



BV DEVELOPMENTS MANAGEMENT INC.

*Unit 301, 791 Goldstream Avenue
Langford, BC
V9B 2X5*

May 8, 2020

Town of Lake Cowichan
P.O. Box 860
39 South Shore Road
Lake Cowichan, BC
V0R 2G0

**Attention: Mr. Joseph A. Fernandez
Approving Officer**

**RE: Rem. Lot A, Plan VIP64669, District Lot 13, Cowichan Lake Land District, Lake Cowichan, BC
Development Permit Application**

Dear Sir:

Please accept the attached information as our application for a Development Permit for the Point Ideal project.

Thank you for consideration of this matter and should you require additional information or have any questions please contact the undersigned.

Yours truly,
BV DEVELOPMENTS MANAGEMENT INC.

A handwritten signature in blue ink, appearing to read 'Brian A. Locher', with a large, stylized flourish at the end.

Brian A. Locher, P.Eng., LL.B.
Senior Project Manager
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TOWN OF LAKE COWICHAN

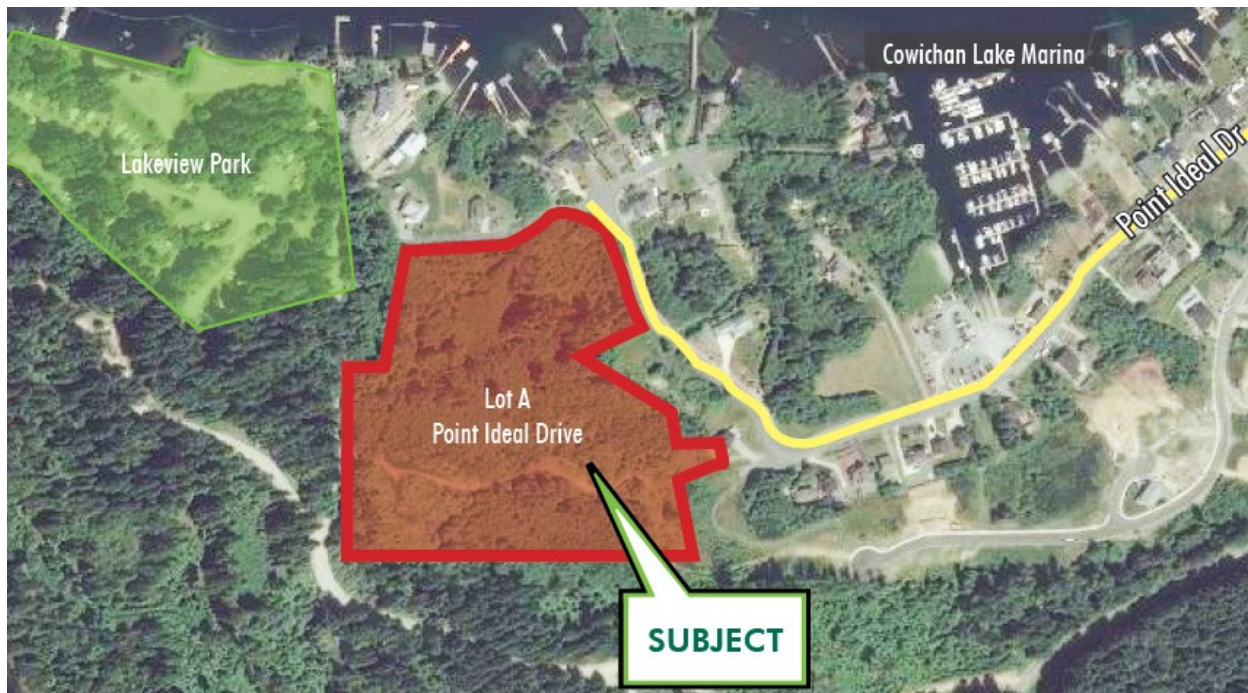
DEVELOPMENT PERMIT APPLICATION – POINT IDEAL

ISSUED MAY 8, 2020

1.0 INTRODUCTION

The graphic below shows the location of the Point Ideal subject property, which was purchased in the early fall of 2019. Since the date of acquisition, the following work has been completed:

- a. A zoning amendment that would permit an alternate layout for the subdivision;
- b. A detailed environmental assessment which identified all environmentally sensitive areas;
- c. A geotechnical investigation of the site including steep slopes and groundwater discharge;
- d. A stormwater management plan;
- e. Detailed engineering design prepared by McElhanney Engineering; and,
- f. Water modeling to determine the adequate supply of potable water to the subdivision.



10, and

Town staff have reviewed all of the above documents and on March 19 a Building Permit for the proposed development was issued, with no changes requested (see Appendix B).

Based upon the strength of the input from Town staff and the issuance of the Building Permit, this project has been tendered and it is currently proposed that site servicing will commence on May 12, 2020. This is subject to a bird survey which is scheduled to be conducted May 9th, 10th and 11th.



The Town has now stated that a Development Permit is required for the subject development due to some steep slopes along a portion of the subdivision. These slopes are located adjacent to a protected environmentally sensitive area (see graphic below) with no or very limited public access and the required retaining walls are all located on private property within the new development.



The subdivision does fall within the DPA-2 (Natural Hazard Lands) and the OCP does require the application for a Development Permit.

2.0 ENGINEERING DESIGN

The drawings in Appendix A are the detail design for site servicing and contain all the information necessary for the application for a Development Permit. Some of the more pertinent basis for the design includes:

- a. Respect the environmentally sensitive areas as identified by an environmental assessment performed by Madrone Consulting (see Appendix C).
- b. Ensure all geotechnical recommendations contained in reports prepared Ryzuk Geotechnical have been fully considered (see Appendix D).
- c. Ensure water supply is adequate (see Appendix E)
- d. Follow the recommendations of the stormwater management plan (see Appendix F) and keep drainage as natural as possible by employing the existing drainage channels and wetlands to control both the quantity and quality of the runoff.



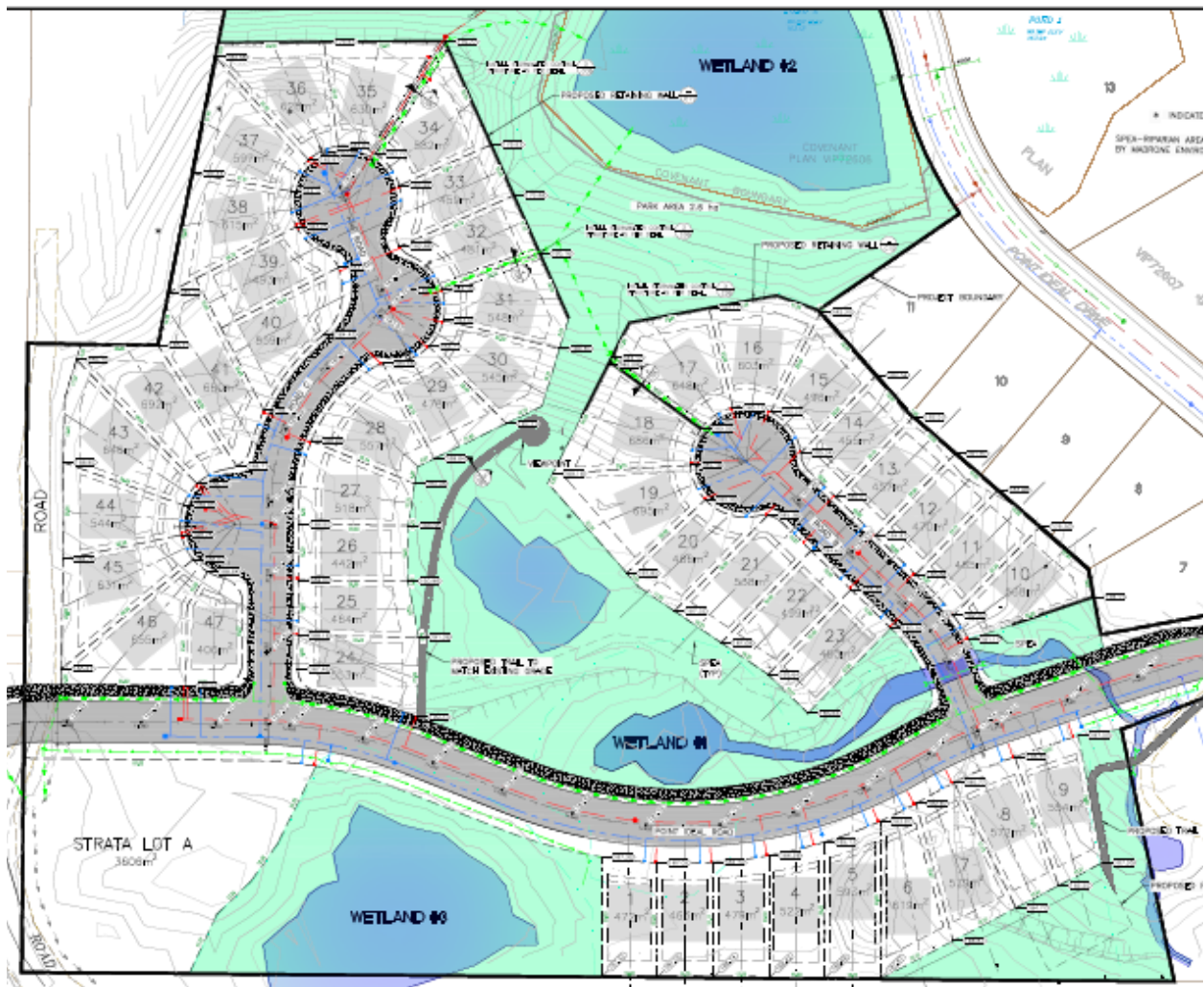
- e. Ensure all Town of Lake Cowichan standards have been fully considered.
- f. Ensure all retaining walls are professionally designed and certification will be provided for the construction of the walls.

NOTE: The design of street trees/landscaping, the trail design and the playground are currently being undertaken and will be forwarded for review in the near future.

In addition, housing is currently being designed and all building materials and landscape design will comply with the recommendations of FireSmart BC.

3.0 ENVIRONMENTAL

All environmentally sensitive areas (shown shaded green in the graphic below) will be protected in accordance with the recommendations of Madrone Consulting (see Madrone assessment contained in Appendix C). Public should not be allowed to access these wetlands and the 15 metre setback area.





4.0 GEOTECHNICAL

Ryzuk Geotechnical was retained to undertake a geotechnical investigation of the site and their report is contained in Appendix D. A portion of their work included a review of steep slopes and determining if there was any indication of groundwater seepage. On Page 3 of their report they state:

“Areas where slope gradient exceeded 30% were assessed for indications of instability and groundwater seepage to determine if hazardous conditions exist. Based on a visual assessment of the surface conditions, slopes within native soils were stable in the current state with no observed indication of seepage or potential for surficial or global slope instability.”

In addition, Ryzuk Geotechnical was retained to provide recommendations pertaining to the proposed foundations of the retaining walls (see Appendix D).

5.0 WATER MODELING

To ensure an adequate supply of potable water for the proposed development, water modeling was performed (see report in Appendix E). The conclusion was that there was sufficient potable water without any requirements for offsite improvements.

6.0 STORMWATER MANAGEMENT

One of the goals of the site servicing was to control stormwater runoff to protect downstream properties and infrastructure. To accomplish this the existing wetlands and creeks are being employed to control the volume of runoff and improve the water quality. The Stormwater Management Plan prepared by McElhanney Engineering is contained in Appendix F.

7.0 RETAINING WALLS

Drawings C10 and C11 show the location and profiles for the proposed retaining walls, which all to be constructed on private property (on the new lots being created), so public will not have access to these walls. Since these walls will be adjacent to a protected wetland it was important that they would be “green walls” so that they would blend with the natural environment.



These retaining walls do range in height from one to nine metres so Nilex Civil Environmental Group has been retained to design the walls and supervise the wall construction. They will provide certification that the walls have been designed and constructed in accordance with professional standards.



Nilex has over 35 years experience, a long-standing commitment to the environment and highly qualified staff.

Nilex has selected the Tensar Sierra Scape wall which has been installed in numerous location in BC and is an approved product by BC Ministry of Transportation for the construction of retaining walls adjacent to highways.

Appendix G includes additional information on Nilex, examples of walls installed in BC and the specifications for the walls to be installed at Point Ideal.

8.0 CLOSURE

The proceeding information was provided to the Town for review prior to their issuance of a Building Permit on March 19, 2020. The site servicing design has been professionally performed and will be supervised to ensure compliance with standards and specifications. Any changes at this point in time may mean that this project will no longer be financially viable.

We are respectfully requesting the issuance of a Development Permit to allow this project to proceed in a timely manner.



BV DEVELOPMENTS MANAGEMENT INC.

APPENDIX A

ENGINEERING DESIGN DRAWINGS



POINT IDEAL DEVELOPMENT DRAWING INDEX

01-095-C00	COVER SHEET
01-095-C01	SITE GRADING PLAN
01-095-C02	POINT IDEAL ROAD - PLAN & PROFILE WATER & SANITARY UTILITIES - STA: 1+000 TO STA: 1+150
01-095-C03	POINT IDEAL ROAD - PLAN & PROFILE WATER & SANITARY UTILITIES - STA: 1+150 TO STA: 1+300
01-095-C04	POINT IDEAL ROAD - PLAN & PROFILE WATER & SANITARY UTILITIES - STA: 1+300 TO STA: 1+420
01-095-C05	ROAD B - PLAN & PROFILE WATER & SANITARY UTILITIES
01-095-C06	ROAD C & D - PLAN & PROFILE WATER & SANITARY UTILITIES
01-095-C07	ROAD D - PLAN & PROFILE SANITARY UTILITY OFFSITE
01-095-C08	TYPICAL SECTIONS & MISCELLANEOUS DETAILS
01-095-C09	CURB RETURN DETAILS - POINT IDEAL ROAD @ ROAD B & C
01-095-C10	ROAD B - BACK OF LOTS WALL PROFILE
01-095-C11	ROAD D - BACK OF LOTS WALL PROFILE
01-095-C12	ARCH CULVERT & RETAINING WALL DETAILS
01-095-C13	LOT PROFILES 1 - 5
01-095-C14	LOT PROFILES 6 - 9
01-095-C15	LOT PROFILES 10 - 14
01-095-C16	LOT PROFILES 15 - 17
01-095-C17	LOT PROFILES 18 - 22
01-095-C18	LOT PROFILES 23 - 26
01-095-C19	LOT PROFILES 27 - 30
01-095-C20	LOT PROFILES 31 - 33
01-095-C21	LOT PROFILES 34 - 37
01-095-C22	LOT PROFILES 38 - 40
01-095-C23	LOT PROFILES 41 - 43
01-095-C24	LOT PROFILES 44 - 47

GENERAL NOTES

- ALL CONSTRUCTION AND MATERIALS TO BE IN ACCORDANCE WITH THE TOWN OF LAKE COWICHAN (TOLC) AND THE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS (MMCD) AND AMENDMENTS TO THE MMCD FOR WORK ON MUNICIPAL ROW OR SROW.
- IF A CONFLICT BETWEEN THE SPECIFICATIONS ARISES, THE MOST STRINGENT SPECIFICATION SHALL APPLY.
- CONTRACTOR TO ENSURE MINIMAL DISRUPTION TO LOCAL TRAFFIC.
- CONTRACTOR TO MAINTAIN AN UP-TO-DATE SET OF REDLINE DRAWINGS FOR THE PREPARATION OF AS-CONSTRUCTED DRAWINGS. THE REDLINES ARE TO BE DELIVERED TO THE ENGINEER PRIOR TO SUBSTANTIAL PERFORMANCE. ALL DATA REQUIRED MUST BE ACCEPTABLE TO THE ENGINEER TO PREPARE THE AS-CONSTRUCTED DRAWINGS. MISSING OR INADEQUATE DATA TO BE PROVIDED BY THE CONTRACTOR OR BY AN INDEPENDENT SURVEYOR AT THE CONTRACTOR'S EXPENSE.
- CONTRACTOR TO ENSURE EXISTING MONUMENTS AND IRON PINS ARE NOT DISTURBED DURING CONSTRUCTION. ANY MONUMENTS OR IRON PINS IN DANGER OF DISTURBANCE ARE TO BE REFERENCED AND, IF DISTURBED, BE REPLACED BY A BOLS AT THE CONTRACTOR'S EXPENSE.
- THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR CONSTRUCTION LAYOUT, MEANS, METHODS, TECHNIQUES, SEQUENCES AND PROCEDURES FOR CO-ORDINATING THE VARIOUS PARTS OF THE WORK IN THESE DRAWINGS. MCELHANNNEY WILL PROVIDE DIGITAL FILES FOR LAYOUT PURPOSES UPON REQUEST.
- PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR SHALL PROVIDE WRITTEN CONFIRMATION TO THE OWNER AND MCELHANNNEY LTD. THAT THEY WILL ASSUME THE RESPONSIBILITIES OF THE PRIME CONTRACTOR AS OUTLINED IN THE WORKERS COMPENSATION ACT FOR THE DURATION OF THE PROJECT.
- NO CONSTRUCTION TO TAKE PLACE UNLESS DRAWINGS ARE ISSUED FOR CONSTRUCTION AND ALL APPROVALS ARE IN PLACE. CONTRACTOR TO CONFIRM WITH ENGINEER.

TRENCHING, EXCAVATING AND BACKFILLING

- CONTRACTOR TO SUBMIT A DEWATERING PLAN & PROCEDURE FOR APPROVAL BY THE AUTHORITY HAVING JURISDICTION PRIOR TO CONSTRUCTION.
- CONTRACTOR TO EXCAVATE TO CONFIRM LOCATION AND ELEVATION OF EXISTING UTILITIES AT ALL CROSSINGS AND CONNECTION POINTS AND CONFIRM ELEVATION WITH THE ENGINEER PRIOR TO CONSTRUCTION. LOCATION OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND ARE REQUIRED TO BE CONFIRMED IN THE FIELD. ANY DAMAGE OR REPAIR TO EXISTING UTILITIES SHALL BE THE FULL RESPONSIBILITY OF THE CONTRACTOR.
- DO NOT START ANY BACKFILL OPERATION DURING CONSTRUCTION PRIOR TO THE ENGINEER'S INSPECTION.
- CONTRACTOR TO ENSURE THAT ALL THE EXISTING SERVICES REMAIN IN OPERATION DURING CONSTRUCTION.
- AFTER CONSTRUCTION, RESTORE WORK AREAS AND ALL EXISTING FEATURES TO THEIR ORIGINAL CONDITION OR BETTER TO THE SATISFACTION OF THE TOWN OF LAKE COWICHAN (TOLC), ENGINEER AND PRIVATE PROPERTY OWNER.
- ADJUST ALL PROPOSED AND EXISTING APPURTENANCES TO MEET THE FINAL GRADES.
- ALL UTILITY TRENCHING TO BE IN ACCORDANCE WITH MMCD STD. DWG. G4 AND MMCD SECTION 31 23 01 - EXCAVATING, TRENCHING & BACKFILLING AND/OR AS REQUIRED BY THE UTILITY COMPANY.
- WHERE A TRENCH IS UNDER OR WITHIN 1.0m OF THE EDGE OF A ROAD OR DRIVEWAY, USE PIT RUN GRAVEL BACKFILL FROM THE TOP OF THE PIPE BEDDING TO THE TOP OF THE ROAD, PARKING OR DRIVEWAY SUBGRADE.
- ALL EXCAVATION TO BE AS PER WCB REQUIREMENTS UNLESS OTHERWISE APPROVED IN WRITING BY A GEOTECHNICAL ENGINEER.
- CONTRACTOR SHALL RETAIN AND PAY FOR THE SERVICES OF A QUALIFIED INDEPENDENT GEOTECHNICAL TESTING ENGINEER TO PROVIDE QUALITY CONTROL SERVICES DURING CONSTRUCTION AND SHALL PROVIDE THE FOLLOWING AT A MINIMUM UNLESS APPROVED IN WRITING BY A GEOTECHNICAL ENGINEER:
 - SIEVE ANALYSIS OF SANDS AND AGGREGATES SUPPLIED TO THE WORK.
 - STANDARD PROCTOR DENSITY CURVES FOR BACKFILL MATERIALS.
 - STANDARD PROCTOR DENSITY CURVES FOR APPROVED BORROW MATERIALS.
 - TRENCH BEDDING DENSITY TEST (MAINLINE) - ONE FOR EVERY 75m OF TRENCH. MINIMUM ONE BETWEEN ANY TWO MANHOLES.
 - TRENCH BACKFILL DENSITY TEST (MAINLINE) - ONE FOR EVERY 75m OF TRENCH AT EACH 1.0m FILL DEPTH. MINIMUM ONE BETWEEN ANY TWO MANHOLES (INCLUDING ONE AT SURFACE LEVEL).
 - TRENCH BACKFILL DENSITY TEST (SERVICE) - ONE PER SERVICE AT EACH 1.0m FILL DEPTH (INCLUDING ONE AT SURFACE LEVEL).

ROADWORKS

- CONSTRUCT ALL ROADWAYS AS SHOWN ON THE TYPICAL SECTIONS AND DETAIL DRAWINGS AND IN ACCORDANCE WITH THE MMCD STANDARD SPECIFICATIONS.
- ALL PAVING TO BE IN ACCORDANCE WITH MMCD SPECIFICATIONS. MIX DESIGN TO BE APPROVED BY GEOTECHNICAL ENGINEER.
- ALL GRANULAR BASE AND GRANULAR SUB-BASE TO BE IN ACCORDANCE WITH MMCD SPECIFICATIONS.
- CONTRACTOR SHALL RETAIN AND PAY FOR THE SERVICES OF A QUALIFIED INDEPENDENT GEOTECHNICAL TESTING ENGINEER TO PROVIDE QUALITY CONTROL SERVICES DURING CONSTRUCTION AND SHALL PROVIDE THE FOLLOWING AT A MINIMUM UNLESS APPROVED IN WRITING BY A GEOTECHNICAL ENGINEER:
 - SIEVE ANALYSIS OF SANDS AND AGGREGATES SUPPLIED TO THE WORK.
 - STANDARD PROCTOR DENSITY CURVES FOR BACKFILL MATERIALS.
 - STANDARD PROCTOR DENSITY CURVES FOR APPROVED BORROW MATERIALS.
 - COMPACTION CONTROL TESTS FOR BACKFILL AND EMBANKMENT MATERIAL INCLUDING:
 - GRANULAR BASE AND SUB-BASE (ROADS) - ONCE PER 50 LINEAL METRES PLUS PROOF ROLL TEST, FULL LENGTH.
 - ASPHALT MIX DESIGN AND TESTING.
 - ASPHALT TESTS FOR THE FOLLOWING:
 - AGGREGATE GRADATION TESTS - ONE PER 300 TONNES OF PRODUCTION (MINIMUM ONE PER DAY DURING ASPHALT PLACEMENT).
 - MARSHALL TEST - THREE BRIQUETTES FOR EVERY 300 TONNES OF PRODUCTION (MINIMUM ONE PER DAY DURING ASPHALT PLACEMENT).
 - COMPACTION - ONE CORE FOR EVERY 500sq.m PLACED.
 - BOULEVARDS TO BE HYDRO-SEEDED IN ACCORDANCE WITH MMCD SECTION 32 92 19 - HYDRAULIC SEEDING. CONTRACTOR TO PROVIDE SEED MIX FOR APPROVAL PRIOR TO INSTALLATION.
 - SUBGRADE TO BE APPROVED BY GEOTECHNICAL ENGINEER. ANY FAILURE OF THE SUBGRADE AFTER APPROVAL IS THE RESPONSIBILITY OF THE CONTRACTOR. ANY MITIGATION PROCEDURES REQUIRED TO PROTECT THE SUBGRADE IS THE RESPONSIBILITY OF AND AT THE EXPENSE OF THE CONTRACTOR.

HYDRO, TELEPHONE, STREETLIGHTING, CABLE & GAS

- ALL ELECTRICAL AND UTILITY DESIGN TO BE COORDINATED, AND AS DIRECTED, BY THE ELECTRICAL ENGINEER.
- CONTACT "BC ONE CALL" AT 1-800-474-6886 A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION. CONTRACTOR TO REVIEW INFORMATION PRIOR TO START OF ANY EXCAVATION.
- CONTACT BC HYDRO, TELUS, SHAW CABLE AND FORTIS BC 48 HOURS PRIOR TO THE START OF ANY EXCAVATION.
- CONNECTION TO, OR ALTERATION OF, EXISTING BC HYDRO, TELUS, SHAW CABLE, FORTISBC OR OTHER UTILITIES WILL BE UNDERTAKEN BY THE APPROPRIATE UTILITY ONLY. CONTRACTOR TO PROVIDE SITE ACCESS TO ALL UTILITIES AS REQUIRED.
- ANY BC HYDRO, TELUS, SHAW CABLE OR FORTIS BC FACILITIES SHOWN ON THE ENGINEERING DRAWINGS ARE SCHEMATIC ONLY. ONLY CONSTRUCT UNDERGROUND HYDRO, TELEPHONE AND CABLE AS SPECIFIED AND IN ACCORDANCE WITH BC HYDRO, TELUS AND SHAW CABLE STANDARD SPECIFICATIONS AND DRAWINGS.
- SEE DRAWINGS AND SPECIFICATIONS BY SITE POWER ENGINEERING CONSULTANTS FOR HYDRO.
- SEE DRAWINGS AND SPECIFICATIONS BY TELUS FOR TELEPHONE.
- SEE DRAWINGS AND SPECIFICATIONS BY SHAW FOR CABLE.

WATER

- VANCOUVER ISLAND HEALTH AUTHORITY WATER SUPPLY CONSTRUCTION PERMIT NO. "W-S-XXXX". THE CONTRACTOR SHALL MEET THE CONDITIONS EXPRESSED IN THE WATER SUPPLY CONSTRUCTION PERMIT ISSUED BY THE VANCOUVER ISLAND HEALTH AUTHORITY AND SHALL NOT COMMENCE CONSTRUCTION WITHOUT A COPY OF THE PERMIT. ANY CHANGES OR ALTERATIONS ARE TO BE PRE-APPROVED BY THE VIHA PUBLIC HEALTH ENGINEERS VIA THE PROJECT ENGINEER.
- ALL WATERWORKS CONSTRUCTION SHALL BE IN ACCORDANCE WITH MMCD SPECIFICATIONS AND STANDARD DRAWINGS.
- WATER MAINS SHALL BE PVC DR18 TO AWWA C900 c/w THRUST BLOCKS OR JOINT RESTRAINTS, UNLESS OTHERWISE NOTED.
- PROVIDE MINIMUM 1.0m COVER FOR WATER MAINS, UNLESS OTHERWISE NOTED.
- MARK WATER MAINS BELOW GRADE USING A METALLIC DETECTABLE REINFORCED UNDERGROUND UTILITY MARKING TAPE. THE TAPE SHALL BE MINIMUM 150mm WIDE, METALLIC BLUE IN COLOR AND SHALL BE MARKED "CAUTION: WATER LINE BURIED BELOW". INSTALL TAPE ON TOP OF THE PIPE CUSHION 300mm ABOVE THE TOP OF THE PIPE. PROVIDE "THORTEX" MARKING TAPE OR APPROVED EQUAL.
- MAINTAIN A MINIMUM OF 3m HORIZONTAL AND 450mm CLEAR VERTICAL SEPARATION BETWEEN WATER SERVICES AND SEWER SERVICES, SANITARY OR STORM/RAIN, IN SPECIAL CIRCUMSTANCES, WHERE A SANITARY OR STORM DRAIN SERVICE IS LOWER THAN A WATER SERVICE BY MORE THAN 450 mm IN ELEVATION THE HORIZONTAL OFFSET MAY BE REDUCED TO NO LESS THAN 1.0 METRES EXCEPT WHERE NOTED AND APPROVED BY TOWN OF LAKE COWICHAN (TOLC). VIHA APPROVAL IS REQUIRED FOR ANY REDUCTION IN THE SEPARATION.
- FOR CROSSING OF EXISTING SEWERS, WHERE THE WATER MAIN DOES NOT HAVE THE REQUIRED 450mm VERTICAL SEPARATION, WRAP WATER MAIN JOINTS WITH PETROLIUM TAPE 3m EITHER SIDE OF THE SEWER, WHERE A VERTICAL SEPARATION OF 150mm CANNOT BE ACHIEVED, SPECIAL MITIGATIVE MEASURES SHALL BE APPROVED BY THE ENGINEER.
- WHERE NEW CATCHBASIN (CB) LEADS DO NOT HAVE A 450mm VERTICAL SEPARATION, WRAP CB LEAD JOINTS WITH PETROLIUM TAPE.
- MAINTAIN A MINIMUM OF 1.5m HORIZONTAL CENTER TO CENTER AND 150mm CLEAR VERTICAL SEPARATION BETWEEN WATERMANS AND ELECTRICAL CONDUITS, GAS MAINS AND TELEPHONE CONDUITS EXCEPT WHERE NOTED IN ENGINEERING DRAWINGS.
- MAINTAIN A MINIMUM OF 1.0m HORIZONTAL CENTER TO CENTER AND 150mm CLEAR VERTICAL SEPARATION BETWEEN WATER SERVICES AND ELECTRICAL CONDUITS, GAS MAINS AND TELEPHONE CONDUITS EXCEPT WHERE NOTED BY MMCD.
- CONTRACTOR SHALL CONDUCT A PRESSURE TEST IN ACCORDANCE WITH MMCD SPECIFICATIONS AND IN THE PRESENCE OF THE CIVIL ENGINEER.
- CONTRACTOR SHALL FLUSH AND DISINFECT WATER MAINS IN ACCORDANCE WITH AWWA STANDARDS, MMCD AND AS APPROVED BY MCELHANNNEY LTD. WATER SAMPLES FOR HEALTH TESTS TO BE COLLECTED AND PROCESSED BY MCELHANNNEY LTD. PROVIDE 24 HOURS NOTICE TO MCELHANNNEY LTD.
- NEUTRALIZE CHLORINE SOLUTIONS IN ACCORDANCE WITH MINISTRY OF ENVIRONMENT AND FISHERIES AND OCEANS CANADA REGULATIONS PRIOR TO DISCHARGE TO ANY DRAINAGE COURSE.
- CONTRACTOR SHALL PROVIDE 24 HOUR NOTICE TO TOWN OF LAKE COWICHAN (TOLC) PRIOR TO PROCEEDING WITH ANY WATERWORKS.
- CONTRACTOR SHALL CONDUCT PRESSURE TESTING IN ACCORDANCE WITH MMCD SECTION 33 11 01 (WATERWORKS) AND IN THE PRESENCE OF THE CIVIL ENGINEER. TEST PRESSURE TO BE 200psi. CONTRACTOR TO PROVIDE A PRESSURE TESTING AND FLUSHING PLAN PRIOR TO ANY PRESSURE TESTING.

SANITARY SEWER

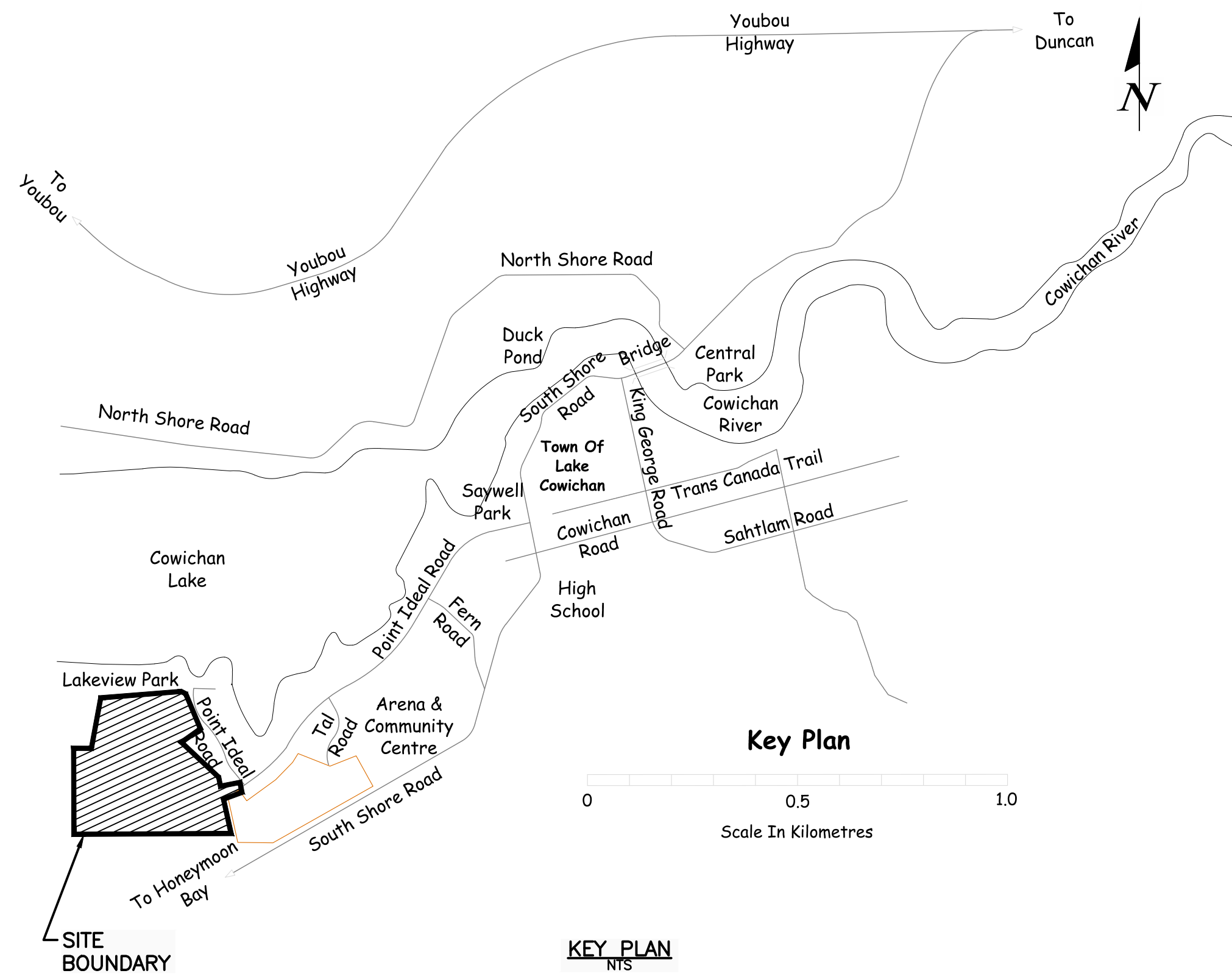
- SANITARY SEWERS AND APPURTENANCES TO BE IN ACCORDANCE WITH TOWN OF LAKE COWICHAN (TOLC) STANDARDS AND MMCD REQUIREMENTS.
- ALL MANHOLES TO BE 1050# UNLESS OTHERWISE NOTED AND TO BE AS PER MMCD STD. DWG. S1. MANHOLE LIDS TO BE SET TO MATCH FINISHED GRADES.
- ALL CLEANOUTS TO BE AS PER MMCD STD. DWG. S6. CLEANOUT LIDS TO BE SET TO MATCH FINISHED GRADES.
- SERVICE CONNECTIONS TO BE AS PER MMCD STD. DWG. S7 COMPLETE WITH INSPECTION CHAMBER. SEWER INSPECTION CHAMBERS TO BE c/w CONCRETE BROOKS BOX AND CAST IRON COVER. SEWER INSPECTION CHAMBER LID AND COVER SHALL BE INSTALLED AS PER MMCD STD. DWG. S9.
- ENSURE ALL EXISTING SEWER SYSTEMS REMAIN IN USE DURING CONSTRUCTION AND RECONNECT EXISTING SERVICES TO PROPOSED MAINS AS REQUIRED.
- WHERE 1.0m COVER CANNOT BE ACHIEVED, THE INSTALLATION MUST BE DONE TO YIELD A MINIMUM SOIL STIFFNESS (E') OF 7000 kPa IN THE HAUNCH ZONE AROUND THE PIPE AS PER MANUFACTURER'S RECOMMENDATIONS.
- THE CONTRACTOR SHALL PROVIDE A LOW PRESSURE AIR TEST ON ALL GRAVITY SEWERS AS PER MMCD SECTION 33 30 01 - SANITARY SEWERS, SUBSECTION 3.14 - LOW PRESSURE AIR TEST. TEST TO BE PERFORMED IN THE PRESENCE OF THE CIVIL ENGINEER.
- CONTRACTOR TO PROVIDE ENGINEER WITH CCTV VIDEO OF SANITARY SEWER SYSTEM AS PER MMCD SPECIFICATIONS INCLUDING FLUSH & CCTV VIDEO PRIOR TO EXPIRY OF ONE YEAR WARRANTY. TWO COPIES OF THE VIDEO (CD AND BINDER) TO BE PROVIDED TO THE CIVIL ENGINEER. INSTALLATION OF THE SEWER TO BE APPROVED BY THE TOLC AND THE ENGINEER.
- PRE-BENCHED, FACTORY PRODUCED MANHOLE BOTTOMS TO BE USED.
- ALL MANHOLES BARRELS TO BE GASKETED. MASTIC TAPE TO BE UTILIZED ON THE BOTTOM BARREL AS WELL.

STORM SEWER

- STORM SEWERS AND APPURTENANCES TO BE IN ACCORDANCE WITH TOWN OF LAKE COWICHAN (TOLC) STANDARDS AND MMCD REQUIREMENTS.
- ALL MANHOLES TO BE 1050# UNLESS OTHERWISE NOTED AND TO BE AS PER MMCD STD. DWG. S1. MANHOLE LIDS TO BE SET TO MATCH FINISHED GRADES.
- ALL CSP DRIVEWAY CULVERTS TO BE GALVANIZED UNLESS OTHERWISE NOTED.
- ENSURE ALL EXISTING DRAIN SYSTEMS REMAIN IN USE DURING CONSTRUCTION.
- WHERE 1.0m COVER CANNOT BE ACHIEVED, THE INSTALLATION MUST BE DONE TO YIELD A MINIMUM SOIL STIFFNESS (E') OF 7000 kPa IN THE HAUNCH ZONE AROUND THE PIPE AS PER MANUFACTURER'S RECOMMENDATIONS.
- CONTRACTOR TO PROVIDE ENGINEER WITH CCTV VIDEO OF STORM SYSTEM AS PER THE MMCD SPECIFICATIONS INCLUDING FLUSH & CCTV VIDEO PRIOR TO EXPIRY OF ONE YEAR WARRANTY. TWO COPIES OF THE VIDEO (CD AND BINDER) TO BE PROVIDED TO THE CIVIL ENGINEER. INSTALLATION OF SEWER TO BE APPROVED BY THE TOWN OF LAKE COWICHAN (TOLC) AND THE ENGINEER.

ENVIRONMENTAL AND TREE PROTECTION

- CONTRACTOR TO PROVIDE AN ENVIRONMENTAL PROTECTION & MANAGEMENT PLAN (TO BE APPROVED BY THE TOWN OF LAKE COWICHAN (TOLC) & MCELHANNNEY LTD.) PREPARED BY A QUALIFIED ENVIRONMENTAL CONSULTANT A MINIMUM OF 48 HOURS BEFORE COMMENCING CONSTRUCTION, WHICH WILL PROVIDE DETAILS AND PROCEDURES, AT A MINIMUM, OF THE FOLLOWING:
 - DISPOSAL OF WASTES.
 - DISCHARGING OF TRENCH WATER.
 - EROSION AND SEDIMENT CONTROL.
 - FUEL SPILL CONTROL, INCLUDING SIZE AND TYPE OF SPILL KITS.
 - DRAINAGE, TREATMENT AND DISPOSAL OF DEWATERING, IN ACCORDANCE WITH REGULATORY AGENCY REQUIREMENTS.

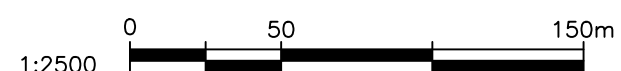


GENERAL LEGEND		
EXISTING	PROPOSED	DESCRIPTION
	EP	EDGE OF PAVEMENT
	NMC	CURB AND GUTTER
	S	SANITARY SEWER AND MANHOLE
	S	SANITARY SEWER SERVICE (c/w INSPECTION CHAMBER)
	D	STORM SEWER AND MANHOLE
	D	SANITARY SEWER OR STORM SEWER CLEANOUT
	D	STORM SEWER HEADWALL
	D	STORM SEWER CULVERT
	D	STORM SEWER SERVICE (c/w INSPECTION CHAMBER)
	CB	CATCH BASIN
	LD	LAWN DRAIN
	SW	SWALE
	DI	DITCH
	TOB	TOP OF BANK
	F	FENCE
	W	WATER MAIN c/w REDUCER
	WSC	WATER SERVICE CONNECTION
	W	WATER MAIN c/w VALVE
	W	WATER MAIN c/w AIR RELEASE VALVE
	W	HYDRANT AND VALVE ASSEMBLY
	W	WATER MAIN c/w CAPPED END
	W	WATER MAIN c/w FLUSH ASSEMBLY
	HTC	UNDERGROUND HYDRO/TEL/CABLE
	G	STATUTORY RIGHT-OF-WAY
	P	PROPERTY LINE
	L	LUMINAIRE
	L	LUMINAIRE - POST TOP
	U	UTILITY POLE c/w ANCHOR
	J	JUNCTION BOX
	K	KIOSK
	S	SIGN
	T	TREE

STANDARD ABBREVIATIONS			
AC	ASBESTOS CONCRETE	IG	INVERTED GUTTER
AV	AIR RELEASE VALVE	INV	INVERT
BC	BARRIER CURB	IP	IRON PIN
c/w	COMPLETE WITH	IRR	IRRIGATION
CB	CATCH BASIN	m	METER
CI	CAST IRON	MAX	MAXIMUM
CO	CLEANOUT	MC	MOUNTABLE CURB
CONC	CONCRETE	RMC	REVERSE MOUNTABLE CURB
CSP	CORRUGATED STEEL PIPE	MIN	MINIMUM
D	DRAIN	NIC	NOT IN CONTRACT
D/W	DRIVEWAY	NMC	NON-MOUNTABLE CURB
DCB	DOUBLE CATCH BASIN	RNMC	REVERSE NON-MOUNTABLE CURB
DI	DUCTILE IRON	OG	ORIGINAL GROUND
DMH	DRAIN MANHOLE	OIC	OIL INTERCEPTOR
EAC	EXTRUDED ASPHALT CURB	PE	POLYETHYLENE
ECC	EXTRUDED CONCRETE CURB	PRV	PRESSURE REDUCING VALVE
EG	EXISTING GROUND	PVC	POLYVINYL CHLORIDE
EL/ELEV	ELEVATION	S	SANITARY
EP	EDGE OF PAVEMENT	S/W	SIDEWALK
EX	EXISTING	SFM	SEWER FORCE MAIN
F	FLANGE	SMH	SANITARY MANHOLE
FC	FLAT CURB	SRW	STATUTORY RIGHT-OF-WAY
FG	FINISHED GROUND	ST	STEEL
F.O.	FLUSH-OUT ASSEMBLY	STA	STATION
FCM	FLOW CONTROL MANHOLE	TYP	TYPICAL
G	GAS	VSP	VERTICAL SEEPAGE PIT
H	HUB	W	WATER
HB	HOSE BIB	WC	WATER CONTROL CURB
IC	INSPECTION CHAMBER		

VIHA WATER SUPPLY SYSTEM
CONSTRUCTION PERMIT X-X-XXXX

MARCH 3, 2020
**ISSUED FOR
TENDER**



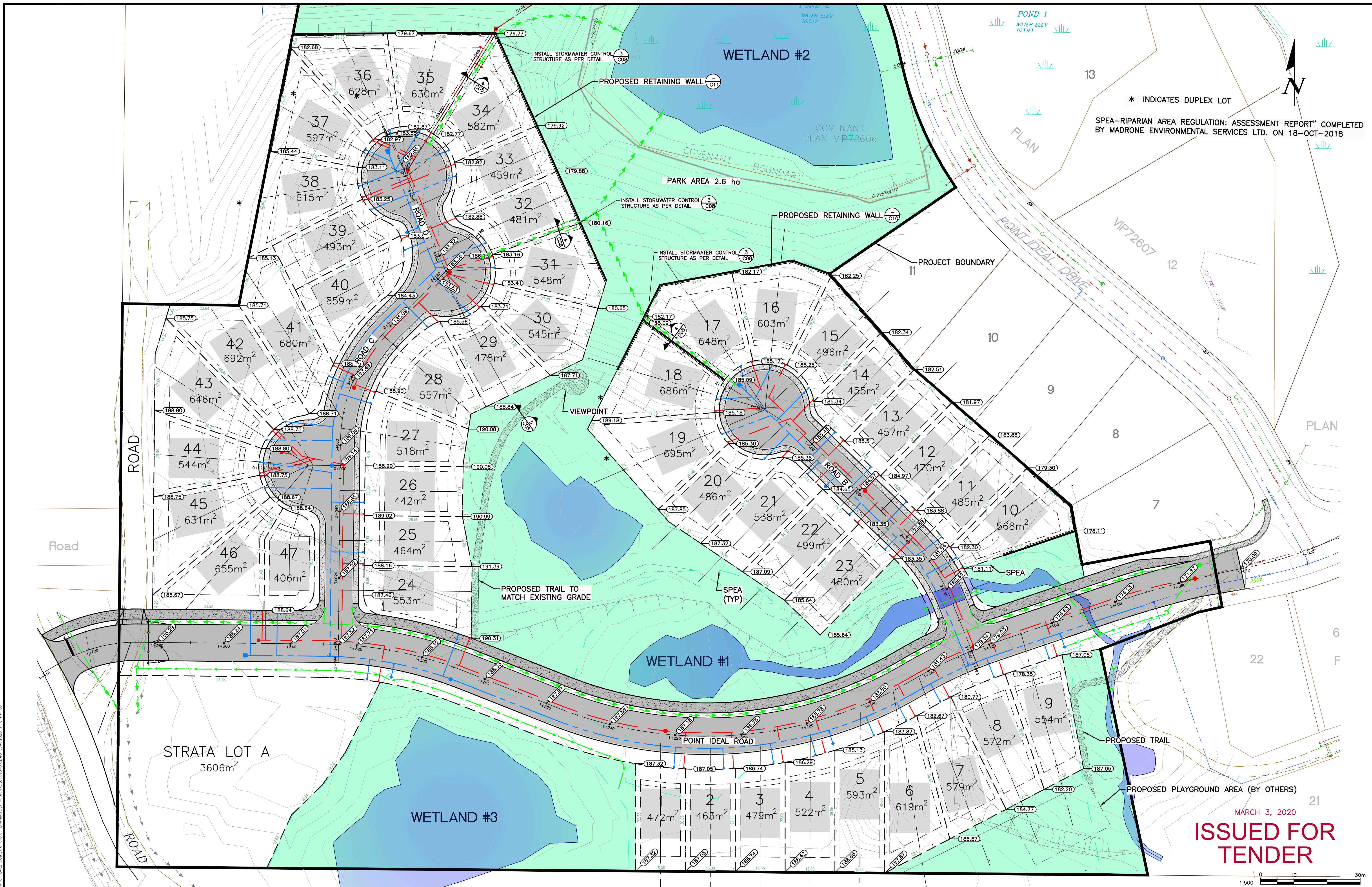
A:\3333\01095-00 - POINT IDEAL - TOWN OF LAKE COWICHAN.DWG - 2/22/2020 4:28 PM GSD

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NO.	DATE	BY	ISSUED
3	2020-03-03	JL	ISSUED FOR TENDER
2	2020-01-24	JL	ISSUED FOR 90% REVIEW
1	2019-12-11	JL	ISSUED FOR 50% REVIEW

202 - 5855 YORK ROAD
DUNCAN, BC V9L 3S3 PH (250) 748-3335

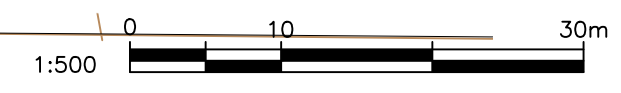
SEAL	PROJECT: POINT IDEAL DEVELOPMENT	SCALE HORIZ: 1:2500 VERT: N/A
TITLE: COVER SHEET	PROJECT NO. 01-095	ISSUED/REVISION 3
	APPROVING AUTHORITY FILE NO.	
	DRAWING NO. 01-095-C00	



* INDICATES DUPLEX LOT

SPEA-RIPARIAN AREA REGULATION: ASSESSMENT REPORT™ COMPLETED BY MADRONE ENVIRONMENTAL SERVICES LTD. ON 18-OCT-2018

MARCH 3, 2020
ISSUED FOR TENDER



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NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
3	2020-03-03		ISSUED FOR TENDER				
2	2020-01-24	JL	ISSUED FOR 90% REVIEW				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

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SEAL

PROJECT: POINT IDEAL DEVELOPMENT

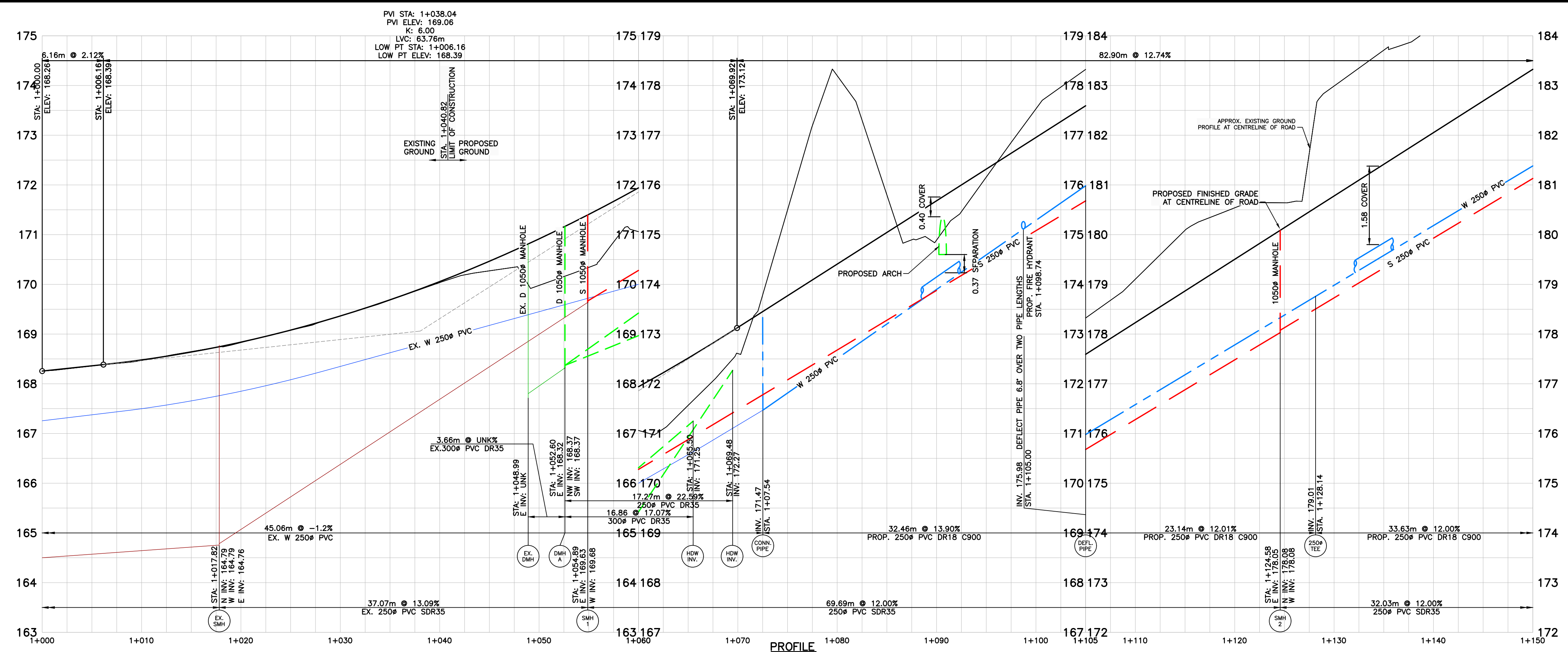
TITLE: SITE GRADING PLAN

SCALE: HORIZ: 1:500 VERT: N/A

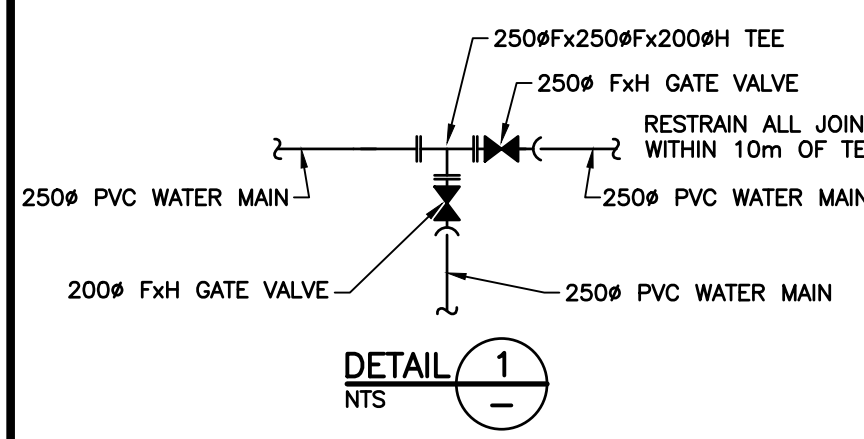
PROJECT NO. 01-095 ISSUED/REVISION 3

APPROVING AUTHORITY FILE NO.

DRAWING NO. 01-095-C01



NOTE:
ROCK PITS TO BE INSTALLED ON INDIVIDUAL LOTS FOR STORMWATER STORAGE. SIZE, LOCATION & ORIENTATION ON LOT TO BE DETERMINED DURING HOME CONSTRUCTION SEE DETAIL 6 ON DRAWING C08

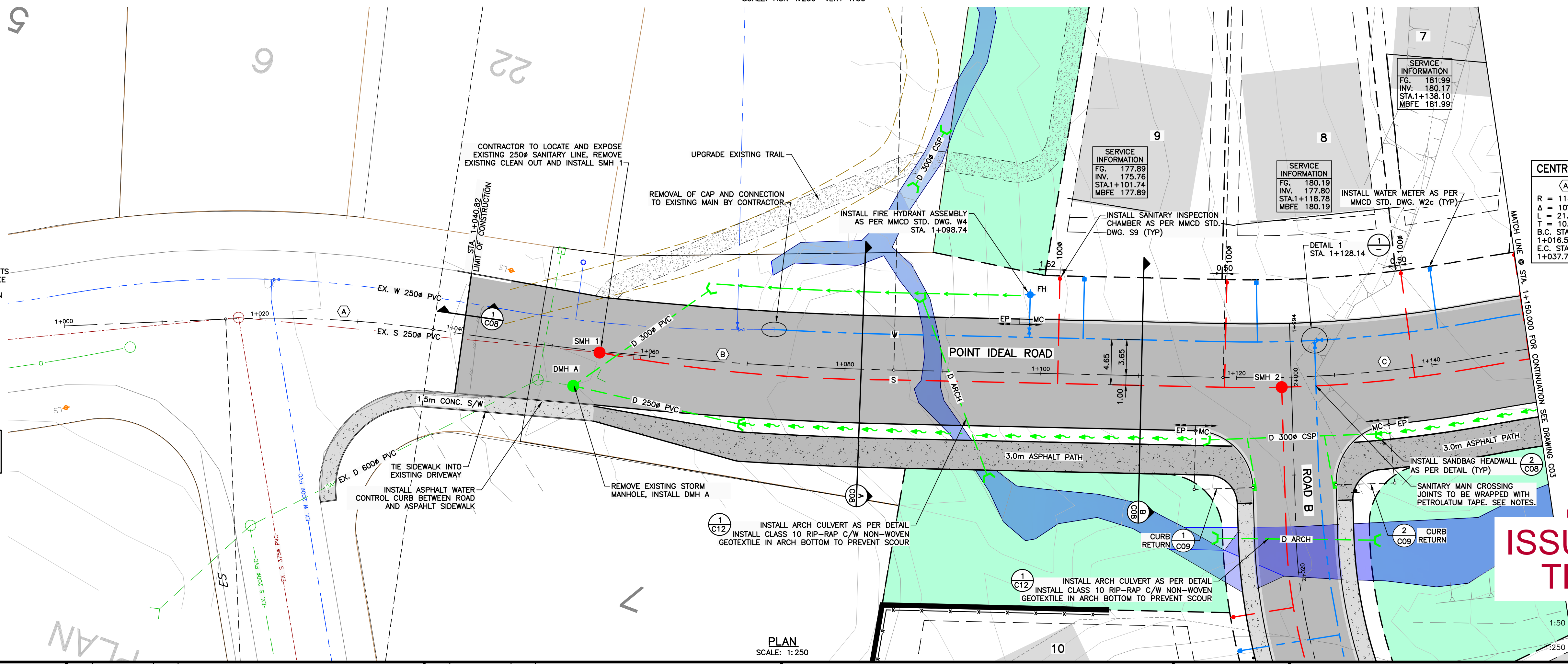


VHA WATER SUPPLY SYSTEM CONSTRUCTION PERMIT X-X-XXXX

SERVICE INFORMATION	
FG. XX.XX	FINISHED GROUND ELEVATION AT PROPERTY LINE
INV. XX.XX	SANI SERVICE INVERT AT PROPERTY LINE
STA. XXX.X	ROAD CENTRELINE STATION AT SANITARY SERVICE
MBFE. XXX	MINIMUM BASEMENT FLOOR ELEVATION

NOTE: CALCULATION OF INVERT AT PROPERTY LINE BASED ON INSTALLATION OF SERVICE AT 2% FROM OVERTOP OF MAIN.

NOTE: LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE AND MUST BE VERIFIED IN AREAS OF POTENTIAL CONFLICT WITH PROPOSED SANITARY SEWER MAINS AND SERVICES PRIOR TO CONSTRUCTION.



CENTRELINE CURVE DATA

(A)	(B)	(C)
R = 114.88m	R = 363.84m	R = 130.00m
Δ = 10°35'21"	Δ = 7°26'29"	Δ = 11°49'25"
L = 21.232m	L = 47.255m	L = 26.827m
T = 10.646m	T = 23.661m	T = 13.461m
B.C. STA. =	B.C. STA. =	B.C. STA. =
E.C. STA. = 1+016.501	E.C. STA. = 1+037.733	E.C. STA. = 1+118.628
E.C. STA. = 1+037.733	E.C. STA. = 1+084.988	E.C. STA. = 1+145.456

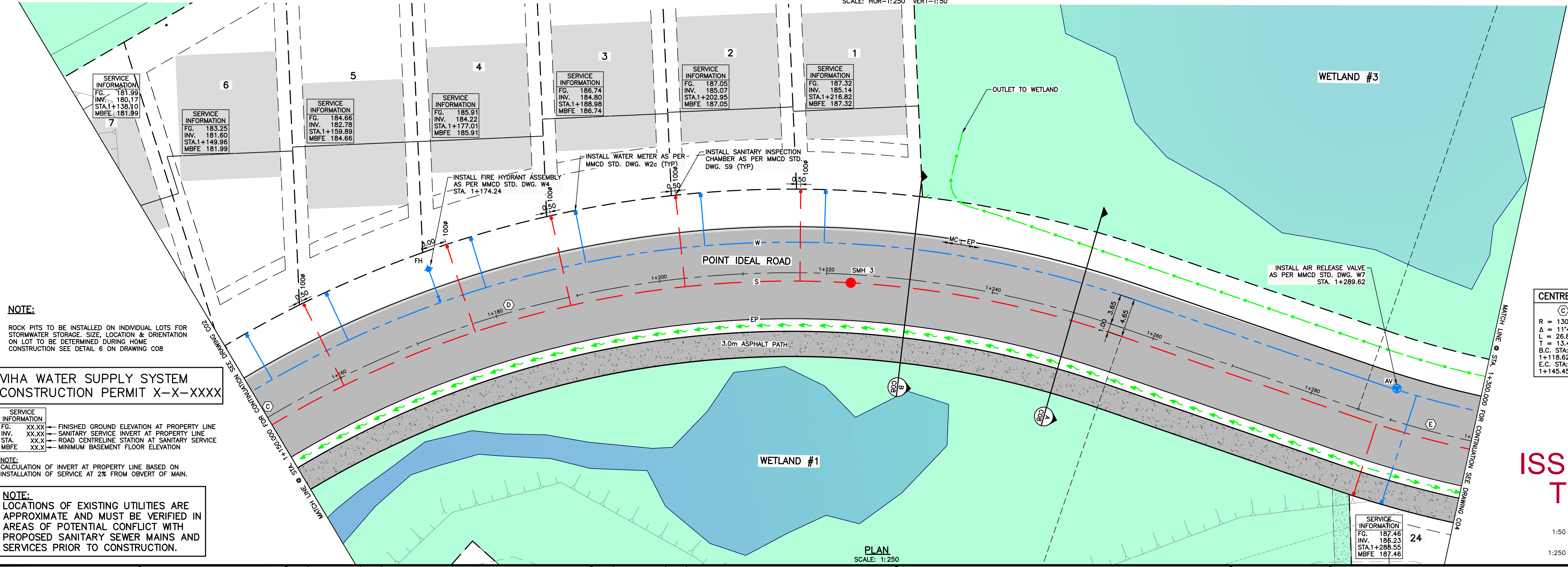
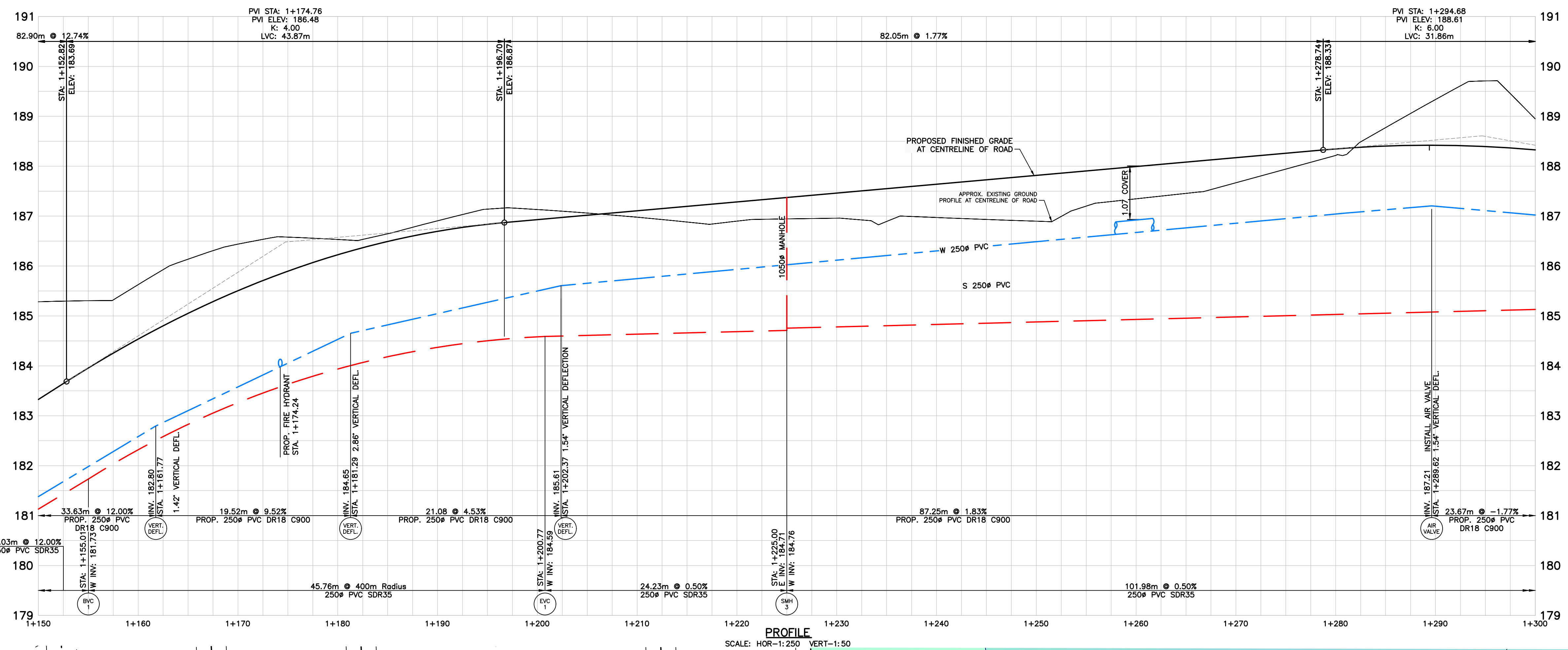
MARCH 3, 2020
ISSUED FOR TENDER

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NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
3	2020-03-03	JL	ISSUED FOR TENDER				
2	2020-01-24	JL	ISSUED FOR 90% REVIEW				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

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PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT	SCALE: HORIZ: 1:250 VERT: 1:50
TITLE: POINT IDEAL ROAD - PLAN & PROFILE WATER, SANITARY & STORM UTILITIES STA. 1+000 TO 1+150	PROJECT NO. 01-095 ISSUED/REVISION 3
	APPROVING AUTHORITY FILE NO.
	DRAWING NO. 01-095-C02



NOTE:
 ROCK PITS TO BE INSTALLED ON INDIVIDUAL LOTS FOR STORMWATER STORAGE. SIZE, LOCATION & ORIENTATION ON LOT TO BE DETERMINED DURING HOME CONSTRUCTION SEE DETAIL 6 ON DRAWING C08

VIIA WATER SUPPLY SYSTEM CONSTRUCTION PERMIT X-X-XXXX

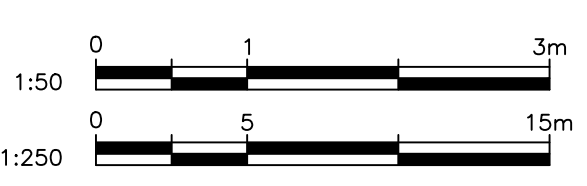
INFORMATION
 FG: XX.XX --- FINISHED GROUND ELEVATION AT PROPERTY LINE
 INV: XX.XX --- SANITARY SERVICE INVERT AT PROPERTY LINE
 STA: XX.XX --- ROAD CENTRELINE STATION AT SANITARY SERVICE
 MBFE: XX.X --- MINIMUM BASEMENT FLOOR ELEVATION

NOTE:
 CALCULATION OF INVERT AT PROPERTY LINE BASED ON INSTALLATION OF SERVICE AT 2% FROM OVERTOP OF MAIN.

NOTE:
 LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE AND MUST BE VERIFIED IN AREAS OF POTENTIAL CONFLICT WITH PROPOSED SANITARY SEWER MAINS AND SERVICES PRIOR TO CONSTRUCTION.

CENTRELINE CURVE DATA		
(C)	(D)	(E)
R = 130.00m	R = 122.00m	R = 120.00m
Δ = 114°23'	Δ = 57°08'59"	Δ = 20°58'33"
L = 26.827m	L = 110.898m	L = 43.943m
T = 13.461m	T = 59.611m	T = 22.220m
B.C. STA: = 1+118.628	E.C. STA: = 1+145.456	E.C. STA: = 1+288.382
E.C. STA: = 1+145.456	E.C. STA: = 1+256.354	E.C. STA: = 1+332.325

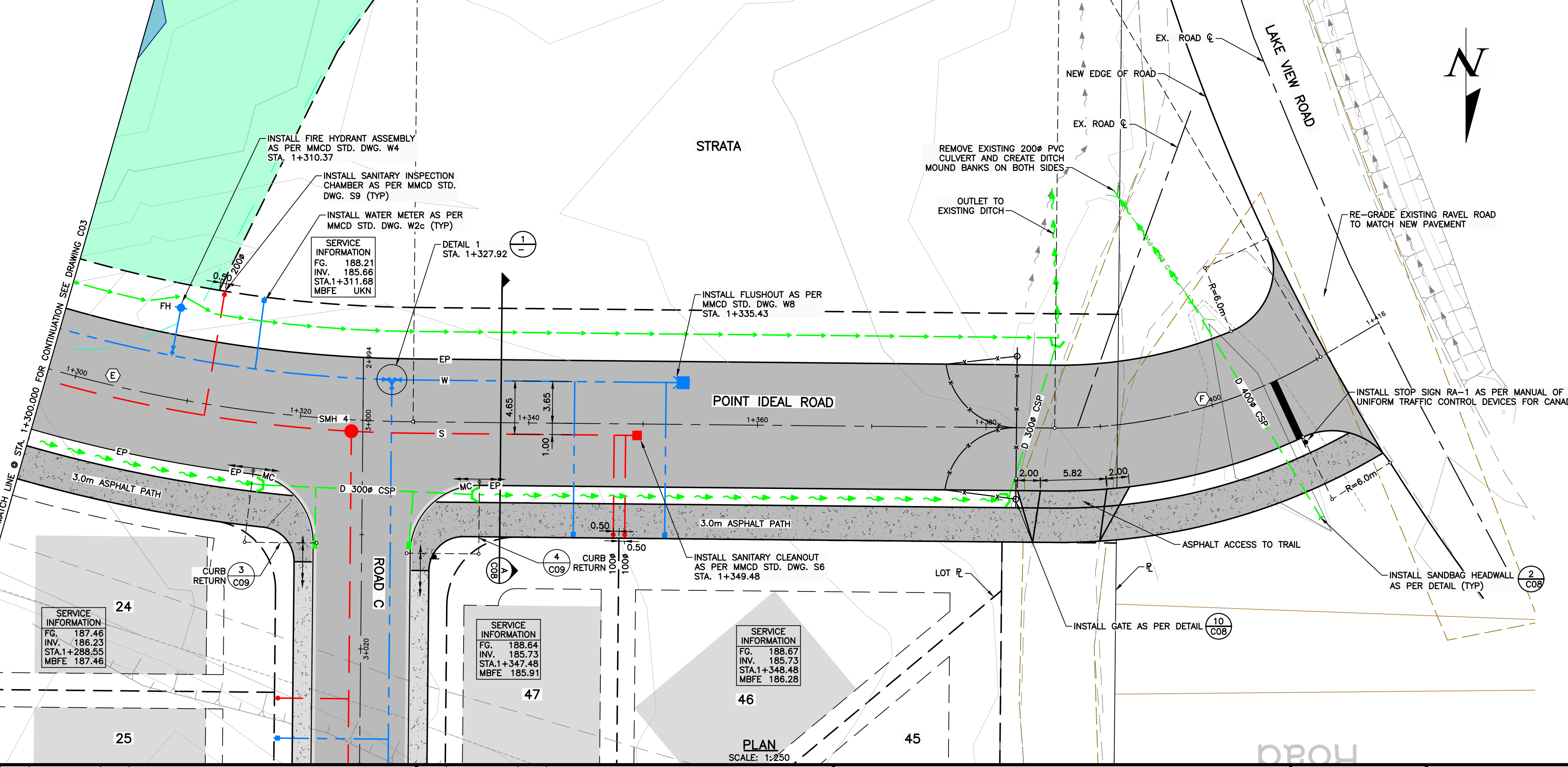
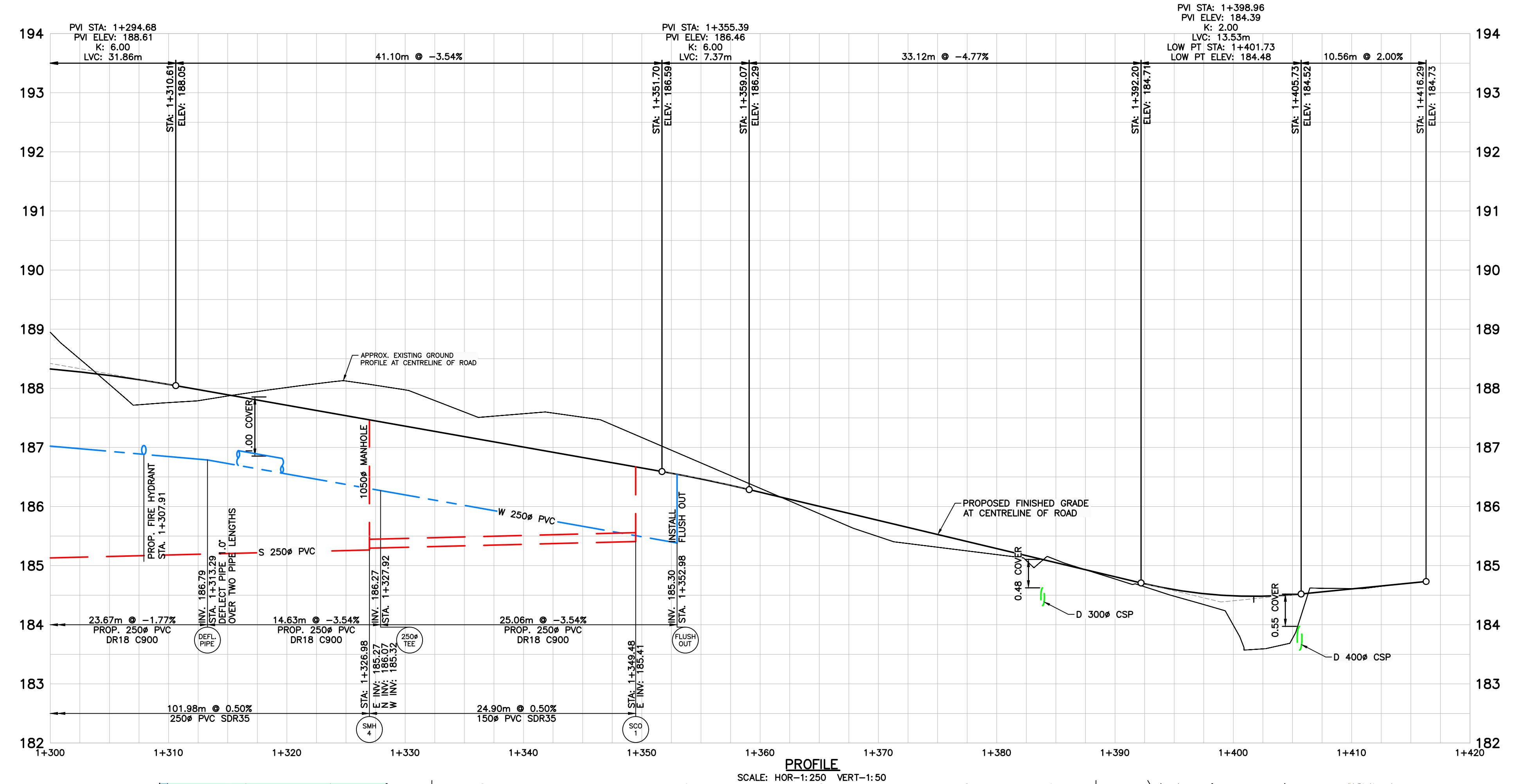
MARCH 3, 2020
ISSUED FOR TENDER



NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
3	2020-03-03	JL	ISSUED FOR TENDER				
2	2020-01-24	JL	ISSUED FOR 90% REVIEW				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

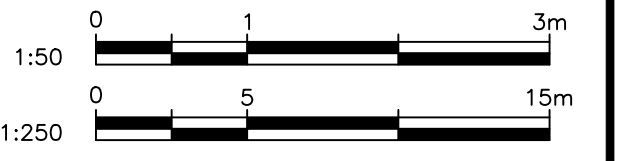
McElhanney
 202 - 5855 YORK ROAD
 DUNCAN, BC V9L 3S3
 PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT	SCALE HORIZ: 1:250 VERT: 1:50
TITLE: POINT IDEAL ROAD - PLAN & PROFILE WATER, SANITARY & STORM UTILITIES STA. 1+150 TO 1+300	PROJECT NO. 01-095
	ISSUED/REVISION 3
	APPROVING AUTHORITY FILE NO.
	DRAWING NO. 01-095-C03



CENTRELINE CURVE DATA	
(E)	(F)
R = 120.00m	R = 45.00m
Δ = 20°58'33"	Δ = 31°02'20"
L = 43.943m	L = 24.378m
T = 22.220m	T = 12.496m
B.C. STA = 1+288.38	B.C. STA = 1+388.46
E.C. STA = 1+332.33	E.C. STA = 1+332.33

MARCH 3, 2020
ISSUED FOR TENDER



VIIA WATER SUPPLY SYSTEM CONSTRUCTION PERMIT X-X-XXXX

INFORMATION	
FG. XX.XX	FINISHED GROUND ELEVATION AT PROPERTY LINE
INV. XX.XX	SANITARY SERVICE INVERT AT PROPERTY LINE
STA. XX.XX	ROAD CENTRELINE STATION AT SANITARY SERVICE
MBFE. XX.X	MINIMUM BASEMENT FLOOR ELEVATION

NOTE:
CALCULATION OF INVERT AT PROPERTY LINE BASED ON INSTALLATION OF SERVICE AT 2% FROM OVERTOP OF MAIN.

NOTE:
LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE AND MUST BE VERIFIED IN AREAS OF POTENTIAL CONFLICT WITH PROPOSED SANITARY SEWER MAINS AND SERVICES PRIOR TO CONSTRUCTION.

NO.	DATE	BY	ISSUED
3	2020-03-03	JL	ISSUED FOR TENDER
2	2020-01-24	JL	ISSUED FOR 90% REVIEW
1	2019-12-11	JL	ISSUED FOR 50% REVIEW

NO.	DATE	BY	REVISIONS

McElhanney
202 - 5855 YORK ROAD
DUNCAN, BC V9L 3S3
PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT	SCALE: HORIZ: 1:500 VERT: N/A
TITLE: POINT IDEAL ROAD - PLAN & PROFILE WATER, SANITARY & STORM UTILITIES STA. 1+300 TO 1+420	PROJECT NO. 01-095 ISSUED/REVISION 3
APPROVING AUTHORITY FILE NO.	DRAWING NO. 01-095-C04

NOTE:

ROCK PITS TO BE INSTALLED ON INDIVIDUAL LOTS FOR STORMWATER STORAGE. SIZE, LOCATION & ORIENTATION ON LOT TO BE DETERMINED DURING HOME CONSTRUCTION SEE DETAIL G ON DRAWING C08

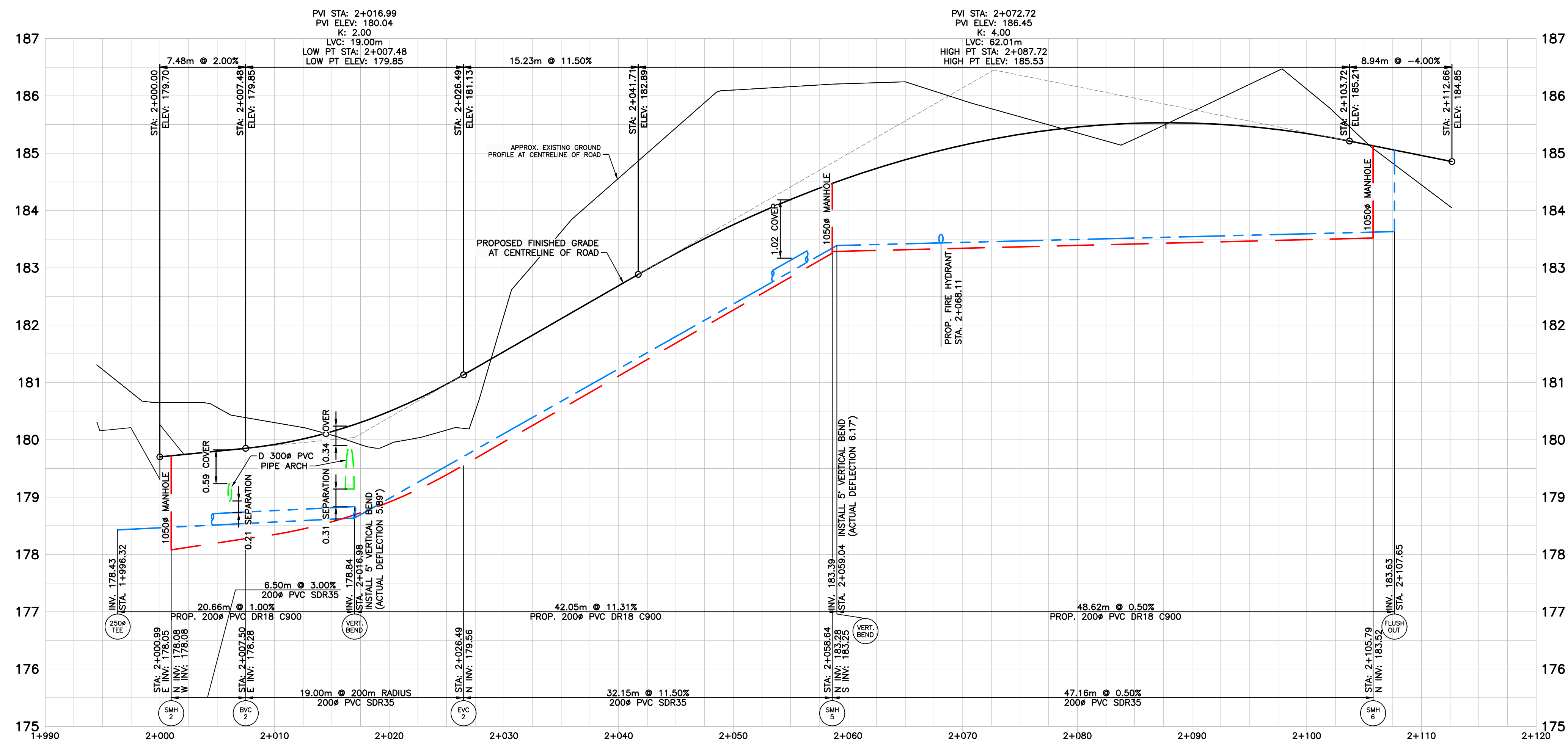
**VIHA WATER SUPPLY SYSTEM
CONSTRUCTION PERMIT X-X-XXXX**

SERVICE INFORMATION	
FG. XX.XX	FINISHED GROUND ELEVATION AT PROPERTY LINE
INV. XX.XX	SANITARY SERVICE INVERT AT PROPERTY LINE
STA. XX.XX	ROAD CENTRELINE STATION AT SANITARY SERVICE
MBFE XX.XX	MINIMUM BASEMENT FLOOR ELEVATION

NOTE: CALCULATION OF INVERT AT PROPERTY LINE BASED ON INSTALLATION OF SERVICE AT 2% FROM OVERT OF MAIN.

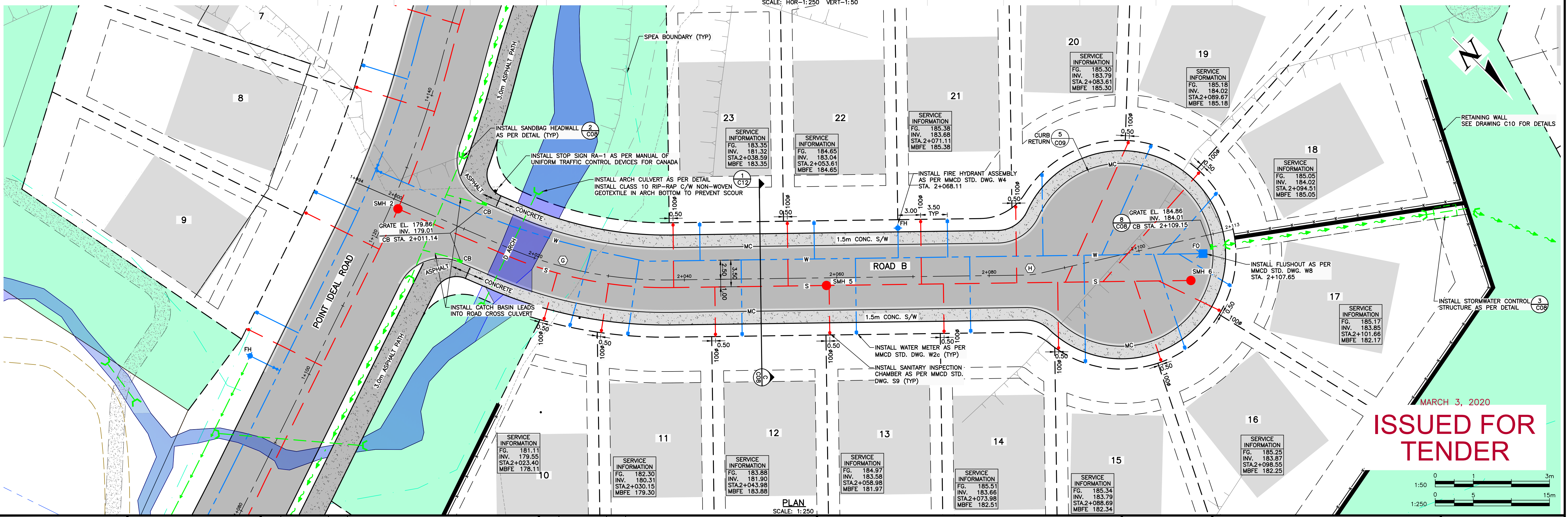
NOTE:

LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE AND MUST BE VERIFIED IN AREAS OF POTENTIAL CONFLICT WITH PROPOSED SANITARY SEWER MAINS AND SERVICES PRIOR TO CONSTRUCTION.



CENTRELINE CURVE DATA

(G)	(H)
R = 52.50m	R = 10.00m
Δ = 24°56'16"	Δ = 120°1'29"
L = 22.575m	L = 2.099m
T = 11.465m	T = 1.053m
B.C. STA: = 2+015.638	B.C. STA: = 2+084.630
E.C. STA: = 2+038.214	E.C. STA: = 2+086.729



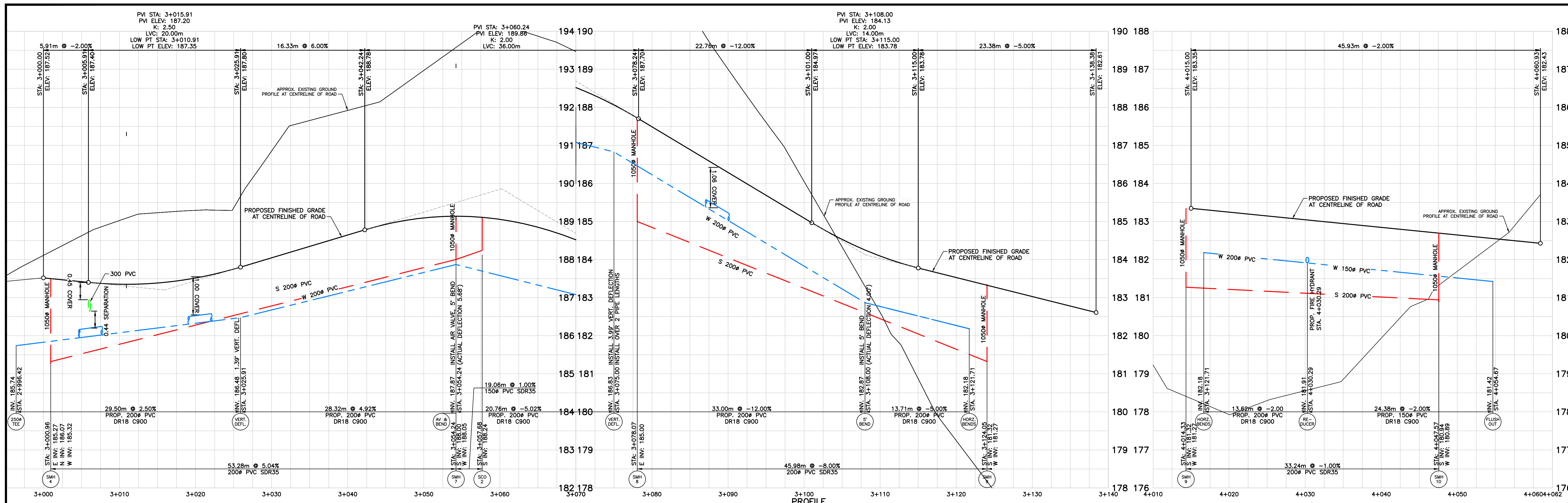
MARCH 3, 2020
ISSUED FOR TENDER

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NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
3	2020-03-03	JL	ISSUED FOR TENDER				
2	2020-01-24	JL	ISSUED FOR 90% REVIEW				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

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202 - 5855 YORK ROAD
DUNCAN, BC V9L 3S3
PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT	SCALE HORIZ: 1:250 VERT: 1:50
TITLE: ROAD B - PLAN & PROFILE WATER, SANITARY & STORM UTILITIES	PROJECT NO. 01-095
SEAL	ISSUED/REVISION 3
	APPROVING AUTHORITY FILE NO.
	DRAWING NO. 01-095-C05



**VIHA WATER SUPPLY SYSTEM
CONSTRUCTION PERMIT X-X-XXXX**

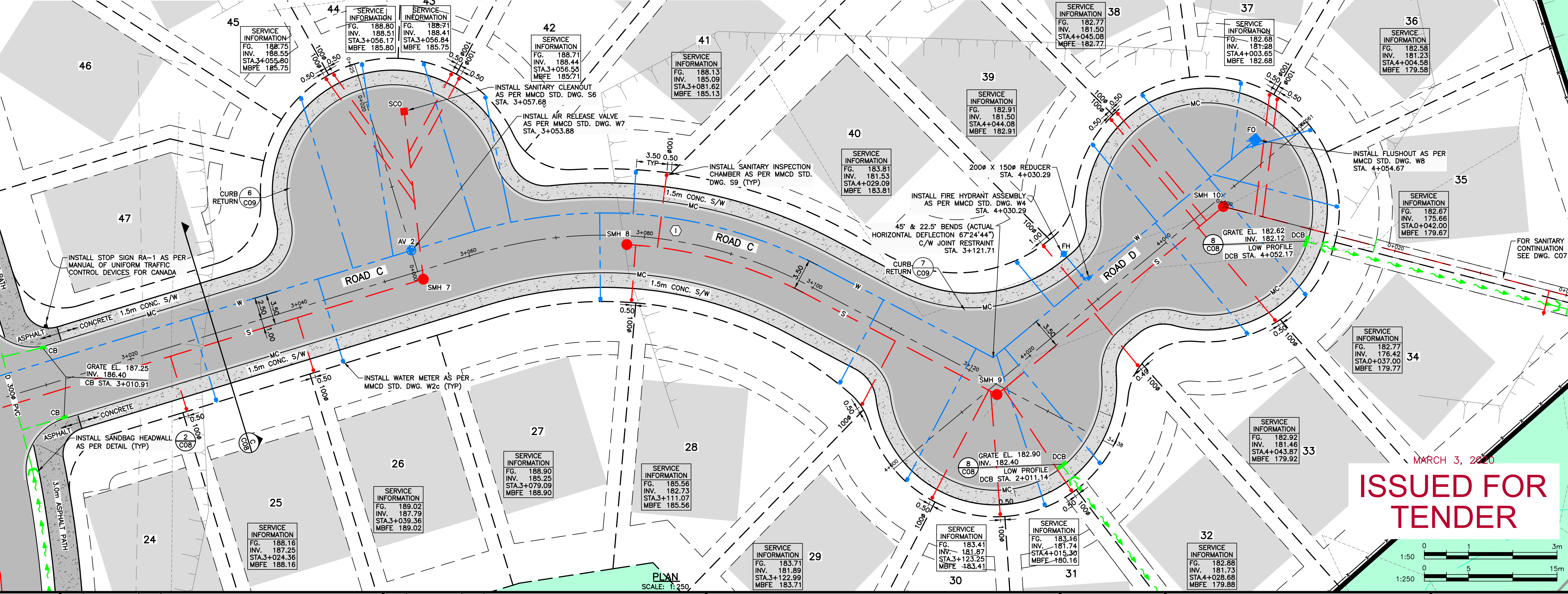
SERVICE INFORMATION
 FG. XX.XX - FINISHED GROUND ELEVATION AT PROPERTY LINE
 INV. XX.XX - SANITARY SERVICE INVERT AT PROPERTY LINE
 STA. XX.X - ROAD CENTRELINE STATION AT SANITARY SERVICE
 MBFE. XX.X - MINIMUM BASEMENT FLOOR ELEVATION

NOTE:
 CALCULATION OF INVERT AT PROPERTY LINE BASED ON INSTALLATION OF SERVICE AT 2% FROM OVERTOP OF MAIN.

NOTE:
 LOCATIONS OF EXISTING UTILITIES ARE APPROXIMATE AND MUST BE VERIFIED IN AREAS OF POTENTIAL CONFLICT WITH PROPOSED SANITARY SEWER MAINS AND SERVICES PRIOR TO CONSTRUCTION.

CENTRELINE CURVE DATA
 R = 50.00m
 Δ = 44°39'43"
 L = 38.975m
 T = 20.538m
 B.C. STA. = 3+090.605
 E.C. STA. = 3+099.580

NOTE:
 ROCK PITS TO BE INSTALLED ON INDIVIDUAL LOTS FOR STORMWATER STORAGE. SIZE, LOCATION & ORIENTATION ON LOT TO BE DETERMINED DURING HOME CONSTRUCTION SEE DETAIL 6 ON DRAWING COB



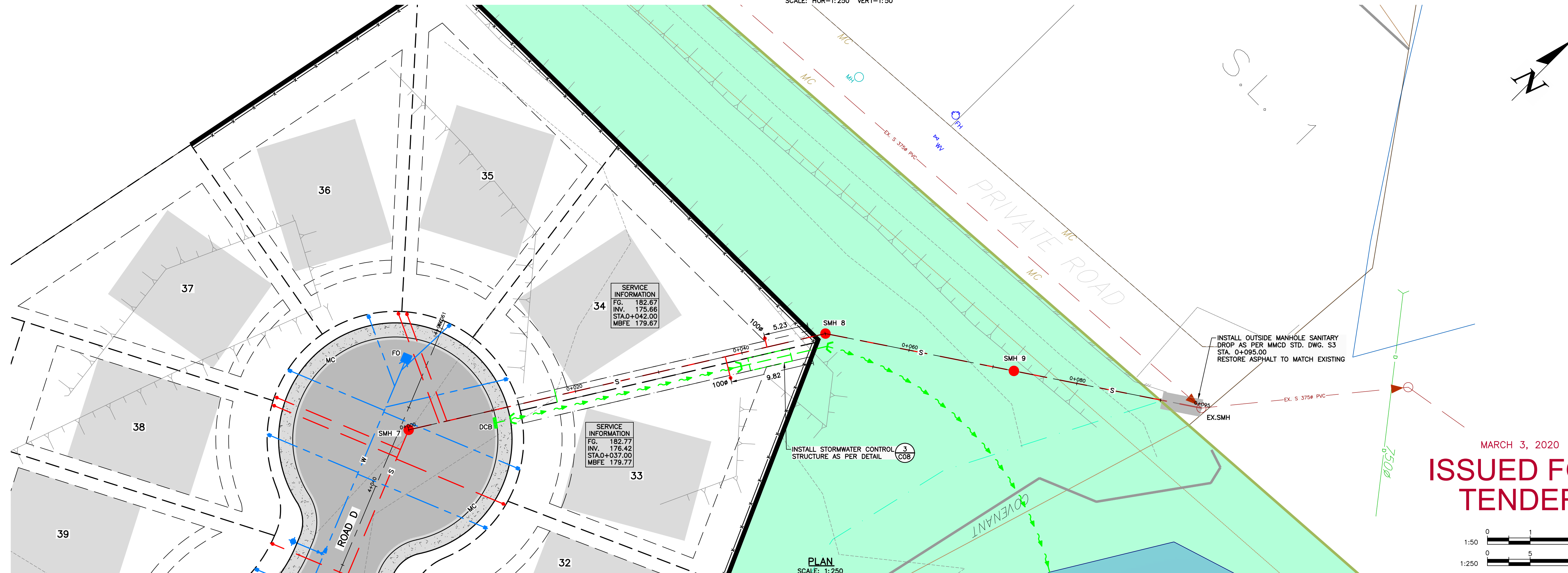
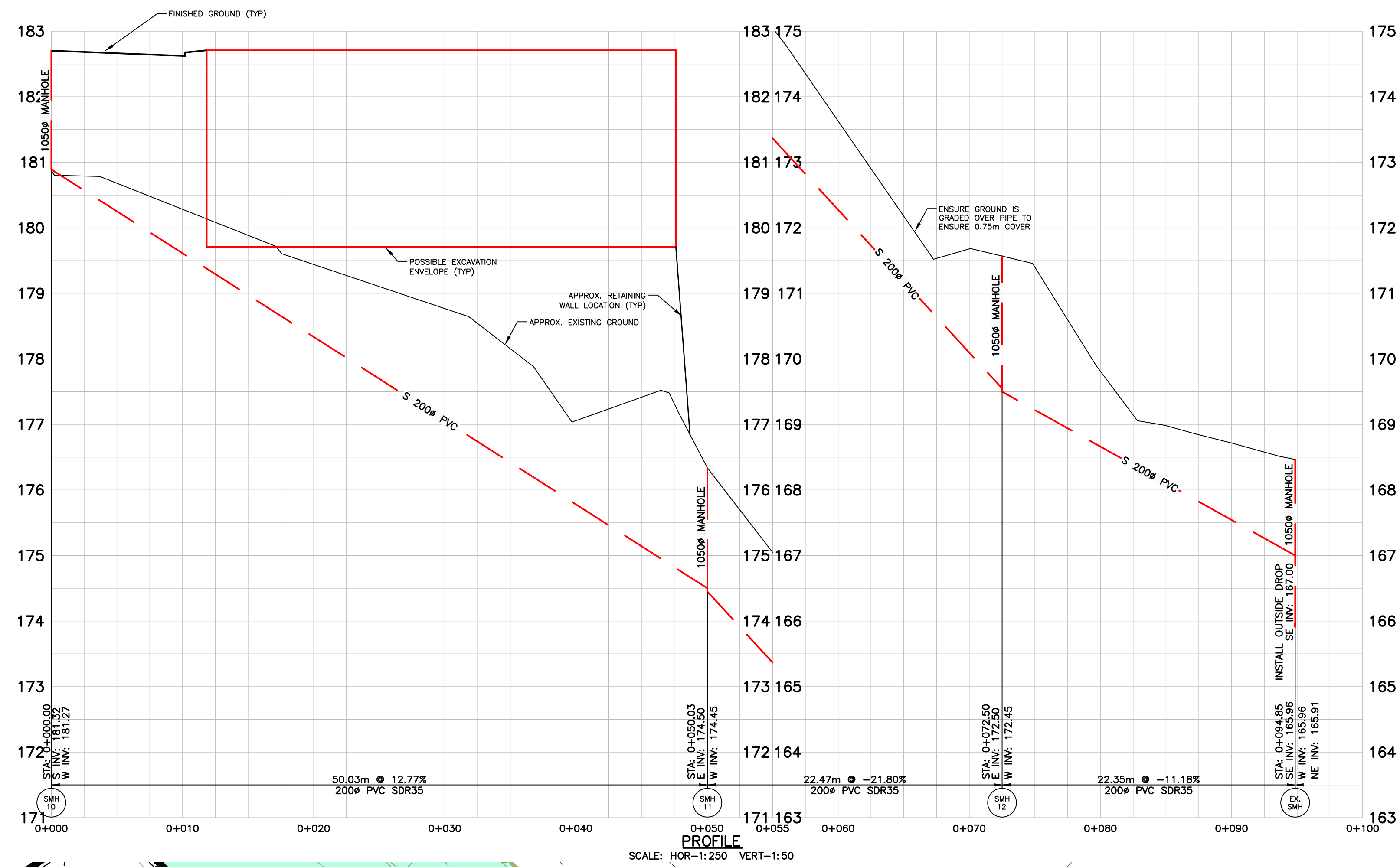
ISSUED FOR TENDER

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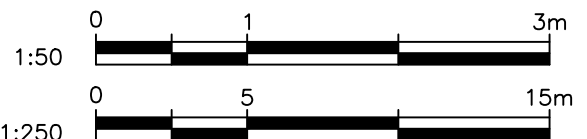
NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
2	2020-03-03	JL	ISSUED FOR TENDER				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

McElhanney
 202 - 5855 YORK ROAD
 DUNCAN, BC V9L 3S3
 PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT
 TITLE: ROAD C & D - PLAN & PROFILE WATER, SANITARY & STORM UTILITIES
 SCALE: HORIZ: 1:250 VERT: 1:50
 PROJECT NO. 01-095
 ISSUED/REVISION 2
 APPROVING AUTHORITY FILE NO.
 DRAWING NO. 01-095-C06



MARCH 3, 2020
ISSUED FOR TENDER



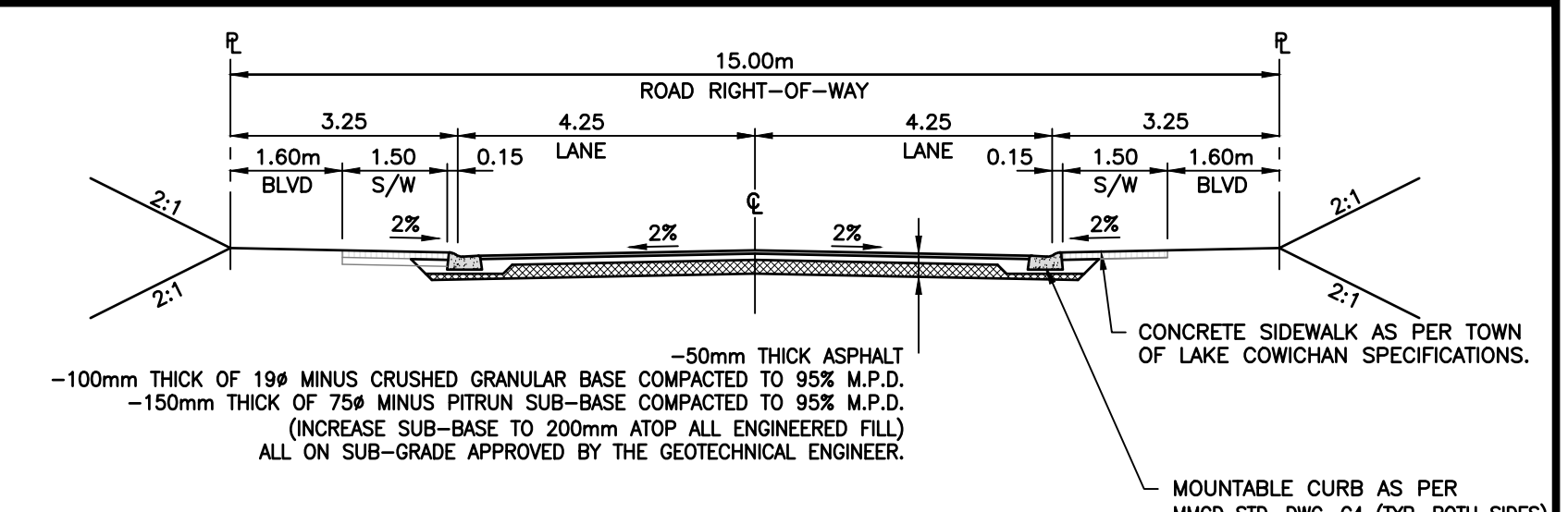
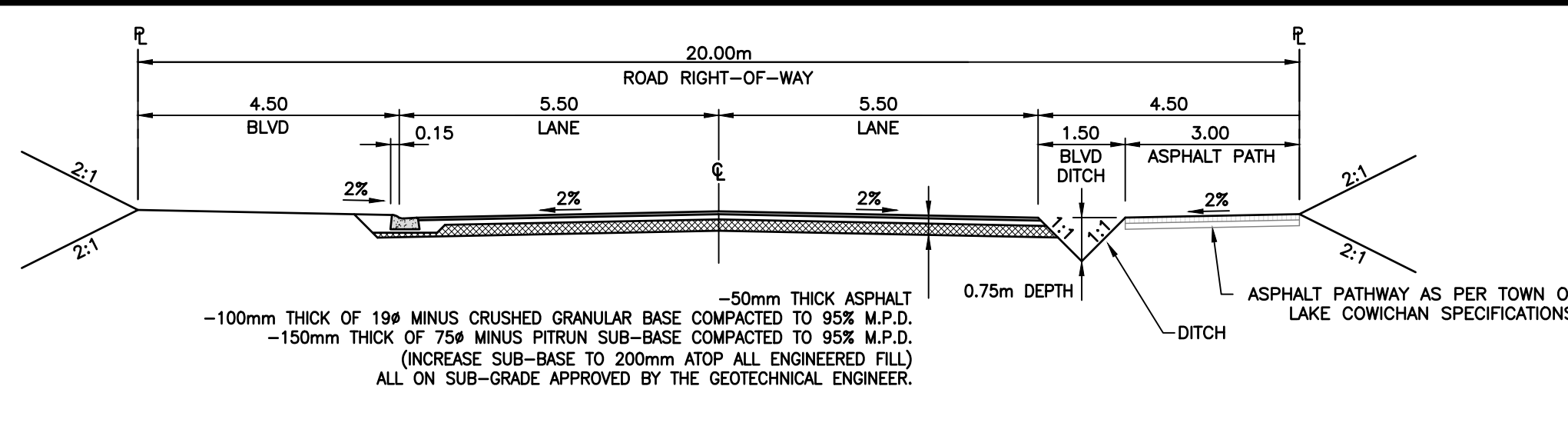
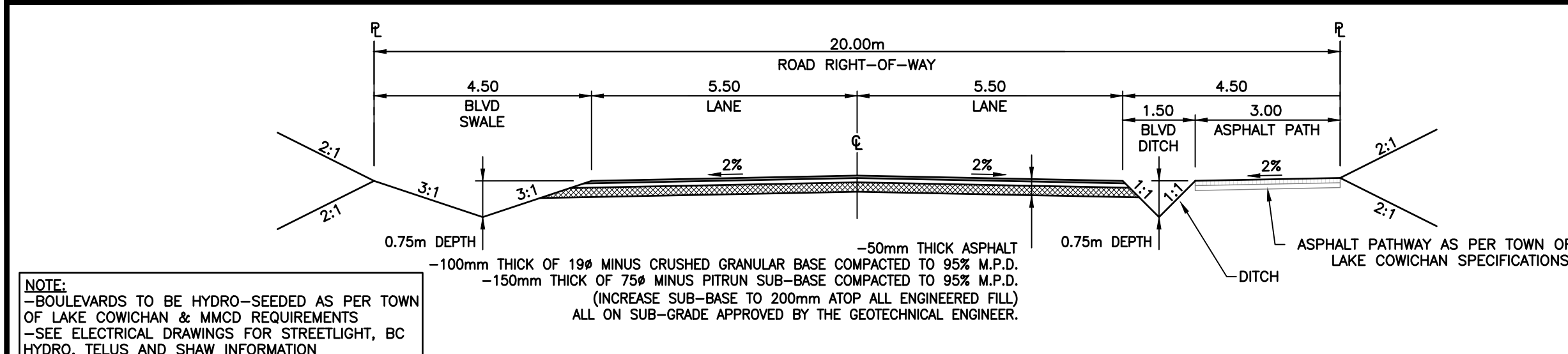
S:\3\333\01095-00_P001.dwg - TOWN OF HALE CORRECTION S.D. - BRANDES11 - ACTING ENGINEER - 3/2/2020 4:28 PM CDT

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NO.	DATE	BY	ISSUED	NO.	DATE	BY	REVISIONS
2	2020-03-03	JL	ISSUED FOR TENDER				
1	2019-12-11	JL	ISSUED FOR 50% REVIEW				

McElhanney
202 - 5855 YORK ROAD
DUNCAN, BC V9L 3S3 PH (250) 748-3335

PROJECT: POINT IDEAL DEVELOPMENT	SCALE HORIZ: 1:250 VERT: 1:50
TITLE: ROAD D - PLAN & PROFILE SANITARY UTILITY OFFSITE	PROJECT NO. 01-095
	ISSUED/REVISION 2
	APPROVING AUTHORITY FILE NO.
	DRAWING NO. 01-095-C07

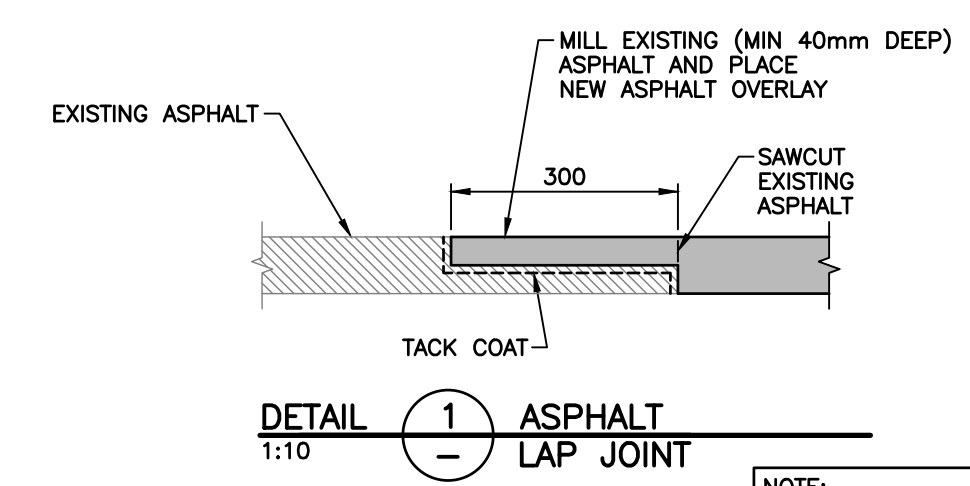


NOTE:
-BOULEVARDS TO BE HYDRO-SEEDED AS PER TOWN OF LAKE COWICHAN & MMCO REQUIREMENTS
-SEE ELECTRICAL DRAWINGS FOR STREETLIGHT, BC HYDRO, TELUS AND SHAW INFORMATION

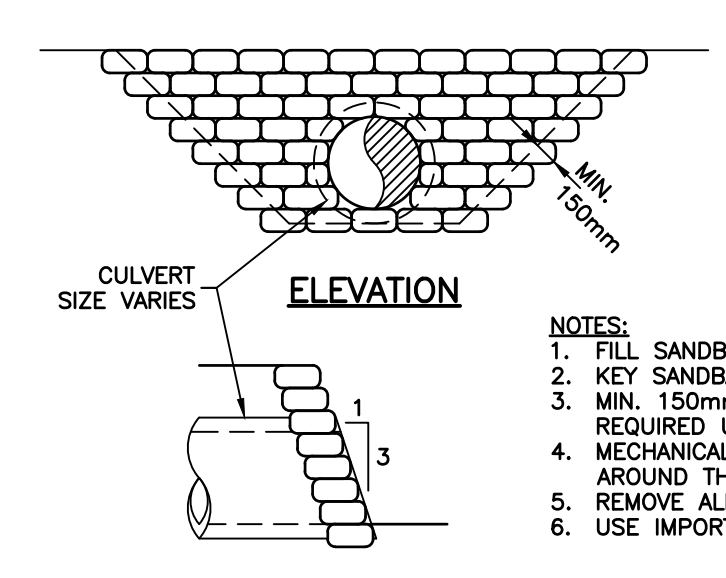
SECTION A POINT IDEAL ROAD
1:100

SECTION B POINT IDEAL ROAD
1:100

SECTION C ROAD B & C
1:100

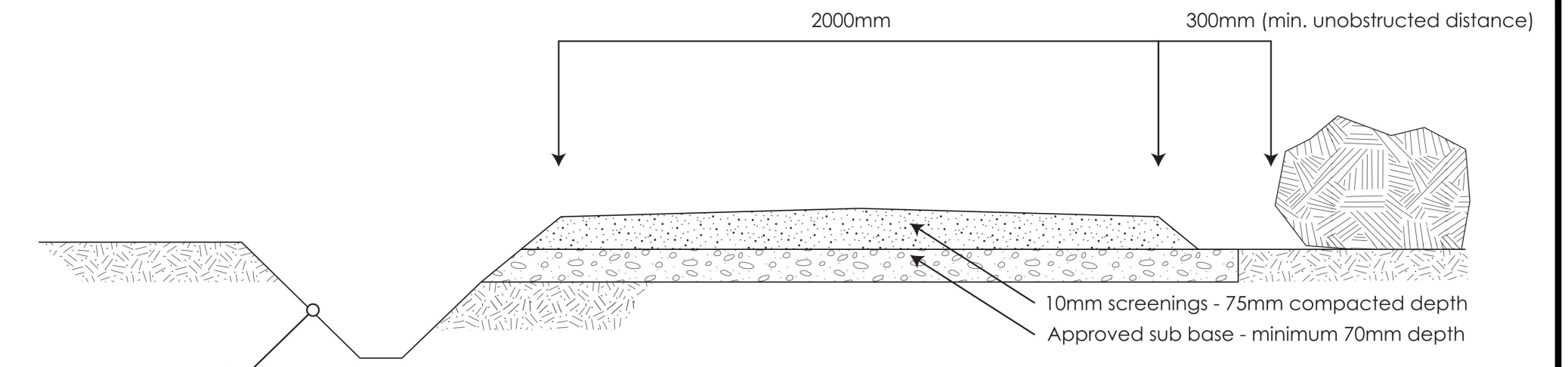


NOTE:
-BUTT JOINT WITH CRACK SEALANT TO BE INSTALLED IF EXISTING ASPHALT DEPTH NOT SUITABLE FOR LAP JOINT INSTALLATION

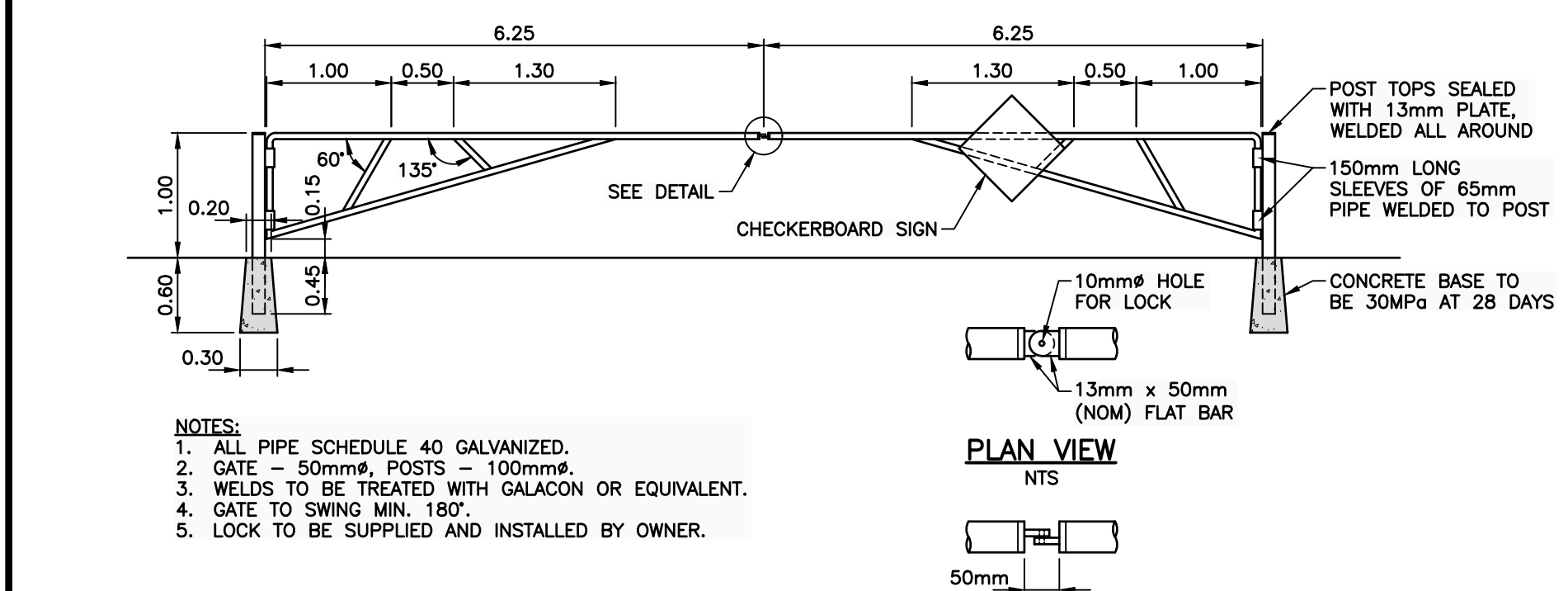


NOTE:
1. FILL SANDBAGS WITH 5:1 SAND-CEMENT MIX.
2. KEY SANDBAGS MIN. 150mm INTO DITCH SIDES.
3. MIN. 150mm OF SUITABLE BEDDING MATERIAL REQUIRED UNDER CULVERT; 250mm IF IN ROCK.
4. MECHANICALLY COMPACT THE BEDDING MATERIAL AROUND THE CULVERT IN MAX. 150mm LIFTS.
5. REMOVE ALL ORGANIC MATERIAL FROM UNDER CULVERT.
6. USE IMPORTED GRANULAR FILL BETWEEN HEADWALLS.

PROFILE
DETAIL 2 SANDBAG HEADWALL
1:10



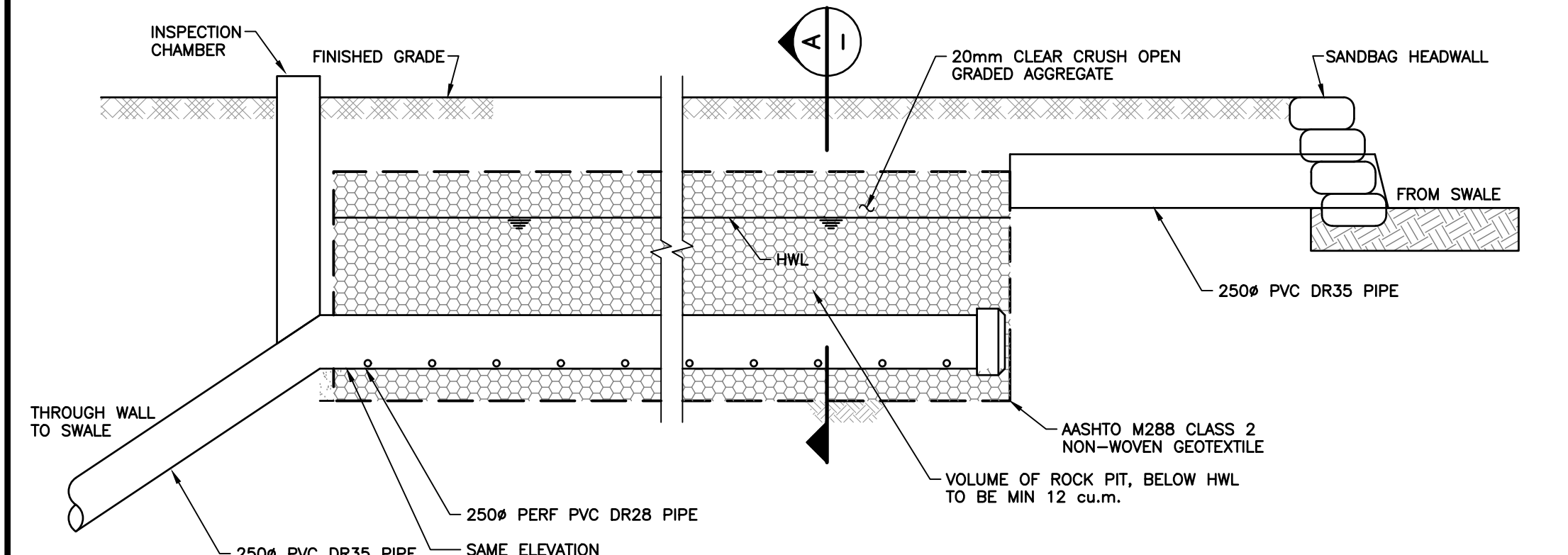
TRAIL CROSS SECTION
5 TRAIL TYPICAL SECTION
NTS



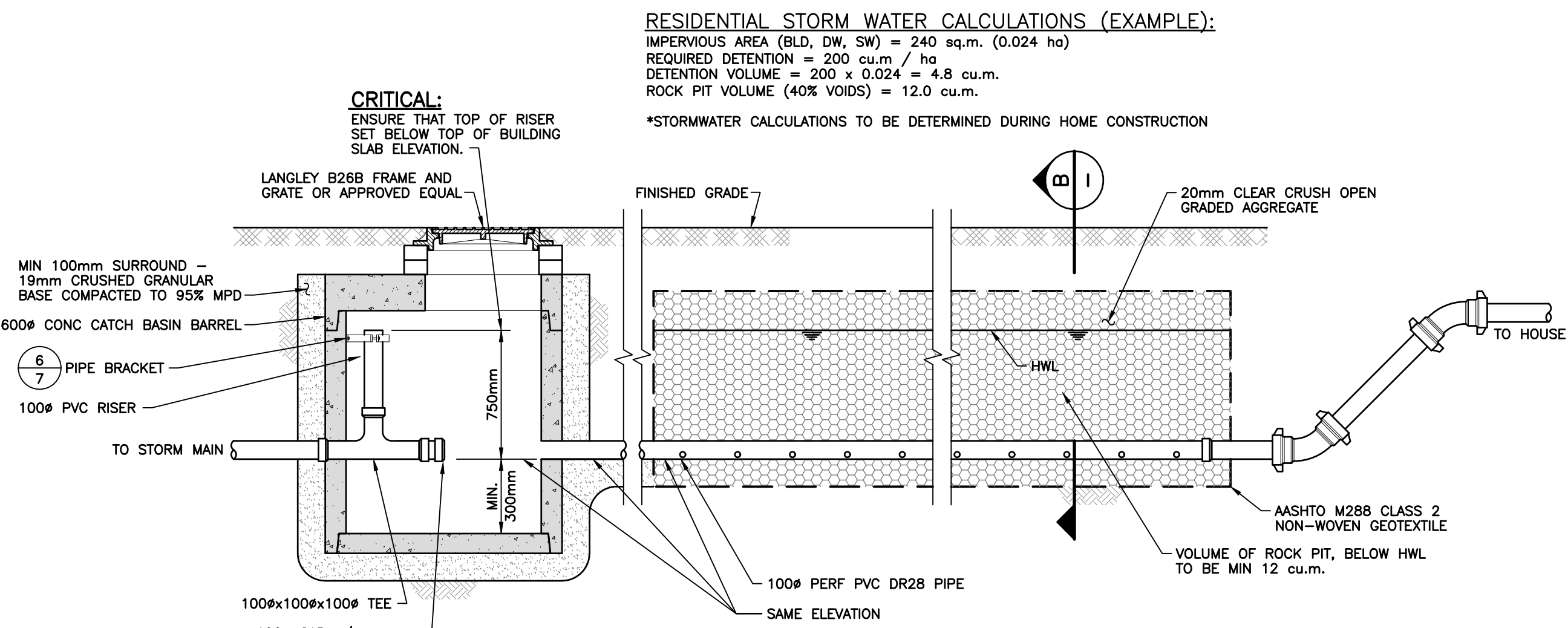
NOTE:
1. ALL PIPE SCHEDULE 40 GALVANIZED.
2. GATE - 50mmØ, POSTS - 100mmØ.
3. WELDS TO BE TREATED WITH GALACON OR EQUIVALENT.
4. GATE TO SWING MIN. 180°.
5. LOCK TO BE SUPPLIED AND INSTALLED BY OWNER.

DETAIL 10 GATE
1:50

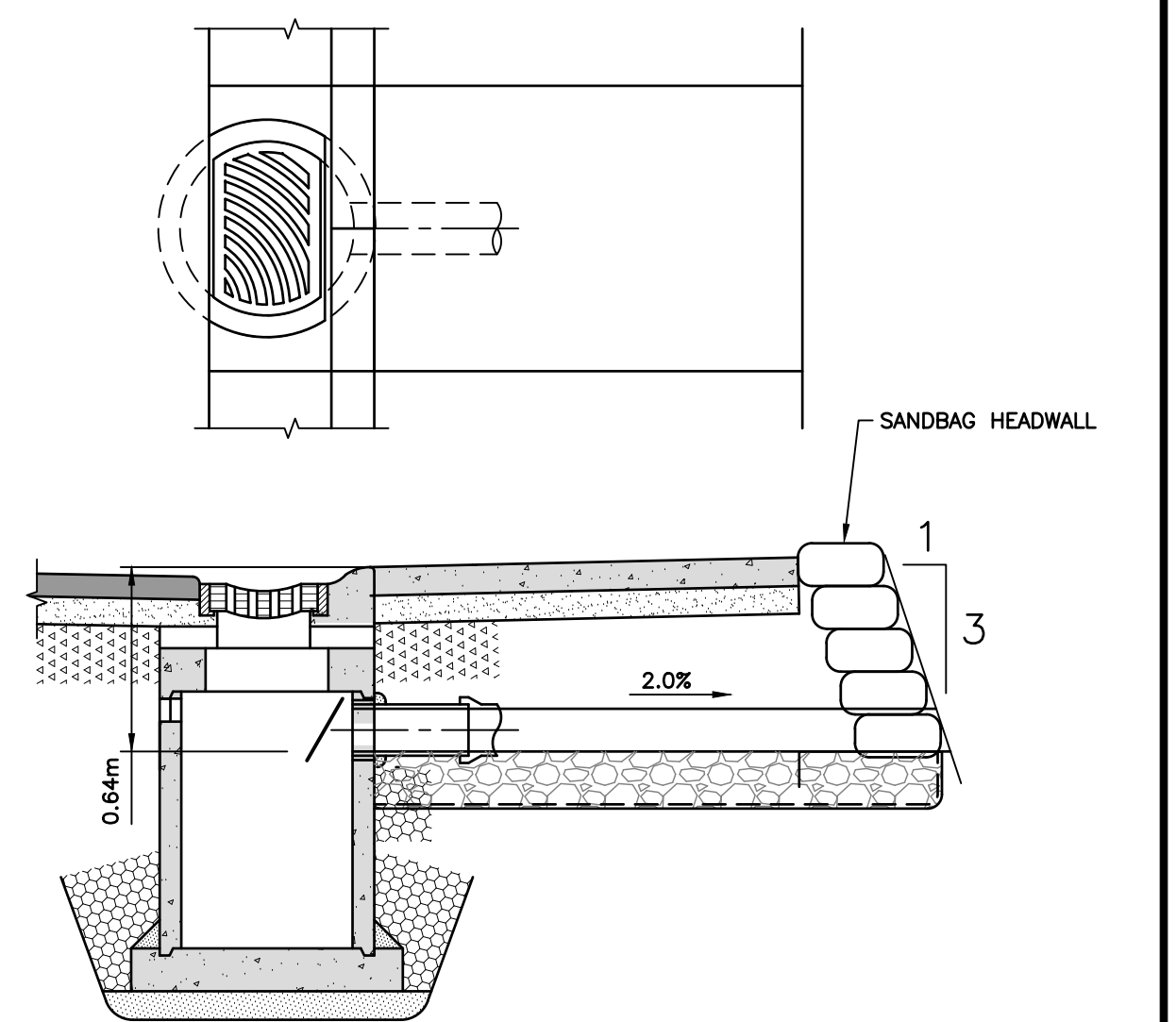
ROCK PIT SIZING:
ROAD B - 1.5m WIDE x 3.0m LONG x 1.0m DEEP
ROAD C - 2.5m WIDE x 4.0m LONG x 2.0m DEEP
ROAD D - 1.5m WIDE x 5.0m LONG x 2.0m DEEP



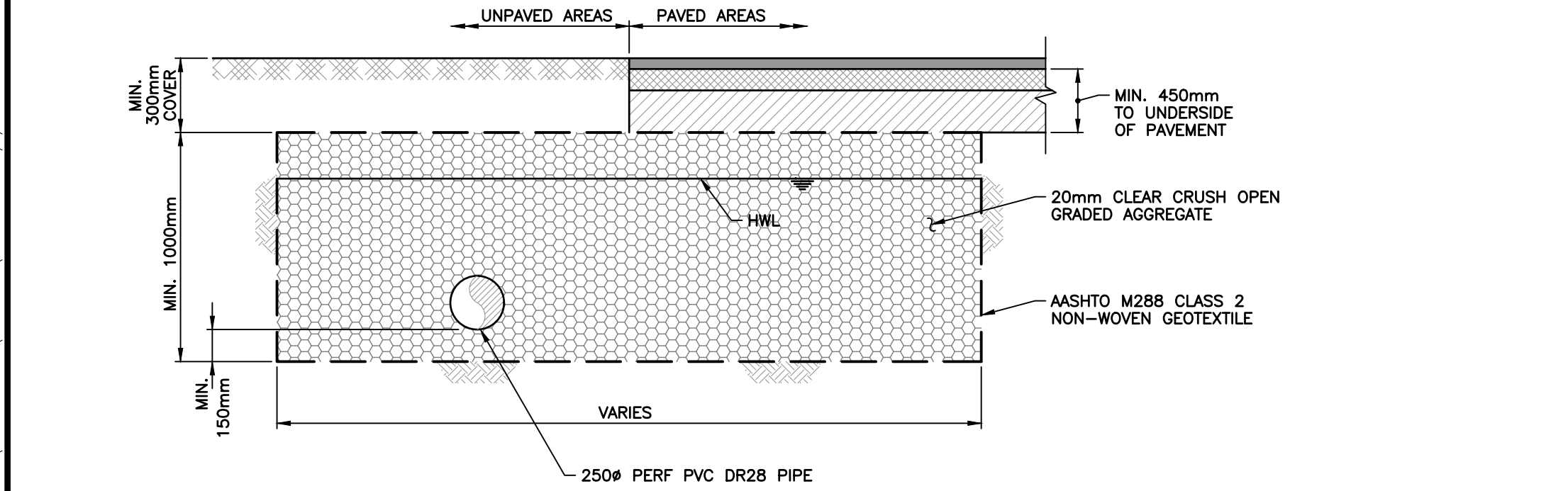
DETAIL 3 STORMWATER ROCK PIT
1:25



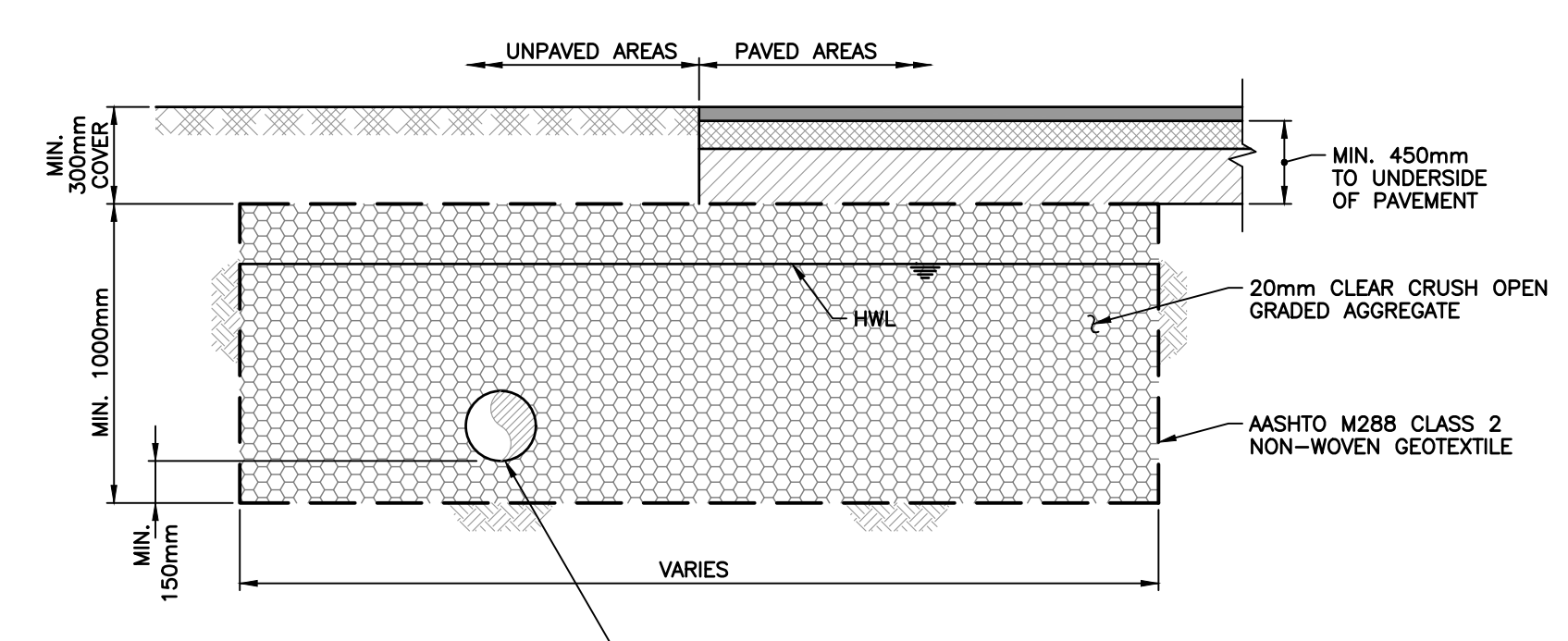
DETAIL 6 RESIDENTIAL STORMWATER ROCK PIT AND FLOW CONTROL MANHOLE
1:25



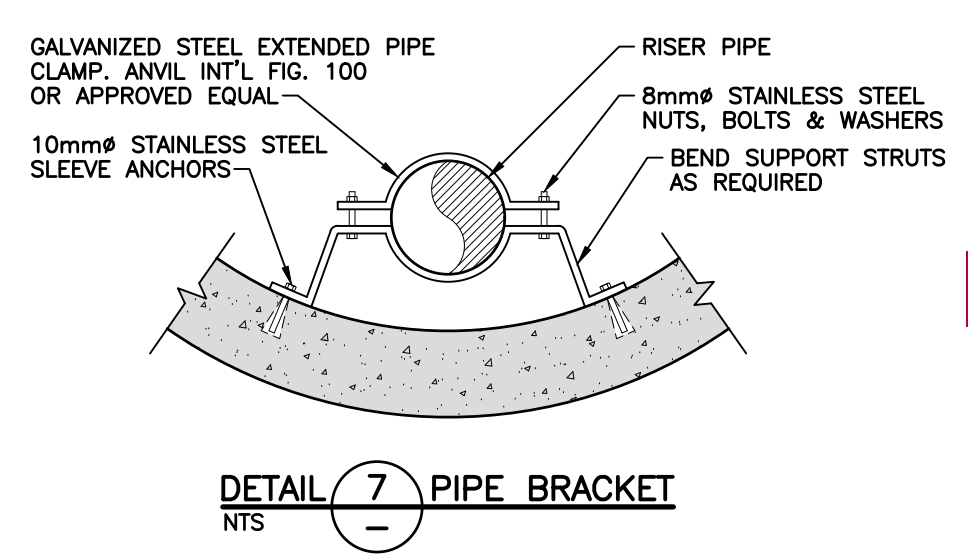
DETAIL 8 CATCH BASIN AT CUL-DE-SAC (TYP)
1:25



SECTION A STORMWATER ROCK PIT
1:25

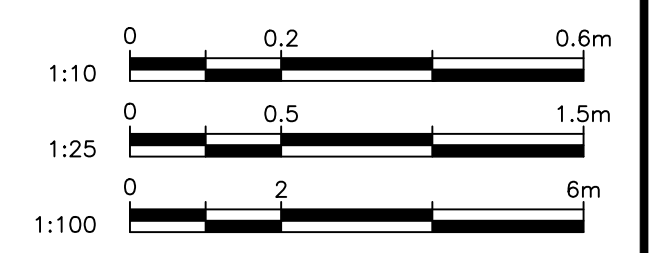


SECTION B STORMWATER ROCK PIT
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DETAIL 7 PIPE BRACKET
NTS

MARCH 3, 2020
ISSUED FOR TENDER

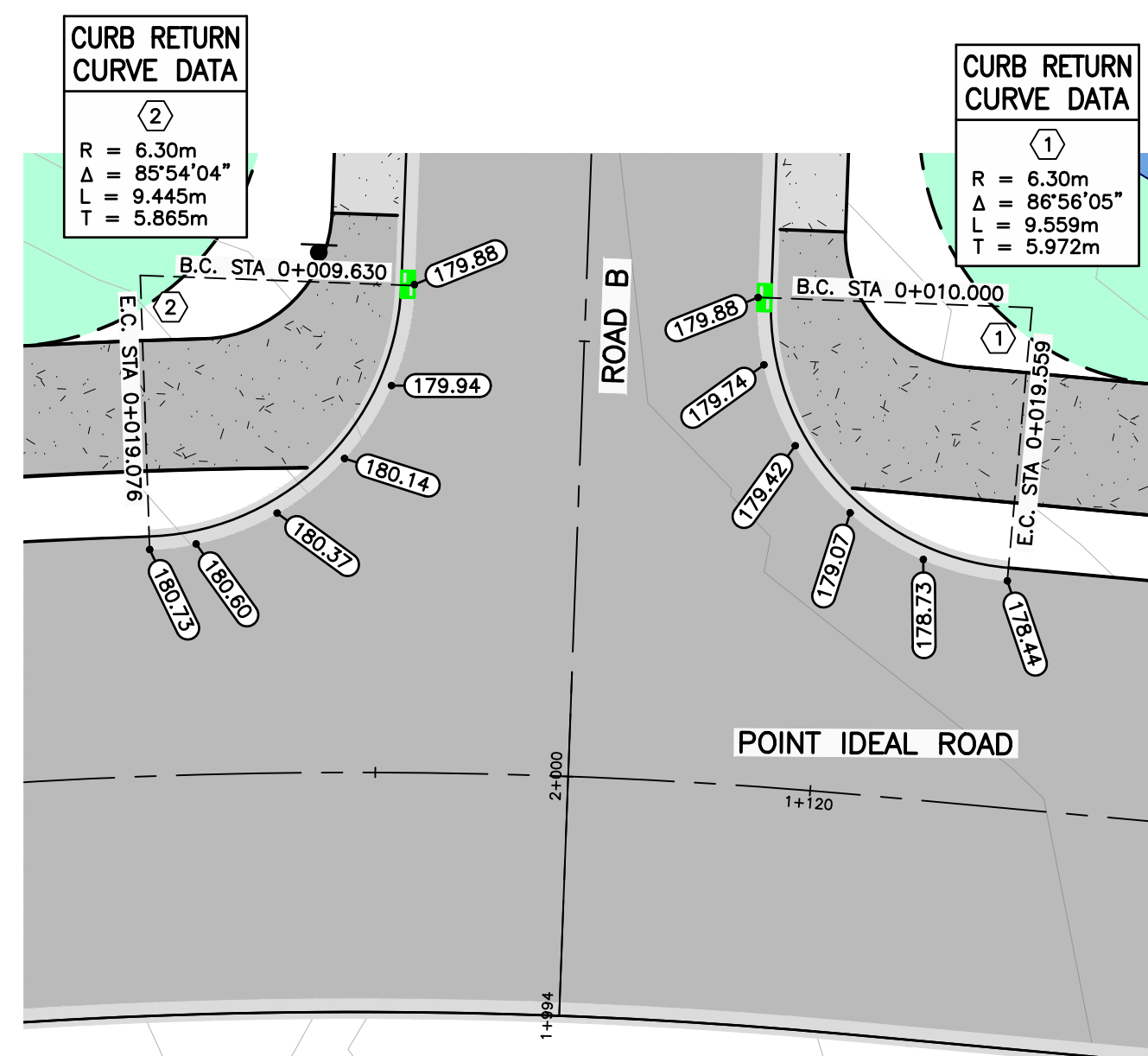


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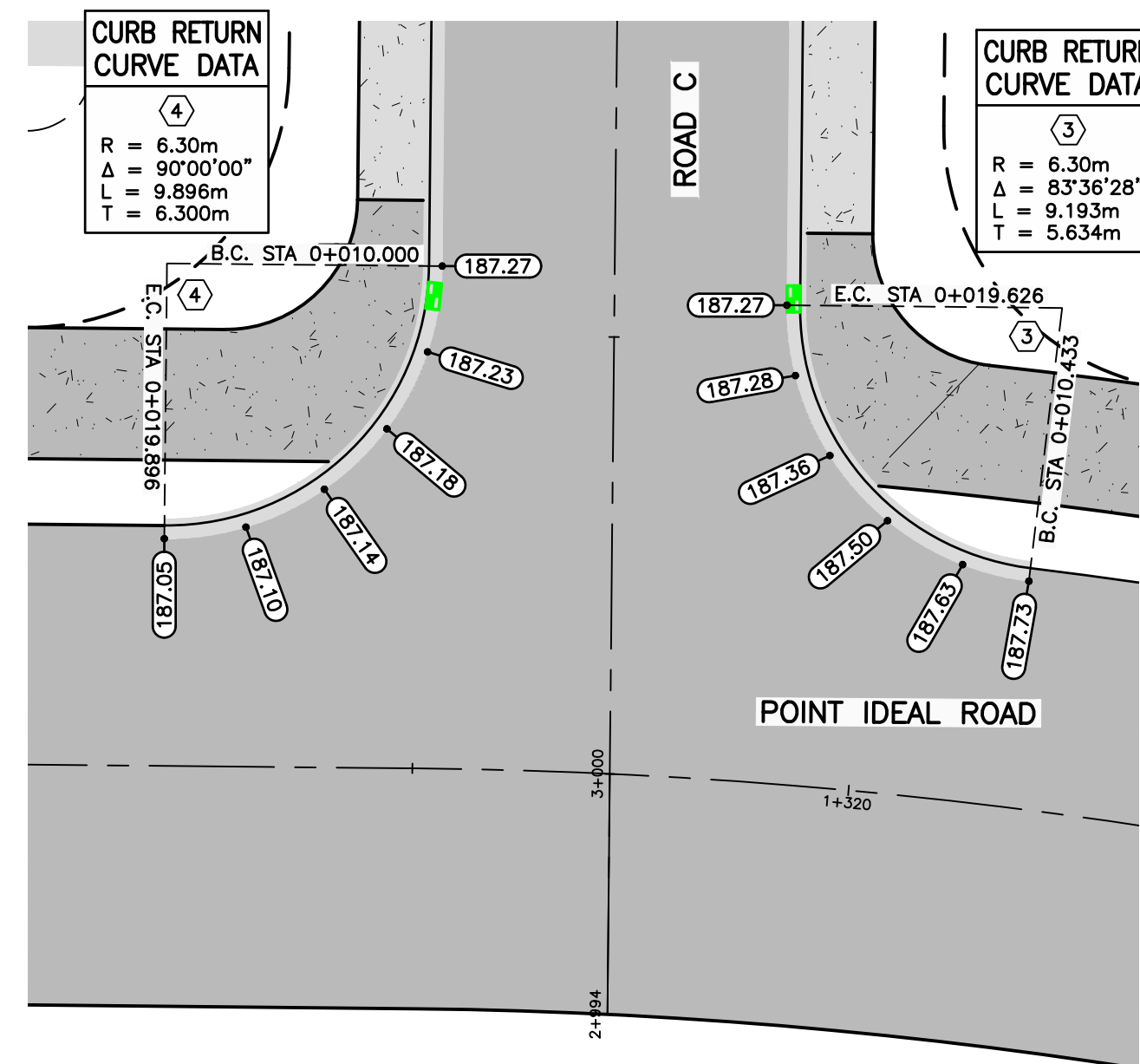
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DUNCAN, BC V9L 3S3
PH (250) 748-3335

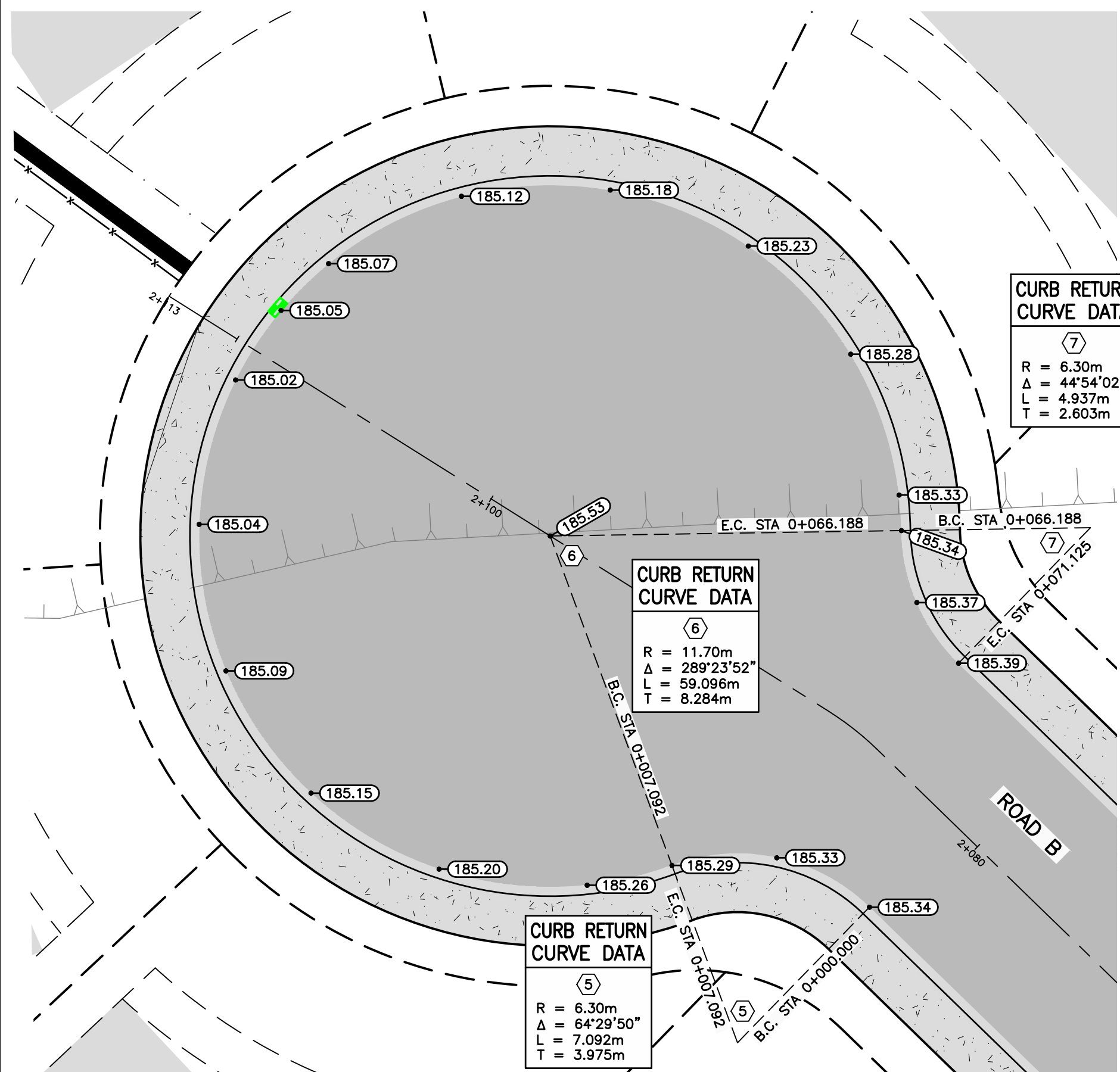
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		ISSUED/REVISION 3
		APPROVING AUTHORITY FILE NO.
		DRAWING NO. 01-095-C08



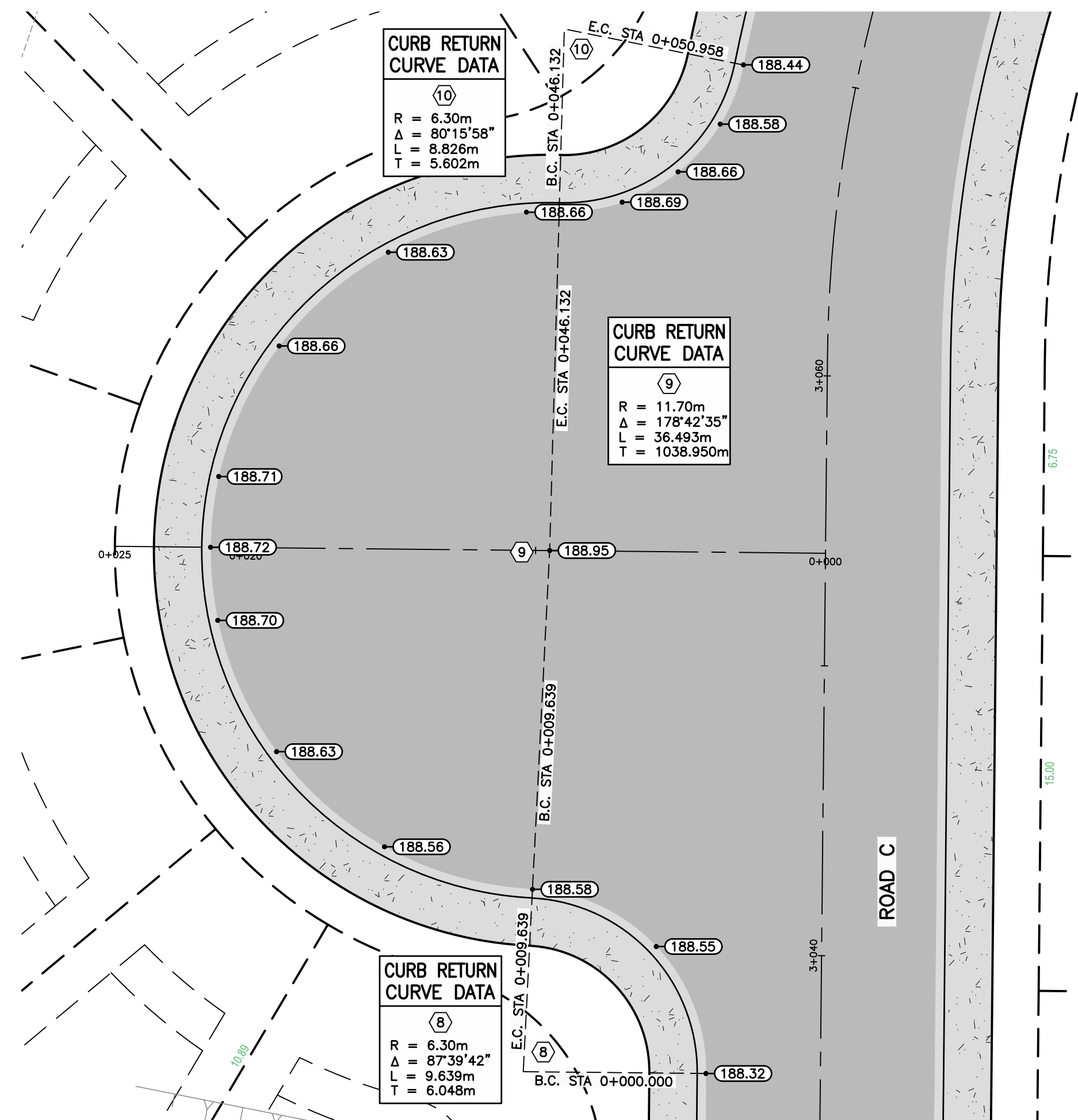
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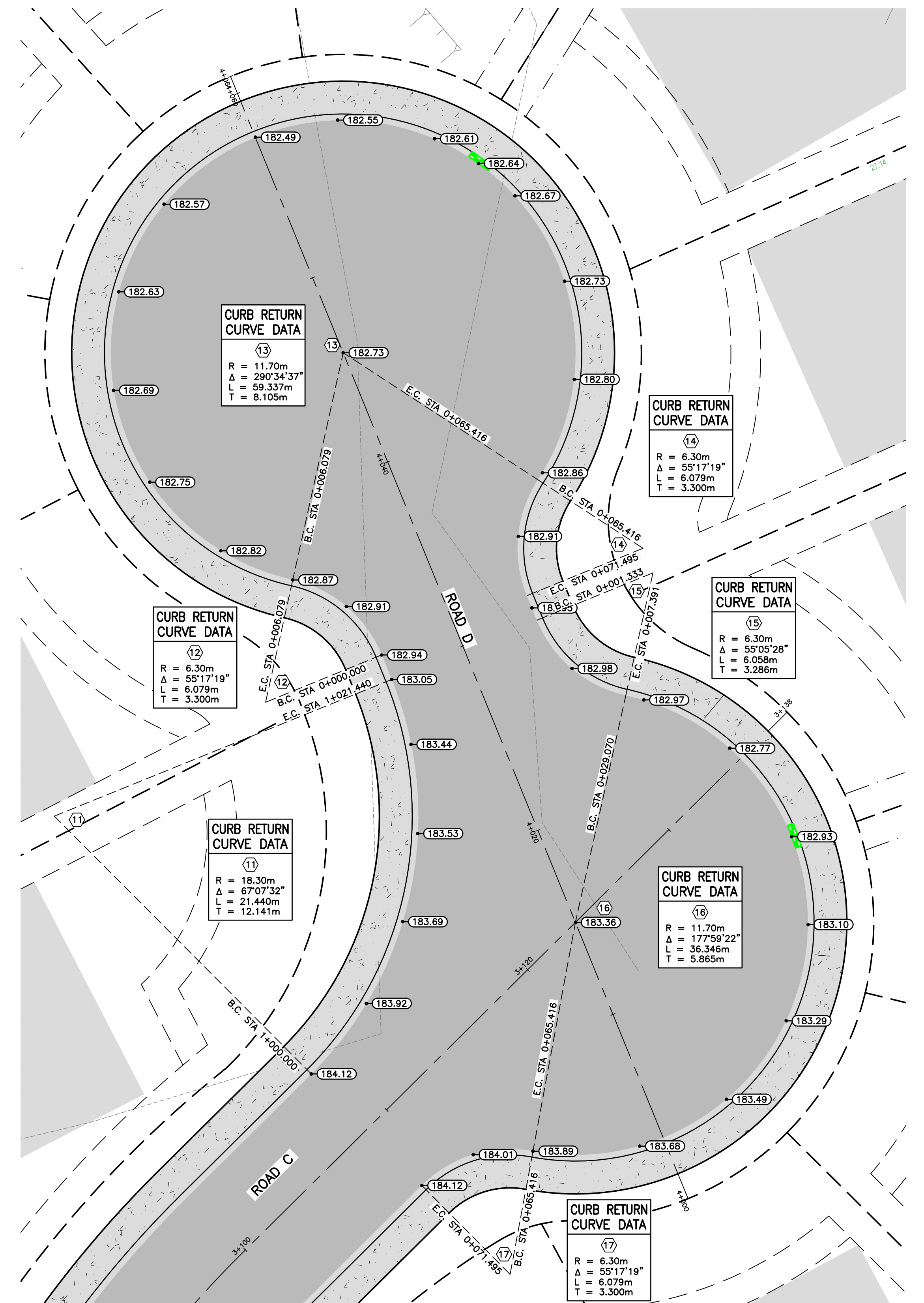
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⑤ CURB RETURN DETAIL
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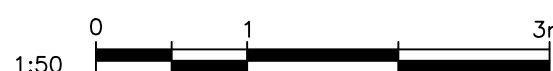


⑧ CURB RETURN DETAIL
1:150



⑰ CURB RETURN DETAIL
1:150

MARCH 3, 2020
ISSUED FOR TENDER

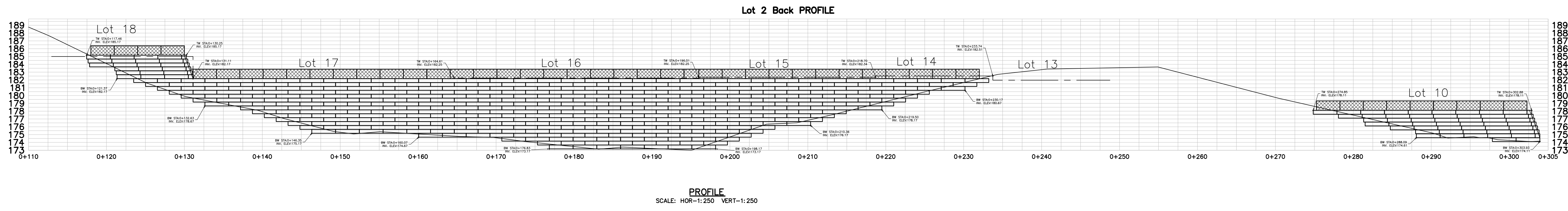


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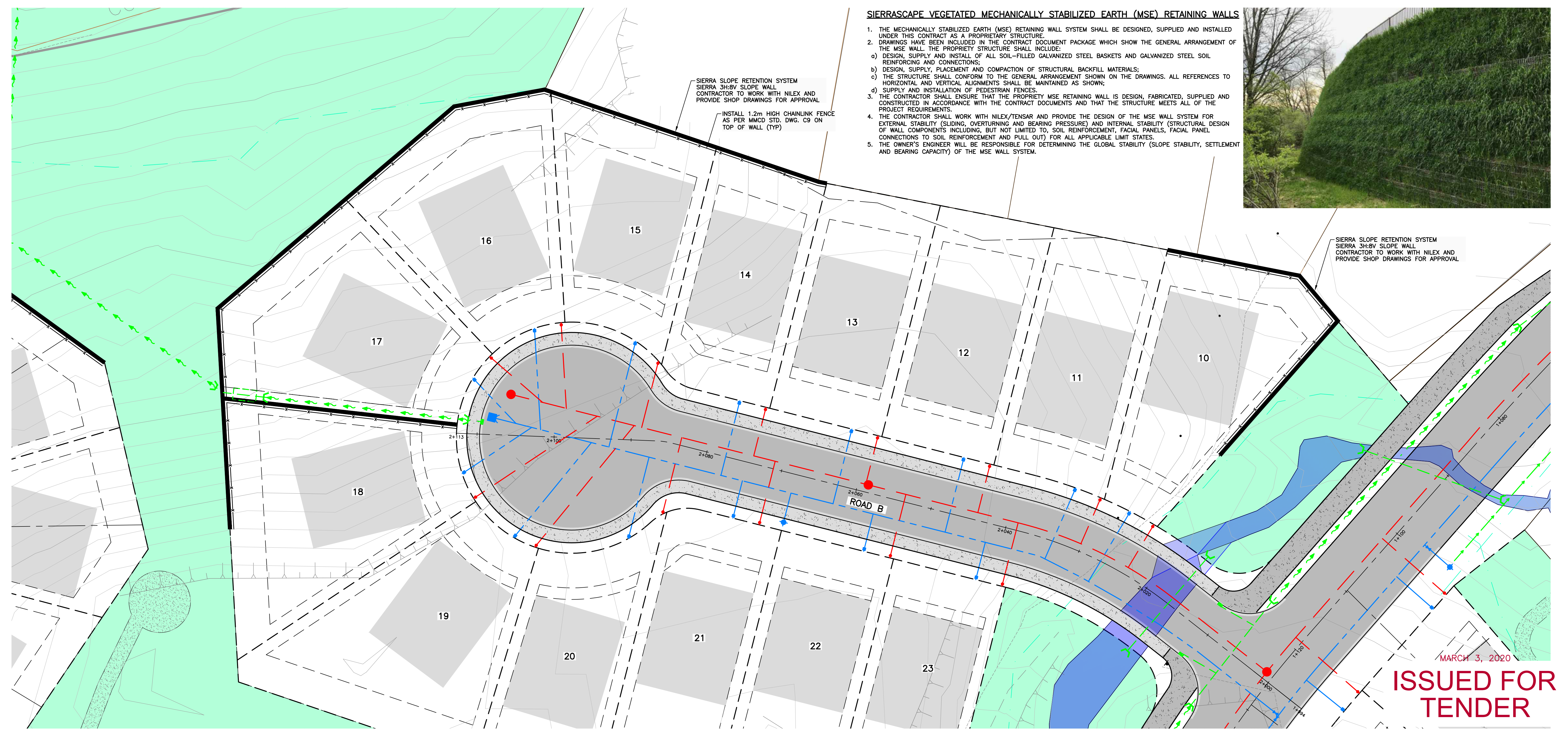
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SEAL	PROJECT: POINT IDEAL	SCALE: HORIZ: AS SHOWN VERT: N/A
	TITLE: CURB RETURN DETAILS POINT IDEAL ROAD @ ROADS B & C ROAD B, C & D CUL DE SACS	PROJECT NO. 01-095 ISSUED/REVISION 2
		APPROVING AUTHORITY FILE NO.
		DRAWING NO. 01-095-C09



PROFILE
SCALE: HOR-1:250 VERT-1:250



PLAN
SCALE: 1:250

SIERRASCAPE VEGETATED MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALLS

1. THE MECHANICALLY STABILIZED EARTH (MSE) RETAINING WALL SYSTEM SHALL BE DESIGNED, SUPPLIED AND INSTALLED UNDER THIS CONTRACT AS A PROPRIETARY STRUCTURE.
2. DRAWINGS HAVE BEEN INCLUDED IN THE CONTRACT DOCUMENT PACKAGE WHICH SHOW THE GENERAL ARRANGEMENT OF THE MSE WALL. THE PROPRIETY STRUCTURE SHALL INCLUDE:
 - a) DESIGN, SUPPLY AND INSTALL OF ALL SOIL-FILLED GALVANIZED STEEL BASKETS AND GALVANIZED STEEL SOIL REINFORCING AND CONNECTIONS;
 - b) DESIGN, SUPPLY, PLACEMENT AND COMPACTION OF STRUCTURAL BACKFILL MATERIALS;
 - c) THE STRUCTURE SHALL CONFORM TO THE GENERAL ARRANGEMENT SHOWN ON THE DRAWINGS. ALL REFERENCES TO HORIZONTAL AND VERTICAL ALIGNMENTS SHALL BE MAINTAINED AS SHOWN;
 - d) SUPPLY AND INSTALLATION OF PEDESTRIAN FENCES.
3. THE CONTRACTOR SHALL ENSURE THAT THE PROPRIETY MSE RETAINING WALL IS DESIGN, FABRICATED, SUPPLIED AND CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND THAT THE STRUCTURE MEETS ALL OF THE PROJECT REQUIREMENTS.
4. THE CONTRACTOR SHALL WORK WITH NILEX/TENSAR AND PROVIDE THE DESIGN OF THE MSE WALL SYSTEM FOR EXTERNAL STABILITY (SLIDING, OVERTURNING AND BEARING PRESSURE) AND INTERNAL STABILITY (STRUCTURAL DESIGN OF WALL COMPONENTS INCLUDING, BUT NOT LIMITED TO, SOIL REINFORCEMENT, FACIAL PANELS, FACIAL PANEL CONNECTIONS TO SOIL REINFORCEMENT AND PULL OUT) FOR ALL APPLICABLE LIMIT STATES.
5. THE OWNER'S ENGINEER WILL BE RESPONSIBLE FOR DETERMINING THE GLOBAL STABILITY (SLOPE STABILITY, SETTLEMENT AND BEARING CAPACITY) OF THE MSE WALL SYSTEM.



SIERRA SLOPE RETENTION SYSTEM
SIERRA 3H:1V SLOPE WALL
CONTRACTOR TO WORK WITH NILEX AND
PROVIDE SHOP DRAWINGS FOR APPROVAL

MARCH 3, 2020
ISSUED FOR TENDER

S:\2019\01-09-20 - ROAD B - PLAN OF M&E CONNECTION TO - BRANDESLEY - ACTING ENGINEER - 3/2/2020 - JRE - PLE C10

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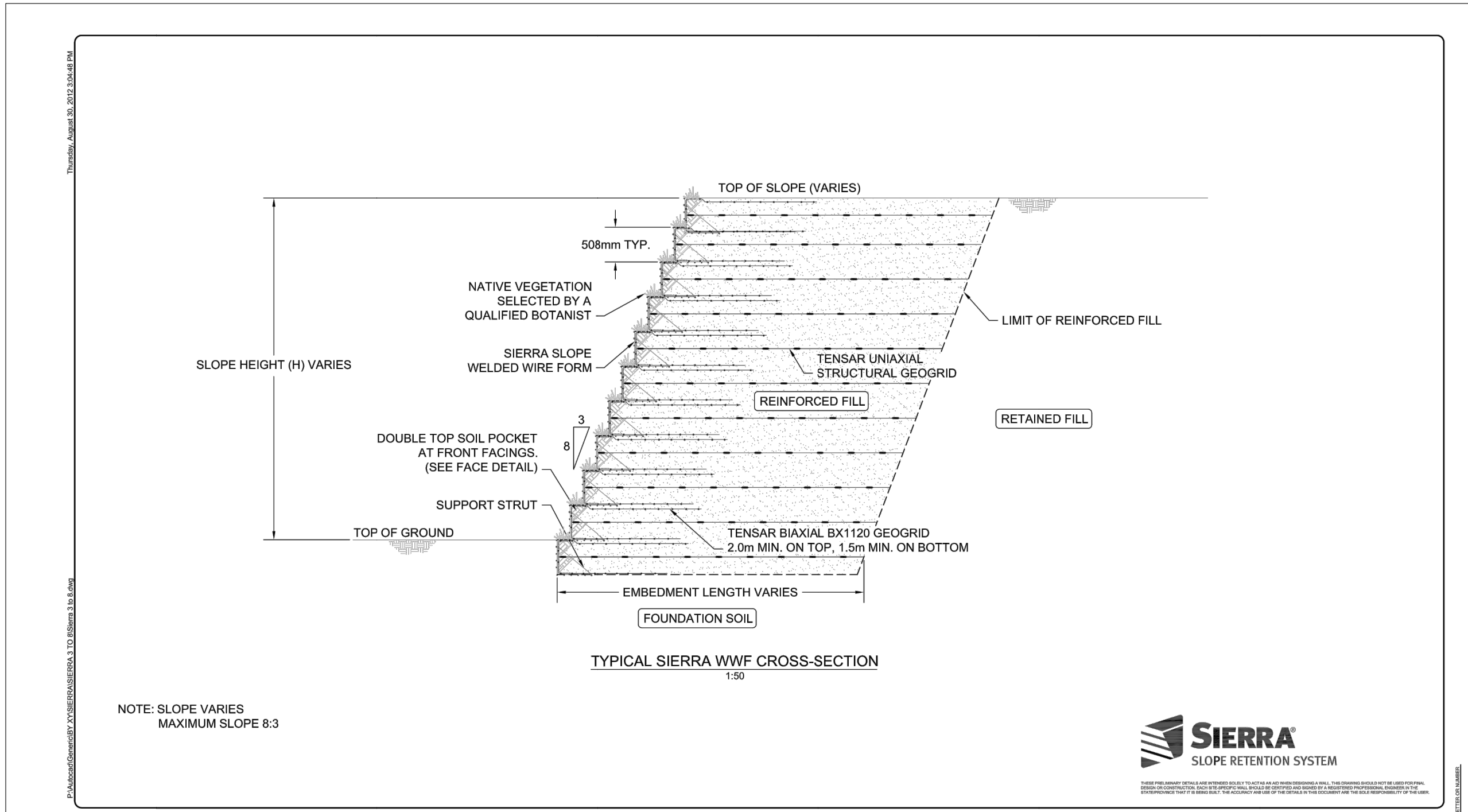
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DUNCAN, BC V9L 3S3 PH (250) 748-3335

SEAL

PROJECT: POINT IDEAL DEVELOPMENT
TITLE: ROAD B - BACK OF LOTS WALL PROFILE

SCALE: HORIZ: 1:250 VERT: 1:50
PROJECT NO. 01-095
ISSUED/REVISION 2
DRAWING NO. 01-095-C10

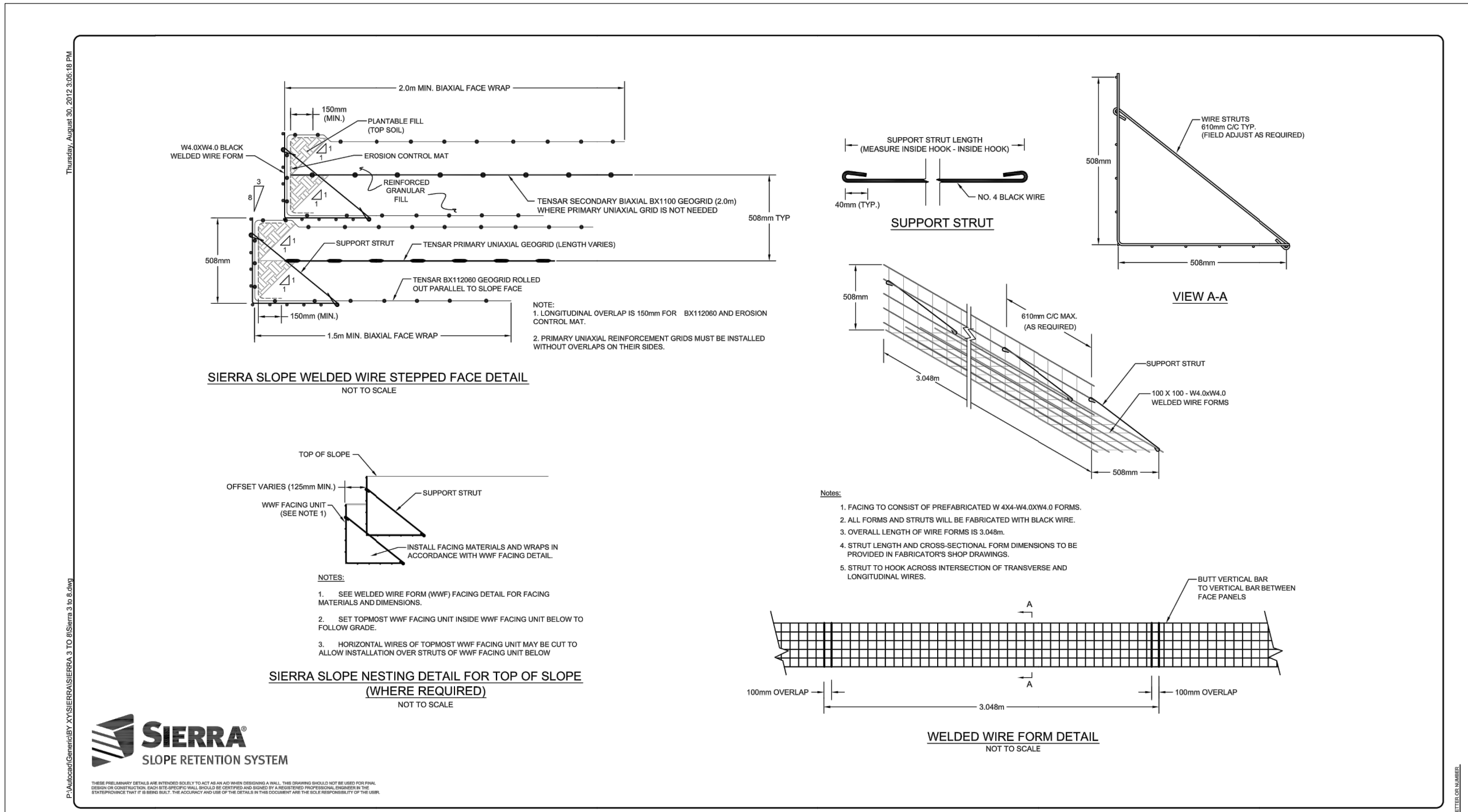


SIERRA SLOPE RETENTION SYSTEM

Issue/Revisions	ISSUED FOR INFORMATION
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Sheet Title: TYPICAL SIERRA 3H:8V SLOPE CROSS SECTION
Drawing Number: 004

PRELIMINARY - NOT FOR CONSTRUCTION

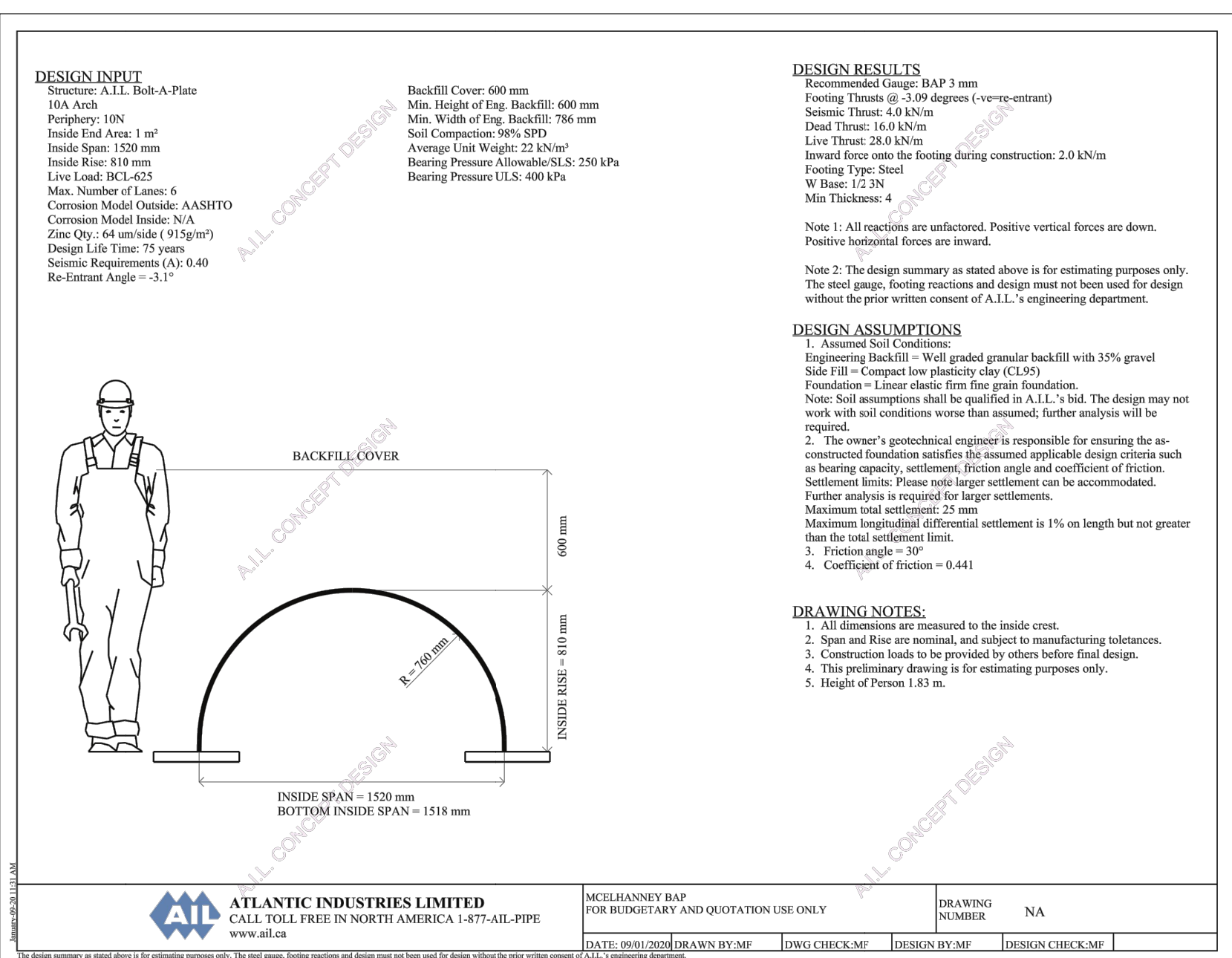


SIERRA SLOPE RETENTION SYSTEM

Issue/Revisions	ISSUED FOR INFORMATION
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Drawing Number: 005

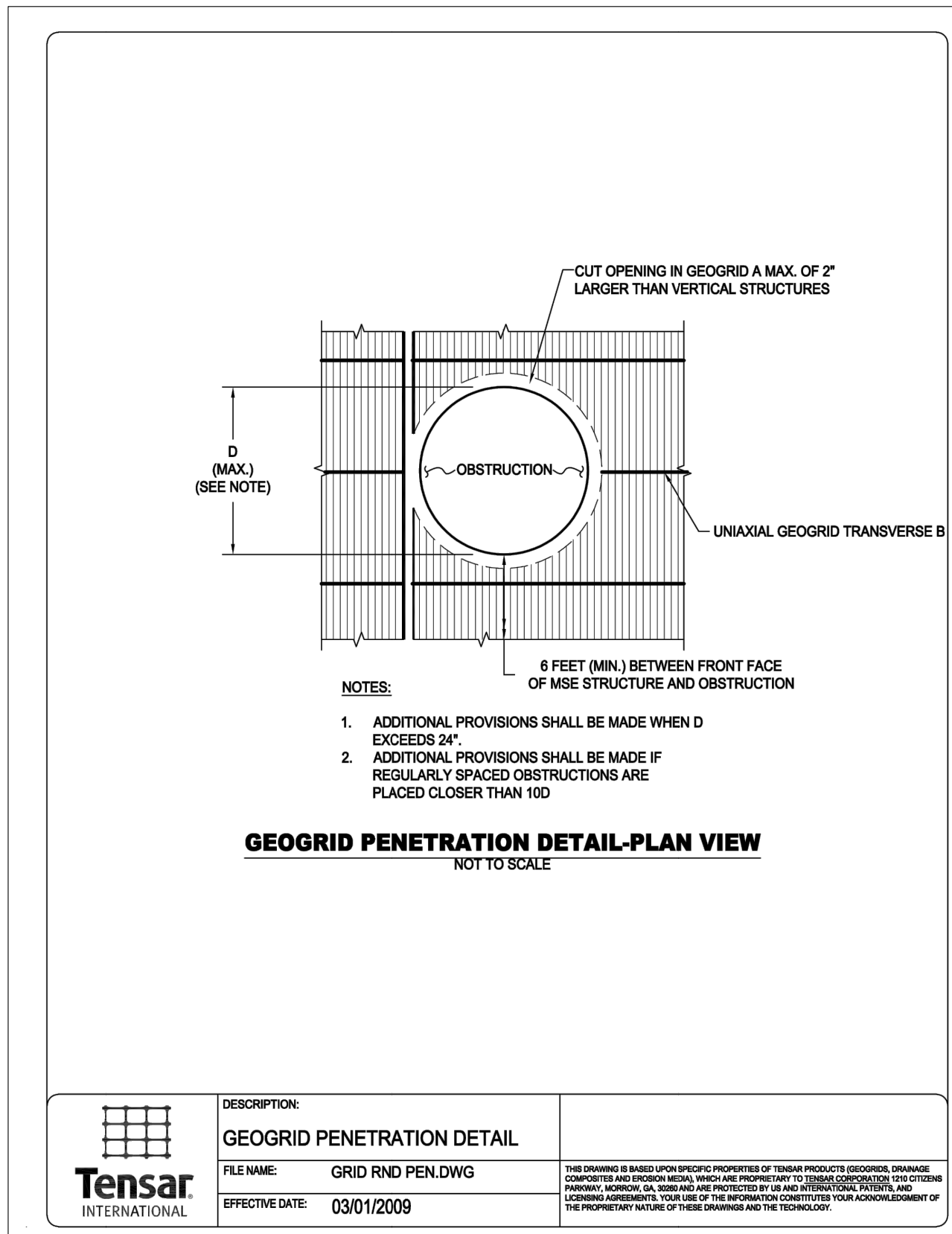
PRELIMINARY - NOT FOR CONSTRUCTION



ATLANTIC INDUSTRIES LIMITED
CALL TOLL FREE IN NORTH AMERICA 1-877-AIL-PIPE
www.aill.ca

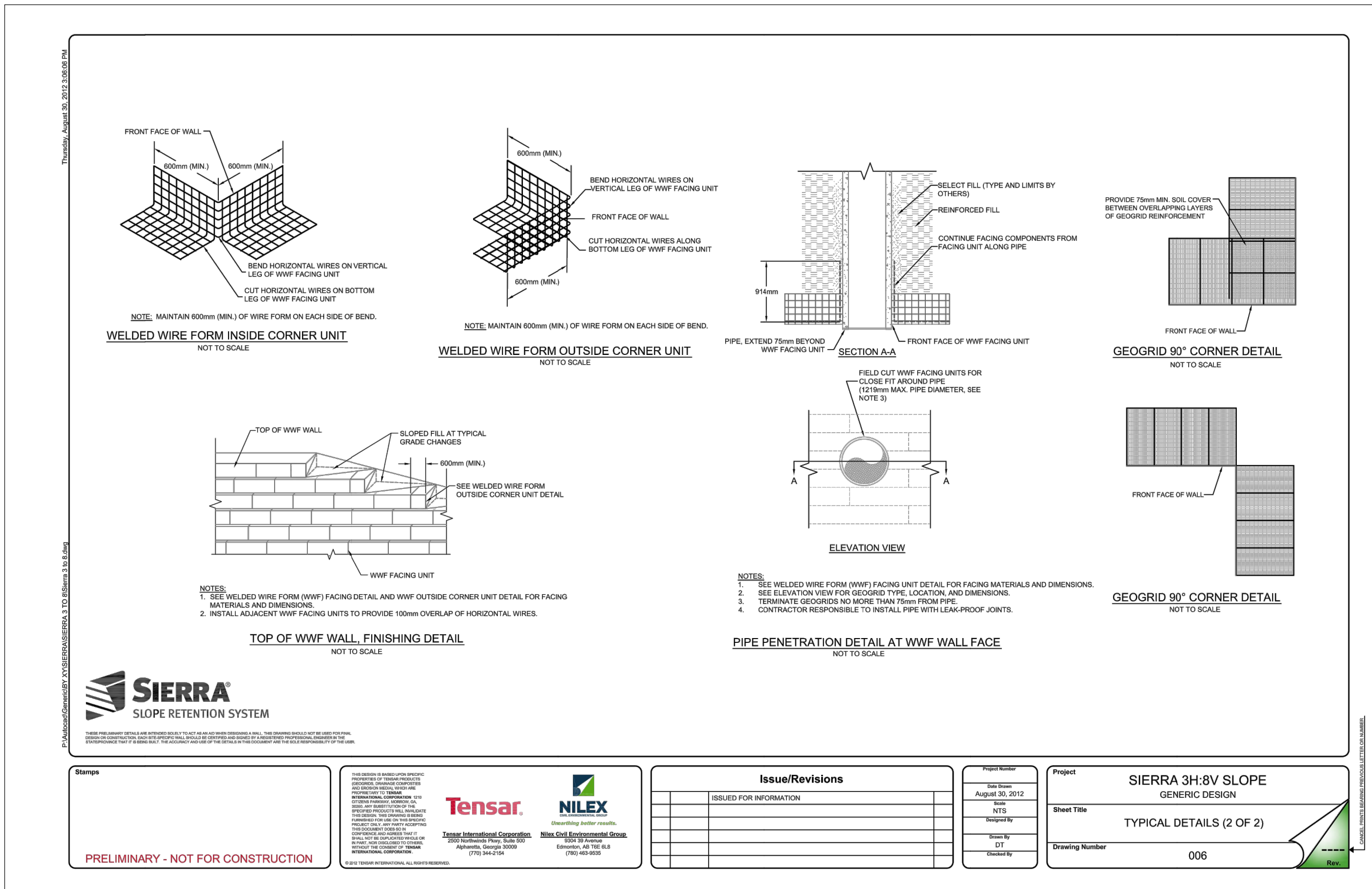
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EFFECTIVE DATE: 03/01/2009



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DESCRIPTION: GEGRID PENETRATION DETAIL
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EFFECTIVE DATE: 03/01/2009



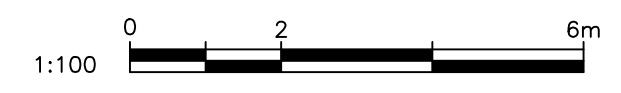
SIERRA SLOPE RETENTION SYSTEM

Issue/Revisions	ISSUED FOR INFORMATION
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Sheet Title: TYPICAL DETAILS (2 OF 2)
Drawing Number: 006

PRELIMINARY - NOT FOR CONSTRUCTION

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ISSUED FOR TENDER



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NO.	DATE	BY	ISSUED																										
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1	2020-01-24	JL	ISSUED FOR 90% REVIEW																										
NO.	DATE	BY	REVISIONS																										



BV DEVELOPMENTS MANAGEMENT INC.

APPENDIX B

BUILDING PERMIT



BV DEVELOPMENTS MANAGEMENT INC.

Unit 301, 791 Goldstream Avenue
Langford, BC
V9B 2X5

March 9, 2020

Town of Lake Cowichan
Public Works and Engineering Services
P.O. Box 860
39 South Shore Road
Lake Cowichan, BC
V0R 2G0

**Attention: Mr. Kam So, P.Eng.
Superintendent, Public Works and Engineering Services**

**RE: Rem. Lot A, Plan VIP64669, District Lot 13, Cowichan Lake Land District, Lake Cowichan, BC
Construction Permit**

Dear Sir:

Attached is our application for a construction permit for the Point Ideal property, along with a cheque in the amount of \$10,000.

Thank you for consideration of this matter and should you require additional information or have any questions please contact the undersigned.

Yours truly,
BV DEVELOPMENTS MANAGEMENT INC.

A handwritten signature in black ink, appearing to read 'Brian A. Locher', is written over a circular stamp or seal.

Brian A. Locher, P.Eng., LL.B.
Senior Project Manager
Phone: (250) 709-0218
Email: brianl@bvdgroup.ca

The information on this form is collected under the authority of the Local Government Act s. 895, 903, and 930. The information provided will be used to process your application for Amendment. If you have any questions about the collection and use of this information contact the Chief Administrative Officer at 250-749-6681.

TOWN OF LAKE COWICHAN

APPLICATION TO CONSTRUCT WORKS WITHIN HIGHWAY RIGHT-OF-WAY



FOLIO NO:

DATE:

March 9, 2020

I (We) hereby apply for permission to construct, use, and maintain works within the limits of highway right-of-way under the jurisdiction of the Town of Lake Cowichan, British Columbia, in accordance with the particulars, plans, and specifications submitted herewith. It is understood that the completion of this form constitutes an application only and that the works applied for will not be commenced until a covering permit has been issued. Also it is understood that by signing this application I (We) hereby release and covenant to indemnify and save harmless the Town of Lake Cowichan of and from any and all manner of action, causes of action, claims and demands whatsoever which a person(s) may have as a result of the works as specified herewith.

APPLICATION INFORMATION		OWNER INFORMATION	
NAME OF APPLICANT(S): BV Developments Management Inc.		NAME OF OWNER(S): 1218676 BC Ltd.	
APPLICANT'S ADDRESS: Unit 301, 791 Goldstream Avenue		OWNER'S ADDRESS: Unit 301, 791 Goldstream Avenue	
CITY: Langford, BC	POSTAL CODE: V9B 2X5	CITY: Langford, BC	POSTAL CODE: V9B 2X5
PHONE: (250) 709-0218	FAX:	PHONE: (250) 709-0218	FAX:
DESCRIPTION OF WORKS			
1. Clearing and removal of vegetation			
2. Rough grading			
3. Construction of retaining walls			
4. Installation of underground services (water, sewer and lot services)			
5. Construction of roads			
6. Road landscaping			
7. Installation of electric and streetlighting			

SIGNATURE	
I / WE hereby declare that all of the above statements and information contained in the material submitted in support of this application are, to the best of my knowledge, true and correct in all respects.	
<p>March 9, 2020</p> <p>_____</p> <p>Date</p>	<p><i>[Signature]</i></p> <p>_____</p> <p>Applicant's Signature</p>
THIS APPLICATION IS MADE WITH MY FULL KNOWLEDGE AND CONSENT	
<p>March 7, 2020</p> <p>_____</p> <p>Date</p>	<p><i>[Signature]</i></p> <p>_____</p> <p>Registered Owner of Subject Property</p>
Where the applicant is not the REGISTERED OWNER, the application must be signed by the REGISTERED OWNER	



FOLIO NO/S:

PERMIT NO:

PROPERTY

LOCATION OF WORKS – INCLUDE CIVIC ADDRESS OF PROPERTY:

Between Point Ideal Drive and Lakeview Park Road

LEGAL DESCRIPTION OF PROPERTY: Lot A, District Lot 13, Cowichan Lake District, Plan VIP64669

Except Part in Plans VIP66922, VIP68015, VIP72607, VIP78144, VIP88404, VIP88405

PERMIT FOR THE WORK IS GRANTED SUBJECT TO THE FOLLOWING CONDITIONS:

CONDITIONS OF PERMIT:

Construct meet all permit
issues.

Construction meets all MMCO
standards.

19-Mar-20

Date

A handwritten signature in blue ink, appearing to be "R. [unclear]".

Superintendent, Public Works and Engineering Services



BV DEVELOPMENTS MANAGEMENT INC.

APPENDIX C

ENVIRONMENTAL ASSESSMENT

FORM 1

Riparian Areas Regulation - Qualified Environmental Professional - Assessment Report

Riparian Areas Regulation: Assessment Report

Please refer to submission instructions and assessment report guidelines when completing this report.

Date 2018-10-18

I. Primary QEP Information

First Name	Justin	Middle Name		
Last Name	Lange			
Designation	R.P.Bio.	Company Madrone Environmental Services Ltd.		
Registration #	2406	Email Justin.lange@madrone.ca		
Address	1081 Canada Avenue			
City	Duncan	Postal/Zip	V9L 1V2	Phone # 250 746 5545
Prov/state	BC	Country	Canada	

II. Secondary QEP Information (use Form 2 for other QEPs)

First Name		Middle Name		
Last Name				
Designation		Company		
Registration #		Email		
Address				
City		Postal/Zip		Phone #
Prov/state		Country		

III. Developer Information

First Name	Nicole	Middle Name		
Last Name	Roberts			
Company	RDY Holdings			
Phone #	(250) 213-3209	Email: Nicole@cubicland.com		
Address	3471 Short Street			
City	Victoria	Postal/Zip	V8X 2V6	
Prov/state	BC	Country	Canada	

IV. Development Information

Development Type	Subdivision		
Area of Development (ha)	6.85	Riparian Length (m)	936.6
Lot Area (ha)	6.85	Nature of Development	New
Proposed Start Date	2018-11-01	Proposed End Date	2019-11-01

V. Location of Proposed Development

Street Address (or nearest town)	Lot A Point Ideal Drive		
Local Government	Town of Lake Cowichan	City	Lake Cowichan
Stream Name	Unnamed Ditch, Stream and Wetlands – tributaries to Cowichan Lake		
Legal Description (PID)	023-666-056	Region 1	
	Lot A, Plan: VIP64669		
Stream/River Type	Ditch, Stream and Wetlands	DFO Area	South Island
Watershed Code	920-257700		
Latitude	48	49	2.6
Longitude	124	4	22.1

Table of Contents for Assessment Report

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3. Site Plan	18
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2. Windthrow	
3. Slope Stability	
4. Protection of Trees	
5. Encroachment	
6. Sediment and Erosion Control	
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8. Floodplain Concerns (Highly Mobile Channel)	
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7. Assessment Report Professional Opinion	34

Section 1. Description of Fisheries Resources Values and a Description of the Development proposal

(Provide as a minimum: Species present, type of fish habitat present, description of current riparian vegetation condition, connectivity to downstream habitats, nature of development, specific activities proposed, timelines)

Nature of Development Proposal:

This Riparian Areas Regulation (RAR) assessment is being completed in response to a subdivision proposal that is being submitted to the Town of Lake Cowichan (TLC). Under the provincial RAR process, subdivision is considered to be a form of "development", which has prompted the assessment. The subdivision proposal involves dividing the 6.85 ha subject property (Lot A, Point Ideal Drive) into 56 single family lots, ranging in size from the minimum of 350 m² to 1,188 m² (refer to site plan). The assessment area is located approximately 1.5 km southwest of the TLC.

Prior to submitting the subdivision proposal and to ensure all riparian related bylaws through the TLC are adhered to, a Qualified Environmental Professional (QEP) was retained to assess all of the watercourses on the site. The property contains 1 ditch, 1 stream and 4 wetlands. Of the four wetlands, three are subject to the RAR process as they connect to known fish habitat. The fourth wetland is not subject to the RAR as it is an isolated feature.

When the subdivision plan and road layout is finalized and approved, there will be a requirement to conduct instream works as part of two road crossings and one driveway crossing. The Section 11 process under the Water Sustainability Act will be used to convey the necessary information related to any instream works. The Section 11 application process will be completed in the future, once the engineered plans have been finalized and prior to any construction being initiated. As part of the Section 11 process, an environmental management plan (EMP) will be produced. The purpose of the EMP will be to develop site specific measures (*i.e.*, erosion and sediment control) for road construction and service installation.

Fisheries Resource Values:

Prior to completing the field portion of the RAR assessment, the Habitat Wizard Website (<http://maps.gov.bc.ca/ess/sv/habwiz/>) was reviewed to determine known distribution of fish. Under the Habitat Wizard Database, the subject waterbodies are not mapped or gazetted, but the unnamed ditch, unnamed stream and Wetland #1, #3 and #4 connect to Cowichan Lake. Cowichan Lake represents an important fishery resource value. Anadromous salmonids known to occur in the lake include Steelhead (*Oncorhynchus mykiss*), Chinook Salmon (*O. tshawytscha*), Coho Salmon (*O. kisutch*) and Chum Salmon (*O. keta*). These salmonids migrate from the ocean, up the Cowichan River and into Cowichan Lake, at which point they enter various tributary streams of the lake in order to spawn.

Resident forms of both Rainbow Trout (*O. mykiss*) and Cutthroat Trout (*O. clarkii clarkii*) also exist in the lake and tributary streams. Brown Trout (*Salmo trutta*), Dolly Varden Char (*Salvelinus malma*) and Lake Lamprey (*Lampetra macrostoma*) also exist in Cowichan Lake. Protected under the *Species at Risk Act* (SARA), the Cowichan Lake Lamprey is completely endemic to Cowichan and Mesachie Lakes. Cowichan Lake Lamprey spawn in shallow water where creeks flow out into the lakes, in suitable substrate (small gravel).

Description of RAR Applicable Waterbodies:

Stream #1

Stream #1 flows near the southeast corner of the property, through an area that has been designated as park. The stream generally flows in a northeast direction until it enters the stormwater system under Point Ideal Drive. The morphology of Stream #1 is consistent with a step-pool classification as the gradient was measured as being between 16% and 19%. On average, the bankfull width is less than 1.0 m and the substrate is composed of small gravel. It was noted that Stream #1 flows seasonally and lacks the necessary attributes to support fish. The stream flows through areas composed of regenerating Douglas-fir (*Pseudotsuga menziesii*) and red alder (*Alnus rubra*). Immediately above the confluence with Ditch #1, Stream #1 flows through an area composed entirely of Himalayan blackberry (*Rubus discolor*) – an invasive species. Based on the channel morphology and the fact that it contributes water to known fish habitat, Stream #1 is subject to a 10 m SPEA.

Ditch #1

The assessment of Ditch #1 was initiated where it joins Stream #1, approximately 30-40 m upslope of Point Ideal Drive. From the start point, the drainage was traversed upstream to its origin (Wetland #1). Over the assessed length, Ditch #1 possesses a bed that is composed of small gravel and flows adjacent to an area comprised of regenerating red alder saplings. It is important to note that the area comprised of red alder is an old road corridor. The ditch was constructed as a way of alleviating stormwater runoff when the road network was in use. The average bankfull width is less than 1.50 m and the gradient ranges between 10% and 14%. Ditch #1 flows on a seasonal basis and does not support populations of fish; however, it does connect by surface flow to known fish habitat. This surface flow connectivity qualifies it as a "stream" under the RAR. Under the RAR process, a 5 m SPEA will be applied to Ditch #1.

Wetland #1

Wetland #1 is a red alder/sedge (*Carex spp.*)/salmonberry (*Rubus spectabilis*) complex located in the south-central portion of the property. The wetland has organic soils throughout and is approximately 15 m wide by 25 m long. When assessed, Wetland #1 was inundated with water due to the recent rains. It is likely that the

wetland only has water on a seasonal basis. Wetland #2 does not support fish, but due to the fact it represents the headwaters for Ditch #1, it is subject to the RAR process (it connects by surface flow to confirmed fish habitat further downstream). As a result, 15 m SPEAs should be applied to the north, east and west sides of the wetland. The south side should have a 30 m SPEA setback.

Wetland #3

Occurring in the southwest corner of study area, wetland #3 represents a red alder/salmonberry unit. Second growth forest dominated by western redcedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*) borders the wetland. The substrate of the wetland is composed entirely of alluvium (gravels). Pockets of open water were noted in low-lying portions of Wetland #3. Wetland #3 likely does not support fish as it contains water on a seasonal basis, but it is subject to the RAR process and will have a 15 m SPEA applied. Wetland #3 is considered the headwaters of a tributary stream that connects to Beaver Lake (known fish habitat), which is connected to Cowichan Lake by Beaver Creek.

Wetland #4

Wetland #4 is at the northern extent of the property. This particular feature is known to support fish over the winter months, as it connects to Cowichan Lake. Wetland #4 is a relatively large wetland and is approximately 60 m wide by 90 m long. The bed of the wetland is composed entirely of organic materials (*i.e.*, decomposing leaf matter and woody debris). Vegetation throughout the wetland is composed mainly of hardhack (*Spiraea douglasii*), red alder, sedges and salmonberry. The wetland is bordered to the north and east by residential properties and Point Ideal Drive. The west and south sides are composed of mature forest, with bigleaf maple (*Acer macrophyllum*), Douglas-fir and western redcedar dominating. At the time of the assessment the entire wetland was inundated with water.

Description of Non-RAR Applicable Waterbodies:

One wetland (Wetland #2) is a feature that does not contain fish or connect to fish-bearing watercourses as it does not possess either an inflow or outflow drainage. As a result, Wetland #2 is considered to be an isolated feature and the RAR methodology does not apply to this waterbody. This wetland is approximately 20 m wide by 45 m long and only has water on a seasonal basis. The substrate throughout the wetland is primarily composed of organic materials. The dominant plant species noted are willows (*Salix spp.*), sedges, salmonberry and water parsley (*Oenanthe sarmentosa*). Red alder occurs around the entire perimeter of the wetland.

Although the isolated wetland possesses no fisheries values, it does represent important breeding and foraging habitat for wildlife in the area, particularly amphibian species. When assessed it was noted that several wildlife species have been using the wetland habitat including Columbia black-tail deer (*Odocoileus hemionus*) – pellets,

American robin (*Turdus migratorius*) - visual, Dark-eyed junco (*Junco hyemalis*) — vocalization, and Steller's jay (*Cyanocitta stelleri*) – vocalization.

To protect the ecological integrity of the isolated wetland ecosystem, we recommend the incorporation of 15 m no-development buffer zone (measured from the High Water Mark - HWM) around the wetland. This recommendation is based on general recommendations in the TLCs Official Community Plan (OCP), which aims to continually identify and protect Ecologically Sensitive Areas.

Section 2. Results of Riparian Assessment (SPEA width)

Attach or insert the Form 3 or Form 4 assessment form(s). Use enough duplicates of the form to produce a complete riparian area assessment for the proposed development

Results of Detailed Riparian Assessment

Refer to Chapter 3 of Assessment Methodology

Date: 2018-10-18

Description of Water bodies involved (number, type)

Stream #1

Stream	X
Wetland	
Lake	
Ditch	
Number of reaches	1
Reach #	1

Channel width and slope and Channel Type (use only if water body is a stream or a ditch, and only provide widths if a ditch)

Channel Width(m)		Gradient (%)	
starting point	0.75		I, Justin Lange, hereby certify that: a) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act; b) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; c) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and d) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.
upstream	0.60	16	
	0.9		
	1.10		
	1.20		
downstream	0.85	19	
	0.80		
	1.10		
	1.40		
	1.30		
	0.70		
Total: minus high /low	8.70	35	
mean	0.97	17.5	
Channel Type	R/P	C/P	
			X

Site Potential Vegetation Type (SPVT)

	Yes	No	
SPVT Polygons		X	Tick yes only if multiple polygons, if No then fill in one set of SPVT data boxes I, Justin Lange, hereby certify that: a) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act; b) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; c) I have carried out an assessment of the development proposal and

my assessment is set out in this Assessment Report; and
 d) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Polygon No:

SPVT Type

LC	SH	TR
<input type="text"/>	<input type="text"/>	X

Method employed if other than TR

Polygon No:

SPVT Type

LC	SH	TR
<input type="text"/>	<input type="text"/>	<input type="text"/>

Method employed if other than TR

Polygon No:

SPVT Type

<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

Method employed if other than TR

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No: If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons

LWD, Bank and Channel Stability ZOS (m)	10					
Litter fall and insect drop ZOS (m)	10					
Shade ZOS (m) max	2.91	South bank	Yes	<input type="text"/>	No	X
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)					
Ditch Fish Bearing	Yes	<input type="text"/>	No	<input type="text"/>	If non-fish bearing insert no fish bearing status report	
SPEA maximum	10 m	(For ditch use table3-7)				

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No: If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons

LWD, Bank and Channel Stability ZOS (m)	10					
Litter fall and insect drop ZOS (m)	10					
Shade ZOS (m) max	2.91	South bank	Yes	X	No	<input type="text"/>
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)					

Ditch Fish Bearing	Yes		No		If non-fish bearing insert no fish bearing status report	
SPEA maximum	10 m	(For ditch use table3-7)				

I, Justin Lange, hereby certify that:

- I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
- I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
- I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
- In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Results of Detailed Riparian Assessment

Refer to Chapter 3 of Assessment Methodology

Date: 2018-10-18

Description of Water bodies involved (number, type)

Ditch #1

Stream	
Wetland	
Lake	
Ditch	X
Number of reaches	1
Reach #	1

Channel width and slope and Channel Type (use only if water body is a stream or a ditch, and only provide widths if a ditch)

Channel Width(m)		Gradient (%)	
starting point	1.20		I, Justin Lange, hereby certify that: e) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act; f) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; g) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and h) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.
upstream	1.50	10	
	1.10		
	1.30		
downstream	1.30		
	1.00	14	
	0.80		
	0.90		
	0.80		
Total: minus high /low	1.40		
	1.30		
	10.3		
mean	1.14	12	
	R/P	C/P	
Channel Type			

Site Potential Vegetation Type (SPVT)

	Yes	No	
SPVT Polygons	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tick yes only if multiple polygons, if No then fill in one set of SPVT data boxes
			<p>I, <u>Justin Lange</u>, hereby certify that:</p> <p>e) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>f) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>g) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and</p> <p>h) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.</p>
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type	LC	SH	TR
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type	LC	SH	TR
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No:	1	If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons				
LWD, Bank and Channel Stability ZOS (m)	5					
Litter fall and insect drop ZOS (m)	5					
Shade ZOS (m) max	5	South bank	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)					
Ditch Fish Bearing	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	If non-fish bearing insert no fish bearing status report	
SPEA maximum	5 m	(For ditch use table3-7)				

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No:	2	If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons					
LWD, Bank and Channel Stability ZOS (m)	5						
Litter fall and insect drop ZOS (m)	5						
Shade ZOS (m) max	5	South bank	Yes	X	No		
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)						
Ditch Fish Bearing	Yes		No		If non-fish bearing insert no fish bearing status report		
SPEA maximum	5 m	(For ditch use table3-7)					

I, Justin Lange, hereby certify that:

- e) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
- f) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
- g) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
- h) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Results of Detailed Riparian Assessment

Refer to Chapter 3 of Assessment Methodology

Date: 2018-10-18

Description of Water bodies involved (number, type)

Wetland #1

Stream	
Wetland	X
Lake	
Ditch	
Number of reaches	n/a
Reach #	n/a

Channel width and slope and Channel Type (use only if water body is a stream or a ditch, and only provide widths if a ditch)

Channel Width(m)	
starting point	
upstream	

Gradient (%)

	I, Justin Lange, hereby certify that:
	i) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act;

downstream			j) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; k) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and l) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.
Total: minus high /low mean			
Channel Type	R/P	C/P	S/P

Site Potential Vegetation Type (SPVT)

	Yes	No	
SPVT Polygons	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tick yes only if multiple polygons, if No then fill in one set of SPVT data boxes
I, <u>Justin Lange</u> , hereby certify that: i) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i> ; j) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; k) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and l) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.			
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type	LC	SH	TR
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type	LC	SH	TR
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polygon No:	<input type="checkbox"/>		Method employed if other than TR
SPVT Type			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No:	1	If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons.
LWD, Bank and Channel	15	

Stability ZOS (m)						
Litter fall and insect drop ZOS (m)	15					
Shade ZOS (m) max	30	South bank	Yes	X	No	
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)					
Ditch Fish Bearing	Yes		No		If non-fish bearing insert no fish bearing status report	
SPEA maximum	30 m	(For ditch use table3-7)				

I, Justin Lange, hereby certify that:

- i) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
- j) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
- k) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
- l) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Results of Detailed Riparian Assessment

Refer to Chapter 3 of Assessment Methodology

Date: 2018-10-18

Description of Water bodies involved (number, type)

Wetland #3

Stream	
Wetland	X
Lake	
Ditch	
Number of reaches	n/a
Reach #	n/a

Channel width and slope and Channel Type (use only if water body is a stream or a ditch, and only provide widths if a ditch)

Channel Width(m)	
starting point	
upstream	
downstream	

Gradient (%)

	I, Justin Lange, hereby certify that:
	m) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act;
	n) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings ;
	o) I have carried out an assessment of the development proposal and my assessment is set

Total: minus high /low mean	<input type="text"/>	<input type="text"/>	out in this Assessment Report; and p) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.
	<input type="text"/>	<input type="text"/>	
	<input type="text"/>	<input type="text"/>	
	<input type="text"/>	<input type="text"/>	
Channel Type	R/P <input type="text"/>	C/P <input type="text"/>	S/P <input type="text"/>

Site Potential Vegetation Type (SPVT)

	Yes	No	
SPVT Polygons	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tick yes only if multiple polygons, if No then fill in one set of SPVT data boxes

I, Justin Lange, hereby certify that:
 m) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
 n) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
 o) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
 p) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Polygon No:	<input type="text"/>	Method employed if other than TR		
	LC SH TR			
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Polygon No:	<input type="text"/>	Method employed if other than TR		
	LC SH TR			
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Polygon No:	<input type="text"/>	Method employed if other than TR		
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Zone of Sensitivity (ZOS) and resultant SPEA

Segment No:	1	If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons				
LWD, Bank and Channel Stability ZOS (m)	15					
Litter fall and insect drop ZOS (m)	15					
Shade ZOS (m) max	30	South bank	Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
Ditch	Justification description for classifying as a ditch (manmade,					

FORM 1

Riparian Areas Regulation - Qualified Environmental Professional - Assessment Report

		no significant headwaters or springs, seasonal flow)			
Ditch Fish Bearing	Yes		No		If non-fish bearing insert no fish bearing status report
SPEA maximum	15 m	(For ditch use table3-7)			

I, Justin Lange, hereby certify that:

- m) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
- n) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
- o) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
- p) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Results of Detailed Riparian Assessment

Refer to Chapter 3 of Assessment Methodology

Date: 2018-10-18

Description of Water bodies involved (number, type)

Wetland #4

Stream	
Wetland	X
Lake	
Ditch	
Number of reaches	n/a
Reach #	n/a

Channel width and slope and Channel Type (use only if water body is a stream or a ditch, and only provide widths if a ditch)

Channel Width(m)	Gradient (%)
starting point	I, Justin Lange, hereby certify that: q) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the Fish Protection Act; r) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; s) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and t) In carrying out my assessment of the development proposal, I have followed the assessment methods
upstream	
downstream	
Total: minus high /low	

mean	<input type="text"/>	<input type="text"/>	set out in the Schedule to the Riparian Areas Regulation.
	R/P	C/P	
Channel Type	<input type="text"/>	<input type="text"/>	

Site Potential Vegetation Type (SPVT)

	Yes	No	
SPVT Polygons	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Tick yes only if multiple polygons, if No then fill in one set of SPVT data boxes
<p>I, <u>Justin Lange</u>, hereby certify that:</p> <p>q) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>r) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>s) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and</p> <p>t) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.</p>			
Polygon No:	<input type="text"/>		Method employed if other than TR
	LC	SH	TR
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Polygon No:	<input type="text"/>		Method employed if other than TR
	LC	SH	TR
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Polygon No:	<input type="text"/>		Method employed if other than TR
SPVT Type	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Zone of Sensitivity (ZOS) and resultant SPEA

Segment	1	If two sides of a stream involved, each side is a separate segment. For all water bodies multiple segments occur where there are multiple SPVT polygons					
No:							
LWD, Bank and Channel Stability ZOS (m)	15						
Litter fall and insect drop ZOS (m)	15						
Shade ZOS (m) max	30	South bank	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>	
Ditch	Justification description for classifying as a ditch (manmade, no significant headwaters or springs, seasonal flow)						
Ditch Fish Bearing	Yes	<input type="checkbox"/>	No	<input type="checkbox"/>	If non-fish bearing insert no fish bearing status report		

SPEA maximum

30 m	(For ditch use table3-7)
------	--------------------------

I, Justin Lange, hereby certify that:

- q) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
- r) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;
- s) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
- t) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.

Comments

This RAR assessment was completed in response to a proposal that involves subdividing a parcel of land off Point Ideal Drive into 56 residential properties. The assessment was necessary as portions of the lots are encompassed within the 30 m Riparian Assessment Areas (RAAs) of an unnamed ditch, stream and wetlands that connect to Cowichan Lake. At the present time no plans for land development have been designed. Only the layout of the 56 residential lots has been finalized.

While traversing the site, the HWM of each waterbody was identified and flagged with blue ribbon. The HWMs have been surveyed and the SPEA boundaries mapped. However, prior to initiating any land clearing on the site, each of the SPEA boundaries must be marked on the ground with a form of fencing that will prevent inadvertent encroachment.



DOSSIER:
17.0428

DRAWN BY:
Jessica Yellowlees

CLIENT:
RDY Holdings Ltd.

MAPPING DATE:
October 24, 2018

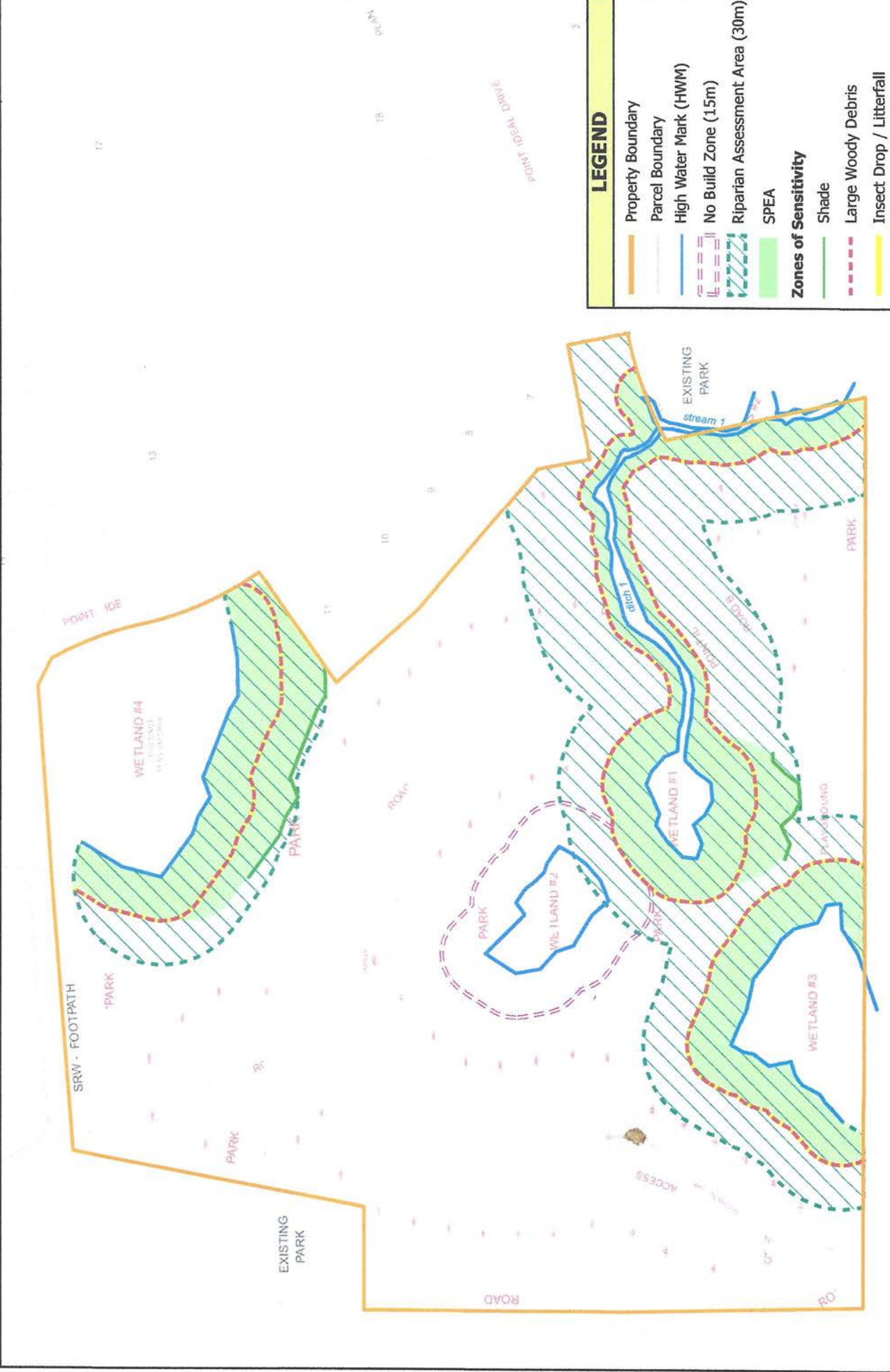
LOCATION:
Lake Cowichan, BC

MAP SCALE:
1:1,750

PROJECT:
Riparian Areas Regulation Assessment: Point Ideal Road

FIELD VISIT:
November 29, 2017

ASSESSED BY:
Justin Lange, B.Sc., R.P.Bio.



LEGEND

- Property Boundary
 - Parcel Boundary
 - High Water Mark (HWM)
 - No Build Zone (15m)
 - Riparian Assessment Area (30m)
 - SPEA
- Zones of Sensitivity**
- Shade
 - Large Woody Debris
 - Insect Drop / Litterfall



*All features on this map are approximate. Features measured in the field were located using a hand held GPS and accuracy can only be guaranteed for 3m.

Section 4. Measures to Protect and Maintain the SPEA

This section is required for detailed assessments. Attach text or document files, as need, for each element discussed in chapter 1.1.3 of Assessment Methodology. It is suggested that documents be converted to PDF *before* inserting into the assessment report. Use your "return" button on your keyboard after each line. You must address and sign off each measure. If a specific measure is not being recommended a justification must be provided.

<p>1. Danger Trees</p>	<p>At the time of the assessment, it was noted that the property is composed mainly of red alder saplings. No danger trees were noted while conducting the RAR assessment. Also, there is currently no requirement to have a formal danger tree assessment completed as this assessment was triggered by a proposal for subdivision. No plans for construction have been finalized at the present time.</p> <p>As trees (particularly deciduous species) within the SPEAs mature, there may be a requirement to implement management measures for hazard trees on a lot-by-lot basis. If future property owners consider any trees on their property to be a hazard they must retain a professional who is qualified in assessing danger trees. A Registered Professional Forester (RPF) or Certified Arborist has the appropriate knowledge and training to make management recommendations for potential danger trees.</p> <p>Any woody material generated from tree management measures should remain inside the SPEA. Course Woody Debris (CWD) provides potential cover/security habitat for wildlife (e.g., amphibians). CWD is also important as it aids in maintaining soil moisture and contributes nutrients into the soil as it decomposes.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p> <ul style="list-style-type: none"> u) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>; v) I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; w) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation 	
<p>2. Windthrow</p>	<p>Currently subdivision is the only form of "development" that has been proposed for Lot A, Point Ideal Drive. As a result there are no concerns related to windthrow.</p> <p>Once the subdivision is complete and individual property owners finalize plans for construction, there will be a need to remove trees. Given this, it is not anticipated that windthrow will be a major concern as trees will only be removed from building sites and not from large expanses of land. Any new forest edges that are created will not be expansive; therefore, the likelihood of increased susceptibility to windthrow is low. It is also important to note that red alder saplings currently cover most of the</p>

	<p>landscape. Based on their young age and height, the trees are less vulnerable to high wind speeds.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p> <ol style="list-style-type: none"> I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>; I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation 	
<p>3. Slope Stability</p>	<p>There are no concerns related to slope stability in the assessment area. The eastern-most side of the property has a slope that is approximately 15-20%, but overall appeared to be stable. At the time of the assessment there was no evidence of sloughing or sidewall slip. The topography of the remainder of the property is subdued with slopes averaging about 5%.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p> <ol style="list-style-type: none"> I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>; I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings; I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation 	
<p>4. Protection of Trees</p>	<p>Currently subdivision is the only form of "development" occurring at Lot A, Point Ideal Drive. There is no requirement to implement tree protection measures at this time. Once the subdivision is complete and individual property owners finalize plans for construction, tree protection measures will be developed on a lot-by-lot basis. In cases where development occurs beyond the 30 m RAA of any waterbody, there will be no requirement to develop tree protection measures. Development of measures for tree protection should be based on the following list, which represents common sources of damage to trees:</p> <ul style="list-style-type: none"> - Trenching through the root zone of trees during excavation activities; - Direct damage to tree limbs, bark, and stems from heavy machinery; - Changing the ground level (grade) around trees (removing or adding soil); - Allowing pollutants to contaminate the soil around trees; - Allowing machinery to travel near or park adjacent to trees; or - Storing construction materials around trees. <p>By eliminating these sources, the possibility of damage to trees within any of the SPEAs is significantly reduced.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p>	

<p>a. I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>b. I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>c. I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation</p>	
<p>5. Encroachment</p>	<p>Under the RAR methodology, land uses and structures that pre-date 2006 are considered legally non-conforming and the client can, continue to use the property as in the past. However, in this case, there are no land uses or structures within any of the 30 m RAAs that would be considered legally non-conforming. The client was made aware that new "development" activities are prohibited within the SPEA. "Development" includes activities such as:</p> <ul style="list-style-type: none"> - Removal, alteration, disruption or destruction of vegetation; - Disturbance of soils; - Construction of temporary or permanent structures; - Creation of non-structural impervious or semi-impervious surfaces; - Flood protection works; - Construction of roads and trails; - Provision and maintenance of sewer/water services; - Development of drainage systems; and - Development of utility corridors. <p>As this proposal is for a 56 lot subdivision, there are currently no concerns related to encroachment of the SPEAs. When construction occurs in the future, the SPEAs will be delineated on the ground using high visibility fencing to ensure there is no encroachment. Once construction is complete a permanent form of SPEA delineation should be considered for the long term protection of the SPEAs. In this particular case, installing informative signage along the SPEAs that explains the sensitivity of riparian habitats and their importance to fish would be beneficial.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p> <p>a. I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>b. I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>c. I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation</p>	
<p>6. Sediment and Erosion Control</p>	<p>Under the Federal Fisheries Act, sediment is regarded as being a deleterious substance and introducing sediment into waterbodies can damage fish habitat. Of particular concern is degradation of water quality and suffocation of spawning beds. As this assessment is related to an application for subdivision, there are currently no concerns related to sediment transport into any of the drainages or wetlands. As a result, there is no recommendation for a detailed erosion and sediment control</p>

	<p>(ESC) plan at this time. When construction does occur in the future, each property owner will be required to have detailed ESC measures developed by a Qualified Environmental Professional (QEP).</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p>	
<p>a. I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>b. I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>c. I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation</p>	
<p>7. Stormwater Management</p>	<p>Stormwater management measures are developed to deal with a net increase of surface run-off as a result of creating impervious surfaces such as rooftops, cement structures and paved driveways. There are no recommendations related to stormwater management as this assessment was completed for a subdivision application. Stormwater management measures will be developed and engineered when the subdivision is complete and construction is initiated.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p>	
<p>a. I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>b. I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>c. I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.</p>	
<p>8. Floodplain Concerns (highly mobile channel)</p>	<p>There are currently no concerns related to flooding or highly mobile channels as subdivision is the only form of development at this time. When construction does occur in the future, flooding will not be a concern at that time either. The drainages and wetlands in this project area represent low magnitude systems that are runoff fed and only contain water on a seasonal basis.</p>
<p>I, <u>Justin Lange</u>, hereby certify that:</p>	
<p>a. I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the <i>Fish Protection Act</i>;</p> <p>b. I am qualified to carry out this part of the assessment of the development proposal made by the developer RDY Holdings;</p> <p>c. I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and in carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation.</p>	

Section 5. Environmental Monitoring

Attach text or document files explaining the monitoring regimen Use your "return" button on your keyboard after each line. It is suggested that all document be converted to PDF *before* inserting into the PDF version of the assessment report.

Include actions required, monitoring schedule, communications plan, and requirement for a post development report.

Environmental monitoring is required when construction activities take place within the 30 m RAA. The purpose of monitoring during the construction phase is to ensure that the recommended measures put in place to protect the functionality of the SPEA are followed.

Currently, subdivision is the only proposed form of "development". If the subdivision application is approved, the lots will be sold and development plans will be established by the new property owners to include construction inside the RAA. When construction plans are finalized in the future, more detailed RAR assessments must be completed by the new property owners.

The SPEA and RAA have now been identified, allowing the local government to assess any new development applications proposed for this property. When plans for development proceed and specific measures have been developed, it will be the responsibility of the property owner to contact the QEP.

Section 6. Photos - Stream #1



Looking downstream at the inlet of the culvert that conveys water off the subject property and into the stormwater system under Point Ideal Drive.



The man-holes (marked with red arrows) of the stormwater infrastructure that is positioned under Point Ideal Road.



Looking downstream at the section of Stream #1 (outlined with a blue line) immediately above Point Ideal Road. Note that invasive plant species (such as blackberry and reed canary grass) dominate the riparian vegetation.



A representative photo of the abundance of invasive plant growth that exists along portions of Stream #1. This particular area contains a significant amount of Himalayan blackberry that has grown over the stream channel.



Looking upstream at Stream #1 as it flows out of the area that has been designated for park. The blue line indicates the position of the channel.

Ditch #1



Looking upstream at Ditch #1 from its confluence with Stream #1. This drainage was built adjacent to an old road network that was used when the property was previously logged.



Looking downstream along Ditch #1, immediately upstream of the confluence with Stream #1. The steepness of the banks show that the ditch was built to direct stormwater runoff.



Looking downstream at the ditch. The red hatched area marks the approximate location of the old logging road.



Looking west at a secondary road network that becomes inundated with water during periods of high flow. Changes over time have altered the ditch channel and as a result water flow is not contained at this point.



Looking upstream at a section of Ditch #1 located immediately below Wetland #1. Note that channel definition is lacking and there is no evidence of water flow. The accumulation of leaf matter and woody debris suggests that water has not flowed through this portion of the ditch for some time. .

Wetland #1



The outlet of Wetland #1 and start of Ditch #1.



A representative photo of Wetland #1. The entire wetland is composed of open water, with pockets of sedges and salmonberry.

Wetland #2



A photo depicting the eastern-most portion of Wetland #2. This wetland is an isolated feature as there is no inlet or outlet.



Looking north at the central portion of Wetland #2. Note the abundance of shrub and herb growth throughout this area.



The western end of Wetland #2. The blue flagging marks the HWM of the wetland.

Wetland #3



Looking south at Wetland #3 from the HWM.



Looking northwest along the HWM of Wetland #3. Note the habitat complexity of the wetland with open water and raised "island-like" habitat units.

Wetland #4



Looking north from the HWM of Wetland #4. This wetland is connected to Cowichan Lake and provides overwintering habitat for salmonids.



Looking northwest at Wetland #4 from Point Ideal Drive.



A representative photo of the 30 m SPEA that extends south of Wetland #4

Section 7. Professional Opinion

Assessment Report Professional Opinion on the Development Proposal's riparian area.

Date

1. I Justin Lange, B.Sc., R.P.Bio.

Please list name(s) of qualified environmental professional(s) and their professional designation that are involved in assessment.)

hereby certify that:

- a) I am a qualified environmental professional, as defined in the Riparian Areas Regulation made under the *Fish Protection Act*;
 - b) I am qualified to carry out the assessment of the proposal made by the developer RDY Holdings, which proposal is described in section 3 of this Assessment Report (the "development proposal"),
 - c) I have carried out an assessment of the development proposal and my assessment is set out in this Assessment Report; and
 - d) In carrying out my assessment of the development proposal, I have followed the assessment methods set out in the Schedule to the Riparian Areas Regulation; AND
2. As a qualified environmental professional, I hereby provide my professional opinion that:
- a) if the development is implemented as proposed by the development proposal there will be no harmful alteration, disruption or destruction of natural features, functions and conditions that support fish life processes in the riparian assessment area in which the development is proposed, **OR**
(Note: include local government flex letter, DFO Letter of Advice, or description of how DFO local variance protocol is being addressed)
 - b) if the streamside protection and enhancement areas identified in this Assessment Report are protected from the development proposed by the development proposal and the measures identified in this Assessment Report as necessary to protect the integrity of those areas from the effects of the development are implemented by the developer, there will be no harmful alteration, disruption or destruction of natural features, functions and conditions that support fish life processes in the riparian assessment area in which the development is proposed.

[NOTE: "qualified environmental professional" means an applied scientist or technologist, acting alone or together with another qualified environmental professional, if

- (a) the individual is registered and in good standing in British Columbia with an appropriate professional organization constituted under an Act, acting under that association's code of ethics and subject to disciplinary action by that association,
- (b) the individual's area of expertise is recognized in the assessment methods as one that is acceptable for the purpose of providing all or part of an assessment report in respect of that development proposal, and
- (c) the individual is acting within that individual's area of expertise.]



BV DEVELOPMENTS MANAGEMENT INC.

APPENDIX D

GEOTECHNICAL INFORMATION

RYZUK GEOTECHNICAL

Engineering & Materials Testing

28 Crease Avenue, Victoria, BC, V8Z 1S3 Tel: 250-475-3131 Fax: 250-475-3611 www.ryzuk.com

November 26, 2018

File No: 6208-1

RDY Holdings
3471 Short Street
Victoria, BC
V8X 2V6

Attn: Ms. Nicole Roberts
(By E-mail: nicole@cubicland.com)

Re: Proposed Subdivision
500 Block Point Ideal Drive – Lake Cowichan, BC

As requested, we have attended the referenced site on October 25 & November 8, 2018, to complete a geotechnical reconnaissance and subsurface investigation of the property proposed for development of a 55-lot residential subdivision. The property is currently designated as a Development Permit Area (DPA-2 Natural Hazard Lands) and therefore this assessment for a permit exemption is required pursuant to the Township of Lake Cowichan Official Community Plan, Bylaw No. 910-2011. Our associated observations, comments, and recommendations in this regard are contained herein, and our work has been undertaken in accordance with, and is subject to, the attached Terms of Engagement. The Township of Lake Cowichan is an approved user of this report and may rely on this information when considering development approval.

PROPOSED DEVELOPMENT

The proposed subdivision is an approximate 6.3 Ha, irregular shaped parcel situated between Point Ideal Drive and Lakeview Park Road in the southern portion of the town Lake Cowichan. The property is generally bounded by residential developments along the north and east, and undeveloped properties and park lands to the south and west.

Based on the Tentative Lot Plan provided by J.E. Anderson and Associates, site preparations for the proposed subdivision would include removal of the existing vegetation topsoil and fills to expose native soil, followed by an extensive cut and fill earthworks program. It is proposed to lower the existing site grades by up to 6 m within the south/southeast portion and subsequently place/compact the excavated material in the northern most area and build up in the order of up to 11 m above existing site grades with engineered fill.

INVESTIGATION PROCEDURE

On October 18, 2018, we attended the site to complete a visual site assessment of the existing geotechnical conditions as such relate to the DPA – 2 property designation. Further to our initial attendance, we completed a subsurface test pit investigation on November 8, 2018 to characterize the soil conditions. This consisted of advancing ten test pits using a large hydraulic excavator. Our test pits were strategically located within the site to assess the soil conditions in areas intended for cuts and fills, as well as along the proposed access road alignment. The general site layout along with test pit locations are indicated on the attached Location Plan (dwg. 6208-1-1), and the results are summarized in the attached Summary of Test Pit Information.

SURFACE AND SUBSURFACE CONDITIONS

Site relief is generally sloping down to the north with variable localized slopes undulating up to inclinations of 30 degrees from horizontal, with intermittent level benches extending across the slope. An access roadway extends across the property from west to east, with branching to the north within the western portion of the property. A small drainage channel is present at the easternmost site access off Point Ideal Drive, however no discharge was observed at the culvert outfall at the time of our visit. We noted that all sloped areas were well vegetated with trees and brush, with no indications of past slope instability occurrences.

Soil conditions observed in test pits TP18-03/04 and TP18-06 to TP18-10 generally consisted of a veneer of topsoil atop native dense sand and gravel with variable silt and cobble overlying very dense silty gravelly sand. A zone of silty fine sand was encountered in TP18-05 at 3.6 m below grade. These observations were consistent with the soils observed in access road cut-slopes at the time of our initial site attendance. No bedrock was encountered during our investigation. Soils provenance are expected to be glaciofluvial/lacustrine and morainal.

Indications of possible fill placement were noted at the north extent of the development site where young alder trees cover a tiered soil slope feature that may have been constructed for site access from Point Ideal Drive. Soils assessed in two test pits located atop the tiered slope consisted of variable silty sand and gravel fills to depths of between 1.2 and 2.1 m below the existing site grade, with organic fill material including logs and mature tree stumps below. It should be noted that in TP18-01, excavator refusal occurred within the bulk organic fill which may extended below 3.0 m depth. An embankment of fill material comprised of silty gravelly sand and organics was encountered adjacent to TP18-10 in the southeast corner, and measured up to approximately 3 m high by 10 m wide and upwards of 30 m long.

GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

Engineered Fill

Based on our subsurface investigation, extensive in situ fills were encountered along the north tiered slope at depths exceeding 3.0 m. These fills are not suitable for support of buildings or infrastructure and therefore will need to be removed and replaced with engineered fills.

The general soil conditions within the areas where cutting is intended consisted of native very dense gravelly sand with a trace to some silt encountered at relatively shallow depths. We expect

that the reuse of this material (as well as similar fill soils) as engineered fill would be feasible, however, such must be done under controlled moisture conditions. Such soils carry an inherent risk of being unworkable during adverse weather conditions. Compaction of the silty gravelly sand fill must be carried out under geotechnical supervision.

The native material to be reused as fill to recover site grade above approved subgrade shall be placed in lifts up to 150 mm and compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD), or judged equivalent. With the presence of water, such as with heavy rain conditions, the compaction techniques including lift thickness and placement conditions may require adjustment to maintain the optimum moisture content necessary to reach 95% SPMDD. Any fill placement within building footprints, as well as the subgrade upon which it is placed, must be approved by a qualified geotechnical professional. All placed engineered fill must have a footprint that extends horizontally beyond the footings a distance equal to the twice the thickness of the engineered fill at that location in order to provide adequate splay for building loads and roadways.

Foundation Considerations

Native dense sandy soils or engineered fill placed atop such should provide suitable bearing for residential foundations and roadway subgrade. Foundations bearing directly upon native soils or, a typical design foundation bearing pressure of 250 and 300 kPa for strip and pad footings respectively may be considered. Additionally, where foundations bear on engineered fill atop native soils, bearing pressures for strip and pad footings of 145 and 170 kPa respectively may be considered. Where loose soils and non-select fills may be present, such would need to be removed within any proposed building/roadway envelopes where encountered. All foundation and road subgrades should be inspected by qualified geotechnical personnel during construction. We recommend that design finished soil slopes be no steeper than 2 H : 1 V (Horizontal : Vertical).

DPA – 2 Natural Hazard Lands

Areas where slope gradient exceeded 30% were assessed for indications of instability and groundwater seepage to determine if hazardous conditions exist. Based on a visual assessment of the surface conditions, slopes within native soils were stable in the current state with no observed indication of seepage or potential for surficial or global slope instability.

The development site is situated outside of the established 200-year flood plain and as such Water Balance Modelling as it pertains to the natural hydraulic regime was not undertaken as a part of this assessment. Ditches and seasonal drainages were limited to within the Streamside Protection and Enhancement Areas (SPEA) and covenanted wetlands. Re-vegetation of finished areas should be undertaken as soon as possible after construction.

To minimize the migration of fines and deleterious materials to nearby properties and environmental areas during construction, siltation mitigation systems should be installed with an assessment of the existing conditions of the storm water system prior to site grading.

Drainage

Given the relatively impermeable nature of the native soils observed, an inground stormwater disposal system would act primarily as storage with minimal infiltration. Suitable overflow contingency would be required to be incorporated into the drainage design with the location of infiltrators positioned a suitable distance from proposed buildings and slopes.

Perched groundwater conditions were observed atop the very dense glacial till layer. Based on the relatively impermeable nature of the material, groundwater influx into excavations below this layer may be experienced.

Road Structure


We consider the undisturbed dense native gravelly sand or engineered fill atop such to be suitable for road subgrade. However, such should be confirmed prior to placement of base and sub-base materials.

For general roadways, a pavement structure consisting of 50 mm of asphalt surfacing overlying at least 100 mm of 19 mm minus crushed base course and at least 150 mm of 75 mm minus subbase is typically recommended over native soils. For pavement structure atop engineered fill, the thickness of the subbase should be thickened to 200 mm. Base and subbase layers should be compacted to 95% of MPMDD. The undisturbed native soil or placed engineered fill should be approved by project personnel prior to subbase placement with subsequent proof roll testing of the compacted base prior to asphalt surfacing.

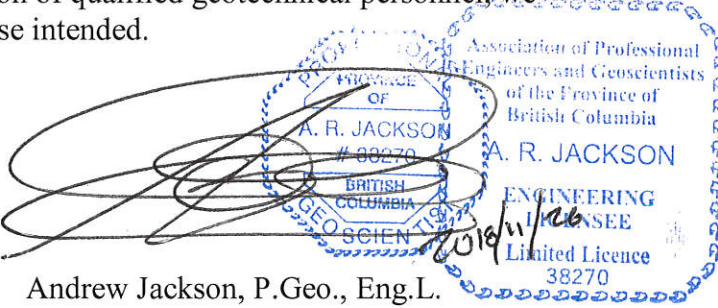
CLOSURE

Given the above, we consider the proposed development to be feasible from a geotechnical prospective and that such can be carried out in accordance with the OCP Guidelines. Provided that site grading be carried out under the supervision of qualified geotechnical personnel, we consider that the land may be safely used for the use intended.

Regards,
Ryzuk Geotechnical



Cam Schellenberg, EIT
Junior Engineer



Andrew Jackson, P. Geo., Eng. L.
Review Geoscientist / Engineer Licensee

Attachments - Terms of Engagement
- Location Plan, drawing 6208-1-1
- Summary of Test Pit Information

TERMS OF ENGAGEMENT

GENERAL

Ryzuk Geotechnical (the Consultant) shall render the Services, as specified in the agreed Scope of Services, to the Client for this Project in accordance with the following terms of engagement. The Services, and any other associated documents, records or data, shall be carried out and/or prepared in accordance with generally accepted engineering practices in the location where the Services were performed. No other warranty, expressed or implied is made. The Consultant may, at its discretion and at any stage, engage sub-consultants to perform all or any part of the Services.

Ryzuk Geotechnical is a wholly owned subsidiary of C. N. Ryzuk & Associates Ltd.

COMPENSATION

All charges will be payable in Canadian Dollars. Invoices will be due and payable by the Client on receipt of the invoice without hold back. Interest on overdue accounts is 24% per annum.

REPRESENTATIVES

Each party shall designate a representative who is authorized to act on behalf of that party and receive notices under this Agreement.

TERMINATION

Either party may terminate this engagement without cause upon thirty (30) days' notice in writing. On termination by either party under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed, including all expenses and other charges incurred by the Consultant for this Project.

If either party breaches this engagement, the non-defaulting party may terminate this engagement after giving seven (7) days' notice to remedy the breach. On termination by the Consultant under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed to the date of termination, including all fees and charges for this Project.

ENVIRONMENTAL

The Consultant's field investigation, laboratory testing and engineering recommendations will not address or evaluate pollution of soil or pollution of groundwater. The Consultant will cooperate with the Client's environmental consultant during the field work phase of the investigation.

PROFESSIONAL RESPONSIBILITY

In performing the Services, the Consultant will provide and exercise the standard of care, skill and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the Services contemplated in this engagement at the time when and the location in which the Services were performed.

INSURANCE

Ryzuk Geotechnical is covered by Professional Indemnity Insurance as follows:

1. \$ 2,000,000 each and every claim
2. \$ 4,000,000 aggregate
3. \$ 5,000,000 commercial/general liability coverage

LIMITATION OF LIABILITY

The Consultant shall not be responsible for:

1. the failure of a contractor, retained by the Client, to perform the work required for the Project in accordance with the applicable contract documents;
2. the design of or defects in equipment supplied or provided by the Client for incorporation into the Project;
3. any cross-contamination resulting from subsurface investigations;
4. any Project decisions made by the Client if the decisions were made without the advice of the Consultant or contrary to or inconsistent with the Consultant's advice;
5. any consequential loss, injury or damages suffered by the Client, including but not limited to loss of use, earnings and business interruption;
6. the unauthorized distribution of any confidential document or report prepared by or on behalf of the consultant for the exclusive use of the Client
7. Subsurface structures and utilities

The Consultant will make all reasonable efforts prior to and during subsurface site investigations to minimize the risk of damaging any subsurface utilities/mains. If, in the unlikely event that damage is incurred where utilities were unmarked and/or undetected, the Consultant will not be held responsible for damages to the site or surrounding areas, utilities/mains or drilling equipment or the cost of any repairs.

The total amount of all claims the Client may have against the Consultant or any present or former partner, executive officer, director, stockholder or employee thereof under this engagement, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the amount of any professional liability insurance the Consultant may have available for such claims.

No claim may be brought against the Consultant in contract or tort more than two (2) years after the date of discovery of such defect.

DOCUMENTS AND REPORTING

All of the documents prepared by the Consultant or on behalf of the Consultant in connection with the Project are instruments of service for the execution of the Project. The Consultant retains the property and copyright in these documents, whether the Project is executed or not. These documents may not be used on any other project without the prior written agreement of the Consultant.

The documents have been prepared specifically for the Project, and are applicable only in the case where there has been no physical alteration to, or deviation from any of the information provided to the Consultant by the Client or agents of the Client. The Client may, in light of such alterations or deviations, request that the Consultant review and revise these documents.

The identification and classification as to the extent, properties or type of soils or other materials at the Project site has been based upon investigation and interpretation consistent with the accepted standard of care in the engineering consulting practice in the location where the Services were performed. Due to the nature of geotechnical engineering, there is an inherent risk that some conditions will not be detected at the Project site, and that actual subsurface conditions may vary considerably from investigation points. The Client must be aware of, and accept this risk, as must any other party making use of any documents prepared by the Consultant regarding the Project.

Any conclusions and recommendations provided within any document prepared by the Consultant for the Client has been based on the investigative information undertaken by the Consultant, and any additional information provided to the Consultant by the Client or agents of the Client. The Consultant accepts no responsibility for any associated deficiency or inaccuracy as the result of a miss-statement or receipt of fraudulent information.

JOBSITE SAFETY AND CONTROL

The Client acknowledges that control of the jobsite lies solely with the Client, his agents or contractors. The presence of the Consultant's personnel on the site does not relieve the Client, his agents or contractors from their responsibilities for site safety. Accordingly, the Client must endeavor to inform the Consultant of all hazardous or otherwise dangerous conditions at the Project site of which the Client is aware.

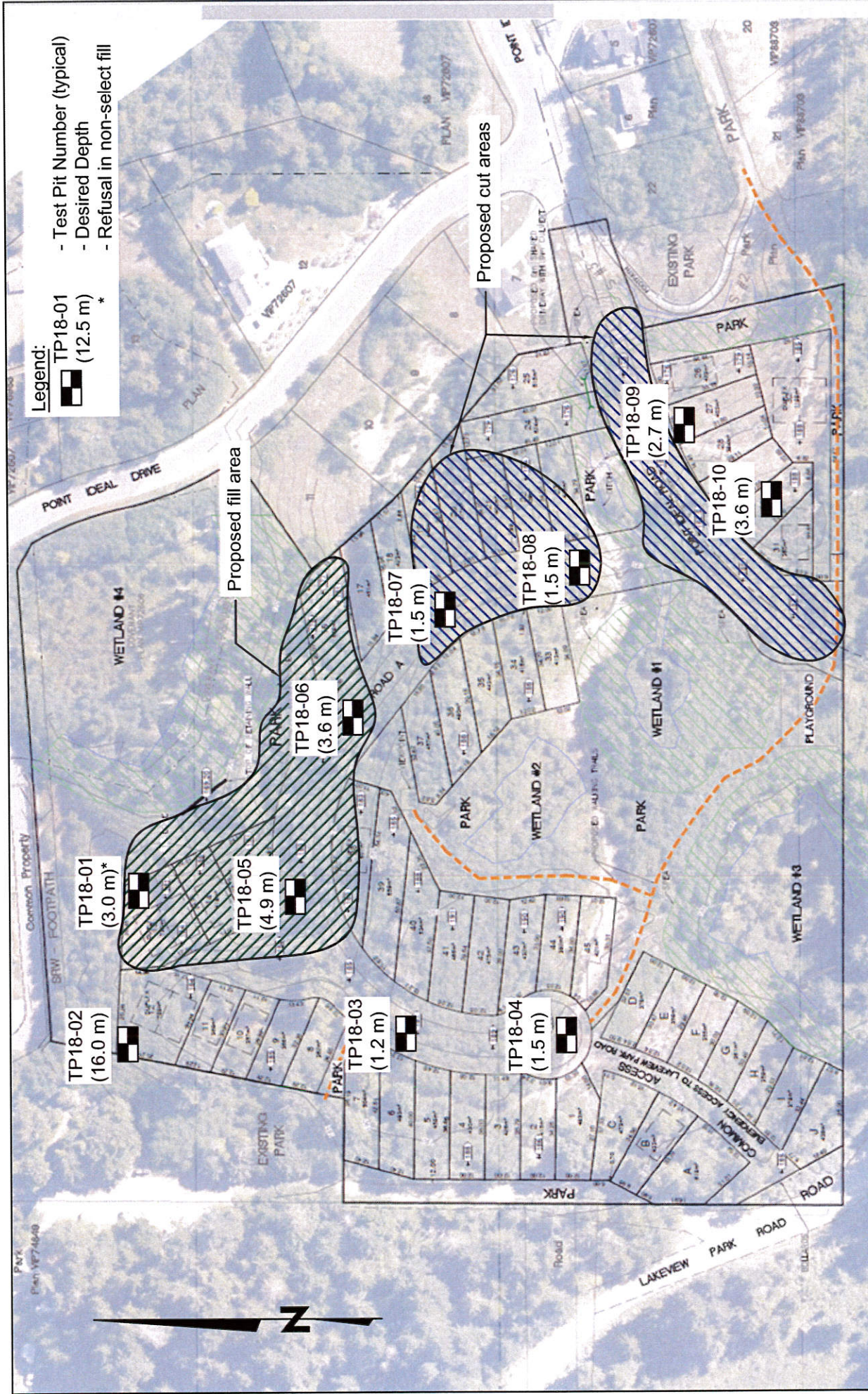
The client must acknowledge that during the course of a geotechnical investigation, it is possible that a previously unknown hazard may be discovered. In this event, the Client recognizes that such a hazard may result in the necessity to undertake procedures which ensure the safety and protection of personnel and/or the environment. The Client shall be responsible for payment of any additional expenses incurred as a result of such discoveries, and recognizes that under certain circumstances, discovery of hazardous conditions or elements requires that regulatory agencies must be informed. The Client shall not bring about any action or dispute against the Consultant as a result of such notification.

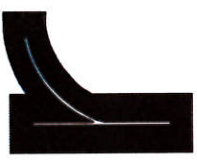

FIELD SERVICES

Where applicable, field services recommended for the Project are the minimum necessary, in the sole discretion of the Consultant, to observe whether the work or a contractor retained by the Client is being carried out in general conformity with the intent of the Services. Any reduction from the level of services recommended will result in the Consultant providing qualified certifications for the work.

DISPUTE RESOLUTION

If requested in writing by either the Client or the Consultant, the Client and the Consultant shall attempt to resolve any dispute between them arising out of or in connection with this Agreement by entering into structured non-binding negotiations with the assistance of a mediator on a without prejudice basis. The mediator shall be appointed by agreement of the parties. If a dispute cannot be settled within a period of thirty (30) calendar days with the mediator, the dispute shall be referred to and finally resolved by arbitration under the rules of the arbitrator appointed by agreement of the parties or by reference to a Judge of the British Columbia Court.



Notes: 1. Base imagery taken from J.E. Anderson & Associates 55 Lot Tentative Plan, dated October 01, 2018. 2. Subsurface investigation carried out by Ryzuk Geotechnical on November 8, 2018. 3. Cut and fill areas are approximate. 4. Test pit locations accurate within +/- 5 m.		RDY Holdings	DRAWN CPAS
		LOCATION PLAN Proposed Subdivision	DATE November, 2018 APPROVED  SCALE 1:1800
		Point Ideal Drive Lake Cowichan, B.C.	DRAWING No. 6208-1-1
		RYZUK GEOTECHNICAL Engineering & Materials Testing	



Practical. Innovative. Experienced.

Project: Proposed Subdivision
Point Ideal Drive – Lake Cowichan, BC
Client: RDY Holdings

Investigation Date: November 8, 2018
Location: See Location Plan

Inspector: CPAS
Ryzuk Job Number: 6208-1

Summary of Test Pit Information

Test Pit 18-01 (TP18-01)

Stratigraphy:

0.0	to	0.15 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.15	to	2.1 m	FILL – loose to compact, sand, silty, trace to some cobble, trace to some gravel, brown, moist
2.1	to	3.0 m	FILL – variable, sand and gravel, silty, logs, stumps dark grey, moist
	at	3.0 m	End of test pit – refusal on large wood material

Notes: No seepage observed.

Test Pit 18-02 (TP18-02)

Stratigraphy:

0.0	to	0.15 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.15	to	1.2 m	FILL – loose to compact, sand, silty, trace to some cobble, trace to some gravel, brown, moist
1.2	to	2.1 m	FILL – variable, sand and gravel, silty, logs, stumps dark grey – original soil horizon at 2.1 m
2.1	to	2.6 m	SAND – loose to compact, gravelly, silty, organic, brown, damp
2.6	to	4.8 m	SAND – dense, gravelly, trace to some silt, brown, damp
	at	4.8 m	End of test pit – maximum machine reach

Notes: No seepage observed.

Test Pit 18-03 (TP18-03)

Stratigraphy:

0.0	to	0.15 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.15	to	1.2 m	SAND – dense, gravelly, trace to some cobble, trace to some silt, brown, moist
1.2	to	1.5 m	SAND – very dense, trace to some gravel, trace to some silt,
	at	1.5 m	trace clay, brown, damp (inferred TILL) End of test pit – desired depth

Notes: No seepage observed.

Test Pit 18-04 (TP18-04)

Stratigraphy:

0.0	to	0.9 m	SAND – dense, gravelly, trace to some silt, trace cobble, brown, moist
0.9	to	1.5 m	SAND – very dense, trace to some gravel, trace to some silt, trace clay, brown, damp (inferred TILL)
	at	1.5 m	End of test pit – desired depth

Notes: No seepage observed.

Test Pit 18-05 (TP18-05)

Stratigraphy:

0.0	to	0.15 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.15	to	0.9 m	FILL – loose, fine sand and gravel, trace to some silt, brown, moist – original soil horizon at 0.9 m
0.9	to	1.5 m	SAND – loose to compact, gravelly, silty, organic, dark brown, moist
1.5	to	3.6 m	SAND – dense, gravelly, trace to some silt, trace cobble, brown, moist
3.6	to	4.5 m	– becomes wet after 2.1 m
4.5	to	4.9 m	SAND – dense, fine, silty, brown, damp to moist
	at	4.9 m	SAND – dense, fine, silty, grey, moist End of test pit – maximum machine reach

Notes: No seepage observed.

Test Pit 18-06 (TP18-06)

Stratigraphy:

0.0	to	0.5 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.5	to	0.9 m	SAND – loose to compact, gravelly, trace to some silt, trace to some cobble, brown, damp
0.9	to	3.6 m	SAND – very dense, gravelly, trace to some silt, trace to some cobble, brown, moist (inferred TILL)
	at	3.6 m	End of test pit – desired depth

Notes: Minor seepage observed at 3.3 m.

Test Pit 18-07 (TP18-07)

Stratigraphy:

0.0	to	0.3 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.3	to	0.9 m	SAND – compact, gravelly, trace to some silt, trace cobble, brown, moist
0.9	to	1.5 m	SAND – very dense, gravelly, some silt, trace to some cobble, brown, moist (inferred TILL)
	at	1.5 m	End of test pit – desired depth

Notes: No seepage observed.

Test Pit 18-08 (TP18-08)

Stratigraphy:

0.0	to	0.3 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.3	to	0.9 m	SAND – compact, gravelly, trace to some silt, trace cobble, brown, moist
0.9	to	1.5 m	SAND – very dense, gravelly, some silt, trace to some cobble, brown, moist (inferred TILL)
	at	1.5 m	End of test pit – desired depth

Notes: No seepage observed.

Test Pit 18-09 (TP18-09)

Stratigraphy:

0.0	to	0.3 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.3	to	0.9 m	SAND – compact, gravelly, trace to some silt, trace cobble, brown, moist
0.9	to	1.4 m	SAND – fine, clean, grey, moist
1.4	to	2.0 m	SAND – very dense, gravelly, trace to some silt, trace cobble, light brown, moist
2.0	to	2.7 m	SAND – very dense, gravelly, some silt, trace to some cobble, brown, moist (inferred TILL)
	at	2.7 m	End of test pit – desired depth

Notes: Seepage observed at 0.9 m within the clean sand layer.

Test Pit 18-10 (TP18-10)

Stratigraphy:

0.0	to	0.3 m	TOPSOIL – loose, sand, silty, highly organic, dark brown, moist
0.3	to	1.5 m	SAND – dense, gravelly, trace to some silt, trace cobble, brown, moist
1.5	to	3.6 m	SAND – very dense, gravelly, some silt, trace to some cobble, brown, moist (inferred TILL)
	at	3.6 m	End of test pit – desired depth

Notes: No seepage observed.



RYZUK GEOTECHNICAL
ENGINEERING & MATERIALS TESTING

28 Crease Avenue
Victoria, B.C.
V8Z 1S3
Tel: 250-475-3131
Fax: 250-475-3611
mail@ryzuk.com

Geotechnical Field Review

Project No: 5313-41
Project: Proposed Retaining Walls, 500 Block Point Ideal Drive - Lake Cowichan, BC
Client: McElhanney Consulting Services Ltd
Contact: Mr. Jon Irving, P.Eng., LEED Green Associate
Email: jirving@mcelhanney.com
Date: March 2, 2020

Copy to:	Email / Fax:	Copy to:	Email / Fax:
<input type="checkbox"/>		<input type="checkbox"/>	
<input type="checkbox"/>		<input type="checkbox"/>	

RE: Soil Parameters

As requested, and further to our geotechnical report of November 26, 2018, we reviewed soil properties as such relate to the design for the proposed retaining walls. Our work has been undertaken in accordance with, and is subject to, the attached Terms of Engagement.


Based on a review of the soil conditions observed during our investigation, we consider the following soil properties can be used for the retaining wall design:

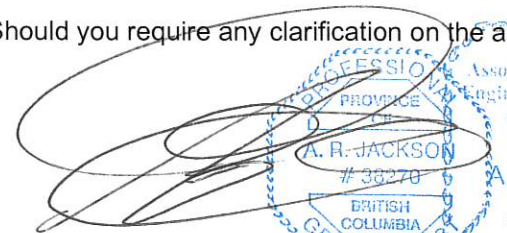
Soil Name	Bearing Capacity (factored SLS) q [kPa]	Unit Weight γ [kN/m ³]	Friction Angle φ [°]	Cohesion c [kN/m ²]
<i>Existing Fill</i> (typ. SAND - loose to compact)	to be removed			
<i>Imported / Engineered Fill</i> (typ. well-graded crushed rock, compacted to a minimum of 95% of the Standard Proctor Maximum Dry Density value)	145*	19-21	35 - 40	0
<i>Native Sand</i> (typ. SAND - loose to compact)	not suitable for bearing	17 - 19	22.5 - 27.5	0
<i>Native Glacial Till</i> (typ. SAND - very dense, trace to some silt, gravel, cobbles)	250	19-21	32.5 - 37.5	0

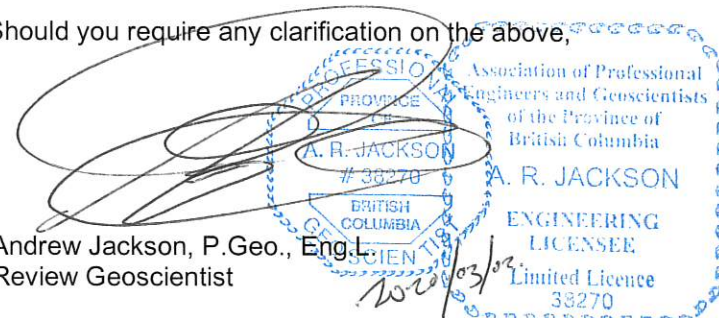
* only if suitably compacted atop approved native subgrade

Information from *National Resources Canada* indicates peak ground accelerations (PGA) of 0.532 g (2% probability of exceedance in 50 years) according to the *2015 National Building Code*. We consider a horizontal coefficient of $k_H = (2/3) \times PGA = 0.355$ to be reasonable.

We trust the above is suitable for your needs at present. Should you require any clarification on the above, please do not hesitate to contact our office.

Best regards,
Ryzuk Geotechnical

Robert Nollau, EIT
Junior Engineer


Andrew Jackson, P.Geo., Eng.L.
Review Geoscientist


Association of Professional Engineers and Geoscientists of the Province of British Columbia
A. R. JACKSON
#38270
BRITISH COLUMBIA
ENGINEERING LICENSEE
38270
2020/03/02



TERMS OF ENGAGEMENT

GENERAL

Ryzuk Geotechnical (the Consultant) shall render the Services, as specified in the agreed Scope of Services, to the Client for this Project in accordance with the following terms of engagement. The Services, and any other associated documents, records or data, shall be carried out and/or prepared in accordance with generally accepted engineering practices in the location where the Services were performed. No other warranty, expressed or implied is made. The Consultant may, at its discretion and at any stage, engage sub-consultants to perform all or any part of the Services.

Ryzuk Geotechnical is a wholly owned subsidiary of C. N. Ryzuk & Associates Ltd.

COMPENSATION

All charges will be payable in Canadian Dollars. Invoices will be due and payable by the Client on receipt of the invoice without hold back. Interest on overdue accounts is 24% per annum.

REPRESENTATIVES

Each party shall designate a representative who is authorized to act on behalf of that party and receive notices under this Agreement.

TERMINATION

Either party may terminate this engagement without cause upon thirty (30) days' notice in writing. On termination by either party under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed, including all expenses and other charges incurred by the Consultant for this Project.

If either party breaches this engagement, the non-defaulting party may terminate this engagement after giving seven (7) days' notice to remedy the breach. On termination by the Consultant under this paragraph, the Client shall forthwith pay to the Consultant its Charges for the Services performed to the date of termination, including all fees and charges for this Project.

ENVIRONMENTAL

The Consultant's field investigation, laboratory testing and engineering recommendations will not address or evaluate pollution of soil or pollution of groundwater. The Consultant will cooperate with the Client's environmental consultant during the field work phase of the investigation.

PROFESSIONAL RESPONSIBILITY

In performing the Services, the Consultant will provide and exercise the standard of care, skill and diligence required by customarily accepted professional practices and procedures normally provided in the performance of the Services contemplated in this engagement at the time when and the location in which the Services were performed.

INSURANCE

Ryzuk Geotechnical is covered by Professional Indemnity Insurance as follows:

1. \$ 3,000,000 each and every claim
2. \$ 5,000,000 aggregate
3. \$ 5,000,000 commercial/general liability coverage

LIMITATION OF LIABILITY

The Consultant shall not be responsible for:

1. the failure of a contractor, retained by the Client, to perform the work required for the Project in accordance with the applicable contract documents;
2. the design of or defects in equipment supplied or provided by the Client for incorporation into the Project;
3. any cross-contamination resulting from subsurface investigations;
4. any Project decisions made by the Client if the decisions were made without the advice of the Consultant or contrary to or inconsistent with the Consultant's advice;
5. any consequential loss, injury or damages suffered by the Client, including but not limited to loss of use, earnings and business interruption;
6. the unauthorized distribution of any confidential document or report prepared by or on behalf of the consultant for the exclusive use of the Client
7. Subsurface structures and utilities

The Consultant will make all reasonable efforts prior to and during subsurface site investigations to minimize the risk of damaging any subsurface utilities/mains. If, in the unlikely event that damage is incurred where utilities were unmarked and/or undetected, the Consultant will not be held responsible for damages to the site or surrounding areas, utilities/mains or drilling equipment or the cost of any repairs.

The total amount of all claims the Client may have against the Consultant or any present or former partner, executive officer, director, stockholder or employee thereof under this engagement, including but not limited to claims for negligence, negligent misrepresentation and breach of contract, shall be strictly limited to the amount of any professional liability insurance the Consultant may have available for such claims.

No claim may be brought against the Consultant in contract or tort more than two (2) years after the date of discovery of such defect.

DOCUMENTS AND REPORTING

All of the documents prepared by the Consultant or on behalf of the Consultant in connection with the Project are instruments of service for the execution of the Project. The Consultant retains the property and copyright in these documents, whether the Project is executed or not. These documents may not be used on any other project without the prior written agreement of the Consultant.

The documents have been prepared specifically for the Project, and are applicable only in the case where there has been no physical alteration to, or deviation from any of the information provided to the Consultant by the Client or agents of the Client. The Client may, in light of such alterations or deviations, request that the Consultant review and revise these documents.

The identification and classification as to the extent, properties or type of soils or other materials at the Project site has been based upon investigation and interpretation consistent with the accepted standard of care in the engineering consulting practice in the location where the Services were performed. Due to the nature of geotechnical engineering, there is an inherent risk that some conditions will not be detected at the Project site, and that actual subsurface conditions may vary considerably from investigation points. The Client must be aware of, and accept this risk, as must any other party making use of any documents prepared by the Consultant regarding the Project.

Any conclusions and recommendations provided within any document prepared by the Consultant for the Client has been based on the investigative information undertaken by the Consultant, and any additional information provided to the Consultant by the Client or agents of the Client. The Consultant accepts no responsibility for any associated deficiency or inaccuracy as the result of a miss-statement or receipt of fraudulent information.

JOBSITE SAFETY AND CONTROL

The Client acknowledges that control of the jobsite lies solely with the Client, his agents or contractors. The presence of the Consultant's personnel on the site does not relieve the Client, his agents or contractors from their responsibilities for site safety. Accordingly, the Client must endeavor to inform the Consultant of all hazardous or otherwise dangerous conditions at the Project site of which the Client is aware.

The client must acknowledge that during the course of a geotechnical investigation, it is possible that a previously unknown hazard may be discovered. In this event, the Client recognizes that such a hazard may result in the necessity to undertake procedures which ensure the safety and protection of personnel and/or the environment. The Client shall be responsible for payment of any additional expenses incurred as a result of such discoveries, and recognizes that under certain circumstances, discovery of hazardous conditions or elements requires that regulatory agencies must be informed. The Client shall not bring about any action or dispute against the Consultant as a result of such notification.

FIELD SERVICES

Where applicable, field services recommended for the Project are the minimum necessary, in the sole discretion of the Consultant, to observe whether the work or a contractor retained by the Client is being carried out in general conformity with the intent of the Services. Any reduction from the level of services recommended will result in the Consultant providing qualified certifications for the work.

DISPUTE RESOLUTION

If requested in writing by either the Client or the Consultant, the Client and the Consultant shall attempt to resolve any dispute between them arising out of or in connection with this Agreement by entering into structured non-binding negotiations with the assistance of a mediator on a without prejudice basis. The mediator shall be appointed by agreement of the parties. If a dispute cannot be settled within a period of thirty (30) calendar days with the mediator, the dispute shall be referred to and finally resolved by arbitration under the rules of the arbitrator appointed by agreement of the parties or by reference to a Judge of the British Columbia Court.

CONFIDENTIALITY

During the period of this Agreement, the Consultant shall not use or disclose any Confidential Information to any third parties. The Consultant will only use Confidential Information for the sole purpose of carrying out the service(s) agreed upon. Access to the Client's Confidential Information will be restricted to employees who need the information to perform work duties. The Consultant may share photos of the project without disclosing any information not already made public unless the Client refuses consent of photos shared on social media. Unless already made public, the Consultant will not share owner or site address information on social media or with outside parties.



BV DEVELOPMENTS MANAGEMENT INC.

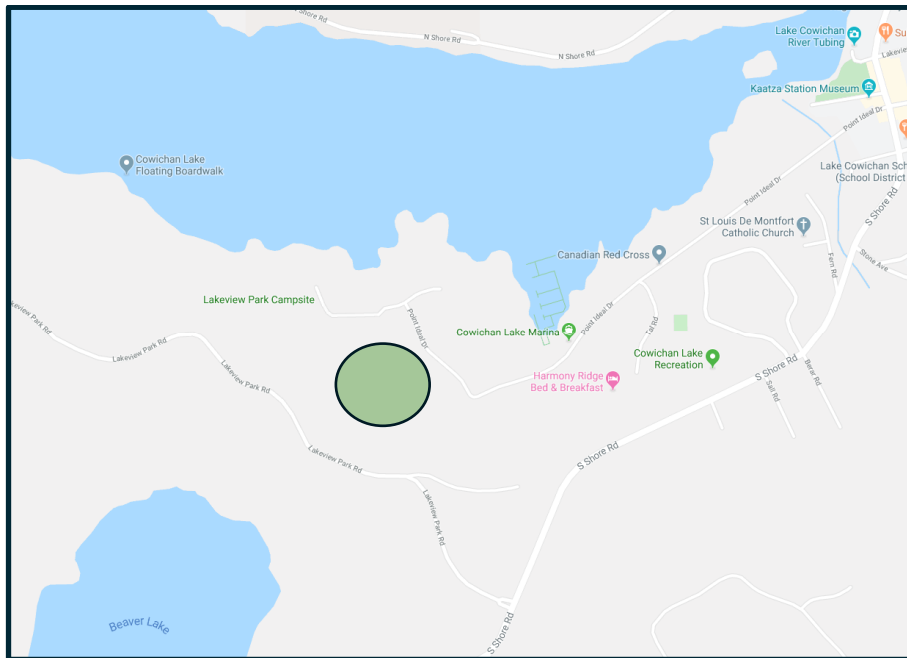
APPENDIX E

WATER MODELING

Town of Lake Cowichan

Water System Review for Point Ideal Development

December 6, 2019 | Our File: 2233-01095



Prepared By:

McElhanney Ltd.

www.mcelhanney.com

Date:

December 6, 2019

REVISION No.	REVISION DESCRIPTION	DATE
1	Initial Results Review (draft)	December 6, 2019

1. INTRODUCTION

McElhanney Ltd. (McElhanney) has been retained by BV Developments Management Inc., the owner of the Point Ideal Development, to review the impacts to the Town of Lake Cowichan's water system from the proposed development.

The proposed development is located at the western end of Point Ideal Drive, west of the Cowichan Lake Marina, within the Town of Lake Cowichan (Town). The proposed development will consist of 47 single family lots and 1 strata lot.

For the analysis, EPANET 2.0 was utilized to model the water system.

2. EXISTING SYSTEM DESCRIPTION

Since the Town does not have a water model of the existing water system, McElhanney engaged Pacific Coast Fire Equipment to complete fire hydrant testing. The tests were completed on an existing fire hydrant located generally in front of 442 Point Ideal Road and 470 Point Ideal Road. A copy of the fire hydrant test information is attached in Appendix A – Fire Hydrant Test Results.

There is an existing 250mm diameter PVC water main that ends in front of 458 Point Ideal Road.

3. HYDRAULIC ASSESSMENT DESIGN CRITERIA

The following design guidelines and criteria were used in the hydraulic system assessment.

- People per single family residence
 - Based on Ministry of Health Sewerage System Standard Practice Manual (Table II-9 - Per Capita Daily Design Flow for Residences, assumed 3 bedroom units)
 - Minimum number of occupants = 3.75 people
- Max Day Demand (MDD)
 - Based on Master Municipal Construction Documents (MMCD) Design Guidelines 2014 (Section 2.3 – Per Capita Demand, new metered development)
 - $MDD = 600 \text{ litres/capita/day} = 0.00694 \text{ litres/capita/second}$
- Peak Hour Demand (PHD)
 - Based on Master Municipal Construction Documents (MMCD) Design Guidelines 2014 (Section 2.3 – Per Capita Demand, new metered development)
 - $PHD = 900 \text{ litres/capita/day} = 0.01042 \text{ litres/capita/second}$

- Fire Service
 - Based on Master Municipal Construction Documents (MMCD) Design Guidelines 2014 (Section 2.5 – Fire Flows, single family residential without sprinklers)
 - Available Fire Storage within Reservoir = unknown
 - Assumed infinite for purposes of the water model
 - Fire flow minimum requirements = 60 L/s
- Hazen Williams Formula, C = 140 for PVC Pipe
 - Based on Master Municipal Construction Documents (MMCD) Design Guidelines 2014 (Section 2.8 – Hydraulic Design, Table 2.8)
- Residual Pressures
 - Based on Master Municipal Construction Documents (MMCD) Design Guidelines 2014 (Section 2.7 – Water Pressure)
 - Minimum 43 psi at PHD
 - Minimum 22 psi at MDD + Fire demand
 - Max allowable pressure is 123 psi
 - Where the maximum pressure exceeds 75 psi, service connections must be individually protected by pressure reducing valves located in the buildings being served.

4. PROPOSED DEVELOPMENT DEMANDS

The Point Ideal development will consist of 47 single family residential units along with a number of Wetland areas. The project is located west of the Cowichan Lake Marina. The following figure indicates the proposed development and is also included in Appendix B – Proposed Site Plan for reference.

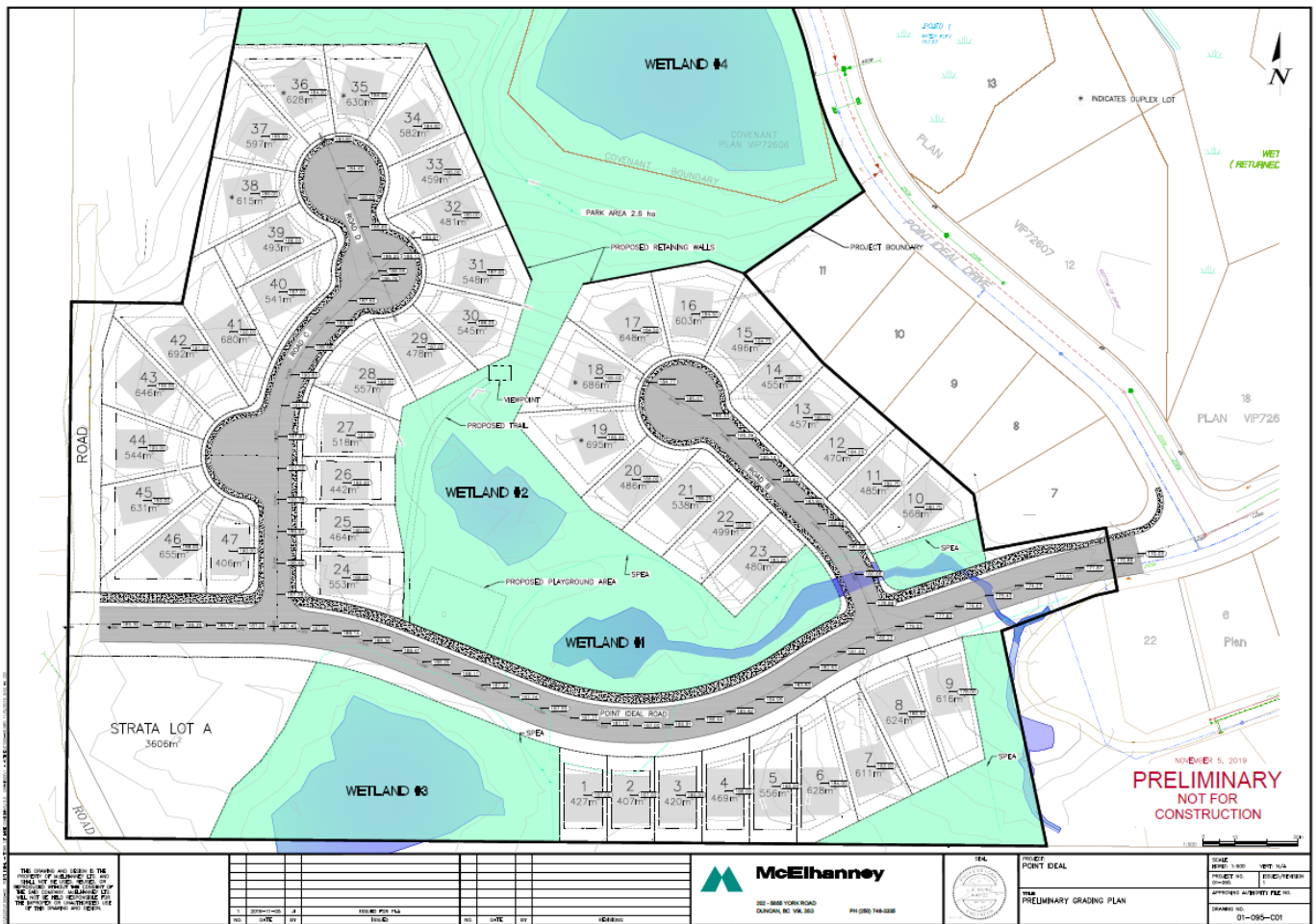


Figure 1 – Development Concept

For 47 single family residential units, the total flows from the proposed development are as follows:

- MDD = 47 units x 0.00694 litres/capita/second x 3.75 capita/unit = 1.22 L/s
- PHD = 47 units x 0.01042 litres/capita/second x 3.75 capita/unit = 1.83 L/s

4.1 Additional Development

As future demand, road elevations, etc. within the Town are unknown, the analysis did not review future development impacts. It is recommended that future developments complete a separate water analysis.

5. EPANET MODEL SETUP

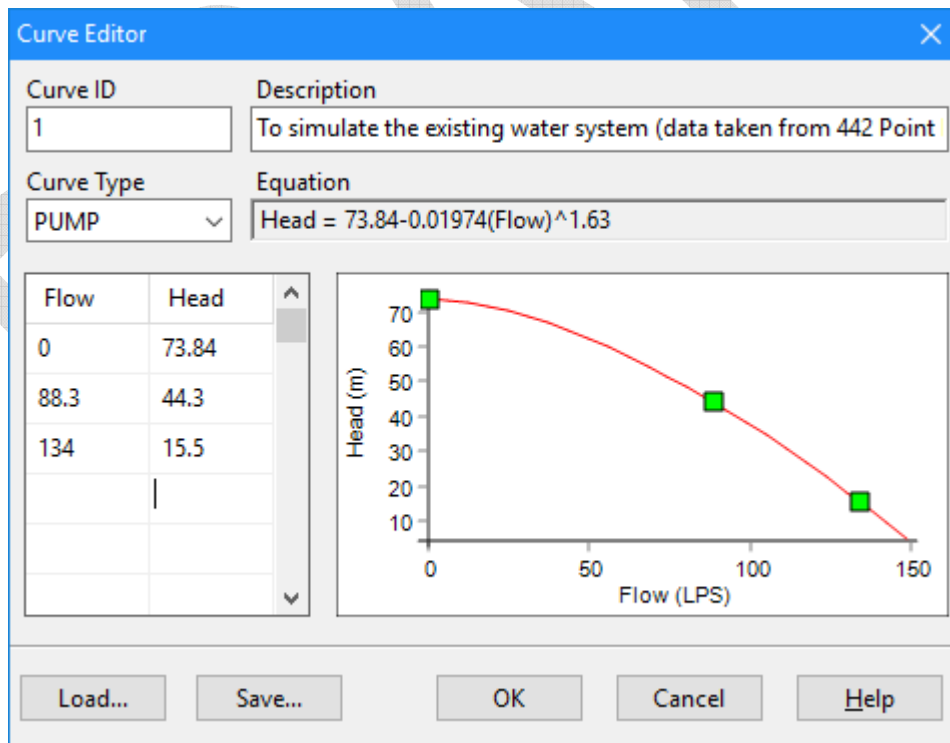
EPANET modeling software was used to model the proposed water system.

To calibrate the model and replicate the “existing condition” (ie. the existing water system where the proposed development will connect to), a reservoir and a pump was used to simulate the parameters of the hydrant flow test. The pump simulates the flow and pressure within the existing water system (ie. system curve) and the reservoir simulates the available water.

The following parameters were input into the pump to simulate the existing water system (based on the hydrant flow tests):

- 1) Static pressure – 105 psi, flow – 0 gpm
 - a. Based on hydrant flow test
- 2) Residual pressure – 22 psi, flow – 2,100 gpm (134 L/s)
 - a. Based on information provided in the GeoAdvice Engineering Inc. report dated September 6, 2019 (Figure 4.3)
- 3) Residual pressure – 63 psi, flow – 1,400 gpm (88 L/s)
 - a. Based on hydrant flow test

The above parameters were utilized in the model and a system curve was created:



No adjustment was made to account for the time of day the hydrant flow test occurred. For the purpose of the model, the pump was placed in front of 454 and 458 Point Ideal Road.

5.1 Water System Model Comments

The Private Fire Hydrant Maintenance Report completed by Pacific Coast Fire Equipment incorrectly notes the residual pressure as 105 psi and the static pressure as 63 psi. Discussions with Pacific Coast Fire Equipment confirmed these numbers were backwards.

6. SYSTEM ASSESSMENT RESULTS

In summary, the hydraulic assessment indicates that fire flow of 60 L/s can be provided while maintaining minimum 22 psi (15.5 m) within the proposed development (see Appendix 3 – Figures 4 and 5). Fire flow was modeled at Nodes 8 and 9 with max day demand within the development.

7. Summary

Although the water model produced for the proposed development is limited in scope with the limited available information, the model generally confirms the findings of the GeoAdvice Engineering Inc. report in that there are available fire flows (60 L/s) to the development.

The “offsite” (ie. existing) system was not reviewed as the GeoAdvice Engineering Inc. report confirms adequate reservoir sizing and provides additional upgrade requirements/ recommendations.

This report has been prepared by **McELHANNEY LTD.**

Prepared by:

Nathan Dunlop P.Eng.
Project Engineer - Civil

Reviewed by:

John Sturdy, P.Eng.
Branch Manager

Appendix A – Fire Hydrant Test Results

DRAFT



Head Office - 2712 Rockbay Avenue Victoria, BC V8T 4R9 (250) 386-8321 Victoria
 Vancouver Office-101-137 Glacier St, Coquitlam, BC V3K 5Z1 (604) 468-6330 Coquitlam 1-888-299-3473 Toll Free www.pacificcoastfire.ca

Private Fire Hydrant Maintenance Report

The purpose of this Standard is to clarify the requirements for the testing, inspection, maintenance, and marking of private fire hydrants. It is the responsibility of the property owner to have all the fire hydrants located on his/her property tested once every year in accordance with NFPA 25.

Address	Owner	McElhanney			Date of Inspection	10/04/2019 10:00am PDT		Inspection Type								
	Property Address	470 Point Ideal Drive							New Installation							
	City	Mesachie Lake	Province	BC	Postal Code	V0R 2N0		Annual	X							
	Phone Number	(778) 762-0660	Mobile Number				5 Year Flow Test									
Service Data	Servicing Company	Pacific Coast Fire Equipment - Victoria Office					Report # 17355096									
	Company Address	2712 Rockbay Ave														
	City	Province			Postal Code	Phone #										
	Make of Hydrants	Mueller	Location of Hydrants	470	Model of Hydrants	Centurv	# of Hydrants Serviced	150								
Semi-Annual Inspections	"✓"- Yes = Satisfactory "X"- No = Unsatisfactory "N/A"-N/A = Not Applicable															
	Hydrants are accessible and free of obstructions. All vegetation, landscaping, and other obstructions are at least three feet away from hydrants							Yes	No	N/A						
	Top of hydrant is not leaking when hydrant is on							✓								
	Gaskets under caps are not leaking when hydrant is on							✓								
	Hydrant barrel is in good condition without cracks or corrosion							✓								
	Operating nut is not worn and does not have rounded corners							✓								
	Outlet threads are not damaged							✓								
	Outlet caps secured							✓								
Annual Tests & Maintenance	Hydrant was fully flowed for not less than 1 minute at full capacity until flowing water is clear							✓								
	Hydrant drains completely within 60 minutes of closing valve							✓								
	Number of turns to full open hydrant		18	GPM		1350	Flow available @ 20psi									
	No. of ports flowed	3	Static Pressure	62	Residual Pressure	100	Pitot Reading psi		52							
	"✓"- Yes = Satisfactory "X"- No = Unsatisfactory "N/A"-N/A = Not Applicable															
		Yes	No	N/A		Yes	No	N/A		Yes	No	N/A				
	Hydrant opens				Stem broken	✓			Set too low/high	✓			Lubed operating nut			■
	Nipples tight				Opens hard	✓			Dome missing	✓			Lubricated hydrant packing			■
	Turn off at gate	✓			Caps missing	✓			Faced wrong	✓			Gate valve accessible	✓		
	Base leaks	✓			Spanner fit	✓			Stem leaking	✓			Lubricated thrust collar			■
Barrel broken	✓			Set improperly	✓			Poor spanner fit	✓							
*All "No" indications shall be explained in detail																

NFPA 291 hydrant testing procedure will apply when the 5-year flow testing is required in accordance with NFPA 25. For the purpose of an annual measurement of flow for reliability purposes, a single fire hydrant flow is sufficient using a pitot or in-line gauge to record static, residual and GPM readings to extrapolate GPM flow out to 20 psi residual pressure. This ensures that each private hydrant continues to meet the original design flow as originally approved in lieu of waiting 5 years.

I hereby certify that inspection, maintenance and flow testing of the hydrants listed above was conducted in accordance with the Fire Code of BC and referenced National Fire Protection Association Standards 25 and 291; and that the foregoing data, statements and documentation are correct.

NOTICE TO OWNER: For items noted as failed or needing attention on this report, you are responsible for correcting these items and resubmitting an inspection report when the work is completed and passes inspection.

I acknowledge a copy of this report must be provided to Office of the Fire Marshal at the above contact information.

Owner/Owner's Representative Signature			
Tester's Signature	MIKE NEWSON	Date	OCT 04, 2019
Print Name	MIKE NEWSON		



Head Office - 2712 Rockbay Avenue Victoria, BC V8T 4R9 (250) 386-8321 Victoria
 Vancouver Office-101-137 Glacier St, Coquitlam, BC V3K 5Z1 (604) 468-6330 Coquitlam 1-888-299-3473 Toll Free www.pacificcoastfire.ca

Private Fire Hydrant Maintenance Report

The purpose of this Standard is to clarify the requirements for the testing, inspection, maintenance, and marking of private fire hydrants. It is the responsibility of the property owner to have all the fire hydrants located on his/her property tested once every year in accordance with NFPA 25.

Address	Owner	McElhanney			Date of Inspection	10/04/2019 10:00am PDT		Inspection Type				
	Property Address	442 Point Ideal Drive						New Installation				
	City	Mesachie Lake	Province	BC	Postal Code	V0R 2N0		Annual	X			
	Phone Number	(778) 762-0660	Mobile Number				5 Year Flow Test					
Service Data	Servicing Company	Pacific Coast Fire Equipment - Victoria Office					Report #	17355102				
	Company Address	2712 Rockbay Ave										
	City	Province			Postal Code	Phone #						
	Make of Hydrants	Muller	Location of Hydrants	442	Model of Hydrants	Century	# of Hydrants Serviced	149				
Semi-Annual Inspections	"✓"- Yes = Satisfactory "X"- No = Unsatisfactory "•"-N/A = Not Applicable											
	Hydrants are accessible and free of obstructions. All vegetation, landscaping, and other obstructions are at least three feet away from hydrants							Yes	No	N/A		
	Top of hydrant is not leaking when hydrant is on							✓				
	Gaskets under caps are not leaking when hydrant is on							✓				
	Hydrant barrel is in good condition without cracks or corrosion							✓				
	Operating nut is not worn and does not have rounded corners							✓				
	Outlet threads are not damaged							✓				
	Outlet caps secured							✓				
	Hydrant was fully flowed for not less than 1 minute at full capacity until flowing water is clear							✓				
	Hydrant drains completely within 60 minutes of closing valve							✓				
Annual Tests & Maintenance	Number of turns to full open hydrant	18	GPM	1400	Flow available @ 20psi							
	No. of ports flowed	3	Static Pressure	62	Residual Pressure	105	Pitot Reading psi					
	"✓"- Yes = Satisfactory "X"- No = Unsatisfactory "•"-N/A = Not Applicable											
	Hydrant opens	✓		Stem broken	✓		Set too low/high	✓		Lubed operating nut		■
	Nipples tight	✓		Opens hard	✓		Dome missing	✓		Lubricated hydrant packing		■
	Turn off at gate	✓		Caps missing	✓		Faced wrong	✓		Gate valve accessible		■
	Base leaks	✓		Spanner fit	✓		Stem leaking	✓		Lubricated thrust collar		■
	Barrel broken	✓		Set improperly	✓		Poor spanner fit	✓				
	*All "No" indications shall be explained in detail											

NFPA 291 hydrant testing procedure will apply when the 5-year flow testing is required in accordance with NFPA 25. For the purpose of an annual measurement of flow for reliability purposes, a single fire hydrant flow is sufficient using a pitot or in-line gauge to record static, residual and GPM readings to extrapolate GPM flow out to 20 psi residual pressure. This ensures that each private hydrant continues to meet the original design flow as originally approved in lieu of waiting 5 years.

I hereby certify that inspection, maintenance and flow testing of the hydrants listed above was conducted in accordance with the Fire Code of BC and referenced National Fire Protection Association Standards 25 and 291; and that the foregoing data, statements and documentation are correct.

NOTICE TO OWNER: For items noted as failed or needing attention on this report, you are responsible for correcting these items and resubmitting an inspection report when the work is completed and passes inspection.

I acknowledge a copy of this report must be provided to Office of the Fire Marshal at the above contact information.

Owner/Owner's Representative Signature			
Tester's Signature	MIKE NEWSON	Date	OCT 04, 2019
Print Name	MIKE NEWSON		

Appendix B – Proposed Site Plan

DRAFT

Appendix C – Assessment Results

DRAFT

The following is a copy of the system printout showing the nodes and links from the water model superimposed on the proposed development lots:

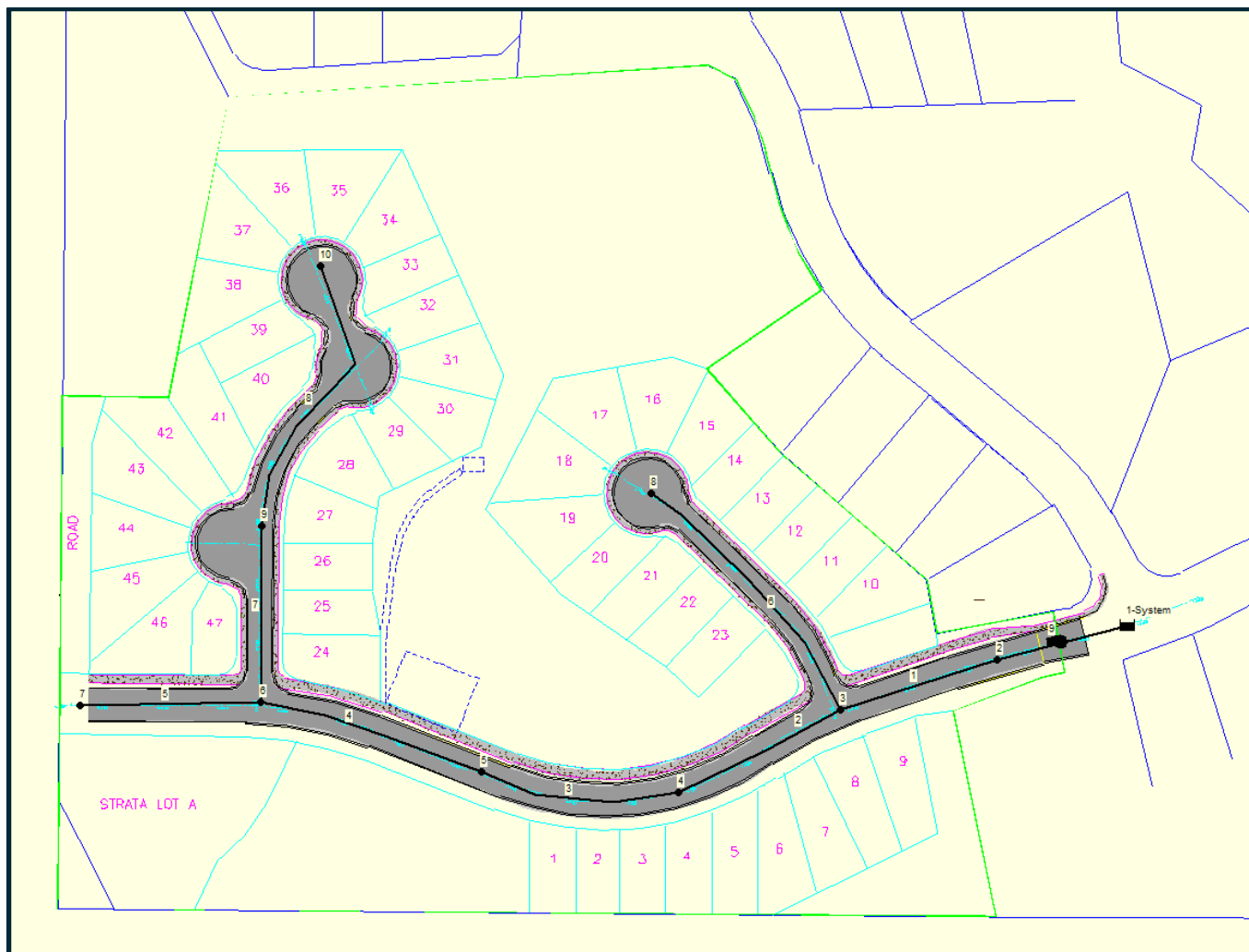
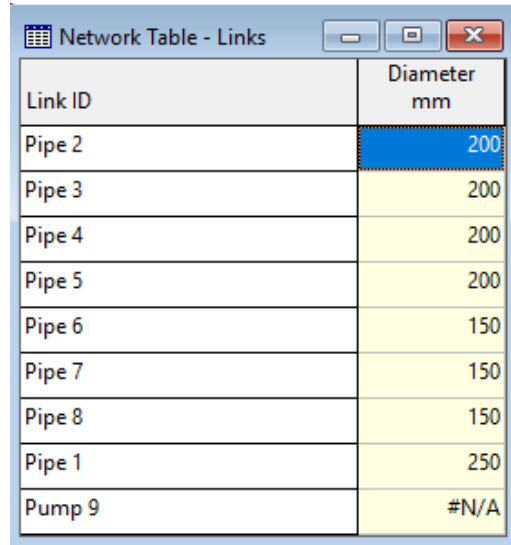


Figure 2 – Nodes and Links reference numbers

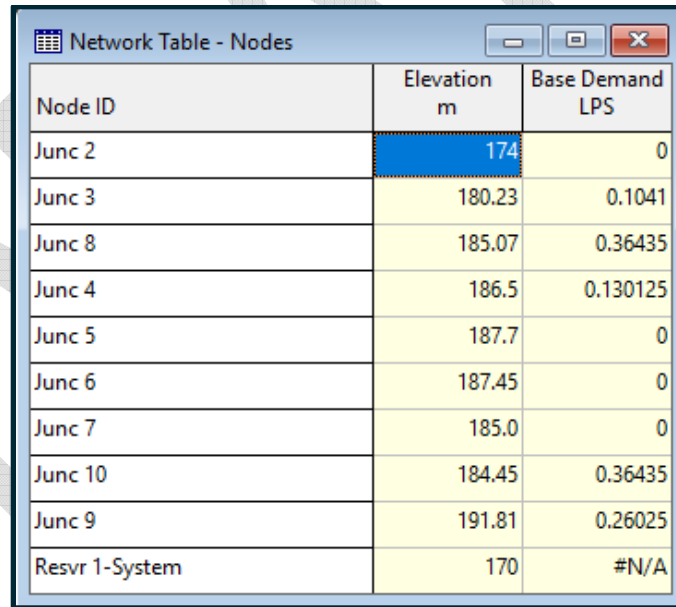
The following is a list of the pipe diameters used for the model:



Link ID	Diameter mm
Pipe 2	200
Pipe 3	200
Pipe 4	200
Pipe 5	200
Pipe 6	150
Pipe 7	150
Pipe 8	150
Pipe 1	250
Pump 9	#N/A

Figure 3 – Pipe Diameters

The Elevation and Base Demand at MDD of each node are as follows:



Node ID	Elevation m	Base Demand LPS
Junc 2	174	0
Junc 3	180.23	0.1041
Junc 8	185.07	0.36435
Junc 4	186.5	0.130125
Junc 5	187.7	0
Junc 6	187.45	0
Junc 7	185.0	0
Junc 10	184.45	0.36435
Junc 9	191.81	0.26025
Resvr 1-System	170	#N/A

Figure 4 – Elevation and Base Demands at MDD

Pressure with a fire demand of 60 L/s at Node 9:

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 2	174	0	0.00	227.59	53.59
Junc 3	180.23	0.1041	0.10	227.29	47.06
Junc 8	185.07	0.36435	0.36	227.29	42.22
Junc 4	186.5	0.130125	0.13	226.32	39.82
Junc 5	187.7	0	0.00	225.27	37.57
Junc 6	187.45	0	0.00	224.00	36.55
Junc 7	185.0	0	0.00	224.00	39.00
Junc 10	184.45	0.36435	0.36	219.85	35.40
Junc 9	191.81	60.26025	60.26	219.85	28.04
Resvr 1-System	170	#N/A	-61.22	170.00	0.00

Figure 5 – Pressure with fire demand at Node 9

Pressure with a fire demand of 60 L/s at Node 8:

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 2	174	0	0.00	227.59	53.59
Junc 3	180.23	0.1041	0.10	227.29	47.06
Junc 8	185.07	60.36435	60.36	220.21	35.14
Junc 4	186.5	0.130125	0.13	227.29	40.79
Junc 5	187.7	0	0.00	227.29	39.59
Junc 6	187.45	0	0.00	227.29	39.84
Junc 7	185.0	0	0.00	227.29	42.29
Junc 10	184.45	0.36435	0.36	227.28	42.83
Junc 9	191.81	0.26025	0.26	227.28	35.47
Resvr 1-System	170	#N/A	-61.22	170.00	0.00

Figure 6 – Pressure with fire demand at Node 8



BV DEVELOPMENTS MANAGEMENT INC.

APPENDIX F

STORMWATER MANAGEMENT PLAN

POINT IDEAL – STORMWATER MANAGEMENT PLAN

To

Brian Locher, P.Eng., LL.B.
Senior Project Manager, BV Developments
Management Inc.
301-791 Goldstream Avenue,
Victoria, BC, V9B 2X5

From

Jon Irving, P.Eng, LEED Green Associate
Project Manager, McElhanney Ltd.
202-5855 York Road, Duncan, BC, V9L 3S3

Re

Point Ideal – Stormwater Management Plan

Date

2019-12-06; Revision: 0

1. Introduction

McElhanney has been retained by BV Developments to provide a Stormwater Management Plan for the proposed 'Point Ideal' development located in the west side of the Town of Lake Cowichan. The purpose of this report is to identify storm water management measures required to manage the runoff from the post development site to the regulations put forth by the Town of Lake Cowichan's bylaws.

The subject property is approximately 6.9 Ha and is currently under a zoning amendment but will be classified as R-1-B (Single Family and Duplex Zoning). The owner is proposing to subdivide the property into 47 single family/duplex parcels, identified as Lots 1 through 47, and 1 strata lot, identified as Lot A. Figure 1 illustrates the existing conditions and site boundary, and Figure 2 shows the proposed lot layout.

The following documents were reviewed during preparation of this Stormwater Management Plan:

- Town of Lake Cowichan Subdivision, Works and Services Bylaw No. 974-2016
- Riparian Areas Regulation: Assessment Report prepared by Madrone Environmental Services dated 2018-10-18
- Geotechnical Memo: Proposed Subdivision, 500 Block Point Ideal Drive – Lake Cowichan, BC, by Ryzuk Geotechnical dated 2019-11-26

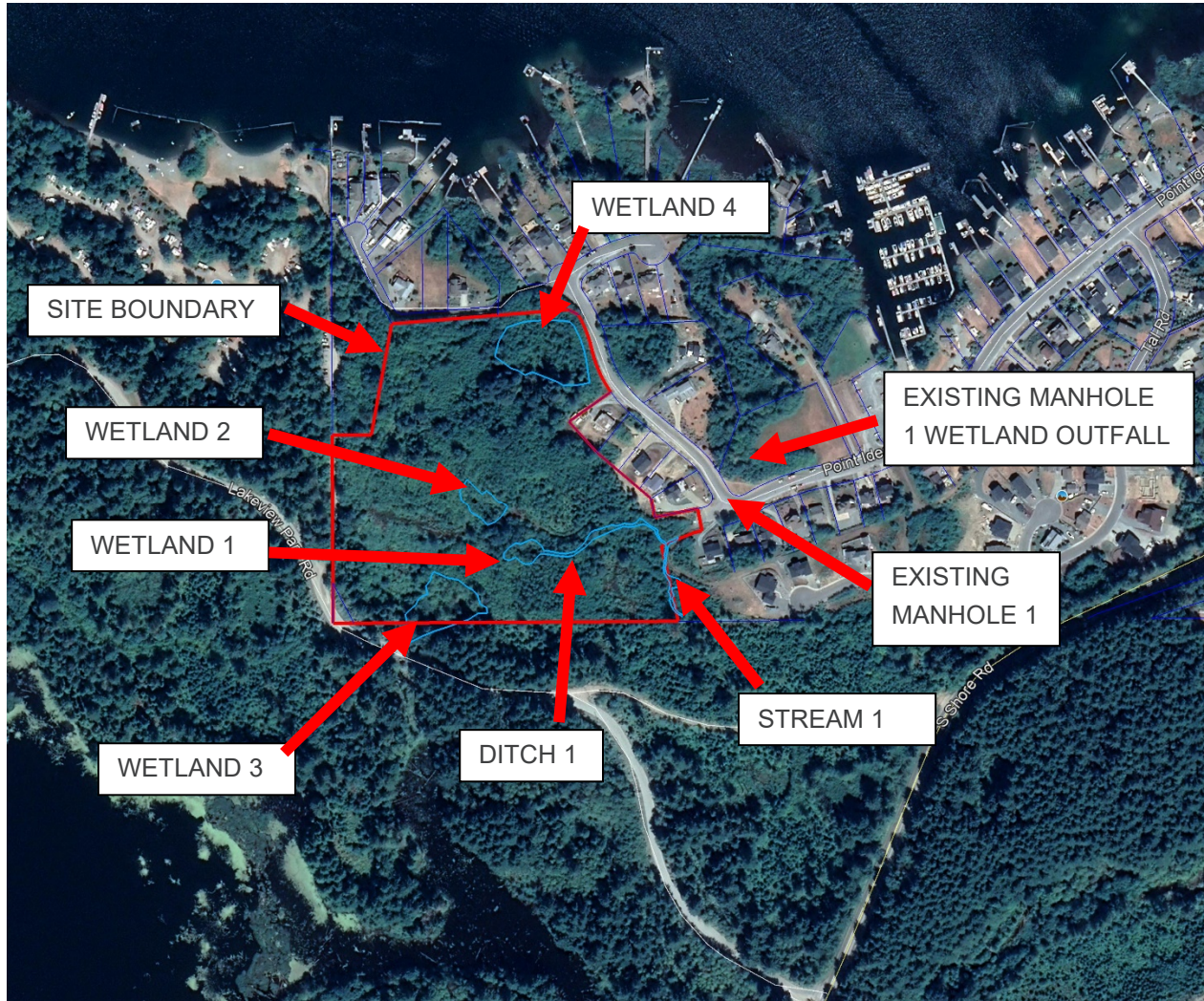


Figure 1 - Existing Site Conditions





Figure 2 - Proposed Site Layout

2. Site Description

The subject property consists of moderate to steep slopes to the NE and SW corners of the site. The middle of the site is bisected by an old logging road. The northern half of the site slopes steeply (approximately 20% to 30%) to a wetland in the NE corner of the site (Wetland 4). The southern half of the site slopes more gently (10% - 20%) to a wetland in the SW corner (Wetland 3) and a stream in the SE corner (Stream 1).

The site contains four wetlands, identified as Wetlands 1 through 4, and 2 drainage features, identified as Ditch 1 and Stream 1 (as identified in the environmental report). Ditch 1 was constructed for drainage for the logging road that crosses the site. It runs west to east from near the middle of the site towards the site access from Point Ideal Road. Stream 1 runs south to north along the east property line towards the site access from Point Ideal Road. The two watercourses join at the eastern boundary of the site and enter a 600Ø culvert that connects to a manhole (Existing Manhole 1) under Point Ideal Road. This manhole also collects runoff from Point Ideal Road before out-letting to a wetland to the northeast. The wetland outlets to Cowichan Lake.

Wetland 1 forms a 'headwater' for Ditch 1. Wetland 2 is an isolated wetland with no identified inflows or outflows. Wetland 3, located in the SW corner of the site, outflows to Beaver Lake to the SW. Wetland 4,



in the NE corner of site flows to Lake Cowichan. For information on the Wetlands, Ditch and Stream can be found in the Riparian Area Assessment.

The property can reasonable be divided into 6 main pre-development catchments, contributing to each of the 4 wetlands as well as Ditch 1 and Stream 1. Catchments were determined using available topographic survey data for the development site. Figure 3 shows the project site and existing catchment areas. Table 1 summarizes the parameters for each catchment area. Based on available topographic data it appears the western edge of the site flows towards the road on the west and north.



Figure 3 - Existing Catchments

Catchment S-W1 – 0.37 Ha – This area is relatively flat and drains towards Wetland 1 at elevation 186m.

Catchment S-W2 – 0.39 Ha – This area is moderately sloped (5% - 10%) and drains to Wetland 2, which has no inflows or outflows. The area is bounded by the logging road to the east and south, a highpoint to the west and the top of bank to the north of the steep slopes that fall to Wetland 4.

Catchment S-W3 – 1.57 Ha – The SW corner of the site south of the logging road ditch flows towards Wetland 3.



Catchment S-W4 – 2.66 Ha – The northern portion of the site slopes steeply (20% to 30%) toward Wetland 4, located in the NW corner of the subject property

The existing site was assumed to be 100% pervious with woods and light underbrush cover. The geotechnical report noted the soils are not conducive to infiltration.

Table 1 - Existing Catchment Parameters

Catchment	Area	Impervious	N Perv	DStore Perv	Soil Group	SCS Curve Number	Outlet
S-W1	0.37	0	0.4	7	D	77	Ditch 1
S-W2	0.39	0	0.4	7	D	77	Wetland 2
S-W3	1.57	0	0.4	7	D	77	Wetland 3
S-W4	2.66	0	0.4	7	D	77	Wetland 4
S-D1	0.72	0	0.4	7	D	77	Ditch 1
S-S1	0.45	0	0.4	7	D	77	Stream 1

Existing flows onsite are carried to a storm system (Existing Manhole 1) at Point Ideal Drive via Ditch 1 and Stream 1. No information is available on the outflows from Wetlands 3 and 4, although it is understood that Wetland 3 flows southwest towards Beaver Lake and Wetland 4 flows north to Cowichan Lake. It has been assumed the 2 year storm will be stored in these wetlands. The following parameters were used for the existing channels onsite.

Table 2 - Existing Channel Parameters

Channel	Width	Depth	N
Ditch 1	1.5	0.3	0.06
Stream 1	1.0	0.3	0.06

POST DEVELOPMENT CONDITIONS

The proposed subdivision will create 47 single family lots ranging from approximately 406m² to 692m² and 1 strata lot, which is 3,606 m². The site will be serviced by 4 new roads, identified as Point Ideal Road and Roads B, C and D on the preliminary plans. Roads B, C, and D will have curb and gutter for their extents. Point Ideal Road has a 1.5m ditch on the north side (assumed 1:1 side slopes for a depth of 0.75m) and a 4.5m bioswale on the south side. The proposed Lots 1 through 9 border Point Ideal Road on the south side. It has been assumed that culverts will be installed at driveway crossings and the bioswale will flow through this area.



The existing wetlands will remain protected by SPEA areas as laid out in the riparian report, resulting in some of the land remaining in its pre-development states. It has been assumed the proposed lots will be 50% impervious, and that all lots connect directly to the storm drain system. It has been assumed that all landscaped areas of the proposed lots will be top-dressed with a minimum of 300mm of topsoil, providing depression storage. Parameters from the untouched SPEA areas remain unchanged from predevelopment conditions. As Strata Lot A in the southwest corner of site is shown as being serviced by the proposed Road A storm main, this parcel was assumed to be developed with parameters similar to the proposed development lots in order to account for future runoff. The following assumptions have been made for modeling the post development runoff.

- Houses fronting Road D and the northern portion of Road C enter a small storm system that runs to the north and outlets to Wetland 4. Runoff from Road D and the northern portion of Road C enters the same system. Note that it appears Wetland 4 currently receives runoff from Point Ideal Drive.
- Houses fronting the south portion of Road C, all of Road B, and all Point Ideal Road connect to Existing Manhole 1 near the site access from Point Ideal Drive.
- Runoff from Road B and the south portion of Road C enters the storm main system connected to Existing Manhole 1.
- Road A drainage west of Road C enters the storm main system connected to Existing Manhole 1.
- Road A drainage between Road C and Road B enters the ditches on either side of the road.
 - The north ditch is proposed to outlet to Ditch 1 upstream of the culvert crossing at Road B, however it may be directed to the storm system in Point Ideal Road at the intersection with Road B. In either case the runoff will be directed to Existing Manhole 1.
 - The south ditch outlets to the confluence of Stream 1 and Ditch 1, although it may be directed to the Point Idea Road storm main near the intersection with Road B. In either case the runoff will be directed to Existing Manhole 1.
- Road A east of Road B enters the storm system which connects to Existing Manhole 1.
- Ditch 1 and Stream 1 enter Existing Manhole 1 via a new inlet structure east of the confluence of the two watercourses.
- Wetland 1 has been assumed full; all inflows to Wetland 1 will enter Ditch 1.
- As no outflows were observed for Wetland 2, it has been assumed it has capacity to store the predevelopment 2 year storm. For the post development scenario, Wetland 2 has been provided with an overflow channel; if total inflow exceeds the total predevelopment inflow (the assumed storage capacity), the additional runoff will be directed to Ditch 1 via Wetland 1.

The post development catchments can be split into three categories: SPEA areas (no change to existing conditions), development lot areas, and road areas. Table 3 below presents the typical parameters associated with each catchment type. Figure 4 shows the post development catchment areas.



Table 3 - Post Development Catchment Parameters

Type	Impervious	N Perv	N Imperv	Dstore Perv	Dstore Imperv	Soil Group	SCS Curve Number
SPEA	0	0.4	N/A	7	N/A	D	77
Road	100	N/A	0.011	N/A	1.25	D	98
Lot	50	0.24	0.011	30	1.25	D	90



Figure 4 - Post Development Catchment Areas



3. Design Criteria

The storm water management measures herein have been designed to follow criteria as outlined in the Town of Lake Cowichan Subdivision, Works & Services Bylaw.

Design Storm Rainfall

As per the Town of Lake Cowichan IDF Curve. SCS Type 1A distribution was used for modeling the design storms.

- 2 year 24 hour storm – 81.6mm
- 10 year 24 hour storm – 108 mm
- 100 year 24 hour storm – 168 mm

Runoff Performance Criteria

- Limit peak post development storm water runoff for the 2-year 24 hour storm to predevelopment peak levels.

Pipe Size Criteria

- Size pipes to convey the 10-year return period storm (for minor systems, pipe size less than 900mm which applies to all pipes on the project).

Analysis was completed using PCSWMM software, which is built on the EPA's SWMM engine, version 5.1.

4. PREDEVELOPMENT AND POST DEVELOPMENT STORMWATER RUNOFF

There are four outlets for storm water from the site for both the predevelopment and post development conditions. Wetlands 2, 3 and 4 are considered storage nodes and receive water in both scenarios. Existing Manhole 1 at Point Ideal Road receives the flows from Wetland 1, Ditch 1 and Stream 1 in the predevelopment scenario, and the flows from Wetland 1, Ditch 1, Stream 1, Point Ideal Road storm system (including development lot runoff), and Point Ideal Road ditches in the post development scenario.

Post development, Wetland 4 receives flow from the north storm drain system and from the natural area around it. Wetlands 1, 2 and 3 receive no flows from the development (only inflows are from the surrounding natural areas).

The predevelopment and post development flows for the 2-year return period storm for each outfall are shown in the Figures below.

As shown in the figures, post development peak flow to Existing Manhole 1 and to Wetland 4 exceed the predevelopment conditions. As such, stormwater storage will be included as part of the development of each lot to reduce the peak runoff from the site. Section 5 discusses storm water detention.



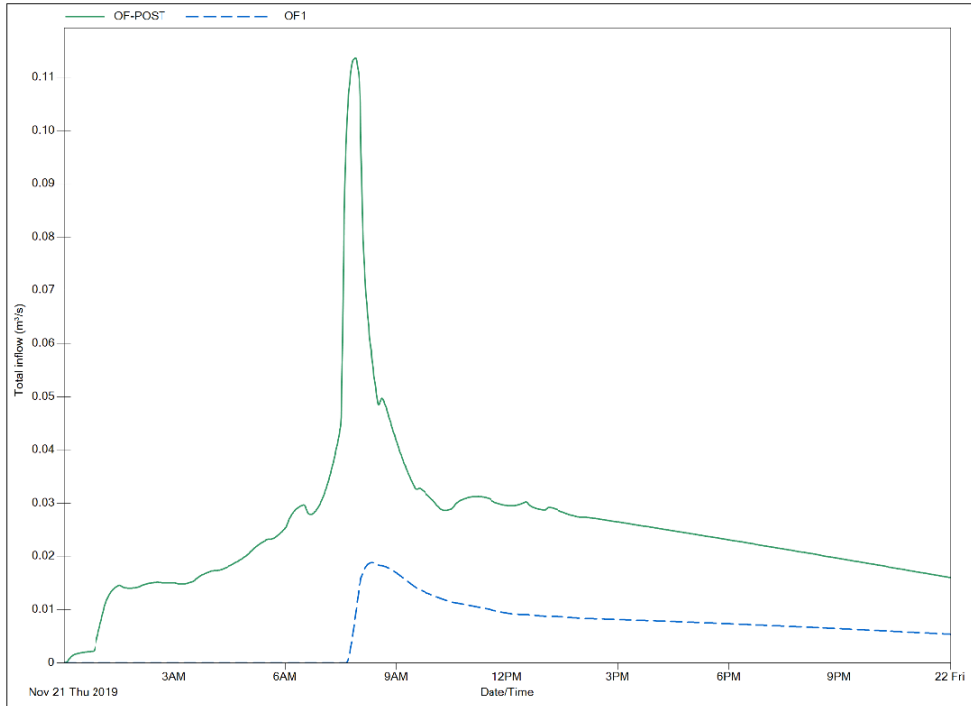


Figure 5 - Existing Manhole 1 Peak Runoff (m³/s). Predevelopment flow is dashed.

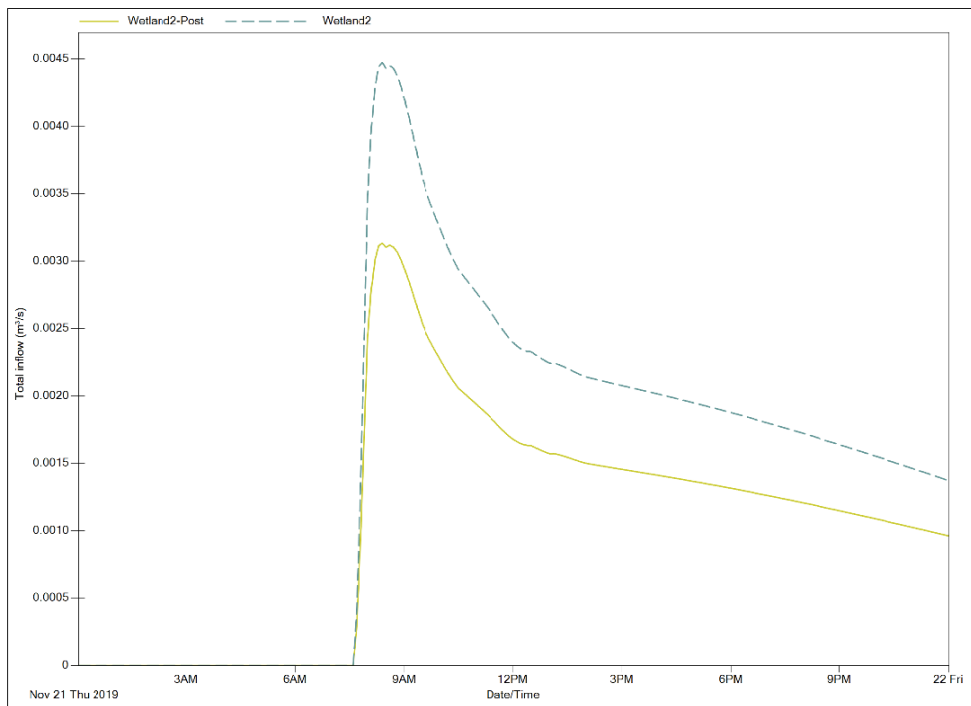


Figure 6 - Wetland 2 Peak Runoff (m³/s). Predevelopment flow is dashed.



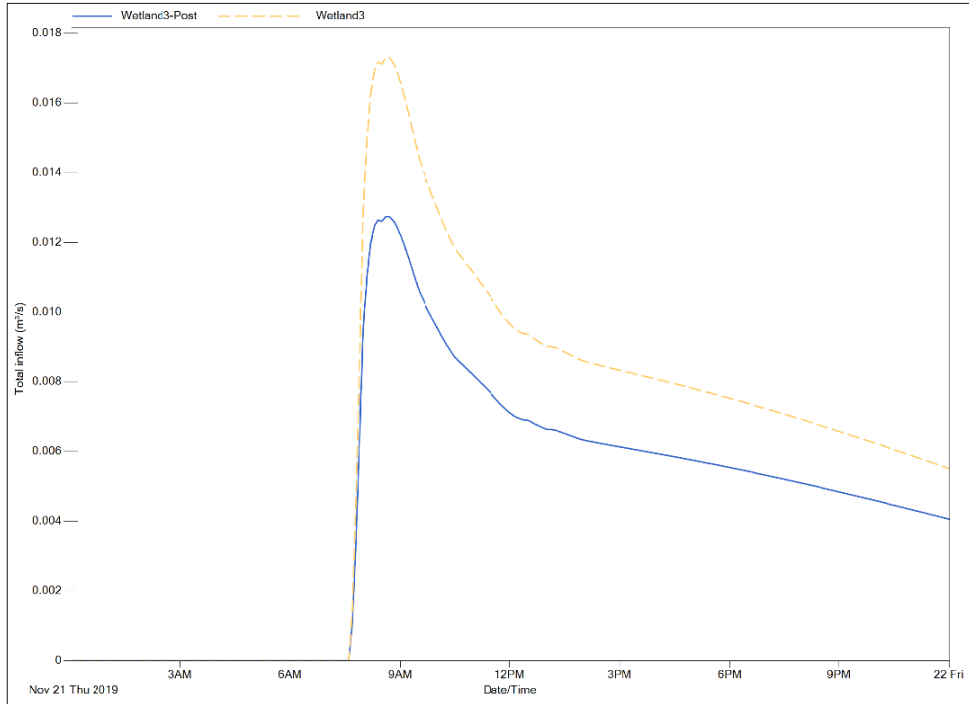


Figure 7 - Wetland 3 Peak Runoff (m3/s). Predevelopment flow is dashed.

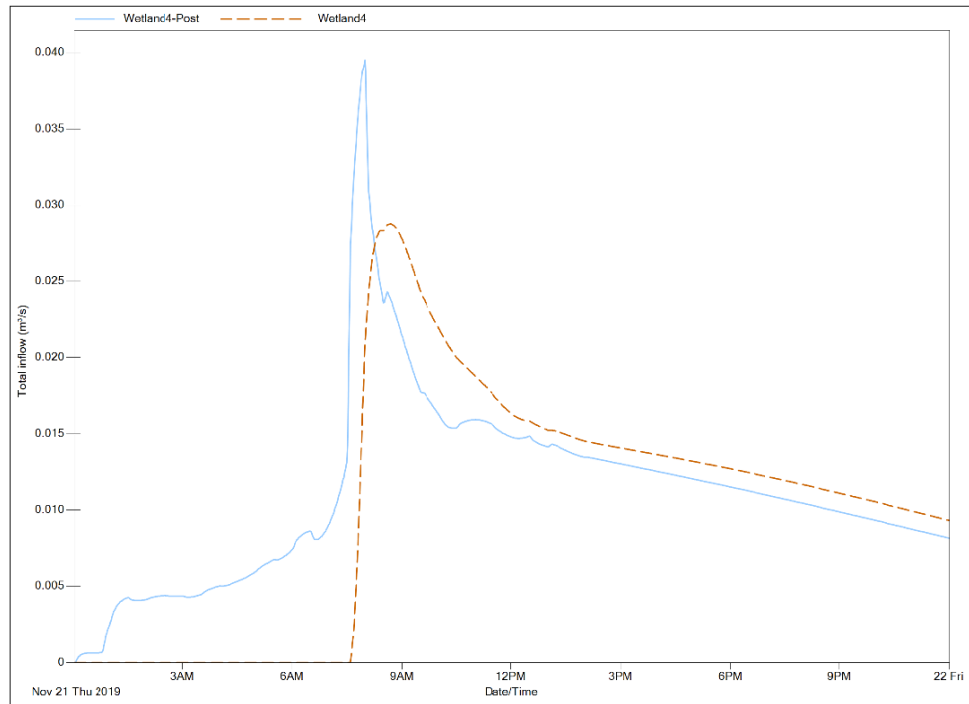


Figure 8 - Wetland 4 Peak Runoff (m3/s). Predevelopment flow is dashed.



5. STORMWATER MANAGEMENT DESIGN

In order to reduce the peak flow to Existing Manhole 1 and to Wetland 4, individual storm water detention systems are proposed for each lot. The detention structures will each be connected to a flow control manhole which will limit outflows for the 2 year storm event to predevelopment levels. For the purpose of the model, the storage was amalgamated for each of the catchment areas that represent a group of lots (identified with a yellow hatch in Figure 4). Alternatively, in detailed design, sitewide or combined detention facilities servicing multiple lots may be utilized, in which case the storage volume of each facility will need to be designed based on its contributing area to achieve the peak runoff limits laid out in the table below. The predevelopment runoff for each post development lot catchment was modeled in PCSWMM using the parameters from the existing conditions model. This runoff was used as the limiting peak runoff in the design of the storage for each catchment. In detailed design, the storage required for each catchment will be distributed to each individual lot within the catchment. The proposed storage will have no impact on the runoff to Wetland 2 and Wetland 3.

Table 4 - Building Lot Storage Requirements

Catchment	Area (Ha)	# of Lots	Predevelopment Peak Runoff (LPS)	Storage Required (m ³)	Post Development Outflow (LPS)	Orifice Size (mm)
S-RD-L1	0.78	14	0.00629	75	0.00623	54
S-RC-L1	0.25	4	0.00186	30	0.00182	30
S-RC-L2	0.14	4	0.00130	15	0.00123	25
S-RB-L1	0.76	14	0.00649	80	0.00644	57
S-RA-L1	0.36	N/A	0.00221	65	0.00222	33
S-RA-L2	0.11	2	0.00086	10	0.00086	20
S-RA-L3	0.05	4	0.00046	6	0.00045	15
S-RA-L4	0.36	7	0.00287	35	0.00287	37
S-RA-L5	0.12	2	0.00100	13	0.00090	20

There is no storage proposed for the new roads Point Ideal Road and Roads B, C and D, therefore the runoff from the new roads will result in an increase in peak flows to Existing Manhole 1. Bioswales and ditches are proposed on Road A, which slows the time for runoff to enter Existing Manhole 1, helping to reduce the impact of the new roads on the peak outflow.

Hydrographs showing the adjusted runoff to Wetland 4 and to Point Ideal Road are presented below.



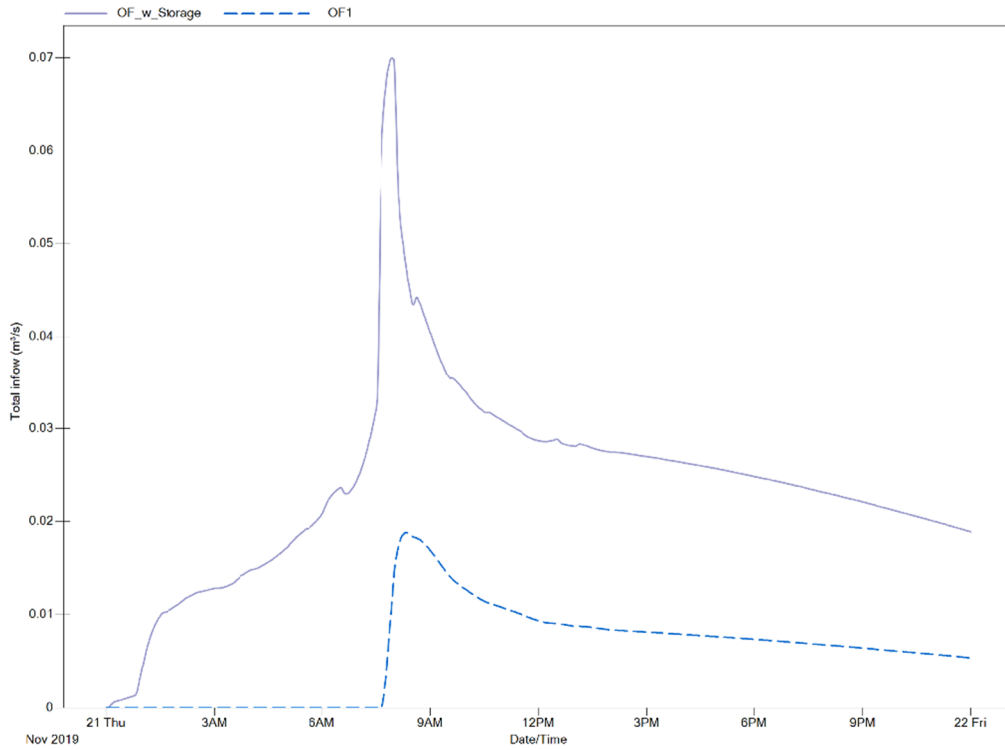


Figure 9 - Existing Manhole 1 Peak Runoff with Post Development Storage (m3s). Predevelopment flow is dashed

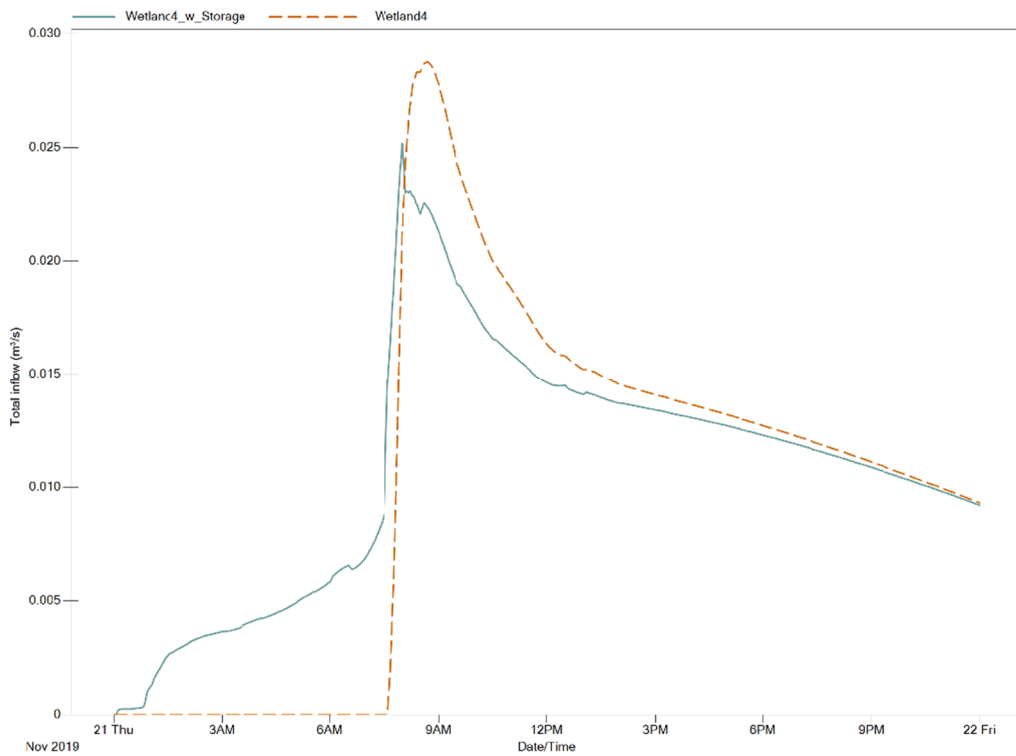


Figure 10 - Wetland 4 Peak Runoff with Post Development Storage (m3s). Predevelopment flow is dashed.



Table 5 presents the peak runoff rate to each outlet for the predevelopment, post development and post development with stormwater detention facilities scenarios.

Table 5 - Peak Runoff Rates (m³/s)

Scenario	Existing Manhole 1	Wetland 2	Wetland 3	Wetland 4
Predevelopment	0.019	0.04	0.017	0.029
Post Development	0.114	0.03	0.013	0.040
Post Development with Detention	0.070	0.03	0.013	0.025

Post development flows will be less than or equal to predevelopment flows for all outlets except for Existing Manhole 1. This outlet is expected to see increased flows due to the increased runoff from the new roads on the development site, and from the increase in catchment area that will be directed to this outlet as a result of the development. The overall increase of 0.051 m³/s represents approximately 5% of the capacity of the 600Ø outlet pipe from Existing Manhole 1 (assuming a slope of 2%).

6. SUMMARY AND CONCLUSION

The predevelopment and post development conditions for the site were modelled for the 2 year storm with the purpose of identifying site stormwater detention measures require to meet criteria laid out in the Town of Lake Cowichan's Subdivisions, Works and Services Bylaw. Stormwater from the existing site currently flows to one of four outlets, Existing Manhole 1 and Wetlands 2, 3 and 4. Onsite stormwater detention for the proposed building lot areas has been defined such that peak runoff from these areas will be less than or equal to predevelopment peak flows. Due to the proposed roads on site, the catchment area and peak runoff to Existing Manhole 1 will increase under post development conditions. Although the roads do not have stormwater detention facilities, they do in part utilize mitigative swales and ditches where possible to lower the peak runoff. The additional flow will be directed to Existing Manhole 1 through a new onsite storm sewer system, from where it outlets to a wetland to the east of site via a 600Ø culvert.



Prepared By:
Colin Davis, P. Eng

Reviewed By:
Jon Irving, P. Eng,
LEED Green Associate





APPENDIX G

RETAINING WALL INFORMATION



Walmart Supercentre



Sierra® Slope provides aesthetically pleasing facing while solving significant grade separation challenge.

LOCATION:

Mission, British Columbia

PRODUCT:

*SierraScape Retaining Wall System
Sierra Slope Retention System
MESA Retaining Wall System*

PROJECT PARTNERS:

*Owner
SmartCentres*

*Consultant
Stantec*

*Contractor
B&B Contracting Group*

*Completion Date
August 2011*

SmartCentres, Canada's largest developer and operator of unenclosed shopping centres, was developing over 117,000 square-feet of commercial retail space in Mission, BC. The 9.22-acre shopping centre, anchored by a 95,000 square-foot Walmart Supercentre, is situated on the south-west corner of Lougheed Highway and Wren Street.

Challenge

The Walmart Supercentre was being constructed on a site where significant grade differences existed. Due to property line constraints, the client required a Mechanically Stabilized Earth (MSE) system that could be constructed near vertical around the site while also establishing vegetation on the face of the structure to preserve the natural beauty of the site. The MSE system would be supporting the construction of a parking lot, the Walmart Supercentre and other retail businesses on the site.

Solution

Nilex recommended the Sierra Slope Retention System with an 80 degree batter along with the versatile SierraScape® Wire-Formed Retaining Wall System with a near vertical batter due to the property constraints of the adjacent businesses. Sierra Slope would be able to withstand the heavy building and seismic loading, while allowing for a vegetated face and meeting the restrictions of the property line. Nilex also provided the MESA® Segmental Retaining Wall System for the entrance and parking lot of the Walmart Supercentre.

WALMART

Installation

Nilex provided assistance at the start of the project to ensure the crews were knowledgeable on how to put the components of the MSE systems together. The install was completed by two crews over approximately 45 days which included excavation, placement of the Sierra Slope and SierraScape systems, backfill and compaction. Nilex visited the site throughout the course of construction to ensure the install was proceeding correctly.



Results

The contractor was able to save time and money as the Sierra Slope and SierraScape systems allowed for the use of non-select backfill. Using Sierra Slope resulted in excellent vegetation establishment almost immediately on the near vertical face which is normally difficult to achieve using conventional wire wall systems. Technically, this solution was able to withstand heavy building and seismic loading while meeting the constraints of the property line.

The Nilex Advantage

Nilex is committed to unearthing better results. Whether it's for a civil, resource or environmental project, we offer the latest engineered and technically superior materials and techniques to save our customers time and money, and minimize the need to move or remove earth, and reduce the need for granular materials.

With over 35 years experience, a long-standing commitment to the environment and highly qualified staff, Nilex delivers the products and technologies that give clients an economic advantage with environmental benefit.



NOTE: All modular block systems with individual block heights of less than 300 mm. must have the top 4 courses grouted. Additional mechanical connections may be required for seismic design considerations.

Note: See MoT's Bridge Standards and Procedures Manual Volume 1 Supplemental to CHBDC S6-06 Section 6.12 and 6.14 for details on abutment and wall requirements (products in this category are governed by a height of 5m).

RETAINING WALLS - (up to 9m in height) Wire Faced Walls

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
AIL Vist-A-Wall Wire Wall with Mesh Reinforcement (1036)	Layfield Wire Mesh Wall (987)
Armtec Wire Mesh Wall Systems (949)	Nilex Tensar Sierra Scape (719)
Hilfiker Wire Walls (various products Art Weld Gabions) (436)	Maccaferri Terrawall (1008)

NOTE: Approval for systems using wire facing is conditional on compliance with AASHTO Standard Specifications for Highway Bridges, corrosion-resistance durability requirements. The design life of Wire Faced MSE Walls shall be 100 years unless otherwise specified by the Ministry. Wire Faced Walls shall be designed for site specific environment and exposure conditions. Exposure to drainage, runoff and spray containing de-icing salts shall be specifically addressed by a corrosion evaluation during the design phase. Corrosion of Wire Faced MSE walls has occurred prematurely on a couple of Ministry walls and a review of Wire Faced MSE walls is being undertaken by the Ministry to find and address the cause.

Note: See MoT's Bridge Standards and Procedures Manual Volume 1 Supplemental to CHBDC S6-06 Section 6.12 and 6.14 for details on abutment and wall requirements (products in this category are governed by a height of 9m).

RETAINING WALLS - (up to 9m in height) Concrete Faced Walls

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
AIL Vist-A-Wall c/w Pre-cast Facing and Grid-Strip Reinforcement (W11 Wire and Bolted Connection) (1036)	Lock + Load (720) <i>facing slope shall not be steeper than 10 vertical to 1 horizontal if geogrid reinforcement is specified Miragrid XT or Stratagrid geogrid shall be used</i>
AIL Vist-A-Wall c/w Pre-cast Facing (W11 Wire and DPTS anchor connection) (1036)	Tensar Ares (Nilex) (719) Tensar Mesa Retaining Wall System (Nilex) (719)
AIL Vista-A-Wall c/w Pre-cast Facing and Wire Mesh Reinforcement (1036)	Redi-Rock (822) <i>with geosynthetic reinforcement</i>
Allan Block (324)	Reinforced Earth GeoMega (264)
Criblock (942)	Reinforced Earth TerraPlus (862)
Hilfiker Eureka Reinforced Soil (436)	Reinforced Earth TerraClass (264)
Hilfiker RSE Smooth Face (436)	Strata Slope System (901) System acceptance based on Strata's geosynthetic products
ISOGRID (146) Discontinued	KeySystem (931)
Layfield Strengthen Soil Retaining Wall (987)	Landmark Retaining Wall System (1153)
VSL Retained Earth now VSL (Vorspann Systems Ltd.) (148)	

NOTE: In areas of the Province where the number of freeze –thaw cycles will exceed 3000 over the design life of the project (Review for compliance to ASTM C1262 and ASTM C1372), dry pack (zero

slump) concrete products will not be used. In these areas, wet poured concrete products may be used with a 4 – 6% entrained air requirement added to the requisition.

Note: See MoT's Bridge Standards and Procedures Manual Volume 1 Supplemental to CHBDC S6-06 Section 6.12 and 6.14 for details on abutment and wall requirements (products in this category are governed by a height of 9m).

RETAINING WALLS (Supporting Loads)-

INTERLOCKING CONCRETE GRAVITY BLOCK (up to 5m in ht.) with Geosynthetic Soil Reinforcement

Products manufactured are to follow the Interlocking Concrete Gravity Block Standard Specification Section in Special Provisions or as follows:

Precast monolithic inter locking concrete blocks have the following nominal dimensions: 750mm x 750mm x (1500mm or 750mm) +/- 6mm long chamfered on all sides or as accepted by the Ministry's RPL standing Committee.

Blocks require manufacturers' legible identification number and name.

Blocks shall have adequate engineered shear key with approximately 12 mm clearance around the shear key; and galvanized steel lifting loops (fabricated from a min. 16 mm nominal dia. galvanized 7 Strand pre-stressed wire cable nominal breaking strength of 16 metric tonnes) as engineered by a Registered Engineer in the Province of BC and anchored sufficiently into the block to limit pull out.

Concrete be poured monolithically with fresh concrete having nominal design strength of a min. 30 MPa, or as required in Special Provisions, and entrained air content of 5 to 7% as tested by plastic concrete testing.

Concrete exposed surfaces shall have a smooth grey finish conforming to CSA 24.4-09 clause 26.2.5 Finish Grade or as required in Special Provisions.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Lock-Block Ltd. (074) <i>with geosynthetic reinforcement. Facing may be textured with other materials as required by the specifications or contract.</i>	Lock-Block Ltd. Rod Lock (074) <i>with connection to geosynthetic reinforcement. Facing may be textured with other materials as required by the specifications or contract.</i>
Redi-Rock (822) <i>with geosynthetic reinforcement</i>	Octa Block (1163)

INTERLOCKING CONCRETE GRAVITY BLOCK (up to 9m in ht.) with Geosynthetic Soil Reinforcement

Products manufactured are to follow the Interlocking Concrete Gravity Block Standard Specification Section in Special Provisions or as follows:

Precast monolithic inter locking concrete blocks have the following nominal dimensions: 750mm x 750mm x (1500mm or 750mm) +/- 6mm long chamfered on all sides or as accepted by the Ministry's RPL standing Committee.

Blocks require manufacturers' legible identification number and name.

Blocks shall have adequate engineered shear key with approximately 12 mm clearance around the shear key; and galvanized steel lifting loops (fabricated from a min. 16 mm nominal dia. galvanized 7 Strand

pre-stressed wire cable nominal breaking strength of 16 metric tonnes) as engineered by a Registered Engineer in the Province of BC and anchored sufficiently into the block to limit pull out.

Concrete be poured monolithically with fresh concrete having nominal design strength of a min. 30 MPa, or as required in Special Provisions, and entrained air content of 5 to 7% as tested by plastic concrete testing.

Concrete exposed surfaces shall have a smooth grey finish conforming to CSA 24.4-09 clause 26.2.5 Finish Grade or as required in Special Provisions.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Lock-Block Ltd. (074) <i>with connection to geosynthetic reinforcement. Facing may be textured with other materials as required by the specifications or contract.</i>	Lock-Block Ltd. Rod Lock (074) <i>with connection to geosynthetic reinforcement. Facing may be textured with other materials as required by the specifications or contract.</i>

INTERLOCKING CONCRETE BLOCK RETAINING WALL 7 STRAND PRESTRESSED WIRE CABLE

ACCEPTED MANUFACTURERS/SUPPLIERS	
Lock-Block Ltd. (074)	Lock-Block Ltd. Rod Lock (074)

INTERLOCKING CONCRETE BLOCK CONCRETE BARRIER

ACCEPTED MANUFACTURERS	

INTERLOCKING CONCRETE BLOCK RETAINING WALL (UP TO 5m IN HT.)

ACCEPTED MANUFACTURERS	
Lock-Block Ltd. Rod Lock (074)	

ACCEPTED INTERLOCKING FORM PATTERN

Forms used in the making of the interlocking concrete gravity blocks.

ACCEPTED MANUFACTURERS/SUPPLIERS	
Lock-Block Ltd. (074)	Lock-Block Ltd. Rod Lock (074)

RETAINING WALLS (Non-Supporting Loads)

LANDSCAPING WALLS – (UP TO 3M IN HEIGHT)

Supporting Retaining Walls (Retaining Walls under 5m and 9m categories) are included in this category and may be used under this category.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Allan Block (324)	Envirolok (1032)
Hilfiker Wire Walls (various products) (436)	Stabil Earth Systems Inc. Stabil Earth System (1151)
Terraforce (469)	Denbow Cascadia Green Wall System (1190)
Macaferri Green Terramesh (867)	Flex MSE (1236)
Strata Slope Systems (901)	
Basalite Geowall Valleystone (931)	

Note: Landscaping Walls are not to be designed for supporting for the loading of the shoulder or travelling lane or structures.

A Landscaping Wall Product needs to have prior acceptance for a product's application that has Design Life of less than 75 years.

Note: See MoT's Bridge Standards and Procedures Manual Volume 1 Supplemental to CHBDC S6-06 Section 6.12 and 6.14 for details on abutment and wall requirements.

SLOPE RETENTION SYSTEMS – (UP TO 5M IN HEIGHT)

NOTE: The following Slope Retention System products are limited to a slope angle of up to 70 degrees. Systems installed steeper than 70 degrees must qualify as a retaining wall. A Slope Retention Product needs to have prior acceptance for a product's application that has Design Life of not less than 75 years.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Hilfiker Wire Walls (various products) (436)	Detalok (791) Discontinued and Replaced with Flex MSE (1236)
Tensar Sierra Slope Retention System (719)	Strata Slope System (901)

SLOPE RETENTION SYSTEMS - (UP TO 9M IN HEIGHT)

NOTE: The following Slope Retention System products are limited to a slope angle of up to 70 degrees. Systems installed steeper than 70 degrees must qualify as a retaining wall. If the product is to be used as a slope embankment application, then the wire needs to be galvanized to have a minimum service life of 50 years and a corrosion rate calculated for the application.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Tensar Sierra Slope Retention System (719)	Strata Slope System (901)
Hilfiker Wire Walls (various products) (436)	

ROCK FALL SYSTEMS

ROCK FALL SLOPE SYSTEMS

NOTE: Products accepted as follows can be applied to a slope according to the manufacture's/design requirements to stabilize and secure/capture loosening materials but not to perform as a retaining system.

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Geobugg System (906)	Maccaferri System (1043)
Trumer Schutzbauten Systems (985)	

ROCK FALL CATCH FENCES

ACCEPTED PRODUCTS	ACCEPTED PRODUCTS
Geobugg Rockfall Protection System (1023)	Trumer Schutzbauten Rock Fall Protection System (985)
Maccaferri High Energy Rockfall Barrier (1043)	

ROCK FALL PROTECTION MESH

As specified in Standard Specifications 207 and Special Provisions.



Port Mann / Highway 1 Improvement



The Sierra® Slope Retention System offers a greener, more cost-effective solution than concrete panel walls.

LOCATION:

Lower Mainland, British Columbia

PRODUCT:

*Sierra® Slope
SierraScape®*

PROJECT PARTNERS:

Owner

BC Ministry of Transportation

Consultant

*MEG Consulting
Thurber Engineering*

Contractor

Kiewit/Flatiron General Partnership

Completion Date

December 2013

The Port Mann/Highway 1 improvement is a \$2.5 billion project which included the construction of the new Port Mann Bridge, widening of Highway 1, replacing nine highway interchanges and improving safety. The project spanned a distance of approximately 37 kilometres from Vancouver to Langley, British Columbia. The 10-lane bridge

is the second longest cable-supported bridge in North America. At 65 metres wide, the new Port Mann Bridge has officially been recognized by the Guinness Book of World Records as the widest bridge in the world.

Challenge

The Mechanically Stabilized Earth (MSE) aspects of the project were originally exclusively specified as concrete panel walls with steel reinforcement. In addition, with the widening of the highway, the walls were being built on soft soils within space constraints and the contractor needed to replace lost green space.

Solution

Nilex approached Kiewit/Flatiron and the BC Ministry of Transportation (MoT) with a solution consisting of Sierra Slope and SierraScape. Sierra Slope has a naturally vegetated face and would maximize the use of the restricted construction space. It is lower in cost than concrete retaining walls and would effectively replace the specified panel walls. The flexible nature of Sierra Scape makes it well suited for applications prone to differential settlement while allowing for construction in two stages.



Unearthing better results.

Port Mann / Highway 1 Improvement

In addition to providing the MSE systems, Nilex provided Rhinoskin™ to protect the Expanded Polystyrene (EPS) lightweight fill, NuDrain™ WD15 to assist with drainage of the bridge abutments, Silt Fence and erosion control products to prevent sediment contamination of local water courses, Tensar Biaxial Geogrids for subgrade and base reinforcement, and Tensar Uniaxial Geogrids cast into Lock-Block walls which separated east and west bound traffic lanes. All of Nilex's solutions were on the MoT's approved products list.

Nilex also performed a FLAC analysis to detail how the system would react during an earthquake.



Installation

Approximately 40 MSE structures were installed over the duration of this four-year project. Each wall was installed by hand only requiring excavators and bobcats for back fill placement, and bulldozers and vibratory riding rollers for compaction. Nilex was on site at least once per week to provide installation guidance.

Results

The SierraScape Retaining Wall System and the Sierra Slope Retention System provided a greener, more cost-effective solution than the specified concrete panel walls. Nilex's recommended solution allowed the contractor to significantly reduce the equipment and time required for installation. The new Port Mann Bridge is projected to sustain Vancouver's traffic growth over the next two decades.

In July 2014, the Port Mann/Highway 1 Improvement Project was the recipient of the Lieutenant Governor's Award for Engineering Excellence in British Columbia. This award is presented annually by the Association of Consulting Engineering Companies of British Columbia to recognize excellence in engineering in a number of disciplines. Nilex's work was recognized along with the project's other major partners.





South Fraser Perimeter Road (SFPR)



Nilex provides multiple solutions for the new four-lane highway along Vancouver’s Fraser River.

LOCATION:

Delta and Surrey, British Columbia

PRODUCTS:

*SierraScape, Sierra Slope & ARES MSE Systems
TriAx® Geogrid & Nonwoven Geotextile
SmartDitch
Turf Reinforcement Mats*

PROJECT PARTNERS:

Owner

BC Ministry of Transportation

Consultant

Stantec, Buckland & Taylor, exp and Associated Engineering

Contractor

FTG Constructors Group, Kan Retain-it, Sea-Jae Builders Ltd, B&B Contracting, M2K Construction, Tyam Group, Stanco Landscaping

Completion Date

January 2014

THE NILEX ADVANTAGE:

Cost Savings

Nearly \$810,000

CO₂ Saved

605 tonnes

South Fraser Perimeter Road in Metro Vancouver, also called Highway 17, is a new four-lane highway along the Fraser River, connecting southwest Delta to North Surrey. Nilex assisted in the design and onsite installation of sections of this 40 km-long road and supplied multiple products for its construction. This included geogrids and geotextiles for a few sections of road, along with systems for Mechanically Stabilized Earth (MSE) walls and slopes, erosion and sediment control and water management.

Challenges

As a new roadway system, this multi-year project had many grade separation challenges. Roads and walls were required in and over areas of poor soils with a high likelihood of settlement caused by proximity to the Fraser River and Burns Bog.

In one location, a drainage pipe from the above-grade roadway required an outlet to the river, several meters away. The chosen conveyance structure had to respect the sensitive terrain in this area as it moved water from the pipe to the outlet without extensive excavation.

South Fraser Perimeter Road (SFPR)

Additional challenges:

- Pile-supported MSE walls were originally specified with steel reinforcement, rather than High Density Polyethylene (HDPE).
- Two-stage bridge abutments were required, but the panels had to be installed after the structure over top had been opened to traffic.
- A complex design was required to place geogrids around the bridge structure piles.
- Slopes and water management systems had to respect archeologically-sensitive sites.
- Vegetation and supporting landscapes were implemented wherever possible, rather than precast walls.

Solutions

Two-Stage MSE Wall Systems

A two-stage wall system was recommended in response to the site's extremely poor soils.



SierraScape, combined with geotextile, served as the permanent wall face for the Stage One wall due to its tolerance of seismic activity and settlement. It was also the best option to save the client time and money on installation and material.

The ARES pre-cast concrete panel system was recommended as Stage Two, as it was the preferred aesthetic in some areas.

Sierra Slope Vegetated MSE Walls

Sierra Slope walls were recommended where land was available, to reduce cost and the carbon footprint. These systems are flexible, tolerate differential settlement well and are much less expensive than steel and rock-face systems. Additionally, they can be built over sensitive sites because there is no need to excavate the base.



SierraScape Rock-Face MSE Walls

Similar to Sierra Slope, SierraScape MSE systems are tolerant of differential settlement and are cost effective compared to precast walls. As the transition to Sierra Slope walls, they combine an appealing rock and vegetation aesthetic ideal for a project with high public visibility.

South Fraser Perimeter Road (SFPR)

Geotextiles & Geogrids for Road Construction

Nilex recommended nonwoven geotextile (Nilex 4551) to prevent the subgrade sand and gravel road structure from mixing.



That separation layer was combined with TriAx Geogrid (TX160) as a reinforcement layer for subgrade stabilization, base reinforcement, and pavement optimization due to the soft subgrades in the Burns bog area.

SmartDitch Water Conveyance Structures

An above-ground water conveyance structure built with additional soils was brought in to create a berm, and SmartDitch was used to line this new above-ground channel. This allowed water to pass from an outlet to the river, above a sensitive site.



SmartDitch offered additional advantages for this project, other than the ability to create a unique above-ground, low-disturbance channel. Its lightweight and durable design meant it could be brought to site easily and off-loaded with minimal disturbance to the surrounding construction and existing soils. It has flow-rate predictability and watertight seams, making it ideal for this project.

Erosion Control & Vegetation Establishment



North American Green SC250 Turf Reinforcement Mat (TRM) was recommended to protect the upslopes and downslopes of the new roadway, and establish vegetation on tricky glacial till soils. The mat protected the seed and soils and improved germination.

South Fraser Perimeter Road (SFPR)

Installation

SierraScape for Preload Stage One Walls

A granular base course levelling pad minimized contracting forces and maintained alignment during the initial placement of the wire wall.

Tensar Uniaxial Geogrids provided the prime soil reinforcement. Heavy-duty galvanized SierraScape wire forms were used as facing elements and were wrapped along the backside with geotextile fabric.



Sierra Slope Vegetated MSE Walls

Nilex provided local engineering and construction support for the project's significant design challenges and incorporated Sierra Slope MSE.



Sierra Slope systems require less area for laydown and material storage and minimize the need for cranes, which are mandatory for systems with steel mesh soil reinforcement. It provides an excellent vegetated appearance as a complement to the SierraScape Rock-Face walls.

SierraScape Rock-Face

For permanent wall applications like public highways, a facing stone rock-fill is required and placed immediately behind the cage. This eases installation, and provides better overall alignment of the final facing system. The facing stone is separated from the structural backfill (river sand in this case), by a nonwoven geotextile separator (Nilex 4551). Approximately 25,000 m² of SierraScape with rock-fill was installed.



ARES Two Stage MSE Walls

Once the engineer confirmed the settlement of the first stage, 5,250 m² of ARES pre-cast concrete panels were attached as a false fascia to complete the abutment wall system.

South Fraser Perimeter Road (SFPR)

Water Management

The SmartDitch system was installed above-ground due to the sensitive soils between the road surface and the river several metres away. A drainage pipe from the road and MSE wall ran to the SmartDitch channel. The channel itself was installed using earth anchors driven into the fill soil that was hauled to site. Each section of SmartDitch was unloaded without the use of a crane, making them easy to position. Since the sections overlap to create a snug fit, only self-tapping screws and weather-resistant adhesive were required to complete the installation.

Roads

The portions of SFPR built over poor soils required 287 rolls of TriAx TX160 and geotextile (approximately 21,525 meters in total) after preloading with sand on top of the subgrade. This helped ensure any possible settlement occurred prior to establishing final grade elevations.



Erosion Control & Vegetation Establishment

To address short-term erosion control and ensure long-term structural stability, 1,500 rolls of TRM were installed on slopes using 250 mm (10-inch) pins and washers.

Results

Nilex's expertise and product knowledge played an important role in the successful completion of the South Fraser Perimeter Road, which opened six months ahead of schedule and was the first major project outside the U.S. to receive Greenroads certification.



The design of a four-lane, 40 km-long road presents many challenges in any environment, but the soil conditions in this area of B.C. proved tricky for all aspects of the work: Roads, walls, abutments, slopes, erosion and sediment control and water management.

Creative, cost-effective and environmentally-sensitive solutions are the hallmark of this project, reducing the need for fill material, and in turn, reducing the carbon emissions from the haul trucks that material would have required.



South Fraser Perimeter Road (SFPR)



Using Nilex's Innovation Calculator, it was possible to show that geotextile and geosynthetic construction choices saved the client \$810,000 and eliminated 605 tonnes of CO₂ emissions.

The durability of the products chosen will further reduce emissions from maintenance vehicles, and thus reduce the related interruptions to drivers.

The Nilex Advantage

Nilex is committed to unearthing better results. Whether it's for a civil, resource or environmental project, we offer the latest engineered and technically-superior materials and techniques to save our customers time and money, minimize the need to move or remove earth, and reduce the need for granular materials.

With over 35 years of experience, a long-standing commitment to the environment and highly-qualified staff, Nilex delivers the products and technologies that give clients an economic advantage with environmental benefits.

CONCEPTUAL DRAWINGS
 PREPARED FOR
SIERRA 3H:8V SLOPE
GENERIC DESIGN

CITY

PROVINCE

INDEX

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005	TYPICAL DETAILS (1 OF 2)
006	TYPICAL DETAILS (2 OF 2)



THESE PRELIMINARY DETAILS ARE INTENDED SOLELY TO ACT AS AN AID WHEN DESIGNING A WALL. THIS DRAWING SHOULD NOT BE USED FOR FINAL DESIGN OR CONSTRUCTION. EACH SITE-SPECIFIC WALL SHOULD BE CERTIFIED AND SIGNED BY A REGISTERED PROFESSIONAL ENGINEER IN THE STATE/PROVINCE THAT IT IS BEING BUILT. THE ACCURACY AND USE OF THE DETAILS IN THIS DOCUMENT ARE THE SOLE RESPONSIBILITY OF THE USER.

Stamps

PRELIMINARY - NOT FOR CONSTRUCTION

THIS DESIGN IS BASED UPON SPECIFIC PROPERTIES OF TENSAR PRODUCTS (GEOGRIDS, DRAINAGE COMPOSITES AND EROSION MEDIA), WHICH ARE PROPRIETARY TO TENSAR INTERNATIONAL CORPORATION. 1210 CITIZENS PARKWAY, MORROW, GA 30260. ANY SUBSTITUTION OF THE SPECIFIED PRODUCTS WILL INVALIDATE THIS DESIGN. THIS DRAWING IS BEING FURNISHED FOR USE ON THIS SPECIFIC PROJECT ONLY. ANY PARTY ACCEPTING THIS DOCUMENT DOES SO IN CONFIDENCE AND AGREES THAT IT SHALL NOT BE DUPLICATED WHOLE OR IN PART, NOR DISCLOSED TO OTHERS, WITHOUT THE CONSENT OF TENSAR INTERNATIONAL CORPORATION.

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Issue/Revisions	
	ISSUED FOR INFORMATION

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Scale NTS
Designed By
Drawn By DT
Checked By

Project SIERRA 3H:8V SLOPE
GENERIC DESIGN

Sheet Title TITLE SHEET

Drawing Number 001

Rev.

CONSTRUCTION REQUIREMENTS FOR TENSAR SIERRA SLOPE SYSTEM

Thursday, August 30, 2012 3:02:46 PM

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- 1.0 **PROJECT INTRODUCTION**
- 1.1 THE SIERRA SLOPE SYSTEM IS A MECHANICALLY STABILIZED EARTH (MSE) STRUCTURE. THE DRAWINGS AND ASSOCIATED ANALYSES ARE PRESENTED BY TENSAR INTERNATIONAL CORPORATION UNDER A SUBCONTRACT AGREEMENT WITH NILEX CIVIL ENVIRONMENTAL GROUP (HEREIN COLLECTIVELY REFERRED TO AS TIC) TO THE CLIENT UNDER CONTRACT.
- 2.0 **MATERIALS**
- 2.1 **BACKFILL**
- 2.1.1 BACKFILL (REINFORCED AND RETAINED ZONES) SHALL BE FREE OF EXCESS MOISTURE, ROOTS, MUCK, SOD, SNOW, FROZEN LUMPS, ORGANIC MATTER OR OTHER DELETERIOUS MATERIALS. ALL ROCK PARTICLES AND HARD EARTH CLODS SHALL BE LESS THAN 100MM IN THE LONGEST DIMENSION. BACKFILL WHICH DOES NOT MEET THESE CRITERIA SHALL BE CONSIDERED UNSUITABLE AND SHALL BE REMOVED.
- 2.1.2 REINFORCED BACKFILL SHALL BE AS DEFINED IN SECTION 4.0. THE PORTION OF THE REINFORCED BACKFILL PASSING THE 0.425 MM SIEVE SHALL BE NON-PLASTIC. REINFORCED BACKFILL SHALL BE CLASSIFIED PER THE UNIFIED SOIL CLASSIFICATION SYSTEM AS NON-PLASTIC SOIL.
- 2.1.3 BACKFILL MATERIALS MUST COMPLY WITH GRADATION AND OTHER REQUIREMENTS AS SHOWN BY THE CLIENT.
- 2.2 **SOIL REINFORCEMENT**
- 2.2.1 FACING MATERIAL
- 2.2.1 EROSION CONTROL/TURF REINFORCEMENT MAT (TRM) SHALL BE MANUFACTURED BY NORTH AMERICAN GREEN, EVANSVILLE, INDIANA, USA.
- 2.3 **DRAINAGE**
- 2.3.1 DRAINAGE AT BASE OF REINFORCED FILL MUST BE CARRIED OUT PER CLIENT.

- 3.0 **DESIGN RESPONSIBILITY**
- 3.1 **TIC RESPONSIBILITY**
- TIC HAS DESIGNED THE SIERRA SLOPE SYSTEM TO MEET FACTORS OF SAFETY FOR THE MSE CHARACTERISTICS.
- 3.2
- | | STATIC | SEISMIC |
|-----------------------------------|--------|---------|
| | XX YR | XX YR |
| INTERNAL STABILITY | 1.5 | X.X |
| GEOGRID TENSILE STRENGTH, MINIMUM | 1.5 | X.X |
| GEOGRID PULLOUT CAPACITY, MINIMUM | 1.5 | X.X |
| SURFICIAL STABILITY, MINIMUM | 1.5 | X.X |
- 3.2.1 SEISMIC ANALYSES WERE CONDUCTED FOR RETURN PERIODS OF XXX YEARS (PGA = 0.XX).
- 3.3 **RESPONSIBILITY OF OTHERS**
- THE SITE CHARACTERISTICS LISTED BELOW AFFECT THE PERFORMANCE OF THE SIERRA SLOPE SYSTEM. TIC IS NOT RESPONSIBLE FOR EVALUATING OR VERIFYING SITE CHARACTERISTICS, THEREFORE TIC ASSUMES NO LIABILITY FOR THE POTENTIAL NEGATIVE EFFECTS OF THE SITE CHARACTERISTICS. THE CLIENT IS RESPONSIBLE FOR ENSURING THAT THE FOLLOWING SITE CHARACTERISTICS ARE PROPERLY ADDRESSED BY A QUALIFIED ENGINEER.
- 3.3.1 TIC REPORTS PHYSICAL AND STRENGTH REQUIREMENTS OF THE BACKFILL. THE CLIENT IS RESPONSIBLE FOR VERIFICATION OF BACKFILL SPECIFICATIONS AND APPROPRIATE BACKFILL TESTING METHODS AND FREQUENCY.
- 3.3.2 **HYDROSTATIC CONDITIONS**
- TIC REPORTS MAXIMUM DESIGN WATER LEVELS (SURFACE AND SUBSURFACE) IN SECTION 4.5. TIC REQUIRES THAT THE REINFORCED ZONE OF THE MSE STRUCTURE REMAINS FREE OF WATER AND ALL UNBALANCED HYDROSTATIC FORCES. THE CLIENT IS RESPONSIBLE FOR ENSURING THAT THE DESIGN, ANALYSIS, DETAILING, AND MITIGATION OF SURFACE WATER AND SUBSURFACE WATER, INCLUDING BUT NOT LIMITED TO COLLECTION, DIVERSION, AND EROSION/SCOUR PROTECTION ARE PROPERLY ADDRESSED BY A QUALIFIED ENGINEER.
- 3.3.3 **SETTLEMENT**
- TOTAL SETTLEMENT AND DIFFERENTIAL SETTLEMENT OF THE MSE STRUCTURE EXCEEDING 1/50 SHALL BE THE RESPONSIBILITY OF THE CLIENT. THE CLIENT IS RESPONSIBLE TO NOTIFY TIC IF IT IS DETERMINED THAT THE POTENTIAL FOR DIFFERENTIAL SETTLEMENT EXCEEDS THIS VALUE. TIC ACCEPTS NO LIABILITY OR RESPONSIBILITY FOR THE EVALUATION OF SETTLEMENT.
- 3.3.4 **GLOBAL STABILITY**
- GLOBAL STABILITY IS OUTSIDE THE SCOPE OF TIC'S RESPONSIBILITY FOR THE PROJECT. THE CLIENT IS RESPONSIBLE FOR ENSURING THAT THE SOILS BEHIND AND BELOW THE MSE STRUCTURES ARE CAPABLE OF RESISTING ROTATIONAL AND WEDGE-SHAPED FAILURE.
- 3.3.5 **THE ENVIRONMENTAL, HYDRAULIC/HYDROGEOLOGICAL AND PERMANENT EROSION CONTROL SHALL BE EVALUATED BY OTHERS.**
- 4.0 **DESIGN PARAMETERS**
- 4.1 THE DESIGN OF THE SIERRA STRUCTURES GENERALLY FOLLOWS THE METHODS AND GUIDELINES STATED IN FHWA-NHI-00-043 "MECHANICALLY STABILIZED EARTH WALLS AND REINFORCED SOIL SLOPES DESIGN AND CONSTRUCTION GUIDE", BISHOP'S MODIFIED METHOD OF LIMIT EQUILIBRIUM SLOPE STABILITY ANALYSIS (BISHOP, 1955), AND THE PROJECT SPECIFICATION. THE FOLLOWING PARAMETERS CONTROL THE DESIGN:

RETAINING STRUCTURE	SOIL ZONE	MOIST UNIT WEIGHT (kN/m ³)	EFFECTIVE FRICTION (DEGREES)	EFFECTIVE COHESION (kPa)
SLOPE STRUCTURE	REINFORCED ZONE	XX.X	XX	X
	RETAINED ZONE	XX.X	XX	X
	FOUNDATION SOIL	XX.X	XX	X

- 4.2 **GEOGRID**
- GEOGRID TENSILE PROPERTIES AND REDUCTION FACTORS ARE REPORTED IN THE TIC DESIGN REPORT DATED AUGUST 11, 2009.
- 4.3 **DESIGN LIFE** = XX yrs.
- 4.4 **LOADINGS**
- 4.4.1 **TRAFFIC SURCHARGE** = XX kPa
- 4.4.2 **LOADING SURCHARGE** = XX kPa
- 4.4.3 **POST-SETTLEMENT SLOPE LEVELING** = XX.X kPa
- 4.5 **HYDROSTATIC PARAMETERS**
- 4.5.1 **FLOODING ELEVATION** = FLOOD LEVEL = XXm
- 4.5.2 **MAXIMUM DIFFERENTIAL HYDRAULIC HEAD** = X M
- 5.0 **CONSTRUCTION**
- 5.1 A COMPLETE SET OF APPROVED CONSTRUCTION DRAWINGS AND CONTRACT SPECIFICATIONS SHALL BE ON SITE AT ALL TIMES DURING CONSTRUCTION OF THE SIERRA SLOPE SYSTEM. THE CONTRACTOR IS RESPONSIBLE TO FOLLOW THE DRAWINGS AND THE INSTRUCTIONS PROVIDED IN THE CONSTRUCTION AND QUALITY CONTROL MANUAL PROVIDED BY TIC.
- 5.2 **FOUNDATION PREPARATION**
- PRIOR TO CONSTRUCTION OF THE SIERRA SLOPE SYSTEM, THE CONTRACTOR SHALL CLEAR AND GRUB THE REINFORCED BACKFILL FOOTPRINT, REMOVING TOP SOIL, BRUSH, SOD OR OTHER ORGANIC OR DELETERIOUS MATERIAL. ANY UNSUITABLE SOILS SHALL BE OVER-EXCAVATED, REPLACED WITH COMPACTED BACKFILL MATERIAL TO PROJECT SPECIFICATIONS OR AS OTHERWISE DIRECTED BY A QUALIFIED GEOTECHNICAL ENGINEER.
- 5.3 THE CLIENT IS RESPONSIBLE TO HAVE A QUALIFIED GEOTECHNICAL ENGINEER CONFIRM THAT THE FOUNDATION IS ADEQUATE AND THE SITE HAS BEEN PROPERLY PREPARED AND MEETS THE DESIGN PARAMETERS STATED IN SECTION 4.0.
- 5.4 **GEOGRID PLACEMENT**
- 5.4.1 THE CLIENT IS RESPONSIBLE TO SURVEY AND LAYOUT THE SIERRA SLOPE FACING AS SHOWN ON THE OWNER'S CONTRACT DRAWINGS.
- 5.4.2 GEOGRIDS SHALL BE INSTALLED AT THE LENGTHS, ELEVATIONS, AND LOCATIONS SHOWN ON THE DRAWINGS HEREIN. CHANGES TO GEOGRID LAYOUT ARE NOT PERMISSIBLE WITHOUT THE EXPRESS WRITTEN CONSENT OF TIC. PRIOR TO PLACING BACKFILL, POSITION THE FACE MATERIALS PARALLEL TO THE MSE SLOPE FACE. GEOGRID SHALL BE ROLLED OUT PERPENDICULAR TO THE SLOPE FACE. THE TRANSVERSE BAR OF THE GEOGRID (ACROSS THE ROLL WIDTH) SHALL BE POSITIONED AT THE SLOPE FACE.
- 5.4.3 GEOGRID REINFORCEMENTS SHALL BE CONTINUOUS THROUGHOUT THEIR EMBEDMENT LENGTH. GEOGRID-TO-GEOGRID CONNECTION IS NOT ALLOWED.
- 5.4.4 TRACKED CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY ON THE GEOGRID REINFORCEMENT. A MINIMUM BACKFILL THICKNESS OF 150MM IS REQUIRED FOR OPERATION OF TRACKED VEHICLES OVER THE GEOGRID REINFORCEMENT. TURNING OF TRACKED VEHICLES SHOULD BE KEPT TO A MINIMUM TO PREVENT TRACKS FROM DISPLACING THE FILL AND/OR GEOGRID REINFORCEMENT. RUBBER-TIRED VEHICLES MAY PASS OVER THE GEOGRID REINFORCEMENT AT SPEEDS LESS THAN 15 KM/H. SUDDEN BRAKING AND SHARP TURNING SHALL BE AVOIDED.

- 5.4.5 A MINIMUM OF 75MM OF REINFORCED BACKFILL SHALL BE PLACED BETWEEN OVERLAPPING LAYERS OF GEOGRID REINFORCEMENT.
- 5.5 **BACKFILL PLACEMENT**
- 5.5.1 THE GEOGRID SHALL BE TENSIONED BY HAND TO ELIMINATE SLACK AND ANCHORED BY PINNING OR PLACING SOIL ON THE GEOGRID AT THE BACK OF THE REINFORCED ZONE. BACKFILL SHALL BE PLACED IN HORIZONTAL LAYERS NOT EXCEEDING 250 MM OR 150 MM IN UNCOMPACTED THICKNESS FOR HEAVY OR LIGHTWEIGHT COMPACTION EQUIPMENT RESPECTIVELY. ONLY LIGHTWEIGHT EQUIPMENT SHALL BE ALLOWED WITHIN 1 M OF THE BACK FACE OF THE MSE STRUCTURE.
- 5.5.2 BACKFILL SHALL BE PLACED FROM THE BACK OF THE MSE STRUCTURE FACING TOWARDS THE ENDS OF THE GEOGRID TO PROMOTE PROPER TENSIONING.
- 5.5.3 BACKFILL SHALL BE PLACED AT A MOISTURE CONTENT NO GREATER THAN TWO PERCENT WET AND NO LESS THAN ONE PERCENT DRY OF OPTIMUM MOISTURE CONTENT AND COMPACTED TO A MINIMUM OF 95% OF STANDARD PROCTOR MAXIMUM DRY DENSITY AS DETERMINED IN ACCORDANCE WITH AASHTO T-99 OR AS SPECIFIED BY PROJECT SPECIFICATIONS.
- 5.5.4 AT THE END OF EACH WORKDAY, BACKFILL SURFACE SHALL BE GRADED AWAY FROM THE WALL FACE A MINIMUM OF TWO PERCENT SLOPE. THE BACKFILL SURFACE SHALL BE COMPACTED WITH A SMOOTH DRUM ROLLER TO MINIMIZE PONDING OF WATER AND SATURATION OF THE BACKFILL. A TEMPORARY SOIL BERM SHALL BE CONSTRUCTED NEAR THE CREST OF THE MSE STRUCTURE TO PREVENT SURFACE WATER RUNOFF FROM OVERTOPPING THE MSE STRUCTURE.
- 6.0 **SPECIAL PROVISIONS**
- 6.1 THE DESIGN PRESENTED HEREIN IS A GENERIC PRELIMINARY GLANCE AT THE SIERRA SLOPE SYSTEM. THE DESIGN IS BASED ON SOIL PARAMETERS, FOUNDATION CONDITIONS, GROUNDWATER CONDITIONS, AND LOADINGS STATED IN SECTION 4.0. TIC ASSUMES NO LIABILITY FOR INTERPRETATION OR VERIFICATION OF SUBSURFACE CONDITIONS, FOR SUITABILITY OF SOIL DESIGN PARAMETERS OR FOR INTERPRETATION OF SUBSURFACE GROUNDWATER CONDITIONS. THE CLIENT IS RESPONSIBLE TO VERIFY THAT ACTUAL SITE CONDITIONS, PARAMETERS, AND STRUCTURE GEOMETRIES ARE AS DESCRIBED HEREIN PRIOR TO AND DURING CONSTRUCTION. PROCEEDING WITH CONSTRUCTION WITHOUT FIRST VERIFYING CONDITIONS AND PARAMETERS DISCUSSED ABOVE SHALL ABSOLVE TIC FROM ALL LIABILITY FOR THE DESIGN AND CONSTRUCTION OF THIS STRUCTURE AND THE CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS TIC FROM ALL RESULTING CLAIMS, DAMAGES, LOSSES AND EXPENSES.
- 6.2 THE CLIENT IS RESPONSIBLE FOR PROVIDING QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMS THAT ENSURE CONSTRUCTION OF THE MSE STRUCTURE IS PERFORMED IN ACCORDANCE WITH THE TIC NOTES AND DRAWINGS, AND THE OWNER'S CONTRACT PLANS AND SPECIFICATIONS.
- 6.3 THE CLIENT SHALL IMMEDIATELY REPORT ANY CHANGES TO TIC (778-918-7085) PRIOR TO PROCEEDING WITH CONSTRUCTION. THE CLIENT SHALL IMMEDIATELY REPORT TO TIC THE DISCOVERY OF ANY ROCK FORMATIONS AND/OR GROUNDWATER DURING CONSTRUCTION.
- 6.4 TIC IS NOT RESPONSIBLE FOR HAVING PERSONNEL ON-SITE UNLESS SPECIFICALLY PROVIDED FOR IN A WRITTEN CONTRACT SIGNED BY TIC. ANY TIC REPRESENTATIVE ON SITE DOES NOT HAVE THE AUTHORITY TO STOP OR START CONSTRUCTION OF THE MSE STRUCTURE OR ANY OTHER WORK.
- 7.0 **REFERENCE DOCUMENTS**
- 7.1 THE DESIGN CALCULATIONS AND CONSTRUCTION DRAWINGS PREPARED BY TIC ARE BASED UPON THE DOCUMENTS REFERENCED FROM THE CLIENT.



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Issue/Revisions	
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Date Drawn August 30, 2012
Scale NTS
Designed By
Drawn By DT
Checked By

Project

SIERRA 3H:8V SLOPE
GENERIC DESIGN

Sheet Title

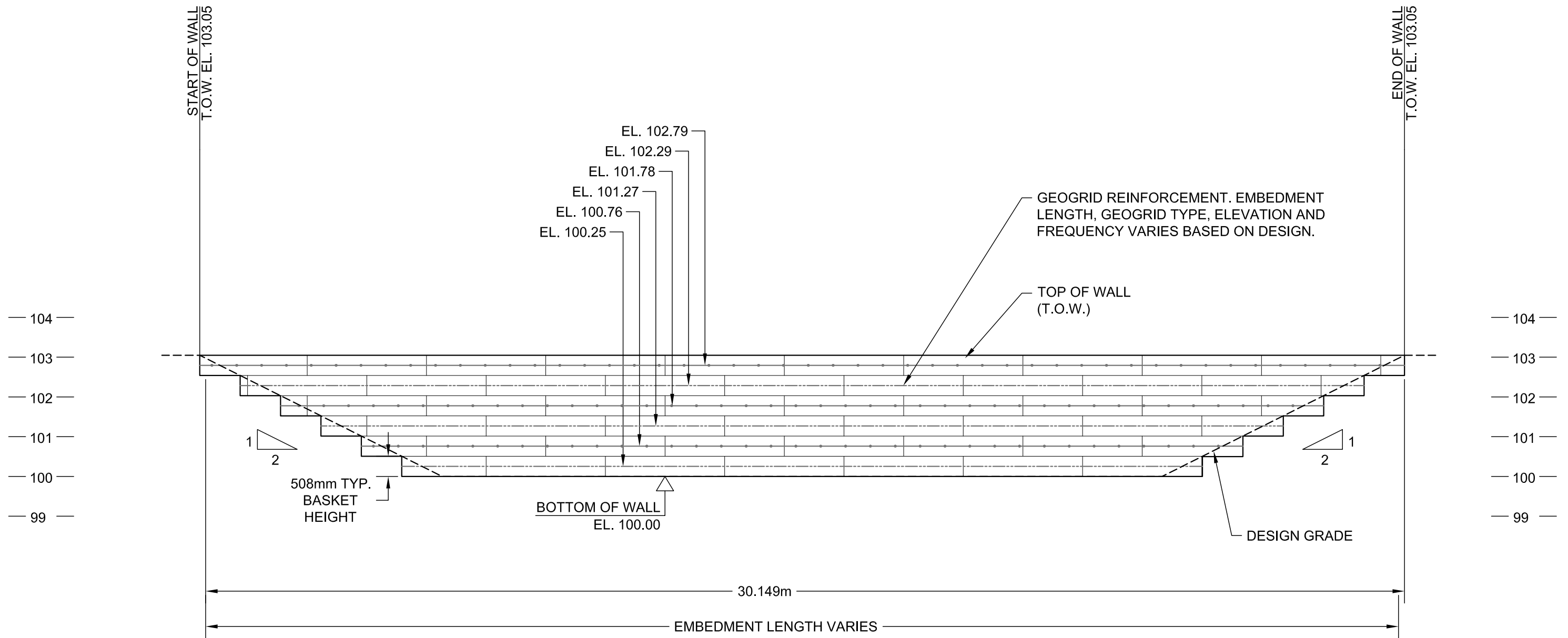
TYPICAL CONSTRUCTION NOTES

Drawing Number

002

Rev.

CANCEL PRINTS BEARING PREVIOUS LETTER OR NUMBER



ELEVATION OF SIERRA 8H:3V SLOPE
VIEWING FRONT FACE



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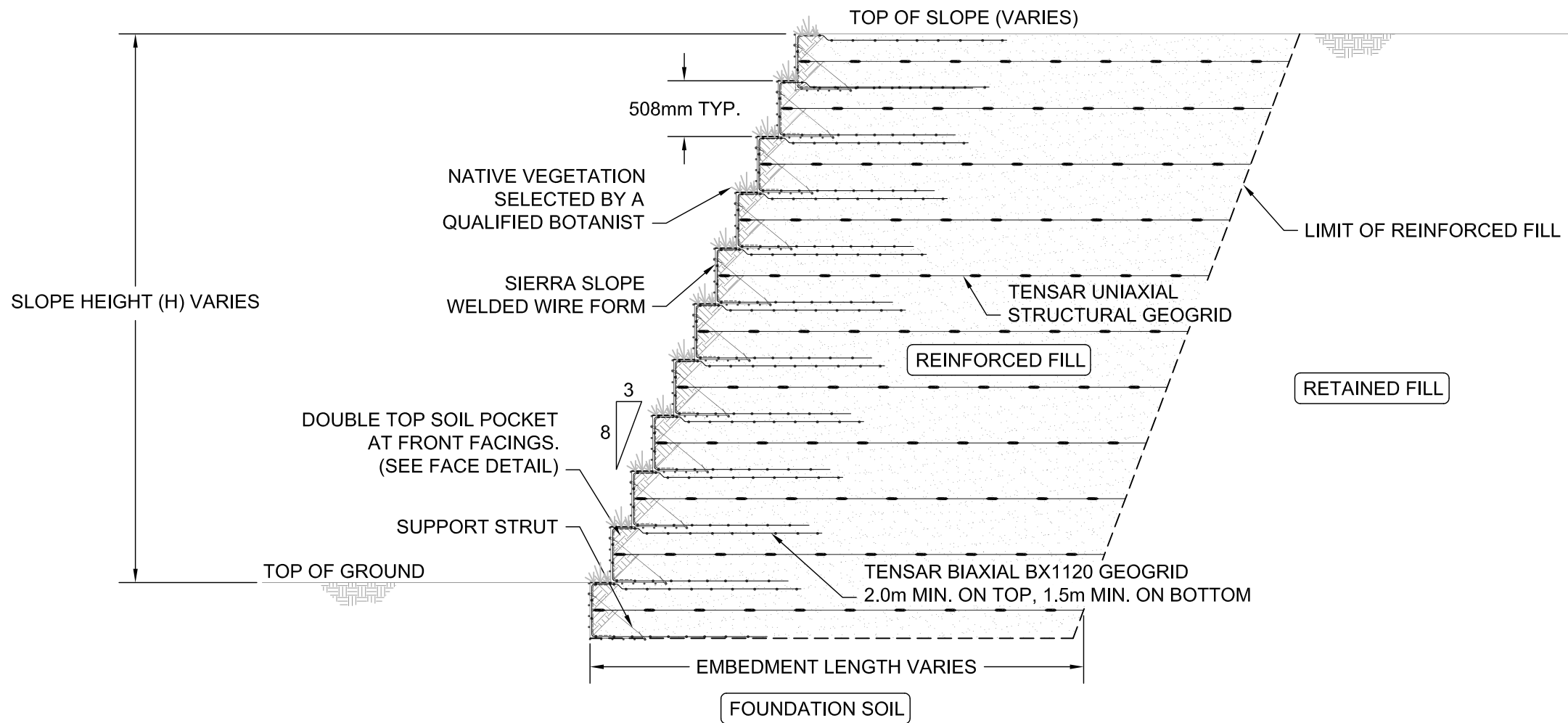
Project Number
Date Drawn August 30, 2012
Scale 1:50
Designed By
Drawn By DT
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Project
SIERRA 3H:8V SLOPE
GENERIC DESIGN

Sheet Title
SAMPLE ELEVATION

Drawing Number
003

Rev. _____



TYPICAL SIERRA WWF CROSS-SECTION
1:50

NOTE: SLOPE VARIES
MAXIMUM SLOPE 8:3



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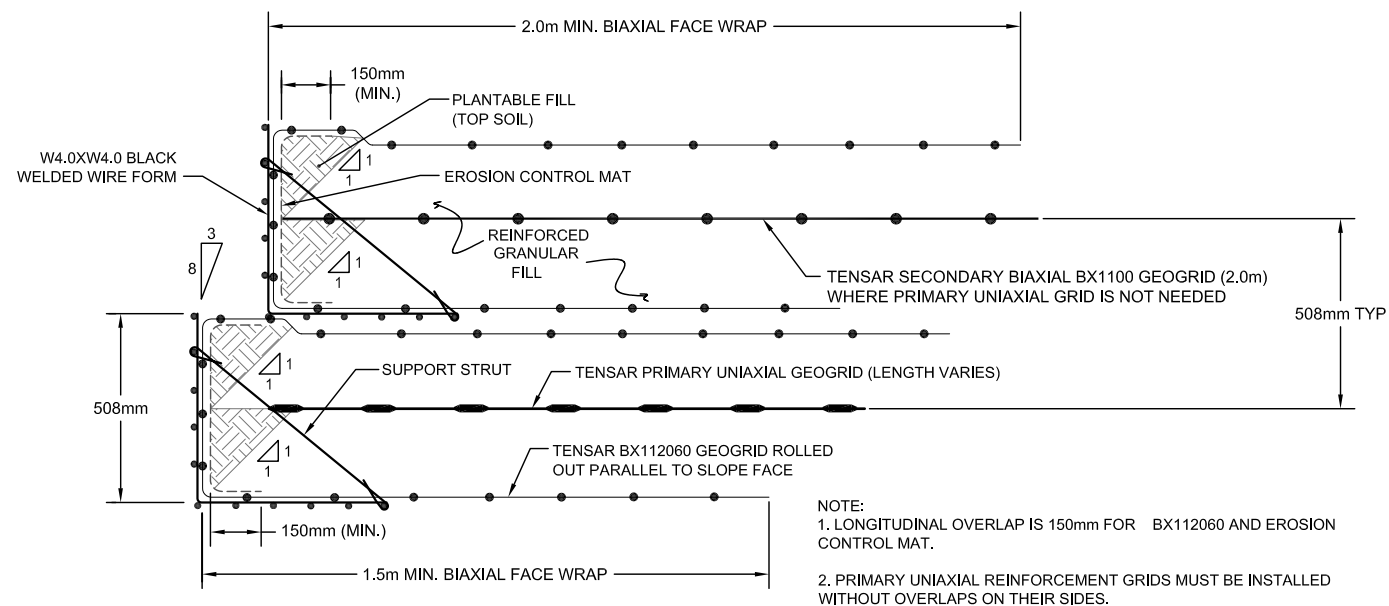
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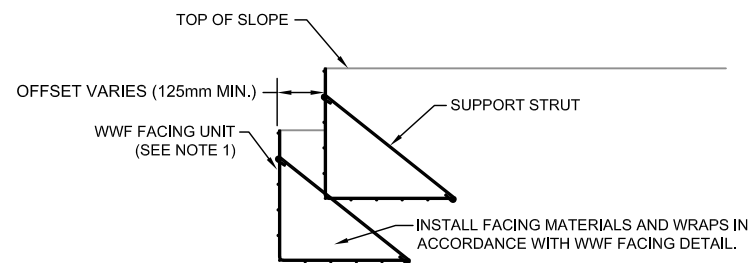
Issue/Revisions	
	ISSUED FOR INFORMATION

Project Number	
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Checked By	

Project	SIERRA 3H:8V SLOPE GENERIC DESIGN
Sheet Title	TYPICAL SIERRA 3H:8V SLOPE CROSS SECTION
Drawing Number	004
Rev.	



SIERRA SLOPE WELDED WIRE STEPPED FACE DETAIL
NOT TO SCALE



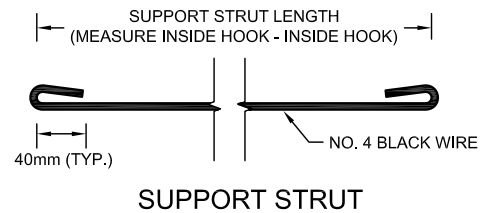
SIERRA SLOPE NESTING DETAIL FOR TOP OF SLOPE
(WHERE REQUIRED)
NOT TO SCALE

- NOTES:
- SEE WELDED WIRE FORM (WWF) FACING DETAIL FOR FACING MATERIALS AND DIMENSIONS.
 - SET TOPMOST WWF FACING UNIT INSIDE WWF FACING UNIT BELOW TO FOLLOW GRADE.
 - HORIZONTAL WIRES OF TOPMOST WWF FACING UNIT MAY BE CUT TO ALLOW INSTALLATION OVER STRUTS OF WWF FACING UNIT BELOW

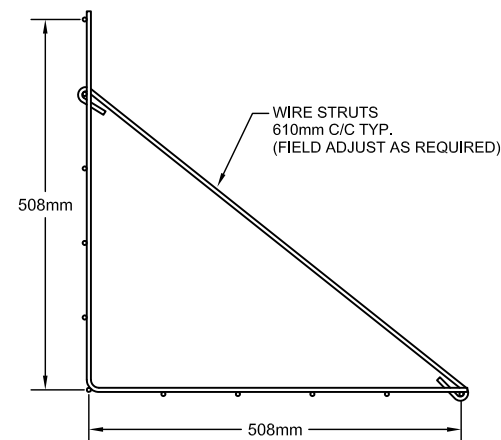


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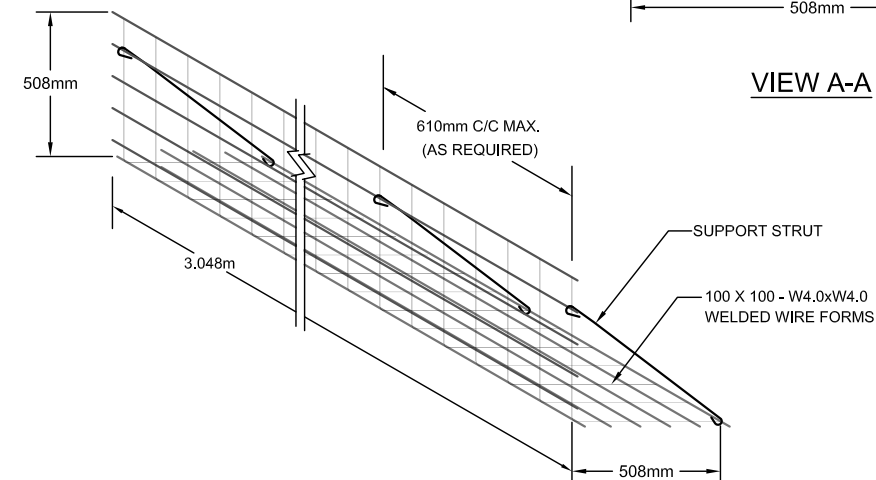
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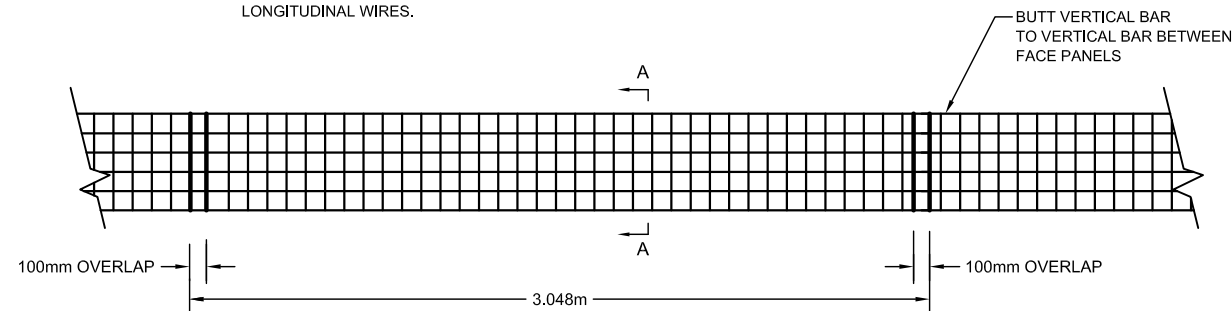
SUPPORT STRUT



VIEW A-A



- Notes:
- FACING TO CONSIST OF PREFABRICATED W 4X4-W4.0XW4.0 FORMS.
 - ALL FORMS AND STRUTS WILL BE FABRICATED WITH BLACK WIRE.
 - OVERALL LENGTH OF WIRE FORMS IS 3.048m.
 - STRUT LENGTH AND CROSS-SECTIONAL FORM DIMENSIONS TO BE PROVIDED IN FABRICATOR'S SHOP DRAWINGS.
 - STRUT TO HOOK ACROSS INTERSECTION OF TRANSVERSE AND LONGITUDINAL WIRES.



WELDED WIRE FORM DETAIL
NOT TO SCALE

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Project	SIERRA 3H:8V SLOPE GENERIC DESIGN
Sheet Title	TYPICAL DETAILS (1 OF 2)
Drawing Number	005
Rev.	

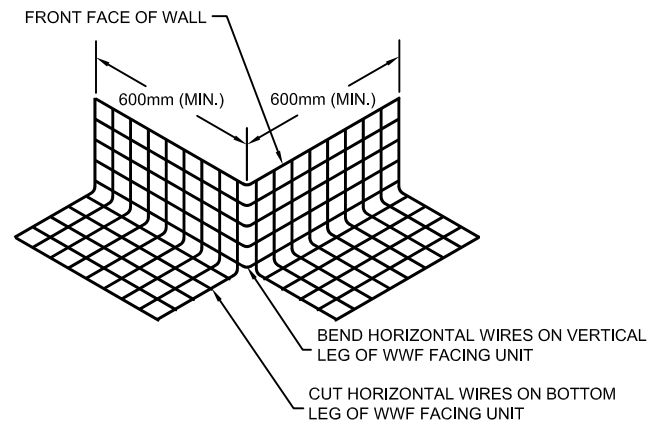
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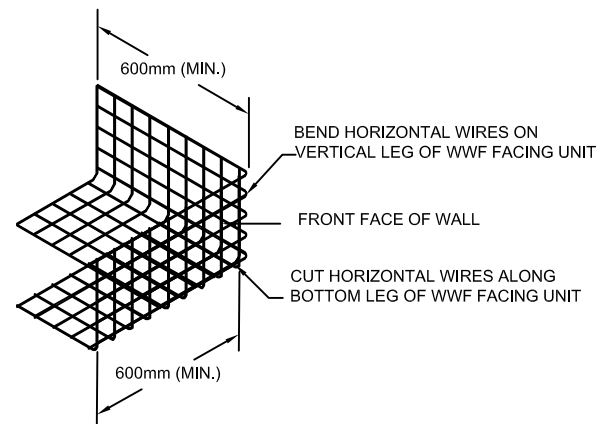
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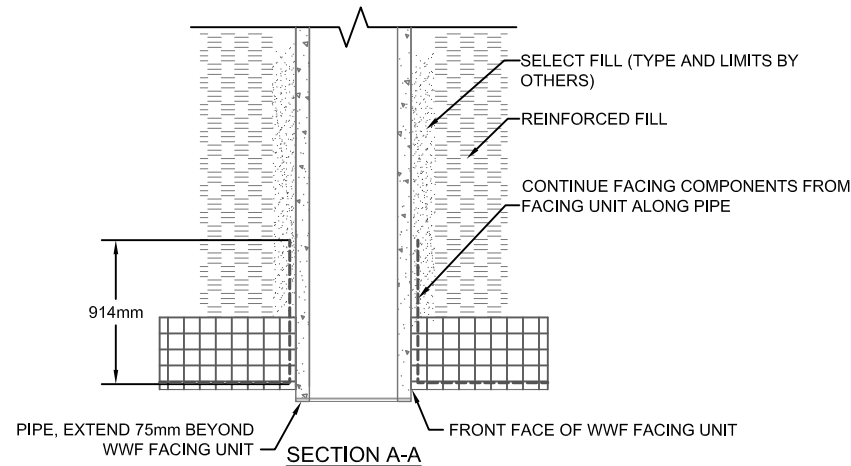
NOTE: MAINTAIN 600mm (MIN.) OF WIRE FORM ON EACH SIDE OF BEND.

WELDED WIRE FORM INSIDE CORNER UNIT
NOT TO SCALE

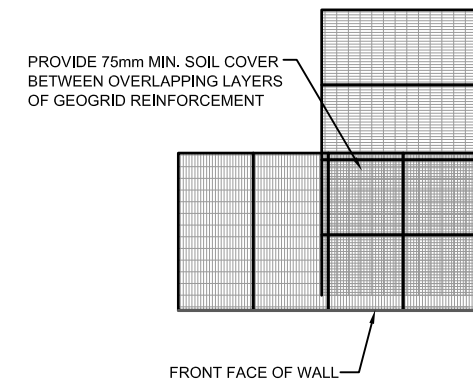


NOTE: MAINTAIN 600mm (MIN.) OF WIRE FORM ON EACH SIDE OF BEND.

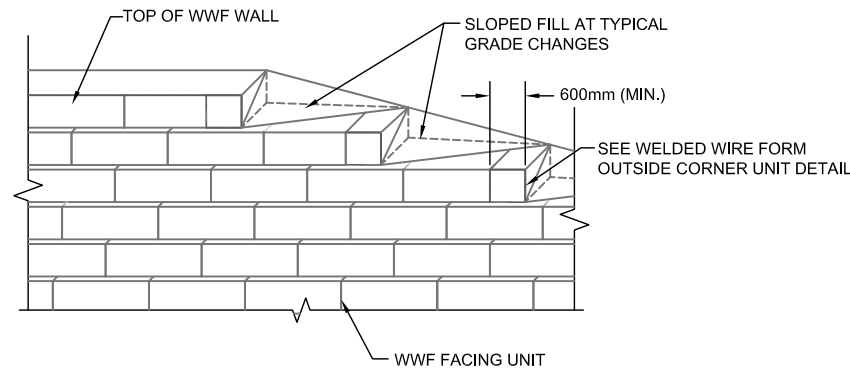
WELDED WIRE FORM OUTSIDE CORNER UNIT
NOT TO SCALE



SECTION A-A
PIPE, EXTEND 75mm BEYOND WWF FACING UNIT

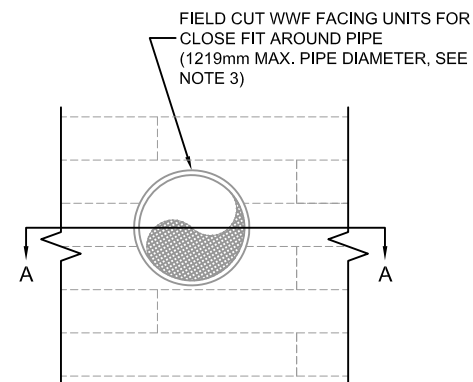


GEOGRID 90° CORNER DETAIL
NOT TO SCALE



NOTES:
1. SEE WELDED WIRE FORM (WWF) FACING DETAIL AND WWF OUTSIDE CORNER UNIT DETAIL FOR FACING MATERIALS AND DIMENSIONS.
2. INSTALL ADJACENT WWF FACING UNITS TO PROVIDE 100mm OVERLAP OF HORIZONTAL WIRES.

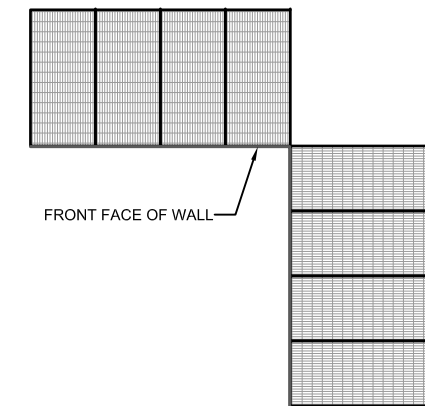
TOP OF WWF WALL, FINISHING DETAIL
NOT TO SCALE



ELEVATION VIEW

NOTES:
1. SEE WELDED WIRE FORM (WWF) FACING UNIT DETAIL FOR FACING MATERIALS AND DIMENSIONS.
2. SEE ELEVATION VIEW FOR GEOGRID TYPE, LOCATION, AND DIMENSIONS.
3. TERMINATE GEOGRIDS NO MORE THAN 75mm FROM PIPE.
4. CONTRACTOR RESPONSIBLE TO INSTALL PIPE WITH LEAK-PROOF JOINTS.

PIPE PENETRATION DETAIL AT WWF WALL FACE
NOT TO SCALE



GEOGRID 90° CORNER DETAIL
NOT TO SCALE



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Project	SIERRA 3H:8V SLOPE GENERIC DESIGN
Sheet Title	TYPICAL DETAILS (2 OF 2)
Drawing Number	006
Rev.	

SECTION 02830

SPECIFICATION FOR GALVANIZED STEEL WIRE FORMED, STONE FILLED MECHANICALLY STABILIZED EARTH RETAINING WALL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes – Mechanically Stabilized Earth (MSE) retaining wall system having high density polyethylene or polypropylene geogrids positively connected to steel welded wire mesh facing units.
- B. Related Sections
 - 1. Section 01400 Testing and Inspection Services.
 - 2. Section 02200 - Site Preparation.
 - 3. Section 02300 - Earthwork; Excavation and preparation.
 - 4. Section 02310 - Grading.
 - 5. Section 02315 - Excavation.
 - 6. Section 02316 - Fill and Backfill.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. T289 - Determining pH of Soil for Use in Corrosion Testing
 - 2. M288-96 - Standard Specification for Geotextiles
 - 3. Standard Specification for Highway Bridges (2002 Interim)
- B. American Society for Testing and Materials (ASTM)
 - 1. A123/A 123M-97 - Standard Specification for Zinc Hot Dipped Galvanized Coating on Iron and Steel Products
 - 2. A186-85 - Standard Specification for Steel Welded Wire Fabric for Concrete Reinforcement
 - 3. D698-98 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort
 - 4. D1388-96 - Standard Test Method for Stiffness of Fabrics, Option A
 - 5. D4355-92 - Standard Test Method for Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
 - 6. D4595-94 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
 - 7. D4716-95 - Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
 - 8. D4759-92 - Practice for Determining the Specification Conformance of Geosynthetics
 - 9. D5262-07 - Standard Test Method for Evaluating Unconfined Tensile Creep Behavior of Geosynthetics
 - 10. D5818-06 – Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics D6706-01 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
 - 11. D6637-01 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method
 - 12. F904-91 - Standard Test Method for Comparison of Bond Strength or Ply Adhesion of Similar Laminates Made from Flexible Materials
- C. Geosynthetic Research Institute (GRI)
 - 1. GG1-87 - Standard Test Method for Geogrid Rib Tensile Strength
 - 2. GG2-87 - Standard Test Method for Geogrid Junction Strength

3. GG5-91 - Standard Method for Geogrid Pullout
- D. Tensar International Corporation (TIC)
 1. "Design Guidelines for Tensar Geogrid Reinforced Soil Walls with SierraScape Facing Units," TTN:SierraScape-DG.

1.03 DEFINITIONS

- A. Ultimate Tensile Strength - Breaking tensile strength when tested in accordance ASTM D6637-01
- B. Junction Strength - Breaking tensile strength of junctions when tested in accordance with GRI-GG2 as modified by AASHTO Standard Specification for Highway Bridges, 2002 Interim, using a single rib having the greater of 3 junctions or 8 inches and tested at a strain rate of 10 percent per minute based on this gauge length. Values shown are minimum average roll values.
- C. Structural Geogrids - A polymeric grid formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function primarily as reinforcement.
- D. Welded Wire Facing Units – A 9.1 foot long by 3 to 3.5 foot wide steel welded wire mesh sheet that is bent 90 degrees at its long center line to form an "L" shaped unit. The vertical 18 inch high section provides a face that retains the fill. The horizontal 1.5 to 2 foot leg extends into the fill. Diagonal wire struts connect the top horizontal wire on the face to the parallel wire at the rear edge to increase the stiffness of the face and increase lateral support of the stone face fill. They are placed at the ends and at about 16 inch spacing along the facing unit.
- E. Mechanical Connection - The horizontal leg of the welded wire facing units have an inverted "U" shaped "loop" bent into the transverse wires near its rear edge. The loops fit up through the apertures of the geogrid and bear against the cross machine bars of the geogrid. This forms a structural connection that transfers load between the facing unit and the geogrid.
- F. Locking Tail Strut – A 24" long, electroplated 0.24" diameter wire with a hook at one end and a 5" long, "locking tail" bent perpendicular to the primary length on the other end. The hook is fastened to the top of the welded wire face unit and the locking tail is placed through 3 inverted "U"s to lock the geogrid reinforcement in place until backfill is placed.
- G. Stone Facing Fill – Stone fill placed immediately behind the vertical wires of the Facing Units if different than Reinforced Backfill.
- H. Reinforced Backfill - Compacted structural fill placed within the geogrid reinforced volume.
- I. Long-Term Design Strength (LTDS or T_{al}) - The maximum allowable stress level of the polymeric grid used in the internal stability design calculations of the retaining wall. Ultimate Tensile Strength reduced by the effects of creep, installation damage and durability.
- J. Long-Term Allowable Design Strength (T_a) - The Long-Term Design Strength (LTDS or T_{al}) reduced by the Factor of Safety for design uncertainties ($T_a = T_{al}/FS_{UNC}$).

1.04 SUBMITTALS

- A. Product Data - Manufacturer's materials specifications, installation instructions, and general recommendations.
- B. Design Data – Design calculations for the retaining wall system sealed by a Registered Professional Engineer.
- C. Construction Plans – Detailed Construction plans for the retaining wall system sealed by a Registered Professional Engineer.
- D. Samples
 1. Geogrid - 4-in. by 16-in. piece
 2. Geotextile Materials - 4-in by 8-in pieces
- E. Quality Control Submittals
 1. Certificates - Manufacturer's certification that the Ultimate Tensile Strength and the Junction Strength of the geogrid are equal to or greater than those specified system designer.

1.05 QUALITY ASSURANCE

- A. Designer - A Professional Engineer, registered in the State where the project is located, who is employed by a firm that has designed at least 500,000 square feet of MSE retaining walls, and who can provide a certificate of Errors and Omissions insurance to the Engineer and/or Architect with a minimum value of \$3,000,000 per occurrence and in the aggregate.
- B. Mock-Ups
 - 1. Prior to construction of retaining walls, erect a sample wall using materials shown and specified. Build mock-up at the site, where directed, approximately 20 feet long by 4.5 feet high. System Supplier shall provide qualified representative on-site for mock-up wall to provide installation guidance of the system.
 - 2. Do not start final construction until the Architect and/or Engineer approves the mock-up. Retain mock-up during construction as a standard for judging completed work. Do not alter or destroy mock-up until work is completed.
- C. Pre-Construction Conference - Prior to erection of retaining walls, hold a meeting at the site with the retaining wall materials supplier, the retaining wall installer, and the Designer to review the retaining wall requirements. Notify the Owner, the Engineer and/or Architect at least 3 days in advance of the time of the meeting.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection
 - 1. General
 - a. Prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to retaining wall materials.
 - 2. Polymeric Materials
 - a. Store at temperatures above -20 degrees F (-29 degrees C).
 - b. Rolled materials may be laid flat or stood on end.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The SierraScape™ Retaining Wall System as designed and manufactured by The Tensar International Corporation, Atlanta, GA.
- B. Alternate retaining wall systems will be considered with similar aesthetic and proven track record. All substitutions must be submitted to owner 2 weeks or 10 business days prior to bid for approval. Bidding contractor should not bid alternate system without approval. No alternate systems will be approved after the bid.

2.02 MATERIALS

- A. Structural Geogrid - The required physical and mechanical properties of geogrid reinforcement shall be determined in accordance with the following performance requirements.
 - 1. Primary Geogrid - The primary geogrid’s long-term design strength shall be determined in accordance with the following:

Where: $T_a = \frac{T_{ULT}}{RF_{CR} \times RF_{ID} \times RF_D}$

- a. T_{ULT} - Ultimate Tensile Strength shall be the minimum average roll value ultimate tensile strength as tested per ASTM D6637. This test shall be conducted without artificially deforming test materials under load before measuring such resistance or employing an artificial “secant” or “offset” tangent basis of measurement so as to overstate tensile properties.
- b. RF_{CR} – The Reduction Factor for Creep is the ratio of T_{ULT} divided by the creep rupture strength determined in accordance with ASTM D5262-07. Long-term creep rupture of the reinforcement shall be determined from controlled laboratory testing conducted for a range of load levels and durations in accordance to ASTM D5262 adequate for extrapolation to the design life. Elevated temperature can be used to accelerate creep rupture test for the purpose of extrapolation. A minimum total of 12 rupture data points with a minimum of 4 data points at each temperature and at least one test having a rupture time over 10,000 hours or more are required to establish a rupture envelope. The requirement for the minimum creep test may be waived for a new product if it can be demonstrated that is sufficiently similar to a proven creep tested product of a similar nature. When these conditions are met, creep testing shall be conducted for at least 1,000 hours before time shifting, with adequate elevated temperature data to permit to 50,000 hours or more. The limited test results of the new product are compared to the results of the previously conducted full testing program. The 1,000 hour creep curves must pattern very closely to the 1,000 hour porting of the similar product to demonstrate equivalency. Creep testing is required on representative samples of the finished product and not a single component of the geogrid (e.g., fiber and/or yarn). The ultimate strength used in this calculation shall be that of the roll used in the testing and not the MARV for the product.

In no event shall the minimum value of RF_{CR} be less than:

PVC-coated and PET geogrid	1.67
Acrylic-coated PET geogrid	1.67
HDPE uniaxial geogrid	2.55
PP biaxial geogrid	4.00

- c. RF_{ID} – The Reduction Factor for Installation Damage is the ratio of the virgin reinforcement T_{ULT} divided by the T_{ULT} of a sample of the same material recovered from an installation damage test. Tests shall be conducted using the actual backfill from the project in accordance with GRI-GG4. However, in lieu of such testing, the Manufacturer

may supply test results from other backfill soils if such soils can be shown to result in more severe construction damage than the proposed backfill. T_{ULT} shall be determined in accordance with ASTM D6637-01 and sample recovery shall be consistent with ASTM D5818-06.

In no event shall the minimum value of RF_D be less than:

PVC-coated and PET geogrid	1.20
Acrylic-coated PET geogrid	1.30
HDPE uniaxial geogrid	1.05
PP biaxial geogrid	1.05

- d. RF_D - Reduction Factor for Durability/Aging is the combined partial factor for potential chemical and biological degradation. RF_D shall be determined from polymer specific (HDPE and PP as identified by their mechanical properties, and PET as identified by CEG number and number average molecular weight, M_n) durability testing covering the range of expected soil environments. Polyolefin geogrids can be used in a pH range from 3 to 12, and polyester geogrids can be used within a pH range of greater than 3 and less than 9.

The minimum Reduction Factor for Durability/Aging for HDPE and PP shall be 1.0. The minimum reduction factors for PET geogrids are as follows:

REINFORCED AND RETAINED FILL pH			
PRODUCT	3 < pH = 5	5 < pH < 8	8 = pH < 9
Polyester Geogrids $M_n < 20,000$; $40 < CEG < 50$	2.0	1.6	2.0
Polyester Geogrids $M_n > 25,000$; $CEG < 30$	1.3	1.15	1.3

- e. For soils of potential concern, as presented below (modified soils shall include lime stabilized soil, cement stabilized soil, or concrete), only polymers listed as "YES" shall be used within or adjacent to (3 feet shortest measurable distance) these soil environments (Reference: Table 8, FHWA NHI-00-044).

SOIL ENVIRONMENT	PET	HDPE	PP
Acid Sulfate Soils	YES	YES	NO
Organic Soils	YES	YES	YES
Saline Soils, pH < 9	YES	YES	YES
Calcareous Soils	NO	YES	YES
Modified Soils/Lime, Cement	NO	YES	YES
Alkaline Soils, pH > 9	NO	YES	YES
Acidic Soils, pH < 3	NO	YES	YES
Soils with Transition Metals	YES	YES	NO

- f. C_i - Soil Interaction Coefficient value shall be determined from long-term effective stress pullout tests per ASTM D6706-01. The C_i value is determined as follows:

$$C_i = \frac{F}{2 L \sigma_N \tan \phi}$$

Where: F = Pullout force (lb/ft), per ASTM D6706-01
L = Geogrid Embedment Length in Test (ft)

σ_N = Effective Normal Stress (psf)
 ϕ = Effective Soil Friction Angle, Degrees

2. Secondary Geogrid - The secondary geogrid, identified as Types S1 and S2, shall meet the following minimum average physical property requirements:

LOAD CAPACITY

PROPERTY	METHOD	SECONDARY REINFORCEMENT TYPES	
		S1	S2
Tensile Strength*			
• 2% Strain, lbs/ft*	ASTM D6637*	450	620
• 5% Strain, lbs/ft*	ASTM D6637*	920	1,340

INTEGRITY OF PRODUCT STRUCTURE

PROPERTY	METHOD	SECONDARY REINFORCEMENT TYPES	
		S1	S2
Junction Efficiency, % of Ult. Tensile Strength	GRI-GG2-87 @ 10%/min	93	93

Unless noted otherwise, values shown are for the cross machine direction and represent minimum average roll values. The tensile strength at 2 percent and 5 percent strain shall be determined with this test conducted without artificially deforming test materials under load before measuring such resistance or employing an artificial “secant” or “offset” tangent basis of measurement so as to overstate tensile properties.

B. Welded Wire Facing Unit:

1. 1.78-in x 12-in (0.192” ϕ x 0.225” ϕ) x 9.1-ft galvanized WWM Facing Form.

C. Wire Support Struts:

1. 24.5-in (0.24” ϕ) Wire Support Strut with 1.5-in hook on one end and a 5” tail bent in a hook fashion and then extend 5” perpendicular to the primary length, electroplated galv. In accordance with ASTM A 641/641.

2.03 ACCESSORIES

- A. Geotextile - 6 oz. per sq. yd. polypropylene non-woven geotextile, AASHTO M288-96, Class 3.
- B. Tie wire or cable ties to hold alignment of adjacent welded wire forms
- C. .If required - Drainage Composite: Non-woven geotextile, AASHTO M288, Class 3, bonded to both sides of a polyethylene net structure.
 1. Minimum Allowable Transmissivity: Not less than 1.5 gallons per minute per foot of width (3×10^{-4} square meters per second) when tested in accordance with ASTM D4716 at a confirming pressure of 14.5 pounds per square inch (100 kPa).
 2. Minimum Allowable Peel Strength of Geotextile from Polyethylene Net: Not less than 1 pound per inch of width (4.45 Newtons per meter of width) when tested in accordance with ASTM F 904.

2.04 BACKFILL MATERIALS

- A. Stone Fill - Free draining, uniformly graded stone that may be placed immediately behind the face of the 1.78-in x 12-in SierraScape Facing Unit as set forth in the plans.
 - 1. 100 percent passing a 4-in. sieve
 - 2. 0 to 10 percent passing a 2-in. sieve
- B. Reinforced Backfill - Granular fills with a pH range of 2 to 12 and graded as follows:
 - 1. 100 to 75 percent passing a 2-in. sieve
 - 2. 100 to 75 percent passing a 3/4-in. sieve
 - 3. 100 to 20 percent passing a No. 4 sieve
 - 4. 0 to 60 percent passing a No. 40 sieve
 - 5. 0 to 35 percent passing a No. 200 sieve**

**Note: The SierraScape System shall include a Drainage Composite located behind the Reinforced Backfill volume (as defined on the Plans) together with an associated outlet pipe system whenever the percentage of Reinforced Backfill material passing the No. 200 sieve exceeds 15 percent.

PART 3 CONSTRUCTION

3.01 QUALIFICATION

- A. Contractor and site supervisor shall provide engineer the following proof of experience prior to the start of construction of the retaining wall system.
 - 1. Successfully installed 10 or more MSE structures of similar size and magnitude.
 - 2. Wall superintendent have at least 5 years of experience constructing similar type walls.
 - 3. At least two (2) letters of reference from other owners on the successful completion of similar type wall system.

3.02 EXCAVATION

- A. The subgrade shall be excavated vertically to the plan elevation and horizontally to the designed geogrid lengths.
- B. Overexcavated or filled areas shall be well compacted and inspected by a qualified Geotechnical Engineer.
- C. Excavated materials that are used for backfilling the reinforcement zone shall be protected from the weather.

3.03 FOUNDATION PREPARATION

- A. Foundation trench shall be excavated to the dimensions indicated on the construction drawings.
- B. The foundation area shall be examined by an Engineer to ensure proper bearing strength.
- C. Soils not meeting required strength shall be removed and replaced with the proper materials as approved by the Engineer.
- D. Foundation materials shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98.

3.04 SIERRASCAPE FACING UNIT INSTALLATION

- A. The first course of SeirraScape Facing Units shall be placed with the leg of the form having the geogrid connection loops placed on the foundation material.
- B. The first row of Facing Units shall be level from end-to-end and from front-to-back.
- C. The ends of the front faces of adjacent Facing Units shall be butted end-to-end. The vertical wires of adjacent facing units may be tied together as required to maintain alignment and prevent escape of backfill material.
- D. A string line or equivalent shall be used to align straight sections of the structure.
- E. Place seven Locking Tail Struts on approximately 16-inch centers connecting the upper horizontal wire of the face of the form to the back wire behind the connection loop after placement of geogrid as described in 3.05.
- F. Subsequent courses of Facing Units shall be placed on previous courses at a setback, if any, as shown on plans.
- H. Subsequent courses of Facing Units shall be aligned using a string line or other suitable method that is independent of the final position of the underlying course of Facing Forms.

3.05 GEOGRID REINFORCEMENT INSTALLATION

- A. Unroll the geogrid and cut it to the length shown on the plans minus the distance between the front face and the front of the connection loop of the Facing Form, approximately 15 inches. The Geogrid shall be cut at the far end of the last aperture along the front side of the cross machine direction, (CMD), bar.

1. Place the Geogrid over the connection loops of the 1.78-in x 12-in Facing Units such that the loops extend up through every other aperture of the geogrid. Pull the geogrid back such that the CMD bar is in contact with the connection loops. Use two full widths of Geogrid per Facing Unit.
 2. Where the CMD bar cannot engage the wire connection loop due to misalignment of apertures and wire loops, the CMD bar shall be cut midway between the wire loops to allow the geogrid to be spread or overlapped slightly to achieve correct alignment of grid apertures with connection loops.
- B. The “tail” end of the stut should then be inserted into the connection loops so that three (3) loop are engaged over the geogrid. Once the tail is inserted into the connection loops the strut hook can be fastened to the top of the basket.

3.07BACKFILL

- A. Place Stone face fill over the horizontal leg of the 1.78-in x 12-in Facing Unit to the dimensions shown on plans and cover with geotextile separator. Compacted lift thickness shall be no greater than 9 inches.
- B. Pull the connection tight and place reinforced backfill or facing fill over the connection to secure it prior to placement of Reinforced Fill over the rest of the Geogrid.
- C. The Reinforced Backfill material shall be placed in maximum compacted lifts of 9 inches and shall be compacted to a minimum of 95 percent Standard Proctor Dry Density in accordance with ASTM D698-98.
- C. Only hand-operated compaction equipment shall be used within 3 feet of the front face.
- D. Soil density testing shall not be performed within 3 feet of the front face.
- E. The backfill shall be smooth and level so that the geogrid lays flat.

END OF SECTION

REFERENCES

- Koerner, Robert M., *Designing with Geosynthetics*, second edition, Prentice Hall, Englewood Cliffs, NJ, 1989, p. 306.
- GRI-GG4 - Standard Test Method for Determination of the Long-Term Design Strength of Geogrids*, Geosynthetic Research Institute, Drexel University, Philadelphia, PA, 1990.
- GRI-GG5 - Test Method for Geogrid Pullout*, Geosynthetic Research Institute, Drexel University, Philadelphia, PA, 1990.
- Berg, R., and Swan, R., *Pullout of Geosynthetics*, (Draft) prepared for International Reinforced Soil Conference, University of Strathclyde, Glasgow, Scotland, September 1990. (Available through Tensar Earth Technologies, Inc.)
- Bonaparte, R. and Berg, R., *Long-Term Allowable Tension for Geosynthetic Reinforcement*, Proceedings of Geosynthetics '87 Conference, Vol. 1, p. 181-192, New Orleans, LA, February 1987. Published by Industrial Fabrics Association International, St. Paul, MN, 1987.
- Standard Specifications for Highway Bridges*, Fourteenth Edition with Interim Specifications - Bridges - 1991, American Association of State Highway and Transportation Officials, Washington, D.C.
- Elias, V., DiMaggio, J.A., and DiMillio, A., "FHWA Technical Note on the Degradation - Reduction Factors for Geosynthetics," *Geotechnical Fabrics Report*, August 1997.

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