

Feasibility Study For:

Dogwood Water System - City of Duncan Water Connection, Cowichan Valley Regional District, BC



Prepared For: **Cowichan Valley Regional District**
175 Ingram Street
Duncan, BC
Attn: Lisa Daugenet

Prepared By:  **CASCARA**
CONSULTING ENGINEERS LIMITED
EGBC Permit No. 1000784

CCEL Project Number: 1050-008

Submitted: July 8, 2024

Revision: 3

Prepared by:
Thomas Amess, P.Eng.

Reviewed by:
Charles Ramos, P.Eng.



A handwritten signature in blue ink, appearing to read "Charles Ramos".

REVISION TABLE

Revision #	Rev. Date	By	Description
1	April 29, 2024	TJA/CDR	Draft Report
2	May 23, 2024	TJA/CDR	Revised Per CVRD Comments
3	July 8, 2024	TJA/CDR	Main Extended

Table of Contents

- 1.0 Background and Scope of Work 1**
- 2.0 Extension Review 2**
 - 2.1 General Considerations 2
 - 2.2 Record Review 3
 - 2.3 Discussions 3
 - 2.4 Water Modeling 4
- 3.0 Recommendations 4**
 - 3.1 Design Drawings 5
 - 3.2 Cost Estimate 6
- 4.0 Conclusions 6**

Appendices:

- Appendix A: Fire Underwriters Survey (FUS) Calculations & Water Model Studies
- Appendix B: Storage Volume Calculations
- Appendix C: Preliminary Drawings
- Appendix D: Preliminary Cost Estimate

1.0 Background and Scope of Work

Cascara Consulting Engineers Ltd. (CCEL) has been retained by the Cowichan Valley Regional District (CVRD) to examine the feasibility of connecting the Dogwood area to the City of Duncan's water supply. The area to be serviced consists of 32 residential lots, 31 of which contain single family homes, and one containing a duplex. The City of Duncan's water currently terminates at a 200mm diameter PVC pipe within Wilson Road and would have to be extended approximately 615m south to the proposed new termination point. The extents of the area are shown in Figure 1.1.

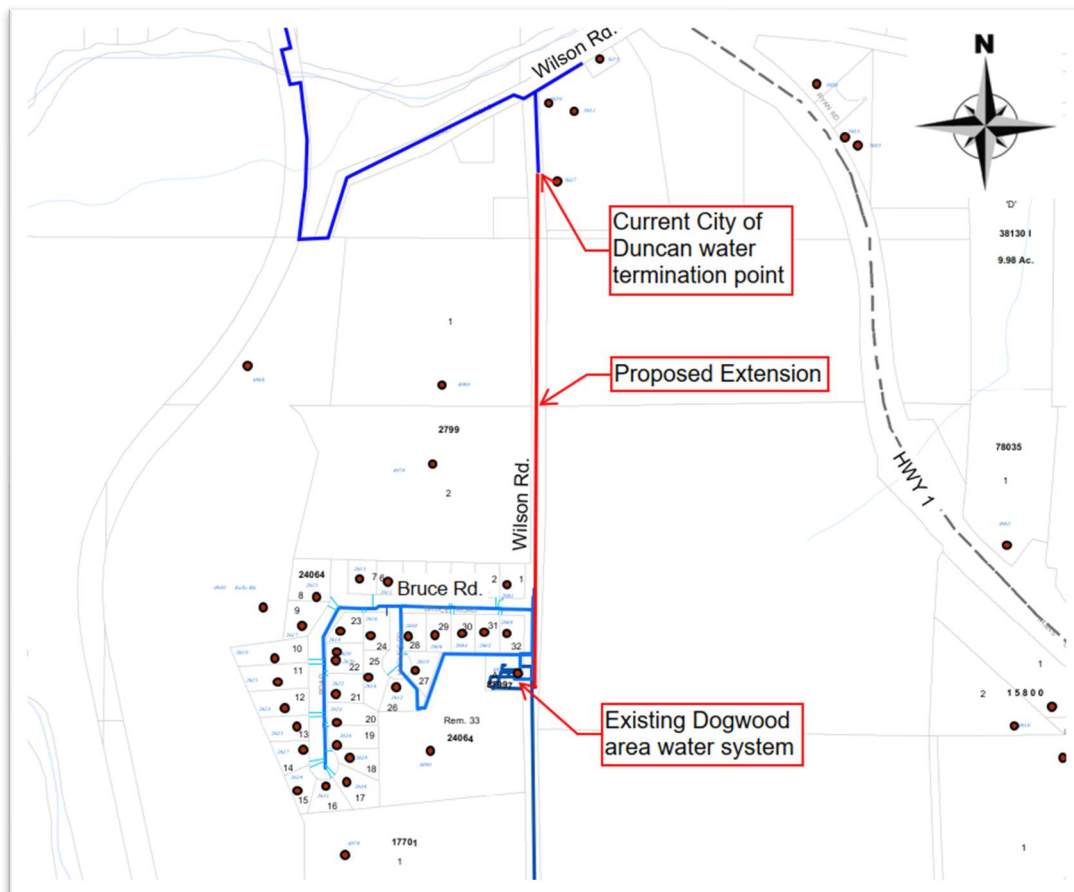


Figure 1: Project Overview

The Dogwood area is currently serviced by well water that is treated and stored in a 227,000 Liter steel reservoir before being pumped throughout the community. Our understanding is that the current well supply is not enough to meet the communities needs in the summer months, reducing domestic water availability and posing potential fire fighting concerns.

The City of Duncan's water supply was previously extended into the Cowichan Tribes land, where a chlorination facility treats the water. The proposed extension would be downstream of this facility.

The main objectives of this study are as follows:

- Determine the requirements to connect the Dogwood area to the City of Duncan's water supply.
- Determine what infrastructure already in place at the Dogwood area can be used.

- Determine the residual chlorine and pressures that would be available from the City water supply to the Dogwood Area.
- Provide design drawings and a cost estimate so that the project can move forward once funding is secured.

2.0 Extension Review

The following sections outline the feasibility of extending the City of Duncan's water supply to the Dogwood area.

2.1 General Considerations

Cross contamination and pressure matching concerns would have to be addressed if the City of Duncan's water supply were to be used in conjunction with the existing well water within the Dogwood area. Direct connection between the two is not advised as backflow prevention and pressure reducing valves would be required, and the City may not accept the connection at all due to these concerns. If both water sources are required, the two water sources could be connected to the reservoir, ensuring the source waters are not mixed and pressures are equalized within the tank. If possible, we advise only using the City's water supply and decommissioning the existing wells. This would also eliminate the need for the chlorination and other treatment facilities in the Dogwood area, allowing for them to be decommissioned.

The City of Duncan's water supply was extended into the Cowichan Tribes land in 2015. As part of this work, a metering/ chlorination station was installed near Miller Road. This should result in sufficient residual chlorine levels at the Dogwood area, although testing would be required to confirm residual chlorine levels meet Island Health's requirements of 1mg/L after construction.

Following the Fire Underwriters Survey (FUS) guidelines, the minimum required storage volume within the reservoir is 1,123,200 liters for fire fighting purposes. MMCD Design Guidelines (2022) specify additional water storage requirements for domestic and emergency use, bringing the minimum required storage volume within the reservoir to 1,421,325 liters. The CVRD mentioned that much of their systems are designed to meet FUS requirements. These numbers can be reduced depending on the rate of recharge in the tank. Calculations are shown in Appendix B.

The Water Supply for Public Fire Protection in Canada specifies that booster pumps must be able to maintain the required fire flows and maximum daily consumption rate at required pressures while the two most important pumps are out of service. Additional requirements are laid out for power and fuel supply for pumps. The existing system consists of three pumps. A review of the pumping capacity was not completed as part of this study, and since pumper trucks would have to be on site to fight fires anyway, they could supply the necessary pumping required if the existing pumps were to fail.

The Dogwood area is approximately 45 meters above Duncan, resulting in a significant reduction in pressure at the Dogwood Area. Wilson Road grades up from the existing main termination point to the Dogwood area at a maximum grade of approximately 10%.

All applicable permitting and approvals will need to be attained prior to construction of the water main extension.

These include, but are not limited to, a Ministry of Transportation and Infrastructure (MoTI) Access Permit, an Island Health Water Supply System Construction Permit, CVRD approvals, City of Duncan approvals, and Cowichan Tribes approvals.

2.2 Record Review

The following record information was available for this study:

- Dogwood area water system record drawings – Provided by the CVRD
- Cowichan Tribes water system record drawings – Provided by the CVRD
- Lidar and Property Lines – Publicly available through the CVRD website
- BC Hydro location schematic – Provided by BC Hydro
- Telus location schematics – Provided by Telus

2.3 Discussions

Extension of the City of Duncan’s water supply has been discussed with both the City of Duncan and Cowichan Tribes representatives.

The CVRD contacted the City of Duncan about the water main extension. We understand that they indicated a general agreement to the project, and 110-120 psi of pressure at Polkey Road, where the City’s watermain crosses from City property to Cowichan Tribes Lands. The City also indicated that there appears to be adequate water supply to service the Dogwood area, and water modeling would be required.

Further discussions between the City of Duncan, the CVRD, and Cascara took place on February 26, 2024. Water modeling had shown that the existing flow capacity would not be enough to provide fire flows, as outlined in section 2.4. It was discussed that the best option would be to use the City water to fill the existing reservoir in the Dogwood area, using its capacity to provide the necessary water for fire flows, and the existing booster pumps to provide appropriate flows and pressures. The CVRD indicated that the existing reservoir and booster pumps are in good condition. The City again indicated that they were generally in support of the project and that they had excess capacity in their system for the proposed work.

The City explained that they currently have a bulk water agreement with Cowichan Tribes and a meter tracks the water usage before entering the Cowichan Tribes chlorination building. A new agreement would have to be made between the CVRD and either Cowichan Tribes or the City, or the existing agreement would have to be revised, depending on how the agreements are written up. The City will also require service connection fees on a per lot basis; these are currently \$3,000.00 per lot.

The CRVD has contacted Cowichan Tribes about the water extension. We understand that they were generally in support of the project and were interested in the possibility of the project providing service to their properties on the East side of Wilson Road, and south of the Dogwood area. The water models, explained in section 2.4, did not include these connections, but it is likely that connecting to these properties would require additional storage tanks and booster pumps to be feasible. The CVRD indicated that they would engage in further discussions with Cowichan Tribes to explain the low pressures available for future service connections to their lands, discuss next steps, and work out a servicing agreement.

2.4 Water Modeling

Water modeling studies were completed by the City's modeling consultant to confirm the available flows and pressures that would be available to the Dogwood area after connecting to the City water supply. The City required that these model studies be completed before confirming their support for the project.

Fire flow calculations were completed based on the "Water Supply for Public Fire Protection" (Fire Underwriters Survey, 2020) guidelines. The calculations were completed for 2620 Bruce Road, as this is the largest building and is within close proximity to other buildings in the area, representing the highest fire flow requirement in the area. The resulting fire flow requirements were found to be 156L/s.

The water model indicated that 82.5L/s of flows are currently available at the main's current termination point, and 43.9L/s of flow would be available if the 200mm main were extended to the Dogwood area. The extra flows would also result in reduced fire flow availability in the upstream sections of the existing main. Various pipe sizes were examined for the extension, and upgrades to the existing mains were modeled. It was found that only extensive upgrades to the existing mains would result in the required fire flows to the Dogwood area.

An additional water model study was completed at the CVRD's request to examine the results of 100mm diameter water main extension being installed to connect the Dogwood Area. The model showed that 2.0L/s of flow and 40psi would be available at the Dogwood area in this scenario.

The fire flow calculations and water model studies are included in Appendix A.

3.0 Recommendations

Based on the available information at this stage, we recommend the following with regards to connecting the Dogwood area to the City of Duncan's water supply.

Since it is not feasible to provide the required fire flows to the area by connecting to the City water supply alone, we recommend that a reservoir be used to provide storage and booster pumps be used to provide the necessary pressures to the area. Following the Fire Underwriter Survey guidelines, the calculated fire flows of 156L/s should be available for a period of 2 hours. Under the assumption that there are 33 homes in the area and the average home houses 2.8 people, the resulting water requirements over 2 hours is 1,123,200L. These calculations are based on the current buildout of the area and would increase if further development and additional water services are added to the system in the future.

We recommend that a new 200mm main be installed to the dogwood area, which would provide a recharge rate to the reservoir of 43.9L/s. As outlined in the model studies, smaller pipe sizes significantly reduce the recharge rate available, and larger pipes provide little improvement to available flows.

Given the limited budget and immediate need to improve water availability to the area, we recommend connecting the City of Duncan's water supply to the existing reservoir and continuing to use the existing booster pumps. The 200mm pipe should be extended to the reservoir.

A second phase of upgrades are recommended which would involve upgrading the existing 75mm and 100mm pipes between the phase one upgrades and the reservoir to 200mm to meet flow requirements. Including the recharge rate provided by a 200mm pipe, the existing system would provide 543,080L of water over the 2 hour fire flow duration, and a more reliable water source to the area.

It is recommended that additional reservoir storage be added when funding is available to meet the required fire flows outlined in Appendix B. The existing booster pumps should also be looked into to ensure they meet current standards.

In order to avoid cross contamination of water sources, the existing wells should be decommissioned. Once the City water connection is complete, and residual chlorination levels can be confirmed, the existing chlorination facility for the area can be decommissioned as well.

Although the City did not provide any requirements for the proposed extension of their system, we anticipate that they will require a reduced pressure backflow valve be installed before the reservoir to ensure there is no concern of back contamination in their system. A meter chamber will also have to be installed to track water usage. Any additional City requirements will have to be confirmed through final design approval.

The existing water system within the dogwood area was not examined as part of this study, but it is not anticipated that any upgrades will be needed beyond those required to connect to the City supply, and to decommission the existing wells and chlorination facility.

3.1 Design Drawings

A preliminary design for the watermain extension is shown in Appendix C, showing the general scope of work that is expected for the phase 1 work at this time. More detailed design drawings can be prepared after a topographic survey is completed and further comments are provided by the CVRD, City of Duncan, and Cowichan Tribes. The available record drawings for the Dogwood area do not align with legal lines available through the CVRD GIS site and will have to be confirmed through the survey.

The current watermain terminates in the East shoulder of Wilson Road. Based on the information currently available, there does not appear to be enough space in the shoulder between utility poles, the road, and private properties to extend the main along this shoulder. To minimize disturbance of the MoTI owned road, and restoration costs, the most feasible alignment for the extension appears to involve crossing to the West shoulder of the road, and following it down to the Dogwood area. Survey will be required to confirm these and other potential constraints.

The reservoir currently has a 100mm PVC inlet pipe. At this stage it is proposed that a short section of the 100mm pipe would remain at the reservoir inlet to avoid retrofitting of the reservoir, connected to the new main with a reducer. A meter chamber and reduced pressure back flow valve is proposed before the reservoir connection. The final configuration of the inlet connection will be determined in detailed design.

Using publicly available lidar data, an approximate profile was determined for the proposed main. The maximum grades appear to be under 10%. At these grades no trench dams would be required as part of the main installation.

There will be a high point in the proposed main where an air valve will have to be installed and a low point at the end of the extension will require a flush out. New fire hydrants are proposed to be installed at a maximum of 150m spacing to meet MMCD guidelines. These hydrants would have reduced flows to those typically expected from a hydrant due to the reduced pressures at this location. We recommend that this information be relayed to the local fire department.

3.2 Cost Estimate

A class C cost estimate is shown in Appendix D based on the drawings and assumptions explained in this report. The total construction costs were estimated to be \$453,840.00, which equates to approximately \$737.95 per meter of pipe installed, including the new meter chamber installation.

4.0 Conclusions

Improvements to the Dogwood area's water system are greatly needed and can be accomplished by connecting to the City of Duncan's water supply, although additional consideration is required to meet fire and domestic water supply standards.

The elevation of the dogwood area, above the City of Duncan's water system, means that extending the existing system to the Dogwood area would result in fire flows not being met by a direct connection alone. For the required flows to be met, a reservoir and booster pumps are required. Connecting to the reservoir and booster pumps currently in place would greatly improve available water flows to the area although fire flow requirements would not be met.

Given the severe need for water to the area and limited funding available, connecting the City's water supply to the current infrastructure in the Dogwood Area is recommended as a minimum first stage of improvement. To meet the standards for fire flows, additional pipe upgrades and a larger reservoir would be necessary, and the existing booster pumps should be examined to ensure they meet fire flow requirements. Opportunities to implement these upgrades should be explored after establishing a more reliable source of water by connecting to the City's system.

Appendix A

Fire Underwriters Survey (FUS) Calculations & Water Model Studies



April 2, 2024
City of Duncan
1091 Marchmont Road Duncan, BC
V9L 2M8

Attention: Mr. Chris Desautels, Manager of Engineering

**Subject: Wilson Rd Watermain Extension to Dogwood Properties – Water Study R1
WSP Project #: 181-02790-00 - Phase 42**

Dear Sir:

The City of Duncan has provided information to complete a water study for a watermain extension between the existing City of Duncan water system termination point on Wilson Road and the existing Dogwood Properties Water system at Bruce Road and Hughes Road. The existing development consists of 32 single family residential lots with homes ranging between 1 and 2 storeys supplied by a well. The first proposed extension would entail approximately 520m of new 200mm PVC pipe to connect the existing Dogwood water system to the City's network and abandon the current well source. *This report has since been revised to include the resulting available flows at the Dogwood connection point with a proposed 520m extension of 100mm PVC.*

The Owner's Engineer has provided the attached Fire Underwriters Survey Calculation with a maximum required fire flow of 156 L/s (2059 IGPM). This was calculated for the building at 2620 Bruce road as it represents the highest fire flow requirement in the existing development. The City of Duncan Works and Services Bylaw No. 3158 Schedule B indicates fire demands for Single Family Residential buildings shall not be less than 60 L/s (792 IGPM).

The following criteria were used to evaluate the available fire flows in this area:

- The water model was run with supply being provided from the Gibbins and Eagle Heights reservoirs with Gibbins Road fire pump and well supply pump stations 3 & 4 operating.
- The water model was run simulating Maximum Day Demand (MDD). Per the latest City of Duncan water consumption data (2019), the measured MDD in the water system was estimated to be 152 L/s.
- Fire flows are provided during system MDD demand and the minimum system residual pressure is 20 psi. The maximum velocity permitted during MDD plus fire flow is 4.0 m/sec.
- The maximum flow that a single hydrant can provide is typically 75 to 80 L/s.
 - Note: The City of Duncan Fire Department operates 3 pumper trucks capable of supplying 120L/s.
- The model was developed using SI units.

A Fire flow 150L/s was used to determine the capacity of the existing system along with the criteria noted above for this water model simulation. Per FUS Water Supply for Public Fire Protection 2020, the total required fire flow should be rounded to the nearest 1,000 L/min, making the total required fire flow 150 L/s (9,000 L/min) rather than the owners calculated fire flow of 156 L/s. Results were as follows:



- Running the model under existing MDD and Fire Flow conditions showed that the fire flow required is not available within the proximity of the site (at the end of the existing termination point on Wilson Rd).
 - Fire Flows available at this point show only 82.5 L/s.
- System capacities were reviewed when 520m of 200mm PVC pipe was modeled as an extension from the termination point leading to a new node (Dogwood) representing the existing subdivision at an elevation of 58m. This results in:
 - Only 43.9 L/s available at the existing Dogwood subdivision
 - Significantly reduced fire flows in the upstream pipes are observed in the south end of the existing Duncan system as a result of the Dogwood connection. The relatively high elevation of the subdivision limits available fire flow to existing buildings, as a minimum residual of 20 psi is required at the Dogwood connection during fire flows (82.5 L/s at the termination point reduces to 49.3 L/s)
- Under this scenario, the model indicates the required fire flow of 150 L/s is not achievable with pipe velocities and pressures within the acceptable range.
- A number of alternate scenarios were run in the model to determine the available fire flows at the new node representing the connection to Dogwood with all pipes within velocity constraints and nodes above residual pressure requirements, as outlined below:

<i>Scenario</i>	<i>Available Fire Flow</i>	<i>Node</i>
<i>Termination at Wilson</i>	82.5 L/s	J-1734
<i>520m extension (200mm), Wilson termination to Dogwood</i>	43.9 L/s	Dogwood
<i>520m extension (250mm), Wilson termination to Dogwood</i>	47.3 L/s	Dogwood
<i>520m extension (300mm), Wilson termination to Dogwood</i>	48.4 L/s	Dogwood
<i>Up-size 1,173m of watermain to 250mm, Dogwood to south of Koksilah River crossing</i>	54.9 L/s	Dogwood
<i>Up-size 1,173m of watermain to 300mm, Dogwood to south of Koksilah River crossing</i>	61.3 L/s	Dogwood
<i>Up-size 1,770m of watermain to 300mm, Dogwood to Miller Rd.</i>	79.5 L/s	Dogwood
<i>Up-size 2,088m of watermain to 300mm, Dogwood to Polkey Rd.</i>	103.8 L/s	Dogwood
<i>Extensive offsite infrastructure upgrades (looping, extensive up-sizing to 300-400mm per attached schematic)</i>	~150 L/s	Dogwood

Model results show that accommodating a fire flow of 150 L/s is not feasible at this location as a result of the long dead end and relative elevation of the site. Extensive infrastructure upgrades would be required to facilitate a connection to this development supplying fire flows of 150 L/s, such as looping the system within the vicinity (likely adding a segment at Miller Road or along Trans Canada Highway) and up-sizing the entire upstream network from the proposed connection point (likely to Polkey Road) with 300-400mm infrastructure.

NOTE: The FUS simple method for calculating required fire flows for one and two family dwellings exceeding 450 m² (FUS Table 8) requires 6,000 L/min (100 L/s). Should the largest building actually be less than 450 m², the suggested fire flow is 3,000 L/min (50 L/s) (FUS Table 7), while the minimum requirement per the City of Duncan Works and Services Bylaw for buildings in this development is 60 L/s.



[April 2, 2024 Update] Per the revised request from the City of Duncan (in email correspondence 2024-02-29), a new model scenario was run with a 520m extension of 100mm PVC from the existing system to the Dogwood connection point. The available pressure and flows at this node are shown in the attached hydrant flow curve. The owners engineer should review this data to determine if existing facilities are adequate or if upgrades are required to support the Dogwood development. The available flow at the end of a 100mm line extending to the Dogwood area would be approximately 2.0 L/s at the standard minimum pressure of 40 psi.

We have attached line diagrams for existing MDD plus available fire flow at the existing termination point and at the extension to Dogwood in addition to a map showing possible infrastructure upgrades to achieve 60 L/s and 150 L/s fire flow at Dogwood. We have also attached a line diagram showing the 100mm extension to Dogwood scenario with observed pressures at MDD.

Based on the requested fire flow of 150 L/s (or 156 L/s) and the above assumptions, the water model simulations indicate that the existing system will not support this development being connected to the City of Duncan water system without significant upgrades to the existing water infrastructure. Should the expected fire flows be revised to 60 L/s or 100 L/s, the flows are still not readily available in the project vicinity. However, it appears 48 L/s could be achieved more manageably. Nevertheless, this connection will result in overall lower available fire flows in the south Duncan area.

If you have any questions or require further information, please feel free to contact the undersigned.

Best Regards,

Ayden Martin, EIT.
Junior Engineer

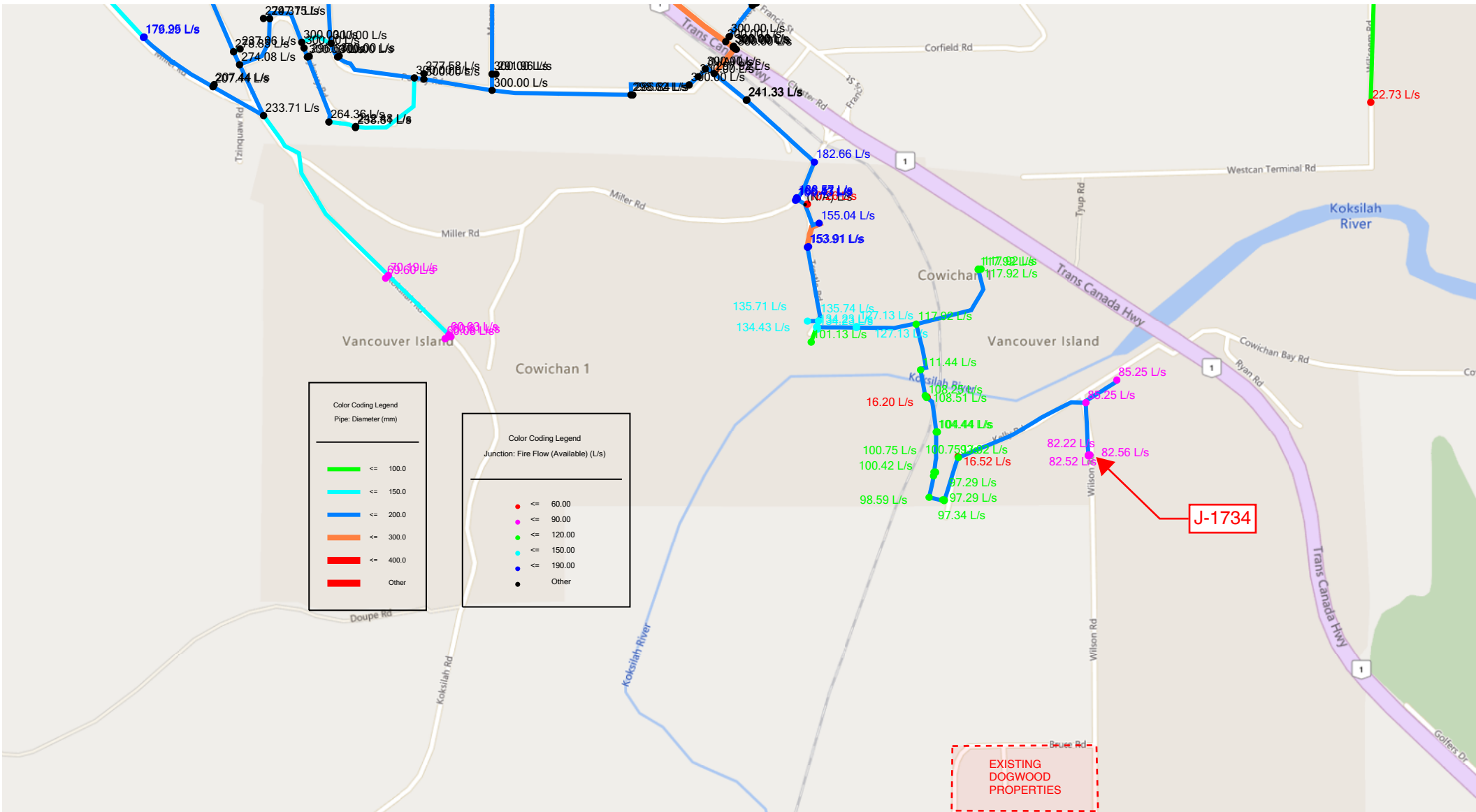
Reviewer,



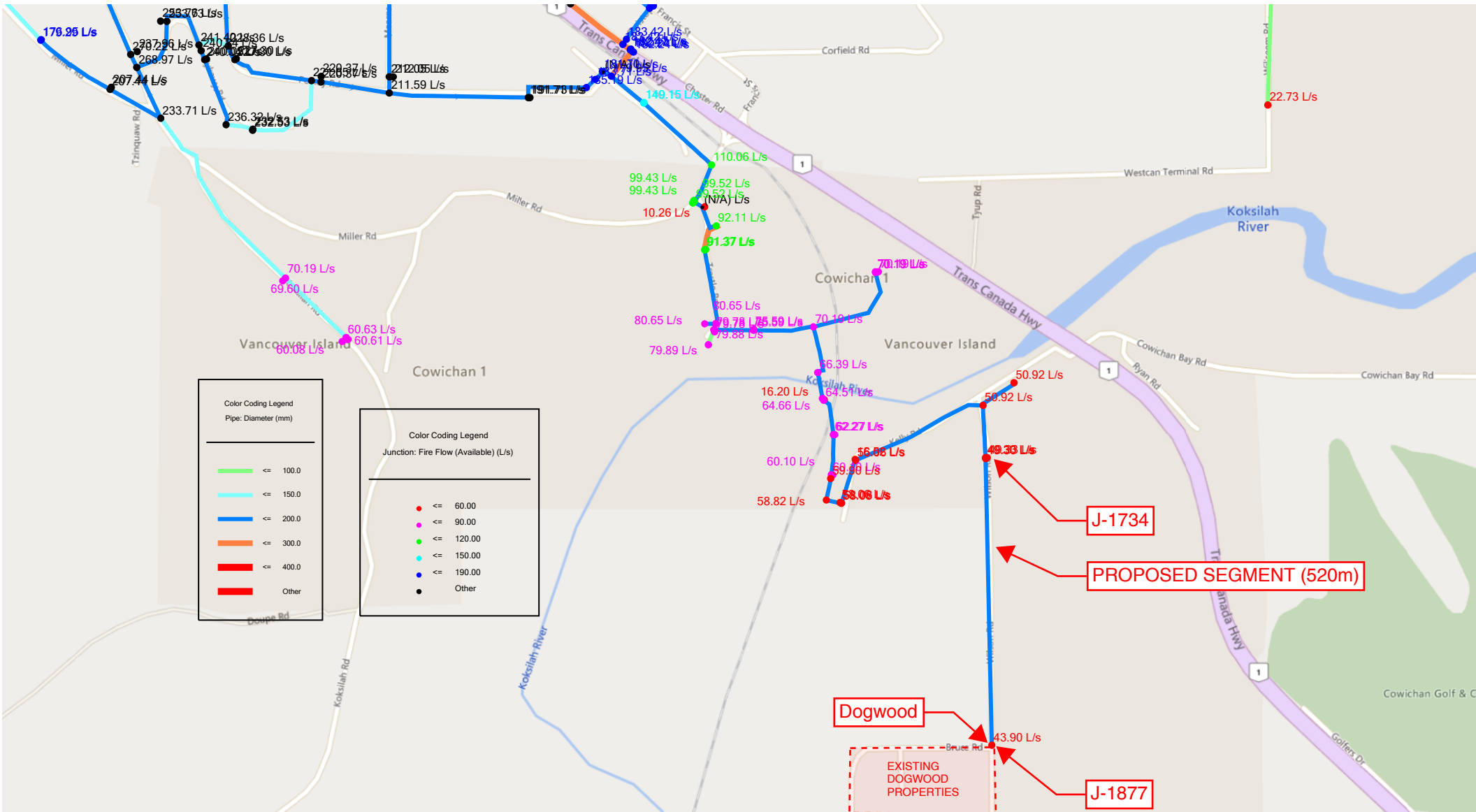
Jeff Somerville, P. Eng
Project Manager

Engineers and Geoscientists BC
Permit to Practice #1000200

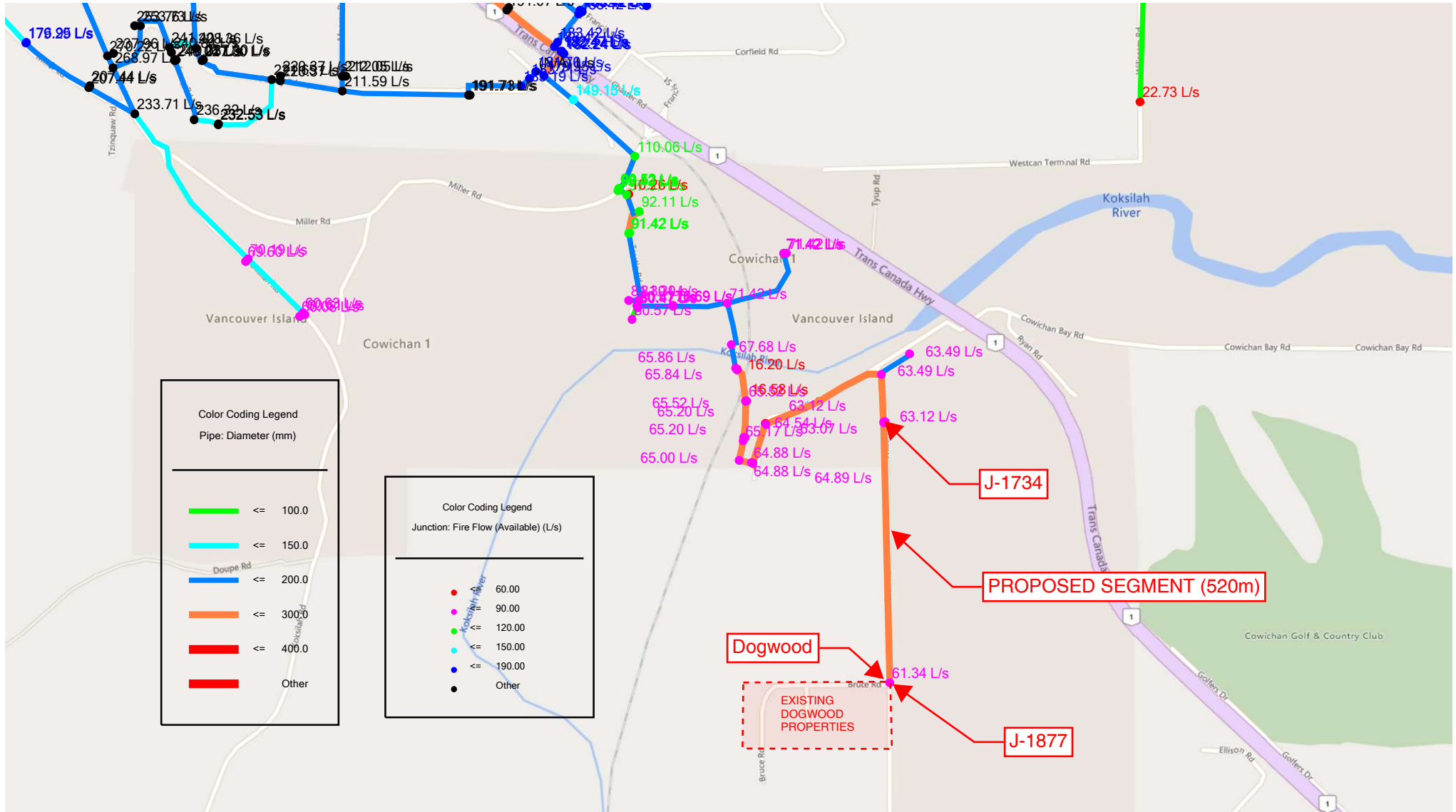
Scenario: MDD+FF AVAILABLE FIRE FLOW - EXISTING SYSTEM



©2017 HERE © 2017 Microsoft Corporation



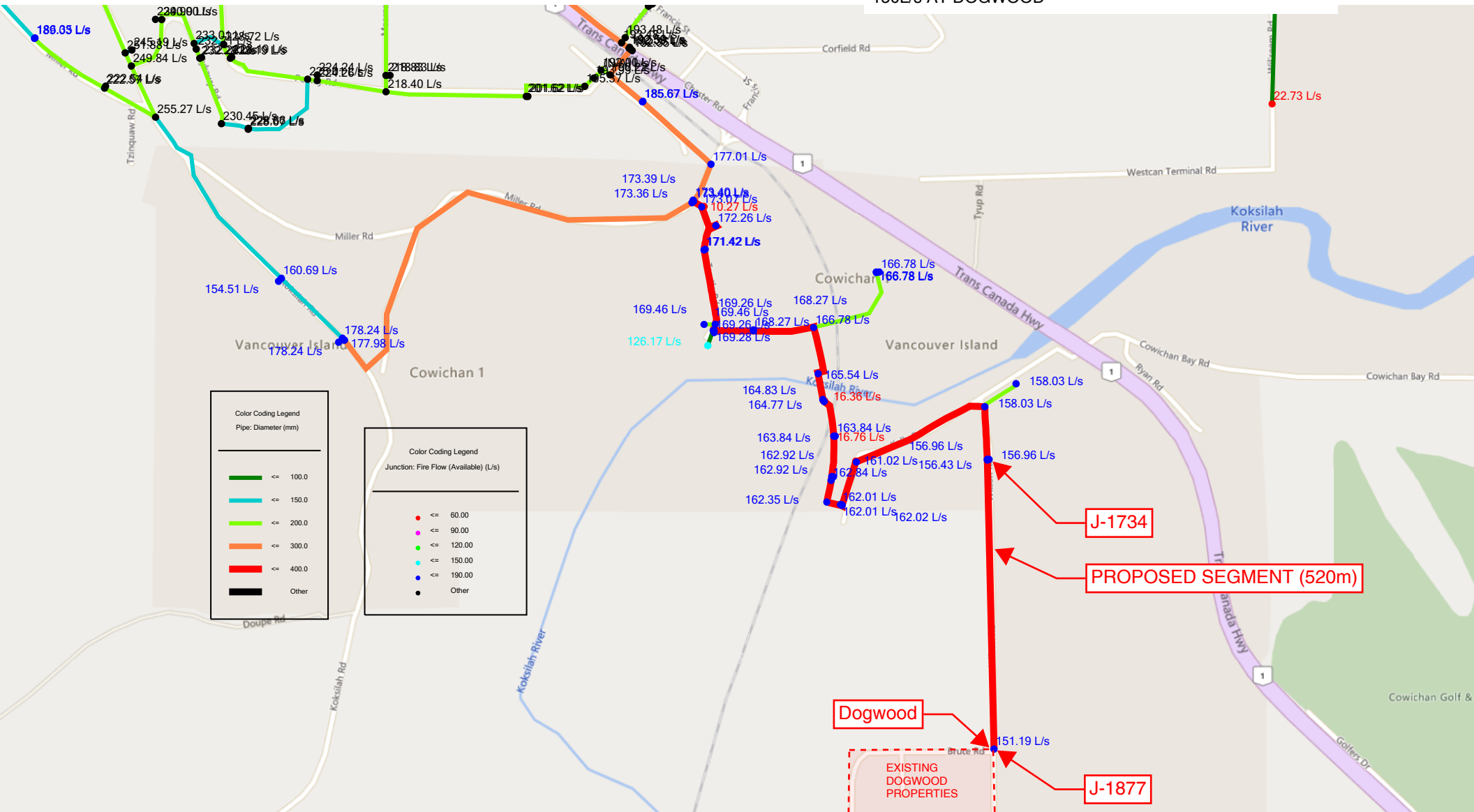
Scenario: MDD+FF 1173m OF 300mm TO ACHIEVE 60L/s AT DOGWOOD



©2017 HERE © 2017 Microsoft Corporation

Scenario: MDD+FF

EXTENSIVE INFRASTRUCTURE UPGRADES TO ACHIEVE
150L/S AT DOGWOOD



©2017 HERE © 2017 Microsoft Corporation

Water Study / Fire Flow Analysis Application

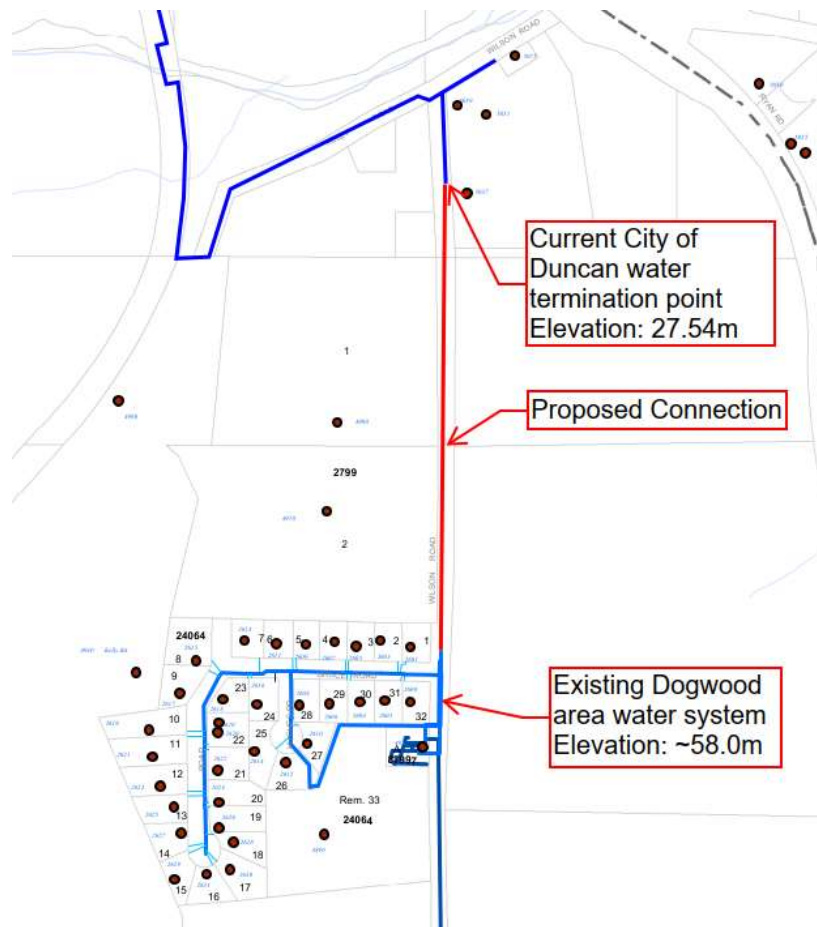
Project Description

The attached water study/ flow analysis application is being submitted as a preliminary check to determine available flows from the City of Duncan's water supply for potential connection to the dogwood area, within the Cowichan Valley Regional District.

A previous study was completed here for a 200mm extension, but this application is to model a 100mm extension.

The current watermain extends into the Cowichan Tribes First Nation and terminates at the north side of Wilson Road. The proposed extension would entail approximately 420m of new 100mm PVC pipe to connect to the existing water system in the Dogwood area, servicing 32 residential lots, replacing the current well source.

Below is a map showing the existing main locations and proposed work.



The attached fire flow calculations were calculated for 2620 Bruce Road, the largest building, located in a central area, close to neighbouring properties to represent the highest fire flow requirement.

FIRE UNDERWRITER'S SURVEY - WATER SUPPLY CALCULATION

Project Dogwood Water Extension
 Address Bruce Rd & Highes Rd Properties
 Building# (if multiple Bldgs) 2620 Bruce Road

Fire flow demands for the FUS method is based on information and guidance provided in "Water Supply for Public Fire Protection" (Fire Underwriters Survey, 2020)

Estimated required fire flow is based on the following formula **RFF = 220 x c x a^{0.5}** where: f= Required fire flow (L/min)
 c= Construction Coefficient
 a= Total gross floor area (m²)

A. Type(s) of Construction	<u>Type V</u>	Const. Coefficient (c)	<u>1.5</u>
c = 1.5 Type V: Wood Frame (structural elements entirely or partially wood) 0.8 Type IV-A: Mass Timber Const. (Encapsulated Mass Timber Construction with 2hr fire rating for structural elements and 1hr fire rating for roof) 0.9 Type IV-B: Mass Timber Const. (Rated Mass Timber with all structural elements having 1hr fire rating) 1.0 Type IV-C: Mass Timber Const. (Ordinary Mass Timber with exterior walls made of mass timber with 1hr fire rating) 1.5 Type IV-D: Mass Timber Const. (Un-Rated Mass Timber when exterior walls do not have fire rating) 1.0 Type III: Ordinary Const. (when exterior walls are masonry with 1hr rating with interior elements with no fire rating) 0.8 Type II: Non-Combustible Construction (all structural elements are made of non-combustible material with 1hr fire rating) 0.6 Type I: Fire Resistive Construction (all structural elements are made of non-combustible material with 2hr fire rating)			

B. No. of Stories	<u>2</u>	Notes: If c = 1.0 to 1.5:	
1st storey (L0)	<u>350 m²</u>		- 100% of all floor areas to be used
2nd storey (L1)	<u>350 m²</u>	If c < 1.0 with unprotected vertical openings:	
3rd storey (L2)	<u>m²</u>		- Two largest adjoining floors + 50% of floors above up to 8
4th storey	<u>m²</u>	If c < 1.0 with protected vertical openings:	
Total Floor Area (a)	<u>700 m²</u>		- Largest floor + 25% of two adjoining floors

C. Initial Required Fire Flow (RFF)	<u>9000 L/min</u>	
-------------------------------------	-------------------	--

D. Occupancy :	<u>Limited Combustible</u>		
add/subtract:	<u>-15%</u>	<u>-1350 L/min</u>	-25% Non-Combustible Content
Adjusted RFF:		<u>7650 L/min</u>	-15% Limit Combustible Content
			No Charge Combustible Content
			+15% Free Burning Content
			+25% Rapid Burning Content
			Note: Refer to Table 3 in 2020 FUS guide for direction

E. Automatic Sprinklers (Y/N)	<u>N</u>		
Credit:	<u>0%</u>		
Adequate Water Supply (Y/N)	<u>N</u>		
Credit:	<u>0%</u>		
Fully Supervised System (Y/N)	<u>N</u>		
Credit:	<u>0%</u>		
Building in Community Level Fire Protection Area (Y/N)	<u>N</u>		
Credit:	<u>0%</u>		
Total Sprinkler Credit:	<u>0%</u>	<u>0 L/min</u>	

F. Exposures	Exposure Dist. (m)	Const. Type	Length-Height Factor	Exposure Adjustment	
North Face	<u>13</u>	<u>Type-V</u>	<u>28</u>	<u>11%</u>	
West Face	<u>>30m</u>	<u>Type-V</u>	<u>50</u>	<u>0%</u>	
East Face	<u>>30m</u>	<u>Type-V</u>	<u>50</u>	<u>0%</u>	
South Face	<u>11</u>	<u>Type-V</u>	<u>28</u>	<u>11%</u>	
Total Exposure Adjustment				<u>22%</u>	<u>1683 L/min</u>

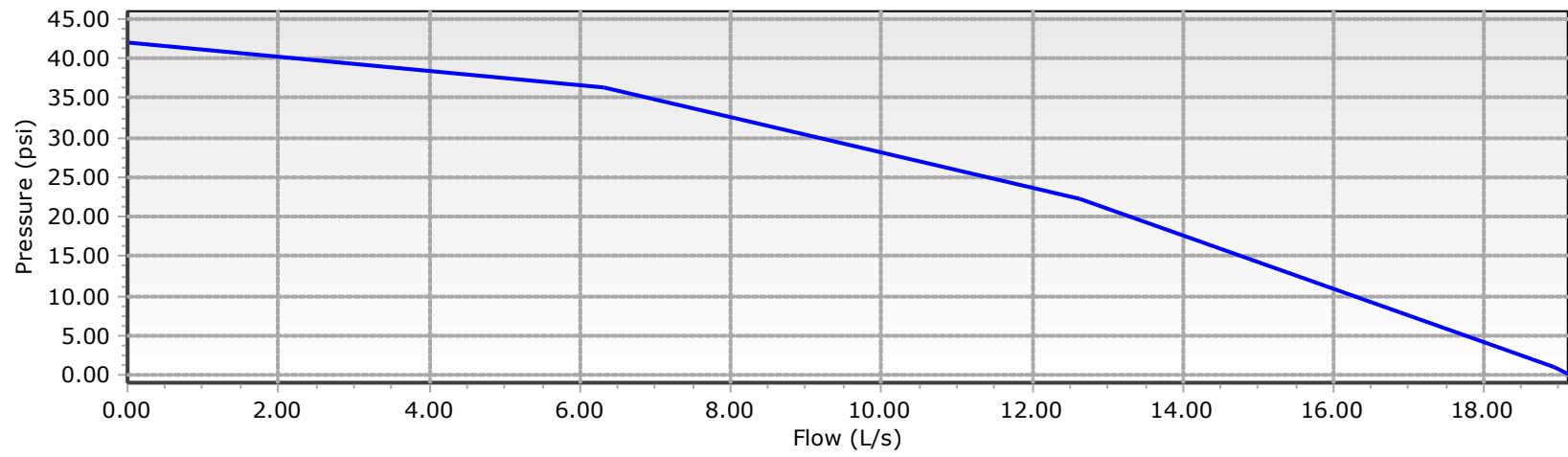
Notes:
 -Info entered is for exposed building | * exposure adjustment 0% (both buildings sprinklered)
 -Exposure adjustments from Table 6 in 2020 FUS guide | ** Exposure adjustment 50% of table value (exposed building sprinklered)

G. **Final Required Fire Flow (D + E + F) :** 9333 L/min
 (156 L/s)

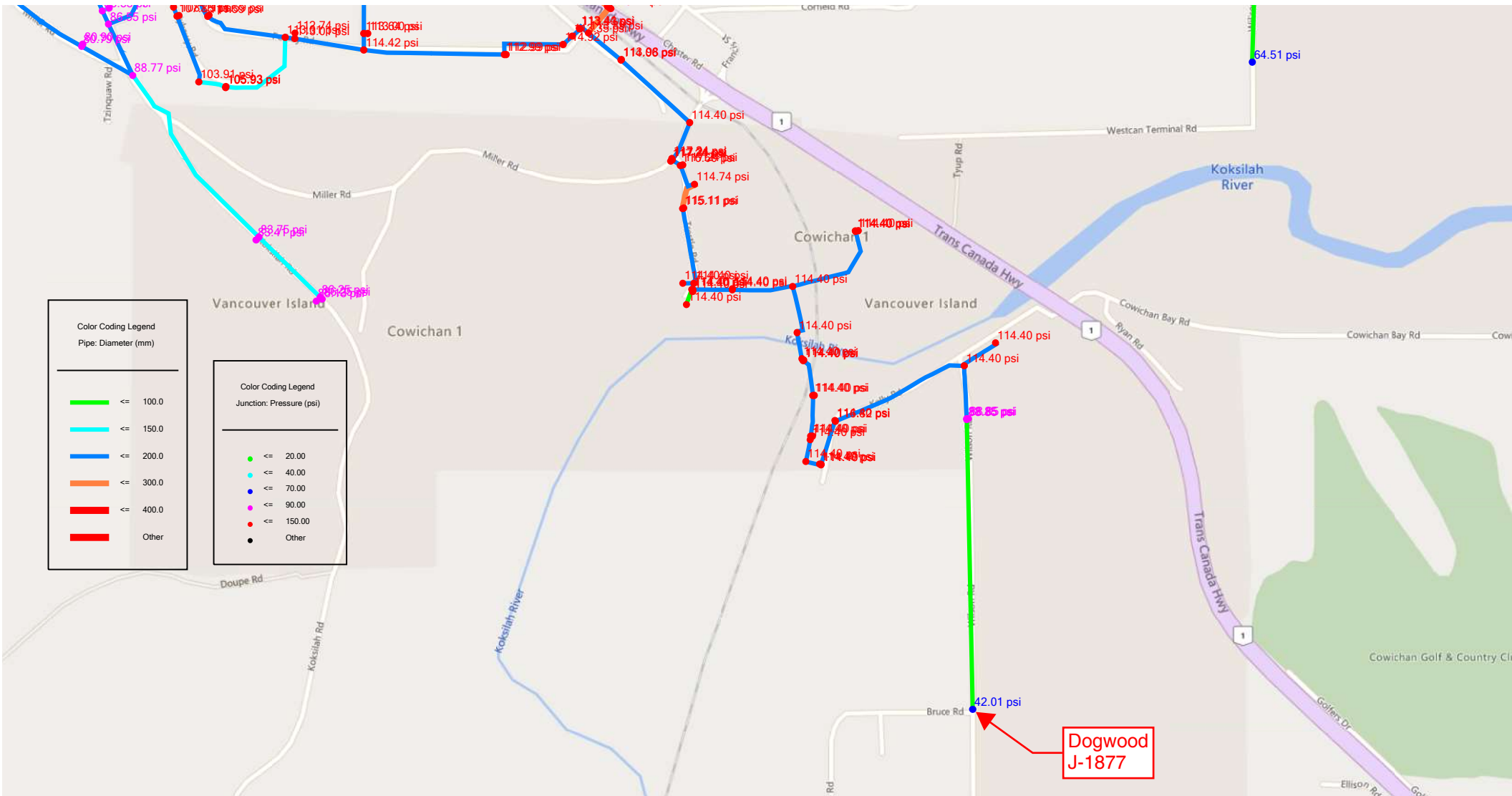
Calculations By: Thomas Amess, P.Eng
 Signature: _____
 Date: _____



Hydrant Flow Curve - J-1877 (Dogwood)



Scenario: MDD



Appendix B

Storage Volume Calculations

STORAGE CALCULATION SUMMARY FOR FIRE FLOW REQUIREMENTS

Project	Dogwood Water Extension
Project #	1050-008
Date	April 26, 2024
Calculations Prepared by	Thomas Amess, P.Eng.

Reservoir Capacity Requirements

MMCD Capacity Equation:

$$V_s = A+B+C$$

Where

Vs= Total Volume of Water Required

A= Fire Storage (From FUS Guide)

B= Equalization Storage (25% of Maximum Day Demand)

C= Emergency Storage (25% of A+B)

FUS required fire flows:	156 L/s	9360 L/min
Required Fire Flow Duration from FUS guide:	2 hr	
Required fire storage (A):	1,123,200 L	

Number of Homes:	33
Average People Per home:	2.8
Equivalent Population:	92.4 People

Maximum Day Demand (From MMCD):	MDD = 600L/capita/day
	55,440 L/day

Equalization Storage (B):	13,860 L
Emergency Storage (C):	284,265 L

Total Storage Required (Vs): 1,421,325 L

Reservoir Sizing

Existing Reservoir Size 227,000 L

Pipe Size (From Model Study)	Recharge Rate (L/s)	Recharge Equivalent Storage (L)	Total Equivalent Storage (L)	Remaining Storage Required (L)
100	2	14400	241,400	1,179,925
200	43.9	316080	543,080	878,245
250	47.3	340560	567,560	853,765
300	48.4	348480	575,480	845,845

Appendix C

Preliminary Drawings



REV.	DATE	BY	DESCRIPTION	ENG
B	8JUL2024	TJA	PRELIMINARY PHASE 1 UPGRADES	CDR
A	26APR2024	TJA	PRELIMINARY ALIGNMENT	CDR
				ENG

PRELIMINARY
NOT FOR CONSTRUCTION

**DOGWOOD AREA
CITY WATER CONNECTION**

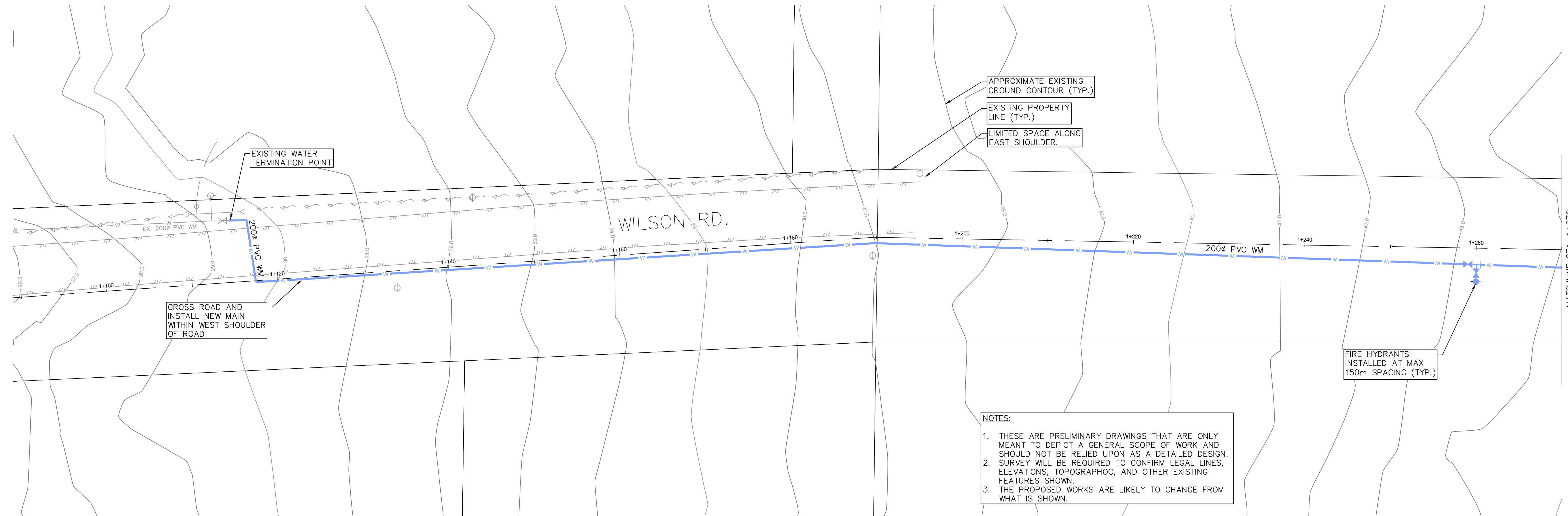
COWICHAN VALLEY REGIONAL DISTRICT, BC

DRAWING TITLE:
**WATER ALIGNMENT & PROFILE
STA. 1+000 TO 1+270**

CASCARA
CONSULTING ENGINEERS LIMITED
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

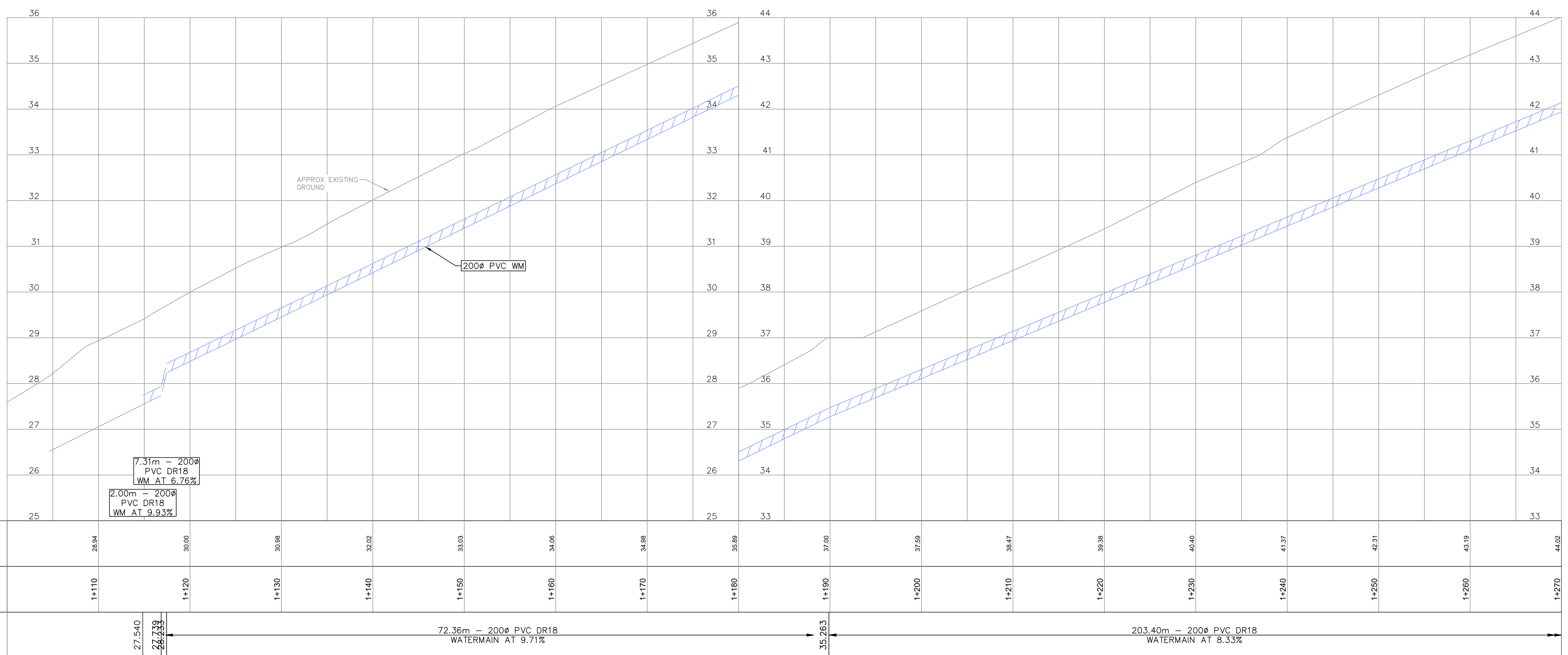
DESIGN BY: TJA CHECKED BY: CDR
DRAWN BY: TJA APPROVED BY: CDR

SCALE: HORIZ: 1:250 VERT: ---
DATE: 10APR2024 SHEET: 1 OF 4
ENG. FILE NUMBER:
CITY DWG #: PROJECT #:
DRAWING NUMBER: 1050-008 REV: B



NOTES:

1. THESE ARE PRELIMINARY DRAWINGS THAT ARE ONLY MEANT TO DEPICT A GENERAL SCOPE OF WORK AND SHOULD NOT BE RELIED UPON AS A DETAILED DESIGN.
2. SURVEY WILL BE REQUIRED TO CONFIRM LEGAL LINES, ELEVATIONS, TOPOGRAPHIC, AND OTHER EXISTING FEATURES SHOWN.
3. THE PROPOSED WORKS ARE LIKELY TO CHANGE FROM WHAT IS SHOWN.



7.8.2024 C:\USERS\TAMSS\DESKTOP - CASCARA CONSULTING ENGINEERS LIMITED\1050-008 CIVIL DOGWOOD WATER\04 - DRAWINGS\1050-008 CIVIL DRAWINGS



REV.	DATE	BY	DESCRIPTION	ENG
B	8JUL2024	TJA	PRELIMINARY PHASE 1 UPGRADES	CDR
A	26APR2024	TJA	PRELIMINARY ALIGNMENT	CDR

PRELIMINARY
NOT FOR CONSTRUCTION

**DOGWOOD AREA
CITY WATER CONNECTION**

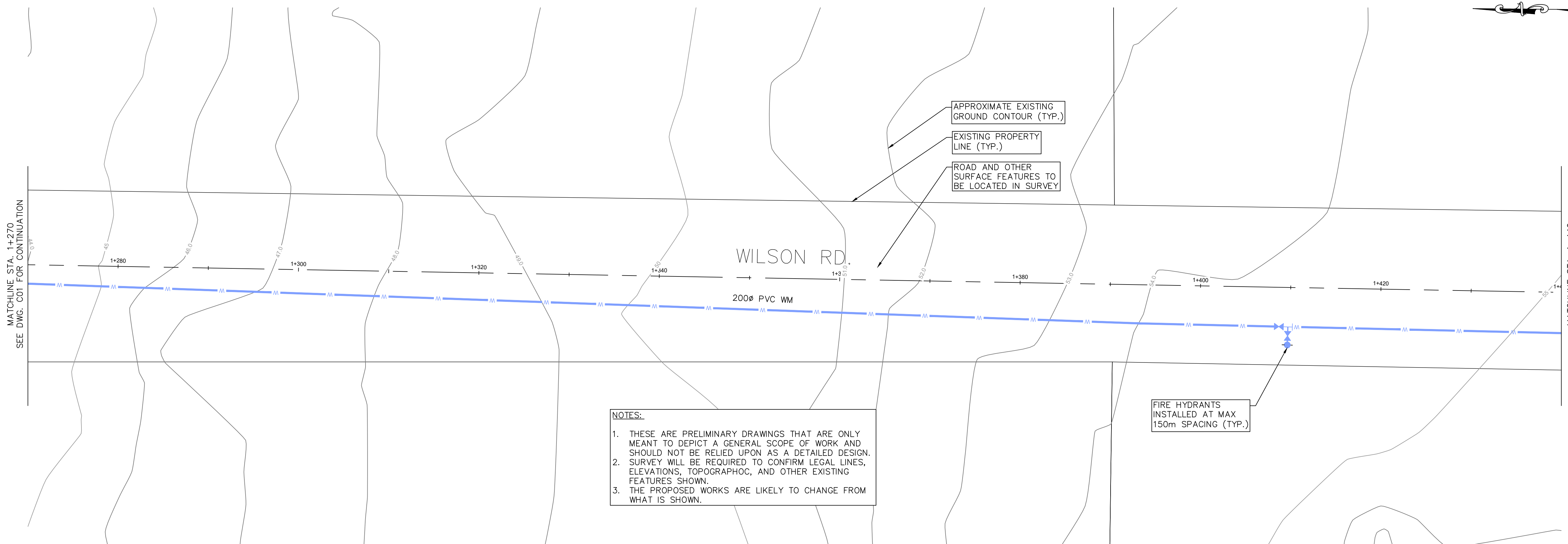
COWICHAN VALLEY REGIONAL DISTRICT, BC

DRAWING TITLE:
**WATER ALIGNMENT & PROFILE
STA. 1+270 TO 1+440**

CASCARA
CONSULTING ENGINEERS LIMITED
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

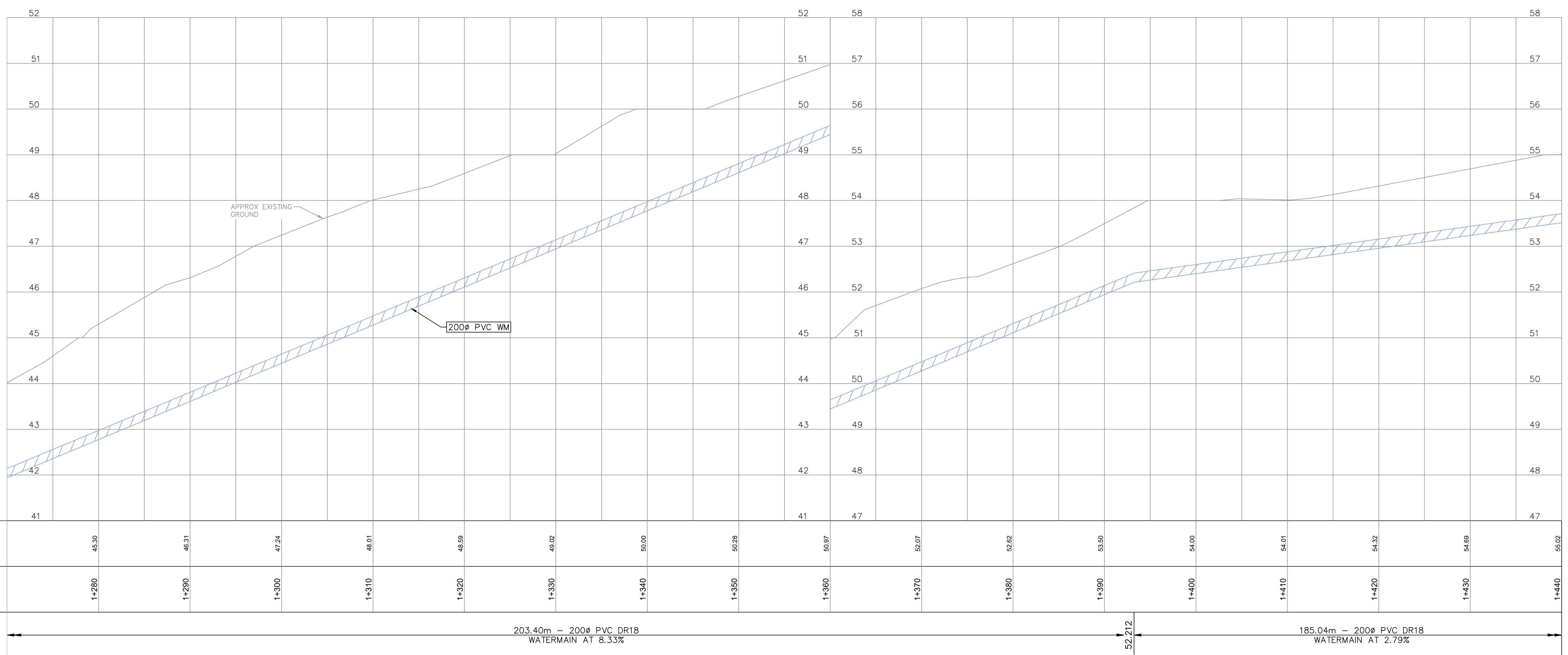
DESIGN BY: TJA	CHECKED BY: CDR
DRAWN BY: TJA	APPROVED BY: CDR

SCALE: HORIZ: 1:250 VERT: ----
DATE: 10APR2024 SHEET: 2 OF 4
ENG. FILE NUMBER:
CITY DWG #: PROJECT #:
1050-008 1050-008
DRAWING NUMBER: REV:
C02 B



- NOTES:**
1. THESE ARE PRELIMINARY DRAWINGS THAT ARE ONLY MEANT TO DEPICT A GENERAL SCOPE OF WORK AND SHOULD NOT BE RELIED UPON AS A DETAILED DESIGN.
 2. SURVEY WILL BE REQUIRED TO CONFIRM LEGAL LINES, ELEVATIONS, TOPOGRAPHIC, AND OTHER EXISTING FEATURES SHOWN.
 3. THE PROPOSED WORKS ARE LIKELY TO CHANGE FROM WHAT IS SHOWN.

FIRE HYDRANTS
INSTALLED AT MAX
150m SPACING (TYP.)



C:\USERS\TAMSS\ONEDRIVE - CASCARA CONSULTING ENGINEERS LIMITED\1050-008 CVRD DOGWOOD WATER\04 - DRAWINGS\1050-008 CIVIL DRAWINGS

7.8.2024



REV.	DATE	BY	DESCRIPTION	ENG
B	8JUL2024	TJA	PRELIMINARY PHASE 1 UPGRADES	CDR
A	26APR2024	TJA	PRELIMINARY ALIGNMENT	CDR

PRELIMINARY
NOT FOR CONSTRUCTION

**DOGWOOD AREA
CITY WATER CONNECTION**

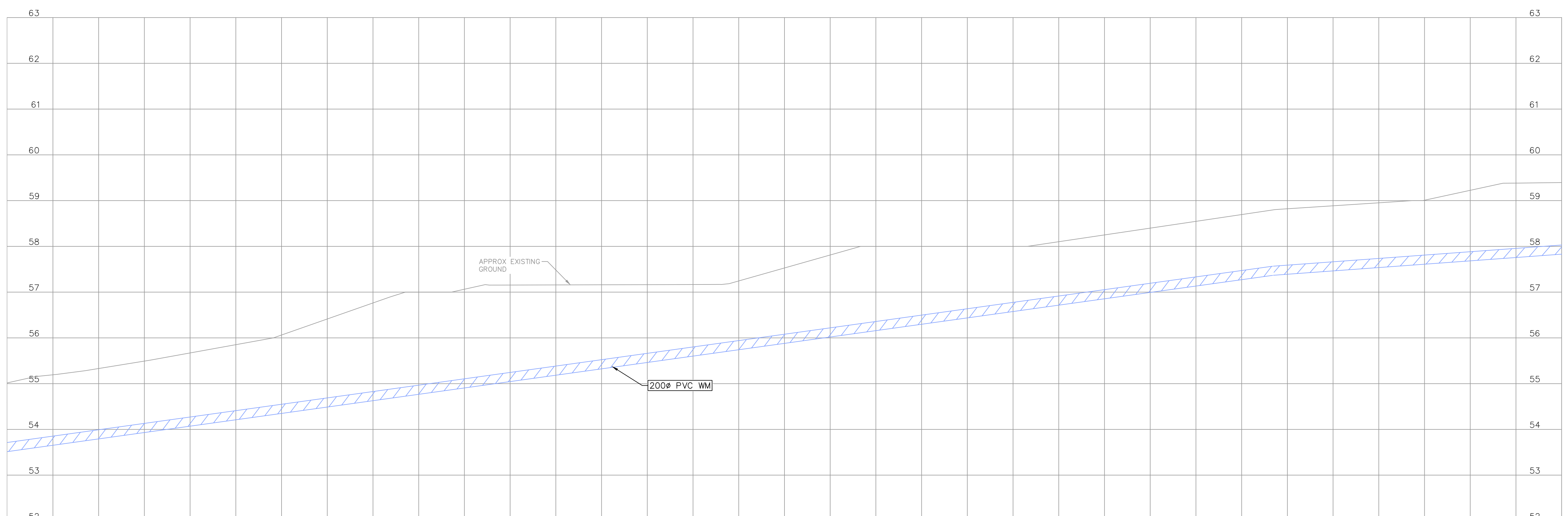
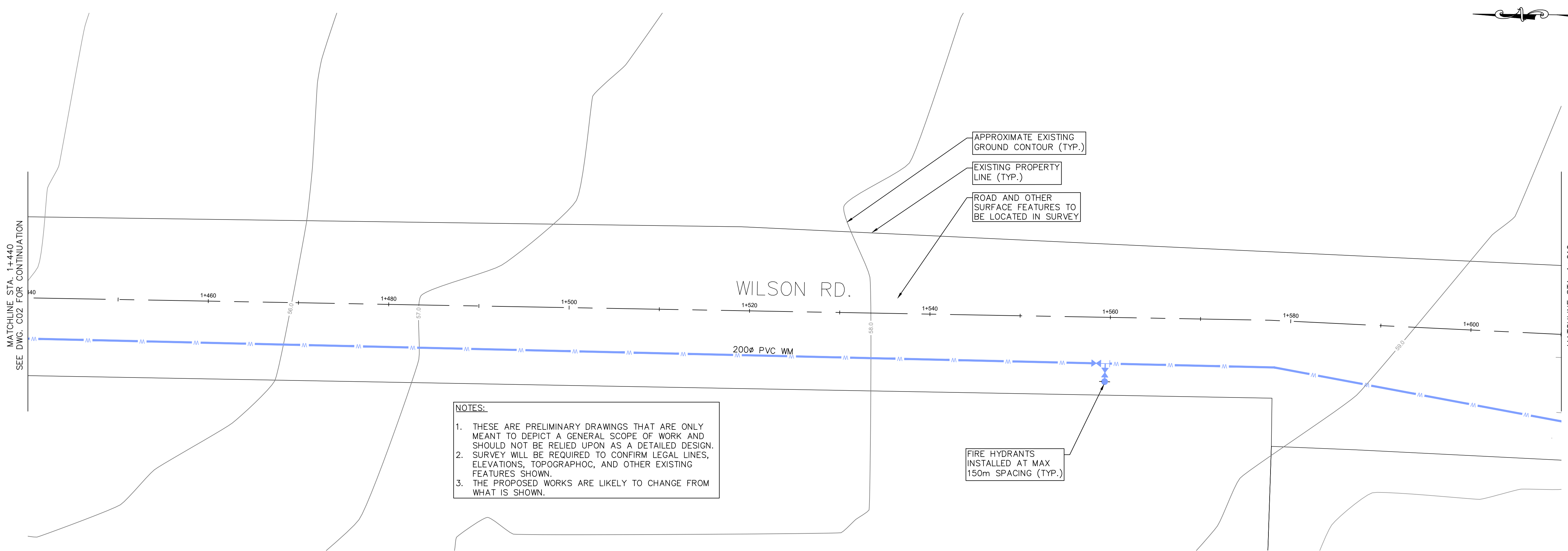
COWICHAN VALLEY REGIONAL DISTRICT, BC

DRAWING TITLE:
**WATER ALIGNMENT & PROFILE
STA. 1+440 TO 1+610**

CASCARA
CONSULTING ENGINEERS LIMITED
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

DESIGN BY: TJA	CHECKED BY: CDR
DRAWN BY: TJA	APPROVED BY: CDR

SCALE: HORIZ: 1:250 VERT: ----
DATE: 10APR2024 SHEET: 3 OF 4
ENG. FILE NUMBER: CITY DWG #: PROJECT #: 1050-008
DRAWING NUMBER: REV: C03 B



EX. ELEVATIONS	55.33	55.67	56.06	56.76	57.06	57.16	57.16	57.24	57.61	58.00	58.00	58.25	58.55	58.82	58.85	59.23	59.40
STATIONING	1+450	1+460	1+470	1+480	1+490	1+500	1+510	1+520	1+530	1+540	1+550	1+560	1+570	1+580	1+590	1+600	1+610
WM INVERT ELEVATIONS	185.04m - 200Ø PVC DR18 WATERMAIN AT 2.79%													57.367	32.89m - 200Ø PVC DR18 WATERMAIN AT 1.45%		

7.8.2024 C:\USERS\TAMSS\ONE DRIVE - CASCARA CONSULTING ENGINEERS LIMITED\1050-008 CVRD DOGWOOD WATER\04 - DRAWINGS\1050-008 CIVIL DRAWINGS



B	8JUL2024	TJA	PRELIMINARY PHASE 1 UPGRADES	CDR
A	26APR2024	TJA	PRELIMINARY ALIGNMENT	CDR
REV.	DATE	BY	DESCRIPTION	ENG

PRELIMINARY
NOT FOR CONSTRUCTION

DOGWOOD AREA
CITY WATER CONNECTION

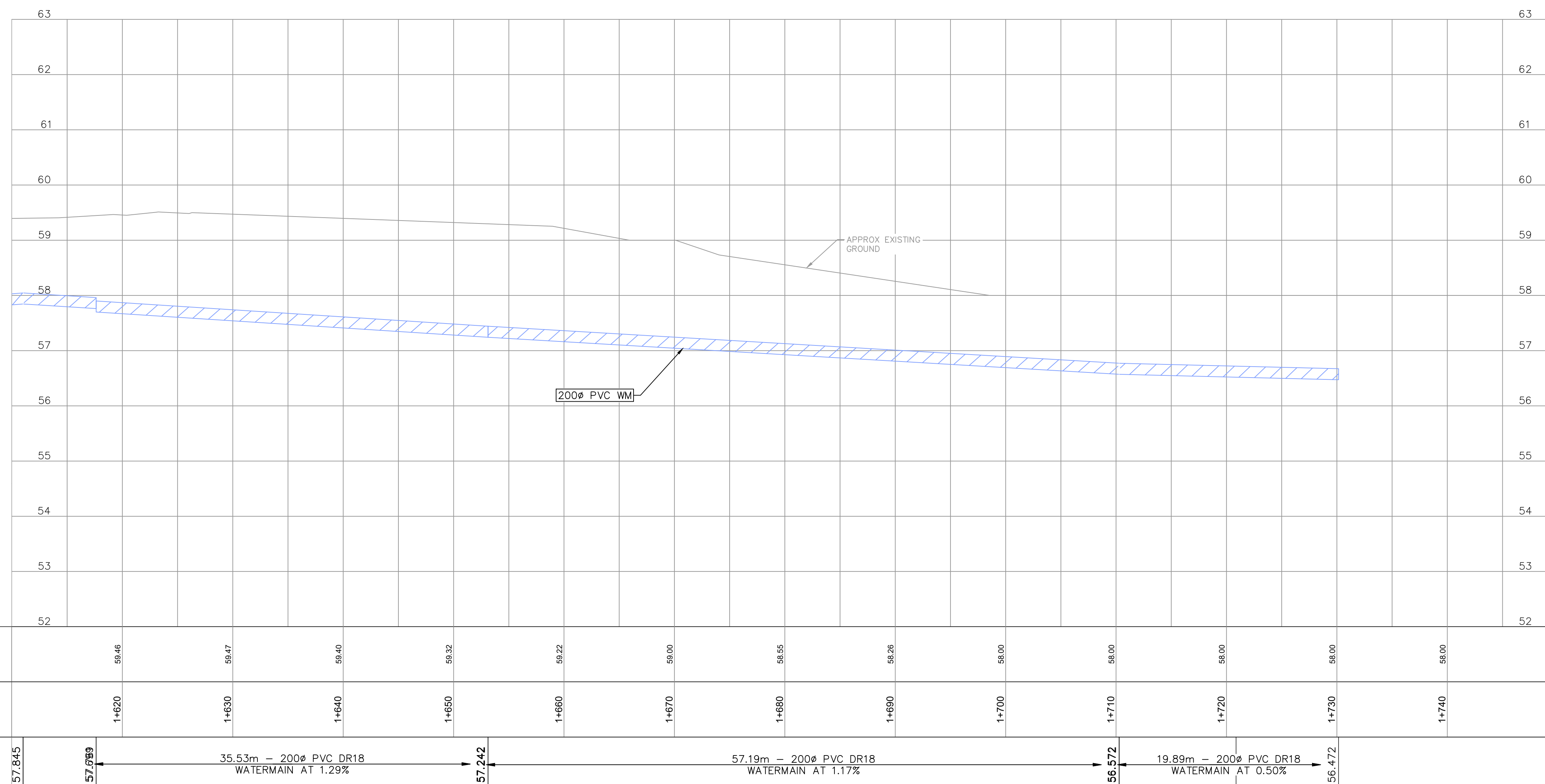
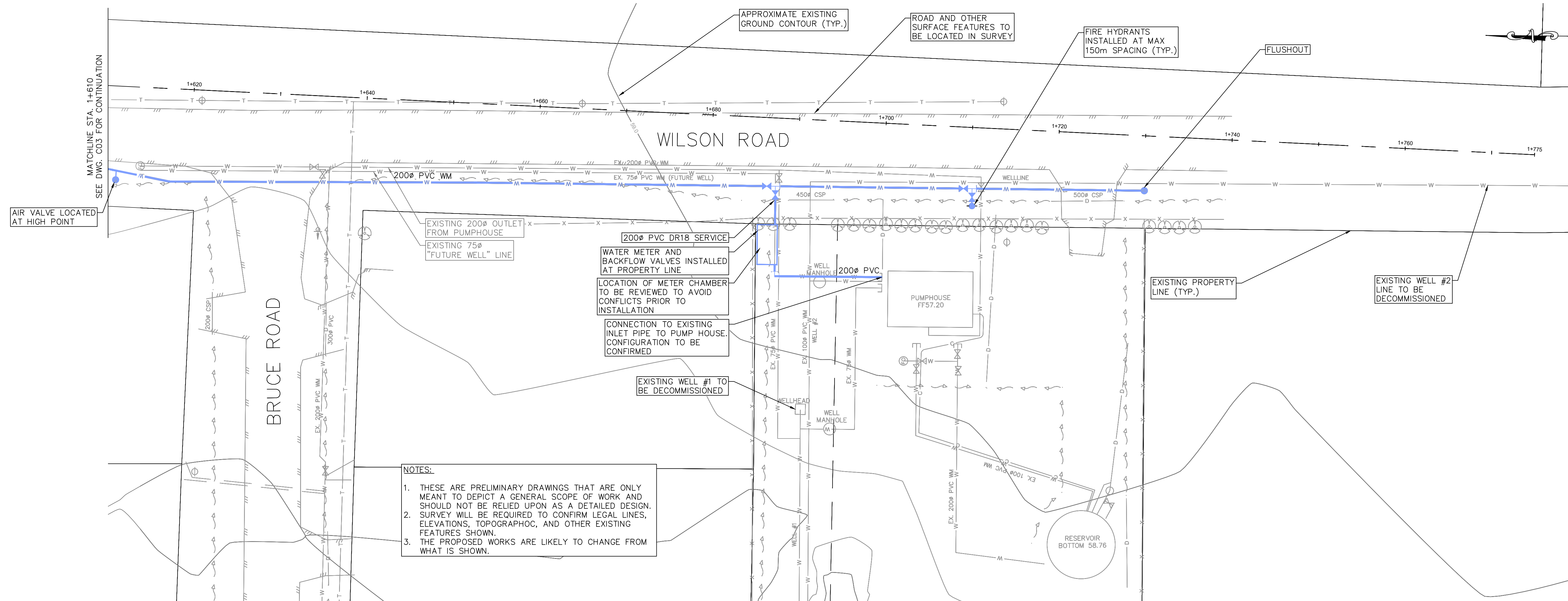
COWICHAN VALLEY REGIONAL DISTRICT, BC

DRAWING TITLE:
WATER ALIGNMENT & PROFILE
STA. 1+610 TO 1+750

CASCARA
CONSULTING ENGINEERS LIMITED
#203-335 WESLEY STREET NANAIMO, BC V9R 2T5
TEL: 250.591.7364 EMAIL: info@cascara.ca

DESIGN BY:	TJA	CHECKED BY:	CDR
DRAWN BY:	TJA	APPROVED BY:	CDR

SCALE:	HORIZ: 1:250	VERT: ---
DATE:	10APR2024	SHEET: 4 OF 4
ENG. FILE NUMBER:	CITY DWG #:	PROJECT #:
DRAWING NUMBER:	C04	REV: B



7.8.2024 C:\USERS\TAMSS\ONE\DRIVE - CASCARA CONSULTING ENGINEERS LIMITED\1050-008 CWRD DOGWOOD WATER\04 - DRAWINGS\1050-008 CIVIL DRAWINGS

Appendix D

Preliminary Cost Estimate

PRELIMINARY OPINION OF PROBABLE COST

Project	Dogwood Water Extension
Project #	1050-008
Date	July 8, 2024
Estimate Prepared by	Thomas Amess, P.Eng.
Description	Phase 1 - Class C Estimate

SUMMARY	General	\$ 29,000
	Water Main	\$ 336,200
	Sanitary Sewer	\$ -
	Storm Sewer	\$ -
	Earthworks, Surface Works & Misc.	\$ 13,000
	Subtotal of Direct Construction Costs	\$ 378,200
	Engineering & Contingency & GST (20%)	\$ 75,640
Total	\$ 453,840	

This Estimate is Valid for a period of 90 days only.

This estimate does not include the following:

- * Civil Engineering Fees
- * Geotechnical Engineering
- * Rock Removal
- * Contaminated Soil Remediation
- * Topographic or Legal Survey

The information shown is an Opinion of Probable Cost for the above noted project. We have prepared this from data in our possession related to the costs of projects of a generally similar nature and scope; However, the actual cost may be affected by a number of factors which are outside our control and which involve information to which we are not privy.

PRELIMINARY OPINION OF PROBABLE COST

Project		Dogwood Water Extension		
Project #		1050-008		
General				
Description	Est. Qty.	Units	Unit Price	Total
Location of Works - Project Layout	1	ls	7,000.00	\$ 7,000
Control of Public Traffic	1	ls	20,000.00	\$ 20,000
Clearing and Grubbing	0.1	ha	20,000.00	\$ 2,000
Utility Pole Hold	0	ea	1,800.00	\$ -
			Subtotal	\$ 29,000
Water Main				
Description	Est. Qty.	Units	Unit Price	Total
100mm PVC DR18		m	280.00	\$ -
150mm PVC DR18		m	300.00	\$ -
200mm PVC DR18	615	m	310.00	\$ 190,650
200mm Bend	3	ea	750.00	\$ 2,250
200mm Tee	5	ea	1,200.00	\$ 6,000
200mm Reducer	1	ea	700.00	\$ 700
200mm Gate Valve	10	ea	3,000.00	\$ 30,000
Air Valve	1	ea	7,000.00	\$ 7,000
Hydrant Assembly	4	ea	8,500.00	\$ 34,000
200mm Back Flow Valve	1	ea	5,000.00	\$ 5,000
Meter Chamber	1	ls	50,000.00	\$ 50,000
Connect to Existing	2	ea	2,800.00	\$ 5,600
Flush Out	1	ea	5,000.00	\$ 5,000
			Subtotal	\$ 336,200
Sanitary Sewer				
Description	Est. Qty.	Units	Unit Price	Total
			Subtotal	\$ -
Storm Sewer				
Description	Est. Qty.	Units	Unit Price	Total
			Subtotal	\$ -

Earthworks, Surface Works & Misc.				
Description	Est. Qty.	Units	Unit Price	Total
Driveway Restoration	3	ea	500.00	\$ 1,500
Road Crossings	1	ea	1,500.00	\$ 1,500
100mm topsoil & seed	500	m ²	20.00	\$ 10,000
			Subtotal	\$ 13,000
				TOTAL \$ 378,200