Memorandum

To:	John McCleod, P.Eng Tony Chen, P.Eng Patricia Taylor	Project:	Eagle Mountain - Woodfibre Gas Pipeline (EGP) Tunnel Project
From:	Stephanie Robillard, P.Eng Joel Bot, EIT	cc:	Doug Grimes, Marco Moccichino, Daniel Dowling
Date:	September 23, 2021	FEI Doc No. MJA Doc No.	P-00763-ENG-MEM-2003 53728_007_MO_BC_1 _BCRail_Discharge_Options_
Subject:	Evaluation of BC Rail Site Water Discharge Options		

Revision Log

Revision No.	Date	Revision Description
A	June 2, 2021	Draft issued for FEI review
0	August 26, 2021	Issued for use
1	September 23, 2021	Issued for use - FEI comments incorporated

1.0 Purpose

McMillen Jacobs Associates (MJA), on behalf of FortisBC Energy Inc. (FortisBC), contracted Urban Systems to undertake an engineering assessment of the existing private storm sewer drainage network at the BC Rail Site, in Squamish B.C. The BC Rail Site will be the location of the East Shaft as well as the staging area for Soft Ground Tunnel construction. Water produced by these construction activities will be treated to meet provincially regulated water quality guidelines and discharged into the surrounding natural environment.

This memo submits and summarizes the report produced by Urban Systems, which evaluates the three identified options for discharge locations (see Appendix A) as well as the findings of "BC Rail Site Water Discharge Options - Biophysical Assessment" completed by Jacobs Engineering (Appendix B). The various considerations (infrastructure, environmental, permitting, etc.) are presented to assist FortisBC with the selection of the preferred discharge location to advance to permitting for the discharge of treated water from EGP Tunnel construction.

2.0 Discharge Feasibility Study

Three options for water discharge (see Figure 1 for overview) were evaluated in Urban Systems' discharge feasibility study, as follows:

- Option 1: BCR Properties Ltd. existing network leading to the Northern Outfall;
- Option 2: A new discharge system to be located within the FortisBC NPS 10 Natural Gas Pipeline ROW; and
- Option 3: BCR Properties Ltd. existing network leading to the Southern Outfall.

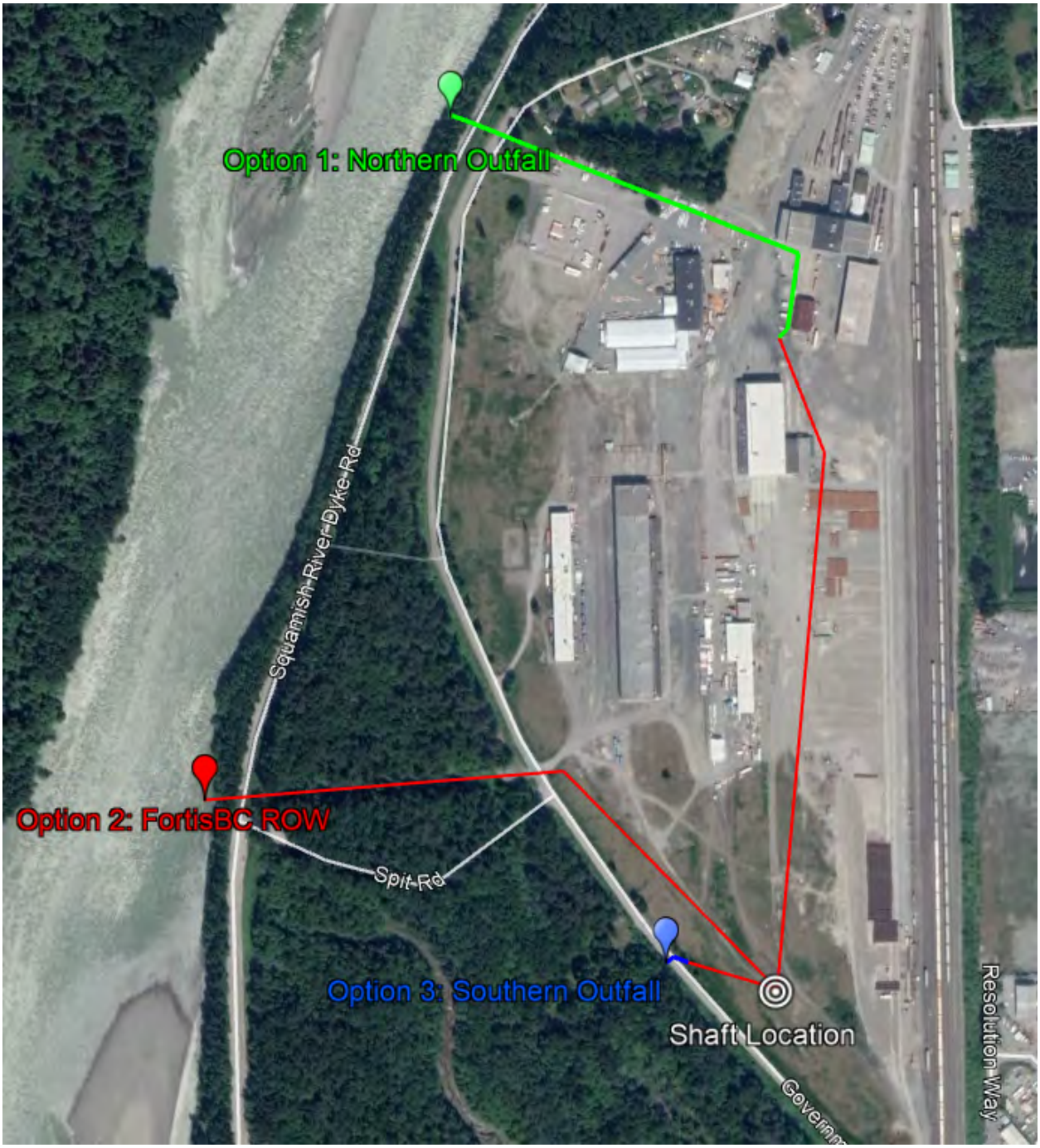

Figure 1: Indicative Outline of Three Options (red: new infrastructure requirements; blue and green: existing infrastructure)

2.1 Hydraulics Assessment

The "BC Rail Discharge Feasibility Study" report prepared by Urban Systems (see Appendix A) is the culmination of a feasibility study using publicly available information (LiDAR and GIS databases), several resources provided by MJA (Construction Surveillance Reports and site plans), and a one-day site visit to inspect existing infrastructure, site terrain and outfall discharge environments. The existing infrastructure assessment reviewed structural integrity, capacity, feasible tie-in locations and discharge

environments for Options 1 and 3. During the site visit, Urban System also assessed the linear infrastructure required to establish Option 2 as a discharge point. To evaluate the capacity of the existing outfall systems, the lateral extent of catchments draining to designated outfalls, existing drainage channels that service the site through perimeter road ditches and culverts and estimated runoff volumes during recorded annual precipitation events were assessed.

Base assumptions for water discharge requirements provided to Urban Systems were a "chronic" industrial water discharge estimate of 150 m^3/day, from tunnel construction activities, for the 3-year construction duration, and two 2,600 m^3 short duration, "acute" discharge events for water used for hydrostatic testing of the gas pipelines. The estimate for chronic discharge does not include the volume of precipitation received on site during rainfall events as this water will not be captured or conveyed to the Contractor's water treatment plant. All precipitation will be drained as per pre-construction conditions. Conceptual infrastructure designs to facilitate discharge of the anticipated water volumes and durations were developed for each of the three options. The designs described in the report include site routing and corresponding lengths of piping, pipe diameters and pumping requirements, based on assumed elevation changes. The conceptual design parameters for new infrastructure required under each option are summarized in Table 1.

Table 1: Conceptual Design Parameters- New Infrastructure

Consideration	Option 1	Option 2	Option 3
Pipe Length	~670 m to tie-in	~650 m	~92 m to tie-in
Piping Diameter Req. - Chronic	100 mm	100 mm	100 mm
Piping Diameter Req.- Acute (w/o discharge restriction)	300 mm	300 mm	300 mm
Pumping	Continuous, likely required due to limited head (proposed 3.2 HP)	Continuous (5-125 HP dep. on pump location)	N/A, based on assumed pipe slopes

One of the primary conclusions of the report is that for Option 1 and 3, the incremental increase in discharge volume that would occur due to anticipated construction water (chronic) discharge is insignificant relative to the volumes currently received in typical large precipitation events. Table 2 shows the increase in flow in the existing systems due to the construction water, relative to a 6-month, 2-year and 5-year rainfall event.

Table 2: Summary of Capacity Assessment

Rainfall Event	Option 1 (increase in flow rate)	Option 2 (increase in flow rate)	Option 3 (increase in flow rate)
6-Month	1.48%	N/A	1.52%
2-Year	0.48%	N/A	0.49%
5-Year	0.33%	N/A	0.33%

2.2 Infrastructure Condition Survey (CCTV)

Following the hydraulic assessment, and at the recommendation of Urban Systems, a closed-circuit television (CCTV) survey was conducted to assess the condition of the storm sewer drainage network for

Options 1 and 3. A remote control vehicle equipped with a video camera was placed in the piping and driven along the extent possible, controlled from surface. Several blockages of sediment and gravel were encountered and did not allow the remote vehicle to assess the entire length of the piping. Some deterioration of the concrete piping was noted; however, Urban Systems review of the CCTV survey results indicates that this is not anticipated to impact use for the duration of tunnel construction. Prior to use of either Options 1 or 3, it is recommended that flushing of the piping take place. Please refer to Appendix A for the detailed assessment of the piping and full CCTV survey report.

2.3 Biophysical Survey

Following the Urban Systems Feasibility Study, a biophysical survey was conducted by Jacobs Engineering to review the receiving environments of each of the three options. This was done to compliment the hydraulic assessment and determine which of the options were most suitable from an environmental perspective. The survey evaluated the receiving environments in terms of the aquatic environment, wetlands and riparian communities, vegetation and wildlife. The biophysical survey indicates that the receiving environment least sensitive to an increase in discharge would be Option 1, as it discharges into a deep flowing reach of the Squamish River, with minimal sedimentation concerns. Option 3's discharge area, on the other hand, is potentially the most sensitive as it discharges into a swamp wetland and estuarine marsh. Discharge at Option 3 directly interacts with potentially important aquatic environments as well as red and blue listed swamp areas (high and moderate risk ecological communities). Please refer to Appendix B for the biophysical survey of the outfall receiving environments. In addition to the survey results, Jacobs Engineering provides proposed mitigation measures that should be considered for each of the three options.

3.0 Summary of Considerations

In order to facilitate FortisBC's selection of a preferred discharge location, MJA have compiled considerations for various criteria in Table 3 which summarizes the primary considerations for planning and implementation of each option. The table includes input from the Urban Systems report, input from MJA and FortisBC as well as the contents of the summary tables from the Jacobs Engineering Biophysical Survey.

For all three discharge options, it is assumed that the water treatment plant on site will have storage capabilities to moderate flow as required. Therefore, this infrastructure consideration has not been included in Table 3.

Due to the insignificant increase in flow rates due to construction water discharge (Table 2), the hydraulics are considered favorable for all three options. The main differentiators, as presented in Table 3, are permitting, stakeholder and environmental considerations as well as the design, implementation, and operation of temporary infrastructure.

Table 3: BC Rail Discharge Options Comparison

	Option 1: BCR Properties Ltd. Northern Outfall	Option 2: FortisBC NPS 10 Natural Gas Pipeline ROW	Option 3: BCR Properties Ltd. Southern Outfall
Engineering Effort	• Overland piping design by Contractor to the tie-in point of the Northern Outfall	• Overland piping and pump design by Contractor • Design of new temporary outfall required for permitting	• Overland piping design by Contractor to the tie-in point of the Southern Outfall
Infrastructure requirements	• ~670 m overland piping to tie-in • Pumps to maintain flow to tie-in location (up to 3 HP depending on flow rate) • Pump back up system • Preliminary assessment (as well as DoS input) indicates outfall requires flushing prior to use, however its condition appears to be suitable for use during construction.	• Establishment/installation of ~650 m of discharge line and construction of temporary secured/enclosed outfall • Pumps to maintain flow over Dike Road (5 HP to 125 HP depending on flow rate and location of pump) • Crossing of Government Road and Dike Road (temporary crossing) required • Pump back up system	• ~92 m overland piping to tie-in
Operation and Maintenance Considerations	• Pump and discharge line monitoring and maintenance • Type of pumps, power requirements; quietness and efficiency of pumps (electric over diesel) • Removal of tie-in piping and reinstatement at end of Project	• Pump and discharge line monitoring and maintenance • Type of pumps, power requirements; quietness and efficiency of pumps (electric over diesel) • Removal and reinstatement of tie-in piping and outfall at end of Project	• Maintenance of discharge line • Gravity feed • Removal of tie-in piping and reinstatement at end of Project
Safety/ Security	• Temporary infrastructure contained within BCR Property • Crossing locations for various BCR Property tenants • Security measures at discharge manhole • Construction limitations along pipeline alignment, O/H cables/ buried services/ tripping hazards etc.	• Traverses area accessible by general public • Susceptible to vandalism • Tamper monitoring/ Security measures at point of discharge and for piping outside of BCR Property	• Temporary infrastructure contained within BC Rail Site

	Option 1: BCR Properties Ltd. Northern Outfall	Option 2: FortisBC NPS 10 Natural Gas Pipeline ROW	Option 3: BCR Properties Ltd. Southern Outfall
Permitting Considerations	• OGC Waste Discharge Authorization required, application already submitted and under review. • If flushing the storm sewer is required prior to use, a separate Waste Discharge Permit may be required • If the outfall needs replacement, agreements with DoS as well as permits from OGC, DFO, Transport Canada and FLNRO will be required.	• Detailed design of outfall will have to be advanced prior to preparing permit application. • OGC Waste Discharge Authorization required, application already submitted and under review. • Permits from DoS will be required for the water line to cross Dike Road and Government Road. Permits under the Dike Maintenance Act may also be required. • Outfall structure and other installations (i.e. pump) on the top of bank of the Squamish River will require OGC and DoS permits and potentially DFO, Transport Canada and FLNRO permits.	• OGC Waste Discharge Authorization required, the application submitted will need to be revised to include this option. An EPN may need to be published with the updated discharge location. • Consultation with key stakeholders including FLNRO, Squamish River Watershed Society, DoS and Squamish Nation required. • No DFO, FLNRO or Transport Canada permits would be required. • OGC Permitting under the Water Sustainability Act (Section 11) may be required if disturbance to the wetland can't be avoided.
Permitting Effort	*Low to Moderate* No additional permitting effort would be required if the outfall structure does not require replacement. Involvement from multiple regulatory agencies and long lead time permits associated with the potential replacement of the existing outfall.	*Moderate* Involvement from multiple regulatory agencies and long lead time permits associated with the installation of the new outfall structure and conveyance system.	*Low to Moderate* Involvement from one regulatory agency (OGC) through two separate permitting processes (Waste Discharge Authorization and Section 11 under Water Sustainability Act) unless the flow can be diverted from the wetland area.

	Option 1: BCR Properties Ltd. Northern Outfall	Option 2: FortisBC NPS 10 Natural Gas Pipeline ROW	Option 3: BCR Properties Ltd. Southern Outfall
Stakeholder Considerations	• Consultation with key stakeholders conducted as part of OGC Waste Discharge Authorization, no major concerns were identified. However, the OGC has not sent referral packages to FNs.	• Consultation with key stakeholders conducted as part of OGC Waste Discharge Authorization, no major concerns were identified. However, the OGC has not sent referral packages to FNs. • DoS: concerns regarding the water line crossing Government Road and to ensure plowing could be conducted during winter months. DoS also expressed concerns regarding impacts to the dike infrastructure. • Dike Authority (FLNRO): no consultation was conducted for this option; however, concerns regarding dike integrity from the installation of infrastructure within or over the regulated dike can be anticipated.	• Consultation with stakeholders will be required to identify concerns with potential environmental impacts. • Although the discharge location is outside of the WMA, concerns from the Squamish River Watershed Society could be anticipated due to interaction with the functional estuary.

Environmental Considerations- Aquatic Environment	• Proposed discharge area is associated with existing outfall infrastructure that drains directly into a deep flowing reach of the Squamish River • There are minimal sedimentation concerns due to existing rip-rap preventing bed scour; however, this area provides important fish habitat values. It is not anticipated that short-term footprint impacts during construction or long-term changes in flow rate due to discharge outfall upgrades will result in a negative impact to fish or fish habitat at this site.	• Proposed discharge area with alignment directly onto the gravel bar would be best for this area; however, downstream sedimentation events are likely and will require sediment controls and downstream monitoring for increases in turbidity. • Due to the seasonal exposure of the gravel bar, fish habitat is limited in this area to high water conditions during freshet.	• Proposed discharge area and estimated flow path interacts with potentially important aquatic environments, including a swamp wetland and an estuarine marsh, that are likely accessible to all fish at varying life stages that can be found within Squamish River and estuary. • The large catchment area associated with the wetlands may allow for sediment to settle which may reduce sediment mobilization into downstream productive fish habitat. Due to the accumulation of loose, deep, and saturated substrates and detritus material in the swamp, any increased flow during discharge activities, may pose a risk for sediment mobilization downstream.
Environmental Considerations- Wetlands and Riparian Communities	• No wetland identified • A riparian community is adjacent to the Squamish River at the proposed discharge location.	• No wetland identified • A riparian community is adjacent to the Squamish River at the proposed discharge location.	• Discharge area will directly interact with high-moderate function Red-listed swamp. Permitting under the Water Sustainability Act will be required for wetland disturbance (that is, changes in and about a stream), which can take some months to obtain, depending on what approvals are required as determined through consultation with the provincial regulator and the site-specific activities. The goal of “no net loss” of Wetland Function will be applied to wetlands as per the Federal Policy on Wetland Conservation (Government of Canada 1991; Lynch-Stewart 1992; Lynch-Stewart et al. 1996) on the EGP Project. Potential compensation for wetland loss may be

			required if permanent disturbance to wetland area or function occurs as a result of the discharge. • A riparian community is within the proposed discharge area, surrounding the wetland swamp.
Environmental Considerations- Vegetation	• Several non-native, regional priority invasive species are present on the dike.	• Canada thistle infestations are present on the east side of the dike. Canada thistle is on Schedule A of the *BC Week Control Regulation.* Several other non-native, regional priority invasive plant species are also present.	• Discharge area will interact with Red and Blue-listed ecological communities: o One Red-listed Sitka willow – Pacific willow – skunk cabbage swamp lies within the catchment area. o Red- and Blue-listed estuarine marsh communities are in the flow path south of the catchment discharge area. • If discharged water follows the proposed flow path and inundates the wetland the catchment area and the estuarine marsh communities to the south of the catchment area, there may be impacts to vegetation resources. • Canada thistle infestations are present along the flow path south of the catchment discharge area. Canada thistle is on Schedule A of the BC Weed Control Regulation. Several other non-native, regional priority invasive plant species are also present along Government Road and along the flow path south of the catchment discharge area. • Three western red cedar trees greater than 130 cm diameter (>200 years old) are present in the western portion of the catchment area.

Wildlife	• Migratory bird nesting habitat present within riparian vegetation along shoreline of the Squamish River.	• Migratory bird nesting habitat present within riparian vegetation along shoreline of the Squamish River and in low shrubs within existing FortisBC ROW.	• Suitable nesting habitat for migratory birds present within the grasses and shrubs within the estuarine marsh communities south of the catchment area.

4.0 Summary

The results of the Urban Systems report have been reviewed by and discussed with the Project team. All three options are considered feasible from a capacity and condition perspective. Based on the considerations summarized in Table 3, Option 1 is the least preferred from an infrastructure standpoint due to the changes in diameters in existing piping (reduced capacity), significant sedimentation blockages and the requirement for piping/pumping equipment. Note: Option 1 was the discharge point considered by Proponents in their bid price, so this infrastructure would already be accounted for in the project cost. Option 1 does have capacity limitations due to the narrow piping at the discharge point, and short-term, minor flooding has been observed within the BC Rail site. Should this option be selected, additional evaluations to better characterize the potential for increased flooding (and baseline the current performance) may be beneficial for discussions with BC Rail. Option 2 is a reasonable alternative but comes with the additional hurdles of detailed design, permitting and constructing a new temporary outfall. Option 3 with temporary tie-in piping to the Southern outfall has the least amount of infrastructure requirements and has less hydraulic limitations.

The results of Jacobs Engineering biophysical survey report indicate that Option 1 is the most preferred as it has the lowest potential for environmental impact; the outfall discharges into a deep flowing section of the Squamish River. For Option 2, the report indicates that sediment controls are required to mitigate erosion and that wetland and wildlife interaction is of little to no concern. Lastly, the Jacobs Engineering report indicates that discharge from Option 3 will interact with a wetland classified as a high-moderate function Red-listed swamp. Jacobs Engineering recommends mitigation measures if this option is selected including sedimentation control and downstream monitoring to mitigate impact to a productive fish habitat.

Unlike Options 1 and 2, Option 3 will require the revision of the existing OGC Water Discharge Authorization as it was not previously included. Option 3 introduces new risks associated with permitting, mitigating environmental impacts and stakeholder acceptance. In particular, these could introduce schedule risks.

5.0 Conclusion and Next Steps

McMillen Jacobs, FortisBC, Jacobs Engineering and Urban Systems participated in a Decision Workshop on September 8th, 2021. The considerations identified in the previous revision (Rev 0) of the present memo above were discussed and Option 1 was selected by ForticBC as the preferred approach to advance into construction, as documented by a FortisBC PDR.

Recommended next steps in the advancement of Option 1 include:

- For improved system performance: Flush the existing drainage system downstream of the tie-in point in advance of construction. Steps include:
    - Create a plan with the Contractor that specifically addresses the environmental impact mitigation.
    - Complete work summer 2022, prior to Contractor mobilization to the BC Rail Site.
- For more informed discussions with BCR Properties Ltd.: Define the risk of flooding/limitations due to river level fluctuation. Steps include:

- Complete a more refined analysis of the hydraulic grade line through the existing Option 1 network. For this analysis, obtain elevation survey data from all manholes and catch basins including inverts and rims.
- Complete a flood extent/flow path analysis to identify potential risk, with and without additional flows to be able to define relative change in risk.
- Evaluate discharge scenarios for the varying historical river stage elevations (freely discharging outfall vs. submerged)
- Urban Systems to document the above analysis in a memorandum.

Respectfully Submitted,

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Attached:

Appendix A- P-00763-ENG-MEM-2002 BC Rail Discharge Feasibility Study - Urban Systems

Appendix B- P-00763-ENV-MEM-2003 BC Rail Site Water Discharge Options - Biophysical Assessment - Jacobs Engineering

Appendix A

P-00763-ENG-MEM-2002 BC Rail Discharge Feasibility Study - Urban Systems

URBAN SYSTEMS MEMORANDUM

DATE: July 29, 2021
TO: Stephanie Robillard, P.Eng, McMillen Jacobs Associates
CC: Brittney Dawney, P.Eng, Urban Systems
FROM: Glen Shkurhan, P.Eng, Selina Gandha, EIT
FEI DOC: #P-00763-ENG-MEM-2002
FILE: 5111.0001.01
SUBJECT: BC Rail Discharge Feasibility Study

1.0 INTRODUCTION

Urban Systems Ltd. (Urban) is currently providing support to McMillen Jacobs Associates (MJA) in conducting a feasibility study of options for discharging water generated by construction activities at the BC Rail site (Site) on Government Road in Squamish, British Columbia, as part of FortisBC Energy Inc. (FortisBC)'s Eagle Mountain - Woodfibre Gas Pipeline (EGP) Project.

The three discharge options under consideration are:

- Option 1: Discharge to the existing Site stormwater collection and transmission infrastructure at the north end of the Site, the North System, with an outfall directly into the Squamish River. Construct new temporary infrastructure to connect the water collection point to the Tie-In Manhole.
- Option 2: Construct a new temporary discharge line within the existing FortisBC transmission pipeline right-of-way (ROW) and discharge directly to the Squamish River.
- Option 3: Discharge to the existing Site stormwater collection and transmission infrastructure at the south end of the Site, the South System, with an outfall to the Squamish River Estuary. Construct new temporary infrastructure to connect the water collection point to the Tie-In Manhole.

The Site location is shown in **Figure 1.**

Figure 1: Site Location

2.0 PARAMETERS AND ASSUMPTIONS

This study is based on the following parameters and assumptions:

- The tunnelling activities will generate approximately 150 cubic meters of water per day (m^3/day) as a continuous flow during tunnelling and portal excavation dewatering, and a flow of approximately 2,600 m^3/day over a 24-hour period for hydrostatic testing. These two activities are isolated events.
- The continuous flow of 150 m^3/day is assumed to be over a 24-hour period. This amounts to a flow rate of 1.75 L/s.
- If the discharge of 2,600 m^3/day is done over a 10-hour work window, an average flow of 70 L/s would be achieved.
- Construction is expected to begin in late 2022 and will occur over approximately three (3) years, spanning all four seasons and a likely wide range of precipitation events. The continuous flow of 150 m^3/day is assumed to occur through all weather conditions.
- All existing storm sewer and transmission infrastructure on the Site is privately owned by BCR Properties Ltd (BCR).
- Pipe surcharging in the existing storm sewer can be tolerated, but not increased surface flooding.
- The East Shaft is estimated at 7 meters deep, however, the final depth is subject to the Contractor's design. Collected water will need to be lifted regardless of which disposal option is selected.

- Contractors will be responsible for providing on-site water treatment and meet BC Approved Water Quality Guidelines. Details of treatment will be designed to meet regulatory requirements. The following assumptions were made regarding the water treatment system:
    - A compact surface mounted treatment system to remove suspended solids such as that provided by Stormtec (Stormtec Filtration Inc.).
    - Water from the East Shaft and from other sources of water will be lifted into an on-site treatment system in which storage tanks with a hydraulic surface 3 meters above ground level at the East Shaft (8 meters geodetic elevation) will flow into the disposal system.

3.0 AVAILABLE DATA AND FIELD REVIEW

Urban referenced LiDAR information of the Site from the District of Squamish (District), *BC Rail Facilities Plan*, BCR Properties Ltd., 1985, and *BC Railway Squamish Yard Land Use Study*, Urban Systems Ltd., 2018 to identify Site layout and existing stormwater infrastructure. In addition, a field inspection of existing infrastructure was conducted on April 26, 2021. The findings from the field visit are described under each option below. An overview of the existing storm infrastructure on Site can be found in **Figure 2**. A CCTV video inspection was conducted on June 25, 2021, by Dougness Holdings Ltd., as discussed in Section 4.4 below. A complete copy of the CCTV report is appended herein.

4.0 MANAGEMENT OPTIONS

4.1 OPTION 1

Option 1 involves building new infrastructure to convey water from the East Shaft into an on-site water treatment system then to the existing stormwater collection and transmission infrastructure at the north end of the Site, where an existing outfall discharges directly into the Squamish River. This option is conceptually shown in **Figure 3**.

During the field investigation it was noted that the manhole at the potential tie-in point showed significant sediment accumulated in the connecting storm sewers. No other manhole exhibited the same, so the extent of sediment is not known. A concrete base in the manhole could be implemented to facilitate future cleaning without risk to destabilizing the manhole.

During the field reconnaissance, pipe sizes and connectivity were confirmed, some of which are not consistent on the BC Rail Facilities Plan. Analysis conducted herein is based on the observed sizes. Of particular note, the final leg of pipe to the Squamish River is a 300 mm diameter pipe, which is significantly reduced from the 600 mm diameter pipe immediately upstream of it. As such, the outfall causes a dramatic reduction in capacity, as seen in **Table 3**. Also of note, the discharge end of the outfall pipe was observed during the field reconnaissance and signs of structural cracking and what appear to be rocks protruding into the pipe appeared. Visual access was generally poor, so observations are only an indicator of concern. However, based on the field investigation, this option may require replacement or upgrading of the outfall, which would need to be confirmed if this is the preferred discharge location. Additional field data would not provide any meaningful changes to the assessed capacity and hydraulic analyses below.

CCTV inspection was completed of Option 1 storm sewers. A summary of the results can be found in Section 4.4.

In June 2021, the northern outfall was found to be completely submerged, even at low tide due to the unusually high Squamish River freshet. It was reported that the outfall was submerged for about 2 to 3 weeks (anecdotal information). The effect on the piping system in the BC Rail site was not monitored. In this case there was no rain through freshet, however had significant precipitation occurred, there may have been noticeable affect. During a high freshet, it is quite possible that the FortisBC project may need to install a temporary pump in the event of another extreme freshet. This could be a temporary response involving a submersible pump at the dyke to pump at 150 m^3/day (1.75 L/s), which is the continuous flow rate of this project. Like Sub-option 2a, the pump would be located at the dike and would be sized to lift the water 4 m vertically with a 1 m head loss over 50 m of piping. A 40 mm diameter force main is suggested for the target flow of 1.75 L/s. The pumping requirement for the continuous 1.75 L/s flow is 3 Hp crank power.

4.1.1 Capacity Assessment

The Rational Method was used to compute design flows to the system, Manning's Equation was used to assess the pipe capacity in a gravity situation, and Hazen William Equation was used to assess the pipe capacity in a pumped situation. Design flows are computed for a 6-month, 2-year, and 5-year storm frequency. Because this is a private system, municipal standards do not apply, however storm sewers are typically sized for the 5-year event.

- Using the LiDAR topography data of the Site and considering the layout of the piping and inlet system, a contributing drainage area of 7.56 ha was identified as shown in **Figure 2**.
- A runoff coefficient of 0.95 was applied.
- Intensity-duration-frequency (IDF) curves from the District were used to determine rainfall intensity (mm/hr) over a 15-minute duration.

Using these parameters, flow rates of 136 L/s, 415 L/s, and 614 L/s were calculated for 6-month, 2-year, and 5-year storm frequencies, respectively. This is the total flow that applies to the outfall pipe. Discrete, incremental flows for each leg of the pipe system have not been computed at this stage. **Table 1** shows the breakdown of the flow computations.

Table 1: North System Flow Rate

Storm Frequency	Drainage Area (ha)	Runoff Coefficient	Duration (min)	Rainfall (mm/hr)	Runoff (L/s)
6-Month	7.56	0.95	15	6.8	136
2-Year	7.56	0.95	15	20.8	415
5-Year	7.56	0.95	15	30.8	614

With the added continuous discharge of 150 m^3/day (1.75 L/s), the flows increase to 138 L/s, 417 L/s, and 616 L/s for 6-month, 2-year, and 5-year storm frequencies, respectively (**Table 2**). The proposed discharge rate is considered insignificant relative to the precipitation driven flows, is well below the margin of error in the analysis and will not fundamentally change system performance or flood risk.

The infrequent flow of 70 L/s (2,600 m³/day), as above, has not been considered because it is understood that the timing of that discharge is controllable with onsite storage and scheduling, and would not occur during a significant rainfall event. This discharge rate is approximately half that of a 6-month precipitation event.

Table 2: Total Catchment Flow Rate with Continuous Discharge (1.75L/s)

Storm Frequency	Existing Flow Rate (L/s)	Flow Rate with Continuous Discharge (L/s)	% Increase
6-Month	136	138	1.47%
2-Year	415	417	0.48%
5-Year	614	616	0.33%

The pipe capacities from the anticipated Tie-in Manhole to the North Outfall were computed. Precise pipe slopes could not be determined from available information and would require a detailed topographic survey. However, for the purpose of this investigation precise pipe slopes are not required. Rather, the assessment can be determined using an estimated hydraulic grade line slope, which simply means that the water surface profile does not necessarily match the pipe profile. Some surcharging within the pipes may occur. Surcharging means that the water surface within a manhole may be observed above the crown (top) of the downstream pipe connecting to the manhole. Based on the information available, an average hydraulic slope of 0.5% was applied. This slope ensures that any surcharging that may occur would remain below ground surface at manholes.

Table 3: Pipe Capacities of North System

From	To	Slope (%)	Nominal Pipe Diameter (mm)	Pipe Material	Full Velocity (m/s)	Pipe Capacity (L/s)
Tie-In MH	MH1	0.5	300	PVC	1.14	80
MH1	MH2	0.5	300	PVC	1.14	80
MH2	MH3	0.5	450	PVC	1.49	235
MH3	MH4	0.5	450	PVC	1.49	235
MH4	MH5	0.5	525	CON	1.42	317
MH5	MH6	0.5	525	CON	1.42	317
MH6	MH7	0.5	600	CON	1.55	453
MH7	North Outfall	0.5	300	CON	1.14	68

The pipe capacities from MH2 to MH7 are fair relative to design flows, however the final leg of pipe from MH7 to the outfall is significantly below computed design flows. Also, the pipe capacity between MH6 and MH7 barely meets the 2-Year storm criteria and does not meet the 5-Year storm criteria. It is Urban's understanding that surface flooding has been observed in this catchment, however the specific circumstances of those observations is not known. The flooded areas are in slightly undulating terrain with insignificant gradient to basins or are not serviced by basins altogether.

4.1.2 Temporary Discharge Connection to Tie-In Manhole

As shown in **Figure 3**, a temporary storm line will be needed to connect the water collection point (Point A) to the Tie-in Manhole. The alignment is only conceptually shown.

The temporary storm line has been sized for 1.75 L/s and secondarily for 70 L/s. With a ground elevation of 5m at the East Shaft and an assumed elevated treatment tank 3 m above ground, the hydraulic elevation is approximately 8 m geodetic. The invert of the pipe at the Tie-In Manhole is estimated at 4 m geodetic elevation, resulting in a hydraulic drop of 4 m over 670 m between the two locations. This results in a hydraulic grade line of 0.6%. This slope requires that the treatment tank remain full and there is no flooding at the Tie-In Manhole. If either of these fails, the hydraulic slope and resulting flow will decease. For example, if flooding to ground surface were to occur at the Tie-In Manhole, the hydraulic slope decreases to 0.4%. As such, the pipe has been sized for both hydraulic slopes, and two flow rates, as shown in **Table 4**. A 100 mm diameter pipe is sufficient for both slopes and a 1.75 L/s flow, however, a 300 mm diameter is needed for a flow of 70 L/s. If the treatment tanks do not remain full and if any surcharging occurs at the receiving manhole, there will be insufficient pressure for 70 L/s to flow by gravity, and so a low pressure 3.2 Hp (crank power) pump will be required.

Table 4: Pipe Sized for Northern Temporary Discharge Connection

Flow Rate (L/s)	Slope (%)	Nominal Pipe Diameter (mm)	Pipe Material	Full Velocity (m/s)	Pipe Capacity (L/s)
1.75	0.6	**100**	PVC	0.60	5
1.75	0.4	**100**	PVC	0.49	4
70	0.6	**300**	PVC	1.25	88
70	0.4	**300**	PVC	1.02	72

4.2 OPTION 2

Option 2 involves constructing a new temporary discharge line within the existing FortisBC ROW and discharging to the Squamish River. The conceptual alignment and ground profile along it is presented in **Figure 4**. The grade from the East Shaft (Point A) to Spit Road is relatively constant, however the ditch on the west side of Government Road is a low point. Spit Road is a dike, representing a significant high point. Both provincial and municipal approval would be required to penetrate the dike with a pipe for gravity drainage. The other option is to pump over the dike, for which there are two sub-options. Sub-option 2a is to gravity drain from the East Shaft to the base of the dike, then install a pump at the base of the dike to lift the water over the dike. Sub-option 2b is to pump the water from the East Shaft all the way to the Squamish River. The exact point of discharge (outfall location) would need to be evaluated as part of the design and approval process.

This option is not impacted by there being a high-water level in the Squamish River.

4.2.1 Sub-Option 2a - Gravity Main and Pumping at Dike

Once again, it is assumed that a storage tank for water treatment would result in a hydraulic elevation of 8 m geodetic at the East Shaft. The base of the dike is at elevation 3 meters with 600 m horizontal distance between the locations, resulting in a hydraulic grade line of 0.83%. Like Option 1, a 100 mm diameter pipe is

sufficient for the continuous flow but requires a 300 mm diameter pipe for the infrequent flow of 70 L/s as shown in **Table 5**. As a temporary line, this pipe could be draped on the ground surface as a low-pressure pipe, and optionally trenched below ground.

Table 5: Pipe Sized for 600 m Gravity Main

From	To	Slope (%)	Nominal Pipe Diameter (mm)	Pipe Material	Full Velocity (m/s)	Pipe Capacity (L/s)
East Shaft	Dike	0.83	**300**	PVC	1.47	103.5

A pump located at the dike is sized to lift the water 4m vertically with a 1m head loss over 50 m of piping. A 200 mm diameter force main is suggested for the higher target flow of 70 L/s. The exit velocity from the pipe is significantly high, therefore anchoring and erosion protection will need to be considered.

The pump station requirements for this system include:

- Hydraulic Power: 5 Hp
- Pump Crank Power: 6 Hp, assuming 80% pump efficiency. Or 10.5 Hp if a 150 mm diameter forcemain used.

Power supply to the pump station would need to be established. Given the extensive duration of operation it is recommended to pursue a BC Hydro power distribution service over a gas-powered generator.

4.2.2 Sub-Option 2b – Pumping from BC Rail Site

Assuming a 150psi high pressure pipe is used, which is equivalent to 105 m of pressure head, **Tables 6 and 7** show the pipe diameters for both 1.75 L/s and 70 L/s.

Table 6: Force Main Pipe Sized for 1.75 L/s

Pipe Diameter (mm)	Pipe Material	Hazen Williams Roughness Coefficient	Pipe Length (m)	Maximum Pressure Head (m)	Velocity (m/s)	Flow Discharge (L/s)
40	Plastic	120	650	105	2.09	2.63

Table 7: Force Main Pipe Sized for 70 L/s

Pipe Diameter (mm)	Pipe Material	Hazen Williams Roughness Coefficient	Pipe Length (m)	Maximum Pressure Head (m)	Velocity (m/s)	Flow Discharge (L/s)
150	Plastic	120	650	105	4.81	85

A 150psi 40 mm diameter force main is required for 1.75 L/s, and a 150psi 150 mm diameter force main is required for 70 L/s. The exit velocity from these pipes is significantly high, therefore erosion protections will need to be considered.

At 3 Hp crank power, the pumping requirements are small for the continuous 1.75 L/s flow, but to achieve the higher 70 L/s flow the pumping requirements are significant at 125 Hp. It is not recommend to attempt to pump 70 L/s over that distance. Sub-Option 2a using gravity to the extent possible is recommended.

Installing a pipe through the dike to avoid pumping all together may be considered, however regulatory challenge in getting approval is anticipated. Regulators will be concerned about the dike's integrity resulting from both the installation and eventual abandonment of the pipe at project completion.

4.3 OPTION 3

Option 3 utilizes an existing storm sewer network and drainage channels near-by the East Shaft location discharging to wetlands to the southwest. Conditions within manholes observed during the field investigation were favourable and the BCR maintenance manager who accompanied Urban and MJA during the field investigation had confidence in the condition of this piping system. As such, there is no information at this time to suggest its condition may be problematic.

CCTV inspection was completed of Option 3 storm sewers. A summary of the results can be found in Section 4.4.

4.3.1 Capacity Assessment

Like Option 1, design flows for Option 3 have been calculated for the 6-month, 2-year, and 5-year rainfall events **(Table 8)**. The total contributing catchment area is estimated at 7.38 ha as shown in **Figure 2**, resulting in peak flow rates of 132 L/s, 405 L/s, and 600 L/s, respectively.

Table 8: South System Flow Rate

Storm Frequency	Drainage Area (ha)	Runoff Coefficient	Duration (min)	Rainfall (mm/hr)	Runoff (L/s)
6-Month	7.38	0.95	15	6.8	132
2-Year	7.38	0.95	15	20.8	405
5-Year	7.38	0.95	15	30.8	600

With the added discharge of 150 m^3/day (1.75 L/s), the south system will be required to handle approximate flows of 134 L/s, 407 L/s, and 602 L/s for 6-month, 2-year, and 5-year storm frequencies, respectively (**Table 9**). Like Option 1, this increase is considered insignificant, below the margin of error in the analysis, and fundamentally will not affect pipe performance or flood risk.

Table 9: Total Catchment Flow Rate with Continuous Discharge (150 m^3/day)

Storm Frequency	Existing Flow Rate (L/s)	Flow Rate with Continuous Discharge (L/s)	% Increase
6-Month	132	134	1.52
2-Year	405	407	0.49
5-Year	600	602	0.33

The pipe capacity from the anticipated Tie-in Manhole to the South Outfall was computed. In absence of accurate pipe invert information, ground elevations estimated from LiDAR and manhole depths measured during the field review were applied to estimating pipe slopes. This approach suggests the outfall pipe may be back sloped, however no standing water was observed in the manhole during the field review. A detailed topographic survey will be required to validate pipe slopes. However, for the purpose of this assessment we have assumed hydraulic slopes of 0.5% and 1% to compute a range of flow capacities, presented in **Table 10**.

Table 10: Pipe Capacities of South System

From	To	Assumed Hydraulic Slope (%)	Nominal Pipe Diameter	Pipe Material	Full Velocity (m/s)	Pipe Capacity (L/s)
Tie-In MH	South Outfall	0.5	600	CON	1.55	453
Tie-In MH	South Outfall	1.0	600	CON	2.19	640

Using a hydraulic slope of 1% provides sufficient capacity for the 5-year runoff event, whereas 0.5% is sufficient for the 2-year runoff event.

Very little infrastructure is required to connect the East Shaft to the assumed Tie-In Manhole. Like the other options, it is anticipated that a 100 mm diameter pipe is required for the continuous flow and a 300 mm pipe for the infrequent flow of 70 L/s.

4.3.2 Receiving System (Wetland)

The existing challenge for Option 3 is that this piping system discharges in the Squamish River Estuary and not directly to the Squamish River. The flow path of discharged water through the wetland was traced using the available LiDAR mapping as shown in **Figure 5**. The watershed area of this local wetland **(Figure 6)** and its storage capacity **(Table 11 and Table 12)** was also defined.

While the performance of storm sewers is governed by short duration peak flow rates, it is recommended that an assessment of the receiving wetland consider runoff volumes within a daily 24-hour cycle, given this wetland is also somewhat tidally influenced. A 6-month, 24-hour rainfall depth of 87 mm, and 2-year, 24 hour rainfall depth of 110 mm have been considered.

In addition to the 7.38 hectare catchment draining from the storm sewer system, there is a 7.7 hectare area collected and drained through a culvert crossing Government Road, and a 3.3 ha catchment surrounding the wetland, both shown in **Figure 6**. Assuming 100% runoff of rain falling on the local wetland and 95% runoff of rain falling on the rail yard catchments, the 24-hour runoff volumes to the wetland were calculated in **Table 11**.

Table 11 also lists the wetlands estimated storage capacity (10,625 m^3) up to its first spill point. For example, the anticipated runoff volume during a 6-month, 24 hour event is about 50% greater than the storage volume of the wetland, therefore would cause the wetland to fill and spill.

Table 11: Runoff Volumes to Wetland

Storm Frequency	Storm Sewer Runoff Volume (m^3)	Culvert Runoff Volume (m^3)	Wetland Runoff Volume (m^3)	Total Existing Runoff Volume (m^3)	Proposed Continuous Discharge (m^3/day)	Continuous Discharge as a % of Total Volume	Proposed Infrequent Discharge (m^3/day)	Infrequent Discharge as a % of Total Volume
6-Month	6,100	6,364	2,871	15,355	150	0.98	2,600	17
2-Year	7,712	8,047	3,630	19,389	150	0.77	2,600	13
Wetland Storage Volume (to first spill point at 2.8m elevation (Point E in Figure 6).				10,625	150	1.41	2,600	24

As **Table 11** shows, the additional 150 m^3/day from construction activities amounts to less than 1% of the total runoff volume to the wetland for both 6-month and 2-year storm frequencies. The additional 2,600 m^3/day is more substantial at roughly 13 to 17% of the total runoff volume to the wetland for both 6-month and 2-year storm events. The timing of infrequent discharge is controllable and could be executed outside of a significant precipitation event. The infrequent discharge volume is far less than that of a precipitation runoff event and 24% of the wetland's holding capacity.

4.3.3 Tidal Influence

A Stage-Storage relationship was determined for the wetland and presented as **Table 12**.

Table 12: Wetland Stage-Storage Relationship

Geodetic Elevation (m)	Volume (m^3)
1.08	0
1.58	14
2.08	1,900
2.58	7,180
2.80 (spill elevation)	10,625
3.00	13,760

The tidal boundary conditions for the Site were taken from the *Integrated Flood Hazard Management Plan Background Report*, Kerr Wood Leidal, 2017. The Higher High Water, Large Tide (HHWLT) for Squamish is 2.05 m and the Higher High Water, Mean Tide (HHWMT) is 1.35 m. Diking prevents direct back flooding from the ocean into the wetland, and reports on the groundwater at the BCR property show that the tidal influence is negligible. It is unlikely that HHWMT significantly influences the wetland, whereas the HHWLT is more significant, but still far below most of the wetland storage volume. It is not expected that the tide significantly influences discharge into the wetland from the storm sewer or culvert.

4.3.4 Storm Sewer Release

The proposed release of flow from construction activity ranges from 1.75 L/s to 70 L/s, both of which are far below the predicted flow released during frequent precipitation events (**see Table 8**). During the field investigation, the receiving channel appeared stable with no signs of active erosion. There is evidence of sand deposition in the channel a short distance downstream of the pipe outfall, which may be suspended solids washed off the current Site which is largely gravel or historic flooding events. It is expected that all water collected and discharged associated with the BCR Site will be treated to provincial guidelines.

4.4 CCTV INSPECTION

After the submission of an earlier version of this report on May 31, 2021, Dougness Holdings Ltd. was contracted to complete a CCTV (video) inspection of Option 1 and 3 storm sewers, downstream of the anticipated connection points. A complete copy of the CCTV report is appended herein.

Findings from the CCTV inspections of Option 1 storm sewers include sediment within the piping system ranging in depth of 10% to 50% of the pipe diameter. The final 150-meter-long segment of pipe discharging to the Squamish River shows some spalling (flaking of the concrete surface inside the pipe) and one small hole at the top of the pipe with some soil backfill visible. This demonstrates the pipe is aged but should not prevent its continued use near term.

CCTV inspections of Option 3 storm sewers show that sands and gravels exist within the invert of the pipe to a depth ranging from 15% to 50% of pipe diameter. The final segment beneath Government Road to the outfall is the worst at an estimated 50% of pipe depth. From a condition perspective, pursuit of this option warrants the pipes to be flushed.

5.0 CONCLUSIONS AND RECOMMENDATION

Based on the investigation to date, the following conclusions and recommendations are made.

- Option 1 – Discharge to the North: From a condition perspective alone, further pursuit of Option 1 warrants pipe flushing to remove sediment deposits. From a capacity perspective, current deposits of sand and gravel limit flow capacity below what is presented in sections above. Assuming the system is flushed, while most of the storm sewers on Site likely have sufficient capacity, the performance of the system is significantly limited by the small 300 mm outfall pipe. With that said, the proposed continuous flow of 1.75 L/s is approximately 1% of the design flow and not deemed significant nor expected to fundamentally change the risk to flooding. The infrequent discharge of 70 L/s is more significant but assumed to be timed so that it does not occur with rainfall events, therefore also should not pose a risk. The advantage of Option 1 is that it utilizes an existing outfall and flows directly into the Squamish River, but the disadvantage is that it requires approximately 670 m of piping and pumping to connect the East Shaft to the existing system.

  Option 1 is also more susceptible to performance impacts from a high water level in the Squamish River, as recently observed during freshet in June 2021. A significantly submerged outfall, as observed, will further reduce the conveyance capacity of the system. In such a condition, the FortisBC project may be compelled to install a temporary pump to manage its 1.75 L/s flow.

- Option 2 – Temporary piping through FortisBC ROW to Squamish River: No drainage infrastructure currently exists along this alignment, so new temporary infrastructure is required over approximately 650 m. This is possibly attainable, but the challenge lies in obtaining Provincial and Municipal approval if it were proposed to breach through the dike with temporary infrastructure. As such, it is recommended that the water is pumped over the dike. Gravity flow appears possible from the East Shaft to the toe of the dike using a pipe ranging from 100 mm in diameter for the continuous flow, to 300 mm in diameter for the infrequent flow. This line could be surface mounted or trenched. A local pump station and forcemain would be used to lift water over the dike. Power supply would need to be brought to the Site. An estimated 6 Hp pump is required for 70 L/s, assuming it is located at the dike, compared to a 125 Hp pump if located at the East Shaft and using a 150 mm diameter, 150psi forcemain. These are estimates for planning purposes and the optimum combination of pump and forcemain would be identified through a design process if there is interest to pursue this option. Position and orientation of the discharge into the Squamish River will need to be done as to not create erosion. A temporary surface mount energy dissipation chamber may be necessary.
- Option 3 – Discharge to the South: The main advantage of Option 3 is that it requires comparably little infrastructure to connect to an existing system. Assuming the pipes are flushed, from a capacity perspective, with a modest hydraulic gradient of 1%, there is sufficient capacity for the outfall to convey the 5-year design flow, and so the added flow from construction will not pose added measurable risk. Based on the *infrastructure*, Option 3 is the most suitable option. The challenge with Option 3 is that it discharges to a local wetland and not the Squamish River. This wetland currently receives considerable runoff from the Site via a storm sewer and culvert. The relative change in runoff volumes being proposed to the wetland is very small. Provided discharged water meets Provincial Water Quality Guidelines the potential impact to the wetland appears extremely small, however this will need to be confirmed by a Qualified Environmental Professional (QEP).

  The Option 3 outfall is not immune, but less susceptible to a high-water level in the Squamish River, because of the less direct connection compared to Option 1, and vast wetland storage between the outfall and its connection to the River. It is not as likely that a temporary pump would need to be installed for Option 3.

In conclusion, we recommend first pursuit of Option 3 – discharge to the south, followed by Option 2 – discharge through the FortisBC ROW, followed by Option 1 – discharge to the north. Option 1 is the least preferred option due to capacity of the existing outfall pipe and extensive infrastructure needed to connect the East Shaft site to the north system. Both Option 1 and 3 warrant pipe flushing to remove sands and gravels.

Further investigation and field data collection will be required to prepare a design and cost estimate.

Sincerely,

URBAN SYSTEMS LTD.

Selina Gandha, EIT
Community Engineer-In-Training

Reviewed By:

Glen Shkurhan, P.Eng.
Senior Engineer, Principal

2021-07-29

cc: Brittney Dawney, P.Eng, Urban Systems

/sg
Enclosure: Figures 2-6, CCTV inspection report

\\usl.urban-systems.com\projects\Projects_VAN\5111\0001\01\R-Reports-Studies-Documents\R1-Reports\2021-07-15 Mem\2021-07-15-Mem-BC Rail Discharge Feasibility.docx

Discharge Location (Option 1)

Discharge Location (Option 2)

Discharge Location (Option 3)

Tie-in Point (Option 1)

Tie-in Point (Option 3)

East Shaft

Government Rd

MH7 (5.4) 2.9

MH6 (5) 3

MH5 (4.9) 3.1

MH4 (5.3)

MH3 (5.8) 3

MH2 (5.7)

MH1 (5.6) 4.2

(5) (5.1) (5.2) 4

18.6 acres (7.5 ha)

18.2 acres (7.4 ha)

(4.7) (4.6) (4.5) (4.8) (4.4) 2.2 (4.5) 2.2

(3.5) 1.3 - Invert elevation estimated

300Ø 600Ø 380Ø 525Ø 250Ø 450Ø 200Ø 102Ø 150Ø 100Ø 530Ø 600Ø

McMILLEN JACOBS ASSOCIATES

BC Rail Discharge Feasibility Study

FIGURE 2

Site Storm Sewer & Transmission Infrastructure Overview

Legend

- Outfall
- Storm Manhole
- Storm Pipe
- Culvert (Approx. Location)
- Shaft Connection Point
- Discharge Location
- Catchment Contributing To Piping System

Surface Elevation

8.67 m

-0.85 m

- Contour (1m)
- (XXX) Rim Elevation (m)
- XXX Invert Elevation (m)

Data Sources:

- Infrastructure data based on District of Squamish Open Data, April 2021

- Imagery (2019) from District of Squamish Open Data, April 2021

Coordinate System:

NAD 1983 UTM Zone 10N

N

0 20 40 60

Meters

Scale:
1:4,000
(When plotted at 11"x17")

URBAN SYSTEMS

Project #:	5111.0001.01
Author:	SF
Checked:	SG / GS
Status:	FINAL
Revision:	A
Date:	2021 / 7 / 29

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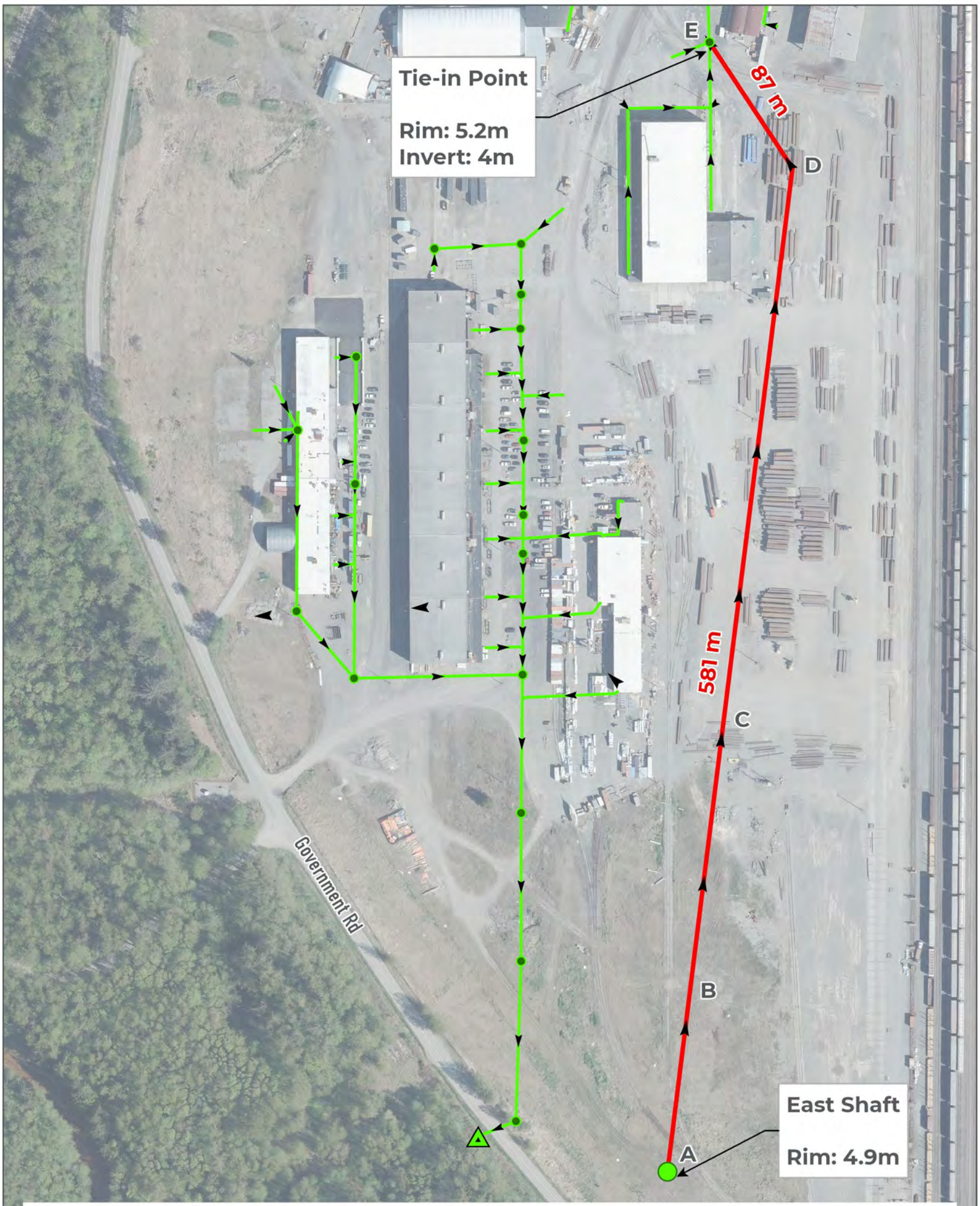

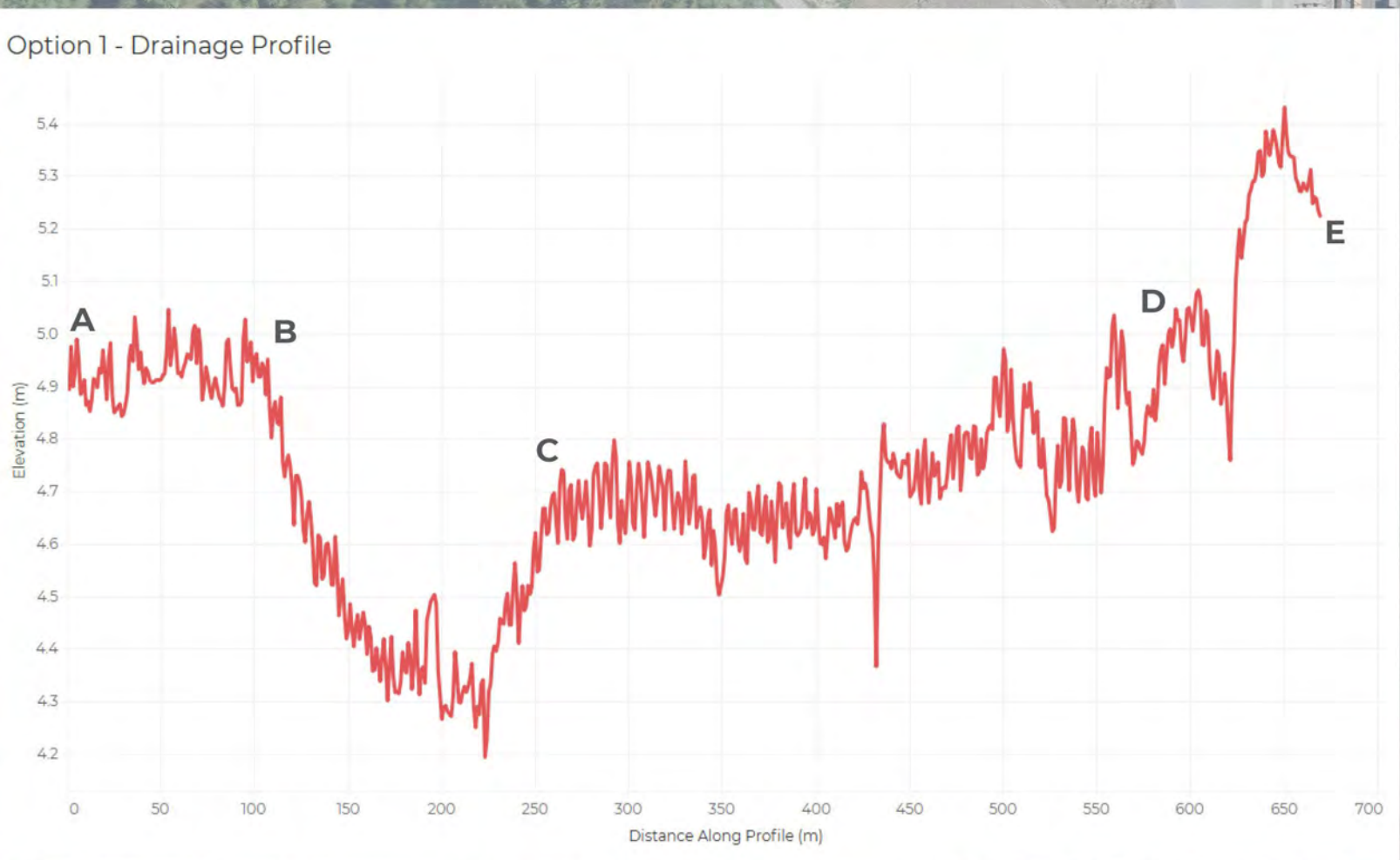

BC Rail Discharge Feasibility Study

FIGURE 3

Option 1 Discharge

Legend

- Outfall
- Storm Manhole
- Storm Pipe
- Shaft Connection Point
- Drainage Path From Shaft Site

Data Sources:
- Infrastructure data based on District of Squamish Open Data, April 2021
- Imagery (2019) from District of Squamish Open Data, April 2021

Coordinate System:

NAD 1983 UTM Zone 10N

0 20 40 60

Meters

Scale:
1:2,500
(When plotted at 11"x17")

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Option 2 - Drainage Profile

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BC Rail Discharge Feasibility Study

FIGURE 4

Option 2 Discharge

Legend

- Outfall
- Storm Manhole
- Storm Pipe
- Culvert (Approx. Location)
- Discharge Location
- Shaft Connection Point
- Drainage Path From Shaft Site
- FortisBC ROW (Approximate)

Data Sources:
- Infrastructure data based on District of Squamish Open Data, April 2021

- Imagery (2019) from District of Squamish Open Data, April 2021

Coordinate System:

NAD 1983 UTM Zone 10N

N

0 30 60 90

Meters

Scale:
1:3,500
(When plotted at 11"x17")

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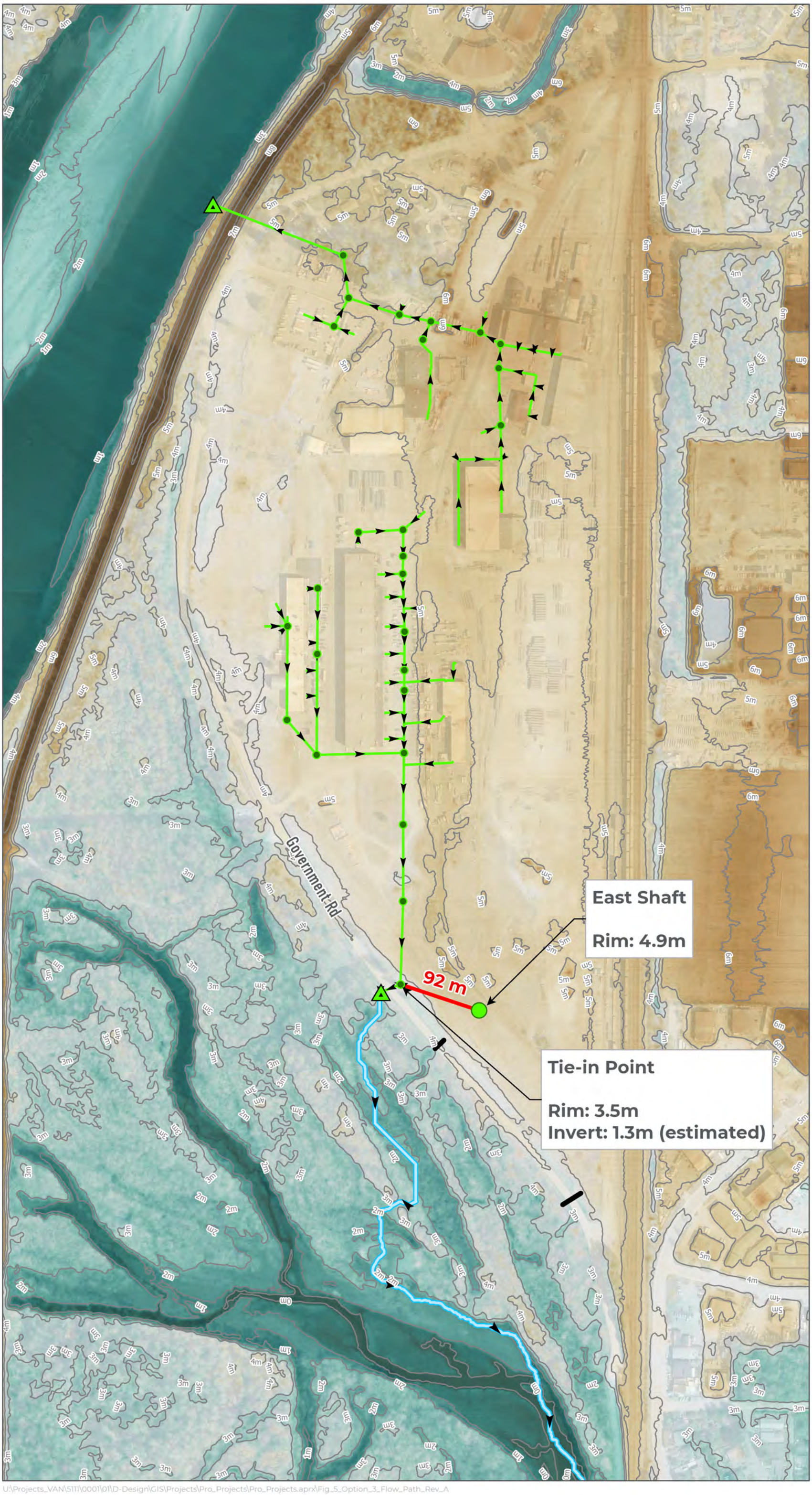

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BC Rail Discharge Feasibility Study

FIGURE 5
Option 3 Flow Path

Legend

- Outfall
- Storm Manhole
- Storm Pipe
- Culvert (Approx. Location)
- Shaft Connection Point
- Flow Path (From Outfall)
- Drainage Path From Shaft Site

Surface Elevation

8.67 m

-0.85 m

Contour (1m)

Data Sources:

- Infrastructure data based on District of Squamish Open Data, April 2021

- Imagery (2019) from District of Squamish Open Data, April 2021

Coordinate System:

NAD 1983 UTM Zone 10N

0 20 40 60

Meters

Scale:
1:4,000
(When plotted at 11"x17")

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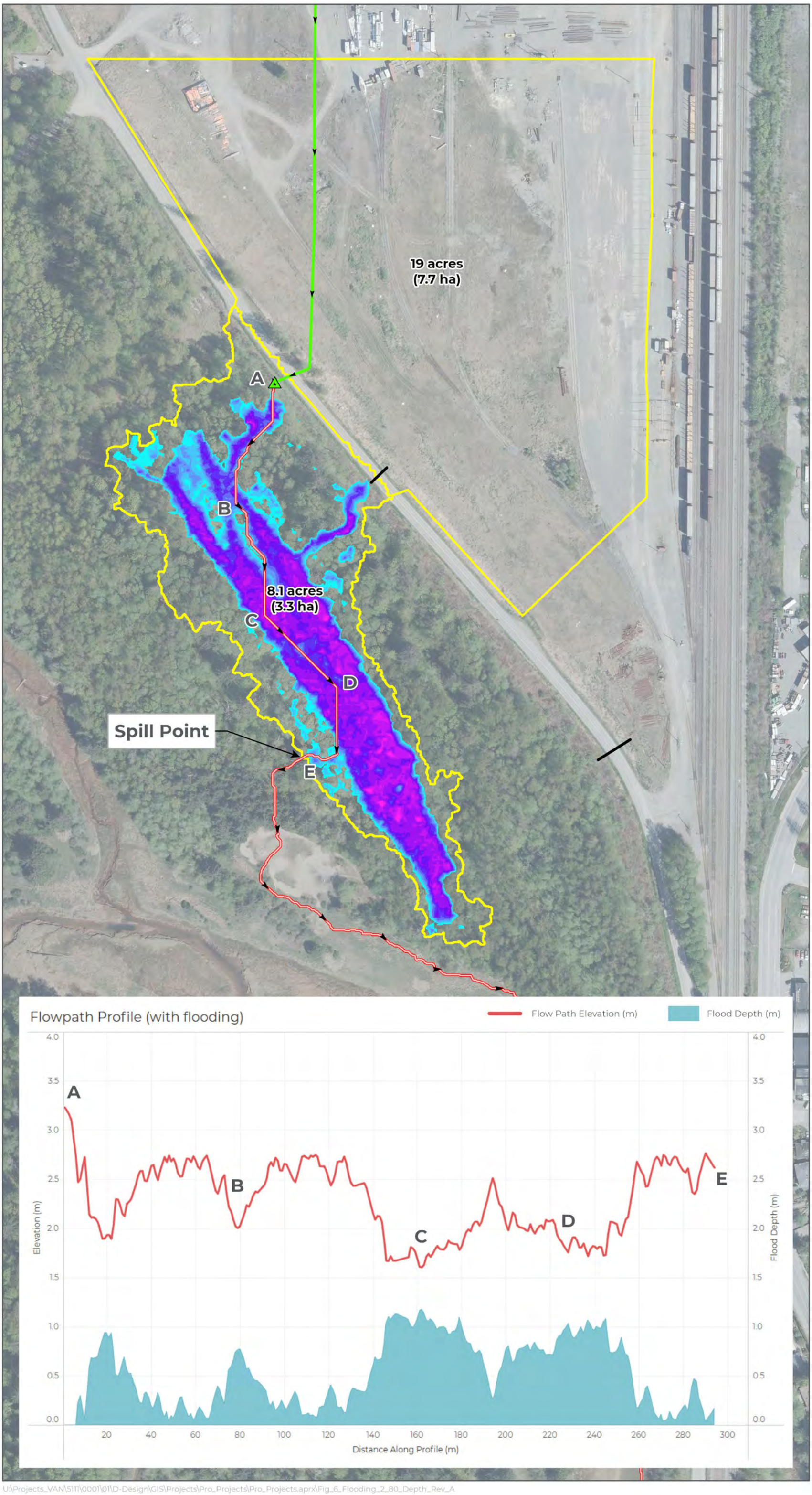

BC Rail Discharge Feasibility Study

FIGURE 6
Flooding (2.80 m Depth)

Legend

- Storm Outfall
- Storm Main
- Flow Path (From Outfall)
- Culvert (Approx. Location)
- Catchment

Flood Depth

- <= 0.15 m
- > 0.15 m - 0.30 m
- > 0.30 m - 0.45 m
- > 0.45 m - 0.60 m
- > 0.60 m - 0.75 m
- > 0.75 m - 0.90 m
- > 0.90 m - 1.05 m
- > 1.05 m - 1.20 m
- > 1.20 m - 1.35 m
- > 1.35 m - 1.72 m

Total Catchment Flood Volume:

10,306 m³

Data Sources:
- Elevation and surface data from District of Squamish

Coordinate System:

NAD 1983 UTM Zone 10N

0 20 40 60
Meters

Scale:
1:2,250
(When plotted at 11"x17")

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

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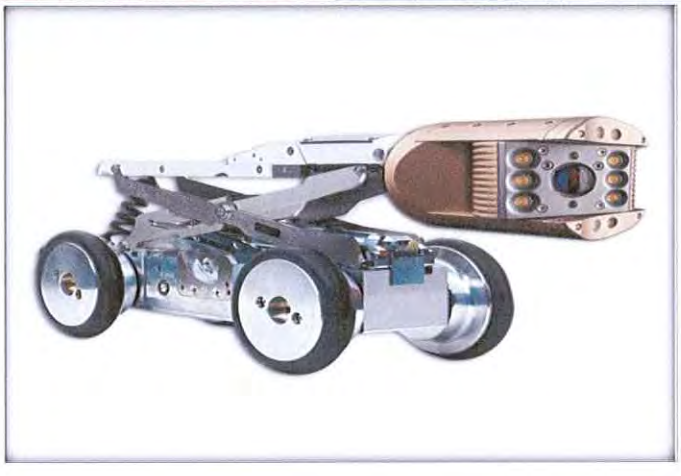
Date:	2021 / 7 / 28

50 YEARS OF SERVICE
Dougness Holdings Ltd
1970 to 2020

URBAN SYSTEMS
CONTRACT: BC RAIL YARD STORM
SQUAMISH, BC

CCTV INSPECTION
STORM SEWER
REPORTS: 001-011

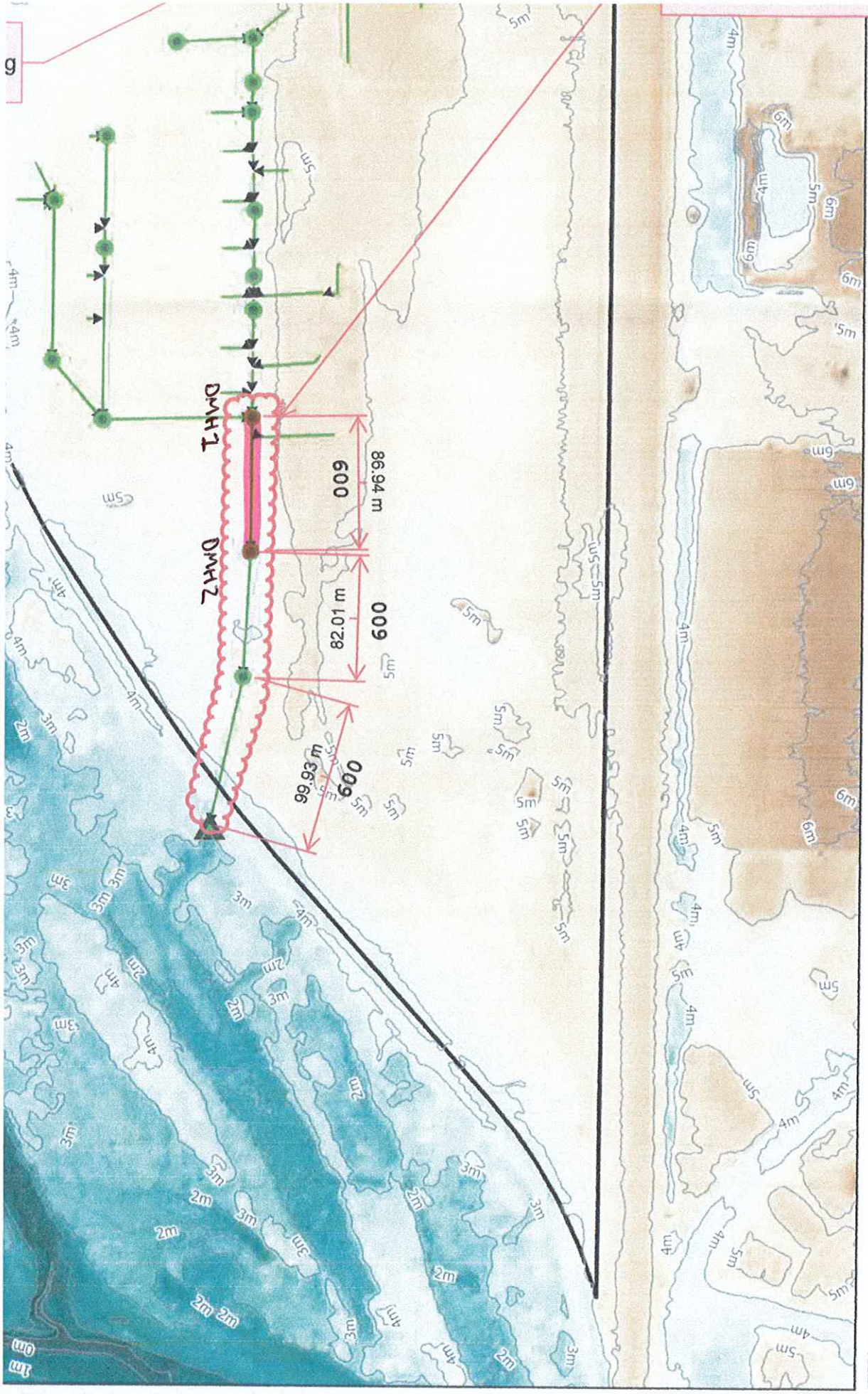
JUNE 25 2021



CCTV Surveys List for URBAN SYSTEMS

Number of surveys in this list is 11 **as of** June 25, 2021 **Unit of measure:** M

Setup	Date	Street	Start MH	Finish MH	Dir	Size mm	Pre Clean	Media Number	Scheduled Length	Surveyed Length
1	2021-06-25	BC RAIL YARD	DMH1	DMH2	D	600	N	201-001	82.0	82.0
2	2021-06-25	BC RAIL YARD	DMH2	DMH3	D	600	N	201-002	84.4	84.4
3	2021-06-25	BC RAIL YARD	DMH3	DMH4	D	600	N	201-003	82.1	82.1
4	2021-06-25	BC RAIL YARD	DMH5	DMH6	D	600	N	201-004	44.2	44.2
5	2021-06-25	BC RAIL YARD	DMH6	DMH7	U	525	N	201-005	63.9	63.9
6	2021-06-25	BC RAIL YARD	DMH7	DMH8	U	525	N	201-006		6.9
7	2021-06-25	BC RAIL YARD	DMH10	DMH11	U	300	N	201-007	30.7	30.7
8	2021-06-25	BC RAIL YARD	DMH9	DMH8	D	450	N	201-008		13.9
9	2021-06-25	BC RAIL YARD	DMH5	OUTFALL 2	D	300	N	201-009		69.7
10	2021-06-25	BC RAIL YARD	DMH13	DMH11	D	300	N	201-010		24.0
11	2021-06-25	BC RAIL YARD	DMH14	DMH11	D	300	N	201-011	15.8	15.8
								Total Scheduled Length	403.1	
								Total Length Surveyed		517.6



Data Sources:
- Infrastructure data based on District of Squamish Open Data April 2021
- Imagery from Bing Maps April 2021

Coordinate System:

Name: NAD 1983 UTM Zone 10

0 25 50 75

Meters

Scale: 1:3,500
(When plotted at 11"x17")

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

URBAN systems

Project #:	5111.0001.01
Author:	RB
Checked:	XX
Status:	Status
Revision:	A
Date:	2021 / 4 / 29

Tabular Report of PSR DMH1X for URBAN SYSTEMS

Setup 1 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-001 **Project** BC RAIL YARD
Date 2021-06-25 **Time** 9:06 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control **Survey Purpose** **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☐ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 600 **Width** mm
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 M **Total length** 82.0 M
Length Surveyed 82.0 M **Year Constructed** **Year Renewed**

Up DMH1 **Rim to invert** 2.00 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH2 **Rim to invert** 2.20 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH1
0.0			MWL	Miscellaneous Water Level			10					
1.9		S01	DSGV	Deposits Settled Gravel			15		06			
9.6			TB	Tap Break-in/Hammer	200				10			
39.7			B	Broken				J	10	12		
39.7			ISSR	Intruding Sealing Material Sealing R			5		10	11		
81.2			MWL	Miscellaneous Water Level			20					
82.0		F01	DSGV	Deposits Settled Gravel			15		06			
82.0			AMH	Manhole								DMH2
82.0			FH	End of Survey								

82.0 M Total Length Surveyed

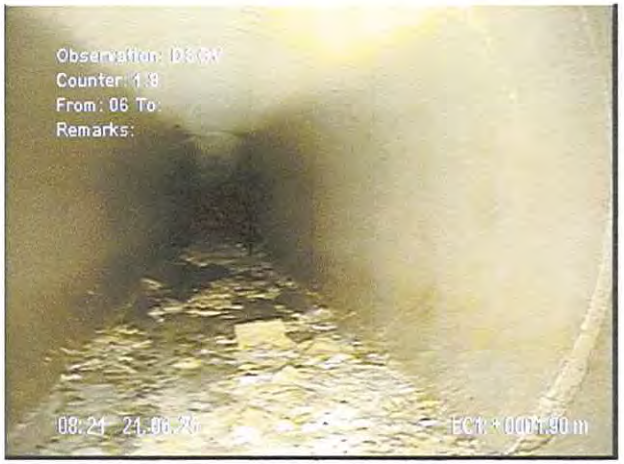
Scores

Structural:	Pipe Rating 4	Pipe Ratings Index 4	Quick Rating 4100
O&M:	Pipe Rating 161	Pipe Ratings Index 3	Quick Rating 3I21
Overall	Pipe Rating 165	Pipe Ratings Index 7	Quick Rating 413I

CCTV pictures of DMH1X **for** URBAN SYSTEMS

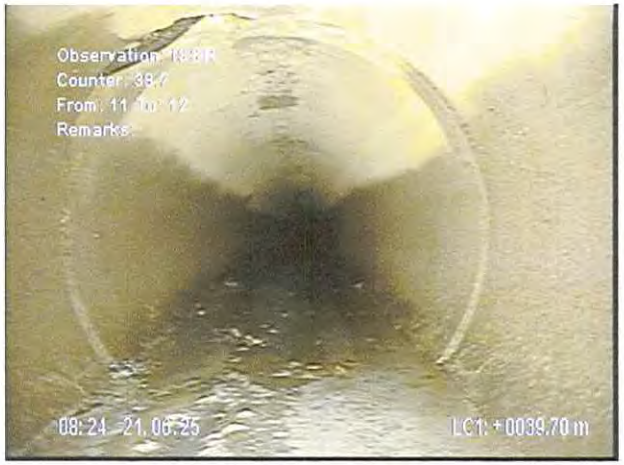
Work Order	Video 201-001	Surveyed On 2021-06-25	Direction Downstream	Setup 1
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH1	**To Manhole** DMH2	

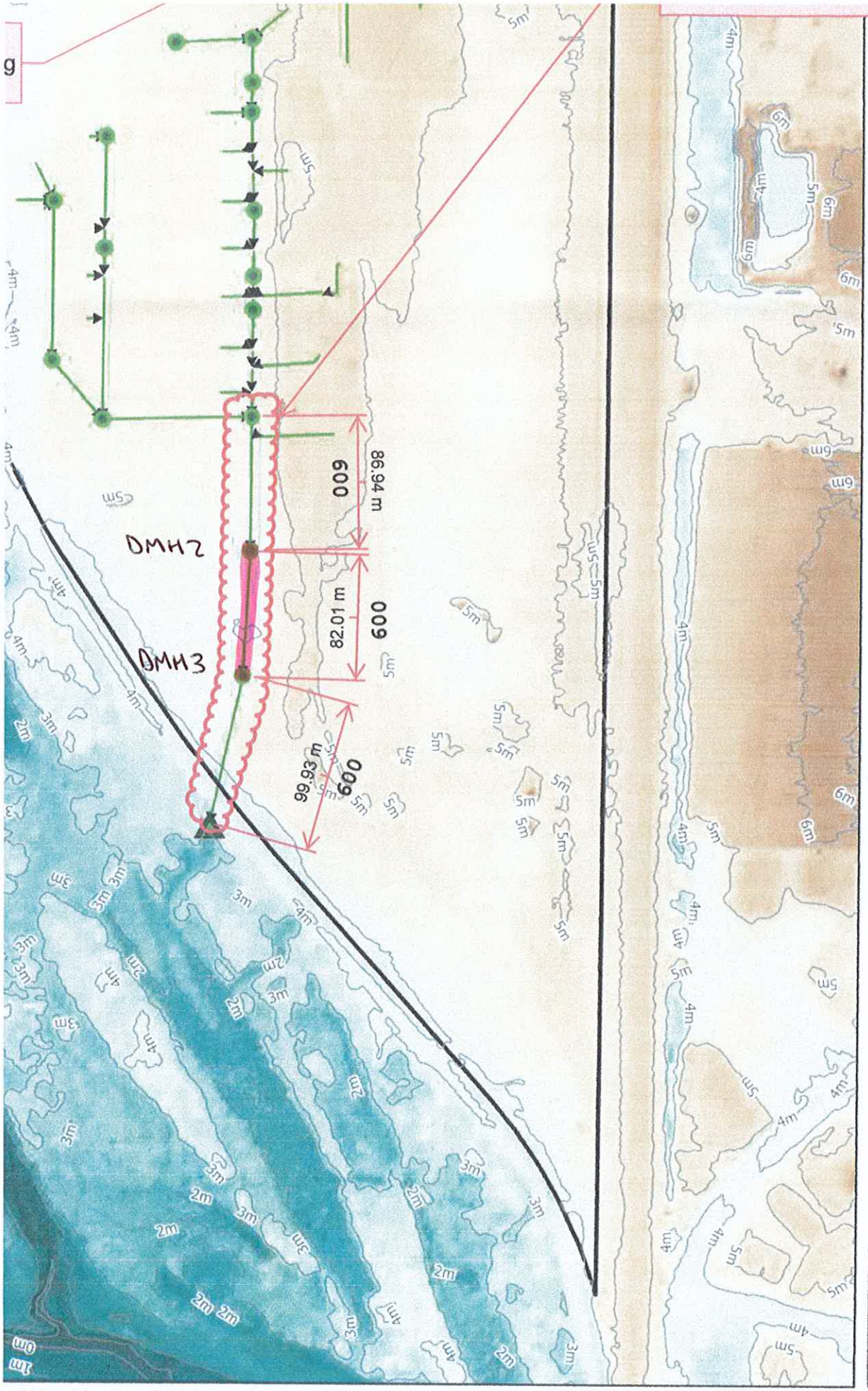
Date: 2021-06-25
Distance: 1.9 M
Obs: Deposits Settled Gravel
Comments:



Date: 2021-06-25
Distance: 39.7 M
Obs: Broken
Comments:

Date: 2021-06-25
Distance: 39.7 M
Obs: Intruding Sealing Material Sealing Ring
Comments:





Data Sources:
- Infrastructure data based on District of Squamish Open Data April 2021
- Imagery from Bing Maps April 2021

Coordinate System:

Name: NAD 1983 UTM Zone 10N

0 25 50 75

Meters

Scale: 1:3,500
(When plotted at 11"x17")

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URBAN systems

Project #:	5111.0001.01
Author:	RB
Checked:	XX
Status:	Status
Revision:	A
Date:	2021 / 4 / 29

Tabular Report of PSR DMH2X for URBAN SYSTEMS

Setup 2 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-002 **Project** BC RAIL YARD
Date 2021-06-25 **Time** 9:34 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control **Survey Purpose** **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☐ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 600 **Width** mm
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 M **Total length** 84.4 M
Length Surveyed 84.4 M **Year Constructed** **Year Renewed**

Up DMH2 **Rim to invert** 2.20 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH3 **Rim to invert** 2.30 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH2
0.0			MWL	Miscellaneous Water Level			20					
0.0		S01	DSGV	Deposits Settled Gravel			10		06			
6.7		F01	DSGV	Deposits Settled Gravel			10		06			
6.7		S02	DSGV	Deposits Settled Gravel			25		06			
34.0		F02	DSGV	Deposits Settled Gravel			25		06			
34.0		S03	DSGV	Deposits Settled Gravel			10		06			
84.4		F03	DSGV	Deposits Settled Gravel			10		06			
84.4			AMH	Manhole								DMH3
84.4			FH	End of Survey								

84.4 M Total Length Surveyed

Scores

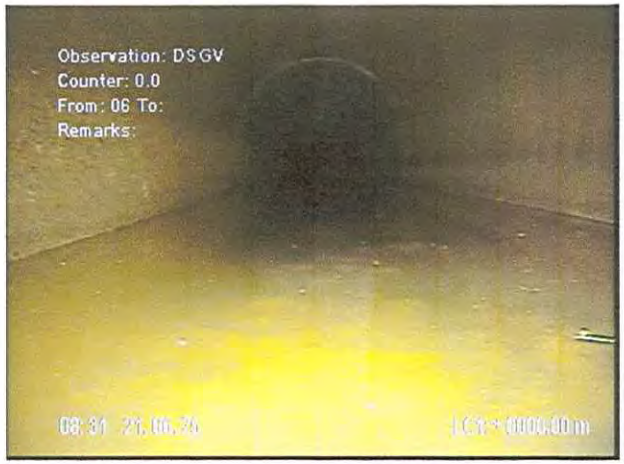
Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 148	**Pipe Ratings Index** 2.6	**Quick Rating** 4B2F
Overall	**Pipe Rating** 148	**Pipe Ratings Index** 2.6	**Quick Rating** 4B2F

CCTV pictures of DMH2X **for** URBAN SYSTEMS

Work Order	Video 201-002	Surveyed On 2021-06-25	Direction Downstream	Setup 2
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH2	**To Manhole** DMH3	

Date: 2021-06-25
Distance: 0.0 M
Obs: Deposits Settled Gravel

Comments:

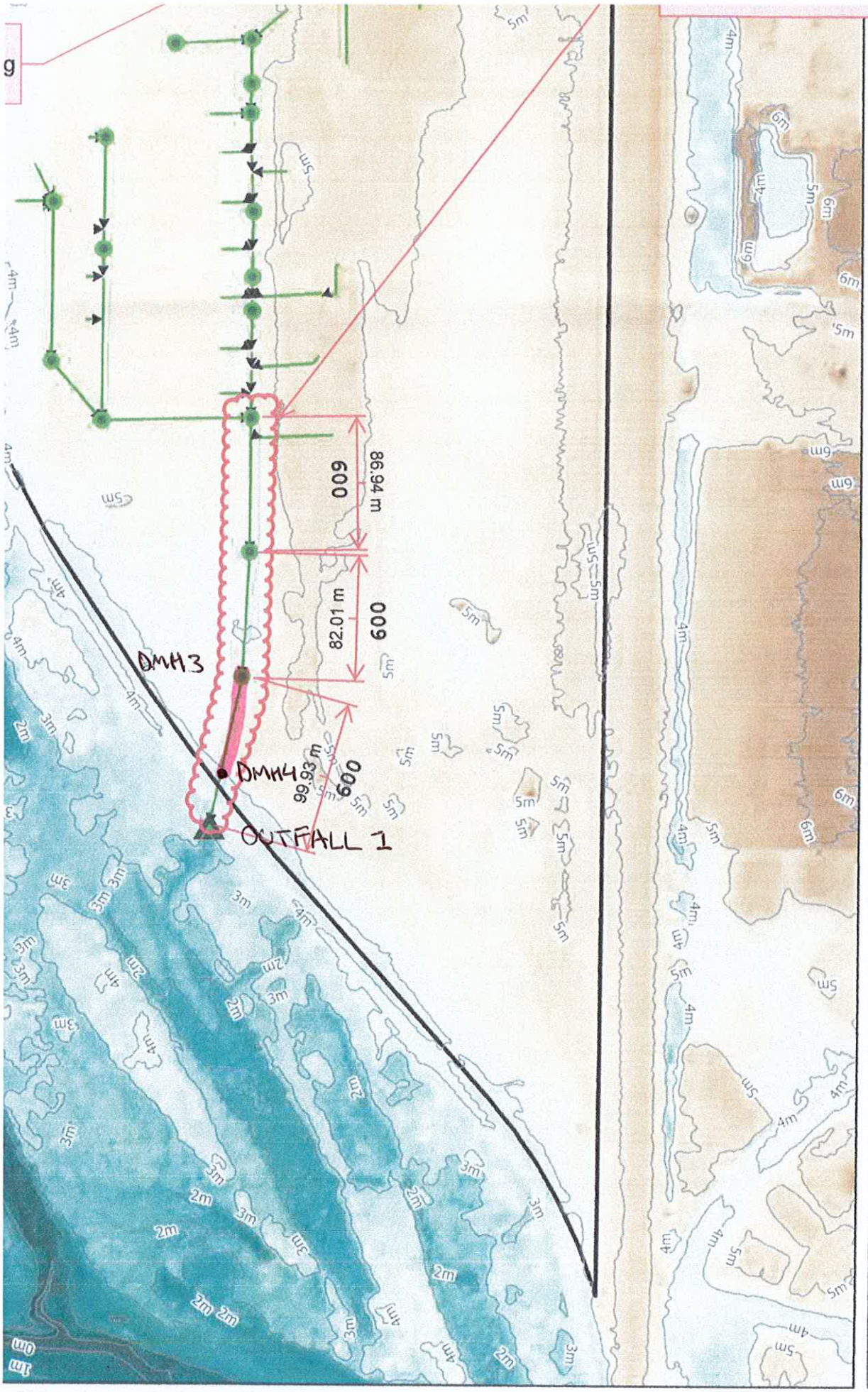


Date: 2021-06-25
Distance: 6.7 M
Obs: Deposits Settled Gravel

Comments:

Date: 2021-06-25
Distance: 34.0 M
Obs: Deposits Settled Gravel

Comments:



Data Sources:
- Infrastructure data based on District of Squamish Open Data April 2021
- Imagery from Bing Maps, April 2021

Coordinate System:

Name: NAD 1983 UTM Zone 10N

0 25 50 75

Meters

Scale: 1:3,500
(When plotted at 11"x17")

The accuracy & completeness of information shown on this drawing is not guaranteed. It will be the responsibility of the user of the information shown on this drawing to locate & establish the precise location of all existing information whether shown or not.

URBAN systems

Project #:	5111.0001.01
Author:	RB
Checked:	XX
Status:	Status
Revision:	A
Date:	2021 / 4 / 29

Tabular Report of PSR DMH3X **for** **URBAN SYSTEMS**

Setup 3 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-003 **Project** BC RAIL YARD
Date 2021-06-25 **Time** 9:44 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control **Survey Purpose** **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☐ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 600 **Width** mm
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 M **Total length** 82.1 M
Length Surveyed 82.1 M **Year Constructed** **Year Renewed**

Up DMH3 **Rim to invert** 2.30 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH4 **Rim to invert** 1.40 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH3
0.0			MWL	Miscellaneous Water Level			25					
0.8		S01	DSGV	Deposits Settled Gravel			15		06			
14.5			MWL	Miscellaneous Water Level			35					
28.7		F01	DSGV	Deposits Settled Gravel			15		06			
44.2			CC	Crack Circumferential					12	01		
44.2			IS	Infil Stain					11	01		
47.2			MWL	Miscellaneous Water Level			40					
48.8		S02	DSF	Deposits Settled Fine			20		06			
53.8		F02	DSF	Deposits Settled Fine			20		06			
61.2			MWL	Miscellaneous Water Level			30					
61.2		S03	DSF	Deposits Settled Fine			20		06			
62.7			B	Broken				J	01	03		
69.3		F03	DSF	Deposits Settled Fine			20		06			
72.2			MWL	Miscellaneous Water Level			40					
78.6			MWL	Miscellaneous Water Level			50					
82.1			AMH	Manhole								DMH4
82.1			FH	End of Survey								

82.1 M **Total Length Surveyed**

Tabular Report of PSR DMH3X **for** **URBAN SYSTEMS**

Setup	3	Date	2021-06-25	Time	9:44	Up	DMH3	Down	DMH4

Scores

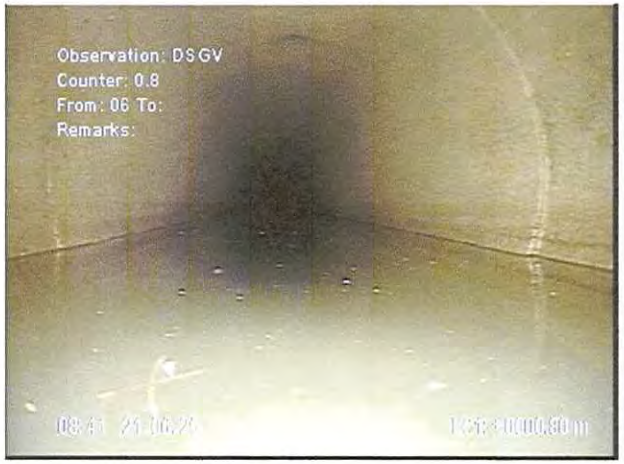
Structural:	Pipe Rating 5	Pipe Ratings Index 2.5	Quick Rating 4111
O&M:	Pipe Rating 82	Pipe Ratings Index 2.9	Quick Rating 3D11
Overall	Pipe Rating 87	Pipe Ratings Index 5.4	Quick Rating 413D

CCTV pictures of DMH3X **for** URBAN SYSTEMS

Work Order	Video 201-003	Surveyed On 2021-06-25	Direction Downstream	Setup 3
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH3	To Manhole DMH4	

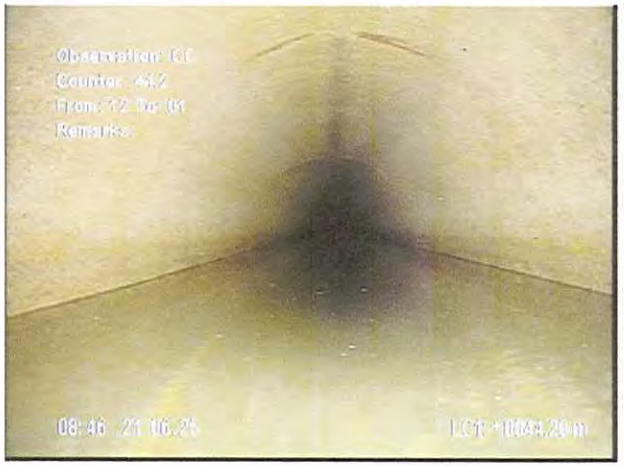
Date: 2021-06-25
Distance: 0.8 M
Obs: Deposits Settled Gravel

Comments:



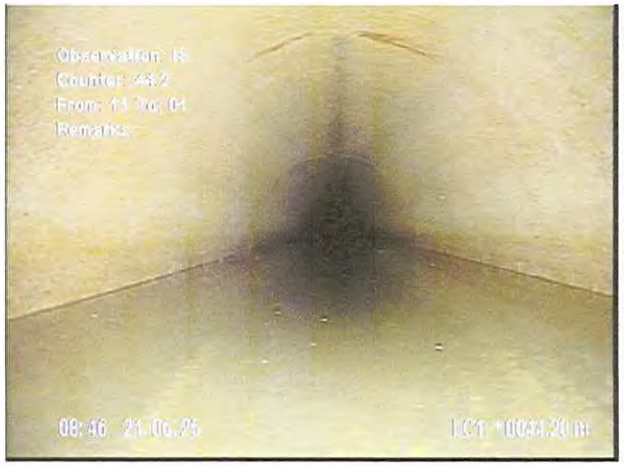
Date: 2021-06-25
Distance: 44.2 M
Obs: Crack Circumferential

Comments:



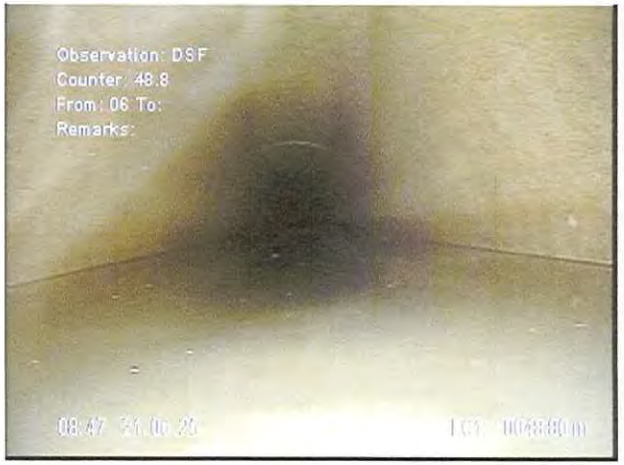
Date: 2021-06-25
Distance: 44.2 M
Obs: Infil Stain

Comments:



Date: 2021-06-25
Distance: 48.8 M
Obs: Deposits Settled Fine

Comments:



CCTV pictures of DMH3X **for** URBAN SYSTEMS

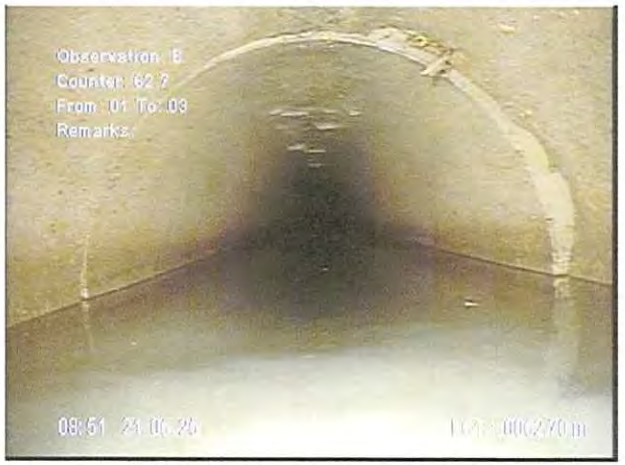
Work Order	Video 201-003	Surveyed On 2021-06-25	Direction Downstream	Setup 3
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH3	**To Manhole** DMH4	

Date: 2021-06-25
Distance: 61.2 M
Obs: Deposits Settled Fine

Comments:

Date: 2021-06-25
Distance: 62.7 M
Obs: Broken

Comments:



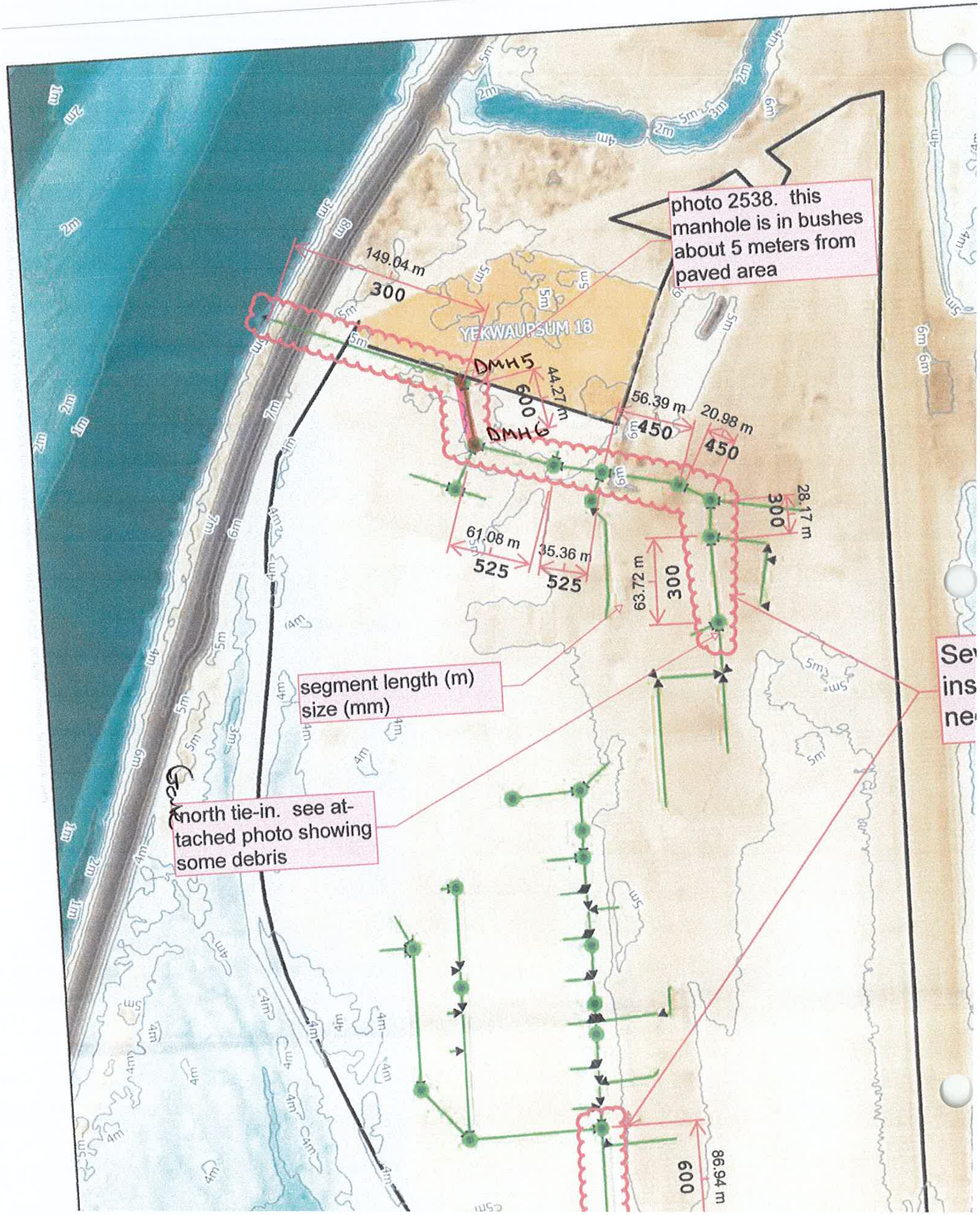


photo 2538. this manhole is in bushes about 5 meters from paved area
YEKWAUPSUM 18
DMH5
DMH6
149.04 m
300
44.27 m
600
56.39 m
450
20.98 m
450
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m) size (mm)
north tie-in. see attached photo showing some debris
86.94 m
600

Tabular Report of PSR DMH5X for URBAN SYSTEMS

Setup 4 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-004 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 10:40 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 600 **Width** **mm**
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 **M** **Total length** 44.2 **M**
Length Surveyed 44.2 **M** **Year Constructed** **Year Renewed**

Up DMH5 **Rim to invert** 2.50 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Down DMH6 **Rim to invert** 2.20 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH6
0.0			MWL	Miscellaneous Water Level			15					
6.2		S01	DSF	Deposits Settled Fine			20		05	07		WANDERS
44.2		F01	DSF	Deposits Settled Fine			20		05	07		WANDERS
44.2			AMH	Manhole								DMH5
44.2			FH	End of Survey								

44.2 **M** **Total Length Surveyed**

Scores

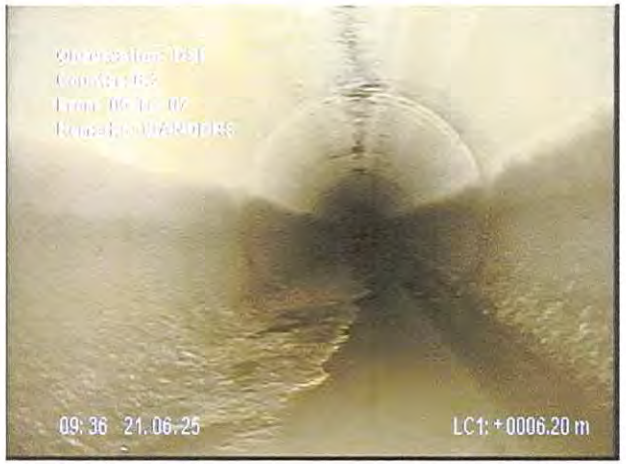
Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 75	**Pipe Ratings Index** 3	**Quick Rating** 3D00
Overall	**Pipe Rating** 75	**Pipe Ratings Index** 3	**Quick Rating** 3D00

CCTV pictures of DMH5X **for** URBAN SYSTEMS

Work Order	Video 201-004	Surveyed On 2021-06-25	Direction Downstream	Setup 4
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH5	**To Manhole** DMH6	

Date: 2021-06-25
Distance: 6.2 M
Obs: Deposits Settled Fine

Comments:
WANDERS



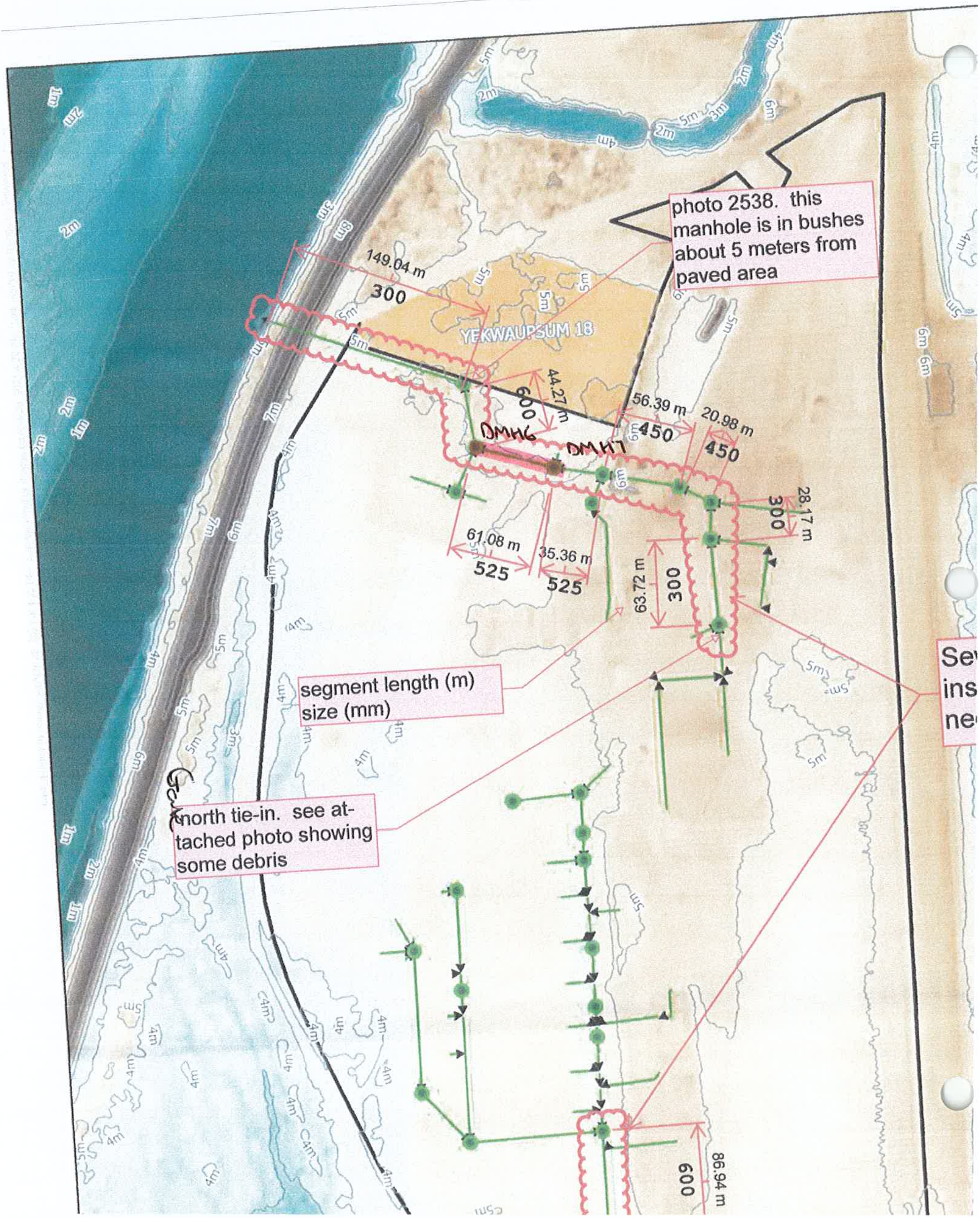


photo 2538. this manhole is in bushes about 5 meters from paved area
149.04 m
300
YEKWAUPSUM 18
44.27 m
600
DMH6
DMH7
56.39 m
450
20.98 m
450
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
86.94 m
600

Tabular Report of PSR DMH7X for URBAN SYSTEMS

Setup 5 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-005 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 10:46 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Up
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 525 **Width** mm
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 **M** **Total length** 63.9 **M**
Length Surveyed 63.9 **M** **Year Constructed** **Year Renewed**

Up DMH7 **Rim to invert** 2.40 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Down DMH6 **Rim to invert** 2.20 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video		CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0				ST	Start of Survey								
0.0				AMH	Manhole								DMH6
0.0				MWL	Miscellaneous Water Level			15					
1.9			S01	DSF	Deposits Settled Fine			10		06			WANDERS
9.2			F01	DSF	Deposits Settled Fine			10		06			WANDERS
9.2				MWL	Miscellaneous Water Level			10					
9.2			S02	DSF	Deposits Settled Fine			5		06			
19.9				LL	Line Left			5					
19.9				MWL	Miscellaneous Water Level			15					
25.0			F02	DSF	Deposits Settled Fine			5		06			
25.0			S03	DSF	Deposits Settled Fine			15		06			
49.7				RFJ	Roots Fine Joint				J	02	11		
57.1				LL	Line Left			5					
63.9			F03	DSF	Deposits Settled Fine			15		06			
63.9				AMH	Manhole								DMH7
63.9				FH	End of Survey								

63.9 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 113	**Pipe Ratings Index** 2.5	**Quick Rating** 3D2B
Overall	**Pipe Rating** 113	**Pipe Ratings Index** 2.5	**Quick Rating** 3D2B

CCTV pictures of DMH7X **for** URBAN SYSTEMS

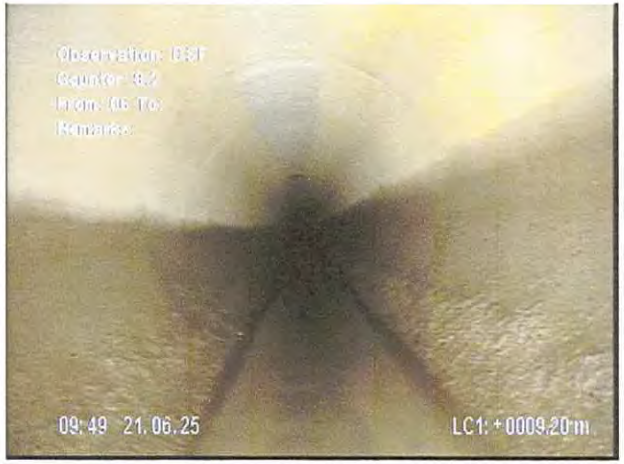
Work Order	Video 201-005	Surveyed On 2021-06-25	Direction Upstream	Setup 5
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH6	To Manhole DMH7	

Date: 2021-06-25
Distance: 1.9 M
Obs: Deposits Settled Fine

Comments:
WANDERS

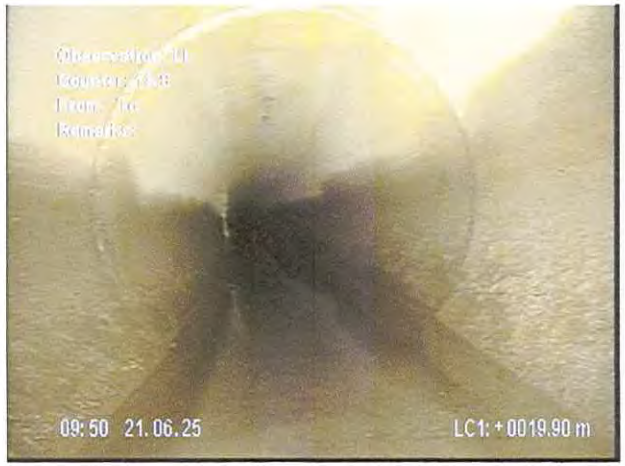
Date: 2021-06-25
Distance: 9.2 M
Obs: Deposits Settled Fine

Comments:



Date: 2021-06-25
Distance: 19.9 M
Obs: Line Left

Comments:



Date: 2021-06-25
Distance: 25.0 M
Obs: Deposits Settled Fine

Comments:

CCTV pictures of DMH7X **for** URBAN SYSTEMS

Work Order	Video 201-005	Surveyed On 2021-06-25	Direction Upstream	Setup 5
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH6	To Manhole DMH7	

Date: 2021-06-25
Distance: 49.7 M
Obs: Roots Fine Joint

Comments:

Date: 2021-06-25
Distance: 57.1 M
Obs: Line Left

Comments:

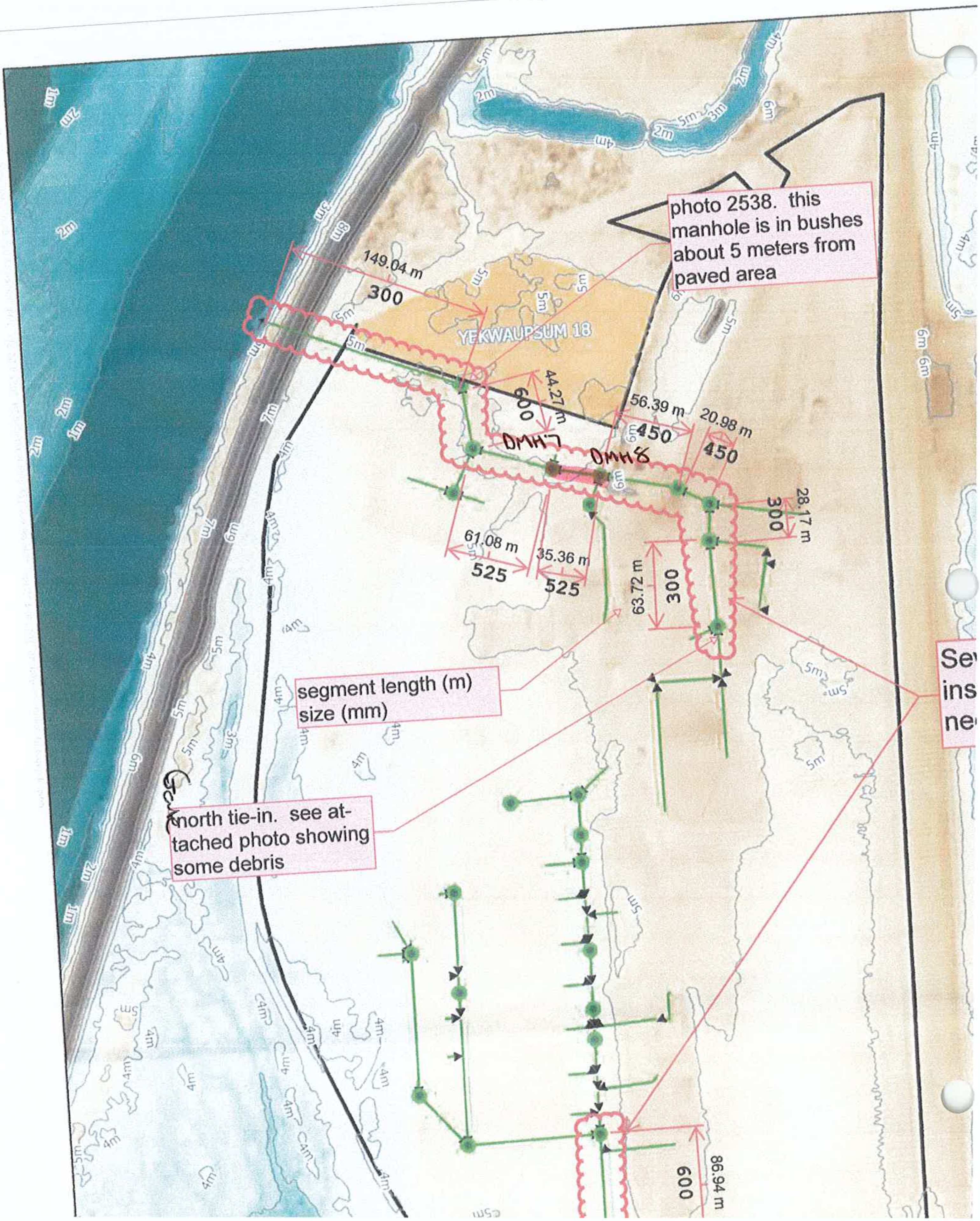


photo 2538. this manhole is in bushes about 5 meters from paved area
YEKWAUPSUM 18
149.04 m
300
44.27 m
600
56.39 m
450
20.98 m
450
DMH7
DMH8
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
86.94 m
600

Tabular Report of PSR DMH8X **for** **URBAN SYSTEMS**

Setup 6 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-006 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 11:00 **Weather** Dry - no PrecipitatioPre-Cleaning N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Up
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 525 **Width** mm
Shape Circular **Material** Reinforced Concrete Pipe **Lining** None
Coating **Pipe Joint length** 2.50 **M** **Total length** **M**
Length Surveyed 6.9 **M** **Year Constructed** **Year Renewed**

Up DMH8 **Rim to invert** 1.90 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Down DMH7 **Rim to invert** 2.40 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info MSA DSF. DMH8 IS UNDER A STEEL CONTAINER (NO ACCESS)

Structural	O & M
Miscellaneous	Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH7
0.0			MWL	Miscellaneous Water Level			10					
0.0		S01	DSF	Deposits Settled Fine			25		06			
0.8			TB	Tap Break-in/Hammer	150				02			
6.9		F01	DSF	Deposits Settled Fine			25		06			
6.9			MSA	Miscellaneous Survey Abandoned								MSA DSF, REVERSAL REQUIRED

6.9 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 20	**Pipe Ratings Index** 4	**Quick Rating** 4500
Overall	**Pipe Rating** 20	**Pipe Ratings Index** 4	**Quick Rating** 4500

CCTV pictures of DMH8X **for** URBAN SYSTEMS

Work Order	Video 201-006	Surveyed On 2021-06-25	Direction Upstream	Setup 6
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH7	**To Manhole** DMH8	

Date: 2021-06-25

Distance: 0.0 M

Obs: Deposits Settled Fine

Comments:

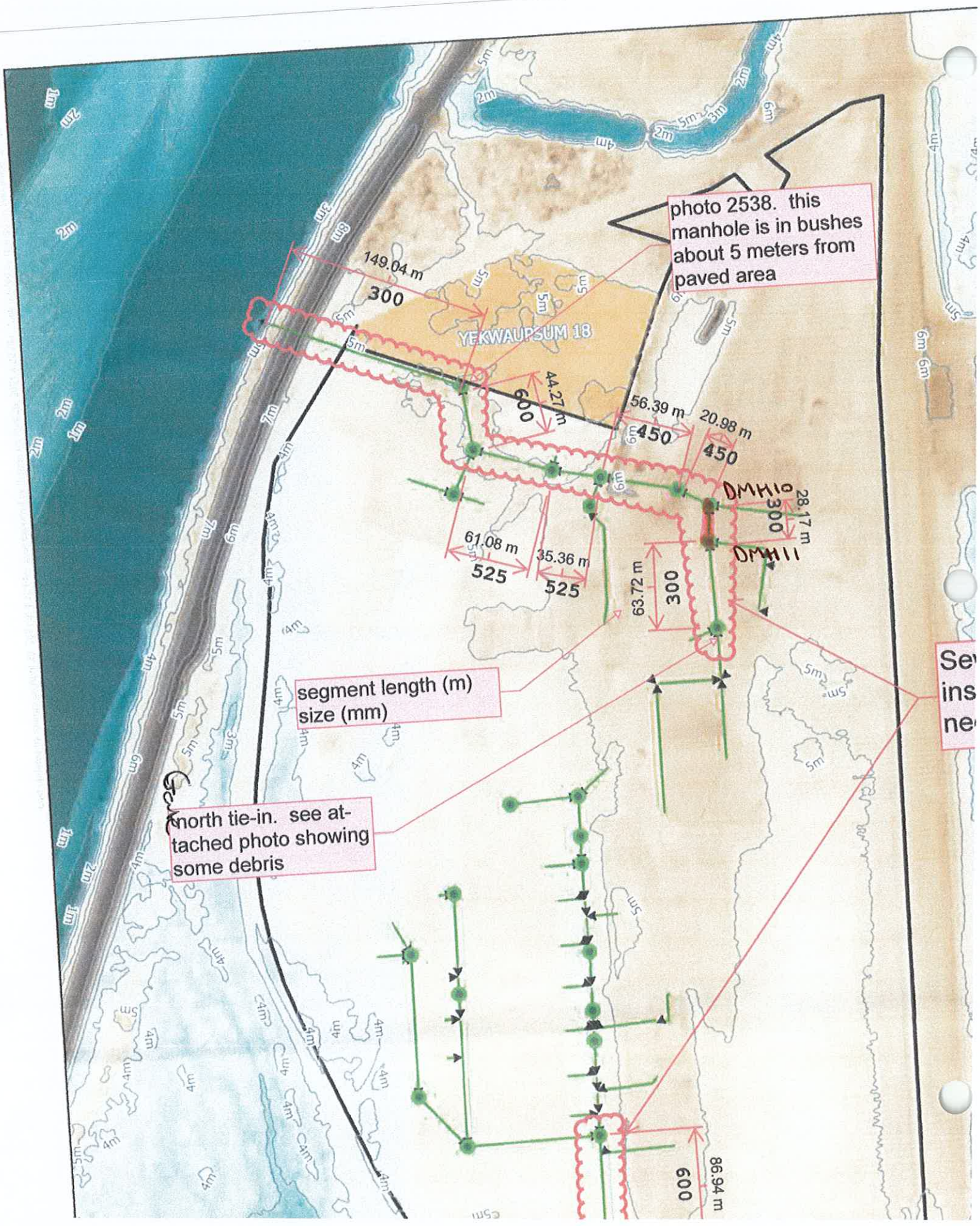


photo 2538. this manhole is in bushes about 5 meters from paved area
YEKWAUPSUM 18
149.04 m
300
44.27 m
600
56.39 m
450
20.98 m
450
DMH10
28.17 m
300
DMH11
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
600
86.94 m

Tabular Report of PSR DMH10X for URBAN SYSTEMS

Setup 7 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-007 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 11:14 **Weather** Dry - no PrecipitatioPre-Cleaning N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Up
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 300 **Width** mm
Shape Circular **Material** Asbestos Cement **Lining** None
Coating **Pipe Joint length** 4.00 M **Total length** 30.7 M
Length Surveyed 30.7 M **Year Constructed** **Year Renewed**

Up DMH11 **Rim to invert** **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH10 **Rim to invert** 1.90 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info DMH11 IS BURIED

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH10
0.0			MWL	Miscellaneous Water Level			5					
1.9		S01	DSF	Deposits Settled Fine			5		06			WANDERS
5.9			DSGV	Deposits Settled Gravel			10		06			
9.4		F01	DSF	Deposits Settled Fine			5		06			WANDERS
12.8		S02	DSGV	Deposits Settled Gravel			15		06			
18.6		F02	DSGV	Deposits Settled Gravel			15		06			
23.2			FL	Fracture Longitudinal					10			
28.7			FL	Fracture Longitudinal					12			
30.7			AMH	Manhole								DMH11
30.7			FH	End of Survey								

30.7 M **Total Length Surveyed**

Scores

Structural:	**Pipe Rating** 6	**Pipe Ratings Index** 3	**Quick Rating** 3200
O&M:	**Pipe Rating** 24	**Pipe Ratings Index** 2.4	**Quick Rating** 3426
Overall	**Pipe Rating** 30	**Pipe Ratings Index** 5.4	**Quick Rating** 3626

CCTV pictures of DMH10X **for** URBAN SYSTEMS

Work Order	Video 201-007	Surveyed On 2021-06-25	Direction Upstream	Setup 7
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH10	To Manhole DMH11	

Date: 2021-06-25
Distance: 1.9 M
Obs: Deposits Settled Fine

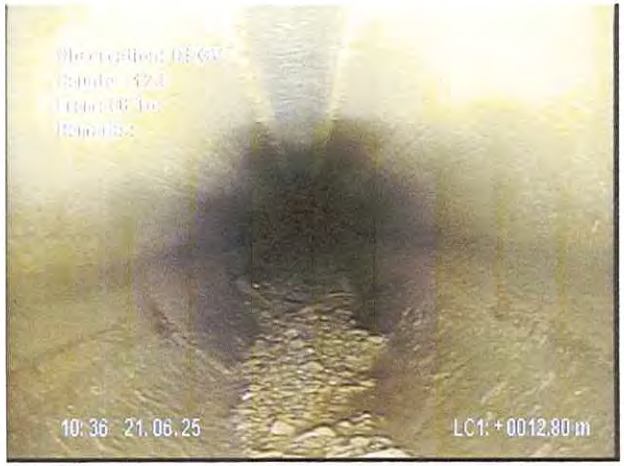
Comments:
WANDERS

Date: 2021-06-25
Distance: 5.9 M
Obs: Deposits Settled Gravel

Comments:

Date: 2021-06-25
Distance: 12.8 M
Obs: Deposits Settled Gravel

Comments:



Date: 2021-06-25
Distance: 23.2 M
Obs: Fracture Longitudinal

Comments:

CCTV pictures of DMH10X **for** URBAN SYSTEMS

Work Order	Video 201-007	Surveyed On 2021-06-25	Direction Upstream	Setup 7
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH10	To Manhole DMH11	

Date: 2021-06-25
Distance: 28.7 M
Obs: Fracture Longitudinal

Comments:

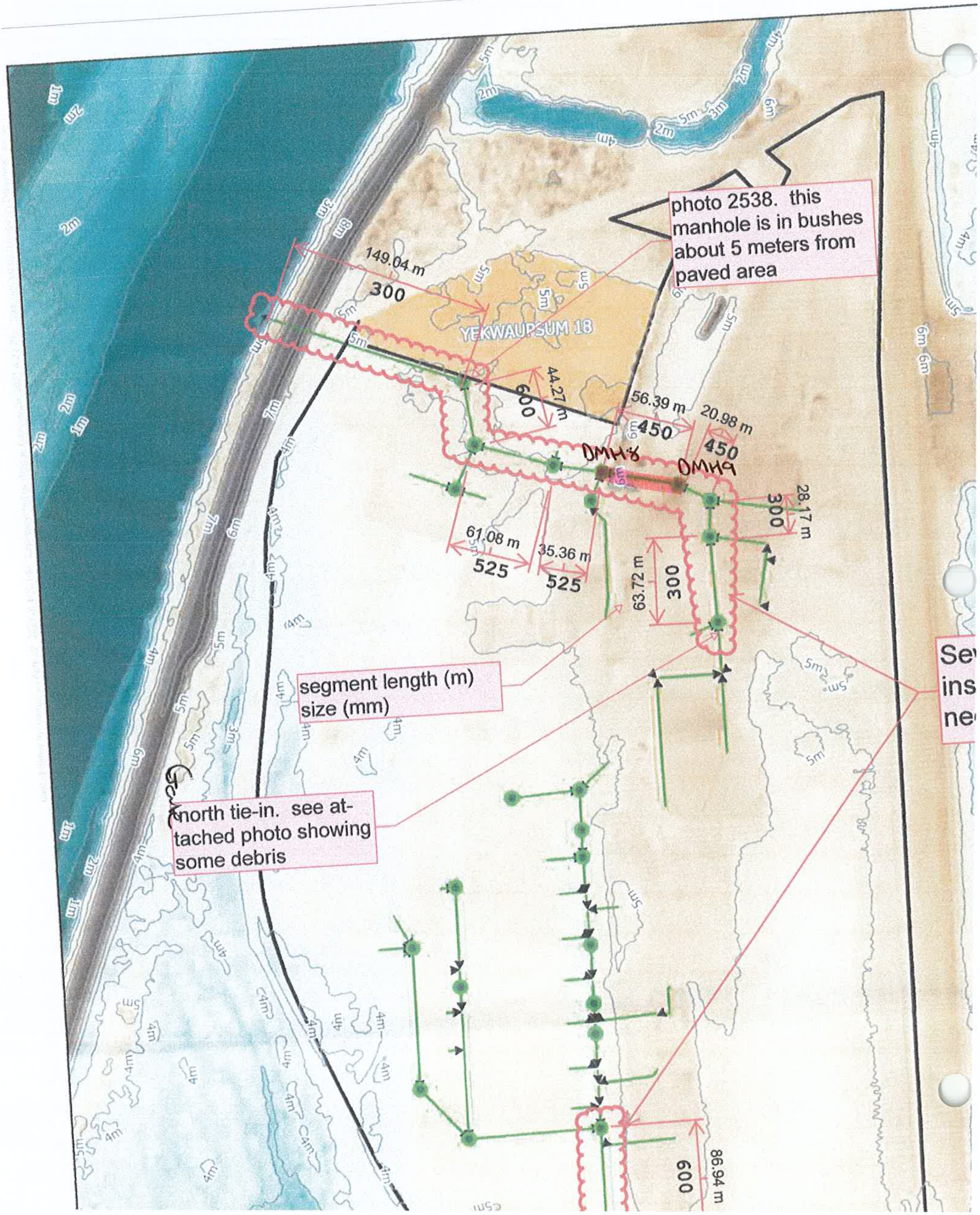


photo 2538. this manhole is in bushes about 5 meters from paved area
149.04 m
300
YEKWAUPSUM 18
44.27 m
600
56.39 m
450
20.98 m
450
DMH8
DMH9
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
86.94 m
600
Sev
ins
ne

Tabular Report of PSR DMH9X for URBAN SYSTEMS

Setup 8 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-008 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 12:11 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 450 **Width** mm
Shape Circular **Material** Concrete Pipe (non-reinforced) **Lining** None
Coating **Pipe Joint length** 2.50 M **Total length** M
Length Surveyed 13.9 M **Year Constructed** **Year Renewed**

Up DMH9 **Rim to invert** 2.90 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH8 **Rim to invert** 1.90 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info MSA DSF. DMH8 IS UNDER A STEEL CONTAINER (NO ACCESS)

Structural	O & M
Miscellaneous	Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH9
0.0			MWL	Miscellaneous Water Level			15					
4.8			DSF	Deposits Settled Fine			30		06			UNDER THE WATER LEVEL
13.2			MWL	Miscellaneous Water Level			50					
13.2			MCU	Miscellaneous Camera Underwater								
13.6			MWL	Miscellaneous Water Level			20					
13.9			MSA	Miscellaneous Survey Abandoned								MSA DSF

13.9 **M** **Total Length Surveyed**

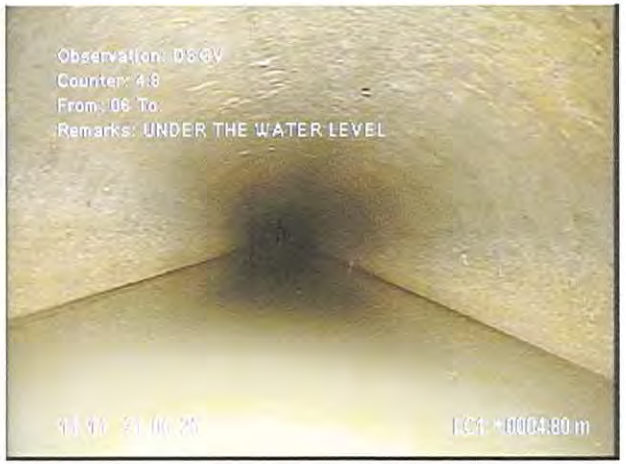
Scores

Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 8	**Pipe Ratings Index** 4	**Quick Rating** 4200
Overall	**Pipe Rating** 8	**Pipe Ratings Index** 4	**Quick Rating** 4200

CCTV pictures of DMH9X **for** URBAN SYSTEMS

Work Order	Video 201-008	Surveyed On 2021-06-25	Direction Downstream	Setup 8
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Yard		From Manhole DMH9	To Manhole DMH8	

Date: 2021-06-25
Distance: 4.8 M
Obs: Deposits Settled Fine



Comments:
UNDER THE WATER LEVEL

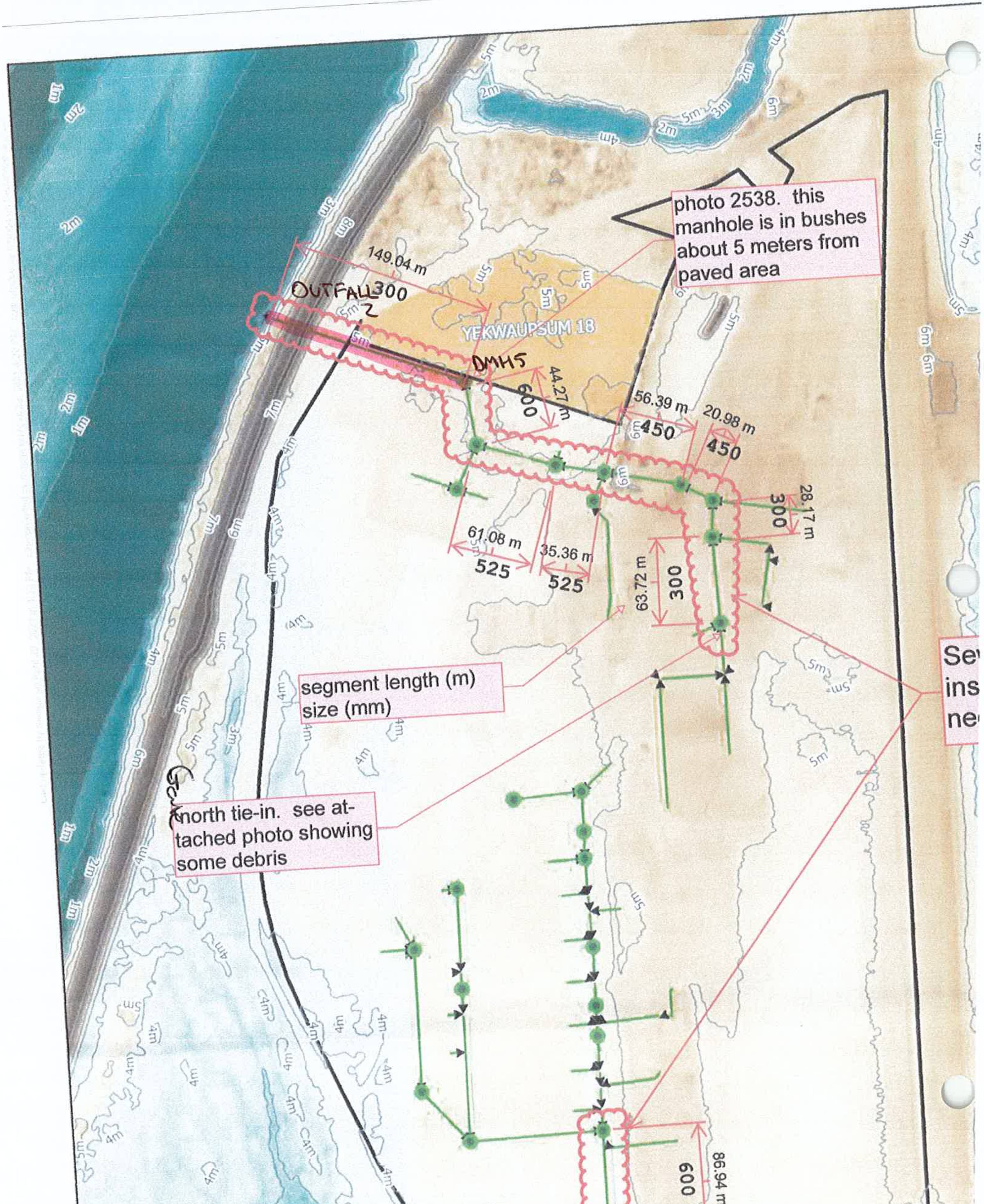


photo 2538. this manhole is in bushes about 5 meters from paved area
OUTFALL300
2
149.04 m
YEKWAUPSUM 18
DMH5
44.27 m
600
56.39 m
450
20.98 m
450
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
Sev
ins
ne
86.94 m
600

Tabular Report of PSR DMH5 for URBAN SYSTEMS

Setup 9 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-009 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 12:56 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Woods **Pipe Use** Stormwater Pipe
Location details **Height** 300 **Width** mm
Shape Circular **Material** Concrete Pipe (non-reinforced) **Lining** None
Coating **Pipe Joint length** 0.90 M **Total length** M
Length Surveyed 69.7 M **Year Constructed** **Year Renewed**

Up DMH5 **Rim to invert** 2.20 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down OUTFALL 2 **Rim to invert** **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info MSA OBZ

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH5
0.0			MWL	Miscellaneous Water Level			15					
3.4		S01	RFJ	Roots Fine Joint				J	05	07		WANDERS
4.5			MWL	Miscellaneous Water Level			10					
16.0			MWL	Miscellaneous Water Level			20					
54.8		F01	RFJ	Roots Fine Joint				J	05	07		WANDERS
57.2			HSV	Hole Soil Visible					12			
60.2			MWL	Miscellaneous Water Level			40					
69.7			TBI	Tap Break-in Intruding	150	70			12			
69.7			OBZ	Obstruction Other			30		06			UNKNOWN OBSTRUCTION UNDE
69.7			MSA	Miscellaneous Survey Abandoned								MSA OBZ

69.7 M Total Length Surveyed

Scores

Structural:	**Pipe Rating** 5	**Pipe Ratings Index** 5	**Quick Rating** 5100
O&M:	**Pipe Rating** 42	**Pipe Ratings Index** 1.2	**Quick Rating** 421E
Overall	**Pipe Rating** 47	**Pipe Ratings Index** 6.2	**Quick Rating** 5142

CCTV pictures of DMH5 **for** URBAN SYSTEMS

Work Order	Video 201-009	Surveyed On 2021-06-25	Direction Downstream	Setup 9
Street Name BC RAIL YARD		City Name SQUAMISH	Weather Dry - no Precipitation during survey	
Location Woods		From Manhole DMH5	To Manhole OUTFALL 2	

Date: 2021-06-25
Distance: 3.4 M
Obs: Roots Fine Joint

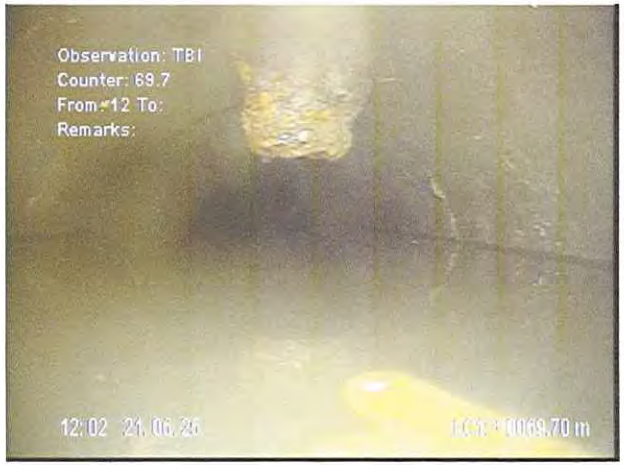
Comments:
WANDERS

Date: 2021-06-25
Distance: 57.2 M
Obs: Hole Soil Visible

Comments:

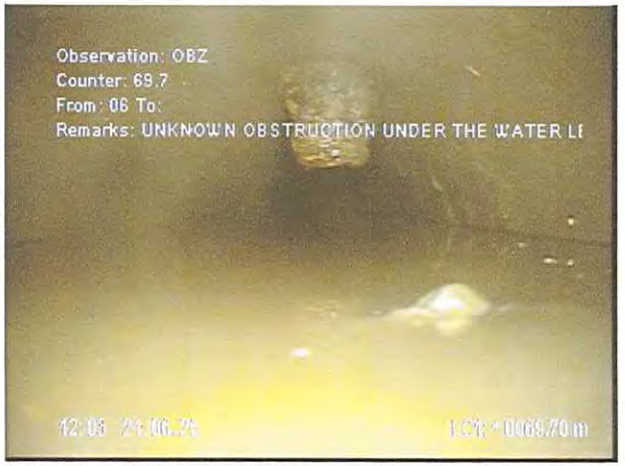
Date: 2021-06-25
Distance: 69.7 M
Obs: Tap Break-in Intruding

Comments:



Date: 2021-06-25
Distance: 69.7 M
Obs: Obstruction Other

Comments:
UNKNOWN OBSTRUCTION UNDER THE WATER LEVEL



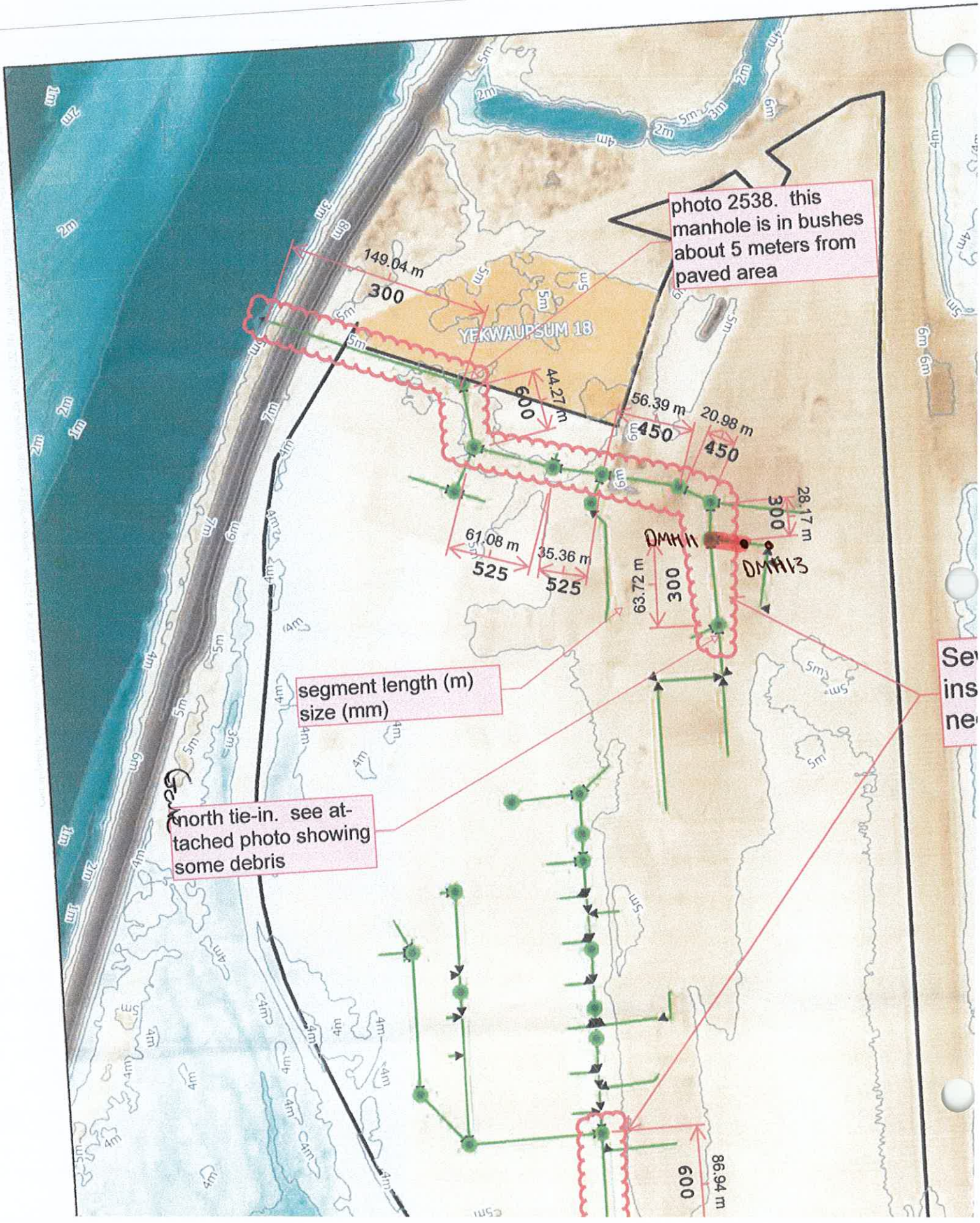


photo 2538. this manhole is in bushes about 5 meters from paved area
149.04 m
300
YEKWAUPSUM 18
44.27 m
600
56.39 m
450
20.98 m
450
28.17 m
300
61.08 m
525
35.36 m
525
63.72 m
300
DMH11
DMH13
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
86.94 m
600

Tabular Report of PSR DMH13X for URBAN SYSTEMS

Setup 10 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-010 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 13:44 **Weather** Dry - no PrecipitatioPre-Cleaning N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 300 **Width** mm
Shape Circular **Material** Polyvinyl Chloride **Lining** None
Coating **Pipe Joint length** 4.00 M **Total length** M
Length Surveyed 24.0 M **Year Constructed** **Year Renewed**

Up DMH13 **Rim to invert** 1.70 **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Down DMH11 **Rim to invert** **Grade to invert** **Rim to grade** M
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info MSA DSF. DMH11 IS BURIED

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH13
0.0			MWL	Miscellaneous Water Level			5					
2.4		S01	DSF	Deposits Settled Fine			10		06			
24.0		F01	DSF	Deposits Settled Fine			10		06			
24.0			MSA	Miscellaneous Survey Abandoned								MSA DSF

24.0 M **Total Length Surveyed**

Scores

Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 28	**Pipe Ratings Index** 2	**Quick Rating** 2A00
Overall	**Pipe Rating** 28	**Pipe Ratings Index** 2	**Quick Rating** 2A00

CCTV pictures of DMH13X **for** URBAN SYSTEMS

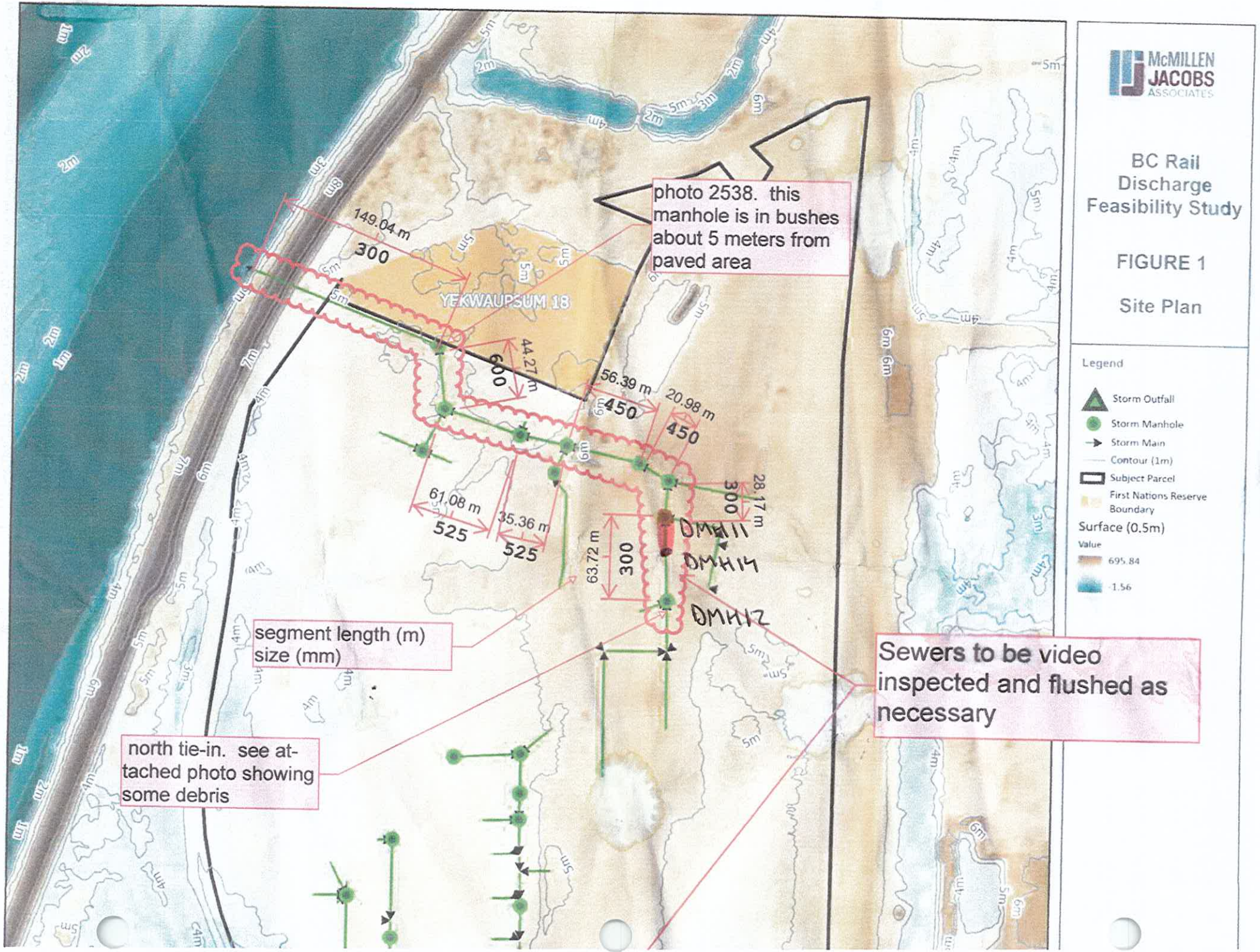
Work Order	Video 201-010	Surveyed On 2021-06-25	Direction Downstream	Setup 10
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH13	**To Manhole** DMH11	

Date: 2021-06-25

Distance: 2.4 M

Obs: Deposits Settled Fine

Comments:


McMILLEN JACOBS ASSOCIATES
BC Rail Discharge Feasibility Study
FIGURE 1
Site Plan
Legend
Storm Outfall
Storm Manhole
Storm Main
Contour (1m)
Subject Parcel
First Nations Reserve Boundary
Surface (0.5m)
Value
695.84
-1.56
YEKWAUPSUM 18
149.04 m
300
600
44.27 m
56.39 m
450
20.98 m
450
61.08 m
525
35.36 m
525
63.72 m
300
28.17 m
300
DMH11
DMH14
DMH12
photo 2538. this manhole is in bushes about 5 meters from paved area
segment length (m)
size (mm)
north tie-in. see attached photo showing some debris
Sewers to be video inspected and flushed as necessary

Tabular Report of PSR DMH14X for URBAN SYSTEMS

Setup 11 **Surveyed By** DLANE **Certificate #** U-0818-07009703 **Owner**
Reviewed By **Reviewer #** **Work Order**
Customer URBAN SYSTEMS **P/O #**
Media Label 201-011 **Project** BC RAIL YARD STORM
Date 2021-06-25 **Time** 14:27 **Weather** Dry - no Precipitatio **Pre-Cleaning** N **Date Cleaned**
Flow control Not Controlled **Survey Purpose** Maintenance Related **Direction** Down
Inspection Status Complete Inspection **Consequence Of Failure** **Pressure**
Inspection Technology Used ☑ CCTV ☐ Laser ☐ Sonar ☐ Sidewall ☐ Zoom ☐ Other

Street BC RAIL YARD **City** SQUAMISH **Drainage area**
Location Code Yard **Pipe Use** Stormwater Pipe
Location details **Height** 300 **Width** **mm**
Shape Circular **Material** Polyvinyl Chloride **Lining** None
Coating **Pipe Joint length** 4.00 **M** **Total length** 15.8 **M**
Length Surveyed 15.8 **M** **Year Constructed** **Year Renewed**

Up DMH14 **Rim to invert** 1.70 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Down DMH11 **Rim to invert** 1.80 **Grade to invert** **Rim to grade** **M**
Northing **Easting** **Elevation**

Coordinate System **Vertical Datum**
GPS Accuracy
Additional info

Structural O & M
Miscellaneous Constructional

Count	Video	CD	Code		Val1	Val2	%	Jnt	Fr	To	ImRef	Remarks
0.0			ST	Start of Survey								
0.0			AMH	Manhole								DMH14
0.0			MWL	Miscellaneous Water Level			5					
1.9		S01	DSGV	Deposits Settled Gravel			20		06			WANDERS
14.8		F01	DSGV	Deposits Settled Gravel			20		06			WANDERS
15.8			AMH	Manhole								DMH11
15.8			FH	End of Survey								

15.8 **M** **Total Length Surveyed**

Scores

Structural:	**Pipe Rating** 0	**Pipe Ratings Index** 0	**Quick Rating** 0000
O&M:	**Pipe Rating** 27	**Pipe Ratings Index** 3	**Quick Rating** 3900
Overall	**Pipe Rating** 27	**Pipe Ratings Index** 3	**Quick Rating** 3900

CCTV pictures of DMH14X **for** URBAN SYSTEMS

Work Order	Video 201-011	Surveyed On 2021-06-25	Direction Downstream	Setup 11
Street Name BC RAIL YARD		**City Name** SQUAMISH	**Weather** Dry - no Precipitation during survey	
Location Yard		**From Manhole** DMH14	**To Manhole** DMH11	

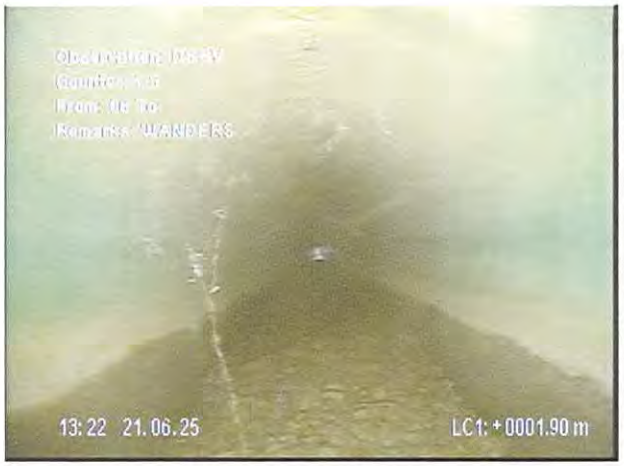
Date: 2021-06-25

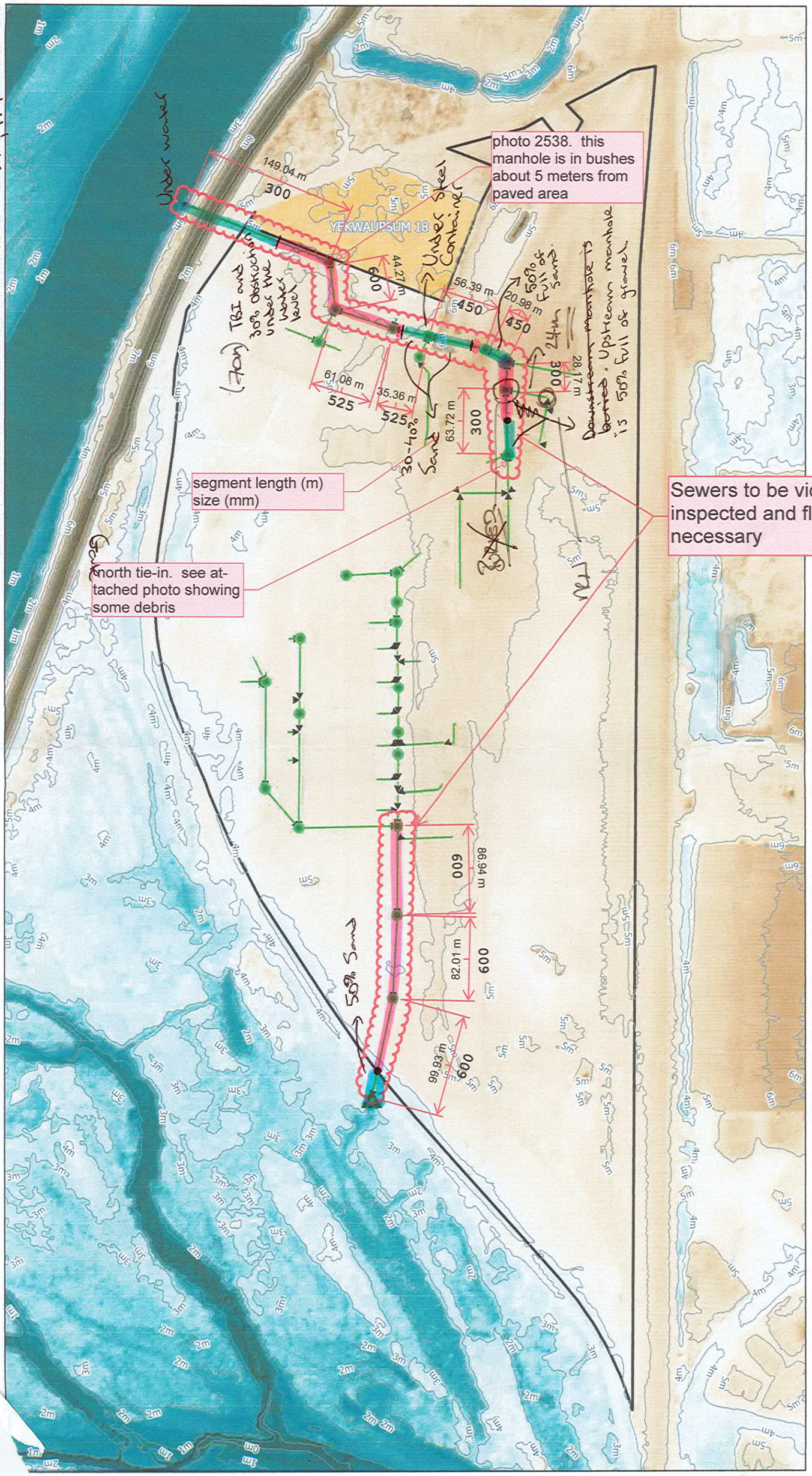
Distance: 1.9 M

Obs: Deposits Settled Gravel

Comments:

WANDERS





McMILLEN JACOBS ASSOCIATES

BC Rail Discharge Feasibility Study

FIGURE 1

Site Plan

Legend

- Storm Outfall
- Storm Manhole
- Storm Main
- Contour (1m)
- Subject Parcel
- First Nations Reserve Boundary

Surface (0.5m)

Value

695.84

-1.56

Data Sources:
- Infrastructure data based on District of Squamish Open Data, April 2021
- Imagery from Bing Maps, April 2021

Coordinate System:

Name: NAD 1983 UTM Zone 10N

0 25 50 75

Meters

Scale: 1:3,500
(When plotted at 11"x17")

URBAN systems

Project #:	5111.0001.01
Author:	RB
Checked:	XX
Status:	Status
Revision:	A
Date:	2021 / 4 / 29

Appendix B

P-00763-ENV-MEM-2003 BC Rail Site Water Discharge Options - Biophysical Assessment - Jacobs Engineering

July 14, 2021

Jacobs

Memorandum

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Subject	**BC Rail Site Water Discharge Options - Biophysical Assessment**
Project Name	Eagle Mountain – Woodfibre Gas Pipeline Project
Attention	Roxanne Tripp and Todd Lewis, FortisBC Energy Inc. (FortisBC)
From	Carissa Stenzel, R.P.Bio, P.Biol, QAES, Tyler Innes, R.P.Bio, Sarah McLaughlin, R.P.Bio., and Diana Chomack, B.I.T., Jacobs Consultancy Canada Inc. (Jacobs)
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1. Introduction

FortisBC is proposing to construct and operate the Eagle Mountain – Woodfibre Gas Pipeline Project (EGP Project), consisting of an approximately 47-kilometre (km) long, Nominal Pipe Size (NPS) 24 sweet natural gas pipeline generally paralleling (or looping) a portion of FortisBC's existing pipeline from the area north of the Coquitlam Watershed in Metro Vancouver to the proposed Woodfibre LNG Limited (WLNG) facility, southwest of Squamish, British Columba (BC).

The EGP Tunnel was identified as a solution for the last 9 km of the alignment of the EGP Project to address Indigenous nations' and public concerns regarding impacts to the Squamish River Estuary, and to avoid steep, difficult terrain around Monmouth Ridge. The EGP Tunnel starts at the southern end of the BC Rail Site, within the District of Squamish Industrial Park (East Shaft), runs under the Skwelwil'em Squamish Estuary Wildlife Management Area (WMA), and terminates in a portal at the WLNG facility site (Woodfibre Portal). Construction activities for the EGP Tunnel will generate water, which will need to be discharged from the BC Rail Site.

McMillen Jacobs Associates (MJA), Owner's Engineer for FortisBC, identified three proposed water discharge options and completed an engineering assessment of the existing private storm sewer drainage network at the BC Rail Site. The three proposed water discharge options under consideration are as follows (see Figure 1 for overview):

- Option1: BCR Properties Ltd. existing network leading to the Northern Outfall.
- Option 2: New discharge system located within the FortisBC NPS 10 natural gas pipeline right-of-way.
- Option 3: BCR Properties Ltd. existing network leading to the Southern Outfall.

The purpose of this memorandum is to assist FortisBC with the selection of the preferred discharge location to advance permitting for the discharge of treated water from the EGP Tunnel construction. Section 2 presents the objectives and assumptions. Section 3 describes the assessment methods. Section 4 presents the results of the assessment. Section 5 details conclusions and recommendations.

FORTIS BC

June 2021

FIGURE 1

BC RAIL WATER DISCHARGE OPTIONS PROJECT OVERVIEW

EAGLE MOUNTAIN - WOODFIBRE GAS PIPELINE PROJECT

Water Discharge Options

- Option 1: Northern Outfall
- Option 2: FortisBC ROW
- Option 3: Southern Outfall
- Option 3: Catchment Area
- Option 3: Flow Path (From Outfall)
- East Shaft

Other

- Public Walking Trails
- Railway
- Existing Transmission Line
- BC Rail Site Lease Area
- Proposed OGAA Application Corridor
- Provincial Park
- Skwelwil'em Squamish Estuary

SCALE: 1:6,000

0 125 250 m

(All Locations Approximate)

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UTM Zone 10 North. NAD 1983.
Pipeline Application Corridor: Jacobs 8-30-2019 (Revision 15); Existing Pipeline: FortisBC 2012; Options 1,2,3, East Shaft: Jacobs 2021; Public Walking Trails: District of Squamish: 6-15-2020; Estuary: BC MFLNRO 2008; Railway: BC MFLNRO 2015 Provincial Park: BC MFLNRO 2008; Existing Transmission Line: BC Hydro; Base Imagery: Atlantic Group 2013; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

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2. Objectives and Assumptions

A biophysical desktop and field assessment were completed to identify and assess potential biophysical constraints (that is, aquatics, wetlands, vegetation, wildlife) associated with the three proposed water discharge options.

The objectives of the biophysical assessment were to:

- Identify potential interactions with fish and fish habitat at each proposed water discharge option.
- Identify potential impacts to wetlands and riparian communities at each proposed water discharge option.
- Identify plant species and ecological communities including plant species and ecological communities at risk with potential be impacted by activities at each proposed water discharge option.
- Identify interactions with invasive plant species listed on Schedule A of the *Weed Control Regulation* under the BC *Weed Control Act* as well as regionally or provincially listed priority invasive plant species (Government of BC 2021d) at each proposed water discharge option.
- Identify wildlife species, including species at risk and associated habitat with potential to be impacted by activities at each water proposed water discharge option.

An assessment of potential impacts of the proposed discharged water volume and flow to surface water or groundwater hydrology was not completed as part of this biophysical assessment. The biophysical assessment was based on the following parameters and assumptions, as provided in the MJA assessment report (MJA 2021):

- Only one discharge location will be selected and advanced for permitting.
- Each discharge location has two potential options, depending on the results of further technical investigations of the integrity of the existing infrastructure.
  - Option 1: There is existing infrastructure in place across the dike and an existing outfall into the Squamish River; however, preliminary assessment indicates that this outfall is not in good condition and may need replacement. If outfall needs replacement, clearing/brushing of riparian vegetation along the banks of the Squamish River may be required.
  - Option 2: Requires installation of new infrastructure through the existing FortisBC right-of-way. Potential need for riparian vegetation clearing associated with the installation of infrastructure within or near the banks of the Squamish River.
  - Option 3: Existing outfall does not need to be replaced; no clearing/brushing will be required.
- The tunnelling activities will generate approximately 150 cubic metres per day (m^3/day) of water as a continuous flow during tunnelling and portal excavation dewatering, and a flow of approximately 2,600 m^3/day over a 24-hour period for hydrostatic testing. These two activities are isolated events.
- The continuous flow of 150 m^3/day is assumed to be over a 24-hour period. This amounts to a flow rate of 1.75 litres per second (L/s).
- The discharge of 2,600 m^3/day is assumed to be ideally done over a 10-hour work window. This would amount to a flow of 70 L/s on average.
- Construction is expected to begin in late 2022 and will occur over approximately 4 years, spanning all four seasons and a likely wide range of precipitation events. The continuous flow of 150 m^3/day is assumed to occur through all weather conditions.

- Water produced by the EGP Tunnel construction activities will be treated to meet Provincially regulated water quality guidelines.

3. Assessment Methods

3.1 Aquatic Environment

A literature and desktop review were conducted to obtain information on the existing conditions and potential aquatic environment interactions at each proposed water discharge option, with a focus on fish and fish habitat conditions within each area. Primary sources of existing spatial data and species information used in the preparation of the aquatic environment information for this report include the following:

- Project imagery and proposed BC Rail Site Discharge Options (Figure 1)
- BC Geographic Data, iMapBC 2.0 (Government of BC 2021a)
- Habitat Wizard (Government of BC 2021b)
- Fisheries and Oceans Canada (DFO) Aquatics Species at Risk Map (DFO 2019)
- Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (2021)
- BC Species & Ecosystems Explorer (Government of BC 2021c)
- Species at risk public registry (Government of Canada 2021a)

On June 12, 2021, a Qualified Professional (QP) specialized in aquatic biology conducted a field assessment to confirm desktop findings and identify potential fish and fish habitat constraints. The field assessment included a high-level fish habitat assessment at each proposed water discharge option to determine fish habitat potential, including spawning, rearing, overwintering, migration, and to evaluate any potential aquatic environmental constraints at the discharge locations and along the routes of the proposed water discharge options (such as, stream characteristics, riparian condition, sediment, and erosion potential).

3.2 Wetlands and Riparian Communities

A literature and desktop review were conducted to obtain information on the existing conditions and potential wetland and riparian interactions at each proposed water discharge option. Primary sources of information used in the preparation of this memo include the following:

- Project imagery and proposed BC Rail Site Discharge Options (Figure 1)
- Wetlands of British Columbia, Land Management Handbook No. 52 (Mackenzie and Moran 2004)
- A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region, Land Management Handbook No. 28 (Green and Klinka 1994)
- BC Geographic Data, iMapBC 2.0 (Government of BC 2021a)
- Develop with Care 2014 (BC MOE 2014)
- BC Freshwater Atlas – wetlands (Government of BC 2021a)
- Ramsar Wetlands (Ramsar Convention Secretariat 2014)

On June 10, 2021, a wetland QP conducted a field assessment to confirm desktop findings and identify potential wetland and riparian constraints at the three proposed water discharge options. The field assessment focused on confirming the presence or absence of wetlands and riparian areas.

Where a wetland was identified, the wetland was delineated and classified, and a Wetland Landscape Functional Assessment was completed, which assigns wetland function based on observable characteristics related to the provision of wetland function.

A functional score corresponding to one of four functional categories (that is, high, high-moderate, low-moderate, and low functional condition) was assigned. At ground-surveyed wetlands, data collection included hydrological, habitat and biogeochemical characteristics that aid in wetland classification according to both the Canadian Wetland Classification System (NWWG 1997) and Wetlands of BC: A Guide to Identification (Mackenzie and Moran 2004). Dominant vegetation community is a key factor in assigning BC site association. Wetlands were also classified according to the *Environmental Protection and Management Regulation* (*EPMR*) riparian classes.

Where riparian communities were identified, the vegetation species were recorded, and the ecological community was classified to site series.

3.3 Vegetation

A literature and desktop review were conducted to obtain information on the existing conditions and potential vegetation interactions at each proposed water discharge option. Primary sources of information used in the preparation of this memo include the following:

- Project imagery and proposed BC Rail Site Discharge Options (Figure 1)
- Inventory and Survey Methods for Rare Plants and Lichens (BC ENV 2018)
- E-Flora BC: Electronic Atlas of the Flora of British Columbia, Protocol for Rare Plant Surveys (Penny and Klinkenberg 2021)
- Wetlands of British Columbia, Land Management Handbook No. 52 (Mackenzie and Moran 2004)
- A Field Guide for Site Identification and Interpretation for the Vancouver Forest Region, Land Management Handbook No. 28 (Green and Klinka 1994)
- BC Geographic Data, iMapBC 2.0 (Government of BC 2021a)
- *Weed Control Act*. *Weed Control Regulation*. (Government of BC 2011)
- Invasive Alien Plant Program (IAPP) datasets and reference guide (Government of BC 2010, 2021d)
- Develop with Care 2014 (BC MOE 2014)

On June 10, 2021, a QP conducted a field assessment to confirm desktop findings and identify potential vegetation constraints at the three proposed water discharge options. The field assessment verified the vegetation interactions from the desktop evaluation and focused on general plant species, plant species of conservation concern, ecological communities of conservation concern and invasive plants. The field assessment was conducted early in the growing season when not all identifiable vegetation characteristics are present (that is, flowers); therefore, not all vegetation (such as, Vancouver Island beggarticks) could be identified during this trip.

Vegetation survey protocols were adapted from the following sources:

- E-Flora's Protocol for Rare Plant Surveys (Penny and Klinkenberg 2021)
- Environmental Best Management Practices for Urban and Rural Land Development in British Columbia, Draft (BC MOE 2012)
- Inventory and Survey Methods for Rare Plants and Lichens (BC ENV 2018)

Invasive plant surveys followed methods consistent with the IAPP inventory methods (Government of BC 2010).

The BC Conservation Data Centre collects and assembles information from many sources for classification and mapping the locations of species and ecological communities at risk and for status assessments in BC. Based on their conservation status rank, each species and ecosystem is assigned to the red, blue or yellow list to help set conservation priorities and provide a simplified view of the status of BC's species and ecosystems. These lists also help to identify species and ecosystems that can be considered for designation as "Endangered" or "Threatened". Red-listed species or ecosystems are those that are at risk of being lost (extirpated, endangered or threatened). Blue-listed species or ecosystems are those that are of special concern and Yellow-listed species or ecosystems are those that are at the least risk of being lost (Government of BC 2020).

3.4 Wildlife

A literature and desktop review were conducted to obtain information on the existing conditions and potential wildlife and wildlife habitat interactions with the three proposed water discharge options. The following information sources were reviewed to obtain information on the existing conditions related to wildlife and wildlife habitat, including species at risk:

- Project imagery and proposed BC Rail Site Discharge Options (Figure 1):
  - COSEWIC (COSEWIC 2021)
  - BC Species & Ecosystems Explorer (Government of BC 2021c)
  - Species at risk public registry (Government of Canada 2021a)
- BC Geographic Data, iMapBC 2.0 (Government of BC 2021a):
  - Federally identified Critical Habitat - Species at risk – Canada for wildlife (Government of Canada 2021b)
  - BC Conservation Data Centre element occurrence database (Government of BC 2021a)
  - Provincial Parks, Eco Reserved, and Protected Areas (BC ENV 2021a)
  - Provincially identified wildlife areas (for example, Ungulate Winter Ranges [UWRs], WMAs, and Wildlife Habitat Areas [WHAs]) (BC MFLNRORD 2021a,b,c,d,e)
- BC Great Blue Herons Atlas (Community Mapping Network 2021a)
- Wildlife Tree Stewardship Atlas (Community Mapping Network 2021b)
- Migratory Bird Sanctuaries (Government of Canada 2020)
- National wildlife areas (Government of Canada 2021c)
- Important Bird Areas (Bird Studies Canada and Nature Canada 2021)
- Western Hemisphere Shorebird Reserves (WHSRN 2020)
- World Biosphere Reserves (UNESCO 2020)

On June 10 and 12, 2021, a wildlife QP conducted a field assessment to confirm desktop findings and identify potential wildlife constraints at each of the three proposed water discharge options. A high-level wildlife habitat assessment was conducted at each option to determine potential habitat suitability for wildlife, including species at risk, and to identify potential wildlife habitat features (such as, nests or amphibian breeding sites).

A pond-dwelling amphibian survey was conducted within wetlands to determine presence/absence of breeding amphibians. Survey methods followed the time-constrained search protocols outlined in the Inventory Methods for Pond-Dwelling Amphibians and Painted Turtles (BC MELP 1998).

Active searching for amphibians of all life stages (that is, egg masses, tadpoles/larvae, metamorphs, and adults) was conducted over a 2 hour period, and the entire wetland was completely searched as the water was shallow enough to walk through all areas.

4. Results

4.1 Land Use

During the biophysical field assessments, it was noted that there are public walking trails near all three of the proposed water discharge options (refer to Figure 1).

The Riverside Trail extends along the length of the existing dike, between the east bank of the Squamish River and the dike (DoS 2021). The existing infrastructure at Option 1 crosses underneath the Riverside Trail with existing outflow draining directly into the Squamish River. With this proposed water discharge option, outflow water would not be clearly visible to the public as the discharge location is along a deep channelized flowing reach of the river. With the new infrastructure requirements of Option 2, the proposed route would also need to cross the Riverside Trail, but the outflow infrastructure and discharged water on the gravel bar at the east side of the Squamish River would be clearly visible to the public. An additional trail, that crosses the existing FortisBC right-of-way perpendicularly, the Swan Trail North (DoS 2021), would also be crossed with the new infrastructure requirements.

The Swan Trail North continues to the south through the estimated flow path from Option 3 (see Figure 1). The trail is aligned south of the estimated catchment area, where a dry drainage channel passes from the southeast end of the catchment area under a culvert and out into the estuarine marsh to the south. Depending on the level of water flow from the Option 3 outfall, water may be visible by public users should it breach the catchment area and either flow through the culvert or follow the proposed flow path.

4.2 Aquatic Environment

Proposed water discharge options have either direct or indirect interactions with the associated aquatic environment of the Squamish River. Fish and fish habitat potential varies between the proposed locations, but all locations are likely accessible to fish at varying life stages and at varying river and tidal water levels throughout the seasons.

No Critical Habitat for fish or other aquatic species at risk was identified within or adjacent to the proposed discharge locations (DFO 2019). However, the habitat of the Squamish River and estuary is important to fish species that are Federally recognized by COSEWIC or under the *Species at Risk Act* (*SARA*) or the Province recognizes to be of conservation concern. Table 3-1 lists some of these fish species.

Table 3-1. Fish Species of Conservation Concern within the Squamish River

Common Name	Scientific Name	Provincial List	COSEWIC	SARA Schedule 1
Sportfish				
Cutthroat trout (coastal)	*Oncorhynchus clarkia clarkii*	Blue	-	-
Yelloweye rockfish	*Sebastes ruberrimus*	-	Threatened	Special Concern
Non-Sportfish				
Bull trout (South Coast)	*Salvelinus confluentus*	Blue	Special Concern	Special Concern

Sources: Government of BC 2021b; Government of BC 2021c; COSEWIC 2021

Blue = "Any species or ecosystem that is of special concern" (Government of BC 2020).

Important salmonid species, including all five species of pacific salmon, steelhead, and cutthroat trout, have recorded observations within the Squamish River (Government of BC 2021b). No listed pacific salmon population at risk occurs within the river; however, with the increasing conservation concern of the pacific salmon species, it is important to recognize their potential presence at these proposed discharge locations. Juvenile salmonids likely rear within the bankside areas of the river, including within the marsh and mudflats associated with the Squamish River Estuary. The Squamish River serves as an important migratory corridor for both juvenile and adult salmonid stages.

The proposed discharge location of Option 1 is an existing outflow infrastructure that drains directly into the channelized flows of the Squamish River. There is a low potential of altering the bed and bank structure at the discharge site, or for sediment mobilization into downstream fish habitat during the proposed discharge activities. This channelized reach of the river has suitable depth and, flow to support the proposed discharge rates. The bank at the outflow consists primarily of large boulders, with existing angular rip-rap beneath the outflow that prevents streambed scour upon discharge. Overall, there is a lack of fine sediment at the discharge location, reducing the potential for downstream sedimentation or erosion events. Fish and fish habitat consisted of instream large woody debris along the length of bank, abundant overhanging vegetation and canopy cover, an undercut bank and a backwater eddy which provided important flow refuge. Riparian vegetation at the discharge outfall was contributing to functional cover extending approximately 10 metres (m) in length into the Squamish River from the edge of the channel. The riparian vegetation present between the footpath located at the top of bank down to the waters edge was significantly contributing to stability of the steep banks.

The proposed discharge location of Option 2 is also located along the east side of the Squamish River; however, the proposed location is across the bank located on a gravel bar. The gravel bar consists of mostly cobble substrates, a mix of small and large gravels, which were highly embedded in fine sediment. The bank consisted primarily of fine sediment (sand) and silty loam. Fish habitat is limited at this proposed location due to the large amount of fine sediments, and the presence of the gravel bar that is likely dry throughout most of the year. A redd survey was conducted in a 50 m radius around the proposed discharge location, and no active, or previously utilized redds were found. Riparian vegetation at this site was not providing a substantial amount of overhang vegetative cover along the bank since riparian vegetation was set back a few metres from the edge of the channel. However, riparian vegetation was providing the important function of bank stability at this location, preventing the fine material from eroding into the watercourse during high flow conditions.

In addition, there is a non-classified drainage (NCD) present within the existing FortisBC right-of-way, perpendicular to the proposed infrastructure alignment. On the north side of the right-of-way, the aquatic feature has no-visible channel, but develops into a NCD as it approaches the south edge of the right-of way. The NCD drains to the south into an area which is characterized by saturated soil, the presence of skunk cabbage, and hydrophilic vegetation. No wetland assessment was conducted for this area, as it will not be impacted by the installed infrastructure, and is outside of the water discharge outfall location zone of influence.

The proposed discharge location of Option 3 interacts with an existing storm drain and culvert outflow. The estimated flow path is through a channelized area which drains to a swamp-like wetland. This wetland may seasonally drain through a culvert that is installed underneath the Swan Trail North trail located south of the wetland, and out into the estuarine marsh along the eastern edge of the tidal channel. The estimated catchment area and associated swamp wetland consists primarily of fine and silt sediments, with minimal emergent and submergent vegetation. The estuarine marsh consisted of an open water channel dominated by fine sediments and minimal submergent vegetation. In areas outside of the main channel flow, there an abundance of emergent vegetation. Fish habitat was limited for salmonids in these areas due to a lack of coarse substrates.

There was a lack of adequate and continuous flows noted for identified fish species which could be preventing large-bodied fish from migrating up the march channel during normal conditions outside of high flows or flood events. Suitable cover was rare in areas that provided enough depth for fish, as there was only a few occurrences of instream woody debris, there was no emergent vegetation overhanging the main channel and minimal submergent aquatic vegetation within the channel. As a result, the wetland and estuarine marsh may only be suitable to small bodied fish throughout the year. The riparian vegetation extends into the identified wetlands far from the edge of the channel that flows through this area. Riparian species that are present within these wetland communities are described in detail in the wetland section below. In the swamp, riparian species were providing functional value such that overhanging cover and canopy closure were providing shade and cooler temperatures for fish. In the marsh, there was very few late-stage riparian species present near the channel. As a result, there no canopy closure shading and very little overhang cover from mature trees or shrubs. The majority of the cover is being provided by early-stage marsh riparian species.

Due to the high potential of scouring the fine substrates and detritus material in the swamp, and for sediment mobilization downstream, during the proposed discharge activities, it is recommended that that sediment bags be used at the end of the discharge pipe if discharge rates allow for it. Otherwise, the EGP Project could consider the construction of a diversion channel along the road ditch to avoid high velocity water inputs into the swamp. The EGP Project could implement a unique construction design where fish suitable coarse substrates would be used to construct the bed and channel in order to promote migration and provide productive rearing habitat for salmonids.

The design could incorporate the installation of riffle/pool habitat in select areas to reduce the flow velocities of the discharged water prior to entering the marsh wetland to the south. Sections of this channel could be constructed so that during fluctuation of flow and higher water levels, water would infiltrate slowly into the swamp wetland from a few areas of the channel. This design would utilize the existing aquatic hydrology to mitigate flooding, while maintaining a suitable water input to support the natural function of the swamp. Building the channel with these functional features would prevent scouring due to increased flows and would reduce the risk of fine sediment mobilization downstream.

4.3 Wetlands and Riparian Communities

4.3.1 Wetlands

No wetlands occur within proposed water discharge Options 1 and 2.

Option 3 will interact with a high-moderate functioning swamp (WET-BCR-03) (10U 488358E 5507150N) encompassed by the discharge area. The swamp is Red-listed in BC and classified as a Sitka willow – Pacific willow – skunk cabbage swamp (Ws51) (MacKenzie and Moran 2004).

This wetland is W2 according to the *EPMR*, which has a 30 m Riparian Management Area. This swamp is dominated by Sitka willow (*Salix sitchensis*), Pacific willow (*Salix lucida* subsp. *lasiandra)*, skunk cabbage (*Lysichiton americanus*), swamp horsetail (*Equisetum fluvatile*), small-flowered bulrush (*Scirpus microcarpus*), marsh skullcap (*Scutellaria galericulata*) and greater water-moss (*Fontinalis antipyretica*). The total area of the wetland is 1 hectare, and 100 percent of the wetland area is located within the Option 3 catchment area.

4.3.3 Riparian Communities

The discharge locations at Options 1 and 2 adjacent to the Squamish River are riparian communities, characterized by diverse vegetation, such as black cottonwood (*Populus trichocarpa*), Sitka spruce (*Picea sitchensis*), red alder (*Alnus rubra*), western redcedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*, western hemlock (*Tsuga heterophylla*), salmonberry (*Rubus spectabilis*), red-osier dogwood (*Cornus stolonifera*), black twinberry (*Lonicera involucrata*), red elderberry (*Sambucus racemosa*), Sitka willow, sword fern (*Polystichum munitum*) and false lily-of-the-valley (*Maianthemum dilatatum*). These riparian communities are best classified as a Sitka spruce - salmonberry high bench floodplains (site series CWHdm/08) (Green and Klinka 1994). These communities do not have the forest age or structural attributes to be considered an ecological community at risk.

The discharge location at Option 3 is a riparian floodplain community. This floodplain community, surrounding the wetland swamp, is best classified as a black cottonwood - red alder - salmonberry medium bench floodplain (site series CWHdm/09, also known as a flood association Fm50) dominated by black cottonwood, Sitka spruce, red alder, western redcedar, salmonberry, red-osier dogwood, black twinberry, red elderberry, and false lily-of-the-valley (Green and Klinka 1994, MacKenzie and Moran 2004). This community does not have the forest age or structural attributes to be considered an ecological community at risk.

Two estuarine marsh communities are present in the flow path approximately 25 m to the south of the catchment area for Option 3. The Lyngbye's sedge site association (Em05: Red-listed) is present along the tidal channels of the Squamish River Estuary, whereas the Lyngbye's sedge – Douglas' water-hemlock site association (Em06: Blue-listed) is present on the tidal benches, just above the Lyngbye's sedge site association (MacKenzie and Moran 2004). The Lyngbye's sedge site association (Em05) is dominated by a continuous cover of Lyngbye's sedge (*Carex lyngbyei*) located nearest to the tidal channel. The Lyngbye's sedge – Douglas' water-hemlock site association (Em06) vegetation species include Lyngbye's sedge (*Carex lyngbyei*), Douglas' water-hemlock (*Cicuta douglasii*), coast silverweed (*Potentilla egedii*), seacoast angelica (*Angelica lucida*), Douglas' aster (*Symphyotrichum subspicatum*), arctic rush (*Juncus arcticus*), marsh peavine (*Lathyrus palustris*), and seaside arrowgrass (*Triglochin maritima*).

4.4 Vegetation

All three proposed discharge locations lie within the Dry Maritime Coastal Western Hemlock Subzone (CWHdm). The CWHdm climate has warm, relatively dry summers and moist, mild winters. The growing seasons extend from March to October and feature only minor water deficits on zonal sites. Forests on zonal sites in the CWHdm are characterized by Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*), western redcedar, western hemlock (*Tsuga heterophylla*), salal (*Gautheria shallon*), red huckleberry (*Vaccinium parvifolium*), and feathermosses (Green and Klinka 1994).

Option 1 will interact with several non-native, regional priority invasive plant species that are present on the Government Road and the dike, including Scotch broom, yellow hawkweed, St. John's-wort, hairy cat's-ear, common tansy, and cypress spurge. See Attachment 2 for more detail.

Option 2 will interact with a Canada thistle (*Cirsium arvense*) infestation that is present on the east side of the dike. Canada thistle is on Schedule A of the *Weed Control Regulation* (Government of BC 2011). Several other non-native, regional priority invasive plant species are also present along the existing FortisBC right-of-way and Government Road, including Scotch broom, Himalayan blackberry, Allegheny blackberry, yellow loosestrife, yellow archangel, morning glory, St. John's-wort, hairy cat's-ear, common comfrey, common tansy, and cypress spurge. See Attachment 2 for more detail.

Option 3 will interact with Red- and Blue-listed ecological communities. As noted in the previous section, one Red-listed Sitka willow – Pacific willow – skunk cabbage swamp (Ws51) lies within the catchment area and two estuarine marsh communities (Lyngbye's sedge site association [Em05: Red-listed] and Lyngbye's sedge – Douglas' water-hemlock site association [Em06: Blue-listed]) are in the southern extent of the flow path (MacKenzie and Moran 2004).

The estuarine tidal benches are potential habitat for Vancouver Island beggarticks (*Bidens amplissima*), where known occurrences lie on the opposite side of the tidal channel south of the discharge flow path for Option 3. Vancouver Island beggarticks are a Federally listed species of Special Concern on the *SARA* and are Provincially Blue-listed (BC ENV 2021b).

Canada thistle infestations and one yellow iris (*Iris pseudacorus*) population are present along the flow path south of the Option 3 catchment discharge area. Canada thistle and yellow iris are on Schedule A of the *Weed Control Regulation* (Government of BC 2011). Several other non-native, regional priority invasive plant species are also present along Government Road and along the flow path south of the catchment discharge area. See Attachment 2 for more detail.

No Old Growth Management Areas are present within the area. Three western redcedar trees greater than 130 centimetres (cm) diameter (>200 years old) are present in the western portion of the catchment area.

4.5 Wildlife

Interactions of discharged water from the BC Rail Site with wildlife and wildlife habitat are expected to be minimal. Wildlife habitat at the proposed water discharge options consists primarily of riparian trees and shrubs along the Squamish River and within the Squamish River Estuary, which provide habitat for a variety of wildlife species common to Squamish, such as songbirds, waterfowl, raptors, black bear, coyotes, raccoons, and bats.

Options 1 and 2 interact directly with the Skwelwil'em Squamish Estuary WMA (BC MFLNRORD 2021a), where as, Option 3 will only interact with the WMA should the discharged water follow the estimated flow path, south of the catchment area. All three of the proposed water discharge options are located within the Squamish River Area Important Bird Area (IBA) BC-023, which is classified as globally significant for congregatory bird species (Bird Studies Canada and Nature Canada 2021) (see Figure 1). From December through February, this area hosts the largest concentration of wintering bald eagles in Canada, which migrate to feed on spawning salmon.

The Squamish River and upstream habitats provide important overwinter and staging habitat for migratory waterfowl and shore birds, which utilize the grasses and shrubs within the estuarine marsh communities (as described in subsection 3.3.) for nesting and foraging, as is present within the flow path for Option 3, south of the catchment area. Riparian vegetation along the banks of the Squamish River also provides suitable habitat for nesting migratory birds, as is present at the Option 1 and 2 outfall locations.

The catchment area for Option 3 is located in a forested area, with patches of older growth surrounding a wetland swamp (refer to subsection 3.3). Although migratory birds would utilize this forested habitat for foraging and nesting, given the low impact work (that is, no clearing), there are no anticipated interactions with nesting or foraging migratory birds from the discharged water at Option 3.

The wildlife habitat at Option 1 and 2 is limited to a small band of disturbed riparian vegetation between the existing dike and the Squamish River, with canopy cover consisting of red alder and black cottonwood, subcanopy of young big leaf maple, western hemlock and western redcedar, and shrub understory dominated by sworn fern, salmonberry, and red elderberry.

At both Option 1 and 2, the forested shoreline transitions directly into the Squamish River, with no grassy intertidal interface or estuary flats to provide nesting or foraging habitat for waterfowl or shore birds. As such, migratory bird foraging and nesting potential at Option 1 and 2 are low. Songbirds common to the area were observed during the site visit, and included, but were not limited to American robin, savannah sparrow, Swainson's thrush, rufous hummingbird, and white-crowned sparrow.

Mature black cottonwood and big leaf maple trees located near all proposed water discharge options have potential to support nesting bald eagles; however, no stick nests were observed during the June 10 or 12 site assessments and, given the low impact of the work (that is, no clearing), there are no anticipated interactions with raptors.

There is Critical Habitat for marbled murrelet located within the Squamish River Estuary (Government of Canada 2021b); however, it is located over 730 m southeast of the southeast end of the catchment zone from Option 3 and will not be impacted by the discharged water. None of the proposed water discharge options overlap with UWRs (BC MFLNRORD 2021b,c), WHAs (BC MFLNRORD 2021d,e), or known occurrences of wildlife species at risk (BC ENV 2021b). There are no known Great Blue Heron nest colonies or Wildlife Habitat Trees within proximity of any of the three proposed water discharge options (Community Mapping Network 2021a,b).

None of the proposed water discharge options are located within suitable amphibian breeding habitat. At Option 1 and 2, the Squamish River is too large, deep, and fast flowing, with no slow-moving side channels for breeding amphibians. Although a wetland swamp was identified within the catchment area at Option 3, which has some potential to support breeding amphibians common to the area (such as, pacific tree frog or northwestern salamander), there were no amphibians of any life stage observed during the amphibian survey.

There is potential for regionally important wildlife species with special conservation status and their associated habitat to be present in areas surrounding the three proposed water discharge options, including migratory birds (that is, in the Skwelwil'em Squamish Estuary WMA). There is suitable nesting habitat for migratory birds within riparian vegetation along the banks of the Squamish River at Option 1 and 2, where there is potential vegetation disturbance required for the installation and replacement of outfall infrastructure. At Option 3, there is suitable nesting habitat for migratory birds within the tall grasses and shrubs within the estuarine communities south of the catchment. There is no vegetation disturbance activities planned at Option 3; however, there is potential for inundation of active bird nests should discharged water flow south of the catchment area.

4.6 Summary

Table 4-1 summarizes several potential environmental and land use constraints that may be encountered by the Program. Figure 2 provides a visual overview of the potential environmental and land use constraints.

Table 4-1. Land Use and Environmental Constraints

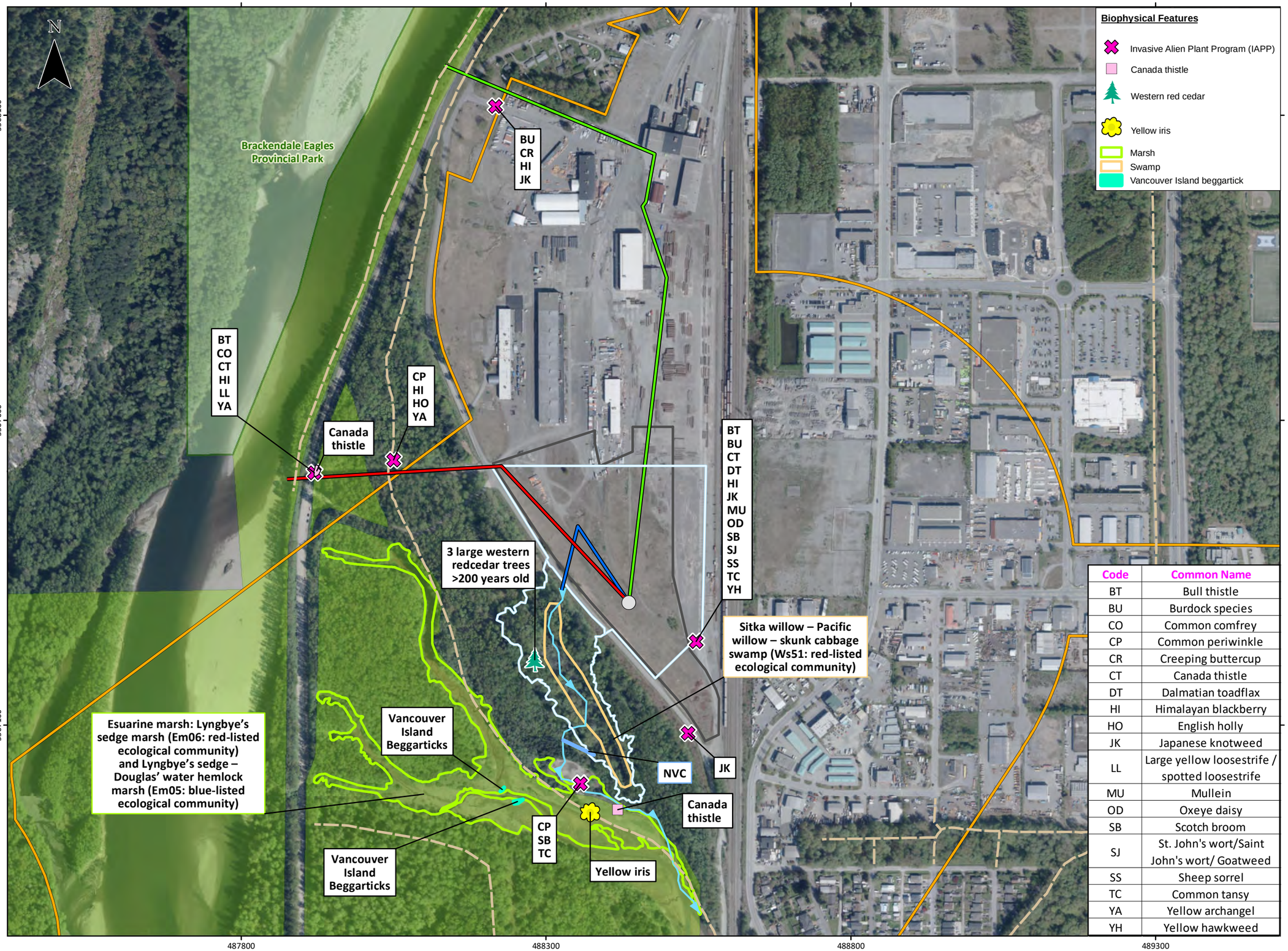
Environmental Receptor	Option 1 BCR Properties Ltd. Northern Outfall	Option 2 FortisBC NPS 10 Natural Gas Pipeline Right-of-Way	Option 3 BCR Properties Ltd. Southern Outfall
Land Use	Existing pipe crosses underneath public walking trail between Squamish River and existing dike.	Proposed pipe would cross public walking trail between Squamish River and existing dike.	Proposed catchment area and flow path would pass through culvert underneath a public walking trail.

Table 4-1. Land Use and Environmental Constraints

Environmental Receptor	Option 1 BCR Properties Ltd. Northern Outfall	Option 2 FortisBC NPS 10 Natural Gas Pipeline Right-of-Way	Option 3 BCR Properties Ltd. Southern Outfall
		Outfall flow would be visible by public walking the sandbar during low tide.	Outfall flow may be visible by public users should it breach the catchment area.
Aquatic Environment	Proposed discharge area is associated with existing outfall infrastructure that drains directly into a deep flowing reach of the Squamish River. There are minimal sedimentation concerns due to existing rip-rap preventing bed scour; however, this area provides important fish habitat values. It is not anticipated that short-term footprint impacts during construction or long-term changes in flow rate due to discharge outfall upgrades will result in a negative impact to fish or fish habitat at this site.	Proposed discharge area with alignment directly onto the gravel bar would be best for this area; however, downstream sedimentation events are likely and will require sediment controls and downstream monitoring for increases in turbidity. Due to the seasonal exposure of the gravel bar, fish habitat is limited in this area to high water conditions during heavy rain events and freshet.	Proposed discharge area and estimate flow path interacts with potentially important aquatic environments, including a swamp wetland and an estuarine marsh, that are likely accessible to all fish at varying life stages that can be found within Squamish River and estuary. The large catchment area associated with the wetlands may allow for sediment to settle which may reduce sediment mobilization into downstream productive fish habitat. Due to the accumulation of loose, deep, and saturated substrates and detritus material in the swamp, any increased flow during discharge activities, may pose a risk for sediment mobilization downstream.
Wetlands and Riparian Communities	No wetland identified. A riparian community is adjacent to the Squamish River at the proposed discharge location.	No wetland identified. A riparian community is adjacent to the Squamish River at the proposed discharge location.	Discharge area will directly interact with high-moderate function Red-listed swamp. Permitting under the *Water Sustainability Act* will be required for wetland disturbance (that is, changes in and about a stream), which can take some months to obtain, depending on what approvals are required as determined through consultation with the provincial regulator and the site-specific activities. The goal of "no net loss" of Wetland Function will be applied to wetlands as per the Federal Policy on Wetland Conservation (Government of Canada 1991; Lynch-Stewart 1992; Lynch-Stewart et al. 1996) on the EGP Project. Potential compensation for wetland loss may be required if permanent disturbance to wetland area or function occurs as a result of the discharge. A riparian community is within the proposed discharge area, surrounding the wetland swamp

Table 4-1. Land Use and Environmental Constraints

Environmental Receptor	Option 1 BCR Properties Ltd. Northern Outfall	Option 2 FortisBC NPS 10 Natural Gas Pipeline Right-of-Way	Option 3 BCR Properties Ltd. Southern Outfall
Vegetation	Several non-native, regional priority invasive species are present on the dike.	Canada thistle infestations are present on the east side of the dike. Canada thistle is on Schedule A of the BC *Weed Control Regulation*. Several other non-native, regional priority invasive plant species are also present.	Discharge area will interact with Red- and Blue-listed ecological communities. • One Red-listed Sitka willow – Pacific willow – skunk cabbage swamp lies within the catchment area. • Red- and Blue-listed estuarine marsh communities are in the flow path south of the catchment discharge area. If discharged water follows the proposed flow path and inundates the wetland in the catchment area and the estuarine marsh communities to the south of the catchment area, there may be impacts to vegetation resources. Canada thistle infestations are present along the flow path south of the catchment discharge area. Canada thistle is on Schedule A of the BC *Weed Control Regulation*. Several other non-native, regional priority invasive plant species are also present along Government Road and along the flow path south of the catchment discharge area. Three western redcedar trees greater than 130 cm diameter (>200 years old) are present in the western portion of the catchment area.
Wildlife	Migratory bird nesting habitat present within riparian vegetation along shoreline of the Squamish River.	Migratory bird nesting habitat present within riparian vegetation along shoreline of the Squamish River and in low shrubs within exiting FortisBC ROW.	Suitable nesting habitat for migratory birds present within the grasses and shrubs within the estuarine marsh communities south of the catchment area.



Code	Common Name
BT	Bull thistle
BU	Burdock species
CO	Common comfrey
CP	Common periwinkle
CR	Creeping buttercup
CT	Canada thistle
DT	Dalmatian toadflax
HI	Himalayan blackberry
HO	English holly
JK	Japanese knotweed
LL	Large yellow loosestrife / spotted loosestrife
MU	Mullein
OD	Oxeye daisy
SB	Scotch broom
SJ	St. John's wort/Saint John's wort/ Goatweed
SS	Sheep sorrel
TC	Common tansy
YA	Yellow archangel
YH	Yellow hawkweed

FORTIS BC

June 2021

FIGURE 2

BC RAIL WATER DISCHARGE OPTIONS BIOPHYSICAL ASSESSMENT

EAGLE MOUNTAIN - WOODFIBRE GAS PIPELINE PROJECT

Water Discharge Options
- Option 1: Northern Outfall
- Option 2: FortisBC ROW
- Option 3: Southern Outfall
- Option 3: Catchment Area
- Option 3: Flow Path (From Outfall)
- East Shaft

Other
- Public Walking Trails
- No Visible Channel (NVC)
- BC Rail Site Lease Area
- Proposed OGAA Application Corridor
- Provincial Park
- Skwelwil'em Squamish Estuary

SCALE: 1:6,000

0 125 250 m

(All Locations Approximate)

JACOBS

JACOBS Project Number CE777000

UTM Zone 10 North, NAD 1983.
Pipeline Application Corridor: Jacobs 8-30-2019 (Revision 15); Existing Pipeline: FortisBC 2012; Options 1,2,3, East Shaft: Jacobs 2021; Tunnel Easement and Workspace: Jacobs, 2020; Canada Thistle, Western red cedar, yellow iris, NVC: Jacobs June 2021; IAPP: BC Gov 4-23-2021; Public Walking Trails: District of Squamish: 6-15-2020; Estuary: BC MFLNRO 2008; Railway: BC MLFNRO 2015 Provincial Park: BC MFLNRO 2008; Existing Transmission Line: BC Hydro; Base Imagery: Atlantic Group 2013; Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present.

Mapped By: SL | Checked By: DJN

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5. Conclusions and Recommendations

Based on the desktop and field investigations, the following conclusions are made:

- **Option 1** – The discharged water at this option would be draining directly into a deep flowing reach of the Squamish River, with minimal sedimentation concerns due to existing rip-rap preventing bed scour and minimal visibility to the public.
- **Option 2** - The discharge water at this option would drain down the shallow, sandy east bank of the Squamish River, and out across a gravel bar. Due to the presence of fines in the substrate of the bank and the gravel bar, downstream sedimentation events are likely to occur and will require sediment controls and downstream monitoring for increases in turbidity.
- **Option 3** - The discharge area at this option will directly interact with high-moderate function Red-listed swamp. Permitting under the *Water Sustainability Act* will be required for wetland disturbance (that is, changes in and about a stream), which can take some months to obtain, depending on what approvals are required as determined through consultation with the provincial regulator and the site-specific activities.

  The goal of "no net loss" of Wetland Function will be applied to wetlands as per the Federal Policy on Wetland Conservation (Government of Canada 1991; Lynch-Stewart 1992; Lynch-Stewart et al. 1996) on the EGP Project. Potential compensation for wetland loss may be required if permanent disturbance to wetland area or function occurs as a result of the discharge.

  Due to the accumulation of loose, deep, and saturated substrates and detritus material in the swamp, any increased flow during discharge activities, may pose a risk for sediment mobilization downstream into productive fish habitat. This option will require sediment controls and downstream monitoring for increases in turbidity.

Table 5-1 summarizes recommendations and proposed mitigation for each of the three proposed water discharge options.

Table 5-1. Recommendations and Proposed Mitigation

Environmental Receptor	Option 1 BCR Properties Ltd. Northern Outfall	Option 2 FortisBC NPS 10 Natural Gas Pipeline Right-of-Way	Option 3 BCR Properties Ltd. Southern Outfall
Land Use	Mitigation related to land use is expected to be minimal for this option as the water discharge uses an existing culvert and is not expected to affect trail access during installation or operations.	The route of discharge for this option crosses multiple public walking trails and the discharge site is clearly visible to the public. Public trail access will need to be managed during culvert installation.	Depending on the level of water flow from the outfall, water may be visible by public users should it breach the catchment area and either flow through the culvert under the public trail or follow the proposed flow path. Public trail access will need to be managed during culvert installation.
Aquatic Environment	If habitat integrity can be maintained and mitigation measures from the Environmental Protection Plan can be implemented, this option is viable from a fisheries perspective. If alterations to the bank are required, then bank stabilization practices should be implemented. The areas of the bank that are undercut should be avoided if possible to ensure that its value to fish as cover habitat is maintained. The planned footprint for the upgrade construction should utilize the area immediately around the discharge outfall where there is existing rip-rap if possible, and avoid placing rip-rap in new areas of the channel below the high water mark. Option 1 is the lowest risk option and preferred for fisheries permitting, The upgrades will require a smaller footprint at the outfall. The Squamish River will be minimally impacted by construction and discharging activities due to available depth, which prevents scour of sediments.	Due to the high risk of bank erosion if riparian vegetation is removed, and the high risk of substrate scour and sediment mobilization downstream, this option is not preferred unless sediment controls can be implemented effectively at all rates of discharge. Option 2 can be considered viable if the works can be designed to mitigate for any sediment mobilization or bank erosion risks. Option 2 may require more extensive planning and will require a more unique outfall design to reduce the potential for sediment mobilization and impacts to important downstream fish habitat. This may extend the regulator review timelines, or require a letter of advice or letter of approval. Authorization from DFO may also be required if sediment risks cannot be mitigated for and there is risk of harm to fish or fish habitat.	Due the high risk of substrate scour and sediment mobilization downstream, this option is not preferred unless sediment controls can be implemented effectively at all rates of discharge, or a diversion channel could be constructed which would contribute to productive fish habitat. Option 3 can be considered viable if the works can be designed to mitigate for any sediment mobilization or bank erosion risks. Option 3 may require more extensive planning and will require a more unique outfall design to reduce the potential for sediment mobilization and impacts to important downstream fish habitat. This may extend the regulator review timelines, or require a letter of advice or letter of approval. Authorization from DFO may also be required if sediment risks cannot be mitigated for and there is risk of harm to fish or fish habitat.
Wetlands	No wetlands identified. Option 1 and 2 are preferred to avoid potential effects to wetlands.		Given the presence of wetland and estuarine communities that are of conservation concern at the proposed discharge location at Option 3, from a wetland perspective, it is recommended to select either Option 1 or 2 to avoid potential impacts to these communities. Option 3 may require more extensive planning and will require a more unique outfall design to moderate water level changes and reduce the potential for sediment mobilization to avoid or reduce impacts to downstream wetland and estuarine communities

Table 5-1. Recommendations and Proposed Mitigation

Environmental Receptor	Option 1 BCR Properties Ltd. Northern Outfall	Option 2 FortisBC NPS 10 Natural Gas Pipeline Right-of-Way	Option 3 BCR Properties Ltd. Southern Outfall
Vegetation	Option 1 and 2 are preferred from a vegetation perspective. If replacement of outfall infrastructure is required and involves vegetation disturbance, then invasive plant species management should be implemented (that is, preventing further introduction or spread of invasive plant species).		If installation of outfall infrastructure involves vegetation disturbance, then invasive plant species management should be implemented (that is, preventing further introduction or spread of invasive plant species) Given the presence of wetland and estuarine vegetation communities that are of conservation concern at the proposed discharge location at Option 3, from a vegetation perspective, it is recommended to select either Option 1 or 2 to avoid potential impacts to these communities. Option 3 may require more extensive planning and will require a more unique outfall design to moderate water level changes and reduce the potential for sediment mobilization to avoid or reduce impacts to downstream Red- and Blue-listed wetland and estuarine communities
Wildlife	If installation and/or replacement of outfall infrastructure is required and involves vegetation disturbance, then nest mitigation should be implemented (that is, scheduling outside of the migratory bird nesting period and conducting pre-disturbance nest sweeps if required).		If installation of outfall infrastructure involves vegetation disturbance, then nest mitigation should be implemented (that is, scheduling outside of the migratory bird nesting period and conducting pre-disturbance nest sweeps if required). If discharged water will flow south of the catchment area and into the grasses within the estuarine marsh, then nest mitigation will also be required to avoid potential inundation of active nests. Releases of large volumes of water should be avoided during the migratory bird nesting season and monitoring may be required.

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Attachment 1
Site Photographs

Discharge Option 1	
	
Photo 1: Looking north along the dike at the Option 1 outfall. Outfall location is to the left, through riparian band of trees (June 10, 2021)	**Photo 2: Looking south along the dike at the Option 1 outfall. Outfall location is to the right, through riparian band of trees (June 10, 2021)**
	
Photo 3: Looking down at existing outfall pipe and rip rap (June 12, 2021)	**Photo 4: Looking down at existing outfall pipe and rip rap (June 12, 2021)**

Photo 5: Looking downstream from outfall location (June 12, 2021)

Discharge Option 2	
	
Photo 6: Looking east along existing FortisBC right-of-way (June 10, 2011)	**Photo 7: Looking west from the dike, out towards the Squamish River, along the sandy banks at the outfall (June 10, 2011)**
	
Photo 8: Looking upstream from discharge location (June 12, 2021). Photo taken closer to low tide	**Photo 9: Looking downstream towards discharge location (June 10, 2021). Photo taken closer to high tide**

Photo 10: Looking down at riverbed. Substrate consists of 50% cobble, and mix of small and large gravel. Marginal fish spawning area due to high amount of silts and fines (June 12, 2021). Photo taken closer to low tide

Photo 11: Looking north along the Riverside Trail, between the dike and the Squamish River (June 10, 2011)

Photo 12: Looking south along the Swan Trail North, where it crosses the FortisBC right-of-way

Discharge Option 3	
	
Photo 13: Looking southwest along Government Road, towards the Option 3 Outfall (June 10, 2021)	**Photo 14: looking south (downstream) at the channelized drainage from the existing storm runoff at the Option 3 Outfall, from Government Road (June 10, 2021)**
	
Photo 15: Looking north (upstream) in the channelized drainage from the existing storm runoff at the Option 3 Outfall (June 12, 2021)	**Photo 16: looking southwest at the wetland swamp downstream of the Option 3 Outfall, within the catchment area**

Photo 17: Looking south at the wetland downstream of the Option 3 Outfall, within the catchment area

Attachment 2
Non-Native Plant Species at Each Proposed Water Discharge Option

Table A2-1. Non-Native Plant Species Detected at Each Discharge Option Location During Field Surveys

Common Name	Scientific Name	Designation Under the BC *Weed Control Regulation*[a]	Regional[b] and Provincial[c] Priority	Location		
				Option 1	Option 2	Option 3
Allegheny blackberry	*Rubus allegheniensis*	--	--		X	
Canada thistle	*Cirsium arvense*	Provincially Noxious	Strategic Control[b]		X	X
common bentgrass	*Agrostis capillaris*	--	Insufficient Information[b]	X		
common burdock	*Arctium minus*	--	Strategic Control[b]		X	
common comfrey	*Symphytum officinale*	--	Strategic Control[b]		X	
common dandelion	*Taraxacum officinale*	--	No action[b]		X	
common evening primrose	*Oenothera biennis*	--	Strategic Control[b]		X	
common foxglove	*Digitalis purpurea*	--	Strategic Control[b]	X	X	
common periwinkle	*Vinca minor*	--	Strategic Control[b]			X
common tansy	*Tanacetum vulgare*	--	Strategic Control[b], Regional Containment/Control[c]	X	X	
creeping buttercup	*Ranunculus repens*	--	No action[b]		X	
curly dock	*Rumex crispus*	--	No action[b]		X	
cut-leaf blackberry	*Rubus laciniatus*	--	Strategic Control[b]		X	X
cypress spurge	*Euphorbia cyparissias*	--	Eradicate[b], Management[c]	X	X	
English holly	*Ilex aquifolium*	--	Contain[b]			X
English oak	*Quercus robur*	--	--	X		
hairy cat's ear	*Hypochaeris radicata*	--	Strategic Control[b]	X	X	
herb Robert	*Geranium robertianum*	--	No action[b]		X	

Table A2-1. Non-Native Plant Species Detected at Each Discharge Option Location During Field Surveys

Common Name	Scientific Name	Designation Under the BC *Weed Control Regulation*[a]	Regional[b] and Provincial[c] Priority	Location		
				Option 1	Option 2	Option 3
Himalayan blackberry	*Rubus armeniacus*	--	Strategic Control [b], Regional Containment/Control[c]		X	X
Japanese quince	*Chaenomeles japonica*	--	--			X
morning glory	*Convolvulus arvensis*	--	No action[b]		X	
musk mallow	*Malva moschata*	--	--		X	
orchard grass	*Dactylis glomerata*	--	Insufficient Information[b]	X	X	
reed canary grass	*Phalaris arundinacea*	--	Insufficient Information[b]	X	X	
red clover	*Trifolium pratense*	--	No action[b]	X		
scotch broom	*Cytisus scoparius*	--	Strategic Control[b], Regional Containment/Control[c]	X		X
sheep sorrel	*Rumex acetosella*	--	No action[b]	X	X	X
St. John's-wort	*Hypericum perforatum*	--	Strategic Control[b]	X	X	
sweet cherry	*Prunus avium*	--	Insufficient Information[b]	X		
sweet vernal grass	*Anthoxanthum odoratum*	--	Insufficient Information[b]	X		
thyme-leaved speedwell	*Veronica serpyllifolia*	--	No action[b]		X	
velvet grass	*Holcus lanatus*	--	Insufficient Information[b]	X	X	
wall lettuce	*Lactuca muralis*	--	No action[b], Provincial Early Detection Rapid Response Program[c]	X		
weeping forsythia	*Forsythia suspensa*	--	--			X
white clover	*Trifolium repens*	--	No action[b]	X	X	

Table A2-1. Non-Native Plant Species Detected at Each Discharge Option Location During Field Surveys

Common Name	Scientific Name	Designation Under the BC *Weed Control Regulation*[a]	Regional[b] and Provincial[c] Priority	Location		
				Option 1	Option 2	Option 3
yellow arch angel	*Lamium galeobdolon*	--	Strategic Control[b], Regional Containment/Control[c]		X	X
yellow flag Iris	*Iris pseudacorus*	Provincially Noxious	Eradicate[b], Regional Containment/Control[c]			X
yellow hawkweed	*Hieracium caespitosum*	--	Strategic Control[b], Management[c]	X		
yellow loosestrife	*Lysimachia punctata*	--	Strategic Control[b]		X	

[a] Designations are assigned to species only if they are Provincially Noxious or Regionally Noxious within the Sea to Sky region.

[b] Regional prioritisations are assigned to species by the Sea to Sky Invasive Species Council (SSISC 2021)

[c] Provincial prioritisations are assigned by the BC Inter-Ministry Invasive Species Working Group (Government of BC 2021)

References

Government of British Columbia (Government of BC). 2021d. Provincial Priority Invasive Species; BC Inter-Ministry Invasive Species Working Group. March 2020. https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/invasive-species/publications/provincial_priority_is_list.pdf

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