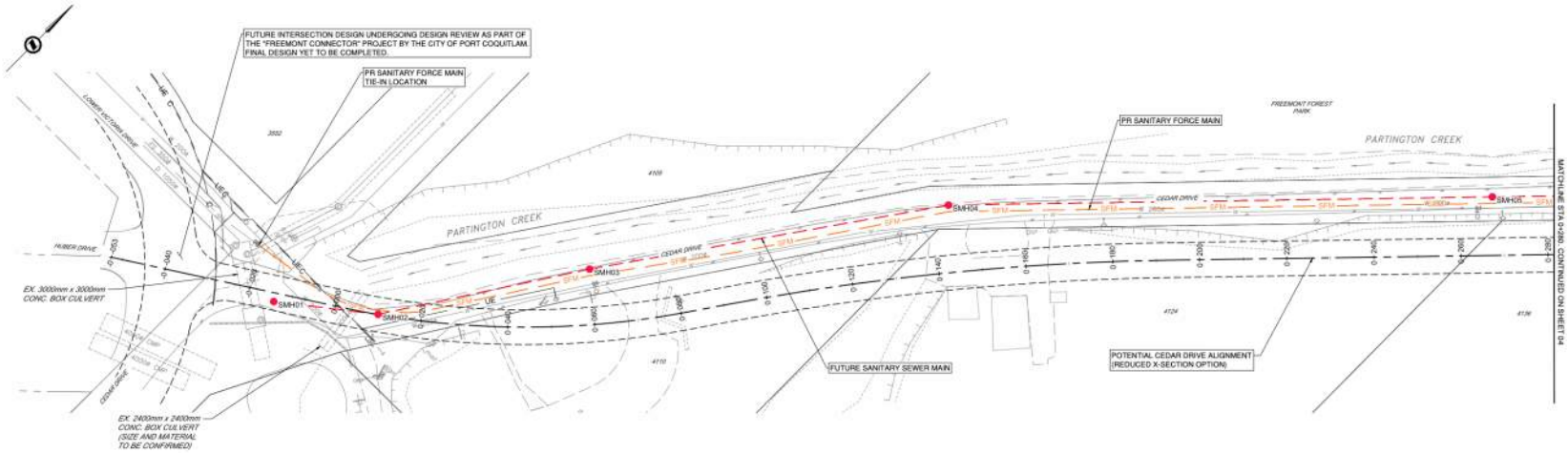
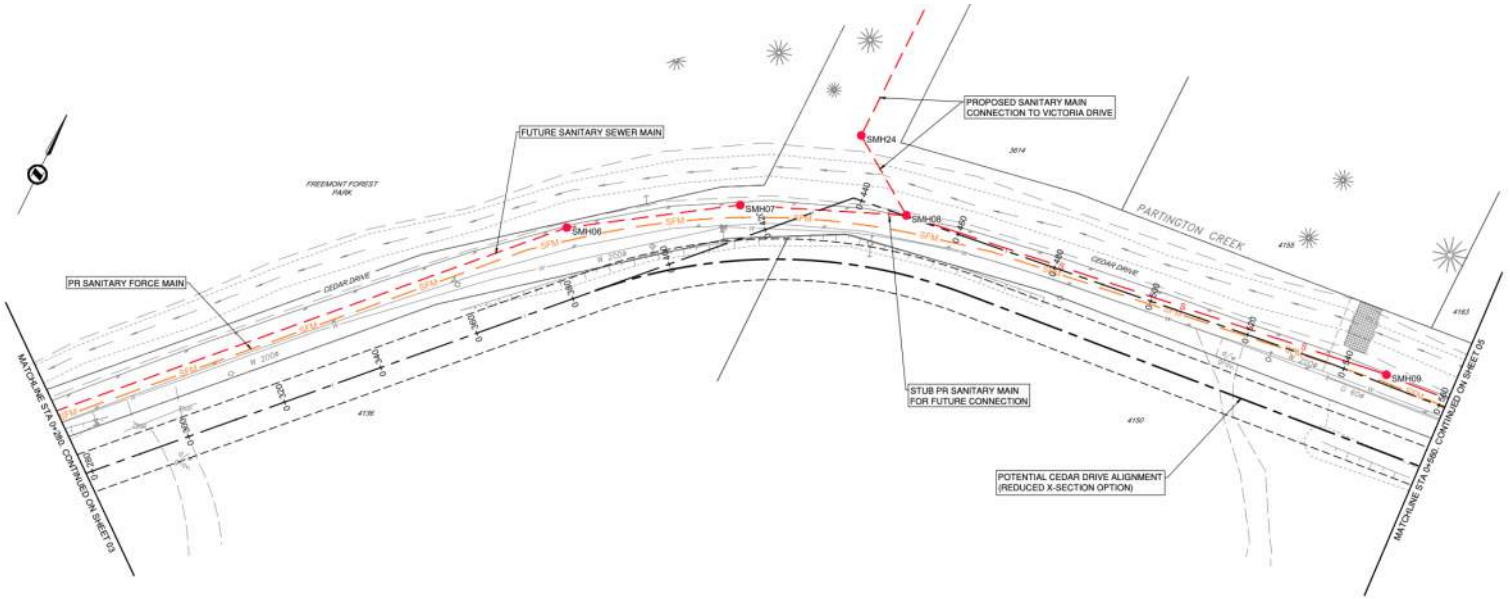
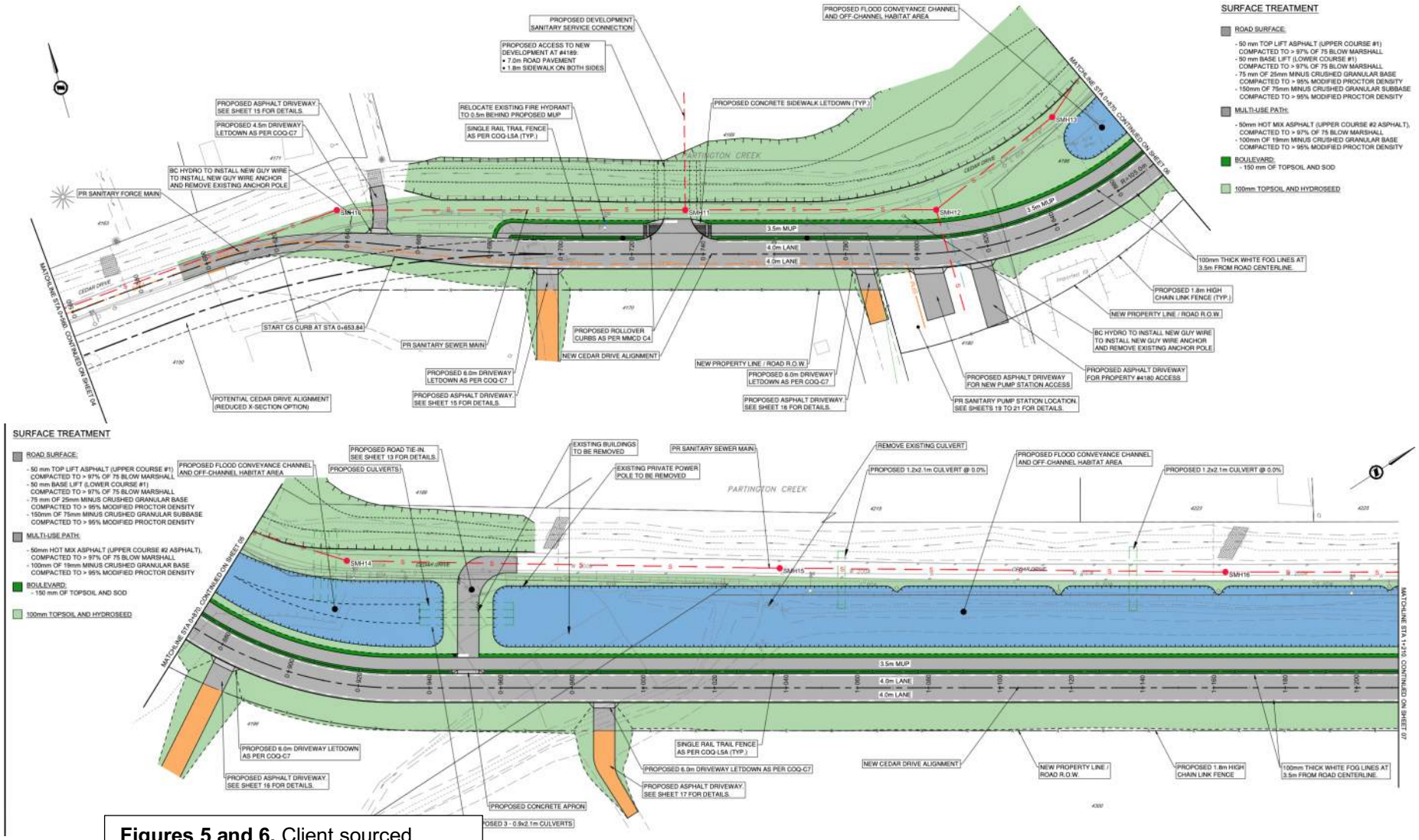


Figure 2. Midrange map of the proposed Cedar Drive road upgrade project. **Base Maps:** Google Roads; BC TRIM Contour Lines.

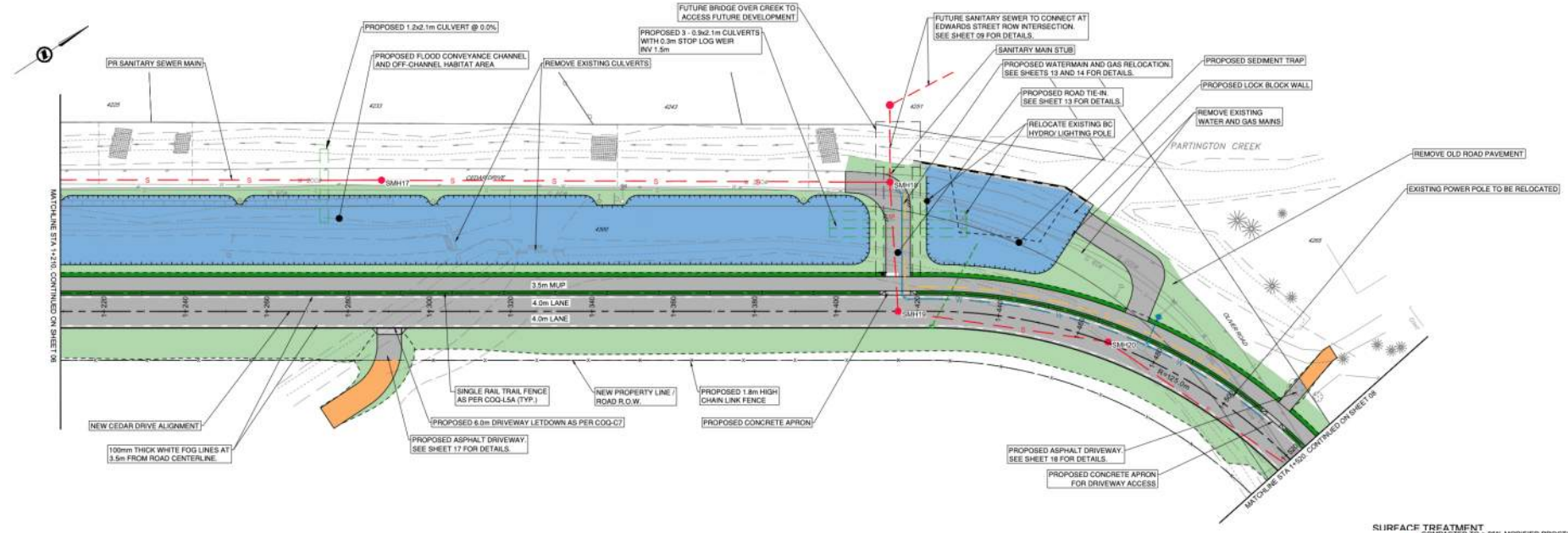


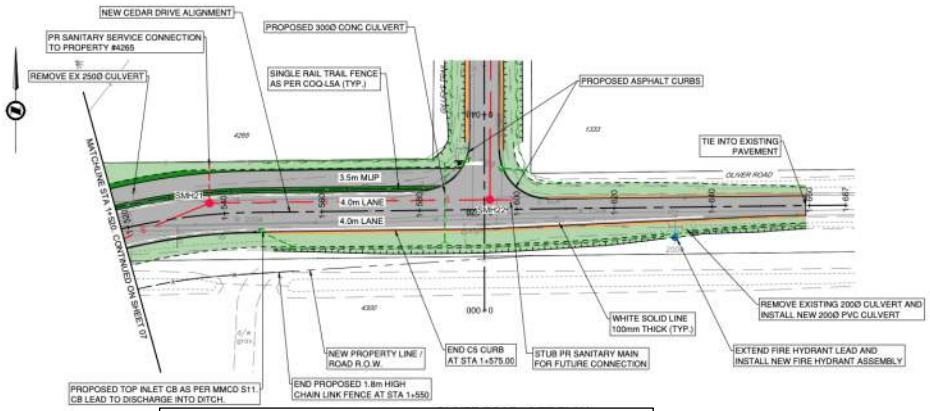
Figures 3 and 4. Client sourced development map for the southern aspect of the proposed road upgrades.

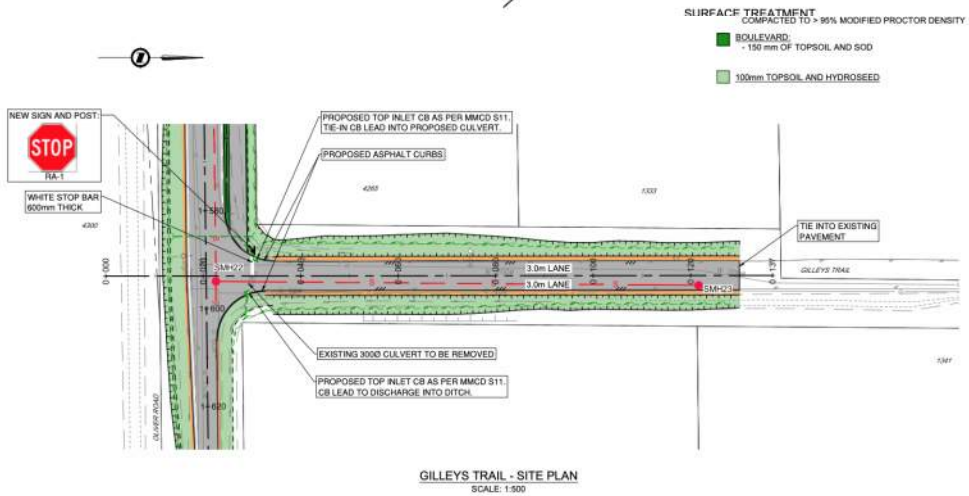

PROPOSED SANITARY MAIN CONNECTION TO VICTORIA DRIVE
FUTURE SANITARY SEWER MAIN
SMH24
SMH07
SMH08
SMH06
SMH09
PR SANITARY FORCE MAIN
STUB PR SANITARY MAIN FOR FUTURE CONNECTION
POTENTIAL CEDAR DRIVE ALIGNMENT (REDUCED X-SECTION OPTION)
PARTINGTON CREEK
CEDAR DRIVE
FREEMONT FOREST PARK
MATCHLINE STA 0+280 CONTINUED ON SHEET 03
MATCHLINE STA 0+560 CONTINUED ON SHEET 05



Figures 5 and 6. Client sourced development map for the central aspect of the proposed road upgrades.







GILLEYS TRAIL - SITE PLAN
SCALE: 1:500

Figures 7, 8, and 9. Client sourced development map for the northern aspect of the proposed road upgrades.

APPENDIX E
Katzie Archeological/Heritage Permit

Katzie Development Limited Partnership of the Katzie First Nation
10946 Katzie Road
Pitt Meadows, BC V3Y 2G6
604.460.8837

archaeology@kdlp.ca

Document implementation date: 2020-06-22

KATZIE DEVELOPMENT LIMITED PARTNERSHIP ARCHAEOLOGICAL/HERITAGE PERMIT[1]

To apply for a Katzie First Nation permit please submit this completed application to archaeology@kdlp.ca; KDLP is an authorized agent for Katzie First Nation. Please submit a cheque or money order to Katzie Development Limited Partnership.

*Fees are provided in Section 6 .**GST #789943123RT0001***

Date of Application	April 8th 2021
Principal Investigator & Company	Mike Rousseau-Antiquus Archaeological Consultants Ltd.
Contact Email	antiquus@shaw.ca
Phone No.	604-467- 3497

1. Project Information	
Project Name	Archaeological Impact Assessment(AIA) for the Impact Zone
Project Location (UTM)	519363.0,5459247.4
Legal Description	LOT 1,SECTION 8, TOWNSHIP 40, EAST OF THE COAST M
Proponent	Kevin Terness
Sector	☐ Residential Property Development
	☐ Commercial Property Development
	☐ Transportation
	☐ Oil and Gas
	☐ Forestry
	☐ Mining/ Mineral Exploration
	☐ Film
	☐ Parks and Recreation
	☐ Academic/Research
	☑ Other: Municipal development

2. Project Type[2, 3]	
Heritage *(please attach all supporting project documents to your application)*	☐ Archaeological Overview Assessment
	☑ Archaeological Impact Assessment
	☐ Archaeological Site Alteration
	☐ Historic Site Assessment (Post-1846)
	☐ Research
	☐ Historical data review (Title/aerial photographs, law, etc.)
	☐ Non-Permitted Archaeological Monitoring
	Is your study affiliated with a University/Academic Institution research program or project? ☐ Yes ☑ No If so, please attach your institution's ethics approval

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3. Project Description[5]

This permit is in support of proposed road upgrade project located near the Pitt River in eastern Coquitlam, BC. Kevin Turness, representing ISL Engineering, has proposed that Cedar Drive (between Victoria Drive to the south and Gilleys Trail to the north) be decommissioned and replaced with a new road directly to the east/south of the original route. The space between the original route and the new road will be occupied by a paved multi-use pathway (MUP) and a flood conveyance channel and off-channel habitat.

List all previously recorded archaeological sites within the proposed project (include those within 50 m of project boundary):

4. Project Dates and Deadlines

Work Start Date	Summer 2021
Work End Date	Fall 2021
Reporting Deadline	April 15th 2023
Designated Repository [6]	Royal BC Museum

5. Permits *(provide all permits acquired for this project)*[7]

Heritage Conservation Act Permits	TBA
Federal Permits	
Environmental Permits	
First Nation Permits	Sto:lo Nation Bands, Musqueam Indian Band

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6. Fees[8, 9]	
Small Project (under 1 km or 100 hectares)	$350
Large Project (above 1 km or 100 hectares)	$500
Expedited permit fee	$100
Permit extension[10]	$100
Junior Field Technical (one full day, 4 to 8 hours)	$650
Junior Field Technical (one half day, maximum of 4 hours)	$325
Mileage	$0.58/km
Late Notice Fee (3 business days notice is required)	$250

A full rate sheet is available upon request.

☑ Checking this box confirms that the Principal Investigator and all on site staff have reviewed, understood, and committed to following Katzie First Nation Protocols for Ancestral Remains, as outlined in the Katzie First Nation Ancestral Remains Policy and Procedures document. A copy of the Katzie First Nation Ancestral Remains Policy and Procedures document is available upon request.

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Terms & Conditions

1. The Katzie First Nation Heritage permit is for a single development, issued for the project based on the information provided by the applicant/proponent. Changes in project area, components, and methods will require an application to amend the permit.
2. The Principal Investigator will make a concerted effort to hire Katzie First Nation Field Technicians/community members to participate in this project. Katzie First Nation requires a minimum of three (3) days' notice to schedule Field Technicians, and a completed Subcontractor agreement.
3. Should Ancestral Remains be identified during fieldwork, Katzie First Nation must be notified immediately (604-460-8837). It is the responsibility of the Principal Investigator to arrange for a Senior Field Technician to be on site should Ancestral Remains be encountered or if the likelihood of encountering Ancestral Remains is high (e.g., shell midden sites). Fees for a Senior Field Technical will be levied according to Katzie First Nation charge-out rates. In accordance with the Ancestral Remains policy, all work onsite is to be stopped by 3:00pm or 1500 hours each day.
4. Draft copies of the reports generated from this project, as required by the relevant regulatory government bodies, will be provided to Katzie First Nation and will be subject to comments, which will be provided to the Principal Investigator within 30 days of receipt, for discussion.
5. Academic researchers from recognized educational institutions are required to gain institutional permission to conduct research on human participants (aka Ethics Approval). A copy of this document must be provided prior to scheduling interviews. Any information or data collected from Katzie First Nation community members must be approved prior to publication. This permit does not grant individual approvals or represent individual consent.
6. Project information must contain a coherent written description of the proposed project, should describe overlapping archaeological or cultural sites, site components and dimensions (including depth), proposed research and field methods, and a rationale for the project. Attachments including shapefiles or maps are appreciated.
7. The designated repository must match the one listed in the *HCA* permit.
8. Acquiring a Katzie permit administered by KDLP does not constitute aboriginal consultation nor does it represent consent.
9. A Katzie First Nation permit must be in place prior to requesting Field technicians and prior to the start of fieldwork.

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10. Payments can be sent using cheque or money order, payable to Katzie Development Limited Partnership. Receipts will be provided upon request. Send requests to archaeology@kdlp.ca.

11. Application for a permit extension must be submitted prior to the permit expiry date. If the permit has expired, a new application for permit must be submitted with the appropriate fee.

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Sign off and Acceptance of the Katzie Development Limited Partnership Archaeology/Heritage Permit Terms and Conditions

Signatories must have the authority to bind the corporation.

TERMS AND CONDITIONS SIGN-OFF	
Proponent  Name, title **Print name:** Kevin Terness **Date:** April 13, 2021	**KDLP** _____ Name, title **Print name** **Date:**

Principal Investigator/Subcontractor  Name, title **Print Name:** Mike Rousseau **Date:** 08/04/2021	**KDLP** _____ Name, title **Print Name:** **Date:**

FOR KDLP STAFF ONLY - PERMIT ISSUANCE	
Date of issuance	
Issued by	
Permit No.	
Permit Expiry Date	
Signature	
Notes	

Please contact Katzie Development Limited Partnership at mleon@kdlp.ca to schedule a Field Technician upon submission of this permit application.

APPENDIX F
KWL IWMP Stakeholder Engagement

Appendix E

Summary of Stakeholder and Public Input

KERR WOOD LEIDAL
associates limited
CONSULTING ENGINEERS

CONTENTS

SUMMARY OF COMMENTS RECEIVED FOR IWMP ALTERNATIVES

TABLES

MINUTES OF MEETINGS

SUMMARY OF COMMENTS RECEIVED FOR IWMP ALTERNATIVES

The IWMP alternatives were presented to City Staff, the IWMP Advisory Committee on March 6, 2007 and the public on March 14, 2007. Tables 1 and 2 summarize comments received from the public and Advisory Committee members respectively. Table 3 summarizes the results and shows the prominent preferences.

Table 3: Summary of Advisory Committee and Public Input Results

	Issues	Support For	Against
Vol Reduction	Baseflow augmentation ponds		
	Infiltrating source controls	DFO, Clara Brolese, Elaine Golds, David Mounteney, 1, 1 ,1	
	Full source controls including reuse	DFO, Clara Brolese, Elaine Golds, Jim McNeil, David Mounteney, 1, 1	
Detention	**Diversion**	Clara Brolese, Mike Bristol, Elaine Golds, David Mounteney, 1, 1	Ron Nordstrand
	Surface Ponds	Mike Bristol, Elaine Golds, David Mounteney, 1	Ron Nordstrand, 1
	Underground Ponds	Mike Bristol, Elaine Golds, Jim McNeil, 1	
Sedimentation /Flooding	Sediment removal	Mike Bristol, Clara Brolese, 1,1	
	Sediment trap	Mike Bristol	DFO
	Sand trap	DFO, Mike Bristol, Ron Nordstrand	
	Widen channel & floodplain/Relocate Cedar	DFO, Mike Bristol, Elaine Golds, Jim McNeil, David Mounteney, 1, 1	1
	Raise Cedar Drive	Jim McNeil, 1	
	Want lowland options investigated Diversion/Enhancements to Irvine Creek	DFO, Mike Bristol, Ron Nordstrand, Elaine Golds	
	City to take over dike/ps	Mike Bristol	
Riparian	RAR	1	
	Increase setback for most streams		
	Increase setback for all streams	DFO, Elaine Golds, Jim McNeil, David Mounteney, 1, 1,	
Upslope Forest	**Maximize forest areas**	DFO, Clara Brolese, Elaine Golds, Jim McNeil, David Mounteney, 1, 1	
Bold text indicates prominent preference for each category			

The Advisory Committee meeting minutes are attached.

Table 1: IWMP Alternatives Comments from Public Open House, March 14, 2007

Commenter	Stormwater Engineering	Environment	Land Use
Anne Holt		▪ Riparian and wildlife protection are of prime importance and should be widest allotment. ▪ Alternative C. ▪ Preserve natural beauty.	
D. McClain	**Volume Reduction**: Alternative B – infiltrating source controls **Detention/Diversion**: diversion **Sediment Management**: Alternative C – relocate Cedar Drive.	**Riparian:** Alternative C **Upland Habitat**: Alternative C Retention of Habitat is a priority.	▪ Land Use Concept 3.
Maureen Forster	▪ Concern re: flooding on Cedar Drive.		
Lynne Cox			▪ Create what is known is needed.
Ledlin	▪ Runoff is a huge issue; bioswales don't address this; your data doesn't reflect the amount of water experienced.		
Marita Sommerville	▪ Support holding back water in ponds, etc. to release gradually. Don't allow ponds to become mosquito-infested/West Nile Virus. ▪ Sediment build-up needs to be removed. ▪ Relocate Cedar Drive slightly to enable overflow areas for the creek.	▪ Beneficial to extend boundaries of riparian areas for wildlife protection and prevents conflict with humans.	
Ken Safarik			▪ Would like the PCIWMP and PCNP boundaries be extended to include areas to the east and north.
Al Smith	▪ Source controls are the most desirable, but implementation impossible to ensure. ▪ Surface ponds are a poor use of land and source of mosquitoes. Diversion is the most practical and eliminates the need for ponds. ▪ Raising Cedar Road is the most practical. Safe overtopping will result in roadbed erosion as is now occurring. Relocating road is totally impractical as access to properties at the eastern end would be impossible to access due to steep terrain. ▪ Prefer yearly sediment removal. High sediment levels give salmon no room to travel, road was flooded, eroded and salmon carcasses carried in large numbers into the blueberry fields. This damage could have been avoided with annual maintenance. ▪ Alternative B is most practical option for all concerns.	▪ RAR Alternative A because creek is border by road and residences.	

Table 2: Alternatives Comments from IWMP Advisory Committee

Commenter	Stormwater Engineering	Environment	Land Use
Murray Manson **DFO**	**Volume Capture**: Support onsite infiltrating source controls to greatest extent possible Alternative B and C emphasizing groundwater recharge and baseflow protection. **Diversion/Detention**: Minimize need for diversion is preferable (Alt C) re: concern of baseflow compromise except if flow could be used to improve habitat in Irvine Creek. **Sediment Management**: Combine high elevation bar scalping with widening channel & floodplain improvements. Do not support sediment trap in spawning area at Oliver/Cedar, sand trap is of less concern, but prefer increased floodplain area & habitat value option. **Cedar Drive Relocation**: is the highest priority for DFO to increase floodplain area. If feasibility of relocation is limited, prefer combination of high flow diversion to Irvine, with partial road relocation, intermittent scalping. **Irvine Creek**: Interested in reconnecting Irvine and Partington to restore historic channel. If not possible, high flow diversion from Partington. Tie Irvine Creek directly to Deboville Slough or improve flood gates and PS at MacLean Creek to improve fish access.	Expansion of riparian setbacks and conservation of forests are favoured.	
Clara Brolese	Prefer diversions for western and mid areas instead of ponds. LID is a given in Hyde and Smiling Creek developments and more innovation and new ideas for on-site infiltration are sure to come. Need compromise and agreement with City and DFO to deal with sediment removal immediately and establish regular sediment control.	Proposed creation of significant green space in Fox Creek and its tributaries would go a long way in establishing a conservation area.	Don't like the Works Yard in this Fox Creek area location. Private land owners are not happy about wider setbacks, unless the City purchases them with park acquisition funds.
Mike Bristol MOE Coquitlam Diking District	**Detention/Diversion**: Alternative B or C. **Sediment Management/Flood Control**: Alternative B or C. Coquitlam to consider taking over Diking District with its pump house and dike maintenance and tax base. Recommend serious look at costing of alternatives affecting pumphouse and dike – engineering & construction costs may be substantial. Raising Cedar Drive as a dike would make it a provincially regulated structure under Dike Maintenance Act – would provide needed flood protection to lowland owners now being flooded.		
Ron Nordstrand Pitt River Boat Club	Prefer sand trap at outlet to reduce sand loading to Slough. **Volume Reduction**: Ponds, settlement or otherwise appear to be poor option. **Detention/Diversion**: Increased flows will move existing slough sediments downstream toward Boat Club. We hope to achieve substantial reduction in sediment loading to the slough. We have doubts particularly with finer sediment particles. Boat Club very concerned about slough sedimentation and cost associated with removal of silt deposits. Development will result in more silt entry and increased frequency of dredging $200K/occurrence. In favour of any measures to intercept before the Slough and flow control measures to reduce water volumes and increased velocities that move upper slough sediments to lower slough. Partington currently overtops Cedar Drive into agricultural area – essentially acting as a partial diversion. Partial diversion appears to be practical. Further investigate diversion to Irvine Creek to reduce slough sediments, reduced maintenance along Cedar Drive, and restoration of additional fish habitat in Irvine Creek and creek that drains Minnekhada Park lake. Investigate fish friendly flood gates to Pitt River and increase capacity of PS.	Riparian/Forest: No comment. Tributary T5F classified as permanent flow, fish bearing has consistently dried up with no flow for approximately one summer month every year for the past 30 years.	Opposed to Option 3 – placement of Work Yard close to my property. Opposed to designating general area as park. This area is within easy walking distance to Minnekhada Park and Pinecone Burke Provincial Park.
Elaine Golds Burke Mtn Naturalists	Very important to realign Partington Creek to minimize future problems – last opportunity to undo mistakes of the past. We must think long term. With global warming, SWM essential to manage large storms. **Volume Reduction**: Alternative B – infiltrating source controls, with some reuse and new technology – focus on groundwater recharge to promote healthy trees/riparian forests/ecosystem. If groundwater not recharge, could impact DeBoville. If ponds required, use wetlands with salamanders for mosquito control. **Detention/Diversion**: Alternative B & C. **Sediment Management**: Alternative'C –relocate road.	Wider stream setbacks more costly upfront but worth it over long term – a healthier ecosystem, windfirm trees and more attractive community, more productive streams. **Riparian**: Alternative C – more stable windfirm riparian forests healthier ecosystem, more appealing green community. **Upland Habitat**: Alternative C – stable forests to wind.	
Jim McNeil	**Volume Reduction**: Alternative C – full source controls on each lot with some regional facilities. Capture, rather than pump, water backup. **Detention/Diversion**: Alternative C – onsite underground detention. **Sediment Management**: Alternative C – relocate eastern edge of Cedar Drive. Raise Cedar Drive with no overtopping.	**Riparian**: Alternative C – more windfirm. Connect riparian areas to Burke/Pinecone for pedestrian and wildlife movement. Border riparian areas with park and add trails. Add game trails opposite pedestrian trails. **Upland Habitat**: Alternative C – connect linear parks so that game trails can be continuous.	
David Mounteney Friends of Deboville Slough	**Volume Reduction**: Combination of Alternative B & C is best – infiltrating and full source controls. Reuse grey water and ensure some recharge. Need water quality and retention. Source controls & reuse very important. **Detention/Diversion**: Alternative B – Diversion for West Area and surface ponds. Very concerned about summer waterflow & diverting to Slough. **Sediment Management**: Alternative C – Create floodplain by relocating and raising Cedar Drive. Flooding: don't think models adequately address climate change & possibility of more extreme flows – see photos. Onsite retention ponds should address both augmenting flows & water quality.	**Riparian**: Alternative C – improved wind firmness & community amenity. **Upland Habitat**: Alternative C – improved wind firmness & community amenity. Need as much green space as possible to offset high-density development. These are needed to increase total pervious area & to locate ponds. Wider setbacks improve riparian function. We only have one chance at this, we must not go cheap if it will have major impacts on the livability of the region in future years.	
Ted Wingrove			Concept 3.

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Meeting Record

MEETING DATE:	September 21, 2005, 6:30 p.m. – 8:30 p.m.
LOCATION:	City Hall's Council Committee Room
ATTENDEES:	Elaine Golds, Burke Mountain Naturalists Duane Redder, Pitt River Boat Club David Mounteney, Friends of Deboville Slough Clara Brolese, North East Coquitlam Ratepayers Association Ted Wingrove, Darin McClain, Hyde Creek Watershed Society Mike Bristol, Coquitlam Diking District (MOE) Heather Wornell, Ron Wood, Regional Parks Central Area, GVRD Steve Zuliani, Zuliani & Company Consultants Limited Randy Chang, Engineering, CoC Dana Soong, Engineering, CoC Pat Bell, Planning CoC Caresse Selk, Parks, CoC Sarah Dal Santo, Environment, CoC Chris Johnston, KWL Crystal Campbell, KWL Nick Page, Raincoast Applied Ecology David Reid, Lanarc Rob Dickin, Gartner Lee
REGRETS:	Fisheries and Oceans Canada Ministry of Environment
RE:	**PARTINGTON CREEK IWMP** **Advisory Committee Meeting #1 – September 21, 2005** **Our File 456.038**

Crystal Campbell introduced the study team and provided an outline of the study process and an introduction to Integrated Watershed Management Planning. Crystal Campbell, Nick Page and Rob Dickin summarized the key findings to date for Partington Creek drainage, environmental values, and hydrogeological issues. Information data collection and inventory work is still underway. Comments were solicited from the group and key issues are summarized as follows.

Advisory Committee Comments/Discussion	Action
Darin McClain, Hyde Creek Watershed Society ▪ Flow monitoring for several months is not representative of overall creek flows; flows vary dramatically from year to year. Chris Johnston: Model will be calibrated with data and will be used to predict additional flows. Randy Chang: Flow monitoring will continue on Hyde and Partington Creeks until after development. ▪ Will debris flows/landslides be investigated? Chris Johnston: It's not included in IWMP, however KWL is assessing the relative risk during fieldwork. Nick Page: Signs of log jams downstream of Hydro corridor were noted. ▪ Volunteers available to help with groundwork. ▪ 90% capture target is too ambitious/not realistic because it's a natural watershed. Has there been modeling done of untouched watersheds to replicate the retention that occurs? Concerned that other plans are based on too much theory and not enough hard evidence. Chris Johnston: Modelling can adequately predict watershed response under different scenarios for different rainfall events.	
Elaine Golds, Burke Mountain Naturalists ▪ Will spawning surveys be done? Nick Page: Abundance and distribution of chum spawning in the lower watershed will be measured at the end of the spawning season (December?); but not spawning coho because they are difficult to find and their spawning season is more spread out. ▪ Flow monitoring is looking at surface flows, what about subsurface flows? Chris Johnston: Base flow, a result of higher elevation subsurface flow, is noted in flow monitoring by looking at climbing and receding tails of runoff events and base flow in between events. Hydrogeology assessment also looked at subsurface flow characteristics. ▪ Concerned that modeling is very theoretical. Don't relate well to terms like 6-month event – use __ mm in 24 hours. ▪ What rain gauge are we using? Chris Johnston: We can also use Doplar radar as well to look at the extent of rainfall areas. ▪ What Pacific Water Shrew surveys will be conducted? Nick Page: Trapping surveys are not part of the IWMP. Elaine noted that that was a shame because the sooner the better and would like to see it done and considered in the development of the plan. Dana Soong and Sarah Dal Santo: More detailed environmental work will be conducted during the neighbourhood planning process (starting shortly). Shrew work planned to be done in high probability areas. Darin McClain: Important that nothing is minimized at this stage so we know what we're dealing with. Duane Redder: What is driving the urgency for doing this work now? Chris Johnston: A plan is needed to shown how this inventory work fits together between the IWMP and Neighbourhood Plan. ▪ Lower reach of Partington is not natural/original watercourse, but a channelized diversion. Original path was southward (now called Irving Creek). Partington will worsen with development. Look at land acquisition at bottom to restore Partington to its original course. This will help to address flooding.	KWL KWL CoC
Ron Wood, Regional Parks Central Area, GVRD ▪ Flooding in lowlands. The area can be 5' underwater; 50+ horses at risk. Cedar Drive was flooded for 1½ week. Creek channel infilling is creating more of a problem. Increased flows are a real concern. ▪ 16 properties maintain dikes – it's a burden.	
Ted Wingrove, Hyde Creek Watershed Society ▪ Need more up to date air photo. CoC has 2003. ▪ There is a tidal influence present. ▪ Oliver Grove/Cedar Road area floods. Flooding issues need to be addressed first before development.	KWL
Mike Bristol, Coquitlam Diking District ▪ SE area is area of concern re: diking.	

Advisory Committee Comments/Discussion	Action
Caresse Selk, Parks, CoC ▪ Where has Japanese Knotweed spread? Nick Page: Along Tributary 7 and the downstream reach of mainstem.	
Dana Soong, Engineering, CoC ▪ Sedimentation issue in lower reaches and limited removal because of DFO restrictions. Apparently people could ride horses under bridges, now there is 2' clearance. Concerned re: maintenance activities of watercourses. ▪ Deboville Slough dyke not adequate.	
Steve Zuliani, Zuliani & Company Consultants Limited ▪ NECAP has indicated this area for land use change including a Village Core. Need to balance human needs, environmental needs and engineering needs.	
Clara Brolese, North East Coquitlam Ratepayers Association ▪ Detention ponds are detested, hopefully plan will look at other alternatives such as Vortechnics and underground facilities. Surface ponds are unsightly. Photos look good, but in reality they don't. Perception of landowners that they're losing area without compensation. Darin McClain: People are losing their fear of West Nile, realizing that the Lower Mainland is surrounded by water. ▪ Flooding at Crouch/Pollard. Local people can tell the history.	
Pat Bell, Planning, CoC ▪ The City is initiating the Partington Creek Village Neighbourhood Planning process. This process will work in coordination with the IWMP.	
Duane Redder, Pitt River Boat Club ▪ Infilling of Deboville Slough. Marina has been there for 50years (need deep water to function) and have records of infilling. Frequency of dredging is increasing. DFO involved. ▪ Concern about increased flows and that Hyde diversion will have negative impact on Slough; who will compensate? Would like Slough brought back to natural water levels. Ron Nordstom has monitored historical water levels. ▪ Water quality impacts – development will increase sedimentation. Who will compensate? Garbage in Slough getting worse; Club cleans it up. With more people, it will worsen. ▪ Wayland biologist undertaking an independent impact study of the Slough.	
Dave Mounteney, Friends of Deboville Slough ▪ Would like to see the riparian area protected. Don't allow stormwater to be discharged to it or parks to use it. Adjacent to riparian areas, use low impact development only and/or passive parks, not high-density areas. ▪ More development means more people! More impact.	
Randy Chang, Engineering, CoC ▪ City will be doing some water quality sampling.	CoC

Prepared by:

Crystal Campbell, P.Eng.
Project Manager

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Meeting Record

MEETING DATE:	June 27, 2006, 6:00 p.m. – 8:30 p.m.
LOCATION:	Coquitlam Innovation Centre Burke Mountain Boardroom
ATTENDEES:	Elaine Golds, Burke Mountain Naturalists Duane Redder & Janie Hiebert, Pitt River Boat Club David Mounteney, Friends of Deboville Slough Clara Brolese, North East Coquitlam Ratepayers Association Ted Wingrove & Darin McClain, Hyde Creek Watershed Society Mike Bristol, Flood Hazard Management MOE Corino Salomi, Brad Fanos, & Mike Engelsjord, DFO Randy Chang, Engineering, CoC Dana Soong, Engineering, CoC Andrew Young, Planning CoC Dave Palidwor, Park Planning, CoC Sarah Dal Santo, Environment, CoC Crystal Campbell & David Zabil, KWL Nick Page, Raincoast Applied Ecology David Reid & Don Crockett, Lanarc
REGRETS:	Regional Parks Central Area, GVRD Zuliani & Company Consultants Limited City of Port Coquitlam
RE:	**PARTINGTON CREEK IWMP** **Advisory Committee Meeting #2 – June 27, 2006** **Our File 456.038**

The study team updated the Advisory Committee on progress to date since the last meeting. Nick Page summarized the findings of the environmental inventory and David Reid summarized the development plans and potential low impact development (LID) techniques. Comments were solicited from the group and key issues are summarized as follows.

Advisory Committee Comments - Discussion on Environmental Issues	Action
Darin McClain, Hyde Creek Watershed Society	
▪ Regarding the B-IBI assessment, asked if this was the first one and if it will continue into the future on a regular basis once the watershed starts developing. Nick replied that future sampling and assessment will be recommended and that the GVRD is currently determining a suitable frequency of resampling. Dana will see what is required to continue these assessments and report back. Nick added that forest cover can also be monitored to show changes over time.	NP DS
▪ Regarding the land cover figure, asked if blue coloured area was water bodies. No, it is low shrub cover with sporadic trees. Colour will be changed on the figure.	KWL
▪ Regarding the high chum densities reported, asked what Coho densities are in Partington given the Chum increases in both Partington and Hyde. Nick said he saw one Coho carcass during his site investigations but it is harder to inventory Coho because of the timing/duration of the spawning run and the area they utilize (would need more resources). Darin asked if it would be useful for environmental groups to do Coho and Cutthroat counts in cooperation with DFO as these are more sensitive to habitat changes and more of a concern. Nick said that Coho counts fluctuate due to factors other than watershed health. Duane added that Coho have been observed in the Calgary Drive ditch in 1970s. Nick to look at escapement.	NP
Elaine Golds, Burke Mountain Naturalists	
▪ Regarding the barriers to fish, asked if there was good fish habitat upstream of barriers. Nick advised that there is on Fox Creek and removal of these barriers could be part of the compensation/restoration plan.	NP
▪ Regarding the uniquely high chum densities in lower Partington, asked how the fish counts compared to those in Hyde Creek. Nick had not performed the comparison. Dave Palidwor thought Hyde Creek had about 1200 but did not know if this was total salmonid count or just Chum compared to the 2100 Chum in Partington Creek as reported by Nick.	
▪ Informed the committee that the forest in the upper watershed is stunted yellow cedar. There is a report by the Pinecone Burke study team on the age of the forest.	
▪ Regarding the lower Partington Creek alignment, suggested the old alignment be obtained from the City (Mike Griffon) and added to the figures. The creek was likely diverted when the dykes were built (pre-dates air photos) and the farmers have not made riparian buffers. Suspects that groundwater from Partington flows subsurface to Irving Creek and that is why there is water in the lowland channels, not just backwater from the Pitt River. Duane speculated that the original alignment would have changed its course through the agricultural area due to beaver dams. David Mounteney added that one of the original channels is buried but still shows up on the mapping. Nick said that he has not visited Irving Creek as this is outside of the scope of this study. KWL to add the original alignment to the figures.	KWL
▪ Asked if the Rubber Boa is present in the watershed. Nick will look into it.	NP
Ted Wingrove, Hyde Creek Watershed Society	
▪ Regarding the dam (fish barrier) on Fox Creek, asked if a concrete fish ladder would be a better solution than removing the dam. Nick replied that this could be an option but would require more maintenance. Andrew asked if the dam was stable or if it was a hazard. Nick said it looked stable but perhaps it should be assessed. KWL to recommend a dam stability/hazard assessment in the final report. Darin asked how much habitat area was above the dam. Nick replied that it was significant and the removal of the dam and culvert was a high priority. Clara asked if the dam supplies water to anyone. KWL has checked water licenses and there appear to be none on Fox Creek. Nick stated that a water intake would be possible without the dam. Study team will consider options for removing/bypassing this barrier.	KWL KWL/ NP

Advisory Committee Comments - Discussion on Environmental Issues	Action
Dave Palidwor, Park Planning, CoC ▪ Regarding figures, pointed out that there are a few wetlands/ponds on Tributary T6 missing from the figure. Duane also noted a pond on Tributary T4. KWL to update the figures. ▪ Informed the committee that during the Smiling Creek Neighbourhood Plan, found that black bear move along the hydro corridors and also head towards the blueberry farms. Asked if there were specific areas in Partington that bears frequent. Clara and Nick said that they also move up Starr Creek to rock bluffs to the north and along old logging roads and into the floodplain areas.	KWL
Randy Chang, Engineering, CoC ▪ Regarding the field reconnaissance, asked if the committee had any concerns with the survey not including the headwaters (inside the park). Duane acknowledged that it is steep terrain but said that there is access from the Swedish gun club near the quarry. Randy asked the committee if KWL/Raincoast should perform a debris flow hazard assessment in the Pinecone Burke Park area. KWL to perform debris flow hazard assessment.	KWL

Advisory Committee Comments - Discussion on Land Use Planning Issues	Action
Elaine Golds, Burke Mountain Naturalists ▪ Asked if the boundary of Freemont Park is fixed or if a portion could be used for stormwater management. Clara added that Mr. Edwards put in a huge effort to get the park dedicated. David Reid responded that opportunities in the park may be difficult to pursue but that the option won't be ruled out at this point. ▪ Regarding impervious percentages, suggested the City allow higher densities to limit building footprints and minimize the increase in impervious area. Higher buildings provide beautiful views of the lower mainland and community gardens can be incorporated. David Reid responded that this would be a big step in the right direction to offset the impacts of impervious area increases but not everyone will like it. Janie pointed out that higher densities are not children friendly.	
Mike Bristol, Coquitlam Diking District ▪ Had several comments on behalf of the dyking district: Increased flows from the Partington watershed pose a flood risk to the lowland areas as Cedar Drive overtops. Increased pumping of lowlands would be a major cost. What is the Partington Creek channel capacity and how to manage sediment deposition? Need a management plan. What is the 200-year peak water level along Cedar Drive? The dyke inspector may designate Cedar Drive as a dyke which would mean that it be raised to the flood level. Crystal responded that many of these issues will be addressed in the next phases of the study. ▪ The dyke along the DeBoville Slough is up to 0.5 m lower than the flood construction level (FCL) and it is an agricultural standard dyke.	
Dave Palidwor, Park Planning, CoC ▪ The City is trying to purchase the parcel at the u/s end of the DeBoville Slough from the owner, Mrs. Francis, for parking at the trailhead. Elaine said that the DeBoville Slough is adored the way it is now, but needs better recreational access. ▪ Inquired if maintaining baseflows is an issue; Crystal responded yes, to be addressed in IWMP. Also asked in the snow pack was monitored; it was not.	

Advisory Committee Comments - Discussion on Land Use Planning Issues	Action
Andrew Young, Planning, CoC ▪ Regarding the LID slides, asked if the Seattle Sea Street was a water quality pond or a rain garden. David Reid clarified that a rain garden serves the purpose of water quality treatment through infiltration and also provides some detention. Maintenance is required to keep rain gardens looking nice. ▪ Brought up the need for well developed and maintained trails so that residents do not make trails where they shouldn't be. ▪ Noted that 25,000 to 30,000 people will be moving into the area as it develops and will need a place for recreation. Elaine suggested exchanging some land with the ALR so that land for a park along the slough could be removed from the ALR. Sarah suggested the land near Calgary Drive and Oliver Road, but Clara and Dave Palidwor noted that this area is reserved for playing fields. Andrew also added that the area is outside the study boundary.	
Clara Brolese, North East Coquitlam Ratepayers Association ▪ Asked about a new road from Freemont Street to David Avenue and its effect on Freemont Park, perhaps bisecting it. Andrew stated that discussion needs to happen with the City of Port Coquitlam regarding the alignment of this road through the ALR. This is to be addressed in the PCVNP.	
Duane Redder, Pitt River Boat Club ▪ Asked what the increase in flows would be for the projected 16% increase in impervious area. KWL to address this in next phase of the IWMP study. Will strive to mitigate the effects of increased impervious area. ▪ Noted that the climate station used for the study (Burke Mountain Firehall) is far away from the Partington watershed. Asked that a gauge be installed in the study area. David Zabil explained that the rainfall from Burke Mountain Firehall was scaled up and the result was a good match to recorded flows at the Victoria Drive bridge flow monitoring station. Darin asked why a rain gauge in Partington Creek was not considered. Randy said that the rainfall will be reviewed in the next phase.	KWL
Dave Mounteney, Friends of Deboville Slough ▪ Asked if limits will be placed on impervious area for each type of land use. David Reid replied that that will be only one of several tools to guide the development. ▪ Noted that the DeBoville Slough is outside of the study boundary for both the IWMP and the PCVNP. Andrew responded that the boundary of the PCVNP has not been finalized and will discuss this with Rob Innes. ▪ The usage of the slough is not being addressed and more people and dogs are using the trails. This leads to garbage in the water and dog feces along the slough. The ALR setbacks are not adequate to provide a good riparian area for the slough. The increased usage by people is hurting the riparian area and there needs to be more trail maintenance. Andrew and Dave Palidwor indicated that they are aware of the issue. Duane also voiced the concern of the Pitt River Boat Club over the amount of garbage getting hung up on the dock. Andrew responded that the area surrounding the slough is located in the ALR and the City is not proposing any changes/development there. It is outside the scope of the IWMP.	AY

Crystal Campbell summarized the major issues to be investigated:

- Flooding at Oliver Road/Cedar Drive and Croutch/Pollard;
- Flooding in lowlands and overtopping of Cedar Drive;
- Sedimentation in lower reach of Partington Creek and in DeBoville Slough;
- Post-development flows and their effects on flooding, sedimentation, and water quality;
- Major post-development flood routing and Hyde Creek Development Reserve flows;
- Thin soil layer, limited infiltration capability, and steep slopes; and
- Maintaining baseflows in Partington Creek.

Prepared by:

David Zabil, P.Eng.
Project Engineer

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Meeting Record

MEETING DATE: November 14, 2006, 6:00 p.m. – 8:30 p.m.

LOCATION: Coquitlam Innovation Centre
Burke Mountain Boardroom

ATTENDEES: Ron Nordstrand & Janie Hiebert, Pitt River Boat Club
David Mounteney, Friends of Deboville Slough
Clara Brolese, North East Coquitlam Ratepayers Association
James McNeil, Partington Resident
Mike Bristol and Scott Barrett, MOE
Corino Salomi, DFO
Dana Soong and Randy Chang, Engineering, CoC
Andrew Young and Pat Bell, Planning, CoC
Dave Palidwor, Park Planning, CoC
Sarah Dal Santo, Environment, CoC
Caresse Selk, Leisure and Park Services, CoC
Chris Johnston & David Zabil, KWL
Nick Page, Raincoast Applied Ecology
Don Crockett, Lanarc

REGRETS: Regional Parks Central Area, GVRD
Zuliani & Company Consultants Limited
Burke Mountain Naturalists
Hyde Creek Watershed Society
City of Port Coquitlam

RE: **PARTINGTON CREEK IWMP**
Advisory Committee Meeting #3 – November 14, 2006
Our File 456.038

The study team updated the Advisory Committee on progress to date since the last meeting. David Zabil summarized the hydrotechnical assessment and Nick Page the environmental assessment. Comments were solicited from the group and key issues are summarized as follows.

Advisory Committee Comments - Discussion on Minutes of Previous Meeting	Action
Jim McNeil, Partington Resident	
▪ Tributary T4 is called Dairy Creek. The "fish observed in Calgary ditch" comment at the previous meeting likely refers to Dairy Creek. KWL to add to future figures.	
▪ Clarified that the dam on T4 Dairy Creek is an old swimming pool.	KWL
▪ Noted that decommissioned fish rearing ponds north of Victoria Drive and east of Partington main stem do not appear on the figures. Nick to investigate this further and add these to figures and refer to them in the text. Jim McNeil to send coordinates.	NP JM

Advisory Committee Comments - Discussion on Minutes of Previous Meeting	Action
Andrew Young, Planning, CoC ▪ Gun club incorrectly referenced as "Swedish Gun Club"; it is "Swiss Gun Club". ▪ In the text, it would be worthwhile to spell out the acronym Seattle SEA Street (Street Edge Alternative).	KWL
Dave Palidwor, Park Planning, CoC ▪ Clarified on page 4 he meant that he was aware of the need for fencing around the slough.	KWL
▪ KWL to include the minutes in the final report.	KWL

Advisory Committee Comments - Discussion on Assessment/Issues	Action
Randy Chang, Engineering, CoC ▪ Passed photos of the Cedar Drive overtopping during the 6 October 2006 storm. ▪ Correct name is "Irvine Creek" not Irving. KWL to update all references to Irvine. ▪ Advised the committee that the rain gauge in the Partington watershed was installed at the Edward property and started recording flows on 9 November 2006. KWL to review data and compare to Burke Mountain Firehall data once a few storms are recorded.	KWL KWL
Mike Bristol, Coquitlam Diking District ▪ Asked how climate change and global warming will be addressed in the IWMP.	
Dana Soong, Engineering, CoC ▪ Suggested that "detention" be added to the list of potential solutions in Section 7.9 of the Phase 2 report. KWL to add. ▪ In regards to the question of how impacts on Deboville Slough will be measured, Dana noted that there are 18 months of water grab samples analysed for water quality. Dana to forward this data to KWL.	KWL DS
Jim McNeil, Partington Resident ▪ Indicated that he has an artesian well on his property near Quarry Road. ▪ Pointed out that the agricultural land around Irvine Creek may be leased, not owned. The City will check. It was also noted that there is a public ROW along a large portion of Irvine Creek. David Zabil noted that it likely is not wide enough to accommodate the required dykes for a high flow bypass route.	AY
Scott Barrett, MOE ▪ Commented that the problem with sediment traps it that they target a certain sediment size (and larger) instead of allowing a portion of all sizes to continue downstream. Usually only the fine sediments continue downstream. ▪ Will the Booth metrics be used in the IWMP? Chris responded that they have not been applied yet. KWL to investigate these further in the alternative evaluation phase. ▪ Noted that because the development is not occurring throughout the watershed, there may be streams that are impacted more than the overall average impact especially Star Creek and the tributaries around it. Nick replied that in the next phase the impacts will be classified on a sub-watershed scale.	KWL NP
Corino Salomi, DFO ▪ Clarified that in January 2005 DFO did not reject the City's gravel removal application.	

Prepared by:

David Zabil, P.Eng.
Project Engineer
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MEETING RECORD

MEETING DATE: March 6, 2007 6:00 PM – 8:00 PM

LOCATION: Coquitlam Innovation Centre
Burke Mountain Boardroom

ATTENDEES:

Mike Bristol, Ministry of Environment, Coquitlam Diking District
Scott Barrett, Ministry of Water, Land & Air Protection
Jim McNeil, North East Coquitlam Ratepayers
Daren McLean, Hyde Creek Watershed Society
Dave Mountenay, Friends of Deboville Slough
Andrew Young, Community Planning, City of Coquitlam
Ron Nordstram, Pitt River Boat Club
Clara Brolese, North East Coquitlam Ratepayers
Elaine Golds, Burke Mountain Naturalists
Dana Soong, Engineering and Public Works, City of Coquitlam
Crystal Campbell, Kerr Wood Leidal Associates
David Zabil – Kerr Wood Leidal Assocaites
Nick Page, Raincoast Applied Ecology
Don Crockett, Lanarc
Ron Wood, Greater Vancouver Regional Board, Parks
Dave Palidwor, Leisure and Parks, City of Coquitlam

Welcome and Introductions

- Dana Soong introduced 4th Meeting of Partington Creek IWMP. Phase 3 copies were handed out. Objective is to preserve watershed health, met objectives and allow development to occur which can integrate these needs.
- Minutes of 3rd meeting were circulated, and adopted as stated.

Update from Partington Creek Village Neighbourhood Plan (Lanarc)

Developing 3 separate Options - A, B, and C. These were included in appendixes of our report.

Option A

- Presence of Fremount Park, location of creeks, minimum setback, park areas throughout neighbourhoods, school sites, village core residential development and creek crossings, David avenue alignment, Princeton avenue crossing, extension of Gislason Avenue, several versions of how David Avenue may come in.

- Adhered as close as possible to North East Coquitlam area plan. Single family, large and small lots and density increasing as we get to village core.
- 15 m set back in Partington Creek area.
- Compensation in form of development cost charges.
- Probably will end up a combination of A,B,and C.
- Can't purchase all of the green space.

Option B

- Main street terminates on Mt. Baker.
- Grades are better with Option B - 7% steepest grade.
- Protecting Nobe ??or Cedar slopes version as public park.
- North area enclosed with bluff protected as green space. Habitat value even though it is outside Partington watershed and is part of Hyde Creek Watershed.

Option C

- Land cover analysis – significant vegetation enclosed area in north part for works yard potential.
- Additional green space on low side of Cedar Drive as public park.
- Option C does a better job of following the contour of hills. Grades are very difficult in this area but village core will have a green space around it and roads are parallel to the contour. This has 3 bench areas for roads.

Review Storm Water Goals and Environmental Alternatives

- Developed alternatives and summarized them in 3 different plans. Feedback from city, advisory groups and public and will use this input to select components from each of the plans with the preferred components and develop overall management plan. Please provide written comments and circle what alternative you would prefer by the end of the night or forward to Dana Soong.
- Review focus of stormwater – summarized on Page 5
- Post development detention and reduce to pre-development levels. Release volume levels at a slower rate then post development. Water quality treatment for 6-month event using ponds and source controls.
- Slows flood conveyance and protection for 100 year event. Lower channel sedimentation problem.
- Mitigate hydrologic impacts of development – volume reduction – 6 month or lower event. Options for this:

Option A

- Water quality treatment ponds or augmentation ponds.
- High flow diversion into Deboville Slough for flows in excess of 5-year pre-development flows.

Option B

- Source controls

    - Infiltration into the soils on site – swales.
    - Rain gardens, permeable pavement, green roofs, every day flow and holding on to it.
- LID grass cell paving, manholes with cells for measuring how much rain fall is coming off of this.

Option C

- Much the same as Option B except to achieve full water quality, volumetric reduction, and detention for storms up to 5 year return period.

Discussion and Evaluation of Alternative Components

- Innovative source controls, stormwater collection and using it for irrigation or toilets etc.
- Look at criteria and make comments for each of these alternatives.
- Source control techniques – landowner taking more responsibility for these and also the risk? Design - do we build a back up system – 100 year event. Overflow mechanisms have a minor and major system built into them and would go into the drainage system.
- 20 years when road has to be repaved then you would redo the rain gardens and other source controls at that time.

Comments

- Elaine Golds
  Option C for protection of the ground water – better growth conditions for trees and vegetation plus stream flows. Alternative A does not protect ground water; slows it down but no recharge and will flow into creeks.
- Andrew Young
  Ponds are very expensive from a land acquisition point of view and a limited resource. Function needs to be incorporated in an aesthetic concept or park setting. City has its business plan in place for its properties and closed a whole series of roads in this area.
- Dana Soong
  Very steep terrain and a lot of these measures will not work. Need caution when we do this evaluation and we need to be practical.
- Andrew Young
  A blending of Options A-C elements. Source controls vs water quality ponds etc. As vegetation grows and area matures ponds may not be required as we can discharge to the creek.
- There are some source controls with Alternative B. Capture water that falls on roofs and store for irrigation or dual plumbing system development and then into sanitary sewer and be carried away.
- Alternative C map is the only one that shows outfalls. Need location of outfalls in each alternative and would depend on each pond location. Low impact paving, swales and outfalls for overflow? Water quality and reduction up to 6 month and retention up to 5 year (rain garden) and would have outfall into creek.

- Other option is diversion of excess predevelopment flows or detain it are 2 major options to this issue. Crystal commented that outfalls haven't been really looked at, more of a detailed option. A lot of water is very usable for landscaping and base flows will suffer. Crucial that water is retained as we get larger events.
- Next level of detail will develop the plan and what we should rule out or add.

Comments

- Elaine Golds
  Need to define for public a 100 year event and a typical 6 month event and 5 year event so people can understand what they are and be more informed to make a decision.
- Scott Barrett
  In a 6 month event – can we release these large ponds at a slow rate?
- Jim McNeil
  Costs, land requirements and maintenance. Alternative C says essentially mitigation is capsulated – no regional facility to catch large event? We should have a regional facility for these recurrent events.
- Dana Soong
  Alternative A would be a pipe – more traditional infiltration.

Mid Range Storms – Pre and Post Development Levels

A High Flow Diversion Strategy
B Post development flow reduction
C Underground on site detention throughout whole watershed

Alternative A – High Flow Diversion

- Up to 5 year goes into creek predevelopment.
- Predevelopment up to 100 year
- Post development
- A lot of restraints to Irvine Creek runoff to get rid of excess water.
- Diversion into Deboville Slough – flooding inside of the dyke is not desirable.
- Hyde Creek - diversion creek is in and how can we consolidate the outfalls head of Deboville Slough. Syphon portion has not bee developed yet and one to the north has not been developed.

Comments

- Andrew Young
  Elements in Alternative A that I like and B relies on ponds and Alternative C has high costs. To what extend can we blend the 3 alternatives. Swales, parking lots, school fields, additional park areas. Costs where underground starts to make sense. Density bonusing – is this an underground opportunity?
- Dana Soong
  Capping flows in the creek at 5 years. Substantial portion of watershed is undeveloped. This would not be a big impact to main stem.

- Scott Barrett
  Diversion pipe in Westwood Plateau where pipes have open connections and ground water diverted. Need to change control structures with excess into creeks. Confusing for salmon returning to area. Alternative B and C no diversion – Cedar Drive cuts off the flow, smaller flows would be contained in the main stem. Provide fish habitat off the slough for mitigation – best place is Irvine Creek. Enhancement for fish operation into low land areas. Flood plain options for this - difficult due to complexities of the issue.
- Jim McNeil
  Alternative C – no onsite underground detention – how are the larger events managed in this case – captured and goes into creek – post development 100 year event. Are there benefits to big flows? Eco systems are adapted to these large flood events – more concerned with flooding property. Need off channel habitat.

Alternative B & C

- Dart Creek – gradient on the west side.
- Fox Creek infiltration – due to more gradient issues of terrain. Small creek below David proposed to be diverted – off channel habitat?
- Star Creek – What are the different impacts of it combined with peak flows coming down Victoria. Mitigate some of that diversion to 100 year event. Pipe is smaller than Alternative A.

Sedimentation

Alternative A

- Overall sediment removal. Clean out whole length of creek channel.

Alternative B

- Partial sediment removal over a number of years. Restricting hydrologic capacity of the channel.

Alternative C

- Relocating Cedar Drive – infrequent sediment removal.

Comments

- Andrew Young
  Is this advantageous from a Fisheries point of view? The less you touch it the better. Freehold land and private land could provide a benefit for Fisheries – compensation for things in the planning area. Would eliminate sediment an advantage for fish channels being developed.
- Don't have to relocate all of Cedar Drive just a bulge and in peak flow periods would drop into this area.
- What would be ideal size for sediment trap in Alternative B – how much is coming down on a yearly basis – and size them accordingly and remove every 5 years?

- Elaine Golds
  Use to be multiple channels to Deboville Slough and now it is all filled in – natural from Partington or sediment?

Flood Conveyance

Alternative A

- Large sediment removal and high diversion pipe – minimal culvert and bridge upgrades and no raising of Cedar Drive. Regardless of capacity of the channel, sediment removal, no overtopping of the road.

Alternative B

- Less sediment removal and diversion taking part of the flow away. Upgrade culverts and bridges and raise Cedar Drive to act as dyke for 200 year level.

Alternative C

- No diversion – extend flood plain. 200 level would be lower than B because you have a wider channel. No upgrade of bridges – Cedar would be moved and accessed by some road above.

Comments

- Andrew Young
  KWL team – What will happen with dyking if 2 m rise as a result of global warming? Need to think about raising Cedar Drive or water table is too high in farming lands. Should we be pumping the water out of these lands as a private property issue? Minnekehada farms – improve the dyking system to protect the properties.

Environment Alternatives

- Changes to stream health and biological condition of Partington Creek. Flooding and sedimentation risks.
- IWMP– more emphasis on wildlife, vegetation and park system and how we can protect these.
- Relate to hydrological and water quality – protect fish habitat, shade, rainfall and slow movement of water through forest. Minimizing imperviousness and how to maintain forest.

Riparian Areas, Fish and Wildlife, Upslope Habitat and Green space.

Riparian

Alternative A

- Use riparian regulation policy of City of Coquitlam. – provincial ministry of environment.
- To protect fish habitat. Small streams, not as much microclimate forest.

- Human/wildlife conflicts with this. Off channel ponds – opp.to create a pond. Cost – requirement of landowner.

Alternative B and C

- Expand riparian protection beyond city wide regulation – Partington Creek above Victoria – tolerate encroachment – 30 m along lower Partington and tributary streams that flow into this creek.
- Doing this for wildlife, hydrological function and protection of forest cover and as green space.
- Dave Palidwor
  Trail component – setbacks will prevent us putting trails in this area. Mature vegetation –we want to take these over as park and want to remove some of these trees. Need to keep setbacks. Storm events need to be included in this report.
- Andrew Young
  City would consider clear cutting and planting to reduce potential liability. Community amenity - Alternative C is going to have more appeal as a livable community and much more attractive area.
- Dave Palidwor
  Assessment of habitat trails on yearly basis and wider riparian areas.

Capital Cost of Riparian Areas

- Following existing regulations and look at anything beyond that and how we are going to pay for this. Solutions and options may be complicated. Development cost charges?
- Andrew Young
  Not noted in Alternative C – not necessarily higher costs - more density provision, five density bonus being sought by developer through rezoning process and dedicating that land in return for development opportunities. Not necessarily going the DCC or burden to all developers – don't like to pay for amenities. 5% land dedication, general revenue, land swap or DCC charges.

Upslope Habitat

- 15 m on Partrington Main Stem – 3 times channel width – 25 m riparian buffer along largest portion.
- Fremount Park is the largest forested area and there are other small area parks in the Fox Creek tributaries. Rock bluffs provide rare habitat concentration in this area. Aesthetic, wind firm, have species of Rubber Boa and interesting plants. Larger private vista area. Forested area off Burke Mtn and into Partington. Watershed and widening out that riparian area, and area of forest adjacent to BC Hydro right of way. ARL land has wildlife value. Option C to include as much of these as possible.

Alternative A

- Biggest protected park is Fremount and small neighbourhood parks, band in island of Fox Creek protected for geotechnical and habitat reasons.

Alternative B

- Expands on A to rock bluff and looks on low lands and different alignments in the neighbourhood parks.

Alternative C

- Goes a lot further in its scope. More upslope habitat protection than A or B. (See above).

Comments

- Dave Palidwor
  Park and open space areas calculated out for neighbourhood public house meeting.
- Andrew Young
  Land use concept C incorporates a lot more green space – intersect with streams north of plan area – how valuable are those lands from a stream and environmental point of view? Securing and protecting those vs other lands in plan area – mass habitat areas together off to the side and connected – these lands go all the way to Garibaldi Park. Works Yard would be a minimum of an acre.
- Dave Palidwor
  Soils and steepness should be protected in this area. Works Yard has been placed in the north east of Alternative C.
- Elaine Golds
  Rocky Bluff and green space and everyone could enjoy this and a destination for a walk.
- Dave Palidwor
  We are now shaping a community for 100 years – what is the cost amortizing this value over a number of years.
- Andrew Young
  Alternatives in stormwater management plan – these 3 alternatives issues 4 and 5 in neighbourhood plan. May be confusing to the public to name them all Alternative A,B,C, should be maybe numerical.
- Andrew Young
  Preserving more green space land. Concept C and how it is distinguished between first 3 issues. IWMP and neighbourhood plan are partnered or integrated and need to be distinguished with Council members saying staff managing neighbourhood plan process through a riparian system through IWMP. SPR system was not public knowledge and not enough consultation. Got RAR but need a full public assessment. Need to distinguish these two different concepts clearly for choosing which one we want to go with.
- Clara Brolese
  Smiling creek neighbourhood plan process was color coded for easier selection and this concept should be used here for less confusion.
- Evaluation Tables need to be given to Dana by March 20th – bring it to open house would be ideal.

Fish Habitat Enhancement

- Leaning more towards Alternative C which includes flood plain restoration and habitat enhancement. Some overlapping of these options and discuss with Dana Soong.
- Jim McNeil
  Wildlife configuration – if there was more connectivity of green spaces through to Fox Creek we may not have as many bear, cougars, deer and lynx in neighbourhood areas. Reduce conflicts with this.
- Andrew Young
  Areas will change as development occurs with wildlife impacts and habitat change.

Dana Soong

Open House – 12 posters presenting 3 storm water options with public's options. Look at developing plan after this and then set up another meeting.

Meeting adjourned at 8:40 pm.

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Meeting Record

MEETING DATE: October 8, 2009, 6:30 p.m. – 8:30 p.m.

LOCATION: Coquitlam City Hall
Council Committee Room

ATTENDEES: Teri Madaisky, Friends of Deboville Slough
Clara Brolese, North East Coquitlam Ratepayers Association
James McNeil, Partington Resident
Ted Wingrove, Brian Wormald, Hyde Creek Watershed Society
Mike Bristol, Coquitlam Diking District (MOE)
Alison Evely, Ron Wood, Regional Parks Central Area, GVRD
Murray Manson, DFO
Dana Soong, Melony Burton, Andrew Young, Dave Palidor, Perry Staniscia, Hagen Hohndorf, CoC
Crystal Campbell, David Zabil, Kerr Wood Leidal Associates (KWL)

REGRETS: Pitt River Boat Club
Zuliani & Company Consultants Limited
Burke Mountain Naturalists
City of Port Coquitlam

RE: **PARTINGTON CREEK IWMP**
Advisory Committee Meeting #5 – October 8, 2009
Our File 456.038

The study team updated the Advisory Committee on progress to date since the last meeting. Melony Burton summarized the City's new Rainwater Management Policy and Andrew Young gave a brief update on the Partington Creek Village Neighbourhood Plan process. Crystal Campbell summarized the Draft IWMP Strategy and resulting watershed health as tracked by the Watershed Health Tracking System. Comments were solicited from the group and key issues are summarized as follows.

Advisory Committee Comments - Discussion on Draft IWMP Strategy	Action
Mike Bristol, Coquitlam Dyking District ▪ Noted that the Cedar Drive/dyke may need to be extended down Oliver Road to prevent the creek from outflanking the dyke in the case of channel movement in the creek fan area. KWL to investigate best alignment of dyke extension. ▪ Noted that the maintenance costs of the regional facilities should be considered in cost estimates.	KWL
Jim McNeil, NE Coquitlam Ratepayers Assoc. and Partington Resident ▪ Asked whether the twin culverts at the mouth of Dairy Creek may present a barrier to fish. Raincoast to investigate and recommend removal if it is an issue.	RAE

Advisory Committee Comments - Discussion on Draft IWMP Strategy	Action
Ted Wingrove, Hyde Creek Watershed Society ▪ Noted that Coho are also present in Partington Creek. ▪ Indicated that the term "storm sewer" is outdated and troublesome and suggested it be called "storm drain". Since the meeting, KWL looked into the usage of both terms and it appears that "storm drain" is used to describe the inlets into the pipes (such as road catch basins and lawn drains). Even tough the term "storm sewer" is still widely used for the piping conveyance system, KWL proposes to use the term "storm pipes" instead of "storm sewer" in this report. ▪ Noted that there are ponds on Fox Creek used by trout upstream of the dam fish barrier. ▪ Asked about the impacts of piping excess peak flows directly into Deboville Slough. Crystal explained that the proposed source controls and regional water quality ponds will treat the water prior to discharge to Partington so that the sediment load is not increased as a result of development. She also noted that the slough is large enough to handle the peak flows from the watershed. David Zabil noted that the majority of sediment issues from urban development is during the construction phase and Sediment and Erosion Control Plans should be implemented to management this. ▪ Ted indicated that sediment and erosion control during construction has been a problem in Hyde Creek. The IWMP will include recommendations for proper sediment control BMPs for the construction phase.	KWL KWL
Teri Madaisky, Friends of Deboville Slough ▪ Asked how we will know if the proposed strategies are effective and if any monitoring will take place. A monitoring program will be recommended in the IWMP and will include flow monitoring, B-IBI sampling, water quality testing, fish counts, etc. A particularly good indicator will be to compare the number of salmon spawning post development to those counted in Phase 1 of the IWMP study.	KWL
Murray Manson, DFO ▪ Asked that the City strengthen the source control policy to require rain barrels. Melony noted that the policy strongly recommends rain barrels and that in Hyde Creek, many of the houses are installing them. ▪ Noted that in addition to the minimum riparian setbacks calculated in the RAR detailed assessment, the qualified professional is to recommend measures to protect the riparian (for example wider setbacks to minimize windthrow).	
Dave Palidwor, Coquitlam Park Planning ▪ Asked under whose jurisdiction is the sedimentation in Deboville Slough. The Pitt River Boat Club receives authorizations from the Fraser River Estuary Management Program (FREMP) to remove accumulated sediment in the lower portion of the slough. KWL to investigate further to determine jurisdiction.	KWL

Everyone was asked to indicate on the sign-in sheet whether they wanted pdf copies of the previous reports or hard copies of the Draft IMWP figures. The City will distribute these as requested.

Prepared by:

David Zabil, P.Eng.
Project Engineer

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Meeting Record

MEETING DATE:	March 11, 2010, 6:00 p.m. – 8:00 p.m.
LOCATION:	Coquitlam City Hall - Council Committee Room
ATTENDEES:	Elaine Golds, Burke Mountain Naturalists David Mounteney, Friends of Deboville Slough Clara Brolese, North East Coquitlam Ratepayers Association James McNeill, Partington Resident Ted Wingrove and Brian Wormald, Hyde Creek Watershed Society Ron Wood, Regional Parks Central Area, Metro Vancouver Murray Manson, DFO Niall Williams, Hoy/Scott Creek Watershed Society Dana Soong, Melony Burton, Andrew Young, Dave Palidwor, Bill Susak, Hagen Hohndorf, CoC Crystal Campbell, David Zabil, Kerr Wood Leidal Associates Ltd. (KWL) Nick Page (Raincoast Applied Ecology) Don Crockett (HB Lanarc)
REGRETS:	Mike Bristol, Coquitlam Diking District (MOE) Ron Nordstrand and Janie Hiebert, Pitt River Boat Club Steve Zuliani, Zuliani & Company Consultants Limited Heather Wornell, Regional Parks Central Area, Metro Vancouver Darin McClain, Hyde Creek Watershed Society Ross Neuman, Ministry of Environment Allen Jensen, City of Port Coquitlam (CoPC) Jason Cordoni, Perry Staniscia, Margaret Birch, CoC
RE:	**PARTINGTON CREEK IWMP** **Advisory Committee Meeting #6 – Draft IWMP** **Our File 456.038**

Hard copies of the report were distributed. The study team updated the Advisory Committee on progress to date and David Zabil presented the Draft IWMP Plan. Comments were solicited from the group and are summarized as follows.

Advisory Committee Comments - Discussion on Draft IWMP Plan	Action
Cedar Drive Relocation	
▪ **Jim McNeil** – has ALC been approached re: Cedar Drive Relocation? AY - preliminary discussions at staff level have been initiated. City will further explore.	
▪ **Murray Manson** - temporary bridges across side channels would be less intrusive than culverts. DZ explained that culverts are not for conveyance capacity but rather for connectivity and may not even be needed if side channels are routed to the main channel before every crossing in the interim.	CoC
▪ **Jim McNeil** – would relocated road meet dyke standards? DS – yes.	
Sediment Management Plan	
▪ **Jim McNeil -** would instream sediment removal be in lifts or zones? DZ – in 100 m long sections. NP – buildup of sediment in the sand reach portion downstream of the high use Chum section would be removed. KWL to add detail of removal into report.	KWL
▪ **Elaine Golds** - would removed gravel be used elsewhere in streams that needed spawning gravels, such as Hyde Creek? NP - this was done in other areas and MB indicated that it could be done in Coquitlam. KWL to add wording into report.	KWL
▪ **Murray Manson** - could gravel removals be timed with the relocating of Cedar Drive to minimize impacts. NP - the first priority was sand removal downstream of the proposed road relocation. CC – the sand removal should be timed together with channel widening and enhancing in the same area (if land can be acquired in time). NP indicated that channel would be dewatered and aquatic life removed to confine impact. KWL to add wording into report.	KWL
▪ **Ted Wingrove** - is the sediment problem just being moved downstream? CC – no, management measures were built into urban development through source controls and regional water quality ponds and sand and sediment traps and instream removals proposed.	
▪ **Murray Manson** – What is meant by excavating gravel to historical channel invert? Historical reports indicated that horses could be ridden under the bridges. NP – normal channel bed is always fluctuating. EG – channel was never natural anyway. KWL to revise wording in report.	KWL
Conveyance Upgrades	
▪ **David Mounteney** - would proposed Partington diversion tie into Hyde diversion? DZ – yes.	
▪ **Brian Wormald** – worried about Upper Hyde flows and impact to lower Hyde diversion. DS - Upper Hyde flows were included in Partington diversion concept. Baseflows continue to creek, high flows to diversion only. The two flow monitors on Hyde Creek indicate that normal rains are conveyed to creek with no flow in pipe.	
▪ **Elaine Golds** – It is important that the Hyde data is analyzed so that community can have confidence in diversion operation.	CoC
▪ **Ted Wingrove** – strongly suggests there should be human monitors too, and not just relying on technology.	
Minimize Development Impacts	
▪ **David Mounteney** – Water quality ponds in the Hyde IWMP have been implemented smaller than originally intended in IWMP. DS – detailed design resulted in smaller ponds.	
▪ **Murray Manson** – 300 mm of absorbent soil on roads? KWL to reword to indicate soil is for boulevards within road ROW.	KWL
▪ **Elaine Golds** – diversion splitter weirs need to be adjustable for future modification if required. DS – yes, Hyde diversion splitters are adjustable. KWL to add to report.	KWL
▪ **Ted Wingrove** – has Hyde diversion been monitored? DS – Hyde Creek has been monitored, but not the diversion yet, but it will be in the future.	CoC

Advisory Committee Comments - Discussion on Draft IWMP Plan	Action
Ditch/Remnant Watercourses	
▪ **Jim McNeil** – Can the existing ditch on Crouch be enhanced to provide a better food and nutrient source to Star Creek?	CoC/ KWL
▪ **Murray Manson** – In Smiling Creek DFO was comfortable with replacing marginal watercourses that were not fish habitat and not connected by surface flow with rain gardens. However, not comfortable eliminating watercourses unless 1. can show unreasonable hardship on an individual lot or 2. not feasible because of an existing road – which are not applicable here at this early planning stage. Don't want to see loss of ditches that have headwaters. DS – improvements have been focused around the good fish habitat areas and losses around non-habitat watercourse.	CoC/ KWL
▪ **Murray Manson** – Even with compensations shown there is still a decrease in watershed health. Eliminating watercourses raises concerns of what it is doing to baseflows and overall creek functioning. Riparian areas are falling short. Look into going further with riparian conservation, going beyond minimum requirements when eliminating watercourses. Need more riparian. Where there are existing watercourses, need to work with that. DS – IWMP is a holistic approach that strives for significant gains in critical areas versus looking at watercourses on an individual basis. Need to have separate meeting with DFO.	CoC
▪ **Ted Wingrove** – perhaps the group should undertake a walk-about to see these watercourses?	CoC
▪ **Elaine Golds** – Can invertebrate move through rain gardens. NP – no, some ditches have been classified for hydrologic contribution only where rain garden replacement would be adequate. Invertebrates are not relevant here.	
▪ **Elaine Golds** – Major concern with all the open channel ditches to be enclosed. Replacement with source controls will take away nutrients and functions. Too much enclosing shown.	KWL/ CoC
Riparian Setbacks	
▪ **Murray Manson** – Ditches that have headwater streams flowing into them are considered channelized watercourses and therefore 10 m riparian setbacks would apply, not 2 m. KWL to revise setbacks.	KWL
▪ **Dana Soong** – when looking at the watershed as a whole, wanted to get away from strict application of RAR rules and look a most benefit i.e. focus on spawning area – otherwise there would be no need for Cedar Drive relocation.	
▪ **Bill Susak** – There has been a lot of concern how watercourse protection based on site specific conditions that has put everyone in a tight spot. City met with DFO to discuss the difficulty that the no-net-loss approach was causing and wanted to focus on leaving the place better off i.e. net environmental benefit. Focus has been on losing less valuable areas and putting emphasis on more valuable areas. If we head into stream by stream approach we are going backward, if we look system wide we are going forward.	
▪ **Jim McNeil** – reiterated that naturalizing ditches could enhance them. NP – yes, that can be done.	
▪ **Murray Manson** – If you want a net environmental benefit concept, we are starting of with a lot of impacts – instream gravel removal and sediment traps, significant increases in impervious area, loss of riparian, and removal of ditches and small watercourses. The best starting point for net environmental benefit is to avoid impacts and leave streams where they exist rather than compensating for them. Don't like to see headwater stream losses.	
▪ **Brian Wormald** – like the idea of conceptual level plan, but most of the impacts are at the detailed level. Should identify the discrete issues now.	

Advisory Committee Comments - Discussion on Draft IWMP Plan	Action
Environmental Restoration and Enhancement	
▪ **Elaine Golds** – the 4.8 ha of riparian restoration areas within the RAR setbacks is 90% on privately owned land and is therefore a very long term solution if at all. NP – there is no precedent for this, but it is a cost effective solution to increase creek health. AY – there are land use planning options that could be considered to achieve it i.e. City purchase land and put covenants for riparian protection/planting. EG – has Coquitlam done it before? AY – No, not yet. EG – this should be carried forward to PCVNP. Concerned that there are good ideas that may be lost as time passes, weakening the plan. Reforestation of riparian is so hypothetical and it may not happen at all. NP – it can't be guaranteed. KWL to look at other options for riparian compensation.	KWL
▪ **Andrew Young** – How valuable is Partington Creek for fish value? MM – Scores one of highest productivity in Lower Mainland even though it is channelized. NP – 2000 chum spawners/year, coho too. It is regionally significant.	
▪ **Ted Wingrove** – Added that Star Creek is very important too for salmon.	
▪ **Clara Brolese** – City could buy strategic properties that come for sale however developers and investors are already gathering in this area of Partington. The City should acquire sooner rather than later. JM also added to not underestimate the cooperation of the landowners. AY added that the IWMP needs to be approved in order to start such a process.	CoC
Miscellaneous	
▪ **Dana Soong -** requested that the numerical dimensions be removed from Figures 9-2 to 9-3. 30 m riparian setback is proposed, but overall road ROW details will be determined during detailed design.	KWL
▪ **Elaine Golds** – was the reinstatement of Irving Creek option abandoned. CC – yes, it was considered but was not pursued as a viable alternative because of complications regarding sustaining baseflows to the high quality fish habitat in lower Partington and increased flood issues to the agricultural lands. EG – It's important that it was considered.	
▪ **Brian Wormald** – IWMP is great, but impacts happen when housing gets going and plan is forgotten; construction phase impacts are difficult to manage.	
▪ **Jim McNeil** – Dairy Creek Figure 9-1 updates – look at reprioritizing some of the culverts for replacement. There may be very limited benefit in improving fish passage at CUL035 as there is another barrier just upstream. A better candidate may be the Gilley's Trail crossing CUL037. NP noted that this is not currently a fish passage barrier. JM – A natural bottom would be better than the existing twin concrete pipes. KWL to note CUL037 upgrade should include a natural bottom.	KWL
▪ **Jim McNeil** – Dam at top end of Dairy Creek maintains baseflows year-round and the two other baseflow supplies further downstream may not be needed. CUL032 was already upgraded to two pipes, 28" and 36". KWL to revise in report.	KWL

Everyone was encouraged to fill out the Comment Sheet and Questionnaire. Please submit comments by March 31 in preparation to take IWMP to Council in April. There will be other opportunity for comment on the Draft report and plan before it is finalized. A public open house is planned for May 2010.

Prepared by:

Crystal Campbell, P.Eng.
Project Manager

APPENDIX G
Restoration Plan

ENVIRONMENTAL SETTING AND CONTEXT:

Cedar Drive is being upgraded and Partington Creek is being widened and an off-channel habitat created to improve flow conveyance and mitigate flood risk. Road construction and Creek widening will affect the riparian areas around Partington Creek. The riparian areas have already been affected by urban development, but in order to secure DFO Authorization and Ministry Approval, it was necessary to develop OFFSETTING measures to address riparian impacts.

This OFF-SETTING/PLANTING PLAN is intended to address riparian effects associated with road construction, channel widening and off-channel creation in and around Partington Creek.

The OFF-SETTING plan is intended in the medium and long term to provide shade cover which will mitigate the loss of shade cover associated with the channel widening activities. The off-channel habitat is intended to provide improved rearing conditions for fish inhabiting Partington Creek.

Implementation of the plan will also improve leaf drop, large woody debris (LWD), coarse woody debris (CWD), insect inputs, etc. to Partington Creek.

The zones designated for planting vary from upland to lowland bench. Site preparation prescriptions vary between upland and lowland. ISL has specified plant species that are best suited to zone and microsite. Protection, maintenance, and plant survival inspections will be required if the planted stock is to survive and thrive.

ACCESS MANAGEMENT AND SITE PREPARATION:

1. SITE PREPARATION WILL BE UNDERTAKEN ONLY UNDER THE FULL-TIME SUPERVISION OF THE EM.
2. PLANTING SITE PREPARATION MUST NOT BE UNDERTAKEN WITHOUT THE EM ONSITE.
3. PRIOR TO CONSTRUCTION THE ENVIRONMENTAL MONITOR (EM) MUST DEMARCATE THE BOUNDARY OF THE APPROVED WORK ZONE, PER THIS PLAN. THE EM WILL FLAG 'LOCK OUT ZONES' WHERE THERE WILL BE NO DISTURBANCE OF EXISTING VEGETATION.
4. THE FLAGGED BOUNDARY WILL BE POSTED WITH TEMPORARY SIGNAGE INDICATING THAT THERE IS TO BE NO DISTURBANCE OF ANY KIND BEYOND THE FENCED BOUNDARY.
5. THE EM WILL MONITOR THE BOUNDARY AT REGULAR INTERVALS TO CONFIRM THAT WORKERS HAVE NOT EXTENDED CONSTRUCTION BEYOND THE DEMARCATED BOUNDARY.
6. MACHINERY IS TO BE OPERATED FROM SWAMP PADS IF TERRAIN IS TOO UNSTABLE TO SUPPORT MACHINE TRACKS .
7. THE CONTRACTOR MUST NOT OPERATE MACHINERY OUTSIDE OF AREAS SHOWN ON THIS PLAN AND THERE IS TO BE NO WORK WITHIN PARTINGTON CREEK, UNTIL SUCH TIME AS FISH SALVAGE HAS BEEN COMPLETED, SITE IS ISOLATED, AND BYPASS AND DEWATERING HAS BEEN IMPLEMENTED.

INVASIVE PLANT MANAGEMENT:

1. SITE PREPARATION WILL BE UNDERTAKEN ONLY UNDER THE FULL-TIME SUPERVISION OF THE EM.
2. HIMALAYAN BLACKBERRY AND REED CANARY GRASS WILL BE EXCAVATED TO ROOTING DEPTH EXPOSING UNDERLYING MINERAL SOILS THAT ARE FREE OF ROOT MATERIAL.
3. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR DETERMINING THE DEPTH OF THE EXCAVATION NECESSARY TO EXPOSE ROOT FREE SOIL.
4. JAPANESE KNOTWEED HAS BEEN IDENTIFIED AT VARIOUS LOCATIONS ALONG THE EXISTING EMBANKMENT OF PARTINGTON CREEK.
5. THE EM IS RESPONSIBLE FOR FLAGGING THE PERIMETER OF THESE AREAS PRIOR TO VEGETATION OR GROUND DISTURBANCE ACTIVITIES.
6. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING A JAPANESE KNOTWEED REMOVAL AND CONTROL PROGRAM
7. THE CONTRACTOR IS CAUTIONED THAT THE DEPTH AND BREADTH OF EXCAVATION NECESSARY TO REMOVE JAPANESE KNOTWEED IS SUBSTANTIAL.
8. THE CONTRACTOR WILL RETAIN THE SERVICES OF A QUALIFIED PROFESSIONAL WHO CAN ADVISE THE CONTRACTOR ON THE STANDARDS FOR REMOVAL, DEEP BURIAL, AND/OR LEGAL OFFSITE DISPOSAL OPTIONS SO THAT THEY APPROPRIATELY PRICE THIS IMPORTANT COMPONENT OF THE PROJECT.
9. NO CHANGE ORDERS WILL BE ENTERTAINED FOR JAPANESE KNOTWEED REMOVAL, CONTROL AND DISPOSAL, BEYOND THAT AMOUNT SET OUT BY THE CONTRACTOR IN THEIR RESPONSE TO THE PROJECT TENDER.

SOIL STABILIZATION/SEED MIX APPLICATION:

1. IMMEDIATELY UPON COMPLETION OF FINE GRADING, ALL PLANTING AREAS MUST BE STABILIZED PER THE FOLLOWING DESCRIPTION:
2. THE CONTRACTOR WILL APPLY A FULLY BIODEGRADABLE EROSION CONTROL BLANKET ON ALL INSTREAM BENCHES AND EARTHEN SLOPES BELOW THE NEW TOP OF BANK.
3. THE EROSION CONTROL BLANKET (ECB) MUST BE SECURED TO THE GROUND PER MANUFACTURERS SPECIFICATIONS. TO PREVENT SLOPE RILLING, THERE MUST BE NO VOID SPACE BETWEEN GROUND AND THE ECB.
4. ALL PLANTING AREAS NOT COVERED BY THE ECB WILL BE HYDRAULICALLY SEEDED WITH GRASS SEED MIX CONSISTING SOLELY OF CREEPING RED FESCUE (FROM PREMIER PACIFIC SEEDS OR APPROVED ALTERNATE), TACKIFIER AND FERTILIZER.
5. NON-NATIVE RED FESCUE SEED WILL NOT BE ACCEPTED.
6. HYDRAULIC SEEDING MUST NOT INTRODUCE FERTILIZER, SEED OR TACKIFIER INTO THE WETTED PERIMETER OF PARTINGTON CREEK.
7. AREAS TREATED WITH ECB AND HYDRAULIC SEEDING WILL BE WATERED WEEKLY IN THE PERIOD OF AUGUST 1-SEPTEMBER 30 IN THE FIRST YEAR AFTER AFTER SUBSTANTIAL COMPLETION
8. THE CONTRACTOR WILL PROVIDE THE CONTRACT ADMINISTRATOR WITH A RECEIPT FROM THE SEED SUPPLIER IDENTIFYING THE SPECIES OF THE STABILIZATION SEED MIX, FOR APPROVAL, PRIOR TO APPLICATION.

LANDSCAPE NOTES:

1. WARRANTY

1.1. THE PROJECT REQUIRES A TWO YEAR WARRANTY ON ALL SOFTSCAPE WORK.

1.2. THE WARRANTY PHASE WILL COMMENCE AT THE TIME OF SUBSTANTIAL COMPLETION OF THE TOTAL CONTRACT. DURING THIS PHASE THE CONTRACTOR WILL BE RESPONSIBLE FOR MAINTAINING PLANT SURVIVAL AT 80% FOR THE TOTAL NUMBER OF PLANTED TREES AND SHRUBS SHOWN IN THIS PLAN.

1.3. ESTABLISHMENT MAINTENANCE OF SOFT LANDSCAPES IS TO BE PROVIDED FROM TIME OF INSTALLATION TO TWO YEARS FROM SUBSTANTIAL COMPLETION OF WORKS.

1.4. THE CONTRACTOR WILL RETAIN A QEP TO COMPLETE POST CONSTRUCTION PLANT MAINTENANCE INSPECTION TWICE PER ANNUM BY MAY 1 AND SEPTEMBER 1. RESULTS WILL BE REPORTED BY MAY 15 AND SEPTEMBER 15

1.5. THE CONTRACTOR WILL CONTROL COMPETING VEGETATION (I.E. LONG GRASS, INVASIVES ETC) TWICE PER ANNUM BY SOLELY MECHANICAL MEANS.

1.6. THE CONTRACTOR WILL REPLACE, AS REQUIRED, PROTECTIVE SMALL MAMMAL GUARDS ON PLANTED TREE STOCK.

1.7. THE CONTRACTOR WILL WATER PLANTS WEEKLY FROM JUNE 15 TO SEPTEMBER 15 IN THE FIRST SUMMER AFTER PLANT INSTALLATION

1.8. THE CONTRACTOR WILL MAINTAIN SURVIVAL RATES OF AT LEAST 80% FOR TREES, SHRUBS AND SEMI-AQUATICS

1.9. THE CONTRACTOR WILL REPLACE DEAD OR MISSING PLANT MATERIAL IN THE SPRING AND FALL SEASON.

1.10. SHOULD PLANT SURVIVORSHIP TARGETS NOT BE ACHIEVED, THE CONTRACTOR IS REQUIRED TO BEAR THE COSTS OF REPLACEMENT PLANTING AND WHATEVER MAINTENANCE EFFORTS (CONTROL OF COMPETING PLANTS, WATERING, SOIL PREPARATION ETC)

2. PERMITS

2.1. CONTRACTOR TO PROVIDE THE FOLLOWING PERMITS:

REFER TO TENDER DOCUMENTS

3. FIELD LAYOUT AND SURVEY COORDINATION

3.1. SITE LAYOUT TO BE BASED ON TSS (TOTAL STATIONING SURVEY) OR APPROVED EQUAL GPS METHOD TO ENSURE ACCURACY IN LAYOUT.

3.2. SITE LAYOUT AND SURVEY FILES CAN BE PROVIDED TO THE CONTRACTOR IN AUTOCAD FORMAT AT THE TIME OF CONSTRUCTION START-UP.

4. SITE MOBILIZATION, STAGING, AND SAFETY

4.1. PROVIDE MOD-U-LOCK FENCE OR APPROVED EQUAL AROUND THE LIMIT OF CONSTRUCTION AND PROTECT THE SITE AT ALL TIMES FROM PUBLIC ACCESS.

4.2. PROVIDE INFORMATION ON INTENDED SITE STORAGE AND STAGING AREA(S) AND HAULING AT CONSTRUCTION START-UP. IF STORAGE OR STAGING AREA(S) ARE TO BE MOVED BETWEEN DIFFERENT PHASES OF WORK, INFORM OWNER AND CONTRACT ADMINISTRATOR AT CONSTRUCTION START-UP WITH MARKED UP PLANS.

4.3. PROVIDE PROOF OF A BC-ONE (BC-1) CALL AT THE TIME OF CONSTRUCTION START-UP MEETING.

4.4. ENSURE ESC (EROSION AND SEDIMENT CONTROL) MEASURES HAVE BEEN REVIEWED PRIOR TO COMMENCING DEMOLITION OR EXCAVATION WORKS OF THE SITE. AMEND ANY ESC RELATED REQUESTS FROM THE EM IMMEDIATELY. PROVIDE PHOTO PROOF AND EMAIL CONFIRMATION TO THE CONTRACT ADMINISTRATOR AND ENVIRONMENTAL CONSULTANT FOR APPROVAL PRIOR TO COMMENCING WORK.

4.5. ENSURE TREE PROTECTION FENCING HAS BEEN REVIEWED PRIOR TO COMMENCING WORK.

5. SOFT LANDSCAPES

5.1. SOFT LANDSCAPE SUPPLY, SUBMITTALS, PREPARATION AND EXECUTION TO COMPLY WITH CANADIAN LANDSCAPE STANDARD (BRITISH COLUMBIA). FULL DOCUMENT APPLIES.

5.2. ENSURE CONTRACTOR INSTALLING SOFT LANDSCAPES HAS A CURRENT COPY OF THE CANADIAN LANDSCAPE STANDARD (BRITISH COLUMBIA) PRESENT ON SITE.

5.3. SUBMIT REQUEST FOR REVIEW BY CONSULTANT OF SITE SOFT LANDSCAPE FINE GRADING PRIOR TO INSTALLATION OF PLANT MATERIAL.

5.4. PLANTS AND TREES:

5.4.1. PROVIDE CONSULTANT WITH OPPORTUNITY TO REVIEW PLANT STOCK AT NURSERY PRIOR TO SHIPMENT TO SITE. CONSULTANT RESERVES RIGHT TO REJECT STOCK ON SITE WHEN INCONSISTENT FROM NURSERY SAMPLE STOCK. PROVIDE CONSULTANT OPPORTUNITY TO REVIEW TREES AT NURSERY AND TAG PREFERRED TREE STOCK FOR THE PROJECT THAT COMPLIES WITH DRAWING SIZE, SPECIES, AND FORM. ONE (1) WEEK NOTICE IS REQUIRED FOR NURSERY REVIEW.

5.4.2. PLANTS TO BE WELL-ESTABLISHED AND UNIFORM IN SIZE. ALL PLANTS TO CONFORM TO THE STANDARDS SPECIFIED IN THE LATEST EDITION OF THE CANADIAN LANDSCAPE AND NURSERY ASSOCIATION STANDARD.

5.4.3. GROWING MEDIUM AS PER SPECIFICATION. GROWING MEDIUM DEPTHS AS PER CONSTRUCTION DETAILS. ALL GROWING MEDIUM TO CONFORM TO CITY OF COQUITLAM SUPPLEMENTARY SPECIFICATIONS AND DETAIL DRAWINGS. CONTRACTOR TO PROVIDE CONSULTANT WITH 1 LITER SAMPLE OF GROWING MEDIUM, FROM IDENTICAL SOURCE AS WILL BE USED ON SITE, AT LEAST 6 WEEKS PRIOR TO INSTALLATION

5.4.4. SUBMIT GROWING MEDIUM REPORT FOR REVIEW PRIOR TO ORDER OR INSTALLATION. REPORT TO MATCH TABLE 2, SECTION 2.11, SUPPLEMENTAL SPECIFICATION 32 92 02. ADDITIONAL GROWING MEDIUM REPORT REQUIREMENTS ARE PROVIDED IN PROJECT SPECIFICATIONS.

5.4.5. ALL PLANTING TO OCCUR IN THE PERIOD OF MARCH 15 TO MAY 1

5.4.6. ALL TREES TO BE FITTED WITH PROTECTIVE SHEATHING TO PREVENT MUSKRAT AND BEAVER DAMAGE

5.5. MULCH:

5.5.1. TO BE COMPOSTED BARK, BROWN (NOT RED) IN COLOUR.

5.5.2. MULCH TO BE COMPLIANT WITH SUPPLEMENTAL SPECIFICATION 32 92 02, SECTION 2.1.4.

5.5.3. A ONE (1) LITRE MULCH SUBMITTAL IS REQUIRED FOR APPROVAL PRIOR TO PURCHASE AND INSTALLATION.

5.5.4. DEPTH OF MULCH TO BE 100mm AFTER SETTLEMENT WITH COMPLETE COVERAGE.

5.5.5. PROVIDE MULCH RING OF 1.2M DIAMETER AND COMPLIANT WITH BC LANDSCAPE STANDARDS FOR EACH NEW TREE.

5.6. THE CONSULTANT MAY REQUEST, AT THE CONTRACTOR'S EXPENSE, UP TO TWO TESTS OF GROWING MEDIUM IF SUSPECTED INCONSISTENCIES APPEAR. TESTS SAMPLES WILL BE SUBMITTED TO PACIFIC SOIL ANALYSIS INC. IN RICHMOND BC. SUITE 5 11720 VOYAGEUR WAY, RICHMOND, BC, V6X 3G9.

5.7. ESTABLISHMENT MAINTENANCE AND WATERING: REFER TO SECTION 1.0 OF THESE LANDSCAPE NOTES.

6. STREAM BED INSTALLATION

6.1. INSTALLATION OF CHANNEL SUBSTRATE AND THALWEG TO OCCUR UNDER FULL-TIME SUPERVISION OF EM

PLOT DATE: June 16, 2022

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DRAFT ENVIRONMENTAL PLAN	21/04/19	GC	CJB
B	DETAILED DESIGN	21/06/01	GC	CJB
C	UPDATED DETAILED DESIGN	21/07/21	GC	CJB
D	REVISED DETAILED DESIGN	22/05/11	GC	CJB

Coquitlam
Engineering & Public Works
3000 Guildford Way, Coquitlam, B.C. V3B 7N2

PARTINGTON CREEK ENHANCEMENT HABITAT
OFF-SETTING/PLANTING NOTES

ISL Engineering and Land Services
#503, 4190 Lougheed Hwy, Burnaby, B.C. V5C 6A8
T: (604)629-2696 F: (604)629-2698

DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Jun-22
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	KPT	APPROVED BY	KPT

DWG. NO. 43 OF 54
REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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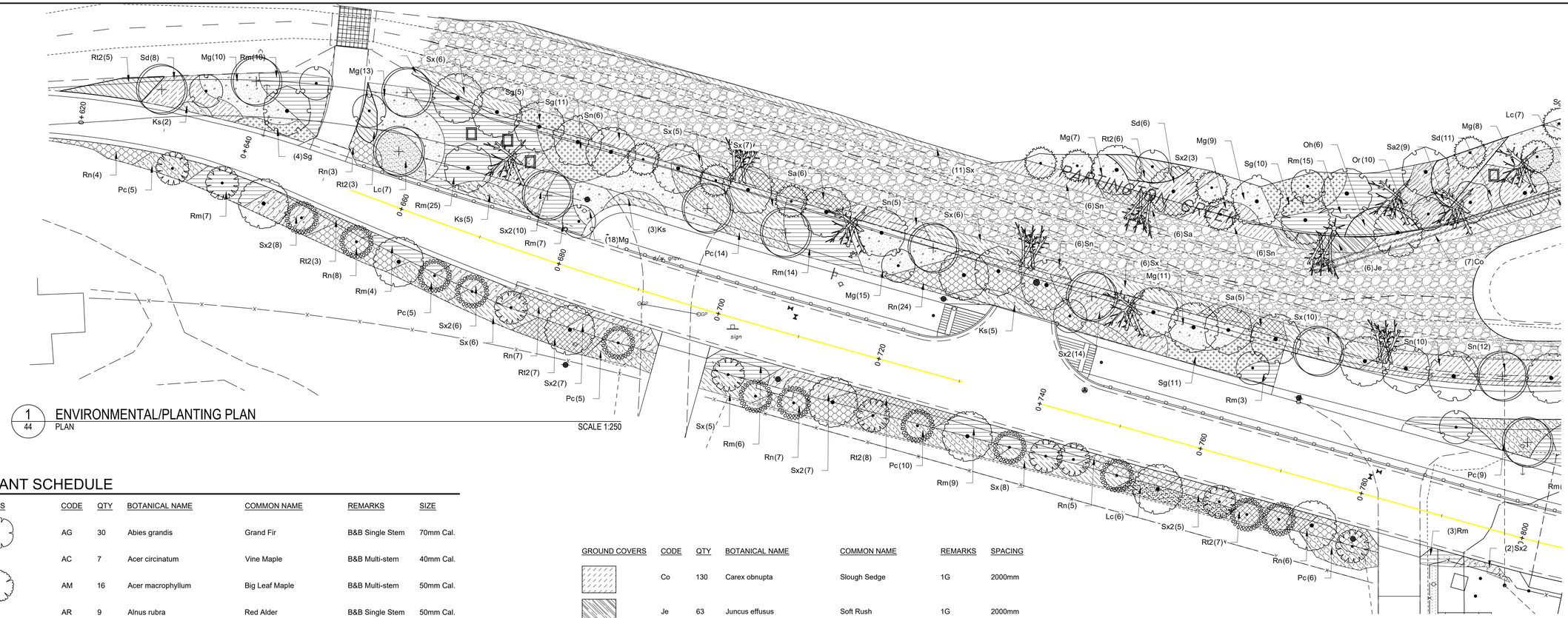

1
44
ENVIRONMENTAL/PLANTING PLAN
PLAN

SCALE 1:250

PLANT SCHEDULE

TREES	CODE	QTY	BOTANICAL NAME	COMMON NAME	REMARKS	SIZE
	AG	30	Abies grandis	Grand Fir	B&B Single Stem	70mm Cal.
	AC	7	Acer circinatum	Vine Maple	B&B Multi-stem	40mm Cal.
	AM	16	Acer macrophyllum	Big Leaf Maple	B&B Multi-stem	50mm Cal.
	AR	9	Alnus rubra	Red Alder	B&B Single Stem	50mm Cal.
	AI	73	Alnus sinuata	Sitka alder	B&B Multi-stem	30mm Cal.
	BP	31	Betula papyrifera	Paper Birch	B&B Single Stem	40mm Cal.
	CN	16	Cornus nuttallii	Pacific Dogwood	B&B Single Stem	40mm Cal.
	CS	52	Cornus stolonifera	Red Twig Dogwood	#5 POT	
	CD	11	Crataegus douglasii suksdorfii	Black Hawthorn	#5 POT	
	MP	13	Malus fusca	Oregon Crab Apple	B&B Single Stem	50mm Cal.
	PS	36	Picea sitchensis	Sitka Spruce	B&B Single Stem	50mm Cal.
	PD	85	Pseudotsuga menziesii	Douglas Fir	B&B Single Stem	50mm Cal.
	RP	60	Rhamnus purshiana	Cascara	B&B Single Stem	50mm Cal.
	TP	109	Thuja plicata	Western Red Cedar	B&B Single Stem	70mm Cal.
	TH	17	Tsuga heterophylla	Western Hemlock	B&B Single Stem	50mm Cal.

SHRUB AREAS	CODE	QTY	BOTANICAL NAME	COMMON NAME	REMARKS	SIZE	SPACING
	Oh	120	Oplopanax horridus	Devil's Club	#2 Pot		2000mm
	Pm	78	Polystichum munitum	Western Sword Fern	#2 Pot		2000mm
	Rt2	390	Rubus parviflorus	Thimbleberry	#2 Pot		2000mm
	Sa2	26	Symphoricarpos albus	Common White Snowberry	#2 Pot		2000mm
	Ud	21	Urtica dioica	Stinging Nettle	#2 Pot		2000mm

GROUND COVERS	CODE	QTY	BOTANICAL NAME	COMMON NAME	REMARKS	SPACING
	Co	130	Carex obnupta	Slough Sedge	1G	2000mm
	Je	63	Juncus effusus	Soft Rush	1G	2000mm
	Ks	136	Kalmia microphylla occidentalis	Western Bog Laurel	2G	2000mm
	Lc	111	Lonicera ciliosa	Orange Honeysuckle	1G	2000mm
	Mg	415	Myrica gale	Sweetgale	3G	2000mm
	Or	47	Oemleria cerasiformis	Indian Plum	3G	2000mm
	Pc	342	Physocarpus capitatus	Pacific Ninebark	2G	2000mm
	Rm	435	Rhododendron macrophyllum	Pacific Rhododendron	3G	2000mm
	Rn	389	Rosa nutkana	Nootka Rose	2G	2000mm
	Sn	209	Salix hookeriana	Hooker's Willow	Live Stake	2000mm
	Sx	401	Salix x `Scouleriana`	Scouler`s Willow	Live Stake	2000mm
	Sg	110	Sambucus racemosa	Red Elderberry	2G	2000mm
	Sa	138	Scirpus acutus	Hardstem Bulrush	5 gal	2000mm
	Sm	127	Scirpus microcarpus	Small-fruited Bulrush	1G	2000mm
	Sd	211	Spiraea douglasii	Western Spirea	3G	2000mm
	Sx2	388	Symphoricarpos x albus	Common Snowberry	150mm Pot	2000mm

LEGEND

SYMBOL	DESCRIPTION
	COARSE WOODY DEBRIS
	LARGE WOODY DEBRIS TYPE 1
	LARGE WOODY DEBRIS TYPE 2
	BAT BOX
	GRAVEL AND BOULDERS
	THALWEG

1:500 0 10 30m

PLOT DATE: June 16, 2022

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DRAFT ENVIRONMENTAL PLAN	21/04/19	GC	CJB
B	DETAILED DESIGN	21/06/01	GC	CJB
C	UPDATED DETAILED DESIGN	21/07/21	GC	CJB
D	REVISED DETAILED DESIGN	22/05/11	GC	CJB

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DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Jun-22
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DWG. NO. 44 OF 54 REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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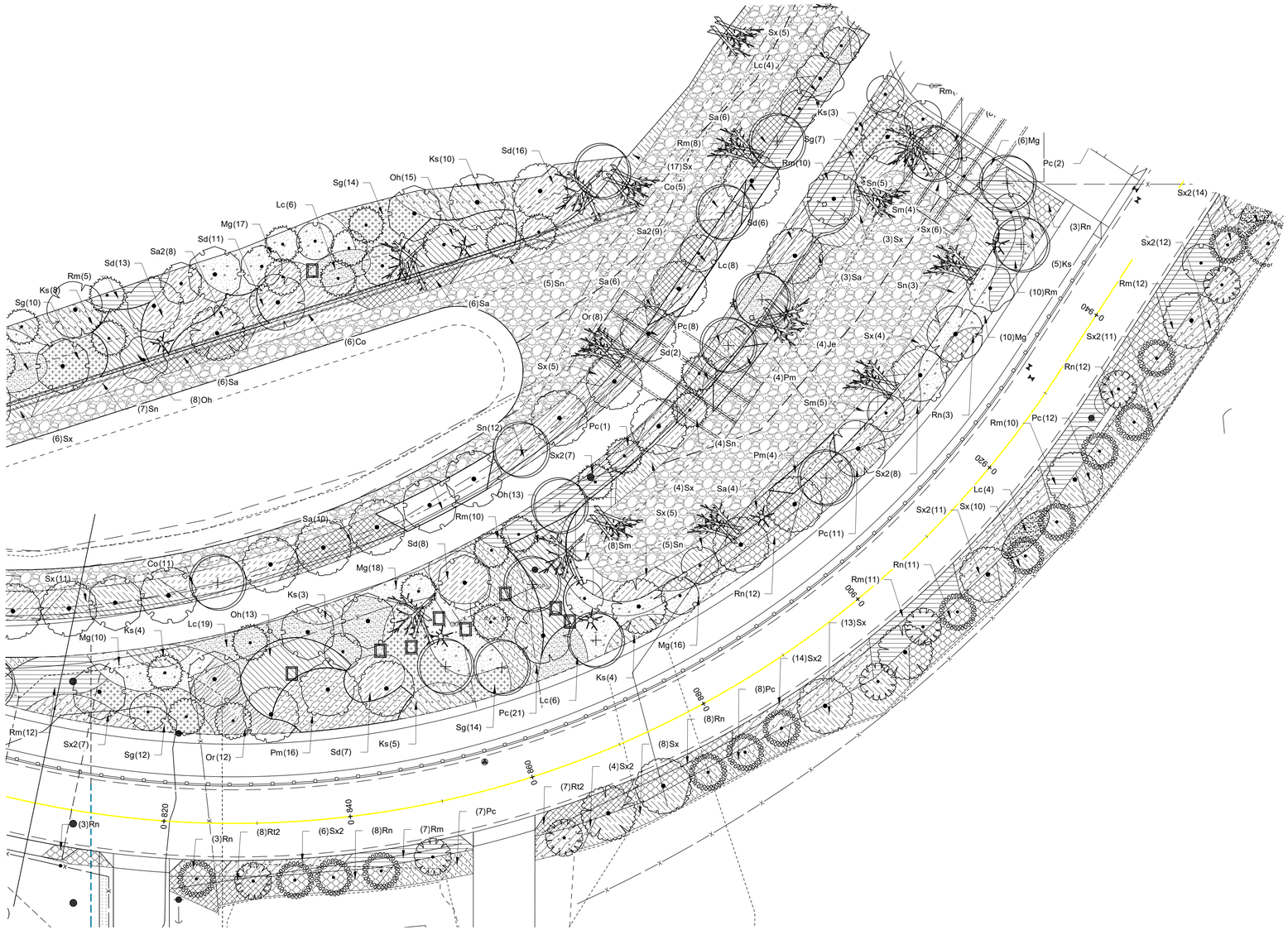

LEGEND	
SYMBOL	DESCRIPTION
	COARSE WOODY DEBRIS
	LARGE WOODY DEBRIS TYPE 1
	LARGE WOODY DEBRIS TYPE 2
	BAT BOX
	GRAVEL AND BOULDERS
	THALWEG

1 / 45 ENVIRONMENTAL/PLANTING PLAN

PLAN

SCALE 1:250

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PLOT DATE: June 16, 2022

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DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Jun-22
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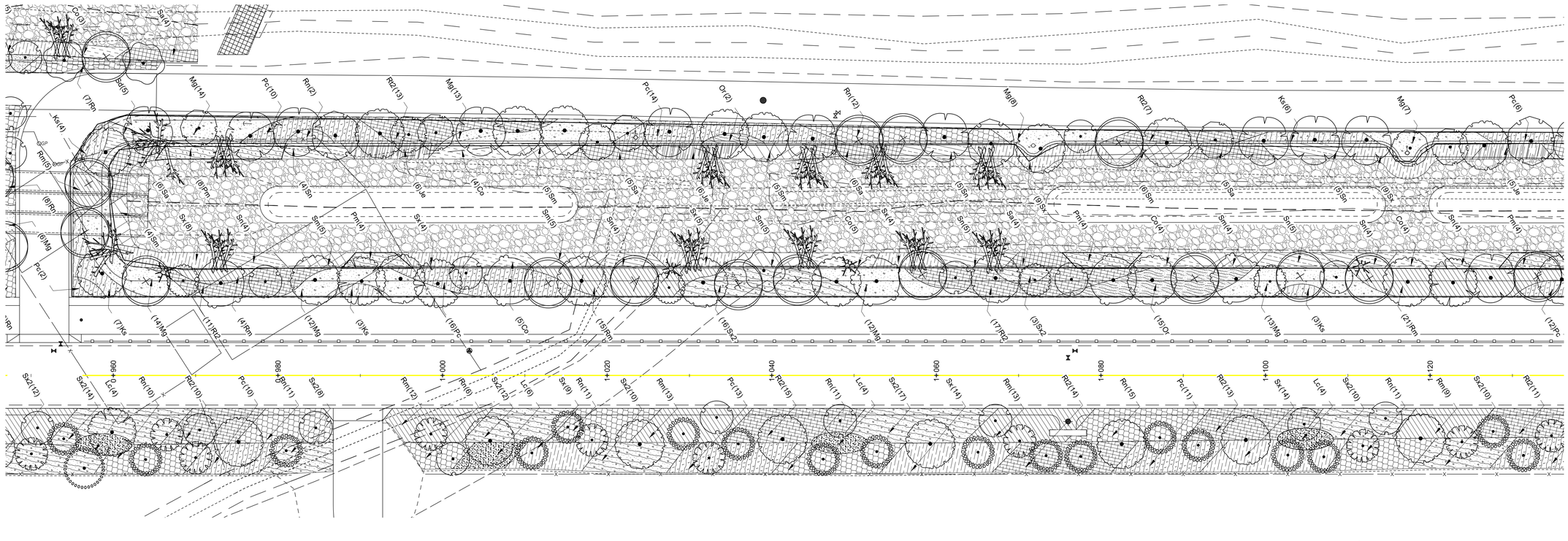
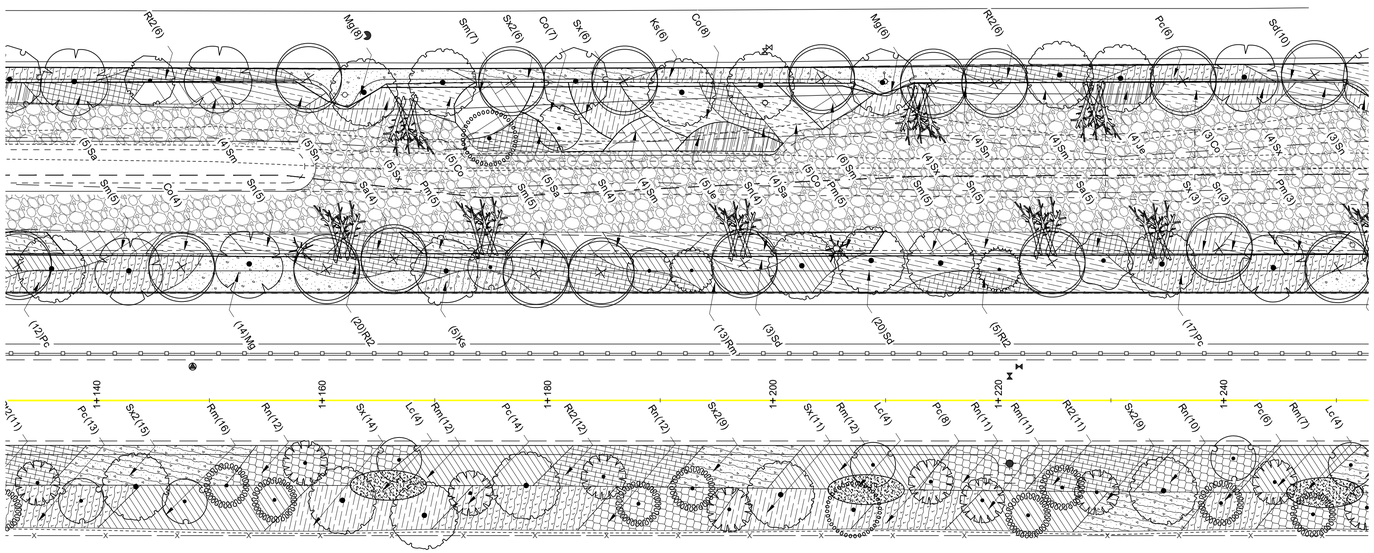
CHECKED BY	KPT	APPROVED BY	KPT

DWG. NO. 45 OF 54

REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.





1:250 0 5 15m

LEGEND	
SYMBOL	DESCRIPTION
	COARSE WOODY DEBRIS
	LARGE WOODY DEBRIS TYPE 1
	LARGE WOODY DEBRIS TYPE 2
	BAT BOX
	GRAVEL AND BOULDERS
	THALWEG

1 / 46 ENVIRONMENTAL/PLANTING PLAN
PLAN

SCALE 1:250

File: G:\Projects\32000\32600\32628_COQ_Cedar_Drive_Upgrades\02_CAD\20_Drafting\203_Sheets\32628_SH_Environmental_Planting_revised plant sizes.dwg

PLOT DATE: June 16, 2022

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DRAFT ENVIRONMENTAL PLAN	21/04/19	GC	CJB
B	DETAILED DESIGN	21/06/01	GC	CJB
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D	REVISED DETAILED DESIGN	22/05/11	GC	CJB

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DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Jun-22
DRAWN BY	GC	DESIGN BY	CJB
CHECKED BY	KPT	APPROVED BY	KPT

DWG. NO. 46 OF 54
REV. F

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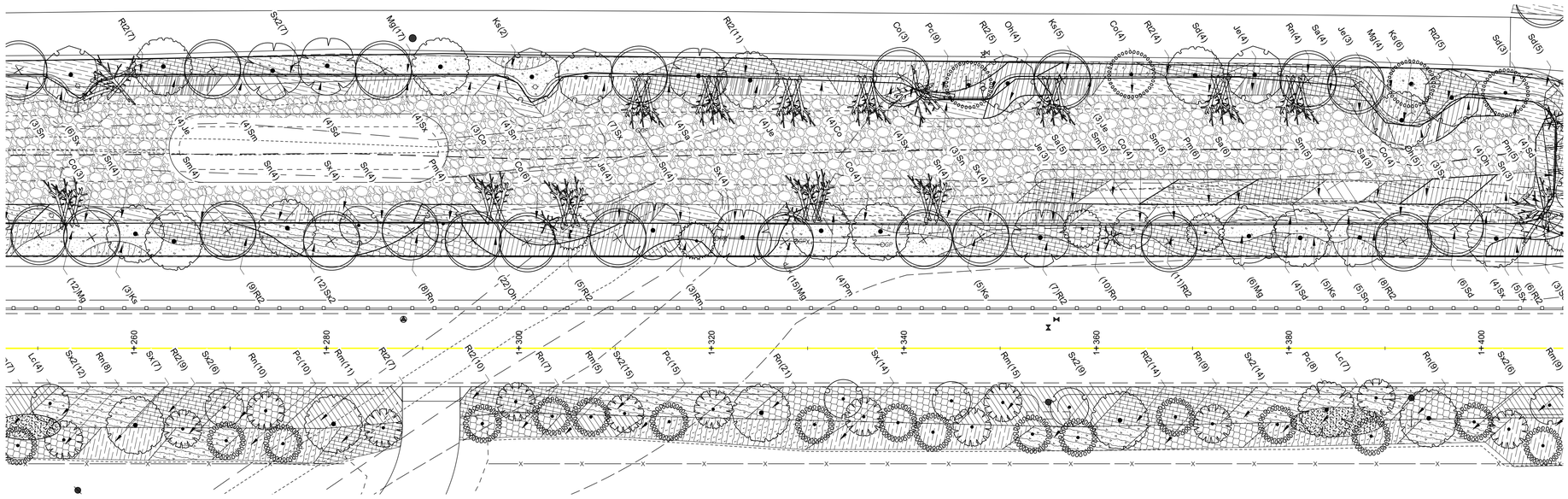

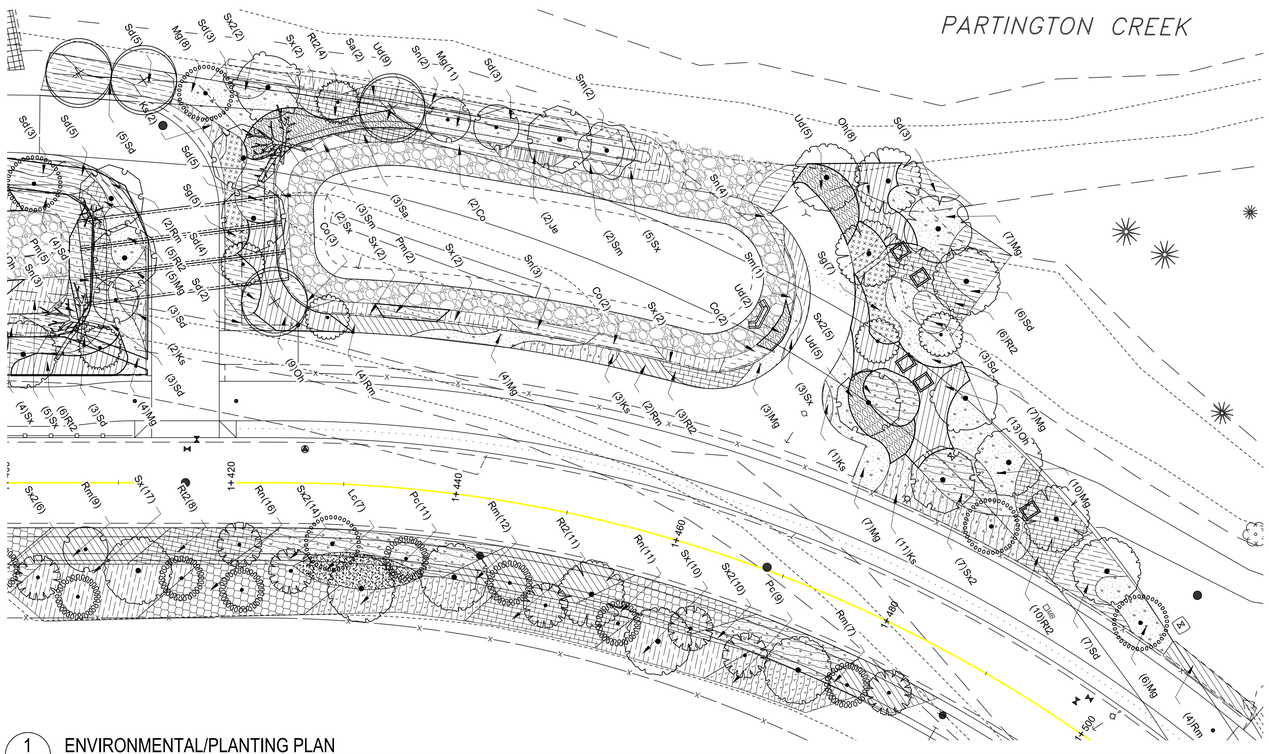

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N

LEGEND

SYMBOL	DESCRIPTION
	COARSE WOODY DEBRIS
	LARGE WOODY DEBRIS TYPE 1
	LARGE WOODY DEBRIS TYPE 2
	BAT BOX
	GRAVEL AND BOULDERS
	THALWEG

1/47 ENVIRONMENTAL/PLANTING PLAN
PLAN

SCALE 1:250

PLOT DATE: June 16, 2022

DETAILED DESIGN DESIGN NO. 32628

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DRAFT ENVIRONMENTAL PLAN	20/06/30	GA	CJB
B	DETAILED DESIGN	21/06/01	GC	CJB
C	DETAILED REVISED DESIGN	21/07/21	GC	CJB
D	REVISED DETAILED DESIGN	22/05/11	GC	CJB

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PARTINGTON CREEK ENHANCEMENT HABITAT
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SCALE	AS SHOWN	DATE	Jun-22
DRAWN BY	GC	DESIGN BY	CJB
CHECKED BY	KPT	APPROVED BY	KPT

DWG. NO. 47 OF 54
REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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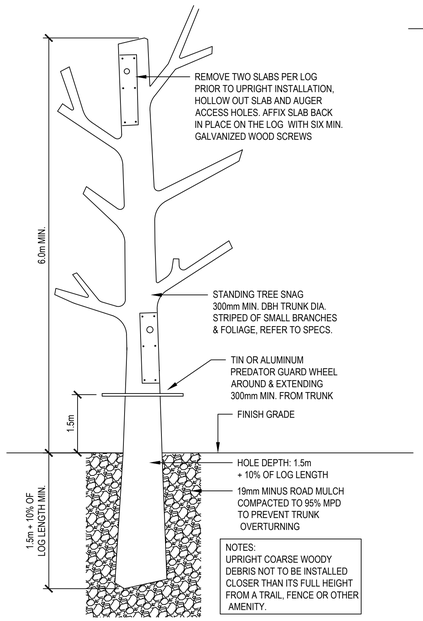

5 / 48 COARSE WOODY DEBRIS TYPE 2
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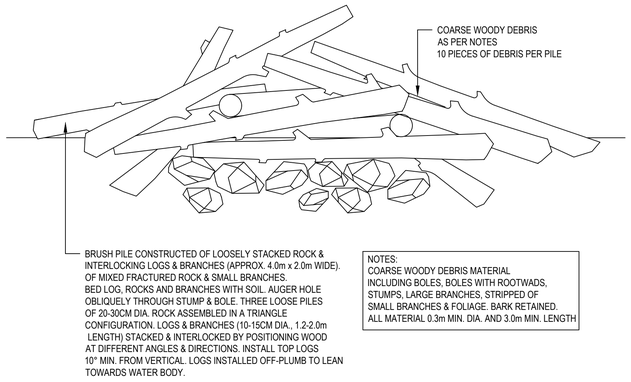

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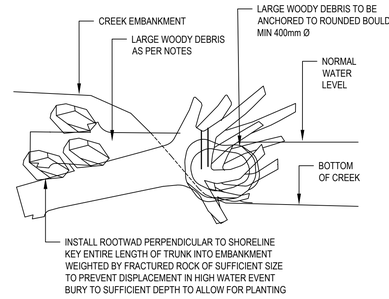
ELEVATION SCALE 1:20



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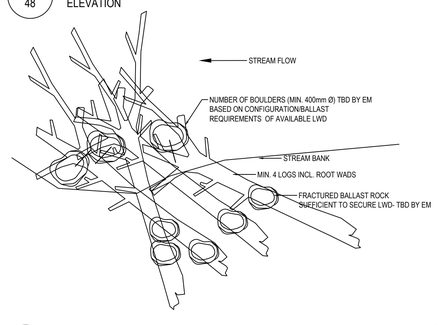
ELEVATION SCALE 1:20



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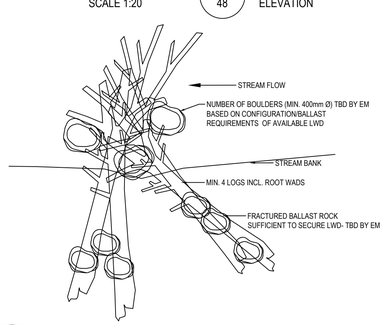
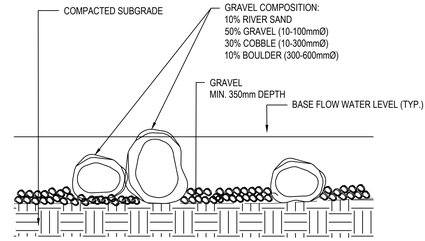
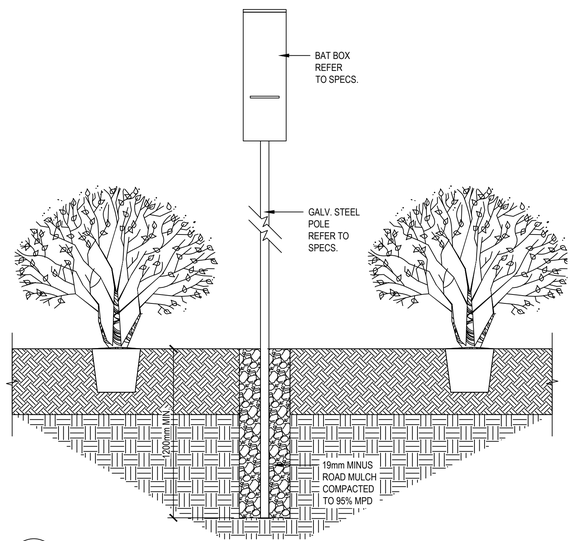


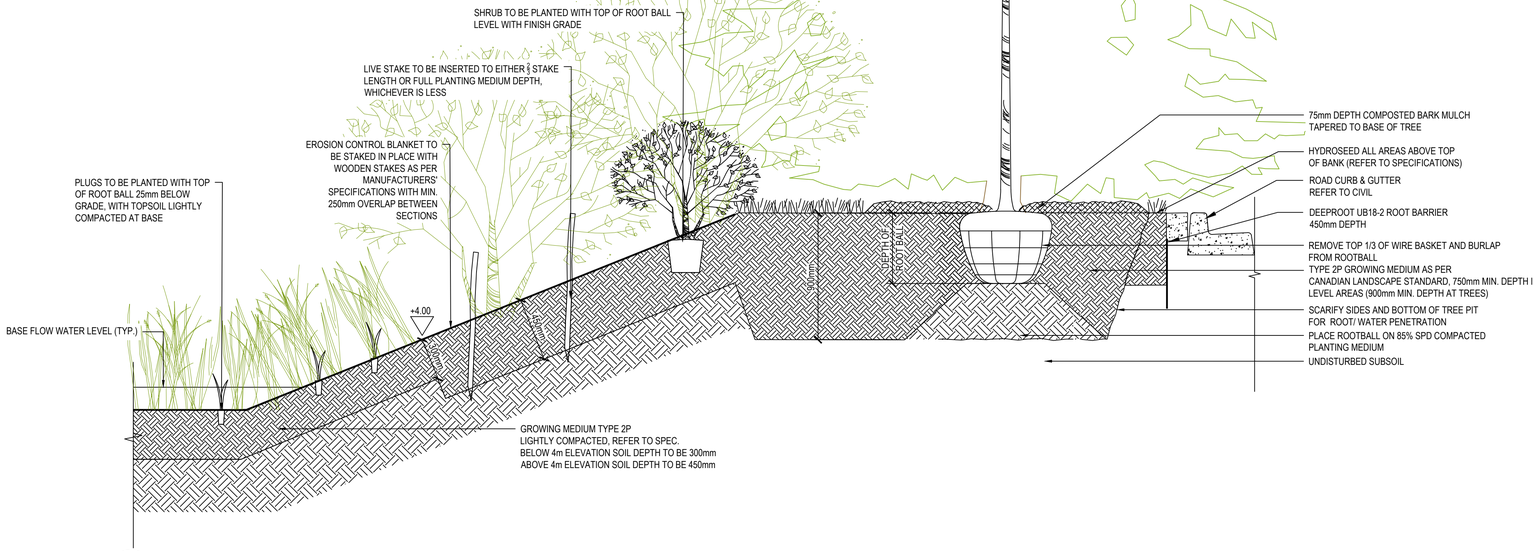
4 / 48 LARGE WOODY DEBRIS TYPE 1 (TRIANGULAR)
PLAN SCALE 1:40



6 / 48 CHANNEL SUBSTRATE
SECTION SCALE 1:20



7 / 48 BAT BOX
ELEVATION SCALE 1:20



8 / 48 PLANTING DETAIL
SECTION SCALE 1:20

PLOT DATE: June 16, 2022

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DRAFT ENVIRONMENTAL PLAN	20/06/30	GA	CJB
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D	REVISED DETAILED DESIGN	22/05/11	GC	CJB

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PARTINGTON CREEK ENHANCEMENT HABITAT
ENVIRONMENTAL/PLANTING PLAN

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SCALE	AS SHOWN	DATE	Jun-22
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DWG. NO. 48 OF 54
REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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1 / 49 COARSE WOODY DEBRIS
PHOTO NTS

2 / 49 LARGE WOODY DEBRIS
PHOTO NTS

3 / 49 COARSE WOODY DEBRIS TYPE 2
PHOTO NTS

4 / 49 CHANNEL SUBSTRATE
PHOTO NTS

5 / 49 BAT BOX
PHOTO NTS

6 / 49 LIVE STAKE
PHOTO NTS

File: G:\Projects\32000\32600\32628_COQ_Cedar_Drive_Upgrades\02_CAD\D20_Drafting\203_Sheets\32628_SH_Environmental_Planting_revised plant sizes.dwg

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D	FINAL DETAILED DESIGN	22/05/11	GC	CJB

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PARTINGTON CREEK ENHANCEMENT HABITAT
ENVIRONMENTAL/PLANTING REFERENCE PHOTOS

ISL Engineering and Land Services
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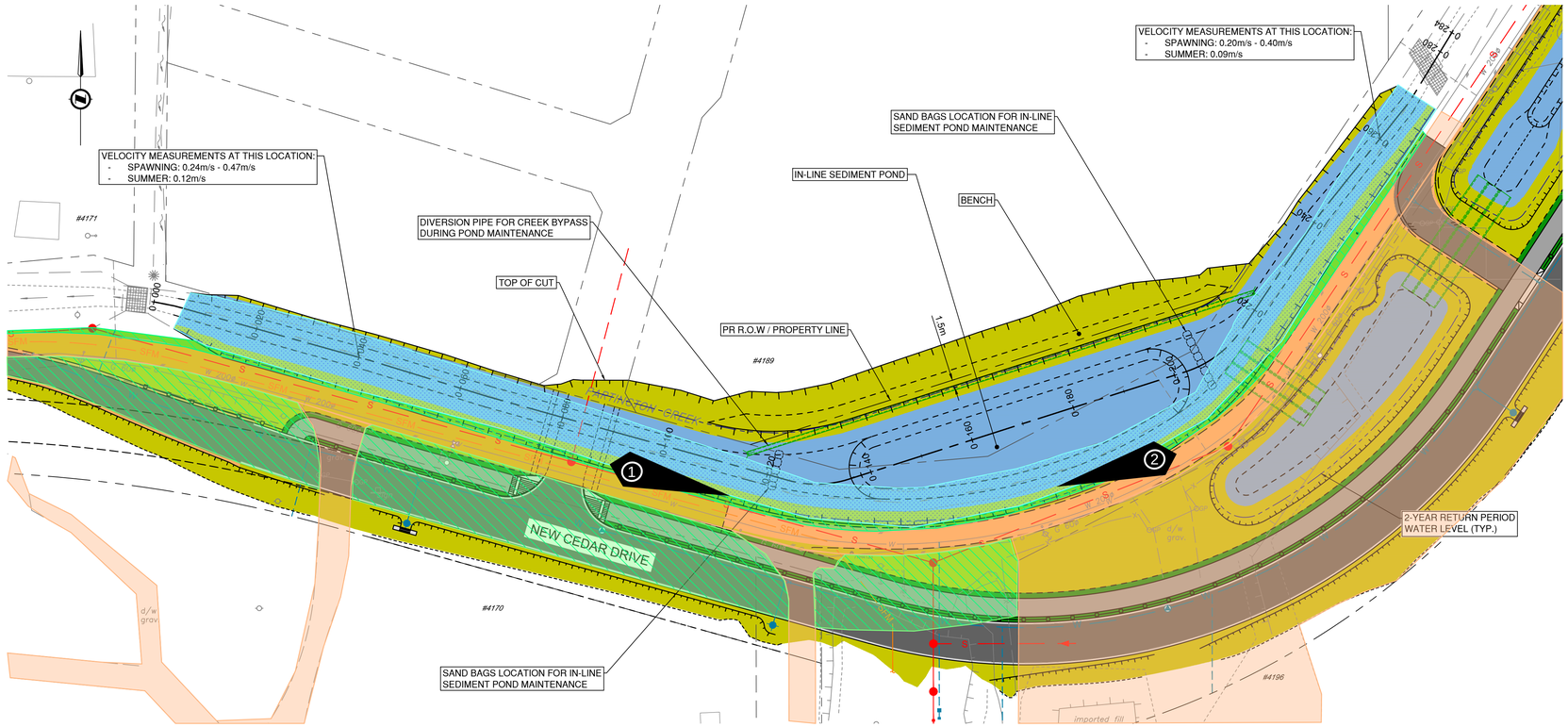
DWG. NO. 49 OF 54 REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

APPENDIX H
Annotated Effect Drawing



LEGEND

- PERMENANT AND TEMPORAL RIPARIAN EFFECT
- PERMINENT AND TEMPORAL INSTREAM EFFECT
- EXISTING PERMENANT STRUCTURES
- RIPARIAN MITGATION/OFFSETTING
- INSTREAM MITGATION/OFFSETTING
- BOULIVARD 150 mm TOPSOIL AND SOD
- ROAD SURFACE
- MULTI-USE PATH / ASPHALT DRIVEWAY
- SHOULDER / GRAVEL DRIVEWAY
- CONCRETE

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW

SCALE 1:500

Figure 1. Upstream view of Partington Creek at the in-line sediment pond. Note vegetation to be removed primarily Himalayan Blackberry and Japanese knotweed.

Figure 2. Downstream view of Partington Creek at the in-line sediment pond.

1:500 0 10 30m

PLOT DATE: July 8, 2021

DETAILED DESIGN DESIGN NO. 32628

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/08	GA	CJB/ND

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PARTINGTON CREEK AND IN-LINE POND
ENVIRONMENTAL ANNOTATED DESIGN

ISL Engineering and Land Services
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SCALE	AS SHOWN	DATE	Apr-21
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ENV. DWG. 01 OF 03 REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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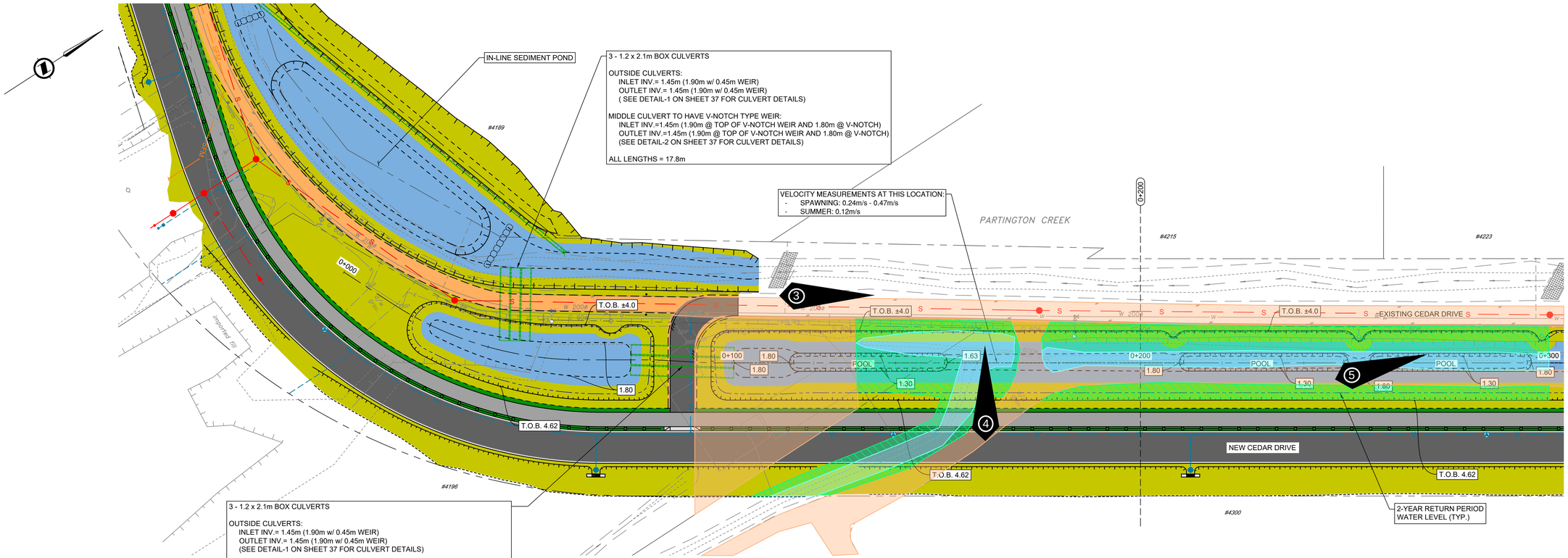

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT

PLAN VIEW

SCALE 1:500

Figure 3. Lack of riparian habitat southeast of Partington Creek and the existing Cedar Drive. Photo facing northeast.

Figure 4. Upstream view of Ditch 1. Note lack of functional riparian habitat.

Figure 5. Upstream view of Ditch 1. Note heavy blackberry to the northwest and agricultural field to the southeast.

1:500 0 10 30m

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OFF-CHANNEL WORKS
ENVIRONMENTAL ANNOTATED DESIGN

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T: (604)629-2696 F: (604)629-2698

SCALE	AS SHOWN	DATE	Apr-21
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ENV. DWG. 02 OF 03
REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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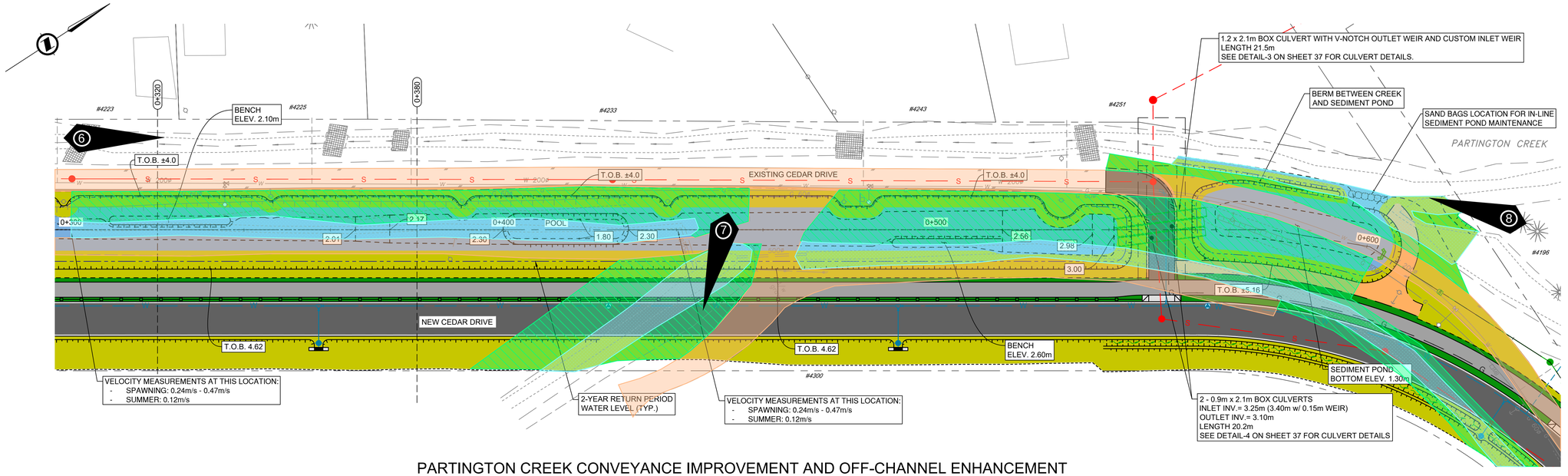

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW

SCALE 1:500

Figure 6. Upstream view of Partington creek at 4223 Cedar Drive. Note Riparian condition and invasive species.

Figure 7. Ditch 2 south of existing Cedar Drive surrounded by agricultural fields.

Figure 8. Downstream view of Partington Creek at upper sediment pond area.

1:500 0 10 30m

DETAILED DESIGN DESIGN NO. 32628

PLOT DATE: July 8, 2021

REV NO	REVISIONS	DATE	DRAWN	APPR'D
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OFF-CHANNEL WORKS
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ENV. DWG. 03 OF 03
REV. B

DESTROY ALL PRINTS BEARING PREVIOUS NO.

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APPENDIX I

Partington Creek Hydraulic Assessment Report

201-3999 Henning Drive, Burnaby, BC V5C 6P9, T: 604.629.2696 F: 604.629.2698

April 21, 2022

Our Reference: 32628

City of Coquitlam
3000 Guildford Way,
Coquitlam, BC V3B 7N2

Attention: Nadeem Kazmi

Dear Sir:

Reference: Cedar Drive Upgrades – Stormwater Modelling Technical Memorandum

1.0 Introduction

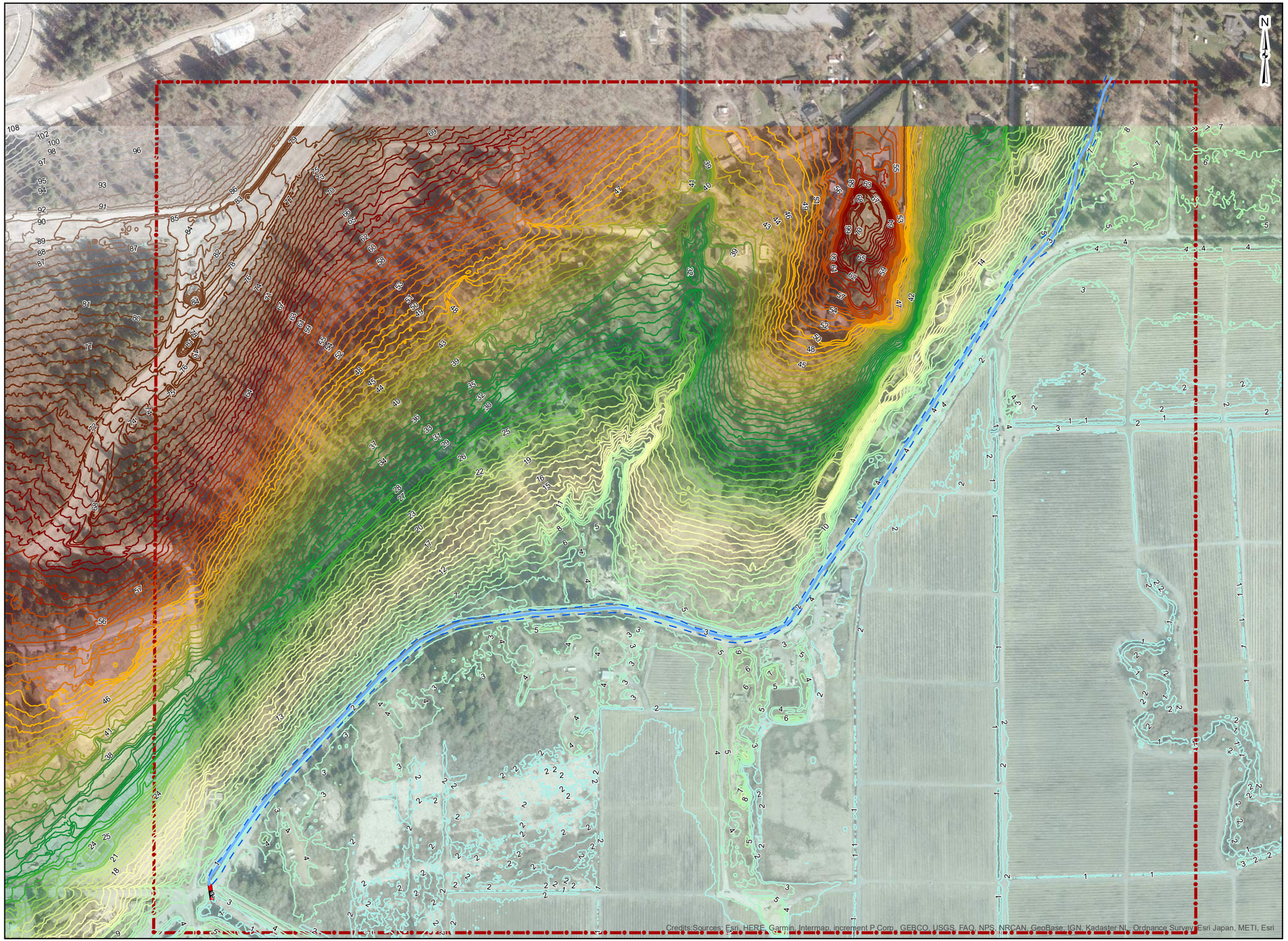
The Cedar Drive Upgrades project was initiated by the City of Coquitlam (the City) and is being undertaken by ISL Engineering and Land Services Ltd. (ISL) to provide feasibility assessments, preliminary and detailed design, tendering, and limited construction services. The project is defined by three sections, and requires work pertaining to Roadworks, Drainage Improvements, and Sanitary/Water upgrades. The three sections are as follows:

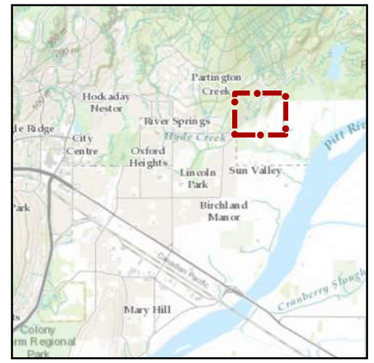
- **Section 1** – from Gilleys Trail to the in-line sediment pond at the Polygon site (4189 Cedar Drive)
- **Section 2** – from the in-line sediment pond to the west side of the Polygon site
- **Section 3** – from west side of the Polygon site to Victoria Drive

Section 1 includes a riparian area and overflow for Partington Creek (referred to herein as the Channel), which is the focus of this memorandum. The purpose of this memorandum is to provide some context on the stormwater modelling exercise that was undertaken to design the Channel.

The Channel is planned to be situated on the southeast side of the old Cedar Drive alignment, from the Edwards Street right-of-way to approximately 4189 Cedar Drive. At the upstream end of the Channel is a sediment pond, while at the downstream end there is a sediment pond that is in-line with Partington Creek (the Creek).

The study area and topography are illustrated in Figure 1.1.





Legend

- Partington Creek Alignment
- Creek Banks
- 2700mm CMP Culvert
- Study Area

Elevation (m)

High : 112.561

Low : 0.281374

0 50 100 200 Meters

1:4,500 NAD 1983 UTM Zone 10N

FIGURE 1.1
STUDY AREA AND TOPOGRAPHY
CEDAR DRIVE UPGRADES

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2.0 Modelling Approach

2.1 Computer Model

The computer software selected for the purposes of this project was PCSWMM Professional 2D (x64) version 7.4.3240 by CHI. PCSWMM generates accurate and intuitive models for robust stormwater management. It incorporates a powerful GIS engine that works seamlessly with the latest GIS data formats, which allows for efficient data processing, model accuracy, and aids to streamline workflow. PCSWMM accounts for various hydrologic and hydraulic processes. In addition to this, PCSWMM features an enhanced graphical user interface that facilitates an easy review of models and allows for customized graphical output.

Based on the simulation, the model can be used to evaluate post-development flows and velocities to assess potential stormwater constraints, identify any downstream impacts, and ensure riparian conditions are met to provide a healthy ecosystem for wildlife. A copy of all modelling scenarios has been provided to the City for their use, as included in Appendix A.

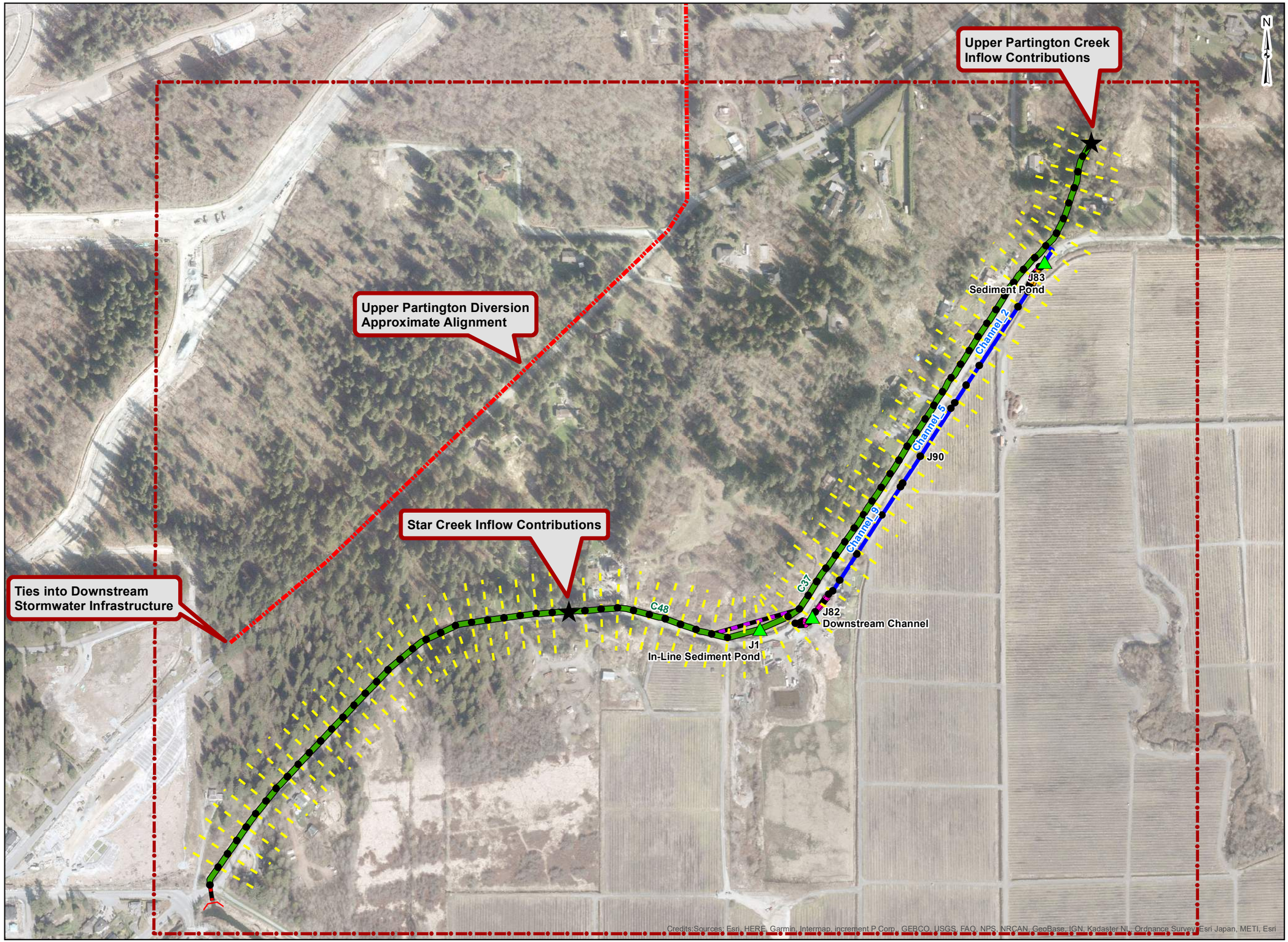
2.2 Model Set-Up

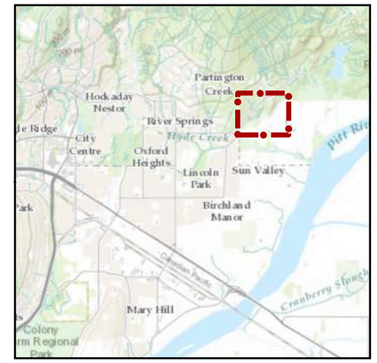
In lieu of the previously built model, which was unavailable for this project, the stormwater model was developed from scratch. An existing condition model was first developed, constituting only Partington Creek. The surveyed alignment of the Creek was imported to the model and divided into 20 m segments from Gilleys Trail to the culvert connecting Partington Creek to DeBoville Slough. Transects were created at each of the 20 m segments to represent the general cross-section for that portion of the Creek.

The culvert at the downstream end of the Creek was also included in the model, as a 15.25 m long, 2700 mm diameter corrugated metal pipe (CMP). To account for tidal conditions at the downstream end of the culvert, many of the scenarios were run with a fixed tailwater elevation to represent high tide. Conversely, low tide was modelled as a free outfall. The fixed tailwater elevation scenarios were applied a tailwater elevation of 2.89 m, which was obtained from the Simulating the Effects of Sea Level Rise and Climate Change on Fraser River Flood Scenarios Final Report (BC Ministry of Forests, Lands and Natural Resource Operations, 2014). This elevation represents the 1:50-year return period winter storm at the Fraser and Pitt River. The value represents the combination of tidal and river flows. Though the value is conservative, it is also at a location downstream of the culvert, thus considered reasonable.

The detailed design drawings were used to set up the model, which are included in Appendix B. An overland link was added to tie Partington Creek to the sediment pond. The sediment pond ties to the Channel via three culverts: one low-flow fish passable 2.1 m x 1.2 m box culvert with a v-notch outlet weir and a custom inlet weir; and two 2.1 m x 0.9 m box culverts with transverse inlet weirs. The Channel itself is divided into segments like the Creek to account for the changes in cross-section, slope and depth. Downstream of the Channel, three 2.1 m x 1.2 m box culverts connect to another section of the Channel due to a road crossing. The middle box culvert is equipped with a v-notch weir at both ends, while the other two have transverse weirs at the outlet and inlet. Three more 2.1 m x 1.2 m box culverts with v-notch weirs at the middle barrel and the transverse weirs at the outside barrels tie the Channel to the in-line sediment pond. There is a 600 mm diversion culvert upstream of the in-line sediment pond within Partington Creek, to provide a bypass route to the downstream end of the in-line sediment pond during maintenance. A schematic of the model is illustrated in Figure 2.1.

The Upper Victoria Diversion north of Partington Creek was excluded from the model. The proposed alignment ties into the system to the west of Freemont Park and has a separate discharge point into the slough. Thus, this diversion pipe would not impact the design of the Channel. That said, the location of this diversion pipe is shown on Figure 2.1 for context.





Legend

- Junctions
- Facilities
- Inflow Locations
- Transects
- Proposed Upper Victoria Diversion
- Study Area

Conduits

- Channel
- Partington Creek Section
- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 50 100 200 Meters

1:4,500 NAD 1983 UTM Zone 10N

FIGURE 2.1
MODEL SCHEMATIC
CEDAR DRIVE UPGRADES

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Proposed culverts were assigned entry and exit loss coefficients of 0.5 to account for energy losses through the structures. The culverts proposed along the Channel were assigned higher roughness coefficients of 0.04, given that the culverts will have a gravel mix at the bottom. The gravel at the bottom will also cause some resultant turbulence, given that there will be different velocities on the bottom of the sides. The higher roughness coefficient here is therefore warranted due to the flow inefficiency. The Channel was assigned a roughness coefficient of 0.03, with the Creek was assigned a roughness coefficient of 0.04 due to the overgrown vegetation. Seepage was assigned to all storage facilities to address infiltration. A suction head of 292.2 mm, conductivity of 1 mm/hr, and initial deficit of 0.092 were assigned. These were assigned based on the watershed having been identified as mostly bedrock with shallow till in the Partington Creek Integrated Watershed Management Plan (KWL, 2011). As it is intended that the Creek and Channel work together as a drainage system to carry the flows, several weirs were set to simulate the exchange of flow between the Creek and Channel during high flow events.

2.3 Modelling Scenarios

Three hydraulic scenarios were modelled, including:

1. Existing Creek Conditions – modelled without the Channel
2. Existing Creek/Proposed Channel Conditions – modelled with the Channel implemented and current cross-sections and profile of the Creek
3. Future Creek/Channel Conditions (Ultimate Conditions) – modelled with the Channel implemented and upgrades to the downstream portion of the Creek (with minor cross-sectional changes to the Creek where parallel to the Channel, as it is anticipated that the bridges within this section will be removed in the future)

It is noted that the Existing Creek Conditions scenario was run to provide a comparison between existing and upgraded (Scenario 2) results, to illustrate the improvement to the Creek with the implementation of the Channel.

Each of the above-mentioned hydraulic scenarios were run for several hydrologic conditions to review the impact of significant rainfall events on the Creek as well as during drier periods. These are summarized as follows:

- Low-tide Summer Conditions – free outfall at the downstream end of the model at the outfall
- High-tide Summer Conditions –fixed tidal elevation of 2.89 m at the outfall
- Low-tide Spawning Conditions – free outfall at the downstream end of the model at the outfall
- High-tide Spawning Conditions – fixed tidal elevation of 2.89 m at the outfall
- 1:2-Year Return Period – fixed tidal elevation of 2.89 m at the outfall
- 1:10-Year Return Period – fixed tidal elevation of 2.89 m at the outfall
- 1:100-Year Return Period – fixed tidal elevation of 2.89 m at the outfall

Most of the flows were obtained from the Partington Creek Integrated Watershed Management Plan (IWMP) (KWL, 2011), given that the previous model was unavailable, and the upstream segments of Partington Creek and its tributaries were not modelled for this project. The exception to this was the summer condition baseflow, which was determined through a review of several years of flow monitoring data. The flows used for each scenario are summarized in Table 2.1 below.

Table 2.1: Summary of Modelled Flows

Scenario	Peak Flow at Upstream Boundary (Main-stem at Victoria Drive)	Distribution	Source
	m^3/s		
Low-tide Summer Conditions	0.03	Constant	Partington Creek Hydrometric Data between 2006-2020
High-tide Summer Conditions	0.03	Constant	Partington Creek Hydrometric Data between 2006-2020
Low-tide Spawning Conditions	0.13	Constant	IWMP – Section 4.5
High-tide Spawning Conditions	0.13	Constant	IWMP – Section 4.5
1:2-Year Return Period	7.3	SCS Type 1A; 24-hour	IWMP – Table 4-3
1:10-Year Return Period	10.73	SCS Type 1A; 24-hour	IWMP – Table 4-3
1:100-Year Return Period	18.96	SCS Type 1A; 24-hour	IWMP – Table 4-3

The flows for the three return period scenarios are based on the peak flow estimates for existing land use conditions at the Main-stem at Victoria Drive, noting that the 100-year flow includes snowmelt. The existing land use conditions (Table 4-3 of IWMP) were used for all assessment scenarios, the assumption being that added flows from future development would be controlled to meet pre-development flow rates. Additional catchments were generated for the contributing areas from Dairy Creek and Star Creek, respectively. Hydrologic parameters were assigned to the Dairy Creek catchment and Star Creek catchment to match the flows stipulated in the IWMP, as described below in Table 2.2. Please note these values were derived to match boundary conditions and are not reflective of actual catchment parameters.

Table 2.2: Tributary Creek Hydrologic Data

Parameter	Unit	Dairy Creek	Star Creek
Targeted 1:100 Year Flows	m^3/s	1.11[1]	1.79[2]
Area	ha	40	40
Width	m	400	400
Slope	%	2.4	19.5
Imperviousness	%	14.75	15
Manning's N (Impervious)		0.025	0.025
Manning's N (Pervious)		0.8	0.8
Depression Storage (Impervious)	mm	2.5	2.5
Depression Storage (Pervious)	mm	15	15

[1] *Stipulated in Table 5-1 of the IWMP (CUL037).*
[2] *Stipulated in Table 5-2 of the IWMP (BRG019).*

For the three return period scenarios, an SCS Type 1A distribution was used. This distribution was used because applying a constant inflow would be over conservative and inlet constraints at the culvert would result in a heavy attenuation of flows and thus elevate the hydraulic grade line (HGL) to unrealistic levels.

To replicate the peak flows, an SCS Type 1A distribution was applied the volume for the respective return period based on the City's Zone 7 IDF curve. For the Main-stem at Victoria Drive catchment, the area was scaled until there was agreement between the peak flows noted in Table 2.1 and the peak catchment runoff. The parameters of the two additional smaller catchments representing Dairy Creek and Star Creek were not adjusted for the 1:2 year and 1:10 year return periods, as flows for these scenarios were not stipulated in the IWMP. Thus, only the rainfall events for these catchments were varied between the return period scenarios. As mentioned above, the three catchments were represented only as 'dummy' catchments in the model, thus are not realistic representations of the actual catchments.

Following the assessment of the above, the Ultimate Condition scenario was simulated to account for climate change. Derivation of the storms used to account for climate change is discussed in Section 2.4 below.

2.4 Climate Change Design Storms

The 2050 IDF curves were provided by the City for various zones within the area. Based on the location of the Creek the IDF parameters for Zone 6 were used, as illustrated below in Figure 2.2. It is noted that the existing and climate change zones are not the same, given that different zonal maps are being applied for each condition.

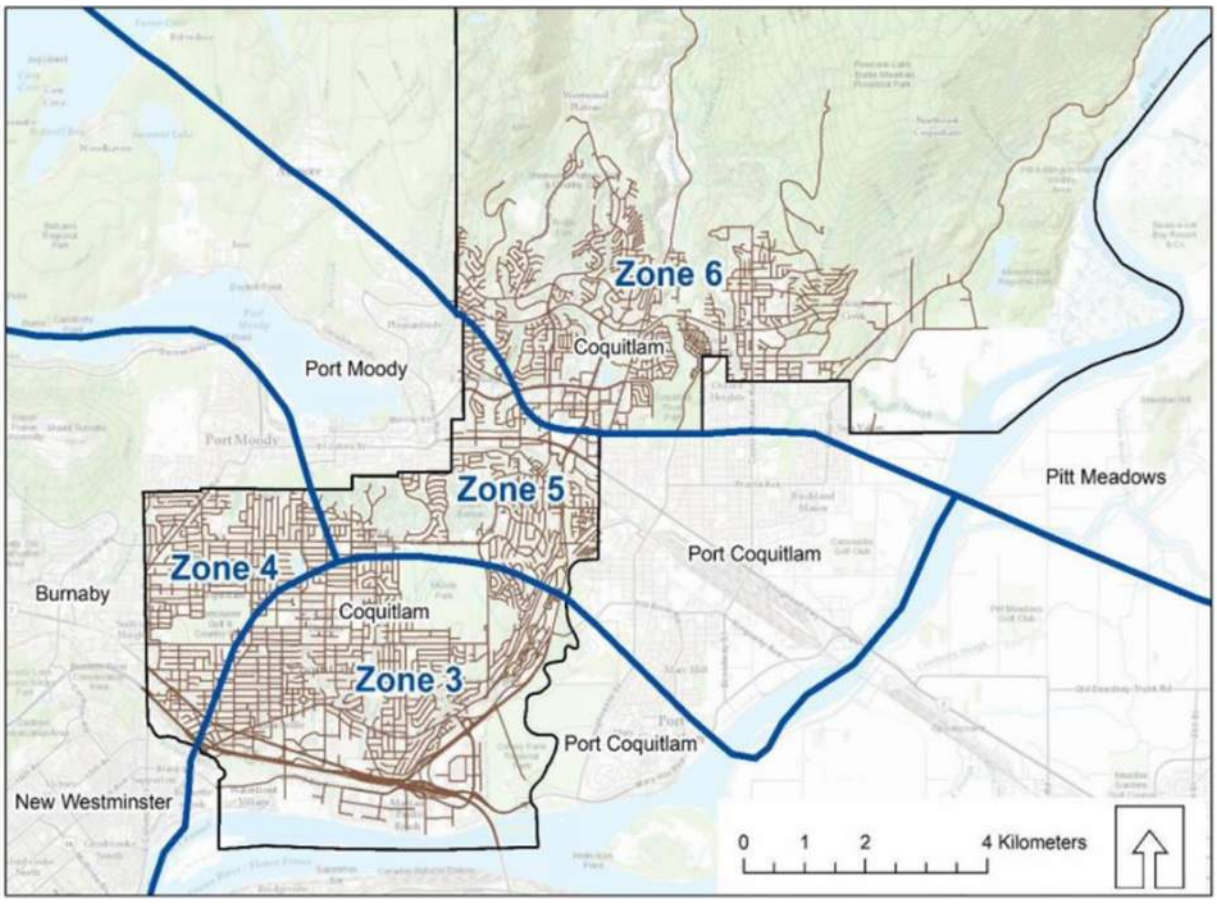


Figure 2.2: Rainfall Zones near Coquitlam Recognized by GHD under Future Climate Conditions

The spreadsheet developed for the Study of the Impacts of Climate Change on Precipitation and Stormwater Management (GHD, 2018) was used to determine the total rainfall with these IDF parameters for Zone 6. The future 2050 and 2100 high change climate conditions that were derived using GHD's spreadsheet for the RCP 8.5 scenario are shown below in Tables 2.3 and 2.4.

Table 2.3: IDF Curve Parameters for 2050 High Change Climate Conditions (Zone 6)

2050 High IDF Curve	Total Rainfall in mm						
Annual Exceedance Probability	50%	20%	10%	4%	2%	1%	0.50%
Return Period	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year
$I=AxT^B$ A	19.254	25.169	29.292	34.650	38.480	42.329	46.224
I in mm/hour, T in hour B	-0.403	-0.416	-0.424	-0.436	-0.443	-0.451	-0.458
5-min	4.6	6.4	7.7	9.7	11.0	12.6	14.1
10-min	6.9	9.5	11.3	13.8	15.7	17.6	19.7
15-min	8.5	11.4	13.5	16.1	18.1	20.0	22.1
30-min	12.0	15.5	18.0	21.2	23.5	25.7	28.0
1-hr	17.4	21.8	25.0	29.1	32.0	35.0	38.0
2-hr	27.7	34.3	38.7	43.9	47.7	51.2	54.7
6-hr	59.6	75.1	85.3	97.6	106.2	114.2	122.0
12-hr	89.6	115.2	132.6	153.7	168.8	183.2	197.1
24-hr	127.2	165.9	192.5	225.7	249.7	273.2	296.2

Table 2.4: IDF Curve Parameters for 2100 High Change Climate Conditions (Zone 6)

2100 High IDF Curve	Total Rainfall in mm						
Annual Exceedance Probability	50%	20%	10%	4%	2%	1%	0.50%
Return Period	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year
$I=AxT^B$ A	21.689	29.077	34.355	41.175	46.070	51.034	55.905
I in mm/hour, T in hour B	-0.400	-0.416	-0.424	-0.436	-0.442	-0.450	-0.457
5-min	5.2	7.4	9.1	11.5	13.2	15.2	17.0
10-min	7.7	11.0	13.2	16.4	18.8	21.2	23.8
15-min	9.4	13.1	15.7	19.1	21.5	24.0	26.6
30-min	13.4	17.8	21.1	25.1	28.0	30.9	33.8
1-hr	19.6	25.1	29.3	34.6	38.4	42.3	46.0
2-hr	31.6	39.8	45.6	52.5	57.5	62.1	66.6
6-hr	68.0	87.2	100.4	116.4	127.6	138.2	148.3
12-hr	101.8	133.5	155.5	182.6	202.1	220.6	238.6
24-hr	144.0	191.8	225.4	267.7	298.5	328.5	357.9

For the existing climate conditions, the 24-hour design storms for the return periods of 1:2-year, 1:10-year and 1:100-year were developed by using the PCSWMM design storm creator tool to match the total rainfall depth of each return period. The total rainfall depths were derived from the parameters presented in Table 4-3 of the City's Stormwater Management Policy and Design Manual (Coquitlam, 2019). The rainfall distribution for the hydrological analysis was SCS Type 1A.

The same approach was undertaken for the future climate change conditions, and the derived future storms were used directly to the catchments without any consideration for land use changes (it is understood that any future development is required to maintain pre-development flows).

The IDF-CC tool (https://www.idf-cc-uwo.ca/home) was also reviewed, however a match between the City's current IDF curve and the IDF-CC tool was not achieved, neither for a gauged nor ungauged location. Therefore, it was determined that the use of the IDF-CC tool would not provide a comparable analysis between existing and future climate change conditions, given the difference between the existing IDF curves.

3.0 System Assessments

3.1 Existing Creek Condition Assessments

The existing creek conditions was simulated to determine the baseline conditions of the Creek. This allowed for a comparison of the existing conditions to upgraded conditions with the Channel in place, as well as the ultimate conditions scenario which includes some additional improvements to the Creek. Figure 3.1 illustrates the longitudinal profile for the Creek with a peak HGL comparison of the seven hydrologic scenarios. A plan view of the water surface elevations (WSE) was developed for the 1:2-year, 1:10-year, and 1:100-year events, as shown in Figure 3.2. The WSE flood lines were generated based on the max HGL and are within a couple of centimeters of difference. A steep increase in grade would mean that the flood lines are closer together than flatter regions where the flooding would be more pronounced. The WSE flood lines are zoomed in to provide more detail in Appendix C.

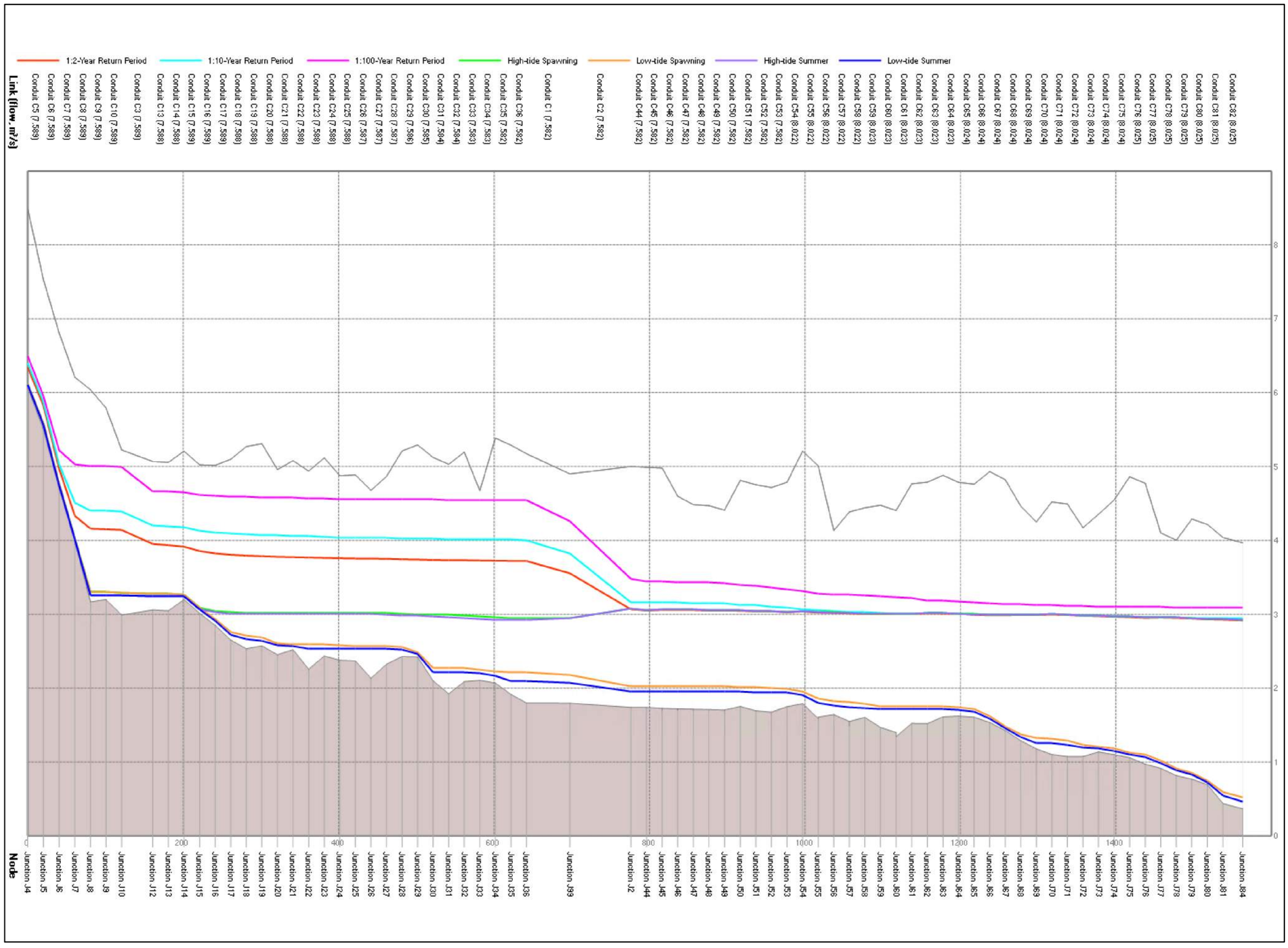
The results of this scenario are used for comparison purposes in Section 3.2 below.

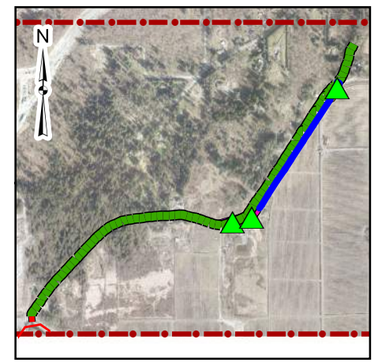
3.2 Existing Creek/Proposed Channel Condition Assessments

The Channel and Partington Creek sections were assessed in terms of flow, velocity, and HGL for the seven hydrologic scenarios discussed above. Figure 3.3 illustrates the longitudinal profile for Partington Creek, along with a peak HGL comparison of the seven hydrologic scenarios. The longitudinal profile for the Channel along with a peak HGL comparison of the seven scenarios is shown in Figure 3.4. A map illustrating the WSEs for the 1:2-year, 1:10-year, and 1:100-year events is illustrated in Figure 3.5. Zoomed in WSE flood line figures are provided in Appendix C. Comparing the WSEs between this scenario and the Existing Creek Conditions scenario (Figures 3.2 and 3.5, respectively), it is evident that the implementation of the Channel improves overtopping of the Creek onto the old Cedar Drive.

The results presented in this section allow flow exchange between the Creek and Channel. In real-life conditions this means that stormwater can overtop the Creek or the Channel and cross the old Cedar Drive alignment into the respective drainage course. The old Cedar Drive alignment will ultimately be downgraded to a gravel laneway for utility access only, thus overtopping is considered acceptable for the major storm events. This interaction balances flows during high flow events, mitigating stormwater from encroaching private properties. The main concern with overtopping is that the sanitary gravity main is proposed for this utility corridor on the old Cedar Drive, thus could lead to increased inflow and infiltration into the sanitary system during these major rainfall events. To alleviate this concern, the manhole lids can be sealed, or riser manholes can be used to keep the tops of manholes above the flood levels.

The following table (Table 3.1) summarizes the HGL at key locations of the model, including the sediment pond, the Channel (roughly the midway point at 230 m from the sediment pond), the downstream portion of the Channel, and the in-line sediment pond. The nodes where the HGLs were obtained are indicated in the table in brackets and correspond to the node IDs in Figure 2.1. A full summary of the HGLs at each node location is included in Appendix D. It is noted that for the four constant flow scenarios, all results were extracted in the later portion of the simulation, allowing the model to stabilize creek/channel conditions.





Legend

- Facilities
- Study Area
- Longitudinal Profile 1 - Creek
- Longitudinal Profile 2 - Channel

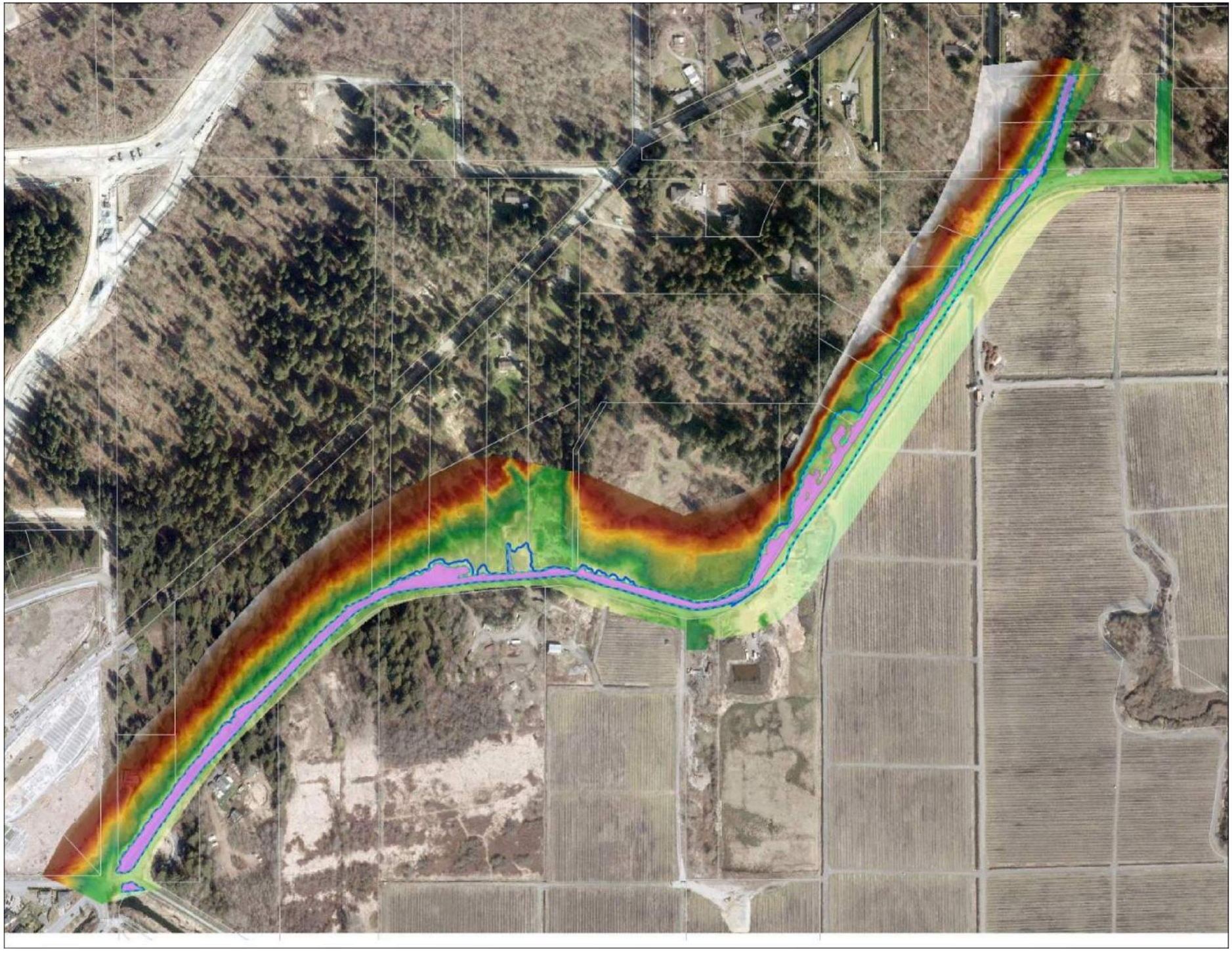
Conduits

- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 235 470 940 Meters

1:20,000 NAD 1983 UTM Zone 10N

FIGURE 3.1
CREEK LONGITUDINAL PROFILE
EXISTING CREEK CONDITIONS
CEDAR DRIVE UPGRADES



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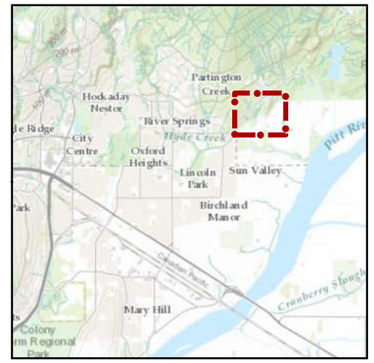

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

NAD 1983 UTM Zone 10N

FIGURE 3.2
MAJOR RAINFALL EVENTS
FLOOD MAPPING
EXISTING CREEK CONDITIONS
CEDAR DRIVE UPGRADES

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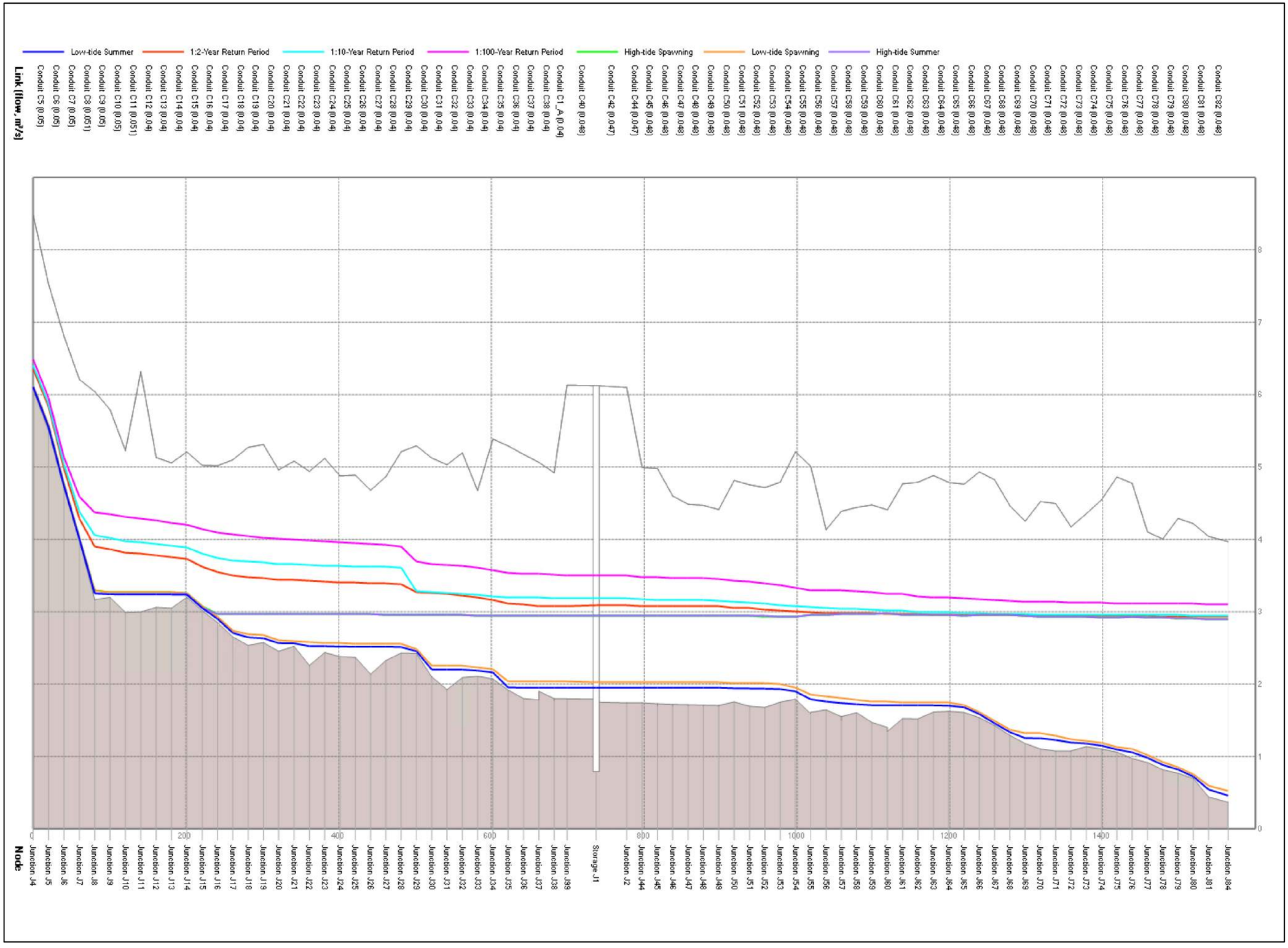

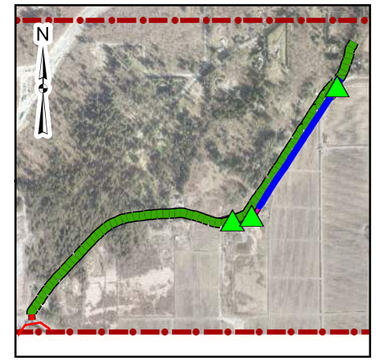

Legend

- Facilities
- Study Area
- Longitudinal Profile 1 - Creek
- Longitudinal Profile 2 - Channel

Conduits

- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 235 470 940 Meters

1:20,000 NAD 1983 UTM Zone 10N

FIGURE 3.3
CREEK LONGITUDINAL PROFILE
EXISTING CREEK/PROPOSED CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

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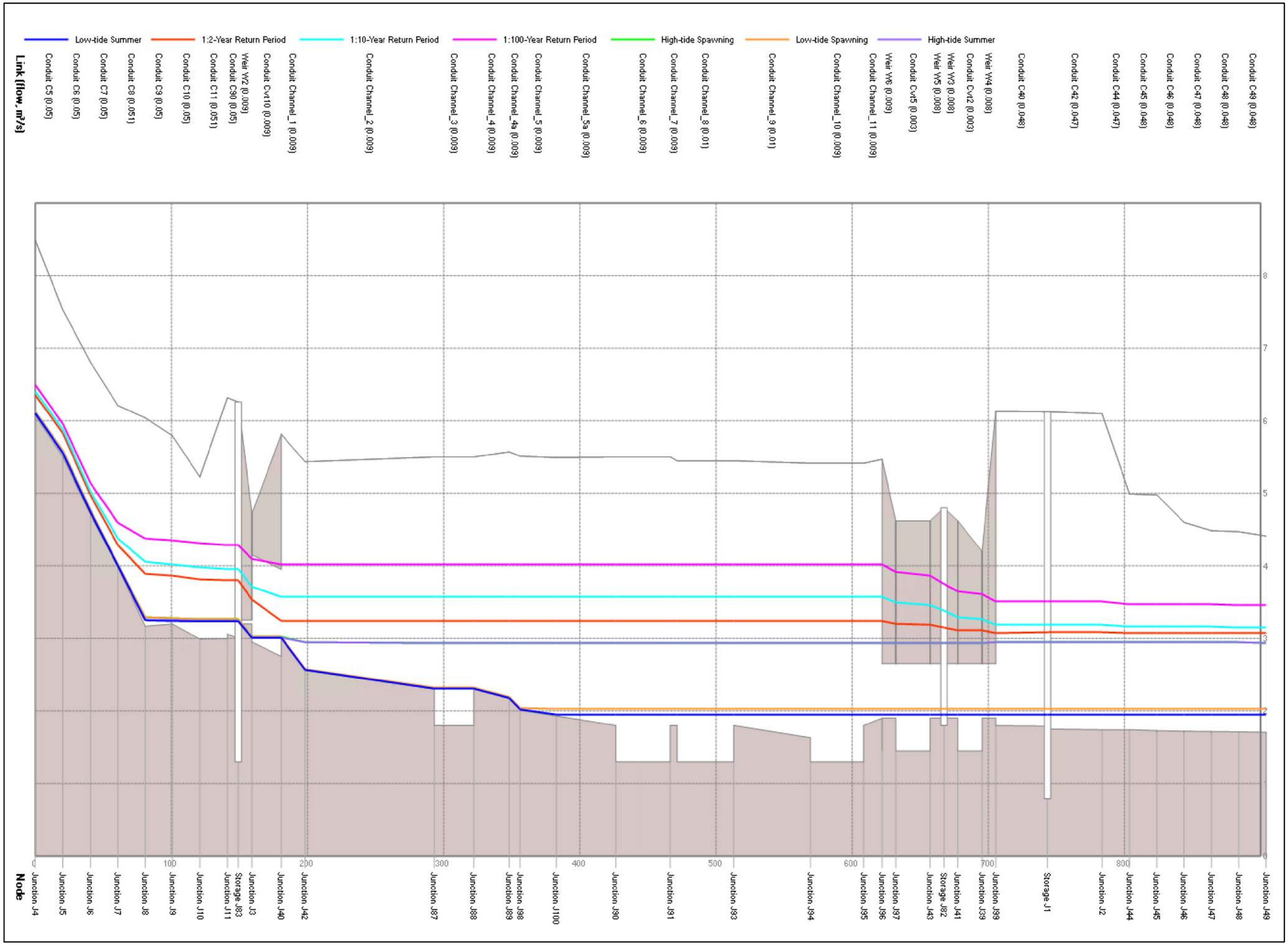

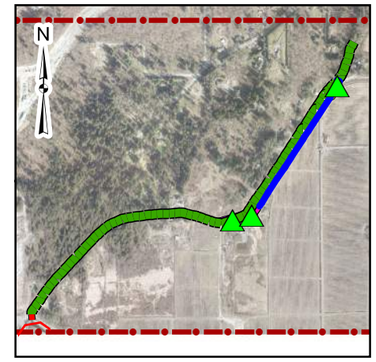

Legend

- Facilities
- Study
- Longitudinal Profile 1 - Creek
- Longitudinal Profile 2 - Channel

Conduits

- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 235 470 940 Meters

1:20,000 NAD 1983 UTM Zone 10N

FIGURE 3.4
CHANNEL LONGITUDINAL PROFILE
EXISTING CREEK/PROPOSED
CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

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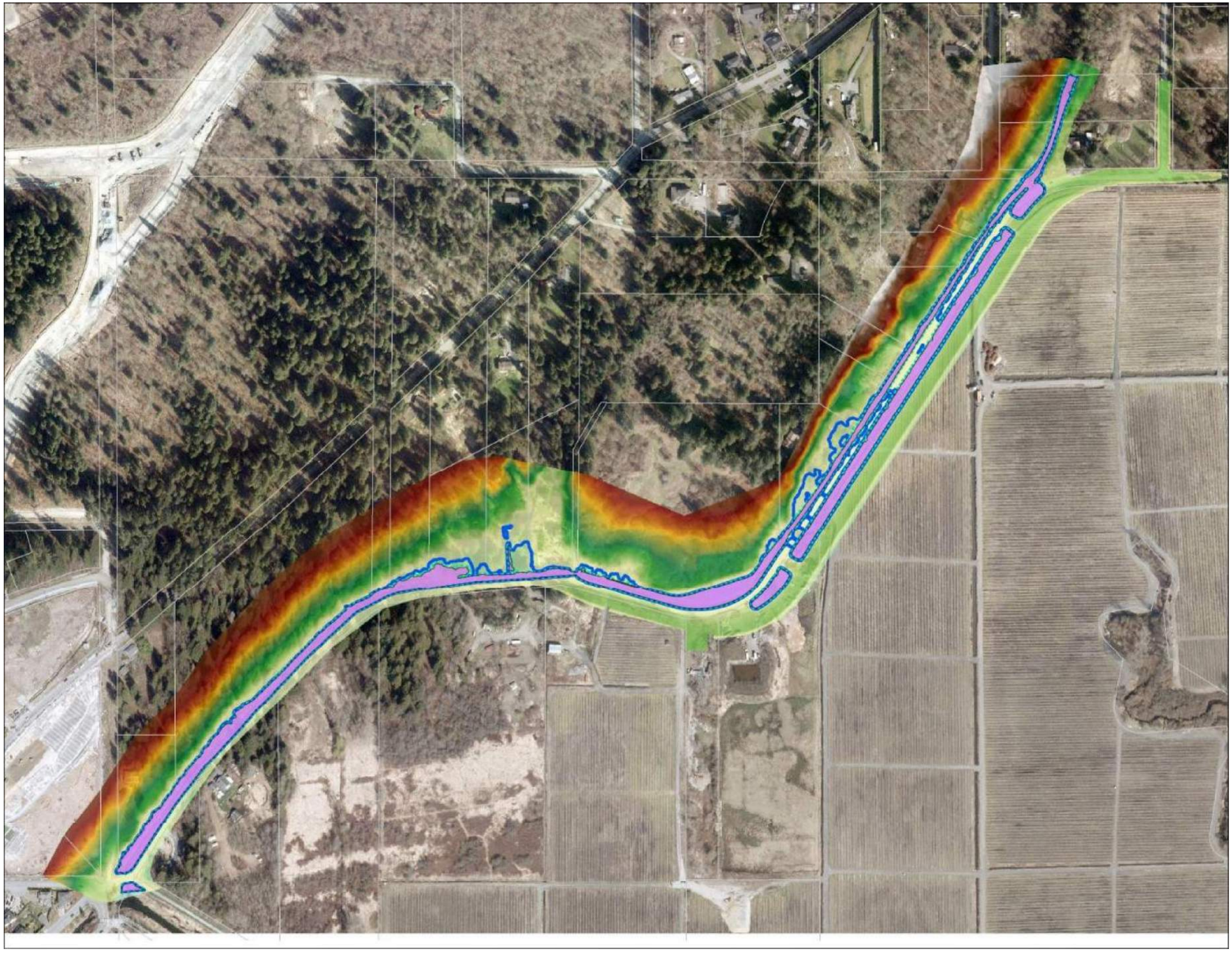

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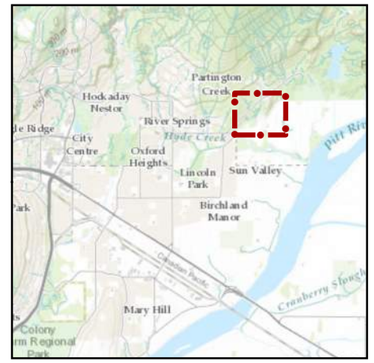

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

NAD 1983 UTM Zone 10N

FIGURE 3.5
MAJOR RAINFALL EVENTS
FLOOD MAPPING
EXISTING CREEK/PROPOSED
CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

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Table 3.1: Maximum HGL Along the Channel

Scenario	Sediment Pond (J83)	Channel (J90)	Downstream Channel (J82)	In-Line Sediment Pond (J1)
	m			
Low-tide Summer Conditions	3.23	1.92	1.92	1.92
High-tide Summer Conditions	3.23	2.93	2.92	2.94
Low-tide Spawning Conditions	3.26	2.03	2.02	2.02
High-tide Spawning Conditions	3.26	2.93	2.93	2.94
1:2-Year Return Period	3.79	3.23	3.14	3.08
1:10-Year Return Period	3.95	3.56	3.37	3.18
1:100-Year Return Period	4.28	4.01	3.75	3.50

Table 3.2 below summarizes the maximum flows while Table 3.3 summarizes the velocities at select locations within Partington Creek and the Channel. The pipe IDs indicated in these tables correspond to those stipulated on Figure 2.1. A full summary of the flows and velocities at each conduit location is included in Appendix D.

Table 3.2: Maximum Flow Along the Channel and Creek

Scenario	Downstream of In-Line Sediment Pond (C48)	Upstream of In-Line Sediment Pond (C37)	Channel (Channel_9)	Channel (Channel_5)	Channel (Channel_2)
	m^3/s				
Low-tide Summer Conditions	0.028	0.025	0.005	0.005	0.005
High-tide Summer Conditions	0.902	0.398	0.339	0.215	0.197
Low-tide Spawning Conditions	0.128	0.100	0.029	0.029	0.029
High-tide Spawning Conditions	0.249	0.189	0.212	0.182	0.155

Scenario	Downstream of In-Line Sediment Pond (C48)	Upstream of In-Line Sediment Pond (C37)	Channel (Channel_9)	Channel (Channel_5)	Channel (Channel_2)
	m^3/s				
1:2-Year Return Period	8.15	7.83	2.17	2.27	2.21
1:10-Year Return Period	11.17	8.16	3.10	3.11	3.16
1:100-Year Return Period	20.80	17.95	4.04	4.58	4.85

Table 3.3: Maximum Velocity Along the Channel and Creek

Scenario	Downstream of In-Line Sediment Pond (C48)	Upstream of In-Line Sediment Pond (C37)	Channel (Channel_9)	Channel (Channel_5)	Channel (Channel_2)
	m/s				
Low-tide Summer Conditions	0.030	0.046	0.005	0.167	0.135
High-tide Summer Conditions	0.028	0.019	0.021	0.025	0.030
Low-tide Spawning Conditions	0.086	0.096	0.018	0.127	0.284
High-tide Spawning Conditions	0.032	0.027	0.024	0.026	0.035
1:2-Year Return Period	0.86	0.94	0.17	0.21	0.27
1:10-Year Return Period	1.07	0.86	0.18	0.23	0.30
1:100-Year Return Period	1.40	1.43	0.19	0.25	0.34

Shown in these two tables, there is flow throughout the Channel under the seven analyzed hydrologic scenarios, though the summer baseflows under low-tide conditions are quite low. This was done to favour flows in the Creek if there are not enough baseflows for each water course. The Channel was designed with a thalweg, to provide a low elevation for fish passage.

Additionally, the Channel ponds were designed to hold a minimum water level, so even if there is no flow, the ponds should not dry out, unless caused by extreme evaporation and infiltration. As well, adjustable wooden weirs are proposed at the sediment pond such that the water levels can be fine-tuned after observing the actual conditions of the system. This will ensure the Channel is never dry and allow for fish passage during spawning months. That said, the flows under the summer and spawning baseflow scenarios are quite low, given the drier seasonal conditions. Any diversions upstream of the Channel under baseflow conditions are not recommended.

Also of note is the culvert at the downstream end of the Creek at Victoria Drive, directly upstream of the Deboville Slough. The City has noted there will be a major future project at this location, thus upgrades to the culvert are possible during this project if necessary. Based on the scenarios modelled, the culvert has not exhibited capacity constraints. The constant flow scenarios (summer and spawning) at low tide demonstrate sufficient capacity, which is expected given the low flows in these scenarios. The remaining five hydrologic scenarios were modelled with a fixed outfall elevation to simulate high tide conditions, thus backwater effects within the Creek are caused by the fixed outfall elevation rather than any culvert restrictions. Further analysis is recommended for a scenario in which a design storm (1:2, 1:10, 1:100-year return periods) occurs under low tide conditions, to document if any culvert constraints exist.

3.3 Future Creek/Channel Condition (Ultimate Condition) Assessments

This scenario is considered the Ultimate Condition of the Creek/Channel system and is not currently part of the Cedar Drive Upgrades scope of work. It considers future potential upgrades to Partington Creek, from the Polygon Site down to the culvert at Victoria Drive. The upgrades would include the removal of several bridges, which are currently pinch points in the system. The intent is that the Creek would be improved and widened, like the Creek upgrades occurring at the Polygon Site for this project. For this purpose, the same cross-sections applied for the Polygon Site Creek upgrades were implemented in the downstream section of the Creek for these Ultimate Condition scenarios. This cross-section is shown below in Figure 3.6. It is also anticipated that some additional bridges will be removed in the Creek section that is adjacent to the Channel. At these bridge locations, the cross-sections were adjusted such that any pinch points caused by the bridges were removed. In this scenario, it has been assumed that only the cross-section changes. The creek bed elevations are therefore consistent with existing conditions.

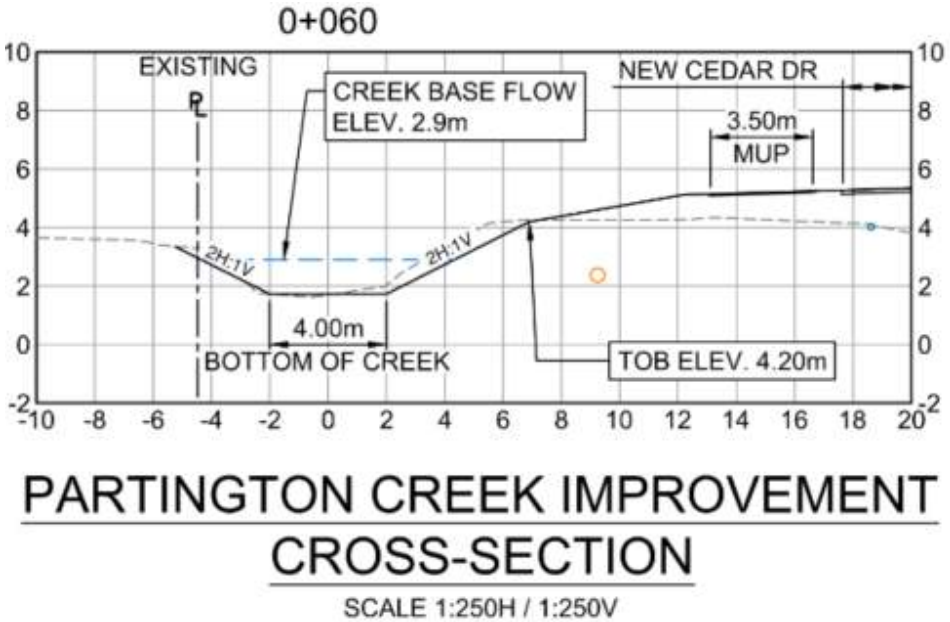


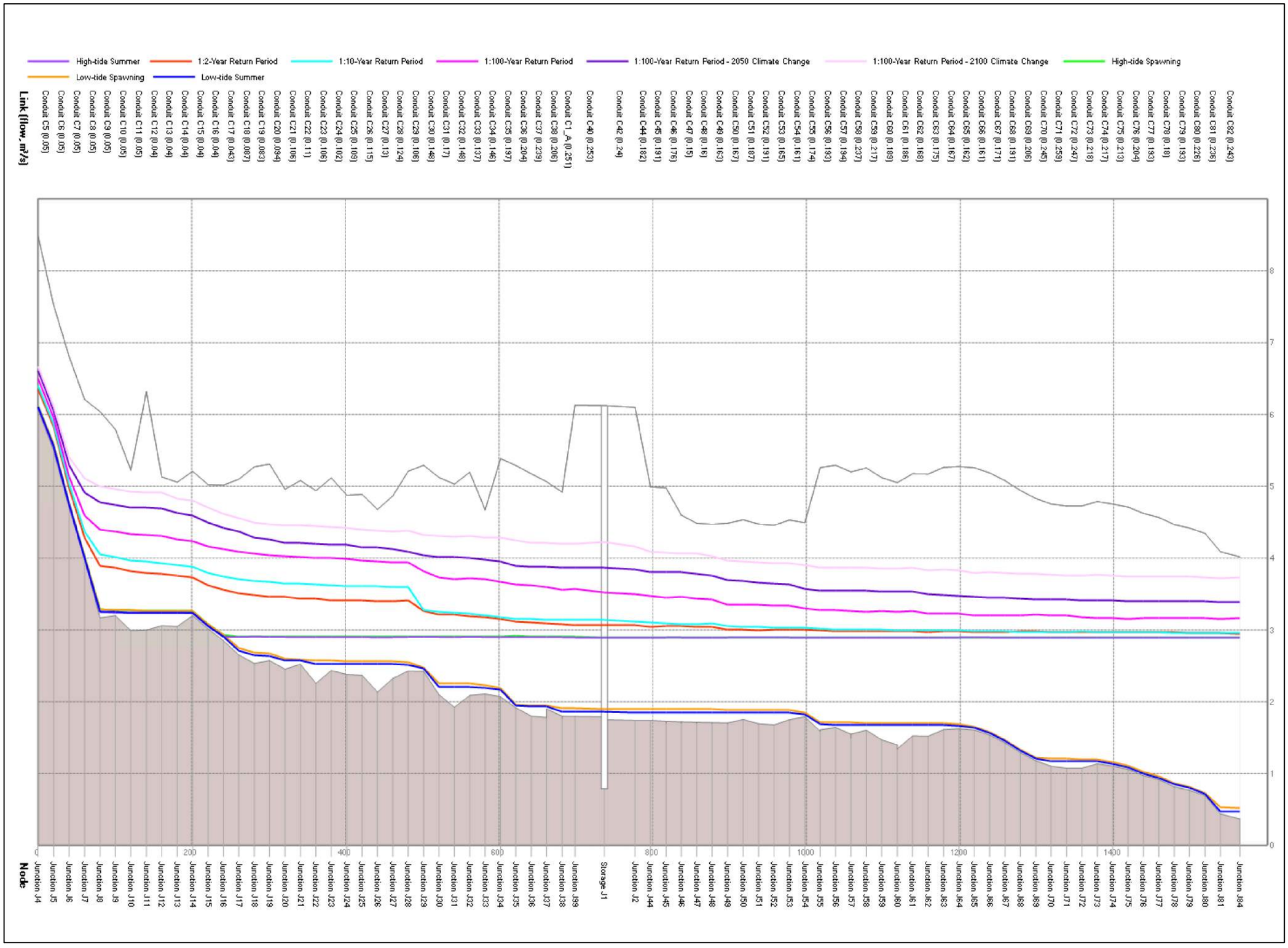
Figure 3.6: Sample Upgraded Creek Cross-Section

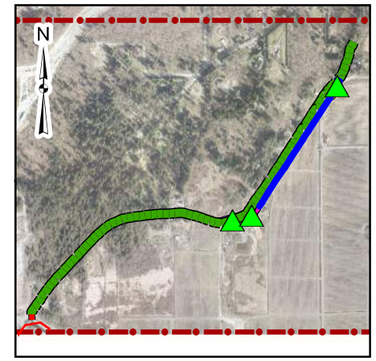
The Channel and re-graded portion of Partington Creek were assessed in terms of flow, velocity, and HGL. Assessments were also performed to consider the effects of climate change, as it is anticipated that these upgrades will be implemented by the time that climate change becomes a more significant influence on the system (i.e., 2050 and beyond).

Figure 3.7 illustrates the longitudinal profile for the upgraded Partington Creek, along with the peak HGLs of the seven hydrologic scenarios for existing and climate change conditions. The longitudinal profile for the Channel along with the peak HGLs of the seven hydrologic scenarios (existing and climate change conditions) is shown in Figure 3.8. Climate change conditions were modelled for the 1:100-year event, given it is the most extreme of the modelled scenarios. Thus, Figures 3.7 and 3.8 each have nine HGLs on the corresponding longitudinal profiles.

It is evident from the results that the impacts from climate change influence the HGL within the Channel and Creek, as expected. The 2050 climate change for the 1:100-year return period indicates that the HGL is below the tops of banks, however in the 2100 climate change scenario, some overtopping would occur in the Channel. Again, the Channel and Creek would function together in this case to convey the flows downstream, and the overtopping is on the old Cedar Drive alignment only.

The results of this scenario were compared to the Existing Creek/Proposed Channel Condition. It is apparent that by upgrading the downstream section of Partington Creek, the HGL of the Creek drops by approximately 250 mm. Improvements to the HGL are generally contained in the upgraded portion of the Creek, and do not extend upstream of the in-line sediment pond.





Legend

- Facilities
- Study Area
- Longitudinal Profile 1 - Creek
- Longitudinal Profile 2 - Channel

Conduits

- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 235 470 940 Meters

1:20,000 NAD 1983 UTM Zone 10N

FIGURE 3.7
CREEK LONGITUDINAL PROFILE
FUTURE CREEK/CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

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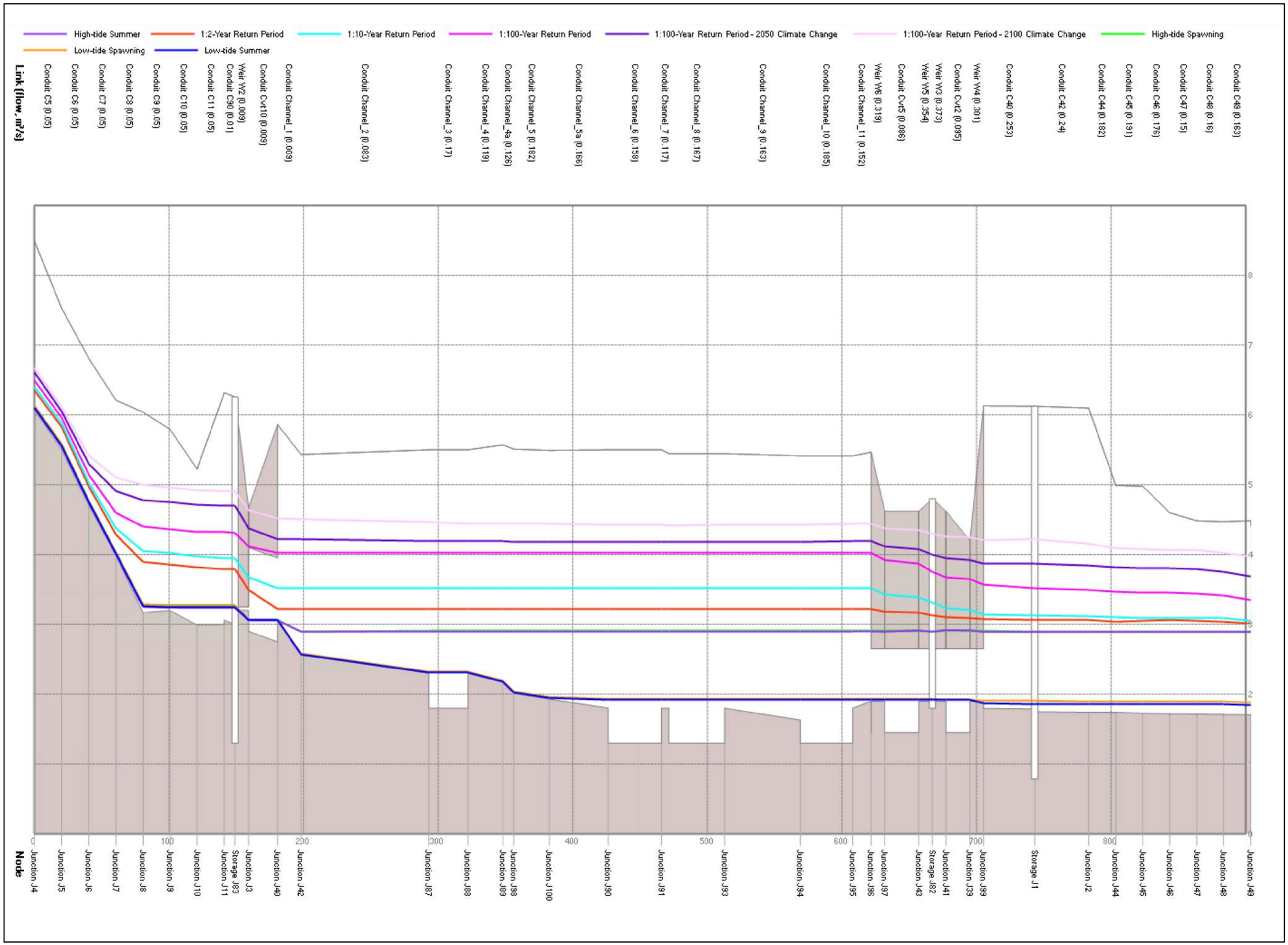

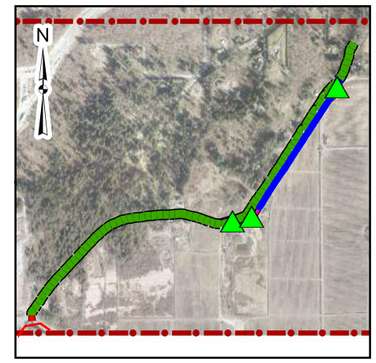

Legend

- Facilities
- Study
- Longitudinal Profile 1 - Creek
- Longitudinal Profile 2 - Channel

Conduits

- 2700mm CMP Culvert
- 600mm Diversion Culvert
- 2.1m x 0.9m Box Culvert
- 2.1m x 1.2m Box Culvert

0 235 470 940 Meters

1:20,000 NAD 1983 UTM Zone 10N

FIGURE 3.8
CHANNEL LONGITUDINAL PROFILE
FUTURE CREEK/CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

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Date: 2022-02-11 Document: Q:\Projects\32628_COQ Cedar Drive Upgrades\25_GIS\251_Figures\1_Report Figures\Figure 3.8 - Channel Longitudinal Profile_Scenario 3.mxd

4.0 Conclusions and Recommendations

The purpose of the Cedar Drive Upgrades stormwater modelling exercise was to validate the performance of the proposed Channel design under various flow conditions. This included ensuring the Channel is sized appropriately to accommodate flows under significant rainfall events and that the Channel has flow even during the lowest baseflow conditions.

The model was developed using the PCSWMM software. The existing survey data pertaining to Partington Creek and the downstream culvert, as well as the proposed design for the Channel were used to develop the base stormwater model, while the upgraded Creek design was used to develop the proposed Creek scenario. Hydrologic conditions were set up to be consistent with previous reporting given that the upstream reaches of Partington Creek and its tributaries were not modelled, while flow monitoring data was used to determine the smaller baseflow conditions.

Three hydraulic conditions were modelled and compared, including:

1. Existing Creek Conditions – modelled without the Channel
2. Existing Creek/Proposed Channel Conditions – modelled with the Channel implemented and current cross-sections and profile of the Creek
3. Future Creek/Channel Conditions (Ultimate Conditions) – modelled with the Channel implemented and upgrades to the downstream portion of the Creek (with minor cross-sectional changes to the Creek where parallel to the Channel, as it is anticipated that the bridges within this section will be removed in the future)

Seven hydrologic scenarios were modelled and compared, including:

- Low-tide Summer Conditions
- High-tide Summer Conditions
- Low-tide Spawning Conditions
- High-tide Spawning Conditions
- 1:2-Year Return Period
- 1:10-Year Return Period
- 1:100-Year Return Period

Climate change was also considered and modelled for the Ultimate Conditions scenario, with the expectation that upgrades to the downstream section of Partington Creek will be implemented before the full effects of climate change are realized (prior to 2050). Climate change IDF parameters were obtained from the City and converted to total rainfalls using GHD's spreadsheet for an RCP 8.5 scenario in Zone 6. The total rainfalls were used to create rainfall hyetographs of an SCS Type 1A distribution with a 24-hour duration.

The low-tide conditions were simulated by applying free outfall conditions at the downstream end of the network (downstream end of the existing 2700 mm CMP culvert). The high-tide conditions were simulated by applying a constant tailwater elevation of 2.89 m at the downstream end of the network based on the Simulating the Effects of Sea Level Rise and Climate Change on Fraser River Flood Scenarios Final Report (BC Ministry of Forests, Lands and Natural Resource Operations, 2014).

Comparisons of the HGLs for the various flow conditions were reviewed through longitudinal profiles, as shown in Figures 3.1, 3.3, 3.4, 3.7 and 3.8. Assessment of the Existing Creek/Proposed Channel conditions (current Cedar Drive upgrades) indicated that overtopping in the Creek and Channel was evident in the 1:100-year event along the old Cedar Drive alignment. That said, the Creek and Channel

work together as a drainage system to carry the flows. The extent of overtopping is also significantly less than under the Existing Creek Conditions, which is shown by comparing the WSEs in Figures 3.2 and 3.5. The Channel will mitigate the current flooding condition and provide wet pools for fish passage when the rate is low. The Future Creek/Channel Conditions are able to handle flooding events up to a 1:100-year return period, even under the future climate change conditions.

Within the Channel for the Existing Creek/Proposed Channel Conditions, the HGL ranges from 1.92 m at the in-line sediment pond under summer low-tide conditions to 4.28 m upstream at the sediment pond under the 1:100-year event. There is flow throughout the Channel under the seven analyzed hydrologic scenarios, however flows are limited in the summer baseflows under low tide scenario (but are not dry). This was done to favour flows in the Creek if there are not enough baseflows for each water course. That said, the Channel has been designed to ensure the ponds hold a minimum water level during dry period with little rainfall. Given the drier seasonal conditions during late spring and summer, any diversions upstream of the Channel under baseflow conditions are not recommended.

Based on this assessment, it is recommended that the implementation of the Channel proceeds as designed, given that it has been sized to accommodate both extreme rainfall events and low flow conditions. Future upgrades to the downstream section of Partington Creek should be considered to enhance the cross-section of the Creek in areas where it is constricted.

5.0 References

BC Ministry of Forests, Lands and Natural Resource Operations. May 2014. Simulating the Effects of Sea Level Rise and Climate Change on Fraser River Flood Scenarios.

City of Coquitlam. July 2003. Stormwater Management Policy and Design Manual.

GHD. August 2018. Study of the Impacts of Climate Change on Precipitation and Stormwater Management.

Kerr Wood Leidal Consulting Engineers. July 2011. Partington Creek integrated Watershed Management Plan.

6.0 Authorization

This document entitled “Cedar Drive Upgrades – Stormwater Modelling Technical Memorandum” has been prepared by ISL Engineering and Land Services Ltd. (ISL) for the use of the City of Coquitlam. The information and data provided herein represent ISL’s professional judgment at the time of preparation. ISL denies any liability whatsoever to any other parties who may obtain this report and use it, or any of its contents, without prior written consent from ISL.

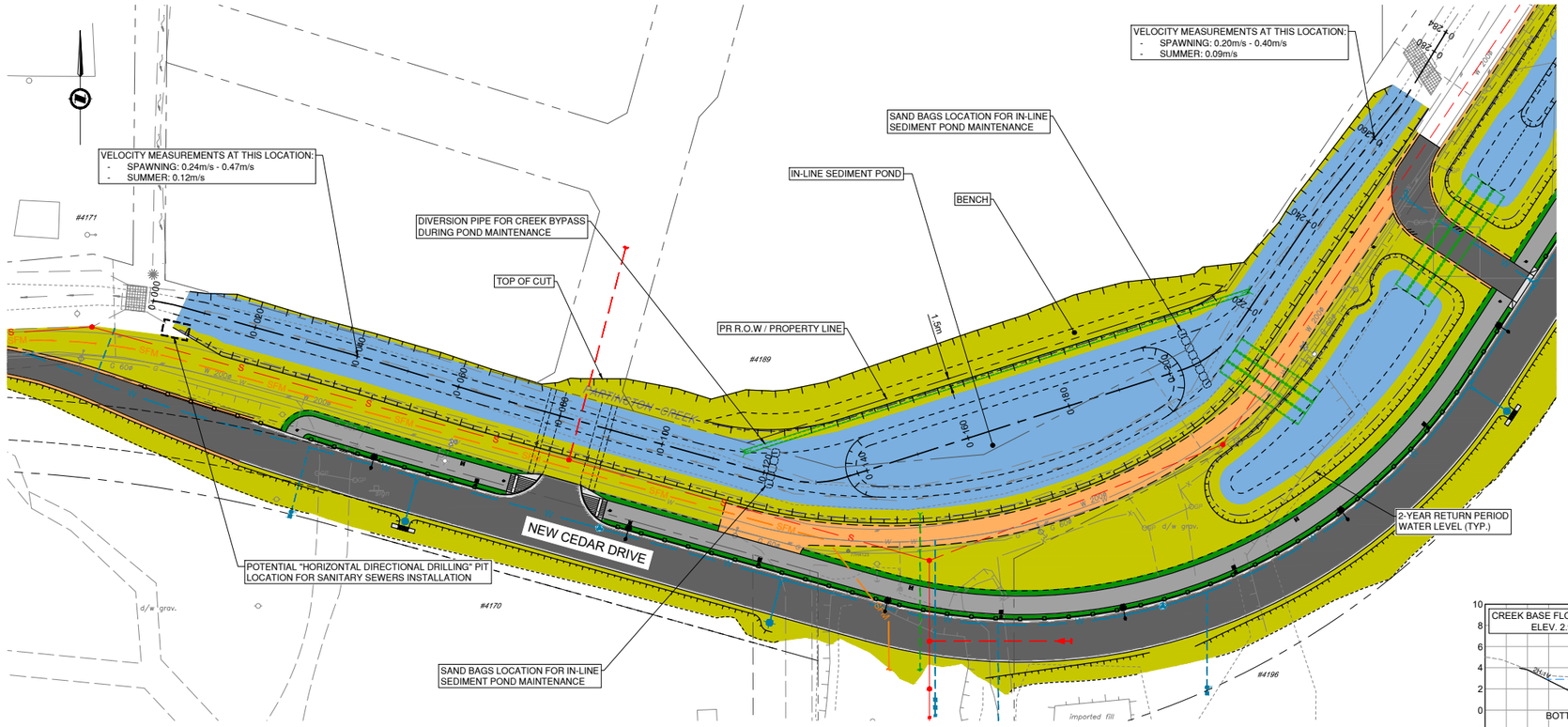
Sarah Barbosa, P.Eng., ENV SP
Technical Author

Kevin Terness, P.Eng.
Senior Technical Reviewer

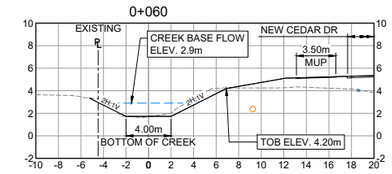
APPENDIX A

Model Files (Click Link)

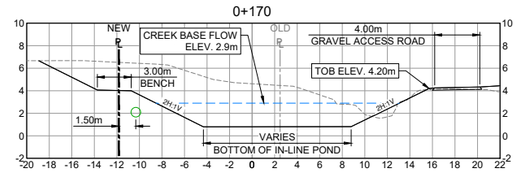
APPENDIX B
Detailed Design of Channel



PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW
SCALE 1:500



PARTINGTON CREEK IMPROVEMENT
CROSS-SECTION
SCALE 1:250H / 1:250V



IN-LINE SEDIMENT POND - CROSS-SECTION
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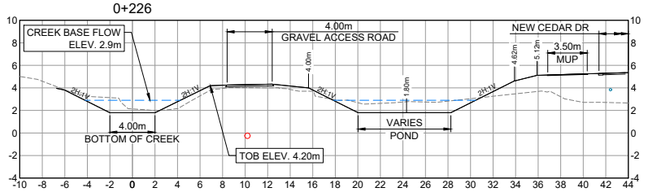
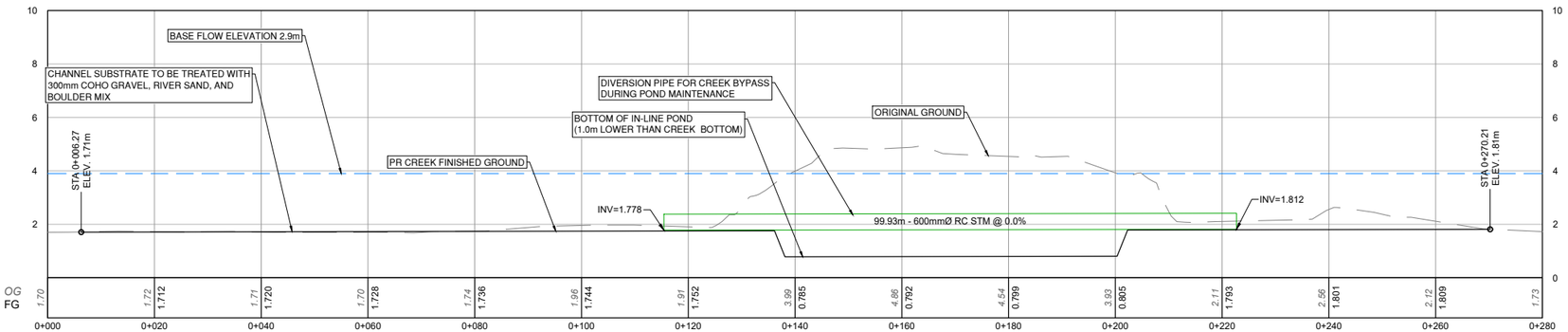


PARTINGTON CREEK IMPROVEMENT
CROSS-SECTION
SCALE 1:250H / 1:250V



PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PROFILE VIEW
SCALE 1:500H / 1:100V

SURFACE TREATMENT

- ROAD SURFACE: SEE ROADWORK DRAWINGS FOR DETAILS
- MULTI-USE PATH / ASPHALT DRIVEWAY: SEE ROADWORK DRAWINGS FOR DETAILS
- GRAVEL DRIVEWAY / SHOULDER: SEE ROADWORK DRAWINGS FOR DETAILS
- BOULEVARD: - 150 mm OF TOPSOIL AND SOD
- 100mm TOPSOIL AND HYDROSEED
- CONCRETE
- RIPARIAN PLANTING
- PARTINGTON CREEK BASE FLOW WATER LEVEL

1:500 0 10 30m

DETAILED DESIGN DESIGN NO. 32628

PLOT DATE: November 16, 2021

REV NO	REVISIONS	DATE	DRAWN	APP'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/15	GA	CJB/ND
C	ISSUED FOR STORMWATER MEMO	21/11/16	GA	CJB

Coquitlam
Engineering & Public Works
3000 Guildford Way, Coquitlam, B.C. V3B 7N2

PARTINGTON CREEK AND IN-LINE POND
CEDAR DRIVE UPGRADES

ISL Engineering and Land Services
#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2696 F: (604)629-2698

SCALE	AS SHOWN	DATE	Jul-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT

DWG. NO. 34 OF 54
REV. C

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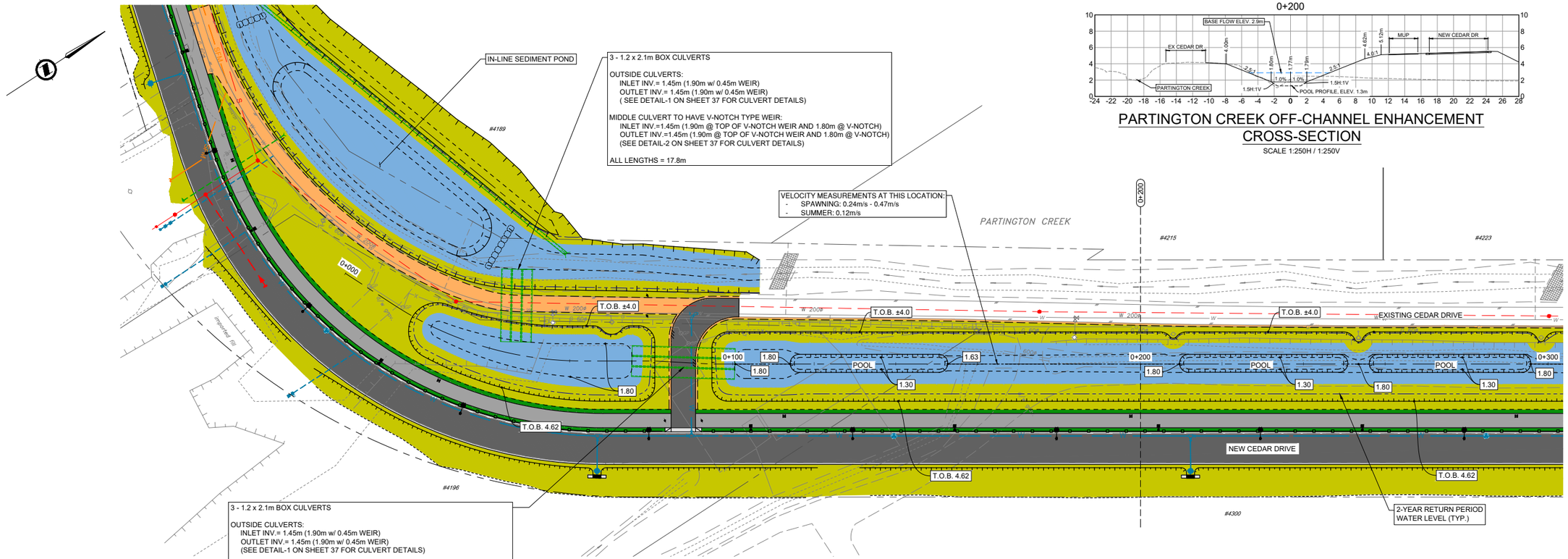

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PARTINGTON CREEK OFF-CHANNEL ENHANCEMENT CROSS-SECTION

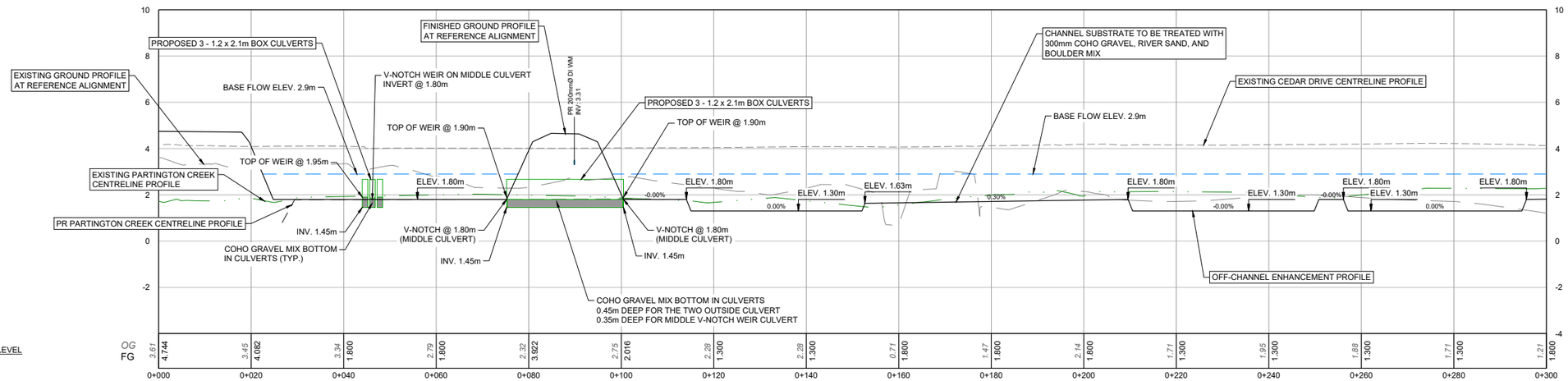
SCALE 1:250H / 1:250V

PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT PLAN VIEW

SCALE 1:500

SURFACE TREATMENT

- ROAD SURFACE: SEE ROADWORK DRAWINGS FOR DETAILS
- MULTI-USE PATH / ASPHALT DRIVEWAY: SEE ROADWORK DRAWINGS FOR DETAILS
- GRAVEL DRIVEWAY / SHOULDER: SEE ROADWORK DRAWINGS FOR DETAILS
- BOULEVARD: - 150 mm OF TOPSOIL AND SOD
- 100mm TOPSOIL AND HYDROSEED
- CONCRETE
- RIPARIAN PLANTING
- PARTINGTON CREEK BASE FLOW WATER LEVEL



PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT PROFILE VIEW

SCALE 1:500H / 1:100V

1:500 0 10 30m

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PLOT DATE: November 16, 2021

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CHECKED BY	CJB/ND	APPROVED BY	KPT

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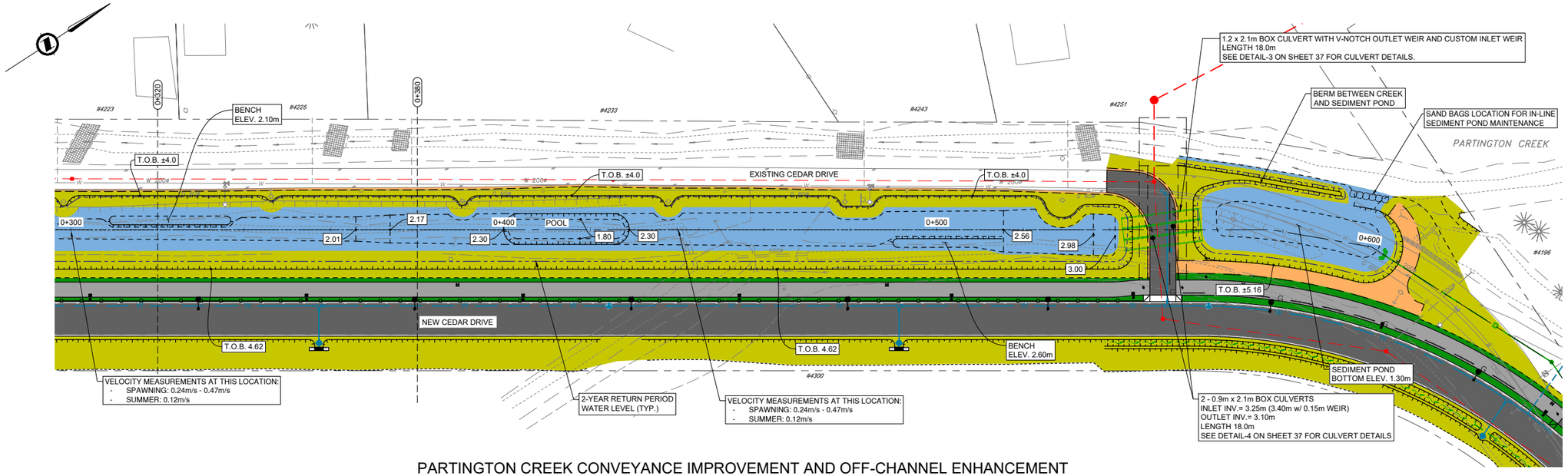
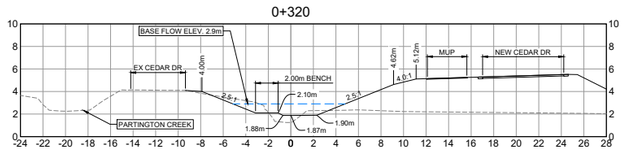


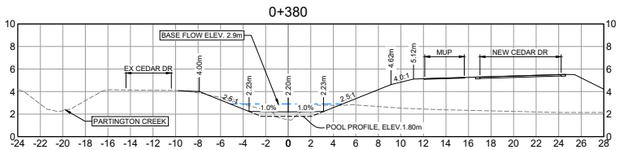
PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PLAN VIEW

SCALE 1:500



PARTINGTON CREEK OFF-CHANNEL ENHANCEMENT
CROSS-SECTION

SCALE 1:250H / 1:250V



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CROSS-SECTION

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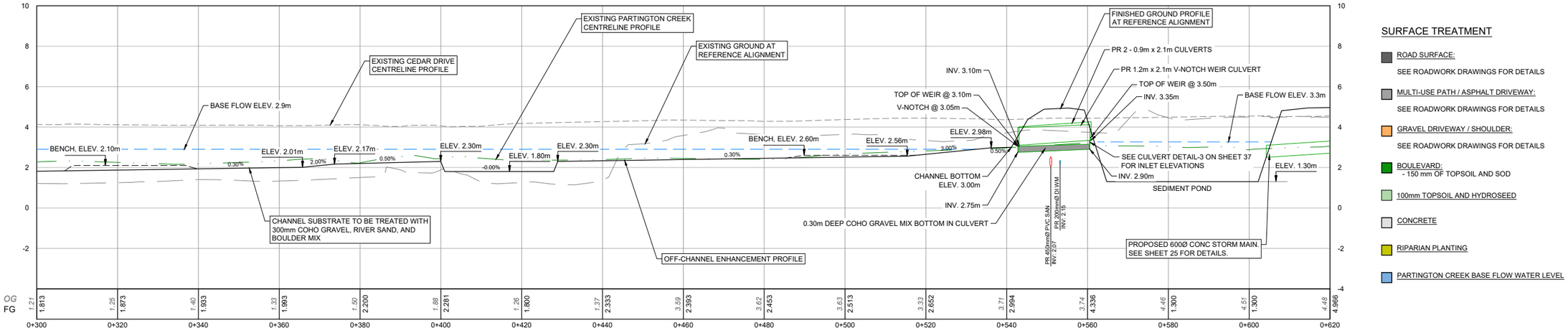

SURFACE TREATMENT

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PARTINGTON CREEK CONVEYANCE IMPROVEMENT AND OFF-CHANNEL ENHANCEMENT
PROFILE VIEW

SCALE 1:500H / 1:100V

1:500 0 10 30m

PLOT DATE: November 16, 2021

REV NO	REVISIONS	DATE	DRAWN	APPRD
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/15	GA	CJB/ND
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T: (604)629-2696 F: (604)629-2698

DETAILED DESIGN DESIGN NO. 32628

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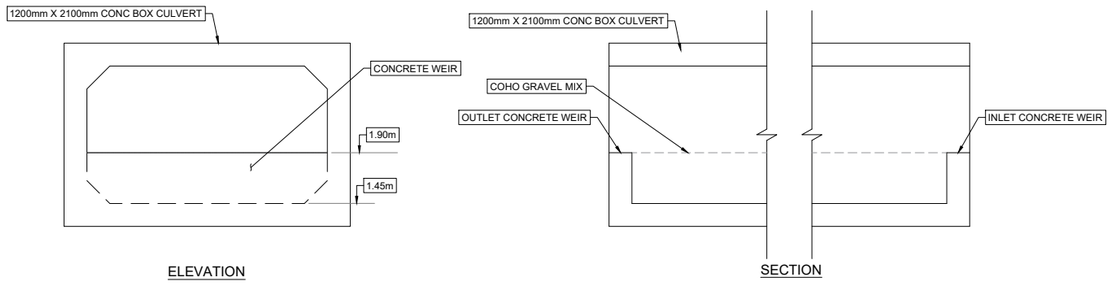

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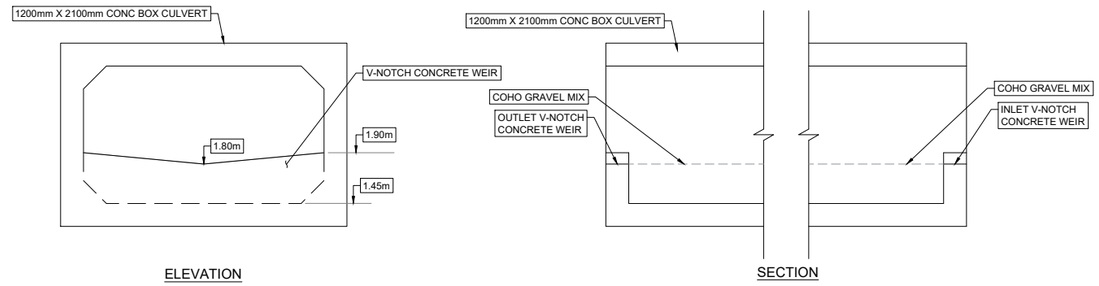

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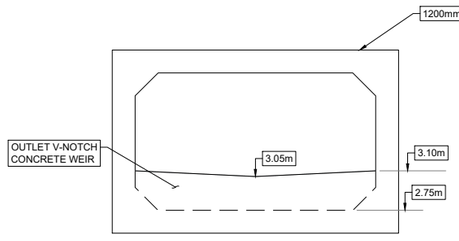

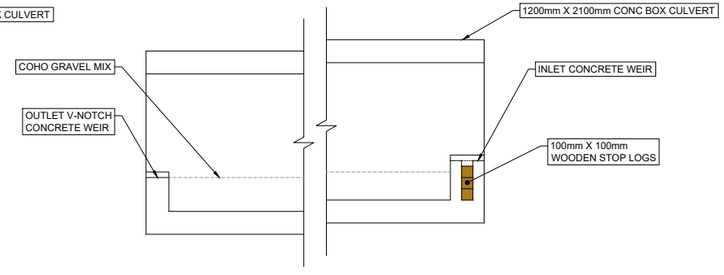

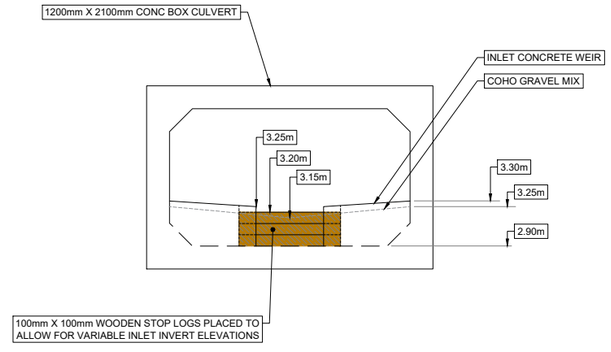

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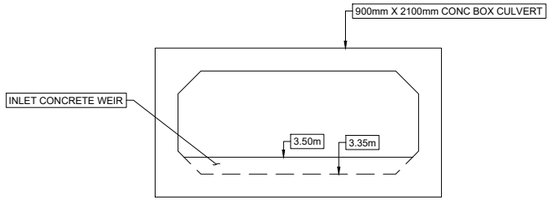

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PLOT DATE: November 16, 2021

REV NO	REVISIONS	DATE	DRAWN	APPR'D
A	DETAILED DESIGN	21/05/06	GA	CJB/ND
B	UPDATED DETAILED DESIGN	21/07/15	GA	CJB/ND
C	ISSUED FOR STORMWATER MEMO	21/11/16	GA	CJB

Coquitlam
Engineering & Public Works
3000 Guildford Way, Coquitlam, B.C. V3B 7N2

CULVERT DETAILS
CEDAR DRIVE UPGRADES

ISL Engineering and Land Services
#201, 3999 Henning Dr, Burnaby, B.C. V5C 6P9
T: (604)629-2696 F: (604)629-2698

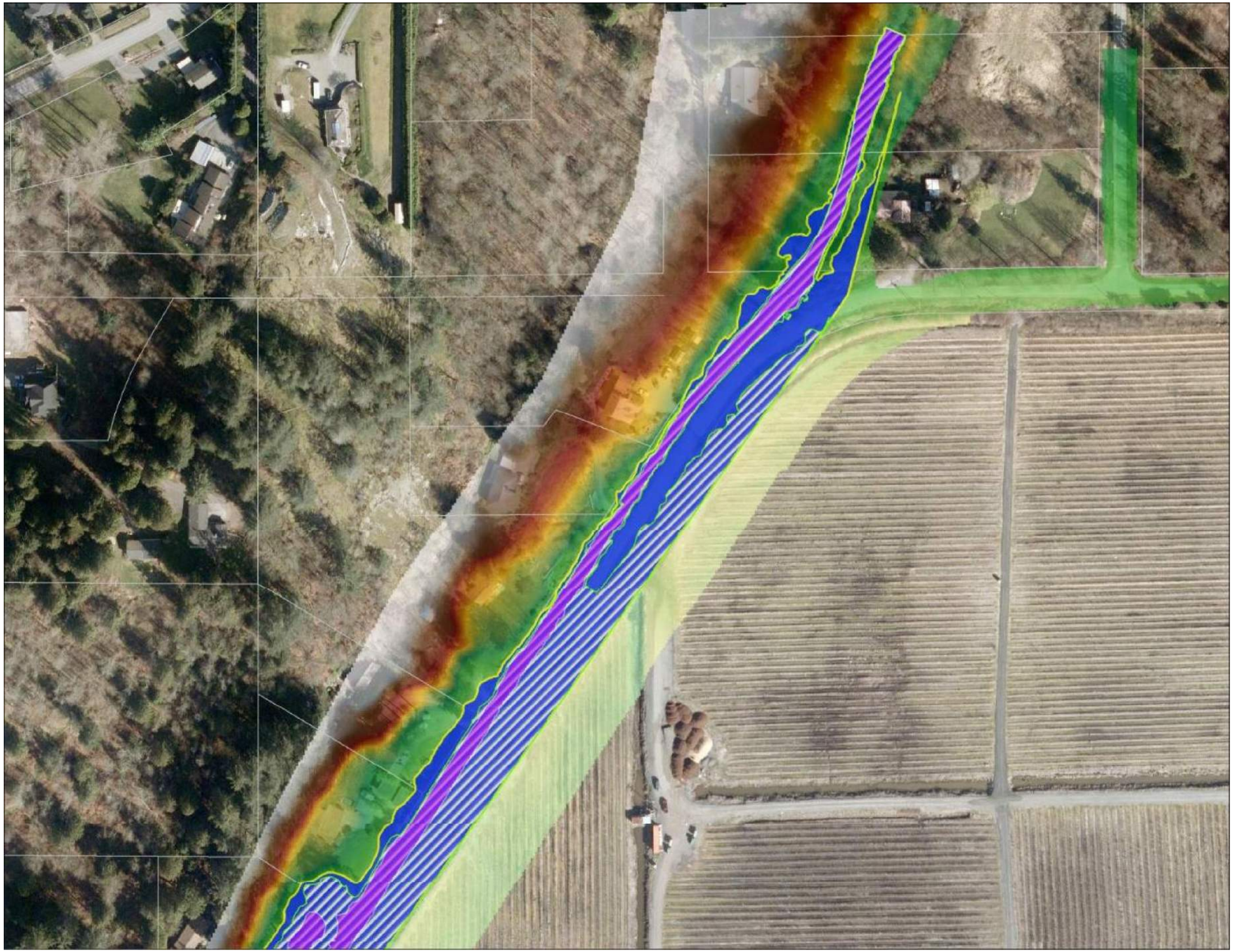
DETAILED DESIGN DESIGN NO. 32628

SCALE	AS SHOWN	DATE	Jul-21
DRAWN BY	GA	DESIGN BY	CJB
CHECKED BY	CJB/ND	APPROVED BY	KPT

DWG. NO. 37 OF 54
REV. C

DESTROY ALL PRINTS BEARING PREVIOUS NO.

APPENDIX C
Water Surface Elevation Flood Lines – Zoomed



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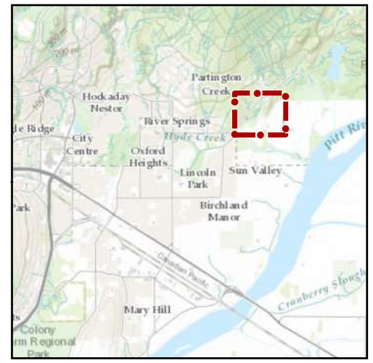

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

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FIGURE C.1
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 1
EXISTING CREEK CONDITIONS
CEDAR DRIVE UPGRADES

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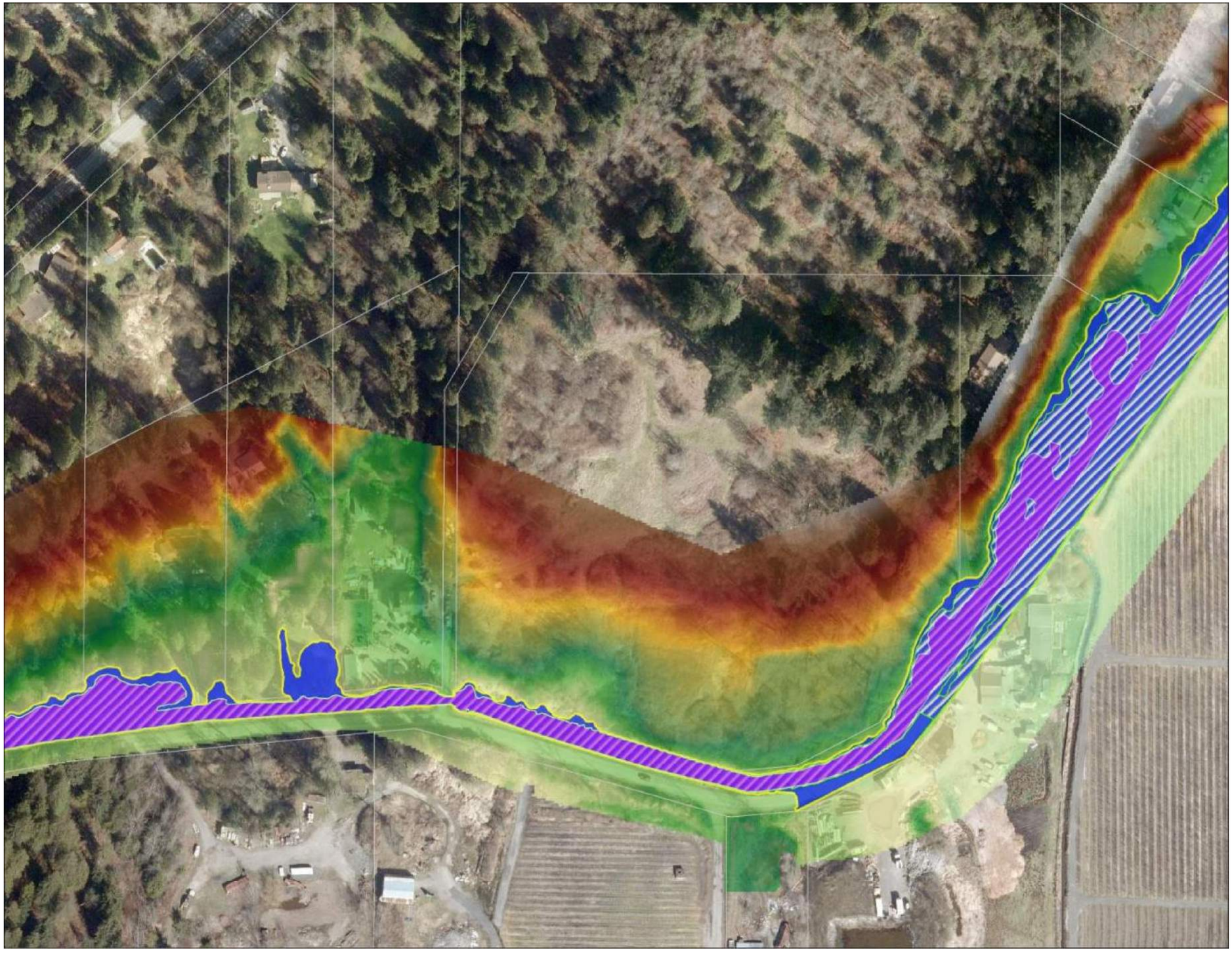
Date: 2022-02-10 Document: Q:\Projects\32628_COQ Cedar Drive Upgrades\25_GIS\251_Figures\1_Report Figures\Appendix C - WSE Flood Lines\Figure C.1 - Major Events Flood Map_Scenario 1.1.mxd



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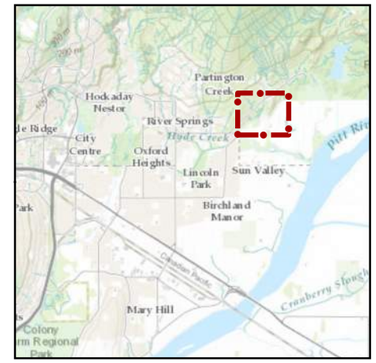

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

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FIGURE C.2
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 2
EXISTING CREEK CONDITIONS
CEDAR DRIVE UPGRADES

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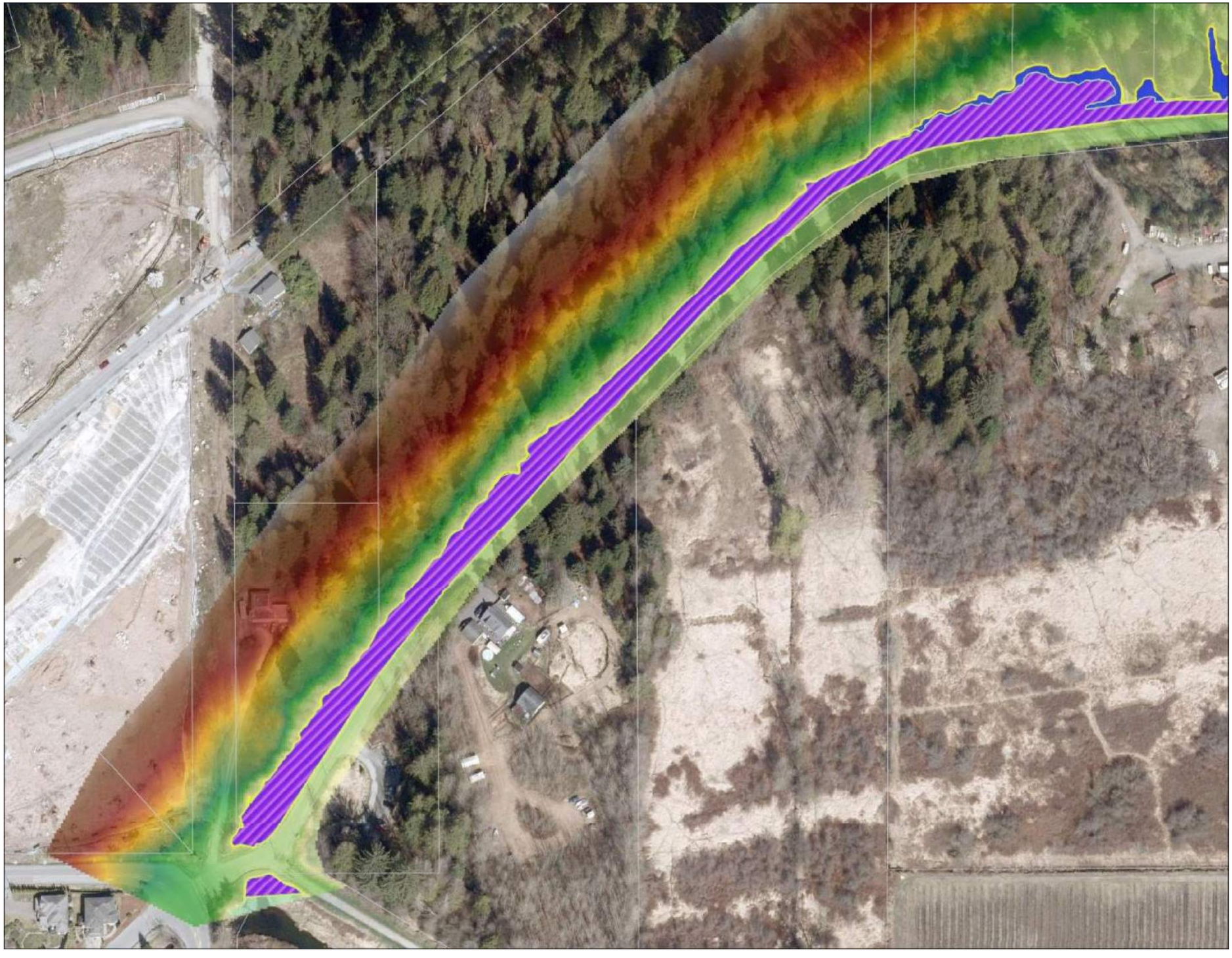
Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

Date: 2022-02-10 Document: Q:\Projects\32628_COQ Cedar Drive Upgrades\25_GIS\251_Figures\1_Report Figures\Appendix C - WSE Flood Lines\Figure C.2 - Major Events Flood Map_Scenario 1.12.mxd



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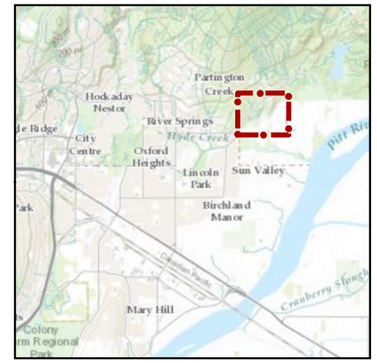

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

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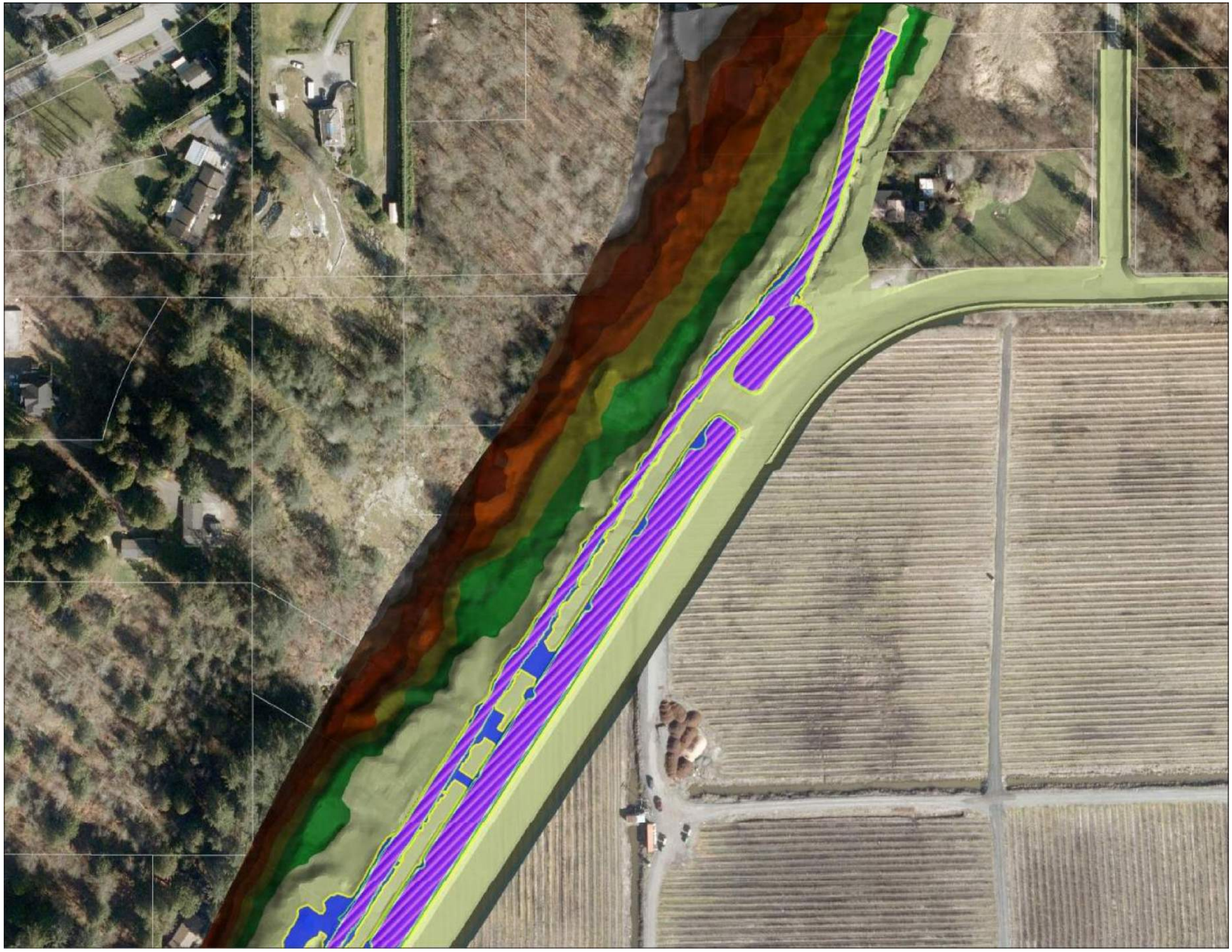
FIGURE C.3
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 3
EXISTING CREEK CONDITIONS
CEDAR DRIVE UPGRADES



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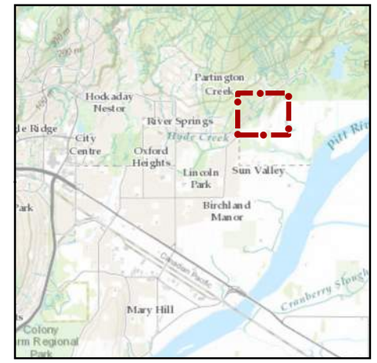

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

NAD 1983 UTM Zone 10N

FIGURE C.4
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 1
EXISTING CREEK/PROPOSED
CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

Date: 2022-02-10 Document: Q:\Projects\32628_COQ Cedar Drive Upgrades\25_GIS\251_Figures\1_Report Figures\Appendix C - WSE Flood Lines\Figure C.4 - Major Events Flood Map_Scenario 2.1.mxd

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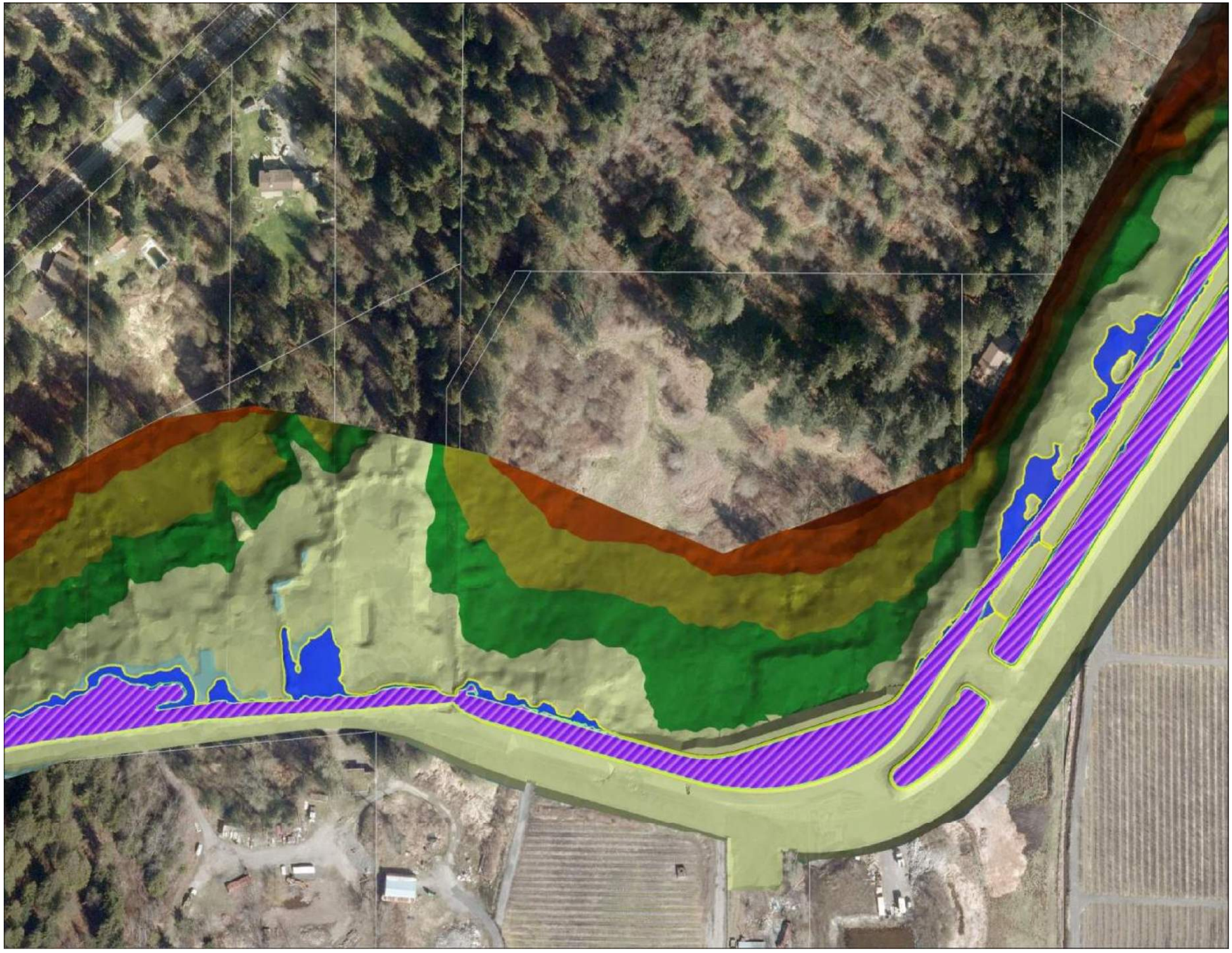

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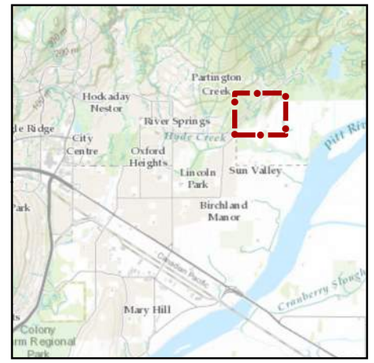

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

NAD 1983 UTM Zone 10N

FIGURE C.5
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 2
EXISTING CREEK/PROPOSED
CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

Credits:Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri

Date: 2022-02-10 Document: Q:\Projects\32628_COQ Cedar Drive Upgrades\25_GIS\251_Figures\1_Report Figures\Appendix C - WSE Flood Lines\Figure C.5 - Major Events Flood Map_Scenario 2.5.mxd

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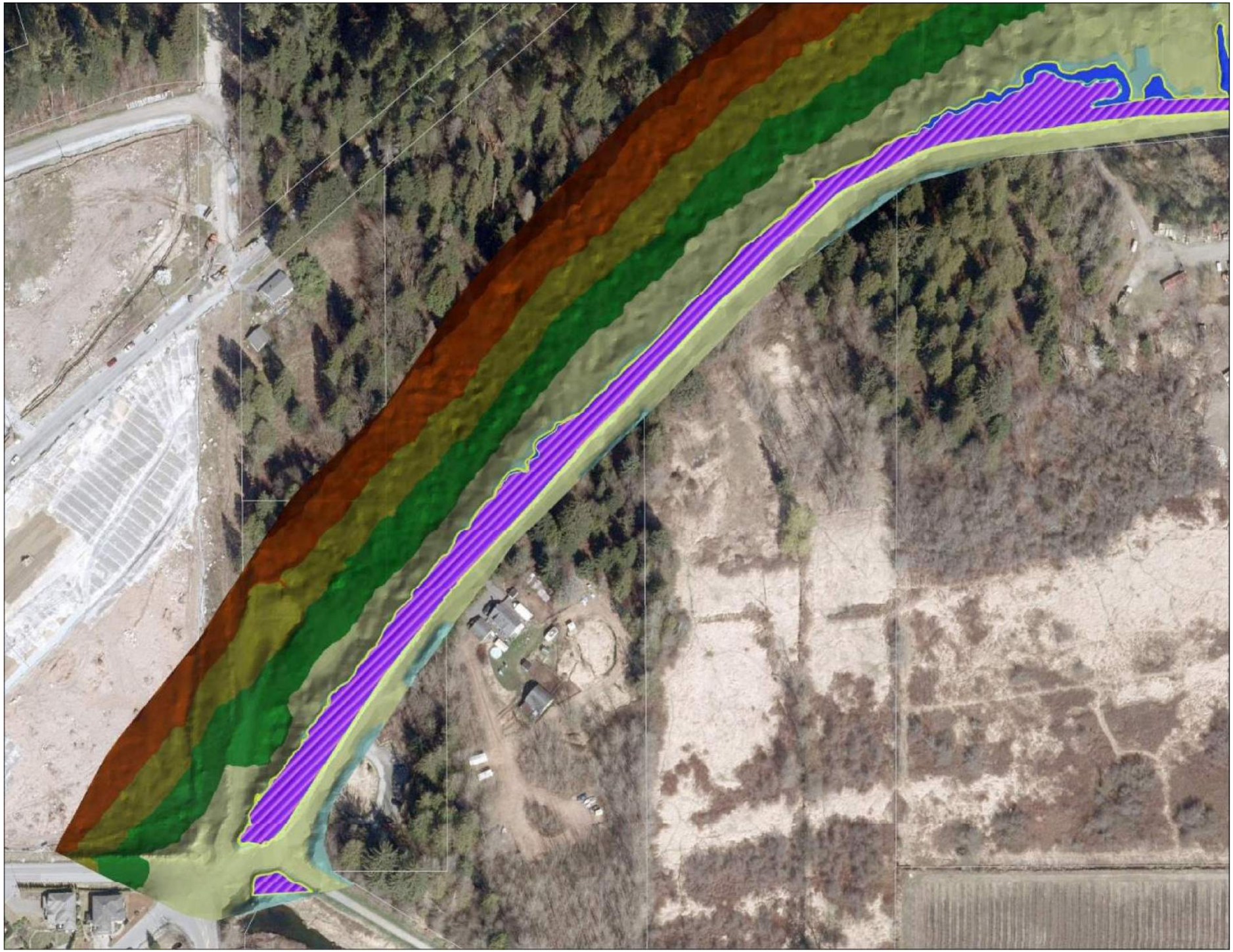

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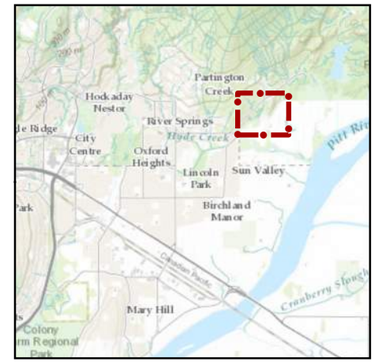

Legend

Water Surface Elevation Extent

- 1:100-Year Event
- 1:10-Year Event
- 1:2-Year Event

NAD 1983 UTM Zone 10N

FIGURE C.6
MAJOR RAINFALL EVENTS
FLOOD MAPPING - SECTION 3
EXISTING CREEK/PROPOSED CHANNEL CONDITIONS
CEDAR DRIVE UPGRADES

APPENDIX D

HGL and Flow Summary – Existing Creek/Proposed Channel Conditions

Table D.1: Maximum Hydraulic Grade Line along Partington Creek

Type	Node	Creek HGL (m)						
		Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Junction	J4	6.1	6.1	6.12	6.12	6.34	6.39	6.49
Junction	J5	5.54	5.54	5.58	5.58	5.82	5.87	5.95
Junction	J6	4.73	4.73	4.76	4.76	4.97	5.02	5.13
Junction	J7	4	4	4.02	4.02	4.28	4.37	4.59
Junction	J8	3.24	3.24	3.29	3.28	3.89	4.05	4.37
Junction	J9	3.23	3.23	3.27	3.27	3.86	4.02	4.34
Junction	J10	3.23	3.23	3.26	3.26	3.81	3.97	4.3
Junction	J11	3.23	3.23	3.26	3.26	3.79	3.95	4.29
Junction	J12	3.23	3.23	3.26	3.26	3.77	3.93	4.29
Junction	J13	3.23	3.23	3.26	3.26	3.75	3.91	4.24
Junction	J14	3.23	3.23	3.26	3.26	3.73	3.88	4.21
Junction	J15	3.04	3.04	3.07	3.07	3.62	3.79	4.14
Junction	J16	2.89	2.97	2.93	2.97	3.56	3.74	4.1
Junction	J17	2.69	2.97	2.74	2.97	3.51	3.7	4.07
Junction	J18	2.63	2.98	2.68	2.98	3.49	3.69	4.05
Junction	J19	2.62	2.97	2.67	2.97	3.47	3.67	4.03
Junction	J20	2.56	2.97	2.59	2.97	3.45	3.66	4.02
Junction	J21	2.55	2.97	2.58	2.97	3.44	3.65	4
Junction	J22	2.51	2.97	2.57	2.97	3.43	3.64	3.99
Junction	J23	2.51	2.96	2.57	2.96	3.43	3.63	3.97
Junction	J24	2.5	2.96	2.56	2.96	3.42	3.62	3.97
Junction	J25	2.5	2.96	2.55	2.96	3.41	3.62	3.95
Junction	J26	2.5	2.96	2.55	2.96	3.4	3.61	3.94
Junction	J27	2.5	2.96	2.55	2.96	3.4	3.61	3.93
Junction	J28	2.5	2.96	2.54	2.96	3.41	3.61	3.93
Junction	J29	2.45	2.95	2.47	2.95	3.3	3.29	3.75
Junction	J30	2.18	2.95	2.25	2.95	3.27	3.26	3.69
Junction	J31	2.18	2.95	2.25	2.95	3.26	3.25	3.69
Junction	J32	2.18	2.95	2.24	2.95	3.25	3.24	3.67
Junction	J33	2.17	2.95	2.22	2.95	3.23	3.23	3.66
Junction	J34	2.15	2.95	2.19	2.95	3.2	3.21	3.65
Junction	J35	1.93	2.95	2.02	2.95	3.15	3.19	3.61
Junction	J36	1.92	2.95	2.02	2.95	3.13	3.19	3.58
Junction	J37	1.92	2.94	2.02	2.94	3.12	3.19	3.57
Junction	J38	1.92	2.95	2.02	2.95	3.1	3.18	3.54
Junction	J39	1.92	2.93	2.03	2.93	3.11	3.26	3.63
Storage	J1	1.92	2.94	2.02	2.94	3.08	3.18	3.50

Junction	J2	1.92	2.94	2.02	2.94	3.09	3.19	3.54
Junction	J44	1.92	2.94	2.02	2.94	3.09	3.17	3.52
Junction	J45	1.92	2.94	2.02	2.94	3.08	3.16	3.52
Junction	J46	1.92	2.94	2.02	2.94	3.08	3.16	3.5
Junction	J47	1.92	2.94	2.02	2.94	3.08	3.15	3.49
Junction	J48	1.92	2.94	2.02	2.94	3.08	3.15	3.49
Junction	J49	1.92	2.94	2.02	2.94	3.08	3.15	3.48
Junction	J50	1.91	3.05	2.01	3.05	3.06	3.13	3.45
Junction	J51	1.91	3.03	2.01	3.03	3.05	3.12	3.44
Junction	J52	1.91	3.07	2	3.07	3.07	3.11	3.41
Junction	J53	1.9	3.05	1.99	3.05	3.05	3.09	3.39
Junction	J54	1.88	3.06	1.95	3.06	3.06	3.07	3.35
Junction	J55	1.76	3.04	1.85	3.04	3.04	3.05	3.31
Junction	J56	1.73	2.99	1.82	2.99	2.99	3.04	3.29
Junction	J57	1.71	3.02	1.8	3.02	3.02	3.04	3.29
Junction	J58	1.7	3.02	1.78	3.02	3.02	3.03	3.29
Junction	J59	1.69	3.03	1.75	3.03	3.03	3.03	3.28
Junction	J60	1.69	3.07	1.75	3.07	3.07	3.07	3.27
Junction	J61	1.69	3.08	1.75	3.08	3.08	3.08	3.28
Junction	J62	1.69	3.07	1.74	3.07	3.07	3.07	3.24
Junction	J63	1.69	3.05	1.74	3.05	3.05	3.05	3.22
Junction	J64	1.69	3.06	1.73	3.06	3.06	3.06	3.2
Junction	J65	1.67	3.12	1.71	3.12	3.12	3.12	3.2
Junction	J66	1.57	3.1	1.61	3.1	3.1	3.1	3.19
Junction	J67	1.45	3.06	1.48	3.06	3.06	3.06	3.18
Junction	J68	1.32	3.08	1.37	3.08	3.08	3.08	3.17
Junction	J69	1.23	3.08	1.32	3.08	3.08	3.08	3.16
Junction	J70	1.23	3.05	1.31	3.05	3.05	3.05	3.16
Junction	J71	1.2	2.96	1.28	2.96	2.96	2.96	3.15
Junction	J72	1.18	3.01	1.23	3.01	3.01	3.01	3.14
Junction	J73	1.17	3.02	1.21	3.02	3.02	3.02	3.13
Junction	J74	1.14	3.06	1.18	3.06	3.06	3.06	3.14
Junction	J75	1.09	3.07	1.12	3.07	3.07	3.07	3.14
Junction	J76	1.04	3.1	1.09	3.1	3.1	3.1	3.14
Junction	J77	0.97	3.06	1.01	3.06	3.06	3.06	3.13
Junction	J78	0.87	3.03	0.91	3.03	3.03	3.03	3.12
Junction	J79	0.81	3	0.85	3	3	3	3.12
Junction	J80	0.71	3.03	0.74	3.03	3.03	3.03	3.12
Junction	J81	0.52	2.99	0.59	2.99	2.99	2.99	3.12
Junction	J84	0.44	2.98	0.52	2.98	2.98	2.98	3.12

Table D.2: Maximum Hydraulic Grade Line along Channel

Type	Node	Channel HGL (m)						
		Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Storage	J83	3.23	3.23	3.26	3.26	3.79	3.95	4.28
Junction	J3	3	3	3.02	3.02	3.53	3.7	4.1
Junction	J86	3.35	3.35	3.35	3.35	3.65	3.78	4.12
Junction	J99	1.92	2.94	2.02	2.94	3.09	3.18	3.54
Junction	J40	3	3	3.01	3.01	3.24	3.57	4.02
Junction	J42	2.56	2.94	2.57	2.94	3.23	3.57	4.02
Junction	J87	2.3	2.93	2.31	2.93	3.23	3.56	4.02
Junction	J88	2.3	2.93	2.31	2.93	3.23	3.56	4.02
Junction	J89	2.18	2.93	2.19	2.93	3.23	3.56	4.02
Junction	J90	1.92	2.93	2.03	2.93	3.23	3.56	4.01
Junction	J91	1.92	2.93	2.03	2.93	3.23	3.56	4.01
Junction	J92	1.92	2.93	2.03	2.93	3.23	3.56	4.01
Junction	J93	1.92	2.93	2.03	2.93	3.23	3.56	4.02
Junction	J94	1.92	2.93	2.03	2.93	3.23	3.56	4.02
Junction	J95	1.92	2.93	2.03	2.92	3.23	3.56	4.01
Junction	J96	1.92	2.93	2.03	2.93	3.23	3.56	4.01
Junction	J97	1.92	2.93	2.02	2.93	3.2	3.48	3.91
Junction	J98	2.02	2.93	2.03	2.93	3.23	3.56	4.02
Junction	J43	1.92	2.93	2.03	2.93	3.18	3.45	3.86
Storage	J82	1.92	2.92	2.02	2.93	3.14	3.37	3.75
Junction	J41	1.92	2.93	2.02	2.93	3.12	3.29	3.66

Table D.3: Maximum Flow along Partington Creek

Type	ID	Creek Maximum Flow (m^3/s)						
		Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Culvert	Cvt1	0.027	1.106	0.128	0.337	8.932	12.260	22.740
Creek	C10	0.030	0.030	0.130	0.130	7.604	11.350	20.100
Creek	C11	0.030	0.032	0.130	0.130	7.614	11.360	20.120
Creek	C12	0.025	0.025	0.100	0.100	5.562	8.158	15.310
Creek	C13	0.025	0.025	0.100	0.100	5.560	8.157	15.260
Creek	C14	0.025	0.025	0.100	0.100	5.554	8.158	15.300
Creek	C15	0.025	0.025	0.100	0.100	5.550	8.160	15.230
Creek	C16	0.025	0.025	0.100	0.100	5.554	8.162	15.300
Creek	C17	0.025	0.035	0.100	0.100	5.604	8.162	15.340
Creek	C18	0.025	0.047	0.100	0.119	5.653	8.161	15.330
Creek	C19	0.025	0.064	0.100	0.128	5.686	8.161	15.360
Creek	C20	0.025	0.088	0.100	0.139	5.747	8.159	15.450
Creek	C21	0.025	0.123	0.100	0.152	5.856	8.158	15.760
Creek	C22	0.025	0.151	0.100	0.148	5.961	8.159	15.830
Creek	C23	0.025	0.177	0.100	0.150	6.046	8.161	15.870
Creek	C24	0.025	0.203	0.100	0.148	6.125	8.162	16.220
Creek	C25	0.025	0.242	0.100	0.147	6.167	8.163	16.480
Creek	C26	0.025	0.270	0.100	0.155	6.187	8.163	16.460
Creek	C27	0.025	0.298	0.100	0.161	6.190	8.163	16.870
Creek	C28	0.025	0.323	0.100	0.169	6.193	8.160	16.970
Creek	C29	0.025	0.332	0.100	0.170	6.181	8.201	17.400
Creek	C30	0.025	0.331	0.100	0.166	6.395	8.156	17.190
Creek	C31	0.025	0.332	0.100	0.159	6.636	8.156	17.250
Creek	C32	0.025	0.336	0.100	0.164	6.859	8.157	17.180
Creek	C33	0.025	0.344	0.100	0.158	7.197	8.158	17.230
Creek	C34	0.025	0.350	0.100	0.161	7.414	8.158	17.320
Creek	C35	0.025	0.354	0.100	0.166	7.556	8.159	17.480
Creek	C36	0.025	0.570	0.100	0.172	7.696	8.160	17.570
Creek	C37	0.025	0.398	0.100	0.189	7.826	8.161	17.950
Creek	C38	0.025	0.585	0.100	0.200	7.862	8.163	18.250
Creek	C1_A	0.024	0.415	0.097	0.203	7.679	8.072	18.190
Creek	C40	0.028	0.818	0.126	0.301	9.527	11.070	21.740
Creek	C42	0.027	0.846	0.125	0.274	8.545	11.080	20.790
Creek	C44	0.027	0.858	0.125	0.263	8.217	11.080	20.550
Creek	C45	0.028	0.888	0.128	0.271	8.158	11.170	20.700
Creek	C46	0.028	0.891	0.128	0.265	8.085	11.170	20.780
Creek	C47	0.028	0.894	0.128	0.255	8.098	11.170	20.810
Creek	C48	0.028	0.902	0.128	0.249	8.145	11.170	20.800
Creek	C49	0.028	0.914	0.128	0.250	8.191	11.170	21.020
Creek	C5	0.030	0.030	0.130	0.130	7.589	11.350	20.010
Creek	C50	0.028	0.922	0.128	0.247	8.214	11.170	21.170

Creek	C51	0.028	0.922	0.128	0.252	8.244	11.180	21.170
Creek	C52	0.028	0.919	0.128	0.259	8.294	11.180	20.950
Creek	C53	0.028	0.931	0.128	0.262	8.318	11.170	20.700
Creek	C54	0.028	0.942	0.128	0.260	8.761	12.190	22.340
Creek	C55	0.028	0.951	0.128	0.254	8.733	12.200	22.450
Creek	C56	0.028	0.957	0.128	0.242	8.721	12.200	22.580
Creek	C57	0.028	0.961	0.128	0.238	8.582	12.210	22.610
Creek	C58	0.028	0.968	0.128	0.230	8.372	12.220	22.500
Creek	C59	0.028	0.958	0.128	0.222	8.438	12.200	22.350
Creek	C6	0.030	0.030	0.130	0.130	7.589	11.350	20.010
Creek	C60	0.028	0.939	0.128	0.224	8.472	12.210	22.170
Creek	C61	0.028	0.934	0.128	0.225	8.534	12.210	22.020
Creek	C62	0.028	0.933	0.128	0.230	8.589	12.190	22.040
Creek	C63	0.028	0.933	0.128	0.237	8.630	12.240	22.160
Creek	C64	0.028	0.934	0.128	0.240	8.661	12.240	22.190
Creek	C65	0.028	0.943	0.128	0.239	8.689	12.230	22.320
Creek	C66	0.028	0.956	0.128	0.235	8.687	12.210	22.470
Creek	C67	0.028	0.956	0.128	0.241	8.656	12.210	22.530
Creek	C68	0.028	0.946	0.128	0.246	8.642	12.210	22.520
Creek	C69	0.028	0.935	0.128	0.249	8.610	12.220	22.480
Creek	C7	0.030	0.030	0.130	0.130	7.589	11.350	20.010
Creek	C70	0.028	0.957	0.128	0.251	8.592	12.210	22.390
Creek	C71	0.027	0.975	0.128	0.252	8.526	12.220	22.240
Creek	C72	0.027	0.996	0.128	0.252	8.443	12.250	22.420
Creek	C73	0.027	1.016	0.128	0.254	8.417	12.240	22.510
Creek	C74	0.027	1.022	0.128	0.260	8.387	12.230	22.530
Creek	C75	0.027	1.019	0.128	0.269	8.394	12.220	22.690
Creek	C76	0.027	1.016	0.128	0.272	8.406	12.230	22.760
Creek	C77	0.027	1.012	0.128	0.272	8.478	12.220	22.760
Creek	C78	0.027	1.013	0.128	0.280	8.570	12.210	22.770
Creek	C79	0.027	1.032	0.128	0.289	8.652	12.210	22.730
Creek	C8	0.030	0.030	0.130	0.130	7.589	11.350	20.030
Creek	C80	0.027	1.049	0.128	0.295	8.734	12.210	22.640
Creek	C81	0.027	1.067	0.128	0.300	8.806	12.220	22.510
Creek	C82	0.027	1.093	0.128	0.325	8.884	12.240	22.620
Creek	C9	0.030	0.030	0.130	0.130	7.595	11.350	20.070

Table D.4: Maximum Flow along Channel

Type	ID	Channel Maximum Flow (m^3/s)						
		Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Culvert	Cvt2	0.001	0.153	0.010	0.095	0.753	1.036	1.316
Culvert	Cvt3	0.001	0.153	0.010	0.095	0.753	1.036	1.316
Culvert	Cvt4	0.001	0.153	0.010	0.095	0.753	1.036	1.316
Culvert	Cvt5	0.001	0.143	0.010	0.071	0.730	1.035	1.301
Culvert	Cvt6	0.001	0.143	0.010	0.071	0.730	1.035	1.301
Culvert	Cvt7	0.001	0.143	0.010	0.071	0.730	1.035	1.301
Culvert	Cvt8	0.000	0.000	0.000	0.000	0.454	0.793	1.493
Culvert	Cvt9	0.000	0.000	0.000	0.000	0.454	0.793	1.493
Culvert	Cvt10	0.005	0.005	0.029	0.029	1.215	1.626	2.097
Culvert	P_Bypath	0.001	0.034	0.003	0.008	0.095	0.112	0.154
Channel	Channel_1	0.005	0.005	0.029	0.029	2.131	3.185	4.838
Channel	Channel_10	0.005	0.369	0.029	0.207	2.166	3.103	3.906
Channel	Channel_11	0.005	0.380	0.030	0.208	2.184	3.103	3.902
Channel	Channel_2	0.005	0.197	0.029	0.155	2.214	3.161	4.851
Channel	Channel_3	0.005	0.227	0.029	0.181	2.261	3.135	4.860
Channel	Channel_4	0.005	0.238	0.029	0.204	2.265	3.125	4.572
Channel	Channel_4a	0.005	0.221	0.029	0.196	2.264	3.118	4.577
Channel	Channel_5	0.005	0.215	0.029	0.182	2.269	3.111	4.581
Channel	Channel_5a	0.005	0.225	0.029	0.188	2.277	3.107	4.303
Channel	Channel_6	0.005	0.248	0.029	0.208	2.265	3.105	4.227
Channel	Channel_7	0.005	0.254	0.029	0.202	2.247	3.104	4.186
Channel	Channel_8	0.005	0.283	0.029	0.212	2.226	3.103	4.143
Channel	Channel_9	0.005	0.339	0.029	0.212	2.169	3.103	4.035

Table D.5: Maximum Velocity along Partington Creek

Type	ID	Creek Maximum Velocity (m/s)						
		Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Culvert	Cvt1	0.913	0.015	1.221	0.059	1.572	2.154	3.971
Creek	C10	0.110	0.110	0.343	0.343	2.657	2.958	3.371
Creek	C11	0.046	0.046	0.164	0.164	1.993	2.258	2.562
Creek	C12	0.067	0.067	0.208	0.208	2.035	2.220	2.600
Creek	C13	0.070	0.070	0.211	0.211	2.023	2.200	2.603
Creek	C14	0.106	0.106	0.297	0.297	2.309	2.438	2.890
Creek	C15	0.731	0.731	1.185	1.185	3.791	3.747	4.235
Creek	C16	0.571	0.571	0.986	0.986	3.210	3.132	3.611
Creek	C17	0.820	0.172	1.244	0.479	2.844	2.826	2.880
Creek	C18	0.376	0.090	0.701	0.220	2.374	2.314	2.733
Creek	C19	0.317	0.095	0.614	0.192	2.246	2.202	2.562
Creek	C20	0.402	0.091	0.797	0.181	2.211	2.180	2.652
Creek	C21	0.152	0.049	0.379	0.109	1.569	1.551	2.059
Creek	C22	0.111	0.055	0.303	0.116	1.825	1.755	2.310
Creek	C23	0.104	0.052	0.262	0.108	1.855	1.766	2.555
Creek	C24	0.238	0.057	0.454	0.119	1.841	1.743	2.321
Creek	C25	0.125	0.051	0.295	0.095	1.643	1.555	2.164
Creek	C26	0.038	0.036	0.116	0.065	1.271	1.209	1.833
Creek	C27	0.036	0.040	0.115	0.068	1.245	1.187	1.687
Creek	C28	0.203	0.082	0.458	0.135	1.922	1.844	2.028
Creek	C29	0.859	0.097	1.390	0.156	2.492	2.268	2.415
Creek	C30	0.325	0.050	0.615	0.082	2.163	2.075	2.537
Creek	C31	0.076	0.030	0.201	0.048	1.435	1.464	1.959
Creek	C32	0.087	0.038	0.235	0.062	1.899	1.807	2.261
Creek	C33	0.360	0.047	0.642	0.072	2.367	2.122	2.662
Creek	C34	0.414	0.046	0.765	0.073	2.503	2.216	2.837
Creek	C35	1.849	0.044	1.430	0.071	2.462	2.208	3.162
Creek	C36	0.122	0.021	0.176	0.032	1.178	1.074	1.708
Creek	C37	0.046	0.019	0.096	0.027	0.939	0.859	1.430
Creek	C38	0.106	0.024	0.147	0.032	1.026	0.930	1.559
Creek	C1_A	0.031	0.018	0.062	0.021	0.703	0.697	1.047
Creek	C40	0.026	0.015	0.051	0.024	0.516	0.536	0.824
Creek	C42	0.012	0.025	0.033	0.017	0.407	0.481	0.715
Creek	C44	0.026	0.031	0.071	0.028	0.717	0.876	1.249
Creek	C45	0.034	0.029	0.094	0.036	0.906	1.122	1.571
Creek	C46	0.032	0.029	0.089	0.034	0.863	1.085	1.525
Creek	C47	0.031	0.029	0.087	0.033	0.865	1.066	1.395

Creek	C48	0.030	0.028	0.086	0.032	0.863	1.070	1.403
Creek	C49	0.030	0.600	0.086	0.031	0.848	1.054	1.457
Creek	C5	0.600	0.068	0.934	0.934	4.558	5.430	6.930
Creek	C50	0.333	0.040	0.648	0.077	2.026	2.384	3.091
Creek	C51	0.191	0.057	0.379	0.046	1.225	1.448	1.926
Creek	C52	0.200	0.065	0.459	0.065	1.710	2.003	2.568
Creek	C53	0.285	0.055	0.619	0.073	1.927	2.267	2.789
Creek	C54	0.536	0.053	0.966	0.060	1.709	2.080	2.646
Creek	C55	0.545	0.037	0.953	0.059	1.718	2.086	2.300
Creek	C56	0.549	0.024	0.846	0.041	1.091	1.243	1.406
Creek	C57	0.418	0.027	0.680	0.026	0.750	0.899	1.072
Creek	C58	0.400	0.042	0.691	0.029	0.812	1.038	1.316
Creek	C59	0.342	1.818	0.761	0.045	1.257	1.623	2.057
Creek	C6	1.818	0.037	2.847	2.847	6.645	7.270	8.402
Creek	C60	0.125	0.036	0.395	0.039	1.116	1.482	2.010
Creek	C61	0.044	0.033	0.157	0.038	1.092	1.470	2.151
Creek	C62	0.059	0.032	0.192	0.037	1.056	1.422	2.107
Creek	C63	0.082	0.032	0.237	0.037	1.067	1.443	2.152
Creek	C64	0.182	0.030	0.431	0.037	1.092	1.471	2.172
Creek	C65	0.324	0.033	0.575	0.034	1.023	1.380	2.071
Creek	C66	0.764	0.031	1.135	0.036	1.149	1.546	2.293
Creek	C67	0.747	0.027	1.254	0.033	1.111	1.513	2.324
Creek	C68	0.467	0.026	0.855	0.029	0.936	1.284	2.007
Creek	C69	0.503	1.694	0.650	0.027	0.875	1.206	1.893
Creek	C7	1.694	0.023	2.342	2.342	5.757	6.175	6.613
Creek	C70	0.118	0.021	0.242	0.024	0.765	1.061	1.677
Creek	C71	0.509	0.018	0.860	0.022	0.696	0.966	1.479
Creek	C72	0.536	0.017	0.998	0.019	0.594	0.839	1.279
Creek	C73	0.281	0.016	0.569	0.017	0.548	0.782	1.235
Creek	C74	0.325	0.020	0.595	0.017	0.522	0.747	1.200
Creek	C75	0.449	0.020	0.805	0.020	0.594	0.845	1.363
Creek	C76	0.269	0.020	0.566	0.019	0.585	0.826	1.345
Creek	C77	0.737	0.020	1.022	0.019	0.576	0.811	1.337
Creek	C78	0.625	0.018	1.058	0.019	0.578	0.806	1.341
Creek	C79	0.549	0.292	0.856	0.018	0.539	0.745	1.238
Creek	C8	0.292	0.016	0.657	0.657	3.703	4.097	4.581
Creek	C80	0.633	0.015	1.126	0.017	0.478	0.657	1.095
Creek	C81	0.243	0.013	0.506	0.014	0.409	0.559	0.936
Creek	C82	0.748	0.236	0.899	0.013	0.360	0.488	0.819
Creek	C9	0.236	0.003	0.504	0.504	2.457	2.777	3.235

Table D.6: Maximum Velocity along Channel

ID	Channel Maximum Velocity (m/s)						
	Low-tide Summer Conditions	High-tide Summer Conditions	Low-tide Spawning Conditions	High-tide Spawning Conditions	1:2-Year Return Period	1:10-Year Return Period	1:100-Year Return Period
Cvt2	0.001	0.038	0.008	0.038	0.299	0.411	0.522
Cvt3	0.001	0.038	0.008	0.038	0.299	0.411	0.522
Cvt4	0.001	0.038	0.008	0.038	0.299	0.411	0.522
Cvt5	0.002	0.028	0.008	0.028	0.290	0.411	0.516
Cvt6	0.002	0.028	0.008	0.028	0.290	0.411	0.516
Cvt7	0.002	0.028	0.008	0.028	0.290	0.411	0.516
Cvt8	0.000	0.000	0.000	0.000	0.924	1.048	1.119
Cvt9	0.000	0.000	0.000	0.000	0.924	1.048	1.119
Cvt10	0.014	0.014	0.085	0.085	1.151	1.187	1.246
P_Bypath	0.015	0.054	0.030	0.030	0.334	0.397	0.543
Channel_1	0.251	0.003	0.511	0.020	0.570	0.625	0.600
Channel_10	0.002	0.019	0.010	0.021	0.164	0.179	0.182
Channel_11	0.009	0.024	0.022	0.021	0.158	0.170	0.172
Channel_2	0.135	0.030	0.284	0.035	0.270	0.299	0.338
Channel_3	0.002	0.018	0.010	0.022	0.195	0.214	0.239
Channel_4	0.151	0.030	0.322	0.036	0.242	0.258	0.287
Channel_4a	0.257	0.028	0.520	0.032	0.232	0.247	0.274
Channel_5	0.167	0.025	0.127	0.026	0.214	0.225	0.250
Channel_5a	0.027	0.021	0.052	0.026	0.208	0.216	0.237
Channel_6	0.002	0.016	0.010	0.021	0.171	0.181	0.193
Channel_7	0.011	0.030	0.033	0.031	0.233	0.238	0.255
Channel_8	0.002	0.016	0.010	0.022	0.168	0.179	0.187
Channel_9	0.005	0.021	0.018	0.024	0.174	0.185	0.188