STORMWATER MANAGEMENT & SERVICING REPORT

3555 BORRISOKANE ROAD, BARRHAVEN

CITY OF OTTAWA

PEARSON
ENGINEERING
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(Revised October 2024)
July 2023
22099

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STORMWATER MANAGEMENT & SERVICING REPORT
3555 BORRISOKANE ROAD, BARRHAVEN

1. INTRODUCTION

PEARSON Engineering Ltd. has been retained by the Ottawa Korean Community Church (Client) to prepare a Stormwater Management (SWM) & Servicing Report in support of a proposed church facility. The development is located at 3555 Borrisokane Road, Barrhaven in the City of Ottawa (City).

The subject property is approximately 1.39 ha in size and fronts onto Borrisokane Road to the west, vacant industrial lot to the north, drainage course to the east and environmentally protected lands to the south. The Project site currently consists of a vacant lot and proposes the development of a single-storey church and associated parking lot. The location of the site can be seen on Figure 1.

The objective of this report is to assess the existing municipal infrastructure in the vicinity of the Project, the onsite Stormwater Management (SWM) facilities and internal services required to service the proposed Project. The report also includes design calculations and a brief outline of the proposed internal services, as well as comments regarding the ability of the various secondary utilities to service the site.

2. SUPPORTING DOCUMENTS

The following documents have been referenced in the preparation of this report:

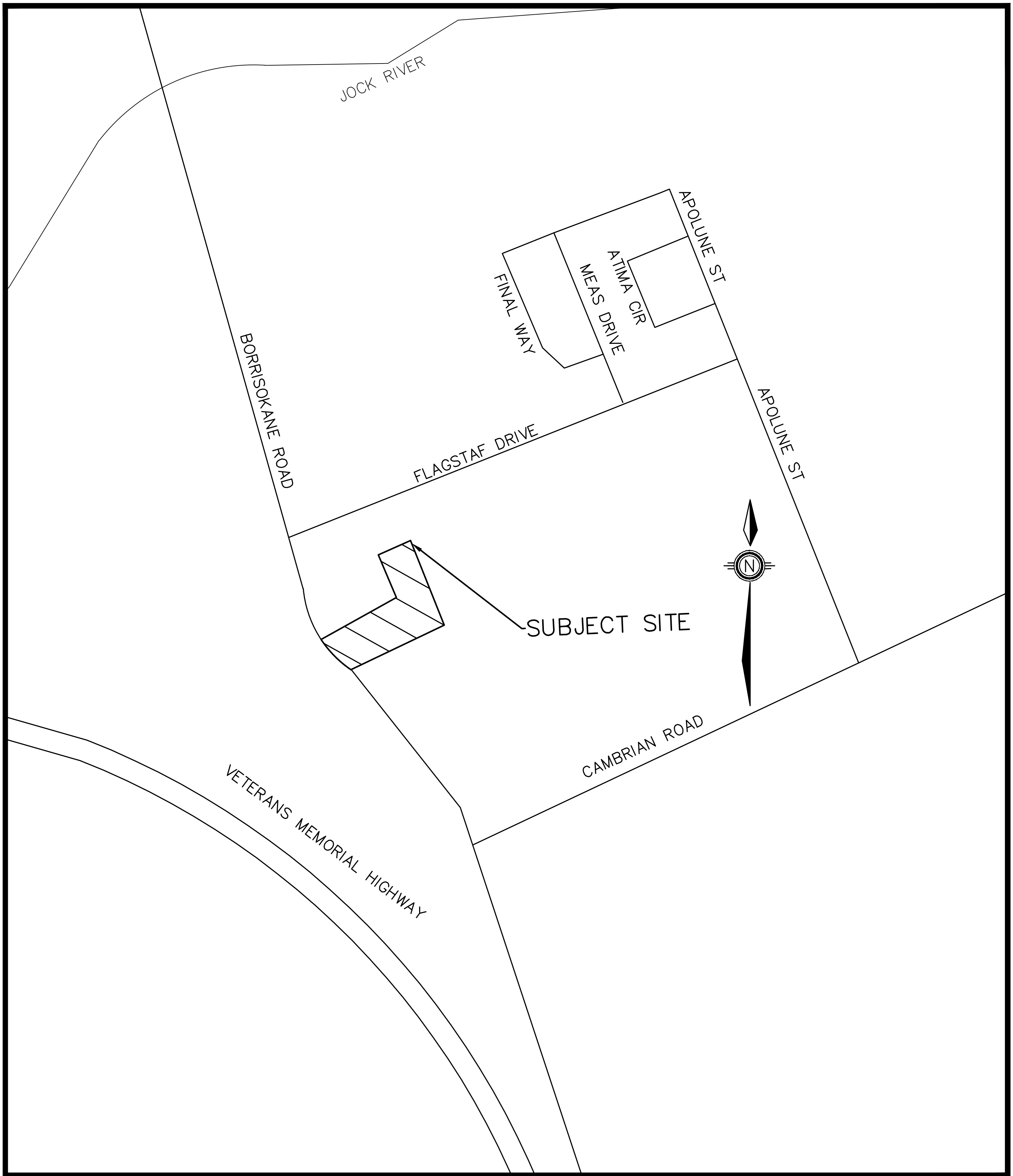
- Ministry of the Environment, Design Guidelines for Sewage Works, 2008
- Ministry of the Environment, Design Guidelines for Drinking-Water Systems, 2008
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- City of Ottawa Sewer Design Guidelines, October 2012
- City of Ottawa Water Distribution Design Guidelines, July 2010

3. WATER SUPPLY AND DISTRIBUTION

3.1. WATER SERVICING DESIGN CRITERIA

The site is to have an Institutional land use area of approximately 1.39 ha. Utilizing the City of Ottawa Water Distribution Design Guidelines for Commercial and Institutional Use of 28,000 L/ha/day, an Average Day Demand (ADD) of 0.45 L/s was calculated. A Peak Rate factor of 1.80 was used in calculating a Peak Hour Demand (PHD) of 1.22 L/s for the development. Calculations for the domestic water requirements for the site can be found in Appendix A.

P:\Autodesk Vault\Working Folders\22099 - Parker, 3555 Borrisokane Road, Ottawa\Engineering\22099 - BASE.dwg Layout:FIG-1 Plotted Jul 07, 2023 @ 11:46am by nparmar © PEARSON ENGINEERING LTD.



KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

SITE LOCATION PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	NW/MWD	HORIZ SCALE	N/A	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	FIG-1
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	0

3.2. INTERNAL WATER DISTRIBUTION SYSTEM

As part of the Half Moon Bay West Subdivision, watermain was installed on Flaggstaff Drive and service stubs were provided for the proposed development block that will contain a car wash, the Korean Church and future development block. The Project will be serviced by extending the existing 200mm diameter water service stubs through the access/servicing easement past the future development site to the property line of the Korean Church site which provide domestic and fire flows. A 50 mm diameter water service for domestic use and a 150 mm diameter water service for fire use are proposed for the development from the property line to the Church building. An internal fire hydrant is proposed to provide adequate firefighting coverage as per City standards. Proposed layout of the water services can be seen on SS-1 Drawing in Appendix K.

3.3. FIRE FIGHTING REQUIREMENTS

Fire Flow calculations have been conducted as per FUS guidelines and resulted in a required fire flow of 133 L/s (2112 GPM). As per Figure F.1 of the Hydraulic Capacity and Modeling Analysis completed by GeoAdvice Engineering Inc. in support of Phase 3 of the Half Moon Bay Subdivision, the available fire flow at the watermain junction closest to the project site, J-82, is 372 L/s. The Hydraulic Capacity and Modeling Analysis Report can be seen in Appendix G.

The Boundary Conditions for the site were provided by the City of Ottawa using the project's domestic and fire flow demands. Water pressures shown in Table 1A and Table 1B were calculated based on the Hydraulic Grade Lines (HGL) provided by the City for existing and future conditions respectively. When comparing to the minimum and maximum allowable water pressures from City of Ottawa Water Design Guidelines, it can be seen that the site water pressures fall within City limits for the future conditions. Fire flow analysis, water pressure conversion and boundary conditions supplied by the City for both existing and future conditions can be found in Appendix A.

Table 1A: Existing Boundary Conditions

Design Parameter	Demand (L/s)	HGL (m)	Pressure (PSI)	Pressure (kPa)	City of Ottawa minimum (kPa)	City of Ottawa maximum (kPa)
Average Daily Demand	N/A	156.5	89.2	614.7	-	552
Peak Hour	N/A	142.6	69.4	478.5	276	552
Max Day + Fire Flow	N/A	137.7	62.4	430.4	140	552

Table 1B: Proposed Boundary Conditions

Design Parameter	Demand (L/s)	HGL (m)	Pressure (PSI)	Pressure (kPa)	City of Ottawa minimum (kPa)	City of Ottawa maximum (kPa)
Average Daily Demand	0.45	146.8	75.4	519.6	-	552
Peak Hour	1.22	142.8	69.7	480.4	276	552
Max Day + Fire Flow	133.7	142.4	69.1	476.5	140	552

4. SANITARY SERVICING

4.1. SANITARY DESIGN CRITERIA

The site is to have an Institutional land use area of approximately 1.39 ha. Utilizing the City of Ottawa Sewer Design Guidelines for Commercial and Institutional Use of 28,000 L/ha/day, an Average Day Demand (ADD) of 0.45 L/s was calculated. Using a Peak Rate factor of 1.50 and an infiltration allowance of 0.33 L/ha/s, a peak flow of 1.13 L/s was calculated for the proposed development. Calculations for the sanitary flows for the site can be found in Appendix B.

4.2. INTERNAL SANITARY SEWER SYSTEM

The sanitary sewers will be constructed in accordance with the City of Ottawa's Sewer Design Guidelines and the Ministry of the Environment, Conservation and Parks (MECP) guidelines in order to service the Project. Similar to the water servicing for the project, the existing sanitary sewer stub will be extended to the Korean Church property line through an access/servicing easement. A proposed 200 mm diameter sanitary sewer system for this Project is to convey sanitary flow to the proposed sanitary stub provided by the Carwash project which connects to monitoring MH1A and ultimately to the 300 mm diameter sanitary sewer on the Flagstaff Drive.

The actual velocity was calculated as per the City of Ottawa Sewer Guidelines for all sanitary sewers that have a flow depth of less than 30% of the diameter. Results provided in Appendix B demonstrate that an actual velocity of 0.60 m/s to 0.82 m/s is provided for the Project's proposed sanitary sewers, which is meeting the City's minimum velocity criteria of 0.60 m/s. Therefore, the Project's sanitary sewers will provide adequate self-cleansing velocities.

As per the Sanitary Sewer Calculation Sheet completed by DSEL for Flagstaff Drive, a future residential flow of 8.31 L/s was calculated from the east of the project site. The 300 mm diameter sanitary sewer on Flagstaff Drive runs east to west and has a capacity of 43.3 L/s at a slope of 0.20%. The Carwash Project (Part 1), future light industrial (Part 3), and the project site will therefore utilize approximately 20.5% of the sewer's capacity. As the proposed peak flow from the project site is 2.6 % of the current capacity of the existing sewer, it is expected to have sufficient capacity to convey the sanitary design flows. Refer to Drawing SS-1 for the proposed sanitary servicing layout in Appendix K.

5. STORMWATER MANAGEMENT

A key component of the development is the need to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City of Ottawa and MECP requirements. This report focuses on the necessary measures to satisfy the MECP's SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion;
- Maintain water quality for ecological integrity, recreational opportunities, etc.;
- Protect and maintain groundwater flow regime(s);
- Protect aquatic and fishery communities and habitats; and
- Maintain and protect significant natural features.

5.1. ANALYSIS METHODOLOGY

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- City of Ottawa, Sewer Design Guidelines, October 2012

In order to design the facilities to meet these requirements, it is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Rational Method is appropriate for the design for the SWM system.

5.2. EXISTING DRAINAGE CONDITIONS

The Project site consists of a cleared lot with a temporary drainage channel along the south side of the property. Most of the site drains overland to a ditch along Borrisokane Road, the rest of the site drains overland to a water course immediately east of the site, in the Half Moon Bay West Subdivision. Both ultimately leading to Jock River. Details of existing storm drainage conditions are shown on Drawing STM-1 in Appendix K.

Paterson Group completed a geotechnical investigation for the site dated March 7th, 2019. The investigation revealed that the site consists of a layer of peat followed by brown silty sand with clay and this layer is followed by grey silty clay. There was no Groundwater found below the existing ground surface.

The site is located within the Half Moon Bay West Phase 3 subdivision. From the DSEL Storm Drainage Plan, dated August 2022, the allowable runoff coefficient for the site is 0.80. The Modified Rational Method and the City of Ottawa IDF curve parameters were used to determine allowable peak flows for the site and can be seen in Table 2 below. DSEL Storm Drainage Plan can be found in Appendix E. Detailed calculations for the existing drainage conditions can be found in Appendix C.

Table 2: Allowable Peak Flows

	2 Year Storm	5 Year Storm	100 Year Storm
Allowable Peak Flows (L/s)	225.8	306.4	306.4

5.3. PROPOSED STORM DRAINAGE SYSTEM

Post-development drainage patterns for the site will generally follow pre-development drainage conditions. The majority of the paved areas will be conveyed overland to a catchbasin and storm sewer system, sized for the 5-year storm event located throughout the site. A portion to the south of the proposed building will flow uncontrolled towards the existing ditch on Borrisokane Road and to the woodland area to the east. Stormwater from the building will drain via a roof leader to the storm sewer which outlets to the existing ditch on Borrisokane Road.

The project's storm sewer was sized for the minor storm event, defined as all storms up to and including the 5-year storm event, using the rational method. An orifice plate will be implemented downstream of CBMH3 to reduce the post-development peak flows leaving the site, causing stormwater to back up onto the surface. Surface ponding on the parking lot provides a total of 178 m^3 of storage volume and underground structures provide a 24.62 m^3 of volume. In the event of a storm greater than 100-year storm and/or if the orifice plate becomes blocked, stormwater will be conveyed overland through the top of curb weir located in the northwest corner of the parking lot towards the existing roadside ditch on Borrisokane Road.

Rideau Valley Conservation Authority (RVCA) requested to mimic the site's hydrological cycle. However, due to the soils present on site, infiltration would not be feasible. As such, best efforts have been implemented to recharge groundwater by proposing a bioretention trench. The runoff of approximately 0.11 ha area, from the southeast corner of the project site will be directed towards bioretention trench to infiltrate the stormwater into the ground.

A 900 mm diameter driveway culvert has been proposed beneath the driveway to Borrisokane Road to convey flows from the roadside ditch on the east side of Borrisokane Road. The culvert sizing was completed based on flow data from the Design Brief for the Half Moon Bay West Subdivision Phase 3, prepared by DSEL, dated November 18, 2021. DSEL calculated a flow of 0.77 m^3/s for 100-year storm event, which was incorporated in the sizing of driveway culvert. Detailed culvert sizing calculations and the Design Brief completed by DSEL can be found in Appendix C and Appendix F respectively.

As per the City of Ottawa Sewer Design Guidelines, the 100-year plus 20% stress test event was considered to convey the flows without negatively affecting the building. A 10.0 m wide emergency weir located in the northwest corner of the parking lot will convey storm flows greater than the 100-year storm event. Calculations in Appendix C demonstrate that the separation between the 20% stress test conveyance elevation and the finished floor elevation of the church building will be 0.23 m. Post-development storm drainage patterns can be found on Drawing STM-2 in Appendix K.

5.4. STORMWATER QUANTITY CONTROL

The proposed development will increase the imperviousness of the site and as such the post development peak flows will increase. The calculated post-development runoff coefficient of 0.63 is smaller than the allowable runoff coefficient (as per DSEL Drawings) of 0.80. However, as per the City of Ottawa Sewer Design Guidelines, the 100-year post-development runoff is required to be controlled to the 5-year allowable flow values.

Quantity control on site will be provided through the use of surface ponding throughout the parking lot. A 240 mm diameter orifice plate will be implemented downstream of CBMH3 to reduce the post-development peak flows leaving the site, causing stormwater to back up onto the surface. Calculations in Appendix C demonstrate that 160 m^3 of volume is required to control the 100-year storm event to the 5-year pre-development values. The site has been graded to provide a total of 178 m^3 of storage in form of surface ponding and 24.6 m^3 within underground structures with a maximum depth of 0.30 m as per the SSD calculations sheet in Appendix C. Table 3 summarizes post-development peak flows for the development.

Table 3: Post-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Controlled Peak Flows (L/s)	104.6	141.5	150.9	155.5	157.8	159.0
Uncontrolled Flows (L/s)	49.6	67.0	78.5	102.3	124.6	143.5
Total Flows (L/s)	154.2	208.5	229.4	257.8	282.4	302.5

By comparing Table 2 and 3, it can be seen that the post-development peak flows for the 2-year to 100-year storm has been reduced to at below 5-year allowable flow values.

5.5. STORMWATER QUALITY CONTROL

The MECP in March 2003 issued a “Stormwater Management Planning and Design Manual”. This manual has been adopted by a variety of agencies including the City of Ottawa. The objective of the Stormwater Quality Control will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

5.5.1. PERMANENT QUALITY CONTROL

The development’s active parking facilities pose a risk to stormwater quality through the collection of grit, salt, sand and oils on the paved surface. A CDS Oil/Grit Separator or equivalent treatment unit is proposed in order to treat the stormwater released from the site to MECP’s Enhanced or Level 1 Protection standards. The MECP standards stipulates a Total Suspended Solids (TSS) removal of at least 80%. The CDS 2020-5-C unit will treat the post-development flows to the required MECP quality standard, achieving 81% TSS removal. Refer to Appendix D for OGS Unit Manufacturer specifications and TSS removal table.

5.5.2. QUALITY CONTROL DURING CONSTRUCTION ACTIVITIES

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure stormwater runoff's quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties;
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed/exposed shall not exceed 30 days;
- Reduce stormwater drainage velocities where possible; and,
- Minimize the amount of existing vegetation removed.

6. CONCLUSIONS

The proposed development will require the connection of sanitary and watermain services to the existing services.

Quantity control for the site is provided through surface ponding which will reduce the 100-year post development peak flows to the 5-year allowable peak flow levels.

An OGS unit is provided for the required quality control to satisfy the MECP Enhanced level requirements.

All of which is respectfully submitted,

PEARSON ENGINEERING LTD.

Taylor Arkell, P.Eng.	Mike Dejean, P.Eng.
Senior Project Manager	Partner, Manager of Engineering Services

LICENCED PROFESSIONAL ENGINEER

M.W. DEJEAN

Oct 16, 2024

PROVINCE OF ONTARIO

APPENDIX A

WATER SERVICING AND FIRE FLOW CALCULATIONS

3555 Borrisokane Road, Barrhaven
Water Flow Calculations - Part 5

Design Criteria:

Average Water Consumption Rate (Q): 28,000 L/ha/d
Max. Daily Factor: 1.50 (From, Table 4.2, Ottawa Design
Max. Hour Factor: 1.80 Guidelines for Water DIstribution)

Site Data:

Description	Density	Site Area	Flow Rate	Peaking Factors	
Institutional	13,923 m^2	1.39 ha	28,000 L/ha/d	Max Daily Factor*	1.50
				Max Hour Factor*	1.80

*From Ottawa Design Guidelines based on Institutional Land Use

Calculate Average Day Demand:

ADD = 28,000 x 1.39
ADD = 38,984 L/day
ADD = 0.45 L/s

Calculate Max Daily Flow

MDF = 0.45 x 1.50
MDF = 0.68 L/s

Calculate Max Hour Demand

PHD = 0.68 x 1.80
PHD = 1.22 L/s
PHD = 19.30 GPM

3555 Borrisokane Road, Barrhaven
Fire Flow Calculations

Required fire flow calculations as per the Fire Underwriters Survey's Water Supply for Public Fire Protection - 2020:

Location: 3555 Borrisokane Road, Barrhaven

OBC Occupancy: A-2 - Churches

Building Foot Print: 2,914 m^2

# of Stories: 1

Date: 7/3/2024
Project: Korean Community Church
Project Number: 22099

Type	Construction Class	Charge
5	Wood Frame	1.50
4	Heavy Timber (A-D)	0.80 - 1.50
3	Ordinary	1.00
2	Non-Combustible	0.80
1	Fire Resistive	0.60

Construction Class: Type 2 Non-Combustible

Contents	Charge
Non-Combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Automated Sprinkler Protection:		Credit	Total
NFPA 13 sprinkler standard	No	0%	0%
Standard Water Supply	No	0%	
Fully Supervised System	No	0%	

Contents Factor: Limited Combustible **Charge:** -15%

Exposure Side & Building	Length - Height Ratio	Distance to Exposure Building (m)	Charge
North Prop. Commercial	> 100	>30	0%
East Ex. Cleared lot	> 100	>30	0%
South Ex. Woodland Area	> 100	>30	0%
West Ex. Cleared lot	> 100	>30	0%
		Total:	**0%**

Separation Distance	Charge
0.0 - 3.0 m	10%
3.1 - 10.0 m	8%
10.1 - 20.0 m	5%
20.1 - 30.0 m	3%
> 30.1 m	0%

Are Buildings Contigious? No

Fire Resistant Building: Are vertical openings and exterior vertical communications protected with a minimum one (1) hr rating?

Calculations: *C* = 0.8 Non-Combustible

Required Fire Flow ***RFF* = 220 x *C* x √*A***

Where: *RFF* = required fire flow in liters per minute
C = Coefficient related to the type of construction
A = the total floor area in square meters (excluding basements in building considered)

Total Effective Area *A* = 2,914 m²

RFF = 9,500 L/min

Round to Nearest 1000 L/min RFF = 9,000 L/min

* Must be > 2,000 L/min or < 45,000 L/min

Correction Factors:

Contents Charge		-1,350	L/min
RFF Adjusted for Contents	**E =**	7,650	L/min
Reduction For Sprinkler	**F =**	0	L/min
RFF w/ Sprinkler Reduction		7,650	L/min

As per "Water Supply for Public Fire Protection" pg.20 note H:
***RFF* = E - F + G**

Exposure Charge	**G =**	0	L/min	RFF = 7650 L/min - 0 L/min + 0 L/min
RFF w/ Exposure Charge		7,650	L/min	RFF = 7650 L/min
Required Fire Flow:	**RFF =**	7,650	L/min	
Round to Nearest 1,000 L/min	**RFF =**	**8,000**	**L/min**	
	RFF=	**2,112**	**GPM**	
	RFF =	**133**	**L/s**	

3555 Borrisokane Road, Barrhaven
Existing Boundary Conditions Unit Conversion

Project: Korean Community Church

Project Number: 22099

Street: Borrisokane Road

Ground Elev (m): 93.8

	Height (m)	m H_2O	PSI	kPa
Avg. Day	156.5	62.7	89.2	614.7
Peak Hour	142.6	48.8	69.4	478.5
Max Day + Fire Flow	137.7	43.9	62.4	430.4

3555 Borrisokane Road, Barrhaven
Proposed Boundary Conditions Unit Conversion

Project: Korean Community Church

Project Number: 22099

Street: Borrisokane Road

Ground Elev (m): 93.8

	Height (m)	m H_2O	PSI	kPa
Avg. Day	146.8	53.0	75.4	519.6
Peak Hour	142.8	49.0	69.7	480.4
Max Day + Fire Flow	142.4	48.6	69.1	476.5

APPENDIX B

SANITARY SERVICING CALCULATIONS

3555 Borrisokane Road, Barrhaven
Sanitary Flow Calculations - Part 5

Design Criteria

Average Water Consumption Rate (Q):	28,000	L/ha/d
Peak Flow	Qp = P * Q * M / 86,400	
Peaking Factor (M)	1.50	(From Ottawa Design Guidelines based on Institutional Land Use)
Infiltration Allowance (I_A):	0.33	L/ha/s

Site Data

Description	Density		Site Area		Flow Rate	
Institutional	13,923	m^2	1.39	ha	28,000	L/ha/d

Calculate Average Daily Demand:

$$ADD = \frac{28,000 \times 1.39}{86,400}$$

ADD = 0.45 L/s

Infiltration Allowance: = 0.33 x 1.39
= 0.46 L/s

Calculate Peak Flow:

Qp = 0.45 x 1.50
= 0.68 L/s

Calculate Peak Flow (with Infiltration Allowance

Qp (with I_A) = 0.46 + 0.68
= 1.14 L/s

PEARSON ENGINEERING

3555 Borrisokane Road, Barrhaven
Sanitary Sewer Design Sheet

$n = 0.013$

$M = 1+(14/(4+(P/1000)^{0.5}))$ $(1.5 <= M <= 4)$

$Q_i = 0.23$ L/ha/day

$Q_{Industrial} = 35\ m^3$/ha/day

$Q_{tot} = Q_{Industrial} + Q_i$

Date: 3-Jul-24

File: 22099

Contract/Project: 3555 Borrisokane Rd., Barrhaven

Areas	Manhole		Area (ha)	Area (ACC.)	M	Industrial Flow (L/s)	Length (m)	Q_i (ACC.) (L/s)	Total Q (L/s)	D (mm)	S (%)	Q Full (L/s)	V Actual (m/s)	V Full (m/s)	Percent Full (%)
	From	To													
Part 5	SAN CAP	MH4A	1.39	0.00	4.00	0.00	22.3	0.46	1.14	200	0.56	24.5	0.60	0.78	4.6
	MH4A	MH3A	0.00	0.00	4.00	0.00	33.8	0.00	1.14	200	0.56	24.5	0.60	0.78	4.6
Part 3	MH3A	MH2A	0.38	0.38	4.00	1.32	56.1	0.13	2.58	200	0.65	26.4	0.82	0.84	9.8
Part 1	MH2A	MH1A	0.53	0.53	4.00	6.14	22.1	0.18	8.90	200	0.65	26.4	*	0.84	33.6
	MH1A	TEE	-	-	4.00	0.00	14.0	0.00	8.90	200	0.65	26.4	*	0.84	33.6
	EX MH 338A	EX MH 339A	-	-	-	-	49.5	-	17.21	300	0.20	43.3	*	0.61	39.8

Note: * indicates that the actual velocity calculation is not required as the flow depth is more than 0.30 m.
The Flow of 17.21 L/s = 8.90 L/s (Part 5, Part 3, Part 1) + 8.31 L/s (Future residential to the east as per DSEL Sanitary Catchments)

APPENDIX C

STORMWATER MANAGEMENT CALCULATIONS

3555 Borrisokane Rd, Barrhaven
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.20	0.90	0.90	0.80	0.90	Weighted Runoff Coefficient
Surface Cover	=	Grass	Asphalt	Building	Gravel	Conc.	
<u>Allowable</u>	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	13232	13232	0	0	0	0	0.80
Pre Total	13232	13232	0	0	0	0	0.80
<u>Post-Development</u>	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	
1	1453	0	0	1453	0	0	0.90
2	6092	946	4422	40	0	685	0.79
3	5686	4005	0	1501	0	181	0.41
Post Total	13232	4950	4422	2994	0	866	0.64

Note: As per DSEL Half Moon Bay West Phase 3 Storm Drainage Plan, an allowable runoff coefficient of 0.80 was used in calculating Pre-development peak flows.

3555 Borrisokane Rd, Barrhaven
Allowable Peak Flows

Storm Event (yrs)	City of Ottawa Coeff A	Coeff B	Coeff C
2	**732.95**	**6.20**	**0.81**
5	**998.07**	**6.05**	**0.81**
10	**1174.18**	**6.01**	**0.82**
25	**1402.88**	**6.02**	**0.82**
50	**1569.58**	**6.01**	**0.82**
100	**1735.69**	**6.01**	**0.82**

Modified Rational Method
Q = CiCIA / 360

Where:
Q - Flow Rate (m^3/s)
C - Rational Method Runoff Coefficient
I - Storm Intensity (mm/hr)
A - Area (ha.)
Ci - Peaking Coefficient

Area Number	1	
Area	1.32	ha
Runoff Coefficient	0.80	*
Time of Concentration	10	min
Return Rate	2	year
Peaking Coefficient (Ci)	1.00	
Rainfall Intensity	76.81	mm/hr
Allowable Peak Flow	225.8	L/s
Return Rate	5	year
Peaking Coefficient (Ci)	1.00	
Rainfall Intensity	104.19	mm/hr
Allowable Peak Flow	306.4	L/s

Note: As per DSEL Half Moon Bay West Phase 3 Storm Drainage Plan, an allowable runoff coefficient of 0.80 was used in calculating peak flows.

3555 Borrisokane Rd, Barrhaven
Post-Development Peak Flows

City of Ottawa

Storm Event (yrs)	Coeff A	Coeff B	Coeff C
2	**732.95**	**6.20**	**0.81**
5	**998.07**	**6.05**	**0.81**
10	**1174.18**	**6.01**	**0.82**
25	**1402.88**	**6.02**	**0.82**
50	**1569.58**	**6.01**	**0.82**
100	**1735.69**	**6.01**	**0.82**

Modified Rational Method
Q = CiCIA / 360

Where:

Q - Flow Rate (m^3/s)
C - Rational Method Runoff Coefficient
I - Storm Intensity (mm/hr)
A - Area (ha.)
Ci - Peaking Coefficient

	Controlled Area		Uncontrolled Area	
Area Number	1 to 2		3	
Area	0.75	ha	0.57	ha
Runoff Coefficient	0.81		0.41	
Time of Concentration	10	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	76.81	mm/hr	76.81	mm/hr
Post-Development Peak Flow	130.8	L/s	49.4	L/s
Return Rate	5	year	5	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	104.19	mm/hr	104.19	mm/hr
Post-Development Peak Flow	177.4	L/s	67.0	L/s
Return Rate	10	year	10	year
Peaking Coefficient (Ci)	1.00		1.00	
Rainfall Intensity	122.14	mm/hr	122.14	mm/hr
Post-Development Peak Flow	207.9	L/s	78.5	L/s
Return Rate	25	year	25	year
Peaking Coefficient (Ci)	1.10		1.10	
Rainfall Intensity	144.69	mm/hr	144.69	mm/hr
Post-Development Peak Flow	271.0	L/s	102.3	L/s
Return Rate	50	year	50	year
Peaking Coefficient (Ci)	1.20		1.20	
Rainfall Intensity	161.47	mm/hr	161.47	mm/hr
Post-Development Peak Flow	329.9	L/s	124.6	L/s
Return Rate	100	year	100	year
Peaking Coefficient (Ci)	1.25		1.25	
Rainfall Intensity	178.56	mm/hr	178.56	mm/hr
Post-Development Peak Flow	380.0	L/s	143.5	L/s
Return Rate	100	year + 20% s	100	year + 20% s
Peaking Coefficient (Ci)	1.50		1.50	
Rainfall Intensity	178.56	mm/hr	178.56	mm/hr
Post-Development Peak Flow	456.0	L/s	172.2	L/s

3555 Borrisokane Rd, Barrhaven
Stage-Storage-Discharge Table

Elevation (m)	Volume (m^3)	Cum. Vol. (m^3)	Orifice Head (m)	Orifice Flow (L/s)	Weir Head (m)	Weir Flow (L/s)	Total Flow (L/s)
90.97	0	0	0.000	0.0	0.000	0.0	0.0
91.78	23.2	23.2	0.690	104.9	0.000	0.0	104.9
92.40	0.0	23.2	1.310	144.5	0.000	0.0	144.5
92.45	0.8	24.0	1.360	147.2	0.000	0.0	147.2
92.50	5.0	29.0	1.410	149.9	0.000	0.0	149.9
92.55	14.0	42.9	1.460	152.5	0.000	0.0	152.5
92.60	29.1	72.1	1.510	155.1	0.000	0.0	155.1
92.65	49.6	121.7	1.560	157.7	0.000	0.0	157.7
92.66	13.0	134.6	1.570	158.2	0.000	0.0	158.2
92.67	14.2	148.9	1.580	158.7	0.000	0.0	158.7
92.68	15.8	164.6	1.590	159.2	0.000	0.0	159.2
92.69	17.5	182.1	1.600	159.7	0.000	0.0	159.7
92.70	19.3	201.4	1.610	160.2	0.000	0.0	160.2
92.75	0	201	1.660	162.7	0.050	47.5	210.2
92.80	0	201	1.710	165.1	0.100	134.4	299.5
92.85	0	201	1.760	167.5	0.150	246.9	414.4
92.90	0	201	1.810	169.8	0.200	380.1	550.0 *
92.95	0	201	1.860	172.2	0.250	531.3	703.4
93.00	0	201	1.910	174.5	0.300	698.3	872.8

Orifice Plate	
Diameter	240 mm
Invert Elevation	90.97
Orifice Constant	0.63
Orifice Centroid	91.09
Orifice Flow Formula	0.63π(D/2,000)2 x (2x9.81xH)0.5

Emergency Overflow Weir	
Width	5.00 m
Invert of Weir	92.70 m
Weir Flow Formula	$1.7WH^{1.5}$

Note: * indicates the 100-year + 20% stress test event flows which will be conveyed through the emergency overflow weir at 0.23 m below the finished floor elevation.

3555 Borrisokane Rd, Barrhaven
Quantity Control Volume Calculations

DATE:	04-Oct-24
FILE:	22099
CONTRACT/PROJECT:	3555 Borrisokane Rd, Barrhaven
COMPLETED BY:	NP

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre Development Runoff Coefficient	Post Development Runoff Coefficient
1.32	0.75	10	1	0.80	0.81

Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.80	0.80	0.80	0.88	0.96	1.00
I	76.81	104.19	122.14	144.69	161.47	178.56
A	1.32	1.32	1.32	1.32	1.32	1.32
Q	225.8	306.4	359.2	468.0	569.8	656.3

Note: Q = 0.00278CIA

Rainfall Station	City of Ottawa

Surface Ponding Design Inputs

Storm Event (yrs)	Rational Method Coefficient A	Rational Method Coefficient B	Rational Method Coefficient C	Controlled Peak Flows (L/s)	Post Development Runoff Coefficient
2	732.95	6.20	0.81	104.6	0.81
5	998.07	6.05	0.81	141.5	0.81
10	1174.18	6.01	0.82	150.9	0.81
25	1402.88	6.02	0.82	155.5	0.89
50	1569.58	6.01	0.82	157.8	0.97
100	1735.69	6.01	0.82	159.0	1

Storm Event (yrs)	Storage (m^3)	Time (min)
2	17	13
5	23	13
10	37	14
25	79	17
50	124	21
100	160	23

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time (min)	2 Year					5 Year					10 Year					25 Year					50 Year					100 Year				
	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference	Intensity mm/hr	Inflow L/s	Outflow L/s	Storage m^3	Difference
1	148.14	252.4	104.6	-19	9	203.51	346.5	141.5	-26	12	239.57	407.8	150.9	-25	15	284.43	532.6	155.5	-19	21	317.75	649.1	157.8	-13	26	351.38	736.5	159.0	-8	30
2	133.33	227.2	104.6	-10	7	182.69	311.0	141.5	-14	9	214.88	365.8	150.9	-10	11	255.03	477.6	155.5	1	16	284.86	581.9	157.8	13	21	315.00	660.2	159.0	22	24
3	121.46	206.9	104.6	-4	5	166.09	282.8	141.5	-4	7	195.22	332.3	150.9	1	9	231.63	433.8	155.5	17	13	258.67	528.5	157.8	34	16	286.05	599.5	159.0	46	19
4	111.72	190.4	104.6	2	4	152.51	259.6	141.5	3	6	179.16	305.0	150.9	10	7	212.51	398.0	155.5	30	10	237.29	484.8	157.8	50	13	262.41	550.0	159.0	65	16
5	103.57	176.5	104.6	6	3	141.18	240.3	141.5	8	4	165.77	282.2	150.9	17	5	196.58	368.1	155.5	40	8	219.48	448.4	157.8	64	11	242.70	508.7	159.0	81	13
6	96.64	164.7	104.6	9	2	131.57	224.0	141.5	13	3	154.42	262.9	150.9	22	4	183.08	342.8	155.5	49	7	204.38	417.5	157.8	75	9	226.01	473.7	159.0	94	11
7	90.66	154.5	104.6	12	2	123.30	209.9	141.5	16	2	144.67	246.3	150.9	26	3	171.48	321.1	155.5	56	6	191.41	391.0	157.8	84	8	211.67	443.6	159.0	105	9
8	85.46	145.6	104.6	13	1	116.11	197.7	141.5	18	2	136.19	231.9	150.9	30	3	161.39	302.2	155.5	61	5	180.14	368.0	157.8	91	6	199.20	417.5	159.0	115	8
9	80.87	137.8	104.6	15	1	109.79	186.9	141.5	20	1	128.74	219.2	150.9	32	2	152.54	285.7	155.5	66	4	170.24	347.8	157.8	98	5	188.25	394.6	159.0	122	7
10	76.81	130.9	104.6	16	1	104.19	177.4	141.5	22	1	122.14	207.9	150.9	34	1	144.69	271.0	155.5	69	3	161.47	329.9	157.8	103	5	178.56	374.2	159.0	129	6
11	73.17	124.7	104.6	16	0	99.19	168.9	141.5	22	0	116.25	197.9	150.9	36	1	137.69	257.9	155.5	72	2	153.65	313.9	157.8	108	4	169.91	356.1	159.0	135	5
12	69.89	119.1	104.6	17	0	94.70	161.2	141.5	23	0	110.96	188.9	150.9	36	0	131.40	246.1	155.5	75	2	146.62	299.5	157.8	112	3	162.13	339.8	159.0	140	4
13	66.93	114.0	104.6	17	0	90.63	154.3	141.5	23	0	106.17	180.8	150.9	37	0	125.71	235.4	155.5	76	1	140.26	286.5	157.8	115	3	155.11	325.1	159.0	144	3
14	64.23	109.4	104.6	17	0	86.93	148.0	141.5	22	-1	101.82	173.3	150.9	37	0	120.55	225.7	155.5	78	1	134.49	274.8	157.8	117	2	148.72	311.7	159.0	147	3
15	61.77	105.2	104.6	16	-16	83.56	142.3	141.5	22	-22	97.85	166.6	150.9	37	0	115.83	216.9	155.5	79	1	129.22	264.0	157.8	119	2	142.89	299.5	159.0	150	2
16	59.50	101.4	0.0	0	0	80.46	137.0	0.0	0	0	94.21	160.4	150.9	36	-1	111.50	208.8	155.5	79	0	124.39	254.1	157.8	121	1	137.55	288.3	159.0	153	2
17	57.42	97.8	0.0	0	0	77.61	132.1	0.0	0	0	90.86	154.7	150.9	36	-36	107.52	201.4	155.5	79	0	119.94	245.0	157.8	122	1	132.63	278.0	159.0	155	2
18	55.49	94.5	0.0	0	0	74.97	127.6	0.0	0	0	87.76	149.4	0.0	0	0	103.84	194.5	155.5	79	0	115.83	236.6	157.8	123	1	128.08	268.4	159.0	156	1
19	53.70	91.5	0.0	0	0	72.53	123.5	0.0	0	0	84.88	144.5	0.0	0	0	100.43	188.1	155.5	79	-1	112.01	228.8	157.8	124	0	123.87	259.6	159.0	158	1
20	52.03	88.7	0.0	0	0	70.25	119.6	0.0	0	0	82.21	140.0	0.0	0	0	97.26	182.1	155.5	79	-1	108.47	221.6	157.8	124	0	119.95	251.4	159.0	159	1
21	50.48	86.0	0.0	0	0	68.13	116.0	0.0	0	0	79.72	135.7	0.0	0	0	94.30	176.6	155.5	78	-1	105.17	214.8	157.8	124	0	116.30	243.7	159.0	159	0
22	49.02	83.5	0.0	0	0	66.15	112.6	0.0	0	0	77.39	131.7	0.0	0	0	91.53	171.4	155.5	77	-1	102.08	208.5	157.8	124	0	112.88	236.6	159.0	160	0
23	47.66	81.2	0.0	0	0	64.29	109.4	0.0	0	0	75.21	128.0	0.0	0	0	88.94	166.6	155.5	76	-1	99.18	202.6	157.8	123	-1	109.68	229.9	159.0	160	0
24	46.37	79.0	0.0	0	0	62.54	106.5	0.0	0	0	73.15	124.5	0.0	0	0	86.51	162.0	155.5	75	-1	96.47	197.1	157.8	123	-1	106.68	223.6	159.0	160	0
25	45.17	77.0	0.0	0	0	60.90	103.7	0.0	0	0	71.22	121.3	0.0	0	0	84.22	157.7	155.5	73	-73	93.91	191.8	157.8	122	-1	103.85	217.7	159.0	160	0
26	44.03	75.0	0.0	0	0	59.35	101.0	0.0	0	0	69.40	118.2	0.0	0	0	82.05	153.7	0.0	0	0	91.50	186.9	157.8	121	-1	101.18	212.1	159.0	159	-1
27	42.95	73.2	0.0	0	0	57.88	98.5	0.0	0	0	67.68	115.2	0.0	0	0	80.01	149.8	0.0	0	0	89.22	182.3	157.8	120	-1	98.66	206.8	159.0	158	-1
28	41.93	71.4	0.0	0	0	56.49	96.2	0.0	0	0	66.05	112.5	0.0	0	0	78.08	146.2	0.0	0	0	87.06	177.9	157.8	119	-1	96.27	201.8	159.0	158	-1
29	40.96	69.8	0.0	0	0	55.18	93.9	0.0	0	0	64.51	109.8	0.0	0	0	76.25	142.8	0.0	0	0	85.02	173.7	157.8	118	-1	94.01	197.0	159.0	157	-1
30	40.04	68.2	0.0	0	0	53.93	91.8	0.0	0	0	63.05	107.3	0.0	0	0	74.51	139.5	0.0	0	0	83.08	169.7	157.8	116	-2	91.87	192.5	159.0	156	-1
31	39.17	66.7	0.0	0	0	52.74	89.8	0.0	0	0	61.65	105.0	0.0	0	0	72.86	136.4	0.0	0	0	81.23	165.9	157.8	115	-2	89.83	188.3	159.0	155	-1

🟨 : Maximum Storage Volume

$Q = 0.0028*C*I*A$ (m^3/s)
C = Runoff Coefficient
I = Rainfall Intensity = $A/(Time+B)^C$
A = Area (ha)

3555 Borrisokane Rd, Barrhaven
Storm Sewer Design Sheet
5-Year Storm Event

DATE: 03-Oct-24
FILE: 22099
CONTRACT/PROJECT 3555 Borrisokane Road

Areas	Manhole		Length (m)	Increment			Total CA	Flow Time (min)		I (mm/h)	Total Q (L/s)	S (%)	D (mm)	Q Full (L/s)	V Full (m/s)	% Full
	From	To		C	A	CA		TO	IN							
2	CB1	CBMH1	24.0	0.83	0.19	0.16	0.16	10.00	0.27	104.19	46.0	1.50	250	72.8	1.48	63.1%
2	CBMH1	CBMH2	25.3	0.84	0.13	0.11	0.27	10.27	0.38	102.79	77.7	0.50	375	124.0	1.12	62.7%
2	CBMH2	CBMH5	43.5	0.72	0.08	0.06	0.33	10.64	0.65	100.91	92.5	0.50	375	124.0	1.12	74.6%
1	BLD	CBMH3	15.7	0.90	0.07	0.06	0.06	10.00	0.21	104.19	17.4	2.00	150	21.5	1.22	80.7%
1	BLD	TEE	13.7	0.90	0.06	0.05	0.05	10.00	0.14	104.19	15.7	3.50	150	28.5	1.61	54.9%
2	CBMH3	CBMH4	27.3	0.78	0.06	0.05	0.16	10.21	0.47	103.07	46.3	0.50	300	68.4	0.97	67.8%
2	CBMH4	MH1	16.2	0.82	0.08	0.06	0.22	10.68	0.24	100.71	62.5	0.50	375	124.0	1.12	50.4%
2	MH1	CBMH5	21.4	0.00	0.00	0.00	0.22	10.93	0.32	99.54	61.8	0.50	375	124.0	1.12	49.9%
-	CBMH5	OGS	5.8	0.72	0.08	0.06	0.61	11.29	0.07	97.84	141.5 *	0.50	525	304.1	1.40	46.5%
-	OGS	OUTLET	18.4	0.00	0.00	0.00	0.61	11.36	0.22	97.52	141.5 *	0.50	525	304.1	1.40	46.5%

Note: * indicates orifice plate flow

3555 Borrisokane Rd, Barrhaven
Bioretention Filter Calculations

Use Infiltration volumes from Table 3.2 to size Bioretention Filter
From Table 3.2 Water Quality Storage Requirements are as follows:

Design Area = 0.11 ha
Imperviousness = 4 %
Storage Volume = 15.0 m^3/ha (Enhanced 80% long-term S.S. removal)

Storage Volume Required = 0.11 x 15.0
= 1.7 m^3

Use Equation 4.12 to find Area of Bioretention Filter

Design Volume (V) = 1.7 m^3
Depth of Controlling Filter Medium (d) = 0.5 m
Coefficient of Permeability of the Controlling Filter Media (k) = 45.0 mm/hr

Operating Head of Water On the Filter (h) = 0.15 m
Design Drawdown Time (t) = 36 hr

$$\text{Surface Area Of Filter (A)} = \frac{1000Vd}{k(h+d)t}$$

= 0.8 m^2

		Required		**Provided**		**Proposed Dimensions**		
Surface Area	=	0.8	m^2	10.0	m^2	10	x	1

Culvert Report

Prop. 800mm diameter driveway culvert @ 0.20% (50year Storm event)

Invert Elev Dn (m) = 90.9000
Pipe Length (m) = 22.8000
Slope (%) = 0.2000
Invert Elev Up (m) = 90.9456
Rise (mm) = 900.0
Shape = Circular
Span (mm) = 900.0
No. Barrels = 1
n-Value = 0.024
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Projecting
Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

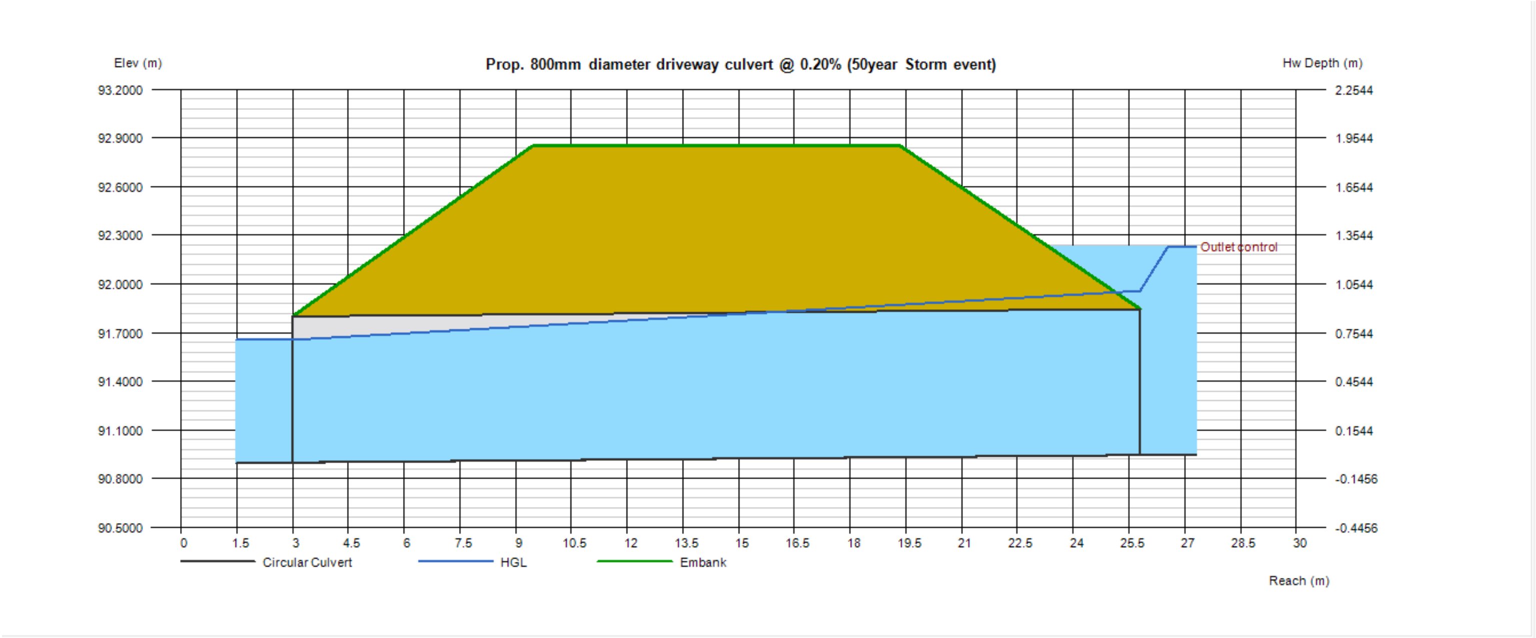
Top Elevation (m) = 92.8500
Top Width (m) = 9.9000
Crest Width (m) = 9.9000

Calculations

Qmin (cms) = 1.0700
Qmax (cms) = 1.0700
Tailwater Elev (m) = (dc+D)/2

Highlighted

Qtotal (cms) = 1.0700
Qpipe (cms) = 1.0700
Qovertop (cms) = 0.0000
Veloc Dn (m/s) = 1.8759
Veloc Up (m/s) = 1.6819
HGL Dn (m) = 91.6559
HGL Up (m) = 91.9570
Hw Elev (m) = 92.2312
Hw/D (m) = 1.4284
Flow Regime = Outlet Control



APPENDIX D

OGS UNIT MANUFACTURER SPECIFICATIONS AND TSS REMOVAL TABLE

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD
BASED ON A FINE PARTICLE SIZE DISTRIBUTION

Project Name:	3555 Borrisokane Rd	**Engineer:**	**Pearson Engineering**
Location:	Ottawa, ON	**Contact:**	Nikhil Parmar E.I.T.
OGS #:	OGS	**Report Date:**	26-Jun-23

Area	0.97	ha	**Rainfall Station #**	215	
Weighted C	0.76		**Particle Size Distribution**	FINE	
CDS Model	2020		**CDS Treatment Capacity**	31	l/s

Rainfall Intensity[1] (mm/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (l/s)	Treated Flowrate (l/s)	Operating Rate (%)	Removal Efficiency (%)	Incremental Removal (%)
0.5	9.2%	9.2%	1.0	1.0	3.3	97.9	9.0
1.0	10.6%	19.8%	2.0	2.0	6.6	97.0	10.3
1.5	9.9%	29.7%	3.1	3.1	9.9	96.0	9.5
2.0	8.4%	38.1%	4.1	4.1	13.2	95.1	8.0
2.5	7.7%	45.8%	5.1	5.1	16.4	94.1	7.2
3.0	5.9%	51.7%	6.1	6.1	19.7	93.2	5.5
3.5	4.4%	56.1%	7.2	7.2	23.0	92.3	4.0
4.0	4.7%	60.7%	8.2	8.2	26.3	91.3	4.3
4.5	3.3%	64.0%	9.2	9.2	29.6	90.4	3.0
5.0	3.0%	67.1%	10.2	10.2	32.9	89.4	2.7
6.0	5.4%	72.4%	12.3	12.3	39.5	87.5	4.7
7.0	4.4%	76.8%	14.3	14.3	46.1	85.7	3.7
8.0	3.5%	80.3%	16.4	16.4	52.6	83.8	3.0
9.0	2.8%	83.2%	18.4	18.4	59.2	81.9	2.3
10.0	2.2%	85.3%	20.5	20.5	65.8	80.0	1.7
15.0	7.0%	92.3%	30.7	30.7	98.7	70.6	4.9
20.0	4.5%	96.9%	41.0	31.2	100.0	53.3	2.4
25.0	1.4%	98.3%	51.2	31.2	100.0	42.7	0.6
30.0	0.7%	99.0%	61.5	31.2	100.0	35.6	0.2
35.0	0.5%	99.5%	71.7	31.2	100.0	30.5	0.1
40.0	0.5%	100.0%	82.0	31.2	100.0	26.7	0.1
45.0	0.0%	100.0%	92.2	31.2	100.0	23.7	0.0
50.0	0.0%	100.0%	102.5	31.2	100.0	21.3	0.0
							87.5

Removal Efficiency Adjustment[2] = 6.5%

Predicted Net Annual Load Removal Efficiency = 81.0%

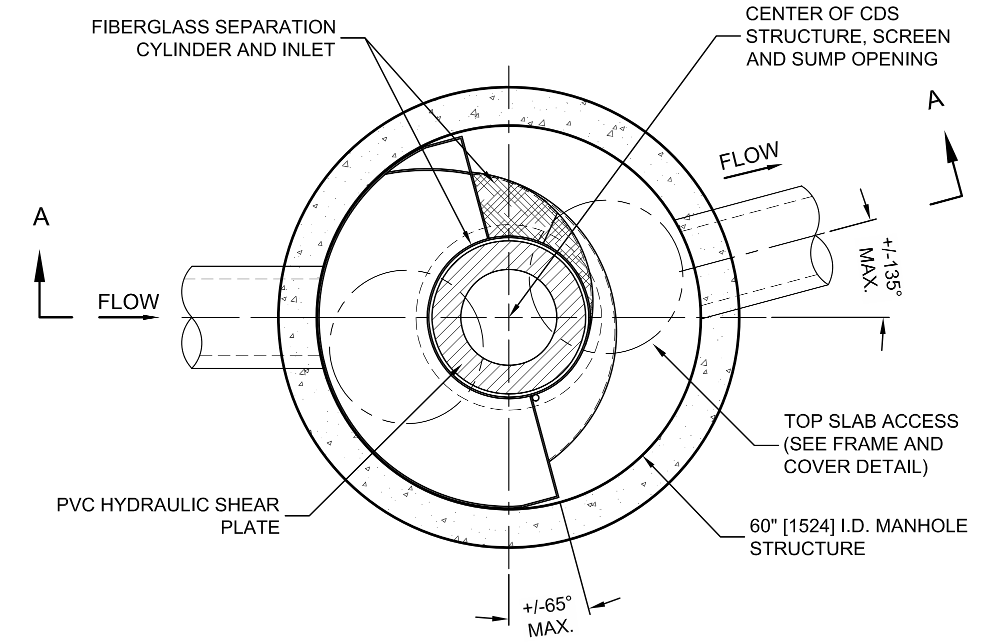
Predicted % Annual Rainfall Treated = 97.4%

1 - Based on 42 years of hourly rainfall data from Canadian Station 6105976, Ottawa ON

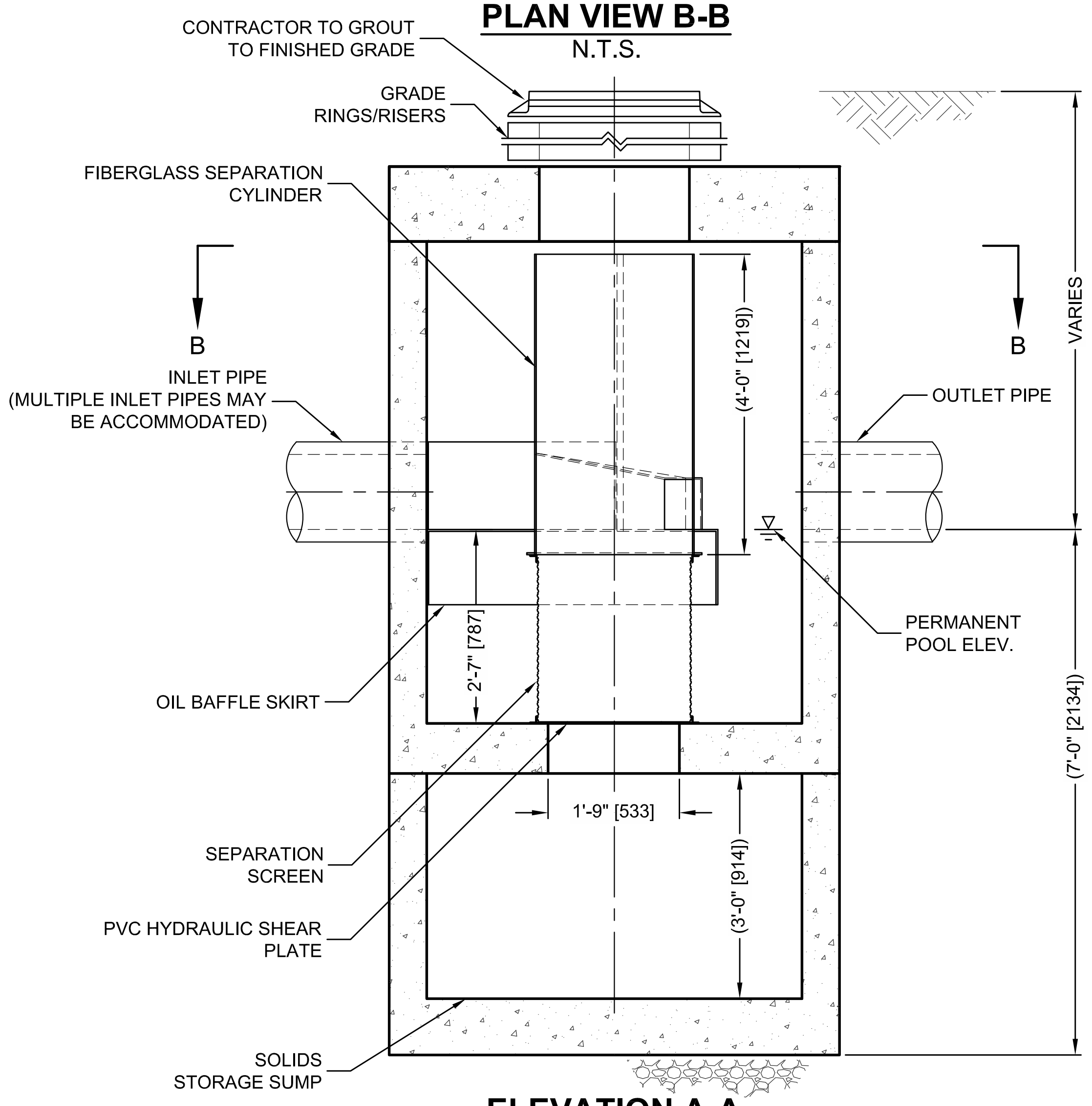
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

* CDS Efficiency based on testing conducted at the University of Central Florida

** CDS design flowrate and scaling based on standard manufacturer model & product specifications



PLAN VIEW B-B
N.T.S.



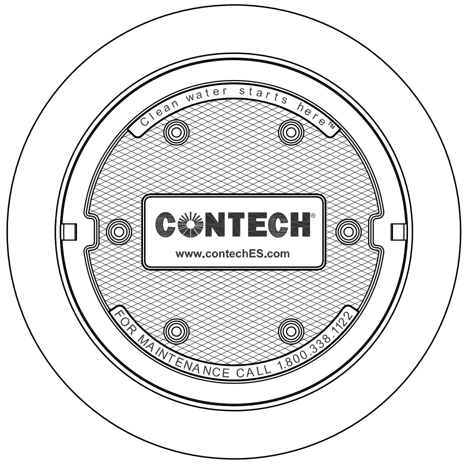
ELEVATION A-A
N.T.S.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CDS PMSU2020-5-C DESIGN NOTES

THE STANDARD CDS PMSU2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES
CUSTOMIZABLE SUMP DEPTH AVAILABLE
ANTI-FLOTATION DESIGN AVAILABLE UPON REQUEST



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE SHALL MEET AASHTO HS20 AND CASTINGS SHALL MEET HS20 (AASHTO M 306) LOAD RATING, ASSUMING GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES
- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
- C. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
- D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
- E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

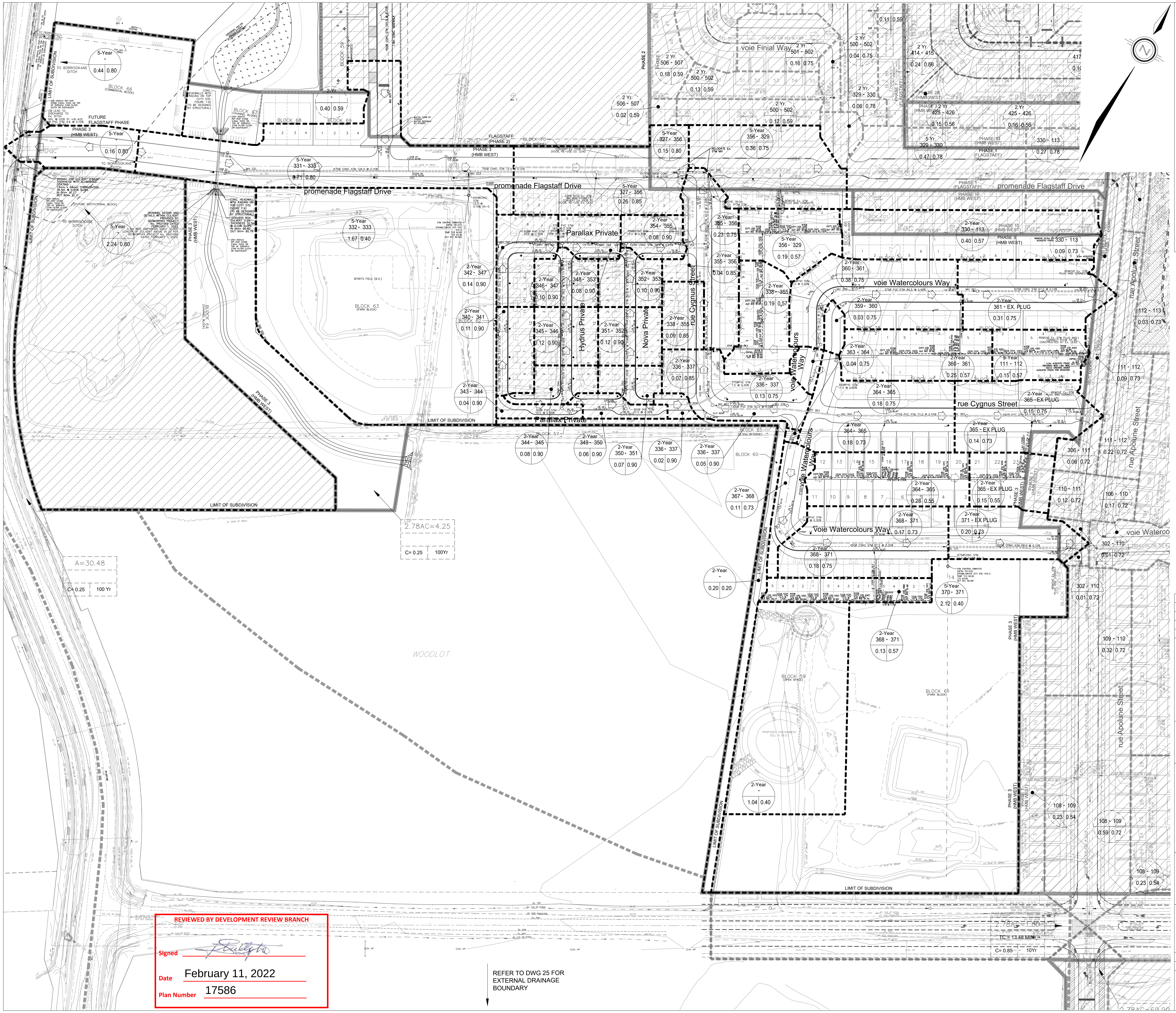
CONTECH®
ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS PMSU2020-5-C
INLINE CDS
STANDARD DETAIL

C:\USERS\HUDA.ECHELONENV\DOCUMENTS\START ITEMS\PMSU SAMPLE DRAWINGS\5\CDS2020-5-C-DTL.DWG 5/29/2022 11:50 PM

APPENDIX E

DSEL STORM DRAINAGE PLAN



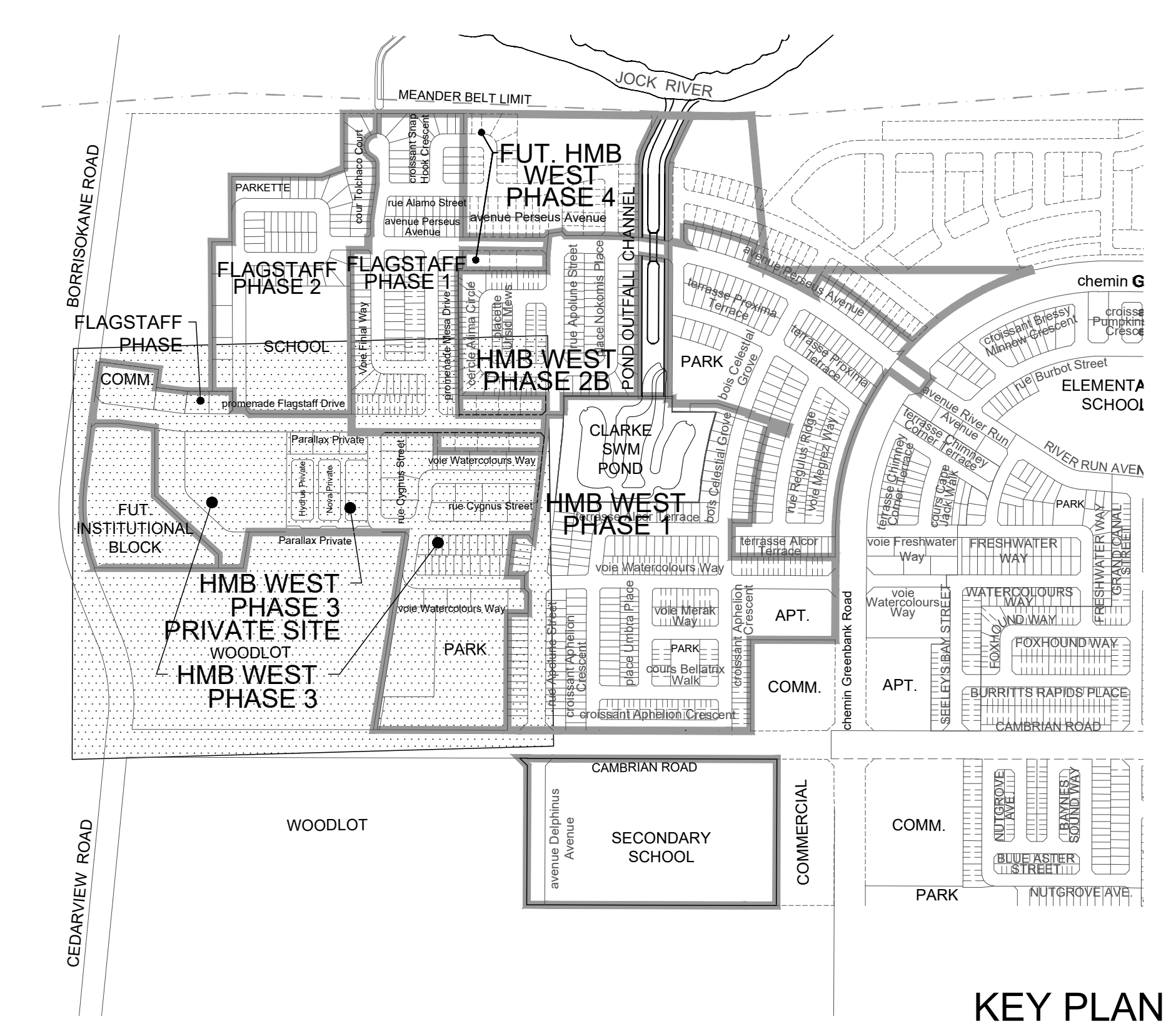
REVIEWED BY DEVELOPMENT REVIEW BRANCH

Signed

Date February 11, 2022

Plan Number 17586

REFER TO DWG 25 FOR
EXTERNAL DRAINAGE
BOUNDARY



KEY PLAN
SCALE 1:10000

LEGEND

STORM DRAINAGE BOUNDARY	▬ ▬ ▬
STORM DRAINAGE BOUNDARY (OTHER PHASES)	▬ ▬ ▬
STORM FREQUENCY	2Yr
UPSTREAM MH TO DOWNSTREAM MH	43 - 44
AREA IN HECTARES	0.37
RUNOFF COEFFICIENT	0.51
UPSTREAM MH TO DOWNSTREAM MH	21–23
AREA IN OTHER PHASES IN HECTARES	0.28
RUNOFF COEFFICIENT	0.78
STREET CATCHBASIN & LEAD	375mmø ST
STREET CATCHBASIN WITH CLOSED LID & LEAD	
MAINTENANCE HOLE	MH202
CURB INLET CATCHBASIN & LEAD	
CATCHBASIN/ MAINTENANCE HOLE	CBMH201
INTERCONNECTED CATCH BASIN & LEADS	
CAP	
OVERLAND FLOW DIRECTION	⇨
EXTERNAL OVERLAND FLOW DIRECTION	⇨
EMERGENCY OVERLAND FLOW DIRECTION	E
EXTERNAL 2.78AC =	2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION	TC=14.5 MIN
EXTERNAL BLENDED RUNOFF COEFFICIENT	C= 0.70
EXTERNAL STORM FREQUENCY	2YR

No.	BY	DATE	DESCRIPTION
5	S.L.M.	22.02.08	5th SUBMISSION
4	S.L.M.	22.01.19	4th SUBMISSION
3	S.L.M.	21.11.18	3rd SUBMISSION
2	S.L.M.	21.08.31	2nd SUBMISSION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED FEBRUARY 22, 2017

TOPOGRAPHIC INFORMATION FOR BORRISOKANE ROAD PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 18-10-145-00, RECEIVED ON JULY 10, 2019

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED NOVEMBER 10, 2021

BENCH MARK

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE PUBLISHED BENCHMARK NUMBER 0011964U3710 HAVING AN ELEVATION OF 71.724 M.

MATTAMY (HALF
MOON BAY) LTD.

HALF MOON BAY WEST
PHASE 3

DSEL
120 Iber Road Unit 103
Stittsville, Ontario, K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

S. L. MERRICK
100186523
2022-02-08

JOB# 19-1140

Ottawa CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY:	G.G.G.	CHECKED BY:	S.L.M.	PROJECT No. 19–1140
DESIGNED BY:	G.G.G.	CHECKED BY:	S.L.M.	
SCALE: 1:1000				SHEET No. 24

CITY PLAN No. 17586

CITY FILE No. D07-16-26-0023 P3

APPENDIX F

DESIGN BRIEF FOR THE HALF MOON BAY WEST SUBDIVISION PHASE 3, PREPARED BY DSEL, DATED NOVEMBER 18, 2021

David Schaeffer Engineering Ltd.
120 Iber Road, Suite 103
Stittsville, ON K2S 1E9
613-836-0856
dsel.ca

DESIGN BRIEF

FOR THE

HALF MOON BAY WEST SUBDIVISION PHASE 3

MATTAMY (HALF MOON BAY) LIMITED

CITY OF OTTAWA

PROJECT NO.: 19-1140

NOVEMBER 18, 2021
3RD SUBMISSION

DESIGN BRIEF
FOR THE
HALF MOON BAY WEST SUBDIVISION
PHASE 3

MATTAMY (HALF MOON BAY) LIMITED

PROJECT NO: 19-1140

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Appendix C	HMB West Phase 3 Sanitary Drainage Area Plans (DSEL, November 18, 2021) HMB West Phase 3 Sanitary Design Sheets (DSEL, November 18, 2021) Glenview Flagstaff Phase 1 Sanitary Drainage Area Plan (DSEL, March 27, 2020) Glenview Flagstaff Phase 1 Sanitary Design Sheets (DSEL, March 27, 2020) HMB West Phase 1 Sanitary Drainage Area Plan (DSEL, October 29, 2018) HMB West Phase 1 Sanitary Design Sheets (DSEL, October 29, 2018)
Appendix D	HMB West Phase 3 Storm Drainage Area Plans (DSEL, November 18, 2021) HMB West Phase 3 Storm Design Sheets (DSEL, November 18, 2021) Phase 3 of the Half Moon Bay West Subdivision / Proposed Culvert under Flagstaff Drive (JFSA, June 3, 2021) Runoff Coefficient Calculations (DSEL, May 2021)
Appendix E	Phase 2 of the Flagstaff Subdivision / Cambrian Woods Natural Channel Design (JFSA, September 28, 2021) Geotechnical recommendations – Frost Protection and for Natural Channel Crossings, PG2246-MEMO.71 Revision 1 (Paterson Group, November 8, 2021)
Appendix F	Sump Pump Feasibility Report, PG4073-LET.02 Revision 6 (Paterson Group, August 25, 2021)

DESIGN BRIEF
FOR THE
HALF MOON BAY WEST SUBDIVISION
PHASE 3

MATTAMY (HALF MOON BAY) LIMITED

PROJECT NO: 19-1140

1.0 INTRODUCTION

This design brief is submitted in support of Half Moon Bay West Phase 3 on behalf of Mattamy (Half Moon Bay) Limited.

The Mattamy Half Moon Bay Lands are located in the Barrhaven South Community in the City of Ottawa. The Half Moon Bay (HMB) West Subdivision is more specifically located west of the Future Greenbank Road, east of Borrisokane Road, south of the Jock River and north of Cambrian Road, as shown on ***Figure 1***. The Clarke SWM Pond and Outlet Channel, HMB West Phase 1, and HMB West Phase 2 are currently constructed and this report describes the servicing of the HMB West Phase 3 development. North of the site is the Flagstaff Subdivision, currently under development by Glenview Homes (Cedarview) Limited.

In addition to HMB West Phase 3, the M-Plan (JD Barnes, November 10, 2021) includes the extension of Flagstaff Drive to Borrisokane Road, Commercial Block 66, and Glenview Homes (Cedarview) Limited townhouse Blocks 68 and 69, on the north side of Flagstaff Drive. The design also provides servicing for the future institutional block on the south side of Flagstaff Drive, adjacent to Borrisokane Road.

HMB West Phase 3 is comprised of the following, as presented on ***Figure 2*** and presented in ***Table 1.1***.

Table 1.1: Development Statistics for HMB West Phase 3

Land Use	Total Area (ha)	Projected Residential Units		Residential Population per Unit*	Projected Population*
Residential & Roads	4.84	Singles	23	3.4	79
		Towns	103	2.7	279
Private Site Block	1.46	Back-to-back Towns	94	2.7	254
Walkway/Servicing Block 58 & 62	0.05				
Artesian Block 59	0.73				
5 m Woodlot Buffer Block 60	0.13				
Park Block 61	2.12				
Park Block 63	1.65				
Natural Corridor Block 64	0.80				
Residential (Glenview)	0.18	Towns	8	2.7	22
Natural Corridor Block 67 (Flagstaff – North)	0.13				
Commercial Block 66 (Flagstaff – North)	0.44				
TOTAL – M-Plan M-Plan (JD Barnes, 2021-11-10)	**12.53**	**228**			**634**
Future Institutional Block (Flagstaff – South)	2.24				
TOTAL – M-Plan + Others	**14.77**	**228**			**634**

**Note: Population projections may differ from population estimates used in other studies. Population projection and residential population per unit values are based on City of Ottawa and MECP design criteria for servicing demand calculations.*

The subject property is within the study area of the ***Barrhaven South Master Servicing Study*** (Stantec, June 2007) and the ***Barrhaven South Master Servicing Study Addendum*** (Stantec, October 12, 2017), which is considered to best represent current servicing for the subject property and adjacent developments.

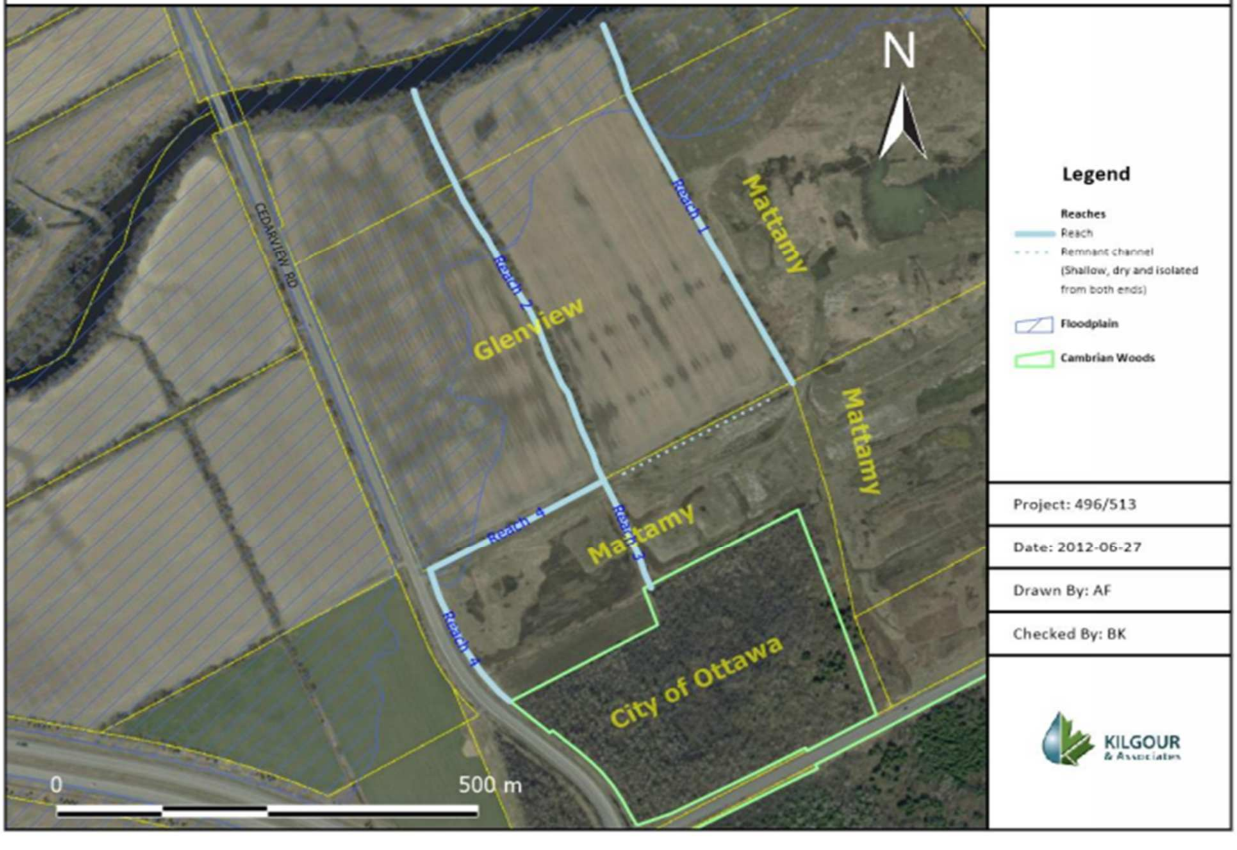
The Private Site Block is included as part of the engineering design for Half Moon Bay West Phase 3; however, it has been presented as a separate drawing set for presentation purposes. This report should be read in conjunction with the ***Engineering Drawings*** for Half Moon Bay West Phase 3 (DSEL, November 18, 2021) and the ***Engineering Drawings*** for Half Moon Bay West Phase 3 – Private Site (DSEL, November 18, 2021).

This design brief is provided to demonstrate conformance with the design criteria of the City of Ottawa, background studies, including the Master Servicing Study, Master Servicing Study Addendum, and general industry practice.

1.1 Existing Conditions

The majority of the overall HMB West site has been stripped of topsoil and earth has been moved over the past 10 years. The overall site previously consisted of agricultural fields, with the exception of the southern portion of the site where a treed area formerly existed. The existing elevations within the proposed overall development area generally range between 91.5 m to 94.0 m. Existing ditches crossed HMB West Phase 3 along with the adjacent Glenview Flagstaff development and are detailed in the ***Headwater Drainage Feature Assessment*** (Kilgour & Associates Ltd., July 2016). Mitigation requirements were reported for Reach 2 and 3, which are on Mattamy and Glenview property, respectively, as shown on the excerpt below from the ***HDFA.***

Figure1 . Studies reaches on site.



Glenview Homes and Mattamy Homes have received permission from the Rideau Valley Conservation Authority (RVCA) for the relocation of these existing features to a new natural corridor west of Glenview's Flagstaff Phase 2. The new natural corridor will allow for development of Flagstaff Phase 2 and HMBW Phase 3 per the Draft Plan of Subdivisions for the two developments. The natural corridor has been designed by others.

HMB West Phase 3 is within the Jock River watershed and is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

Throughout the site, the soil consists of silty sand to silty clay fill or topsoil at ground surface underlain by a relatively deep deposit of silty clay overlying glacial till.
The Clarke SWM Pond, Outlet Channel and HMB West Phase 1 and 2 are approved and have been constructed.

HMB West Phase 3 is subject to grade raise restrictions with permissible being between 93.6 m and 93.9 m for the road and between 93.3 m and 93.6 m for the housing, based on the ***Geotechnical Investigation*** by Paterson Group (PG2246-1, Revision 7, April 19, 2021). The grading and servicing have been designed to keep grades as low as possible due to the grade raise restrictions in the area.

1.2 Existing Permits / Approvals

The existing approvals related to the HMB West Phase 3 development are presented in ***Table 1.2*** and the approvals are enclosed in ***Appendix A***.

Table 1.2 – Existing Approvals

Agency	Approval Type	Approval Number	Remarks
Ministry of the Environment, Conservation and Parks (MECP)	Permit To Take Water	3205-A4ZLZ6 January 27, 2016	Permit to take water for overall Half Moon Bay Subdivision
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	3029-ACNJPT August 12, 2016	Construction of sanitary and storm sewers in Half Moon Bay North Phase 7 Subdivision
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	6068-AWUPL5 April 11, 2018	Construction of Clarke stormwater management pond (SWM Pond) and outlet channel
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	2725-B5VKYF October 30, 2018	Construction of sanitary and storm sewers, temporary diversion ditch and temporary culvert in Half Moon Bay West Phase 1 Subdivision
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	3997-BF2GWX August 16, 2019	Construction of sanitary and storm sewers, temporary diversion ditch and temporary culvert in Half Moon Bay West Phase 2A Subdivision
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval	3263-BKWJW9 January 28, 2020	Construction of sanitary and storm sewers in Half Moon Bay West Phase 2B Subdivision
Rideau Valley Conservation Authority (RVCA)	Alteration of Waterways Permit	RV5-01/18 March 15, 2018	Permit for Clarke SWM Pond and outlet channel design
Rideau Valley Conservation Authority (RVCA)	Alteration of Waterways Permit	RV5-1421 June 2, 2020	Permit for closure and relocation of an existing headwater drainage feature, with the new design featuring natural channel design principles and habitat features.
Department of Fisheries and Oceans (DFO)	Authorization	PR-05-1840	Authorization was attained to authorize the harmful alteration, disruption or destruction of fish habitat due to infilling of the existing drain channels and realignment of the West Clarke, East Clarke, Todd and Corrigan Drains.

1.3 Required Permits / Approvals

HMB West Phase 3 is subject to the following permits and approvals, presented in ***Table 1.3***:

Table 1.3: Required Permits and Approvals

Agency	Approval Type	Trigger	Remarks
City of Ottawa	Commence Work Notification (CWN)	Construction of new sanitary and storm sewers throughout the subdivision.	The City of Ottawa will issue a commence work notification for construction of the sanitary and storm sewers in Phase 3 once an ECA is issued by the MECP.
City of Ottawa	MECP Form 1 – Record of Watermains Authorized as a Future Alteration	Construction of watermains throughout the subdivision.	The City of Ottawa will review the watermains on behalf of the MECP through the Form 1 - Record of Watermains Authorized as a Future Alteration.
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval (ECA) for sanitary and storm sewers in Phase 3 – Subdivision, artesian containment cells, and outlet ditch	Construction of new sanitary and storm sewers throughout the subdivision. Construction of artesian containment cells and associated outlet ditch.	The MECP will review and approve the sanitary sewer, storm sewer, artesian containment cell, and outlet ditch designs through the Transfer of Review Program.
Ministry of the Environment, Conservation and Parks (MECP)	Environmental Compliance Approval (ECA) for sanitary and storm sewers in Phase 3 – Private Site	Construction of new sanitary and storm sewers throughout the private site.	Submitted separate application for Private site. The MECP will review and approve the sanitary and storm sewer design for through the Transfer of Review Program.

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following studies were utilized in the preparation of this report.

- **Ottawa Sewer Design Guidelines**
  City of Ottawa, October 2012
  (Sewer Design Guidelines)
  - **Technical Bulletin ISDTB-2014-01**
    City of Ottawa, February 5, 2014
    (ITSB-2014-01)
  - **Technical Bulletin PIEDTB-2016-01**
    City of Ottawa, September 6, 2016
    (PIEDTB-2016-01)
  - **Technical Bulletin ISTB-2018-01**
    City of Ottawa, March 21, 2018
    (ISTB-2018-01)
  - **Technical Bulletin ISTB-2018-04**
    City of Ottawa, June 27, 2018
    (ISTB-2018-04)
  - **Technical Bulletin ISTB-2019-02**
    City of Ottawa, July 8, 2019
    (ISTB-2019-02)
- **Ottawa Design Guidelines – Water Distribution**
  City of Ottawa, July 2010
  (*Water Supply Guidelines*)
  - **Technical Bulletin ISD-2010-2**
    City of Ottawa, December 15, 2010
    (ISDTB-2010-2)
  - **Technical Bulletin ISDTB-2014-02**
    City of Ottawa, May 27, 2014
    (ISDTB-2014-02)
  - **Technical Bulletin ISTB-2018-02**
    City of Ottawa, March 21, 2018
    (ISTB-2018-02)
  - **Technical Bulletin ISTB-2021-03**
    City of Ottawa, August 18, 2021
    (ISTB-2021-03)

- **City of Ottawa Official Plan**
  adopted by Council 2003.
  (*Official Plan*)

- **Stormwater Management Planning and Design Manual**
  Ministry of Environment, March 2003
  (*SWMP Design Manual*)

- **Erosion & Sediment Control Guidelines for Urban Construction**
  TRCA, 2019
  (*E&S Guidelines*)

- **Barrhaven South Master Servicing Study**
  Stantec, June 2007
  (*MSS*)

- **Barrhaven South Master Servicing Study Addendum**
  Stantec, October 12, 2017
  (*Stantec MSS Addendum*)

- **Design Brief for the Clarke Stormwater Management Pond**
  JFSA and DSEL, October 19, 2017
  (*Clarke PDB*)

- **Half Moon Bay West Subdivision / Hydraulic Analysis of the Proposed Outlet Channel for the Clarke Pond**
  JFSA, September 23, 2019
  (Outlet Channel Memo)

- **Headwater Drainage Feature Assessment**
  Kilgour Associates Ltd., July 22, 2016
  (HDFA)

- **Functional Servicing and Stormwater Management Report for the Half Moon Bay West Subdivision**
  DSEL, March 8, 2019
  (*FSR*)

- **Changes from Approved Draft Plan - Half Moon Bay West Subdivision Phase 3**
  DSEL, May 17, 2021
  (*Draft Plan Changes Letter*)

- **Design Brief for the Half Moon Bay West Subdivision Phase 1**
  DSEL, October 29, 2018
  (*Phase 1 Design Brief*)

- **Design Brief for the Half Moon Bay West Subdivision Phase 2A/2B**
  DSEL, November 6, 2019
  (Phase 2A/2B Design Brief)

- **Barrhaven South Master Servicing Study Addendum, HMB West – Phase 1**
  DSEL, September 5, 2018
  (*DSEL MSS Addendum*)

- **Hydraulic Capacity and Modeling Analysis Mattamy Half Moon Bay West Phase 3**
  GeoAdvice, May 31, 2021
  (*GeoAdvice Report*)

- **Geotechnical Investigation for Proposed Residential Development – Half Moon Bay West, PG2246-1 Revision 7**
  Paterson Group, April 19, 2021
  (Geotechnical Investigation)

- **Geotechnical Design – Artesian Point Source Drainage System and Containment Cell Construction, PG22560-MEMO52 Revision 11**
  Paterson Group, August 26, 2021
  (Artesian Memo)

- **Geotechnical Recommendations – Artesian Point Source Contingency Plan, PG2246-MEMO.77 Revision 1**
  Paterson Group, November 16, 2021
  (*Artesian Contingency Plan*)

- **Sump Pump Feasibility Report, PG4073-LET.02 Revision 6**
  Paterson Group, August 25, 2021
  (Sump Pump Memo)

- **Stormwater Management Report for Phase 3 the Half Moon Bay West Subdivision**
  JFSA, November 2021
  (*SWM Report*)

- **Phase 3 of the Half Moon Bay West Subdivision / Use of Modified Imperviousness in DDSWMM Models for Rear Yard Drainage**
  JFSA, August 30, 2021
  (Imperviousness Memo)

- **HMB Detailed Design – PCSWMM Width Parameter**
  JFSA, November 4, 2021
  (*Width Parameter Memo*)

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

HMB West Phase 3 is located within Zone 3SW. The development will be connecting to existing watermains at the following locations:

- Existing 300 mm diameter watermain on Apolune Street within HMB West Phase 1 at three locations (Street 1 for two connections and Cygnus Street (former Street A); and
- Existing 300 mm diameter watermain on Flagstaff Drive, which was extended from Apolune Street through the development of Glenview's Flagstaff Phase 1 and Mattamy's HMB West Phase 10.

The existing watermain network is depicted on ***Figure 3***.

The City has plans to change the Barrhaven South area to a different pressure zone, South Urban Community (Zone SUC). The timeline is for the reconfiguration is currently unknown.

3.2 Proposed Water Supply

Potable water will be delivered to the proposed development area through the extension of new watermains from the existing watermains. HMB West Phase 3 will connect to existing infrastructure at the locations identified in ***Section 3.1***.

The existing 300 mm diameter watermain on Flagstaff Drive will be extended westward to Borrisokane Road. An automatic flushing chamber is to be installed near the interim dead-end 300 mm diameter watermain at Borrisokane Road per City Detail W3.2, included on ***Sheet 3 – Details and Table***. The flushing system is intended to keep the water fresh until the looping of the watermain is completed in the future. The location of the flushing system is shown on ***Sheet 14 – Plan and Profile of Flagstaff Drive***.

The remainder of the subdivision will be serviced by a network of new 150 mm, 200 mm and 300 mm diameter watermains designed in accordance with City of Ottawa Guidelines as summarized in ***Table 3.1***.

Table 3.1: Water Supply Design Criteria

Design Parameter	Value
Residential – Single Family	3.4 p/unit
Residential – Townhome	2.7 p/unit
Residential – Average Daily Demand	280 L/p/day
Residential – Maximum Daily Demand	2.5 x Average Daily Demand
Residential – Maximum Hourly Demand	2.2 x Maximum Daily Demand
Residential – Minimum Hourly Demand	0.5 x Average Daily Demand
Commercial / Institutional Average Daily Demand	28,000 L/ha/day
Park Average Daily Demand	28,000 L/ha/day
Commercial / Institutional / Park Maximum Daily Demand	1.5 x Average Daily Demand
Commercial / Institutional / Park Maximum Hour Demand	1.8 x Maximum Daily Demand
Commercial / Institutional / Park Minimum Hour Demand	0.5 x Average Daily Demand
Fire Flow	Calculated as per the Fire Underwriter’s Survey 1999 and as amended by ISTB-2014-02 & ISTB-2018-02)
Minimum Watermain Size	150 mm diameter
Service Lateral Size	19 mm dia. Copper or equivalent
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
Peak hourly demand operating pressure	275 kPa and 552 kPa
Fire flow operating pressure minimum	140 kPa
Extracted from Section 4: Ottawa Design Guidelines, Water Distribution (July 2010) and Technical Bulletins	

The proposed water supply network is depicted on ***Figure 3***. In addition to providing servicing for HMB West Phase 3, the design includes Blocks 61 and 62 (formerly known as Block 68 and 69) by Glenview Homes (Cedarview) Limited, which are fronting Flagstaff Drive.

A complete hydraulic analysis has been prepared for the proposed water distribution network to confirm that water supply is available within the required pressure range under the anticipated demand during average day, peak hour and fire flow conditions. Refer to the ***Hydraulic Capacity and Modeling Analysis, Mattamy Half Moon Bay West Phase 3*** prepared by GeoAdvice Engineering Inc. dated May 31, 2021 (GeoAdvice Report), enclosed in ***Appendix B***.

3.2.1 Fire Flow Demand

Fire flow calculations for single detached dwellings and townhouses are detailed in the ***GeoAdvice Report***, enclosed in ***Appendix B***. Calculations for the single detached dwellings and traditional townhomes reached the City of Ottawa’s cap of 10,000 L/min (167 L/s) as outlined in *ISDTB-2014-02*. For the townhouse units where the 10,000 L/min cap could not be applied, the FUS calculations yielded the following required fire flows:

- Block 40: 11,000 L/min (183 L/s)
- Block 33: 16,000 L/min (267 L/s)

The FUS calculations for the back-to-back townhouse blocks yielded the following required fire flows:

- 12-unit back-to-back townhouse:14,000 L/min (233 L/s), accounts for one firewall
- 10-unit back-to-back townhouse:14,000 L/min (233 L/s), accounts for one firewall
- 8-unit back-to-back townhouse: 16,000 L/min (267 L/s), no firewall accounted for

At this time, there is not enough information available to calculate the required fire flows of the park. It is assumed that a fire flow of 167 L/s is required for the parks based on previously completed projects.

The fire flows are calculated in accordance with the Fire Underwriters Survey's Water Supply for Public Fire Protection Guideline (1999) and Technical Bulletins ISDTB-2014-02 and ISTB-2018-02.

3.2.2 Boundary Conditions

Boundary conditions were requested from the City of Ottawa by GeoAdvice Engineering for Peak Hour, Max Day Plus Fire Flow and Maximum HGL (high pressure check) conditions. Please refer to the ***Water Distribution Network Boundary Condition Request – Flagstaff and Half Moon Bay West*** *(GeoAdvice, March 11, 2021),* enclosed in ***Appendix B***.

The City of Ottawa anticipates reconfiguring the pressure zone feeding the development; as such, boundary conditions were provided under two (2) separate pressure zone configurations; existing and post reconfiguration.

The City of Ottawa provided boundary conditions at Cambrian Road and at Perseus Avenue, just west of Future Greenbank Road. Specifically, boundary conditions have been provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- ➢ Connection 1: Perseus Avenue (300 mm diameter)
- ➢ Connection 2: Cambrian Road (400 mm diameter)

The demands from Flagstaff Phase 1 and HMB West Phases 1, 2 and 10 were included in the boundary condition request as they are located downstream of the connection locations under existing conditions. Refer the ***GeoAdvice Report*** in ***Appendix B*** for details.

A hybrid of the existing and future pressure zone configuration results were used in the GeoAdvice Report to ensure that the most conservative results were considered for the Peak Hour, Maximum Day Plus Fire Flow and Maximum HGL conditions. The boundary conditions used in the ***GeoAdvice Report*** are summarized in ***Table 3.2***.

Table 3.2: Boundary Conditions

	Connection 1 Perseus Avenue		**Connection 2 Cambrian Road**	
Condition	**HGL (m)**	**Pressure (psi)**	**HGL (m)**	**Pressure (psi)**
Maximum HGL *	157.0	89.6	157.0	90.3
Peak Hour * (min pressure)	136.9	61.0	136.9	61.8
Max Day + Fire (167 L/s) **	140.7	66.5	140.9	67.6
Max Day + Fire (233 L/s) **	137.3	61.6	137.7	62.9
Max Day + Fire (250 L/s) **	134.3	57.3	134.8	58.9

*Existing pressure zone condition results provided by the City of Ottawa
** Zone reconfiguration condition results provided by the City of Ottawa

3.2.3 Water Demands

A summary of water demands considered for HMB West Phase 3 is in ***Table 3.3***.

Table 3.3 – Summary of Water Demands in HMB West Phase 3

Dwelling Type	Number of Units	**Population**		**Allocated Demand**	**Avg Day** (L/s)	**Max Day** 2.5 x Avg Day (L/s)	**Peak Hour** 2.2 x Max Day (L/s)	**Min Hour** 0.5 x Avg Day (L/s)
		Persons per unit	Population with 10% Contingency*					
Single Detached	23	3.4	87	280 L/c/d	0.28	0.71	1.55	0.15
Townhomes	205	2.7	610	280 L/c/d	1.98	4.94	10.87	0.98
Total	**228**		**697**		**2.26**	**5.65**	**12.42**	**1.13**
Land Use Type	Area			**Allocated Demand**	**Avg Day** (L/s)	**Max Day** 1.5 x Avg Day (L/s)	**Peak Hour** 1.8 x Max Day (L/s)	**Min Hour** 0.5 x Avg Day (L/s)
Park	2.85 ha			28,000 L/ha/d	0.92	1.39	2.49	0.46
Park	1.67 ha			28,000 L/ha/d	0.54	0.27	0.49	0.09
Total	**4.52**				**1.46**	**1.66**	**2.98**	**0.55**

3.2.4 Summary of Hydraulic Modeling Analysis

A complete watermain analysis has been prepared to confirm that the network is sized adequately, which is the greater of maximum day plus fire and maximum hour. Refer to the ***GeoAdvice Report,*** enclosed in ***Appendix B.***

The modeling indicates that the development can be adequately serviced by the proposed watermain network. Modeled service pressures for the development are summarized in ***Table 3.4***. The detailed pipe and junction tables are contained in the ***GeoAdvice Report***, enclosed in ***Appendix B.***

Table 3.4: Summary of Available System Pressures

	Minimum Hour Demand Maximum Pressure		**Peak Hour Demand Minimum Pressure**	
	kPa	psi	kPa	psi
HMB West Phase 3	640	93	418	61

The generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi) as outlined in the City of Ottawa Design Guidelines. Based on the anticipated service pressures, pressure reducing valves may be required in the development where elevations are lower than 102 m until the existing pressure zone reconfiguration but may not be required after the pressure zone reconfiguration.

The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire. A summary of the available fire flows is presented in ***Table 3.5***. The detailed fire flow results are found in the ***GeoAdvice Report*** enclosed in ***Appendix B***.

Table 3.5: Summary of Minimum Available Fire Flows

Required Fire Flow (L/s)	**Minimum Available Flow (L/s)**	**Junction ID**
167	372	J-82
183	510	J-89
233	277	J-99
267	353	J-91

As shown in ***Table 3.5***, the model predicts the network will be able to provide the required fire flows at all junctions within the study area.

3.3 MSS Conformance

The extension of the 300 mm diameter watermain on Flagstaff Drive to Borrisokane Road conforms to the ***Stantec MSS Addendum*** and has not been oversized. The looping for the subdivision will be made via connections to the Glenview development to the north (Flagstaff Subdivision).

3.4 Water Supply Conclusion

The proposed watermain network must meet maximum hour and maximum day plus fire flow demands. Detailed analysis for the network indicates that the 150 mm, 200 mm and 300 mm diameter sizes satisfy these demands, with connections to existing watermains on Apolune Street and Flagstaff Drive.

Water supply will be available within the required pressure range under the anticipated demand during average day and peak hour conditions. Water supply for fire flow conditions will be adequate at all junctions within HMB West Phase 3.

The proposed water supply design conforms to all relevant City guidelines and policies and conforms to current guidelines.

The extension of the 300 mm diameter watermain on Flagstaff Drive to Borrisokane Road conforms to the ***Stantec MSS Addendum***. The extension of the 300 mm diameter watermain Flagstaff Drive will remain as dead end in the interim and a flushing system has been added to keep the water fresh until the watermain is looped in the future.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

The existing South Nepean Collector (SNC) will provide the sanitary outlet for the entire Barrhaven South Community, which includes the HMB West Subdivision. The ***MSS*** determined that the sewer is able to accommodate sanitary flows from approximately 26,000 people in the Barrhaven South Community.

Trunk sanitary sewers exist within the existing HMB North and HMB West developments to the east. The following connections and outlets are available for HMB West Phase 3:

- North Outlet: Existing 300 mm diameter sanitary sewer on Flagstaff Drive, discharging to Perseus Road to the north, the trunk sanitary on Future Greenbank Road through HMB North Phase 7 and, ultimately, the SNC; and

- South Outlet: Existing 250 mm diameter sanitary sewer on Apolune Street, discharging to the trunk sanitary on Cambrian Road to the south and, ultimately, the SNC.

4.2 Wastewater Design

The entire HMB West subdivision, including Phase 3 will be serviced by a network of new gravity sewers designed in accordance with City of Ottawa design criteria and will outlet to the existing sanitary sewers described in ***Section 4.1***. The proposed sanitary sewer layout is depicted on ***Figure 4***. There are two outlets for the sanitary sewer design described below to service HMB West Phase 3.

North Outlet

A proposed sanitary sewer will be extended west along Flagstaff Drive to Borrisokane Drive from its current termination approximately 250 m west of Apolune Drive. The proposed sanitary sewers and sanitary trunk sewer extension are depicted on ***Figure 4.***

South Outlet

There are three proposed connections to the existing sanitary 250 mm diameter on Apolune Drive. The proposed sanitary sewers and connections to existing are depicted on ***Figure 4***.

The proposed sanitary sewer design uses the sanitary design parameters per Technical Bulletin ISTB-2018-01 (March 21, 2018) of the ***Sewer Design Guidelines***, which is updated from the parameters used in the ***FSR***. The peak flows are lower with the updated parameters and should be considered acceptable.

Table 4.1 summarizes the ***Sewer Design Guidelines*** employed in the design of the proposed wastewater sewer system.

Table 4.1: Wastewater Design Criteria

Design Parameter	Value
Residential – Detached Single	3.4 p/unit
Residential – Townhouse	2.7 p/unit
Residential – Apartment	1.8 p/unit
Peak Wastewater Generation per Person	280 L/p/d
Peaking Factor Applied	Harmon's Equation, where K = 0.8
Commercial / Institutional Flows	28,000 L/ha/day
Commercial / Institutional Peaking Factor	1.5 if contribution area > 20%, otherwise 1.0
Infiltration and Inflow Allowance	0.33 L/s/ha
Park Flows	9,300 L/ha/day
Park Peaking Factor	1.0
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
Minimum Sewer Size	200 mm diameter
Minimum Manning's 'n'	0.013
Service Lateral Size	135 mm dia PVC SDR 28 with a minimum slope of 1.0%
Minimum Depth of Cover	2.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6 m/s
Maximum Full Flowing Velocity	3.0 m/s

Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012 and Technical Bulletins

4.2.1 Design Flows

Sanitary drainage area plans and design sheets are enclosed in ***Appendix C*** for reference.

Wastewater flows from the study area were considered as part of previous phases of HMB West and HMB North, as well as existing downstream infrastructure, per the ***MSS***.

North Outlet

With the extension of the sanitary sewer along Flagstaff Drive to Borrisokane Road, areas external to the HMB West Phase 3 development have been considered in the design per the ***MSS***. The external areas to the north outlet are summarized in ***Table 4.2***.

Table 4.2: External Areas to the North Outlet

Land Use	Connecting Location	Area (ha)	Population
Residential	MH 373A on Flagstaff Drive extension	6.55	559
Commercial Block 71	MH 336A to MH 388A on Flagstaff Drive extension	0.44	
Institutional	MH 337A to MH 338A on Flagstaff Drive extension	2.24	
Residential Blocks 68 and 69 (Glenview)	MH339A to MH341A on Flagstaff Drive extension	0.18	22

The peak sanitary flow from HMB West Phase 3 to the north outlet, including external flows is 15.82 L/s (MH 355A to existing 333A). This length of sewer was previously constructed with the Glenview Flagstaff Phase 1 development as MH 332A to 333A. The peak sanitary flow was anticipated to be 19.92 L/s. Refer to the Glenview Flagstaff Phase 1 sanitary drainage area plan and design sheet, included in ***Appendix C***. MH 355A has been added based on updated lotting for the HMB West Phase 3 lots.

South Outlet

There are no external lands directed to the existing sanitary sewer on Apolune Street.

The peak flows from HMB West Phase 3 to Apolune Street at the three connection locations are presented in ***Table 4.3***, as compared to anticipated flows at the time of the detailed design of HMB West Phase 1.

Table 4.3: Peak Flows to the South Outlet

Street Name	Connecting Location	Phase 3 Peak Flow (L/s)	Phase 1 Anticipated Peak Flow (L/s)
Watercolours Way (north leg)	MH 360A to existing MH122A on Apolune Street	1.87	1.28
Cygnus Street (former Street A)	MH 365A to existing MH 123A on Apolune Street	1.44	1.86
Watercolours Way (south leg)	MH 371A to existing MH 125A on Apolune Street	1.29	2.43
Total		**4.60**	**5.57**

The proposed peak flow based on the current design is less than what was anticipated through the design of HMB West Phase 1. This confirms that there is capacity in the downstream infrastructure for the proposed development.

4.3 MSS Conformance

The proposed sanitary sewer system generally conforms to the ***Stantec MSS Addendum***. The proposed trunk sewer along the extension of Flagstaff Drive was contemplated as a 450 mm diameter pipe in the ***Stantec MSS Addendum***, but due to updated sewer design guidelines per Technical Bulletin ISTB-2018-01 (March 21, 2018) and sanitary rerouting, it has been updated to 250 mm and 300 mm. Based on the current design, the sanitary sewers remain slightly oversized to keep the sewer as flat as possible to cross under the habitat channel at Flagstaff Drive. If the sizes were reduced, the minimum slope would be steepened, reducing the clearance between the sanitary sewer and the culvert in the habitat channel.

4.4 Wastewater Servicing Conclusion

HMB West Phase 3 will be serviced by two outlets; the north outlet to Perseus Drive, Future Greenbank Road and through HMB North Phase 7; and the south outlet to Apolune Drive to Cambrian Road. Ultimately the flows are directed to the South Nepean Collector.

It has been confirmed that there is capacity in the downstream sanitary sewer system to accommodate HMB West Phase 3 including external drainage areas.

The proposed sanitary sewer system generally conforms to the ***Stantec MSS Addendum***. The proposed trunk sewer along the extension of Flagstaff Drive was contemplated as a 450 mm diameter pipe in the ***Stantec MSS Addendum***, but due to updated sewer design guidelines per Technical Bulletin ISTB-2018-01 (March 21, 2018) and sanitary rerouting, it has been updated to 250 mm and 300 mm. The sanitary sewers remain slightly oversized to keep the sewer as flat as possible to cross under the habitat channel at Flagstaff Drive.

5.0 STORMWATER CONVEYANCE

5.1 Existing Conditions

The Half Moon Bay West Subdivision is located within Jock River Watershed and is under the jurisdiction of the Rideau Valley Conservation Authority (RVCA).

Currently, the majority of the overall HMB West site has been stripped of topsoil and earthworks have been undertaken over the past 10 years. The overall site previously consisted of agricultural fields, with the exception of the southern portion of the site where a treed area formerly existed. The existing elevations within the overall proposed development area generally range between 91.5 m to 94.0 m.

The West Clarke Drain, which was identified in previous studies as fish habitat, has been redirected and infilled according to the Authorization developed between the Barrhaven South Landowners Group (BSLO) and the Department of Fisheries and Oceans (DFO). The Clarke SWM Pond and Outlet Channel and HMB West Phase 1, and HMB West Phase 2 are constructed. The Flagstaff Subdivision by Glenview Homes (Cedarview) Limited is north of HMB West Phase 3, with Phase 1 constructed and Phase 2 under engineering review.

A new natural corridor is to be provided to link the existing woodlot south of the subject property to the Jock River north of the site. Further details are contained in ***Section 1.1***

There are existing storm sewers along Apolune Street and Flagstaff Drive, all discharging to the existing Clarke SWM Pond.

Refer to ***Figure 5*** for the existing storm sewer network.

5.2 Minor System

HMB West Phase 3 will be serviced by a storm sewer system designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01).

The minor storm sewer system has been sized as follows:

- 2-year event for local streets without any ponding;
- 5-year event for collector streets (Flagstaff Drive) without any ponding; and
- 5-year event for commercial and park blocks.

The storm sewers will outlet to the Clarke SWM Pond, within the HMB West Lands, and discharge from the pond to the Jock River via a naturalized channel. The Clarke SWM Pond has been designed to service a large drainage area, including the HMB West Phase 3 Lands. Refer to the ***Clarke PDB*** for details. The proposed storm sewer layout is depicted on ***Figure 5.*** Refer to Storm Design Sheet and Storm Drainage Plans, located in ***Appendix D***.

Table 5.1 summarizes the relevant ***Sewer Design Guidelines*** employed in the design of the proposed storm sewer system referred to as the minor system.

Table 5.1: Storm Sewer Design Criteria

Design Parameter	Value
Minor System Design Return Period	2-Year (Local Streets), 5-Year (Collector Streets), per PIEDTB-2016-01 5-Year for Commercial and Park Blocks
Major System Design Return Period	100-Year
Intensity Duration Frequency Curve (IDF) 2-year storm event: A = 723.951, B = 6.199, C = 0.810 5-year storm event: A = 998.071, B = 6.053, C = 0.814	$i = \frac{A}{(t_c + B)^C}$
Initial Time of Concentration	10 minutes
Rational Method	$Q = CiA$
Runoff coefficient for paved and roof areas	0.9
Runoff coefficient for landscaped areas	0.2
Storm sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{2/3} S^{1/2}$
Minimum Sewer Size	250 mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.0 m from crown of sewer to grade, unless circumstances require lower
Minimum Full Flowing Velocity	0.8 m/s
Maximum Full Flowing Velocity	6.0 m/s (above 3.0 m/s may require protection against displacement by sudden jarring)
Clearance from 100-Year HGL	Should not be above ground surface
Clearance from 100-Year Grade Line to Building Opening	0.30 m
Max Allowable Flow Depth on Municipal Roads	35 cm above gutter (PIEDTB-2016-01)

Extracted from Sections 5, 6 and 8 of the City of Ottawa Sewer Design Guidelines, October 2012 and Technical Bulletins.

The paved area and grassed area runoff coefficients of 0.90 and 0.20 were used to calculate average runoff coefficients that were applied across the site. Detailed runoff coefficient calculations based on the maximum zoning envelopes, storm drainage area plans and storm design sheets are enclosed in ***Appendix D*** for reference.

Based on the Rational Method, the peak flows from the proposed development to the existing storm sewers are as follows:

- 727 L/s to the existing 975 mm diameter storm pipe on Flagstaff Drive;
- 302 L/s to the existing 3000 mm diameter storm pipe on Apolune Drive at Watercolours Way (south leg);

- 149 L/s to the existing 3000 mm diameter storm pipe on Apolune Drive at Cygnus Street; and
- 132 L/s to the existing 3000 mm diameter storm pipe on Apolune Drive at Watercolours Way (north leg)

All flows are conveyed to the existing Clarke SWM Pond via the existing 3000 mm diameter storm trunk on Apolune Street to the existing west inlet.

A minor system analysis was completed using the XPSWMM program based on the peak flows captured during the rainfall events, as calculated with the DDWSWMM and SWMHYMO programs. The complete analysis is contained in the ***Stormwater Management Report for Phase 3 of the Half Moon Bay West Subdivision (HMB West Phase 3 SWM Report)*** by J.F. Sabourin and Associates dated November 2021.

The total 2-year, 5-year and 100-year DDSWMM/XPSWMM minor system flow to the Clarke SWM Pond based on the current simulation is 9,266 L/s, 13,350 L/s and 26,773 L/s, respectively.

The proposed design for HMB West Phase 3, future phases of HMB West, and external drainage areas to the Clarke SWM Pond assumes that no ICDs or capture limitations are imposed, with a few exceptions, as discussed and supported in the ***HMB West Phase 3 SWM Report.***

A comparison of the 100-year 24-hour SCS Type II design storm pond inflows, levels and storage between the current design and the ***Clarke PDB*** is included in the ***HMB West Phase 3 SWM Report.*** The current design indicates that the 100-year 24-hour SCS Type II design storm inflow to the Clarke Pond is 23.7629 m^3/s and the SCS storm pond level is 92.072 m (33,621 m^3) active storage. In comparison, in the ***Clarke PDB***, the 100-year 24-hour SCS Type II design storm inflow to the Clarke Pond is 20.119 m^3/s and the SCS storm pond level of 92.089 m (34,058 m^3 active storage). The difference in the inflows is due to the removal of ICDs and subsequent reduction in attenuation by surface storage. Refer to the ***HMB West Phase 3 SWM Report*** for further justification.

Note that a less than a freeboard of 0 m between the 100-year hydraulic grade line and the top of catch basin grate elevations is simulated throughout HMB West Phase 1-3. The water depths over catch basins are simulated dynamically in XPSWMM and are driven by a combination of backwater from the 100-year HGL in the main storm sewer, the restriction of the lead pipe and catch basin grate, and the available surface storage in road ponding areas. The 100-year water depths on the road are less than 0.35 m above the catch basin top of grade elevation as detailed in the ***HMB West Phase 3 SWM Report.***

5.3 Major System

The pond is a quality control pond only and is not intended to provide quantity control treatment. Note major system inflow to the pond occurs only during large rainfall events, and do not include the "frequent event" flows requiring quality treatment, which will be conveyed to the pond via the minor system. Safe conveyance of 100-year flows through the pond is provided. The major system has generally been designed with sufficient road surface storage to allow the excess runoff of a 100-year storm to be retained within road ponding areas. Excess major system flows will outlet directly to the pond.

The major system is to be designed in accordance with the amendment to the storm sewer and stormwater management elements of the Ottawa Design Guidelines – Sewer (Technical Bulletin PIEDTB-2016-01). Road ponding areas up to 35 cm deep were used to fully contain the 100-year major system flows. It is proposed that there be no inlet control devices or capture limitations for HMB West Phase 3, as discussed in the ***HMB West Phase 3 SWM Report***.

The maximum depth of flow on local and collector streets is 0.35 m during the 100-year event. The depth of flow may extend adjacent to the right-of-way provided that the water level must not touch any part of the building envelope and must remain below the lowest building opening during the stress test event (100 year + 20%). There must be at least 15 cm of vertical clearance between the spill elevation on the street and the ground elevation at the nearest building envelope. There must be at least 30 cm of vertical clearance between the rear yard spill elevation and the ground elevation at the adjacent building envelope.

Excess major system flows up to the 100-year return period are to be retained on-site in development blocks such as parks. The minor system release rate from the park blocks and the commercial blocks was limited to the 5-year flow.

5.4 Sump Pumps

The proposed centerline of road grades do not allow for standard basements with a gravity connection to the storm sewer system. It is proposed that the subdivision be serviced entirely by sump pumps due to site constraints imposed by grade raise restrictions and the proximity to Jock River stormwater outlet. The ***Stantec MSS Addendum*** specifically considered the use of private sump pumps for the development of areas with grade raise restrictions (including Half Moon Bay West), but did not carry forward this alternative solution based on City policy at the time of preparation of the study; however, the City has published Technical Bulletins ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July, 8, 2019), which outline the criteria for sump pumps, the requirements for hydrogeological assessments areas with sump pumps, and revised information on HGL for storm sewers with sump pumps. The proposed design for sump pumps is consistent with the approach previously used in HMB West Phase 1 and 2 and conforms to Technical Bulletins ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July 8, 2019).

The proposed use of sump pumps within HMB West Phase 3 is addressed in the ***Sump Pump Feasibility Report, PG4073-LET.02*** (Paterson Group, August 25, 2021), enclosed in ***Appendix F***. The sump pump detail can be found on Details, Sheet 3. The sump pump components and requirements are outlined in ***Table 5.2***.

Table 5.2: Sump Pump Design Criteria

Component	Requirements
Sump Pump (General)	Shall be: o In accordance with City of Ottawa Technical Bulletin ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July 8, 2019); o A submersible pump; o Automatically controlled and set to maintain the water level at the same elevation as the foundation drain; capable of discharging a minimum flow of 0.9 L/s at 3.6 m head.
Sump Pump (Primary)	Shall be: o CSA Approved; o Connected to an electrical circuit that supplies no other outlets, switches or equipment; o Equipped with a self-resetting thermal overload protection switch; o Rated for continuous duty.
Sump Pump (Backup)	Shall be: o CSA Approved; o Connected to an electrical circuit that supplies no other outlets, switches or equipment except: A) Charging equipment for backup power and B) Alarm system for primary pump and power failure; o Equipped with a self-resetting thermal overload protection switch; o Rated for continuous duty; o Equipped with an audible failure alarm to notify homeowner that the primary pump has failed or the power supply has been interrupted; o Capable of discharging a minimum capacity of 0.90 L/s at 3.6 m head; o Powered by a deep-cycle lead-acid battery with a minimum ampere-hour (AH) rating of 100 AH.
Sump Pit	Shall: o Have walls and bottoms constructed of concrete polyethylene, polypropylene, or fiberglass; o Be provided with a sealed cover; o Have a cover which must be secured in a manner acceptable to the authority having jurisdiction; o Be vented to the outdoors.
Discharge Pipe System from Sump Pump	Shall: o Be in accordance with *Appendix 9 – Standard Sump Pump Configuration in Greenfield Subdivisions with Clay Soils on Full Municipal Services*; o Consist of materials and be installed in conformance with the Ontario Building Code; o Have a minimum internal diameter of 38 mm (1-1/2”) from the sump pump to the 100 mm (4”) storm building drain; o Have a union, a check valve and a shut-off valve installed in that sequence in the direction of discharge outside of the sump pit;

	o Have a goose neck with a height of no more than 250 mm below the top of the foundation wall and discharge into the vertical leg of the storm building drain; o Have a minimum dimension of 600 mm from the vertical leg of the storm discharge pipe to the horizontal offset upstream of the backwater valve; o Include a CSA approved backwater valve for the stormwater discharge; o Include an emergency discharge pipe to the outside ground surface; o Be vented to the outdoors; o Rodent guard/screen to be provided at both the end of the overflow (emergency discharge) pipe and vent pipe; Be graded or otherwise protected to prevent the freezing of water in the system.
Connections	o Only the perimeter foundation drainage system will be connected to the sump pit. Eaves trough, surface exterior drainage, swimming pool backwash, floor drains and any other water sources shall not be connected to the sump pit; o All new residences with installed sump pump systems must include: o Eaves troughs discharging to the surface with appropriate drainage away from the house at the time of the original sale; o Drainage layer as per the Ontario Building Code; o Clay backfill placed against the drainage layer with the clay extending a minimum 1.5 m out from the drainage layer for all sides of the foundation except around service laterals where backfill has been placed in service trench per City Standard S6 and S7 unless otherwise specified in an approved geotechnical report; o Impervious backfill capping at the ground surface surrounding the perimeter of the residence area and slope away from the building after settling of backfill; except in areas where window wells are required by Ontario Building Code; o Sewer laterals that pass through porch foundations must have no joints for a length of 0.6 m measured from the exterior porch wall; The sump pump shall be directly connected to a storm building drain from the building to the property line.

5.5 Submerged Sewers

As indicated in the ***Stantec MSS Addendum***, due to grade raise restrictions and lack of relief in the Barrhaven South area, portions of the minor system to the Greenbank and Cedarview Ponds may be partially or fully submerged throughout the year. There are partially submerged sewers in the minor system to the Clarke Pond. The ***Stantec MSS Addendum*** states appropriate solutions, that are acceptable to the City, are required to avoid and/or manage the accumulation of sediments for sewers subject to standing water.

Through the detailed design of HMB West Phase 1, submerged sewers for storm trunks tributary to the Clarke SWM Pond were reviewed and approved by the City of Ottawa and the MECP.

Revisions have been made to the Clarke SWM Pond inlets to allow for isolation of the submerged trunk storm sewers for the purposes of cleaning.

Based on the Clarke SWM Pond permanent pool elevation of 89.55 m, it is anticipated that the proposed storm sewers within HMB West Phase 3 will be submerged at the following limited locations:

- First leg of the 675 mm diameter storm sewer on Watercolours Way (north leg)
- First leg of the 900 mm diameter storm sewer on Flagstaff Drive

5.6 Proposed Outlet – Stormwater Management (SWM) Pond

The Clarke SWM Pond was identified in the ***Stantec MSS Addendum*** to service the Mattamy Half Moon Bay West Development and the external lands. The Clarke SWM Pond and Outlet Channel have been constructed. Further details of the design can be found in the ***Clarke PDB.*** The Clarke SWM Pond is located within the Jock River Watershed and is designed with water quality targets as per the MECP Enhanced Level of Protection (80% TSS removal). No quantity control storage is required for flood control purposes, as the hydrograph from the sub-watershed will peak before the upstream peak in the Jock River; however, as per the ***HMB West Phase 3 SWM Report,*** surface storage will be provided at the low point of road segments.

5.7 Flagstaff Drive Culvert Crossing at Borrisokane

The design of HMB West Phase 3 includes the extension of Flagstaff Drive to Borrisokane Road where it crosses an existing ditch on the east side of Borrisokane Road. A 900 mm diameter CSP culvert has been designed at this location. The sizing of the culvert is detailed in the Phase 3 of the ***Half Moon Bay West Subdivision / Proposed Culvert under Flagstaff Drive*** memo by J.F. Sabourin and Associates dated June 3, 2021, enclosed in ***Appendix D***.

5.8 Flagstaff Drive Habitat Channel Culvert Crossing

As noted in ***Section 1.1***, Glenview Homes and Mattamy Homes previously made a joint permit application to the Rideau Valley Conservation Authority (RVCA) for the relocation of existing features to a new natural corridor, which included an interim culvert at Flagstaff Drive. The design of the ultimate Flagstaff Drive culvert crossing, required for the natural habitat channel, is included with the design of HMB West Phase 3 with the Flagstaff Drive extension. The permit application for the ultimate culvert is currently underway with the Rideau Valley Conservation Authority (RVCA). The crossing is depicted on ***Sheet 15 – Plan and Profile of Flagstaff Drive*** and is comprised of a 1200 mm x 900 mm concrete box culvert.

The sizing of the ultimate culvert crossing is detailed in the ***Phase 2 of the Flagstaff Subdivision / Cambrian Wood Natural Channel Design*** memo by J.F. Sabourin and Associates dated September 28, 2021, enclosed in ***Appendix E***. The memo provides results for the proposed 1200 mm x 900 mm box culvert. The capacity of the ultimate culvert has been confirmed to be sufficient as Flagstaff Drive will not be overtopped by flows in an 100-year storm. This exceeds the 25-year storm requirement for collector roads, outlined in the ***Ottawa Sewer Design Guidelines***.

A geotechnical review of watermain and sanitary services crossing the culvert is detailed in ***Geotechnical Recommendations – Frost Protection Recommendations for Natural Channel Crossings***, PG2246-MEMO.71 Revision 1 by Paterson Group dated November 8, 2021, enclosed in ***Appendix E***.

5.9 MSS Conformance

In general, the location of the Clarke Pond and drainage boundaries are all in conformance with the ***Stantec MSS Addendum,*** but the design has since been updated to reflect City of Ottawa guidelines that were revised subsequent to the approval of the report. Additional support for the deviation is documented in the ***DSEL MSS Addendum***.

5.10 Stormwater Conveyance Conclusion

The storm sewers are designed as per the City of Ottawa guidelines, including the amendment to the guidelines per Technical Bulletin PIEDTB-2016-01 (Sept 6, 2016).

The storm flows will discharge to the existing 900 mm diameter storm sewer on Flagstaff Drive and to the existing 3000 mm diameter trunk sewer on Apolune Street. The storm sewers outlet to the west inlet of the existing Clarke SWM Pond, where the flows will be treated for quality prior to discharging to the Jock River.

The Clarke SWM Pond is designed to provide quality control treatment to achieve an enhanced level of protection (80% TSS removal per MECP guidelines). There are no quantity control requirements tributary to the Jock River.

The minor system has been designed to accommodate a minimum of the 2-year post-development flows from within the site plus 5-year flows on collector roads (Flagstaff Drive) and for park and commercial blocks.

The proposed design of HMB West Phase 3, future phases of HMB West and external drainage areas to the Clarke SWM Pond assumes that no ICDs or capture limitations are imposed, with a few exceptions.

A freeboard of less than 0 m between the 100-year hydraulic grade line and the top of catch basin grade elevations was simulated throughout HMB West Phase 1-3. The water depths over catch basins are simulated dynamically in XPSWMM and are driven by a combination of backwater from the 100-year HGL in the main storm sewer, the restriction of the lead pipe and catch basin grate, and the available surface storage in road ponding areas. The 100-year water depths on the road are less than 0.35 m above the catch basin top of grade elevation.

The proposed design for sump pumps is consistent with the approach previously used in HMB West Phase 1 and conforms to Technical Bulletins ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July 8, 2019). Further information is detailed in the ***Sump Pump Memo.***

The product of the velocity and depth of flow does not exceed the maximum allowable 0.60 m^2/s for the simulated 100-year storm.

The maximum extent of surface water during the 100-year + 20% stress test will not touch the building envelopes.

Full pipe velocities are between 0.80 m/s and 6.0 m/s for all proposed pipes.

The design includes a proposed 900 mm diameter CSP culvert for the extension of Flagstaff Drive to Borrisokane Road where it crosses an existing ditch on the east side of Borrisokane Road.

The design also includes a 1200 mm x 900 mm concrete box culvert for the ultimate crossing of the natural corridor under Flagstaff Drive. The natural corridor was designed by others.

In general, the location of the Clarke SWM Pond, drainage boundaries and storm servicing are all in conformance with the ***Stantec MSS Addendum,*** but the design has since been updated to reflect City of Ottawa guidelines that were revised subsequent to the approval of the report. Additional support for the deviation is documented in the ***DSEL MSS Addendum***.

6.0 SITE GRADING

6.1 Grading and Drainage

The grading for HMB West Phase 3 is restricted by the existing adjacent subdivisions and the Clarke SWM Pond (based on the Jock River water levels).

The ***Stantec MSS Addendum*** indicates that proposed centerline of road grades for the overall HMB West subdivision will vary between approximately 92.50 m and 94.50 m. Detailed grading confirms that the proposed centerline of road grades for HMB West Phase 3 will vary between approximately 92.50 m and 93.60 m.

To achieve the planned storm drainage and meet City of Ottawa and MECP guidelines, fill is required from existing ground for the proposed development. The proposed finished grades range between 92.75 m and 93.75 m. It is noted in the ***Geotechnical Investigation*** by Paterson Group (April 19, 2021) that the permissible grade raise elevations vary from 93.3 m to 93.6 m (houses) and from 93.6 m to 93.9 m (roads) within HMB West Phase 3.

Based on the conditions on-site, a surcharge program is underway and lightweight fill and/or other measures will be employed to reduce the risks of long-term differential settlement. Despite the proposed surcharge program and the proposed storm drainage schemes, the proposed centerline of road grades do not allow for standard basements with a gravity connection to the storm sewer system. As such, sump pumps are proposed to be installed for all residential blocks and residential lots with basements. The proposed design approach for the subdivision is consistent with the approach previously used in HMB West Phase 1 and 2 and conforms to Technical Bulletins ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July 8, 2019).

In September 2018, several artesian point sources were discovered within Block 54 by Paterson Group during the topsoil removal program. The point sources are proposed to be captured within designed containment cells with artesian flows discharging to the existing roadside ditch on the north side of Cambrian Road as shown on ***Figure 5*** and ***Sheet 20 – Grading Plan***. The design of the containment cells is detailed in the ***Artesian Memo*** by Paterson Group (August 26, 2021). Recommendations have been provided in the ***Artesian Contingency Plan*** by Paterson Group (November 16, 2021), should new artesian point sources be discovered during construction,

6.2 Grading Criteria

The following grading criteria and guidelines will be applied at the time of detailed design as per City of Ottawa Guidelines:

- Maximum slope in grassed areas between 2% and 5%;
- Grades in excess of 7% require terracing to a maximum of a 3:1 slope;
- Driveway grades between 2% and 6%;
- Drainage ditches and swales should have a minimum slope of 1.5%;
- Perforated pipe is required for swales less than 1.5% in slope; and
- Swales are to be 0.15 m deep with 3:1 side slopes unless otherwise indicated.

7.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. The extent of erosion losses is exaggerated during construction where the vegetation has been removed and the top layer of soil is disturbed.

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

- Limit extent of exposed soils at any given time.
- Re-vegetate exposed areas as soon as possible.
- Minimize the area to be cleared and grubbed.
- Protect exposed slopes with plastic or synthetic mulches.
- Install silt fence to prevent sediment from entering existing ditches.
- No refueling or cleaning of equipment near existing watercourses.
- Provide sediment traps and basins during dewatering.
- Install filter cloth between catch basins and frames.
- Installation of mud mats at construction accesses.
- Construction of temporary sedimentation ponds to treat water prior to outletting to existing wetlands and watercourses.
- Plan construction at proper time to avoid flooding.

A detailed erosion and sediment control plan will be implemented for HMB West Phase 3 prior to construction to ensure there are no negative impacts on existing stormwater works and natural areas, including the Clarke SWM Pond and Jock River. Refer to ***Sheet 30*** – ***Erosion and Sediment Control Plan – Stage 1*** and ***Sheet 31 – Erosion and Sediment Control Plan – Stage 2*** for details.

8.0 CONCLUSIONS AND RECOMMENDATIONS

A summary of the Design Brief for the HMB West Phase 3 Subdivision is as follows:

- HMB West Phase 3 includes the extension of Flagstaff Drive to Borrisokane Road, residential development, including the Private Site Block, and parks.
- HMB West Phase 1 and 2 are approved and constructed. The Flagstaff Subdivision by Glenview Homes (Cedarview) Limited is to the north with Phase 1 constructed and the design of Phase 2 underway.
- Several approvals are in place for the proposed subdivision. Approvals will be required from the City of Ottawa and Ministry of the Environment, Conservation and Parks (MECP) and Rideau Valley Conservation Authority (RVCA).
- Watermains are designed as per the City of Ottawa guidelines and connect to existing watermains on existing Flagstaff Drive and Apolune Drive.
- The site is proposed to be serviced by 200 mm and 300 mm watermains. Water supply will be available within the required pressure range under the anticipated demand during average day and peak hour conditions. Water supply for fire flow conditions will be adequate at all junctions.
- The extension of the 300 mm diameter watermain on Flagstaff Drive to Borrisokane Road conforms to the ***Stantec MSS Addendum***. The extension of the 300 mm diameter watermain Flagstaff Drive will remain as dead end in the interim and a flushing system has been added to keep the water fresh until the watermain is looped in the future.
- HMB West Phase 3 will be serviced by two sanitary outlets; the north outlet to Perseus Drive, Future Greenbank Road and through HMB North Phase 7; and the south outlet to Apolune Drive and Cambrian Road. Ultimately the flows are directed to the South Nepean Collector.
- The proposed sanitary sewer system generally conforms to the ***Stantec MSS Addendum***. The proposed trunk sewer along the extension of Flagstaff Drive was contemplated as a 450 mm diameter pipe in the ***Stantec MSS Addendum***, but due to updated design standards, the diameter of the pipes was revised to 250 mm and 300 mm. The proposed trunk sewer along the extension of Flagstaff Drive is oversized based on updated design standards to keep it as flat as possible to cross under the natural habitat channel.
- The storm sewers are designed as per the City of Ottawa guidelines, including the amendment to the guidelines per Technical Bulletin PIEDTB-2016-01 (September 6, 2016).
- The storm flows will discharge to the existing 900 mm diameter storm sewer on Flagstaff Drive and to the existing 3000 mm diameter trunk sewer on Apolune

Street. The storm sewers outlet to the west inlet of the existing Clarke SWM Pond, where the flows will be treated for quality prior to discharging to the Jock River.

- The Clarke SWM Pond is designed to provide quality control treatment to achieve an enhanced level of protection (80% TSS removal per MECP guidelines). There are no quantity control requirements tributary to the Jock River. Based on the current design, the overall drainage area to the Clarke Pond is smaller and the percent imperviousness is lower when compared to the approved design. This confirms that there is capacity in the existing Clarke Pond for HMB West Phase 3.
- The minor system has been designed to accommodate a minimum of the 2-year post-development flows from within the site plus 5-year flows on collector roads (Flagstaff Drive) and for park and commercial blocks.
- The proposed design of HMB West Phase 3, future phases of HMB West and external drainage areas to the Clarke SWM Pond assumes that no ICDs or capture limitations are imposed, with a few exceptions.
- A freeboard of less than 0 m between the 100-year hydraulic grade line and the top of catch basin grade elevations was simulated throughout HMB West Phase 1-3 is provided. The water depths over catch basins are simulated dynamically in XPSWMM and are driven by a combination of backwater from the 100-year HGL in the main storm sewer, the restriction of the lead pipe and catch basin grate, and the available surface storage in road ponding areas. The 100-year water depths on the road are less than 0.35 m above the catch basin top of grade elevation.
- The proposed design for sump pumps is consistent with the approach previously used in HMB West Phase 1 and conforms to Technical Bulletins ISTB-2018-04 (June 27, 2018) and ISTB-2019-02 (July 8, 2019). The sump pump design is detailed in the ***Sump Pump Memo***.
- The product of the velocity and depth of flow does not exceed the maximum allowable 0.60 m^2/s for the simulated 100-year storm.
- The maximum extent of surface water during the 100-year + 20% stress test will not touch the building envelopes.
- Full pipe velocities are between 0.80 m/s and 6.0 m/s for all proposed pipes.
- The design includes a proposed 900 mm diameter CSP culvert for the extension of Flagstaff Drive to Borrisokane Road where it crosses the existing ditch and a concrete 1200 mm x 900 mm box culvert for the crossing of the natural corridor under Flagstaff Drive. The natural corridor was designed by others.
- In general, the location of the Clarke SWM Pond, drainage boundaries and storm servicing are all in conformance with the ***Stantec MSS Addendum,*** but the design has since been updated to reflect City of Ottawa guidelines that were revised subsequent to the approval of the report as documented in the ***DSEL MSS Addendum***.

- There are permissible grade raise restrictions for the site as further discussed in the ***Geotechnical Investigation***. Due to conditions on-site, measures may be required for lots to reduce the risks of long-term differential settlement.
- Erosion and sediment control measures will be implemented and maintained throughout construction. The Clarke SWM Pond, Jock River and all other watercourses will be protected from any negative impacts from construction.
- The design of HMB West Phase 3 has been completed in general conformance with the City of Ottawa Design Guidelines and criteria presented in other background study documents.

Prepared by,
David Schaeffer Engineering Ltd.

LICENSED PROFESSIONAL ENGINEER
2021/11/18
J. AILEY
100079299
J. Ailey
PROVINCE OF ONTARIO

J. Ailey

Per: Jennifer Ailey, P.Eng.

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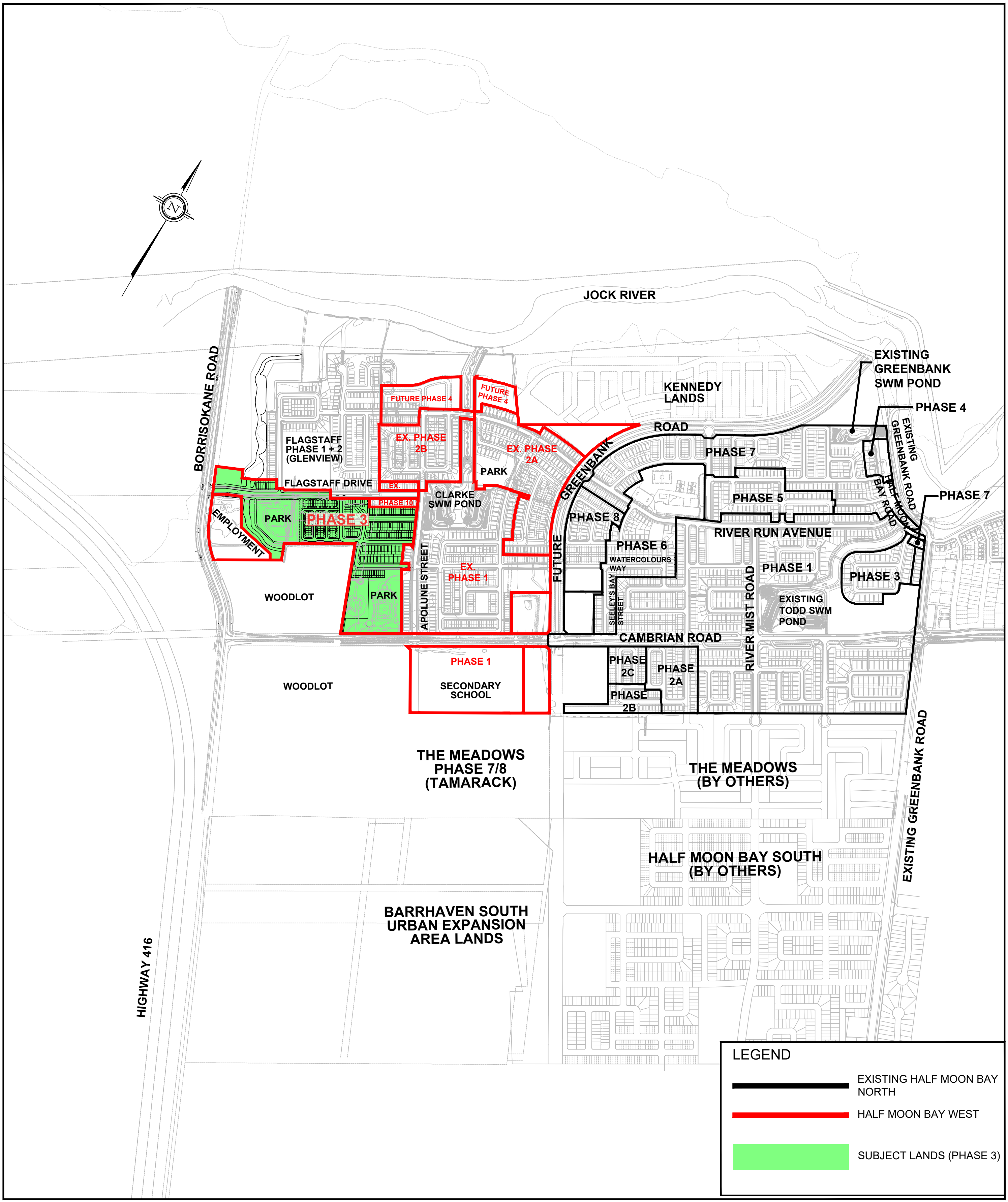

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FAX: (613) 836-7183
www.DSEL.ca

HALF MOON BAY WEST
PHASE 3
KEY PLAN

PROJECT No.:	19-1140
SCALE:	1:15000
DATE:	NOVEMBER 2021
FIGURE:	1

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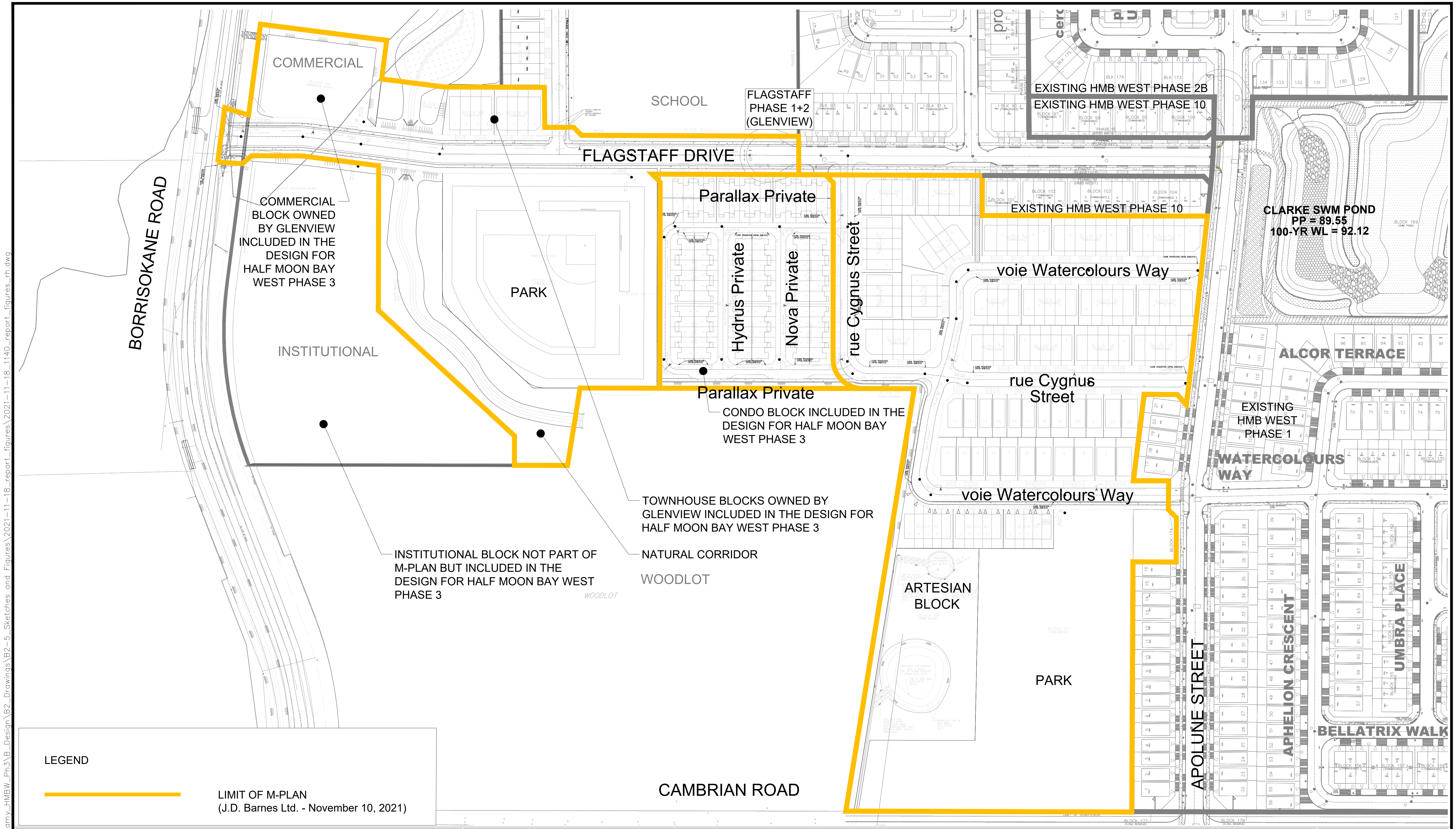

LEGEND

▬	LIMIT OF M-PLAN (J.D. Barnes Ltd. - November 10, 2021)

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MATTAMY HOMES
HALF MOON BAY WEST PHASE 3
SUBDIVISION PLAN
CITY OF OTTAWA

DATE:
NOVEMBER 2021
SCALE:
1:2000
PROJECT No.:
19-1140
FIGURE
2

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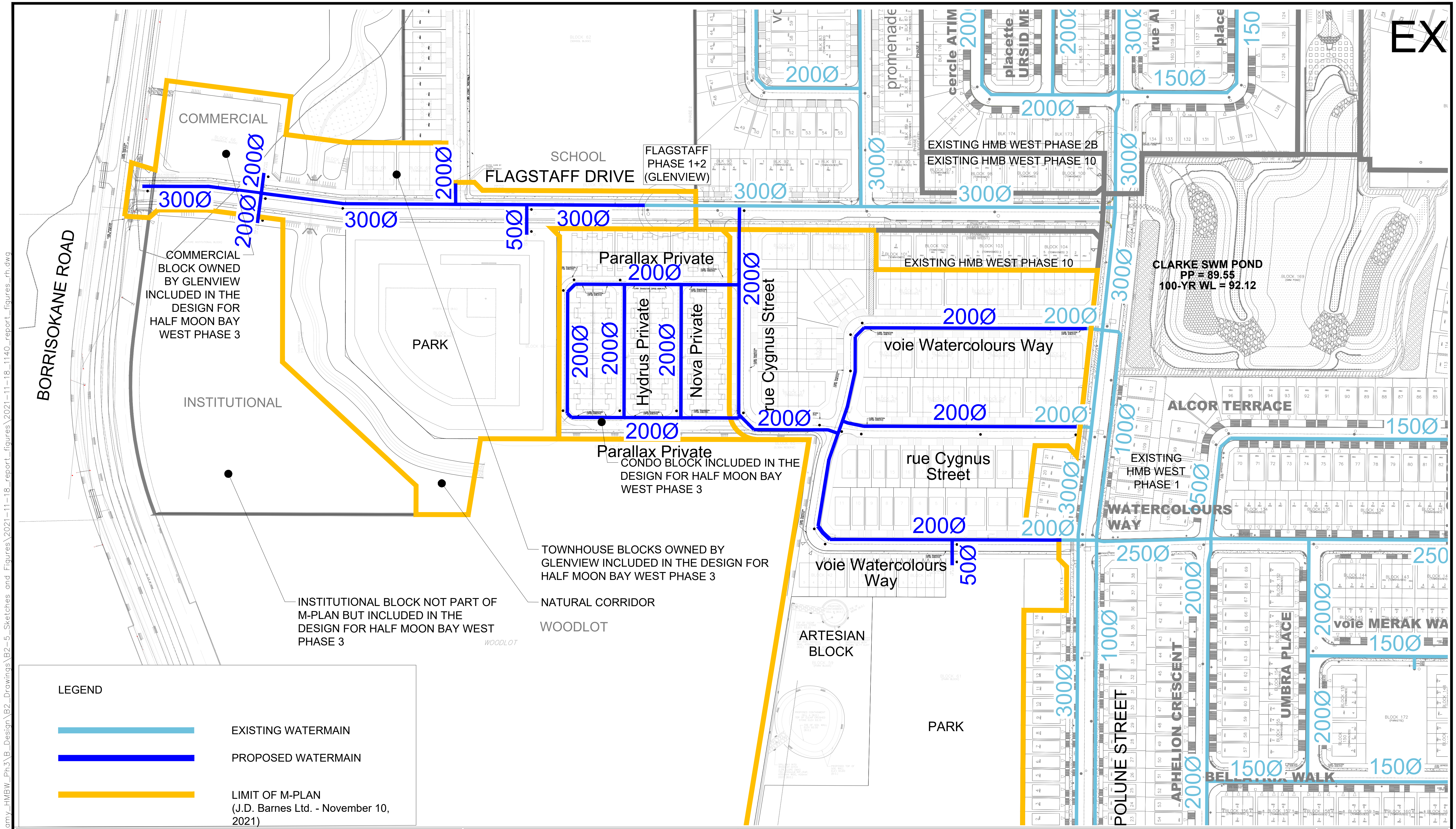

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MATTAMY HOMES
HALF MOON BAY WEST PHASE 3
WATER SERVICING
CITY OF OTTAWA

DATE:	NOVEMBER 2021
SCALE:	1:2000
PROJECT No.:	19-1140
FIGURE	3

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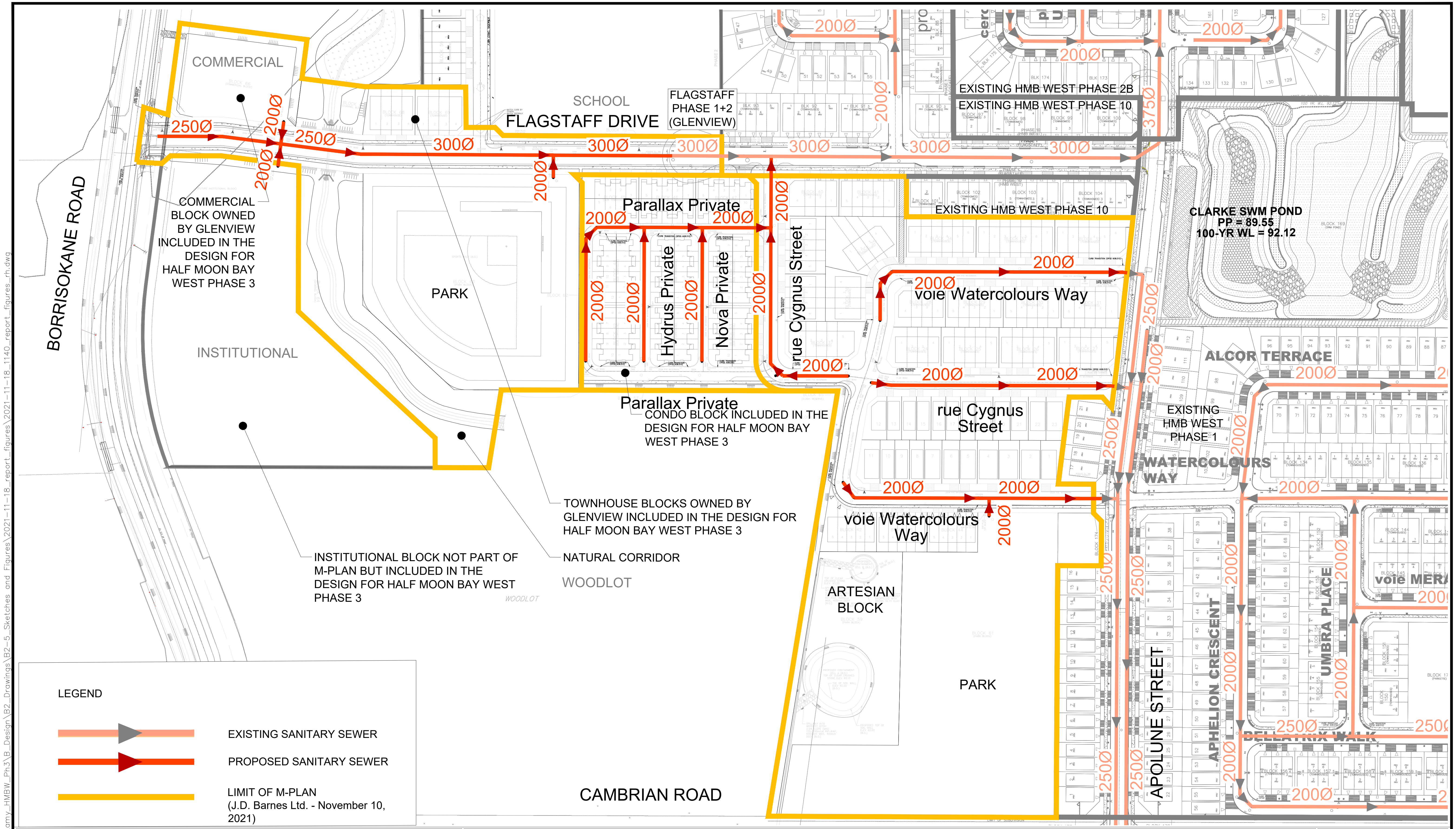

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MATTAMY HOMES
HALF MOON BAY WEST PHASE 3
SANITARY SERVICING
CITY OF OTTAWA

DATE: NOVEMBER 2021
SCALE: 1:2000
PROJECT No.: 19-1140
FIGURE 4

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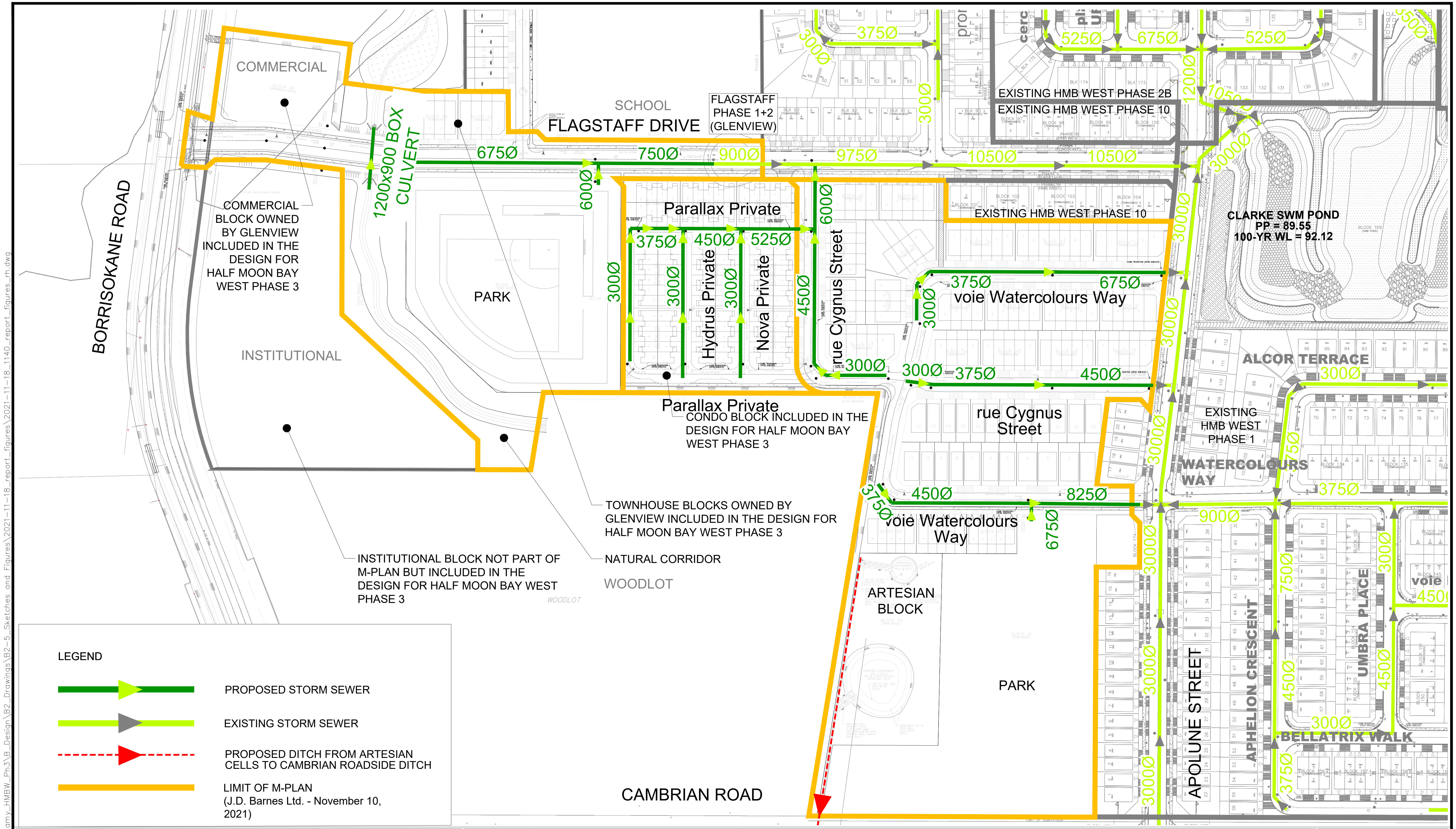

LEGEND

🟩	PROPOSED STORM SEWER
🟩	EXISTING STORM SEWER
🟥	PROPOSED DITCH FROM ARTESIAN CELLS TO CAMBRIAN ROADSIDE DITCH
🟧	LIMIT OF M-PLAN (J.D. Barnes Ltd. - November 10, 2021)

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MATTAMY HOMES
HALF MOON BAY WEST PHASE 3
STORM SERVICING
CITY OF OTTAWA

DATE:
NOVEMBER 2021
SCALE:
1:2000
PROJECT No.:
19-1140
FIGURE
5

APPENDIX A

EXISTING APPROVALS

Ministry of the Environment and Climate Change
Eastern Region
Technical Support Section
Water Resources
1259 Gardiners Rd, PO Box 22032
Kingston, ON
K7P 3J6
Tel: (613) 549-4000

Ministère de l'Environnement et de l'Action en matière de changement climatique
Direction régionale de l'Est
Section du Soutien Technique
Ressource en eau
1259 Chemin Gardiners, CP 22032
Kingston, ON
K7P 3J6
Tél:(613) 549-4000

January 27, 2016

Bronwyn Anderson
Mattamy (Half Moon Bay) Limited
2360 Bristol Circle
Oakville, Ontario
L6H 6M5

Dear Sir/Madam:

RE: Permit To Take Water 3205-A4ZLZ6
Proposed Multi-Use Development - Half Moon Bay
Lot: 8-12, Concession: 3
Geographic Township of Nepean
Ottawa
Reference Number 6071-A3PQPJ

Please find attached Permit to Take Water 3205-A4ZLZ6 which authorizes the withdrawal of water in accordance with the application for this Permit to Take Water, dated October 7, 2015 and signed by Bronwyn Anderson.

Please note this Permit expires December 31, 2025 and cancels and replaces Permit 1413-8H9LLY. This Permit has been amended to more accurately reflect the water takings at the site.

Please also note that it is the responsibility of the Permit Holder to ensure that all other approvals required by law are obtained for this project. Such approvals may include but are not limited to a Section 53, Ontario Water Resources Act, R.S.O. 1990 (Sewage Works Environmental Compliance Approval).

Ontario Regulation 387/04 (Water Taking and Transfer) requires all water takers to report daily water taking amounts to the Water Taking Reporting System (WTRS) electronic database (https://www.lrcsde.lrc.gov.on.ca/wtrs/). Daily water taking must be reported on a calendar year basis. If no water is taken, then a "no taking" report must be entered. Please consult the Regulation and Section 4 of this Permit for monitoring requirements.

If you have questions about reporting requirements, please call the WTRS Help Desk at 416-235-6322 (toll free: 1-877-344-2011) or by email, WTRSHelpdesk@ontario.ca. It is preferred that you submit your data directly and electronically to the WTRS. Where this is impracticable, please contact the WTRS Help Desk to arrange for written submission of your data.

Please note that the contact information for the Environmental Review Tribunal has recently changed. The Environmental Review Tribunal's new contact information is as follows:

New public inquiry telephone number: (416) 212-6349; toll free: 1 (866) 448-2248
New fax number: (416) 326-5370; toll free: 1 (844) 213-3474

Take notice that in issuing this Permit, terms and conditions pertaining to the taking of water and to the results of the taking have been imposed. The terms and conditions have been designed to allow for the development of water resources, while providing reasonable protection to existing water uses and users.

Yours truly,

Greg Faaren
Director, Section 34.1, Ontario Water Resources Act, R.S.O. 1990
Eastern Region

File Storage Number: SI OT 3205 220 (TS)

c: Michael Laflamme, Paterson Group, mlaflamme@patersongroup.ca

Ottawa District Office

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

AMENDED PERMIT TO TAKE WATER

Surface and Ground Water
NUMBER 3205-A4ZLZ6

Pursuant to Section 34.1 of the Ontario Water Resources Act, R.S.O. 1990 this Permit To Take Water is hereby issued to:

Mattamy (Half Moon Bay) Limited
2360 Bristol Circle
Oakville, Ontario L6H 6M5
Canada

For the water taking from:
Housing Excavation - North (S1)
Site Servicing Excavation - North (S2)
Greenbank Stormwater Management Pond Excavation (S3)
Housing Excavation - West (S4)
Site Servicing Excavation - West (S5)
Clarke Stormwater Management Pond Excavation (S6)
Housing Excavation - South (S7)
Site Servicing Excavation - South (S8)

Located at: Lot 8-12, Concession 3, Geographic Township of Nepean
Ottawa

For the purposes of this Permit, and the terms and conditions specified below, the following definitions apply:

DEFINITIONS

(a) "Director" means any person appointed in writing as a Director pursuant to section 5 of the OWRA for the purposes of section 34.1, OWRA.

(b) “Provincial Officer” means any person designated in writing by the Minister as a Provincial Officer pursuant to section 5 of the OWRA.

(c) "Ministry" means Ontario Ministry of the Environment and Climate Change.

(d) "District Office" means the Ottawa District Office.

(e) "Permit" means this Permit to Take Water No. 3205-A4ZLZ6 including its Schedules, if any, issued in accordance with Section 34.1 of the OWRA.

(f) "Permit Holder" means Mattamy (Half Moon Bay) Limited.

(g) "OWRA " means the *Ontario Water Resources Act,* R.S.O. 1990, c. O. 40, as amended.

You are hereby notified that this Permit is issued subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. Compliance with Permit

1.1 Except where modified by this Permit, the water taking shall be in accordance with the application for this Permit To Take Water, dated October 7, 2015 and signed by Bronwyn Anderson, and all Schedules included in this Permit.

1.2 The Permit Holder shall ensure that any person authorized by the Permit Holder to take water under this Permit is provided with a copy of this Permit and shall take all reasonable measures to ensure that any such person complies with the conditions of this Permit.

1.3 Any person authorized by the Permit Holder to take water under this Permit shall comply with the conditions of this Permit.

1.4 This Permit is not transferable to another person.

1.5 This Permit provides the Permit Holder with permission to take water in accordance with the conditions of this Permit, up to the date of the expiry of this Permit. This Permit does not constitute a legal right, vested or otherwise, to a water allocation, and the issuance of this Permit does not guarantee that, upon its expiry, it will be renewed.

1.6 The Permit Holder shall keep this Permit available at all times at or near the site of the taking, and shall produce this Permit immediately for inspection by a Provincial Officer upon his or her request.

1.7 The Permit Holder shall report any changes of address to the Director within thirty days of any such change. The Permit Holder shall report any change of ownership of the property for which this Permit is issued within thirty days of any such change. A change in ownership in the property shall cause this Permit to be cancelled.

2. General Conditions and Interpretation

2.1 Inspections
The Permit Holder must forthwith, upon presentation of credentials, permit a Provincial Officer to carry out any and all inspections authorized by the OWRA, the *Environmental Protection Act* , R.S.O. 1990, the *Pesticides Act* , R.S.O. 1990, or the *Safe Drinking Water Act,* S. O. 2002.

2.2 Other Approvals

The issuance of, and compliance with this Permit, does not:

(a) relieve the Permit Holder or any other person from any obligation to comply with any other applicable legal requirements, including the provisions of the *Ontario Water Resources Act* , and the *Environmental Protection Act* , and any regulations made thereunder; or

(b) limit in any way any authority of the Ministry, a Director, or a Provincial Officer, including the authority to require certain steps be taken or to require the Permit Holder to furnish any further information related to this Permit.

2.3 Information

The receipt of any information by the Ministry, the failure of the Ministry to take any action or require any person to take any action in relation to the information, or the failure of a Provincial Officer to prosecute any person in relation to the information, shall not be construed as:

(a) an approval, waiver or justification by the Ministry of any act or omission of any person that contravenes this Permit or other legal requirement; or

(b) acceptance by the Ministry of the information's completeness or accuracy.

2.4 Rights of Action

The issuance of, and compliance with this Permit shall not be construed as precluding or limiting any legal claims or rights of action that any person, including the Crown in right of Ontario or any agency thereof, has or may have against the Permit Holder, its officers, employees, agents, and contractors.

2.5 Severability

The requirements of this Permit are severable. If any requirements of this Permit, or the application of any requirements of this Permit to any circumstance, is held invalid or unenforceable, the application of such requirements to other circumstances and the remainder of this Permit shall not be affected thereby.

2.6 Conflicts

Where there is a conflict between a provision of any submitted document referred to in this Permit, including its Schedules, and the conditions of this Permit, the conditions in this Permit shall take precedence.

3. Water Takings Authorized by This Permit

3.1 Expiry

This Permit expires on **December 31, 2025**. No water shall be taken under authority of this Permit after the expiry date.

3.2 Amounts of Taking Permitted

The Permit Holder shall only take water from the source, during the periods and at the rates and amounts of taking specified in Table A. Water takings are authorized only for the purposes specified in Table A.

Table A

	Source Name / Description:	Source: Type:	Taking Specific Purpose:	Taking Major Category:	Max. Taken per Minute (litres):	Max. Num. of Hrs Taken per Day:	Max. Taken per Day (litres):	Max. Num. of Days Taken per Year:	Zone/ Easting/ Northing:
1	Housing Excavation - North (S1)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	5,000,000	365	18 441394 5011476
2	Site Servicing Excavation - North (S2)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	6,000,000	210	18 441394 5011476
3	Greenbank Stormwater Management Pond Excavation (S3)	Pond Dugout	Other - Dewatering	Dewatering	5,000	24	2,000,000	210	18 441840 5011790
4	Housing Excavation - West (S4)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	5,000,000	365	18 440999 5010853
5	Site Servicing Excavation - West (S5)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	5,000,000	210	18 440999 5010853
6	Clarke Stormwater Management Pond Excavation (S6)	Pond Dugout	Other - Dewatering	Dewatering	5,000	24	3,500,000	210	18 440817 5010974
7	Housing Excavation - South (S7)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	6,000,000	365	18 442168 5010109
8	Site Servicing Excavation - South (S8)	Pond Dugout	Other - Dewatering	Dewatering	8,500	24	6,000,000	210	18 442168 5010109
						Total Taking:	38,500,000		

3.3 Notwithstanding Table A above, water shall only be taken from the Stormwater Management Ponds (Source 3 and Source 6) during construction of the ponds for construction purposes.

4. Monitoring

4.1 The Permit Holder shall maintain a record of all water takings. This record shall include the dates and times of water takings, the rates of taking and an estimated calculation of the total amounts of water taken per day for each day that water is taken under the authorization of this Permit. A separate record shall be maintained for each source. The Permit Holder shall keep all required records up to date and available at or near the site of the taking and shall produce the records immediately for inspection by a Provincial Officer upon his or her request.

5. Impacts of the Water Taking

5.1 Notification
The Permit Holder shall immediately notify the local District Office of any complaint arising from the taking of water authorized under this Permit and shall report any action which has been taken or is proposed with regard to such complaint. The Permit Holder shall immediately notify the local District Office if the taking of water is observed to have any significant impact on the surrounding waters. After hours, calls shall be directed to the Ministry's Spills Action Centre at 1-800-268-6060.

5.2 For Surface-Water Takings
The taking of water (including the taking of water into storage and the subsequent or simultaneous withdrawal from storage) shall be carried out in such a manner that streamflow is not stopped and is not reduced to a rate that will cause interference with downstream uses of water or with the natural functions of the stream.

For Groundwater Takings
If the taking of water is observed to cause any negative impact to other water supplies obtained from any adequate sources that were in use prior to initial issuance of a Permit for this water taking, the Permit Holder shall take such action necessary to make available to those affected, a supply of water equivalent in quantity and quality to their normal takings, or shall compensate such persons for their reasonable costs of so doing, or shall reduce the rate and amount of taking to prevent or alleviate the observed negative impact. Pending permanent restoration of the affected supplies, the Permit Holder shall provide, to those affected, temporary water supplies adequate to meet their normal requirements, or shall compensate such persons for their reasonable costs of doing so.

If permanent interference is caused by the water taking, the Permit Holder shall restore the water supplies of those permanently affected.

5.3 Prevention of Adverse Effects:
The Permit Holder shall ensure the taking of water under authority of this Permit does not result in an adverse effect on area waters.

5.4 Prevention of Structural Adverse Effects:

The Permit Holder shall take all measures necessary to prevent damage to buildings, bridges, structures, roads and/or railway lines that may be impacted either directly or indirectly by this taking.

5.5 The Permit Holder shall ensure that any water that is taken for dewatering purposes and discharged to the City of Ottawa sewer system is in accordance with a City of Ottawa Sewer Use Agreement.

5.6 The Permit Holder shall ensure that any water that is taken for dewatering purposes and discharged to the on-site Stormwater Management Ponds is in accordance with an Environmental Compliance Approval issued by this Ministry.

5.7 The Permit Holder shall ensure that any water that is taken for dewatering purposes and discharged to the temporary holding ponds labelled as Housing or Site Services Excavation ponds and numbered as Sources S1, S2, S4, S5 ,S7 and S8 in Section 3.0 of this Permit is analyzed for turbidity and meets the criteria in Condition 5.12 prior to discharge to the Jock River or the requirements in Condition 5.5 if discharged to the City of Ottawa sewer system.

5.8 The Permit Holder shall keep a record of all discharge dates to either the Jock River or the City of Ottawa sewer system from either the housing excavation or site servicing ponds and/or the Greenbank and Clarke Stormwater Management Ponds as well as a record of the water quality analyses conducted to determine if the discharge water quality meets the requirements of Condition 5.5 and Condition 5.12.

5.9 Discharge Control Measures for Water that is Discharged to the Natural Environment: Siltation control measures shall be installed at the discharge site(s) and shall be sufficient to control the volumes. Continuous care shall be taken to properly maintain the siltation control devices.

5.10 The discharge of water shall be controlled in such a way as to avoid erosion and sedimentation in the receiving stream.

5.11 The Permit Holder shall ensure that any water discharged to the natural environment does not result in scouring, erosion or physical alteration of stream channels or banks and that there is no flooding in the receiving area or water body, downstream water bodies, ditches or properties caused or worsened by this discharge.

5.12 The Permit Holder shall not discharge turbid water to any watercourse. Turbid water shall be defined as any discharge water from the excavation or diverted water with a maximum increase of 8 NTUs above the receiving stream's background levels.

6. **Director May Amend Permit**
The Director may amend this Permit by letter requiring the Permit Holder to suspend or reduce the taking to an amount or threshold specified by the Director in the letter. The suspension or reduction in taking shall be effective immediately and may be revoked at any time upon notification by the Director. This condition does not affect your right to appeal the suspension or reduction in taking to the Environmental Review Tribunal under the *Ontario Water Resources Act* , Section 100 (4).

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is included to ensure that the conditions in this Permit are complied with and can be enforced.

2. Condition 2 is included to clarify the legal interpretation of aspects of this Permit.

3. Conditions 3 through 6 are included to protect the quality of the natural environment so as to safeguard the ecosystem and human health and foster efficient use and conservation of waters. These conditions allow for the beneficial use of waters while ensuring the fair sharing, conservation and sustainable use of the waters of Ontario. The conditions also specify the water takings that are authorized by this Permit and the scope of this Permit.

In accordance with Section 100 of the Ontario Water Resources Act, R.S.O. 1990, you may by written notice served upon me, the Environmental Review Tribunal and the Environmental Commissioner, ***Environmental Bill of Rights****, R.S.O. 1993, Chapter 28, within 15 days after receipt of this Notice, require a hearing by the Tribunal. The Environmental Commissioner will place notice of your appeal on the Environmental Registry. Section 101 of the Ontario Water Resources Act, as amended provides that the Notice requiring a hearing shall state:*

1. The portions of the Permit or each term or condition in the Permit in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

In addition to these legal requirements, the Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The Permit to Take Water number;
6. The date of the Permit to Take Water;
7. The name of the Director;
8. The municipality within which the works are located;

This notice must be served upon:

The Secretary
Environmental Review Tribunal
655 Bay Street, 15th Floor
Toronto ON
M5G 1E5
Fax: (416) 326-5370
Email:
ERTTribunalsecretary@ontario.ca

AND

The Environmental Commissioner
1075 Bay Street
6th Floor, Suite 605
Toronto, Ontario M5S 2W5

AND

The Director, Section 34.1,
Ministry of the Environment and Climate Change
1259 Gardiners Rd, PO Box 22032
Kingston, ON
K7P 3J6

Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal:

by Telephone at	by Fax at	by e-mail at
(416) 212-6349	(416) 326-5370	www.ert.gov.on.ca
Toll Free 1(866) 448-2248	Toll Free 1(844) 213-3474	

This instrument is subject to Section 38 of the ***Environmental Bill of Rights*** *that allows residents of Ontario to seek leave to appeal the decision on this instrument. Residents of Ontario may seek to appeal for 15 days from the date this decision is placed on the Environmental Registry. By accessing the Environmental Registry, you can determine when the leave to appeal period ends.*

This Permit cancels and replaces Permit Number 1413-8H9LLY, issued on 2011/05/30.

Dated at Kingston this 27th day of January, 2016.

Greg Faaren
Director, Section 34.1
Ontario Water Resources Act , R.S.O. 1990

Schedule A

This Schedule “A” forms part of Permit To Take Water 3205-A4ZLZ6, dated January 27, 2016.

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

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ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 3029-ACNJPT
Issue Date: August 12, 2016

Mattamy (Half Moon Bay) Limited
50 Hines Road, Unit 100
Kanata, Ontario
K2K 2M5

Site Location: Half Moon Bay North Phases 4 and 7
Part of Lots 10, 11 and 12, Concession 3 (Rideau Front)
City of Ottawa

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

storm and sanitary sewers to be constructed in the City of Ottawa, on River Run Avenue (from 0+031.6 to 0+167.9), Burbot Street (from 0-001.6 to 0+351.5), Brassy Minnow Crescent (from 0+004.2 to 0+292.7), Pumpkinseed Crescent (from 0+002.1 to 0+175.4), Riverboat Heights (from 0+023.8 to 0+138.7), Logperch Circle (from 0+001.2 to 0+421.9), Pearl Dave Crescent (from 0-002.0 to 0+370.9), Finescale Way (from 0+000.0 to 132.1), Millars Sound Way (from 0-000.6 to 0+287.3), River Landing Avenue (from 0+011.7 to 0+160.0), Block 203 (from 0-002.3 to 0+070.9), Block 204 (from 0+015.5 to 0+090.5), Block 205 (from 0+000.0 to 0+156.3), Half Moon Bay Road (from 0+014.7 to 0+234.4), Greenbank Storm Pond Inlet (0-000.4 to 0+013.4), Greenbank Storm Pond Outlet (from 0+000.0 to 0+030.0);

all in accordance with the application from Mattamy (Half Moon Bay) Limited, dated July 28, 2016, including final plans and specifications prepared by David Schaeffer Engineering Ltd..

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

1. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
2. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

3. The name of the appellant;
4. The address of the appellant;
5. The environmental compliance approval number;
6. The date of the environmental compliance approval;
7. The name of the Director, and;
8. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment and
Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

*** Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 12th day of August, 2016

Gregory Zimmer, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

AF/

c: District Manager, MOECC Ottawa
M. Rick O'Connor, City Clerk, City of Ottawa
Jeff Shillington, Project Manger, Development Review City of Ottawa (File No. D07-16-13-0019)
Linda Carkner, Program Manager, Infrastructure Services, City of Ottawa
Jennifer Ailey, P. Eng., David Schaeffer Engineering Limited (DSEL)

Ontario

Ministry of the Environment and Climate Change
Ministère de l'Environnement et de l'Action en matière de changement climatique

AMENDED ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 6068-AWUPL5
Issue Date: April 11, 2018

Mattamy (Half Moon Bay) Limited
50 Hines Road, Suite 100
Kanata, Ontario
K2K 2M5

Site Location: Half Moon Bay West – Clarke Stormwater Management Pond
Part of Lot 10, 11, 12, Concession 3 (Rideau Front)
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the *Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:*

An amendment to the interim stormwater management system with the replacement of the existing sediment control pond, temporary drainage swales and erosion and sediment control measures with the establishment of the proposed wet pond and outlet channel serving Half Moon Bay West, Half Moon Bay North, Meadows in Half Moon Bay and Half Moon Bay South in Barrhaven South, located in the vicinity of Cambrian Road, east of Borrisokane Road (formerly Cedarview Road), for the collection, transmission, treatment and disposal of stormwater run-off from a total catchment area of approximately 123.41 ha, within the Jock River watershed, in the City of Ottawa providing Enhanced Level water quality control, consisting of the following:

Proposed Works:

one (1) wet pond, located within the Half Moon Bay West lands, serving a total drainage area of 123.41 hectares and having a total length of 180 m and a total width of 160 m, consisting of:

- two (2) riprap-lined sediment forebays that have a minimum length-to-width ratio of 2:1, a depth of 2.0 m, and are separated from the main cell via a berm;
- a main cell that has a minimum permanent storage volume of 22400 m3, a minimum active storage volume of 6803 m3, a maximum permanent pool depth of 3.0 m and a maximum available depth of 5.543 m, including a freeboard of 0.3 m;

- an inlet structure consisting of a 3000 mm diameter storm inlet pipe and a concrete headwall;

- an inlet structure consisting of a 1800 mm diameter storm inlet pipe, a 2700 mm diameter storm inlet pipe and a concrete headwall;

- two (2) overland flow routes with 5 m bottom width and erosion control mat located on the east and west side of the pond;

- a low flow outlet structure comprised of a 1350 mm diameter storm outlet pipe equipped with a 250 mm diameter orifice plate and a 700 mm long weir, allowing a maximum discharge of 1389 L/s under the 100-year storm event to a proposed outlet channel and the Jock River located north of the pond;

- a high flow outlet structure consisting of a 50 m long broad crested weir, spillway and scour pool. Outlet structure to include toe wall and concrete block surface treatment. Designed to convey flows of 0.469 m3/s (2 year event) to 17.946 m3/s (100 year event) and to function as an emergency overflow.

AND

- **an outlet channel**, 340 m long, with 15.0 m bottom width, 0.1% longitudinal slope and 3:1 side slopes, complete with a 9000 mm x 2400 mm culvert crossing under Street 18.

Previous Works:

Interim West Clarke Drain realignment (catchment area approximately 109 hectares):

- construction of a new ditch to redirect the West Clarke Drain flows consisting of:

- a ditch approximately 1.0 m deep with a 4.0 m wide bottom and 3:1 side slopes, with approximately 595 m at a slope of 0.12% and approximately 572.5 m at a slope of 0.10%, designed to convey the 100-year flows of 4.62 m^3/s and 4.85 m^3/s respectively;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

1. "*Approval* " means this entire document and any schedules attached to it, and the application;

2. "*Director* " means a person appointed by the Minister pursuant to section 5 of the *EPA* for the purposes of Part II.1 of the *EPA* ;

3. "*District Manager* " means the District Manager of the appropriate local District Office of the *Ministry* , where the *Works* are geographically located;}

4. "*EPA* " means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;

5. "*Equivalent* " means a substituted oil and grit separator that meets the required quality and performance standards of the approved oil and grit separator;

6. "*Interim Works* " means the interim stormwater management works, described in this *Approval* and that are to be used for short-term purposes only in accordance with this *Approval,* until otherwise approval for an extension of this period has been granted;

7. "*Ministry* " means the ministry of the government of Ontario responsible for the *EPA* and *OWRA* and includes all officials, employees or other persons acting on its behalf;

8. "*Owner* " means Mattamy (Half Moon Bay) Limited, and includes its successors and assignees;

9. "*OWRA* " means the *Ontario Water Resources Act, R.S.O. 1990, c. O.40* , as amended;

10. "*Previous Works* " means those portions of the sewage Works previously approved under an Approval;

11. "*Proposed Works* " means the sewage works described in the *Owner's* application, this *Approval* , to the extent approved by this *Approval* ;

12. "*Works* " means the sewage Works described in the *Owner's* application, and this *Approval* , and includes *Proposed Works* and *Previous Work* .

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The *Owner* shall ensure that any person authorized to carry out work on or operate any aspect of the *Works* is notified of this *Approval* and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the *Owner* shall design, build, install, operate and maintain the *Works* in accordance with the description given in this *Approval*, and the application for approval of the *Works*.

3. Where there is a conflict between a provision of any document in the schedule referred to in this *Approval* and the conditions of this *Approval*, the conditions in this *Approval* shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this *Approval* are severable. If any condition of this *Approval*, or the application of any requirement of this *Approval* to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this *Approval* shall not be affected thereby.

6. The issuance of, and compliance with the conditions of, this *Approval* does not:

   a. relieve any person of any obligation to comply with any provision of any applicable statute, regulation or other legal requirement, including, but not limited to, the obligation to obtain approval from the local conservation authority/MNR necessary to construct or operate the sewage works; or

   b. limit in any way the authority of the *Ministry* to require certain steps be taken to require the *Owner* to furnish any further information related to compliance with this *Approval*.

2. EXPIRY OF APPROVAL

1. This *Approval* will cease to apply to those parts of the Work which have not been constructed within five (5) years of the date of this *Approval*.

2. In the event that completion and commissioning of any portion of the *Works* is anticipated to be delayed beyond the specified expiry period, the *Owner* shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the *Works* are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. This Approval to the Interim Works shall become null and void on March 21, 2023.

3. CHANGE OF OWNER

1. The *Owner* shall notify the *District Manager* and the *Director* , in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of Owner;

    b. change of address of the *Owner* ;

    c. change of partners where the *Owner* is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act* , R.S.O. 1990, c.B17 shall be included in the notification to the *District Manager* ; or

    d. change of name of the corporation where the *Owner* is or at any time becomes a corporation, and a copy of the most current information filed under the *Corporations Information Act* , R.S.O. 1990, c. C39 shall be included in the notification to the *District Manager* .

2. In the event of any change in ownership of the *Works* , other than a change to a successor municipality, the *Owner* shall notify in writing the succeeding owner of the existence of this *Approval* , and a copy of such notice shall be forwarded to the *District Manager* and the *Director* .

3. The *Owner* shall ensure that all communications made pursuant to this condition refer to the number at the top of this *Approval* .

4. Notwithstanding any other requirements in this *Approval* , upon transfer of the ownership or assumption of the *Works* to a municipality if applicable, any reference to the *District Manager* shall be replaced with the *Water Supervisor* .

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this *Approval* can be constructed but not operated until the proposed stormwater management facilities in this *Approval* or any other *Approval* that are designed to service the storm sewers or other stormwater conveyance are in operation.

2. The *Owner* shall make all necessary investigations, take all necessary steps and obtain all necessary approvals so as to ensure that the physical structure, siting and operations of the *Works* do not constitute a safety or health hazard to the general public.

3. The *Owner* shall inspect and ensure that the design minimum liquid retention volume is maintained in the *Works* at all times, except when maintenance is required.

4. The *Owner* shall undertake an inspection of the condition of the *Works* , at least once a year, and undertake any necessary cleaning and maintenance to ensure that sediment, debris and excessive decaying vegetation are removed from the *Works* to prevent the excessive build-up of sediment, oil/grit, debris and/or decaying vegetation, to avoid reduction of the capacity and/or permeability of the *Works* , as applicable. The *Owner* shall also regularly inspect and clean out the inlet to and outlet from the *Works* to ensure that these are not obstructed.

5. The *Owner* shall design, construct and operate the *Works* with the objective that the effluent from the *Works* is essentially free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration on the receiving waters.

6. The *Owner* shall maintain a logbook to record the results of these inspections and any cleaning and maintenance operations undertaken, and shall keep the logbook at the *Owner's* administration office for inspection by the *Ministry* . The logbook shall include the following:

    a. the name of the *Works* ; and

    b. the date and results of each inspection, maintenance and cleaning, including an estimate of the quantity of any materials removed and method of clean-out of the *Works* .

7. The *Owner* shall prepare an operations manual prior to the commencement of operation of the *Works* that includes, but is not necessarily limited to, the following information:

    a. operating and maintenance procedures for routine operation of the *Works* ;

    b. inspection programs, including frequency of inspection, for the *Works* and the methods or tests employed to detect when maintenance is necessary;

    c. repair and maintenance programs, including the frequency of repair and maintenance for the *Works* ;

    d. contingency plans and procedures for dealing with potential spills and any other abnormal situations and for notifying the *District Manager* ; and

    e. procedures for receiving, responding and recording public complaints, including recording any follow-up actions taken.

8. The *Owner* shall maintain the operations manual current and retain a copy at the location of the *Works* for the operational life of the *Works* . Upon request, the *Owner* shall make the manual available to *Ministry* staff.

5. TEMPORARY EROSION AND SEDIMENT CONTROL

1. The *Owner* shall install and maintain temporary sediment and erosion control measures during construction and conduct inspections once every two (2) weeks and after each significant storm event (a significant storm event is defined as a minimum of 25 mm of rain in any 24 hours period). The inspections and maintenance of the temporary sediment and erosion control measures shall continue until they are no longer required and at which time they shall be removed and all disturbed areas reinstated properly.

2. The *Owner* shall maintain records of inspections and maintenance which shall be made available for inspection by the *Ministry* , upon request. The record shall include the name of the inspector, date of inspection, and the remedial measures. if any, undertaken to maintain the temporary sediment and erosion control measures.

6. MONITORING AND RECORDING

The *Owner* shall, upon commencement of operation of the *Works* , carry out the following monitoring program:

1. All samples and measurements taken for the purposes of this *Approval* are to be taken at a time and in a location characteristic of the quality and quantity of the effluent stream over the time period being monitored.

2. Samples shall be collected at the following sampling points, at the frequency specified, by means of the specified sample type and analyzed for each parameter listed and all results recorded, as outlined in Schedule "B".

3. The methods and protocols for sampling, analysis and recording shall conform, in order of precedence, to the methods and protocols specified in the following:

    a. the *Ministry's* Procedure F-10-1, "Procedures for Sampling and Analysis Requirements for Municipal and Private Sewage Treatment Works (Liquid Waste Streams Only)", as amended from time to time by more recently published editions;

    b. the *Ministry's* publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (January 1999), ISBN 0-7778-1880-9, as amended from time to time by more recently published editions; and

    c. the publication "Standard Methods for the Examination of Water and Wastewater" (21st edition), as amended from time to time by more recently published editions.

7. REPORTING

1. One (1) week prior to the start-up of the operation of the *Works* , the *Owner* shall notify the *District Manager* (in writing) of the pending start-up date.

2. The *Owner* shall, upon request, make all manuals, plans, records, data, procedures and supporting documentation available to *Ministry* staff.

3. The *Owner* shall prepare and submit a performance report to the *District Manager* on an annual basis, within ninety (90) days following the end of the period being reported upon. The first such report shall cover the first annual period following the commencement of operation of the *Works* and subsequent reports shall be submitted to cover successive annual periods following thereafter. The reports shall contain, but shall not be limited to, the following information:

    a. a summary and interpretation of all monitoring data and an overview of the success and adequacy of the *Works* , including demonstration using the monitoring data that the appropriate level of quality control has been achieved;

    b. a description of any operating problems encountered and corrective actions taken;

    c. a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the *Works* , including an estimate of the quantity of any materials removed from the *Works* ;

    d. a summary of the calibration and maintenance carried out on all monitoring equipment;

    e. a summary of any complaints received during the reporting period and any steps taken to address the complaints;

    f. a summary of all spill or abnormal discharge events; and

    g. any other information the *District Manager* requires from time to time.

SCHEDULE "A"

1. Application for Approval of Sewage Works , dated November 2, 2012, submitted by Mark Parsons, President of Mattamy (Half Moon Bay) Limited, and supporting documentation;
2. Email from Jennifer Ailey of David Schaeffer Engineering Ltd. to the Ministry, dated February 1, 2013;
3. Application for Approval of Municipal and Private Sewage Works, dated December 4, 2013 and received on February 28, 2014, submitted by the City of Ottawa;
4. Copy of letter from Jennifer Ailey of David Schaeffer Engineering Ltd. to the City of Ottawa, dated February 24, 2013, and supporting documentation;
5. Erosion Control Plan, Sheet 1 and Siltation Control Plan Details, Sheet 2, dated January 20, 2014, prepared by David Schaeffer Engineering Ltd.;
6. E-mail from Jennifer Ailey of David Schaeffer Engineering Ltd. to the Ministry, dated May 30, 2014;
7. Application for Approval of Municipal and Private Sewage Works, dated June 7, 2016 and received on June 9, 2016, submitted by the Mattamy (Half Moon Bay) Limited;
8. Application for Environmental Compliance Approval, dated February 13, 2018, and received on February 15, 2018, including final plans and specifications prepared by David Schaeffer Engineering Ltd.;
9. Transfer of Review Letter of Recommendation, dated February 9, 2018 and signed by Charles Warnock, Program Manager, Development Review, City of Ottawa.
10. Emails from Jennifer Ailey, David Schaeffer Engineering Ltd., dated March 19, 2018 and Jeffrey Shillington, dated March 20, 2018 and March 21, 2018 responses to draft ECA sent by Ricki Allum, Ministry of the Environment and Climate Change dated March 16, 2018.

SCHEDULE "B"

Table 1: Effluent Monitoring

(Samples to be collected from the influent and effluent streams of the Half Moon Bay West - Clarke Stormwater Management Pond)

Sample Type	Grab
Frequency	Three (3) rainfall *Wet Events* per year, with two (2) of the events occurring between May and September
Parameters	Total Suspended Solids, Phosphorus and Temperature

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the *Works* are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the *Approval* and the practice that the *Approval* is based on the most current document, if several conflicting documents are submitted for review. Condition 1.6 is included to emphasize that the issuance of this *Approval* does not diminish any other statutory and regulatory obligations to which the *Owner* is subject in the construction, maintenance and operation of the *Works* . The Condition specifically highlights the need to obtain any necessary conservation authority approvals. The Condition also emphasizes the fact that this *Approval* doesn't limit the authority of the *Ministry* to require further information.

2. Condition 2 is included to ensure that, when the *Works* are constructed, the *Works* will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the *Ministry* records are kept accurate and current with respect to approved Works and to ensure that subsequent owners of the *Works* are made aware of the *Approval* and continue to operate the *Works* in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management *Works* are also constructed. This Condition is included as regular inspection and necessary removal of sediment and excessive decaying vegetation from the *Works* are required to mitigate the impact of sediment, debris and/or decaying vegetation on the treatment capacity of the *Works* . The Condition also ensures that adequate storage is maintained in the *Works* at all times as required by the design. Furthermore, this Condition is included to ensure that the *Works* are operated and maintained to function as designed.

5. Condition 5 is included as installation, regular inspection and maintenance of the temporary sediment and erosion control measures is required to mitigate the impact on the downstream receiving watercourse during construction until they are no longer required.

6. Condition 6 is included to enable the *Owner* to evaluate and demonstrate the performance of the *Works* , on a continual basis, so that the *Works* are properly operated and maintained at a level which is consistent with the design objectives specified in the *Approval* and that the *Works* do not cause any impairment to the receiving watercourse or the environment.

7. Condition 7 is included to provide a performance record for future references, to ensure that the *Ministry* is made aware of problems as they arise, and to provide a compliance record for all the terms and conditions outlined in this *Approval* , so that the *Ministry* can work with the *Owner* in resolving any problems in a timely manner.

Upon issuance of the environmental compliance approval, I hereby revoke Approval No(s). 1153-ACHP3E issued on August 17, 2016

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

- a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
- b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

Pursuant to subsection 139(3) of the Environmental Protection Act, a hearing may not be required with respect to any terms and conditions in this environmental compliance approval, if the terms and conditions are substantially the same as those contained in an approval that is amended or revoked by this environmental compliance approval.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of Part II.1 of the Environmental Protection Act
Ministry of the Environment and Climate Change
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 11th day of April, 2018

C. Labarge

Christina Labarge, P.Eng.
Director

appointed for the purposes of Part II.1 of the
Environmental Protection Act

RA/

c: District Manager, MOECC Ottawa
Jason Rumer, Mattamy (Half Moon Bay) Limited
Jeffery Shillington, City of Ottawa
Jennifer Ailey, David Schaeffer Engineering Ltd.

888 A9.3

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 2725-B5VKYF
Issue Date: October 30, 2018

Mattamy (Half Moon Bay) Limited
50 Hines Road, Suite 100
Ottawa, Ontario
K2K 2M5

Site Location: Half Moon Bay West – Phase 1
Lots 10-12, Concession 3 (Rideau Front)
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

the establishment of wastewater infrastructure Works located in the City of Ottawa, consisting of the following:

- **storm sewers** on rue Apolune Street (from Station 0-021.13 to Station 0+466.68), croissant Aphelion Crescent (West Leg) (from Station 0-005.38 to Station 0+186.83), croissant Aphelion Crescent (South Leg) (from Station 0-005.74 to Station 0+171.59), croissant Aphelion Crescent (East Leg) (from Station 0-021.38 to Station 0+189.60), place Umbra Place (from Station 0+002.00 to Station 0+146.41), chemin Greenbank Road (from Station 4+976.10 to Station 5+387.68), cours Bellatrix Walk (from Station 0-001.99 to Station 0+175.00), voie Merak Way (from Station 0+002.00 to Station 0+104.49), voie Watercolours Way (from Station 0-011.89 to Station 0+386.39), bois Celestial Grove (from Station 0-001.99 to Station 0+235.66), terrasse Alcor Terrace (from Station 0-002.84 to Station 0+242.86), Cambrian Road (from Station 0+812.53 to Station 971.08), Stormwater Management Pond Inlet Headwall 2 and Servicing Block (from Station 0+000.00 to Station 0+221.12), and Stormwater Management Pond Inlet Headwall 1 (from Station 0-000.714 to Station 0+060.00), discharging to the Clarke Stormwater Management Pond, located in Half Moon Bay West;
- **sanitary sewers** on rue Apolune Street (from Station 0-004.67 to Station 0+356.20), croissant Aphelion Crescent (West Leg) (from Station 0-005.05 to Station 0+189.60), croissant Aphelion Crescent (South Leg) (from Station 0-005.74 to Station 0+171.59), croissant Aphelion Crescent (East Leg) (from Station 0-020.00 to Station 0+189.60), place Umbra Place (from Station 0+000.00 to Station 0+148.41), cours Bellatrix Walk (from Station 0+000.00 to Station 0+177.03), voie Merak Way (from Station 0+000.00 to Station 0+106.51), voie Watercolours Way (from Station 0-011.89 to Station 0+388.55), bois Celestial Grove (from Station 0+000.00 to Station 0+214.79), terrasse Alcor Terrace (from Station 0-000.57 to Station 0+242.86), and Cambrian Road (from Station 0+556.66 to Station 950.81), discharging to existing sanitary sewers, located on Cambrian Road;

- **temporary diversion ditch** in Half Moon Bay West – Phase 1, discharging to the Clarke Stormwater Management Pond located in Half Moon Bay West: Leg 1 – approximately 413.0 metres long at 0.32% average bottom slope, 3:1 side slopes, approximately 2.0 metres bottom width; Leg 2 – approximately 32.0 metres long at 0.79% average bottom slope, 2.5:1 side slopes, approximately 4.0 metres bottom width; Leg 3 – approximately 136.7 metres long at 1.80% average bottom slope, 3:1 side slopes, approximately 4.0 metres bottom width; and

- **temporary culvert** in Half Moon Bay West – Phase 1, 1600 millimetre diameter, approximately 39.0 metres long at 0.50% slope, discharging to the temporary diversion ditch and Clarke Stormwater Management Pond, located in Half Moon Bay West;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

1. "Approval" means this entire document and any schedules attached to it, and the application;

2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;

3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;

4. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;

5. "Interim Works" means the interim Works, described in this Approval and that are to be used for short-term purposes only in accordance with this Approval, until otherwise approval for an extension of this period has been granted;

6. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;

7. "Owner" means Mattamy (Half Moon Bay) Limited, and includes its successors and assignees;

8. "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;

9. "Works" means the sewage Works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. This Approval to the Interim Works shall expire and become null and void on October

26, 2023.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

    a. change of Owner;

    b. change of address of the Owner;

    c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act,* R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

    d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

Schedule "A"

1. Application for Environmental Compliance Approval, dated October 4, 2018, received on October 11, 2018, submitted by Mattamy (Half Moon Bay) Limited;
2. Transfer of Review Letter of Recommendation, dated October 9, 2018 and signed by Jeff Shillington, P.Eng., Project Manager, Development Review, Planning, Infrastructure and Economic Development Department, City of Ottawa;
    a. Final Plans and Specifications prepared by David Schaeffer Engineering Ltd.
    b. Pipe Data Form - Watermain, Storm Sewer, Sanitary Sewer, and Forcemain Design Supplement to Application for Approval for Water and Sewage Works.
    c. Hydraulic Design Sheets prepared by David Schaeffer Engineering Ltd.
3. Emails dated October 24, 2018 and October 25, 2018 from Jeff Shillington, P.Eng., Project Manager, Development Review, Planning, Infrastructure and Economic Development Department, City of Ottawa to Florence Poon, MECP.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment,
Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 30th day of October, 2018

C. Labarge

Christina Labarge, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

FP/
c: District Manager, MECP Ottawa
Clerk, City of Ottawa (File No. D07-16-16-0023)
Jeff Shillington, P.Eng., Project Manager, City of Ottawa
Peter McKay, Infrastructure Renewal Program Manager, Infrastructure Assessment - Water Resources, City of Ottawa
Jennifer Ailey, P.Eng., David Schaeffer Engineering Ltd. ✓

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 3997-BF2GWX
Issue Date: August 16, 2019

Mattamy (Half Moon Bay) Limited
50 Hines Road, Unit 100
Kanata, Ontario
K2K 2M5

Site Location: Half Moon Bay West Subdivision, Phase 2A
Part of Lot 11 and 12, Concession 3 (Rideau Front)
City of Ottawa, Ontario

You have applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:

the establishment of wastewater infrastructure Works located in the City of Ottawa, consisting of the following:

- **sanitary sewers** on Proxima Terrace (from approximately 77 metres southeast of Perseus Avenue to Megrez Way), Celestial Grove (from approximately 95 metres south of Proxima Terrace to Perseus Avenue), Perseus Avenue (from Proxima Terrace to Greenbank Road, Perseus Avenue (from approximately 69 metres east of Proxima Terrace to Greenbank Road), Regulus Ridge (from approximately 126 metres north of Alcor Terrace to Alcor Terrace), Regulus Ridge (from approximately 77 metres south of Proxima Terrace to Proxima Terrace), Megrez Way (from approximately 100 metres north of Alcor Terrace to Alcor Terrace), Megrez Way (from approximately 28 metres south of Proxima Terrace to Proxima Terrace), Alcor Terrace (from Megrez Way to Celestial Grove) and Greenbank Road (from Perseus Avenue to Pearl Dace Crescent), discharging to existing sewers, located on Pearl Dace Crescent; and

- **storm sewers** on Proxima Terrace (from approximately 47 metres southeast of Perseus Avenue to Megrez Way), Celestial Grove (from Perseus Avenue to approximately 86 metres south of Proxima Terrace), Perseus Avenue (from approximately 70 metres east of Proxima Terrace to approximately 35.5 metres west of Greenbank Road), Regulus Ridge (from approximately 125 metres north of Alcor Terrace to Alcor Terrace), Regulus Ridge (from approximately 77 metres south of Proxima Terrace to Proxima Terrace), Megrez Way (from approximately 103 metres north of Alcor Terrace to Alcor Terrace), Megrez Way (from approximately 28 metres south of Proxima Terrace to Proxima Terrace), Alcor Terrace (from Megrez Way to Celestial Grove), discharging to existing sewers, located on Half

Moon Bay West Subdivision, Phase 1;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

DEFINITIONS

1. "Approval" means this entire document and any schedules attached to it, and the application;
2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;
3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;
4. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;
5. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;
6. "Owner" means Mattamy (Half Moon Bay) Limited, and includes its successors and assignees;
7. "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;
8. "Works" means the sewage Works described in the Owner's application, and this Approval.

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS AND CONDITIONS

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.
2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval,

and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

   a. change of Owner;

   b. change of address of the Owner;

   c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act,* R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or

   d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the

District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.

3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

Schedule "A"

1. Application for Environmental Compliance Approval, dated July 11, 2019, received on July 30. 2019, submitted by Mattamy (Half Moon Bay) Limited;

2. Transfer of Review Letter of Recommendation, dated July 26, 2019, and revised on August 13, 2019, and signed by Jeff Shillington, P.Eng., Project Manager, Planning, Infrastructure and Economic Development Department, City of Ottawa;

    a. Final Plans and Specifications prepared by David Schaeffer Engineering Ltd.

    b. Pipe Data Form - Watermain, Storm Sewer, Sanitary Sewer, and Forcemain Design Supplement to Application for Approval for Water and Sewage Works.

    c. Hydraulic Design Sheets prepared by David Schaeffer Engineering Ltd.

3. Emails dated August 12, 2019 and August 13, 2019 from Shillington, P.Eng., Project Manager, Planning, Infrastructure and Economic Development Department, City of Ottawa.

The reasons for the imposition of these terms and conditions are as follows:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal
655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment,
Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the**

Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 16th day of August, 2019

Youssouf Kalogo, P.Eng.
Director
appointed for the purposes of Part II.1 of the
Environmental Protection Act

RB/

c: District Manager, MECP Ottawa
Lily Xu, Manager, DR South Branch
Clerk, City of Ottawa (File No. D07-16-16-0023)
Jennifer Ailey, David Schaeffer Engineeirng Ltd.
Jeff Shillington, P.Eng., Project Manager, Planning, Infrastructure and Economic Development Department, City of Ottawa
Peter McKay, Infrastructure Renewal Program Manager, Infrastructure Assessment- Water Resources Asses Unit (MC 26-61)

Ontario

Ministry of the Environment, Conservation and Parks
Ministère de l'Environnement, de la Protection de la nature et des Parcs

ENVIRONMENTAL COMPLIANCE APPROVAL

NUMBER 3263-BKWJW9
Issue Date: January 28, 2020

Mattamy (Half Moon Bay) Limited
50 Hines Road, Suite 100
Kanata, Ontario
K2K 2M5

Site Location: Half Moon Bay West - Phase 2B
Lots 10 - 12, Concession 3 (Rideau Front)
City of Ottawa

You have applied under section 20.2 of Part II.1 of the *Environmental Protection Act, R.S.O. 1990, c. E. 19 (Environmental Protection Act) for approval of:*

the establishment of wastewater infrastructure Works located in the City of Ottawa, consisting of the following:

- **sanitary sewers** on Ursid Mews (from approximately 14 metres southeast of Atima Circle (north leg) to Atima Circle (south leg)), Atima Circle (north leg) (from Atima Circle (west leg) to Apolune Street), Atima Circle (west leg) (from Atima Circle (north leg) to Apolune Street), Apolune Street (from approximately 79 metres southeast of Atima Circle (south leg) to approximately 17 metres northwest of Perseus Avenue), Nokomis Place (from approximately 15 metres northeast of Apolune Street to approximately 14 metres northwest of Perseus Avenue), Perseus Avenue (from approximately 10 metres southwest of Apolune Street to Proxima Terrace and from approximately 14 metres east of Proxima Terrace to approximately 71 metres east of Proxima Terrace), Proxima Terrace (from approximately 14 metres northwest of Perseus Avenue), discharging to existing sanitary sewers, located on Perseus Avenue;

- **storm sewers** on Ursid Mews (from approximately 10 metres southeast of Atima Circle (north leg) to Atima Circle (south leg)), Atima Circle (north leg) (from Atima Circle (west leg) to Apolune Street), Atima Circle (west leg) (from Atima Circle (north leg) to Atima Circle (south leg)), Atima Circle (south leg) (from Atima Circle (west leg) to Apolune Street), Apolune Street (from approximately 16 metres northwest of Perseus Avenue to approximately 29 metres east of Apolune Street), Nokomis Place (from approximately 11 metres northwest of Perseus Avenue to Perseus Avenue and from approximately 15 metres southeast of Perseus Avenue to Apolune Street), Perseus

Avenue (from approximately 12 metres southwest of Apolune Street to Nokomis Place and from Proxima Terrace to approximately 71 metres east of Proxima Terrace), Proxima Terrace (from approximately 11 metres northwest of Perseus Avenue to Perseus Avenue), discharging to existing storm sewers, located on the Clarke Stormwater Management Pond Block;

- **storm sewers** on Greenbank Road (from approximately 40 metres south of Cambrian Road to approximately 20 metres south of Cambrian Road), discharging to existing sewers, located on Greenbank Road;

including erosion/sedimentation control measures during construction and all other controls and appurtenances essential for the proper operation of the aforementioned Works;

all in accordance with the submitted application and supporting documents listed in Schedule "A" forming part of this approval.

For the purpose of this environmental compliance approval, the following definitions apply:

DEFINITIONS

1. "Approval" means this entire document and any schedules attached to it, and the application;
2. "Director" means a person appointed by the Minister pursuant to section 5 of the EPA for the purposes of Part II.1 of the EPA;
3. "District Manager" means the District Manager of the appropriate local District Office of the Ministry, where the Works are geographically located;
4. "EPA" means the *Environmental Protection Act,* R.S.O. 1990, c.E.19, as amended;
5. "Ministry" means the ministry of the government of Ontario responsible for the EPA and OWRA and includes all officials, employees or other persons acting on its behalf;
6. "Owner" means Mattamy (Half Moon Bay) Limited, and includes its successors and assignees;
7. "OWRA" means the Ontario Water Resources Act, R.S.O. 1990, c. O.40, as amended;
8. "Works" means the sewage Works described in the Owner's application, and this Approval.(applicable definitions pasted in or entered by Reviewer)

You are hereby notified that this environmental compliance approval is issued to you subject to the terms and conditions outlined below:

TERMS and CONDITIONS:

1. GENERAL CONDITIONS

1. The Owner shall ensure that any person authorized to carry out work on or operate any aspect of the Works is notified of this Approval and the conditions herein and shall take all reasonable measures to ensure any such person complies with the same.

2. Except as otherwise provided by these Conditions, the Owner shall design, build, install, operate and maintain the Works in accordance with the description given in this Approval, and the application for approval of the Works.

3. Where there is a conflict between a provision of any document in the schedule referred to in this Approval and the conditions of this Approval, the conditions in this Approval shall take precedence, and where there is a conflict between the documents in the schedule, the document bearing the most recent date shall prevail.

4. Where there is a conflict between the documents listed in Schedule "A" and the application, the application shall take precedence unless it is clear that the purpose of the document was to amend the application.

5. The conditions of this Approval are severable. If any condition of this Approval, or the application of any requirement of this Approval to any circumstance, is held invalid or unenforceable, the application of such condition to other circumstances and the remainder of this Approval shall not be affected thereby.

2. EXPIRY OF APPROVAL

1. This Approval will cease to apply to those parts of the Works which have not been constructed within five (5) years of the date of this Approval.

2. In the event that completion and commissioning of any portion of the Works is anticipated to be delayed beyond the specified expiry period, the Owner shall submit an application of extension to the expiry period, at least twelve (12) months prior to the end of the period. The application for extension shall include the reason(s) for the delay, whether there is any design change(s) and a review of whether the standards applicable at the time of Approval of the Works are still applicable at the time of request for extension, to ensure the ongoing protection of the environment.

3. CHANGE OF OWNER

1. The Owner shall notify the District Manager and the Director, in writing, of any of the following changes within thirty (30) days of the change occurring:

   a. change of Owner;
   b. change of address of the Owner;
   c. change of partners where the Owner is or at any time becomes a partnership, and a copy of the most recent declaration filed under the *Business Names Act,* R.S.O. 1990, c.B17 shall be included in the notification to the District Manager; or
   d. change of name of the corporation where the Owner is or at any time becomes a corporation, and a copy of the most current information filed under the Corporations Information Act, R.S.O. 1990, c. C39 shall be included in the notification to the District Manager.

2. In the event of any change in ownership of the Works, other than a change to a successor municipality, the Owner shall notify in writing the succeeding owner of the existence of this Approval, and a copy of such notice shall be forwarded to the District Manager and the Director.
3. The Owner shall ensure that all communications made pursuant to this condition refer to the number at the top of this Approval.

4. OPERATION AND MAINTENANCE

1. If applicable, any proposed storm sewers or other stormwater conveyance in this Approval can be constructed but not operated until the proposed stormwater management facilities in this Approval or any other Approval that are designed to service the storm sewers or other stormwater conveyance are in operation.

Schedule "A"

1. Application for Environmental Compliance Approval, dated December 19, 2019, received on January 3, 2020, submitted by Mattamy (Half Moon Bay) Limited;

2. Transfer of Review Letter of Recommendation, dated December 20, 2019 and signed by Jeff Shillington, P.Eng., Project Manager, Development Review, South Branch, Planning and Infrastructure Portfolio, Planning, Infrastructure & Economic Development Department, City of Ottawa;

    a. Final Plans and Specifications prepared by David Schaeffer Engineering Ltd.

    b. Pipe Data Form - Watermain, Storm Sewer, Sanitary Sewer, and Forcemain Design Supplement to Application for Approval for Water and Sewage Works.

    c. Hydraulic Design Sheets prepared by David Schaeffer Engineering Ltd.

3. Email dated January 20, 2020, from Anthony Temelini, P.Eng., Junior Project Manager, David Schaeffer Engineering Ltd.

The reasons for the imposition of these terms and conditions are as follows:

REASONS:

1. Condition 1 is imposed to ensure that the Works are constructed and operated in the manner in which they were described and upon which approval was granted. This condition is also included to emphasize the precedence of conditions in the Approval and the practice that the Approval is based on the most current document, if several conflicting documents are submitted for review.

2. Condition 2 is included to ensure that, when the Works are constructed, the Works will meet the standards that apply at the time of construction to ensure the ongoing protection of the environment.

3. Condition 3 is included to ensure that the Ministry records are kept accurate and current with respect to the approved Works and to ensure that subsequent owners of the Works are made aware of the Approval and continue to operate the Works in compliance with it.

4. Condition 4 is included to prevent the operation of stormwater pipes and other conveyance until such time that their required associated stormwater management Works are also constructed.

In accordance with Section 139 of the Environmental Protection Act, you may by written Notice served upon me and the Environmental Review Tribunal within 15 days after receipt of this Notice, require a hearing by the Tribunal. Section 142 of the Environmental Protection Act provides that the Notice requiring the hearing shall state:

a. The portions of the environmental compliance approval or each term or condition in the environmental compliance approval in respect of which the hearing is required, and;
b. The grounds on which you intend to rely at the hearing in relation to each portion appealed.

The Notice should also include:

1. The name of the appellant;
2. The address of the appellant;
3. The environmental compliance approval number;
4. The date of the environmental compliance approval;
5. The name of the Director, and;
6. The municipality or municipalities within which the project is to be engaged in.

And the Notice should be signed and dated by the appellant.

This Notice must be served upon:

The Secretary*
Environmental Review Tribunal

The Director appointed for the purposes of
Part II.1 of the Environmental Protection Act
Ministry of the Environment,

655 Bay Street, Suite 1500
Toronto, Ontario
M5G 1E5

AND

Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, Ontario
M4V 1P5

* **Further information on the Environmental Review Tribunal's requirements for an appeal can be obtained directly from the Tribunal at: Tel: (416) 212-6349, Fax: (416) 326-5370 or www.ert.gov.on.ca**

The above noted activity is approved under s.20.3 of Part II.1 of the Environmental Protection Act.

DATED AT TORONTO this 28th day of January, 2020

A. Ahmed

Aziz Ahmed, P.Eng.
Director
appointed for the purposes of Part II.1 of the *Environmental Protection Act*

OS/
c: District Manager, MECP Ottawa
Clerk, City of Ottawa
Jennifer Ailey, David Schaeffer Engineering Ltd. (jailey@dsel.ca)
Anthony Temelini, David Schaeffer Engineering Ltd. (atemelini@dsel.ca)
Jeff Shillington, Project Manager, Development Review, South Branch, Planning and Infrastructure Portfolio, Planning, Infrastructure & Economic Development Department, City of Ottawa (jeff.shillington@ottawa.ca)
(File No.: D07-16-16-0023)

RIDEAU VALLEY
CONSERVATION AUTHORITY

3889 Rideau Valley Drive, P.O. Box 599, Manotick, ON K4M 1A5
tel 613-692-3571 | 1-800-267-3504 | fax 613-692-0831 | www.rvca.ca

A member of Conservation Ontario

LETTER OF PERMISSION - ONTARIO REGULATION 174/06, SECTION 28 CONSERVATION AUTHORITIES ACT 1990, AS AMENDED.

Date March 15, 2018
File: RV5-01/18
Contact: Hal Stimson
(613) 692-3571 ext. 1127
hal.stimson@rvca.ca

Mr. Jason Rumer
Mattamy (Half Moon Bay) Ltd
50 Hines Road, Suite 100
Ottawa, Ontario
K2K 2M5

Permit to alter a waterway under Section 28 of the Conservation Authorities Act for stormwater outlet at Lot 11-13 Concession 3, former City of Nepean, and now in the City of Ottawa

Dear Mr. Jason Rumer

The Rideau Valley Conservation Authority has reviewed your application on behalf of Mattamy Ltd. and understands the proposal to be for the construction of an outlet channel for a proposed storm water management facility which will outlet/connect the proposed Clarke Storm Water Management Pond to the Jock River

This proposal was reviewed under Ontario Regulation 174/06, the "*Development, Interference with Wetlands and Alterations to Shorelines and Watercourses*" regulation.

PERMISSION AND CONDITIONS

By this letter the Rideau Valley Authority hereby grants you approval to undertake this project as outlined in your permit application but subject to the following conditions:

1. Approval is subject to the understanding of the project as described above and outlined in the application and submitted drawings including:

- Drawing Nos. P2, P4, P7, P8, (4 sheets) for Project No. 16-888 titled Half Moon Bay West Clarke SWM Pond, all revision No. 4, dated 17-12-07 as prepared by DSEL Engineering Ltd. and stamped by W. Liu, P. Eng.
- Drawing Nos. GEO-1, GEO-2, DET-1, DET-2 (4 sheets) for Project No. 17125 titled Half Moon Bay West Mattamy Homes, all revision No. 1, dated Dec 17 as prepared by GEOMorphix and stamped by Paul V. Villard, P. Geo.
- Drawing Sheet L0, L1, L2 (3 sheets) for Job No. 18-012 titled Mattamy Homes Clarke Pond Half Moon Bay West, all revision No. 1, dated Jan. 15/18 as prepared by NAK Design Strategies and stamped by Silvano Tardella, L.A.
- Report titled Design Brief for the Clarke Stormwater Management Pond for the Half Moon Bay West Subdivision Davidson Lands by DSEL Project No. 16-888 dated Revised October 19, 2017.
- Report titled Technical Design Brief: Clarke SWM Pond Outlet Channel and Spillway Design by Geomorphix, dated December 1, 2017.

  No conditions are subject to change/revision by the on-site contractor(s).

2. **A De-watering Plan and Sediment and Erosion Control Plan must be submitted to this office by the contractor for review prior to construction activities.**

3. Any excess excavated material, as a result of the work, must be disposed of in a suitable location outside any regulatory floodplain and fill regulated area.

4. It is recommended that you retain the services of a professional engineer to conduct on-site inspections to ensure adequacy of the work, verify stability of the final grade and slopes and confirm all imported fill is of suitable type and has been adequately placed and compacted.

5. **There will be no in-water works between March 15 and June 30, of any given year to protect local aquatic species populations during their spawning and nursery time periods.**

6. It is recommended that you ensure your contractor(s) are provided with a copy of this letter so as to ensure compliance with the conditions listed herein.

7. Work in-water shall not be conducted at times when flows are elevated due to local rain events, storms or seasonal floods. Existing stream flows must be maintained downstream of the de-watered work area without interruption, during all stages of the work. There must be no increase in water levels upstream of the de-watered work area.

8. Any aquatic species (fish, turtles) trapped within an enclosed work area are to be safely relocated outside of the enclosed area to the main watercourse downstream of the work zone.

9. All in-stream work should be completed in the dry by de-watering the work area and diverting and/or pumping any flows around cofferdams placed at the limits of the work area. Silt or debris that has accumulated around the temporary cofferdams should be cautiously removed prior to their withdrawal. No channel modifications or dredging is permitted or implied by this letter.

10. Sediment barriers should be used on site in an appropriate method according to the Ontario Provincial Standard Specifications (OPSS) for silt barriers as a minimum. Soil type, slope of land, drainage area, weather, predicted sediment load and deposition should be considered when selecting the type of sediment/erosion control.

11. Sediment and erosion control measures shall be in place before any excavation or construction works commence. All sediment/erosion control measures are to be monitored regularly by experienced personnel and maintained as necessary. In the event that the erosion and sedimentation control measures are deemed not to be performing adequately, the contractor shall undertake immediate additional measures as appropriate to the situation to the satisfaction of the Conservation Authority.

12. The waters of the creek/drain are NOT to be considered as machine staging areas. Activities such as equipment refuelling and maintenance must be conducted away from the water to prevent entry of petroleum products, debris, or other deleterious substances into the water. Operate machinery from outside the water, or on the water in a manner that minimizes disturbance to the banks or bed of the watercourse. Equipment shall not be cleaned in the watercourse or where wash-water can enter any watercourse. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.

13. Demolition or construction debris is not to be deposited in the waters of any creek; inert concrete/asphalt debris will be considered a deleterious substance. An emergency spill kit should be kept on site in case of fluid leaks or spills from machinery.

14. All disturbed soil areas must be appropriately stabilized to prevent erosion.

15. Only clean material free from particulate matter may be placed in the water.

16. Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance. This plan is to include measures to: a) stop work, contain sediment-laden water and other deleterious substances and prevent their further migration into the watercourse and downstream receiving watercourses; b) notify the RVCA and all applicable authorities in the area c) promptly clean-up and appropriately dispose of the sediment-laden water and deleterious substances; and d) ensure clean-up measures are suitably applied so as not to result in further alteration of the bed and/or banks of the watercourse.

17. The RVCA is to receive 48 hours' notice of the proposed commencement of the works to ensure compliance with all conditions. The applicant agrees that Authority staff may visit the subject property, before, during and after project completion, to ensure compliance with the conditions as set out in this letter of permission.

18. A new application must be submitted should any work as specified in this letter be ongoing or planned for or after March 15, 2020.

19. All other approvals as might be required from the Municipality, and/or other Provincial or Federal Agencies must be obtained prior to initiation of work. This includes but is not limited to the Drainage Act, the Endangered Species Act, the Ontario Water Resources Act, Environmental Protection Act, Public Lands Act, or the Fisheries Act.

By this letter the Rideau Valley Conservation Authority assumes no responsibility or liability for any flood, erosion, or slope failure damage which may occur either to your property or the structures on it or if any activity undertaken by you adversely affects the property or interests of adjacent landowners. This letter does not relieve you of the necessity or responsibility for obtaining any other federal, provincial or municipal permits. This permit is not transferable to subsequent property owners.

Should you have any questions regarding this letter, please contact Hal Stimson at our Manotick office.

Terry K. Davidson

Terry K. Davidson P.Eng
Conservation Authority S. 28 Signing delegate
O. Reg. 174/06

c.c: J. Ailey, P. Eng. DSEL

- Pursuant to the provisions of S. 28(12) of the Conservation Authorities Act (R.S.O.1990, as amended.) any or all of the conditions set out above may be appealed to the Executive Committee of the Conservation Authority in the event that they are not satisfactory or cannot be complied with.
- Failure to comply with the conditions of approval or the scope of the project may result in the cancelling of the permission and/or initiation of legal action under S. 28(16) of the Act.
- This letter of permission does not come into full force and effect until the attached copy of this letter is returned to the Authority offices in Manotick signed and dated which return shall be taken as indicating acceptance of the conditions of the Authority's approval and acknowledgement that the details of the proposal as described in this letter are a fair and accurate representation of the proposed undertaking.

Name: ______________________________ (print)

Signed: ______________________________ Date: ______________________________

RVCA Letter of Permission —

Ont. Reg. 174/06, S. 28 *Conservation Authorities Act*
1990, As Amended.

Rideau Valley Conservation Authority
3889 Rideau Valley Drive
PO Box 599, Manotick ON K4M 1A5
T 613-692-3571 | 1-800-267-3504
F 613-692-0831 | www.rvca.ca

June 2, 2020
File: RV5-1421
Contact: hal.stimson@rvca.ca (613) 692-3571 Ext 1127

Jillian Normand
Glenview Homes (Cedarview) Ltd.
190 O'Connor St. 11th Flr
Ottawa, Ontario
K2P 2R3

Permit to alter a waterway under Section 28 of the *Conservation Authorities Act* for headwater drain relocation at Lot 11 & 12, Concession 3, former City of Nepean, now in the City of Ottawa.

Dear Jillian Normand,

The Rideau Valley Conservation Authority has reviewed your application on behalf of Glenview Homes and understands the proposal to be for:

> **The closure and relocation of an existing headwater drainage feature. The watercourse is a tributary of the Jock River and is being relocated to accommodate area development. The new design features natural channel design principles and habitat features and upon completion may reconfigure the existing flood plain. Final grades will need to be confirmed and submitted prior to RVCA accepting a change to the regulatory flood plain limits.**

This proposal was reviewed under Ontario Regulation 174/06, the "*Development, Interference with Wetlands, and Alteration to Watercourse and Shorelines"* regulation and the RVCA Development Policies (approved by the RVCA, Board of Directors), specifically Section 3.0 Alteration to Waterways. The proposal is not expected to impact the control of flooding, pollution, erosion or conservation of land providing conditions are followed.

PERMISSION AND CONDITIONS

By this letter the Rideau Valley Authority hereby grants you approval to undertake this project as outlined in your permit application but subject to the following conditions:

1. Approval is subject to the understanding of the project as described above and outlined in the application and submitted plans including:
    - Cover letter dated April 14, 2021 from L. Maxwell, B. Sc., M. Pl. of DSEL describing the project.
    - Landscape drawings by CSW titled Flagstaff HMB all revision 3, dated 18 May 2021, including Drawings, L1.0, L1.1, L1.2, L1.3, L2.1 (5 pages).

- Drawings titled Bioswale and Amphibian Habitat, Project No. 17119, all revision no. 3, dated 21/05/17, (6 pgs.) including Drawing Nos. GEO-1, GEO-2, GEO-3, DET-1, DET-2, and DET-3 as prepared by Geo Morphix and stamped by Paul V. Villard, PhD, P. Geo.
- Letter report dated April 14, 2021 from Geo Morphix Ltd. (13 pgs.)
- Drawings by DSEL titled Erosion Sediment Control Figure, Project 15-809, dated April 2021 and Temp Grading & Erosion Sediment. Drawing Figure 1, also dated April 2021.
- Monitoring program Report by Kilgour & Associates (12 Pgs.) dated April 12, 2021 signed by A. Francis, PhD.
- Patterson Group memo titled Geotechnical Recommendations dated May 18, 2021 (5 pgs.) stamped by D. J. Gilbert, P.Eng.
- Patterson Group memo titled Geotechnical Summary of Design Details dated May 5, 2021 (9 pgs.) stamped by D. J. Gilbert, P.Eng.

2. Any excess excavated material, as a result of the work must be disposed of in a suitable location outside any regulatory floodplain and fill regulated area. RVCA must be consulted to ensure fill is not placed elsewhere within a flood plain.

3. It is recommended that you retain the services of a professional engineer to conduct on-site inspections to ensure adequacy of the work, verify stability of the final grade and slopes and confirm all imported fill is of suitable type and has been adequately placed and compacted.

4. Prior to connecting the new channel and decommissioning the former channel an inspection will be completed by the RVCA and the contractor to ensure that the new channel is stable for the connection to be made.

5. **A final as built drawing of the re-aligned channel including a grading plan shall be submitted upon completion of the approved works prepared by an Ontario Land Surveyor or Professional Engineer licensed to practice in Ontario indicating that grades achieved on the site conform to those indicated on the approved plan and that the flood plain storage volumes are maintained.**

6. The detailed post effectiveness monitoring plan titled “Monitoring Program for the Realignment of a Minor Watercourse in Glenview’s Flagstaff Community and Mattamy’s Halfmoon Bay West,” prepared by Kilgour and Associates, dated April 12, 2021”. Shall be implemented as designed. Any proposed modifications to the monitoring plan are to be discussed with the RVCA prior to implementation.

7. As per the monitoring plan the program will be focused on monitoring the channel realignment over a six-year period including the year of construction (2021). Post construction monitoring is scheduled as follows: Year 1 (2022), 3 (2024), and 5 (2026) to ensure the compensation works are functioning as intended.

8. Work in-water shall not be conducted at times when flows are elevated due to local rain events, storms or seasonal floods. Existing stream flows must be maintained during all stages of the work.

9. Only clean non-contaminated fill material will be used, and all work is to occur on your property, or if on other property, only with full authorization of the owner(s).

10. Sediment barriers should be used on site in an appropriate method according to the Ontario Provincial Standard Specifications (OPSS) for silt barriers as a minimum. If the sediment and erosion control methods include silt fence it should be placed along the shoreline to prevent overland flow on disturbed areas from entering the watercourse. Soil type, slope of land, drainage area, weather, predicted sediment load and deposition should be considered when selecting the type of sediment/erosion control.

11. Demolition or construction debris is not to be deposited in the waters of any creek; inert concrete/asphalt debris will be considered a deleterious substance. An emergency spill kit should be kept on site in case of fluid leaks or spills from machinery.

12. Sediment and erosion control measures shall be in place before any excavation or construction works commence. All sediment/erosion control measures are to be monitored regularly by experienced personnel and maintained as necessary to ensure good working order. If the erosion and sedimentation control measures are deemed not to be performing adequately, the contractor shall undertake immediate additional measures as appropriate to the situation to the satisfaction of the Conservation Authority.

13. All materials and equipment used for the purpose of site preparation and project completion must be operated and stored in a manner that prevents any deleterious substance (e.g. petroleum products, silt, debris etc.) from entering the water.

14. The waters of the creek are NOT to be considered as machine staging areas. Activities such as equipment refuelling, and maintenance must be conducted away from the water to prevent entry of petroleum products, debris, or other deleterious substances into the water. All in-stream work on the new channel should be completed in the dry.

15. All equipment that is to be used near water will arrive on-site in a clean state; In order to mitigate the potential risk for invasive species recolonization within the newly excavated areas please follow the guidance in the Clean Equipment Protocol Document https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf

16. Operate machinery from outside the water, or on the water in a manner that minimizes disturbance to the banks or bed of the watercourse. Equipment shall not be cleaned in the watercourse or where wash-water can enter any watercourse. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.

17. All disturbed soil areas must be appropriately stabilized to prevent erosion.

18. It is recommended that you ensure your contractor(s) are provided with a copy of this letter to ensure compliance with the conditions listed herein.

19. Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance. This plan is to include measures to: a) stop work, contain sediment-laden water and other deleterious substances and prevent their further migration into the watercourse and downstream receiving watercourses; b) notify the RVCA and all applicable authorities in the area c) promptly clean-up and appropriately dispose of the sediment-laden water and deleterious substances; and d) ensure clean-up measures are suitably applied so as not to result in further alteration of the bed and/or banks of the watercourse.

20. **There will be no in-water works between March 15 and June 30, of any given year to protect local aquatic species populations during their spawning and nursery time periods.**

21. Any aquatic species (fish, turtles) trapped within an enclosed work area are to be safely relocated outside of the enclosed area to the main watercourse downstream of the work zone.

22. The RVCA is to receive 48 hours' notice of the proposed commencement of the works to ensure compliance with all conditions. The applicant agrees that Authority staff may visit the subject property before, during and after project completion to ensure compliance with the conditions as set out in this letter of permission.

23. A new application must be submitted should any work as specified in this letter be ongoing or planned for or after June 2, 2022.

All other approvals as might be required from the Municipality, and/or other Provincial or Federal Agencies must be obtained prior to initiation of work. This includes but is not limited to the Drainage Act, the Endangered Species Act, the Ontario Water Resources Act, Environmental Protection Act, Public Lands Act, or the Fisheries Act.

By this letter the Rideau Valley Conservation Authority assumes no responsibility or liability for any flood, erosion, or slope failure damage which may occur either to your property or the structures on it or if any activity undertaken by you adversely affects the property or interests of adjacent landowners. This letter does not relieve you of the necessity or responsibility for obtaining any other federal, provincial or municipal permits. This permit is not transferable to subsequent property owners.

Should you have any questions regarding this letter, please contact Hal Stimson.

Terry K. Davidson

____

Terry K. Davidson P.Eng
Conservation Authority S. 28 Signing delegate
O. Reg. 174/06

c.c. L. Maxwell, B. Sc., M.Pl., DSEL

- Pursuant to the provisions of S. 28(12) of the Conservation Authorities Act (R.S.O.1990, as amended.) any or all of the conditions set out above may be appealed to the Executive Committee of the Conservation Authority in the event that they are not satisfactory or cannot be complied with.
- Failure to comply with the conditions of approval or the scope of the project may result in the cancelling of the permission and/or initiation of legal action under S. 28(16) of the Act.
- Commencement of the work **and/or** a signed and dated copy of this letter indicates acknowledgement and acceptance of the conditions of the RVCA's approval letter concerning the application and the undertaking and scope of the project.

Name: ____ (print)

Signed: ________________________________ Date: ____________________________

Fisheries and Oceans Canada
Pêches et Océans Canada

Central and Arctic Region
520 Exmouth Street
Sarnia, Ontario
N7T 8B1

Région du centre et de l'arctique
520 rue Exmouth
Sarnia (Ontario)
N7T 8B1

APR 0 8 2015

05-HCAA-CA4-01840

Mattamy Homes
50 Hines Road
Ottawa, Ontario
K2K 2M5
Attention: Kevin Murphy – Project Manager, Land Development

Dear Mr. Murphy:

Subject: Notification of modifications to dates in conditions of Paragraph 35(2)(*b*) *Fisheries Act* authorization (PR-05-1840)

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada hereby modifies the conditions that relate to the period during which the work, undertaking or activity that will result in serious harm to fish can be carried on, for the authorization issued to you under paragraph 35(2)(*b*) of the *Fisheries Act* on October 26, 2013.

The period during which the work, undertaking, or activity can be carried on is modified as follows:

From	To
Date of Issuance	December 31, 2017

The Program also acknowledges that the proponent name and contact information for this project has changed from Barrhaven South Land Owners Inc.to Mattamy Homes. At your request, we are re-issuing the original letter sent to you on February 6, 2015 with the correct proponent information.

The Program has determined that the modification of the dates in the conditions of authorization will not increase the level of harm to fish and habitat described in the authorization.

A copy of this authorization and a copy of this letter must be kept on site while the work is in progress. Work crews must be familiar with and able to adhere to the conditions.

.../2

Failure to comply with the conditions of the authorization may lead to prosecution under the *Fisheries Act*.

If you or anyone conducting work on your behalf have any questions, please contact Gary Cooper at our Burlington office at 905-336-6248, or by email at gary.cooper@dfo-mpo.gc.ca.

Sincerely,

David Burden
Regional Director General
Central and Arctic Region
Fisheries and Oceans Canada

ATTACHMENT: AUTHORIZATION

c.c.: Gary Cooper – DFO
Liza Hamilton – Kilgour & Associates Ltd.

Fisheries and Oceans Canada | Pêches et Océans Canada

401 King Street West
Prescott, ON
K0E 1T0

Your file *Votre référence*

Our file *Notre référence*
05-HCAA-CA4-01840

October 21, 2010

Barrhaven South Land Owners Inc
Ursula K. Melinz
427 Laurier Ave West. Suite 900
Ottawa, Ontario
K1R Y72
Dear Ms. Melinz:

Subject: Amendment to Fisheries Act Authorization

Fisheries and Oceans Canada is hereby amending the *Fisheries Act* Authorization issued to you on November 13, 2007 and amended on April 14, 2009.

The changes to the Authorization 05-HCAA-CA4-01840 covered by this Amendment include:

The valid authorization period for the harmful alteration, disruption or destruction of fish habitat associated with the work or undertaking is:

From	**To**
Date of Issuance	**December 31, 2013**

We have determined that the extent of the changes to the Authorization will not result in any impacts to fish and fish habitat greater than previously authorized nor significantly alter the mitigation measures. Therefore an additional environmental assessment is not required. The changes described above have been included on the attached original *Fisheries Act* Authorization.

Failure to comply with all the conditions of the amended Authorization may lead to prosecution under the *Fisheries Act*.

A copy of this Authorization should be kept on site while the work is in progress. Work crews should be familiar with and able to adhere to the conditions.

If you or anyone conducting work on your behalf have any questions, please contact Mark Ferguson at our Prescott office at (613) 925- 2865 ext 145, by fax at (613) 925-2245, or by email at Mark.Ferguson@dfo-mpo.gc.ca.

Yours sincerely,

Karen Ralph
A/Director, Ontario Great Lake Area
Fisheries & Oceans Canada
ATTACHMENT-AUTHORIZATION

Fisheries and Oceans Canada
Pêches et Océans Canada

DFO File No.: 05-HCAA-CA4-000-001840
Referral File No.: PR-05-1840
Authorization No.: 2

AUTHORIZATION FOR WORKS OR UNDERTAKINGS AFFECTING FISH HABITAT

Authorization issued to:

Barrhaven South Land Owners Inc.
427 Laurier Avenue West, Suite 900
Ottawa, ON
K1R 7Y2

Location of Project

The work or undertaking is located at

East Clarke Municipal Drain
From Latitude: 45°15’26.4” Longitude: 75 ° 45’3.1”to Latitude: 45°14’41.6” Longitude:75 ° 44’26.4

West Clarke Municipal Drain
From Latitude: 45 ° 15’16.6” Longitude: 75 ° 45’16.8”to Latitude: 45 ° 14’42.4” Longitude:75 ° 44’43.9”

Todd Municipal Drain
From Latitude:45 ° 15’23” Longitude: 75 ° 44’20”to Latitude: 45 ° 15’4” Longitude:75 ° 44 ’26”

Corrigan Drain
From Latitude: 45 ° 15’28.1”Longitude: 75 ° 44’9.7”to Latitude: 45 ° 15’16.1” Longitude:75 ° 44’0.3”

In the City of Ottawa, Ontario

.../2

Valid Authorization Period

The valid authorization period for the harmful alteration, disruption or destruction of fish habitat associated with the work or undertaking is:

From	To
Date of Issuance	December 31, 2013

The valid authorization periods for other conditions of the authorization are as set out below.

Description of Works or Undertakings (Type of work, schedule, etc.)

The harmful alteration, disruption or destruction of fish habitat hereby authorized is the destruction of 13268m^2 of fish habitat due to infilling of the existing drain channels and realignment of West Clarke Municipal Drain, East Clarke Municipal Drain, Todd Municipal Drain and Corrigan Drain.

Conditions of Authorization

1. The conditions of this Authorization notwithstanding, should the above works or undertaking, due to weather conditions, different soil or other natural conditions, or for any other reason, appear, in the opinion of the Department of Fisheries and Oceans ("DFO") likely to cause greater impacts than the parties previously contemplated, then DFO may direct Barrhaven South Land Owners Inc and City of Ottawa ("the Proponent") and its agents and contractors, to suspend or alter works and activities associated with the project, to avoid or mitigate adverse impacts to fisheries resources. DFO may also direct the Proponent and its agents and contractors, to carry out at the Proponent's expense any works or activities deemed necessary by DFO to avoid or mitigate further adverse impacts to fisheries resources. In circumstances where DFO is of the view that greater impacts may occur than were contemplated by the parties DFO may also modify or rescind this authorization. If the authorization is to be changed the Proponent will be given an opportunity to discuss any proposed modifications or rescission.
2. Conditions that relate to the **Proponent plan**:

    2.1 The Proponent confirms that all plans and specifications relating to this authorization have been duly prepared and reviewed by appropriate professionals working on behalf of the Proponent. The Proponent acknowledges that (s)he is solely responsible for all design, safety and workmanship aspects of all the works associated with this Authorization.

    2.2 The construction must comply with those criteria as identified within this Authorization. Harmful alteration, disruption or destruction of fish habitat other than that specifically identified within this Authorization is not permitted.

    2.3 Works will be conducted following the practices outlined in the following reports:

    2.3.1 *Application for the Authorization for works or undertakings affecting fish habitat, submitted by Barrhaven South Land Owners Inc., signed by Alan Cohen and dated October 4, 2007.*

    2.3.2 *Application for the Authorization for works or undertakings affecting fish habitat,*

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submitted by the City of Ottawa, signed by Gordon MacNair and dated October 4, 2007.

2.3.3 *Barrhaven South Development and Fish Habitat Compensation, Department of Fisheries and Oceans Canada Permit Application, Prepared by Stantec Consulting Ltd. August 2007.*

2.3.4 *Barrhaven South Fish Compensation, Clarke Pond Tributary Design, "Clarke 3" prepared by Stantec Consulting Ltd. July 2007.*

2.3.5 *Barrhaven South Fish Compensation, Todd Pond Tributary Design* "Todd 3" *prepared by Stantec Consulting Ltd. July 2007.*

2.3.6 *Barrhaven South Fish Habitat Compensation, Plan and Profile Fish Habitat Compensation Pond, Prepared by Stantec Consulting Ltd.*

3. Conditions that relate to the **mitigation** of potential harmful alteration, disruption or destruction of fish habitat. The following measures shall be implemented:

3.1 No in-water work shall occur from **March 15th to June 30th** to protect local fish populations during their spawning and nursery periods.

3.2 All materials and equipment used for the purpose of site preparation and project completion shall be operated and stored in a manner that prevents any deleterious substance (e.g. petroleum products, debris etc.) from entering the water.

3.2.1 Any stockpiled materials shall be stored and stabilized away from the water.

3.2.2 Vehicle and equipment re-fuelling and maintenance shall be conducted in a controlled manner so as to prevent fuel spillage and away from the water where feasible.

3.2.3 Any part of equipment entering the water shall be free of fluid leaks and externally cleaned/degreased to prevent any deleterious substance from entering the water.

3.2.4 Vehicles or heavy machinery operating at a watercourse shall be equipped with a spill kit.

3.2.5 Only clean material free of fine particulate matter shall be placed in the water.

3.2.6 A spill kit shall be kept on site during construction.

3.3 Sediment and erosion control measures shall be implemented prior to work and maintained during the work phase, to prevent entry of sediment into the water.

3.3.1 All sediment and erosion control measures shall be inspected daily to ensure that they are functioning properly and are maintained and/or upgraded as required.

3.3.2 If the sediment and erosion control measures are not functioning properly, no further work shall occur until the sediment and/or erosion problem is addressed.

3.3.3 Sediment and erosion control measures shall be left in place until all disturbed areas have been stabilized.

3.3.4 All disturbed areas susceptible to erosion/soil loss with potential for transport into the water, shall be stabilized and re-vegetated as required upon completion of work and restored to a pre-disturbed state or better.

3.3.5 To prevent sediment release earthen "plugs" shall be maintained at the upstream and downstream limits of the newly constructed channel during construction phases and shall be removed only after the newly constructed channel and riparian vegetative cover is established and the site stabilized before permanent flows are directed to the channel.

3.4 Except material used to restore the streambed, materials used for the project shall not be taken from the shoreline or bed of any water body.

3.5 Dredged or excavated material shall be disposed of on land above the high water level and suitably contained/stabilized to prevent the material from re-entering the water.

3.6 All in-stream work shall be completed *in the dry* by de-watering the work area and diverting and/or pumping flows around cofferdams placed at the limits of the work area.

3.6.1 Existing stream flows shall be maintained downstream of the de-watered work area without interruption, during all stages of the work.

3.6.2 A fish stranding program shall be implemented if necessary by a qualified fisheries person , who is experienced in this area, immediately following isolation and prior to de-watering to ensure that fish are removed from any dewatered area and released alive immediately downstream of the work area.

3.6.3 Flow dissipaters and/or filter bags, or equivalent, shall be placed at water discharge points to prevent erosion and sediment release.

3.6.4 Silt or debris that has accumulated around the temporary cofferdams shall be removed prior to their withdrawal.

3.7 Construction debris and litter shall not be allowed to enter the water or left on the shoreline.

3.8 An environmental inspector with fish habitat experience shall be on site to verify all in-water fish habitat compensation and restoration works are constructed as designed.

4. Conditions that relate to the **compensation** for the loss of 13268m^2 of fish habitat.

4.1 A new outlet channel from the Clarke stormwater management pond will be constructed using principles of natural channel design. It will be 400m in length and 1m wide therefore 400m^2 of fish habitat will be created. This channel will be a linear wetland interspersed with refugia pools. At the confluence with the Jock River there will be an embayment designed to promote submergent plant growth. The riparian zone will be revegetated with a variety of native shrubs and trees to provide > 70% canopy cover.

4.2 A new outlet channel from the Todd stormwater management pond will be constructed using the principles of natural channel design. It will be 400m in length and 1 m wide therefore 400m^2 of fish habitat will be created. This channel will contain rock riffle and pool habitats. At the confluence with the Jock River the channel will be wider and shallower to promote emergent macrophyte growth. The riparian zone will be revegetated with a variety of native shrubs and trees to provide >70% canopy cover.

4.3 A new outlet channel from the Corrigan stormwater management pond will be constructed using principles of natural channel design. It will be 300m in length and 2m in width therefore $600m^2$ of fish habitat will be created. The channel design, embayment and riparian planting will be similar to the outlet channel from the Todd stormwater management pond.

4.3.1 Detailed design drawings for the Corrigan outlet channel shall be submitted to DFO by November 30, 2007 for review.

4.4 A habitat pond will be constructed within the floodplain of the Jock River. The new pond will have an approximate surface area of $8930m^2$ at the high water mark. This pond will be designed to provide spawning and nursery habitat for northern pike and muskellunge in the spring and nursery and refugia habitat in the summer and fall.

4.4.1 The pond will be connected to the Jock River by way of 1m deep inlet and outlet channels to provide inflow and outflow of water year round.

4.4.2 The depth of the pond will match the Jock River adjacent to the site. The deepest area of the pond will be on the south side with bank slopes between 3:1 and 5:1. On the north side of the pond slopes will gradually decrease to between 1:10 and 1:20 with 2m wide finger channels throughout leading to grassy hummocks of Carex sp. or meadow grass. The hummocks will be partially submerged during spring flows.

4.4.3 The pond will contain large woody debris consisting of tree trunks with root wads attached.

4.4.4 The pond margins and finger channel banks will be planted with native lowland riparian plant species including red osier dogwood, speckled alder, white cedar and Salix sp.

5. Conditions that relate to the **monitoring** of the **Proponent plan**, the mitigation and the compensation, the "Monitoring Program".

A **monitoring program** shall be implemented from start of construction to the end of the two year post-construction monitoring to ensure that the compensation and mitigation measures are installed, maintained and function as intended. The monitoring program shall include the following:

Construction Phase Monitoring

5.1 The monitoring program shall be conducted by an environmental inspector with fish habitat experience. The environmental inspector must be present on site during in water works and implementation of the compensation measures.

5.2 The effectiveness of the sediment and erosion controls will be inspected a minimum of once a week. Additional inspections will be undertaken after and/or in anticipation of rain events.

5.3 A photographic record showing that all works and undertakings have been completed according to the plan and conditions of this Authorization shall be prepared.

5.3.1 The photographic record shall include, but not be limited to, a record of existing conditions, the work phase including sediment and erosion control measures, and completed works including compensation measures, site stabilization and restoration.

5.3.2 The photographs for each period of documentation shall be taken from the same vantage point(s), direction and angle of view.

5.3.3 All photographs shall be clearly labelled with the date, location and viewing direction. The photographic locations and viewing directions shall be indicated on a plan view drawing of the work site and clearly indexed to the photographs.

5.4 Copies of the construction monitoring reports prepared by the environmental inspector shall be provided by fax or email to the Prescott Office of DFO within two working days of the date of the inspection.

5.5 Construction phase monitoring shall end when all fish habitat compensation measures are completed and site is stabilized.

Post-construction Monitoring:

5.6 A photographic record of completed fish habitat compensation measures and site stabilization measures as outlined in section 5.3.3 of construction phase monitoring.

5.7 A survey of fish presence and use of the fish habitat compensation measures shall be conducted each spring and summer for 2 years following construction.

5.8 An assessment of the stability of newly constructed channels, habitat pond and the fish habitat structures.

5.9 The success of all vegetative plantings shall be assessed not less than once each spring and fall for 2 years following planting. If at any time during monitoring any plantings are dead or dying, measures shall be implemented to reduce the risk of future failure and the plants shall be replaced and monitoring continued.

5.10 A written report and the photographic record summarizing the above monitoring results shall be submitted to the Prescott Office of DFO on or before November 30 for each year of the monitoring program.

6 Notification of the commencement of in-water works or undertaking shall be provided the Prescott Office of DFO via facsimile (fax) at (613) 925-2245, within ten days prior to the initiation of the works or undertaking.

6.1. The notification shall include the Section 35 Authorization number, PR-05-1840 and the date when in-water works or undertakings are scheduled to take place.

7. Any deviation from the approved plan, work schedule or compensation and mitigation measures stated above, shall be discussed with and approved in writing by the Prescott Office of DFO, prior to implementation.

8. All compensation and mitigation measures shall be implemented to the satisfaction of the Prescott Office of DFO.

The holder of this authorization is hereby authorized under the authority of section 35(2) of the Fisheries Act. R.S.C., 1985, c.F. 14, to carry out the work or undertaking described herein. This authorization is valid only with respect to fish habitat and for no other purposes. It does not purport to release the applicant from any obligation to obtain permission from or to comply with the requirements of any other regulatory agencies.

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Failure to comply with any condition of this authorization may result in charges being laid under the Fisheries Act.

This authorization form should be held on site and work crews should be made familiar with the conditions attached.

Date of Issuance: Oct 26 2010

Approved by:

Karen Ralph
A/Area Director, Ontario Great Lakes Area
Central & Arctic Region
Fisheries and Oceans Canada

APPENDIX B

WATER DISTRIBUTION NETWORK BOUNDARY CONDITION REQUEST FOR FLAGSTAFF AND HALF MOON BAY WEST

(GEOADVICE, MARCH 11, 2021)

HYDRAULIC CAPACITY AND MODELING ANALYSIS FOR HALF MOON BAY WEST PHASE 3 – FINAL REPORT

(GEOADVICE, MAY 31, 2021)

March 11, 2021

Sent by email: BKaminski@dsel.ca

David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

Attention: **Mr. Braden Kaminski, E.I.T.**
Junior Project Manager

Re: **Water Distribution Network Boundary Condition Request**
Flagstaff and Half Moon Bay West (HMBW)
GeoAdvice Project ID: 2021-023-DSE

Dear Mr. Kaminski,

In order to carry out the watermain analysis and hydraulic modeling for the Flagstaff Phase 2 development in the City of Ottawa, we request the hydraulic boundary conditions (HGL) for the proposed connection points as shown on the attached schematic. Flow conditions are outlined in the attached consumer water demand calculations.

Scenario 1 – (Flagstaff Phases 1 + 2, HMBW Phases 1 + 2)

Boundary conditions at the connection points 1 and 2 are required for the Scenario 1 demand conditions:

- Minimum hour demand = 6.71 L/s
- Maximum day demand = 29.26 L/s
- Maximum day demand + fire flow (167 L/s) = 196.26 L/s
- Maximum day demand + fire flow (217 L/s) = 246.26 L/s
- Maximum day demand + fire flow (233 L/s) = 262.26 L/s
- Maximum day demand + fire flow (283 L/s) = 312.26 L/s
- Peak hour demand = 61.80 L/s

Scenario 2 – (Flagstaff Phase 1, HMBW Phases 1 + 2 + 3)

Boundary conditions at the connection points 1 and 2 are required for the Scenario 2 demand conditions:

- Minimum hour demand = 8.19 L/s
- Maximum day demand = 35.29 L/s
- Maximum day demand + fire flow (167 L/s) = 202.29 L/s
- Maximum day demand + fire flow (217 L/s) = 252.29 L/s
- Maximum day demand + fire flow (233 L/s) = 268.29 L/s
- Maximum day demand + fire flow (283 L/s) = 318.29 L/s
- Peak hour demand = 74.26 L/s

Scenario 3 – (Flagstaff Phases 1 + 2, HMBW Phases 1 + 2 + 3 + 4)

Boundary conditions at the connection points 1 and 2 are required for the Scenario 3 demand conditions:

- Minimum hour demand = 9.65 L/s
- Maximum day demand = 41.65 L/s
- Maximum day demand + fire flow (167 L/s) = 208.65 L/s
- Maximum day demand + fire flow (217 L/s) = 258.65 L/s
- Maximum day demand + fire flow (233 L/s) = 274.65 L/s
- Maximum day demand + fire flow (283 L/s) = 324.65 L/s
- Peak hour demand = 87.65 L/s

Scenario 4 – (Flagstaff Phases 1 + 2 Full Build Out, HMBW Phases 1 + 2 + 3 + 4)

Boundary conditions at the connection points 1 and 2 are required for the Scenario 4 demand conditions:

- Minimum hour demand = 10.21 L/s
- Maximum day demand = 44.05 L/s
- Maximum day demand + fire flow (167 L/s) = 211.05 L/s
- Maximum day demand + fire flow (217 L/s) = 261.05 L/s
- Maximum day demand + fire flow (233 L/s) = 277.05 L/s
- Maximum day demand + fire flow (283 L/s) = 327.05 L/s
- Peak hour demand = 92.72 L/s

Please note the following:

- The above demands and fire flows should be applied equally between Connection Points 1 and 2.
- FUS calculations will be completed for the single-family units and traditional townhomes not complying with the conditions of City of Ottawa Technical Bulletin ISDTB-2018-02.

For the maximum day demand plus fire flow scenarios, the HGLs for the lowest (167 L/s) and highest (283 L/s) fire flow requirement scenarios could be provided. In this case, the HGLs of the intermediate fire flow scenarios will be interpolated. If there are any pumps feeding the development area and any additional pumps turning on during any of these intermediate scenarios, the HGLs **cannot** be interpolate or extrapolated. A previous iteration of boundary conditions provided by the City required additional pumps to be turned on at the Barrhaven Pump Station for some of the fire flow scenarios, which affect the ability to interpolate intermediate fire flow scenarios. The additional pump was turned on at the Barrhaven Pump Station to increase the HGLs at the connections from approximately 120 m to approximately 137 m under the 10,000 L/min (167 L/s) fire flow scenario. Please confirm the number of pumps in operation for each scenario.

Finally, the previous iteration of boundary conditions provided by the City, HGLs were provided for before and after the proposed pressure zone realignment in the BARR (3SW) and the 3C (SUC) pressure zones. Please confirm which boundary condition results most accurately reflect the system operation.

If you have any questions, please do not hesitate to contact me.

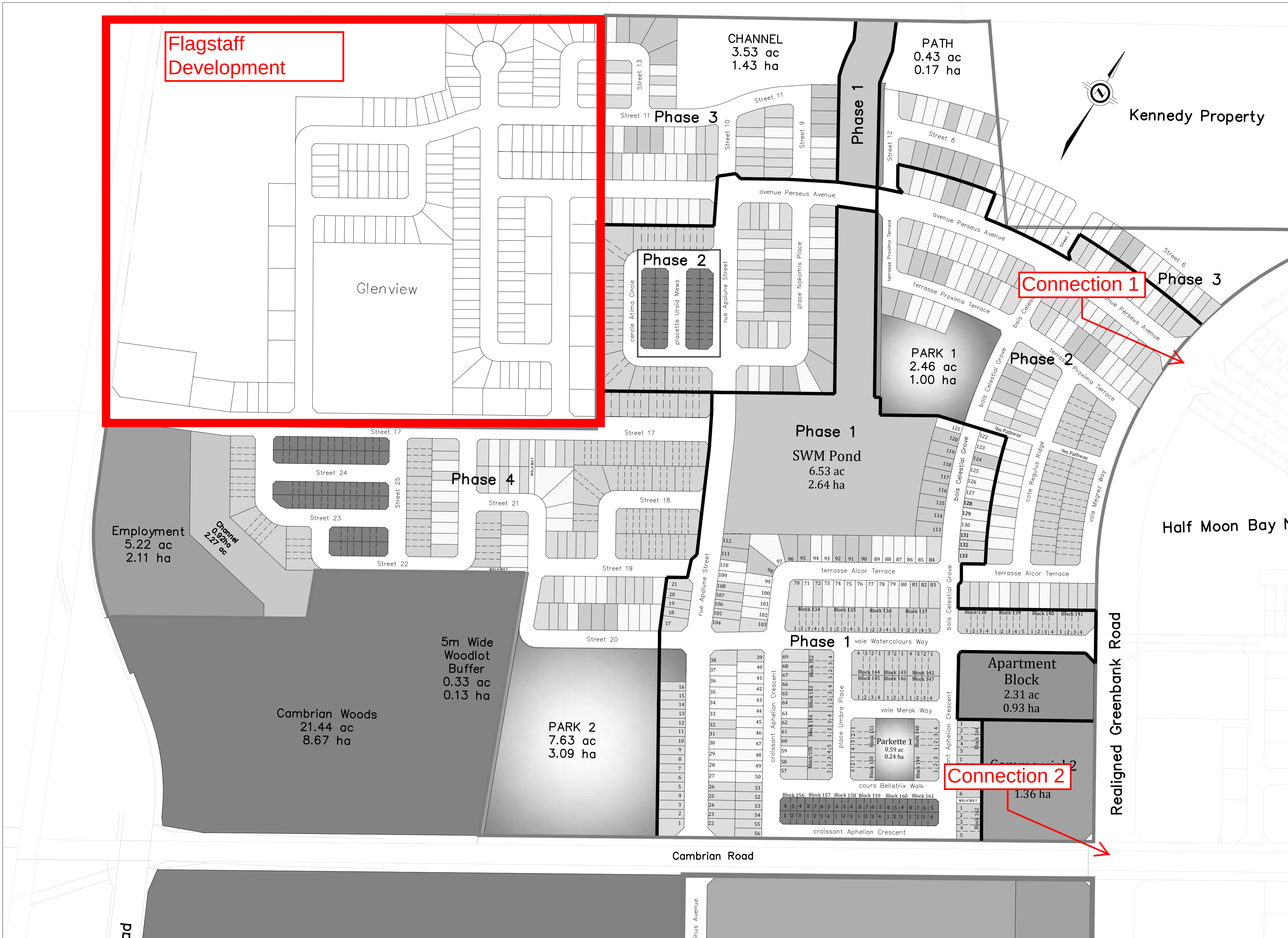
Yours truly,

GeoAdvice Engineering Inc.

Werner de Schaetzen

Werner de Schaetzen, Ph.D., P.Eng.
President and Chief Executive Officer
werner@geoadvice.com
GeoAdvice Engineering Inc.

Attachments: Mark up for connection locations and demand calculations


Flagstaff Development
Glenview
CHANNEL
3.53 ac
1.43 ha
PATH
0.43 ac
0.17 ha
Kennedy Property
Phase 3
Phase 1
Phase 2
Phase 2
Phase 3
Phase 2
Connection 1
PARK 1
2.46 ac
1.00 ha
Phase 1
SWM Pond
6.53 ac
2.64 ha
Phase 4
Half Moon Bay N
Employment
5.22 ac
2.11 ha
Channel
0.92ha
2.27 ac
5m Wide
Woodlot
Buffer
0.33 ac
0.13 ha
Cambrian Woods
21.44 ac
8.67 ha
PARK 2
7.63 ac
3.09 ha
Phase 1
Apartment
Block
2.31 ac
0.93 ha
Parkette 1
0.59 ac
0.24 ha
Connection 2
1.36 ha
Realigned Greenbank Road
Cambrian Road
Street 11
Street 13
Street 10
Street 9
Street 12
Street 8
Street 7
Street 6
avenue Perseus Avenue
terrasse Proxima Terrace
cercle Atima Circle
placette Ursid Mews
rue Apolune Street
place Nokomis Place
bois Celestial Grove
cote Regulus Ridge
voie Megrez Way
9m Pathway
Street 17
Street 18
Street 19
Street 20
Street 21
Street 22
Street 23
Street 24
Street 25
WALKWAY
terrasse Alcor Terrace
voie Watercolours Way
voie Merak Way
croissant Aphelion Crescent
place Umbra Place
cours Bellatrix Walk

Consumer Water Demands

Flagstaff Phase 1 Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	94	3.4	320	280	89,600	1.04	2.59		5.70	0.52
Traditional Townhome	61	2.7	165		46,200	0.53	1.34		2.94	0.27
Subtotal	**155**		**485**		**135,800**	**1.57**	**3.93**		**8.64**	**0.79**

Flagstaff Phase 2 Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	42	3.4	143	280	40,040	0.46	1.16		2.55	0.23
Traditional Townhome	34	2.7	92		25,760	0.30	0.75		1.64	0.15
Subtotal	**76**		**235**		**65,800**	**0.76**	**1.90**		**4.19**	**0.38**

Flagstaff Phase 2 Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Commercial	0.42		28,000	11,760	0.14	0.20		0.37	0.07
Institutional	2.40		28,000	67,200	0.78	1.17		2.10	0.39
Parkette	0.20		28,000	5,600	0.06	0.10		0.18	0.03
Subtotal	**3.02**			**84,560**	**0.98**	**1.47**		**2.64**	**0.49**

Flagstaff Phase 2 Alternate Residential Demands

Dwelling Type	Number of Units	Population*		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	42	3.4	172	280	48,160	0.56	1.39		3.07	0.28
Traditional Townhome	34	2.7	111		31,080	0.36	0.90		1.98	0.18
School Converted to Residential			182		51,072	0.59	1.48		3.25	0.30
Subtotal	**76**		**465**		**130,312**	**1.51**	**3.77**		**8.30**	**0.75**

Flagstaff Phase 2 Alternate Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Commercial	0.42		28,000	11,760	0.14	0.20		0.37	0.07
Park	3.50		28,000	98,000	1.13	1.70		3.06	0.57
Parkette	0.20		28,000	5,600	0.06	0.10		0.18	0.03
Subtotal	**4.12**			**115,360**	**1.34**	**2.00**		**3.61**	**0.67**

HMBW Phase 1 Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	133	3.4	453	280	126,840	1.47	3.67		8.07	0.73
Traditional Townhome	106	2.7	287		80,360	0.93	2.33		5.12	0.47
Back-to-back Townhome	42	2.7	114		31,920	0.37	0.92		2.03	0.18
Apartment Block	72	2.7	195		54,600	0.63	1.58		3.48	0.32
Subtotal	**353**		**1,049**		**293,720**	**3.40**	**8.50**		**18.70**	**1.70**

HMBW Phase 1 Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Commercial	2.87		28,000	80,360	0.93	1.40		2.51	0.47
School	6.07		28,000	169,960	1.97	2.95		5.31	0.98
Park	0.24		28,000	6,720	0.08	0.12		0.21	0.04
Subtotal	**9.18**			**257,040**	**2.98**	**4.46**		**8.03**	**1.49**

HMBW Phase 2A Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	115	3.4	391	280	109,480	1.27	3.17		6.97	0.63
Traditional Townhome	41	2.7	111		31,080	0.36	0.90		1.98	0.18
Subtotal	**156**		**502**		**140,560**	**1.63**	**4.07**		**8.95**	**0.81**

HMBW Phase 2A Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Park	1.00		28,000	28,000	0.32	0.49		0.88	0.16
Subtotal	**1.00**			**28,000**	**0.32**	**0.49**		**0.88**	**0.16**

HMBW Phase 2B Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	46	3.4	157	280	43,960	0.51	1.27		2.80	0.25
Traditional Townhome	39	2.7	106		29,680	0.34	0.86		1.89	0.17
Back-to-Back Townhome	42	2.7	114		31,920	0.37	0.92		2.03	0.18
Subtotal	**127**		**377**		**105,560**	**1.22**	**3.05**		**6.72**	**0.61**

HMBW Phase 10 Residential Demands

Dwelling Type	Number of Units	Population		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	11	3.4	38	280	10,640	0.12	0.31		0.68	0.06
Traditional Townhome	49	2.7	133		37,240	0.43	1.08		2.37	0.22
Subtotal	**60**		**171**		**47,880**	**0.55**	**1.39**		**3.05**	**0.28**

HMBW Phase 3 Residential Demands

Dwelling Type	Number of Units	Population*		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	23	3.4	94	280	26,320	0.30	0.76		1.68	0.15
Traditional Townhome	101	2.7	328		91,840	1.06	2.66		5.85	0.53
Back-to-Back Townhome	94	2.7	305		85,400	0.99	2.47		5.44	0.49
Subtotal	**218**		**727**		**203,560**	**2.36**	**5.89**		**12.96**	**1.18**

HMBW Phase 3 Non Residential Demands

Property Type	Area * (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Employment	2.68		28,000	75,040	0.87	1.30		2.35	0.43
Park	4.56		28,000	127,680	1.48	2.22		3.99	0.74
Subtotal	**7.24**			**202,720**	**2.35**	**3.52**		**6.34**	**1.17**

HMBW Phase 4 Residential Demands

Dwelling Type	Number of Units	Population*		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	90	3.4	368	280	103,040	1.19	2.98		6.56	0.60
Subtotal	**90**		**368**		**103,040**	**1.19**	**2.98**		**6.56**	**0.60**

Flagstaff		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:		1.57	3.93	8.64	0.79
Phase 2 Total Demand:		1.74	3.37	6.83	0.87
Phase 2 Alternate Total Demand*		2.84	5.77	11.90	1.42

Half Moon Bay West		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:		6.37	12.96	26.73	3.19
Phase 2A Total Demand:		1.95	4.55	9.82	0.98
Phase 2B Total Demand:		1.22	3.05	6.72	0.61
Phase 10 Total Demand:		0.55	1.39	3.05	0.28
Phase 3 Total Demand*:		4.70	9.41	19.29	2.35
Phase 4 Total Demand*:		1.19	2.98	6.56	0.60
Total		**16.00**	**34.35**	**72.17**	**8.00**

Scenario Totals		**ADD**	**MDD**	**PHD**	**MHD**
Scenario 1		**13.41**	**29.26**	**61.80**	**6.71**
Scenario 2		**16.38**	**35.29**	**74.26**	**8.19**
Scenario 3		**19.31**	**41.65**	**87.65**	**9.65**
Scenario 4		**20.41**	**44.05**	**92.72**	**10.21**

*20% increase applied to account for possible future refinements in concept plan, as per DSEL

Hydraulic Capacity and Modeling Analysis Mattamy Half Moon Bay West Phase 3

Final Report

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Project: 2021-033-DSE

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Contents

1 Introduction

GeoAdvice Engineering Inc. ("GeoAdvice") was retained by David Schaeffer Engineering Ltd. ("DSEL") to size the proposed water main network for Phase 3 of the Mattamy Half Moon Bay West (HMBW) development ("Development") in the City of Ottawa, ON ("City").

Analysis for one (1) scenario of the Mattamy HMBW Phase 3 development was completed using boundary conditions provided by the City (Scenario 2 in **Appendix C**) and is discussed within this report. The analysis includes the demands for the following existing developments in addition to the proposed Mattamy HMBW Phase 3 demands:

- Mattamy HMBW Phases 1, 2, and 10, Flagstaff Phase 1 (Glenview Homes development)

The development will have two (2) connections to the City water distribution system along the realigned Greenbank Road:

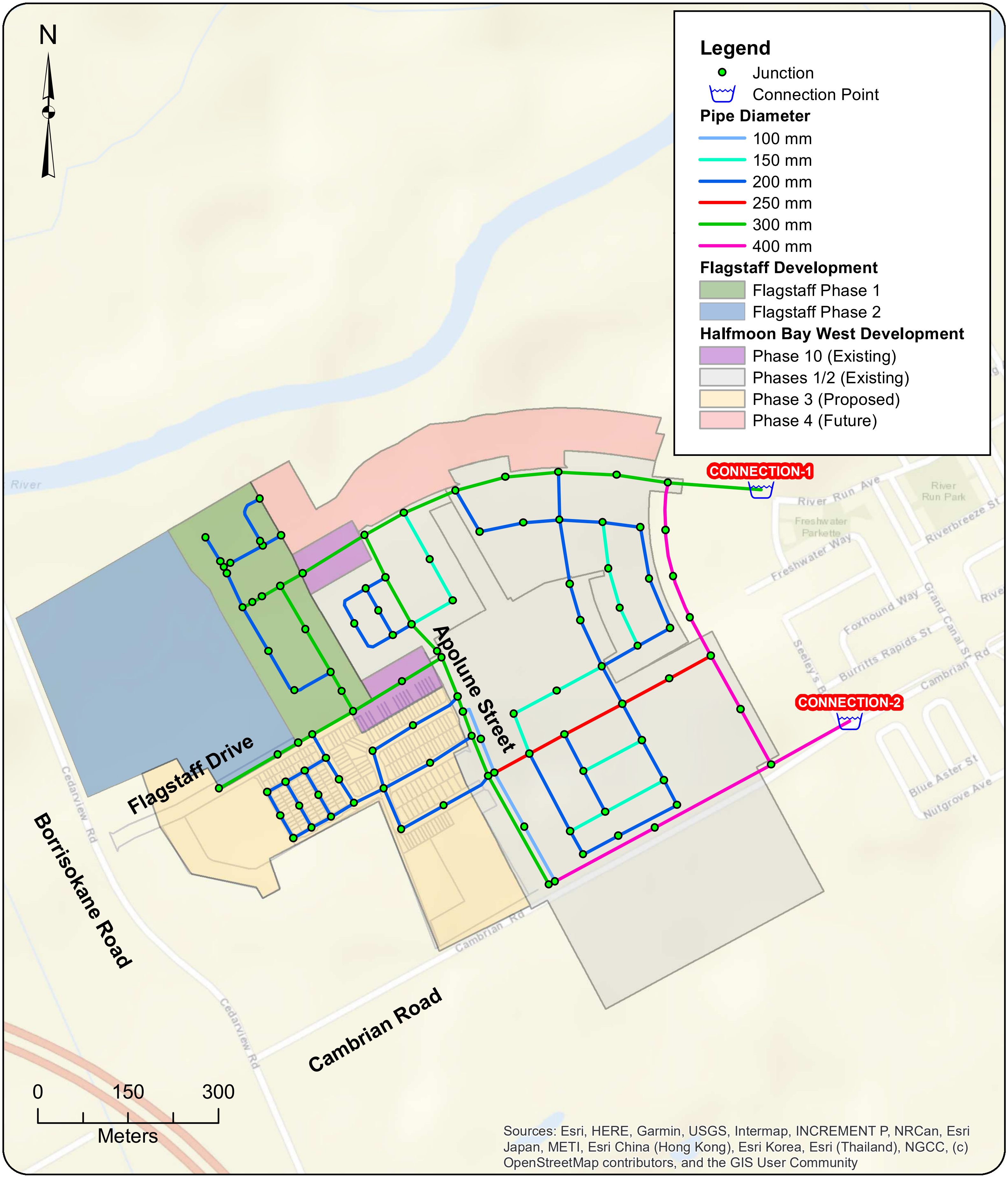
- Connection 1: Perseus Avenue
- Connection 2: Cambrian Road

HMBW Phase 3 will connect east to Apolune Street in Mattamy HMBW Phase 1 and north to Flagstaff Drive.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this report are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi at the hydrant. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Site Layout and Connection Points

Figure 1.1

2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on drawings prepared by DSEL (16-10-100_M-Plan PH3 (April22-21).dwg) and provided to GeoAdvice on April 26th, 2021.

The 300 mm water main on Flagstaff Drive is expected to extend to Borrisokane Road as per the Barrhaven South Master Servicing Study. No analysis was conducted for the water main west of pipe P-102 shown in **Appendix D**.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a preliminary site grading plan prepared by DSEL (2020-12-04_1140_grad_wcs.dwg) and provided to GeoAdvice on April 26th, 2021. The preliminary site grading plan provided was based on a different road alignment from that of the final road alignment of the development and as such, the allocation of the elevations was approximated using best judgement.

2.3 Consumer Demands

The existing residential demands (Mattamy HMBW Phases 1, 2, 10 and Flagstaff Phase 1) and the proposed residential demands for the Mattamy HMBW Phase 3 development were based on a demand rate of 280 L/cap/d as per City of Ottawa technical bulletin ISTB 2018-01. The park rate of 28,000 L/ha/d was assumed as per the City of Ottawa design guidelines and are consistent with similar previously completed developments within the City of Ottawa. Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1**.

Finally, the Mattamy HMBW Phase 3 water main network was also analyzed for an ultimate condition including the demands for the planned future Mattamy Phase 4 of the HMBW development and Flagstaff Phase 2 using boundary conditions provided by the City (Scenario 3 in **Appendix C**). The proposed water main network was confirmed to not require any changes in this ultimate condition.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	280	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 to **Table 2.3** summarize the water demand calculations for Mattamy HMBW Phase 3.

Table 2.2: Development Population and Demand Calculations – Mattamy HMBW Phase 3

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	23	3.4	87	0.28	0.70	1.55	0.14
Traditional Townhome	111	2.7	330	1.07	2.67	5.88	0.53
Back-to-Back Townhouse	94	2.7	280	0.91	2.27	4.99	0.45
Total	**228**		**697**	**2.26**	**5.65**	**12.42**	**1.13**

*City of Ottawa Design Guidelines.

Table 2.3: Non Residential Demand Calculations – Mattamy HMBW Phase 3

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	4.52	1.46	2.20	3.96	0.73

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02. The required fire flow for single detached and traditional townhomes that meet Technical Bulletin ISTB-2018-02 requirements are to be capped at 10,000 L/min (167 L/s). For the townhouse units where the 10,000 L/min cap could not be applied, the FUS calculations yielded the following required fire flows:

- Block 40: 11,000 L/min (183 L/s)
- Block 33: 16,000 L/min (267 L/s)

The FUS calculations for the back-to-back townhouse blocks yielded the following required fire flows:

- 12-unit back-to-back townhouse: 14,000 L/min (233 L/s), accounts for one (1) firewall
- 10-unit back-to-back townhouse: 14,000 L/min (233 L/s), accounts for one (1) firewall
- 8-unit back-to-back townhouse: 16,000 L/min (267 L/s), no firewall accounted for

At this time, there is not enough information available to calculate the required fire flows of the park. As such, the following required fire flow was assumed, based on similar information from previously completed projects:

- Park: 167 L/s

Fire flow simulations were completed at each model node. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.

2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Perseus Avenue
- Connection 2: Cambrian Road

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour (PHD), Maximum Day plus Fire (MDD+FF) and Minimum Hour (high pressure check, MHD) demand conditions.

Under existing conditions, the Mattamy HMBW development will be serviced by the Barrhaven pressure zone (zone BARR); however, in the future, it will be serviced by the South Urban Community (SUC) pressure zone. The future pressure realignment for the SUC pressure zone includes the previous 3C pressure zone, portions of the current adjacent pressure zones, and the portion of the BARR pressure zone where the Mattamy HMBW development is located. The future SUC pressure zone is expected to be serviced by additional pumps and storage tanks.

Boundary conditions were provided under the existing and future pressure zone configurations. As the timeline for the pressure zone realignment is unconfirmed at this time, a hybrid approach was used to ensure that the most conservative option was selected for each of the PHD, MDD+FF and MHD scenarios.

The results presented in this report are based on this hybrid approach, which uses the most conservative HGLs for the PHD, MDD+FF and MHD scenarios from both of the existing and future boundary conditions as outlined below:

- The HGLs provided by the City for the PHD and MHD scenarios under the existing condition are more conservative than those of the SUC Zone reconfiguration condition.
- The HGLs provided by the City for the MDD+FF scenarios are more conservative under the SUC Zone reconfiguration condition than those of the existing condition.

The City boundary conditions were provided to GeoAdvice on April 9, 2021 and can be found in **Appendix C**.

The demands from the Flagstaff Phase 1 and the Mattamy Half Moon Bay West Phases 1, 2, 3 and 10 were included in the boundary condition request as they are located downstream from the connection points used in the boundary conditions.

Table 2.4 summarizes the City of Ottawa boundary conditions used (Scenario 2) to size the water network.

Table 2.4: Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)
Min Hour (max. pressure)	158.3*	158.3*
Peak Hour (min. pressure)	136.4*	136.4*
Max Day + Fire Flow (167 L/s)	140.5**	140.7**
Max Day + Fire Flow (183 L/s)	137.9**	138.3**
Max Day + Fire Flow (233 L/s)	137.0**	137.4**
Max Day + Fire Flow (267 L/s)	134.0**	134.5**

*Based on the existing boundary conditions provided by the City of Ottawa.

** Based on the SUC Zone reconfiguration boundary conditions provided by the City of Ottawa.

3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
150	155	100
200	204	110
250	250	110
300	297	120
400	400	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2.**

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-

4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

The modeling results indicate that the Mattamy HMBW Phase 3 development can be adequately serviced by the proposed water main layout shown in **Figure 1.1**. Modeled service pressures for the Mattamy HMBW Phase 3 development are summarized in **Table 4.1** below.

Table 4.1: Summary of Mattamy HMBW Phase 3 Available Service Pressures

Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
93 psi (640 kPa)	61 psi (418 kPa)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). As such, based on the City boundary conditions for the minimum hour demand, pressure reducing valves may be required throughout Mattamy HMBW Phase 3. In summary:

- Under the existing pressure zone conditions, any location with elevation lower than 102 m may experience high pressures (≥ 80 psi).
- Under the future pressure zone conditions, any location with the elevation lower than 91.5 m may experience high pressures (≥ 80 psi).

Detailed pipe and junction result tables and maps can be found in **Appendix E**.

4.2 Development Fire Flow Analysis

Summaries of the minimum available fire flows in Mattamy HMBW Phase 3 is shown in **Table 4.2**.

Table 4.2: Summary of the Mattamy HMBW Phase 3 Minimum Available Fire Flows

Required Fire Flow	Minimum Available Flow*	Junction ID
167 L/s	372 L/s	J-82
183 L/s	510 L/s	J-89
233 L/s	277 L/s	J-99
267 L/s	353 L/s	J-91

*The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi at the hydrant. High available fire flows (>500 L/s) are theoretical values. Actual available fire flow is limited by the hydraulic losses through the hydrant lateral and hydrant port sizes.

As shown in **Table 4.2**, the fire flow requirements can be met at all junctions within the development.

Summaries of the residual pressures in Mattamy HMBW Phase 3 is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.

Table 4.3: Summary of the Mattamy HMBW Phase 3 Residual Pressures (MDD + FF)

Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
59 psi (405 kPa)	45 psi (312 kPa)	32 psi (217 kPa)

As shown in **Table 4.3**, there is sufficient residual pressure at all the junctions within the development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.

5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m^3/day and require two (2) feeds if the development exceeds 50 m^3/day for supply security, according to Technical Bulletin ISDTB-2018-02.

The HMBW Phase 3 development services a total average day demand of 322 m^3/day; as such, two (2) feeds are required. Four (4) feeds to the Mattamy HMBW Phase 3 development from Apolune Street and Flagstaff Drive were modeled as part of the analysis.

5.2 Valves

No comment has been made in this report with respect to exact placement of isolation valves within the distribution network for the development other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that "small diameter water mains shall be drained through hydrant via pumping if needed."

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal "can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers."

The detailed engineering drawings for the Mattamy HMBW Phase 3 development are expected to identify valves in accordance with the requirements noted above.

5.3 Hydrants

No additional comment has been made in this report with respect to exact placement of hydrants within the distribution network for the development other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

Additionally, based on the FUS document *Water Supply for Public Fire Protection (1999)*, the hydrant coverage areas for the following fire flows are:

- 167 L/s: 12,000 m^2 (radial coverage of 62 m)
- 183 L/s: 11,500 m^2 (radial coverage of 61 m)
- 233 L/s: 10,000 m^2 (radial coverage of 56 m)
- 267 L/s: 9,500 m^2 (radial coverage of 55 m)

The detailed engineering drawings for the Mattamy HMBW Phase 3 development are expected to identify hydrant locations in accordance with the requirements noted above.

5.4 Water Quality

The turnover rate of the water within the Mattamy HMBW Phase 3 development network, calculated from the connections to the development is about 5 hours (ADD is 322 m^3/day).

The above rate is based on the volume of the development network and the development average day demand.

6 Conclusions

The hydraulic capacity and modeling analysis of the Mattamy HMBW Phase 3 development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 61 psi (418 kPa) and 93 psi (640 kPa).
- The proposed water main network is able to deliver fire flows at all junctions.
- Pressure reducing valves may be required, since maximum pressures are predicted to exceed the City of Ottawa Design Guidelines (> 80 psi).
    - Under the existing pressure zone conditions, any location with elevation lower than 102 m may experience high pressures (≥ 80 psi).
    - Under the future pressure zone conditions, any location with the elevation lower than 91.5 m may experience high pressures (≥ 80 psi).
- Hydraulic modeling was completed using a hybrid format of the boundary conditions provided, using the most conservative HGLs from the existing and SUC Zone reconfiguration conditions for the PHD, MDD+FF and MHD scenarios.
    - The HGLs for the PHD and MHD scenarios under the existing condition are more conservative than those of the SUC Zone reconfiguration condition.
    - The HGLs for the MDD+FF scenarios are more conservative under the SUC Zone reconfiguration condition than those of the existing condition.

Submission

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May 31, 2021

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Appendix A Domestic Water Demand Calculations and Allocation

Consumer Water Demands

HMBW Phase 3 Residential Demands

Dwelling Type	Number of Units	Population*		Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)				
Single Detached	23	3.4	87	280	24,360	0.28	0.70		1.55	0.14
Traditional Townhome	111	2.7	330		92,400	1.07	2.67		5.88	0.53
Back-to-Back Townhome	94	2.7	280		78,400	0.91	2.27		4.99	0.45
Subtotal	**228**		**697**		**195,160**	**2.26**	**5.65**		**12.42**	**1.13**

HMBW Phase 3 Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Fire Flow (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
			(L/ha/d)	(L/d)	(L/s)				
Park	4.52		28,000	126,560	1.46	2.20		3.96	0.73
Subtotal	**4.52**			**126,560**	**1.46**	**2.20**		**3.96**	**0.73**

Flagstaff	Number of Units	Population	Non Residential Area (ha)		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:	155	485			1.57	3.93	8.64	0.79

Half Moon Bay West	Number of Units	Population	Non Residential Area (ha)		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:	353	1,049	9.18		6.37	12.96	26.73	3.19
Phase 2A Total Demand:	156	502	1.00		1.95	4.55	9.82	0.98
Phase 2B Total Demand:	127	377			1.22	3.05	6.72	0.61
Phase 10 Total Demand:	60	171			0.55	1.39	3.05	0.28
Phase 3 Total Demand*:	228	697	4.52		3.72	7.84	16.38	1.86

Scenario Totals

		ADD	**MDD**	**PHD**	**MHD**
Scenario 2	Flagstaff Phase 1, HMBW Phases 1, 2A, 2B, 3, 10	**15.40**	**33.73**	**71.34**	**7.70**

*10% increase applied to account for possible future refinements in concept plan, as per DSEL

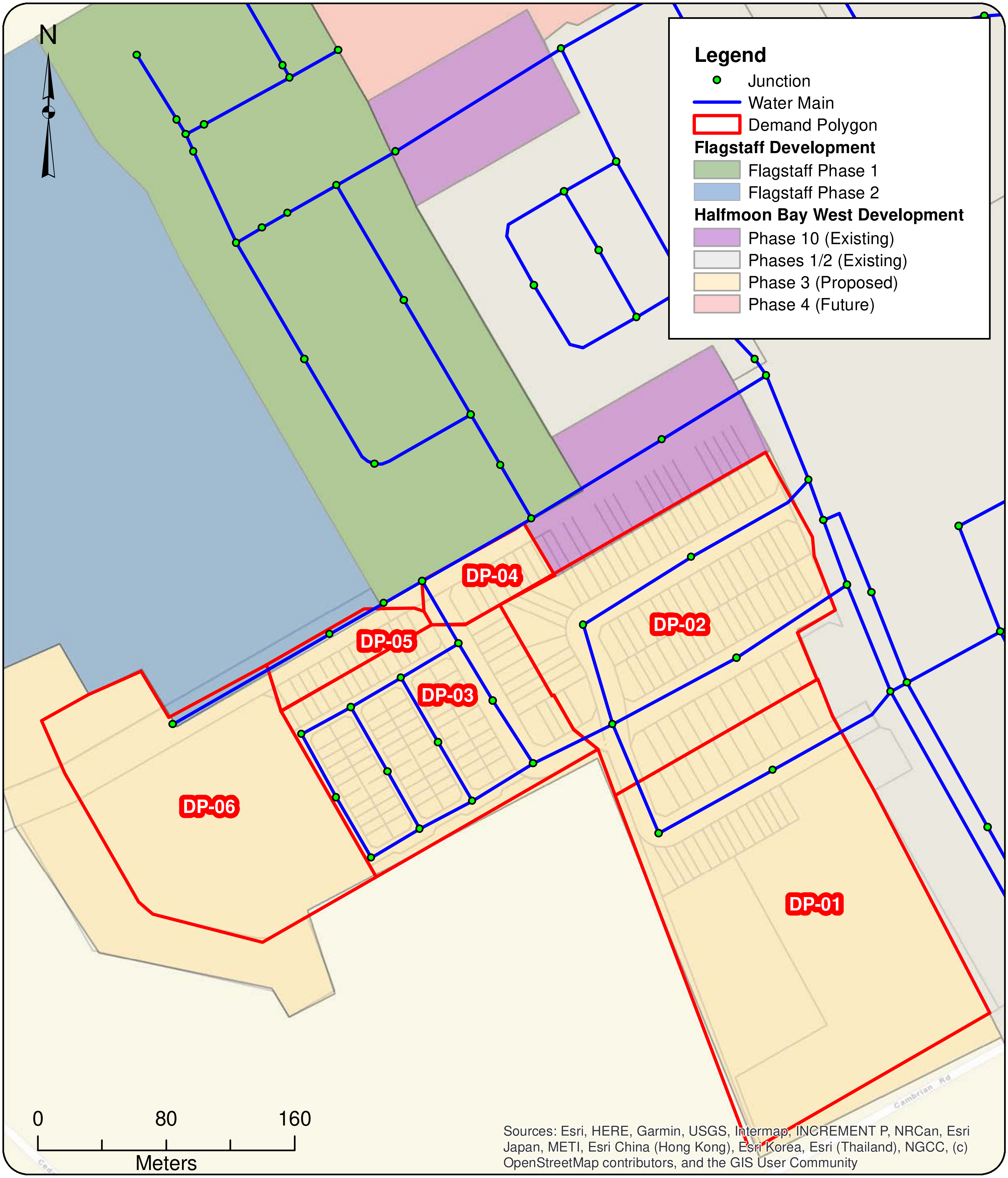
Domestic Demand Calculations and Allocation

HMBW Phase 3 Domestic Demands

Demand Polygon	Junction ID	Dwelling Type	Number of Units	Population	Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
					L/c/d	L/d	L/s			
1	J-87	Single Detached	11	42	280	12,068	0.14	0.35	0.77	0.07
	J-88	Traditional Townhouse	15	45	280	12,068	0.14	0.35	0.77	0.07
2	J-89	Single Detached	12	45	280	17,121	0.20	0.50	1.09	0.10
	J-90					17,121	0.20	0.50	1.09	0.10
	J-91	Traditional Townhouse	67	199	280	17,121	0.20	0.50	1.09	0.10
	J-92					17,121	0.20	0.50	1.09	0.10
3	J-93	Traditional Townhouse	12	36	280	6,393	0.07	0.18	0.41	0.04
	J-94					6,393	0.07	0.18	0.41	0.04
	J-95					6,393	0.07	0.18	0.41	0.04
	J-96					6,393	0.07	0.18	0.41	0.04
	J-97					6,393	0.07	0.18	0.41	0.04
	J-98					6,393	0.07	0.18	0.41	0.04
	J-99	Back-to-Back Townhouse	80	238	280	6,393	0.07	0.18	0.41	0.04
	J-100					6,393	0.07	0.18	0.41	0.04
	J-101					6,393	0.07	0.18	0.41	0.04
	J-102					6,393	0.07	0.18	0.41	0.04
	J-103					6,393	0.07	0.18	0.41	0.04
	J-104					6,393	0.07	0.18	0.41	0.04
4	J-105	Traditional Townhouse	9	27	280	7,492	0.09	0.22	0.48	0.04
5	J-107	Back-to-Back Townhouse	14	42	280	11,677	0.14	0.34	0.74	0.07
7	J-82	Traditional Townhouse	8	24	280	6,659	0.08	0.19	0.42	0.04
	Total:		**228**	**697**		**195,160**	**2.26**	**5.65**	**12.42**	**1.13**

HMBW Phase 3 Non-Domestic Demands

Property Type	Junction ID	Phase	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
				(L/ha/d)	(L/d)	(L/s)			
Park	J-87	Phase 3	2.85	28,000	79,800	0.92	1.39	2.49	0.46
Park	J-82	Phase 3	1.67	28,000	46,760	0.54	0.27	0.49	0.09
	Total:		**4.52**		**126,560**	**1.46**	**1.66**	**2.98**	**0.55**



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

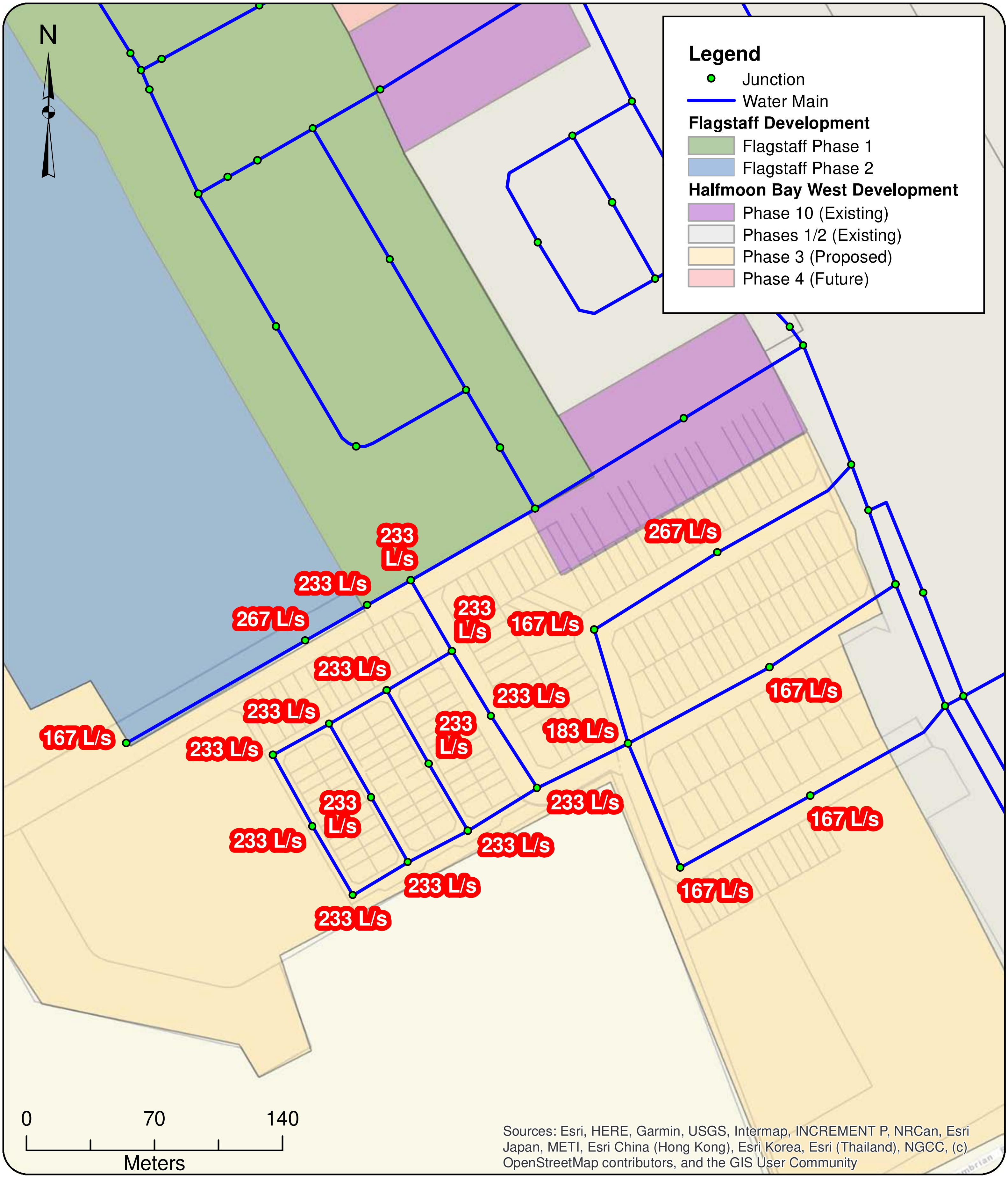
GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Demand Allocation

Figure A.1

Appendix B FUS Fire Flow Calculations and Allocation



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Required Fire Flow
Flagstaff Phase 2

Figure B.1

FUS Required Fire Flow Calculation

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3
Zoning: Multi Family Residential
Date: May 10, 2021

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Townhouse Block 40

Note: For other townhouse blocks that do not comply with the City of Ottawa Technical Bulletin ISDTB-2018-02 4.2, a similar fire flow as calculated below will be used (Block 37).

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 358 **m^2**

C. Number of Storeys: 2

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction **C =** 1.5

A: Effective area **A =** 715 **m^2**

The total floor area in m^2 in the building being considered

F = 8,826 L/min **D = 9,000 L/min***

E. Occupancy

Occupancy content hazard Limited Combustible -15 % of **D** **-1,350 L/min** **E = 7,650 L/min**

F. Sprinkler Protection

Automatic sprinkler protection None 0 % of **E** **0 L/min** **F = 7,650 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	30.1 to 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	5%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
West	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
			Total	**47%**

% of **E** **+ 3,596 L/min** **G = 11,246 L/min**

H. Wood Shake Charge No **0 L/min** **H = 11,246 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**11,000**	**L/min****
	183	**L/s**
Required Duration of Fire Flow	**2.25**	**Hrs**
Required Volume of Fire Flow	**1,485**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 Townhouse Block 33
Zoning: Multi Family Residential
Date: May 10, 2021

Note: For other townhouse blocks that do not comply with the City of Ottawa Technical Bulletin ISDTB-2018-02 4.2, a similar fire flow as calculated below will be used.

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 609 **m^2** Note: Block 33 has 7 units

C. Number of Storeys: 2

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction **C =** 1.5

A: Effective area **A =** 1218 **m^2**

The total floor area in m^2 in the building being considered

F = 11,517 L/min **D = 12,000 L/min***

E. Occupancy

Occupancy content hazard Limited Combustible -15 % of **D** **-1,800 L/min** **E = 10,200 L/min**

F. Sprinkler Protection

Automatic sprinkler protection None 0 % of **E** **0 L/min** **F = 10,200 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	61-90 m-storeys	Wood Frame or Non-Combustible	9%
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
			Total	**57%**

% of **E** **+ 5,814 L/min** **G = 16,014 L/min**

H. Wood Shake Charge No **0 L/min** **H = 16,014 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**16,000**	**L/min****
	267	**L/s**
Required Duration of Fire Flow	**3.5**	**Hrs**
Required Volume of Fire Flow	**3,360**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 — 12-unit Back-to-Back Townhouse
Zoning: Multi Family Residential — Firewall located in the middle of the block.
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 353 m^2

C. Number of Storeys: 3

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 1059 m^2

The total floor area in m^2 in the building being considered

F = 10,738 L/min — **D = 11,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-1,650 L/min** — **E = 9,350 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 9,350 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	Firewall	61-90 m-storeys	Wood Frame or Non-Combustible	10%
East	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
South	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
West	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
			Total	**55%**

% of **E** — **+ 5,143 L/min** — **G = 14,493 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 14,493 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**14,000**	**L/min****
	233	**L/s**
Required Duration of Fire Flow	**3**	**Hrs**
Required Volume of Fire Flow	**2,520**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

12-unit Back-to-Back Townhouse

Proposed fire wall location

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 — 10-unit Back-to-Back Townhouse
Zoning: Multi Family Residential — Firewall located with 6 units on one side and 4 units on the other.
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 357 **m^2**

C. Number of Storeys: 3

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 1071 **m^2**

The total floor area in m^2 in the building being considered

F = 10,798 L/min — **D = 11,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-1,650 L/min** — **E = 9,350 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 9,350 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
East	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
South	Firewall	61-90 m-storeys	Wood Frame or Non-Combustible	10%
West	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
			Total	**55%**

% of **E** — **+ 5,143 L/min** — **G = 14,493 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 14,493 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**14,000**	**L/min****
	233	**L/s**
Required Duration of Fire Flow	**3**	**Hrs**
Required Volume of Fire Flow	**2,520**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

10-unit Back-to-Back Townhouse

Proposed fire wall location

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 — 8-unit Back-to-Back Townhouse
Zoning: Multi Family Residential — No Firewall
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 481 m^2

Note: The exposure to the School block located to the North was taken at the property line to be conservative.

C. Number of Storeys: 3

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 1444 **m^2**

The total floor area in m^2 in the building being considered

F = 12,538 L/min — **D = 13,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-1,950 L/min** — **E = 11,050 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 11,050 L/min**

G. Exposures

Side	**Separation Distance**	**Length-Height Factor - Adjacent Structure**	**Construction Type - Adjacent Structure**	**Exposure**
North	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
East	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
South	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
West	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
			Total	**41%**

% of **E** — **+ 4,531 L/min** — **G = 15,581 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 15,581 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**16,000**	**L/min****
	267	**L/s**
Required Duration of Fire Flow	**3.5**	**Hrs**
Required Volume of Fire Flow	**3,360**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Back-to-Back Townhouse Proposed Fire Wall Locations

Fire wall locations are based off the FUS calculations completed, which were the worst-case scenarios for each townhouse block type (8-unit, 10-unit, 12-unit). It is possible that by completing additional FUS calculations, the fire wall recommendations may not be the same for the other back-to-back townhouse blocks.

Appendix C Boundary Conditions

Boundary Conditions
Flagstaff and Mattamy's Half Moon Bay West

Location

Scenario 1

Provided Information

Scenario 1	Demand	
	L/min	L/s
Average Daily Demand	403	6.71
Maximum Daily Demand	1,756	29.26
Peak Hour	3,708	61.80
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.0	89.6
Peak Hour	136.9	61.0
Max Day plus Fire 1	144.6	72.0
Max Day plus Fire 2	141.0	66.9
Max Day plus Fire 3	139.7	65.0
Max Day plus Fire 4	135.2	58.6

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.0	90.3
Peak Hour	136.9	61.8
Max Day plus Fire 1	144.9	73.1
Max Day plus Fire 2	141.4	68.2
Max Day plus Fire 3	140.1	66.3
Max Day plus Fire 4	135.7	60.1

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.3
Peak Hour	140.9	66.7
Max Day plus Fire 1	140.7	66.5
Max Day plus Fire 2	138.2	62.9
Max Day plus Fire 3	137.3	61.6
Max Day plus Fire 4	134.3	57.3

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.1
Peak Hour	140.9	67.5
Max Day plus Fire 1	140.9	67.6
Max Day plus Fire 2	138.6	64.2
Max Day plus Fire 3	137.7	62.9
Max Day plus Fire 4	134.8	58.9

Ground Elevation = 93.5 m

Scenario 2

Provided Information

Scenario 2	Demand	
	L/min	L/s
Average Daily Demand	491	8.19
Maximum Daily Demand	2,117	35.29
Peak Hour	4,456	74.26
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	158.3	91.4
Peak Hour	136.4	60.4
Max Day plus Fire 1	144.2	71.5
Max Day plus Fire 2	140.6	66.2
Max Day plus Fire 3	139.2	64.3
Max Day plus Fire 4	134.6	57.8

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	158.3	92.2
Peak Hour	136.4	61.1
Max Day plus Fire 1	144.5	72.6
Max Day plus Fire 2	140.9	67.5
Max Day plus Fire 3	139.6	65.6
Max Day plus Fire 4	135.2	59.4

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.3
Peak Hour	140.2	65.8
Max Day plus Fire 1	140.5	66.2
Max Day plus Fire 2	137.9	62.5
Max Day plus Fire 3	137.0	61.2
Max Day plus Fire 4	134.0	56.9

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	140.2	66.5
Max Day plus Fire 1	140.7	67.3
Max Day plus Fire 2	138.3	63.8
Max Day plus Fire 3	137.4	62.5
Max Day plus Fire 4	134.5	58.5

Ground Elevation = 93.5 m

Scenario 3

Provided Information

Scenario 3	Demand	
	L/min	L/s
Average Daily Demand	579	9.65
Maximum Daily Demand	2,499	41.65
Peak Hour	5,259	87.65
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	92.7
Peak Hour	135.1	58.4
Max Day plus Fire 1	143.8	70.9
Max Day plus Fire 2	140.1	65.6
Max Day plus Fire 3	138.7	63.6
Max Day plus Fire 4	134.1	57.1

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	93.4
Peak Hour	135.1	59.2
Max Day plus Fire 1	144.1	72.0
Max Day plus Fire 2	140.5	66.9
Max Day plus Fire 3	139.1	65.0
Max Day plus Fire 4	134.7	58.7

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.2
Peak Hour	139.5	64.7
Max Day plus Fire 1	140.3	65.8
Max Day plus Fire 2	137.7	62.2
Max Day plus Fire 3	136.7	60.8
Max Day plus Fire 4	133.6	56.4

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	139.5	65.5
Max Day plus Fire 1	140.5	66.9
Max Day plus Fire 2	138.0	63.4
Max Day plus Fire 3	137.1	62.2
Max Day plus Fire 4	134.2	58.0

Ground Elevation = 93.5 m

Scenario 4

Provided Information

Scenario 4	Demand	
	L/min	L/s
Average Daily Demand	613	10.21
Maximum Daily Demand	2,643	44.05
Peak Hour	5,563	92.72
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	92.6
Peak Hour	134.5	57.7
Max Day plus Fire 1	143.7	70.7
Max Day plus Fire 2	139.9	65.4
Max Day plus Fire 3	138.5	63.4
Max Day plus Fire 4	133.9	56.8

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	93.4
Peak Hour	134.5	58.4
Max Day plus Fire 1	143.9	71.8
Max Day plus Fire 2	140.3	66.6
Max Day plus Fire 3	138.9	64.7
Max Day plus Fire 4	134.5	58.4

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.2
Peak Hour	139.2	64.3
Max Day plus Fire 1	140.2	65.7
Max Day plus Fire 2	137.6	62.0
Max Day plus Fire 3	136.6	60.7
Max Day plus Fire 4	133.5	56.3

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	139.2	65.1
Max Day plus Fire 1	140.4	66.8
Max Day plus Fire 2	137.9	63.3
Max Day plus Fire 3	137.0	62.0
Max Day plus Fire 4	134.1	57.9

Ground Elevation = 93.5 m

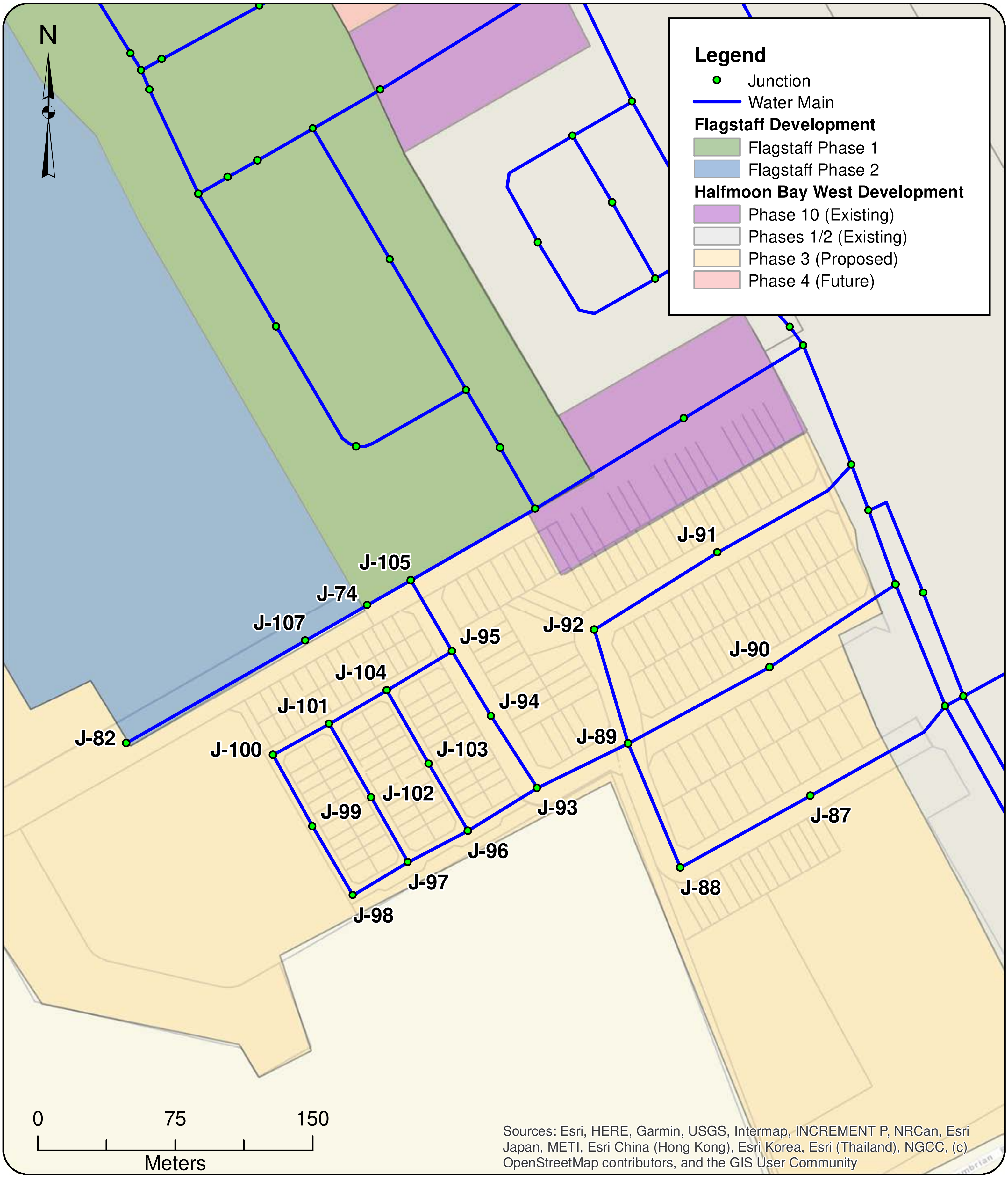
Notes

1. As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
    a. If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
    b. Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Appendix D Pipe and Junction Model Inputs



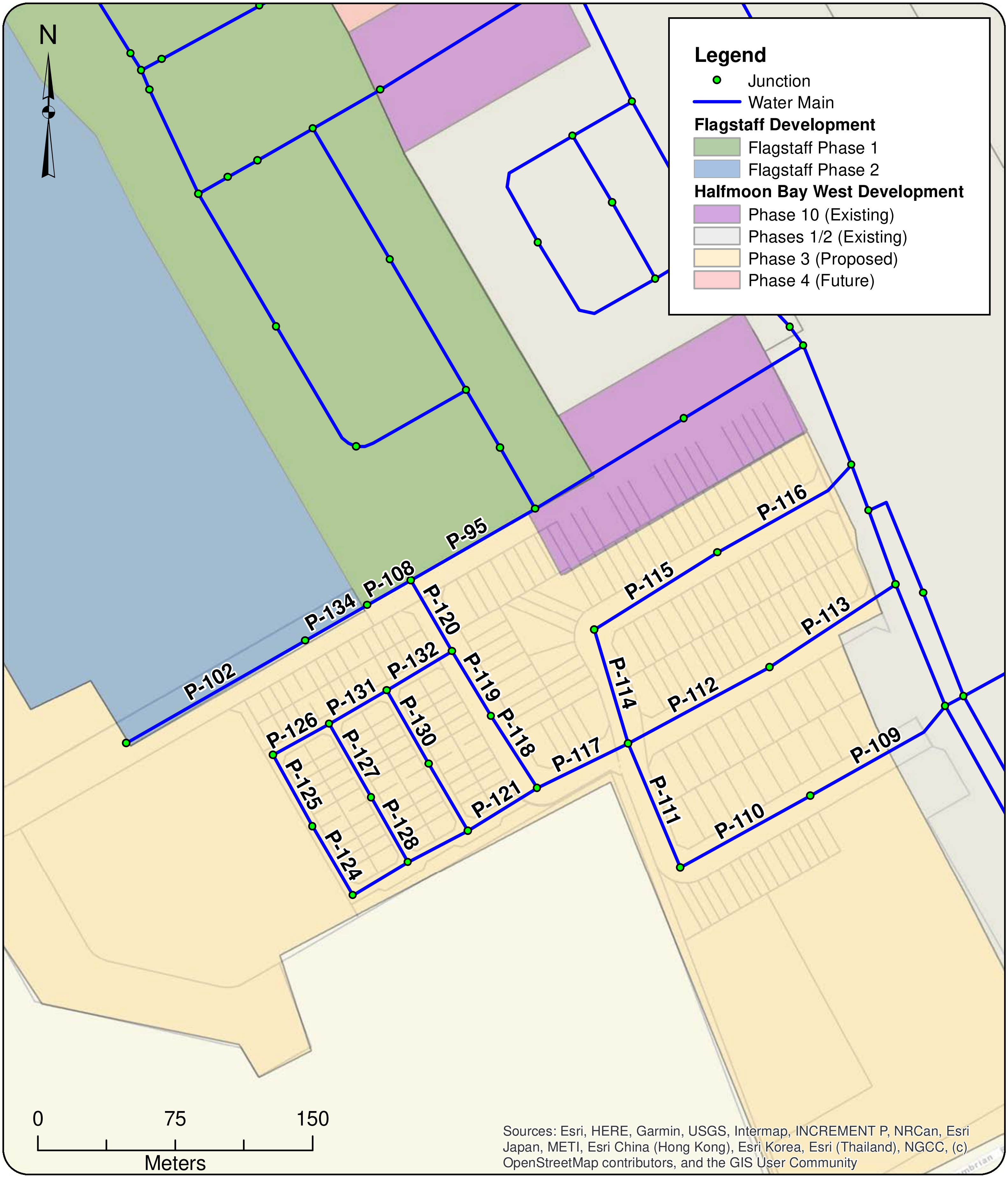
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Junction IDs

Figure D.1



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Pipe IDs

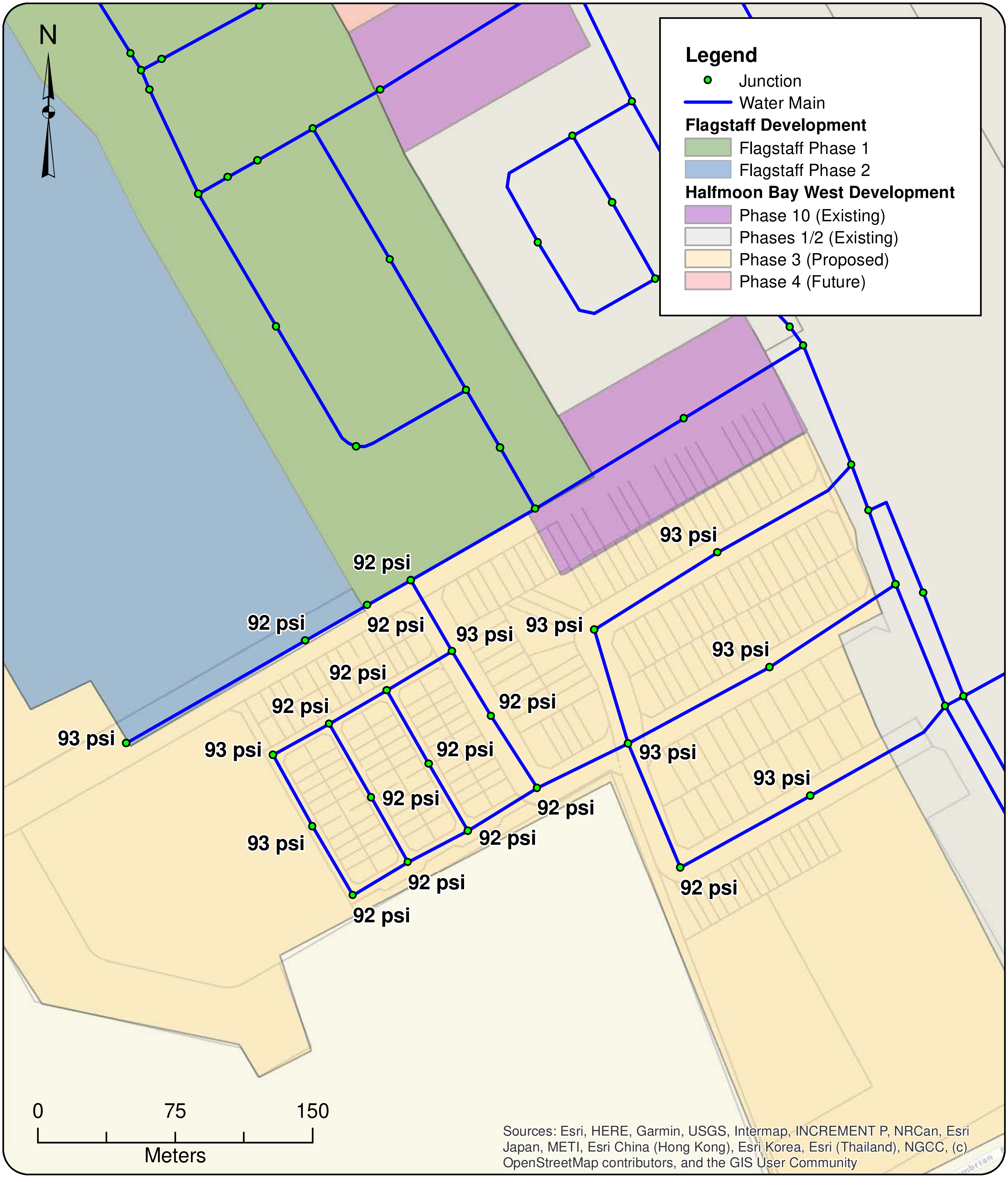
Figure D.2

Model Inputs

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness ()
P-102	J-82	J-107	112.76	297	120
P-108	J-105	J-74	27.31	297	120
P-109	J-14	J-87	89.29	204	110
P-110	J-87	J-88	81.18	204	110
P-111	J-88	J-89	73.64	204	110
P-112	J-89	J-90	87.69	204	110
P-113	J-90	J-13	82.42	204	110
P-114	J-89	J-92	64.70	204	110
P-115	J-92	J-91	79.40	204	110
P-116	J-91	J-19	88.28	204	110
P-117	J-89	J-93	55.19	204	110
P-118	J-93	J-94	46.56	204	110
P-119	J-94	J-95	41.31	204	110
P-120	J-95	J-105	44.98	204	110
P-121	J-93	J-96	44.58	204	110
P-122	J-96	J-97	37.02	204	110
P-123	J-97	J-98	35.03	204	110
P-124	J-98	J-99	43.48	204	110
P-125	J-99	J-100	44.77	204	110
P-126	J-100	J-101	35.00	204	110
P-127	J-101	J-102	46.13	204	110
P-128	J-102	J-97	40.79	204	110
P-129	J-96	J-103	42.30	204	110
P-130	J-103	J-104	46.37	204	110
P-131	J-104	J-101	36.29	204	110
P-132	J-104	J-95	41.56	204	110
P-134	J-107	J-74	39.00	297	120
P-95	J-73	J-105	78.42	297	120

ID	Elevation (m)
J-100	93.10
J-101	93.40
J-102	93.40
J-103	93.40
J-104	93.30
J-105	93.43
J-107	93.46
J-74	93.46
J-82	93.08
J-87	93.10
J-88	93.30
J-89	93.20
J-90	93.10
J-91	93.00
J-92	93.20
J-93	93.40
J-94	93.30
J-95	93.20
J-96	93.40
J-97	93.50
J-98	93.30
J-99	93.20

Appendix E MHD and PHD Model Results



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

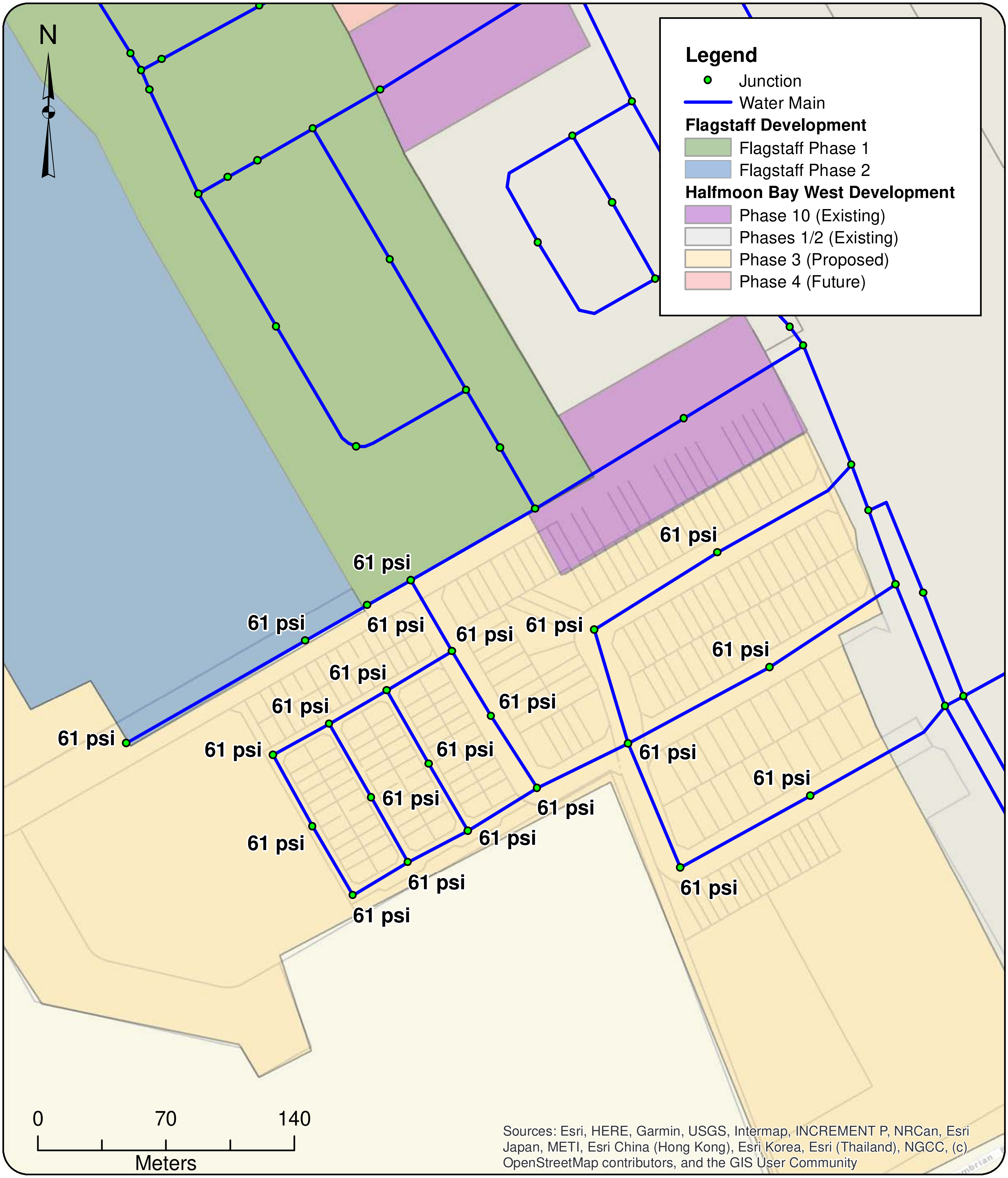
MHD Pressure Results HMBW Phase 3

Figure E.1

Minimum Hour Demand Modeling Results - Half Moon Bay West Phase 3

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/k-m)
P-102	J-82	J-107	112.76	297	120	-0.13	0.00	0.00	0.00
P-108	J-105	J-74	27.31	297	120	0.25	0.00	0.00	0.00
P-109	J-14	J-87	89.29	204	110	0.63	0.02	0.00	0.01
P-110	J-87	J-88	81.18	204	110	0.10	0.00	0.00	0.00
P-111	J-88	J-89	73.64	204	110	0.03	0.00	0.00	0.00
P-112	J-89	J-90	87.69	204	110	-0.28	0.01	0.00	0.00
P-113	J-90	J-13	82.42	204	110	-0.38	0.01	0.00	0.00
P-114	J-89	J-92	64.70	204	110	-0.09	0.00	0.00	0.00
P-115	J-92	J-91	79.40	204	110	-0.18	0.01	0.00	0.00
P-116	J-91	J-19	88.28	204	110	-0.28	0.01	0.00	0.00
P-117	J-89	J-93	55.19	204	110	0.29	0.01	0.00	0.00
P-118	J-93	J-94	46.56	204	110	0.08	0.00	0.00	0.00
P-119	J-94	J-95	41.31	204	110	0.04	0.00	0.00	0.00
P-120	J-95	J-105	44.98	204	110	-0.15	0.01	0.00	0.00
P-121	J-93	J-96	44.58	204	110	0.18	0.01	0.00	0.00
P-122	J-96	J-97	37.02	204	110	0.11	0.00	0.00	0.00
P-123	J-97	J-98	35.03	204	110	0.06	0.00	0.00	0.00
P-124	J-98	J-99	43.48	204	110	0.02	0.00	0.00	0.00
P-125	J-99	J-100	44.77	204	110	-0.02	0.00	0.00	0.00
P-126	J-100	J-101	35.00	204	110	-0.06	0.00	0.00	0.00
P-127	J-101	J-102	46.13	204	110	0.02	0.00	0.00	0.00
P-128	J-102	J-97	40.79	204	110	-0.02	0.00	0.00	0.00
P-129	J-96	J-103	42.30	204	110	0.03	0.00	0.00	0.00
P-130	J-103	J-104	46.37	204	110	-0.01	0.00	0.00	0.00
P-131	J-104	J-101	36.29	204	110	0.11	0.00	0.00	0.00
P-132	J-104	J-95	41.56	204	110	-0.16	0.01	0.00	0.00
P-134	J-107	J-74	39.00	297	120	-0.20	0.00	0.00	0.00
P-95	J-73	J-105	78.42	297	120	0.45	0.01	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-100	0.04	93.10	158	93
J-101	0.04	93.40	158	92
J-102	0.04	93.40	158	92
J-103	0.04	93.40	158	92
J-104	0.04	93.30	158	92
J-105	0.04	93.43	158	92
J-107	0.07	93.46	158	92
J-74	0.06	93.46	158	92
J-82	0.13	93.08	158	93
J-87	0.53	93.10	158	93
J-88	0.07	93.30	158	92
J-89	0.10	93.20	158	93
J-90	0.10	93.10	158	93
J-91	0.10	93.00	158	93
J-92	0.10	93.20	158	93
J-93	0.04	93.40	158	92
J-94	0.04	93.30	158	92
J-95	0.04	93.20	158	93
J-96	0.04	93.40	158	92
J-97	0.04	93.50	158	92
J-98	0.04	93.30	158	92
J-99	0.04	93.20	158	93



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

PHD Pressure Results
HMBW Phase 3

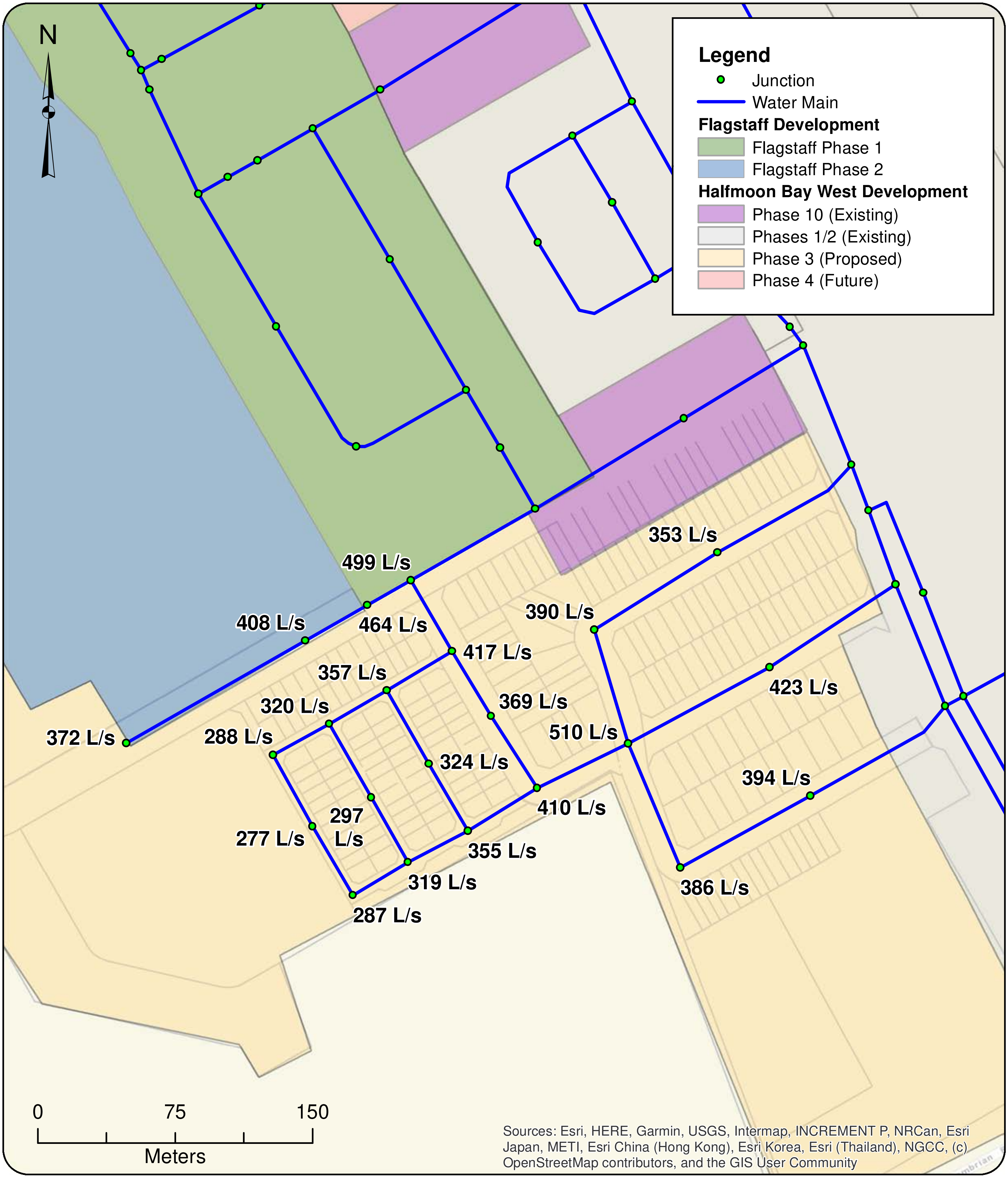
Figure E.2

Peak Hour Demand Modeling Results - Half Moon Bay West Phase 3

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/k-m)
P-102	J-82	J-107	112.76	297	120	-0.91	0.01	0.00	0.00
P-108	J-105	J-74	27.31	297	120	2.28	0.03	0.00	0.01
P-109	J-14	J-87	89.29	204	110	5.68	0.17	0.03	0.28
P-110	J-87	J-88	81.18	204	110	2.42	0.07	0.01	0.06
P-111	J-88	J-89	73.64	204	110	1.65	0.05	0.00	0.03
P-112	J-89	J-90	87.69	204	110	-2.63	0.08	0.01	0.07
P-113	J-90	J-13	82.42	204	110	-3.72	0.11	0.01	0.13
P-114	J-89	J-92	64.70	204	110	-0.46	0.01	0.00	0.00
P-115	J-92	J-91	79.40	204	110	-1.54	0.05	0.00	0.03
P-116	J-91	J-19	88.28	204	110	-2.63	0.08	0.01	0.07
P-117	J-89	J-93	55.19	204	110	3.65	0.11	0.01	0.12
P-118	J-93	J-94	46.56	204	110	1.16	0.04	0.00	0.02
P-119	J-94	J-95	41.31	204	110	0.75	0.02	0.00	0.01
P-120	J-95	J-105	44.98	204	110	-1.24	0.04	0.00	0.02
P-121	J-93	J-96	44.58	204	110	2.08	0.06	0.00	0.04
P-122	J-96	J-97	37.02	204	110	1.26	0.04	0.00	0.02
P-123	J-97	J-98	35.03	204	110	0.62	0.02	0.00	0.01
P-124	J-98	J-99	43.48	204	110	0.21	0.01	0.00	0.00
P-125	J-99	J-100	44.77	204	110	-0.20	0.01	0.00	0.00
P-126	J-100	J-101	35.00	204	110	-0.60	0.02	0.00	0.01
P-127	J-101	J-102	46.13	204	110	0.17	0.01	0.00	0.00
P-128	J-102	J-97	40.79	204	110	-0.23	0.01	0.00	0.00
P-129	J-96	J-103	42.30	204	110	0.42	0.01	0.00	0.00
P-130	J-103	J-104	46.37	204	110	0.01	0.00	0.00	0.00
P-131	J-104	J-101	36.29	204	110	1.18	0.04	0.00	0.02
P-132	J-104	J-95	41.56	204	110	-1.58	0.05	0.00	0.03
P-134	J-107	J-74	39.00	297	120	-1.65	0.02	0.00	0.00
P-95	J-73	J-105	78.42	297	120	4.00	0.06	0.00	0.02

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-100	0.41	93.10	136	61
J-101	0.41	93.40	136	61
J-102	0.41	93.40	136	61
J-103	0.41	93.40	136	61
J-104	0.41	93.30	136	61
J-105	0.48	93.43	136	61
J-107	0.74	93.46	136	61
J-74	0.63	93.46	136	61
J-82	0.91	93.08	136	61
J-87	3.26	93.10	136	61
J-88	0.77	93.30	136	61
J-89	1.09	93.20	136	61
J-90	1.09	93.10	136	61
J-91	1.09	93.00	136	61
J-92	1.09	93.20	136	61
J-93	0.41	93.40	136	61
J-94	0.41	93.30	136	61
J-95	0.41	93.20	136	61
J-96	0.41	93.40	136	61
J-97	0.41	93.50	136	61
J-98	0.41	93.30	136	61
J-99	0.41	93.20	136	61

Appendix F MDD+FF Model Results



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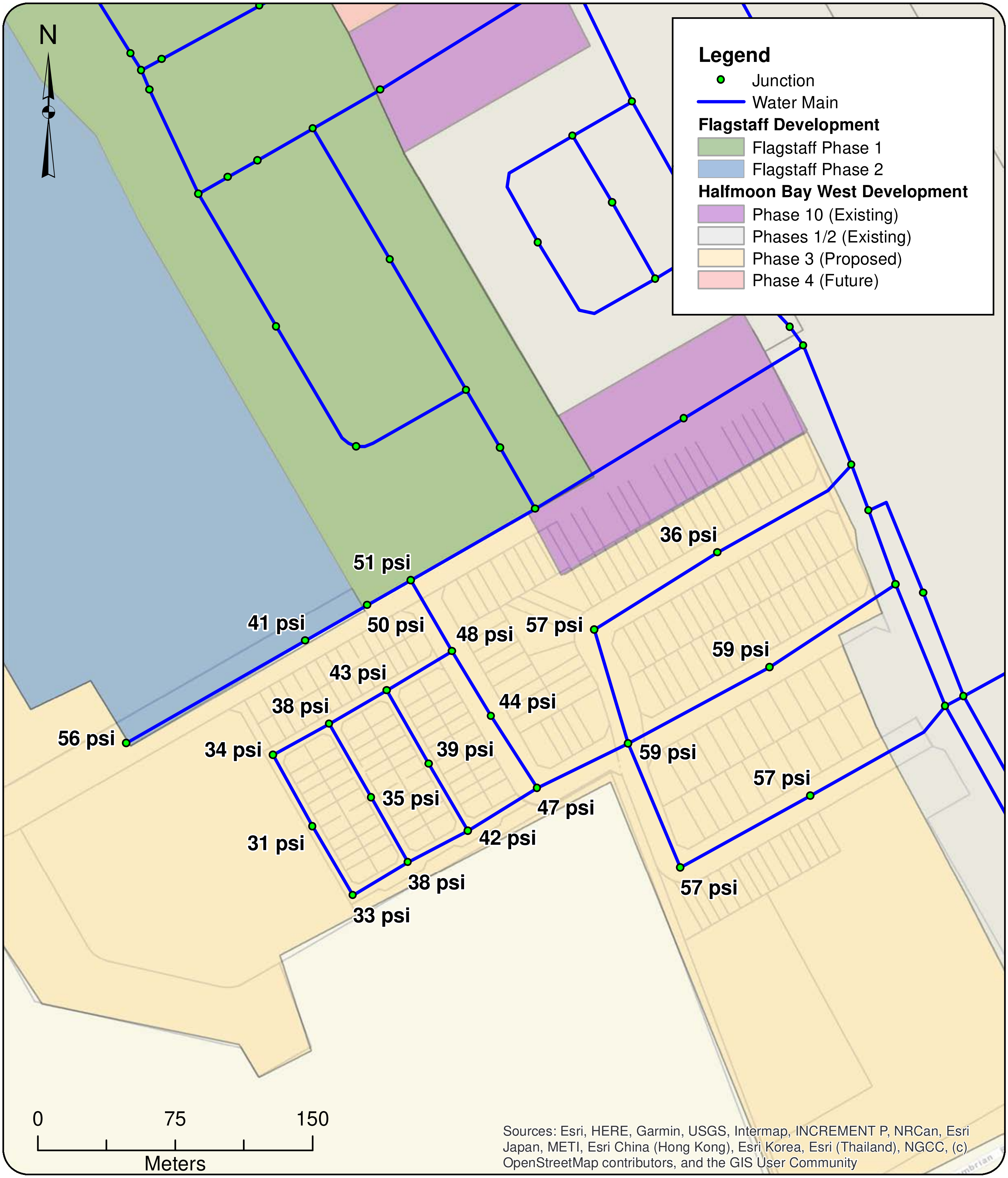
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Available Fire Flow @ 20 psi HMBW Phase 3

Figure F.1



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Mattamy Half Moon Bay West Phase 2
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Residual Pressure @ Required Fire Flow HMBW Phase 3

Figure F.2

Fire Flow Modeling Results - Half Moon Bay West Phase 3

ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-82	0.46	67	141	167	56	372	20
J-87	1.74	67	141	167	57	394	20
J-88	0.35	67	141	167	57	386	20
J-90	0.50	67	141	167	59	423	20
J-92	0.50	67	141	167	57	390	20
J-89	0.50	66	140	183	59	510	20
J-100	0.19	63	137	233	34	288	20
J-101	0.19	62	137	233	38	320	20
J-102	0.19	62	137	233	35	297	20
J-103	0.19	62	137	233	39	324	20
J-104	0.19	62	137	233	43	357	20
J-105	0.22	62	137	233	51	499	20
J-74	0.29	62	137	233	50	464	20
J-93	0.19	62	137	233	47	410	20
J-94	0.19	62	137	233	44	369	20
J-95	0.19	62	137	233	48	417	20
J-96	0.19	62	137	233	42	355	20
J-97	0.19	62	137	233	38	319	20
J-98	0.19	62	137	233	33	287	20
J-99	0.19	62	137	233	31	277	20
J-107	0.34	59	135	267	41	408	20
J-91	0.50	60	135	267	36	353	20

APPENDIX C

HMB WEST PHASE 3 SANITARY DRAINAGE AREA PLANS
(DSEL, NOVEMBER 18, 2021)

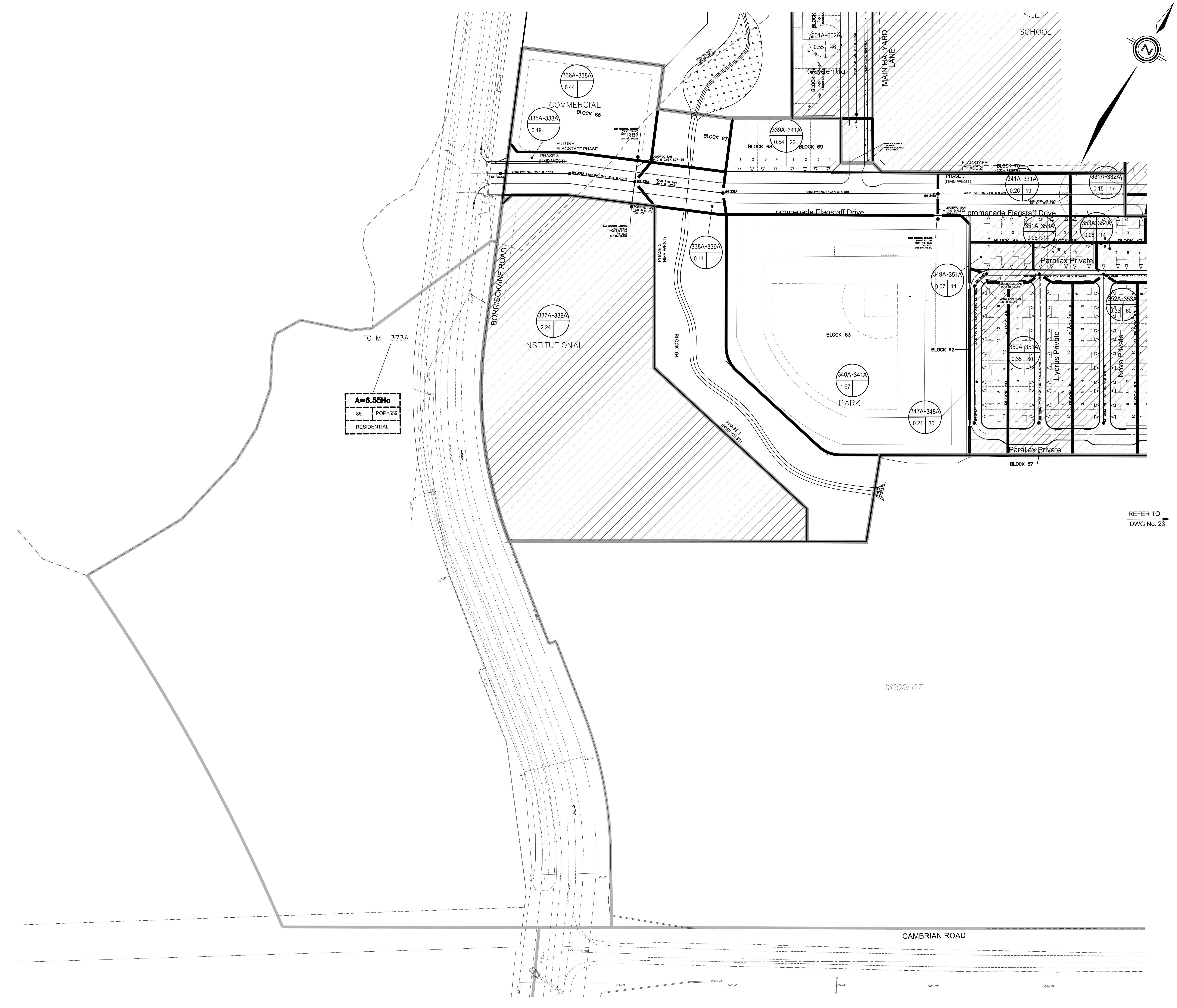
HMB WEST PHASE 3 SANITARY DESIGN SHEETS
(DSEL, NOVEMBER 18, 2021)

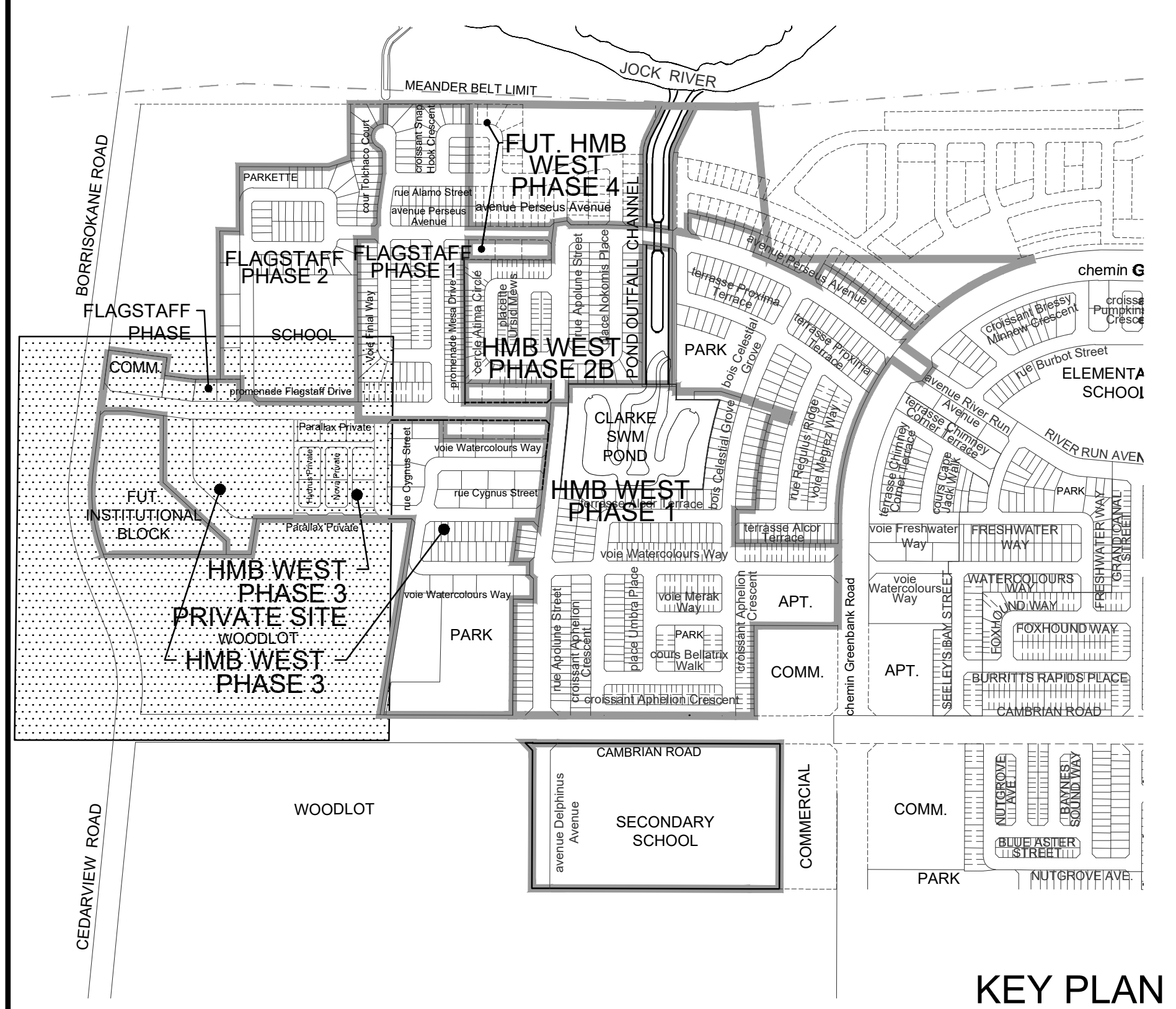
GLENVIEW FLAGSTAFF PHASE 1 SANITARY DRAINAGE AREA PLAN
(DSEL, MARCH 27, 2020)

GLENVIEW FLAGSTAFF PHASE 1 SANITARY DESIGN SHEETS
(DSEL, MARCH 27, 2020)

HMB WEST PHASE 1 SANITARY DRAINAGE AREA PLAN
(DSEL, OCTOBER 29, 2018)

HMB WEST PHASE 1 SANITARY DESIGN SHEETS
(DSEL, OCTOBER 29, 2018)





KEY PLAN
SCALE 1:10000

LEGEND

UPSTREAM MH TO DOWNSTREAM MH — 1001A-602A
AREA IN HECTARES — 2.40
POPULATION — 0
TRIBUTARY TYPE — SCHOOL

UPSTREAM MH TO DOWNSTREAM MH — 507A-508A
PREVIOUS PHASE AREA IN HECTARES — 0.18
POPULATION — 14

MAINTENANCE HOLE — MH202A (200mmø SAN)
CAP

EXTERNAL AREA IN HECTARES — A=53.63
EXTERNAL POPULATION — POP=5739
DENSITY (PERSONS/HECTARE) — 107
EXTERNAL LAND USE — RESIDENTIAL

SANITARY DRAINAGE BOUNDARY
SANITARY DRAINAGE SUB–BOUNDARY
SANITARY DRAINAGE BOUNDARY (OTHER PHASES)
OTHER PHASES NOT PART OF THIS APPLICATION
AREA INCLUDED IN SEPERATE DRAWING SET

No.	BY	DATE	DESCRIPTION
3	S.L.M.	21.11.18	3rd SUBMISSION
2	S.L.M.	21.08.31	2nd SUBMISSION
1	S.L.M.	21.06.04	1st SUBMISSION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED FEBRUARY 22, 2017
TOPOGRAPHIC INFORMATION FOR BORRISOKANE ROAD PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 18-10-145-00, RECEIVED ON JULY 10, 2019

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED NOVEMBER 10, 2021

BENCH MARK

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE PUBLISHED BENCHMARK NUMBER 0011964U3710 HAVING AN ELEVATION OF 71.724 M.

MATTAMY (HALF
MOON BAY) LTD.

HALF MOON BAY WEST
PHASE 3

DSEL
120 Iber Road Unit 103
Stittsville, Ontario, K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

LICENSED PROFESSIONAL ENGINEER
S. L. MERRICK
100186523
2021-11-18
PROVINCE OF ONTARIO
JOB#19-1140

CITY OF OTTAWA

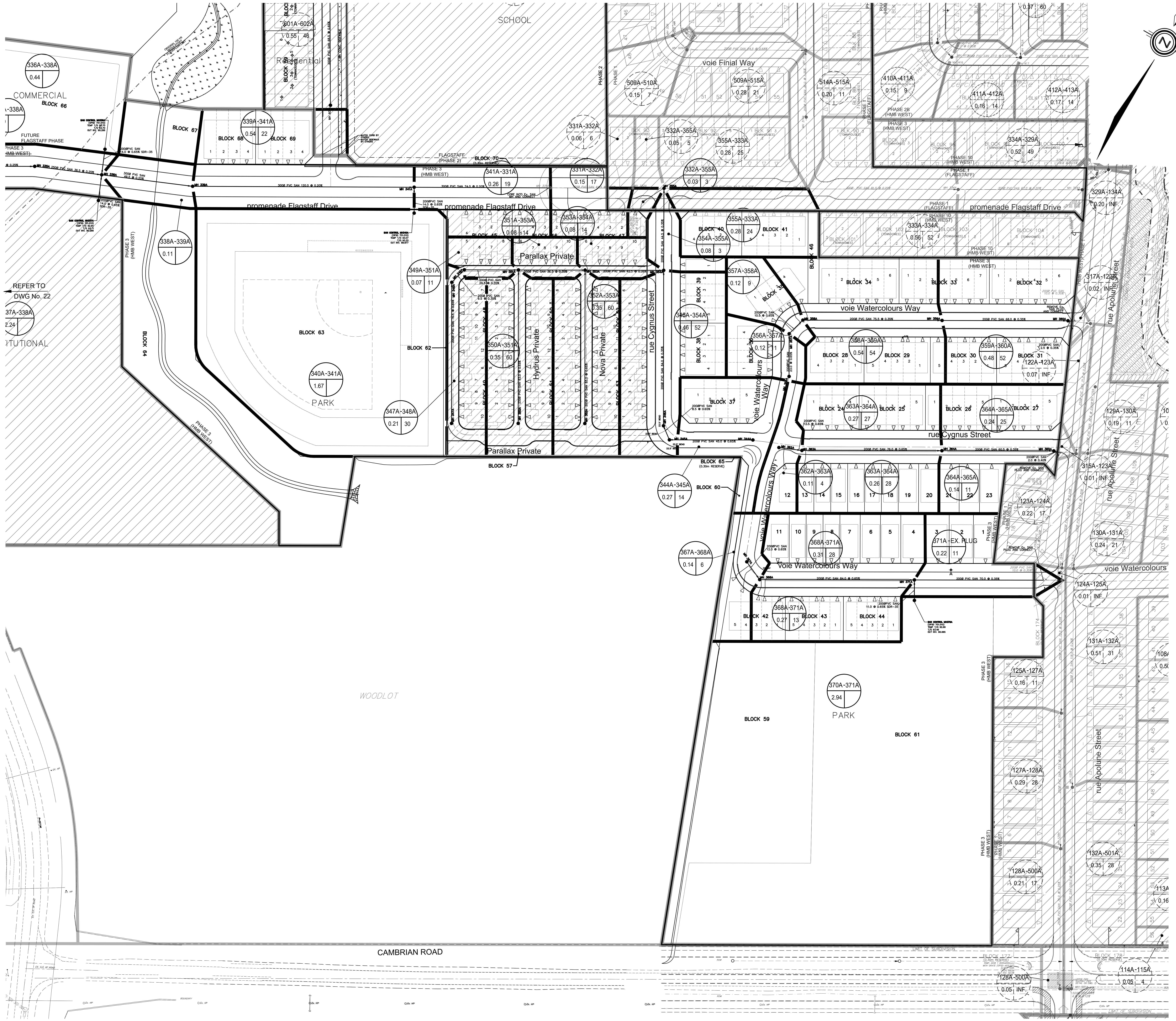
SANITARY DRAINAGE PLAN

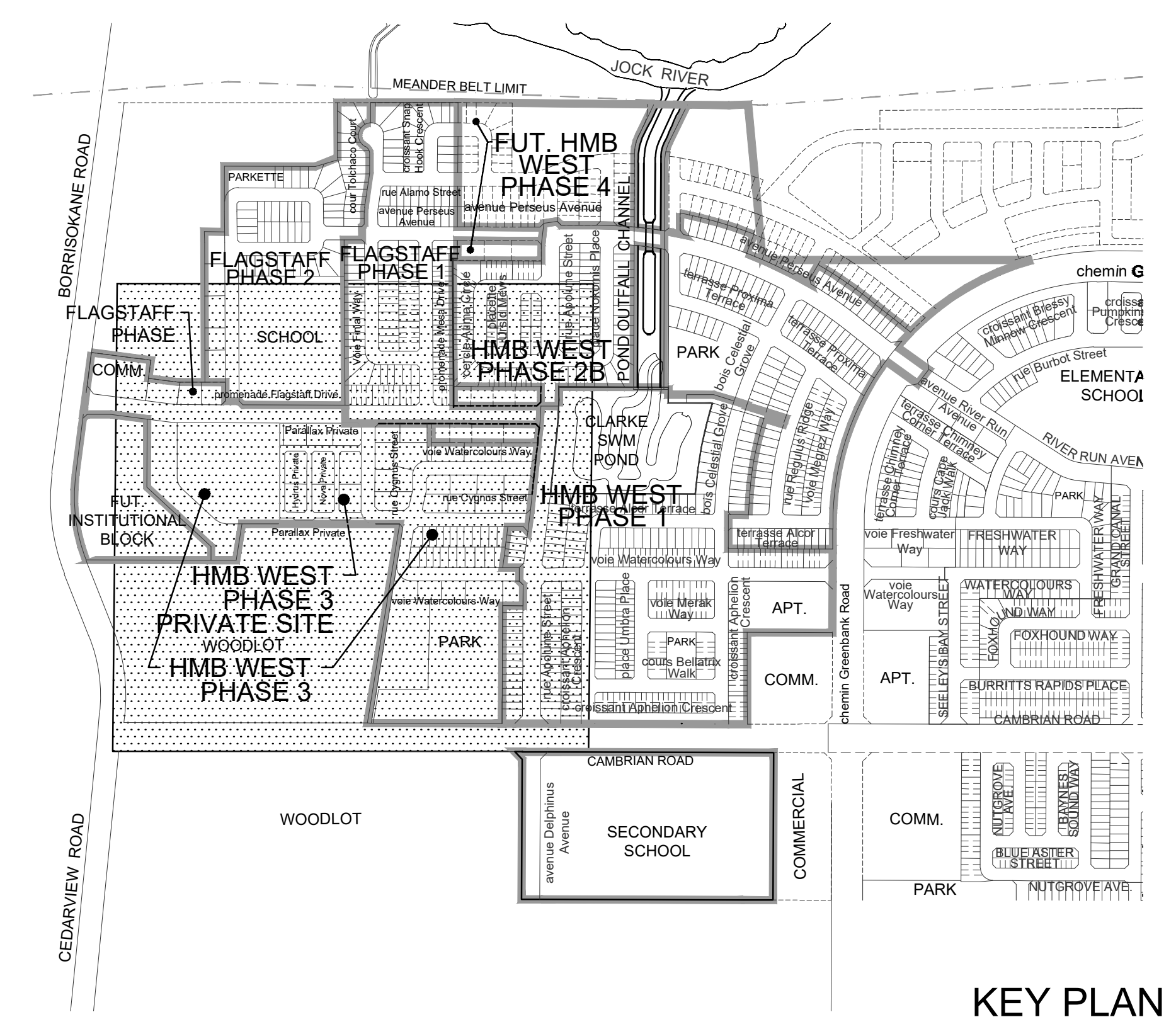
© DSEL

DRAWN BY:	G.G.G.	CHECKED BY:	S.L.M.	PROJECT No. 19–1140
DESIGNED BY:	G.G.G.	CHECKED BY:	S.L.M.	
SCALE: 1:1000				SHEET No. 22

CITY PLAN No. 17586

CITY FILE No. D07-16-26-0023 P3





KEY PLAN
SCALE 1:10000

LEGEND

UPSTREAM MH TO DOWNSTREAM MH → 1001A-602A
AREA IN HECTARES → 2.40
POPULATION → 0
TRIBUTARY TYPE → SCHOOL

UPSTREAM MH TO DOWNSTREAM MH → 507A-508A
PREVIOUS PHASE AREA IN HECTARES → 0.18
POPULATION → 14

MAINTENANCE HOLE → MH202A (200mmø SAN)
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SANITARY DRAINAGE BOUNDARY	■
SANITARY DRAINAGE SUB–BOUNDARY	■
SANITARY DRAINAGE BOUNDARY (OTHER PHASES)	■
OTHER PHASES NOT PART OF THIS APPLICATION	▨
AREA INCLUDED IN SEPERATE DRAWING SET	▨

3	S.L.M.	21.11.18	3rd SUBMISSION
2	S.L.M.	21.08.31	2nd SUBMISSION
1	S.L.M.	21.06.04	1st SUBMISSION
No.	BY	DATE	DESCRIPTION

TOPOGRAPHIC INFORMATION
TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED FEBRUARY 22, 2017
TOPOGRAPHIC INFORMATION FOR BORRISOKANE ROAD PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 18-10-145-00, RECEIVED ON JULY 10, 2019

LEGAL INFORMATION
CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED NOVEMBER 10, 2021

BENCH MARK
ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE PUBLISHED BENCHMARK NUMBER 0011964U3710 HAVING AN ELEVATION OF 71.724 M.

MATTAMY (HALF
MOON BAY) LTD.

HALF MOON BAY WEST
PHASE 3

DSEL
120 Iber Road Unit 103
Stittsville, Ontario, K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
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LICENSED PROFESSIONAL ENGINEER
S. L. MERRICK
100186523
2021-11-18
PROVINCE OF ONTARIO
JOB#19-1140

CITY OF OTTAWA

SANITARY DRAINAGE PLAN

DRAWN BY:	G.G.G.	CHECKED BY:	S.L.M.	PROJECT No. 19–1140
DESIGNED BY:	G.G.G.	CHECKED BY:	S.L.M.	
SCALE: 1:1000				SHEET No. 23

CITY FILE No. D07-16-26-0023 P3
CITY PLAN No. 17586

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
PARK BLOCK 61																													
	370A	371A						0.00					0.00		0.00	2.94	2.94	0.32	2.94	2.94	0.97	1.29	11.0	200	0.65	26.44	0.05	0.84	0.43
To voie Watercolours Way, Pipe 371A - Ex. Plug								0.00	0				0.00		0.00		2.94			2.94									
voie Watercolours Way																													
	367A	368A	0.14	2		2	6	0.14	6	3.75	0.07		0.00		0.00		0.00	0.00	0.14	0.14	0.05	0.12	12.0	200	0.65	26.44	0.00	0.84	0.20
			0.27	13		13	36	0.41	42				0.00		0.00		0.00		0.27	0.41									
	368A	371A	0.31	8	8		28	0.72	70	3.63	0.82		0.00		0.00		0.00	0.00	0.31	0.72	0.24	1.06	84.0	200	0.65	26.44	0.04	0.84	0.41
Contribution From PARK BLOCK 61, Pipe 370A - 371A								0.00	0				0.00		0.00		2.94		2.94	3.66									
	371A	Ex. Plug	0.22	3	3		11	0.94	70	3.63	0.82		0.00		0.00		2.94	0.32	0.22	3.88	1.28	2.42	70.0	200	0.35	19.40	0.12	0.62	0.42
	356A	357A	0.12	4		4	11	0.12	11	3.73	0.13		0.00		0.00		0.00	0.00	0.12	0.12	0.04	0.17	23.0	200	0.65	26.44	0.01	0.84	0.23
	357A	358A	0.12	3		3	9	0.24	20	3.70	0.24		0.00		0.00		0.00	0.00	0.12	0.24	0.08	0.32	10.5	200	0.65	26.44	0.01	0.84	0.28
	358A	359A	0.54	20		20	54	0.78	74	3.62	0.87		0.00		0.00		0.00	0.00	0.54	0.78	0.26	1.13	75.5	200	0.35	19.40	0.06	0.62	0.33
	359A	360A	0.48	19		19	52	1.26	126	3.57	1.46		0.00		0.00		0.00	0.00	0.48	1.26	0.42	1.87	68.0	200	0.35	19.40	0.10	0.62	0.39
	360A	Ex. Plug						1.26	126	3.57	1.46		0.00		0.00		0.00	0.00	0.00	1.26	0.42	1.87	2.5	200	0.35	19.40	0.10	0.62	0.39
Cygnus Street																													
	362A	363A	0.11	1	1		4	0.11	4	3.76	0.05		0.00		0.00		0.00	0.00	0.11	0.11	0.04	0.08	12.5	200	0.65	26.44	0.00	0.84	0.19
			0.26	8	8		28	0.37	32				0.00		0.00		0.00		0.26	0.37									
	363A	364A	0.27	10		10	27	0.64	59	3.64	0.70		0.00		0.00		0.00	0.00	0.27	0.64	0.21	0.91	76.0	200	0.65	26.44	0.03	0.84	0.39
			0.14	3	3		11	0.78	70				0.00		0.00		0.00		0.14	0.78									
	364A	365A	0.24	9		9	25	1.02	95	3.60	1.11		0.00		0.00		0.00	0.00	0.24	1.02	0.34	1.44	60.5	200	0.35	19.40	0.07	0.62	0.36
	365A	Ex. Plug						1.02	95	3.60	1.11		0.00		0.00		0.00	0.00	0.00	1.02	0.34	1.44	2.0	200	0.40	20.74	0.07	0.66	0.37
Nova Private																													
	352A	353A	0.35	22		22	60	0.35	60	3.64	0.71		0.00		0.00		0.00	0.00	0.35	0.35	0.12	0.82	83.0	200	0.65	26.44	0.03	0.84	0.38
To Parallax private, Pipe 353A - 354A								0.35	60				0.00		0.00		0.00			0.35									
Hydrus Private																													
	350A	351A	0.35	22		22	60	0.35	60	3.64	0.71		0.00		0.00		0.00	0.00	0.35	0.35	0.12	0.82	83.0	200	0.65	26.44	0.03	0.84	0.38
To Parallax private, Pipe 351A - 353A								0.35	60				0.00		0.00		0.00			0.35									
Parallax private																													
	347A	348A	0.21	11		11	30	0.21	30	3.68	0.36		0.00		0.00		0.00	0.00	0.21	0.21	0.07	0.43	76.5	200	0.65	26.44	0.02	0.84	0.30
	348A	349A						0.21	30	3.68	0.36		0.00		0.00		0.00	0.00	0.00	0.21	0.07	0.43	9.5	200	0.35	19.40	0.02	0.62	0.25
	349A	351A	0.07	4		4	11	0.28	41	3.67	0.49		0.00		0.00		0.00	0.00	0.07	0.28	0.09	0.58	29.5	200	0.35	19.40	0.03	0.62	0.27
Contribution From Hydrus Private, Pipe 350A - 351A								0.35	60				0.00		0.00		0.00		0.35	0.63									
	351A	353A	0.08	5		5	14	0.71	115	3.58	1.33		0.00		0.00		0.00	0.00	0.08	0.71	0.23	1.57	36.0	200	0.35	19.40	0.08	0.62	0.37
Contribution From Nova Private, Pipe 352A - 353A								0.35	60				0.00		0.00		0.00		0.35	1.06									
	353A	354A	0.08	5		5	14	1.14	189	3.53	2.16		0.00		0.00		0.00	0.00	0.08	1.14	0.38	2.54	42.5	200	0.35	19.40	0.13	0.62	0.42
To Cygnus Street, Pipe 354A - 355A								1.14	189				0.00		0.00		0.00			1.14									
Cygnus Street																													
	344A	345A	0.27	5		5	14	0.27	14	3.72	0.17		0.00		0.00		0.00	0.00	0.27	0.27	0.09	0.26	45.0	200	0.65	26.44	0.01	0.84	0.26
	345A	346A						0.27	14	3.72	0.17		0.00		0.00		0.00	0.00	0.00	0.27	0.09	0.26	8.5	200	0.65	26.44	0.01	0.84	0.26
	346A	354A	0.46	19		19	52	0.73	66	3.63	0.78		0.00		0.00		0.00	0.00	0.46	0.73	0.24	1.02	84.0	200	0.35	19.40	0.05	0.62	0.33

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha				
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph			
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s
Max Res. Peak Factor =	4.00				Manning's n =	(Conc)	0.013	(Pvc) 0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		2.7	
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4	

Designed: GGG

Checked: SLM

Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 22-23

PROJECT: **Mattamy Half Moon Bay West Phase 3**

LOCATION: **City of Ottawa**

File Ref: 19-1140

Date: **18 Nov 2021**

Sheet No. 1 of 2

S. L. MERRICK
100186523
2021-11-18

JOB #19-1140

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Contribution From Parallax private, Pipe 353A - 354A								1.14	189				0.00		0.00		0.00		1.14	1.87									
	354A	355A	0.08	1		1	3	1.95	258	3.48	2.91		0.00		0.00		0.00	0.00	0.08	1.95	0.64	3.56	44.5	200	0.35	19.40	0.18	0.62	0.47
To promenade Flagstaff Drive, Pipe 355A - Ex. 333A								1.95	258				0.00		0.00		0.00			1.95									
PARK BLOCK 63																													
	340A	341A						0.00					0.00		0.00	1.67	1.67	0.18	1.67	1.67	0.55	0.73	14.0	200	0.65	26.44	0.03	0.84	0.36
To promenade Flagstaff Drive, Pipe 341A - 331A								0.00	0				0.00		0.00		1.67			1.67									
COMMERCIAL / INSTITUTIONAL BLOCK																													
	336A	338A						0.00				0.44	0.44		0.00		0.00	0.14	0.44	0.44	0.15	0.29	14.0	200	0.65	26.44	0.01	0.84	0.27
To promenade Flagstaff Drive, Pipe 338A - 339A								0.00	0				0.44		0.00		0.00			0.44									
	337A	338A						0.00					0.00	2.24	2.24		0.00	0.73	2.24	2.24	0.74	1.47	14.0	200	0.65	26.44	0.06	0.84	0.44
To promenade Flagstaff Drive, Pipe 338A - 339A								0.00	0				0.00		2.24		0.00			2.24									
promenade Flagstaff Drive																													
	373A	335A	6.55				559	6.55	559	3.36	6.09		0.00		0.00		0.00	0.00	6.55	6.55	2.16	8.25	38.5	250	0.25	29.73	0.28	0.61	0.52
	335A	338A	0.19				0	6.74	559	3.36	6.09		0.00		0.00		0.00	0.00	0.19	6.74	2.22	8.31	36.5	250	0.25	29.73	0.28	0.61	0.52
Contribution From COMMERCIAL / INSTITUTIONAL BLOCK, Pipe 336A - 338A								0.00	0				0.44		0.00		0.00		0.44	7.18									
Contribution From COMMERCIAL / INSTITUTIONAL BLOCK, Pipe 337A - 338A								0.00	0				0.00		2.24		0.00		2.24	9.42									
	338A	339A	0.11				0	6.85	559	3.36	6.09		0.44		2.24		0.00	0.87	0.11	9.53	3.14	10.10	49.5	300	0.20	43.25	0.23	0.61	0.50
	339A	341A	0.54	8		8	22	7.39	581	3.35	6.31		0.44		2.24		0.00	0.87	0.54	10.07	3.32	10.50	120.0	300	0.20	43.25	0.24	0.61	0.50
Contribution From PARK BLOCK 63, Pipe 340A - 341A								0.00	0				0.00		0.00		1.67		1.67	11.74									
	341A	331A	0.26	7		7	19	7.65	600	3.35	6.51		0.44		2.24		1.67	1.05	0.26	12.00	3.96	11.51	74.0	300	0.20	43.25	0.27	0.61	0.52
			0.06	2		2	6	7.71	606				0.44		2.24		1.67		0.06	12.06									
	Ex. 331A	Ex. 332A	0.15	6		6	17	7.86	623	3.34	6.74		0.44		2.24		1.67	1.05	0.15	12.21	4.03	11.82	44.5	300	0.21	44.31	0.27	0.63	0.53
			0.03	1		1	3	7.89	626				0.44		2.24		1.67		0.03	12.24									
	Ex. 332A	355A	0.05	2		2	5	7.94	631	3.34	6.82		0.44		2.24		1.67	1.05	0.05	12.29	4.06	11.93	17.0	300	0.20	43.25	0.28	0.61	0.52
Contribution From Cygnus Street, Pipe 354A - 355A								1.95	258				0.00		0.00		0.00		1.95	14.24									
			0.28	9		9	25	10.17	914				0.44		2.24		1.67		0.28	14.52									
	355A	Ex. 333A	0.28	9		9	24	10.45	938	3.25	9.89		0.44		2.24		1.67	1.05	0.28	14.80	4.88	15.82	78.0	300	0.20	43.25	0.37	0.61	0.56

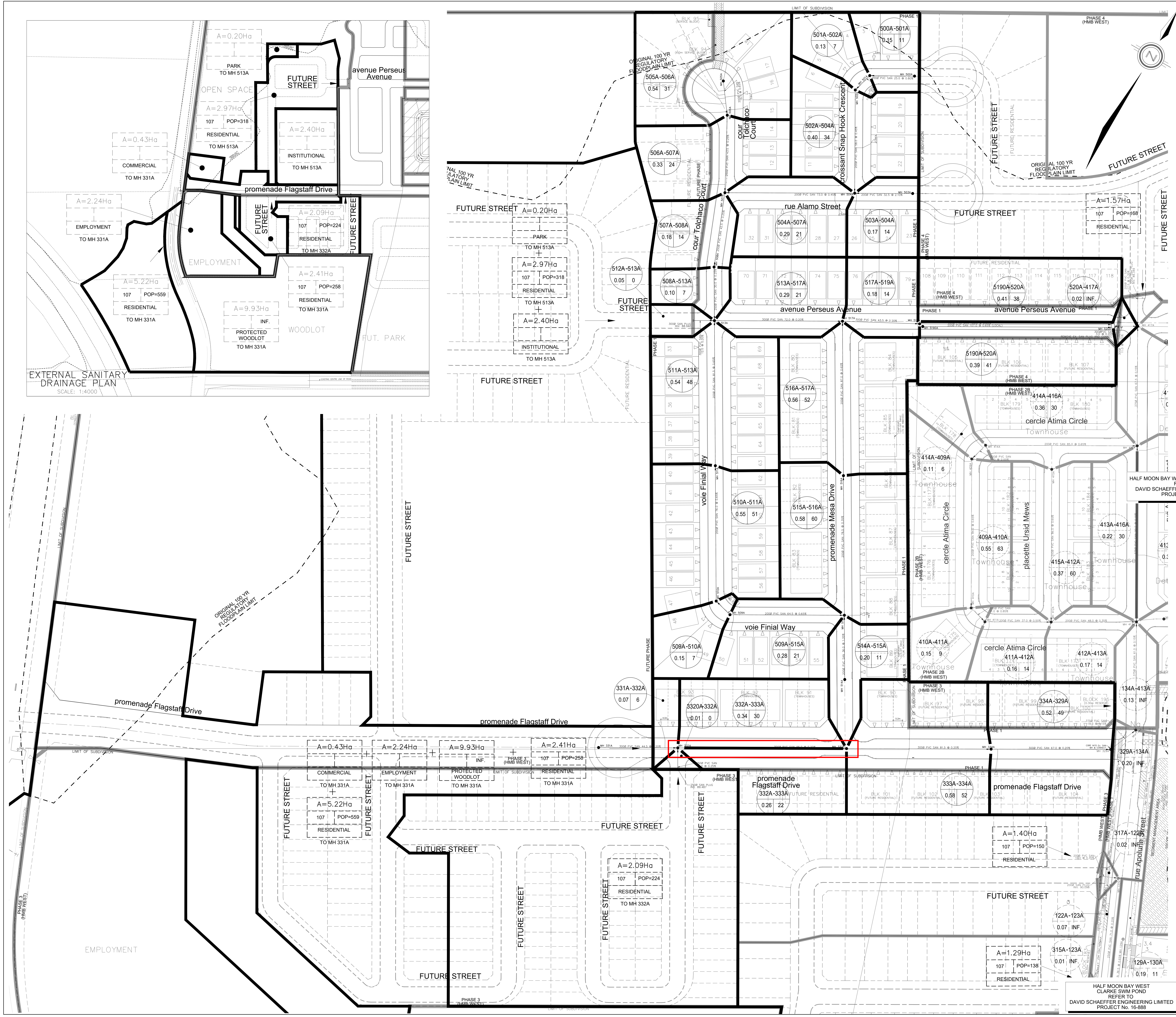
S. L. MERRICK
100186523
2021-11-18

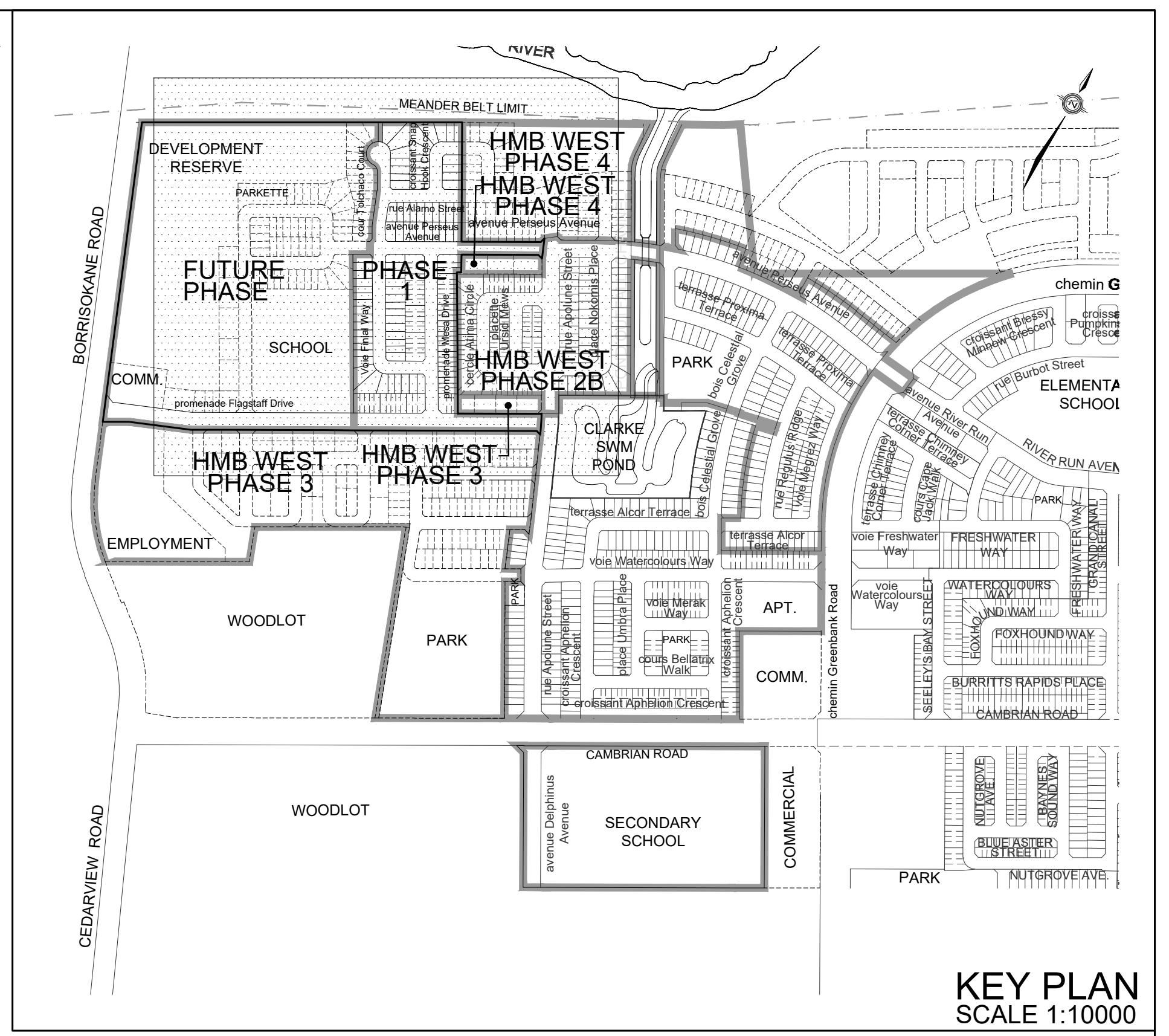
JOB #19-1140

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha					
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph				
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =		0.330	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =		0.600	m/s	
Max Res. Peak Factor =	4.00				Manning's n =	(Conc)	0.013	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		2.7		
Institutional =	0.32	l/s/Ha			Single house coeff=		3.4		

Designed: GGG	PROJECT: **Mattamy Half Moon Bay West Phase 3**			
Checked: SLM	LOCATION: **City of Ottawa**			
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 22-23	File Ref: 19-1140	Date: **18 Nov 2021**	Sheet No. of	2 2





KEY PLAN
SCALE 1:10000

LEGEND

SANITARY DRAINAGE BOUNDARY ▬
SANITARY SUB-DRAINAGE BOUNDARY ▬
SANITARY DRAINAGE BOUNDARY (OTHER PHASES) ▬

UPSTREAM MH TO DOWNSTREAM MH → 43A - 44A
AREA IN HECTARES → 0.78
POPULATION → 61

UPSTREAM MH TO DOWNSTREAM MH → 43A–44A
AREA IN OTHER PHASES IN HECTARES → 0.78
POPULATION → 61

EXTERNAL AREA IN HECTARES → A=53.63
EXTERNAL POPULATION → POP=5739
DENSITY (PERSONS/HECTARE) → 107
EXTERNAL LAND USE → RESIDENTIAL

200mmø SAN
MAINTENANCE HOLE → ● MH202A
CAP

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. JOB No. 16371–15, RECEIVED ON DECEMBER 12, 2015.
TOPOGRAPHIC INFORMATION PROVIDED BY STANTEC JOB No. 161613485–111, RECEIVED ON JUNE 16, 2016.

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY STANTEC, PROJECT No. 161613485–132, RECEIVED ON FEBRUARY 24, 2020.

3rd SUBMISSION 20–03–27

ELEVATION NOTE

ELEVATIONS SHOWN ARE GEODETIC AND ARE REFERRED TO THE CGVD28 GEODETIC DATUM.

No.	BY	DATE	DESCRIPTION
3	W.L.	20–03–27	3rd SUBMISSION
2	W.L.	20–02–28	2nd SUBMISSION
1	W.L.	19–10–18	1st SUBMISSION

CITY OF OTTAWA

PROJECT No. 15–809

W. LIU
100167932
20-03-27

SANITARY DRAINAGE PLAN

GLENVIEW
HOMES
(CEDARVIEW)
LTD.

FLAGSTAFF
PHASE 1 (3387 BORRISOKANE ROAD)

david schaeffer engineering ltd
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY:	R.A./A.K.	CHECKED BY:	C.M./P.P.	SHEET NO.
DESIGNED BY:	C.M./W.L.	CHECKED BY:	W.L.	25
SCALE:	1:1000	DATE:	OCTOBER 2019	

CITY FILE No. D07-16-16-0018PH1 CITY PLAN No. 18057

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION					COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
FUTURE ROAD																									
			0.01		0	0.01	0		0.00		0.00		0.00		0.01	0.01									
	Plug	332A	2.09		224	2.10	224		0.00		0.00		0.00	0.00	2.09	2.10	0.69	3.24	12.0	250	0.25	29.73	0.11	0.61	0.39
To promenade Flagstaff Drive, Pipe 332A - 333A						2.10	224		0.00		0.00		0.00			2.10									
promenade Flagstaff Drive																									
						0.00	0	0.43	0.43		0.00		0.00		0.43	0.43									
						0.00	0	2.24	2.24		0.00		0.00		2.24	2.67									
			5.22		559	5.22	559		0.00		0.00		0.00		5.22	7.89									
		(Woodlot)	9.93		0	9.93	0		0.00		0.00		0.00		9.93	17.82									
			0.07	2	6	0.07	6		0.00		0.00		0.00		0.07	17.89									
	331A	332A	2.41		258	17.63	823		2.67		0.00		0.00	0.87	2.41	20.30	6.70	16.32	44.5	300	0.20	43.25	0.38	0.61	0.57
Contribution From FUTURE STREET, Pipe 3320A - 332A						2.10	224		0.00		0.00		0.00		2.10	22.40									
			0.34	11	30	20.07	1077		2.67		0.00		0.00		0.34	22.74									
	332A	333A	0.26	8	22	20.33	1099		2.67		0.00		0.00	0.87	0.26	23.00	7.59	19.92	95.0	300	0.20	43.25	0.46	0.61	0.60
	333A	334A	0.58	19	52	20.91	1151		2.67		0.00		0.00	0.87	0.58	23.58	7.78	20.61	81.5	300	0.20	43.25	0.48	0.61	0.60
	334A	329A	0.52	18	49	21.43	1200		2.67		0.00		0.00	0.87	0.52	24.10	7.95	21.26	67.0	300	0.20	43.25	0.49	0.61	0.61
promenade Mesa Drive																									
	514A	515A	0.20	4	11	0.20	11		0.00		0.00		0.00	0.00	0.20	0.20	0.07	0.20	36.0	200	1.35	38.11	0.01	1.21	0.31
Contribution From voie Finial Way, Pipe 509A - 515A						0.28	21		0.00		0.00		0.00		0.28	0.48									
	515A	516A	0.58	22	60	1.06	92		0.00		0.00		0.00	0.00	0.58	1.06	0.35	1.42	78.5	200	0.35	19.40	0.07	0.62	0.36
	516A	517A	0.56	19	52	1.62	144		0.00		0.00		0.00	0.00	0.56	1.62	0.53	2.19	87.0	200	0.65	26.44	0.08	0.84	0.50
To avenue Perseus Avenue, Pipe 517A - 519A						1.62	144		0.00		0.00		0.00			1.62									
voie Finial Way																									
	509A	515A	0.28	6	21	0.28	21		0.00		0.00		0.00	0.00	0.28	0.28	0.09	0.34	64.5	200	0.65	26.44	0.01	0.84	0.29
To promenade Mesa Drive, Pipe 515A - 516A						0.28	21		0.00		0.00		0.00			0.28									
	509A	510A	0.15	2	7	0.15	7		0.00		0.00		0.00	0.00	0.15	0.15	0.05	0.13	11.0	200	0.70	27.44	0.00	0.87	0.22
	510A	511A	0.55	15	51	0.70	58		0.00		0.00		0.00	0.00	0.55	0.70	0.23	0.92	76.0	200	0.65	26.44	0.03	0.84	0.39
	511A	513A	0.54	14	48	1.24	106		0.00		0.00		0.00	0.00	0.54	1.24	0.41	1.64	81.5	200	0.65	26.44	0.06	0.84	0.46
Toavenue Perseus Avenue, Pipe 513A - 517A						1.24	106		0.00		0.00		0.00			1.24									
croissant Snap Hook Crescent																									
	500A	501A	0.15	3	11	0.15	11								0.15	0.15	0.05	0.18	25.0	200	0.80	29.34	0.01	0.93	0.26
	501A	502A	0.13	2	7	0.28	18								0.13	0.28	0.09	0.31	11.5	200	1.15	35.17	0.01	1.12	0.34
	502A	504A	0.40	10	34	0.68	52								0.40	0.68	0.22	0.84	58.0	200	0.45	22.00	0.04	0.70	0.33
To rue Alamo Street, Pipe 504A - 507A						0.68	52									0.68									
rue Alamo Street																									
	503A	504A	0.17	4	14	0.17	14								0.17	0.17	0.06	0.22	32.5	200	2.10	47.53	0.00	1.51	0.36
Contribution From croissant Snap Hook Crescent, Pipe 502A - 504A						0.68	52								0.68	0.85									
	504A	507A	0.29	6	21	1.14	87								0.29	1.14	0.38	1.39	73.0	200	0.45	22.00	0.06	0.70	0.39
To cour Tolchaco Court, Pipe 507A - 508A						1.14	87									1.14									
cour Tolchaco Court																									
	505A	506A	0.54	9	31	0.54	31								0.54	0.54	0.18	0.55	19.5	200	0.65	26.44	0.02	0.84	0.33
	506A	507A	0.33	7	24	0.87	55								0.33	0.87	0.29	0.94	43.5	250	0.25	29.73	0.03	0.61	0.27
Contribution From rue Alamo Street, Pipe 504A - 507A						1.14	87								1.14	2.01									
	507A	508A	0.18	4	14	2.19	156								0.18	2.19	0.72	2.52	42.5	250	0.25	29.73	0.08	0.61	0.37

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
20-03-27
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha
Average Daily Flow =	280	l/p/day		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha
Max Res. Peak Factor =	4.00			
Commercial/Inst./Park Peak Factor =	1.00			
Institutional =	0.32	l/s/Ha		

Industrial Peak Factor = as per MOE Graph
Extraneous Flow = L/s/ha
Minimum Velocity = m/s
Manning's n = (Pvc) 0.013
Townhouse coeff=
Single house coeff=

Designed: A.K.

Checked: W.L.

Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 25

PROJECT: **FLAGSTAFF SUBDIVISION - PHASE 1**

LOCATION: **City of Ottawa**

File Ref: 16-809

Date: **Mar 2020**

Sheet No. 1 of 2

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION					COMM		INSTIT		PARK		C+I+I	INFILTRATION				PIPE						
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	POP.	CUMULATIVE		AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL.	
						AREA (ha)	POP.																	(FULL) (m/s)	(ACT.) (m/s)
	508A	513A	0.10	2	7	2.29	163		0.00		0.00		0.00	0.00	0.10	2.29	0.76	2.63	30.0	250	0.25	29.73	0.09	0.61	0.37
To avenue Perseus Avenue, Pipe 513A - 517A						2.29	163		0.00		0.00		0.00			2.29									
avenue Perseus Avenue																									
			0.05		0	0.05	0		0.00	2.40	2.40	0.20	0.20		2.65	2.65									
	512A	513A	2.97		318	3.02	318		0.00		2.40		0.20	0.80	2.97	5.62	1.85	6.21	12.0	300	0.20	43.25	0.14	0.61	0.43
Contribution From cour Tolchaco Court, Pipe 508A - 513A						2.29	163		0.00		0.00		0.00		2.29	7.91									
Contribution From voie Finial Way, Pipe 511A - 513A						1.24	106		0.00		0.00		0.00		1.24	9.15									
	513A	517A	0.29	6	21	6.84	608		0.00		2.40		0.20	0.80	0.29	9.44	3.12	10.50	72.0	300	0.20	43.25	0.24	0.61	0.50
Contribution From promenade Mesa Drive, Pipe 516A - 517A						1.62	144		0.00		0.00		0.00		1.62	11.06									
			0.19	6	17	8.65	769		0.00		2.40		0.20		0.19	11.25									
	517A	519A	0.18	4	14	8.83	783		0.00		2.40		0.20	0.80	0.18	11.43	3.77	12.93	43.5	300	0.20	43.25	0.30	0.61	0.53
			0.41	11	38	0.41	38		0.00		0.00		0.00		0.41	0.41									
	5190A	520A	0.39	15	41	0.80	79		0.00		0.00		0.00	0.00	0.39	0.80	0.26	1.19	107.0	200	0.65	26.44	0.04	0.84	0.42
	519A	520A				8.83	783		0.00		2.40		0.20	0.80	0.00	11.43	3.77	12.93	108.5	300	0.20	43.25	0.30	0.61	0.53
	5190A	520A	0.02		0	9.65	862		0.00		2.40		0.20	0.80	0.02	12.25	4.04	13.98	68.0	300	0.20	43.25	0.32	0.61	0.55

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
20-03-27
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Park Flow =	9300	L/ha/da	0.10764	l/s/Ha			
Average Daily Flow =	280	l/p/day			Industrial Peak Factor = as per MOE Graph		
Comm/Inst Flow =	28000	L/ha/da	0.3241	l/s/Ha	Extraneous Flow =	L/s/ha	
Industrial Flow =	35000	L/ha/da	0.40509	l/s/Ha	Minimum Velocity =	m/s	
Max Res. Peak Factor =	4.00				Manning's n =	(Pvc)	0.013
Commercial/Inst./Park Peak Factor =	1.00				Townhouse coeff=		
Institutional =	0.32	l/s/Ha			Single house coeff=		

Designed:
A.K.

Checked:
W.L.

Dwg. Reference:
Sanitary Drainage Plan, Dwgs. No. 25

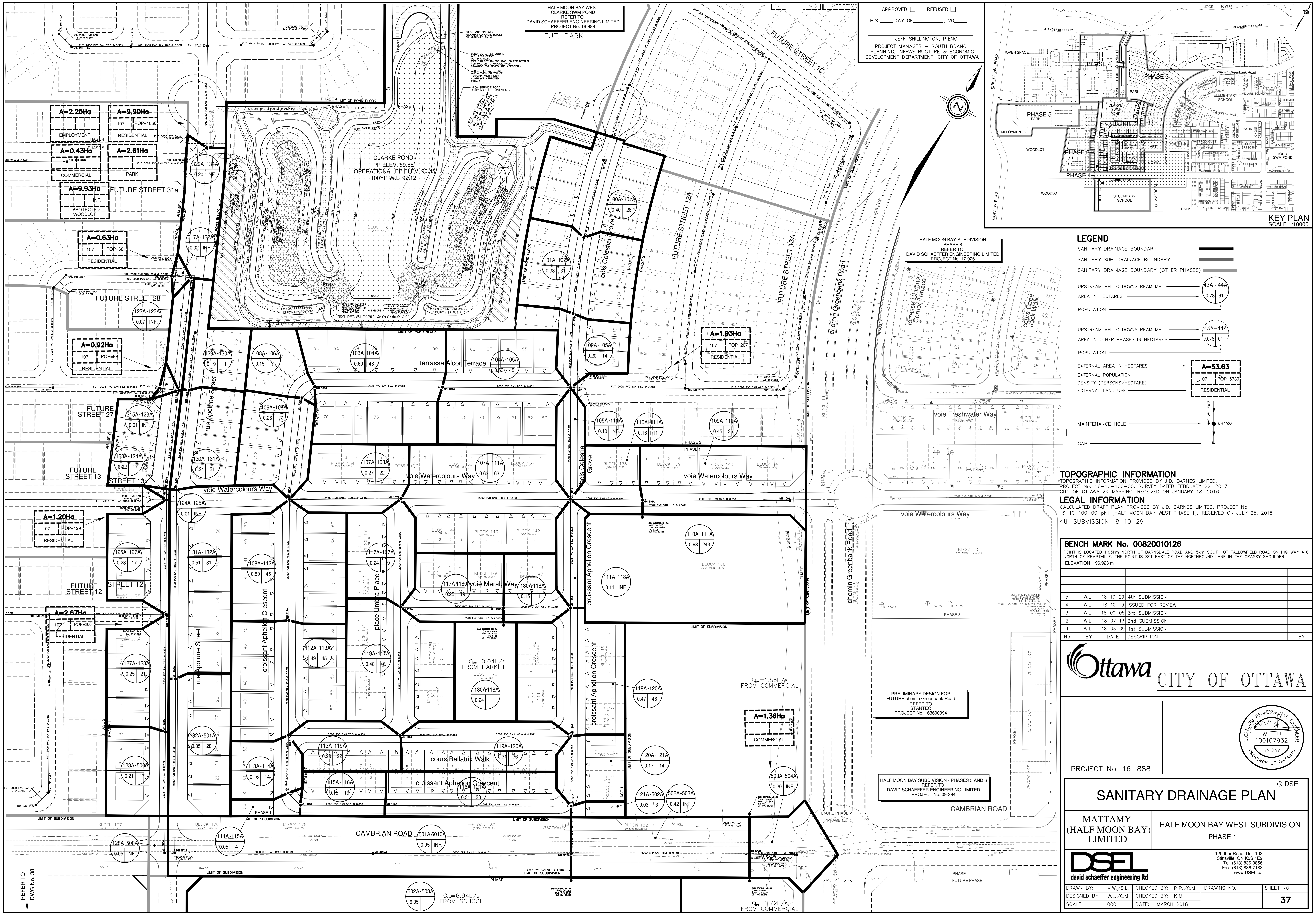
PROJECT:
FLAGSTAFF SUBDIVISION - PHASE 1

LOCATION:
City of Ottawa

File Ref: 16-809

Date: **Mar 2020**

Sheet No. 2 of 2



APPROVED ☐ REFUSED ☐

THIS ____ DAY OF__________, 20____

JEFF SHILLINGTON, P.ENG
PROJECT MANAGER – SOUTH BRANCH
PLANNING, INFRASTRUCTURE & ECONOMIC
DEVELOPMENT DEPARTMENT, CITY OF OTTAWA

LEGEND

SANITARY DRAINAGE BOUNDARY

SANITARY SUB–DRAINAGE BOUNDARY

SANITARY DRAINAGE BOUNDARY (OTHER PHASES)

UPSTREAM MH TO DOWNSTREAM MH → 43A - 44A
AREA IN HECTARES → 0.78
POPULATION → 61

UPSTREAM MH TO DOWNSTREAM MH → 43A–44A
AREA IN OTHER PHASES IN HECTARES → 0.78
POPULATION → 61

EXTERNAL AREA IN HECTARES → A=53.63
EXTERNAL POPULATION → POP=5739
DENSITY (PERSONS/HECTARE) → 107
EXTERNAL LAND USE → RESIDENTIAL

200mmø SAN

MAINTENANCE HOLE → MH202A

CAP

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16–10–100–00. SURVEY DATED FEBRUARY 22, 2017. CITY OF OTTAWA 2K MAPPING, RECEIVED ON JANUARY 18, 2016.

LEGAL INFORMATION

CALCULATED DRAFT PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16–10–100–00–ph1 (HALF MOON BAY WEST PHASE 1), RECEIVED ON JULY 25, 2018.

4th SUBMISSION 18–10–29

BENCH MARK No. 00820010126

POINT IS LOCATED 1.65km NORTH OF BARNSDALE ROAD AND 5km SOUTH OF FALLOWFIELD ROAD ON HIGHWAY 416 NORTH OF KEMPTVILLE. THE POINT IS SET EAST OF THE NORTHBOUND LANE IN THE GRASSY SHOULDER.

ELEVATION = 96.923 m

No.	BY	DATE	DESCRIPTION	BY
5	W.L.	18–10–29	4th SUBMISSION	
4	W.L.	18–10–19	ISSUED FOR REVIEW	
3	W.L.	18–09–05	3rd SUBMISSION	
2	W.L.	18–07–13	2nd SUBMISSION	
1	W.L.	18–03–09	1st SUBMISSION	

Ottawa CITY OF OTTAWA

PROJECT No. 16–888

W. LIU
100167932
18-10-29

SANITARY DRAINAGE PLAN

MATTAMY
(HALF MOON BAY)
LIMITED

HALF MOON BAY WEST SUBDIVISION
PHASE 1

david schaeffer engineering ltd

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

DRAWN BY:	V.W./S.L.	CHECKED BY:	P.P./C.M.	DRAWING NO.		SHEET NO.
DESIGNED BY:	W.L./C.M.	CHECKED BY:	K.M.			37
SCALE:	1:1000	DATE:	MARCH 2018			

CITY FILE No. D07-16-16-0023 P1

CITY PLAN No. 17586

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		I+C+I+P	INFILTRATION				PIPE							
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (Nominal) (mm)	DIA (Actual) (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
place Umbra Place																														
	117A	107A	0.24	7		7.00	19	0.24	19	4.00	0.31								0.24	0.24	0.07	0.38	68.0	200	200	0.65	26.44	0.01	0.84	0.27
To voie Watercolours Way, Pipe 107A - 111A								0.24	19											0.24										
	119A	117A	0.48	17		17.00	46	0.48	46	4.00	0.75								0.48	0.48	0.13	0.88	80.5	200	200	0.65	26.44	0.03	0.84	0.37
To voie Merak Way, Pipe 117A - 1180A								0.48	46											0.48										
voie Merak Way																														
Contribution From place Umbra Place, Pipe 119A - 117A								0.48	46										0.48	0.48										
	117A	1180A	0.25	7		7.00	19	0.73	65	4.00	1.05								0.25	0.73	0.20	1.25	64.5	200	200	0.85	30.24	0.04	0.96	0.46
	CTRL 5A	1180A														0.24	0.24	0.04	0.24	0.24	0.07	0.11	11.0	200	200	1.00	32.80	0.00	1.04	0.06
	1180A	118A	0.15	4		4.00	11	0.88	76	4.00	1.23						0.24	0.04	0.15	1.12	0.31	1.58	42.0	200	200	0.35	19.40	0.08	0.62	0.37
To croissant Aphelion Crescent, Pipe 118A - 120A								0.88	76								0.24			1.12										
voie Watercolours Way																														
	107A	108A	0.27	8		8.00	22	0.27	22	4.00	0.36								0.27	0.27	0.08	0.44	70.0	200	200	0.65	26.44	0.02	0.84	0.33
To croissant Aphelion Crescent, Pipe 108A - 112A								0.27	22											0.27										
	109A	110A	0.45	13		13.00	36	0.45	36	4.00	0.58								0.45	0.45	0.13	0.71	92.5	200	200	0.65	26.44	0.03	0.84	0.37
Apartment Block		-	0.93	90		90.00	243	0.93	243	4.00	3.94								0.93	0.93	0.26	4.20	11.0	200	200	1.00	32.80	0.13	1.04	0.71
	110A	111A	0.16	4		4.00	11	1.54	281	4.00	4.55								0.16	1.54	0.43	4.98	45.0	200	200	0.40	20.74	0.24	0.66	0.54
To croissant Aphelion Crescent, Pipe 111A - 118A								1.54	281											1.54										
Contribution From place Umbra Place, Pipe 117A - 107A								0.24	19										0.24	0.24										
	107A	111A	0.63	23		23.00	63	0.87	82	4.00	1.33								0.63	0.87	0.24	1.57	106.0	200	200	0.65	26.44	0.06	0.84	0.46
To croissant Aphelion Crescent, Pipe 111A - 118A								0.87	82											0.87										
terrasse Alcor Terrace																														
	103A	104A	0.60	14	14.00		48	0.60	48	4.00	0.78								0.60	0.60	0.17	0.95	80.0	200	200	0.65	26.44	0.04	0.84	0.40
	104A	105A	0.53	13	13.00		45	1.13	93	4.00	1.51								0.53	1.13	0.32	1.83	80.5	200	200	0.40	20.74	0.09	0.66	0.41
To bois Celestial Grove, Pipe 105A - 111A								1.13	93											1.13										
	103A	106A	0.15	2	2.00		7	0.15	7	4.00	0.11								0.15	0.15	0.04	0.15	10.5	200	200	0.65	26.44	0.01	0.84	0.27
	106A	108A	0.26	5	5.00		17	0.41	24	4.00	0.39								0.26	0.41	0.11	0.50	64.0	200	200	0.65	26.44	0.02	0.84	0.33
To croissant Aphelion Crescent, Pipe 108A - 112A								0.41	24											0.41										
Contribution From Phase 3, Pipe PLUG - 105A								1.93	207										1.93	1.93										
	PLUG	105A						1.93	207	4.00	3.35								0.00	1.93	0.54	3.89	9.0	200	200	0.35	19.40	0.20	0.62	0.48
To bois Celestial Grove, Pipe 105A - 111A								1.93	207											1.93										
cours Bellatrix Walk																														
Contribution From croissant Aphelion Crescent, Pipe 112A - 113A								1.67	136										1.67	1.67										
	113A	119A	0.20	8		8.00	22	1.87	158	4.00	2.56								0.20	1.87	0.52	3.08	70.0	250	250	0.25	29.73	0.10	0.61	0.38
	119A	120A	0.31	13		13.00	36	2.18	194	4.00	3.14								0.31	2.18	0.61	3.75	107.0	250	250	0.25	29.73	0.13	0.61	0.41
To croissant Aphelion Crescent, Pipe 120A - 121A								2.18	194											2.18										

W. LIU
100167932
Oct 29, 2018

DESIGN PARAMETERS

Park Flow =	9300	L/ha/day
Average Daily Flow =	350	L/p/day
Comm/Inst Flow =	50000	L/ha/day
Industrial Flow =	35000	L/ha/day
Max Res. Peak Factor =	4.00	
Commercial/Inst./Park Peak Factor =	1.50	

Industrial Peak Factor = as per MOE Graph
Extraneous Flow = 0.280 L/s/ha
Minimum Velocity = 0.600 m/s
Manning's n = (Conc) 0.013 (Pvc) 0.013
Townhouse coeff= 2.7
Single house coeff= 3.4

Designed: P.P.
Checked: W.L.
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 36, 37 & 38

PROJECT: Half Moon Bay West - Phase 1
LOCATION: City of Ottawa
File Ref: 16-888
Date: October, 2018
Sheet No. 1 of 3

SANITARY SEWER CALCULATION SHEET

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		I+C+I+P	INFILTRATION				PIPE							
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (Nominal) (mm)	DIA (Actual) (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
bois Celestial Grove																														
	100A	101A	0.40	8	8.00		28	0.40	28	4.00	0.45								0.40	0.40	0.11	0.56	50.5	200	200	0.65	26.44	0.02	0.84	0.33
	101A	102A	0.38	9	9.00		31	0.78	59	4.00	0.96								0.38	0.78	0.22	1.18	48.0	200	200	0.35	19.40	0.06	0.62	0.34
	102A	105A	0.20	4	4.00		14	0.98	73	4.00	1.18								0.20	0.98	0.27	1.45	46.5	200	200	0.35	19.40	0.07	0.62	0.35
Contribution From terrasse Alcor Terrace, Pipe 104A - 105A								1.13	93										1.13	2.11										
Contribution From terrasse Alcor Terrace, Pipe PLUG - 105A								1.93	207										1.93	4.04										
	105A	111A	0.10					4.14	373	4.00	6.04								0.10	4.14	1.16	7.20	70.0	200	200	0.35	19.40	0.37	0.62	0.57
To croissant Aphelion Crescent, Pipe 111A - 118A								4.14	373											4.14										
croissant Aphelion Crescent																														
Contribution From terrasse Alcor Terrace, Pipe 106A - 108A								0.41	24										0.41	0.41										
Contribution From voie Watercolours Way, Pipe 107A - 108A								0.27	22										0.27	0.68										
	108A	112A	0.50	13	13.00		45	1.18	91	4.00	1.47								0.50	1.18	0.33	1.80	75.5	200	200	0.35	19.40	0.09	0.62	0.38
	112A	113A	0.49	13	13.00		45	1.67	136	4.00	2.20								0.49	1.67	0.47	2.67	72.0	200	200	0.35	19.40	0.14	0.62	0.43
To cours Bellatrix Walk, Pipe 113A - 119A								1.67	136											1.67										
	113A	114A	0.16	4	4.00		14	0.16	14	4.00	0.23								0.16	0.16	0.04	0.27	36.0	200	200	0.65	26.44	0.01	0.84	0.27
	114A	115A	0.05	1	1.00		4	0.21	18	4.00	0.29								0.05	0.21	0.06	0.35	11.0	200	200	0.65	26.44	0.01	0.84	0.27
	115A	116A	0.15	7		7.00	19	0.36	37	4.00	0.60								0.15	0.36	0.10	0.70	53.0	200	200	0.65	26.44	0.03	0.84	0.37
	116A	121A	0.31	14		14.00	38	0.67	75	4.00	1.22								0.31	0.67	0.19	1.41	116.5	200	200	0.40	20.74	0.07	0.66	0.38
To Cambrian Road, Pipe 121A - 502A								0.67	75											0.67										
Contribution From bois Celestial Grove, Pipe 105A - 111A								4.14	373										4.14	4.14										
Contribution From voie Watercolours Way, Pipe 107A - 111A								0.87	82										0.87	5.01										
Contribution From voie Watercolours Way, Pipe 110A - 111A								1.54	281										1.54	6.55										
	111A	118A	0.11					6.66	736	3.88	11.57								0.11	6.66	1.86	13.43	68.0	300	300	0.20	43.25	0.31	0.61	0.54
Contribution From voie Merak Way, Pipe 1180A - 118A								0.88	76								0.24		1.12	7.78										
	118A	120A	0.47	17		17.00	46	8.01	858	3.84	13.35						0.24	0.04	0.47	8.25	2.31	15.70	80.0	300	300	0.20	43.25	0.36	0.61	0.56
Contribution From cours Bellatrix Walk, Pipe 119A - 120A								2.18	194										2.18	10.43										
	120A	121A	0.17	5		5.00	14	10.36	1066	3.78	16.32						0.24	0.04	0.17	10.60	2.97	19.33	43.5	300	300	0.20	43.25	0.45	0.61	0.59
Contribution From croissant Aphelion Crescent, Pipe 116A - 121A								0.67	75										0.67	11.27										
	121A	502A	0.03	1		1.00	3	11.06	1144	3.76	17.42						0.24	0.04	0.03	11.30	3.16	20.62	30.0	300	300	0.20	43.25	0.48	0.61	0.60
To Cambrian Road, Pipe 502A -503A								11.06	1144								0.24			11.30										
rue Apolune Street																														
	129A	130A	0.19	3	3.00		11	0.19	11	4.00	0.18								0.19	0.19	0.05	0.23	36.5	200	200	0.65	26.44	0.01	0.84	0.27
	130A	131A	0.24	6	6.00		21	0.43	32	4.00	0.52								0.24	0.43	0.12	0.64	63.0	200	200	0.35	19.40	0.03	0.62	0.27
	131A	132A	0.51	9	9.00		31	0.94	63	4.00	1.02								0.51	0.94	0.26	1.28	118.5	250	250	0.25	29.73	0.04	0.61	0.29
	132A	501A	0.35	8	8.00		28	1.29	91	4.00	1.47								0.35	1.29	0.36	1.83	109.0	250	250	0.25	29.73	0.06	0.61	0.34
To Cambrian Road, Pipe 501A - 5010A								1.29	91											1.29										
Contribution From Phase 2 Future Street 28, Pipe PLUG - 122A								0.63	68										0.63	0.63										
	PLUG	122A	0.02					0.65	68	4.00	1.10								0.02	0.65	0.18	1.28	10.0	200	200	0.35	19.40	0.07	0.62	0.35
	122A	123A	0.07					0.72	68	4.00	1.10								0.07	0.72	0.20	1.30	71.0	250	250	0.25	29.73	0.04	0.61	0.29

W. LIU
100167932
Oct 29, 2018

DESIGN PARAMETERS

Park Flow =	9300	L/ha/day
Average Daily Flow =	350	L/p/day
Comm/Inst Flow =	50000	L/ha/day
Industrial Flow =	35000	L/ha/day
Max Res. Peak Factor =	4.00	
Commercial/Inst./Park Peak Factor =	1.50	

Industrial Peak Factor = as per MOE Graph
Extraneous Flow = 0.280 L/s/ha
Minimum Velocity = 0.600 m/s
Manning's n = (Conc) 0.013 (Pvc) 0.013
Townhouse coeff= 2.7
Single house coeff= 3.4

Designed: P.P.
Checked: W.L.
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 36, 37 & 38

PROJECT: Half Moon Bay West - Phase 1
LOCATION: City of Ottawa
File Ref: 16-888
Date: October, 2018
Sheet No. 2 of 3

SANITARY SEWER CALCULATION SHEET

Ottawa

Manning's n=0.013

LOCATION			RESIDENTIAL AREA AND POPULATION									COMM		INSTIT		PARK		I+C+I+P	INFILTRATION				PIPE							
STREET	FROM M.H.	TO M.H.	AREA (ha)	UNITS	UNITS Singles	UNITS Townhouse	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (l/s)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (l/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (l/s)	DIST (m)	DIA (Nominal) (mm)	DIA (Actual) (mm)	SLOPE (%)	CAP. (FULL) (l/s)	RATIO Q act/Q cap	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Contribution From Phase 2 Future Street 27, Pipe PLUG - 123A								0.92	99										0.92	1.64										
	PLUG	123A	0.01					0.93	99	4.00	1.60								0.01	0.93	0.26	1.86	10.0	200	200	0.35	19.40	0.10	0.62	0.39
	123A	124A	0.22	5	5.00		17	1.87	184	4.00	2.98								0.22	1.87	0.52	3.50	62.5	250	250	0.25	29.73	0.12	0.61	0.41
	124A	125A	0.01					1.88	184	4.00	2.98								0.01	1.88	0.53	3.51	6.5	250	250	0.25	29.73	0.12	0.61	0.41
Contribution From Phase 2 Fut. Street 13, Pipe PLUG - 125A								1.20	129										1.20	3.08										
	PLUG	125A						1.20	129	4.00	2.09								0.00	1.20	0.34	2.43	10.0	200	200	0.35	19.40	0.13	0.62	0.42
	125A	127A	0.23	5	5.00		17	3.31	330	4.00	5.35								0.23	3.31	0.93	6.28	72.0	250	250	0.25	29.73	0.21	0.61	0.48
Contribution From Phase 2 Fut. Street 12, Pipe PLUG - 127A								2.67	286										2.67	5.98										
	PLUG	127A						2.67	286	4.00	4.63								0.00	2.67	0.75	5.38	15.0	200	200	0.35	19.40	0.28	0.62	0.53
	127A	128A	0.25	6	6.00		21	6.23	637	3.92	10.12								0.25	6.23	1.74	11.86	73.5	250	250	0.25	29.73	0.40	0.61	0.57
			0.05					6.28	637										0.05	6.28										
	128A	500A	0.21	5	5.00		17	6.49	654	3.91	10.36								0.21	6.49	1.82	12.18	76.0	250	250	0.25	29.73	0.41	0.61	0.58
To Cambrian Road, Pipe 500A - 501A								6.49	654											6.49										
Cambrian Road																														
Contribution From External								32.44	3473										32.44	32.44										
Contribution From External								13.44											13.44	45.88										
Contribution From External (BSUEA)								17.26	1179				0.60		1.23		1.21		20.30	66.18										
Contribution From rue Apolune Street, Pipe 128A - 500A								6.49	654										6.49	72.67										
	500A	501A	0.48					70.11	5306	3.22	69.21		0.60		1.23		1.21	1.78	0.48	73.15	20.48	91.47	6.5	**500**	**500**	**0.12**	130.80	0.70	0.67	0.72
Contribution From rue Apolune Street, Pipe 132A - 501A								1.29	91										1.29	74.44										
	501A	5010A	0.95					72.35	5397	3.21	70.18		0.60		1.23		1.21	1.78	0.95	75.39	21.11	93.07	124.0	**500**	**500**	0.12	130.80	0.71	0.67	0.72
	5010A	502A						72.35	5397	3.21	70.18		0.60		1.23		1.21	1.78	0.00	75.39	21.11	93.07	124.0	**500**	**500**	0.12	130.80	0.71	0.67	0.72
Contribution From croissant Aphelion Crescent, Pipe 121A - 502A								11.06	1144								0.24		11.30	86.69										
School														6.05	7.28			6.32	6.05	6.05	1.69	8.01	16.5	200	200	1.00	32.80	0.24	1.04	0.85
	502A	503A	0.42					83.83	6541	3.13	82.94		0.60		7.28		1.45	7.07	0.42	93.16	26.08	116.09	111.5	**500**	**500**	**0.15**	146.24	0.79	0.74	0.82
Future Commercial Block												1.36	1.36					1.18	1.36	1.36	0.38	1.56	25.5	200	200	1.00	32.80	0.05	1.04	0.54
Future Commercial Block												1.50	1.50					1.30	1.50	1.50	0.42	1.72	17.0	200	200	1.00	32.80	0.05	1.04	0.54
	503A	504A	0.20					84.03	6541	3.13	82.94		3.46		7.28		1.45	9.56	0.20	96.22	26.94	119.44	29.5	**500**	**500**	**0.15**	146.24	0.82	0.74	0.82
To Cambrian Road, Ex. Pipe 504A - 57A								84.03	6541				3.46		7.28		1.45			96.22										

LICENSED PROFESSIONAL ENGINEER
W. LIU
100167932
Oct 29, 2018
PROVINCE OF ONTARIO

DESIGN PARAMETERS

Park Flow =	9300	L/ha/day
Average Daily Flow =	350	L/p/day
Comm / Inst Flow =	50000	L/ha/day
Industrial Flow =	35000	L/ha/day
Max Res. Peak Factor =	4.00	
Commercial / Inst. / Park Peak Factor =	1.50	

Industrial Peak Factor = as per MOE Graph

Extraneous Flow =		0.280	L/s/ha	
Minimum Velocity =		0.600	m/s	
Manning's n =	(Conc)	0.013	(PVC)	0.013
Townhouse coeff=		2.7		
Single house coeff=		3.4		

Designed: P.P.	PROJECT: **Half Moon Bay West - Phase 1**		
Checked: W.L.	LOCATION: **City of Ottawa**		
Dwg. Reference: Sanitary Drainage Plan, Dwgs. No. 36, 37 & 38	File Ref: 16-888	Date: October, 2018	Sheet No. 3 of 3

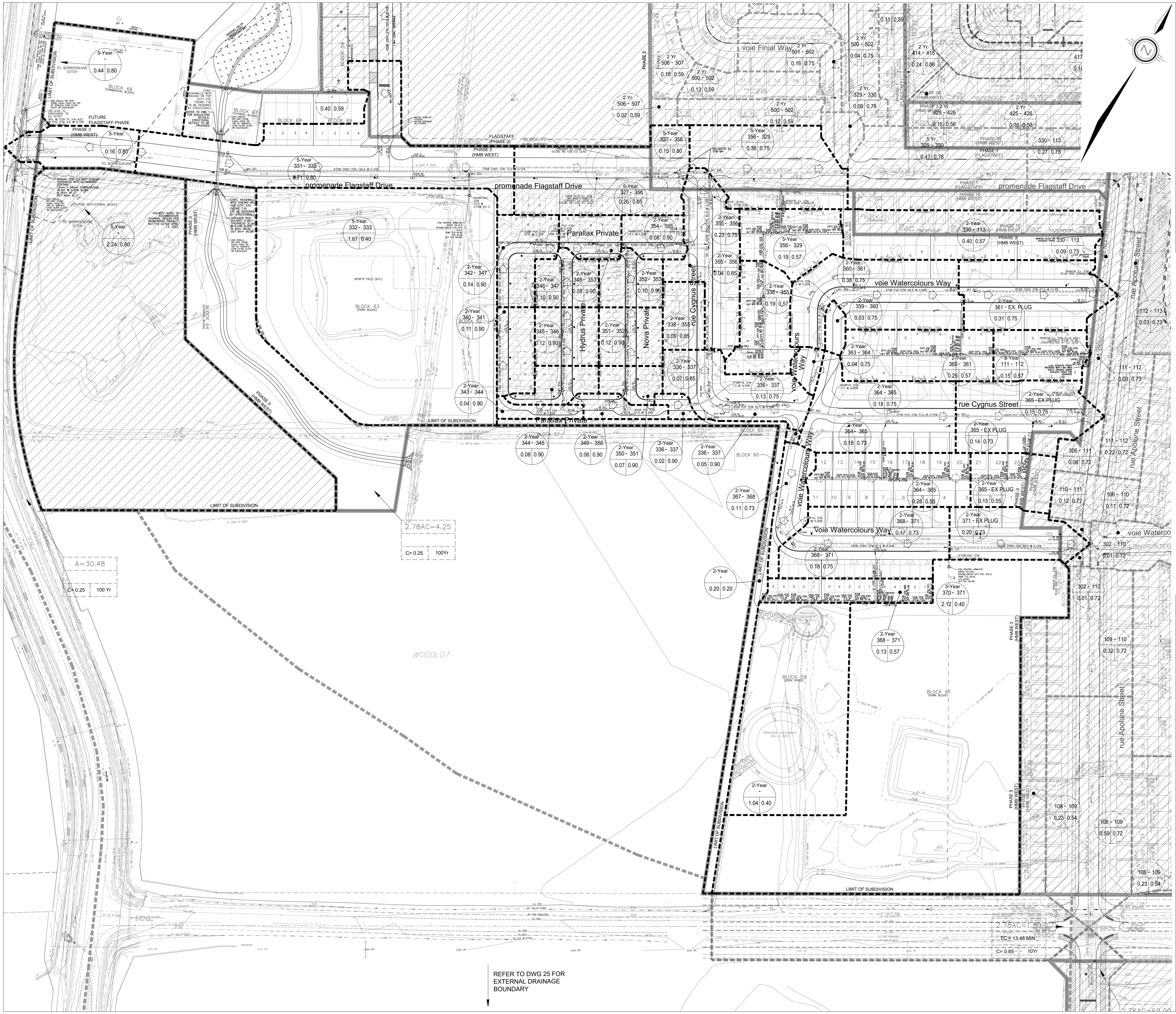
APPENDIX D

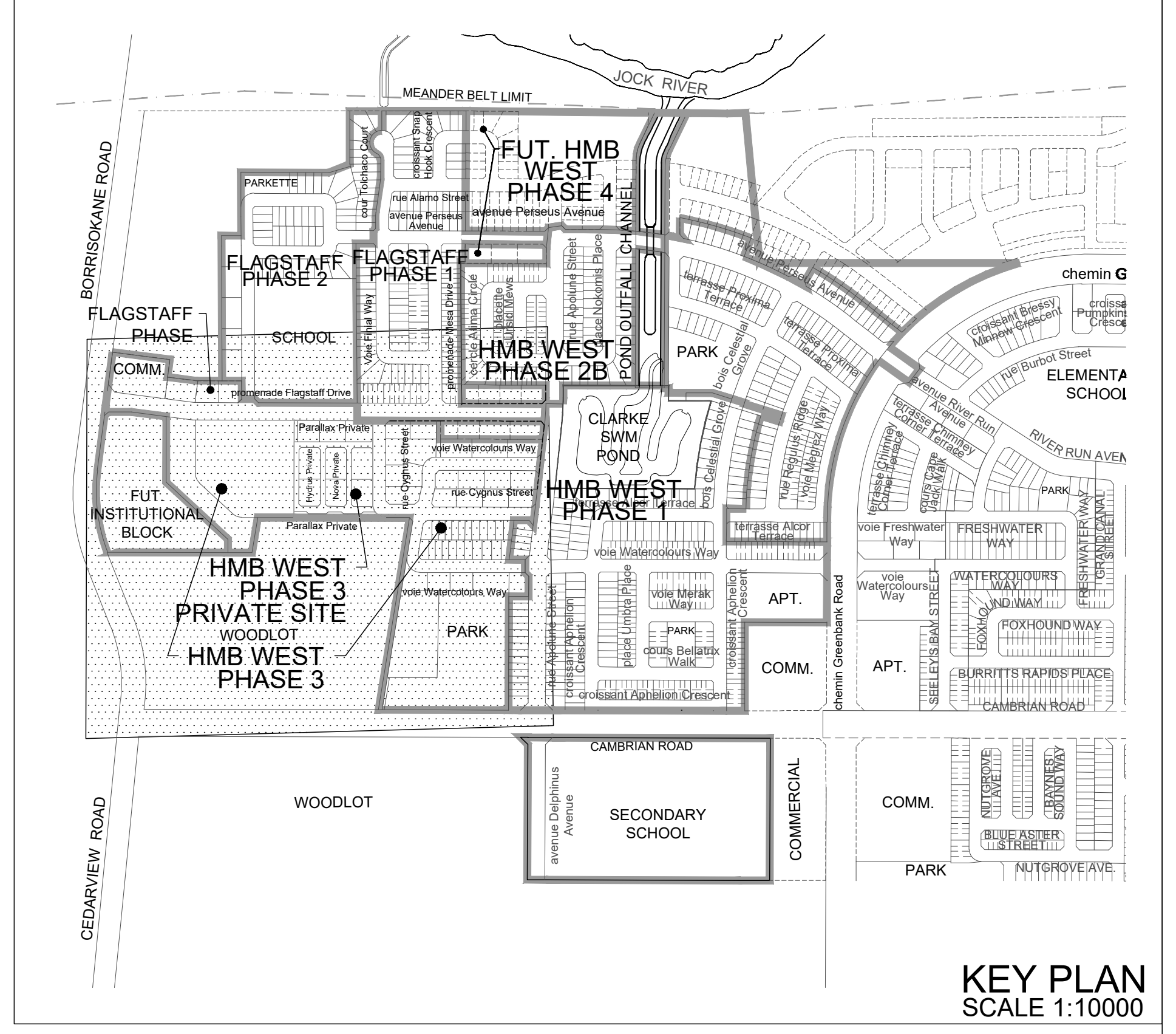
HMB WEST PHASE 3 STORM DRAINAGE AREA PLANS
(DSEL, NOVEMBER 18, 2021)

HMB WEST PHASE 3 STORM DESIGN SHEETS
(DSEL, NOVEMBER 18, 2021)

PHASE 3 OF THE HALF MOON BAY WEST SUBDIVISION / PROPOSED CULVERT UNDER FLAGSTAFF DRIVE (JFSA, JUNE 3, 2021)

RUNOFF COEFFICIENT CALCULATIONS (DSEL, MAY 2021)





KEY PLAN
SCALE 1:10000

LEGEND

STORM DRAINAGE BOUNDARY ▬ ▬ ▬

STORM DRAINAGE BOUNDARY (OTHER PHASES)

STORM FREQUENCY → 2Yr
UPSTREAM MH TO DOWNSTREAM MH → 43 - 44
AREA IN HECTARES → 0.37
RUNOFF COEFFICIENT → 0.51

UPSTREAM MH TO DOWNSTREAM MH → 21–23
AREA IN OTHER PHASES IN HECTARES → 0.28
RUNOFF COEFFICIENT → 0.78

STREET CATCHBASIN & LEAD →
STREET CATCHBASIN WITH CLOSED LID & LEAD →
MAINTENANCE HOLE → MH202
375mmø ST
CURB INLET CATCHBASIN & LEAD →
CATCHBASIN/ MAINTENANCE HOLE → CBMH201
INTERCONNECTED CATCH BASIN & LEADS →
CAP →
OVERLAND FLOW DIRECTION
EXTERNAL OVERLAND FLOW DIRECTION
EMERGENCY OVERLAND FLOW DIRECTION E
EXTERNAL 2.78AC = → 2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION → TC=14.5 MIN
EXTERNAL BLENDED RUNOFF COEFFICIENT → C= 0.70
EXTERNAL STORM FREQUENCY → 2YR

No.	BY	DATE	DESCRIPTION
3	S.L.M.	21.11.18	3rd SUBMISSION
2	S.L.M.	21.08.31	2nd SUBMISSION
1	S.L.M.	21.06.04	1st SUBMISSION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED FEBRUARY 22, 2017
TOPOGRAPHIC INFORMATION FOR BORRISOKANE ROAD PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 18-10-145-00, RECEIVED ON JULY 10, 2019

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED NOVEMBER 10, 2021

BENCH MARK

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE PUBLISHED BENCHMARK NUMBER 0011964U3710 HAVING AN ELEVATION OF 71.724 M.

MATTAMY (HALF
MOON BAY) LTD.

HALF MOON BAY WEST
PHASE 3

DSEL
120 Iber Road Unit 103
Stittsville, Ontario, K2S 1E9
Tel. (613) 836-0856
Fax. (613) 836-7183
www.DSEL.ca

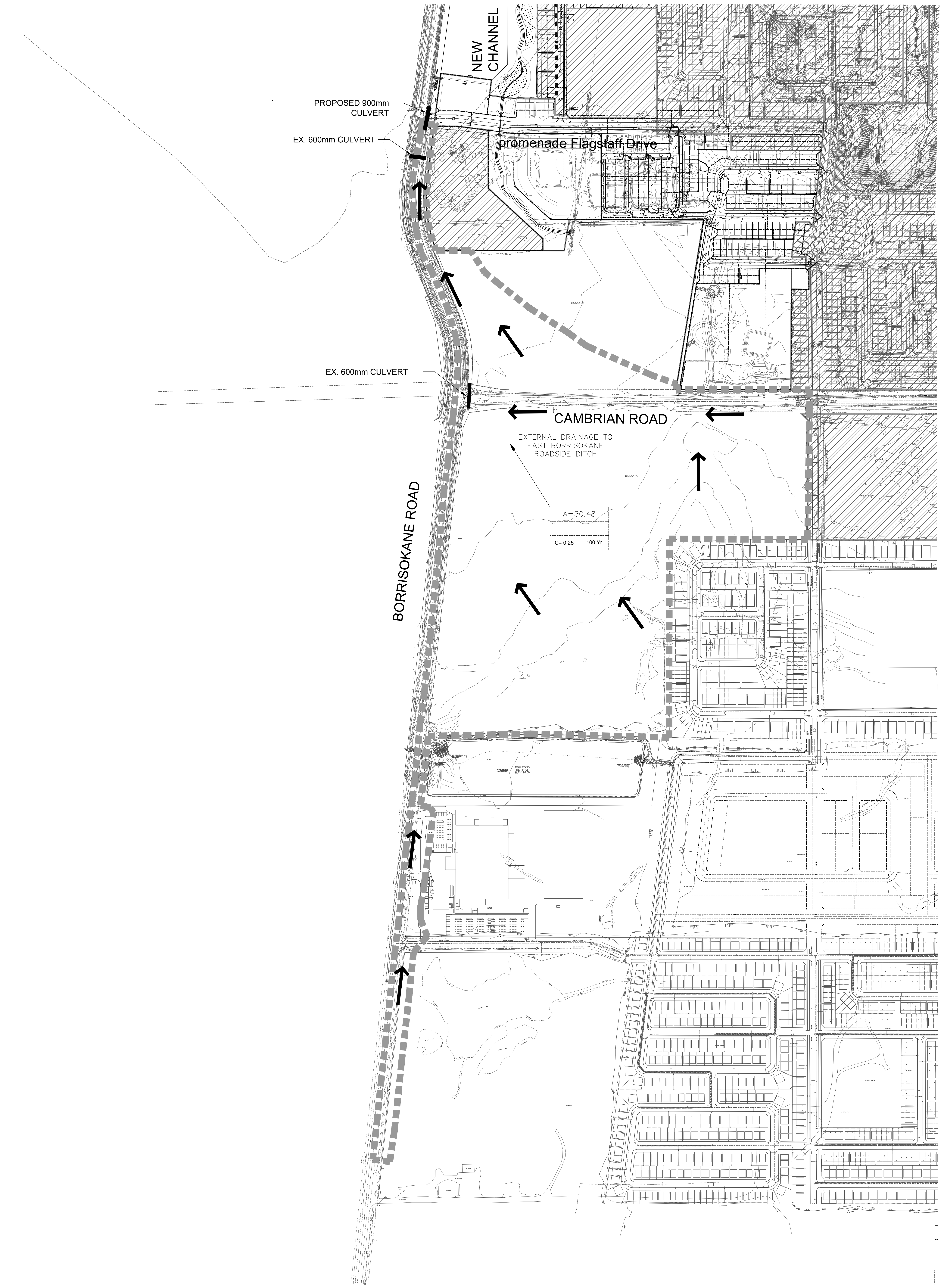
S. L. MERRICK
100186523
2021-11-18
JOB #19-1140

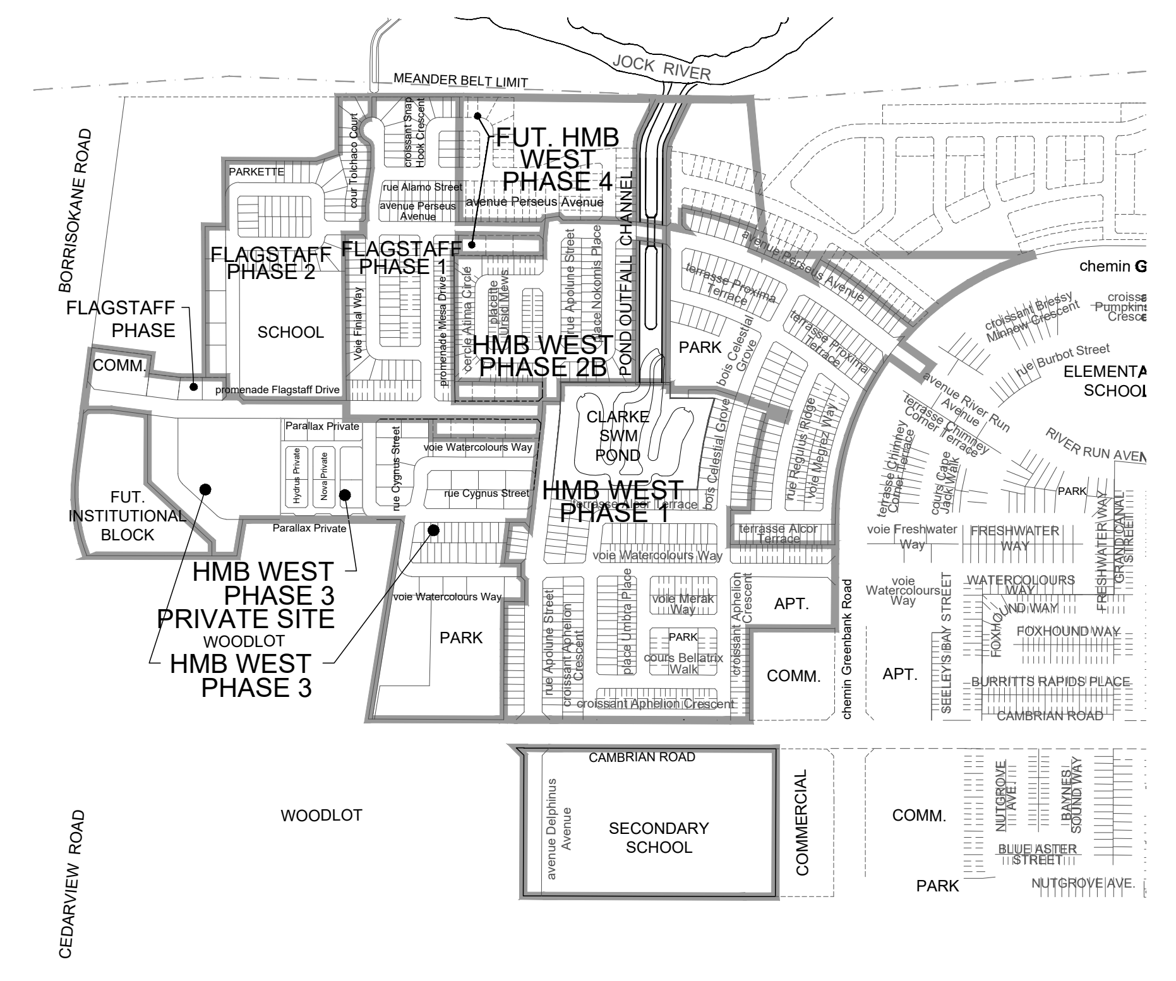
CITY OF OTTAWA

STORM DRAINAGE PLAN

DRAWN BY: G.G.G.
CHECKED BY: S.L.M.
DESIGNED BY: G.G.G.
CHECKED BY: S.L.M.
SCALE: 1:1000
PROJECT No. 19–1140
SHEET No. 24

CITY FILE No. D07-16-26-0023 P3
CITY PLAN No. 17586





KEY PLAN
SCALE 1:10000

LEGEND

SUBDIVISION DRAINAGE BOUNDARY	▬ ▬ ▬ ▬ ▬ ▬
EXTERNAL STORM BOUNDARY	■ ■ ■

EMERGENCY OVERLAND FLOW DIRECTION
EXTERNAL 2.78AC = → 2.78AC=14.40
EXTERNAL TIME OF CONCENTRATION → TC=14.5 MIN
EXTERNAL BLENDED RUNOFF COEFFICIENT → C= 0.70
EXTERNAL STORM FREQUENCY → 2YR

FLOW DIRECTION ←

No.	BY	DATE	DESCRIPTION
3	S.L.M.	21.11.18	3rd SUBMISSION
2	S.L.M.	21.08.31	2nd SUBMISSION
1	S.L.M.	21.06.04	1st SUBMISSION

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED FEBRUARY 22, 2017
TOPOGRAPHIC INFORMATION FOR BORRISOKANE ROAD PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 18-10-145-00, RECEIVED ON JULY 10, 2019

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 16-10-100-00, DATED NOVEMBER 10, 2021

BENCH MARK

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE PUBLISHED BENCHMARK NUMBER 0011964U3710 HAVING AN ELEVATION OF 71.724 M.

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www.DSEL.ca

LICENSED PROFESSIONAL ENGINEER
S. L. MERRICK
100186523
2021-11-18
PROVINCE OF ONTARIO
JOB#19-1140

CITY OF OTTAWA

EXTERNAL STORM DRAINAGE PLAN

DRAWN BY: G.G.G.
CHECKED BY: S.L.M.
DESIGNED BY: G.G.G.
CHECKED BY: S.L.M.
SCALE: 1: 3500
PROJECT No. 19–1140
SHEET No. 25

CITY PLAN No. 17586
CITY FILE No. D07-16-26-0023 P3

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

LOCATION			AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR																		
Location	From Node	To Node	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	AREA (Ha)	R	Indiv. 2.78 AC	Accum. 2.78 AC	Time of Conc. (min)	Intensity 2 Year (mm/h)	Intensity 5 Year (mm/h)	Intensity 10 Year (mm/h)	Intensity 100 Year (mm/h)	Peak Flow Q (l/s)	DIA. (mm) (actual)	DIA. (mm) (nominal)	TYPE	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME OF LOW (min	RATIO Q/Q full
PARK BLOCK 61																																	
					0.00	0.00	2.12	0.40	2.36	2.36			0.00	0.00			0.00	0.00	14.00														
	370	371			0.00	0.00			0.00	2.36			0.00	0.00			0.00	0.00	14.00	64.23	86.93	101.82	148.72	205	675	675	CONC	0.15	11.0	325.56	0.91	0.20	0.63
To voie Watercolours Way, Pipe 371 - 110						0.00				2.36				0.00				0.00	14.20														
voie Watercolours Way																																	
	358	359			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	0	300	300	PVC	0.80	22.5	86.49	1.22	0.31	0.00
	359	360	0.03	0.75	0.06	0.06			0.00	0.00			0.00	0.00			0.00	0.00	10.31	75.65	102.60	120.27	175.80	5	300	300	PVC	0.40	11.0	61.16	0.87	0.21	0.08
			0.25	0.57	0.40	0.46			0.00	0.00			0.00	0.00			0.00	0.00															
	360	361	0.37	0.75	0.77	1.23			0.00	0.00			0.00	0.00			0.00	0.00	10.52	74.87	101.53	119.01	173.96	92	375	375	PVC	0.40	80.5	110.89	1.00	1.34	0.83
	361	Ex. Plug	0.31	0.75	0.65	1.88			0.00	0.00			0.00	0.00			0.00	0.00	11.85	70.35	95.32	111.69	163.21	132	675	675	CONC	0.14	67.0	314.52	0.88	1.27	0.42
	367	368	0.11	0.73	0.22	0.22			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	17	375	375	PVC	0.30	14.5	96.0323	0.8695	0.2779	0.179
			0.13	0.57	0.21	0.43			0.00	0.00			0.00	0.00			0.00	0.00															
			0.17	0.73	0.34	0.77			0.00	0.00			0.00	0.00			0.00	0.00															
	368	371	0.18	0.75	0.38	1.15			0.00	0.00			0.00	0.00			0.00	0.00	10.28	75.75	102.75	120.44	176.06	87	450	450	CONC	0.30	87.5	156.1591	0.9819	1.4853	0.558
Contribution From PARK BLOCK 61, Pipe 370 - 371						0.00				2.36				0.00				0.00	14.20														
	371	Ex. Plug	0.20	0.73	0.41	1.56			0.00	2.36			0.00	0.00			0.00	0.00	14.20	63.72	86.23	100.99	147.51	302	825	825	CONC	0.15	68.0	555.94	1.04	1.09	0.54
Cygnus Street																																	
	363	364	0.04	0.75	0.08	0.08			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	6	300	300	PVC	0.60	17.0	74.90	1.06	0.27	0.09
			0.18	0.73	0.37	0.37			0.00	0.00			0.00	0.00			0.00	0.00															
			0.18	0.73	0.37	0.37			0.00	0.00			0.00	0.00			0.00	0.00															
	364	365	0.28	0.55	0.43	1.24			0.00	0.00			0.00	0.00			0.00	0.00	10.27	75.79	102.80	120.50	176.15	94	375	375	PVC	0.55	72.5	130.03	1.18	1.03	0.72
			0.14	0.73	0.28	0.28			0.00	0.00			0.00	0.00			0.00	0.00															
			0.15	0.55	0.23	0.23			0.00	0.00			0.00	0.00			0.00	0.00															
	365	Ex. Plug	0.15	0.75	0.31	2.07			0.00	0.00			0.00	0.00			0.00	0.00	11.29	72.17	97.82	114.64	167.54	149	450	450	CONC	0.40	65.0	180.32	1.13	0.96	0.83
Nova Private																																	
	349	350	0.06	0.90	0.15	0.15			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	12	300	300	PVC	0.35	10.5	57.21	0.81	0.22	0.20
	350	351	0.07	0.90	0.18	0.33			0.00	0.00			0.00	0.00			0.00	0.00	10.22	75.98	103.06	120.81	176.61	25	300	300	PVC	0.35	32.5	57.21	0.81	0.67	0.43
	351	352	0.12	0.90	0.30	0.63			0.00	0.00			0.00	0.00			0.00	0.00	10.89	73.56	99.74	116.89	170.85	46	300	300	PVC	0.35	39.5	57.21	0.81	0.81	0.80
	352	353	0.10	0.90	0.25	0.88			0.00	0.00			0.00	0.00			0.00	0.00	11.70	70.84	96.00	112.49	164.39	62	375	375	PVC	0.30	10.0	96.03	0.87	0.19	0.65
To Parallax private, Pipe 353 - 354						0.88				0.00				0.00				0.00	11.89														
Hydrus Private																																	
	343	344	0.04	0.90	0.10	0.10			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	8	300	300	PVC	0.35	10.5	57.21	0.81	0.22	0.13
	344	345	0.08	0.90	0.20	0.30			0.00	0.00			0.00	0.00			0.00	0.00	10.22	75.98	103.06	120.81	176.61	23	300	300	PVC	0.35	33.0	57.21	0.81	0.68	0.40
	345	346	0.12	0.90	0.30	0.60			0.00	0.00			0.00	0.00			0.00	0.00	10.90	73.53	99.69	116.84	170.76	44	300	300	PVC	0.35	39.5	57.21	0.81	0.81	0.77
	346	347	0.10	0.90	0.25	0.85			0.00	0.00			0.00	0.00			0.00	0.00	11.71	70.81	95.96	112.44	164.31	60	375	375	PVC	0.30	10.0	96.03	0.87	0.19	0.63
To Parallax private, Pipe 347 - 348						0.85				0.00				0.00				0.00	11.90														
Parallax private																																	
	339	340			0.00	0.00			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	0	300	300	PVC	0.35	33.0	57.21	0.81	0.68	0.00
	340	341	0.11	0.90	0.28	0.28			0.00	0.00			0.00	0.00			0.00	0.00	10.68	74.29	100.74	118.07	172.58	20	300	300	PVC	0.35	50.0	57.21	0.81	1.03	0.36
	341	342			0.00	0.28			0.00	0.00			0.00	0.00			0.00	0.00	11.71	70.81	95.96	112.44	164.31	19	300	300	PVC	0.35	20.0	57.21	0.81	0.41	0.34
	342	347	0.14	0.90	0.35	0.63			0.00	0.00			0.00	0.00			0.00	0.00	12.12	69.52	94.18	110.35	161.24	43	375	375	PVC	0.30	16.0	96.03	0.87	0.31	0.45
Contribution From Hydrus Private, Pipe 346 - 347						0.85				0.00				0.00				0.00	11.90														
	347	348			0.00	1.48			0.00	0.00			0.00	0.00			0.00	0.00	12.43	68.59	92.91	108.85	159.04	101	450	450	CONC	0.20	19.0	127.50	0.80	0.39	0.79
	348	353	0.08	0.90	0.20	1.68			0.00	0.00			0.00	0.00			0.00	0.00	12.82	67.43	91.32	106.99	156.30	113	450	450	CONC	0.25	17.0	142.55	0.90	0.32	0.79
Contribution From Nova Private, Pipe 352 - 353						0.88				0.00				0.00				0.00	11.89														
	353	354			0.00	2.55			0.00	0.00			0.00	0.00			0.00	0.00	13.14	66.54	90.10	105.54	154.18	170	525	525	CONC	0.25	30.0	215.03	0.99	0.50	0.79
	354	355	0.08	0.90	0.20	2.75			0.00	0.00			0.00	0.00			0.00	0.00	13.64	65.17	88.22	103.33	150.94	179	525	525	CONC	0.25	16.0	215.03	0.99	0.27	0.83
To Cygnus Street, Pipe 355 - 356						2.75				0.00				0.00				0.00	13.91														

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

S. L. MERRICK
100186523
2021-11-18

Designed: GGG	PROJECT:		HALF MOON BAY WEST PHASE 3	
Checked: SLM	LOCATION:		City of Ottawa	
Dwg. Reference: Dwg 22	File Ref:	19-1140	Date: 18 Nov 2021	Sheet No. SHEET 1 OF 2

JOB #19-1140

1140_STM.xlsx

STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Local Roads Return Frequency = 2 years
Collector Roads Return Frequency = 5 years
Manning 0.013 Arterial Roads Return Frequency = 10 years

	LOCATION		AREA (Ha)																FLOW						SEWER DATA								
			2 YEAR				5 YEAR				10 YEAR				100 YEAR				Time of	Intensity	Intensity	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year	10 Year	100 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
Cygnus Street																																	
			0.02	0.90	0.05	0.05			0.00	0.00			0.00	0.00			0.00	0.00															
			0.05	0.90	0.13	0.18			0.00	0.00			0.00	0.00			0.00	0.00															
			0.07	0.85	0.17	0.34			0.00	0.00			0.00	0.00			0.00	0.00															
	336	337	0.13	0.75	0.27	0.61			0.00	0.00			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	47	300	300	PVC	0.35	42.5	57.21	0.81	0.88	0.82
	337	338			0.00	0.61			0.00	0.00			0.00	0.00			0.00	0.00	10.88	73.60	99.79	116.95	170.94	45	375	375	PVC	0.30	7.5	96.03	0.87	0.14	0.47
			0.09	0.85	0.21	0.82			0.00	0.00			0.00	0.00			0.00	0.00															
	338	355	0.19	0.57	0.30	1.13			0.00	0.00			0.00	0.00			0.00	0.00	11.02	73.10	99.10	116.15	169.75	82	450	450	CONC	0.20	84.0	127.50	0.80	1.75	0.65
Contribution From Parallax private, Pipe 354 - 355						2.75				0.00				0.00				0.00	13.91														
			0.04	0.85	0.09	3.97			0.00	0.00			0.00	0.00			0.00	0.00															
	355	356	0.23	0.75	0.48	4.45			0.00	0.00			0.00	0.00			0.00	0.00	13.91	64.46	87.25	102.20	149.27	287	600	600	CONC	0.30	40.5	336.31	1.19	0.57	0.85
To promenade Flagstaff Drive, Pipe 356 - Ex. 329						4.45				0.00				0.00				0.00	14.48														
PARK BLOCK 63																																	
					0.00	0.00	1.67	0.40	1.86	1.86			0.00	0.00			0.00	0.00	12.00														
	332	333			0.00	0.00			0.00	1.86			0.00	0.00			0.00	0.00	12.00	69.89	94.70	110.96	162.13	176	600	600	CONC	0.15	13.5	237.81	0.84	0.27	0.74
To promenade Flagstaff Drive, Pipe 333 - 327						0.00				1.86				0.00				0.00	12.27														
promenade Flagstaff Drive																																	
	331	333			0.00	0.00	0.71	0.80	1.58	1.58			0.00	0.00			0.00	0.00	10.00	76.81	104.19	122.14	178.56	165	675	675	CONC	0.15	126.5	325.56	0.91	2.32	0.51
Contribution From PARK BLOCK 63, Pipe 332 - 333						0.00				1.86				0.00				0.00	12.27														
	333	Ex. 327			0.00	0.00			0.00	3.44			0.00	0.00			0.00	0.00	12.32	68.92	93.36	109.39	159.83	321	750	750	CONC	0.15	72.5	431.17	0.98	1.24	0.74
					0.00	0.00	0.15	0.80	0.33	3.77			0.00	0.00			0.00	0.00															
	Ex. 327	Ex. 326			0.00	0.00	0.26	0.85	0.61	4.38			0.00	0.00			0.00	0.00	13.56	65.40	88.53	103.71	151.49	388	900	900	CONC	0.12	46.0	627.11	0.99	0.78	0.62
	Ex. 326	356			0.00	0.00	0.00	0.00	0.00	4.38			0.00	0.00			0.00	0.00	14.33	63.39	85.77	100.46	146.72	376	900	900	CONC	0.12	17.0	627.11	0.99	0.29	0.60
Contribution From Cygnus Street, Pipe 355 - 356						4.45				0.00				0.00				0.00	14.48														
					0.00	4.45	0.19	0.59	0.31	4.70			0.00	0.00			0.00	0.00															
	356	Ex. 329			0.00	4.45	0.36	0.75	0.75	5.45			0.00	0.00			0.00	0.00	15.11	61.51	83.20	97.43	142.28	727	975	975	CONC	0.16	77.0	896.42	1.20	1.07	0.81

LICENSED PROFESSIONAL ENGINEER
S. L. MERRICK
100186523
2021-11-18
PROVINCE OF ONTARIO

JoB #19-1140

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Velocity = 0.80 m/s

Designed: GGG
Checked: SLM
Dwg. Reference: Dwg 22
PROJECT: HALF MOON BAY WEST PHASE 3
LOCATION: City of Ottawa
File Ref: 19-1140
Date: 18 Nov 2021
Sheet No. SHEET 2 OF 2

J.F. Sabourin and Associates Inc.
52 Springbrook Drive,
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T 613-836-3884 F 613-836-0332

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WATER RESOURCES AND
ENVIRONMENTAL CONSULTANTS

Ottawa. ON
Paris. ON
Gatineau. QC
Montréal. QC
Québec. QC

June 03, 2021 Project Number: P598(07)

David Schaeffer Engineering Limited
120 Iber Road, Unit 103
Ottawa, Ontario
K2S 1E9

Attention: **Ms. Jennifer Ailey, P.Eng.**

Subject: **Phase 3 of the Half Moon Bay West Subdivision / Proposed Culvert under Flagstaff Drive**

As requested by your office, we have evaluated, based on the provided information as described below, the 100-year peak flows to the proposed culvert under Flagstaff Drive to the east of Borrisokane Road, and the culvert diameter required to convey the 100-year flows without overtopping the road. The proposed crossing of Flagstaff Drive is located within the City of Ottawa, in the Half Moon Bay West subdivision.

The drainage area to the proposed culvert includes 30.48 ha of existing drainage from a woodlot and the east side of Borrisokane Road, and 5-year minor system outflows from a 2.239 ha future commercial block. Flows in excess of the 5-year Rational Method flow on the future commercial block are to be stored on-site, in accordance with the June 2021 *Stormwater Management Report for Phase 3 of the Half Moon Bay West Subdivision*.

In order to best represent the infiltration rates over a long simulation period, the SCS procedure was used to simulate infiltration over the 30.48 ha existing drainage area. Calculations for SCS Curve Number (CN) values are presented in Attachment B. The drainage areas are underlaid by Osgoode Loam, Muck, Kars Gravelly Sandy Loam, and Uplands Sand according to Carleton County Ontario Soil Survey Map No. 7, which correspond to hydrologic soil groups ranging between A, B and BC.

A time to peak value for the 30.48 ha existing drainage area was estimated based on topographic data provided by DSEL, using the FAA equation. Time to peak calculations are presented in Attachment B.

A SWMHYMO model of the drainage areas to the culvert was prepared based on the information described above, for the purposes of simulating peak flows in the channel during the 100-year 3-hour Chicago and 100-year 24-hour SCS Type II design storms. Digital SWMHYMO modelling input and output files are attached.

Based on these SWMHYMO simulations, the peak flows under to the proposed culvert under Flagstaff Drive are 685 L/s for the 100-year 3-hour Chicago storm and 769 L/s for the 100-year 24-hour SCS Type II storm.

As provided by DSEL, a 36.5 m long circular CSP culvert is proposed under Flagstaff Drive at a slope of 0.45%, with an upstream invert of 91.39 m and a downstream invert of 91.23 m. We understand from DSEL that the top of road elevation at this location is 92.53 m.

The diameter of culvert required to convey the 100-year flows without overtopping the road was evaluated in the HY-8 program under outlet control, based on the 100-year flood level of 91.83 m at cross-section 6016, per the November 2004 *Jock River Flood Risk Mapping (within the City of Ottawa) Hydraulics Report*. At the proposed road crossing, a 900 mm diameter circular CSP culvert results in a maximum 100-year water level of 92.32 m at the upstream side of the culvert; 0.21 m below the top of road elevation of 92.53 m. Refer to Attachment A for the HY-8 culvert analysis report.

Yours truly,
J.F Sabourin and Associates Inc.

L. Pipkins

Laura Pipkins, P.Eng.
Project Engineer in Water Resources

cc: J.F Sabourin, M.Eng, P.Eng
Director of Water Resources Projects

Attachments

Attachment A:	HY-8 Culvert Analysis Report
Attachment B:	SCS Curve Number and Time to Peak Calculations

Ottawa. ON
Paris. ON
Gatineau. QC
Montréal. QC
Québec. QC

Attachment A

HY-8 Culvert Analysis Report

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: FlagStaff Drive

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	FlagStaff Drive Discharge (cms)	Roadway Discharge (cms)	Iterations
92.25	100-Yr 3-Hr Chicago	0.69	0.69	0.00	1
92.32	100-Yr 24-Hr SCS	0.77	0.77	0.00	1
92.53	Overtopping	0.98	0.98	0.00	Overtopping

Table 2 - Culvert Summary Table: FlagStaff Drive

****

Straight Culvert

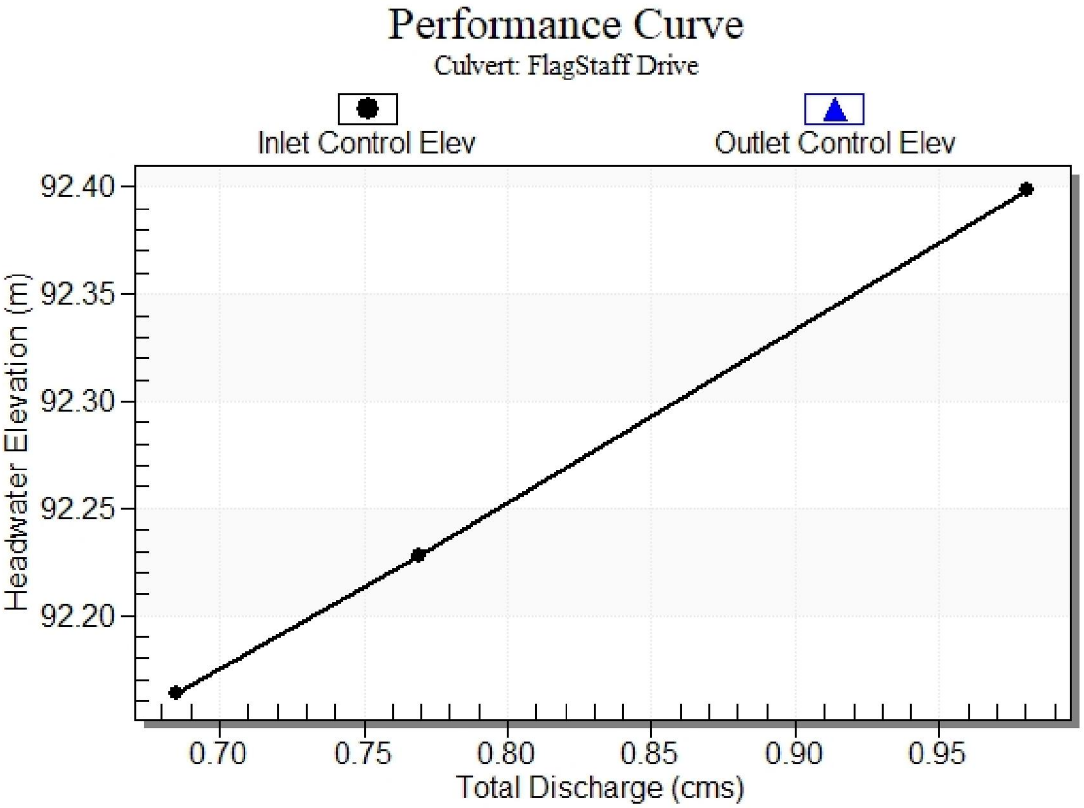
Inlet Elevation (invert): 91.39 m, Outlet Elevation (invert): 91.23 m

Culvert Length: 36.50 m, Culvert Slope: 0.0044

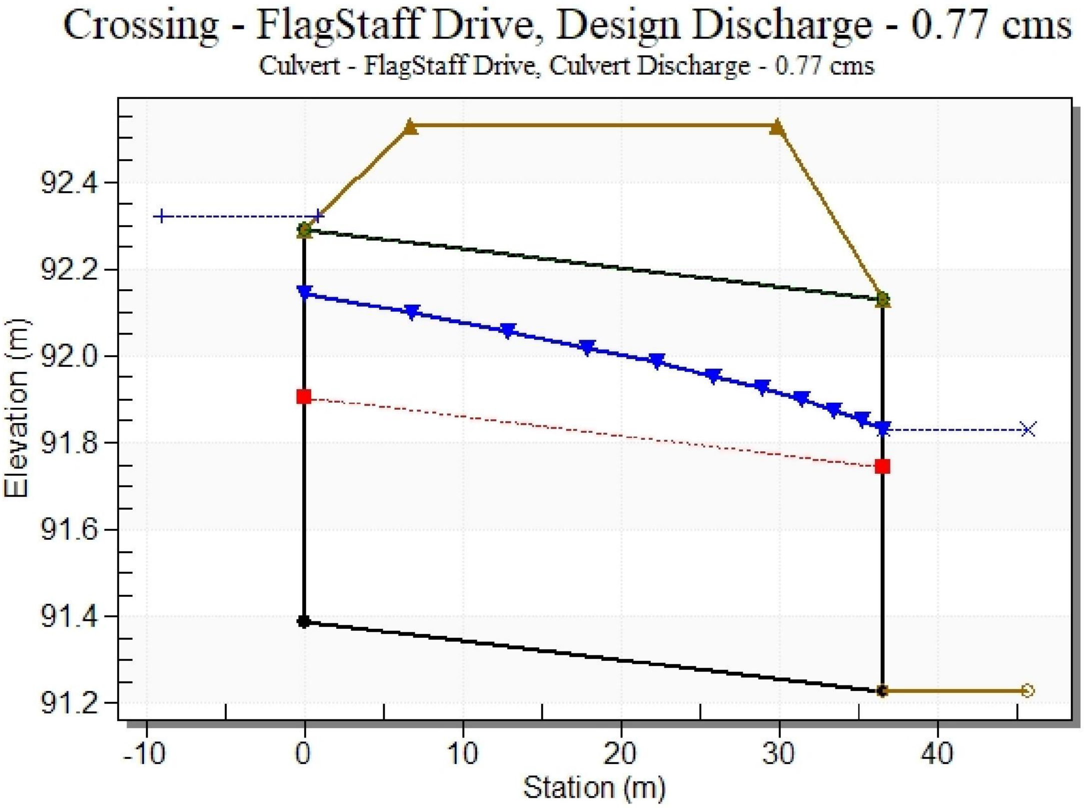
****

Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
100-Yr 3-Hr Chicago	0.69	0.69	92.25	0.774	0.861	3-M2t	0.900	0.484	0.600	0.600	1.520	0.000
100-Yr 24-Hr SCS	0.77	0.77	92.32	0.838	0.930	3-M2t	0.900	0.515	0.600	0.600	1.707	0.000

Culvert Performance Curve Plot: FlagStaff Drive



Water Surface Profile Plot for Culvert: FlagStaff Drive



Site Data - FlagStaff Drive

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 91.39 m

Outlet Station: 36.50 m

Outlet Elevation: 91.23 m

Number of Barrels: 1

Culvert Data Summary - FlagStaff Drive

Barrel Shape: Circular

Barrel Diameter: 900.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: FlagStaff Drive)

Flow (cms)	Water Surface Elev (m)	Depth (m)
24.19	91.83	0.60
27.16	91.83	0.60

Tailwater Channel Data - FlagStaff Drive

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 91.83 m

Roadway Data for Crossing: FlagStaff Drive

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 20.00 m

Crest Elevation: 92.53 m

Roadway Surface: Paved

Roadway Top Width: 23.20 m

Ottawa. ON
Paris. ON
Gatineau. QC
Montréal. QC
Québec. QC

Attachment B

SCS Curve Number and Time to Peak Calculations

Table B-1: Calculation of SCS Curve Number (CN) and Modified Curve Number (CN*)

Natural Drainage Area to Proposed Flagstaff Drive Culvert

Soil type (1)	Land Use (2)	% of the Study Area (2)	Drainage Type (1)	Soil Description (1)	Hydrologic Soil Group (3)	CN (4)
Osgoode Loam	Urban Lawn	2%	Imperfect	Loam and Clay Loam	BC	74
Muck	Woods	13%	Imperfect	Decomposed Organic Material	B	60
Kars	Woods	34%	Imperfect	Gravely Sandy Loam	B	60
Uplands Sand	Woods	36%	Imperfect	Gravely Sandy Loam	A	45
Uplands Sand	Urban Lawn	5%	Imperfect	Gravely Sandy Loam	A	49
Uplands Sand	Impervious	10%	Imperfect	Organic Matter and Sand	A	98
Total		**100%**				**58**
CN* (5)						**44**

(1) As per *Ontario Soil Survey Map No. 7, Soils of the Carleton County.*

(2) As per Google Earth Satellite Imagery.

(3) As per November 1985 *Ministry of Transporation Drainage Manual,* Chart H2.

(4) As per *SWMHYMO User's Manual* , J.F. Sabourin and Associates Inc., May 2000. Assume soils in good/fair condition.

(5) As per *Runoff Curve Number Method: Examination of the Initial Abstraction Ratio* (Woodward et. al., 2003).

Table B-2: Calculation of Time to Peak

	UNITS	NAT
Area	(ha)	30.48
Hydrologic Soil Group (1)		A/B/BC
CN (1)		58
C (as per Rational Method)		0.25
Length of Channel (2)	(m)	1100
Elevation of Channel Outlet (2)	(m)	91.25
Elevation of Channel Headwater (2)	(m)	106
Average Slope of Channel	(m/m)	0.0134
Time of Concentration Calculations (3)		
Kirpich	(min)	23
	(hrs)	0.38
FAA	(min)	83
	(hrs)	1.39
SCS	(min)	139
	(hrs)	2.32
Bransby Williams	(min)	42
	(hrs)	0.71
Time to Peak (=2/3 Tc) (3)		
Kirpich	(min)	15
FAA	(min)	56
SCS	(min)	93
Bransby Williams	(min)	28
Final (FAA)	**(h)**	**0.93**

(1) As per Table B-1 of Appendix B.

(2) As measured based on topographic data provided by DSEL and Google Earth.

(3) As per 1997 *Ministry of Transportation Drainage Management Manual,* Ch8.

Tc Equations applicability

Kirpich	Best for rural watersheds with slopes ranging from 3% to10%
FAA	Best for flat drainage areas (was developped for air field drainage) but used frequently for urban watersheds
SCS	Best for Agricultural SW in general and urban SW < 2000 acres
BW	One of the best method for predicting Tc. Especially for good for small culvert design

	Tc Equations and inputs (imperial unless otherwise noted)	Result in	input L as
Kirpich	$Tc = 0.0078\ L^{0.77}\ S^{-0.385}$	(min)	(ft)
FAA	$Tc = (1.8(1.1-C)L^{0.50}) / (S^{0.333})$	(min)	(ft)
SCS Lag	$Tc = (100L^{0.8}((1000/CN)-9)^{0.7} / (1900\ S^{0.5})$	(min)	(ft)
BW (metric)	$Tc = (0.605L) / (S^{0.2}\ A^{0.1})$	(hrs)	(km)

Date: May 2021
Project: Half Moon Bay West - Phase 3
DSEL File: 19-1140

Summary

Townhouses

Lot Type	Number of Lots (#)	Front Lot C	Back Lot C	# x C (Front)	# x C (Back)	Front Area (FA)	Back Area (BA)	# x FA	# x BA
Townhouse 7.8 x 25.00m (TH) - Ext Corner - 18m	5	0.66	0.47	3.32	2.36	156.00	109.20	780.00	546.00
Townhouse 7.8 x 25.00m (TH) - Ext Corner - 18m w/ Sidewalk	2	0.70	0.47	1.39	0.94	156.00	109.20	312.00	218.40
Townhouse 8.2 x 25.00m (TH) - Int End - 18m	17	0.70	0.53	11.85	8.96	164.00	114.80	2788.00	1951.60
Townhouse 8.2 x 25.00m (TH) - Int End - 18m - w/ Sidewalk	14	0.73	0.53	10.21	7.38	164.00	114.80	2296.00	1607.20
Townhouse 6.5x 25.00m (TH) - Int - 18m	35	0.77	0.60	26.80	21.00	130.00	91.00	4550.00	3185.00
Townhouse 6.5x 25.00m (TH) - Int - 18m - w/ Sidewalk	21	0.79	0.60	16.68	12.60	130.00	91.00	2730.00	1911.00
Townhouse 6.5x 25.00m (TH) - Int - 24m - w/ Sidewalk	5	0.78	0.60	3.92	3.00	149.50	91.00	747.50	455.00
Townhouse 8.2 x 25.00m (TH) - IntEnd - 24m - w/ Sidewalk	3	0.72	0.53	2.17	1.58	188.60	114.80	565.80	344.40
Townhouse 10.05 x 25.00m (TH) - ExtCo - 24m - w/ Sidewalk	1	0.69	0.48	0.69	0.48	188.60	114.80	188.60	114.80
Sub-Total	103			77.05	58.29	1426.70	950.60	14957.90	10333.40
Average:		**0.748**	**0.566**						
	Use	**0.75**	**0.57**						
	1082	**0.73**	**0.56**						

Singles

Lot Type	Number of Lots (#)	Front Lot C	Back Lot C	# x C (Front)	# x C (Back)	Front Area (FA)	Back Area (BA)	# x FA	# x BA
Single 9.14x 27.00m (D) - Int - 18m	3	0.70	0.54	2.10	1.61	191.94	137.10	575.82	411.30
Single 9.14x 27.00m (D) - Int - 18m -w/ Sidewalk	6	0.73	0.54	4.38	3.22	191.94	137.10	1151.64	822.60
Single 13.10 x 27.00m (D) - Int - 18m	3	0.72	0.56	2.17	1.69	275.10	196.50	825.30	589.50
Single 13.10 x 27.00m (D) - Int - 18m w/ Sidewalk	0	0.75	0.56	0.00	0.00	275.10	196.50	0.00	0.00
Single 11.00 x 27.00m (D) - Int - 18m	4	0.73	0.55	2.90	2.21	231.00	165.00	924.00	660.00
Single 11.00 x 27.00m (D) - Int - 18m - w/ Sidewalk	5	0.75	0.55	3.76	2.76	231.00	165.00	1155.00	825.00
Single 13.15 x 27.00m (D) - ExtCo - 18m	1	0.69	0.52	0.69	0.52	276.15	197.25	276.15	197.25
Single 9.62 x 27.00m (D) - ExtCo - 18m w/ Sidewalk	1	0.72	0.48	0.72	0.48	202.02	144.30	202.02	144.30
Sub-Total	23			16.7114525	12.4895502	1874.25	1338.75	5109.93	3649.95
Average:		**0.727**	**0.543**						
	Use	**0.73**	**0.55**	<----round up to be conservative and consistant with Townhomes					
	1082.00	0.72	0.54						

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 7.8 x 25.00m (TH) - Ext Corner - 18m

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	7.80	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	0.00	m	Sideyard Setback 1 (SS1):	2.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:
Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 156.00 m^2

2. Impervious Areas:
a. Half of Road: = LW * (PW/ 2 + CW + SW) = 34.71 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 42.40 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 26.425 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 103.54 m^2

3. Imperviousness Ratio (%): = 66.37 %

4. Runoff Coefficient: **0.66**

Lot Back

1. Overall Area:
Lot Back: = LW * ((LD-FS-RS)/2+RS) = 109.20 m^2

2. Impervious Areas:
a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 42.40 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 42.40 m^2

3. Imperviousness Ratio (%): = 38.83 %

4. Runoff Coefficient: **0.47**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 7.8 x 25.00m (TH) - Ext Corner - 18m w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	7.80	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60	m	Sideyard Setback 1 (SS1):	2.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 156.00 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 47.19 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 42.40 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 20.825 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 110.42 m^2

3. Imperviousness Ratio (%): = 70.78 %

4. Runoff Coefficient: **0.70**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 109.20 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 42.40 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 42.40 m^2

3. Imperviousness Ratio (%): = 38.83 %

4. Runoff Coefficient: **0.47**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 8.2 x 25.00m (TH) - Int End - 18m

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	8.20	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	0.00	m	Sideyard Setback 1 (SS1):	1.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 164.00 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 36.49 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 53.60 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 26.425 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 116.52 m^2

3. Imperviousness Ratio (%): = 71.05 %

4. Runoff Coefficient: **0.70**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 114.80 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 53.60 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 53.60 m^2

3. Imperviousness Ratio (%): = 46.69 %

4. Runoff Coefficient: **0.53**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 8.2 x 25.00m (TH) - Int End - 18m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50 m		Lot Width (LW):	8.20	m
Boulevard Width (BW):	4.75 m		Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20 m		Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60 m		Sideyard Setback 1 (SS1):	1.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 164.00 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 49.61 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 53.60 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 20.825 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 124.04 m^2

3. Imperviousness Ratio (%): = 75.63 %

4. Runoff Coefficient: **0.73**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 114.80 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 53.60 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 53.60 m^2

3. Imperviousness Ratio (%): = 46.69 %

4. Runoff Coefficient: **0.53**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 6.5x 25.00m (TH) - Int - 18m

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	6.50	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	0.00	m	Sideyard Setback 1 (SS1):	0.00	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.20	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:
Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 130.00 m^2

2. Impervious Areas:
a. Half of Road: = LW * (PW/ 2 + CW + SW) = 28.93 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 52.00 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 24.16 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 105.09 m^2

3. Imperviousness Ratio (%): = 80.83 %

4. Runoff Coefficient: **0.77**

Lot Back

1. Overall Area:
Lot Back: = LW * ((LD-FS-RS)/2+RS) = 91.00 m^2

2. Impervious Areas:
a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 52.00 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 52.00 m^2

3. Imperviousness Ratio (%): = 57.14 %

4. Runoff Coefficient: **0.60**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 6.5x 25.00m (TH) - Int - 18m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	6.50	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60	m	Sideyard Setback 1 (SS1):	0.00	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.20	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front:	= LW * (PW/2+BW+ ((LD-FS-RS)/2+FS))	=	130.00 m^2

2. Impervious Areas:

a. Half of Road:	= LW * (PW/ 2 + CW + SW)	=	39.33 m^2
b. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	52.00 m^2
c. Driveway:	= DW * ((BW - SW- CW) + FS)	=	19.04 m^2
d. Side Path:	= SPW * (LD - FS - RS) * 2	=	0 m^2

Total Impervious Areas: 110.37 m^2

3. Imperviousness Ratio (%): = 84.90 %

4. Runoff Coefficient: **0.79**

Lot Back

1. Overall Area:

Lot Back:	= LW * ((LD-FS-RS)/2+RS)	=	91.00 m^2

2. Impervious Areas:

a. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	52.00 m^2
b. Rear Pad:	= RPW * RPD	=	0 m^2

Total Impervious Areas: 52.00 m^2

3. Imperviousness Ratio (%): = 57.14 %

4. Runoff Coefficient: **0.60**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 6.5x 25.00m (TH) - Int - 24m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	11.00	m	Lot Width (LW):	6.50	m
Boulevard Width (BW):	6.50	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.80	m	Sideyard Setback 1 (SS1):	0.00	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.20	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 149.50 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 48.75 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 52.00 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 24 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 124.75 m^2

3. Imperviousness Ratio (%): = 83.44 %

4. Runoff Coefficient: **0.78**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 91.00 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 52.00 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 52.00 m^2

3. Imperviousness Ratio (%): = 57.14 %

4. Runoff Coefficient: **0.60**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 8.2 x 25.00m (TH) - IntEnd - 24m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	11.00 m		Lot Width (LW):	8.20	m
Boulevard Width (BW):	6.50 m		Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20 m		Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.80 m		Sideyard Setback 1 (SS1):	1.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front:	= LW * (PW/2+BW+ ((LD-FS-RS)/2+FS))	=	188.60 m^2

2. Impervious Areas:

a. Half of Road:	= LW * (PW/ 2 + CW + SW)	=	61.50 m^2
b. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	53.60 m^2
c. Driveway:	= DW * ((BW - SW- CW) + FS)	=	26.25 m^2
d. Side Path:	= SPW * (LD - FS - RS) * 2	=	0 m^2
Total Impervious Areas:			141.35 m^2

3. Imperviousness Ratio (%): = 74.95 %

4. Runoff Coefficient: **0.72**

Lot Back

1. Overall Area:

Lot Back:	= LW * ((LD-FS-RS)/2+RS)	=	114.80 m^2

2. Impervious Areas:

a. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	53.60 m^2
b. Rear Pad:	= RPW * RPD	=	0 m^2
Total Impervious Areas:			53.60 m^2

3. Imperviousness Ratio (%): = 46.69 %

4. Runoff Coefficient: **0.53**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Townhouse 10.05 x 25.00m (TH) - ExtCo - 24m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	11.00	m	Lot Width (LW):	8.20	m
Boulevard Width (BW):	6.50	m	Lot Depth (LD):	25.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.80	m	Sideyard Setback 1 (SS1):	2.50	m
			Sideyard Setback 2 (SS2):	0.00	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	3.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:
Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 188.60 m^2

2. Impervious Areas:
a. Half of Road: = LW * (PW/ 2 + CW + SW) = 61.50 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 45.60 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 26.25 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 133.35 m^2

3. Imperviousness Ratio (%): = 70.71 %

4. Runoff Coefficient: **0.69**

Lot Back

1. Overall Area:
Lot Back: = LW * ((LD-FS-RS)/2+RS) = 114.80 m^2

2. Impervious Areas:
a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 45.60 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 45.60 m^2

3. Imperviousness Ratio (%): = 39.72 %

4. Runoff Coefficient: **0.48**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 9.14x 27.00m (D) - Int - 18m

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	9.14	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	27.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	0.00	m	Sideyard Setback 1 (SS1):	1.20	m
			Sideyard Setback 2 (SS2):	0.60	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	4.00	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 191.94 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 40.67 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 66.06 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 30.2 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 136.93 m^2

3. Imperviousness Ratio (%): = 71.34 %

4. Runoff Coefficient: **0.70**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 137.10 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 66.06 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 66.06 m^2

3. Imperviousness Ratio (%): = 48.18 %

4. Runoff Coefficient: **0.54**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 9.14x 27.00m (D) - Int - 18m -w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	9.14	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	27.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60	m	Sideyard Setback 1 (SS1):	1.20	m
			Sideyard Setback 2 (SS2):	0.60	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	4.00	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 191.94 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 55.30 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 66.06 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 23.8 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 145.16 m^2

3. Imperviousness Ratio (%): = 75.63 %

4. Runoff Coefficient: **0.73**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 137.10 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 66.06 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 66.06 m^2

3. Imperviousness Ratio (%): = 48.18 %

4. Runoff Coefficient: **0.54**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 11.00 x 27.00m (D) - Int - 18m

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	11.00	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	27.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	0.00	m	Sideyard Setback 1 (SS1):	1.20	m
			Sideyard Setback 2 (SS2):	0.60	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	5.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 231.00 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 48.95 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 82.80 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 41.525 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 173.28 m^2

3. Imperviousness Ratio (%): = 75.01 %

4. Runoff Coefficient: **0.73**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 165.00 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 82.80 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 82.80 m^2

3. Imperviousness Ratio (%): = 50.18 %

4. Runoff Coefficient: **0.55**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 11.00 x 27.00m (D) - Int - 18m - w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50 m	Lot Width (LW):	11.00 m
Boulevard Width (BW):	4.75 m	Lot Depth (LD):	27.00 m
Curb Width (CW):	0.20 m	Frontyard Setback (FS):	3.00 m
Sidewalk Width (SW):	1.60 m	Sideyard Setback 1 (SS1):	1.20 m
		Sideyard Setback 2 (SS2):	0.60 m
		Rearyard Setback (RS):	6.00 m
		Side Path Width (SPW):	0.00 m
		Driveway Width (DW):	5.50 m
		Rear Pad Width (RPW):	m
		Rear Pad Depth (RPD):	m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 231.00 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 66.55 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 82.80 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 32.725 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 182.08 m^2

3. Imperviousness Ratio (%): = 78.82 %

4. Runoff Coefficient: **0.75**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 165.00 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 82.80 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 82.80 m^2

3. Imperviousness Ratio (%): = 50.18 %

4. Runoff Coefficient: **0.55**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 13.10 x 27.00m (D) - Int - 18m

Design Parameters

Pavement Width (PW):	8.50 m		Lot Width (LW):	13.10 m
Boulevard Width (BW):	4.75 m		Lot Depth (LD):	27.00 m
Curb Width (CW):	0.20 m		Frontyard Setback (FS):	3.00 m
Sidewalk Width (SW):	0.00 m		Sideyard Setback 1 (SS1):	0.60 m
			Sideyard Setback 2 (SS2):	1.20 m
			Rearyard Setback (RS):	6.00 m
			Side Path Width (SPW):	0.00 m
			Driveway Width (DW):	6.00 m
			Rear Pad Width (RPW):	m
			Rear Pad Depth (RPD):	m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front:	= LW * (PW/2+BW+ ((LD-FS-RS)/2+FS))	=	275.10 m^2

2. Impervious Areas:

a. Half of Road:	= LW * (PW/ 2 + CW + SW)	=	58.30 m^2
b. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	101.70 m^2
c. Driveway:	= DW * ((BW - SW- CW) + FS)	=	45.3 m^2
d. Side Path:	= SPW * (LD - FS - RS) * 2	=	0 m^2

Total Impervious Areas: 205.30 m^2

3. Imperviousness Ratio (%): = 74.63 %

4. Runoff Coefficient: **0.72**

Lot Back

1. Overall Area:

Lot Back:	= LW * ((LD-FS-RS)/2+RS)	=	196.50 m^2

2. Impervious Areas:

a. Half of the House:	= (LD - FS - RS) * (LW - SS1 - SS2)/2	=	101.70 m^2
b. Rear Pad:	= RPW * RPD	=	0 m^2

Total Impervious Areas: 101.70 m^2

3. Imperviousness Ratio (%): = 51.76 %

4. Runoff Coefficient: **0.56**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 13.10 x 27.00m (D) - Int - 18m w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50 m	Lot Width (LW):	13.10	m
Boulevard Width (BW):	4.75 m	Lot Depth (LD):	27.00	m
Curb Width (CW):	0.20 m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60 m	Sideyard Setback 1 (SS1):	0.60	m
		Sideyard Setback 2 (SS2):	1.20	m
		Rearyard Setback (RS):	6.00	m
		Side Path Width (SPW):	0.00	m
		Driveway Width (DW):	6.00	m
		Rear Pad Width (RPW):		m
		Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 275.10 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 79.26 m^2

b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 101.70 m^2

c. Driveway: = DW * ((BW - SW- CW) + FS) = 35.7 m^2

d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 216.66 m^2

3. Imperviousness Ratio (%): = 78.75 %

4. Runoff Coefficient: **0.75**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 196.50 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 101.70 m^2

b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 101.70 m^2

3. Imperviousness Ratio (%): = 51.76 %

4. Runoff Coefficient: **0.56**

Date: May 2021
DSEL File: 19-1140

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Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 13.15 x 27.00m (D) - ExtCo - 18m

Design Parameters

Pavement Width (PW):	8.50 m	Lot Width (LW):	13.15 m
Boulevard Width (BW):	4.75 m	Lot Depth (LD):	27.00 m
Curb Width (CW):	0.20 m	Frontyard Setback (FS):	3.00 m
Sidewalk Width (SW):	0.00 m	Sideyard Setback 1 (SS1):	0.60 m
		Sideyard Setback 2 (SS2):	2.50 m
		Rearyard Setback (RS):	6.00 m
		Side Path Width (SPW):	0.00 m
		Driveway Width (DW):	6.00 m
		Rear Pad Width (RPW):	m
		Rear Pad Depth (RPD):	m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 276.15 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 58.52 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 90.45 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 45.3 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 194.27 m^2

3. Imperviousness Ratio (%): = 70.35 %

4. Runoff Coefficient: **0.69**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 197.25 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 90.45 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 90.45 m^2

3. Imperviousness Ratio (%): = 45.86 %

4. Runoff Coefficient: **0.52**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Single 9.62 x 27.00m (D) - ExtCo - 18m w/ Sidewalk

Design Parameters

Pavement Width (PW):	8.50	m	Lot Width (LW):	9.62	m
Boulevard Width (BW):	4.75	m	Lot Depth (LD):	27.00	m
Curb Width (CW):	0.20	m	Frontyard Setback (FS):	3.00	m
Sidewalk Width (SW):	1.60	m	Sideyard Setback 1 (SS1):	0.60	m
			Sideyard Setback 2 (SS2):	2.50	m
			Rearyard Setback (RS):	6.00	m
			Side Path Width (SPW):	0.00	m
			Driveway Width (DW):	5.50	m
			Rear Pad Width (RPW):		m
			Rear Pad Depth (RPD):		m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 202.02 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 58.20 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 58.68 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 32.725 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 149.61 m^2

3. Imperviousness Ratio (%): = 74.06 %

4. Runoff Coefficient: **0.72**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 144.30 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 58.68 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 58.68 m^2

3. Imperviousness Ratio (%): = 40.67 %

4. Runoff Coefficient: **0.48**

Date: May 2021
DSEL File: 19-1140

Half Moon Bay West - Phase 3
City of Ottawa
Calculation of Imperviousness / Runoff Coefficient
Back-to-Back 6.4x 14.7m (B2B) - Int - 18m

Design Parameters

Pavement Width (PW):	8.50 m	Lot Width (LW):	6.40 m
Boulevard Width (BW):	4.75 m	Lot Depth (LD):	14.70 m
Curb Width (CW):	0.20 m	Frontyard Setback (FS):	3.00 m
Sidewalk Width (SW):	0.00 m	Sideyard Setback 1 (SS1):	0.00 m
		Sideyard Setback 2 (SS2):	0.00 m
		Rearyard Setback (RS):	0.00 m
		Side Path Width (SPW):	0.00 m
		Driveway Width (DW):	3.20 m
		Rear Pad Width (RPW):	m
		Rear Pad Depth (RPD):	m

(See Figure Attached for Configuration Details)

Calculation

Half of the Street and Lot Front

1. Overall Area:

Half of Road and Lot Front: = LW * (PW/2+BW+ ((LD-FS-RS)/2+FS)) = 114.24 m^2

2. Impervious Areas:

a. Half of Road: = LW * (PW/ 2 + CW + SW) = 28.48 m^2
b. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 37.44 m^2
c. Driveway: = DW * ((BW - SW- CW) + FS) = 24.16 m^2
d. Side Path: = SPW * (LD - FS - RS) * 2 = 0 m^2

Total Impervious Areas: 90.08 m^2

3. Imperviousness Ratio (%): = 78.85 %

4. Runoff Coefficient: **0.75**

Lot Back

1. Overall Area:

Lot Back: = LW * ((LD-FS-RS)/2+RS) = 37.44 m^2

2. Impervious Areas:

a. Half of the House: = (LD - FS - RS) * (LW - SS1 - SS2)/2 = 37.44 m^2
b. Rear Pad: = RPW * RPD = 0 m^2

Total Impervious Areas: 37.44 m^2

3. Imperviousness Ratio (%): = 100.00 %

4. Runoff Coefficient: **0.90**

APPENDIX E

PHASE 2 OF THE FLAGSTAFF SUBDIVISION / CAMBRIAN WOODS NATURAL CHANNEL DESIGN (JFSA, SEPTEMBER 28, 2021)

GEOTECHNICAL RECOMMENDATIONS – FROST PROTECTION FOR NATURAL CHANNEL CROSSINGS, PG2246-MEMO.71 REVISION 1 (PATERSON GROUP, NOVEMBER 8, 2021)

JFSA
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September 28, 2021 Project Number: P598(07)

David Schaeffer Engineering Limited
120 Iber Road, Unit 103
Ottawa, Ontario
K2S 1E9

Attention: **Ms. Laura Maxwell**

Subject: **Phase 2 of the Flagstaff Subdivision / Cambrian Woods Natural Channel Design**

As requested by your office, we have evaluated, based on the provided information as described below, the 25 mm, 2- to 100-year and average annual peak flows in the proposed natural channel servicing Cambrian Woods under interim and ultimate development conditions. The performances of interim and ultimate culverts in the channel under Flagstaff Drive and a temporary access road have also been evaluated. The proposed natural drainage is located within the City of Ottawa, and drains through the Half Moon Bay West and Flagstaff subdivisions.

The channel alignment and culvert details are presented in Attachment A, as provided by DSEL. Note that the channel is located within the Jock River floodplain; as such, we understand that the channel will be designed by Geo Morphix to provide conveyance for the 2-year flows from the Cambrian Woods and other contributing drainage areas, but will function as part of the larger floodplain during less frequent events.

The drainage area to the channel is 11.97 ha under interim conditions and 9.78 ha under ultimate conditions. The interim drainage area includes a 8.79 ha area of the woodlot and proposed channel south of Flagstaff Drive, a 0.23 ha allowance for a future park block south of Flagstaff Drive (29% imperviousness assumed), a 2.08 ha channel block north of Flagstaff Drive, and a 0.87 ha allowance for proposed Flagstaff Phase 2 and future rearyards north of Flagstaff Drive. Under ultimate conditions, the 8.79 ha area of woodlot and channel south of Flagstaff Drive will be reduced to 6.60 ha.

In order to best represent the infiltration rates over a long simulation period, the SCS procedure was used to simulate infiltration over the both natural and developed areas. Calculations for SCS Curve Number (CN) values are presented in Attachment B. The drainage areas are underlaid by Osgoode Loam, Muck and Kars Gravelly Sandy Loam according to Carleton County Ontario Soil Survey Map No. 7, which correspond to hydrologic soil groups BC and B. Soils in the developed park and rearyard areas will be defined by the characteristics of topsoil, which has a CN of 79 for urban lawns in fair / imperfect condition.

Time to peak values for the natural drainage areas were estimated based on topographic data provided by DSEL, using the FAA equation. Time to peak calculations are presented in Attachment B.

A SWMHYMO model of the drainage areas to the natural channel was prepared based on the information described above, for the purposes of simulating peak flows in the channel during the 25 mm 3-hour Chicago storm and the 2- to 100-year 24-hour SCS Type II design storms. Additionally, by means of 36 years of continuous hydrologic simulations using hourly rainfall data from the Ottawa International Airport from 1967 to 2003 (missing data in 2001), the average annual peak flows to the channel were also computed using the SWMHYMO program. Note that the period of interest is from April 1st to October 31st of each year, as Environment Canada indicates that the hourly rainfall data is typically only available for April to October, with a greater occurrence of missing data (or simply no rainfall) during the winter months. The continuous modelling parameters were set as shown in Table 1.

Table 1: Continuous Modelling Parameters

Parameter	Description
APII = 50 APIK = 0.90/day	Used to compute the Antecedent Precipitation Index during the continuous simulation. Without model calibration, these are the default values.
IaRECper = 6 hrs	Time required for the Initial Abstraction over pervious areas to recover during a dry period in undeveloped areas.
SMIN = -1 mm SMAX = -1 mm	The negative values indicate that the storage volume in the SCS procedure will vary between the "S" determined for AMC I and AMC III conditions of the entered CN value in undeveloped and urban areas.
SK=[0.03]/(mm);	A calibration coefficient that can typically vary from 0.01 to 0.3 for undeveloped and urban areas. The higher the value, the more surface runoff generated. To set the baseline for pre-development conditions, a value in the low range was selected.
InitGWResVol = 100 mm GWResK = 0.9 mm/day/mm VhydCond = 1 mm/hr	Parameters that are used to simulate both the groundwater storage and discharge to surface watercourses from undeveloped areas. Without adequate field measurements, these parameters were selected based on previous experience.
IaRECper = 3 hrs	Time required for the Initial Abstraction over pervious areas to recover during a dry period in urban areas.
IaRECimp = 1.5 hrs	Time required for the Initial Abstraction over impervious areas to recover during a dry period in urban areas.
InterEventTime = 24 hrs	Continuous dry time required to reset the parameters in the SCS procedure to their initial values.

Based on these single event and continuous simulations, the peak flows under interim and ultimate conditions are summarized in Table 2.

Table 2: Summary of Peak Flows in the Natural Channel Servicing Cambrian Woods

Storm	Interim Conditions Peak Flow (m^3/s)		Ultimate Conditions Peak Flow (m^3/s)	
	South of Flagstaff Drive	North of Flagstaff Drive	South of Flagstaff Drive	North of Flagstaff Drive
25mm/3hr Chicago	0.021	0.028	0.017	0.024
2yr/24hr SCS	0.058	0.073	0.047	0.063
5yr/24hr SCS	0.100	0.125	0.082	0.106
10yr/24hr SCS	0.133	0.164	0.108	0.139
25yr/24hr SCS	0.178	0.218	0.144	0.184
50yr/24hr SCS	0.214	0.263	0.173	0.221
100yr/24hr SCS	0.256	0.313	0.207	0.263
Average Annual	0.083	0.110	0.067	0.097

Detailed continuous modelling results may be found in Attachment C. Digital SWMHYMO modelling input and output files are also attached.

As shown in Attachment A, under interim conditions a 1200 mm circular CSP culvert under Flagstaff Drive, and a 1200 mm circular CSP culvert under a temporary access road, will be installed in the channel. Under ultimate conditions, the temporary access road will be removed, and the 1200 mm circular CSP culvert under Flagstaff Drive will be replaced by a 1200 mm x 900 mm concrete box culvert. All culverts are to be buried by 10% of their diameter.

The performance of these interim and ultimate conditions culverts was assessed in the HY-8 program under outlet control, based on the 100-year flood level of 91.78 m at cross-section 5910, per the November 2004 *Jock River Flood Risk Mapping (within the City of Ottawa) Hydraulics Report*. At the temporary access road, the water level at the upstream side of the crossing is 91.79 m based on 100-year interim conditions flows. At Flagstaff Drive, the water level at the upstream side of the crossing is 91.80 m based on 100-year interim conditions flows and culvert characteristics, and 91.79 m based on 100-year ultimate conditions flows and culvert characteristics. Refer to Attachment D for the HY-8 culvert analysis report.

Yours truly,
J.F Sabourin and Associates Inc.

J. Burnett

Jonathon Burnett, B.Eng, P.Eng.
Water Resources Engineer

cc: J.F Sabourin, M.Eng, P.Eng
Director of Water Resources Projects

Attachments

Attachment A:	Natural Channel Corridor Drawing (DSEL, April 2021)
Attachment B:	SCS Curve Number and Time to Peak Calculations
Attachment C:	Summary of Continuous Surface Runoff Volumes
Attachment D:	HY-8 Culvert Analysis Report

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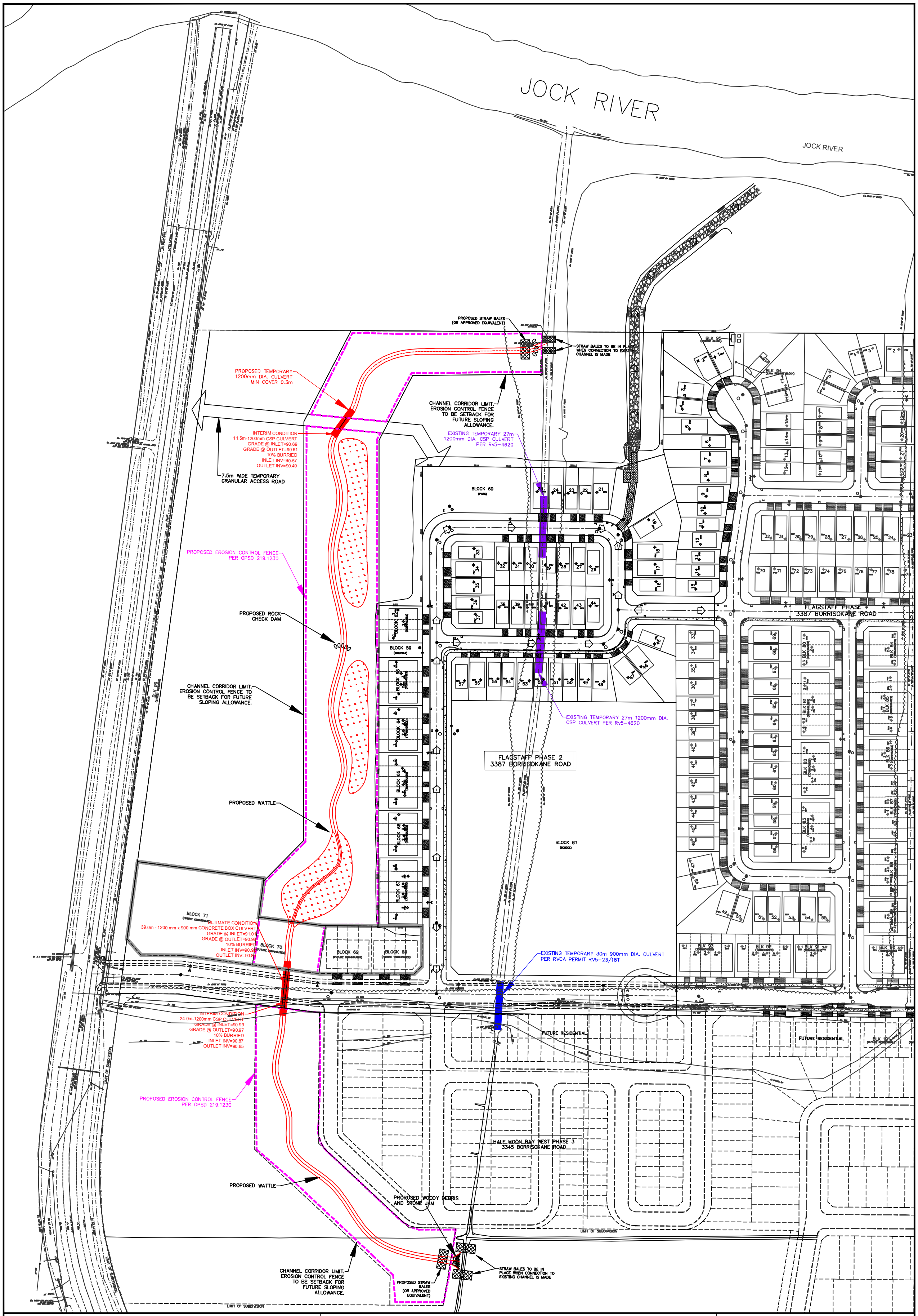
Attachment A

Natural Channel Corridor Drawing

(DSEL, April 2021)



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TEMP GRADING & EROSION SEDIMENT CONTROL FIGURE NATURAL CHANNEL CORRIDOR
3387 & 3345 BORRISOKANE ROAD

PROJECT No. :	15-809
SCALE:	1:1000
DATE:	APRIL 2021
DRAWING No.	FIG 1

w:\design\15809_glennview_borrisokane\preliminary\05_apr2121_channel-sketch\2021-04-13_809_channel_esc.dwg

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Attachment B

SCS Curve Number and Time to Peak Calculations

Table B-1: Calculation of SCS Curve Number (CN) and Modified Curve Number (CN*)

Ultimate Conditions Woodlot and Channel South of Flagstaff Drive (uWL)

Soil type (1)	Land Use (2)	% of the Study Area (2)	Drainage Type (1)	Soil Description (1)	Hydrologic Soil Group (3)	CN (4)
Muck	Woods	55%	Imperfect	Decomposed Organic Material	B	73
Kars	Woods	10%	Imperfect	Gravely Sandy Loam	B	73
Osgoode Loam	Meadow	35%	Imperfect	Loam and Clay Loam	BC	65
Total		**100%**				**70**
CN* (5)						**59**

Interim Conditions Woodlot and Channel South of Flagstaff Drive (iWL)

Soil type (1)	Land Use (2)	% of the Study Area (2)	Drainage Type (1)	Soil Description (1)	Hydrologic Soil Group (3)	CN (4)
Muck	Woods	50%	Imperfect	Decomposed Organic Material	B	73
Kars	Woods	10%	Imperfect	Gravely Sandy Loam	B	73
Osgoode Loam	Meadow	40%	Imperfect	Loam and Clay Loam	BC	65
Total		**100%**				**70**
CN* (5)						**58**

Proposed Conditions Channel North of Flagstaff Drive (pChan)

Soil type (1)	Land Use (2)	% of the Study Area (2)	Drainage Type (1)	Soil Description (1)	Hydrologic Soil Group (3)	CN (4)
Osgoode Loam	Meadow	100%	Imperfect	Loam and Clay Loam	BC	65
Total		**100%**				**65**
CN* (5)						**51**

Post-Development Park (pPK) and Rearyards (pRY)

Soil type (1)	Land Use (2)	% of the Study Area (2)	Drainage Type (1)	Soil Description (1)	Hydrologic Soil Group (3)	CN (4)
Top Soil	Urban Lawn	100%	Imperfect	Top Soil	C	79
Total		**100%**				**79**
CN* (5)						**71**

(1) As per *Ontario Soil Survey Map No. 7, Soils of the Carleton County.*

(2) As per Google Earth Satellite Imagery.

(3) As per November 1985 *Ministry of Transporation Drainage Manual,* Chart H2.

(4) As per *SWMHYMO User's Manual* , J.F. Sabourin and Associates Inc., May 2000. Assume soils in good/fair condition.

(5) As per *Runoff Curve Number Method: Examination of the Initial Abstraction Ratio* (Woodward et. al., 2003).

(6) Standard CN values for urban grassed area over top soil. Assume soils in fair conditions.

Table B-2: Calculation of Time to Peak

	UNITS	uWL	iWL	pChan
Area	(ha)	6.6	8.79	2.08
Hydrologic Soil Group (1)		B/BC	B/BC	BC
CN (1)		70	70	65
C (as per Rational Method)		0.25	0.25	0.25
Length of Channel (2)	(m)	480	540	460
Elevation of Channel Outlet (2)	(m)	90.99	90.99	90.17
Elevation of Channel Headwater (2)	(m)	92.75	93	90.97
Average Slope of Channel	(m/m)	0.0037	0.0037	0.0017
Time of Concentration Calculations (3)				
Kirpich	(min)	20	21	25
	(hrs)	0.33	0.36	0.42
FAA	(min)	85	89	106
	(hrs)	1.41	1.49	1.77
SCS	(min)	101	111	163
	(hrs)	1.68	1.85	2.72
Bransby Williams	(min)	28	30	35
	(hrs)	0.47	0.51	0.58
Time to Peak (=2/3 Tc) (3)				
Kirpich	(min)	13	14	17
FAA	(min)	57	60	71
SCS	(min)	67	74	109
Bransby Williams	(min)	19	20	23
Final (FAA)	**(h)**	**0.94**	**0.99**	**1.18**

(1) As per Table B-1 of Appendix B.

(2) As measured based on topographic data provided by DSEL and Google Earth.

(3) As per 1997 *Ministry of Transportation Drainage Management Manual,* Ch8.

Tc Equations applicability

Kirpich	Best for rural watersheds with slopes ranging from 3% to10%
FAA	Best for flat drainage areas (was developped for air field drainage) but used frequently for urban watershed
SCS	Best for Agricultural SW in general and urban SW < 2000 acres
BW	One of the best method for predicting Tc. Especially for good for small culvert design

	Tc Equations and inputs (imperial unless otherwise noted)	Result in	input L as
Kirpich	$Tc = 0.0078\ L^{0.77}\ S^{-0.385}$	(min)	(ft)
FAA	$Tc = (1.8(1.1\text{-}C)L^{0.50}) / (S^{0.333})$	(min)	(ft)
SCS Lag	$Tc = (100L^{0.8}((1000/CN)\text{-}9)^{0.7} / (1900\ S^{0.5})$	(min)	(ft)
BW (metric)	$Tc = (0.605L) / (S^{0.2}\ A^{0.1})$	(hrs)	(km)

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Attachment C

Summary of Continuous Surface Runoff Volumes

Table C-1: Continuous Flows in the Natural Channel Servicing Cambrian Woods (Interim Conditions)

Year	South of Flagstaff Drive				North of Flagstaff Drive			
	Area (ha)	Peak Flow (m^3/s)	R.V. (mm)	Volume (m^3)	Area (ha)	Peak Flow (m^3/s)	R.V. (mm)	Volume (m^3)
1967	9.02	0.063	57.92	5224	11.97	0.081	57.11	6836
1968	9.02	0.068	63.05	5687	11.97	0.095	62.19	7444
1969	9.02	0.064	45.35	4091	11.97	0.080	44.45	5320
1970	9.02	0.088	51.37	4634	11.97	0.115	50.50	6044
1971	9.02	0.061	46.25	4172	11.97	0.085	45.34	5427
1972	9.02	0.133	112.22	10123	11.97	0.170	111.86	13390
1973	9.02	0.105	81.03	7309	11.97	0.138	80.47	9632
1974	9.02	0.036	28.65	2584	11.97	0.051	27.64	3308
1975	9.02	0.065	54.30	4897	11.97	0.090	53.57	6412
1976	9.02	0.029	43.39	3914	11.97	0.038	42.31	5064
1977	9.02	0.065	56.75	5119	11.97	0.088	55.96	6699
1978	9.02	0.082	44.57	4020	11.97	0.112	43.72	5233
1979	9.02	0.116	100.26	9044	11.97	0.157	99.72	11937
1980	9.02	0.055	54.09	4879	11.97	0.073	53.59	6415
1981	9.02	0.310	148.72	13414	11.97	0.401	148.42	17766
1982	9.02	0.044	40.67	3668	11.97	0.058	39.69	4751
1983	9.02	0.055	50.60	4564	11.97	0.074	49.94	5978
1984	9.02	0.050	48.46	4371	11.97	0.064	47.70	5710
1985	9.02	0.033	41.66	3758	11.97	0.047	40.88	4893
1986	9.02	0.123	114.88	10362	11.97	0.162	114.65	13723
1987	9.02	0.083	65.97	5950	11.97	0.113	65.22	7807
1988	9.02	0.126	64.40	5809	11.97	0.173	63.69	7623
1989	9.02	0.042	43.84	3954	11.97	0.052	42.96	5142
1990	9.02	0.088	78.26	7059	11.97	0.116	77.73	9304
1991	9.02	0.053	47.79	4310	11.97	0.067	47.02	5629
1992	9.02	0.140	66.02	5955	11.97	0.185	65.21	7805
1993	9.02	0.014	41.25	3721	11.97	0.019	40.53	4851
1994	9.02	0.045	59.70	5385	11.97	0.060	58.98	7060
1995	9.02	0.166	54.28	4896	11.97	0.217	53.16	6363
1996	9.02	0.047	40.19	3625	11.97	0.065	39.47	4725
1997	9.02	0.012	28.19	2543	11.97	0.018	27.22	3258
1998	9.02	0.032	41.02	3700	11.97	0.042	40.20	4812
1999	9.02	0.046	55.31	4989	11.97	0.062	54.54	6529
2000	9.02	0.099	57.42	5179	11.97	0.129	56.97	6819
2002	9.02	0.297	98.22	8859	11.97	0.359	97.63	11687
2003	9.02	0.068	74.04	6678	11.97	0.090	73.44	8791
Average		0.083	61.11	5512		0.110	60.38	7227
Minimum		0.012	28.19	2543		0.018	27.22	3258
Maximum		0.310	148.72	13414		0.401	148.42	17766

Notes: Based on a simulation period from April 1st to October 31st. Rainfall data missing from AES file for 2001.

Table C-2: Continuous Flows in the Natural Channel Servicing Cambrian Woods (Ultimate Conditions)

Year	South of Flagstaff Drive				North of Flagstaff Drive			
	Area (ha)	Peak Flow (m^3/s)	R.V. (mm)	Volume (m^3)	Area (ha)	Peak Flow (m^3/s)	R.V. (mm)	Volume (m^3)
1967	6.83	0.051	59.38	4055	9.78	0.070	57.95	5667
1968	6.83	0.055	64.97	4437	9.78	0.090	63.34	6194
1969	6.83	0.053	46.62	3184	9.78	0.072	45.13	4414
1970	6.83	0.071	52.89	3612	9.78	0.109	51.36	5023
1971	6.83	0.049	47.62	3252	9.78	0.074	46.09	4507
1972	6.83	0.108	115.57	7893	9.78	0.154	114.11	11160
1973	6.83	0.086	83.52	5704	9.78	0.127	82.07	8027
1974	6.83	0.030	29.32	2003	9.78	0.045	27.88	2727
1975	6.83	0.052	55.84	3814	9.78	0.080	54.48	5328
1976	6.83	0.023	44.60	3046	9.78	0.032	42.90	4196
1977	6.83	0.053	58.54	3998	9.78	0.081	57.04	5579
1978	6.83	0.066	46.00	3142	9.78	0.106	44.53	4355
1979	6.83	0.095	103.22	7050	9.78	0.148	101.66	9943
1980	6.83	0.044	55.84	3814	9.78	0.062	54.70	5350
1981	6.83	0.245	152.66	10427	9.78	0.336	151.11	14779
1982	6.83	0.035	41.91	2862	9.78	0.050	40.34	3945
1983	6.83	0.044	52.17	3563	9.78	0.062	50.89	4977
1984	6.83	0.041	49.76	3398	9.78	0.054	48.44	4737
1985	6.83	0.027	42.97	2935	9.78	0.042	41.62	4070
1986	6.83	0.097	118.41	8087	9.78	0.138	117.06	11448
1987	6.83	0.067	67.91	4638	9.78	0.101	66.41	6495
1988	6.83	0.101	66.38	4533	9.78	0.150	64.91	6348
1989	6.83	0.034	45.13	3082	9.78	0.047	43.67	4271
1990	6.83	0.070	80.66	5509	9.78	0.097	79.29	7754
1991	6.83	0.043	49.25	3364	9.78	0.058	47.87	4682
1992	6.83	0.112	67.96	4642	9.78	0.157	66.39	6493
1993	6.83	0.011	42.73	2919	9.78	0.016	41.40	4049
1994	6.83	0.036	61.53	4202	9.78	0.052	60.10	5877
1995	6.83	0.130	55.23	3772	9.78	0.184	53.58	5240
1996	6.83	0.038	41.40	2828	9.78	0.056	40.16	3928
1997	6.83	0.010	28.93	1976	9.78	0.016	27.52	2691
1998	6.83	0.026	42.26	2886	9.78	0.037	40.89	3999
1999	6.83	0.037	56.83	3882	9.78	0.053	55.44	5422
2000	6.83	0.079	59.24	4046	9.78	0.114	58.13	5685
2002	6.83	0.240	100.94	6894	9.78	0.329	99.40	9721
2003	6.83	0.055	76.30	5211	9.78	0.081	74.88	7323
Average		0.067	62.90	4296		0.097	61.46	6011
Minimum		0.010	28.93	1976		0.016	27.52	2691
Maximum		0.245	152.66	10427		0.336	151.11	14779

Notes: Based on a simulation period from April 1st to October 31st. Rainfall data missing from AES file for 2001.

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Attachment D

Hy-8 Culvert Analysis Report

Phase 2 of the Flagstaff Subdivision / Cambrian Woods Natural Channel Design
September 2021

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 1 - Summary of Culvert Flows at Crossing: Borris

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Culvert 1 Discharge (cms)	Roadway Discharge (cms)	Iterations
91.77	2YrSCS24Hr	0.11	0.11	0.00	1
91.87	5YrSCS24Hr	0.18	0.18	0.00	1
91.94	10YrSCS24Hr	0.23	0.23	0.00	1
92.02	25YrSCS24Hr	0.29	0.29	0.00	1
92.09	50YrSCS24Hr	0.34	0.34	0.00	1
92.17	100YrSCS24Hr	0.39	0.39	0.00	1
92.25	Overtopping	0.43	0.43	0.00	Overtopping

Rating Curve Plot for Crossing: Borris

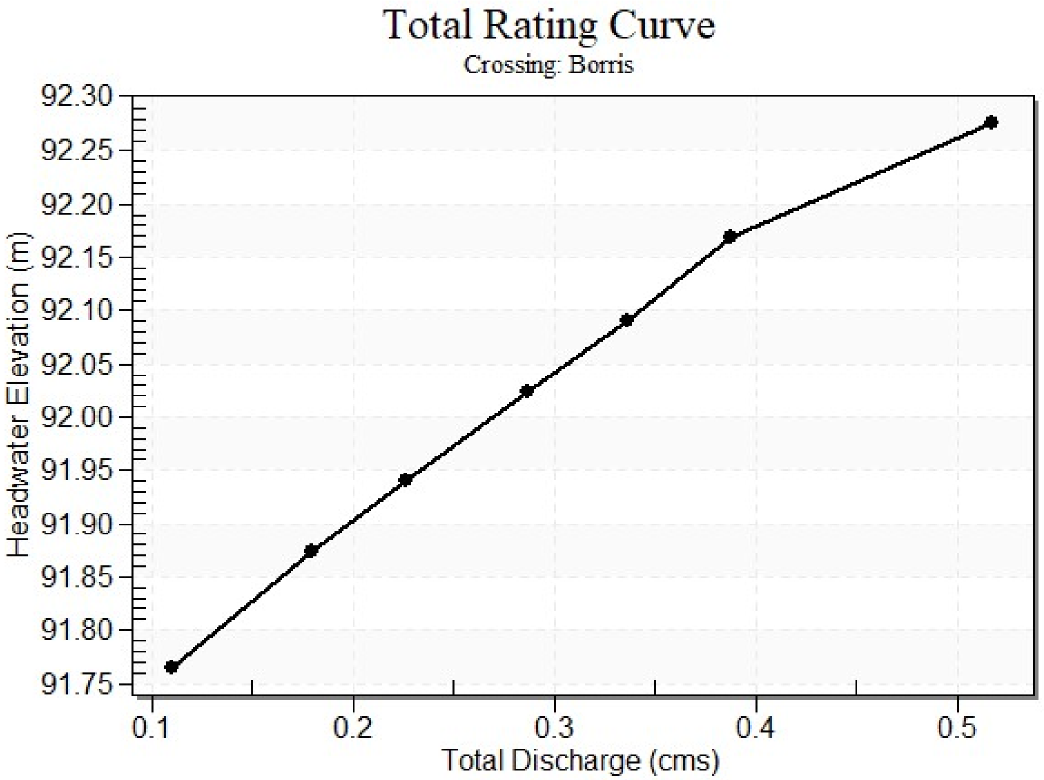
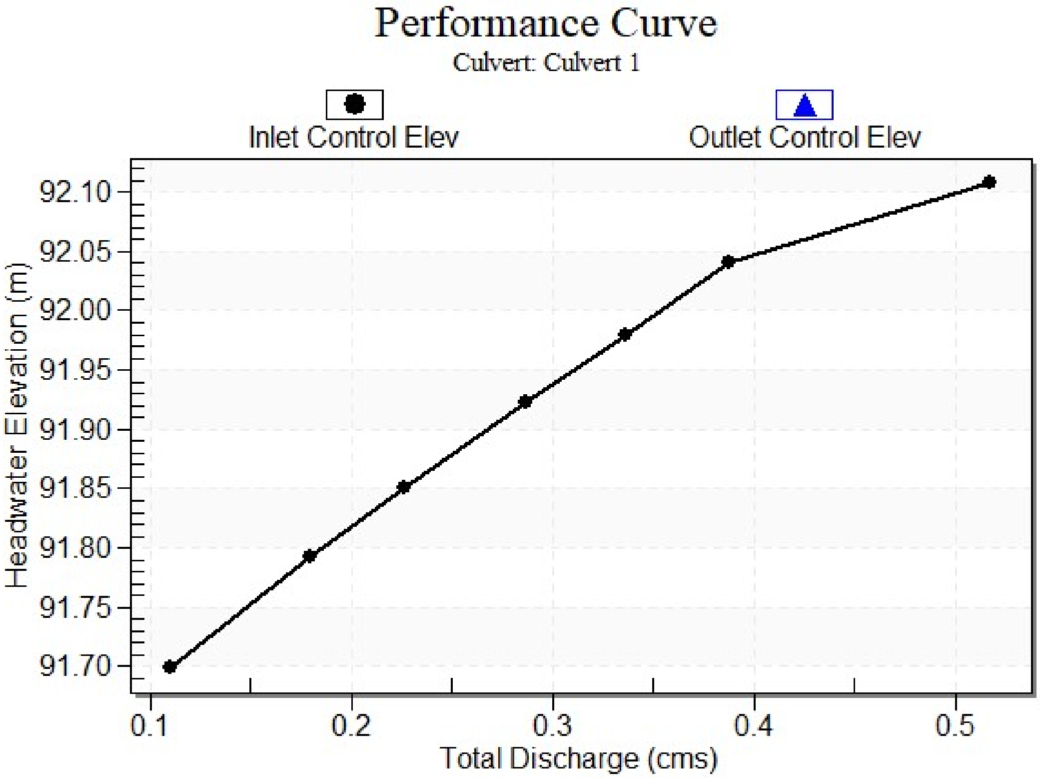


Table 2 - Culvert Summary Table: Culvert 1

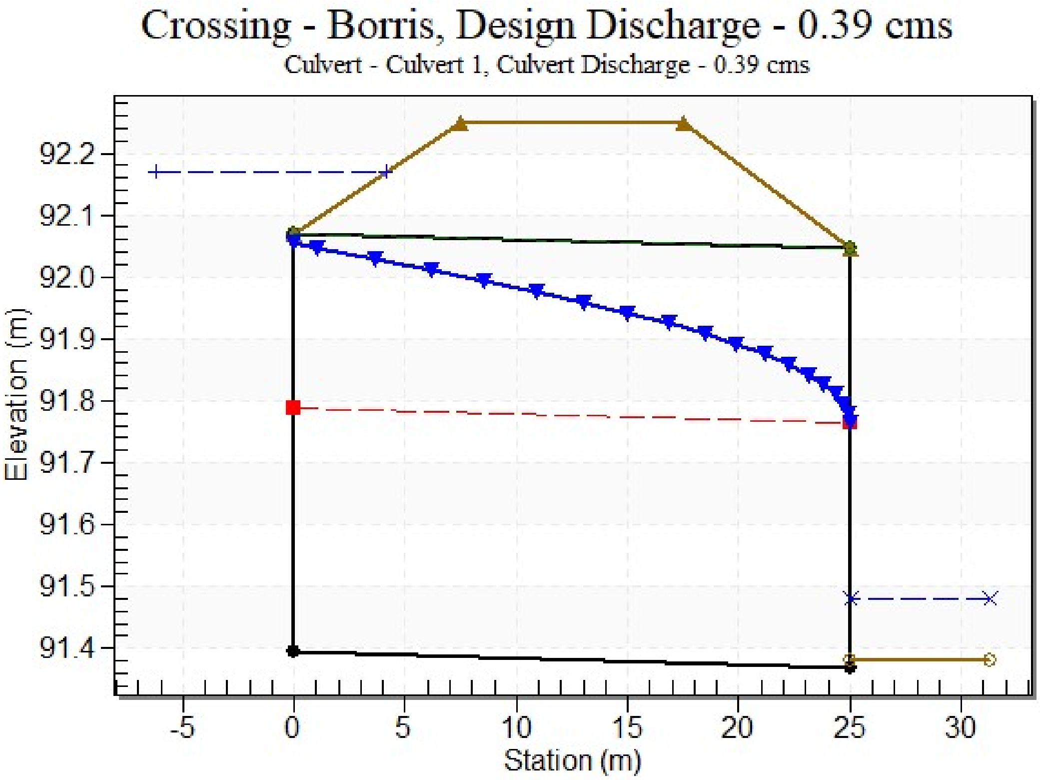
Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)
2YrSCS24Hr	0.11	0.11	91.77	0.304	0.370	2-M2c	0.441	0.204	0.204	0.068	1.203
5YrSCS24Hr	0.18	0.18	91.87	0.397	0.479	2-M2c	0.675	0.263	0.263	0.085	1.387
10YrSCS24Hr	0.23	0.23	91.94	0.455	0.545	2-M2c	0.675	0.297	0.297	0.094	1.490
25YrSCS24Hr	0.29	0.29	92.02	0.527	0.628	2-M2c	0.675	0.337	0.337	0.105	1.610
50YrSCS24Hr	0.34	0.34	92.09	0.584	0.696	7-M2c	0.675	0.365	0.365	0.113	1.699
100YrSCS24Hr	0.39	0.39	92.17	0.645	0.774	7-M2c	0.675	0.394	0.394	0.121	1.789

```
*******************************************************************************
                               Straight Culvert
   Inlet Elevation (invert): 91.39 m,    Outlet Elevation (invert): 91.37 m
               Culvert Length: 25.00 m,    Culvert Slope: 0.0010
*******************************************************************************
```

Culvert Performance Curve Plot: Culvert 1



Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 91.39 m

Outlet Station: 25.00 m

Outlet Elevation: 91.37 m

Number of Barrels: 1

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 675.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Borris)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
0.11	91.44	0.06	0.32	5.66	0.53
0.18	91.45	0.07	0.38	6.98	0.55
0.23	91.46	0.08	0.42	7.72	0.57
0.29	91.47	0.09	0.45	8.58	0.59
0.34	91.47	0.09	0.48	9.21	0.62
0.39	91.48	0.10	0.49	9.84	0.64

Tailwater Channel Data - Borris

Tailwater Channel Option: Irregular Channel

Roadway Data for Crossing: Borris

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 92.25 m

Roadway Surface: Paved

Roadway Top Width: 10.00 m

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 4 - Summary of Culvert Flows at Crossing: Interim Flagstaff Drive

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Interim Flagstaff Drive Discharge (cms)	Roadway Discharge (cms)	Iterations
91.78	2-Year	0.06	0.06	0.00	1
91.80	100-Year	0.26	0.26	0.00	1
93.33	Overtopping	2.64	2.64	0.00	Overtopping

Rating Curve Plot for Crossing: Interim Flagstaff Drive

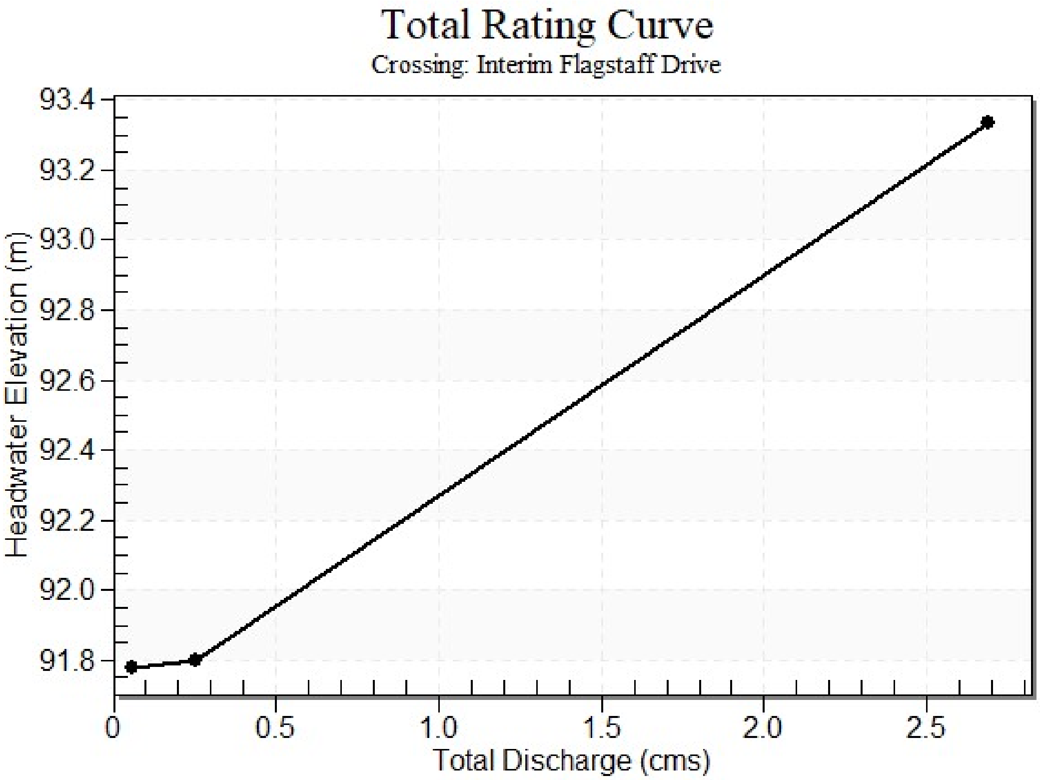
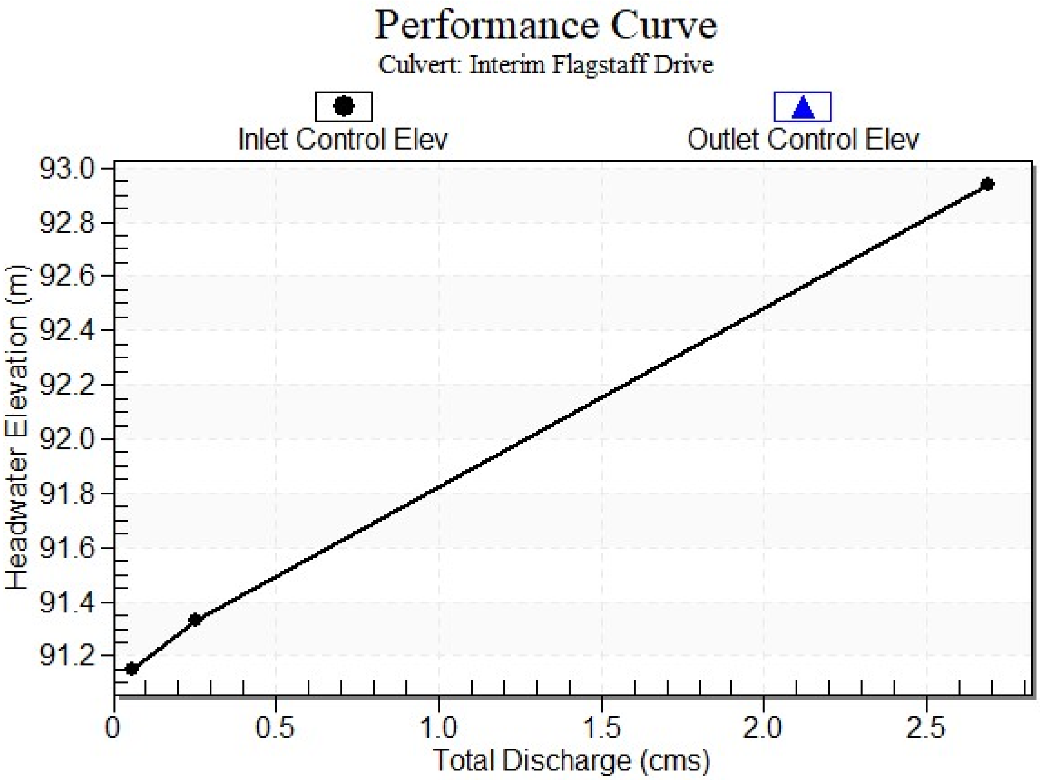


Table 5 - Culvert Summary Table: Interim Flagstaff Drive

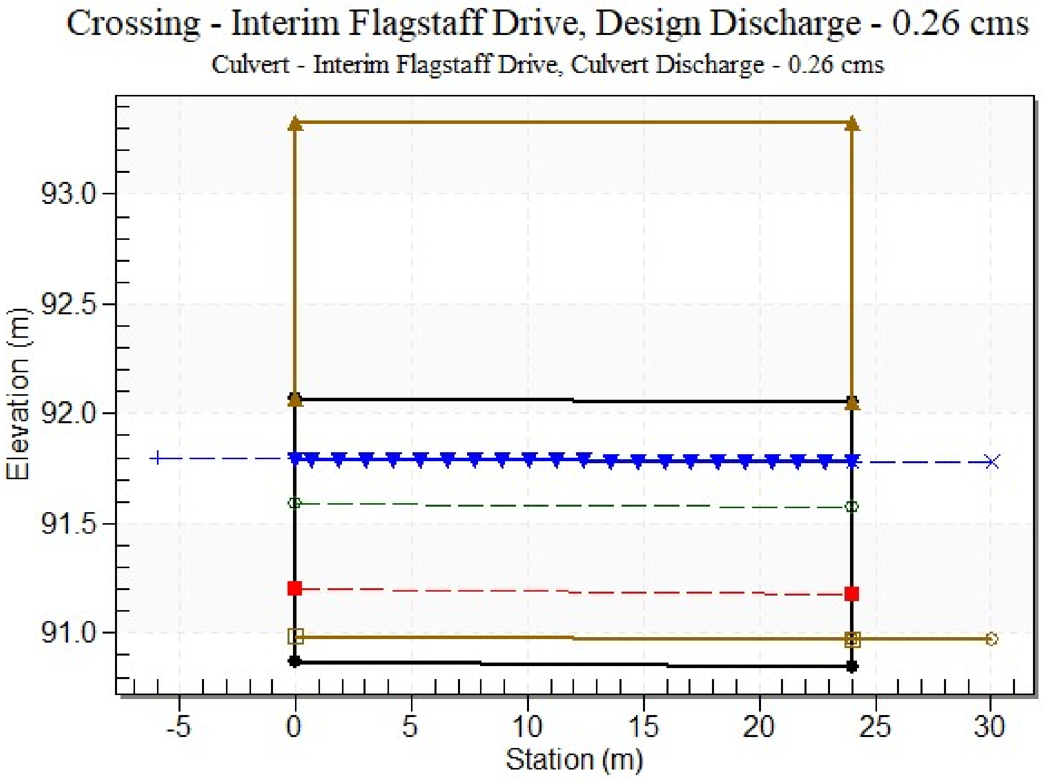
Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)
2-Year	0.06	0.06	91.78	0.158	0.791	3-M1t	0.243	0.084	0.810	0.810	0.066
100-Year	0.26	0.26	91.80	0.338	0.808	3-M1t	0.601	0.210	0.810	0.810	0.292

```
********************************************************************************
                              Straight Culvert
  Inlet Elevation (invert): 90.99 m,    Outlet Elevation (invert): 90.97 m
           Culvert Length: 24.00 m,    Culvert Slope: 0.0008
********************************************************************************
```

Culvert Performance Curve Plot: Interim Flagstaff Drive



Water Surface Profile Plot for Culvert: Interim Flagstaff Drive



Site Data - Interim Flagstaff Drive

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 90.87 m

Outlet Station: 24.00 m

Outlet Elevation: 90.85 m

Number of Barrels: 1

Culvert Data Summary - Interim Flagstaff Drive

Barrel Shape: Circular

Barrel Diameter: 1200.00 mm

Barrel Material: Corrugated Steel

Embedment: 120.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 6 - Downstream Channel Rating Curve (Crossing: Interim Flagstaff Drive)

Flow (cms)	Water Surface Elev (m)	Depth (m)
0.06	91.78	0.81
0.26	91.78	0.81

Tailwater Channel Data - Interim Flagstaff Drive

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 91.78 m

Roadway Data for Crossing: Interim Flagstaff Drive

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 m

Crest Elevation: 93.33 m

Roadway Surface: Paved

Roadway Top Width: 24.00 m

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 7 - Summary of Culvert Flows at Crossing: Interim Access Road

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Interim Access Road Discharge (cms)	Roadway Discharge (cms)	Iterations
91.78	2-Year	0.07	0.07	0.00	1
91.80	100-Year	0.31	0.31	0.00	1
92.07	Overtopping	1.38	1.38	0.00	Overtopping

Rating Curve Plot for Crossing: Interim Access Road

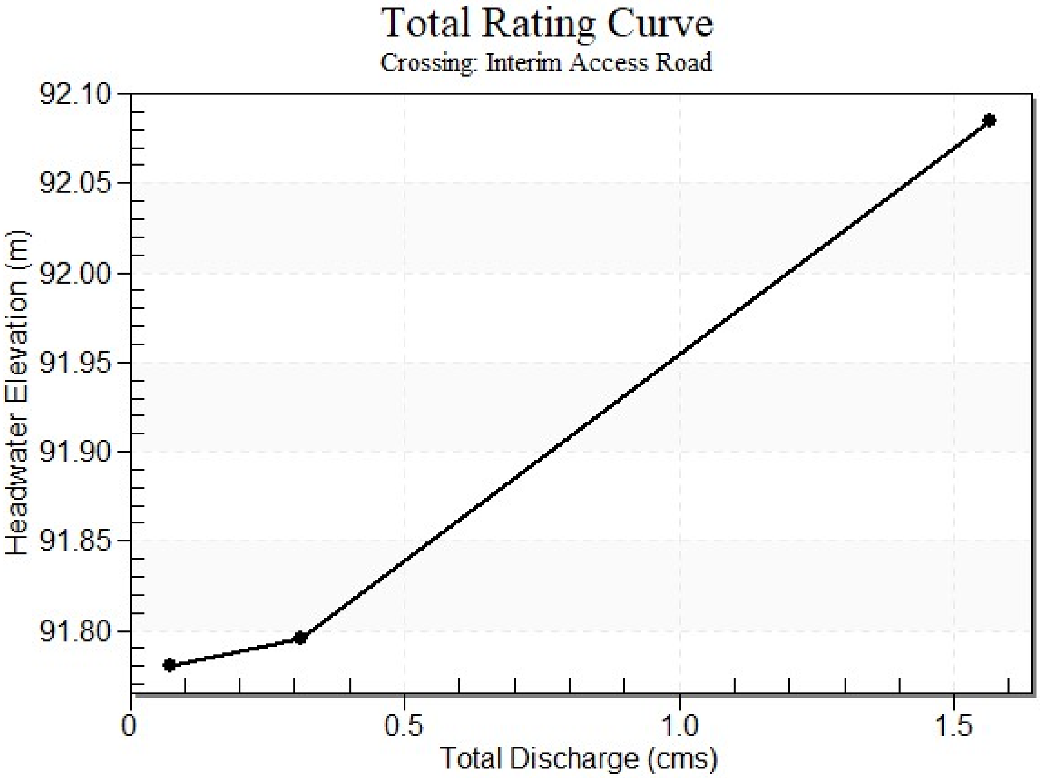
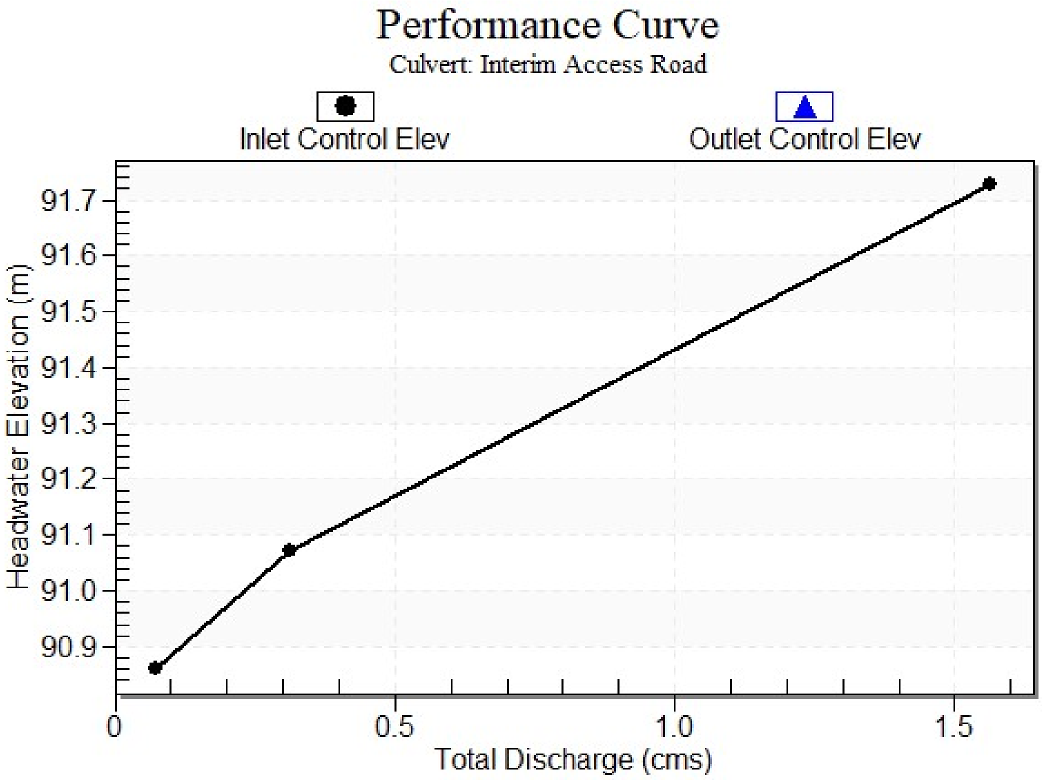


Table 8 - Culvert Summary Table: Interim Access Road

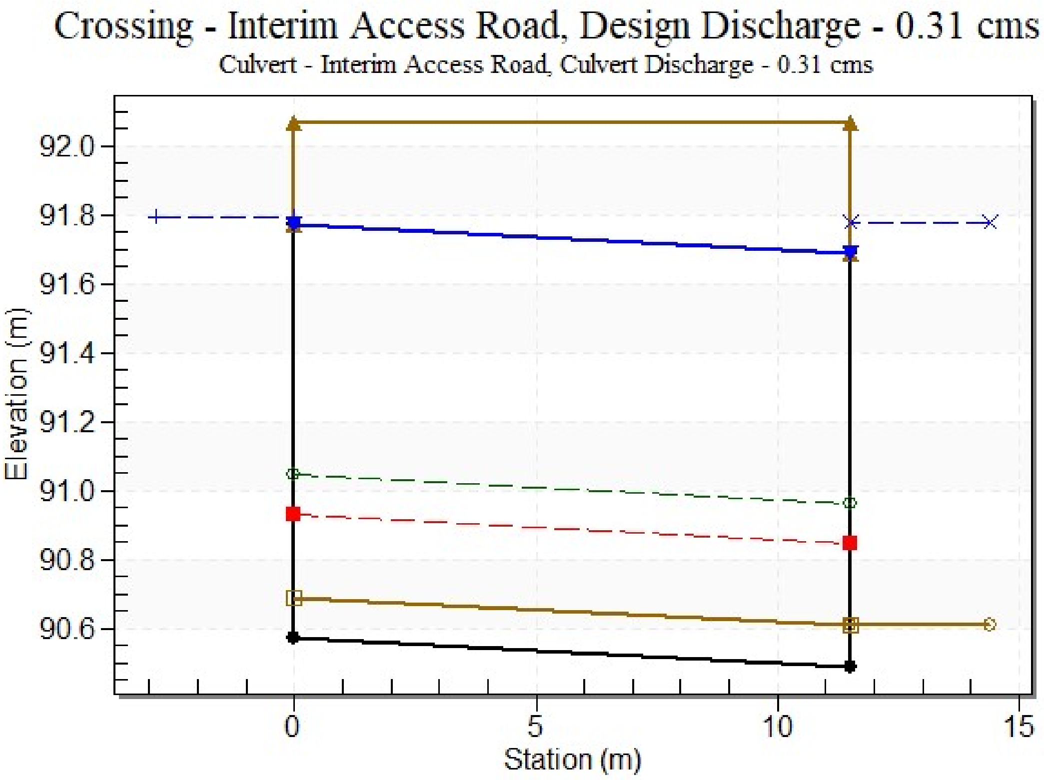
Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)
2-Year	0.07	0.07	91.78	0.170	1.091	4-FFf	0.149	0.098	1.080	1.170	0.068
100-Year	0.31	0.31	91.80	0.380	1.105	4-FFf	0.353	0.238	1.080	1.170	0.294

```
********************************************************************************
                              Straight Culvert
   Inlet Elevation (invert): 90.69 m,    Outlet Elevation (invert): 90.61 m
              Culvert Length: 11.50 m,    Culvert Slope: 0.0070
********************************************************************************
```

Culvert Performance Curve Plot: Interim Access Road



Water Surface Profile Plot for Culvert: Interim Access Road



Site Data - Interim Access Road

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 90.57 m

Outlet Station: 11.50 m

Outlet Elevation: 90.49 m

Number of Barrels: 1

Culvert Data Summary - Interim Access Road

Barrel Shape: Circular

Barrel Diameter: 1200.00 mm

Barrel Material: Corrugated Steel

Embedment: 120.00 mm

Barrel Manning's n: 0.0240 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 9 - Downstream Channel Rating Curve (Crossing: Interim Access Road)

Flow (cms)	Water Surface Elev (m)	Depth (m)
0.07	91.78	1.17
0.31	91.78	1.17

Tailwater Channel Data - Interim Access Road

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 91.78 m

Roadway Data for Crossing: Interim Access Road

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 47.00 m

Crest Elevation: 92.07 m

Roadway Surface: Paved

Roadway Top Width: 11.50 m

Crossing Discharge Data

Discharge Selection Method: User Defined

Table 10 - Summary of Culvert Flows at Crossing: Ultimate Flagstaff

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Ultimate Flagstaff Drive Discharge (cms)	Roadway Discharge (cms)	Iterations
91.78	2-Year	0.05	0.05	0.00	1
91.79	100-Year	0.21	0.21	0.00	1
93.33	Overtopping	2.65	2.65	0.00	Overtopping

Rating Curve Plot for Crossing: Ultimate Flagstaff Drive-UpdateSept2021

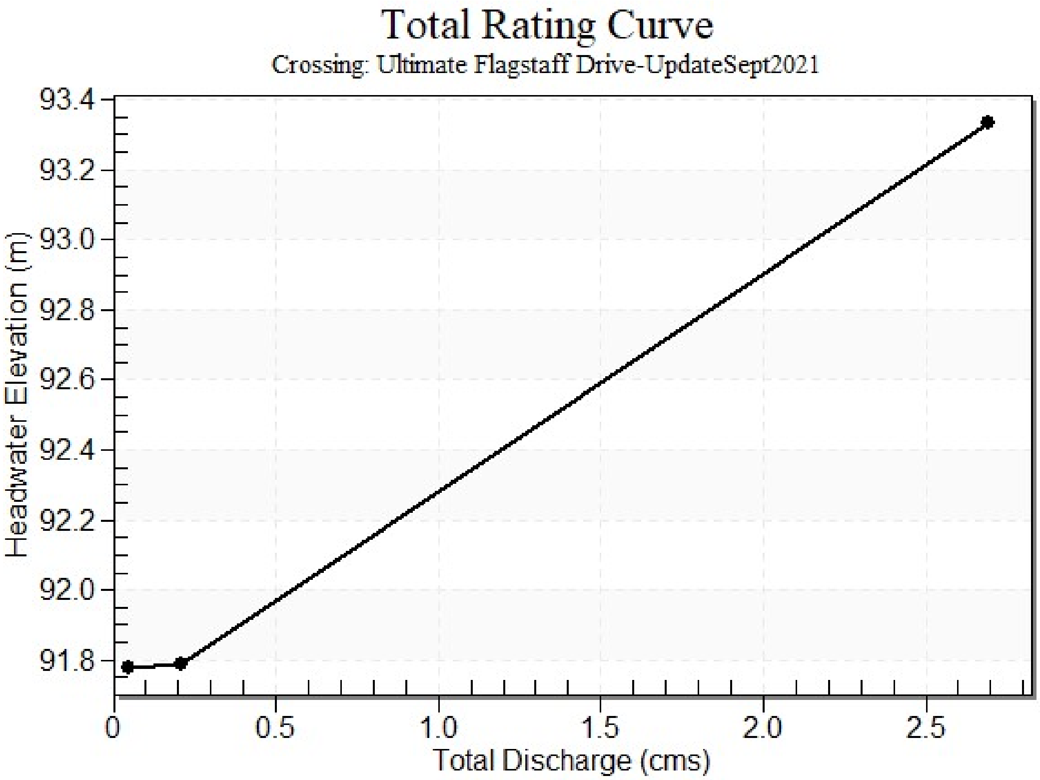
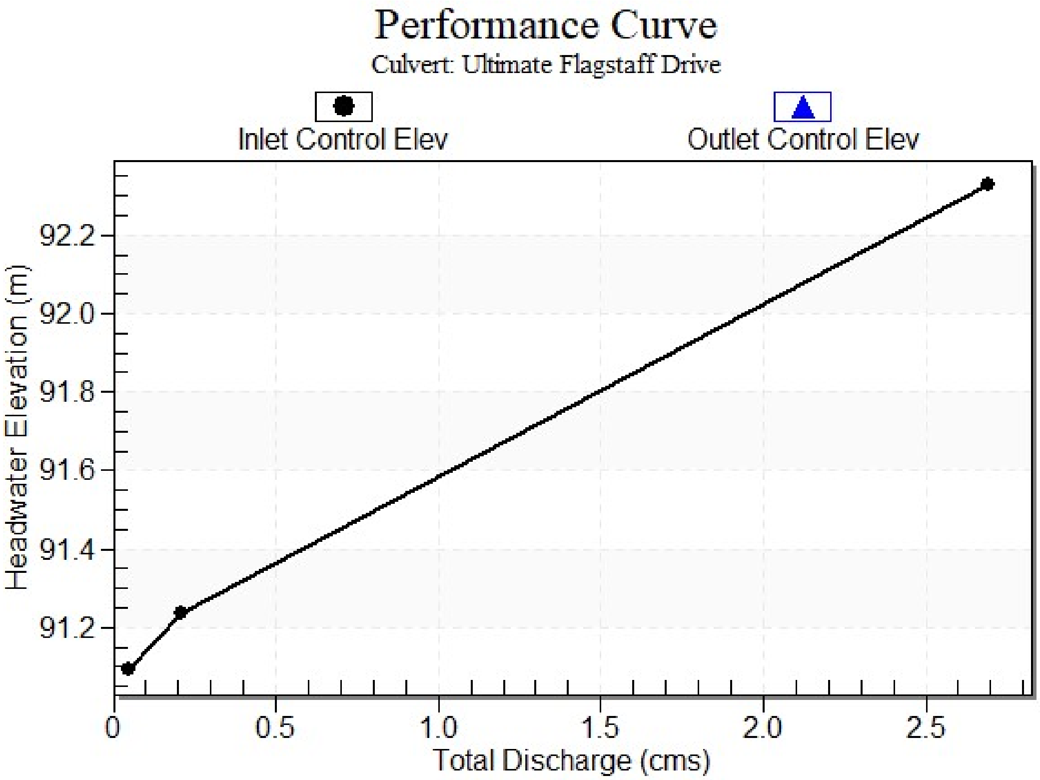


Table 11 - Culvert Summary Table: Ultimate Flagstaff Drive

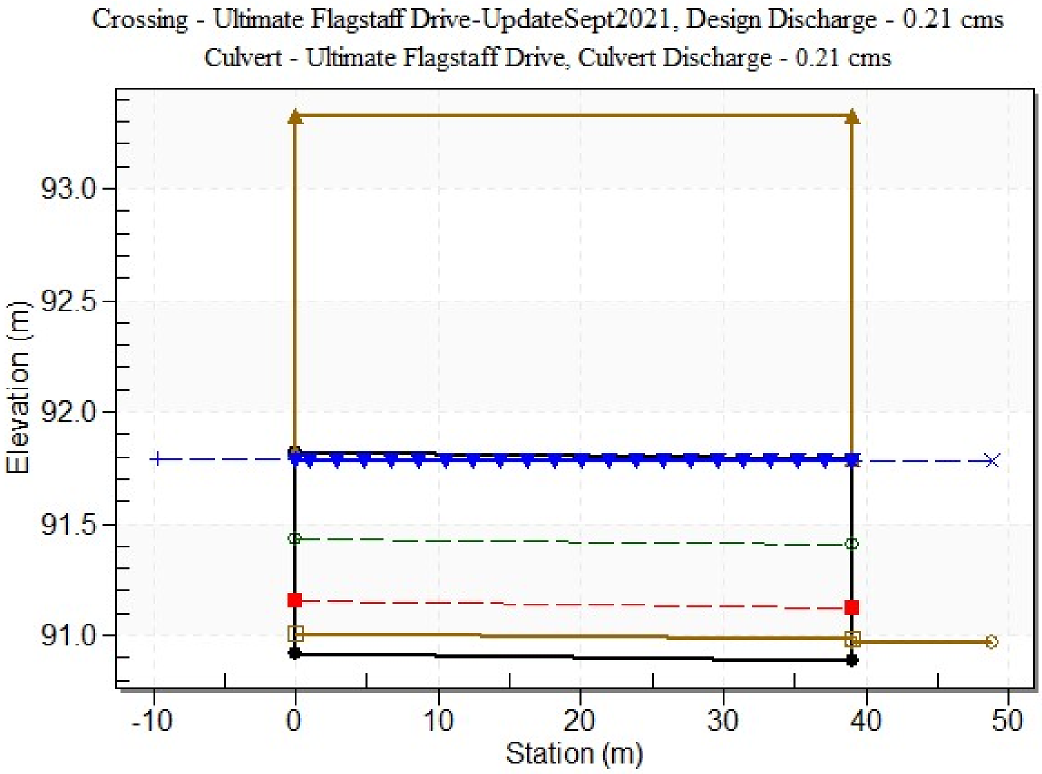
Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)
2-Year	0.05	0.05	91.78	0.082	0.770	3-M1t	0.168	0.054	0.800	0.810	0.049
100-Year	0.21	0.21	91.79	0.226	0.777	3-M1t	0.425	0.145	0.800	0.810	0.216

```
********************************************************************************
                              Straight Culvert
   Inlet Elevation (invert): 91.01 m,    Outlet Elevation (invert): 90.98 m
              Culvert Length: 39.00 m,    Culvert Slope: 0.0008
********************************************************************************
```

Culvert Performance Curve Plot: Ultimate Flagstaff Drive



Water Surface Profile Plot for Culvert: Ultimate Flagstaff Drive



Site Data - Ultimate Flagstaff Drive

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 90.92 m

Outlet Station: 39.00 m

Outlet Elevation: 90.89 m

Number of Barrels: 1

Culvert Data Summary - Ultimate Flagstaff Drive

Barrel Shape: Concrete Box

Barrel Span: 1200.00 mm

Barrel Rise: 900.00 mm

Barrel Material: Concrete

Embedment: 90.00 mm

Barrel Manning's n: 0.0130 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: 1.5:1 Bevel (90º) Headwall

Inlet Depression: None

Table 12 - Downstream Channel Rating Curve (Crossing: Ultimate Flagstaff Drive-

Flow (cms)	Water Surface Elev (m)	Depth (m)
0.05	91.78	0.81
0.21	91.78	0.81

Tailwater Channel Data - Ultimate Flagstaff Drive-UpdateSept2021

Tailwater Channel Option: Enter Constant Tailwater Elevation

Constant Tailwater Elevation: 91.78 m

Roadway Data for Crossing: Ultimate Flagstaff Drive-UpdateSept2021

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 40.00 m

Crest Elevation: 93.33 m

Roadway Surface: Paved

Roadway Top Width: 39.00 m

patersongroup
consulting engineers

memorandum

re: **Geotechnical Recommendations - Frost Protection Recommendations for Natural Channel Crossings**
Proposed Residential Development - Half Moon Bay West - Phase 3
Cambrian Road - Ottawa

to: Mattamy Homes - **Mr. Reuben Noel** - reuben.noel@mattamycorp.com

cc: DSEL - **Ms. Jennifer Ailey** - JAiley@dsel.ca

date: November 8, 2021

file: PG2246-MEMO.71 Revision 1

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to provide geotechnical recommendations in consideration of the service alignments anticipated to cross below the future natural channel to be located in Phase 3 of the subject site. This memorandum should be read in conjunction with Paterson Report PG2246-1 Revision 7 dated April 19, 2021.

Background Information

The following site servicing drawings prepared by David Schaeffer Engineering Ltd. (DSEL) for Phase 3 of the aforementioned development were reviewed for this memorandum:

- ☐ Plan and Profile of Flagstaff Drive - Half Moon Bay West Phase 3 - Project No. 19-1140 - Sheet No. 15, Revision 2 dated August 31, 2021
- ☐ Cross Section - Half Moon Bay West Phase 2 - Project 19-1140 - Sheet No. 21, Revision 2 dated August 31, 2021

It is understood a 1,200 x 900 mm concrete box culvert crosses below and across Flagstaff Drive and two service alignments consisting of 300 mm diameter PVC watermain and sanitary services.

Geotechnical Recommendations - Service Crossings

Considering both ends of the concrete culvert will be open to ambient temperatures, insufficient soil cover is in place above the crossing watermain and sanitary pipes to provide adequate protection against frost action.

Prior to carrying out the work throughout the area of the pipe crossings, water influx from the future channel should be controlled so that the servicing operations can be conducted “in the dry”. Based on the existing test hole coverage, the pipe crossings will be carried out within a deposit of stiff to firm brown silty clay.

This clay deposit is considered to be of very low permeability, such that it is anticipated that pumping from open excavations will be sufficient to control the minimal groundwater influx throughout the work area. However, due to the overlying permeable layer of sand, the contractor should be prepared for potentially initially moderate influx due to excavations crossing below the permeable sand layer. The contractor should be prepared to direct surface water away from subgrade areas during the construction process.

Protection Against Frost Action

Based on our review, insufficient soil cover is provided to the sanitary service pipe crossings for protection against frost action. It is recommended to insulate above the pipe cover layer for both pipes using the methodology provided in Table 1. It should be noted that the insulation should extend a minimum of 2.0 m beyond the footprint of the culvert crossing and top of the banks for the proposed natural channel along the sanitary pipe.

The recommended City of Ottawa frost protection detail *"Thermal Insulation for Storm and Sanitary Sewer/Services in Shallow Trenches*" is considered acceptable to provide adequate frost protection. However, it should be noted that installing vertical rigid insulation within an excavated trench can be difficult to implement in an efficient manner without introducing gaps which may reduce the effectiveness to protect against the detrimental effects of frost to the underlying service pipe.

The following frost protection criteria outlined in Table 1 below should be followed in lieu of the City of Ottawa standard details with additional recommendations provided for each section below:

Table 1 - Rigid Insulation Recommendations for Sewer Pipes with Reduced Soil Cover

Thermal Condition	Soil Cover Provided D (mm)	Insulation Dimensions (mm)	
		t (thickness)	L (extension)
Unheated	Less than 250	Not Recommended	
	250 to 500	150	Extend 1,200 mm horizontally beyond edge face of the sewer
	500 to 750	100	Extend 1,200 mm horizontally beyond edge face of the sewer
	750 to 1,100	75	Extend 900 mm horizontally beyond edge face of the sewer
	1,100 to 1,700	50	Extend 600 mm horizontally beyond edge face of the sewer
	1,700 to 2,000	25	Extend 300 mm horizontally beyond edge face of the sewer

Notes:	All designs are based on a freezing index of 1000°C-days.

All rigid insulation should consist of either DOW Chemical High-Load 40 (HI-40) or Owens Corning Canada Foamular 400 XPS-type rigid insulation. All rigid insulation placed to improve the frost protection of the above-noted service alignments should be inspected and approved by the geotechnical consultant at the time of construction.

Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer pipes. The bedding layer should be increased to a minimum of 300 mm where the subgrade consists of a grey silty clay. The alignment of the service pipes located over the culvert structure will require a non-woven geotextile, such as Terrafix 270 or equivalent and biaxial geogrid bedding, such as Geosynthetics TBX2500 or equivalent, to be placed over the top of the culvert structure to permit adequate compaction of the granular bedding. Alternatively, if adequate compaction of the granular bedding layer cannot be obtained, then a lean concrete bedding layer can be provided for the overlying service pipes where the storm culvert crossing occurs. The granular bedding material should extend to the spring line of the pipe. For Cover material, extending from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 99% of the material’s standard Proctor maximum dry density.

Temporary Excavation Side Slopes for Pipe Crossings

The excavations for the proposed pipe crossings will be mostly through a stiff silty clay. Where excavations are above the groundwater level to a depth of approximately 3 m, the excavation side slopes should be stable in the short term at 1H:1V. Flatter slopes could be required for deeper excavations or for excavation below the groundwater level. Where such side slopes are not permissible or practical, temporary shoring should be used. The subsoil at this site is considered to be mainly a Type 2 or 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

It is expected that deep service trenches in excess of 3 m will be completed using a temporary shoring system designed by a structural engineer, such as stacked trench boxes in conjunction with steel plates. The trench boxes should be installed to ensure that the excavation sidewalls are tight to the outside of the trench boxes and that the steel plates are extended below the base of the excavation to prevent basal heave (if required).

It is recommended to reinstate sidewall banks below the culvert crossing using an engineered fill, such as OPSS Granular A or OPSS Granular B Type II crushed stone if a shoring system will not be used. This sidewall reinstatement fill should placed in maximum 300 mm thick loose lifts and compacted to a minimum of 99% of the materials SPMDD.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

We trust that this information satisfies your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Nov 9-2021
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Drew Petahtegoose, B.Eng.

David J. Gilbert, P.Eng.

APPENDIX F

SUMP PUMP FEASIBILITY REPORT, HALF MOON BAY RESIDENTIAL DEVELOPMENT, PG4073-LET.02, REVISION 6
(PATERSON GROUP, AUGUST 25, 2021)

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August 25, 2021
File: PG4073-LET.02 Revision 6

Mattamy Homes
50 Hines Road, Suite 100
Ottawa, Ontario
K2K 2M5

Attention: **Mr. Colin Haskin**

Subject: **Sump Pump Feasibility Report**
Half Moon Bay West Residential Development
Ottawa, Ontario

Dear Sir,

Paterson Group Inc. (Paterson) has prepared the following letter to detail the results of our groundwater monitoring program and provide design recommendations to ensure the current phase of the development meets the City of Ottawa criteria within the technical bulletin for sump pump systems for residential developments. The current report has been updated to include responses to recent City comments prepared for Phase 3 of Half Moon Bay West. Our responses to the comments have been highlighted throughout the report. It should be noted that the investigation coverage area discussed in the current revision of this report includes the current development phase (Phase 3).

The proposed groundwater monitoring program within the developed area was recommended to provide information on the effect that development has on groundwater levels within a former agricultural field over a low permeability soil, such as a deep silty clay deposit. The results of the monitoring program within the developed area will be compared to the pre-construction area within Half Moon Bay West, which is located within the adjacent agricultural field and over the same deep silty clay deposit to provide a more detailed analysis on the loss of the shallow perched water typically observed within agricultural fields over low permeability soils.

Paterson also completed a supplemental soil review consisting of a series of sieve and hydrometer tests on selected soil samples from within the 1.5 m interval below design underside of footing elevation to provide supplemental information regarding the anticipated soil profile. The results of our sieve and hydrometer testing are attached to the present letter report. For additional details regarding soil profiles encountered within the proposed Half Moon Bay West development, reference should be made to our geotechnical investigation report presented under cover Report PG2246-1 Revision 4 dated November 7, 2017. Falling head (slug) testing was also completed at the recently installed monitoring wells as part of our groundwater monitoring program to determine hydraulic conductivity at a 150 m grid spacing as per City recommendations.

1.0 Groundwater Monitoring Program

The groundwater monitoring wells installed for the monitoring program within the future development of Half Moon Bay West were completed by a licensed well contractor under the supervision of Paterson personnel in April 2017 and July 2018. At that time, the well contractor installed two (2) groundwater monitoring wells at each of the ten (10) well cluster locations (MW 1 to MW 10) and an additional 10 well locations (MW 17 to 24). The monitoring wells were constructed in accordance with design recommendations from City of Ottawa staff. Refer to the attached figures entitled Monitoring Well Details attached for specific details of the monitoring well construction. The monitoring well locations within Half Moon Bay West are presented in Drawing PG4073-1 - Test Hole Location Plan attached. Based on the results of the additional boreholes completed to meet City of Ottawa borehole spacing guidelines, the native silty clay soils within the study area are considered to be laterally continuous. A total of 93 boreholes were completed across the subject site and a silty clay deposit was identified at each borehole location at similar elevations across the subject site. Therefore, the silty clay deposit is considered to be laterally continuous across the proposed Half Moon Bay West development.

Paterson personnel completed the initial groundwater readings at MW 1 to MW 10 on April 27, 2017, at which time continuous groundwater data loggers were installed at each of the monitoring well locations. The data from the data loggers are presented in Figures 13 to 22 from MW 1 to MW 10.

Six monitoring well clusters (MW 11 to MW 16) were also installed within the developed portion of the Half Moon Bay development. Details of the monitoring well construction are presented in the Monitoring Well Details attached. The monitoring well locations within the developed area are presented in Drawing PG4073-1 - Temporary Monitoring Well Location Plan.

Groundwater data loggers were also installed at MW 11 and MW 12 within the developed areas. The recorded data from November 2017 to present is detailed in Figures 24 and 25.

Falling Head (Slug) testing was completed at well locations within the pre-developed area (MW3A, MW6A, MW7A, MW7B, MW8A, MW9A, MW9B and MW10A) on April 19 and 20, 2018, (MW 1A, MW2A, MW2B, MW3A, MW4A, MW5A and MW5B) on June 21, 2018 and (MW17A, MW18B, MW19A, MW20A, MW20B, MW21A, MW22A, MW22B and MW23A) on July 11, 2018. Based on our testing results within the pre-developed area, a horizontal hydraulic conductivity varying between **1.32 x10-6 to 9.13 x10-8 m/sec** was observed at the selected monitoring well locations. Falling Head (Slug) testing was also completed at well locations within the developed area (MW12B, MW13A, MW14A and MW15A).

Based on our testing results within the developed area, a horizontal hydraulic conductivity varying between **2.79 x 10-6 to 1.54 x 10-8 m/sec** was observed at the selected monitoring well locations. The results of our testing are attached to the present letter report.

Based on the results of our falling head (slug) testing program, the soils below the proposed founding elevation are considered to have adequately met the requirement for a low permeability soil to be present below design underside of footing level for the subject buildings where sump pumps are required.

2.0 Site and Groundwater Observations

The existing ground surface throughout the proposed Half Moon Bay West development area has been re-shaped over the years. Topsoil stripping work was completed several years ago and windrows of topsoil were stockpiled on site along with various other large fill piles, which has led to ponding of surface water from precipitation events. It is expected that the re-shaping of the former farm field surface caused a disruption of the original sheet drainage pattern toward the field ditches. Photographs of site conditions are attached.

During the installation of the monitoring wells in 2017, several areas within Half Moon Bay West were noted to have surface water ponded above original ground surface. It should be noted that surface water was not present during our original field investigations between 2003 to 2011. At the time of installation in the spring of 2017, groundwater levels at the monitoring well locations generally ranged from 91 to 93 m above sea level (asl). Over the course of the monitoring program, groundwater levels across the subject site have fluctuated by an average of 0.5 to 1 m. It should be noted that the data retrieved from MW 2B between October 26 and November 30, 2017 is expected to be the result of instrument malfunction and has been excluded from the hydrogeological evaluation presented below.

The range of fluctuations in groundwater elevations is consistent with expectations given the general composition of overburden materials on site. Silty clay has a typical hydraulic conductivity in the range of 1×10^{-7} to 1×10^{-9} m/sec, with the variability provided to account for differences in compaction and majority composition of the material at a given location. Similarly, the transmissivity of the soil, which is dependant on hydraulic conductivity, is also low, resulting in a limited ability for water to travel through the clay. The result of these low hydraulic properties is a minimal potential for groundwater elevation fluctuations, and an elevated probability that surface water will remain at surface rather than infiltrate the low permeability clay soils.

Currently, a temporary drainage ditch running north-south across the central portion of the site was installed to provide drainage for the surface water ponding throughout the site. MW1A/1B and MW5A/5B are located in close proximity to the drainage ditch and surface water drains well after precipitation events in the area of these two well cluster locations. The groundwater level at MW1A/1B and MW5A/5B is approximately 2.2 to 2.3 m below existing ground surface.

The well clusters installed for the groundwater monitoring program within Half Moon Bay West were installed within raised fill piles to verify the impact that construction activities have had on drainage and surface water issues within the subject site. Recorded water levels were noted to be above original ground surface at the well cluster locations due to the lack of surficial drainage caused by stockpiled materials and construction activities, as well as, the underlying low permeability soils. **These pre-development groundwater level readings recorded at our well cluster locations should not be considered for design of footing level for the proposed development. It should be noted that historic groundwater level observations at our borehole locations indicate the long-term groundwater level (pre-development) is located approximately 1 to 2 m below original ground surface (~91.5 to 92.5 m).**

To contrast the pre-development conditions within Half Moon Bay West, six well clusters (MW11A/11B to MW16A/16B) were installed within a developed portion of the Half Moon Bay development. These areas were developed within the last 8 years and adequately represent a post-development groundwater level for the Half Moon Bay area. The results of our monitoring within the post-developed area indicate that the water level is located well below existing and original ground surface. **The current results of the on-going post-development monitoring program indicate that the groundwater level is approximately 2.7 to 3.4 m below existing ground surface.**

The recorded groundwater levels within the developed area are approximately located at or below spring level of the adjacent storm sewer pipes. It is anticipated that this same level of dewatering will occur within Half Moon Bay West, once service pipes have been installed. It is further expected that the proposed building sump pumps will handle water flows from precipitation events and during spring melt only, as per City guidelines.

3.0 Summary and Recommendations

Based on review of grading plans for the overall HMB West development and review of detailed grading plans for Phase 3 of the HMB West development prepared by David Schaeffer Engineering Limited (DSEL), it was noted that design underside of footing elevations will not extend below spring line of storm sewers for Half Moon Bay West. **Based on the results of our monitoring program to date, the conceptual design underside of footing elevations are acceptable and will be located above the pre-development long-term groundwater level and post-development groundwater level. Therefore, the use of sump pumps should be permitted for Half Moon Bay West residential development.**

It is recommended that a post-development groundwater monitoring program be initiated for Phase 1 of the development. A series of monitoring wells should be installed adjacent to foundations under construction to monitor the dewatering activity, which occurs during the construction period. Long-term monitoring wells can be installed in public right-of-ways to further monitor the groundwater level lowering. Periodic reports summarizing groundwater levels can be submitted for discussion purposes. Additional details can be provided at a later date.

Further to your request and authorization, Paterson Group (Paterson) has completed a review of the foundation drainage infiltration levels anticipated for the proposed buildings to be constructed at the Half Moon Bay West development. The present memorandum summarizes the results of our foundation drainage infiltration review.

4.0 Sump Pump Feasibility and Drainage Infiltration Review

Our sump pump feasibility and foundation drainage infiltration review was completed for two scenarios (transient conditions and long-term Steady State conditions) using several assumptions. The most critical case to be reviewed would be during transient conditions where the pre-development groundwater level is lowered due to the installation of a storm sewer system. For review purposes, a transient groundwater level of 1 m below finished grade was assumed. This value considers that the installation of the services has been completed several months prior to the construction of the proposed building foundation. The presence of the service alignments are anticipated to lower the observed pre-development groundwater levels over the next several months after installation. It is further anticipated that the long-term groundwater level (post-development) will establish below the design footing level. Therefore, the foundation drainage system will only handle water from storm events and spring melt for the long-term scenario.

With respect to the existing fill material present throughout the site, it is expected that this will be stripped as the development progresses and replaced with previously excavated site clay (sourced from the SWMP excavation works) currently stockpiled on site as part of the ongoing surcharge program. Based on current grading plans, the majority of the proposed building footings will be founded directly over the native silty clay. However, it is expected that engineered fill could be required for areas where sub-excavation due to disturbed soils is required and/or in areas where native soils are below design footing level. For areas where the proposed footings will be placed on engineered fill, it is recommended extend the engineered fill beyond the footing face to provide a 1.5H:1V slope down and out from the footing to provide adequate lateral support. This granular fill lateral support profile will be capped with a minimum 600 mm thick layer of suitable clay fill along the building perimeter to further ensure that an adequate seal is in place surrounding the proposed building foundation.

The clay backfill, placed with suitable moisture levels to permit adequate compaction, will then be proof-rolled using a small sheepsfoot roller in order to achieve adequate compaction. Once compacted, the backfill is expected to exhibit lower hydraulic properties than the underlying native material. As such, the drainage infiltration calculations included as part of this review utilise the highest hydraulic conductivity obtained from the slug testing completed on site in order to provide the most conservative estimate of groundwater infiltration volumes.

The following items were used in our calculations for both scenarios:

☐ Typical Single Lot - Building Dimensions: 7.5 m x 16 m
☐ Worst Case Perimeter Drainage Depth below Finished Grade: 3 m
☐ Groundwater level at 1 m below finished grade.
☐ Surface Water - 100 year, 24 hr. storm event: 115.6 mm
☐ Infiltration factors of 0.5 based on Topographic factor of 0.25 (1 to 2 m over 1 km), soil factor of 0.15 (clay/clay loam) and cover factor of 0.1 (grass) using the MOE Stormwater Management and Design Manual.
☐ Hydraulic Conductivity: 7.9 x 10^{-7} m/sec
☐ Clay backfill against building foundation with composite drainage blanket against exterior foundation wall (typical residential construction).

Using the Dupuit Forchheimer relationship, a volume of approximately 19,000 L/day is anticipated as a worst case scenario under transient groundwater conditions. Surface water infiltration was calculated using an infiltration factor of 0.5 as noted above. Given the relatively impermeable nature of the backfill being used at the subject site, it was conservatively estimated that the only surface water contributions to pumping volumes will result from poor roof drainage infiltrating along the foundation walls. As such, volumes were calculated using the above noted building dimensions of 7.5 m x 16 m. A volume of 7,000 L was calculated for surface water infiltration during a 100 year, 24 hour storm event. Therefore, it is expected that the building's sump pump will handle approximately 26,000 L/Day as a worst case scenario during transient conditions.

An additional sensitivity analysis was completed to determine the maximum potential infiltration volumes during transient conditions for a scenario in which the soils surrounding the foundation were fully saturated. For this scenario, the groundwater level was raised to 0 m below finished grade and the remaining hydraulic properties were kept the same as those noted above, which is a conservative estimate given the clay fill being placed at the subject site. The results of the additional analysis provided a groundwater infiltration volume of approximately 21,000 L/day and a total of 28,000 L/day when factoring in surface water volumes, a relatively minimal increase over the previously noted transient condition infiltration volumes.

Upon completion of construction activities, the long-term (post-development) static groundwater table will be located below design footing level. Therefore, the most significant water infiltration for the foundation drainage system will be the surface infiltration volumes during storm events and a temporary increase in groundwater level. Using the same infiltration factor and a more typically occurring 5 year, 1 hour storm event that produces an estimated total of 0.0265 m of precipitation, the building's sump pump will handle a maximum of approximately 1,600 L of water, well below the minimum requirements of the required sump system and backup as outlined in Sections 5.12.2.1 and 5.12.2.4 of City of Ottawa Technical Bulletin ISTB-2018-04.

A sample groundwater infiltration calculation and the intensity duration frequency (IDF) curve used to calculate the surface water infiltration component have been appended to the current report.

Based on our review, a sump pump system can handle the anticipated ingress rates during both transient and static long-term groundwater conditions for a typical house constructed at the Half Moon Bay West development provided that the buildings' sump systems are installed in accordance with City of Ottawa Technical Bulletin ISTB-2018-04.

Criteria for sump pumps for the subject site, including criteria specific to the primary and back-up sump pump are detailed below:

Sump pumps shall be:
☐ **a submersible pump;**
☐ **automatically controlled and set to maintain the water level at the same elevation as the foundation drain;**
☐ **capable of discharging a minimum flow of 0.9 L/sec at 3.6 meters head.**

5.0 Clay Seal at Servicing Trench, Impermeable Cap and Drainage Boundary along Foundation

Clay Seal Recommendations

A clay seal within the service trench is required to be placed within the City side of the property line for each residence and placed in accordance with the following recommendations and City of Ottawa Drawing S8 - Clay Seal for Pipe Trenches. The clay seal should be at least 1 m long (in the trench direction), and should extend from trench wall to trench wall. Generally, the seals should extend from the underside of the pavement structure and/or bedding layer for sidewalk and fully penetrate the bedding, sub-bedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay approved by the geotechnical consultant at the time of placement and be placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The placement of the clay seal should be reviewed and approved by the geotechnical consultant at the time of placement.

Impermeable Cap

An impermeable cap is recommended to be placed at ground surface and shaped in accordance with the lot grading design. The cap material should consist of an asphalt finish (ie.- driveway areas) or a **minimum 150 mm thick topsoil layer**, which includes a minimum 60% fines content (ie.- less than 0.074 mm/No. 200 sieve). It is recommended that at least 3 representative soil samples of the topsoil layer be collected by the geotechnical consultant at the time of placement to determine suitability for use as the impermeable cap layer. Hydrometer (sieve) testing on the representative soil samples and in-situ permeameter testing are recommended to determine the soil's suitability as an impermeable cap. It is recommended that the impermeable cap material provide a maximum field saturated hydraulic conductivity rate of **1 x10^{-6} m/sec** for areas where the topsoil layer is required.

Drainage Boundary along Foundation Walls

It is recommended that the drainage boundary along the exterior side of each building foundation wall consist of minimum 1.5 m wide clay backfill placed in maximum 300 mm loose lifts and lightly compacted. A composite drainage system (such as system Platon or Miradrain G100N) connected to a perimeter drainage system is required to be in place for each exterior wall of the subject building. The clay backfill should extend from the underside of the footing to the subgrade level of the pavement structure or landscaping finishing layer. It should be noted that clay backfill is not required within the garage and front porch. The backfill below the garage and front porch should consist of free draining, non-frost susceptible backfill, such as clear crushed stone, clean sand, Granular B Type I (pit run) or geofoam EPS blocks (lightweight fill).

It is recommended that two representative soil samples of the clay backfill be submitted for hydrometer testing by the geotechnical consultant to determine fines content of the backfill material. The fines content should be no less than 50% for the representative soil sample and 90% of the material should pass through a 2 mm sieve size to be considered suitable for placement within the building's drainage boundary.

6.0 Artesian Groundwater Pressure encountered within Park Block

It should be noted that the underlying soil profile has been evaluated for the potential impact of an artesian groundwater condition below the proposed buildings located in close proximity to the identified artesian openings (park block). The artesian openings were encountered within the proposed Park Block of Phase 3 during a topsoil removal program and the flowing condition was noted for the past several years. However, it should be noted that the area previously observed as undergoing an artesian groundwater flowing condition has recently stopped flowing as first noted in March 2021. Construction of the artesian containment cell system is still recommended for the area identified in Paterson Report PG2246-MEMO.52 Revision 11 dated August 26, 2021. However, no additional construction precautions are required for the housing (Phase 3) located adjacent to the park block based on our recent investigation for excavation limits. The results of our review of the servicing, sump pump system and housing design details and our recommendations are presented in Report PG2246-MEMO.72 dated July 28, 2021 attached. It should be further noted that no future additional discharge sources are expected based on our investigation observations, absence of active groundwater artesian flow conditions and review of the development design details for the Half Moon Bay West (including Phase 3) development area.

We trust that this information satisfies your requirements.

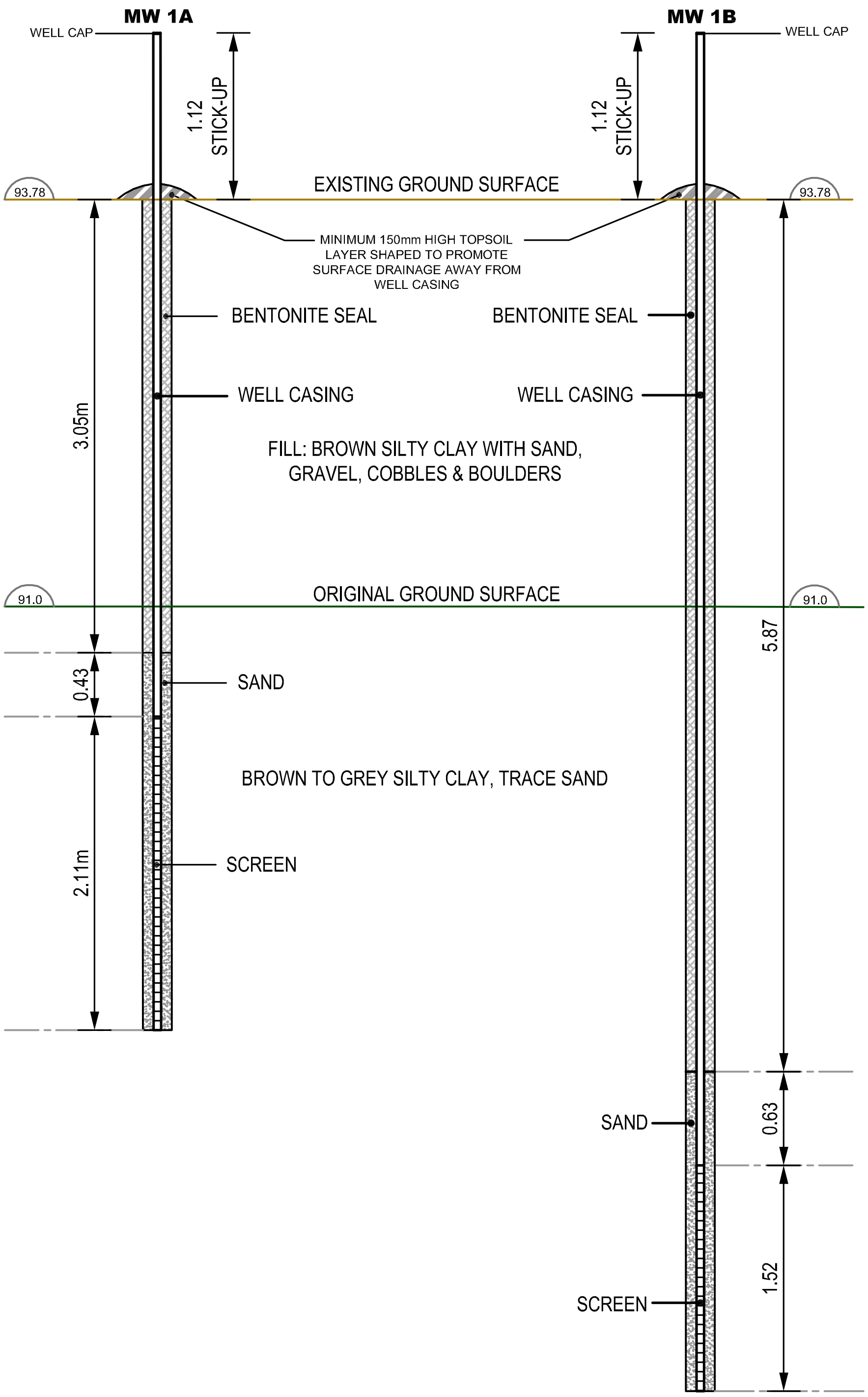
Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Aug. 26, 2021
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Michael Killam, P.Eng.

David J. Gilbert, P. Eng.



NOTE:

GROUND SURFACE ELEVATIONS PROVIDED BY ASL.

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MATTAMY HOMES

GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 1A & MW 1B
MONITORING WELL DETAILS

Date: **03/2018**	Report No.: **PG4073**
Scale: **1:50**	Drawing No.: **FIG. 1**
Drawn by: **MPG**	Checked by: **DJG**

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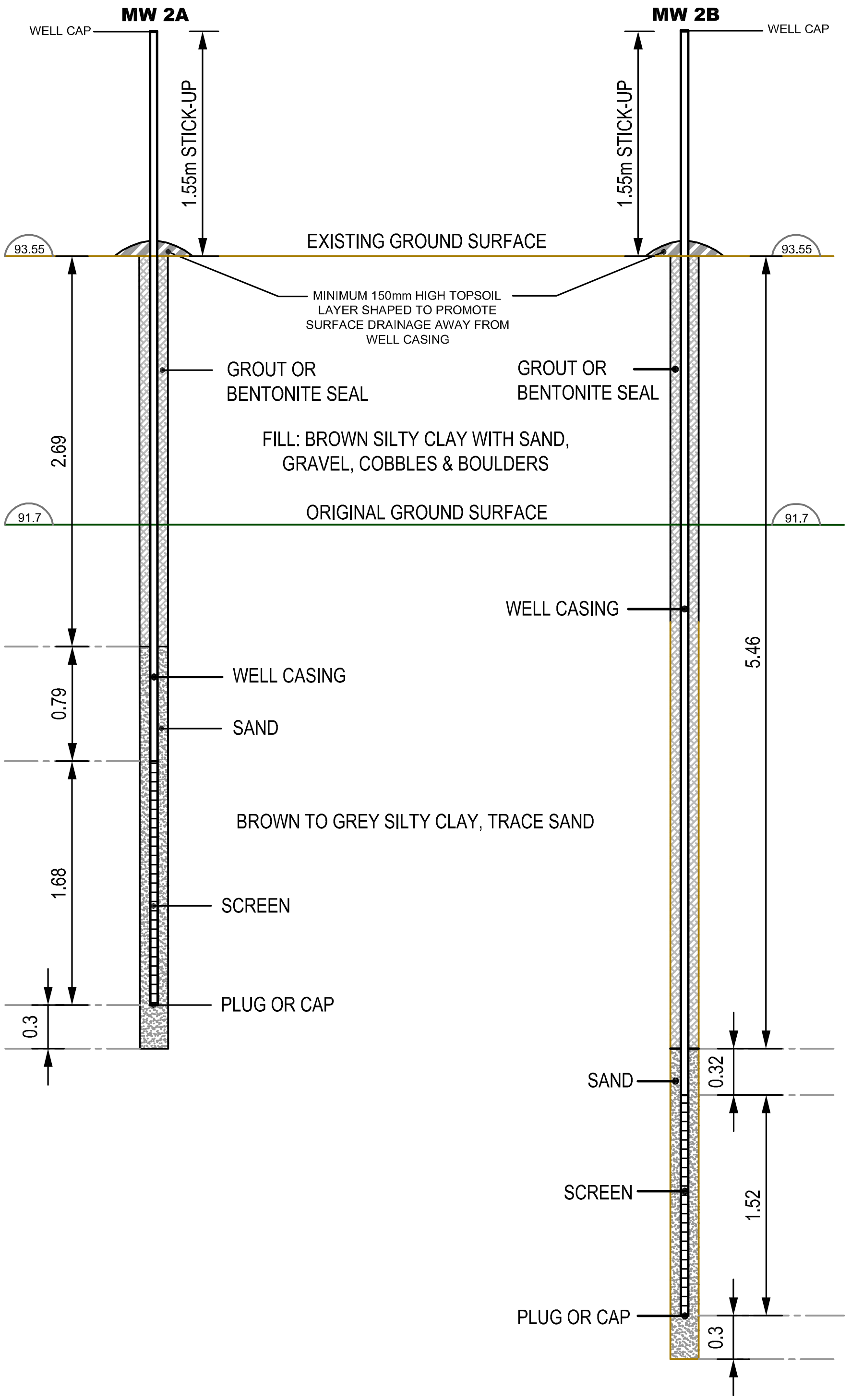

NOTE:

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 2A & MW 2B MONITORING WELL DETAILS

Date: 03/2018	Report No.: PG4073
Scale: 1:50	Drawing No.: FIG. 2
Drawn by: MPG	Checked by: DJG

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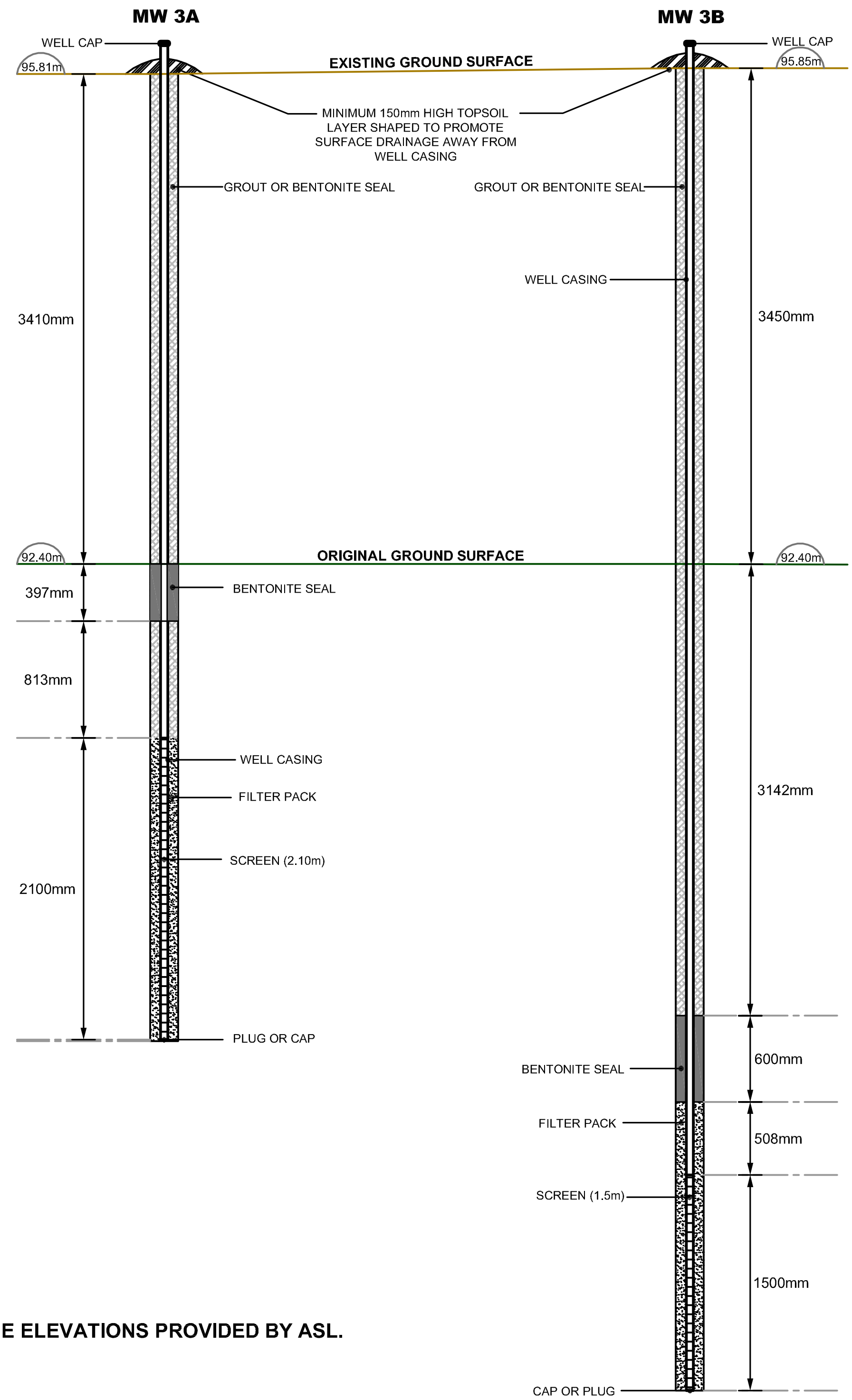

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GROUNDWATER MONITORING PROGRAM
HALF MOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 3A & MW 3B MONITORING WELL DETAILS

Date: **05/2017**

Report No.: **PG4073-LET.02**

Scale: **1:50V**

Drawing No.: **FIG. 3**

Drawn by: **RCG**

Checked by: **RM**

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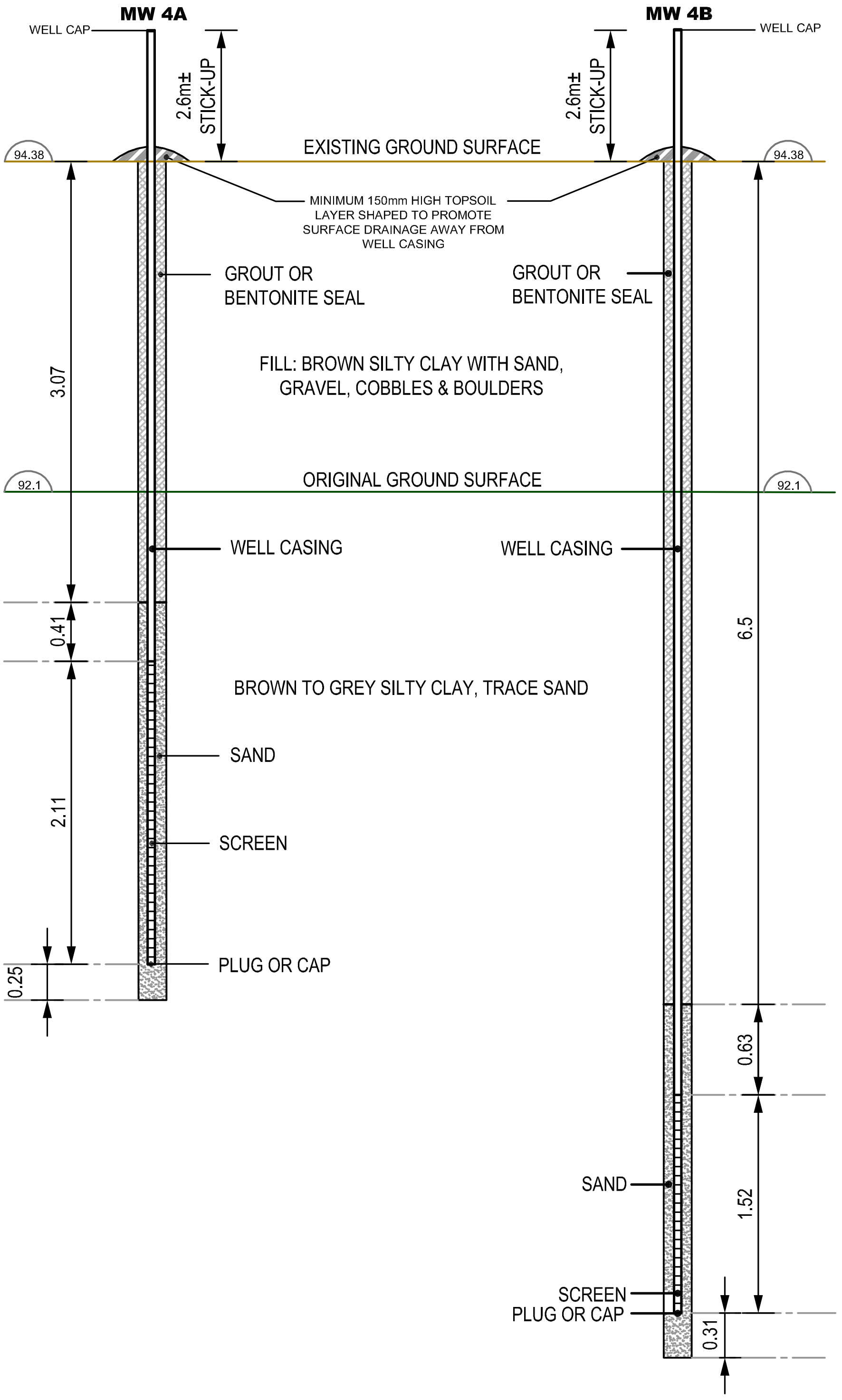

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HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 4A & MW 4B MONITORING WELL DETAILS

Date: **03/2018**	Report No.: **PG4073**
Scale: **1:50**	Drawing No.: **FIG. 4**

Drawn by: **MPG**	Checked by: **DJG**

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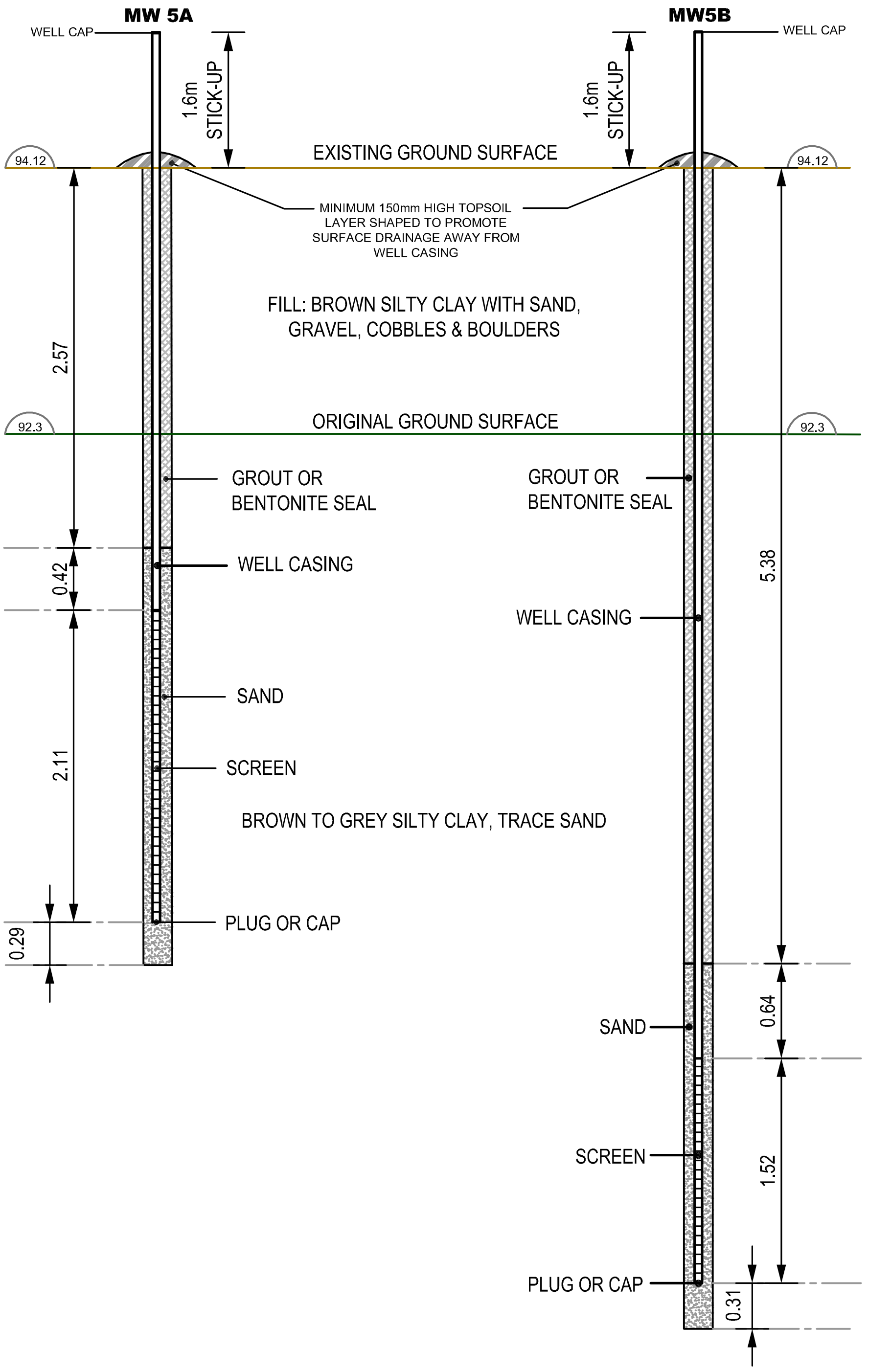

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 5A & MW 5B MONITORING WELL DETAILS

Date: **03/2018**

Report No.: **PG4073**

Scale: **1:50**

Drawing No.: **FIG. 5**

Drawn by: **MPG**

Checked by: **DJG**

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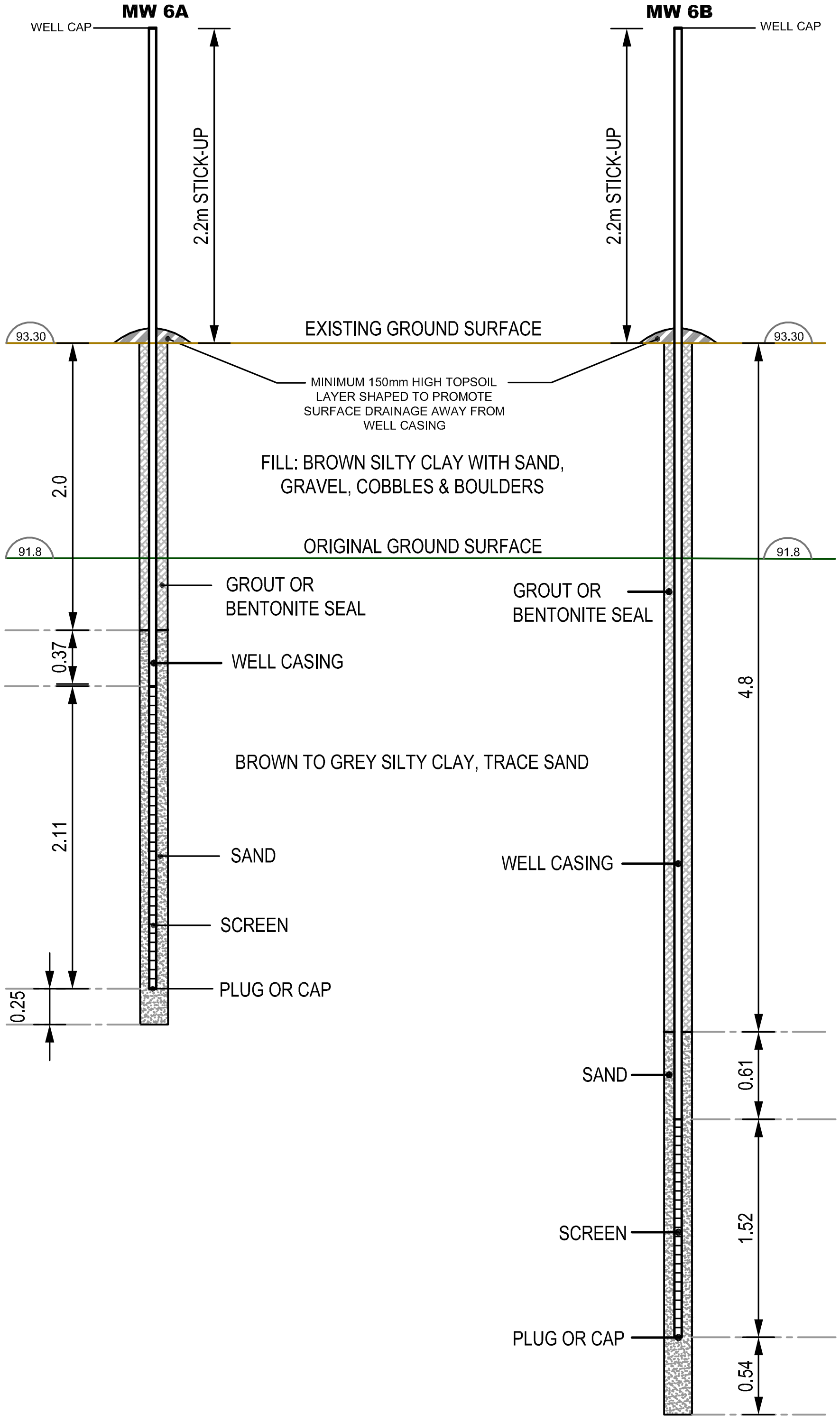

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OTTAWA, ONTARIO

Title:

MW 6A & MW 6B MONITORING WELL DETAILS

Date: 03/2018	Report No.: PG4073
Scale: 1:50	Drawing No.: FIG. 6
Drawn by: MPG	Checked by: DJG

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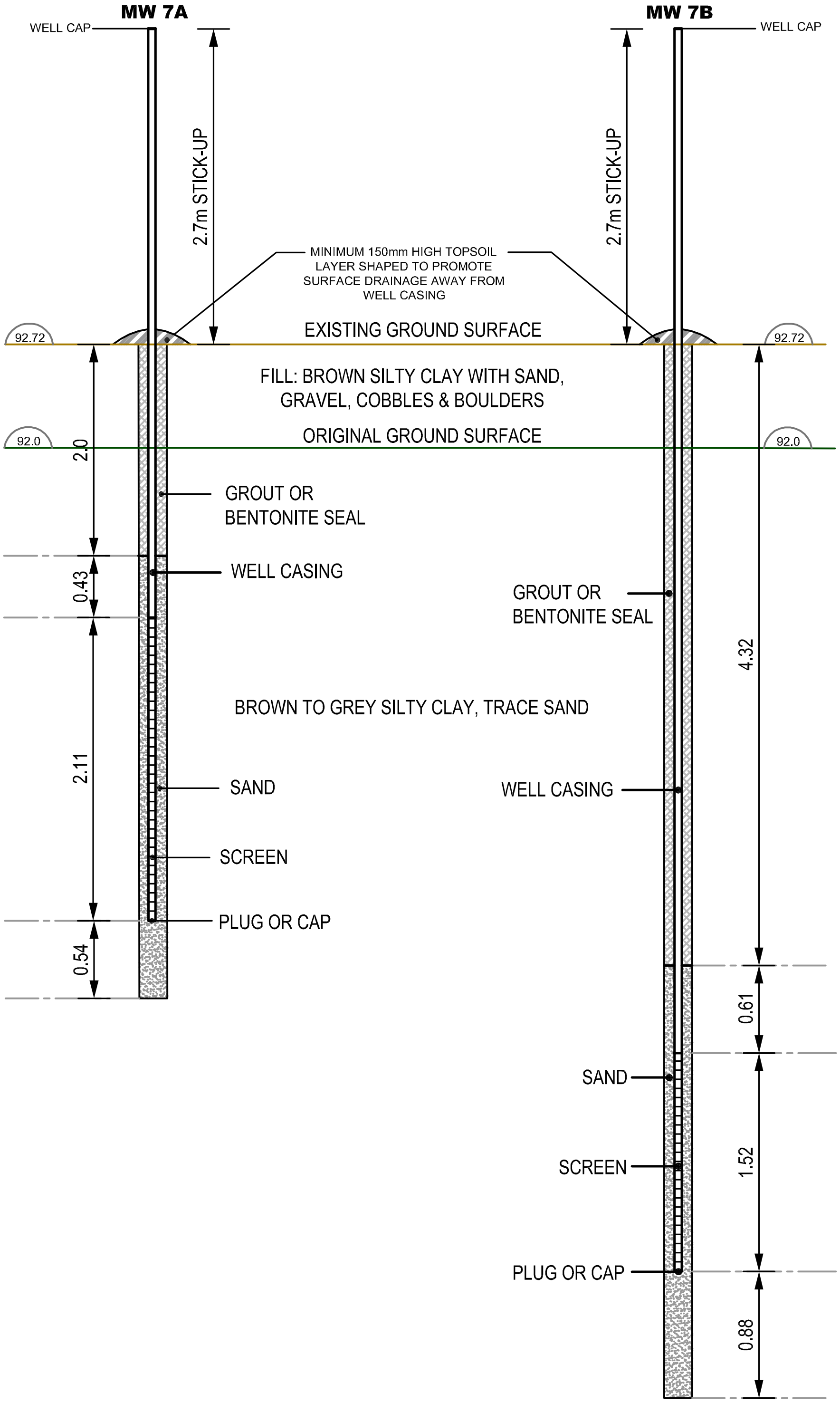

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HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 7A & MW 7B MONITORING WELL DETAILS

Date: 03/2018	Report No.: PG4073
Scale: 1:50	Drawing No.: FIG. 7
Drawn by: MPG	Checked by: DJG

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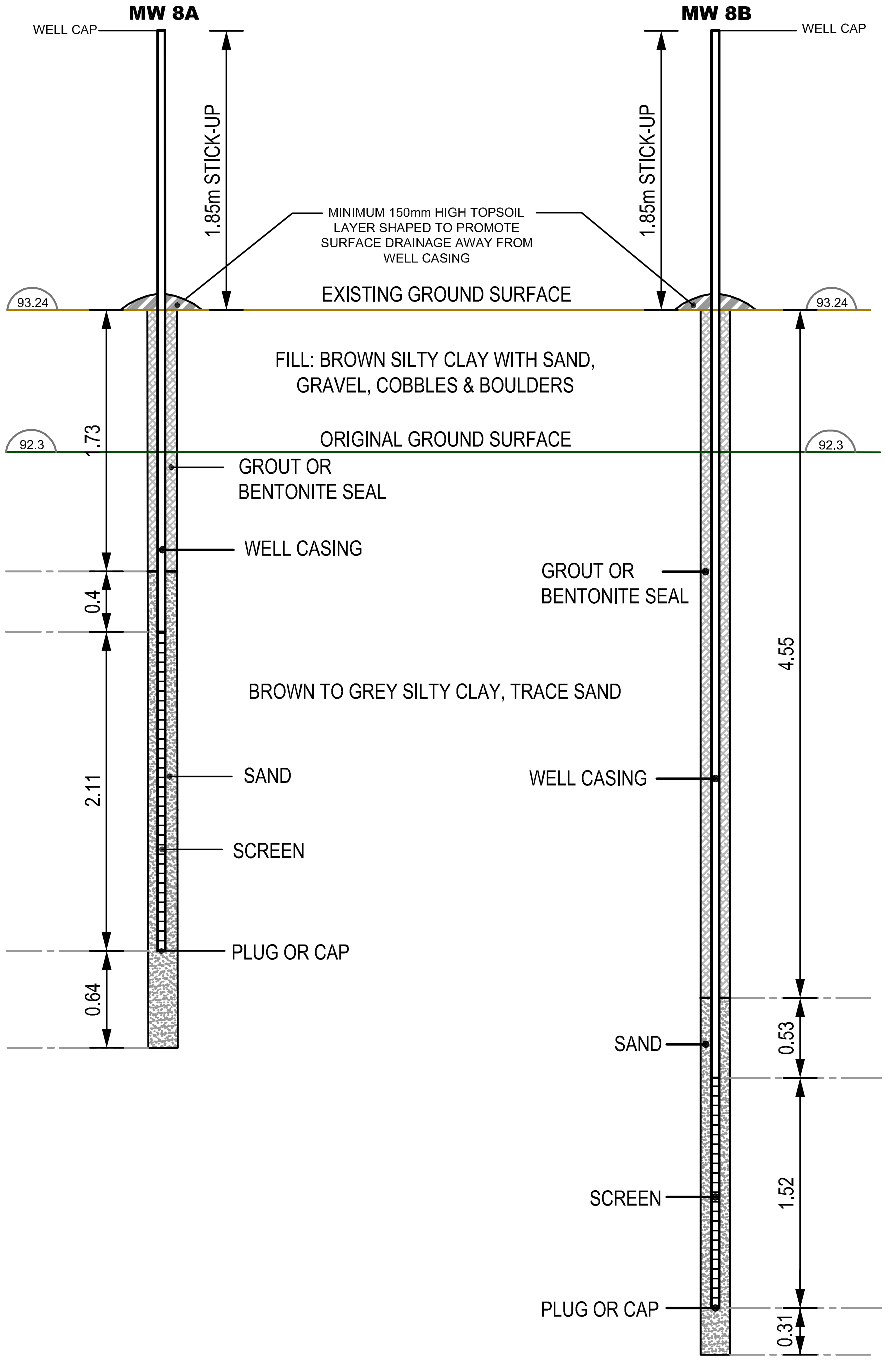

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 8A & MW 8B
MONITORING WELL DETAILS

Date: **03/2018**

Report No.: **PG4073**

Scale: **1:50**

Drawing No.: **FIG. 8**

Drawn by: **MPG**

Checked by: **DJG**

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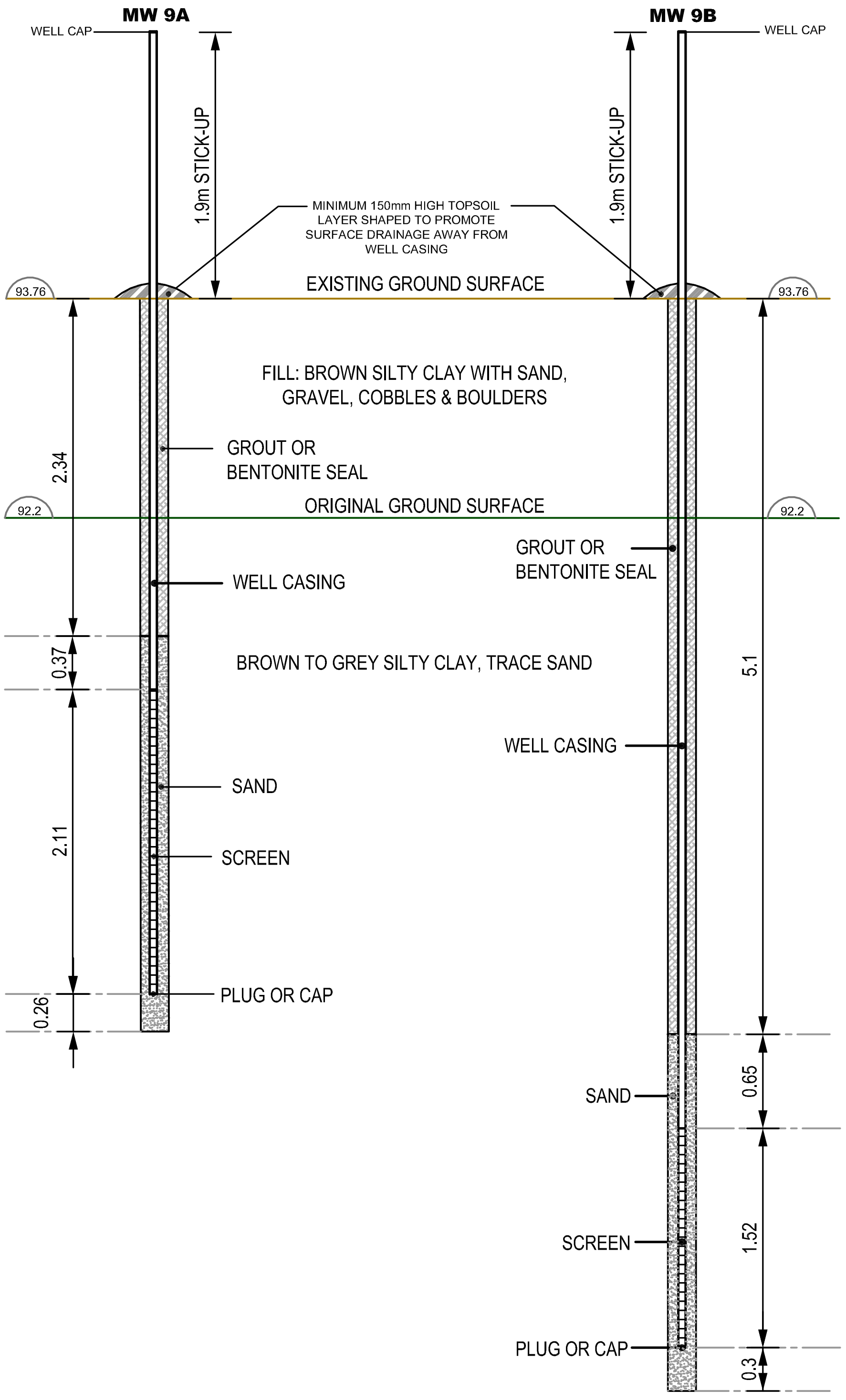

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 9A & MW 9B MONITORING WELL DETAILS

Date: **03/2018**

Report No.: **PG4073**

Scale: **1:50**

Drawing No.: **FIG. 9**

Drawn by: **MPG**

Checked by: **DJG**

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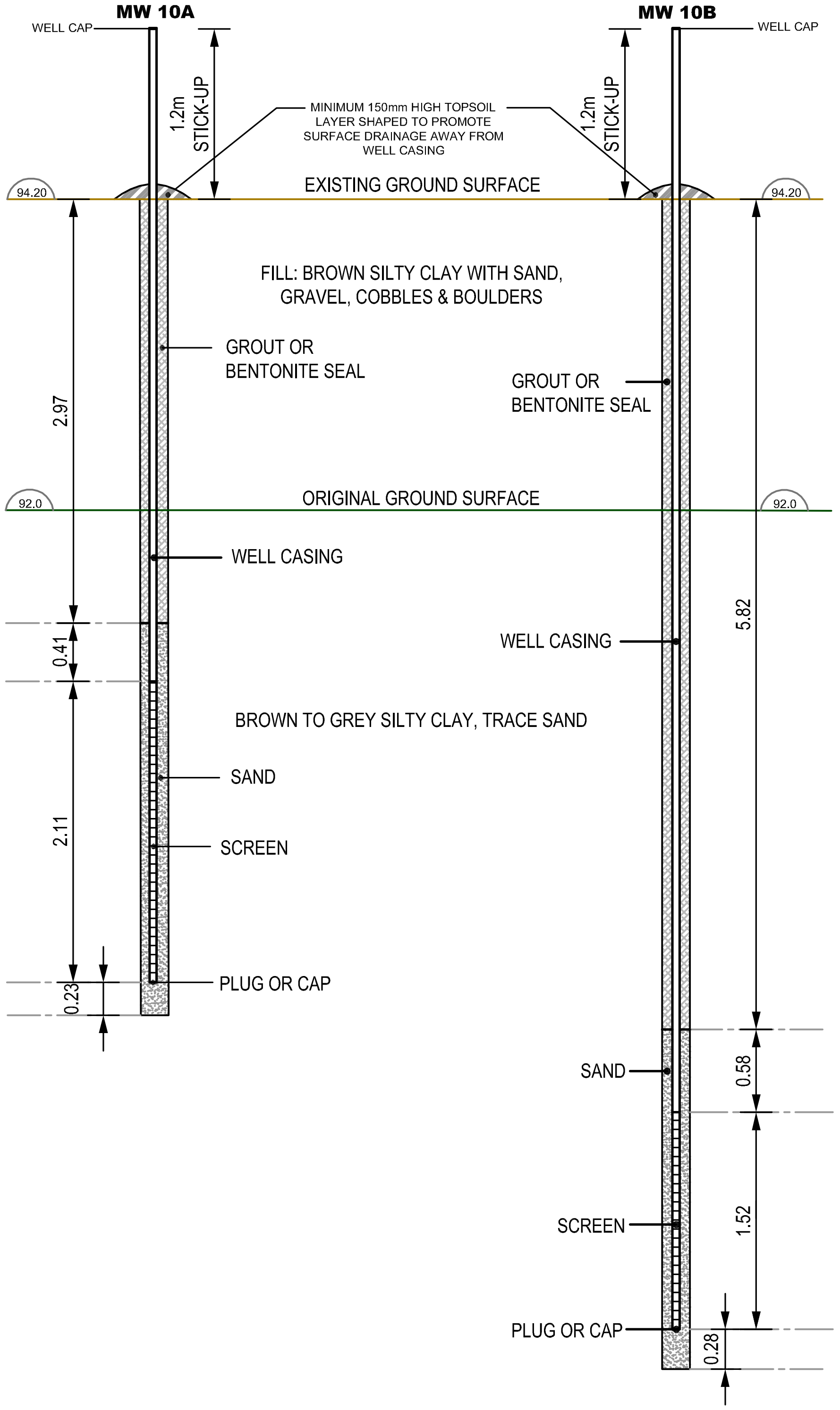

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HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 10A & MW 10B MONITORING WELL DETAILS

Date: **03/2018**

Report No.: **PG4073**

Scale: **1:50**

Drawing No.: **FIG. 10**

Drawn by: **MPG**

Checked by: **DJG**

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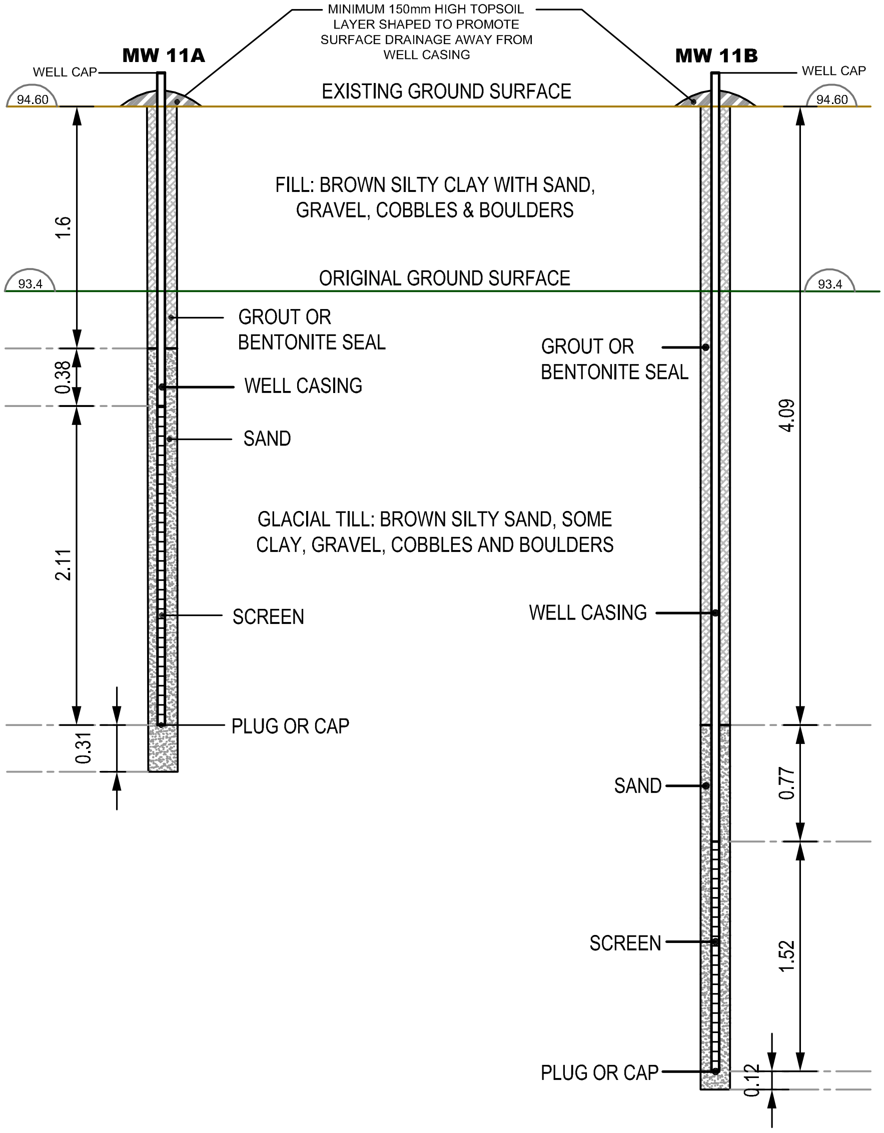

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 11A & MW 11B
MONITORING WELL DETAILS

Date: **03/2018**	Report No.: **PG4073**
Scale: **1:50**	Drawing No.: **FIG. 11**
Drawn by: **MPG**	Checked by: **DJG**

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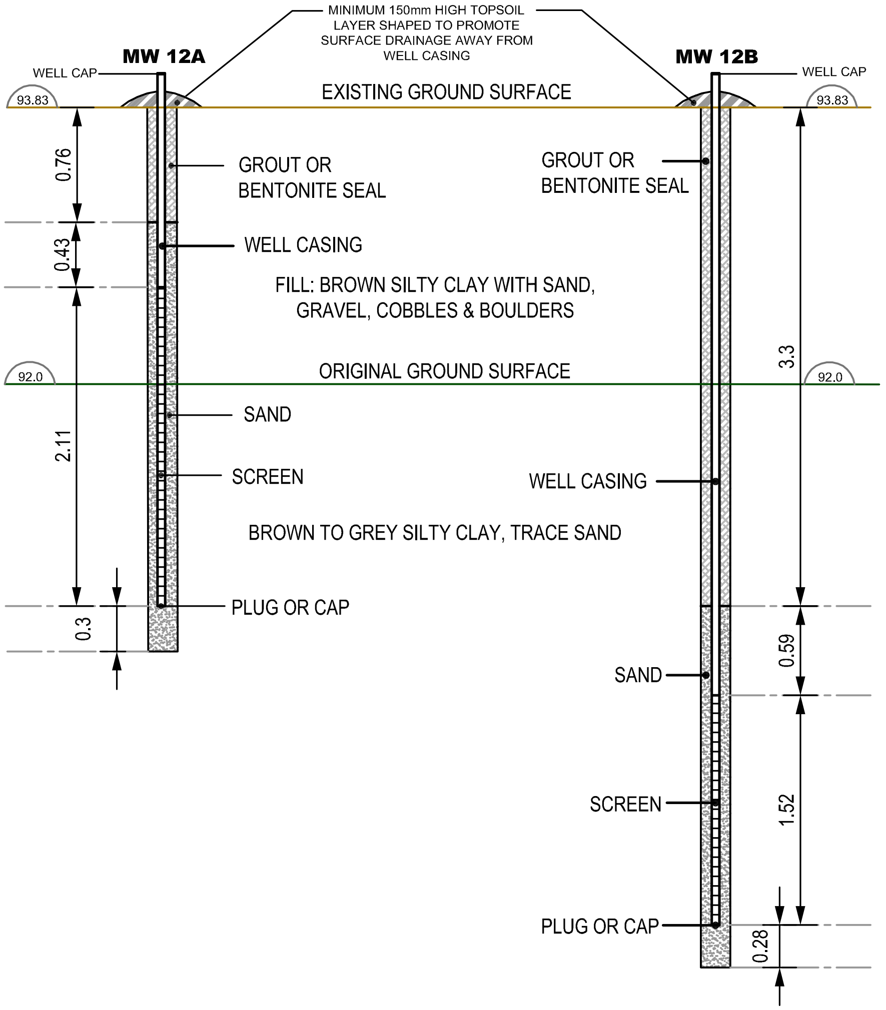

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 12A & MW 12B
MONITORING WELL DETAILS

Date: **03/2018**

Report No.: **PG4073**

Scale: **1:50**

Drawing No.: **FIG. 12**

Drawn by: **MPG**

Checked by: **DJG**

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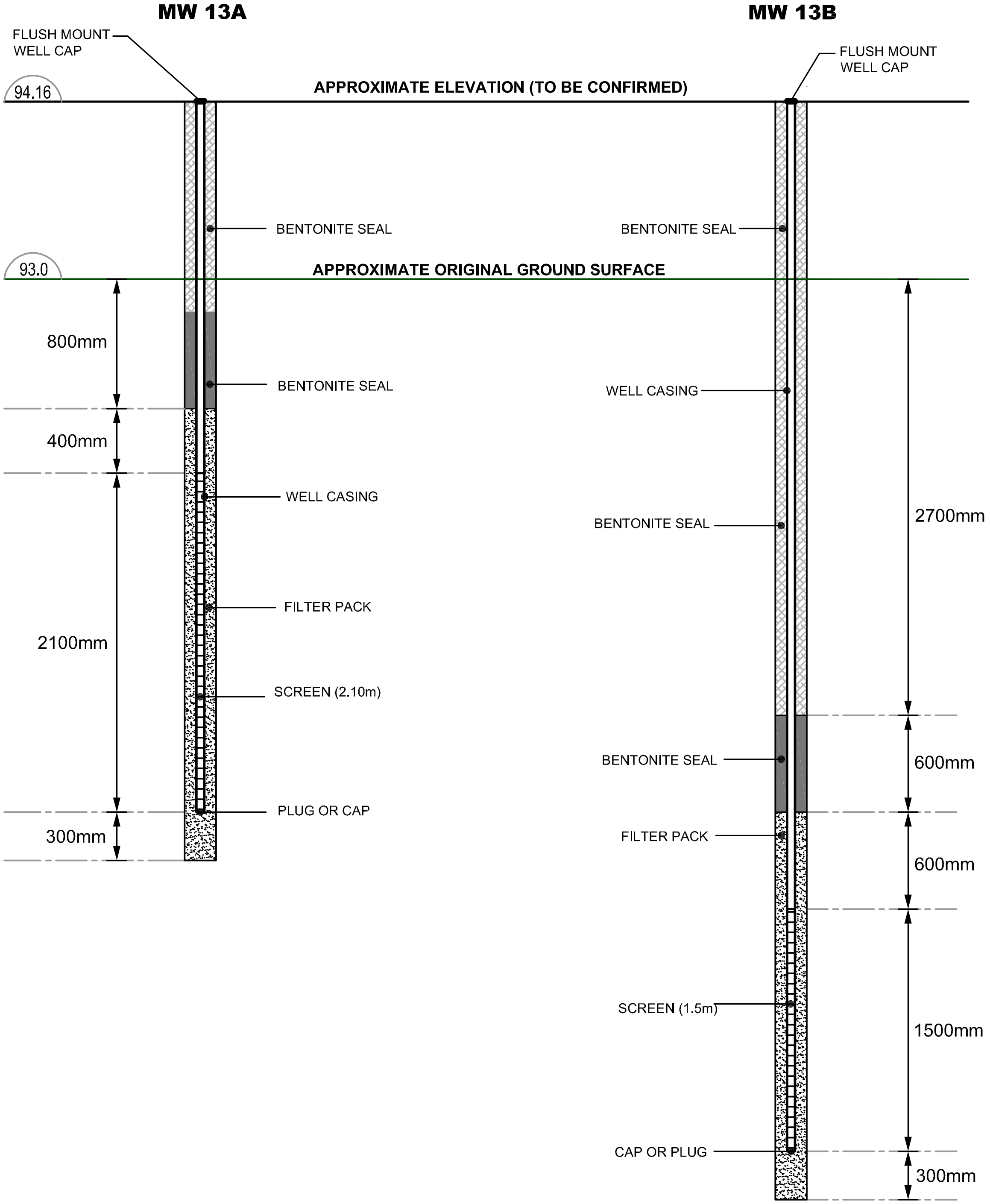

NOTE:

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GROUNDWATER MONITORING PROGRAM
HALF MOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 13A & MW 13B MONITORING WELL DETAILS

Date: **01/2018**	Report No.: **PG4073-LET.02**
Scale: **N.T.S.**	Drawing No.: **FIG. 1**
Drawn by: **RCG** / Checked by: **DJG**	

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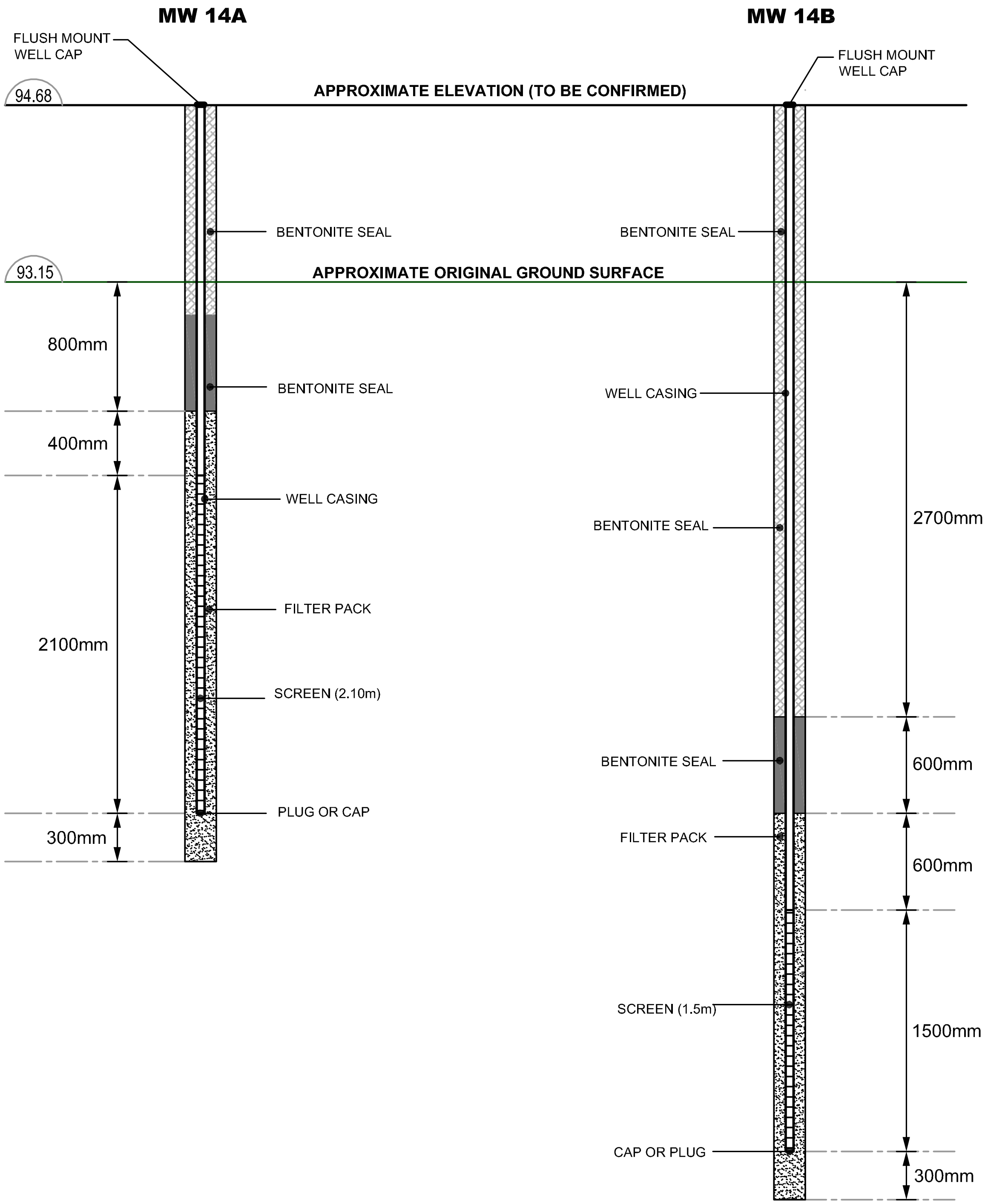

NOTE:

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GROUNDWATER MONITORING PROGRAM
HALF MOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 14A & MW 14B MONITORING WELL DETAILS

Date: **01/2018**	Report No.: **PG4073-LET.02**
Scale: **N.T.S.**	Drawing No.: **FIG. 1**
Drawn by: **RCG**	Checked by: **DJG**

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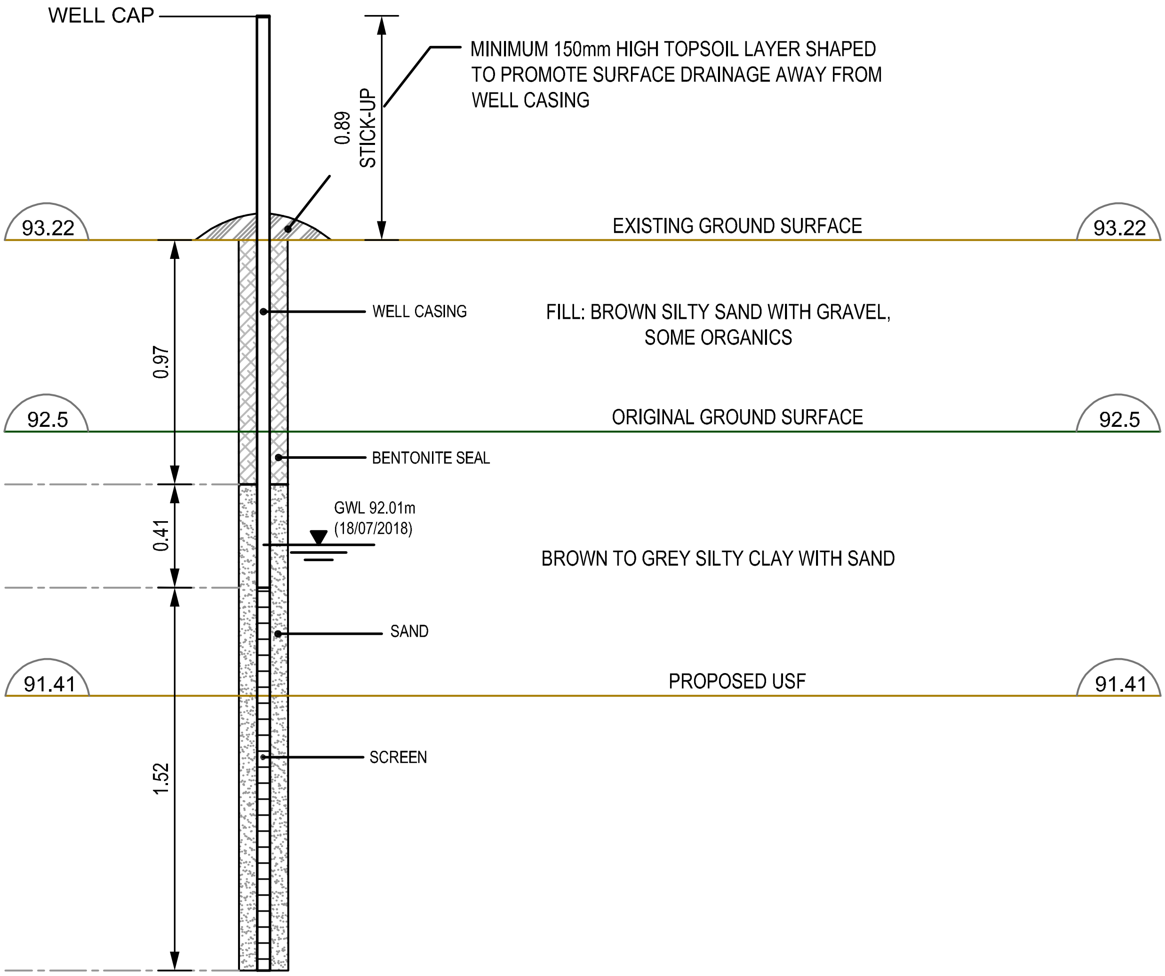
MW 17A



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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 17A
MONITORING WELL DETAILS

Date: **07/2018**	Report No.: **PG4073**
Scale: **1:30**	Drawing No.: **FIG. 17**
Drawn by: **MPG**	Checked by: **DJG**

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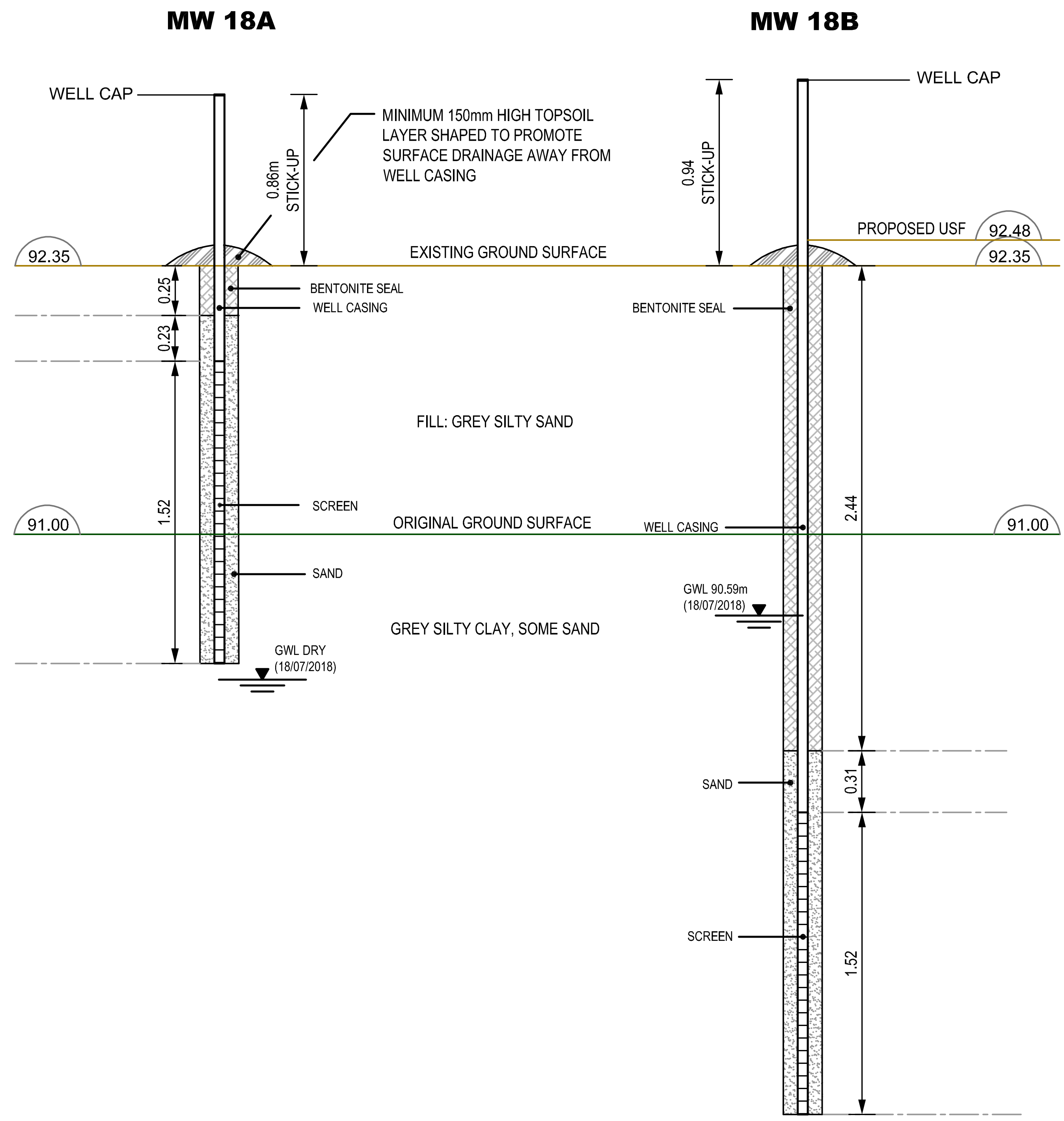

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 18A & MW 18B
MONITORING WELL DETAILS

Date: **07/2018**

Report No.: **PG4073**

Scale: **1:30**

Drawing No.: **FIG. 18**

Drawn by: **MPG**

Checked by: **DJG**

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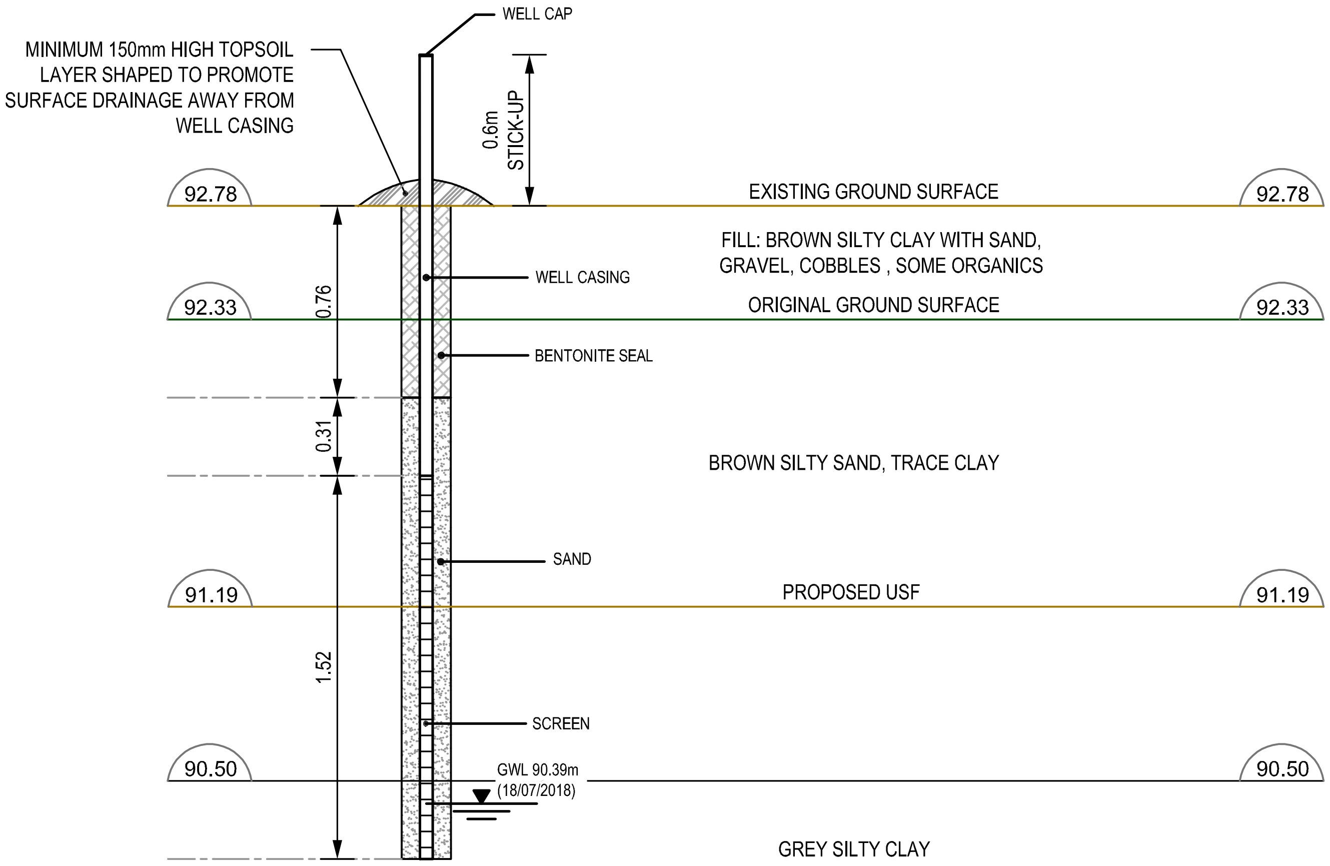
MW 19A



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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:
MW 19A
MONITORING WELL DETAILS

Date: **07/2018**
Report No.: **PG4073**
Scale: **1:30**
Drawing No.: **FIG. 19**
Drawn by: **MPG**
Checked by: **DJG**

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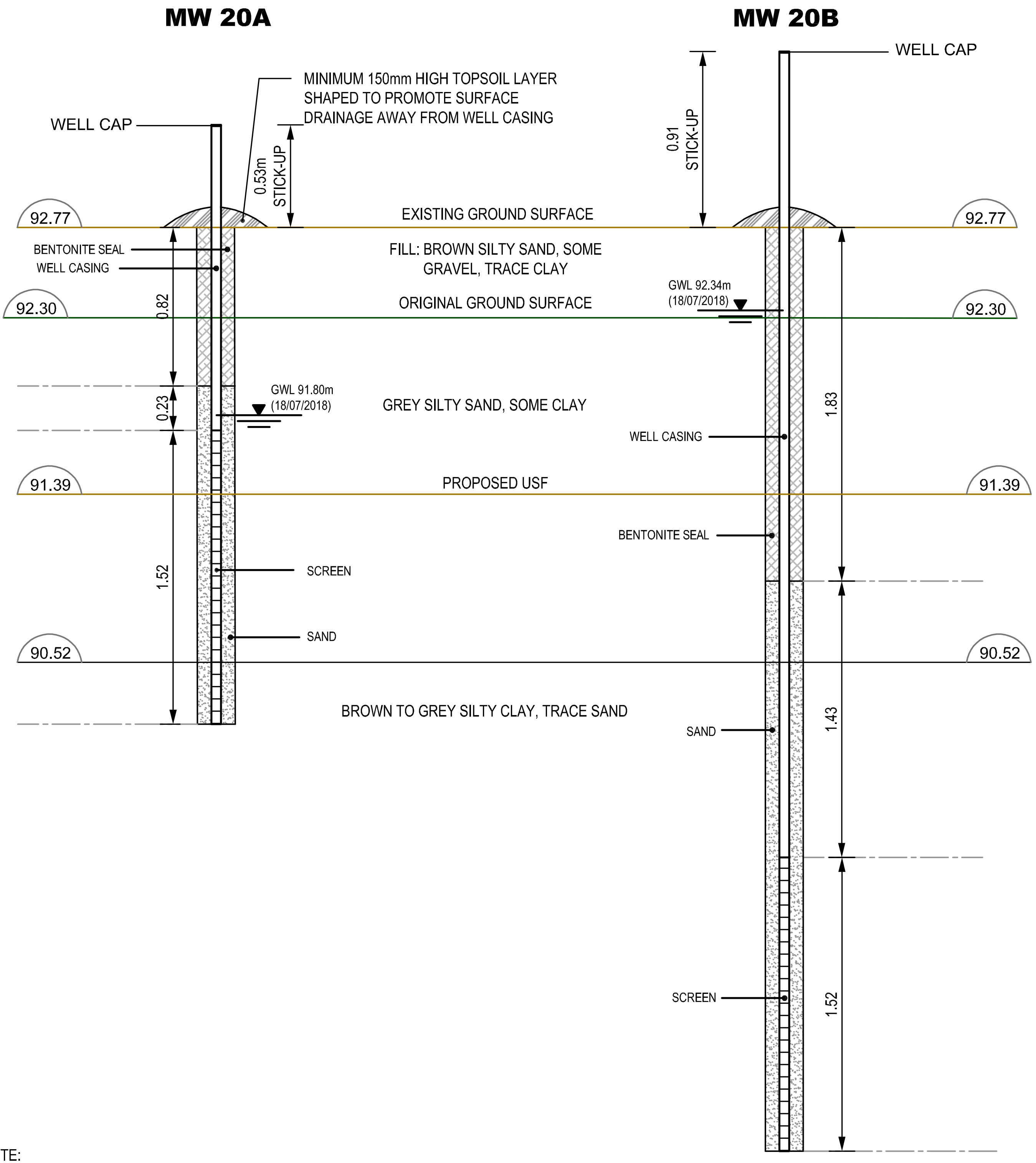

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 20A & MW 20B MONITORING WELL DETAILS

Date: **07/2018**

Report No.: **PG4073**

Scale: **1:30**

Drawing No.: **FIG. 20**

Drawn by: **MPG**

Checked by: **DJG**

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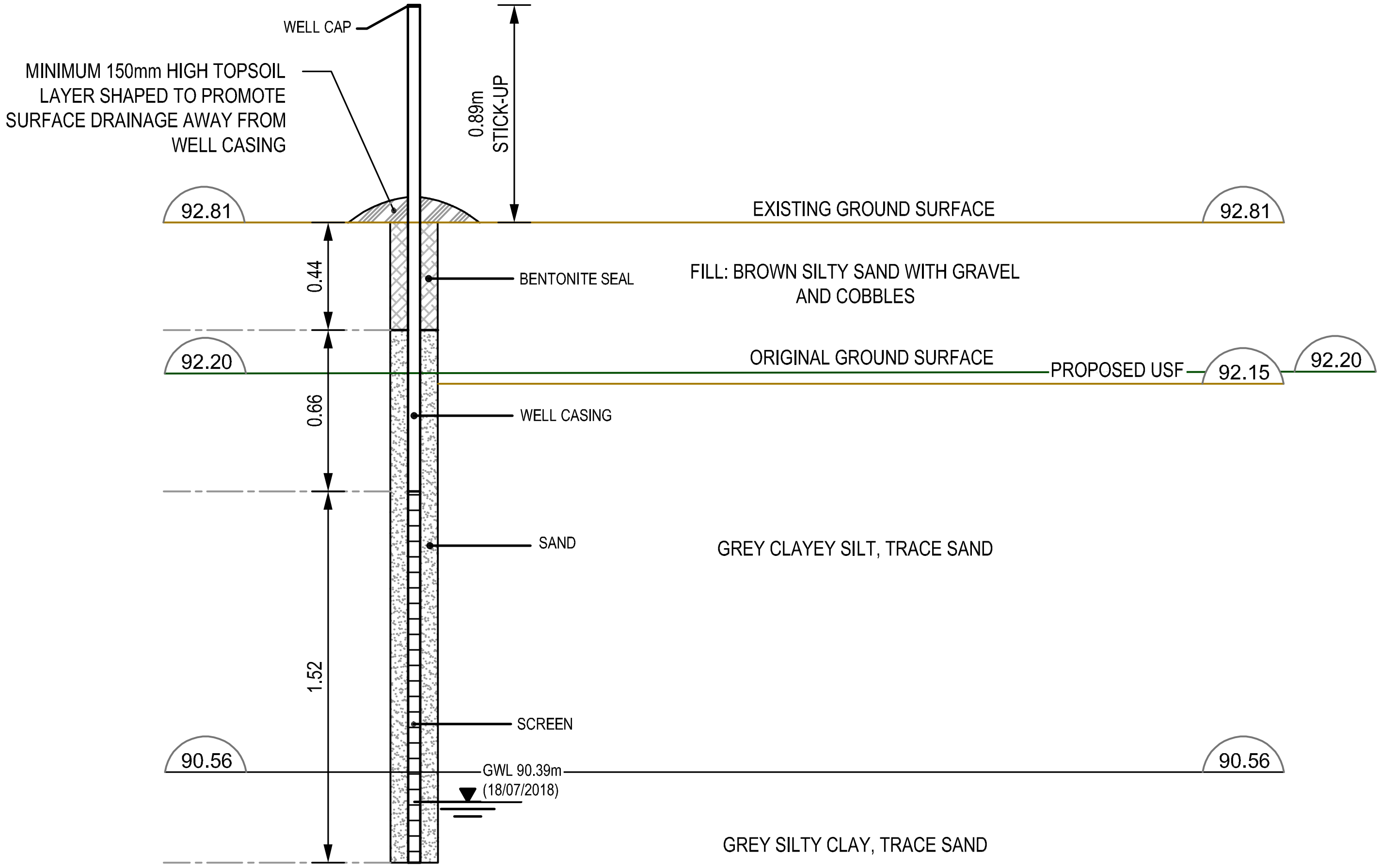
MW 21A



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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 21A
MONITORING WELL DETAILS

Date: 07/2018	Report No.: PG4073
Scale: 1:30	Drawing No.: FIG. 21
Drawn by: MPG	Checked by: DJG

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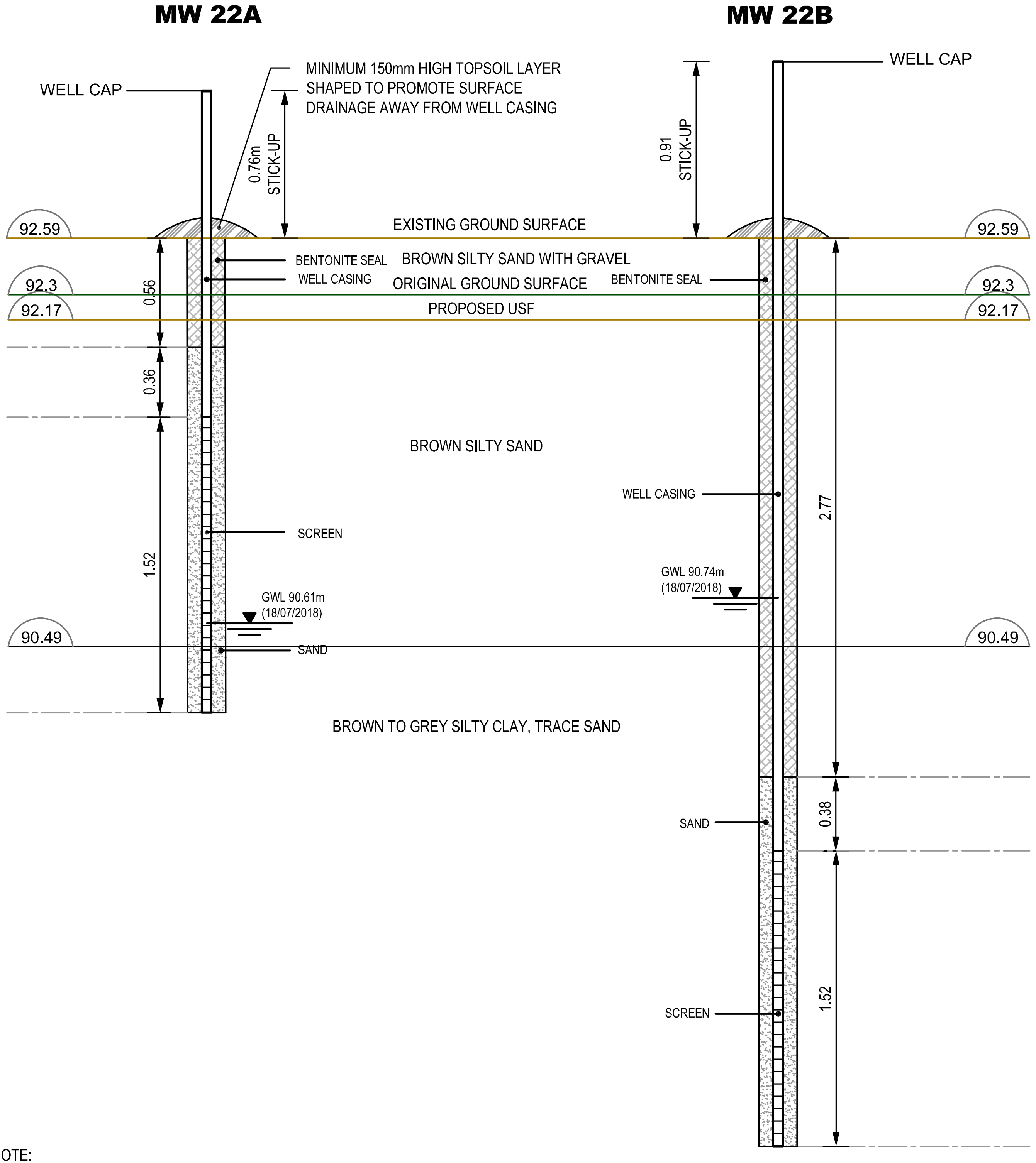

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 22A & MW 22B MONITORING WELL DETAILS

Date: **07/2018**

Report No.: **PG4073**

Scale: **1:30**

Drawing No.: **FIG. 22**

Drawn by: **MPG**

Checked by: **DJG**

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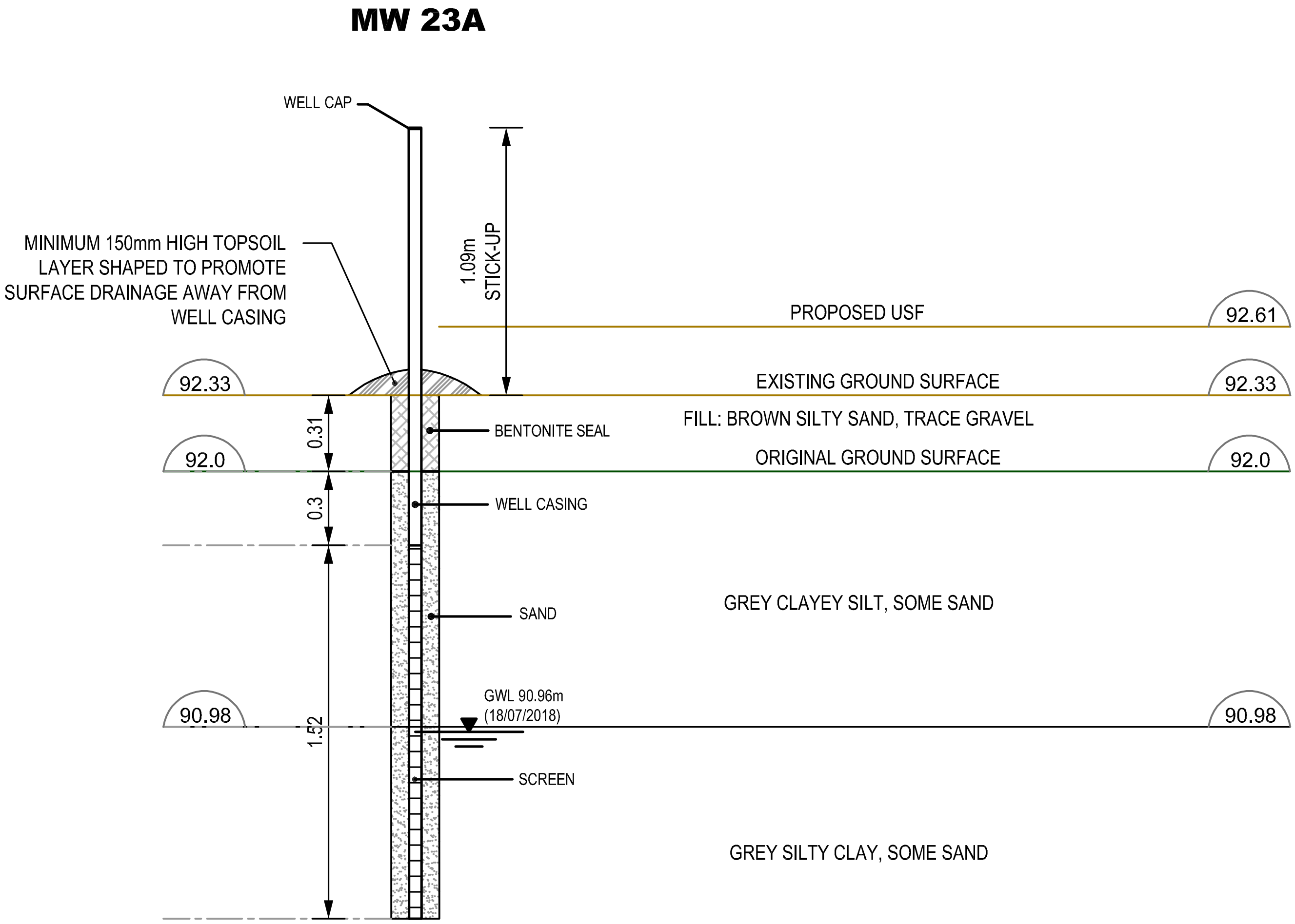

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GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:
MW 23A
MONITORING WELL DETAILS

Date: **07/2018**	Report No.: **PG4073**
Scale: **1:30**	Drawing No.: **FIG. 23**
Drawn by: **MPG**	Checked by: **DJG**

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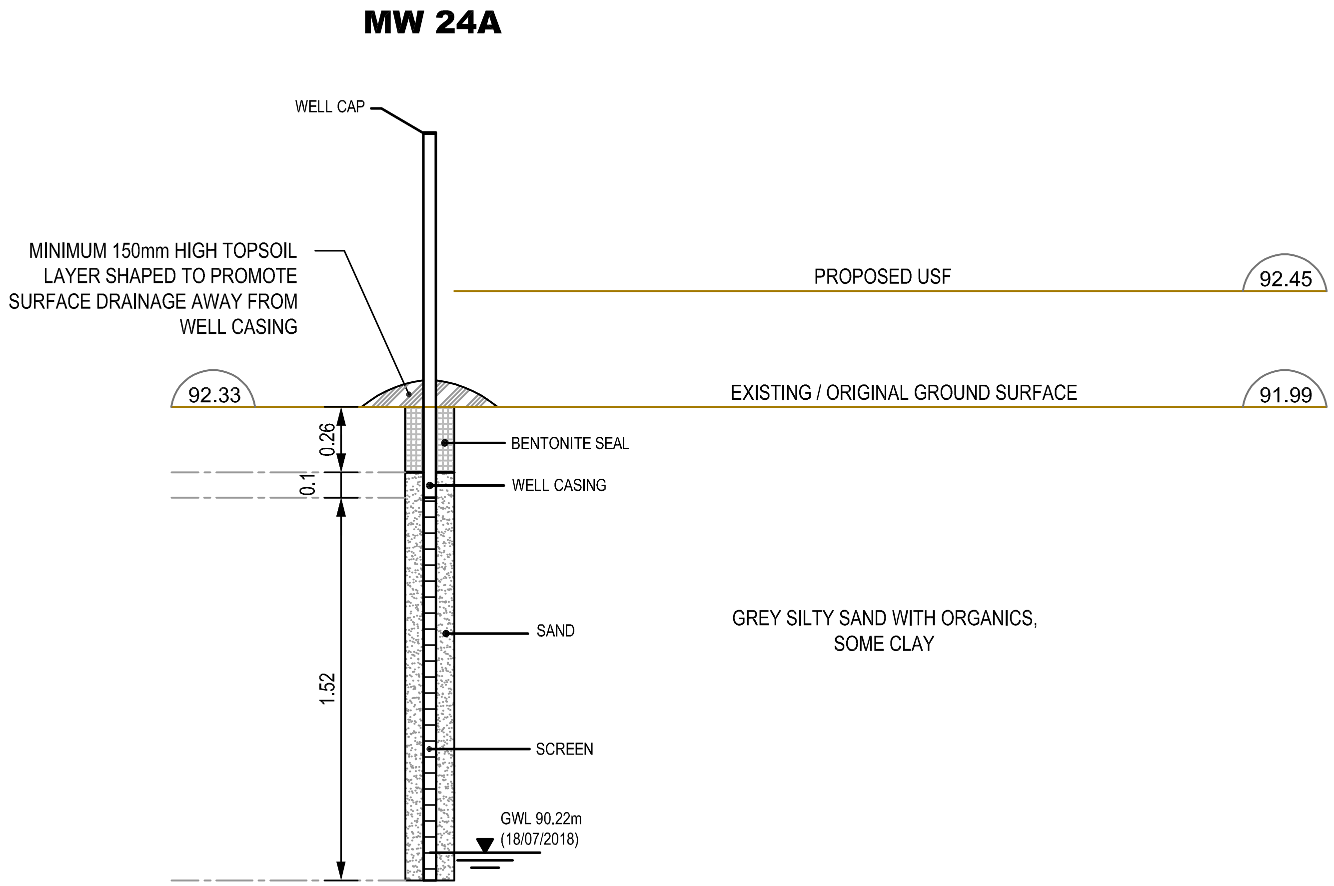

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MATTAMY HOMES

GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:
MW 24A
MONITORING WELL DETAILS

Date: **07/2018**	Report No.: **PG4073**
Scale: **1:30**	Drawing No.: **FIG. 24**
Drawn by: **MPG**	Checked by: **DJG**

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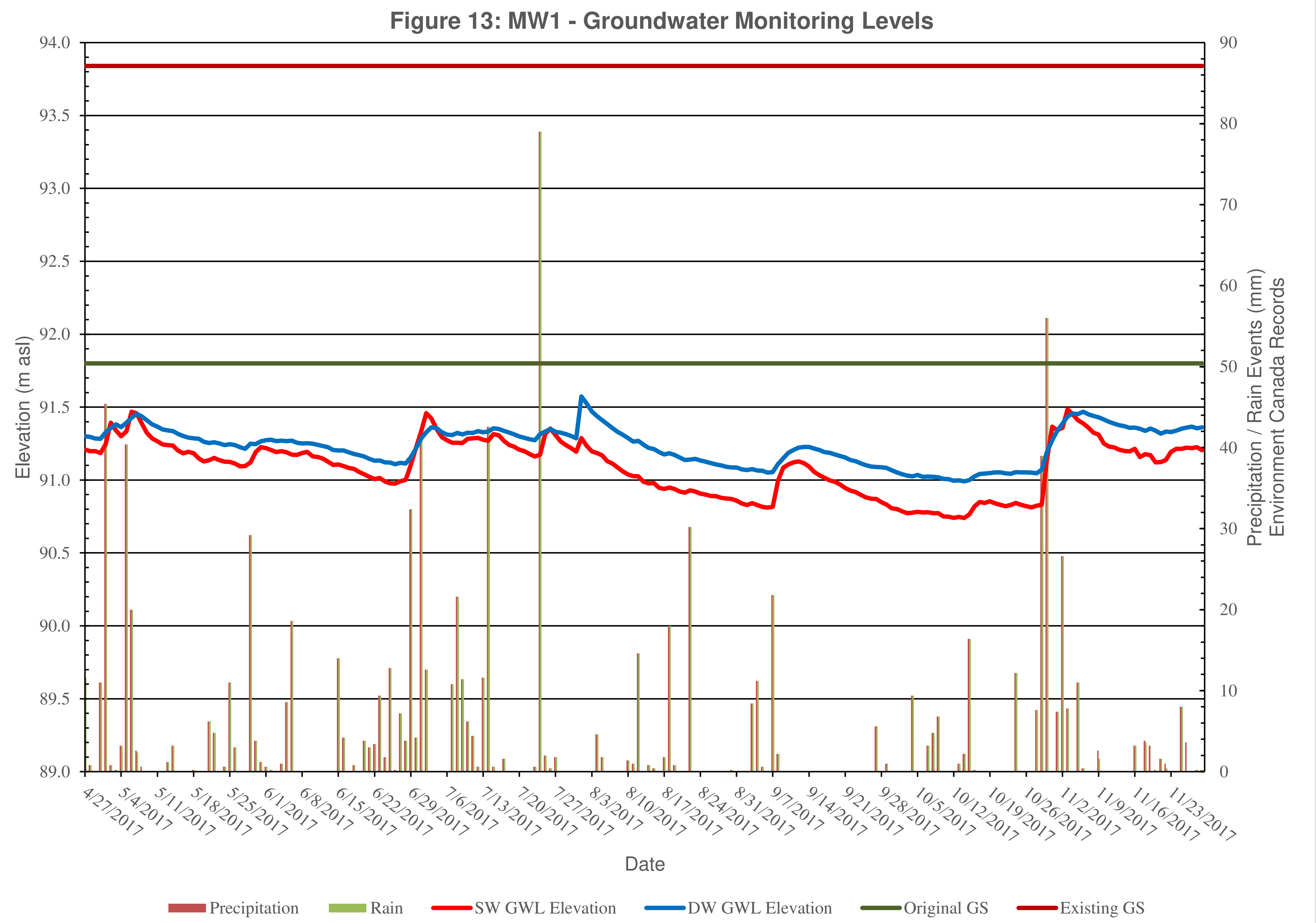
Figure 13: MW1 - Groundwater Monitoring Levels
Elevation (m asl)
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

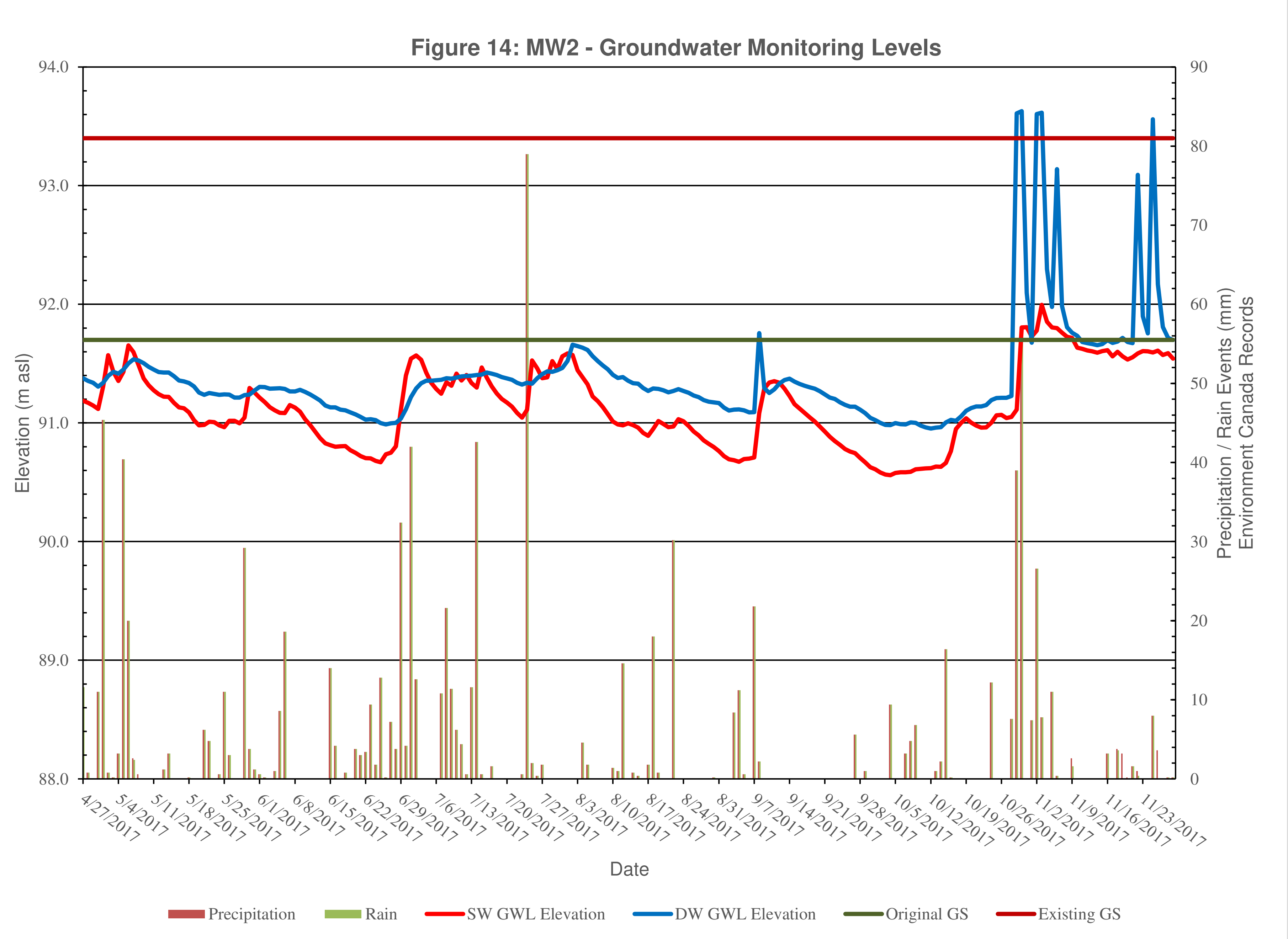
Figure 14: MW2 - Groundwater Monitoring Levels
Elevation (m asl)
94.0
93.0
92.0
91.0
90.0
89.0
88.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
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8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

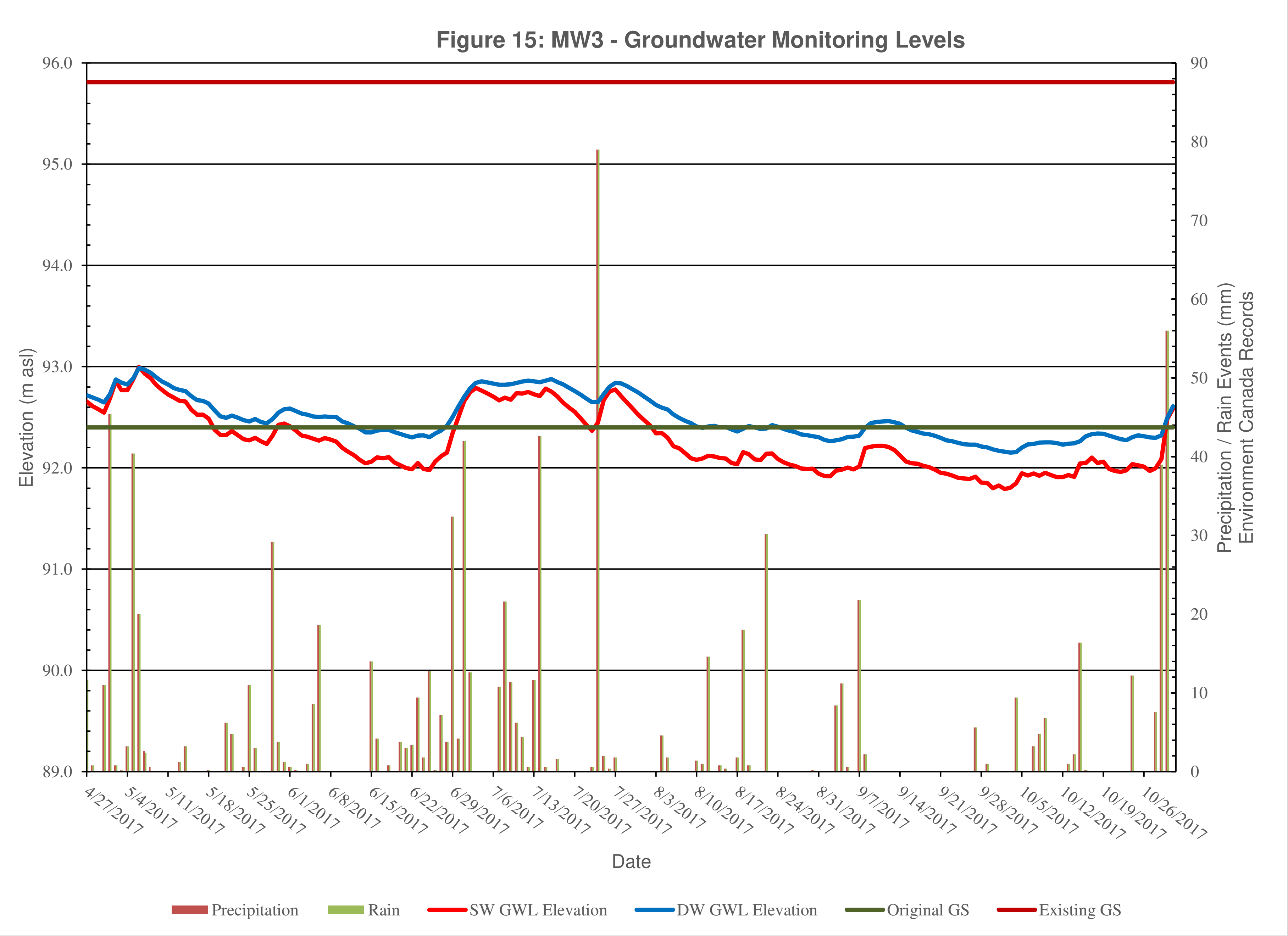


Figure 15: MW3 - Groundwater Monitoring Levels
Elevation (m asl)
96.0
95.0
94.0
93.0
92.0
91.0
90.0
89.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

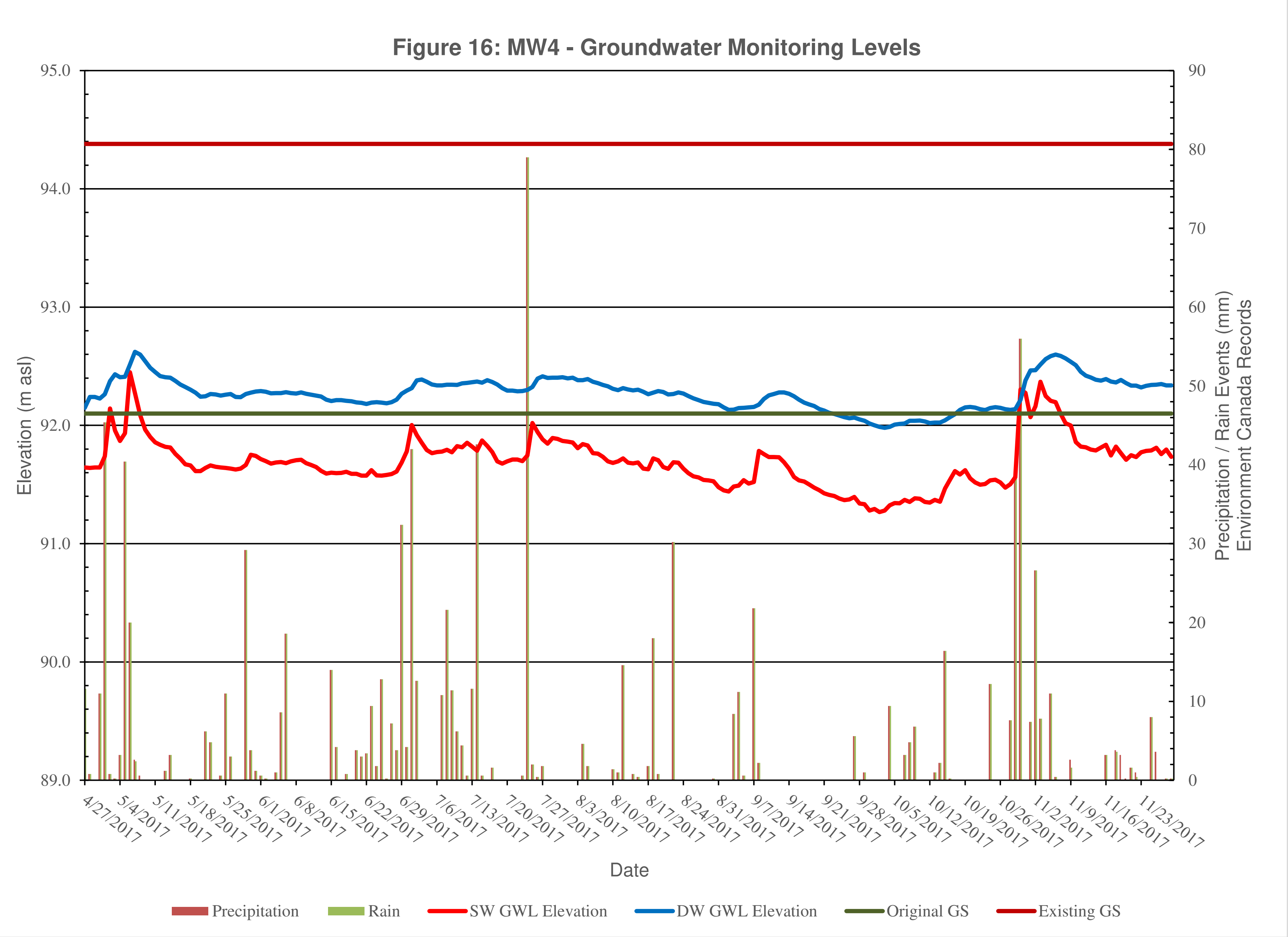


Figure 16: MW4 - Groundwater Monitoring Levels
95.0
94.0
93.0
92.0
91.0
90.0
89.0
Elevation (m asl)
90
80
70
60
50
40
30
20
10
0
Precipitation / Rain Events (mm)
Environment Canada Records
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

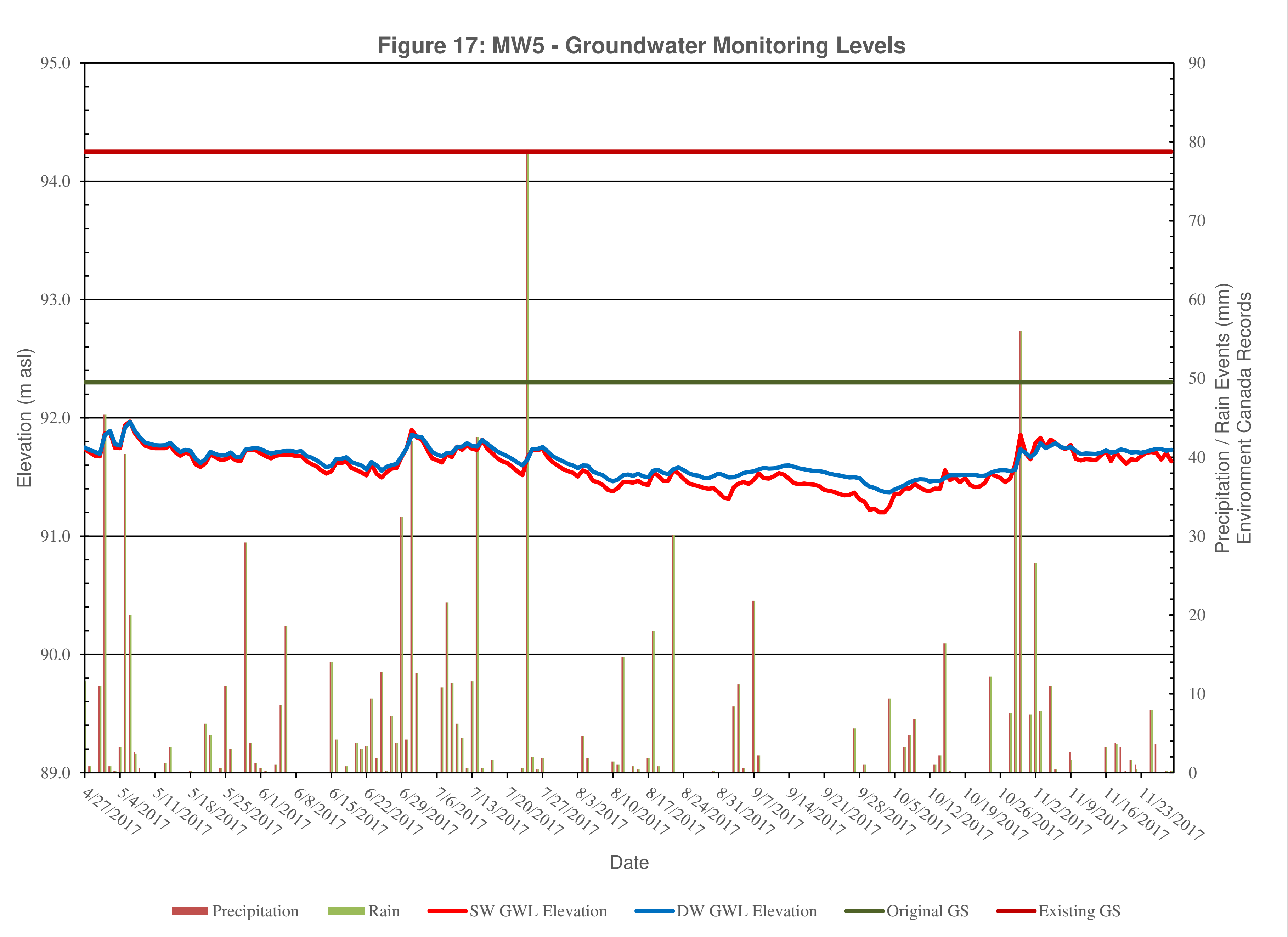


Figure 17: MW5 - Groundwater Monitoring Levels
Elevation (m asl)
95.0
94.0
93.0
92.0
91.0
90.0
89.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
Date
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

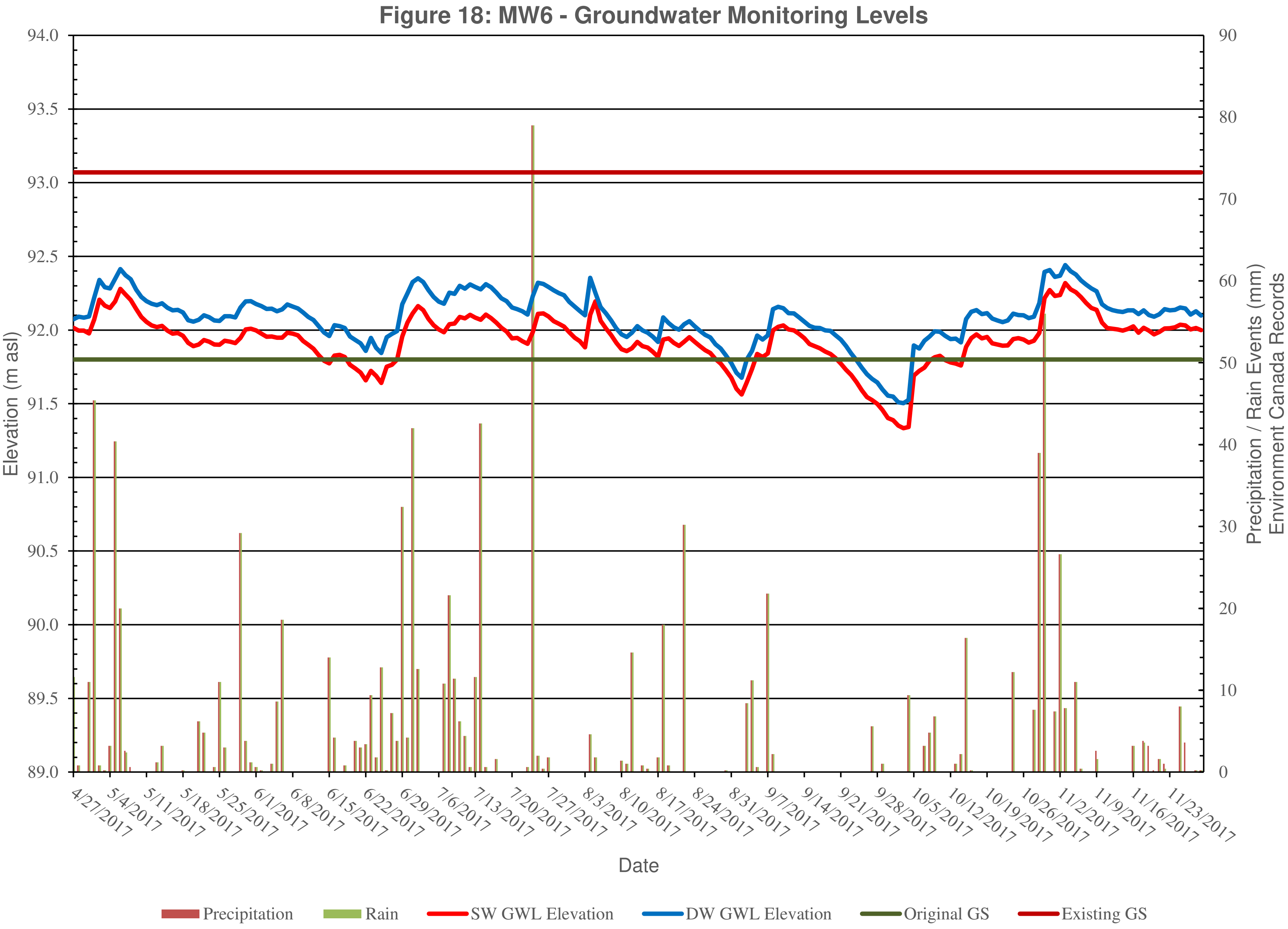


Figure 18: MW6 - Groundwater Monitoring Levels
Elevation (m asl)
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

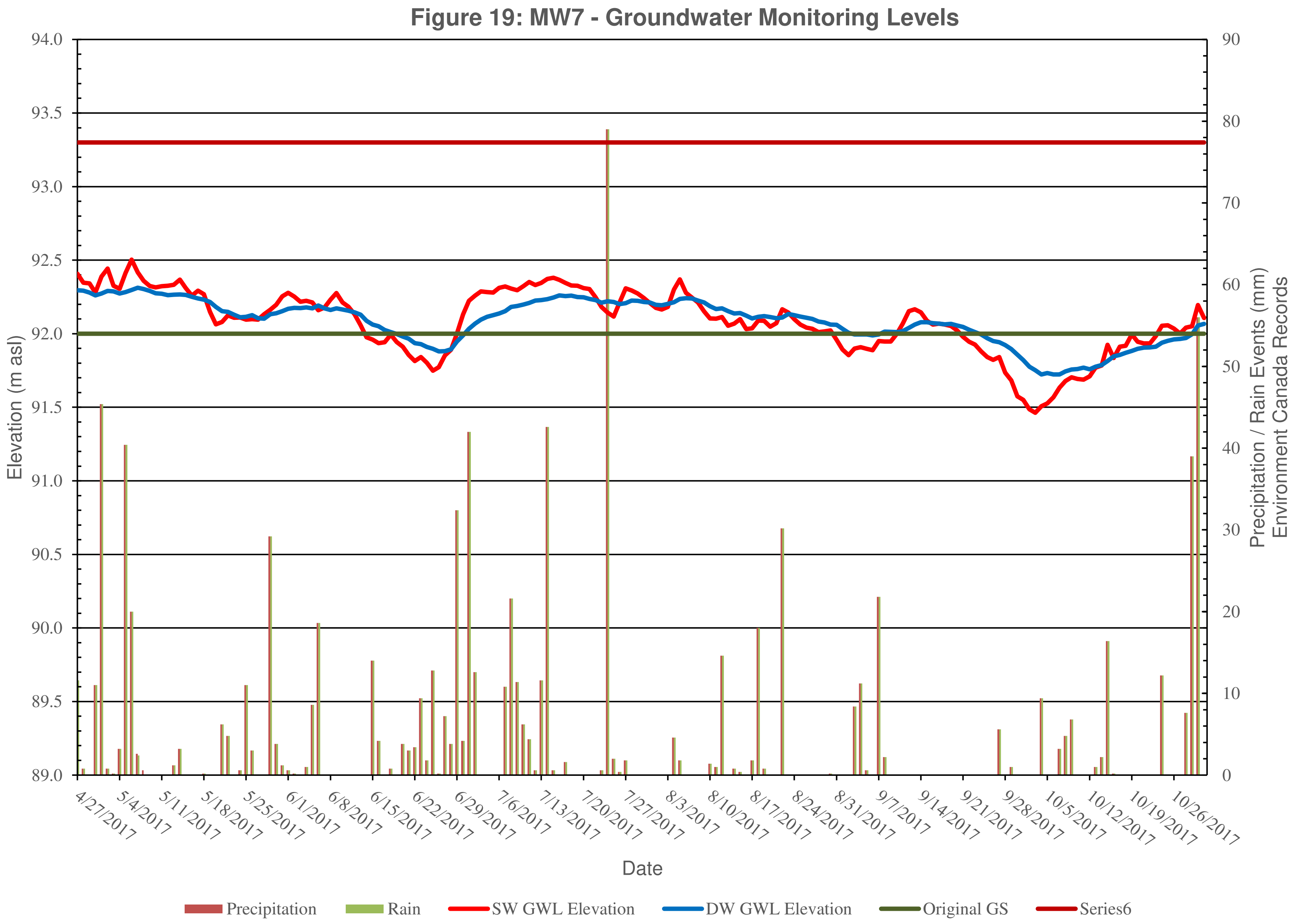
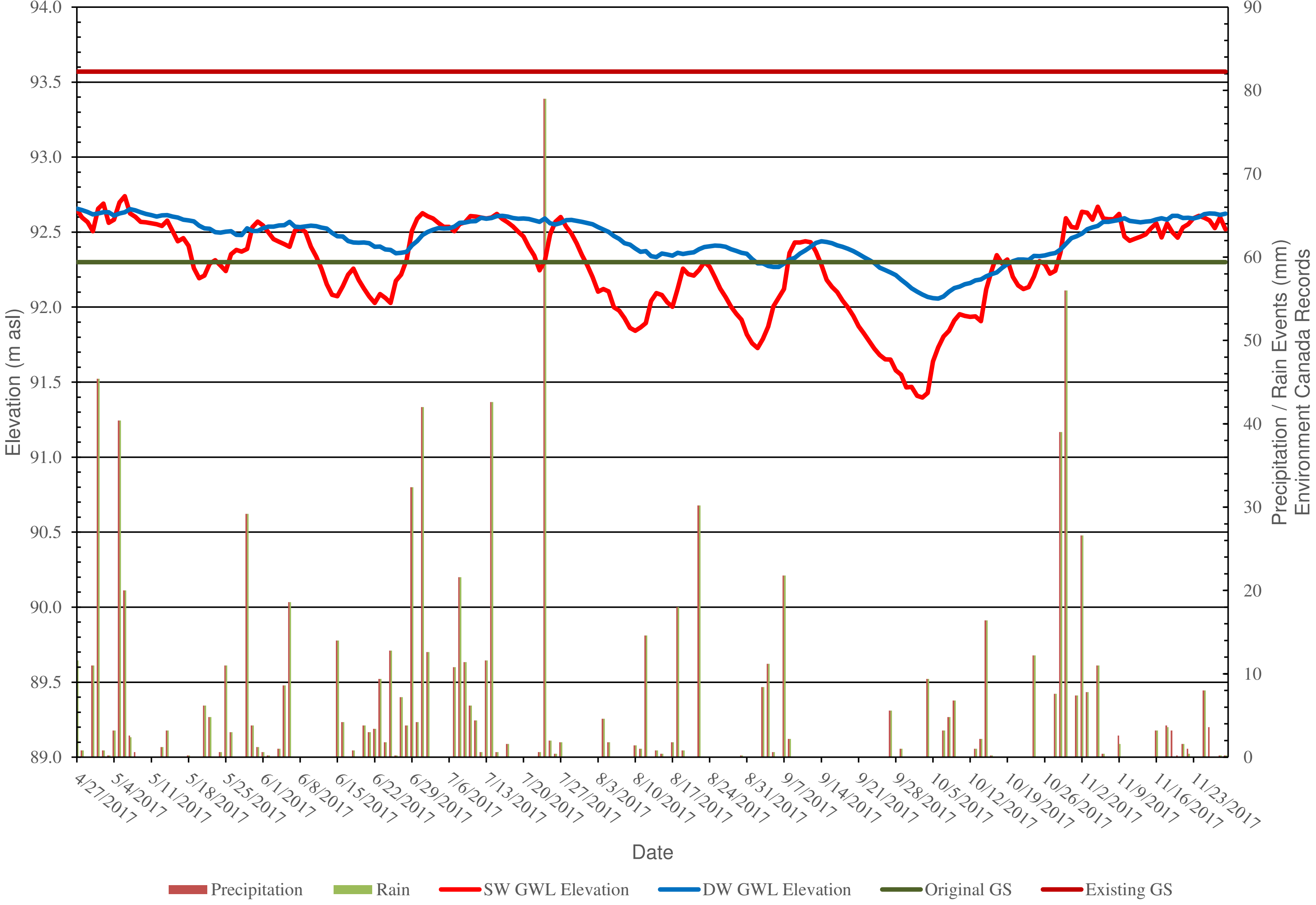


Figure 19: MW7 - Groundwater Monitoring Levels
Elevation (m asl)
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
Precipitation / Rain Events (mm)
Environment Canada Records
90
80
70
60
50
40
30
20
10
0
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Series6

Figure 20: MW8 - Groundwater Monitoring Levels



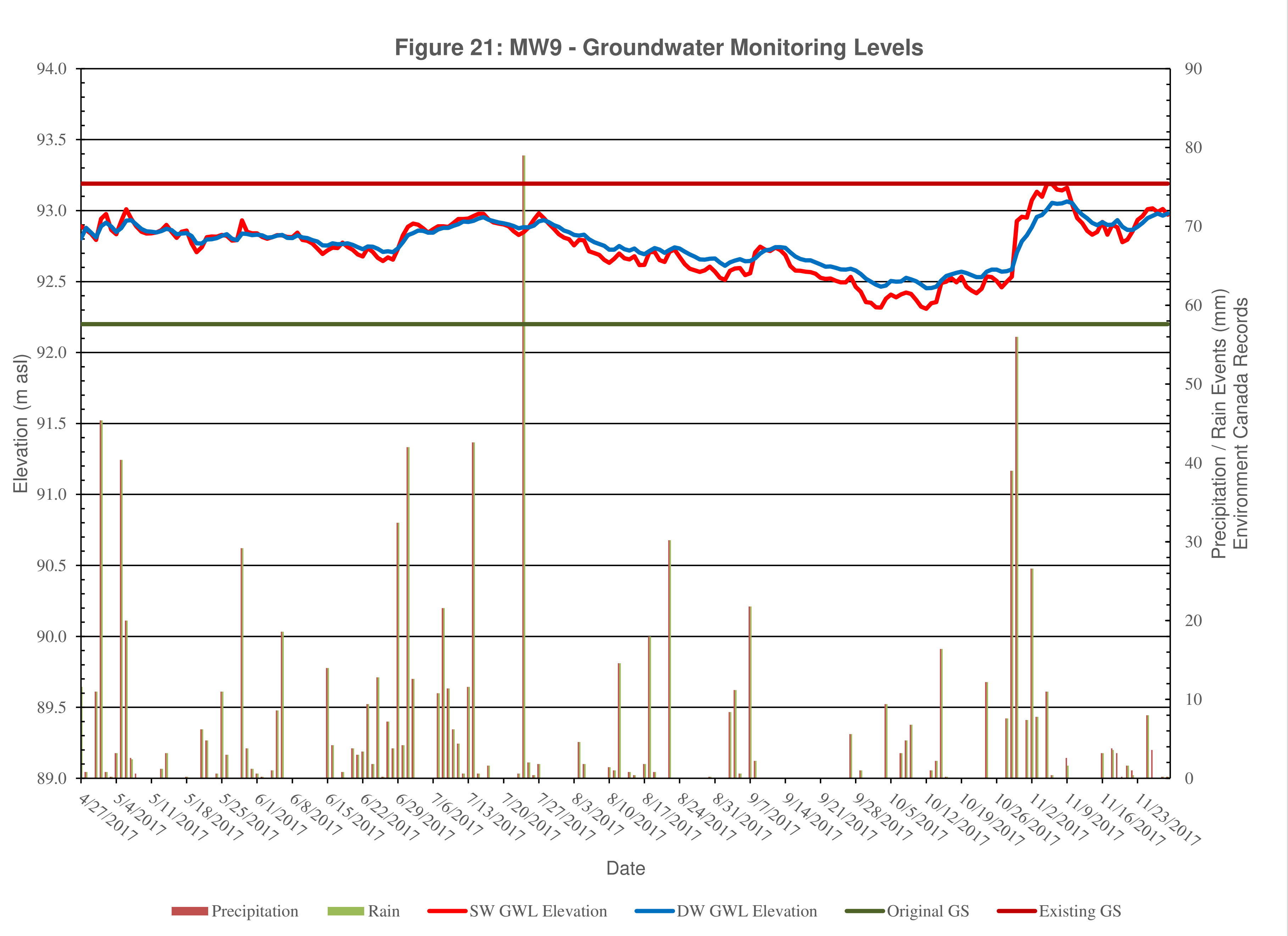
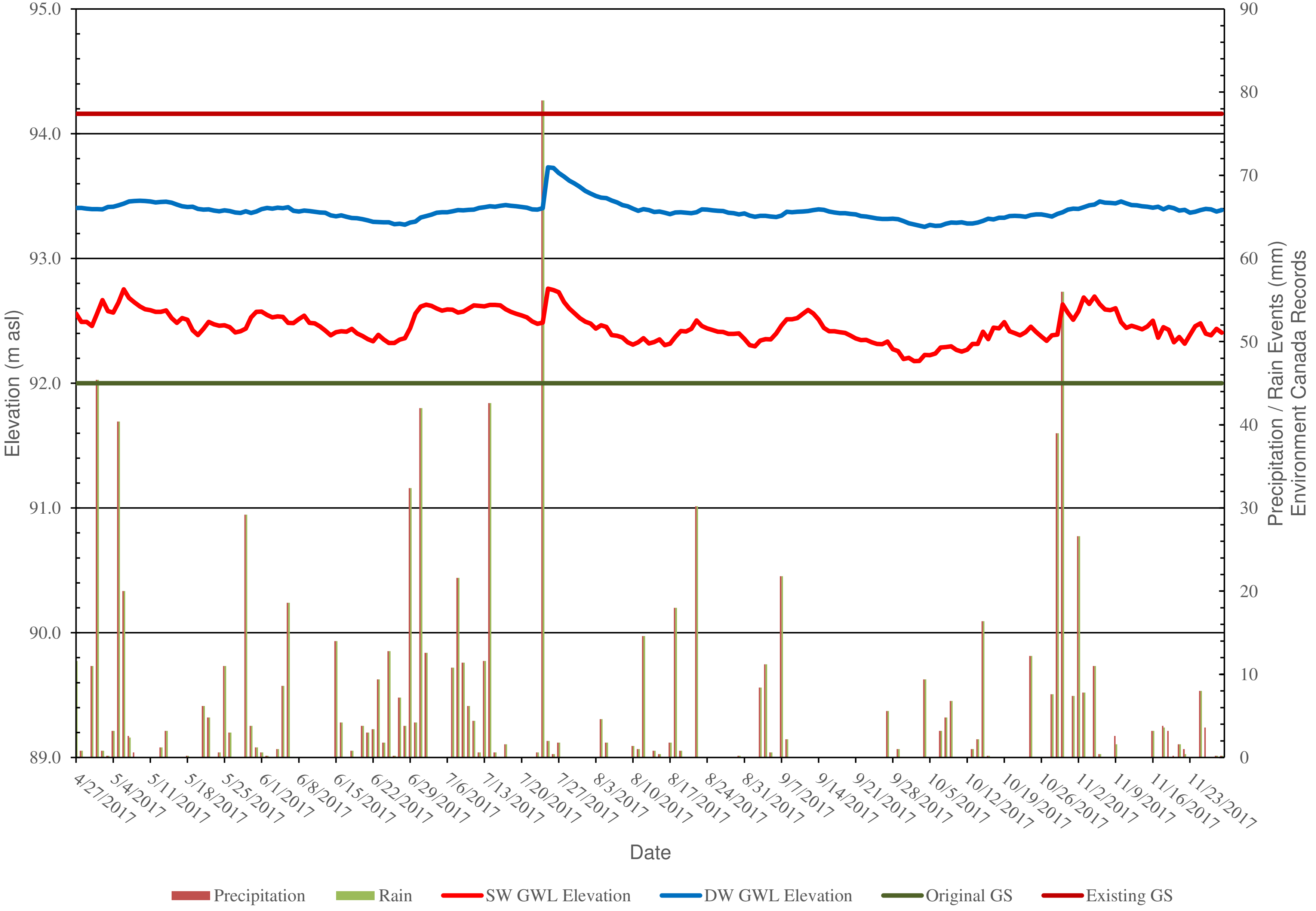


Figure 21: MW9 - Groundwater Monitoring Levels
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
89.5
89.0
Elevation (m asl)
90
80
70
60
50
40
30
20
10
0
Precipitation / Rain Events (mm)
Environment Canada Records
4/27/2017
5/4/2017
5/11/2017
5/18/2017
5/25/2017
6/1/2017
6/8/2017
6/15/2017
6/22/2017
6/29/2017
7/6/2017
7/13/2017
7/20/2017
7/27/2017
8/3/2017
8/10/2017
8/17/2017
8/24/2017
8/31/2017
9/7/2017
9/14/2017
9/21/2017
9/28/2017
10/5/2017
10/12/2017
10/19/2017
10/26/2017
11/2/2017
11/9/2017
11/16/2017
11/23/2017
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Original GS
Existing GS

Figure 22: MW10 - Groundwater Monitoring Levels



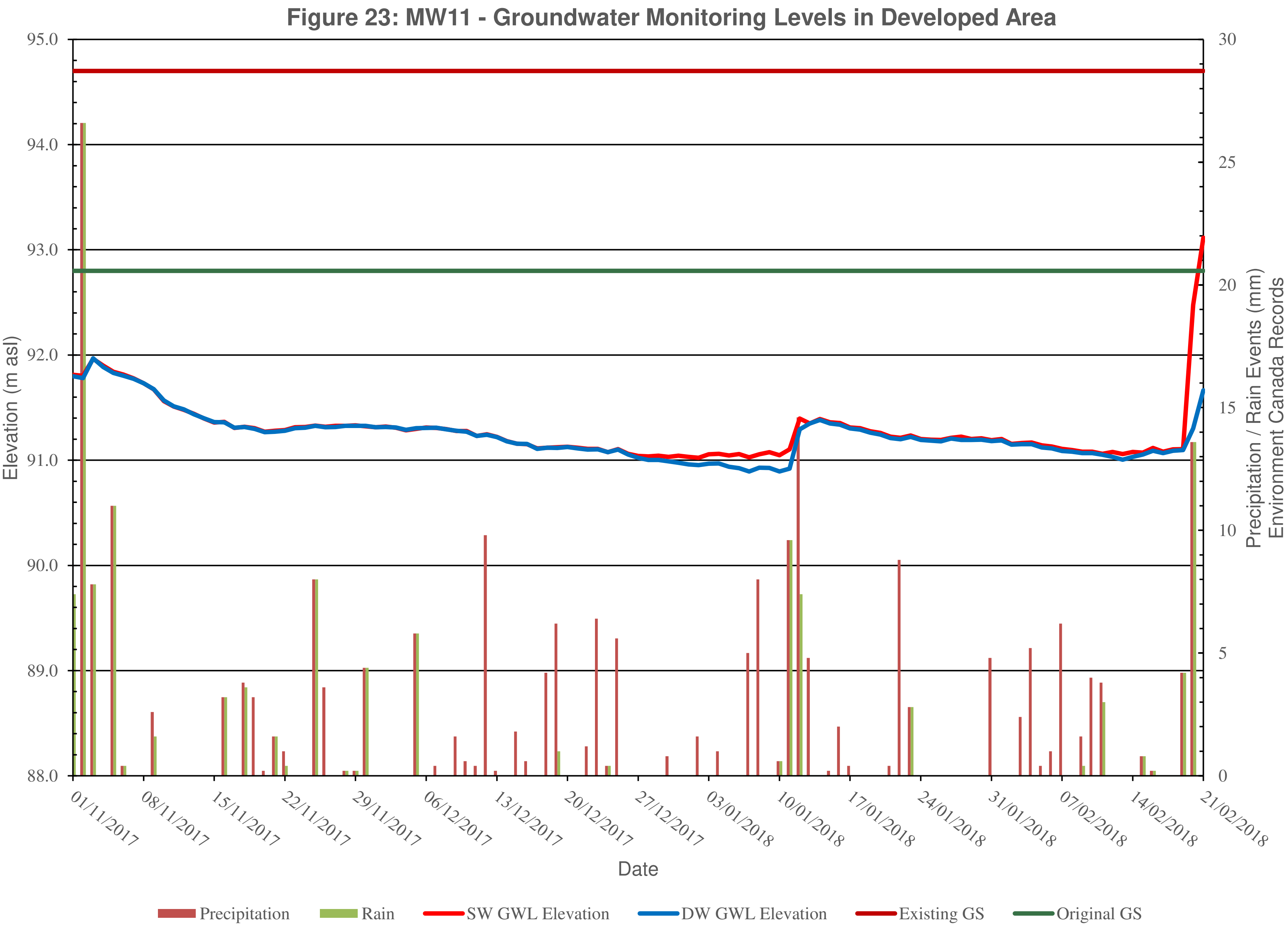


Figure 23: MW11 - Groundwater Monitoring Levels in Developed Area
Elevation (m asl)
95.0
94.0
93.0
92.0
91.0
90.0
89.0
88.0
Precipitation / Rain Events (mm)
Environment Canada Records
30
25
20
15
10
5
0
01/11/2017
08/11/2017
15/11/2017
22/11/2017
29/11/2017
06/12/2017
13/12/2017
20/12/2017
27/12/2017
03/01/2018
10/01/2018
17/01/2018
24/01/2018
31/01/2018
07/02/2018
14/02/2018
21/02/2018
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Existing GS
Original GS

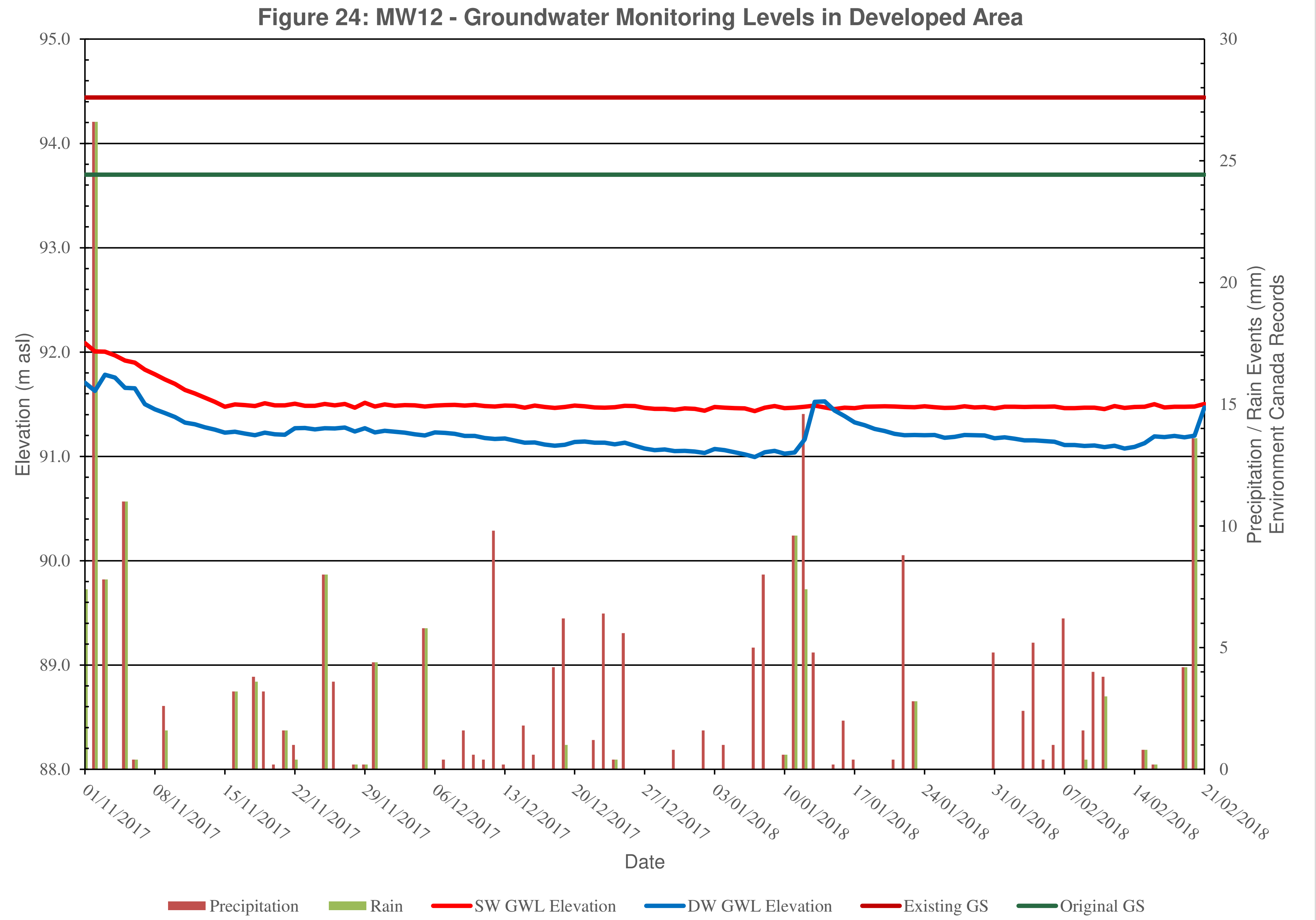
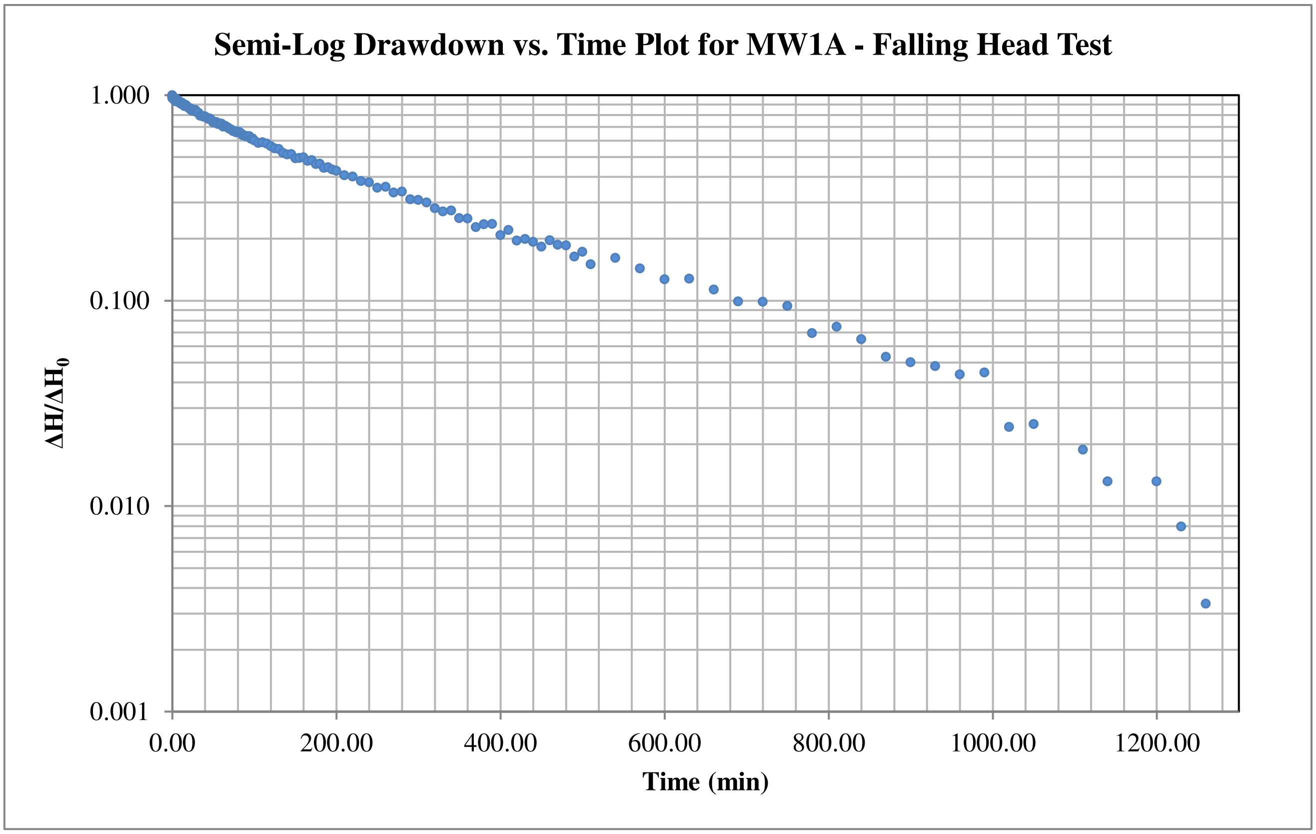


Figure 24: MW12 - Groundwater Monitoring Levels in Developed Area
Elevation (m asl)
95.0
94.0
93.0
92.0
91.0
90.0
89.0
88.0
Precipitation / Rain Events (mm)
Environment Canada Records
30
25
20
15
10
5
0
01/11/2017
08/11/2017
15/11/2017
22/11/2017
29/11/2017
06/12/2017
13/12/2017
20/12/2017
27/12/2017
03/01/2018
10/01/2018
17/01/2018
24/01/2018
31/01/2018
07/02/2018
14/02/2018
21/02/2018
Date
Precipitation
Rain
SW GWL Elevation
DW GWL Elevation
Existing GS
Original GS

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW1A
Test: Falling Head
Date: June 22, 2018



Semi-Log Drawdown vs. Time Plot for MW1A - Falling Head Test

Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.98864

Well Parameters:

L	2.1	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

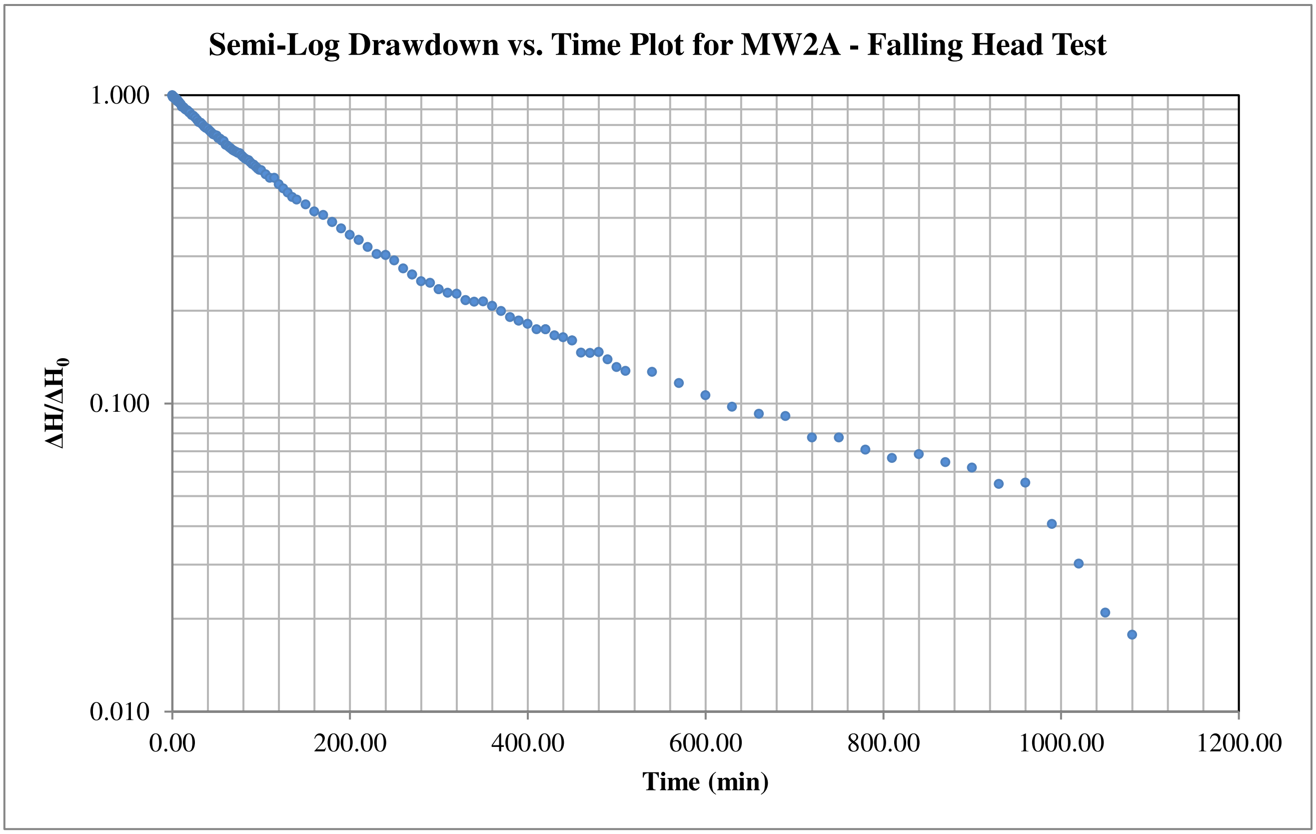
Data Points (from plot):

t*: 242.134 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.64E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW2A
Test: Falling Head
Date: June 21, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.98864

Well Parameters:

L	2.1	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

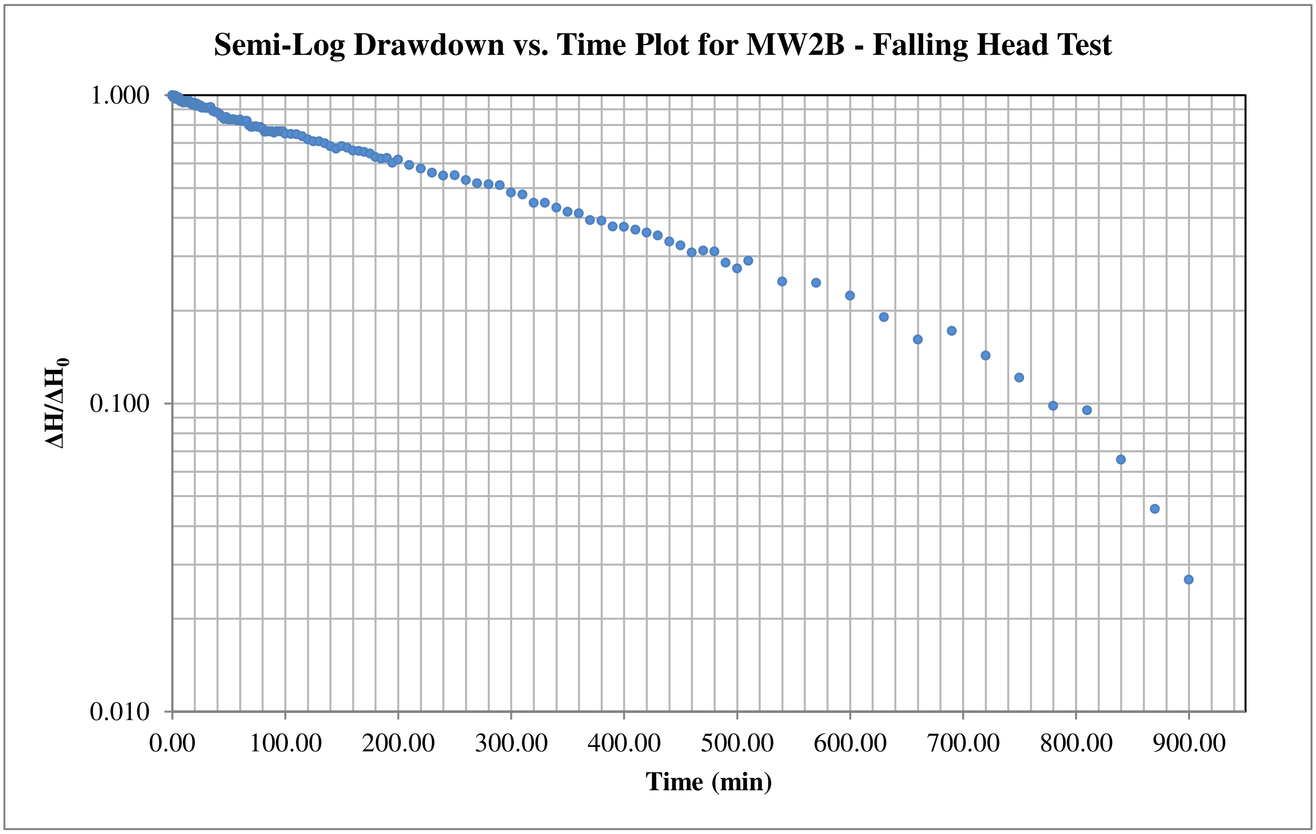
Data Points (from plot):

t*: 188.618 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 5.96E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW2B
Test: Falling Head
Date: June 21, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

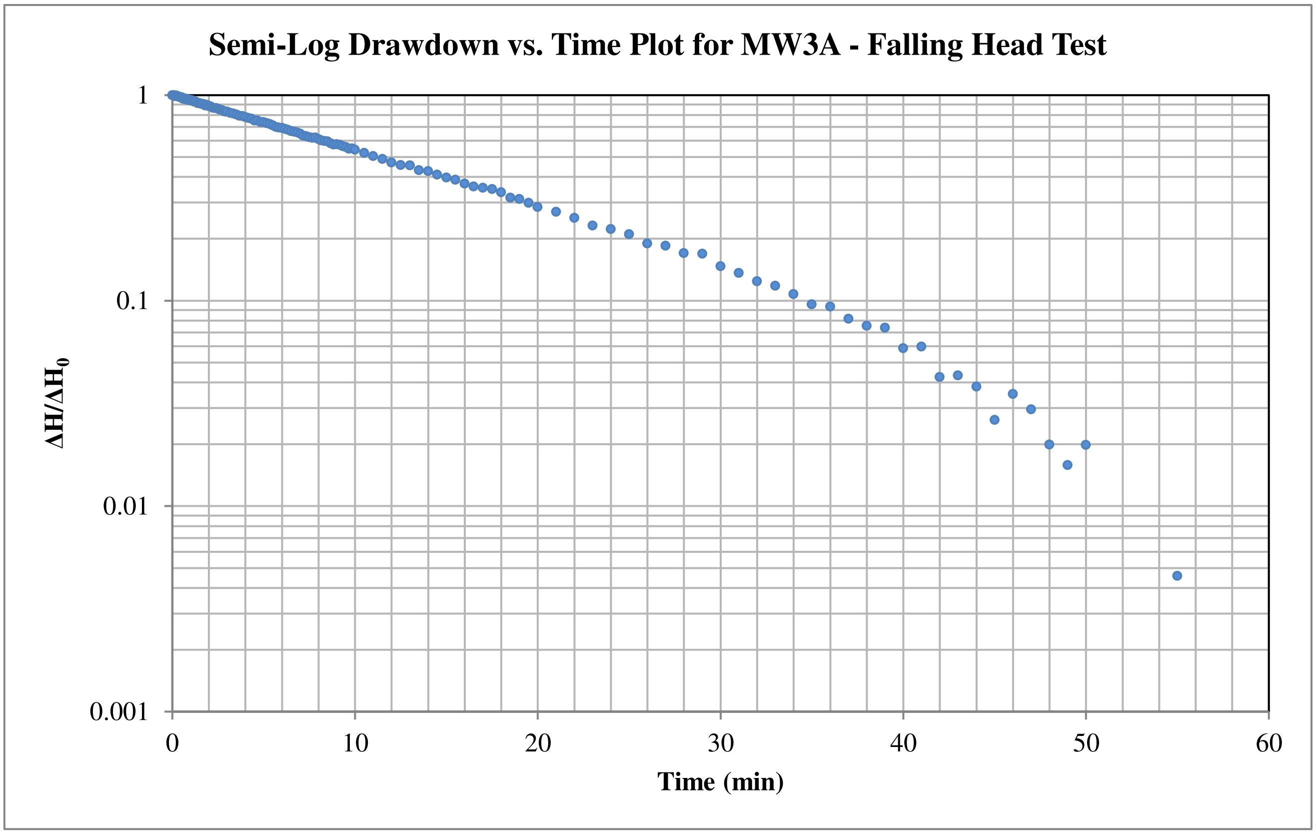
Data Points (from plot):

t*: 393.409 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.69E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW3A
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 3.02163

Well Parameters:

L	2.13 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

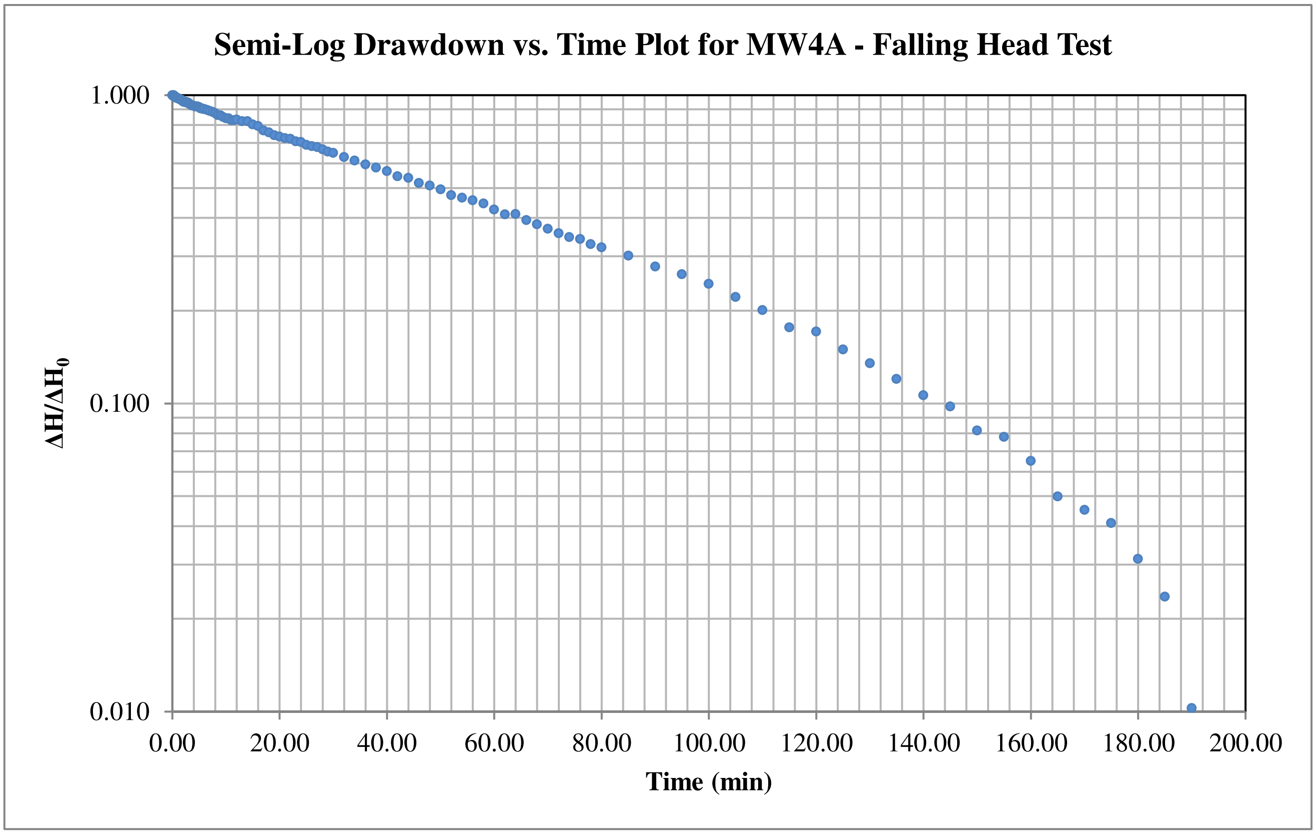
Data Points (from plot):

t*: 16.037 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 6.93E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW4A
Test: Falling Head
Date: June 21, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$\boxed{K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)}$$

Hvorslev Shape Factor

$$\boxed{F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.98864

Well Parameters:

L	2.1	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

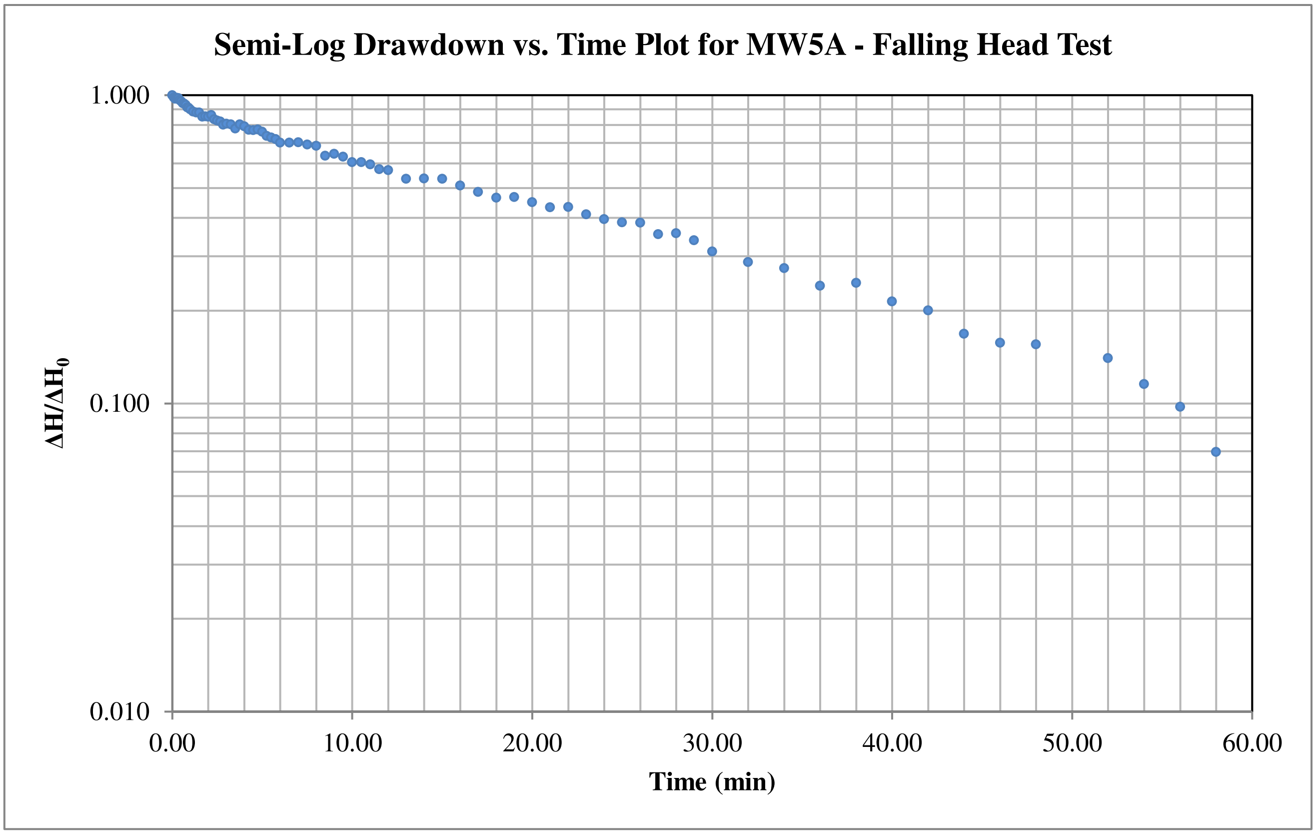
Data Points (from plot):

t*: 69.653 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.61E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW5A
Test: Falling Head
Date: June 22, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.98864

Well Parameters:

L	2.1	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

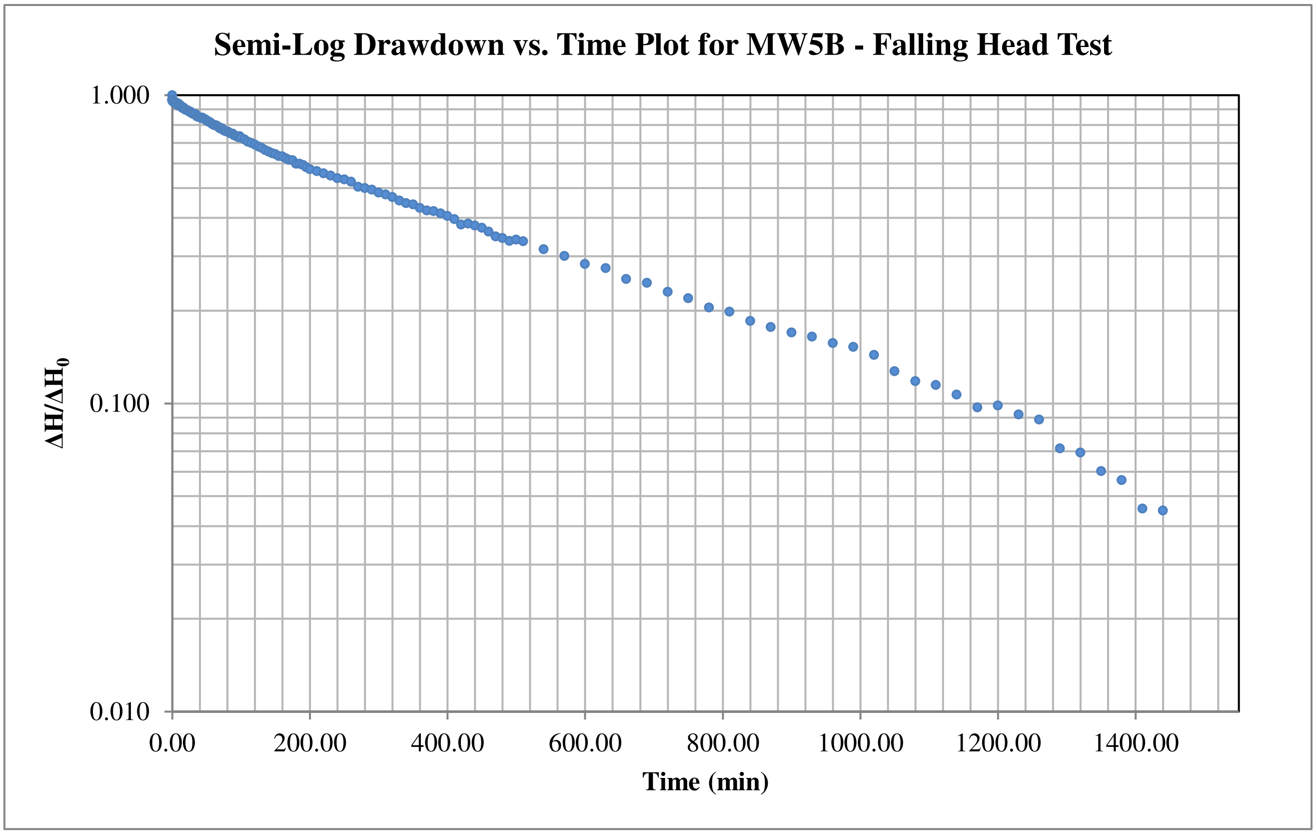
Data Points (from plot):

t*: 26.167 minutes ΔH*/ΔH_0: 0.37

Horizontal Hydraulic Conductivity
K = 4.29E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW5B
Test: Falling Head
Date: June 22, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$\boxed{K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)}$$

Hvorslev Shape Factor

$$\boxed{F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

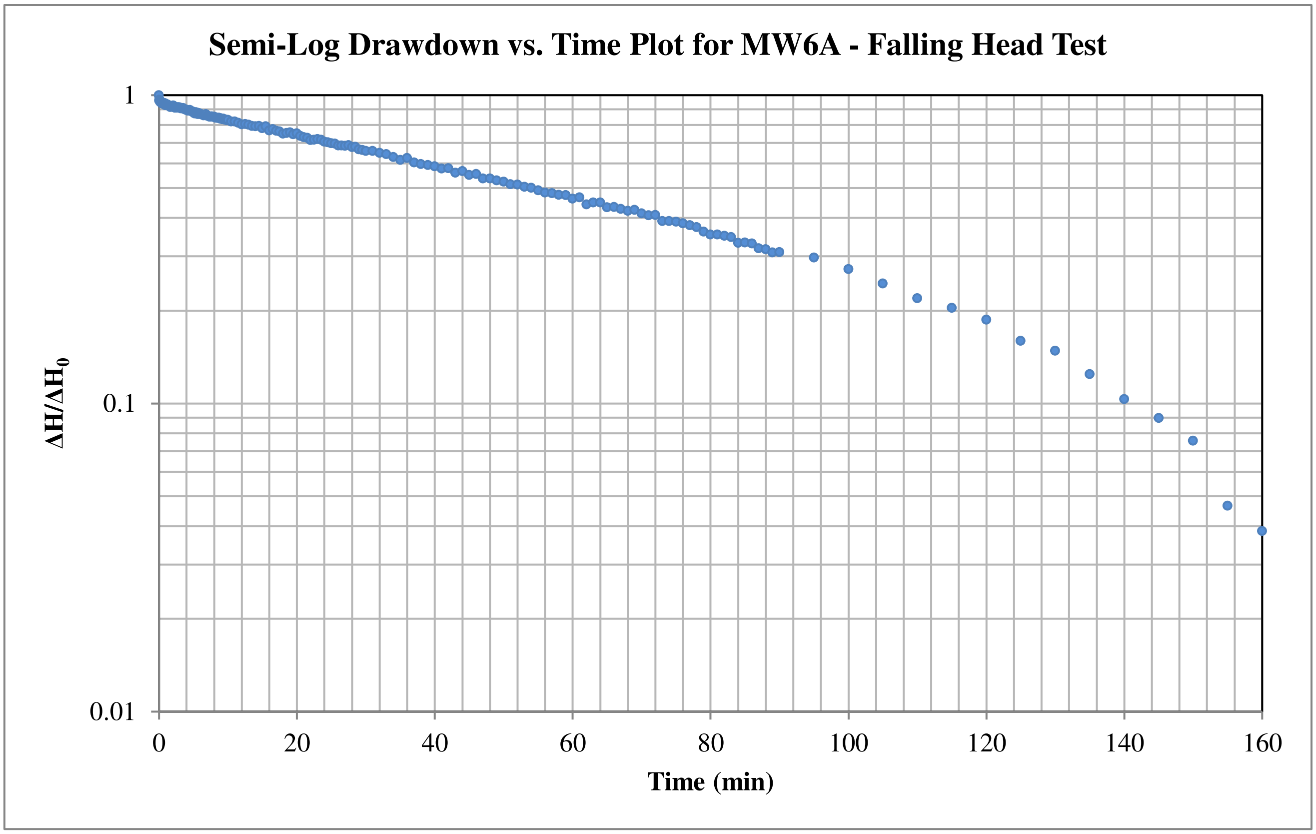
Data Points (from plot):

t*: 453.268 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.21E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW6A
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.99965

Well Parameters:

L	2.11	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

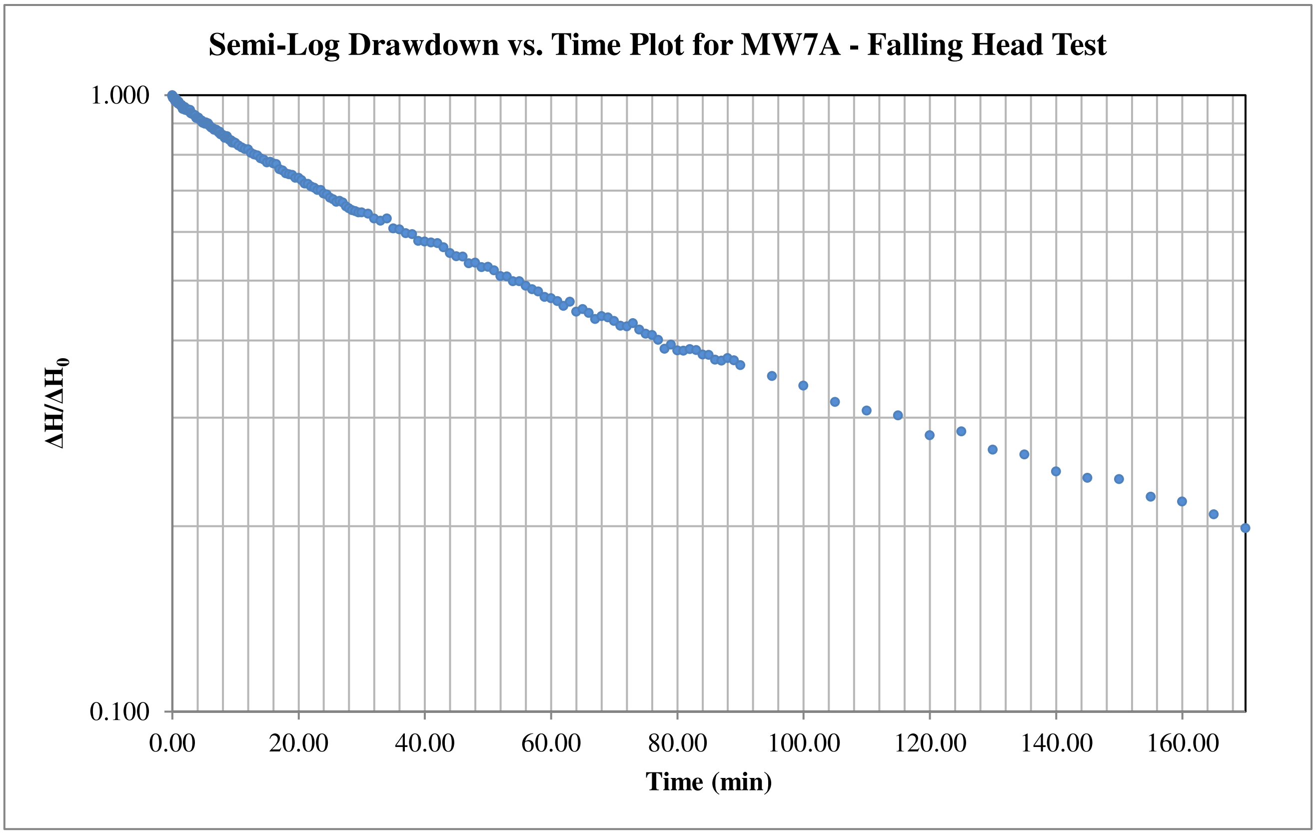
Data Points (from plot):

t*: 77.448 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.45E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW7A
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.99965

Well Parameters:

L	2.11	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

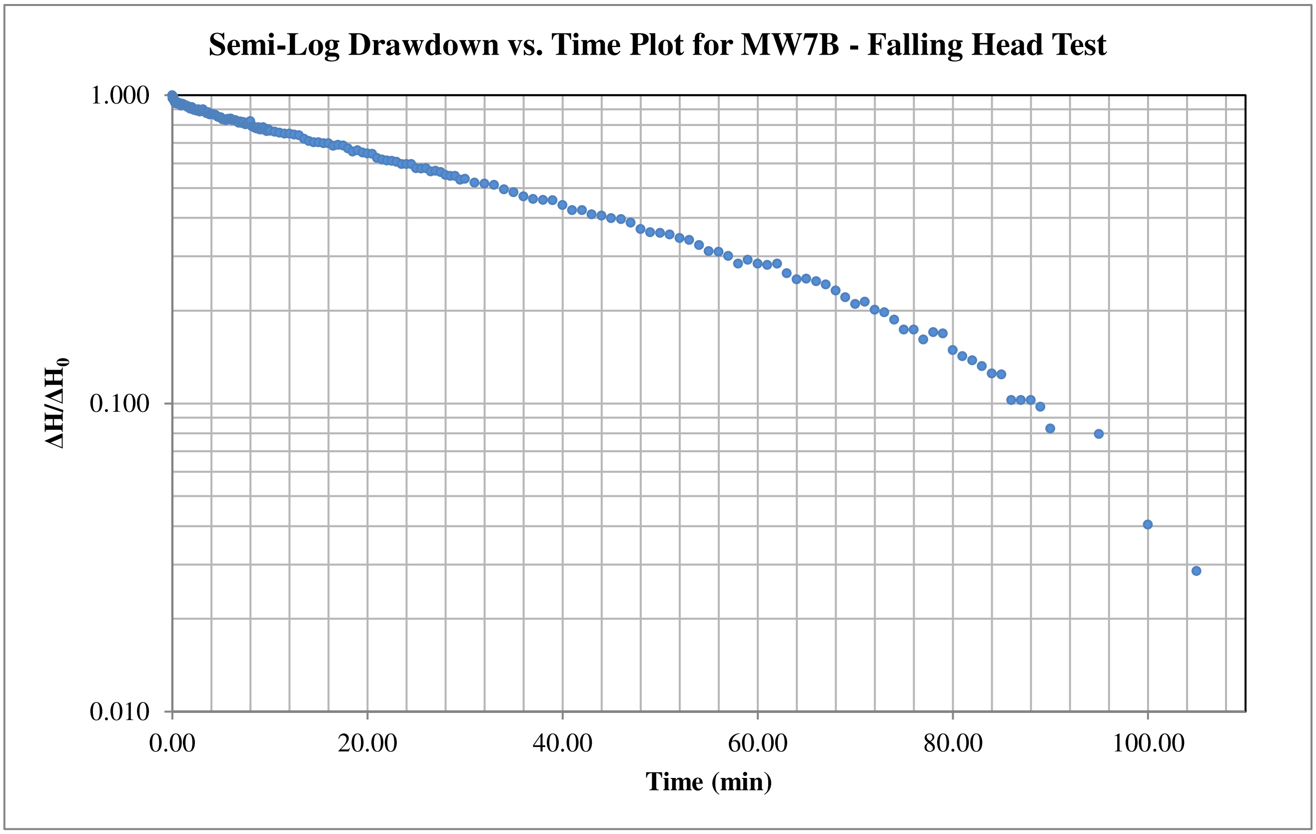
Data Points (from plot):

t*: 86.224 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.30E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW7B
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

L	1.52 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

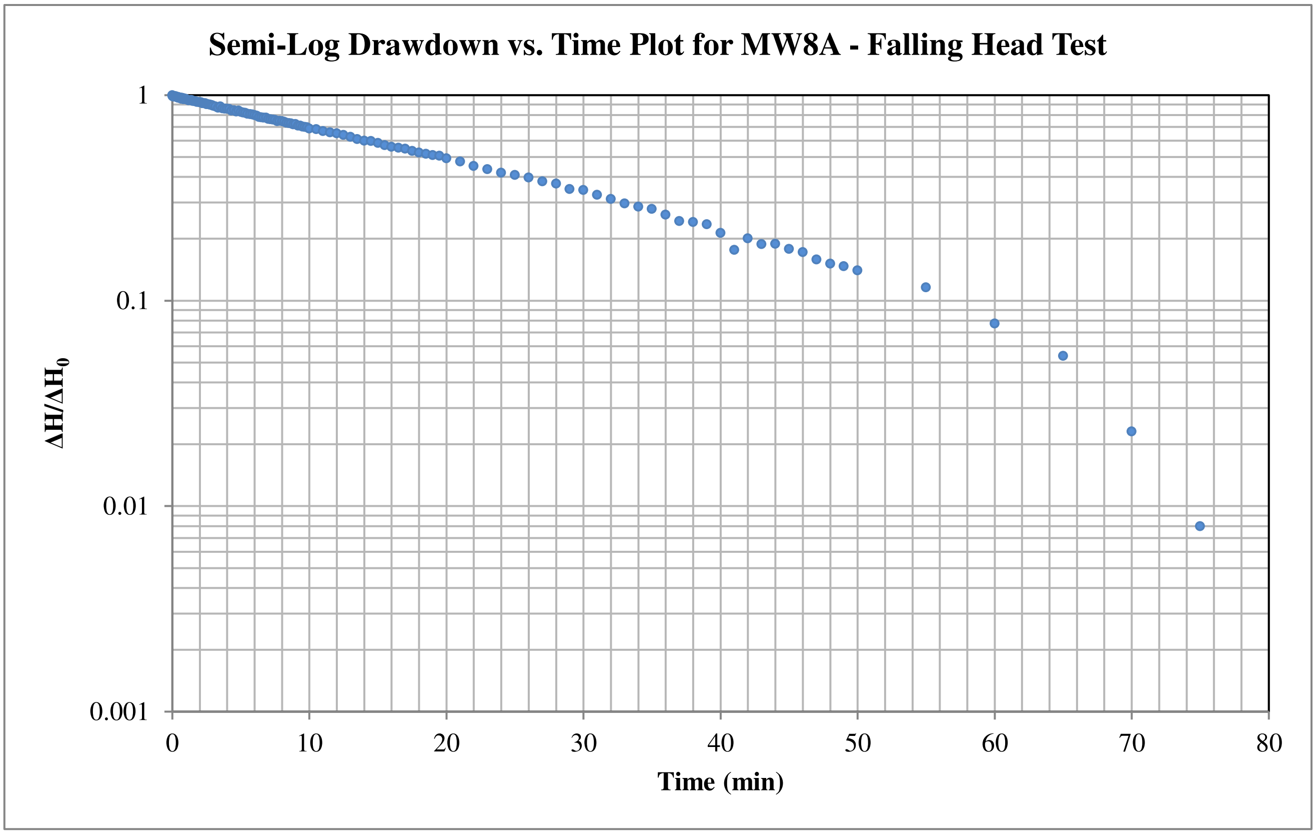
Data Points (from plot):

t*: 47.455 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.03E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW8A
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.99965

Well Parameters:

L	2.11	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

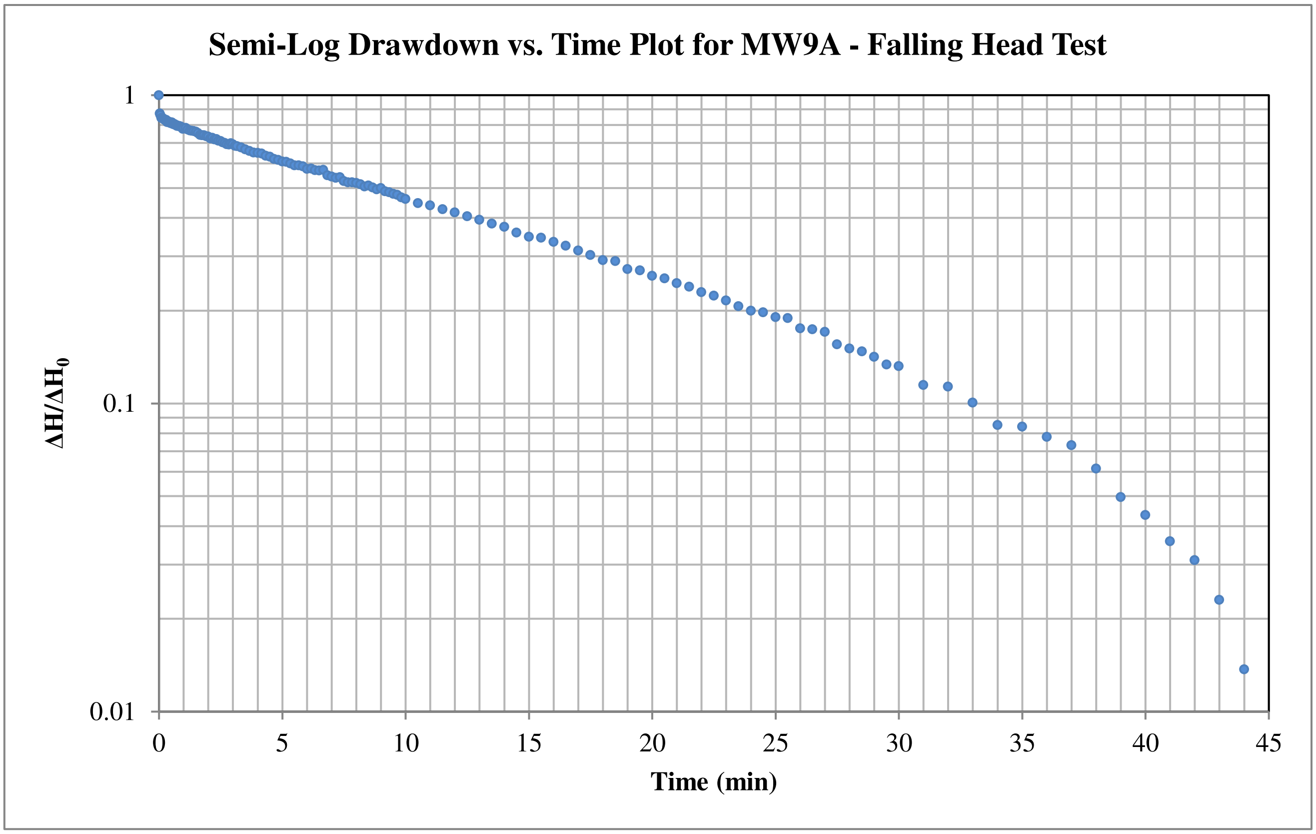
Data Points (from plot):

t*: 28.016 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.00E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW9A
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.99965

Well Parameters:

L	2.11	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

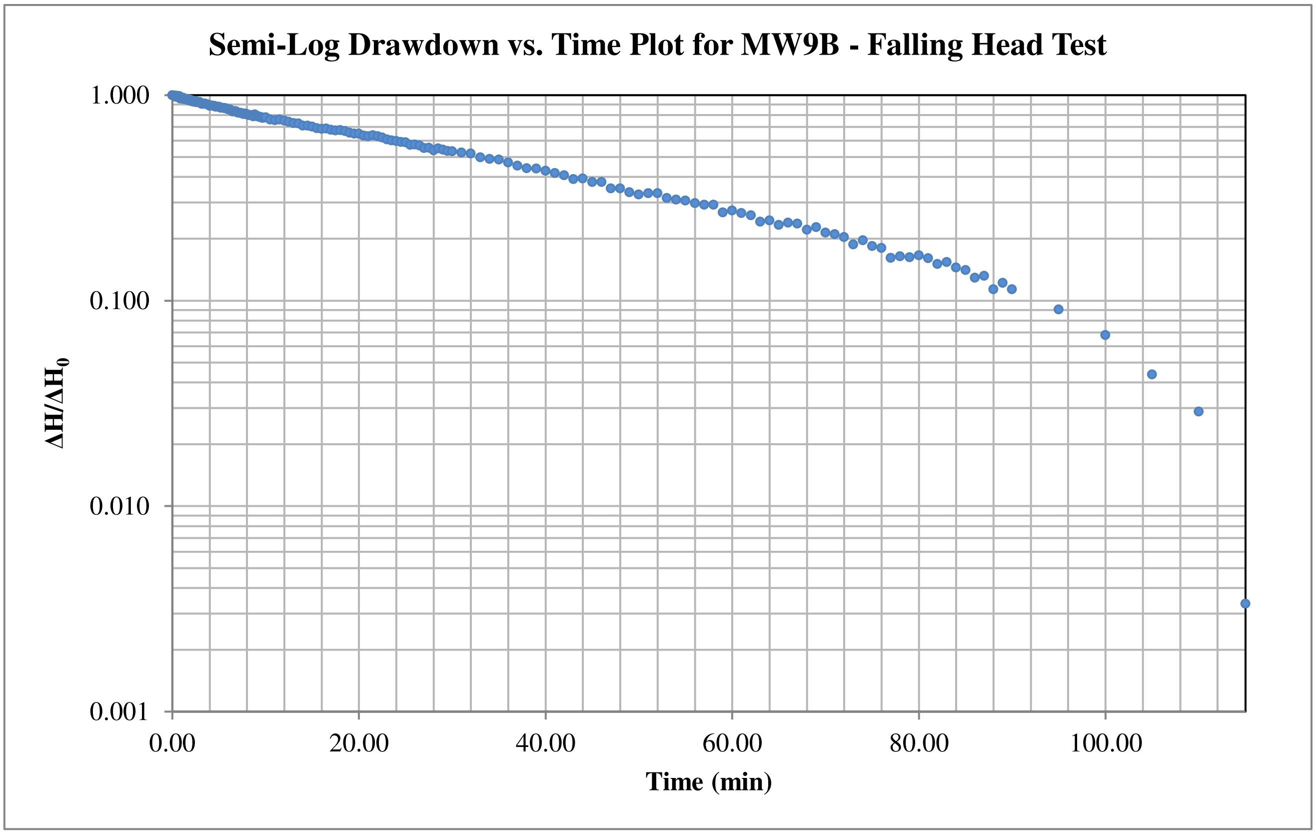
Data Points (from plot):

t*: 14.077 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 7.95E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW9B
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.33409

Well Parameters:

L	1.52	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

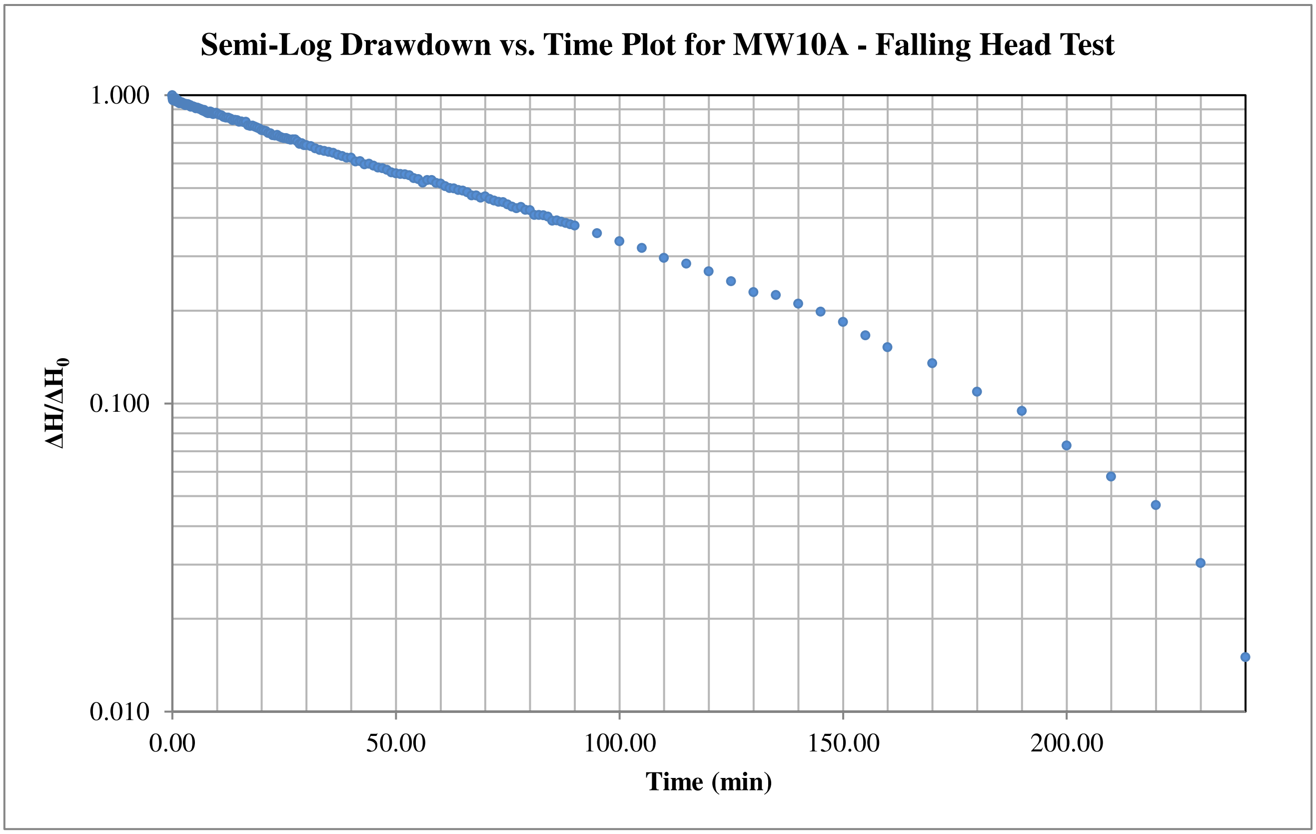
Data Points (from plot):

t*: 46.167 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.12E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW10A
Test: Falling Head
Date: April 19, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.99965

Well Parameters:

L	2.11	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

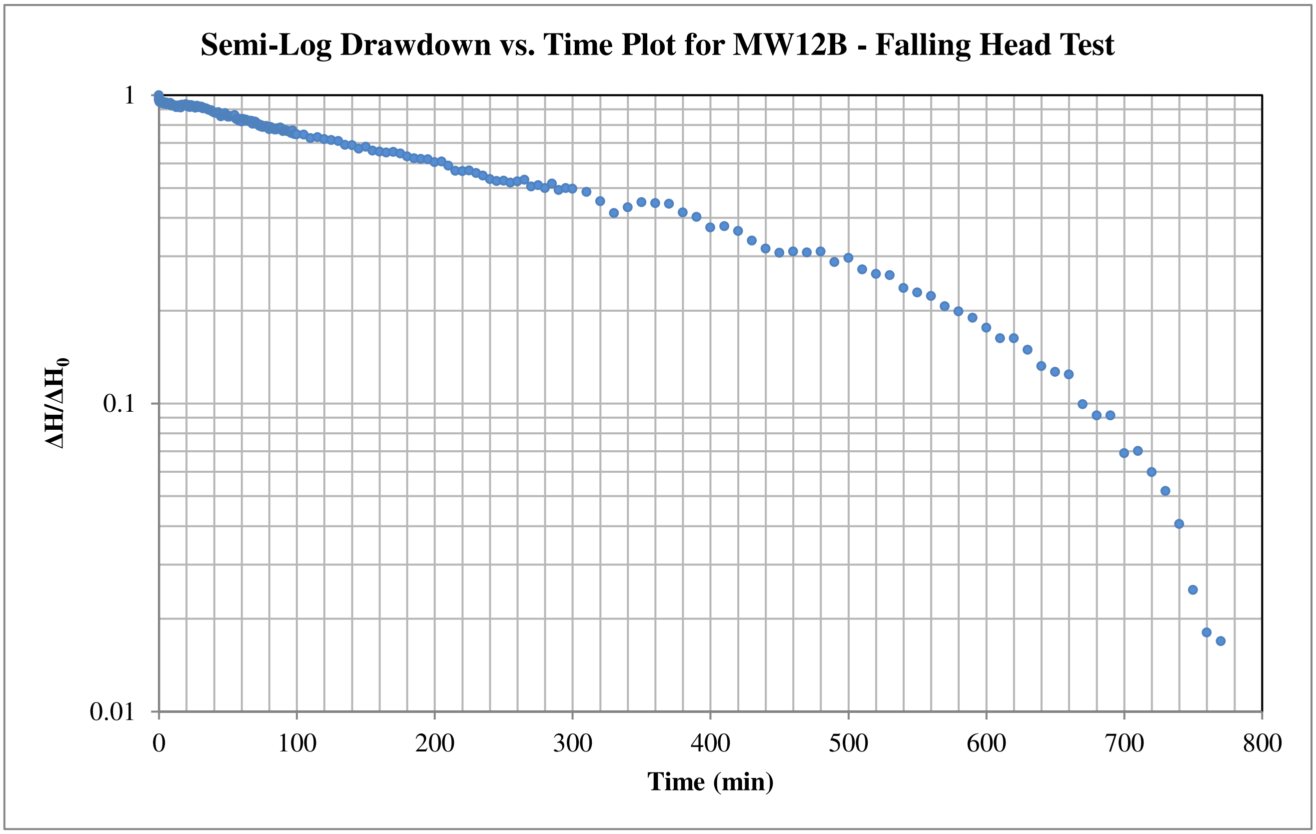
Data Points (from plot):

t*: 91.740 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.22E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW12B
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.09288

Well Parameters:

L	1.52	m	Saturated length of screen or open hole
D	0.0317	m	Diameter of well
r_c	0.01585	m	Radius of well

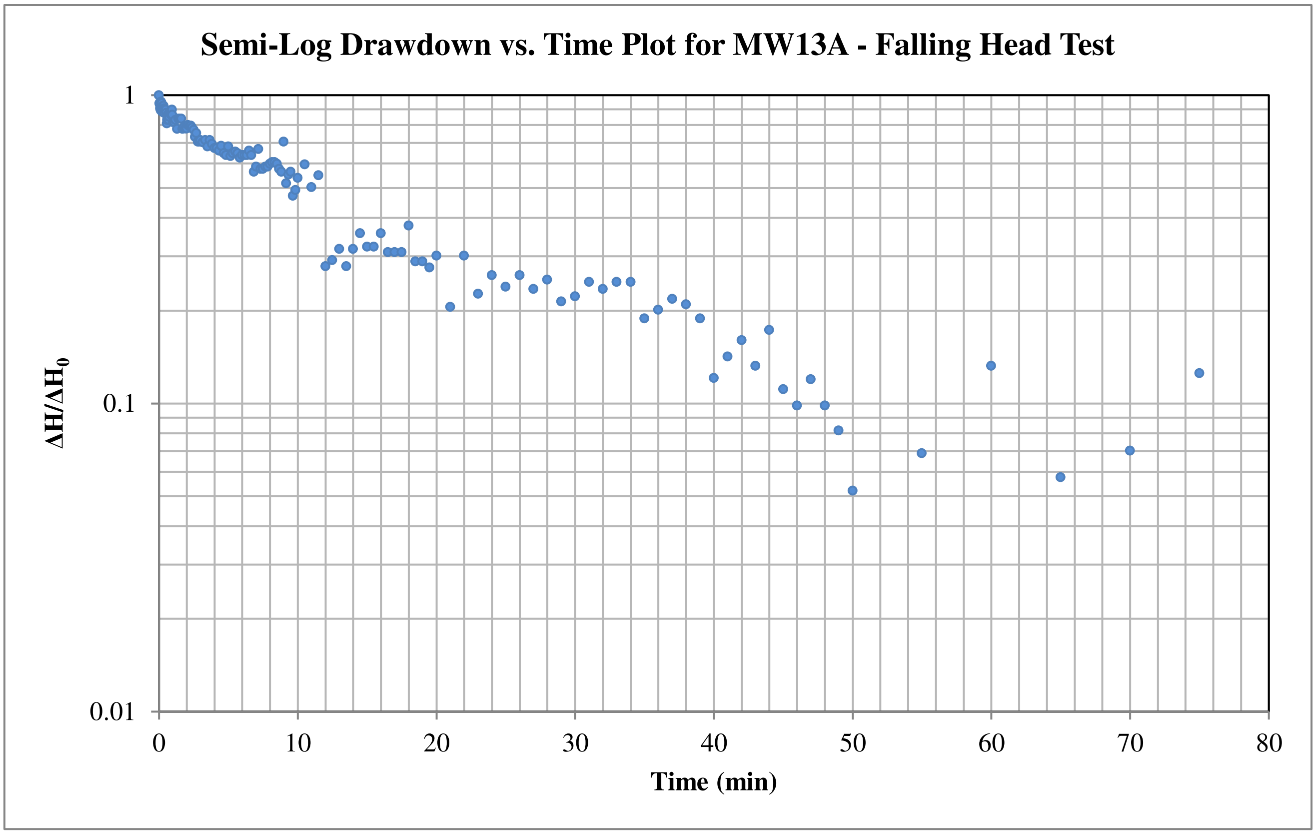
Data Points (from plot):

t*: 407.066 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.54E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW13A
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 3.02163

Well Parameters:

L	2.13 m	Saturated length of screen or open hole
D	0.0508 m	Diameter of well
r_c	0.0254 m	Radius of well

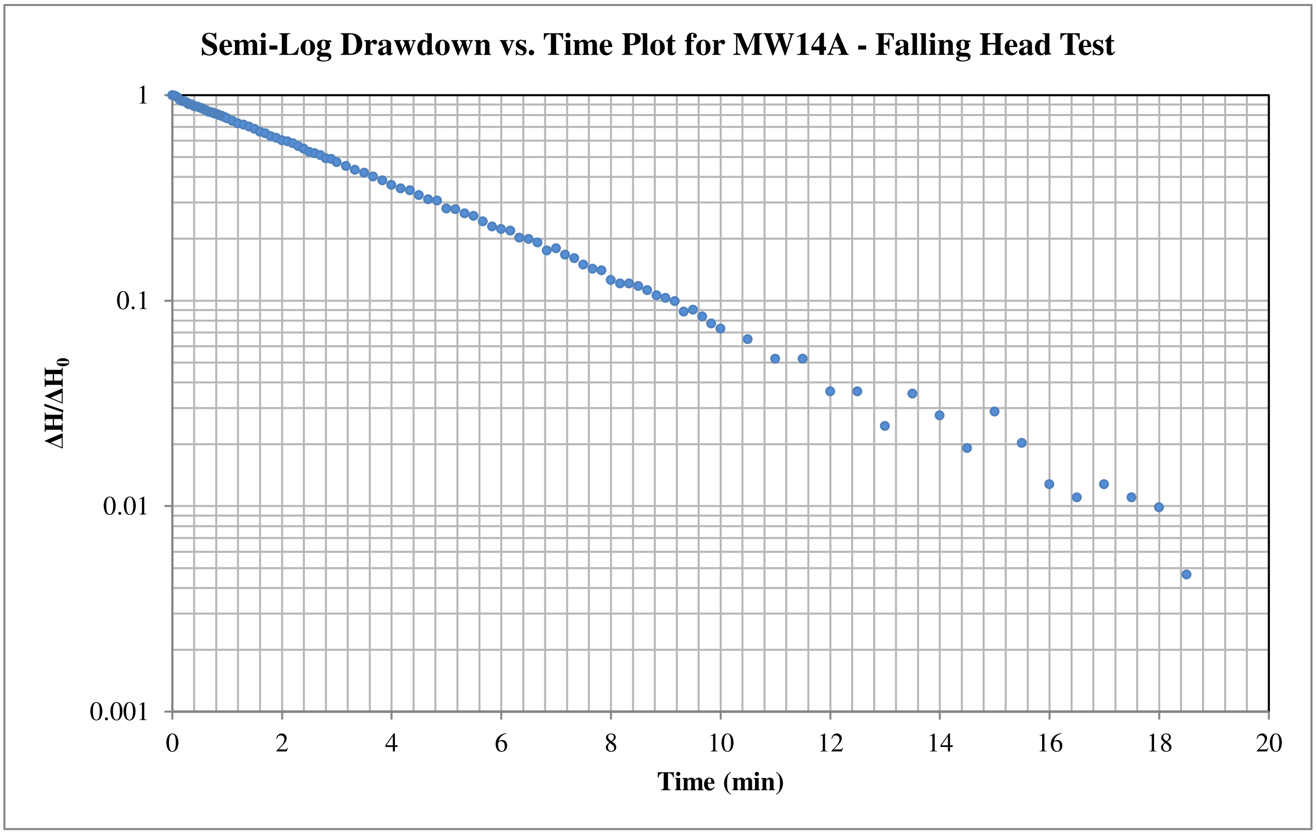
Data Points (from plot):

t*: 16.798 minutes ΔH*/ΔH_0: 0.37

Horizontal Hydraulic Conductivity
K = 6.62E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW14A
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 3.02163

Well Parameters:

L	2.13	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

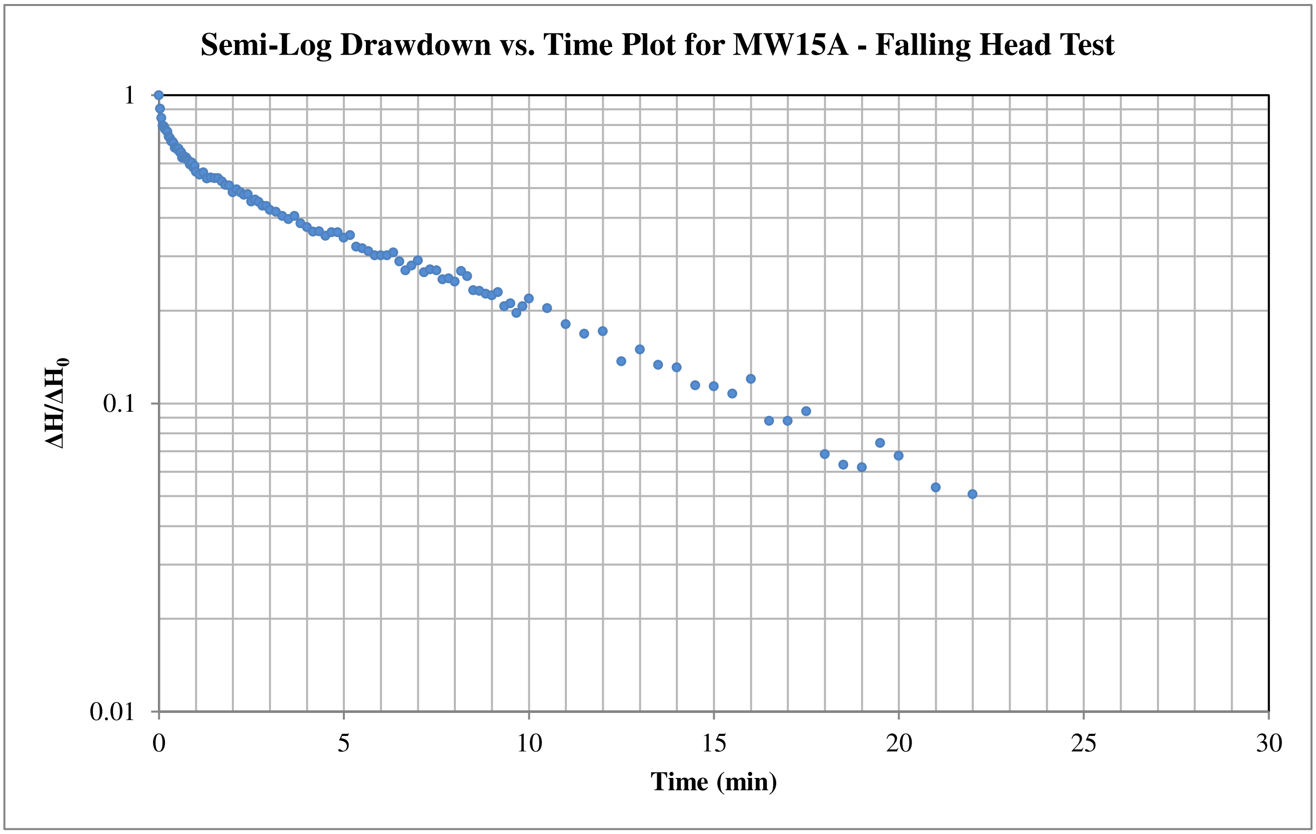
Data Points (from plot):

t*: 3.977 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 2.79E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW15A
Test: Falling Head
Date: April 20, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 3.02163

Well Parameters:

L	2.13	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

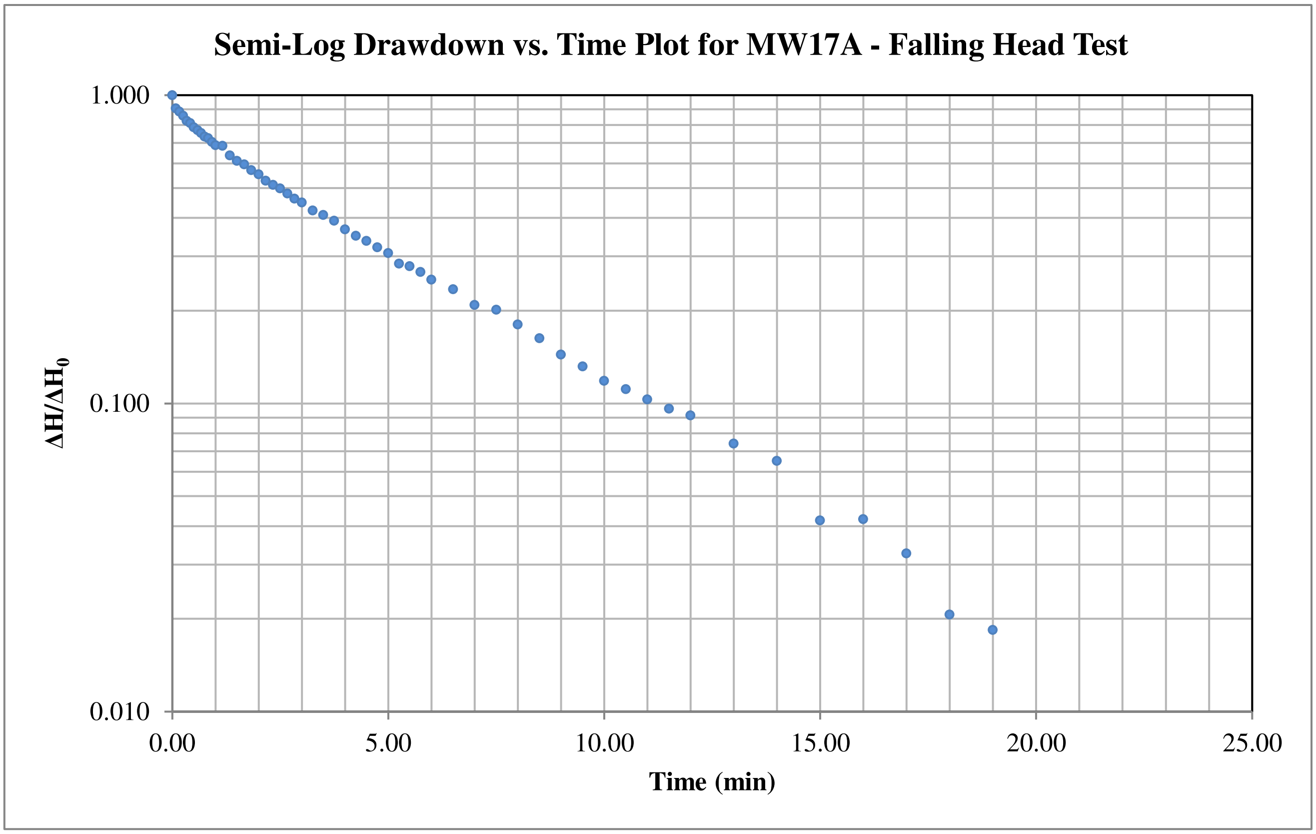
Data Points (from plot):

t*: 4.392 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 2.53E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW17A
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

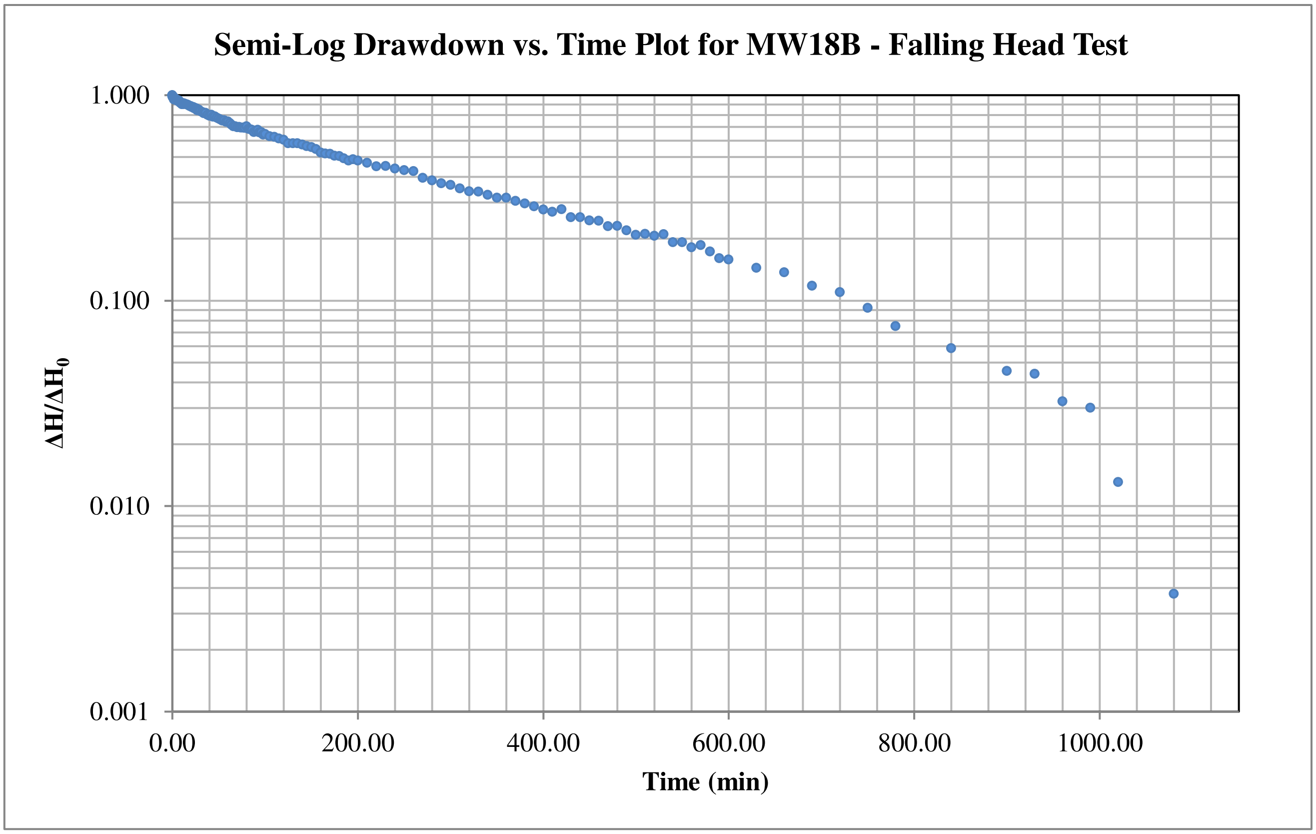
Data Points (from plot):

t^*: 3.956 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 3.67E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW18B
Test: Falling Head
Date: July 12, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

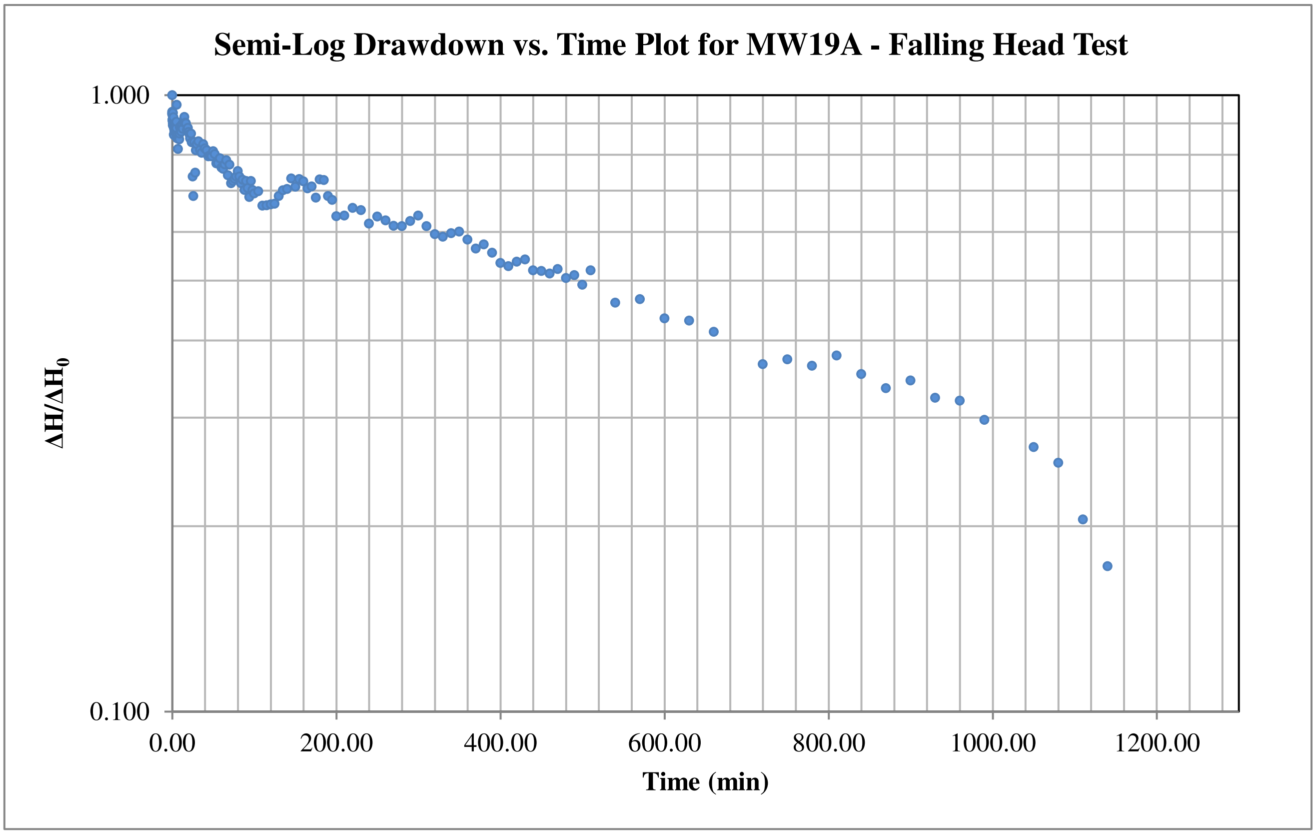
Data Points (from plot):

t*: 290.480 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 5.00E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW19A
Test: Falling Head
Date: July 12, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

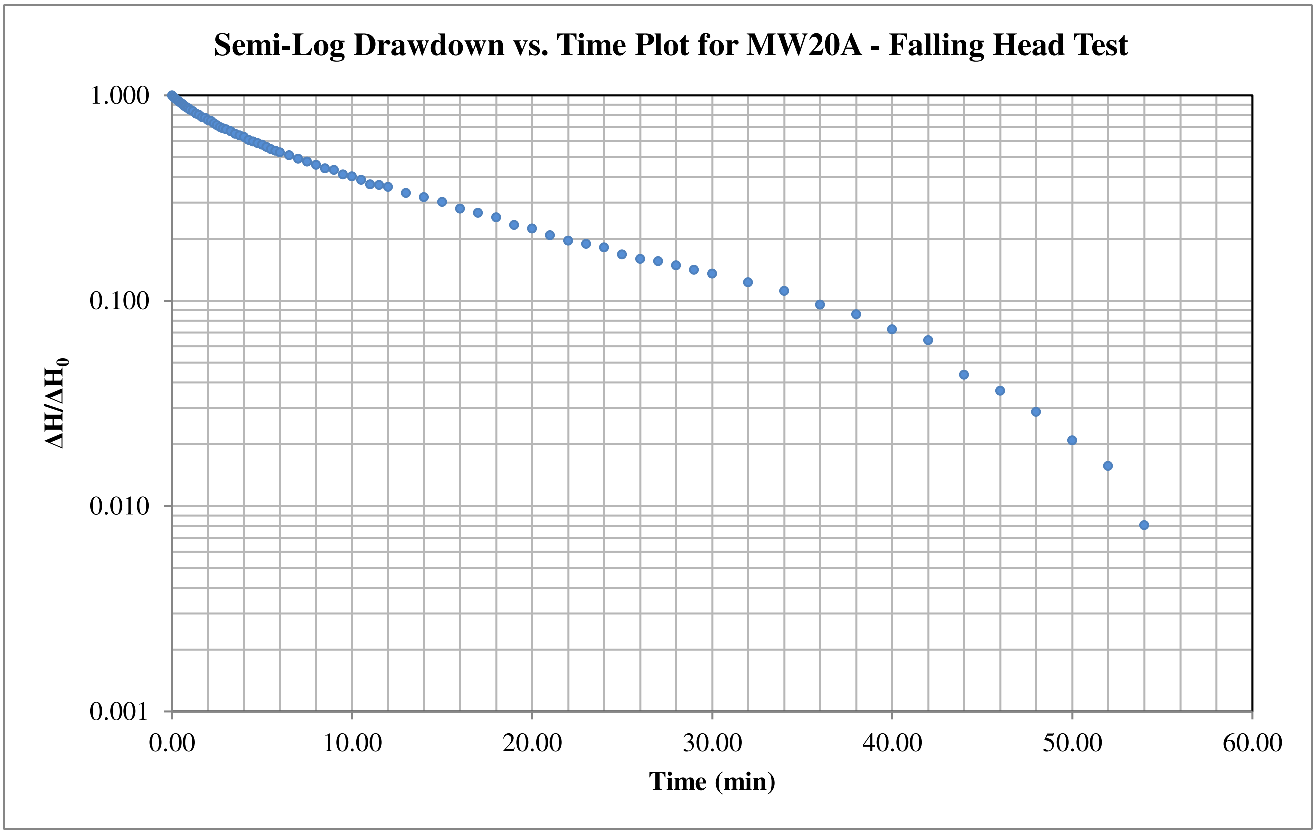
Data Points (from plot):

t*: 752.068 minutes ΔH*/ΔH_0: 0.37

Horizontal Hydraulic Conductivity
K = 1.93E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW20A
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t*} \ln\left(\frac{\Delta H *}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

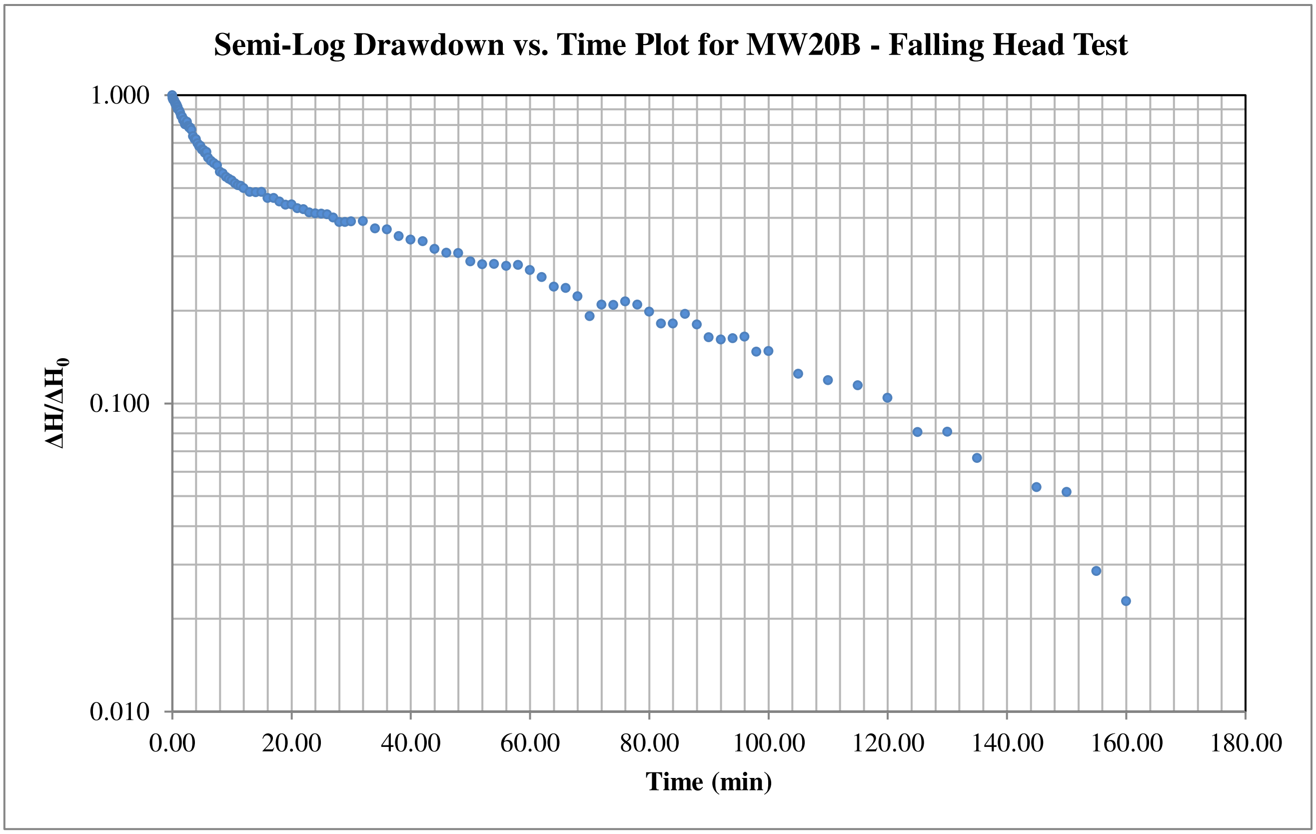
Data Points (from plot):

t*: 10.989 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.32E-06 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW20B
Test: Falling Head
Date:July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F}\frac{1}{t^*}\ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

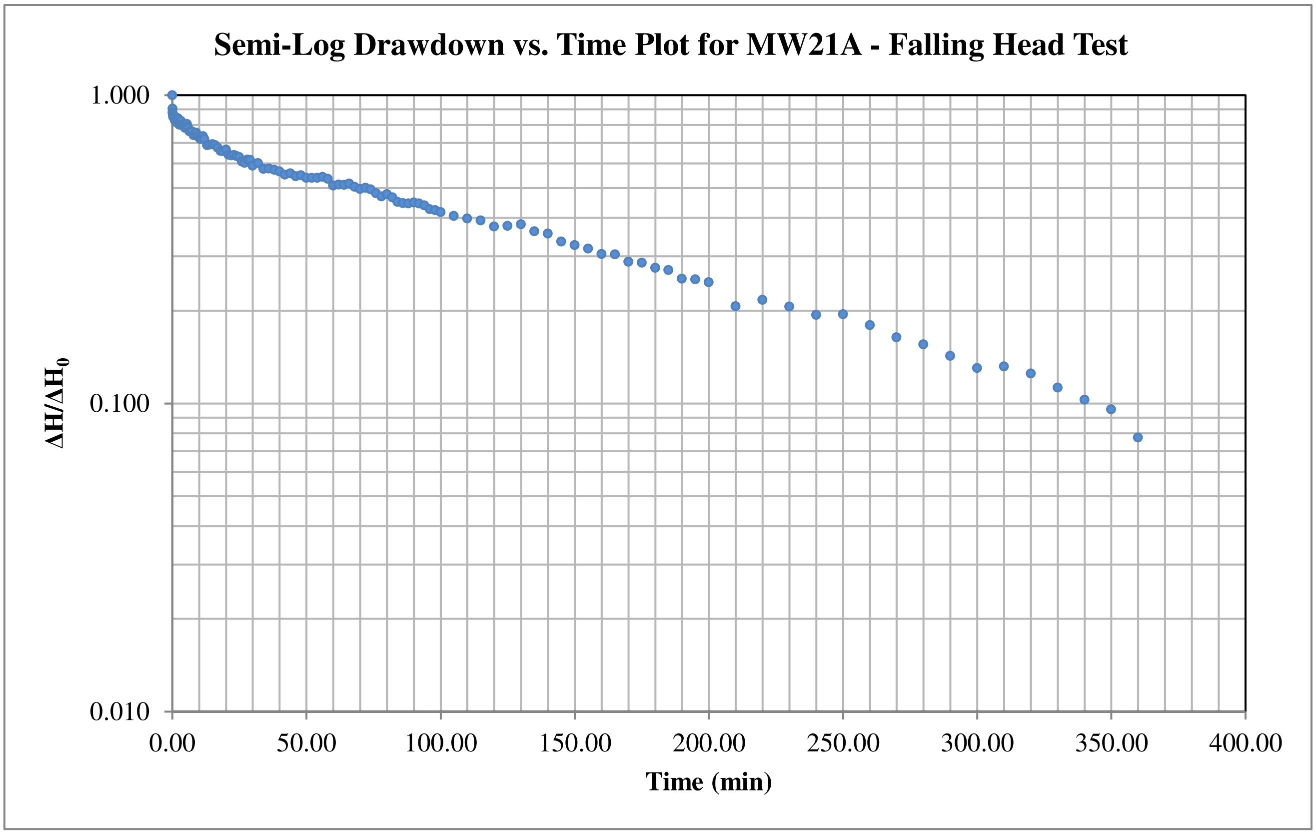
Data Points (from plot):

t*: 33.479 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.34E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW21A
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$\boxed{K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)}$$

Hvorslev Shape Factor

$$\boxed{F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

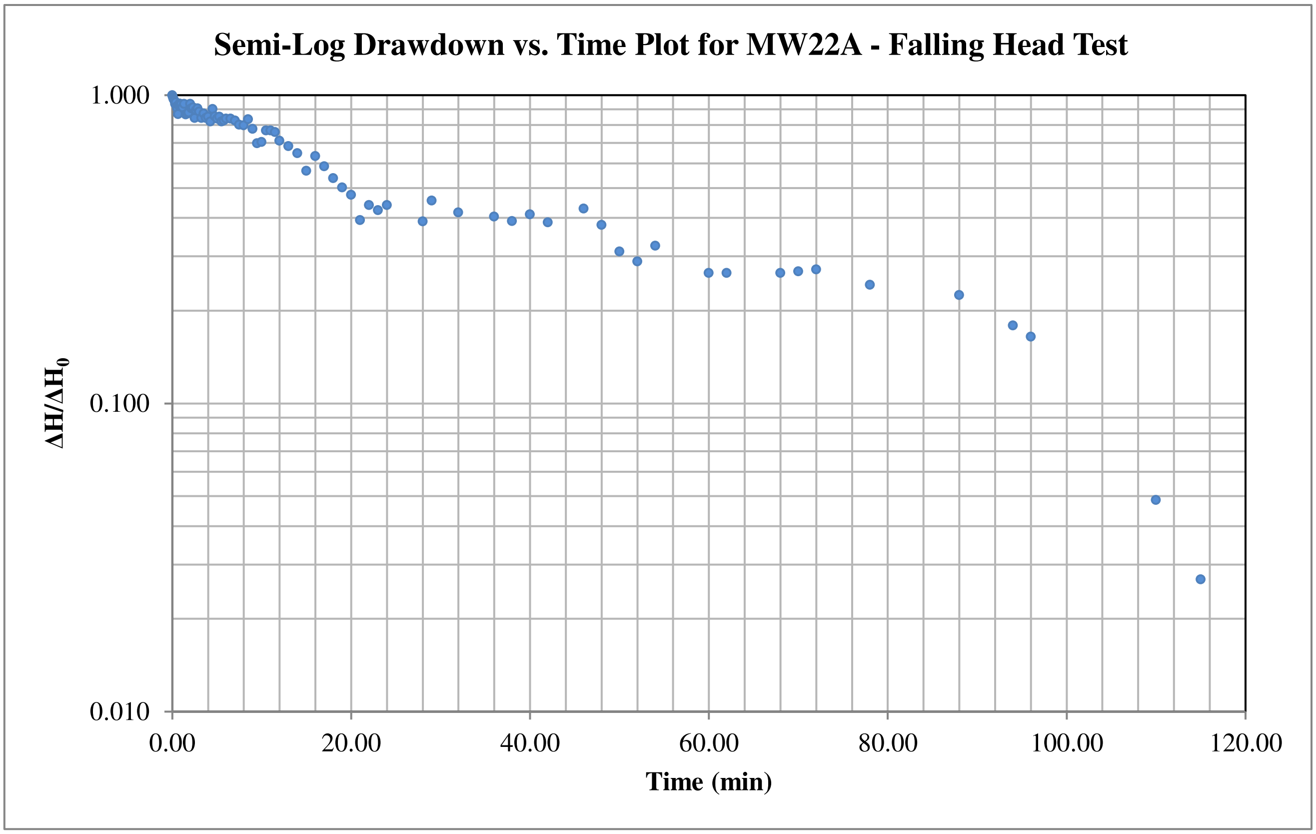
Data Points (from plot):

t^*: 131.480 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.11E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW22A
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

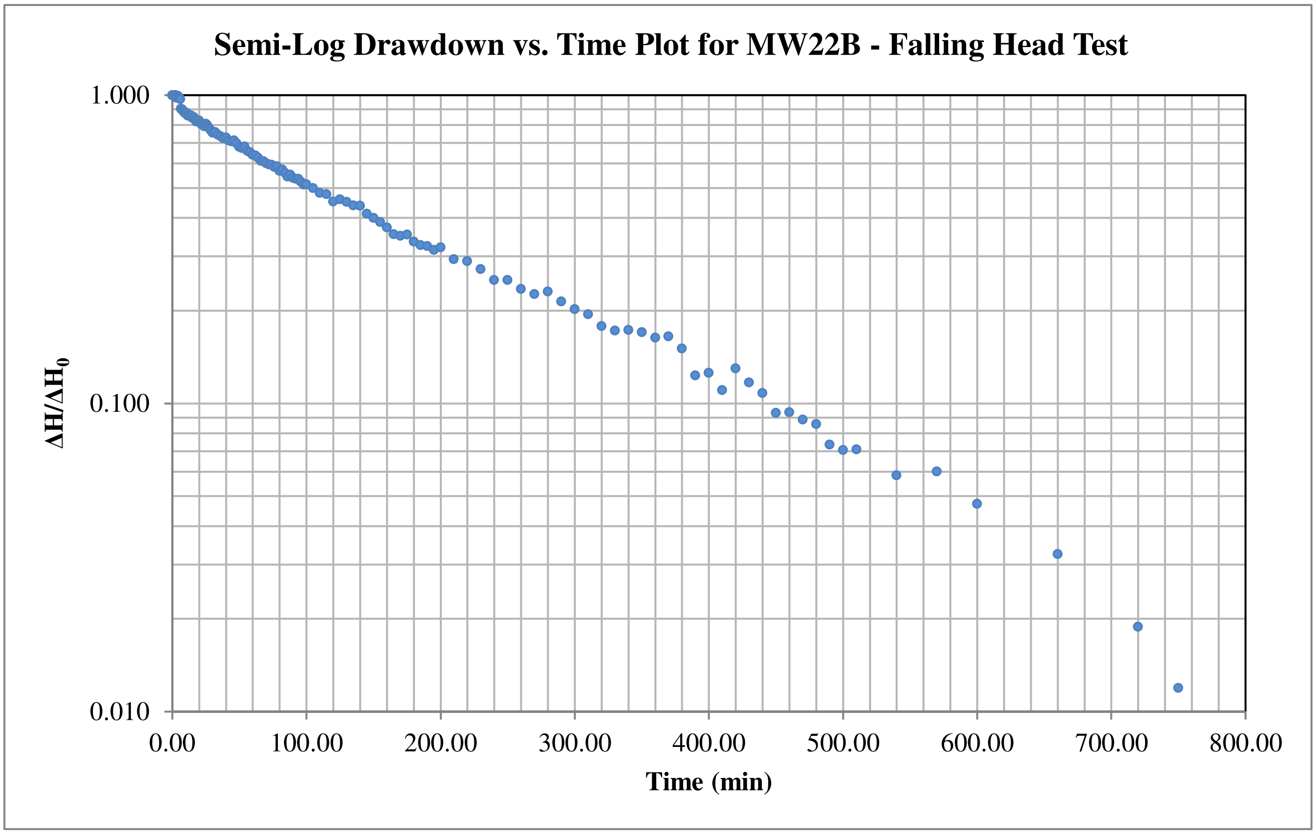
Data Points (from plot):

t*: 34.344 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 4.23E-07 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW22B
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

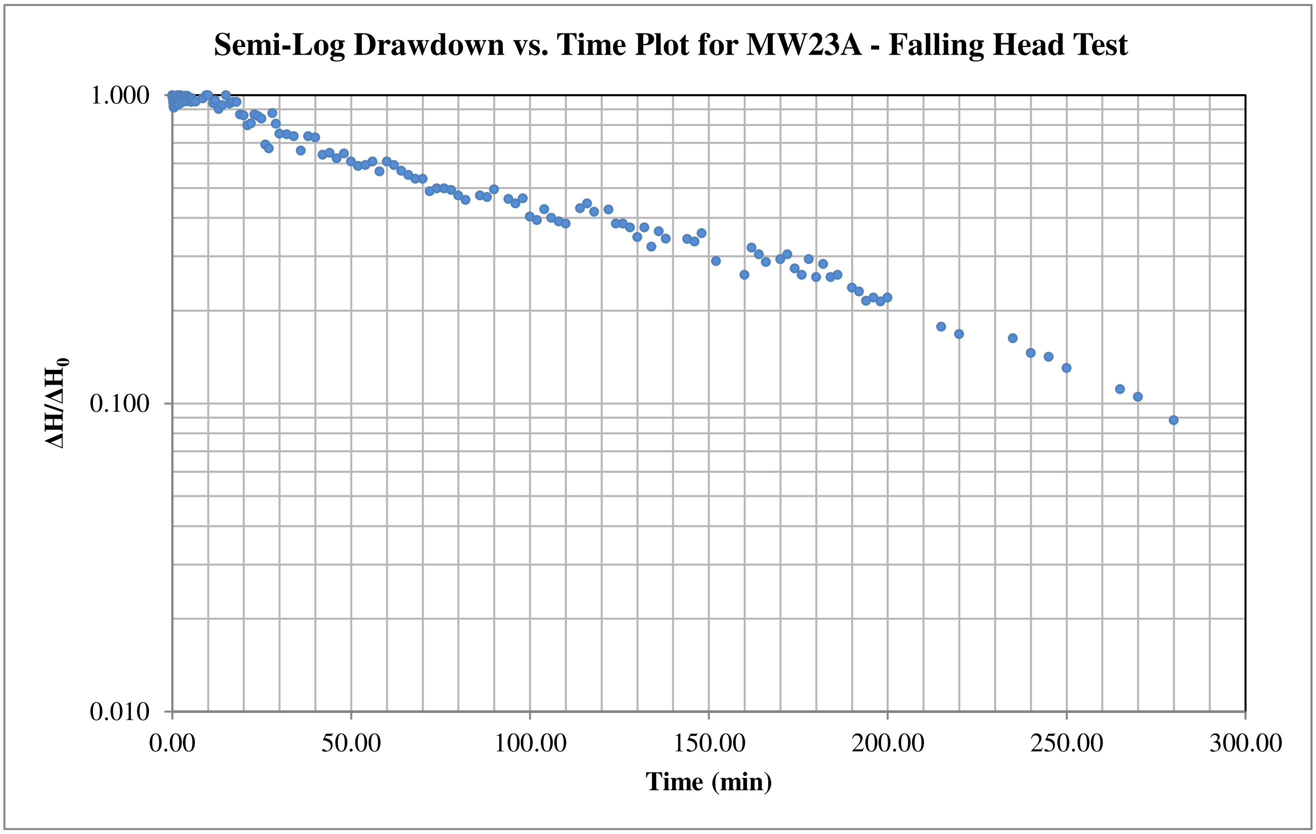
Data Points (from plot):

t^*: 159.151 minutes $\Delta H^*/\Delta H_0$: 0.37

Horizontal Hydraulic Conductivity
K = 9.13E-08 m/sec

Hvorslev Hydraulic Conductivity Analysis

Project: PG4073 - Half Moon Bay West
Test Location: MW23A
Test: Falling Head
Date: July 11, 2018



Hvorslev Horizontal Hydraulic Conductivity

$$K = \frac{\pi r_c^2}{F} \frac{1}{t^*} \ln\left(\frac{\Delta H^*}{\Delta H_0}\right)$$

Hvorslev Shape Factor

$$F = \frac{2\pi L}{\ln\left(\frac{2L}{D}\right)}$$

Valid for L>>D

Hvorslev Shape Factor F: 2.31086

Well Parameters:

L	1.5	m	Saturated length of screen or open hole
D	0.0508	m	Diameter of well
r_c	0.0254	m	Radius of well

Data Points (from plot):

t*: 127.857 minutes ΔH*/ΔH$_0$: 0.37

Horizontal Hydraulic Conductivity
K = 1.14E-07 m/sec

Table 1 - USCS Soil Classification Results

Job ID	Client	BH ID	Sample ID	Depth	Sieve/Hydrometer Analysis				Liquid Limit (%)	Plasticity Index	Group Symbol	Group Name (USCS)
					Gravel (%)	Sand (%)	Silt (%)	Clay (%)				
PG2246	Mattamy Homes	TP1-18	G1	2'6"-3'6"	0	42.9	57.1		32.1*	17.7*	CL	Inorganic Sandy Clay of Medium Plasticity
PG2246	Mattamy Homes	TP1-18	G2	5'-6'	0	10.7	54.8	34.5	32.1	17.7	CL	Inorganic Clay of Medium Plasticity, Some Sand
PG2246	Mattamy Homes	TP2-18	G1	1'6"-2'6"	0	26.4	56.6	17	28.2*	11.1*	CL	Inorganic Clay of Low Plasticy, with Sand
PG2246	Mattamy Homes	TP2-18	G2	4'-5'	N/A				28.2	11.1	CL	Inorganic Clay of Low Plasticy
PG2246	Mattamy Homes	TP2-18	G3	6'-7'	0	7.4	52.1	40.5	28.2*	11.1*	CL	Inorganic Clay of Low Plasticity, Trace Sand
PG2246	Mattamy Homes	TP3-18	G2	4'-5'	0	31.4	50.6	18	37.9*	22.1*	CL	Inorganic Sandy Clay of Medium Plasticity
PG2246	Mattamy Homes	TP3-18	G3	7'-8'	N/A				37.9	22.1	CL	Inorganic Clay of Medium Plasticity
PG2246	Mattamy Homes	TP3-18	G3	8'-9'	0	11	52.9	36.1	37.9*	22.1*	CL	Inorganic Clay of Medium Plasticity, Some Sand
PG2246	Mattamy Homes	TP4-18	G4	17'6"-18'6"	0	40.9	36.6	22.5	27.6	12.6	CL	Inorganic Sandy Clay of Low Plasticity
PG2246	Mattamy Homes	TP4-18	G5	15'-16'	0	19.9	54.1	26	27.6*	12.6*	CL	Inorganic Clay of Low Plasticity, Some Sand
PG2246	Mattamy Homes	TP5-18	G2	5'-6'	0	16.7	54.8	28.5	28	8.3	CL	Inorganic Clay of Low Plasticity, Some Sand
PG2246	Mattamy Homes	TP5-18	G3	10'-11'	0	26.7	55.3	18	28*	8.3*	CL	Inorganic Clay of Low Pasticity, with Sand
PG2246	Mattamy Homes	TP6-18	G2	4'-5'	0	31.8	68.2		30*	14.5*	CL	Inorganic Sandy Clay of Low Plasticity
PG2246	Mattamy Homes	TP6-18	G3	6'-7'	0	38.2	40.3	21.5	30*	14.5*	CL	Inorganic Sandy Clay of Low Plasticity
PG2246	Mattamy Homes	TP6-18	G4	8'-9'	N/A				30	14.5	CL	Inorganic Clay of Low Plasticity
PG2246	Mattamy Homes	TP7-18	G2	4'-5'	0	22.2	61.6	16.2	27.3*	11.7*	CL	Inorganic Clay of Low Plasticity, with Sand
PG2246	Mattamy Homes	TP7-18	G3	6'6"-7'6"	0	14.8	55.7	29.5	27.3	11.7	CL	Inorganic Clay of Low Plasticity, some Sand
PG2245	Mattamy Homes	TP8-18	G2	7'-8'	0.5	27.5	49.5	22.5	25.4*	9.9*	CL	Inorganic Clay of Low Plasticity, with Sand
PG2246	Mattamy Homes	TP8-18	G3	10'-11'	0	25.8	52	22.2	25.4	9.9	CL	Inorganic Clay of Low Plasticity, with Sand
PG2246	Mattamy Homes	TP9-18	G3	8'-9'	0	25.9	74.1		33.9*	21*	CL	Inorganic Clay of Medium Plasticity, with Sand
PG2246	Mattamy Homes	TP9-18	G4	10'-11'	0	34.9	36.6	28.5	33.9	21	CL	Inorganic Sandy Clay of Medium Plasticity
PG2246	Mattamy Homes	TP10-18	G2	2'6"-3'6"	0	70.4	29.6		25*	10.6*	CL	Inorganic Sandy Clay of Low Plasticity
PG2246	Mattamy Homes	TP10-18	G3	4'-5'	0	39.6	39.7	20.5	25	10.6	CL	Inorganic Sandy Clay of Low Plasticity
PG4073	Mattamy Homes	MW17A	SS4	7'6"-9'6"	0	34	52	14	-	-	ML	Inorganic Sandy Silt, some Clay
PG4073	Mattamy Homes	MW18A	SS2	2'6"-4'6"	0	30.9	55.6	13.5	-	-	ML	Inorganic Sandy Silt, some Clay
PG4073	Mattamy Homes	MW18B	SS5	10'-12'	0	8.3	64.2	27.5	-	-	ML	Inorganic Clayey Silt, trace Sand
PG4073	Mattamy Homes	MW19A	SS3	5'-7'	0	35.1	44.9	20	-	-	ML	Inorganic Sandy Silt, some Clay
PG4073	Mattamy Homes	MW20A	SS3	5'-7'	0	34.6	48.6	16.5	-	-	ML	Inorganic Sandy Silt, some Clay
PG4073	Mattamy Homes	MW20B	SS6	12'6"-14'6"	0	8.6	55.4	36	-	-	ML	Inorganic Clayey Silt, trace Sand
PG4073	Mattamy Homes	MW21A	SS3	5'-7'	0	42.6	46.9	10.5	-	-	ML	Inorganic Sandy Silt, trace Clay
PG4073	Mattamy Homes	MW23A	SS2	2'6"-4'6"	0	33.7	55.8	10.5	-	-	ML	Inorganic Sandy Silt, trace Clay

* Assumed values based on proximity of samples

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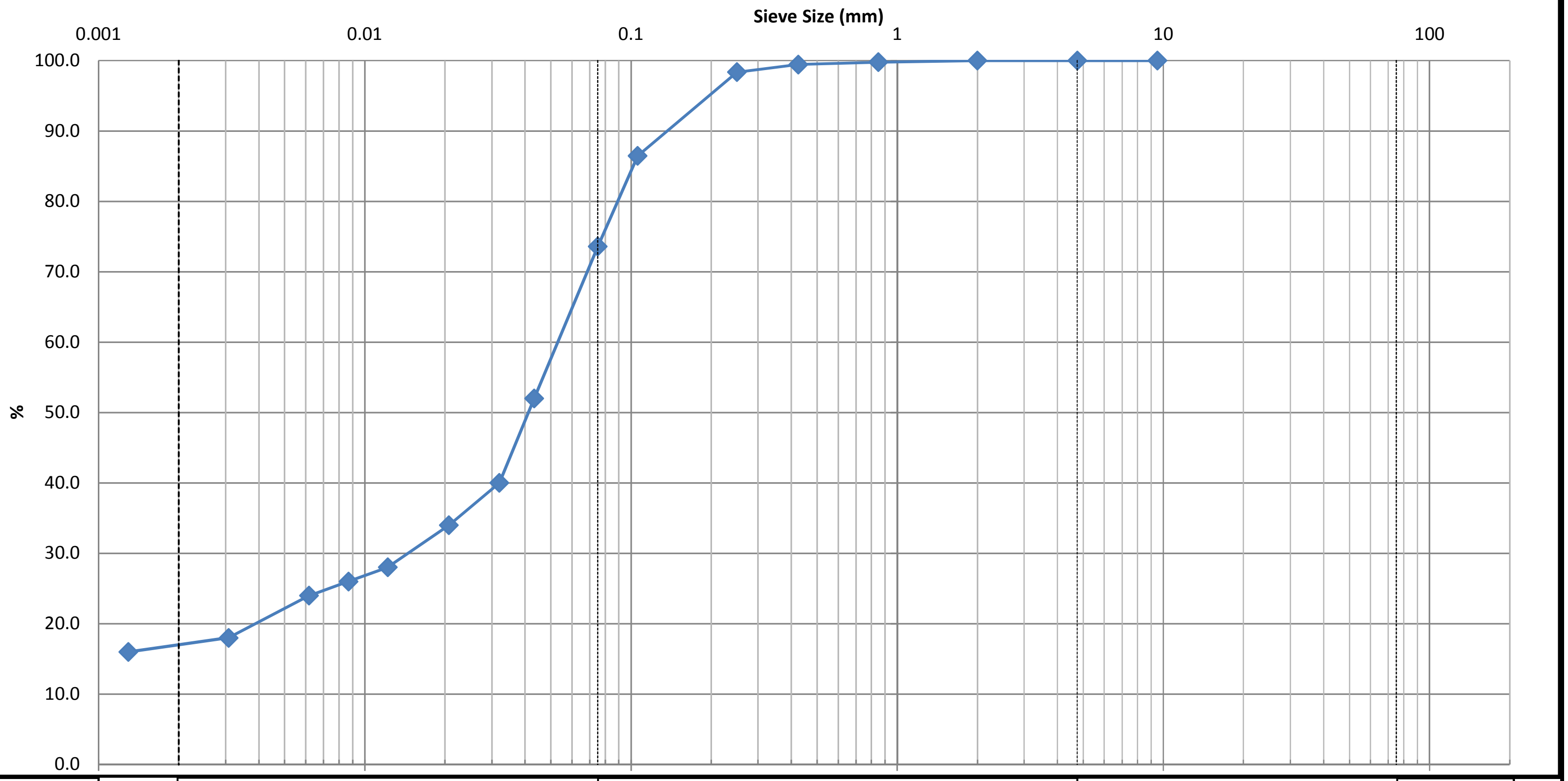
CLIENT:	Mattamy Homes	DEPTH:	1'6" - 2'6"	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP2-18 - G1	LAB NO:	99138
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		20.7					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	26.4	56.6	17.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	1'6" - 2'6"	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP2-18 - G1	DATE SAMPLED:	-
LAB No. :	99138	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	164.9		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	148.85	98.85	
F=(Wo/Wa)	0.989		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	49.43		
Wt. AFTER WASH BACK SIEVE		20.24	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**164.9**		
0.850	**0.11**	0.2	99.8
0.425	**0.28**	0.6	99.4
0.250	**0.82**	1.6	98.4
0.106	**6.77**	13.5	86.5
0.075	**13.21**	26.4	73.6
Pan	**20.22**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:03	32.0	6.0	22.0	0.0433	52.0	52.0
2	9:04	26.0	6.0	22.0	0.0320	40.0	40.0
5	9:07	23.0	6.0	22.0	0.0207	34.0	34.0
15	9:17	20.0	6.0	22.0	0.0122	28.0	28.0
30	9:32	19.0	6.0	22.0	0.0087	26.0	26.0
60	10:02	18.0	6.0	22.0	0.0062	24.0	24.0
250	13:12	15.0	6.0	22.0	0.0031	18.0	18.0
1440	9:02	14.0	6.0	22.0	0.0013	16.0	16.0

COMMENTS

Moisture Content = 20.7%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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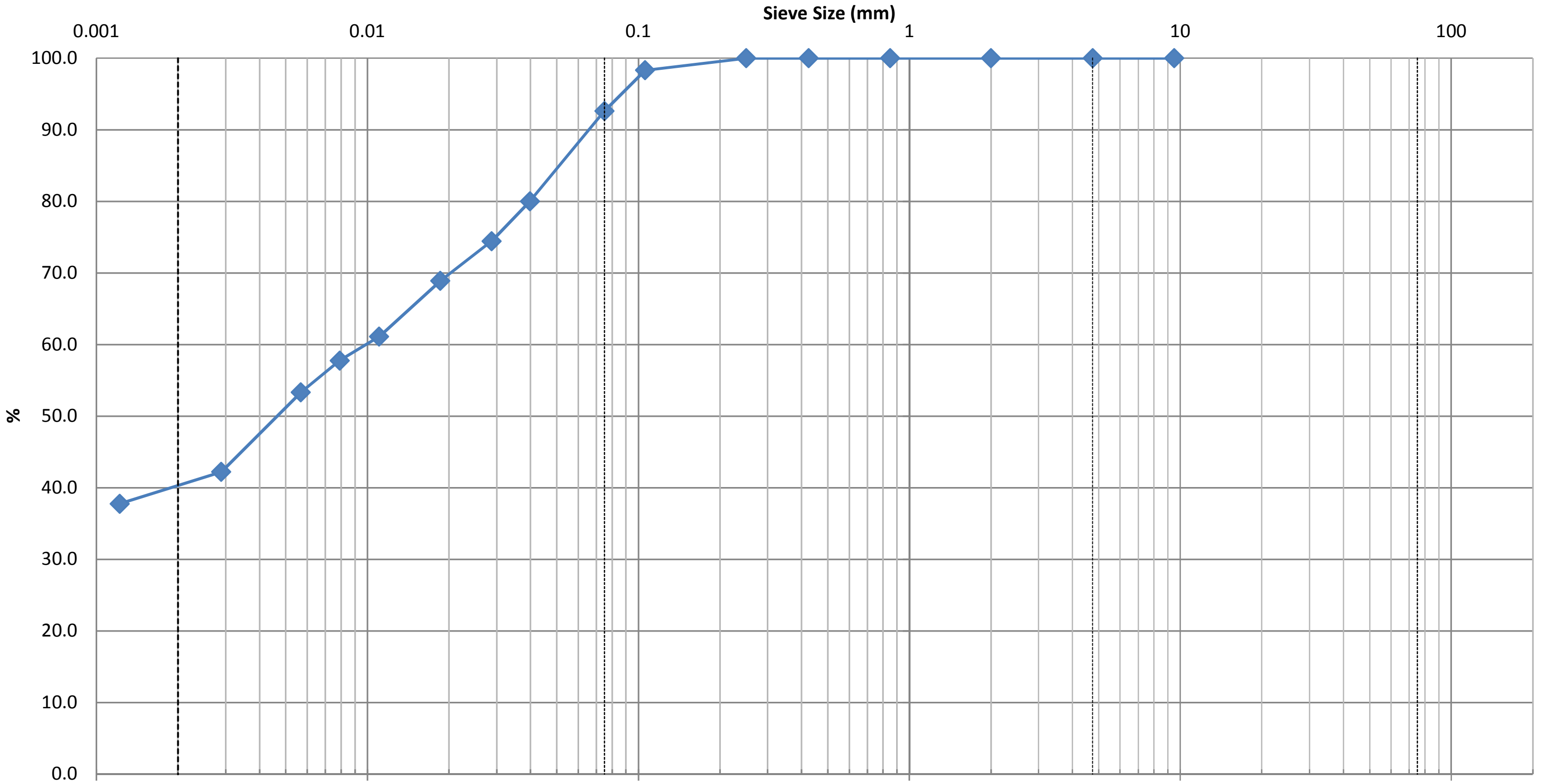
CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP2-18 - G3	LAB NO:	99139
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					39.3					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	7.4		52.1	40.5	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP2-18 - G3	DATE SAMPLED:	-
LAB No. :	99139	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	120.3		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	139.00	89.00	
F=(Wo/Wa)	0.890		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	44.50		
Wt. AFTER WASH BACK SIEVE		4.13	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**120.3**		
0.850	**0.00**	0.0	100.0
0.425	**0.00**	0.0	100.0
0.250	**0.01**	0.0	100.0
0.106	**0.84**	1.7	98.3
0.075	**3.69**	7.4	92.6
Pan	**4.12**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:15	42.0	6.0	22.0	0.0398	80.0	80.0
2	9:16	39.5	6.0	22.0	0.0288	74.4	74.4
5	9:19	37.0	6.0	22.0	0.0186	68.9	68.9
15	9:29	33.5	6.0	22.0	0.0111	61.1	61.1
30	9:44	32.0	6.0	22.0	0.0079	57.8	57.8
60	10:14	30.0	6.0	22.0	0.0057	53.3	53.3
250	13:24	25.0	6.0	22.0	0.0029	42.2	42.2
1440	9:14	23.0	6.0	22.0	0.0012	37.8	37.8

COMMENTS

Moisture Content = 39.3%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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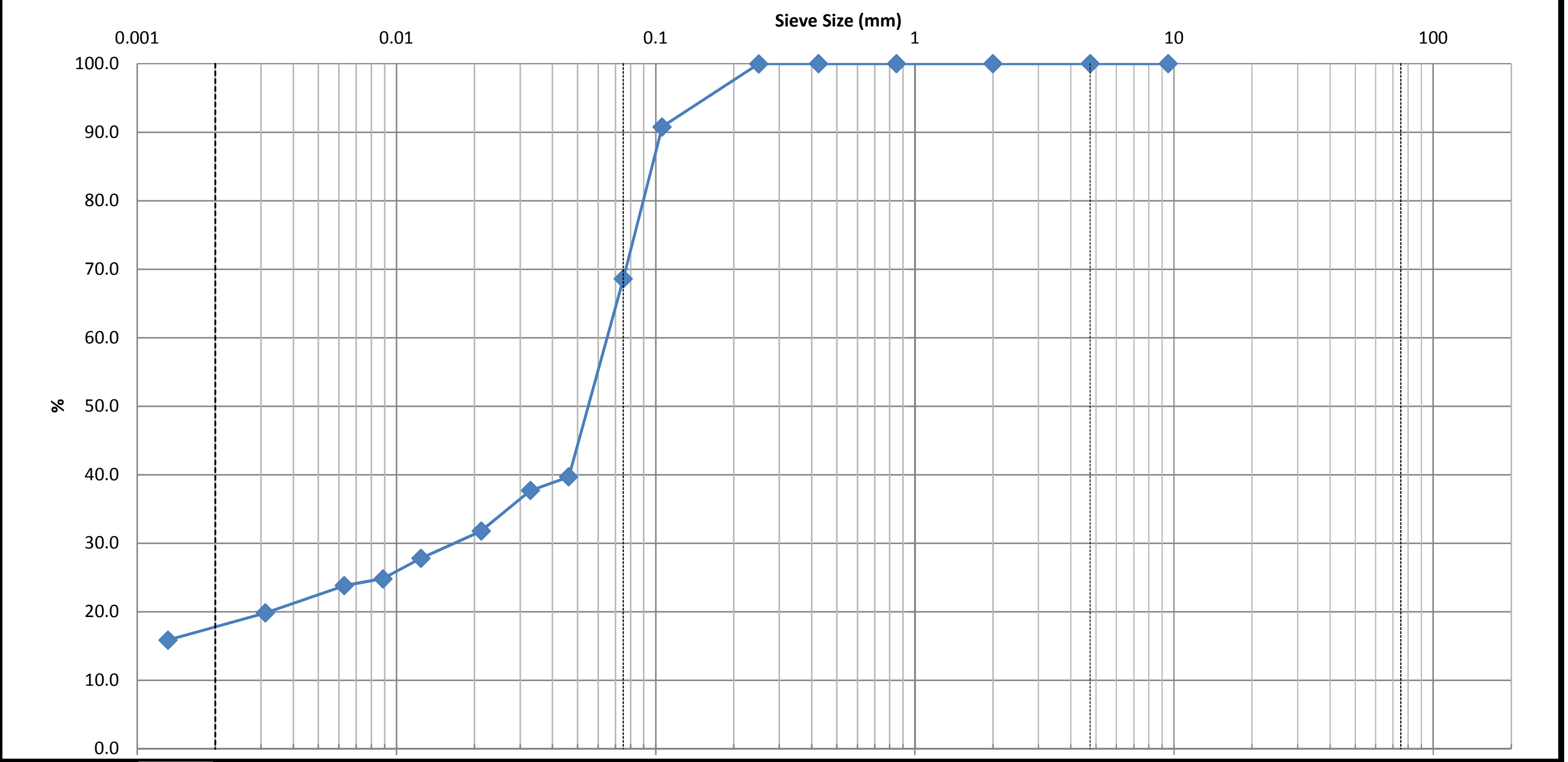
CLIENT:	Mattamy Homes	DEPTH:	1.22 - 1.52	FILE NO:	PG2246
CONTRACT NO.:		BH OR TP No.:	TP3-18 - G2	LAB NO:	98982
PROJECT:	Half Moon Bay West	DESCRIPTION:	Silty Fine Sand to Sandy Silty, some Clay	DATE RECEIVED:	7-Mar-18
				DATE TESTED:	9-Mar-18
DATE SAMPLED:	6-Mar-18			DATE REPORTED:	12-Mar-18
SAMPLED BY:	N. Christie			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**					**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
						16.7					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
					0.0	31.4		50.6		18.0	

Comments	

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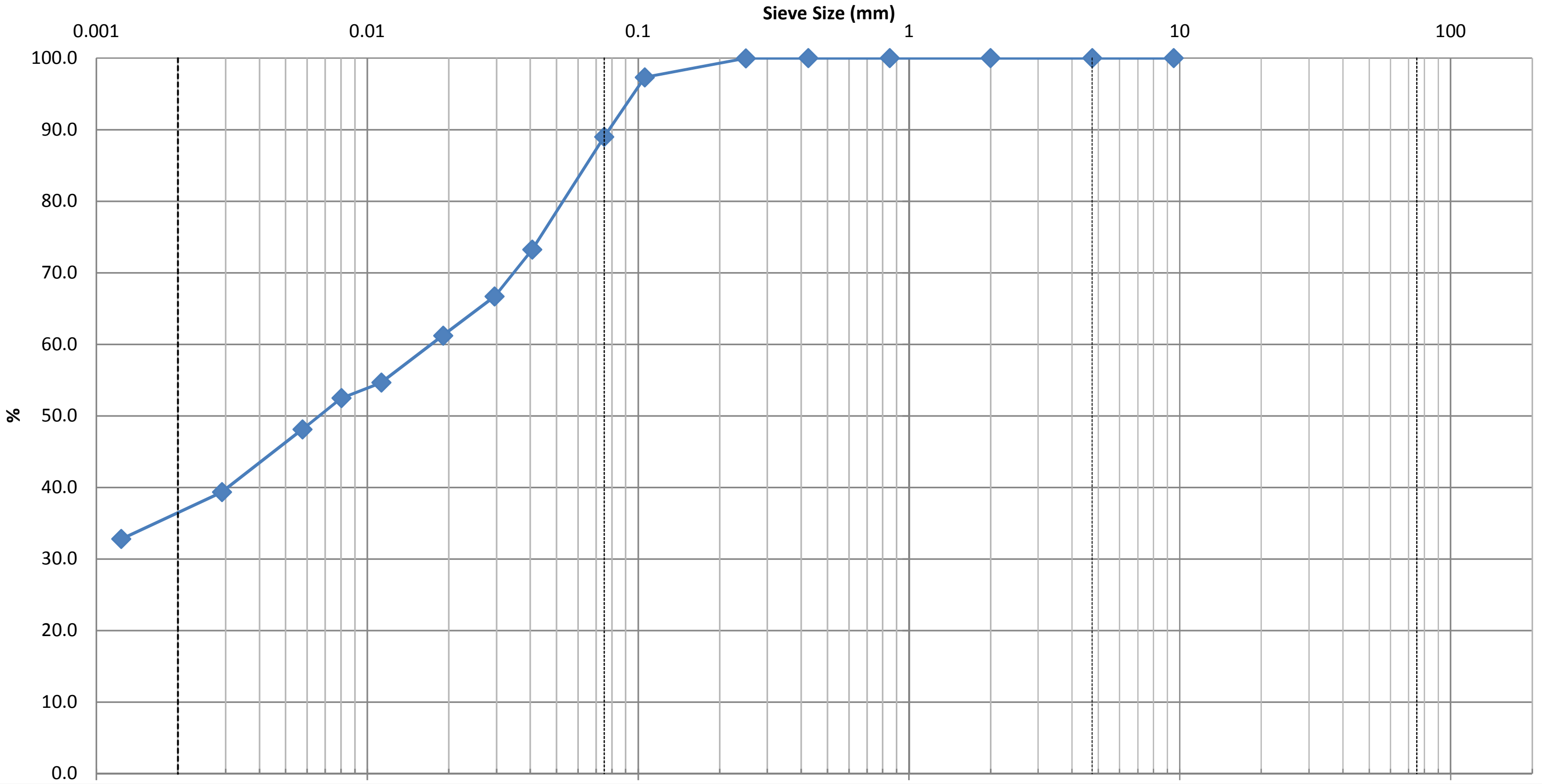
CLIENT:	Mattamy Homes	DEPTH:	8' - 9'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP3-18 - G3	LAB NO:	99140
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					36.1					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	11.0		52.9	36.1	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	8' - 9'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP3-18 - G3	DATE SAMPLED:	-
LAB No. :	99140	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	127.8		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	140.45	90.45	
F=(Wo/Wa)	0.905		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	45.23		
Wt. AFTER WASH BACK SIEVE		6.48	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**127.8**		
0.850	**0.00**	0.0	100.0
0.425	**0.01**	0.0	100.0
0.250	**0.02**	0.0	100.0
0.106	**1.34**	2.7	97.3
0.075	**5.50**	11.0	89.0
Pan	**6.48**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:28	39.5	6.0	22.0	0.0407	73.2	73.2
2	9:29	36.5	6.0	22.0	0.0295	66.7	66.7
5	9:32	34.0	6.0	22.0	0.0191	61.2	61.2
15	9:42	31.0	6.0	22.0	0.0113	54.7	54.7
30	9:57	30.0	6.0	22.0	0.0080	52.5	52.5
60	10:27	28.0	6.0	22.0	0.0058	48.1	48.1
250	13:37	24.0	6.0	22.0	0.0029	39.4	39.4
1440	9:27	21.0	6.0	22.0	0.0012	32.8	32.8

COMMENTS

Moisture Content = 36.1.1%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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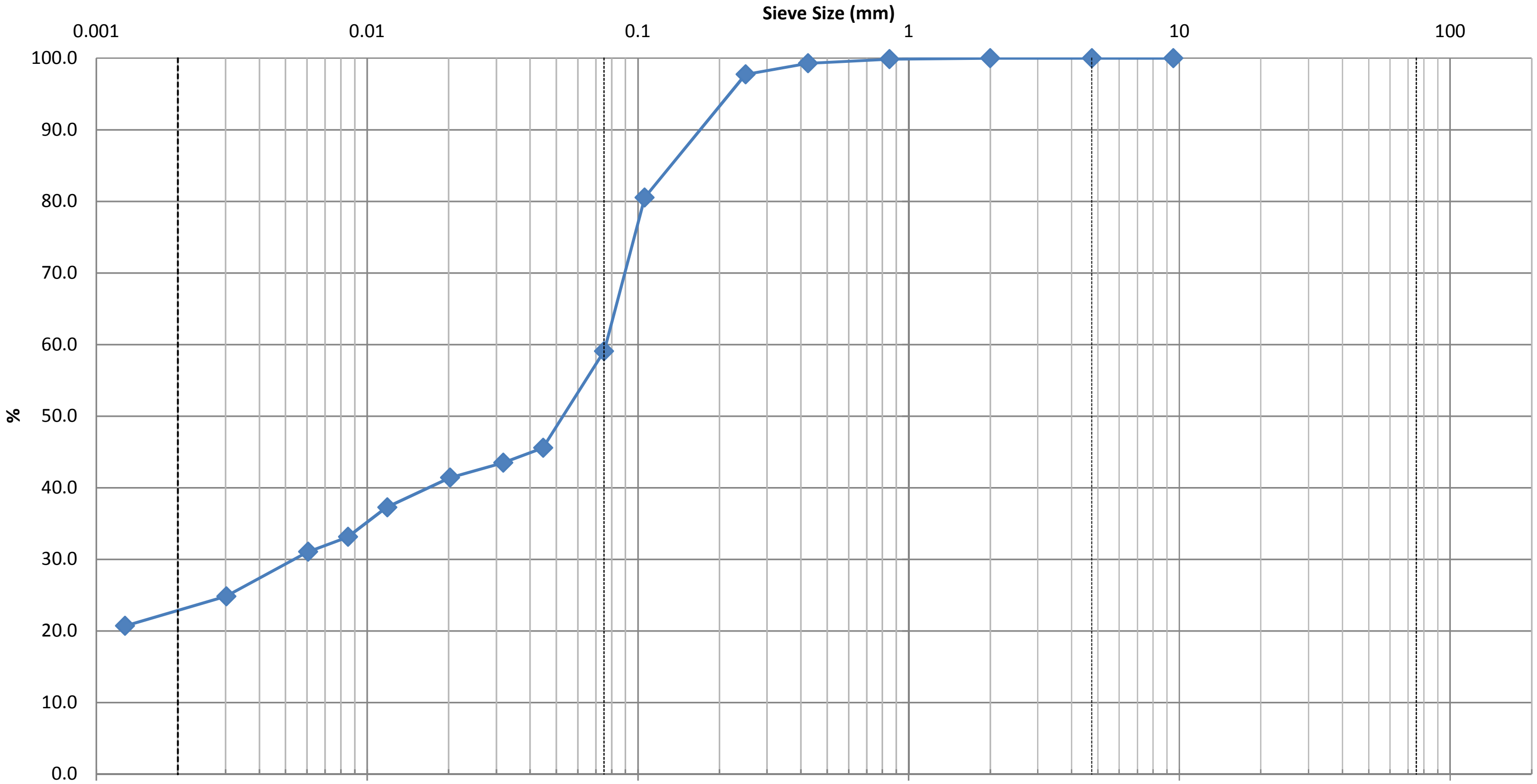
CLIENT:	Mattamy Homes	DEPTH:	17'6" - 18'6"	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP4-18 - G4	LAB NO:	99141
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		23.1					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	40.9	36.6	22.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	17'6" - 18'6"	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP4-18 - G4	DATE SAMPLED:	-
LAB No. :	99141	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	169.4	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	145.45	95.45
F=(Wo/Wa)	0.955	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	47.73	
Wt. AFTER WASH BACK SIEVE	22.25	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**169.5**		
0.850	**0.07**	0.1	99.9
0.425	**0.36**	0.7	99.3
0.250	**1.14**	2.3	97.7
0.106	**9.74**	19.5	80.5
0.075	**20.47**	40.9	59.1
Pan	**22.25**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

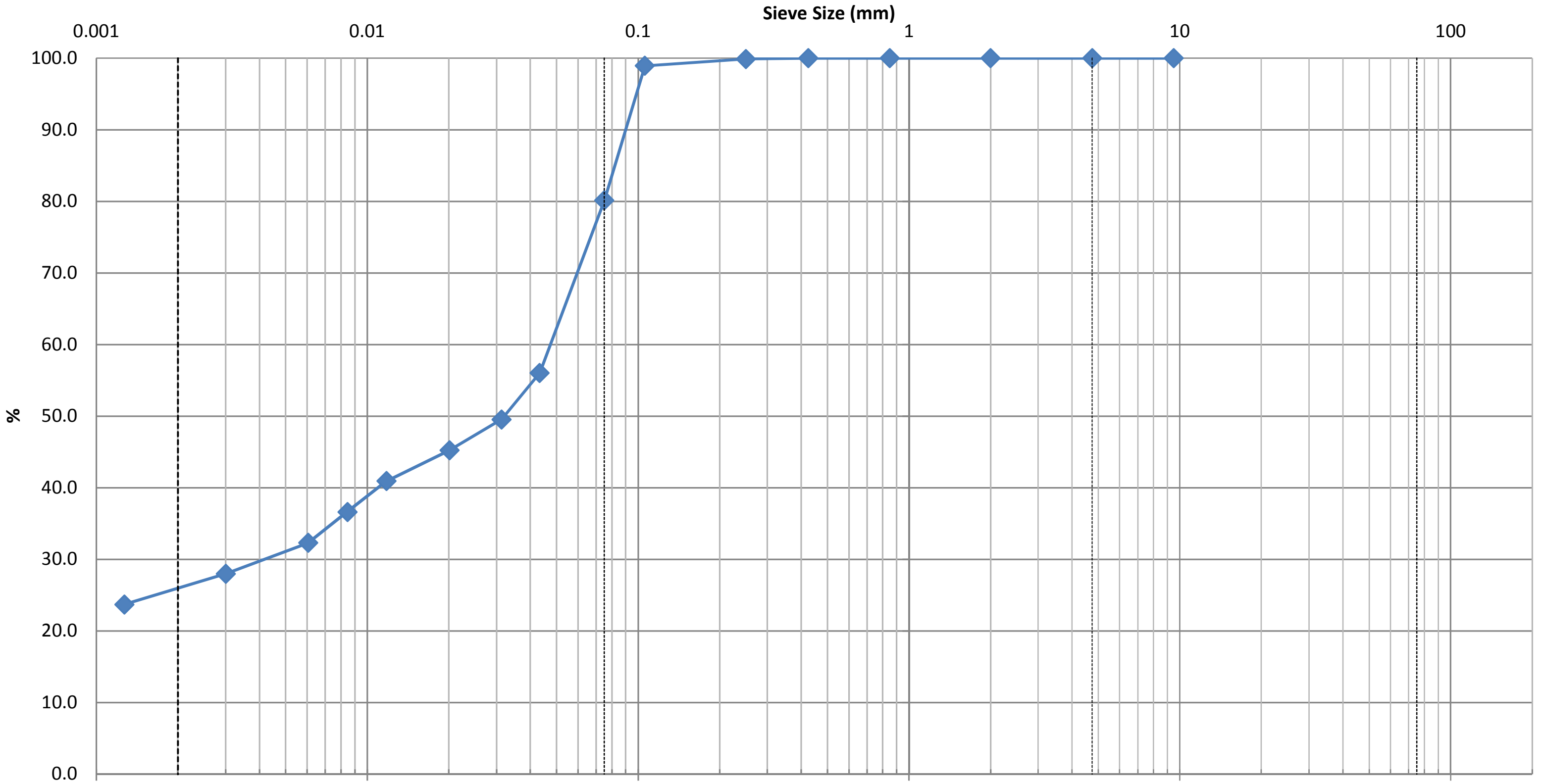
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:40	28.0	6.0	22.0	0.0447	45.6	45.6
2	9:41	27.0	6.0	22.0	0.0318	43.5	43.5
5	9:44	26.0	6.0	22.0	0.0203	41.4	41.4
15	9:54	24.0	6.0	22.0	0.0119	37.3	37.3
30	10:09	22.0	6.0	22.0	0.0085	33.1	33.1
60	10:39	21.0	6.0	22.0	0.0061	31.1	31.1
250	13:49	18.0	6.0	22.0	0.0030	24.9	24.9
1440	9:39	16.0	6.0	22.0	0.0013	20.7	20.7

COMMENTS

Moisture Content = 23.1%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	15' - 16'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP4-18 - G5	LAB NO:	99142
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		29.5					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	19.9	54.1	26.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	15' - 16'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP4-18 - G5	DATE SAMPLED:	-
LAB No. :	99142	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	163.4	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	141.80	91.80
F=(Wo/Wa)	0.918	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	45.90	
Wt. AFTER WASH BACK SIEVE	12.56	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**163.4**		
0.850	**0.00**	0.0	100.0
0.425	**0.01**	0.0	100.0
0.250	**0.06**	0.1	99.9
0.106	**0.53**	1.1	98.9
0.075	**9.94**	19.9	80.1
Pan	**12.56**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:53	32.0	6.0	22.0	0.0433	56.0	56.0
2	9:54	29.0	6.0	22.0	0.0313	49.5	49.5
5	9:57	27.0	6.0	22.0	0.0201	45.2	45.2
15	10:07	25.0	6.0	22.0	0.0118	40.9	40.9
30	10:22	23.0	6.0	22.0	0.0084	36.6	36.6
60	10:52	21.0	6.0	22.0	0.0061	32.3	32.3
250	14:02	19.0	6.0	22.0	0.0030	28.0	28.0
1440	9:52	17.0	6.0	22.0	0.0013	23.7	23.7

COMMENTS

Moisture Content = 29.5%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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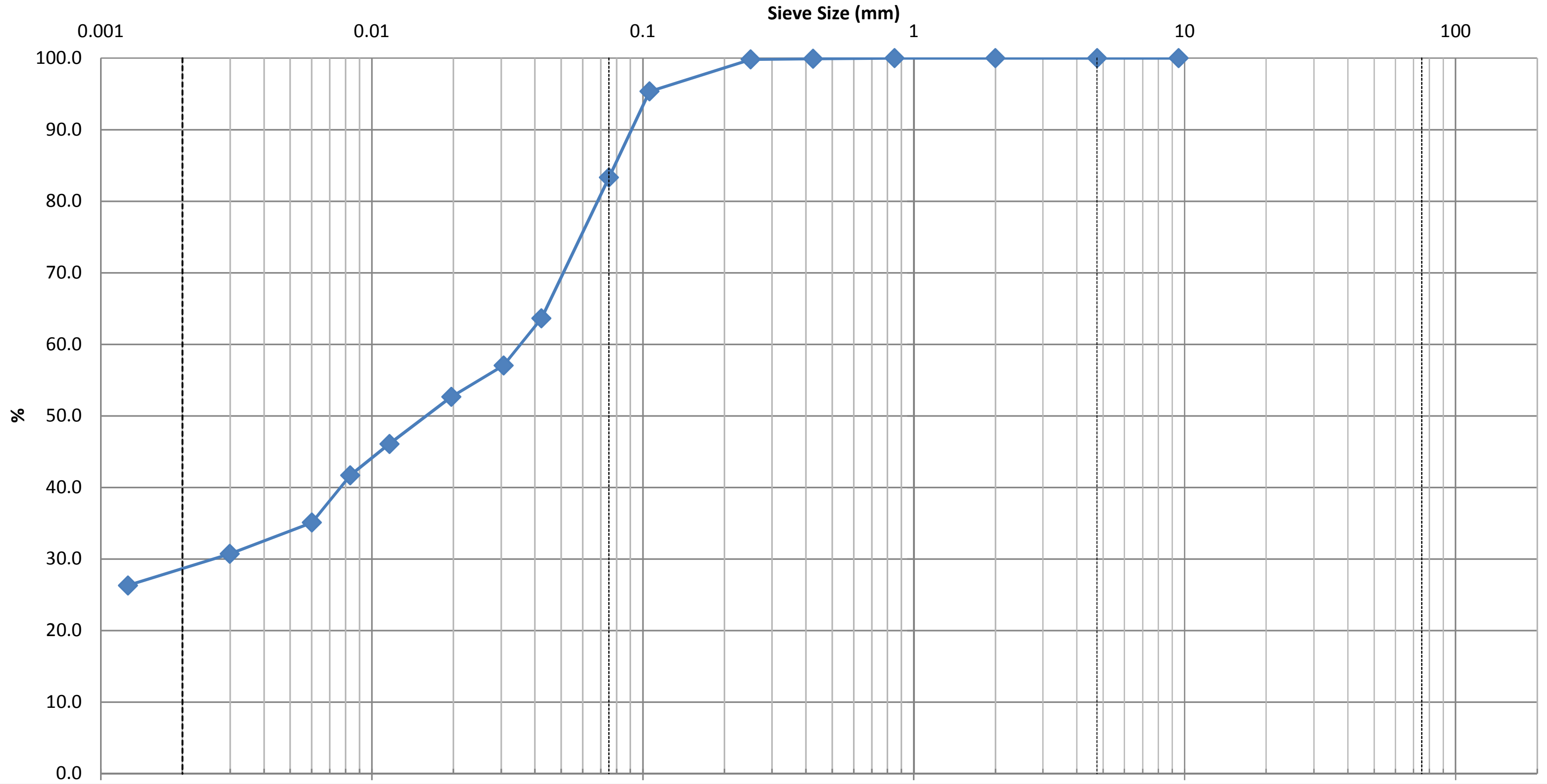
CLIENT:	Mattamy Homes	DEPTH:	5' - 6'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP5-18 - G2	LAB NO:	99143
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					33.2					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	16.7		54.8	28.5	

Comments

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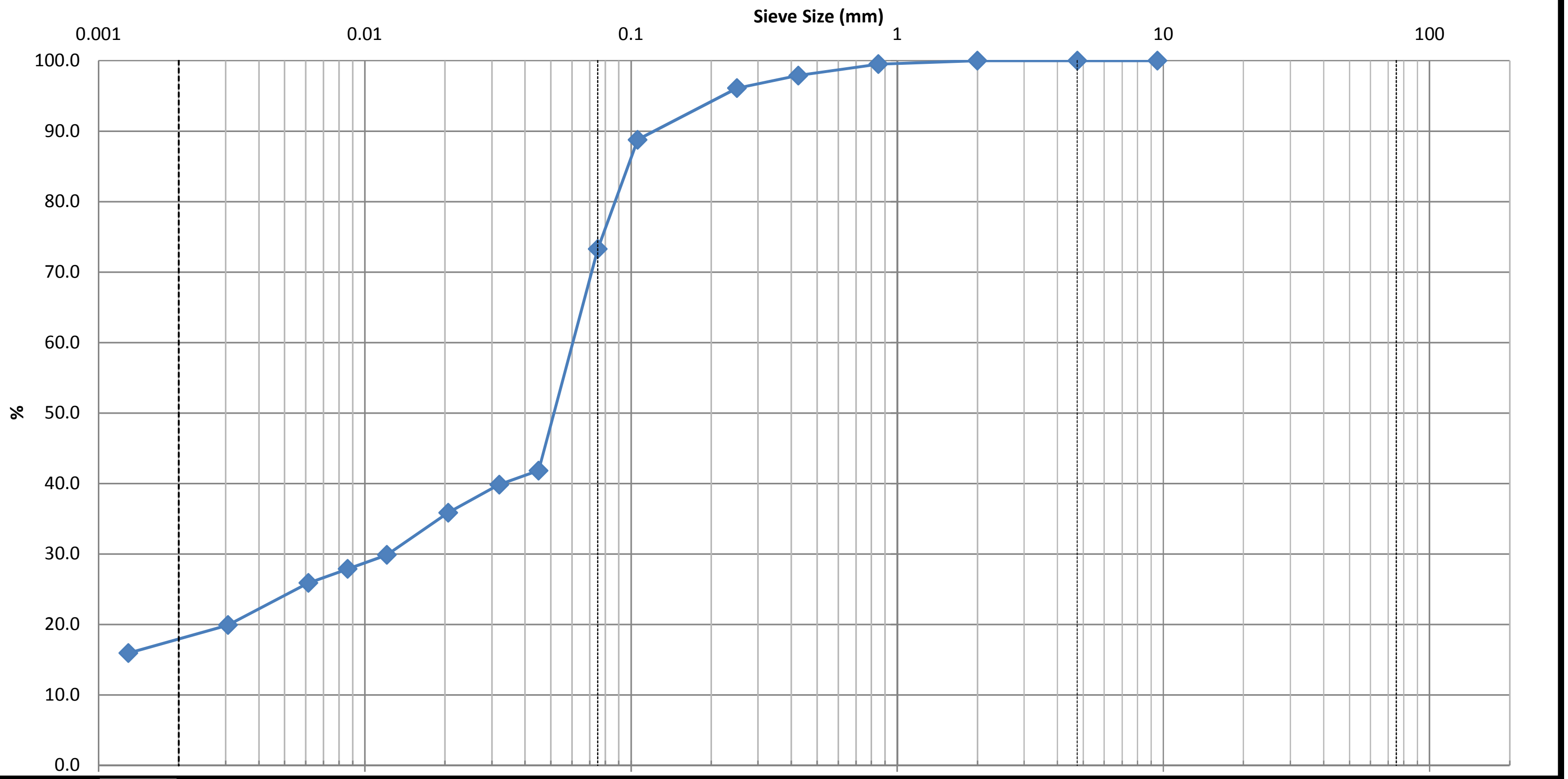
CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP5-18 - G3	LAB NO:	99144
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		18.9					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	26.7	55.3	18.0

Comments

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP5-18 - G3	DATE SAMPLED:	-
LAB No. :	99144	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	142.6	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	149.25	99.25
F=(Wo/Wa)	0.993	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.63	
Wt. AFTER WASH BACK SIEVE	14.58	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**142.6**		
0.850	**0.25**	0.5	99.5
0.425	**1.06**	2.1	97.9
0.250	**1.95**	3.9	96.1
0.106	**5.61**	11.2	88.8
0.075	**13.35**	26.7	73.3
Pan	**14.56**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:16	27.0	6.0	22.0	0.0450	41.8	41.8
2	9:17	26.0	6.0	22.0	0.0320	39.9	39.9
5	9:20	24.0	6.0	22.0	0.0206	35.9	35.9
15	9:30	21.0	6.0	22.0	0.0121	29.9	29.9
30	9:45	20.0	6.0	22.0	0.0086	27.9	27.9
60	10:15	19.0	6.0	22.0	0.0061	25.9	25.9
250	13:25	16.0	6.0	22.0	0.0031	19.9	19.9
1440	9:15	14.0	6.0	22.0	0.0013	15.9	15.9

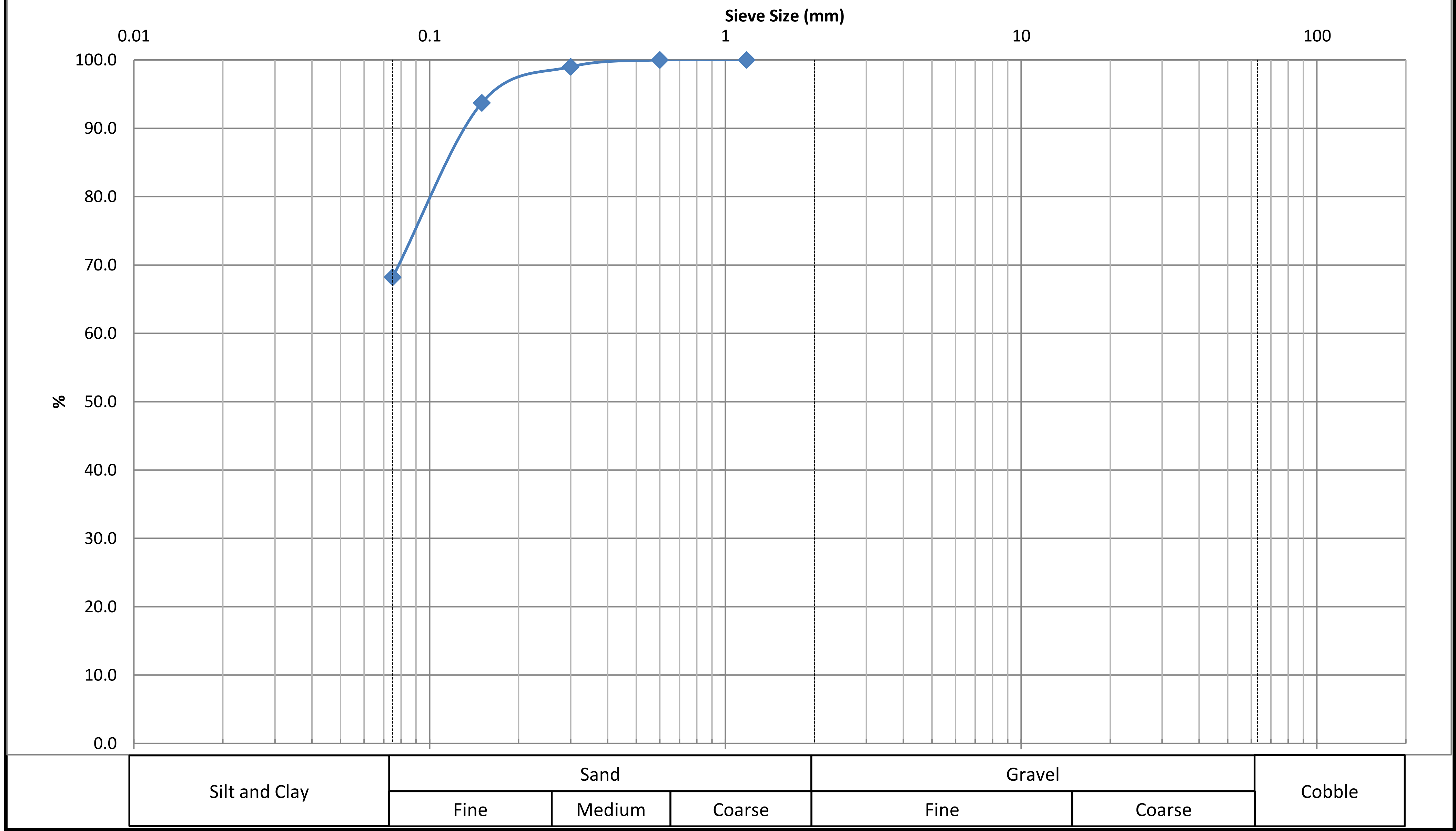
COMMENTS

Moisture Content = 18.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Fine Sand to Sandy Silty with Clay	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO:	98983
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP6-18 - G2	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	1.22 to 1.52	TESTED BY:	D.B



Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
									0.60	3.3
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)		Clay (%)	
	1.3	0.065	0.028	0.02	0.0	31.8	68.2			

Comments	

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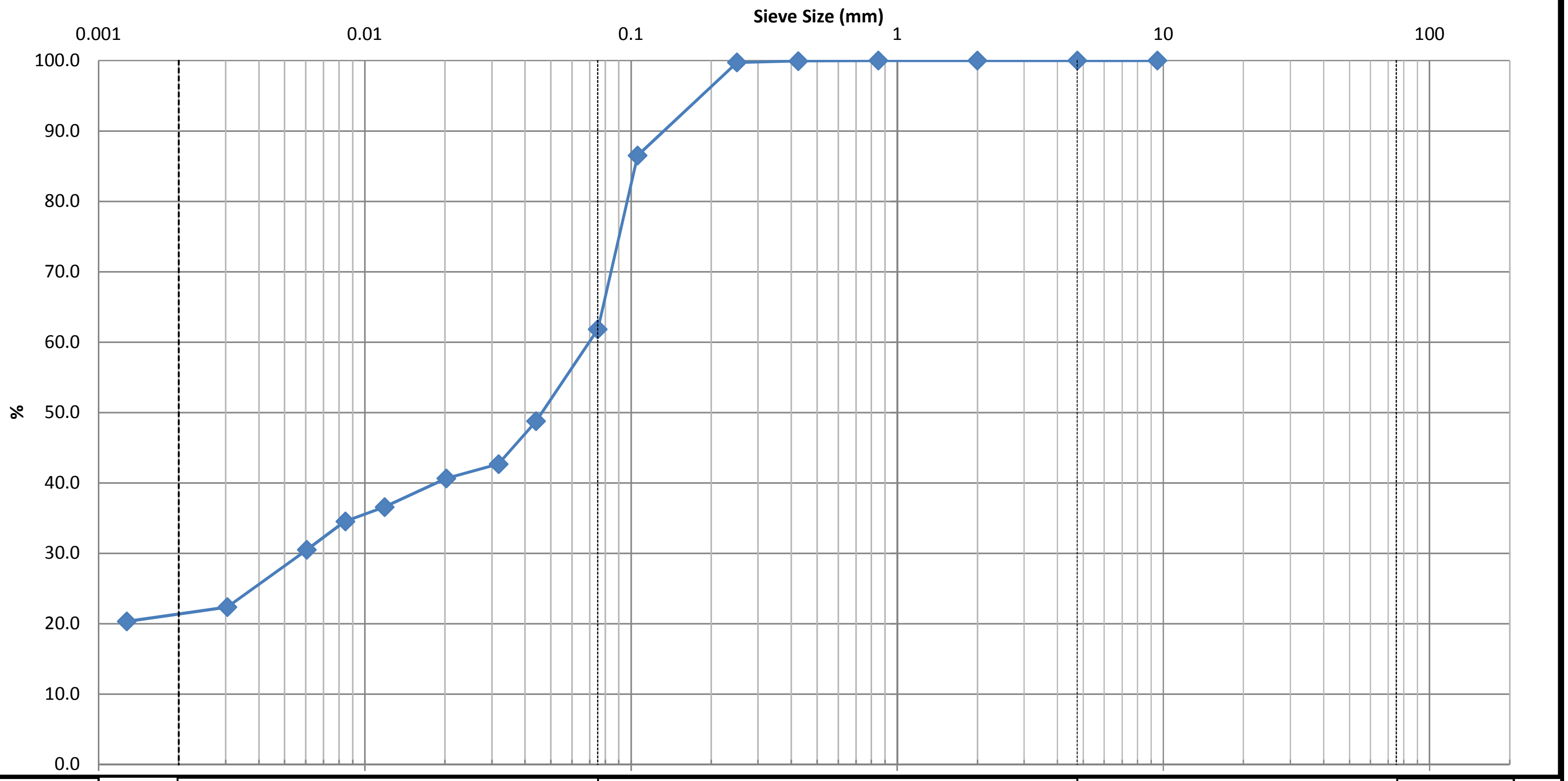
CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP6-18 - G3	LAB NO:	99145
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					24.8					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	38.2		40.3		21.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP6-18 - G3	DATE SAMPLED:	-
LAB No. :	99145	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	171.9	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	147.30	97.30
F=(Wo/Wa)	0.973	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	48.65	
Wt. AFTER WASH BACK SIEVE	21.07	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**171.9**		
0.850	**0.01**	0.0	100.0
0.425	**0.04**	0.1	99.9
0.250	**0.14**	0.3	99.7
0.106	**6.74**	13.5	86.5
0.075	**19.09**	38.2	61.8
Pan	**21.07**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

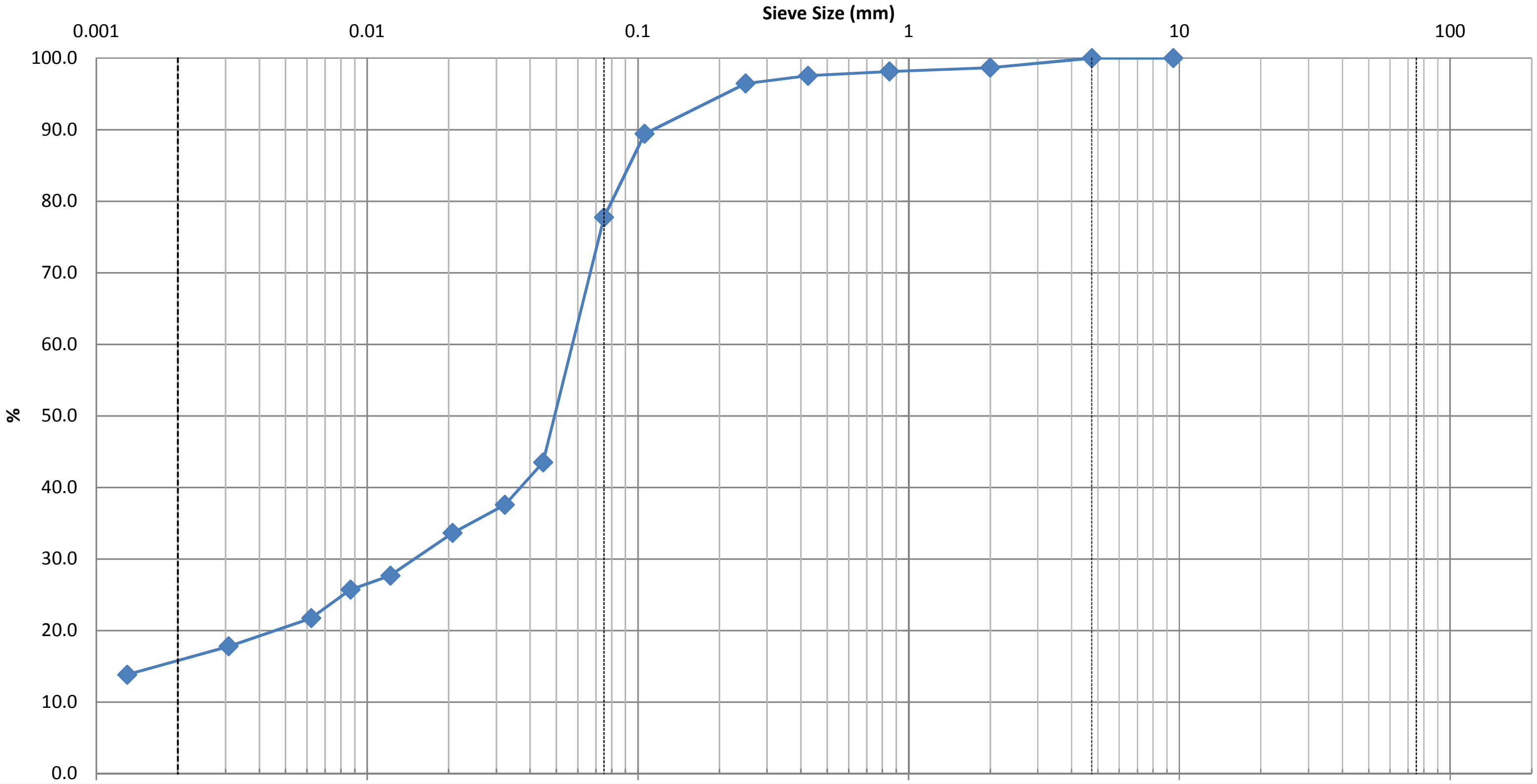
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:28	30.0	6.0	22.0	0.0440	48.8	48.8
2	9:29	27.0	6.0	22.0	0.0318	42.7	42.7
5	9:32	26.0	6.0	22.0	0.0203	40.6	40.6
15	9:42	24.0	6.0	22.0	0.0119	36.6	36.6
30	9:57	23.0	6.0	22.0	0.0084	34.6	34.6
60	10:27	21.0	6.0	22.0	0.0061	30.5	30.5
250	13:37	17.0	6.0	22.0	0.0030	22.4	22.4
1440	9:27	16.0	6.0	22.0	0.0013	20.3	20.3

COMMENTS

Moisture Content = 24.8%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP7-18 - G2	LAB NO:	99146
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					20.6					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	22.2		61.6	16.2	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP7-18 - G2	DATE SAMPLED:	-
LAB No. :	99146	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	177.7		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	148.63	98.63	
F=(Wo/Wa)	0.986		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	49.32		
Wt. AFTER WASH BACK SIEVE		12.6	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**2.4**	1.4	98.6
Pan	**175.3**		
0.850	**0.26**	1.9	98.1
0.425	**0.57**	2.5	97.5
0.250	**1.12**	3.6	96.4
0.106	**4.68**	10.6	89.4
0.075	**10.59**	22.2	77.8
Pan	**12.58**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:41	28.0	6.0	22.0	0.0447	44.1	43.5
2	9:42	25.0	6.0	22.0	0.0323	38.1	37.6
5	9:45	23.0	6.0	22.0	0.0207	34.1	33.6
15	9:55	20.0	6.0	22.0	0.0122	28.1	27.7
30	10:10	19.0	6.0	22.0	0.0087	26.1	25.7
60	10:40	17.0	6.0	22.0	0.0062	22.1	21.8
250	13:50	15.0	6.0	22.0	0.0031	18.0	17.8
1440	9:40	13.0	6.0	22.0	0.0013	14.0	13.8

COMMENTS

Moisture Content = 20.6%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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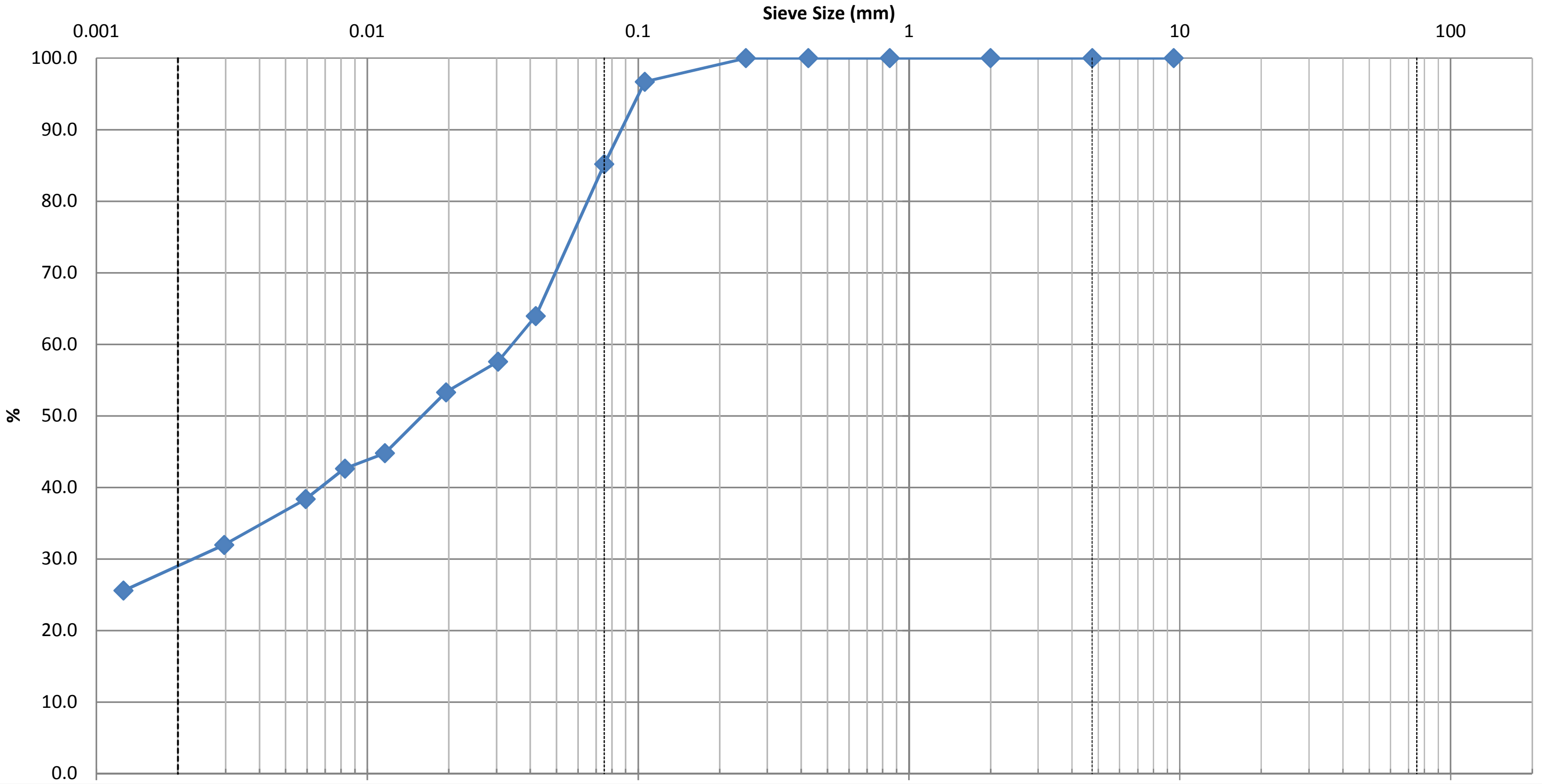
CLIENT:	Mattamy Homes	DEPTH:	6.6' - 7.6'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP7-18 - G3	LAB NO:	99147
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					31.9					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	14.8		55.7	29.5	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6.6' - 7.6'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP7-18 - G3	DATE SAMPLED:	-
LAB No. :	99147	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	187.9	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	142.75	92.75
F=(Wo/Wa)	0.928	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	46.38	
Wt. AFTER WASH BACK SIEVE	8.95	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**187.9**		
0.850	**0.00**	0.0	100.0
0.425	**0.00**	0.0	100.0
0.250	**0.01**	0.0	100.0
0.106	**1.65**	3.3	96.7
0.075	**7.41**	14.8	85.2
Pan	**8.93**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

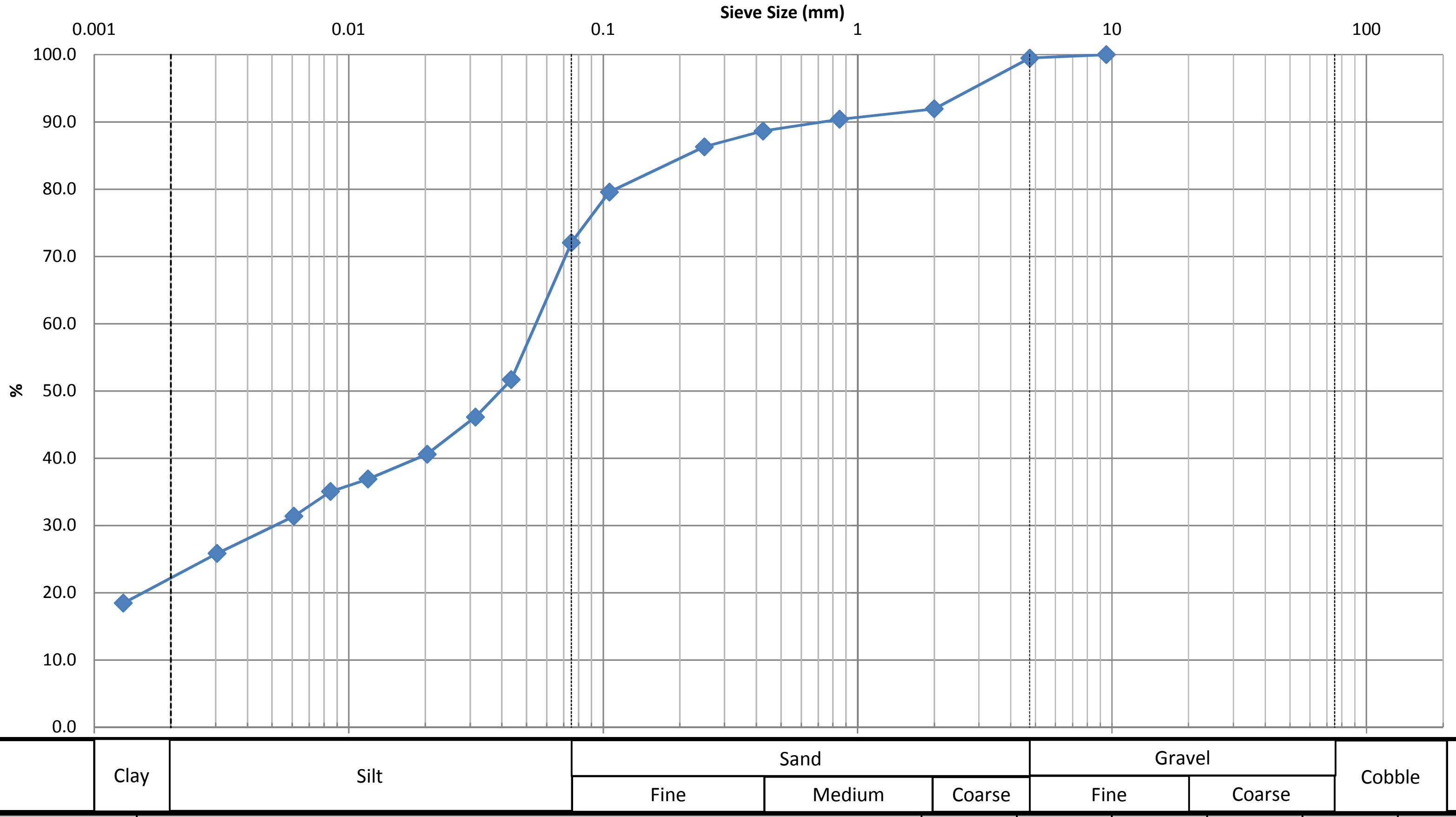
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:53	36.0	6.0	22.0	0.0419	64.0	64.0
2	9:54	33.0	6.0	22.0	0.0304	57.6	57.6
5	9:57	31.0	6.0	22.0	0.0195	53.3	53.3
15	10:07	27.0	6.0	22.0	0.0116	44.8	44.8
30	10:22	26.0	6.0	22.0	0.0083	42.6	42.6
60	10:52	24.0	6.0	22.0	0.0059	38.4	38.4
250	14:02	21.0	6.0	22.0	0.0030	32.0	32.0
1440	9:52	18.0	6.0	22.0	0.0013	25.6	25.6

COMMENTS

Moisture Content = 31.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	2.13 - 2.44	FILE NO:	PG2246
CONTRACT NO.:		BH OR TP No.:	TP8-18 - G2	LAB NO:	98984
PROJECT:	Half Moon Bay West	DESCRIPTION:	Silty Fine Sand to Sandy Silty, some Clay	DATE RECEIVED:	7-Mar-18
				DATE TESTED:	9-Mar-18
DATE SAMPLED:	6-Mar-18			DATE REPORTED:	12-Mar-18
SAMPLED BY:	N. Christie			TESTED BY:	D. Bertrand



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		18.7					

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					0.5	27.5	49.5	22.5

Comments	

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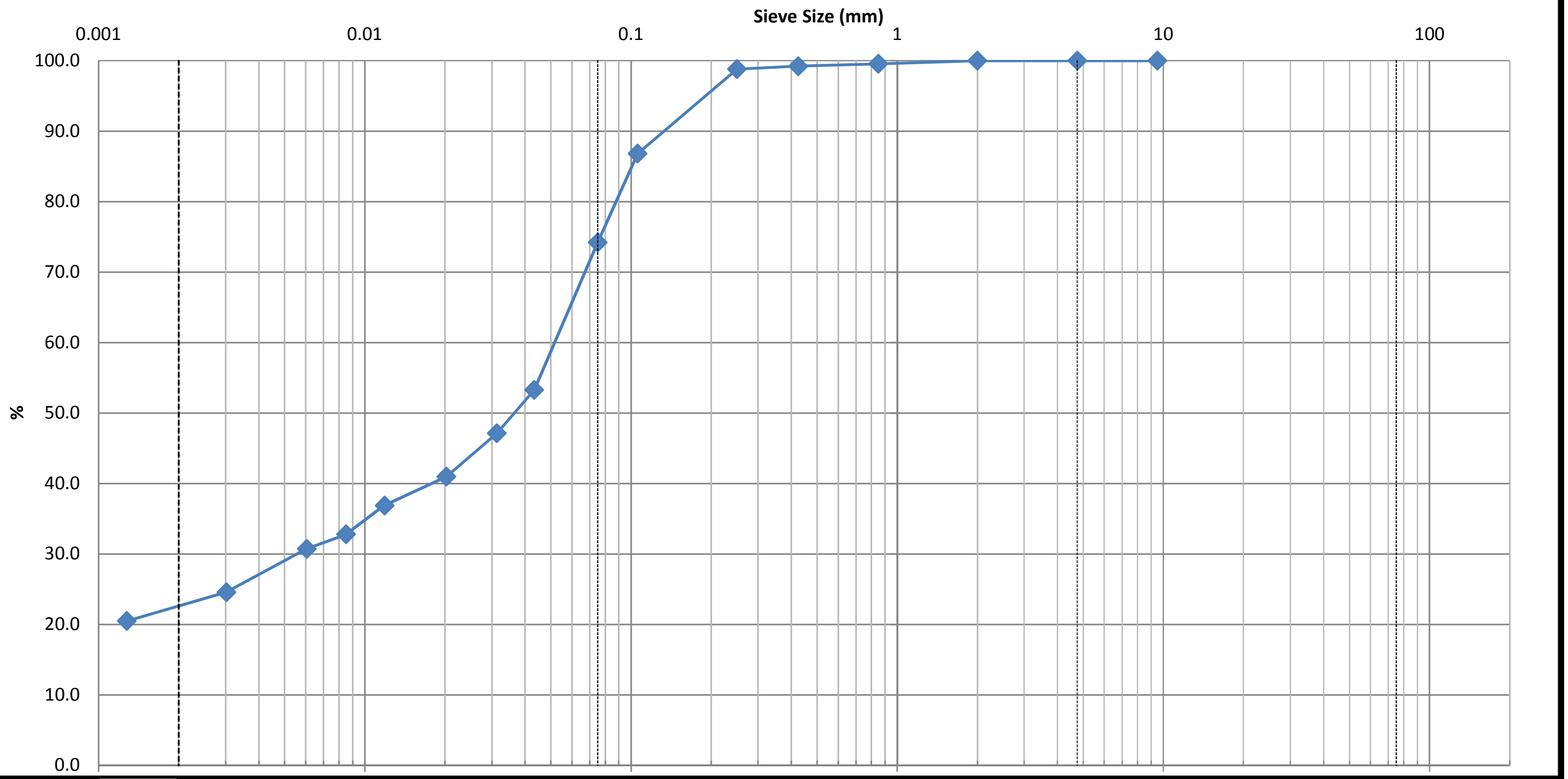
CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP8-18 - G3	LAB NO:	99148
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					28.2					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	25.8		52.0	22.2	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP8-18 - G3	DATE SAMPLED:	-
LAB No. :	99148	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	155.1		50.00
SPECIFIC GRAVITY (Gs)		2.700	
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	146.50	96.50	
F=(Wo/Wa)	0.965		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	48.25		
Wt. AFTER WASH BACK SIEVE		13.75	
SOLUTION CONCENTRATION		40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**155.1**		
0.850	**0.23**	0.5	99.5
0.425	**0.39**	0.8	99.2
0.250	**0.60**	1.2	98.8
0.106	**6.60**	13.2	86.8
0.075	**12.89**	25.8	74.2
Pan	**13.75**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:06	32.0	6.0	22.0	0.0433	53.3	53.3
2	10:07	29.0	6.0	22.0	0.0313	47.1	47.1
5	10:10	26.0	6.0	22.0	0.0203	41.0	41.0
15	10:20	24.0	6.0	22.0	0.0119	36.9	36.9
30	10:35	22.0	6.0	22.0	0.0085	32.8	32.8
60	11:05	21.0	6.0	22.0	0.0061	30.7	30.7
250	14:15	18.0	6.0	22.0	0.0030	24.6	24.6
1440	10:05	16.0	6.0	22.0	0.0013	20.5	20.5

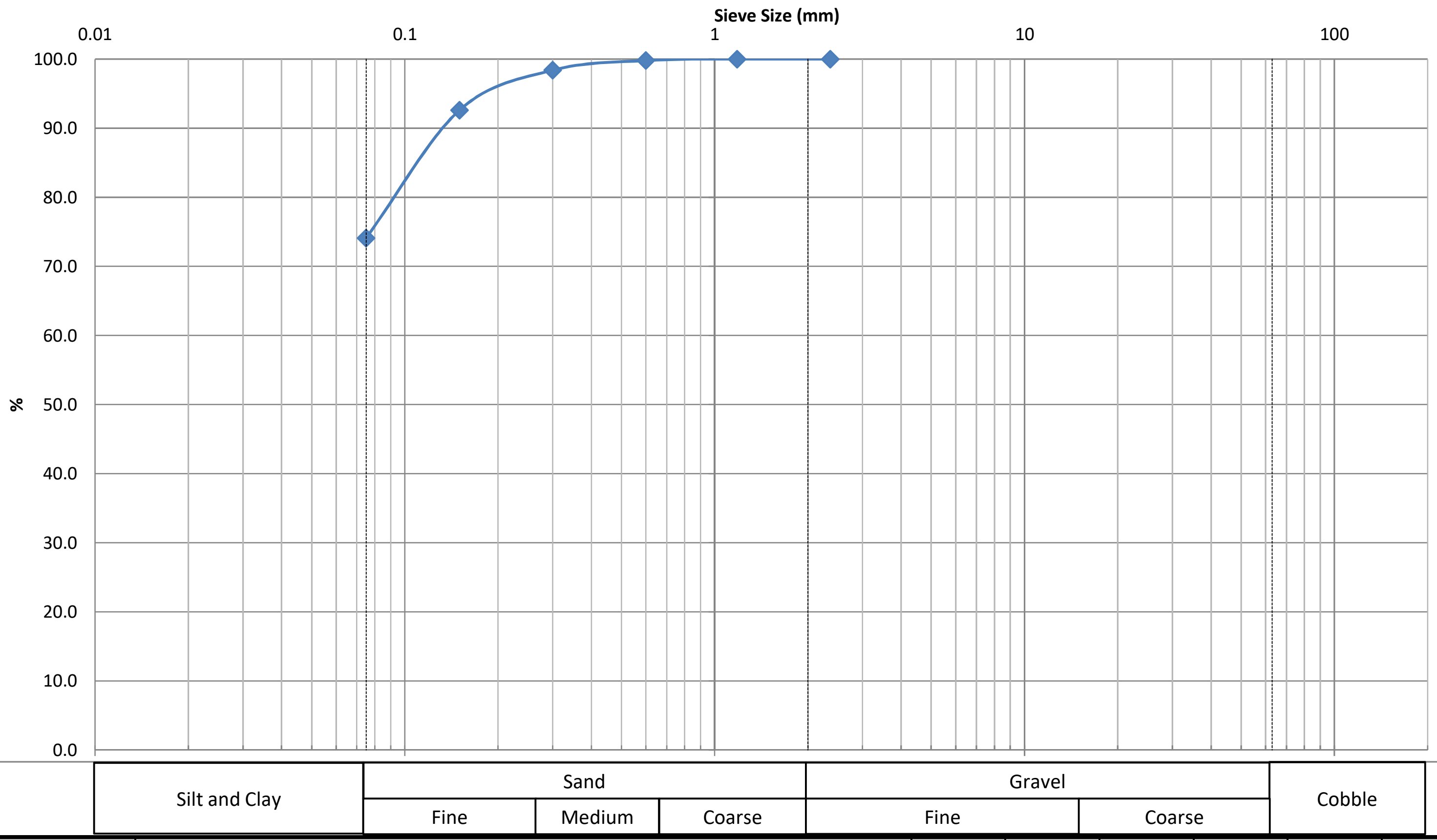
COMMENTS

Moisture Content = 28.2%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						0.65	3.0

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
2.5	0.045	0.021	0.015	0.0	25.9	74.1	

Comments	

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO.:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	255.5
WEIGHT AFTER WASH	A	B	A+B	100.4

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75						
2.36	**0.0**	0.0	**100.0**			
1.18	**0.1**	0.0	**100.0**			
0.6	**0.6**	0.2	**99.8**			
0.3	**4.0**	1.6	**98.4**			
0.15	**19.0**	7.4	**92.6**			
0.075	**66.3**	25.9	**74.1**			
PAN	**100.4**					
SIEVE CHECK FINE		0.00	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	**RESULT**	**LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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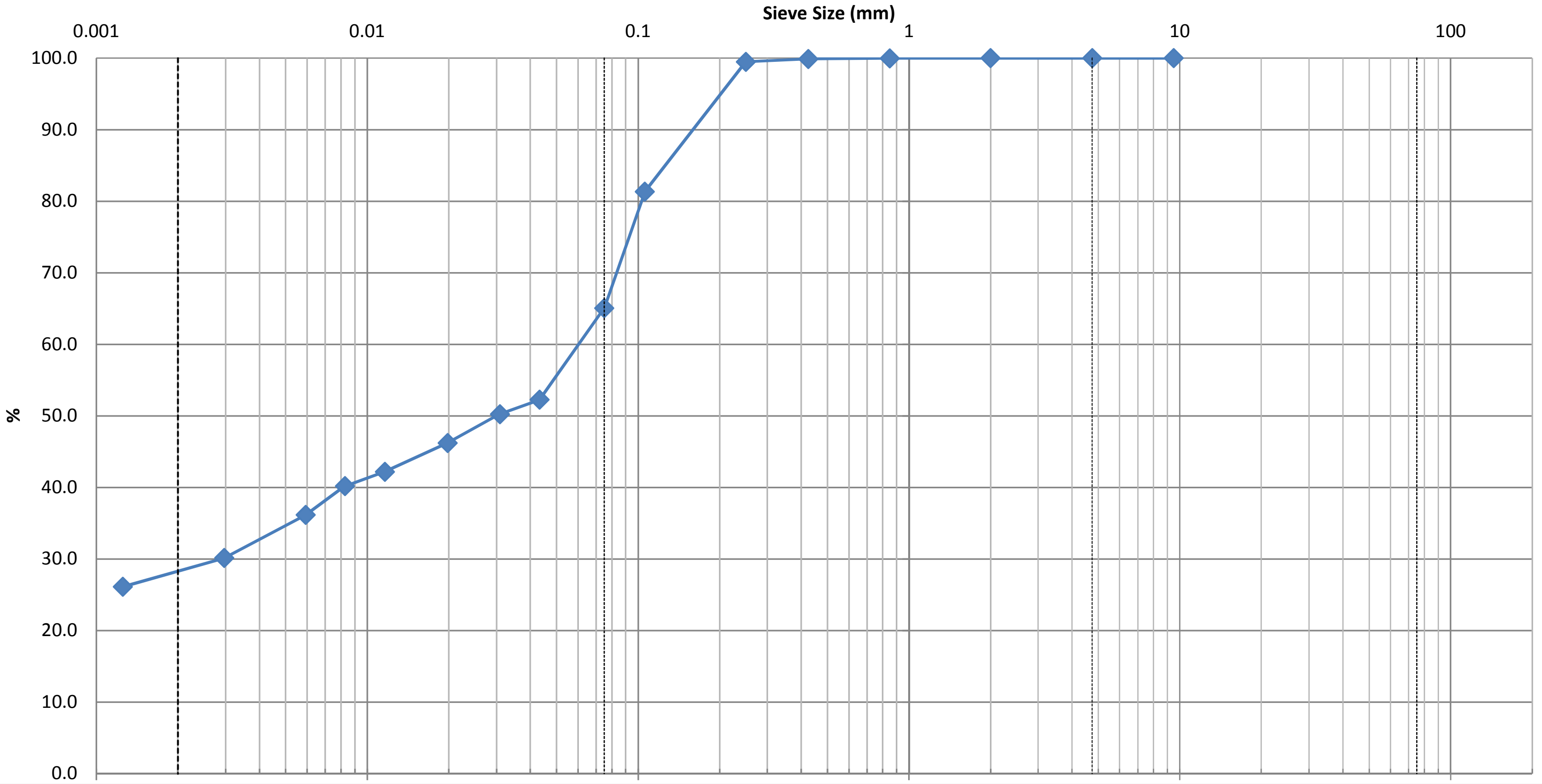
CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP9-18 - G4	LAB NO:	99149
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		24.9					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	34.9	36.6	28.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP9-18 - G4	DATE SAMPLED:	-
LAB No. :	99149	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	164.6	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.40	98.40
F=(Wo/Wa)	0.984	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.20	
Wt. AFTER WASH BACK SIEVE	18.83	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**164.6**		
0.850	**0.02**	0.0	100.0
0.425	**0.06**	0.1	99.9
0.250	**0.26**	0.5	99.5
0.106	**9.34**	18.7	81.3
0.075	**17.47**	34.9	65.1
Pan	**18.81**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:20	32.0	6.0	22.0	0.0433	52.3	52.3
2	10:21	31.0	6.0	22.0	0.0309	50.2	50.2
5	10:24	29.0	6.0	22.0	0.0198	46.2	46.2
15	10:34	27.0	6.0	22.0	0.0116	42.2	42.2
30	10:49	26.0	6.0	22.0	0.0083	40.2	40.2
60	11:19	24.0	6.0	22.0	0.0059	36.2	36.2
250	14:29	21.0	6.0	22.0	0.0030	30.1	30.1
1440	10:19	19.0	6.0	22.0	0.0013	26.1	26.1

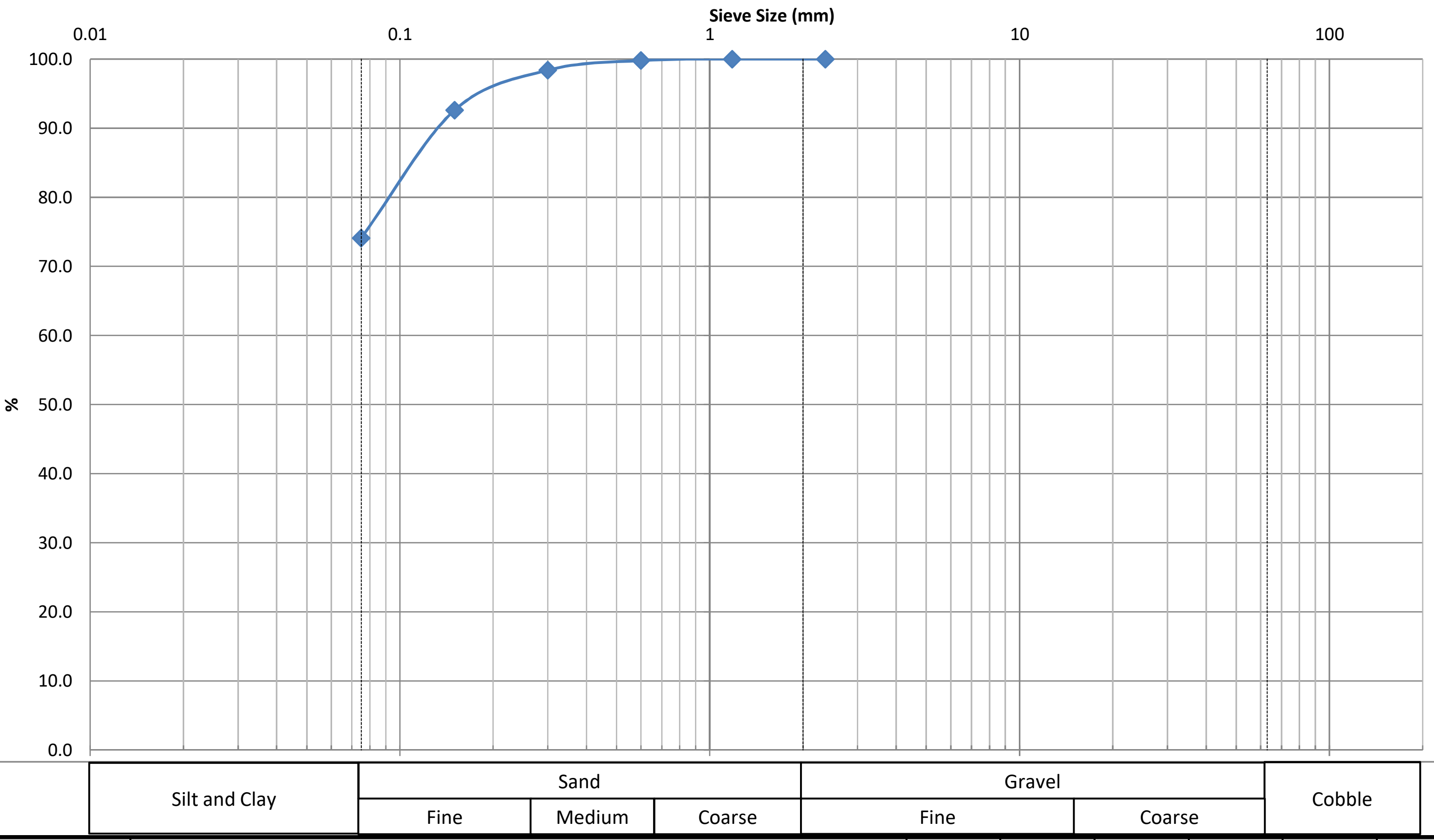
COMMENTS

Moisture Content = 24.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B



Identification	**Soil Classification**					**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
										0.65	3.0
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
	2.5	0.045	0.021	0.015	0.0	25.9		74.1			

Comments	

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO.:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	255.5
WEIGHT AFTER WASH	A	B	A+B	100.4

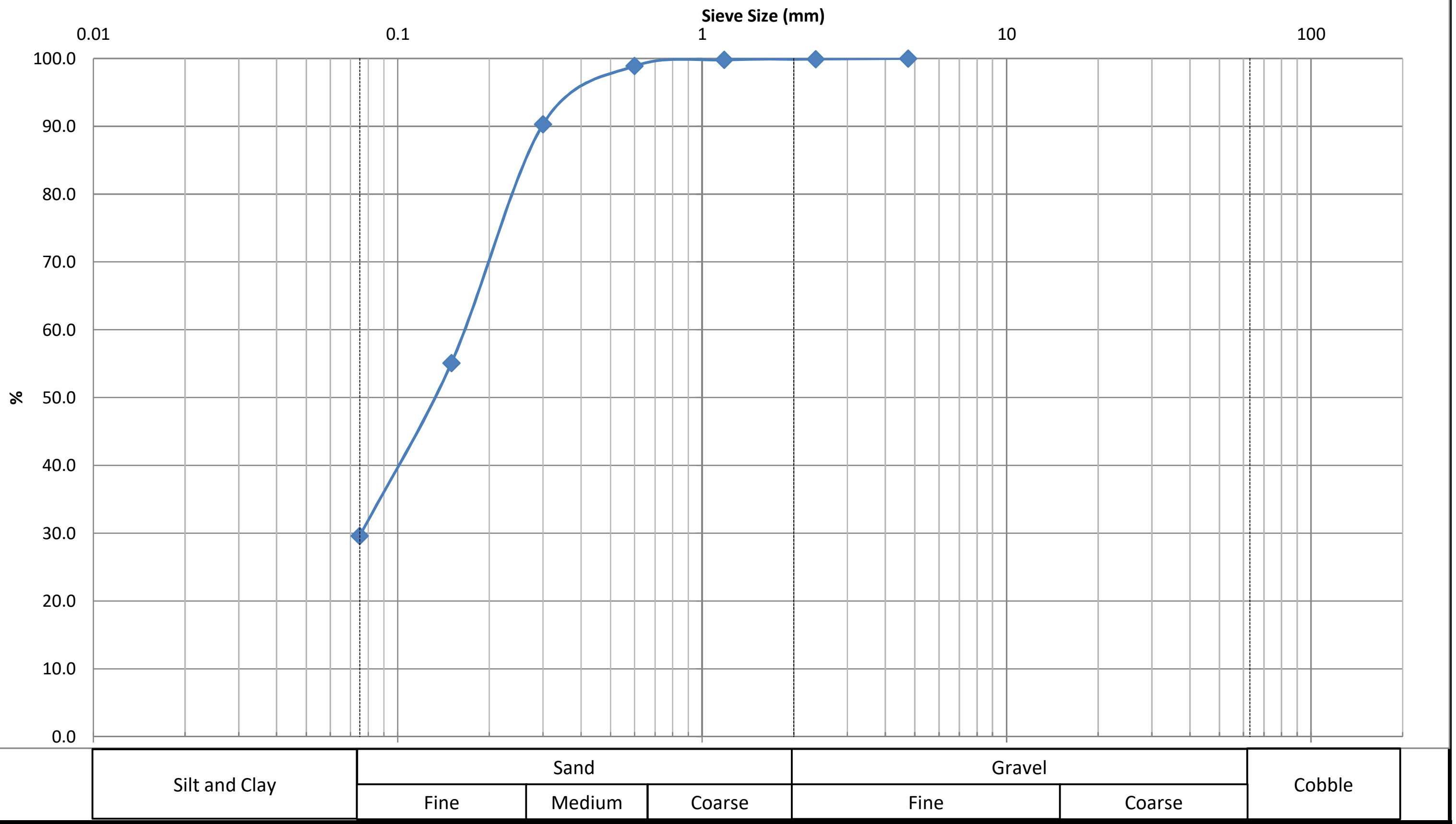
SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75						
2.36	**0.0**	0.0	**100.0**			
1.18	**0.1**	0.0	**100.0**			
0.6	**0.6**	0.2	**99.8**			
0.3	**4.0**	1.6	**98.4**			
0.15	**19.0**	7.4	**92.6**			
0.075	**66.3**	25.9	**74.1**			
PAN	**100.4**					
SIEVE CHECK FINE		0.00	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	**RESULT**	**LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Sand w Some Silt**	LAB NO:	98986
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP10 - 18 G2	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	0.76 to 1.07	TESTED BY:	D.B



Identification	**Soil Classification**	**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
						0.95	4.9

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
	4.9	0.17	0.075	0.035	0.0	70.4	29.6	

Comments	

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Sand w Some Silt**	LAB NO.:	98986
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP10 - 18 G2	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	0.76 to 1.07	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	281.4
WEIGHT AFTER WASH	A	B	A+B	215.9

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75	**0.0**	0.0	**100.0**			
2.36	**0.2**	0.1	**99.9**			
1.18	**0.6**	0.2	**99.8**			
0.6	**3.0**	1.1	**98.9**			
0.3	**27.3**	9.7	**90.3**			
0.15	**126.3**	44.9	**55.1**			
0.075	**198.0**	70.4	**29.6**			
PAN	**215.5**					
SIEVE CHECK FINE		0.19	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	**RESULT**	**LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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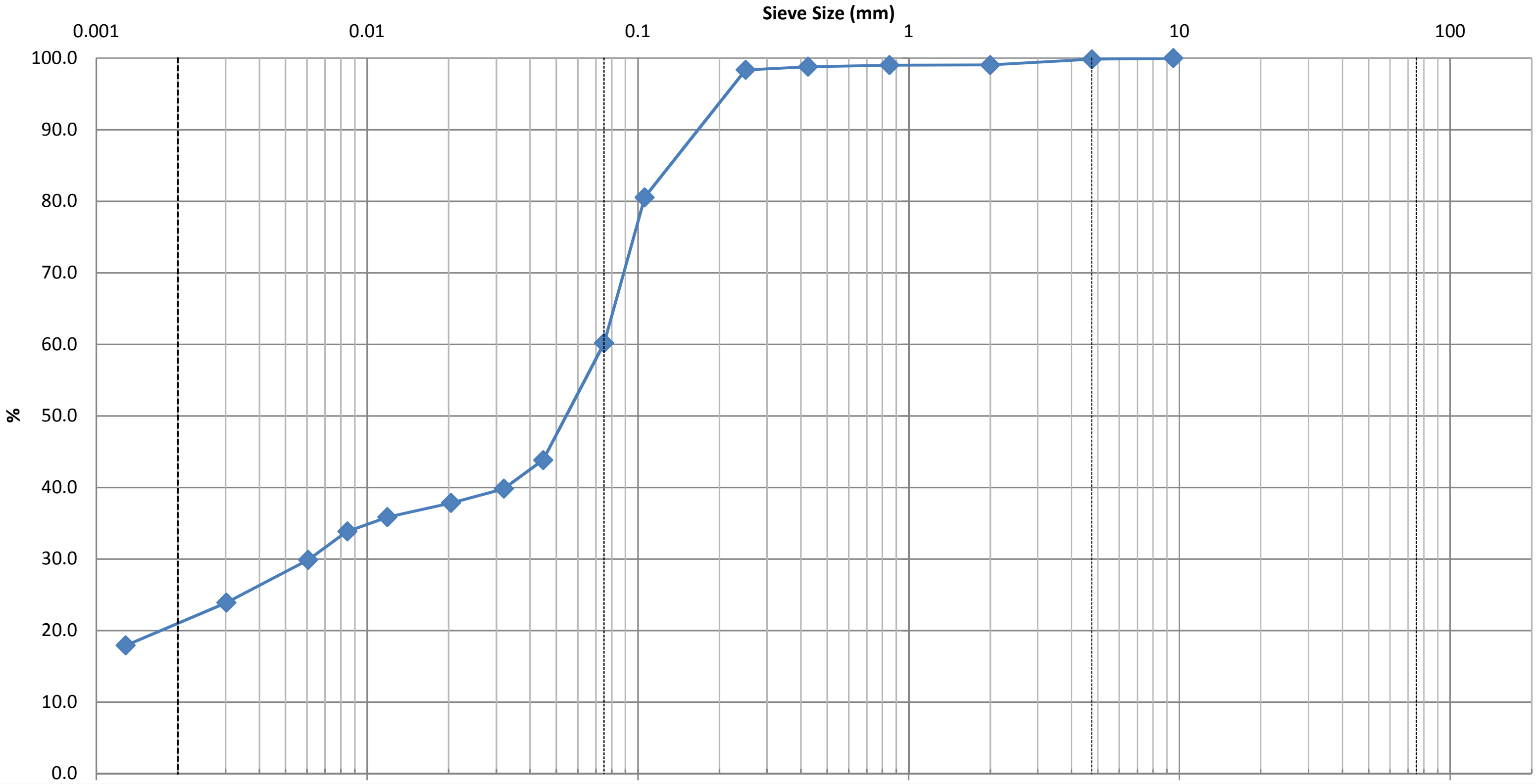
CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP10-18 - G3	LAB NO:	99150
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					20.6					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.2	39.6		39.7	20.5	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP10-18 - G3	DATE SAMPLED:	-
LAB No. :	99150	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	177	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.35	98.35
F=(Wo/Wa)	0.984	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.18	
Wt. AFTER WASH BACK SIEVE	21.13	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.3**	0.2	99.8
2.0	**1.7**	1.0	99.0
Pan	**175.3**		
0.850	**0.01**	1.0	99.0
0.425	**0.13**	1.2	98.8
0.250	**0.35**	1.7	98.3
0.106	**9.34**	19.5	80.5
0.075	**19.62**	39.8	60.2
Pan	**21.12**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:32	28.0	6.0	22.0	0.0447	44.2	43.8
2	10:33	26.0	6.0	22.0	0.0320	40.2	39.8
5	10:36	25.0	6.0	22.0	0.0204	38.2	37.8
15	10:46	24.0	6.0	22.0	0.0119	36.2	35.8
30	11:01	23.0	6.0	22.0	0.0084	34.2	33.9
60	11:31	21.0	6.0	22.0	0.0061	30.2	29.9
250	14:41	18.0	6.0	22.0	0.0030	24.1	23.9
1440	10:31	15.0	6.0	22.0	0.0013	18.1	17.9

COMMENTS

Moisture Content = 20.6%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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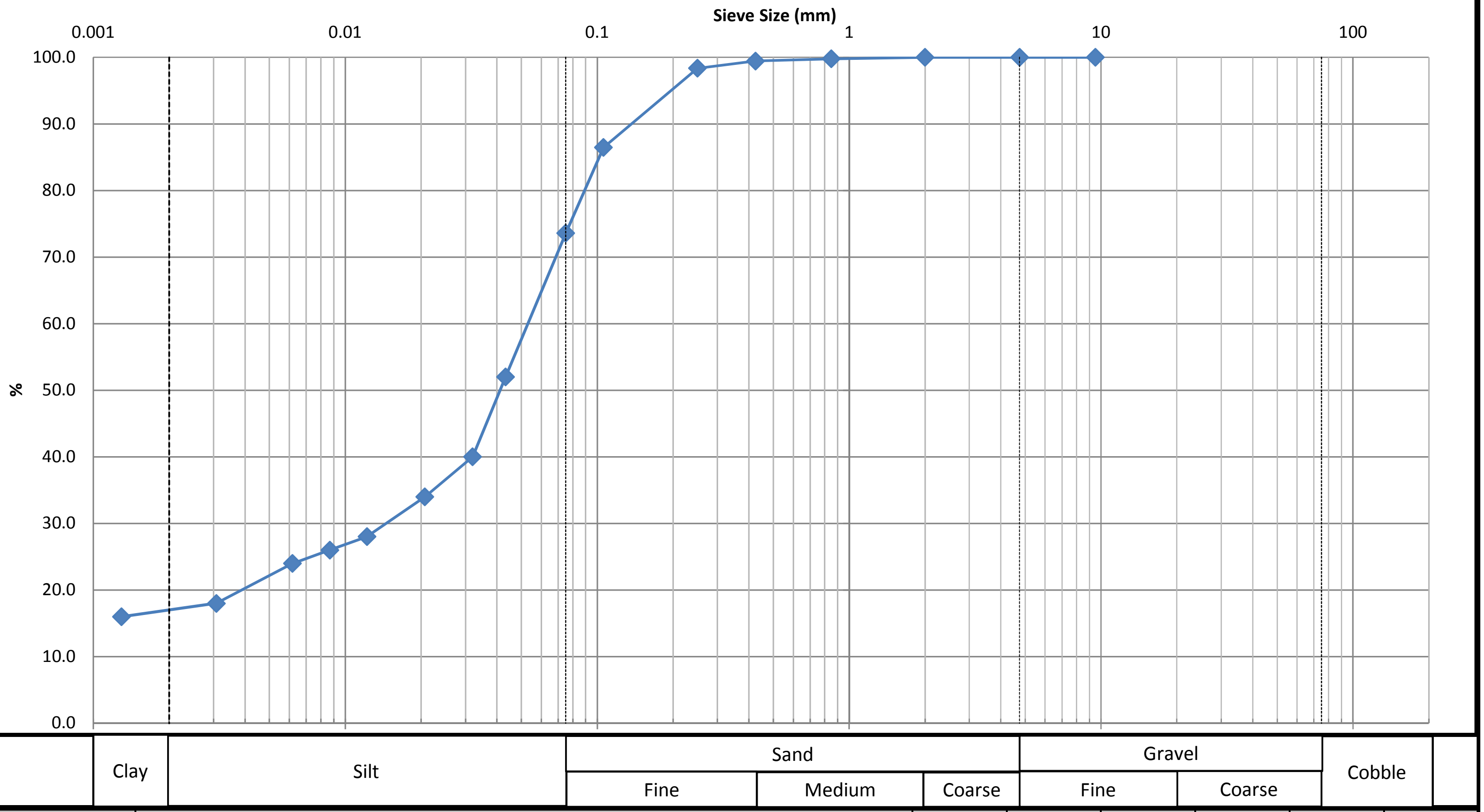
CLIENT:	Mattamy Homes	DEPTH:	1'6" - 2'6"	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP2-18 - G1	LAB NO:	99138
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		20.7					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	26.4	56.6	17.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	1'6" - 2'6"	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP2-18 - G1	DATE SAMPLED:	-
LAB No. :	99138	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	164.9	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.85	98.85
F=(Wo/Wa)	0.989	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.43	
Wt. AFTER WASH BACK SIEVE	20.24	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**164.9**		
0.850	**0.11**	0.2	99.8
0.425	**0.28**	0.6	99.4
0.250	**0.82**	1.6	98.4
0.106	**6.77**	13.5	86.5
0.075	**13.21**	26.4	73.6
Pan	**20.22**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

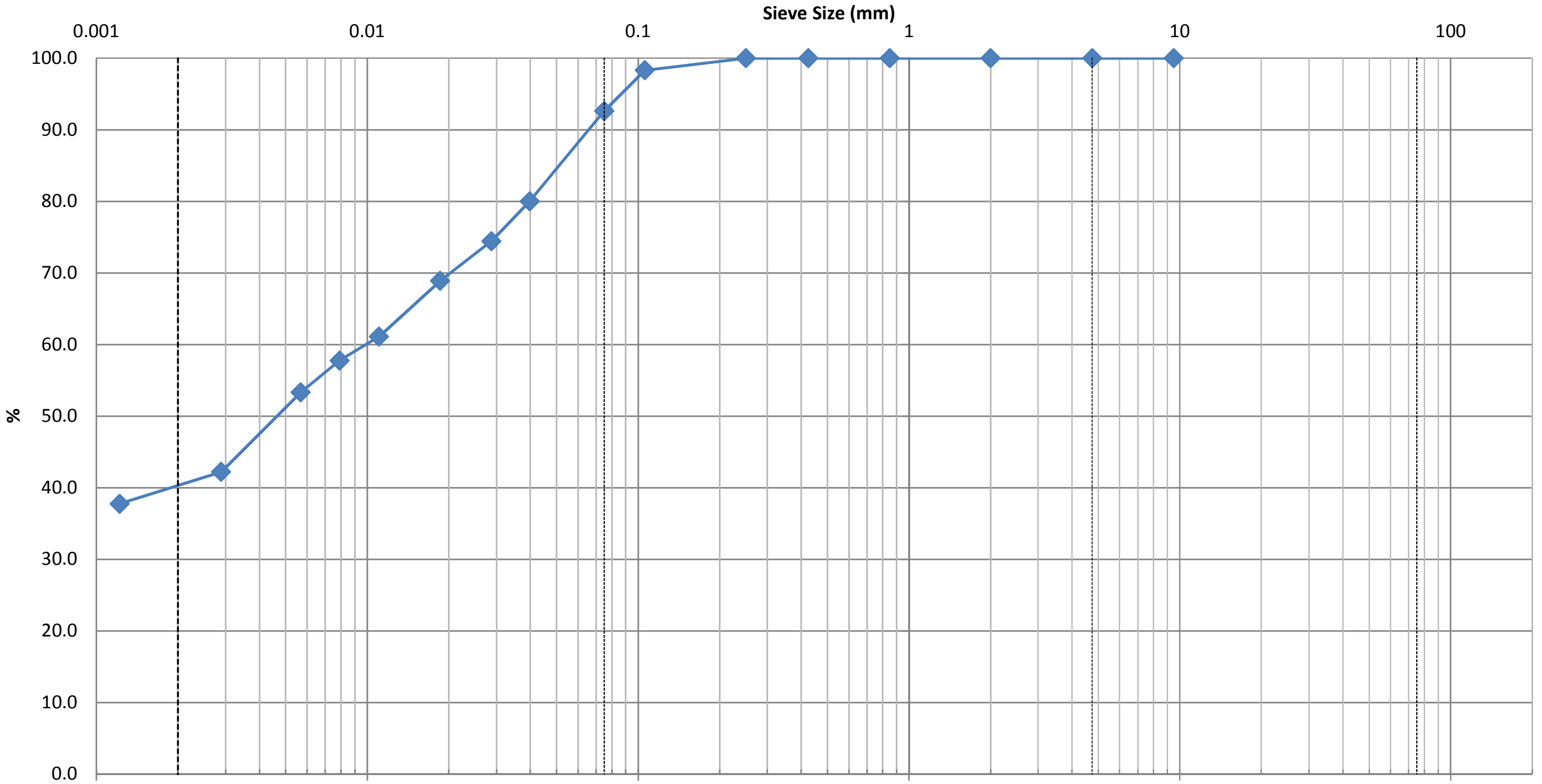
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:03	32.0	6.0	22.0	0.0433	52.0	52.0
2	9:04	26.0	6.0	22.0	0.0320	40.0	40.0
5	9:07	23.0	6.0	22.0	0.0207	34.0	34.0
15	9:17	20.0	6.0	22.0	0.0122	28.0	28.0
30	9:32	19.0	6.0	22.0	0.0087	26.0	26.0
60	10:02	18.0	6.0	22.0	0.0062	24.0	24.0
250	13:12	15.0	6.0	22.0	0.0031	18.0	18.0
1440	9:02	14.0	6.0	22.0	0.0013	16.0	16.0

COMMENTS

Moisture Content = 20.7%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP2-18 - G3	LAB NO:	99139
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble	
		Fine	Medium	Coarse	Fine	Coarse		

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					39.3					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	7.4		52.1		40.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP2-18 - G3	DATE SAMPLED:	-
LAB No. :	99139	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	120.3	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	139.00	89.00
F=(Wo/Wa)	0.890	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	44.50	
Wt. AFTER WASH BACK SIEVE	4.13	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**120.3**		
0.850	**0.00**	0.0	100.0
0.425	**0.00**	0.0	100.0
0.250	**0.01**	0.0	100.0
0.106	**0.84**	1.7	98.3
0.075	**3.69**	7.4	92.6
Pan	**4.12**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:15	42.0	6.0	22.0	0.0398	80.0	80.0
2	9:16	39.5	6.0	22.0	0.0288	74.4	74.4
5	9:19	37.0	6.0	22.0	0.0186	68.9	68.9
15	9:29	33.5	6.0	22.0	0.0111	61.1	61.1
30	9:44	32.0	6.0	22.0	0.0079	57.8	57.8
60	10:14	30.0	6.0	22.0	0.0057	53.3	53.3
250	13:24	25.0	6.0	22.0	0.0029	42.2	42.2
1440	9:14	23.0	6.0	22.0	0.0012	37.8	37.8

COMMENTS

Moisture Content = 39.3%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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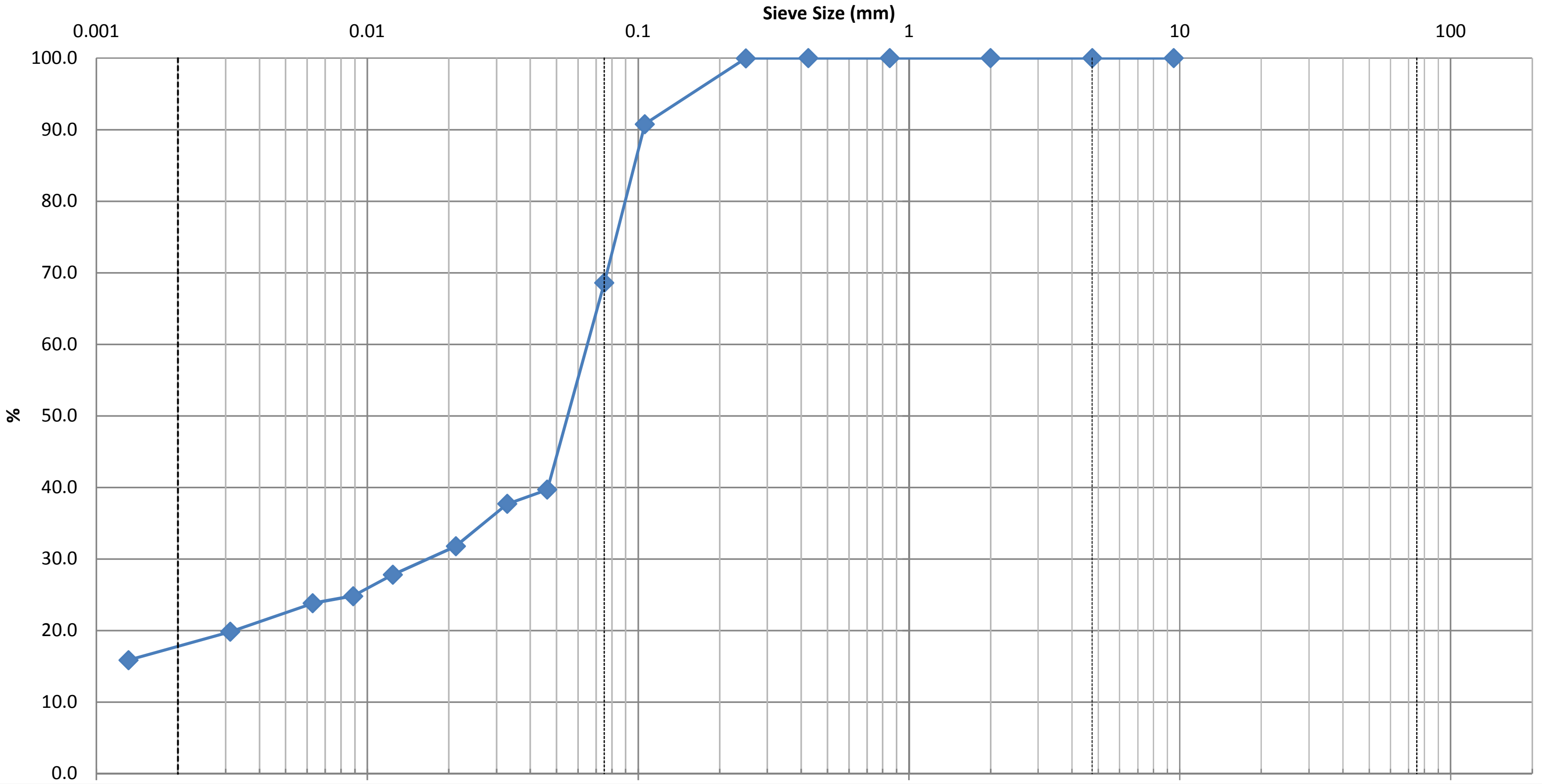
CLIENT:	Mattamy Homes	DEPTH:	1.22 - 1.52	FILE NO:	PG2246
CONTRACT NO.:		BH OR TP No.:	TP3-18 - G2	LAB NO:	98982
PROJECT:	Half Moon Bay West	DESCRIPTION:	Silty Fine Sand to Sandy Silty, some Clay	DATE RECEIVED:	7-Mar-18
				DATE TESTED:	9-Mar-18
DATE SAMPLED:	6-Mar-18			DATE REPORTED:	12-Mar-18
SAMPLED BY:	N. Christie			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					16.7					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	31.4		50.6	18.0	

Comments	

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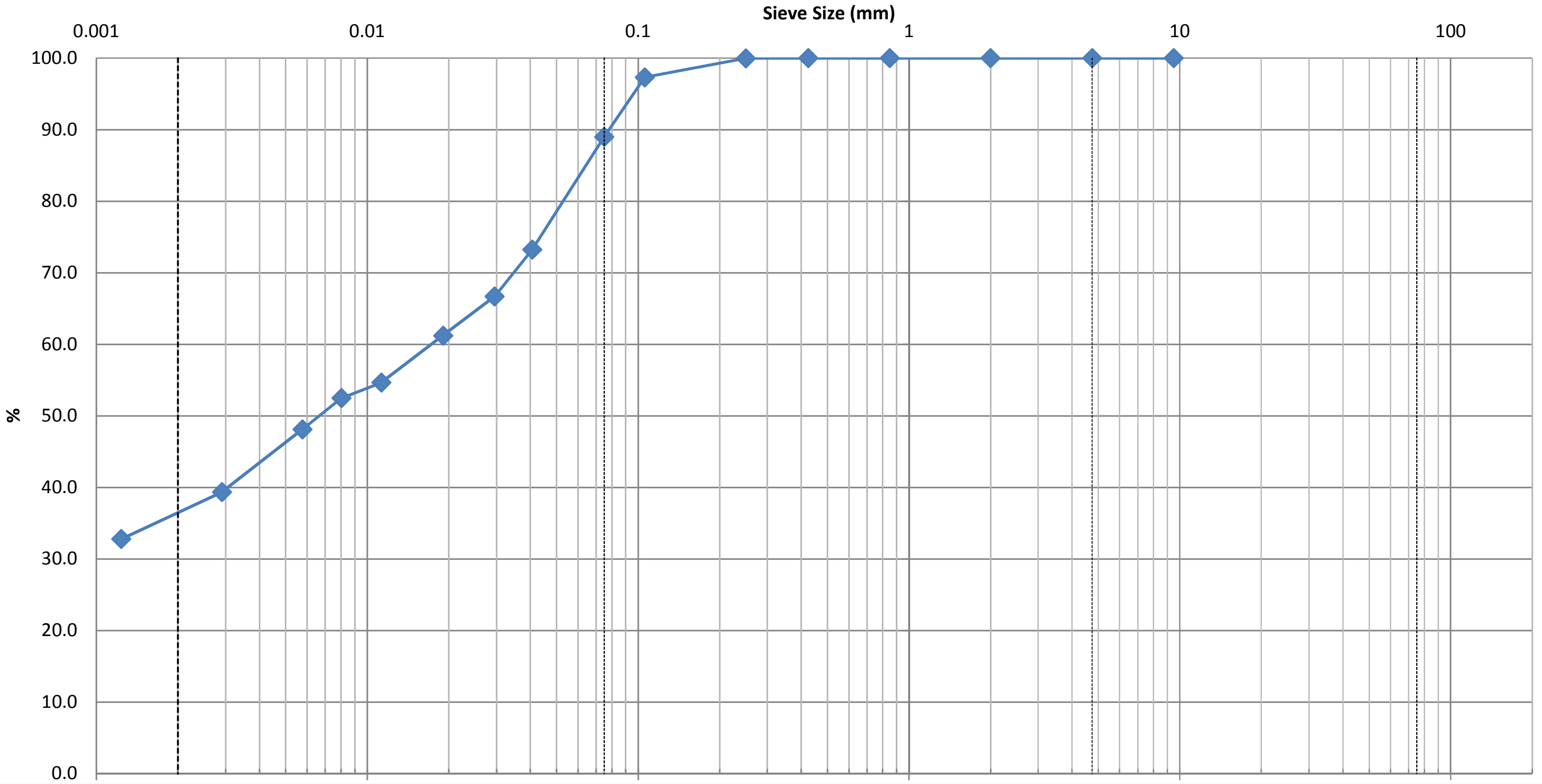
CLIENT:	Mattamy Homes	DEPTH:	8' - 9'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP3-18 - G3	LAB NO:	99140
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					36.1					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	11.0		52.9		36.1

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	8' - 9'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP3-18 - G3	DATE SAMPLED:	-
LAB No. :	99140	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	127.8	50.00
SPECIFIC GRAVITY (Gs)		2.700
HYGROSCOPIC MOISTURE		Tare No.
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	140.45	90.45
F=(Wo/Wa)	0.905	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	45.23	
Wt. AFTER WASH BACK SIEVE		6.48
SOLUTION CONCENTRATION		40 g / L

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**127.8**		
0.850	**0.00**	0.0	100.0
0.425	**0.01**	0.0	100.0
0.250	**0.02**	0.0	100.0
0.106	**1.34**	2.7	97.3
0.075	**5.50**	11.0	89.0
Pan	**6.48**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:28	39.5	6.0	22.0	0.0407	73.2	73.2
2	9:29	36.5	6.0	22.0	0.0295	66.7	66.7
5	9:32	34.0	6.0	22.0	0.0191	61.2	61.2
15	9:42	31.0	6.0	22.0	0.0113	54.7	54.7
30	9:57	30.0	6.0	22.0	0.0080	52.5	52.5
60	10:27	28.0	6.0	22.0	0.0058	48.1	48.1
250	13:37	24.0	6.0	22.0	0.0029	39.4	39.4
1440	9:27	21.0	6.0	22.0	0.0012	32.8	32.8

COMMENTS

Moisture Content = 36.1.1%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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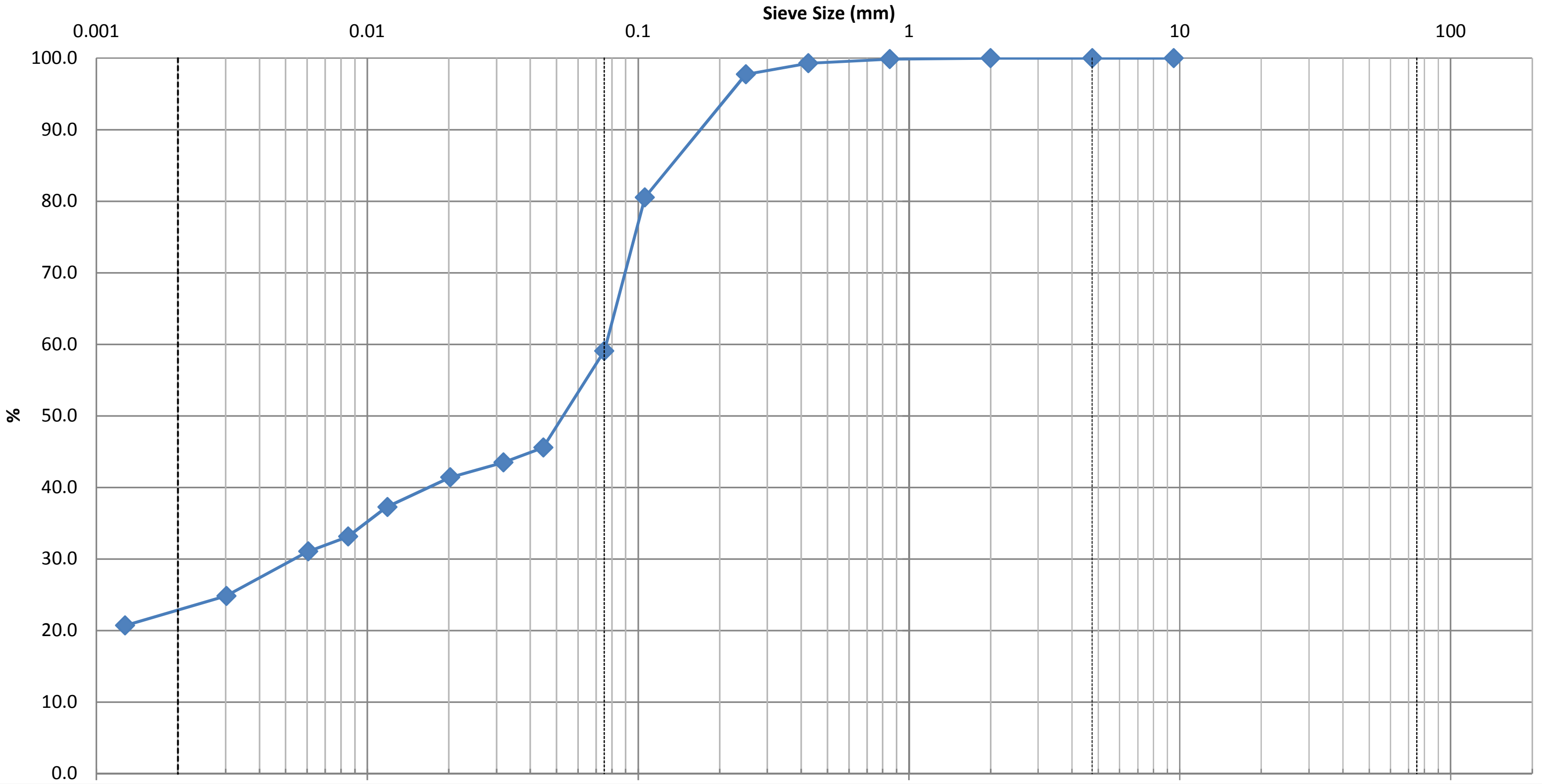
CLIENT:	Mattamy Homes	DEPTH:	17'6" - 18'6"	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP4-18 - G4	LAB NO:	99141
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		23.1					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	40.9	36.6	22.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	17'6" - 18'6"	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP4-18 - G4	DATE SAMPLED:	-
LAB No. :	99141	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	169.4		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	145.45	95.45	
F=(Wo/Wa)	0.955		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	47.73		
Wt. AFTER WASH BACK SIEVE		22.25	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**169.5**		
0.850	**0.07**	0.1	99.9
0.425	**0.36**	0.7	99.3
0.250	**1.14**	2.3	97.7
0.106	**9.74**	19.5	80.5
0.075	**20.47**	40.9	59.1
Pan	**22.25**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:40	28.0	6.0	22.0	0.0447	45.6	45.6
2	9:41	27.0	6.0	22.0	0.0318	43.5	43.5
5	9:44	26.0	6.0	22.0	0.0203	41.4	41.4
15	9:54	24.0	6.0	22.0	0.0119	37.3	37.3
30	10:09	22.0	6.0	22.0	0.0085	33.1	33.1
60	10:39	21.0	6.0	22.0	0.0061	31.1	31.1
250	13:49	18.0	6.0	22.0	0.0030	24.9	24.9
1440	9:39	16.0	6.0	22.0	0.0013	20.7	20.7

COMMENTS

Moisture Content = 23.1%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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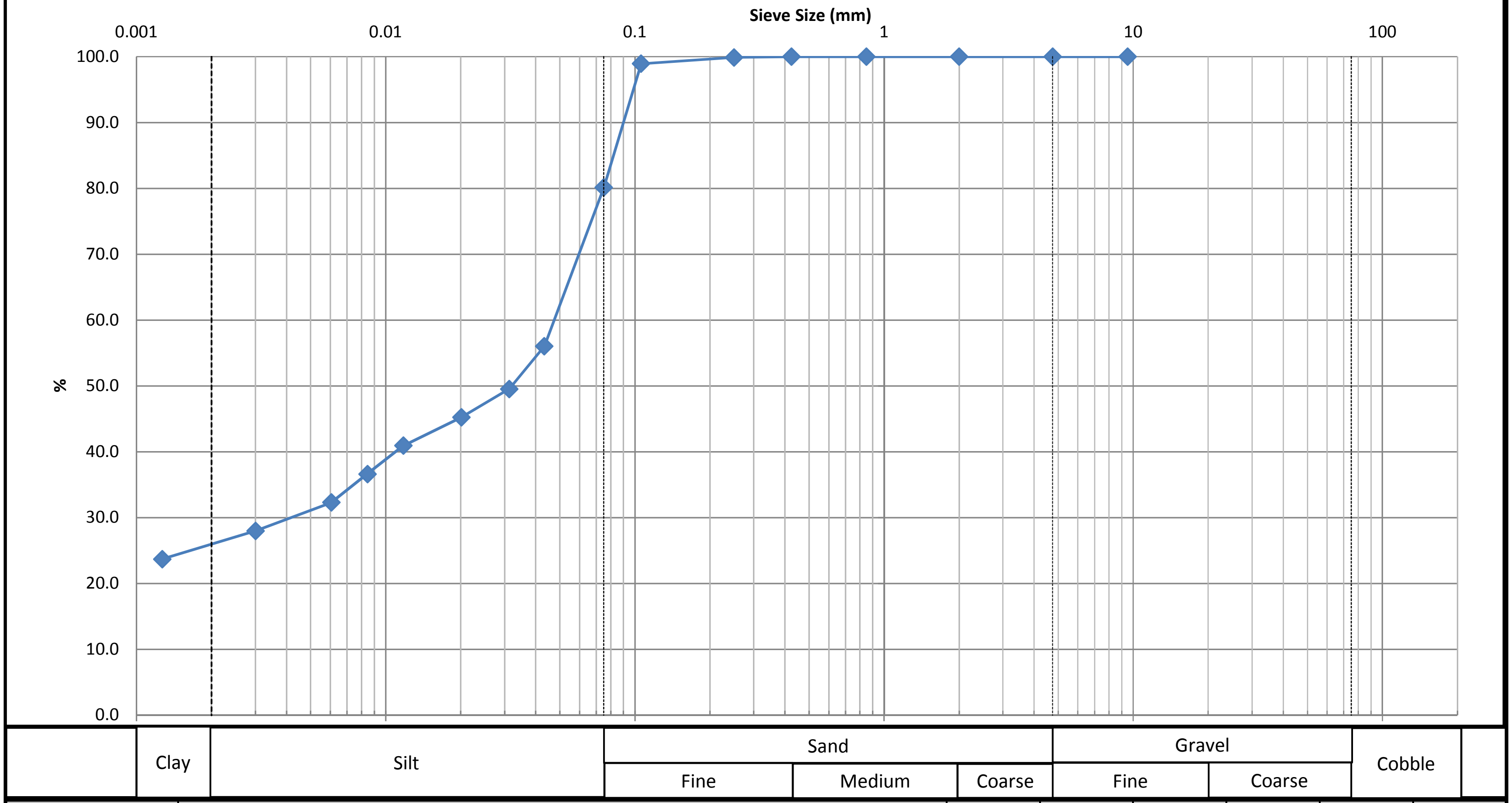
CLIENT:	Mattamy Homes	DEPTH:	15' - 16'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP4-18 - G5	LAB NO:	99142
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Identification	**Soil Classification**	**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
		29.5					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	19.9	54.1	26.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	15' - 16'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP4-18 - G5	DATE SAMPLED:	-
LAB No. :	99142	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	163.4	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	141.80	91.80
F=(Wo/Wa)	0.918	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	45.90	
Wt. AFTER WASH BACK SIEVE	12.56	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**163.4**		
0.850	**0.00**	0.0	100.0
0.425	**0.01**	0.0	100.0
0.250	**0.06**	0.1	99.9
0.106	**0.53**	1.1	98.9
0.075	**9.94**	19.9	80.1
Pan	**12.56**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:53	32.0	6.0	22.0	0.0433	56.0	56.0
2	9:54	29.0	6.0	22.0	0.0313	49.5	49.5
5	9:57	27.0	6.0	22.0	0.0201	45.2	45.2
15	10:07	25.0	6.0	22.0	0.0118	40.9	40.9
30	10:22	23.0	6.0	22.0	0.0084	36.6	36.6
60	10:52	21.0	6.0	22.0	0.0061	32.3	32.3
250	14:02	19.0	6.0	22.0	0.0030	28.0	28.0
1440	9:52	17.0	6.0	22.0	0.0013	23.7	23.7

COMMENTS

Moisture Content = 29.5%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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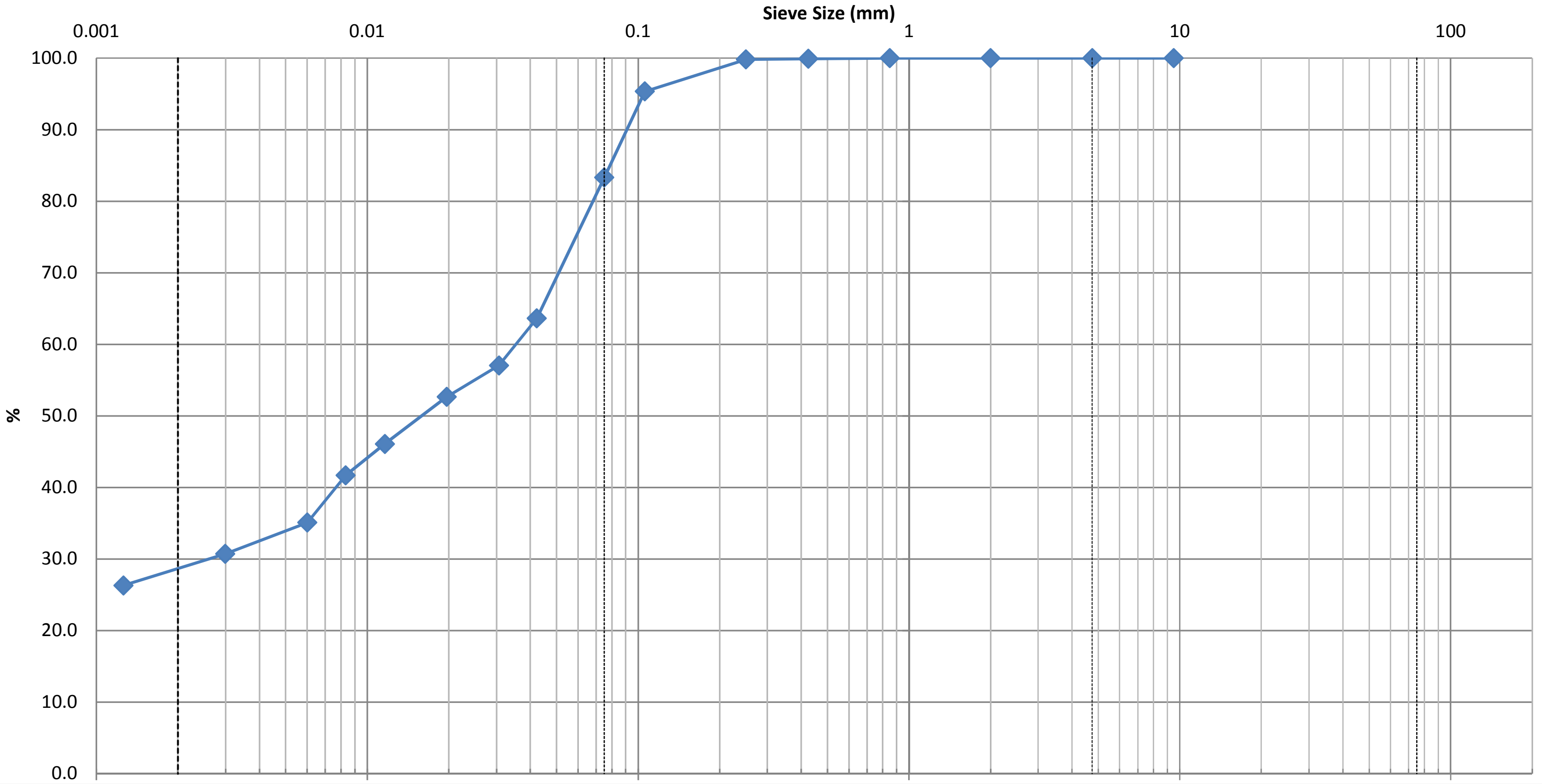
CLIENT:	Mattamy Homes	DEPTH:	5' - 6'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP5-18 - G2	LAB NO:	99143
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		33.2					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	16.7	54.8	28.5

Comments	

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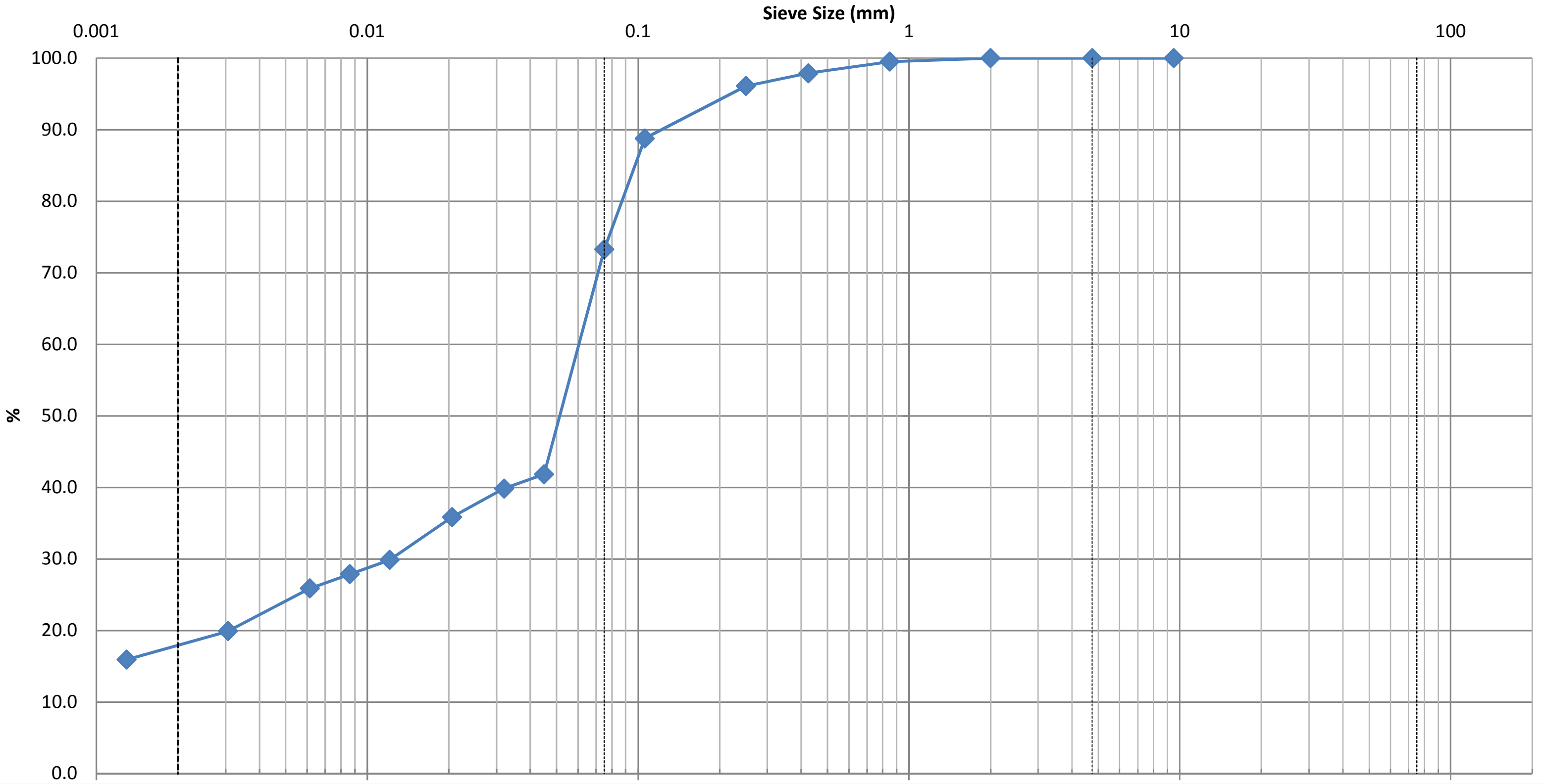
CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP5-18 - G3	LAB NO:	99144
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		18.9					

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					0.0	26.7	55.3	18.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP5-18 - G3	DATE SAMPLED:	-
LAB No. :	99144	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	142.6		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	149.25	99.25	
F=(Wo/Wa)	0.993		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	49.63		
Wt. AFTER WASH BACK SIEVE		14.58	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**142.6**		
0.850	**0.25**	0.5	99.5
0.425	**1.06**	2.1	97.9
0.250	**1.95**	3.9	96.1
0.106	**5.61**	11.2	88.8
0.075	**13.35**	26.7	73.3
Pan	**14.56**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:16	27.0	6.0	22.0	0.0450	41.8	41.8
2	9:17	26.0	6.0	22.0	0.0320	39.9	39.9
5	9:20	24.0	6.0	22.0	0.0206	35.9	35.9
15	9:30	21.0	6.0	22.0	0.0121	29.9	29.9
30	9:45	20.0	6.0	22.0	0.0086	27.9	27.9
60	10:15	19.0	6.0	22.0	0.0061	25.9	25.9
250	13:25	16.0	6.0	22.0	0.0031	19.9	19.9
1440	9:15	14.0	6.0	22.0	0.0013	15.9	15.9

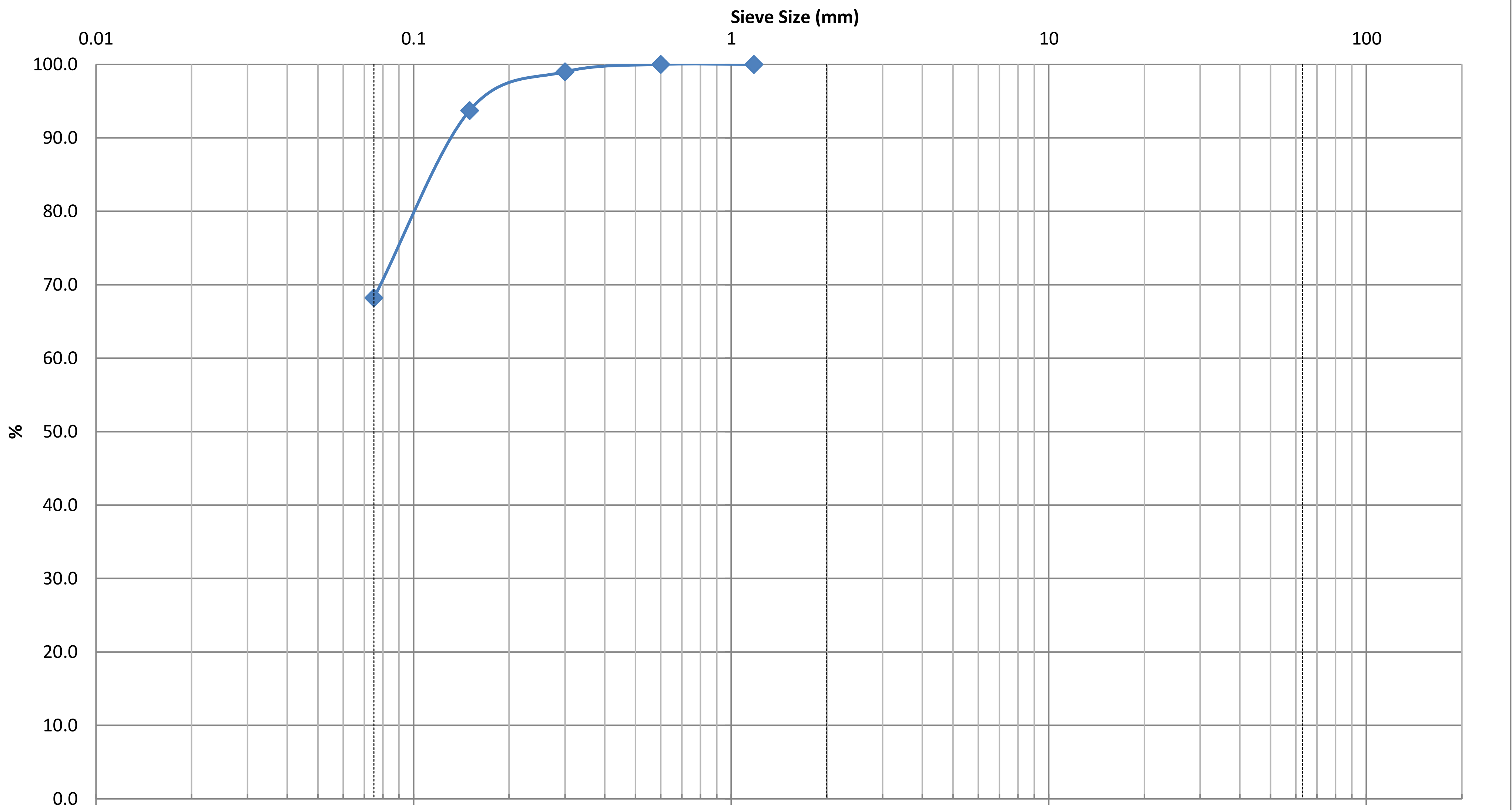
COMMENTS

Moisture Content = 18.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Fine Sand to Sandy Silty with Clay	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	-	LAB NO:	98983
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP6-18 - G2	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	1.22 to 1.52	TESTED BY:	D.B



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
									0.60	3.3
	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)		Clay (%)	
	1.3	0.065	0.028	0.02	0.0	31.8	68.2			

Comments	

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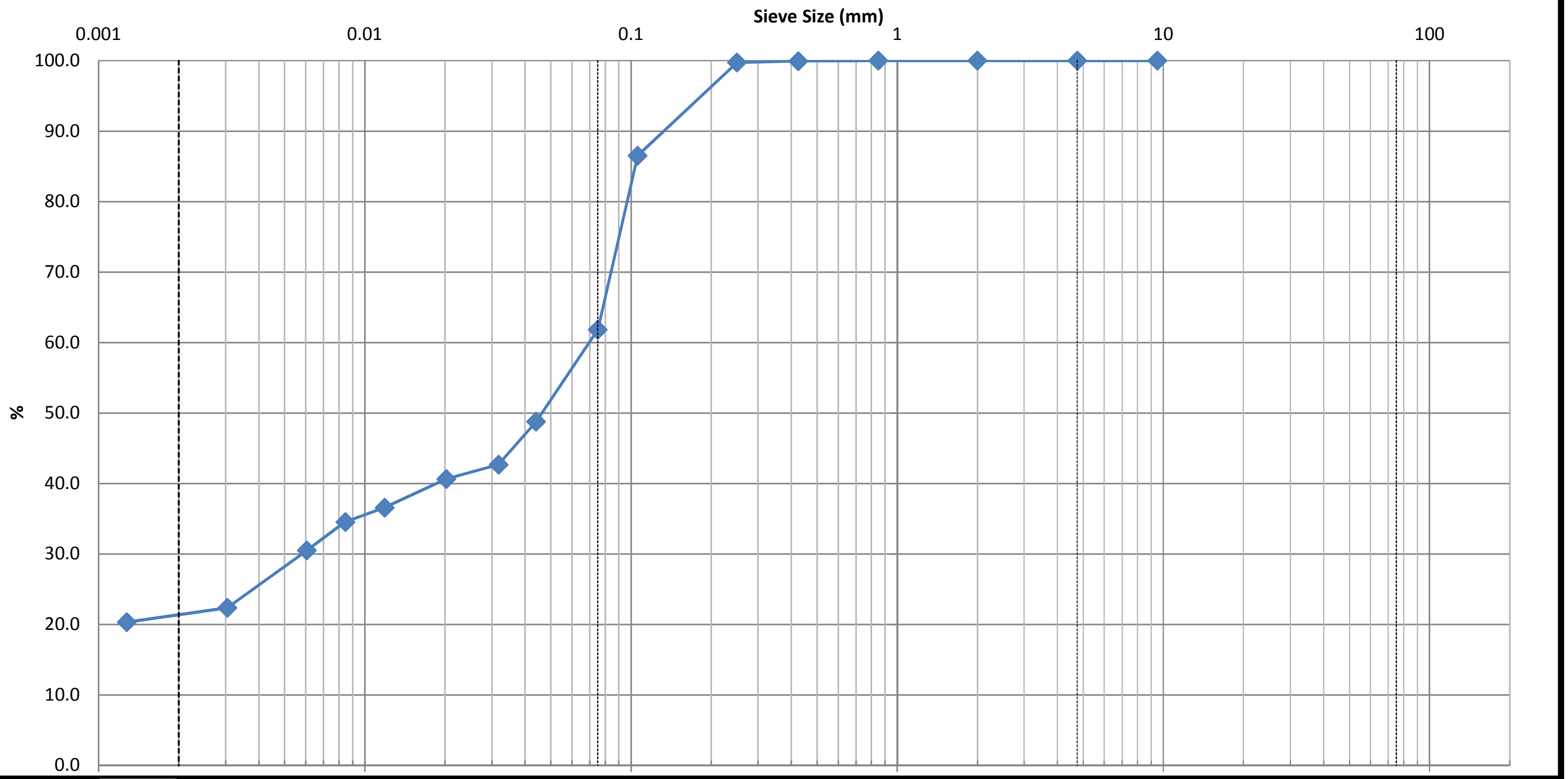
CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP6-18 - G3	LAB NO:	99145
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					24.8					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	38.2		40.3	21.5	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6' - 7'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP6-18 - G3	DATE SAMPLED:	-
LAB No. :	99145	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	171.9	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	147.30	97.30
F=(Wo/Wa)	0.973	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	48.65	
Wt. AFTER WASH BACK SIEVE	21.07	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**171.9**		
0.850	**0.01**	0.0	100.0
0.425	**0.04**	0.1	99.9
0.250	**0.14**	0.3	99.7
0.106	**6.74**	13.5	86.5
0.075	**19.09**	38.2	61.8
Pan	**21.07**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

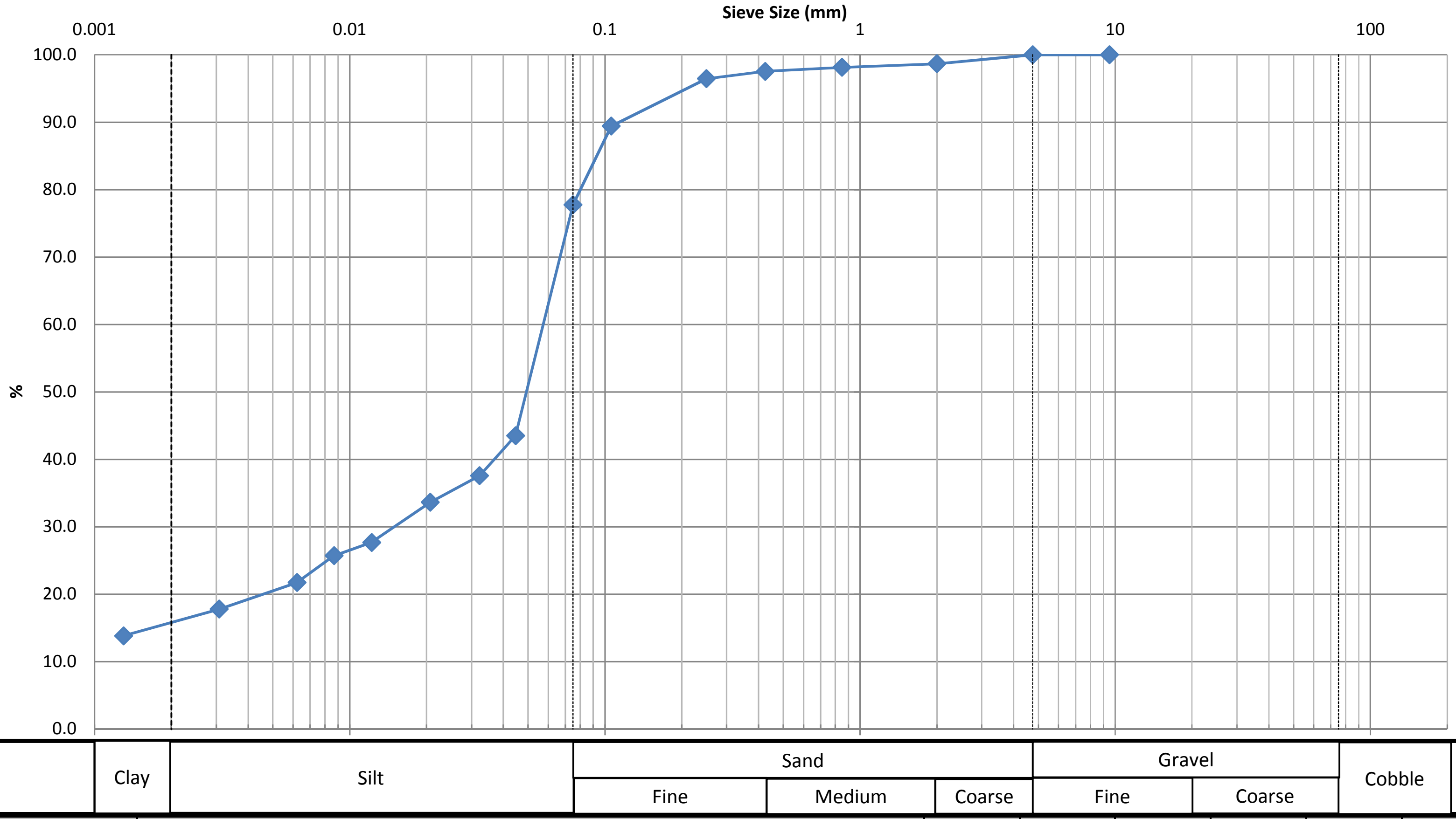
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:28	30.0	6.0	22.0	0.0440	48.8	48.8
2	9:29	27.0	6.0	22.0	0.0318	42.7	42.7
5	9:32	26.0	6.0	22.0	0.0203	40.6	40.6
15	9:42	24.0	6.0	22.0	0.0119	36.6	36.6
30	9:57	23.0	6.0	22.0	0.0084	34.6	34.6
60	10:27	21.0	6.0	22.0	0.0061	30.5	30.5
250	13:37	17.0	6.0	22.0	0.0030	22.4	22.4
1440	9:27	16.0	6.0	22.0	0.0013	20.3	20.3

COMMENTS

Moisture Content = 24.8%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP7-18 - G2	LAB NO:	99146
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		20.6					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	22.2	61.6	16.2

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP7-18 - G2	DATE SAMPLED:	-
LAB No. :	99146	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	177.7	50.00
SPECIFIC GRAVITY (Gs)		2.700
HYGROSCOPIC MOISTURE		Tare No.
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.63	98.63
F=(Wo/Wa)	0.986	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.32	
Wt. AFTER WASH BACK SIEVE		12.6
SOLUTION CONCENTRATION		40 g / L

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**2.4**	1.4	98.6
Pan	**175.3**		
0.850	**0.26**	1.9	98.1
0.425	**0.57**	2.5	97.5
0.250	**1.12**	3.6	96.4
0.106	**4.68**	10.6	89.4
0.075	**10.59**	22.2	77.8
Pan	**12.58**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:41	28.0	6.0	22.0	0.0447	44.1	43.5
2	9:42	25.0	6.0	22.0	0.0323	38.1	37.6
5	9:45	23.0	6.0	22.0	0.0207	34.1	33.6
15	9:55	20.0	6.0	22.0	0.0122	28.1	27.7
30	10:10	19.0	6.0	22.0	0.0087	26.1	25.7
60	10:40	17.0	6.0	22.0	0.0062	22.1	21.8
250	13:50	15.0	6.0	22.0	0.0031	18.0	17.8
1440	9:40	13.0	6.0	22.0	0.0013	14.0	13.8

COMMENTS

Moisture Content = 20.6%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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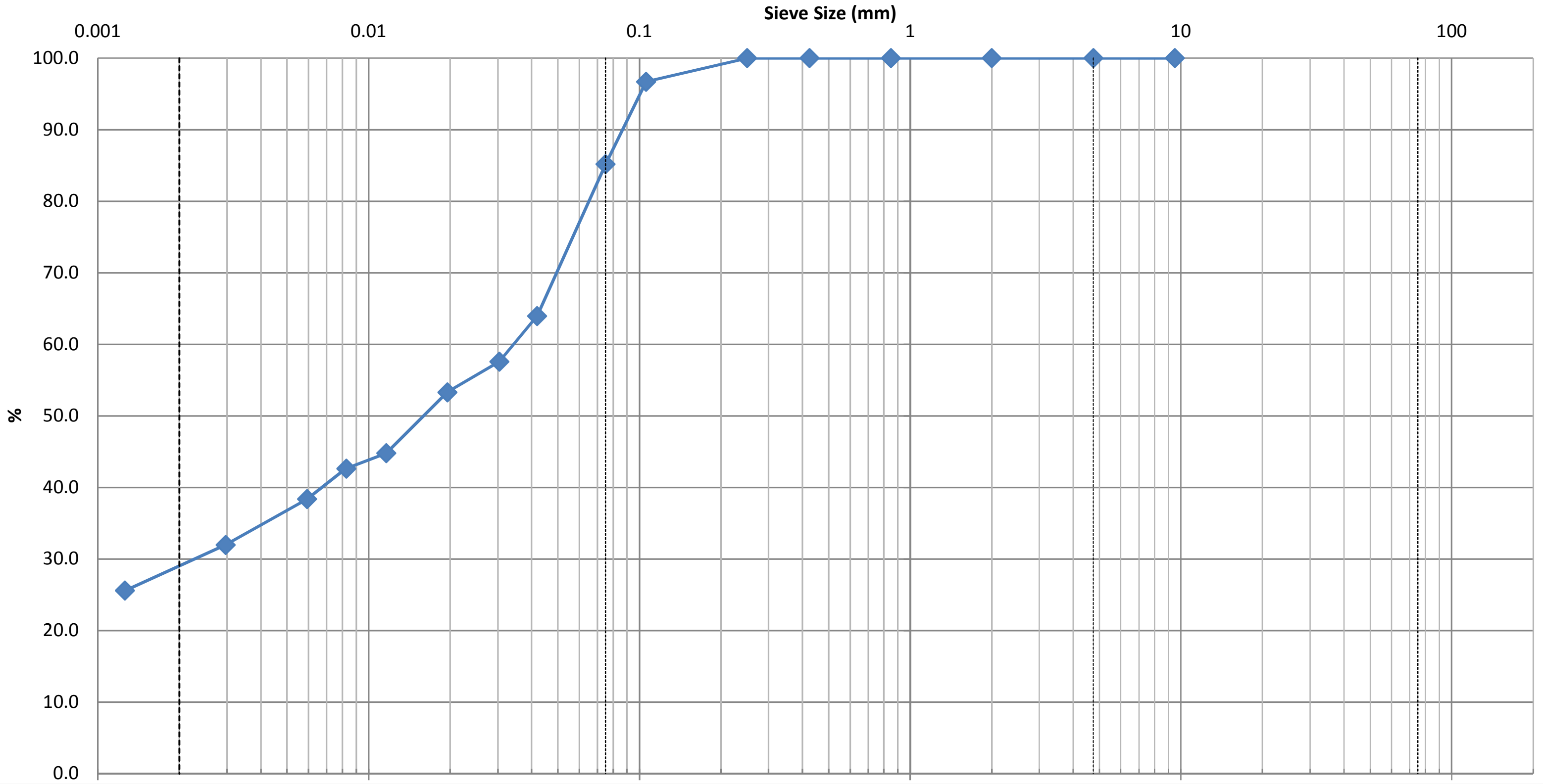
CLIENT:	Mattamy Homes	DEPTH:	6.6' - 7.6'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP7-18 - G3	LAB NO:	99147
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		31.9					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	14.8	55.7	29.5

Comments

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	6.6' - 7.6'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP7-18 - G3	DATE SAMPLED:	-
LAB No. :	99147	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	187.9		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	142.75	92.75	
F=(Wo/Wa)	0.928		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	46.38		
Wt. AFTER WASH BACK SIEVE		8.95	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**187.9**		
0.850	**0.00**	0.0	100.0
0.425	**0.00**	0.0	100.0
0.250	**0.01**	0.0	100.0
0.106	**1.65**	3.3	96.7
0.075	**7.41**	14.8	85.2
Pan	**8.93**		
SIEVE CHECK 0.2	MAX = 0.3%		

HYDROMETER DATA

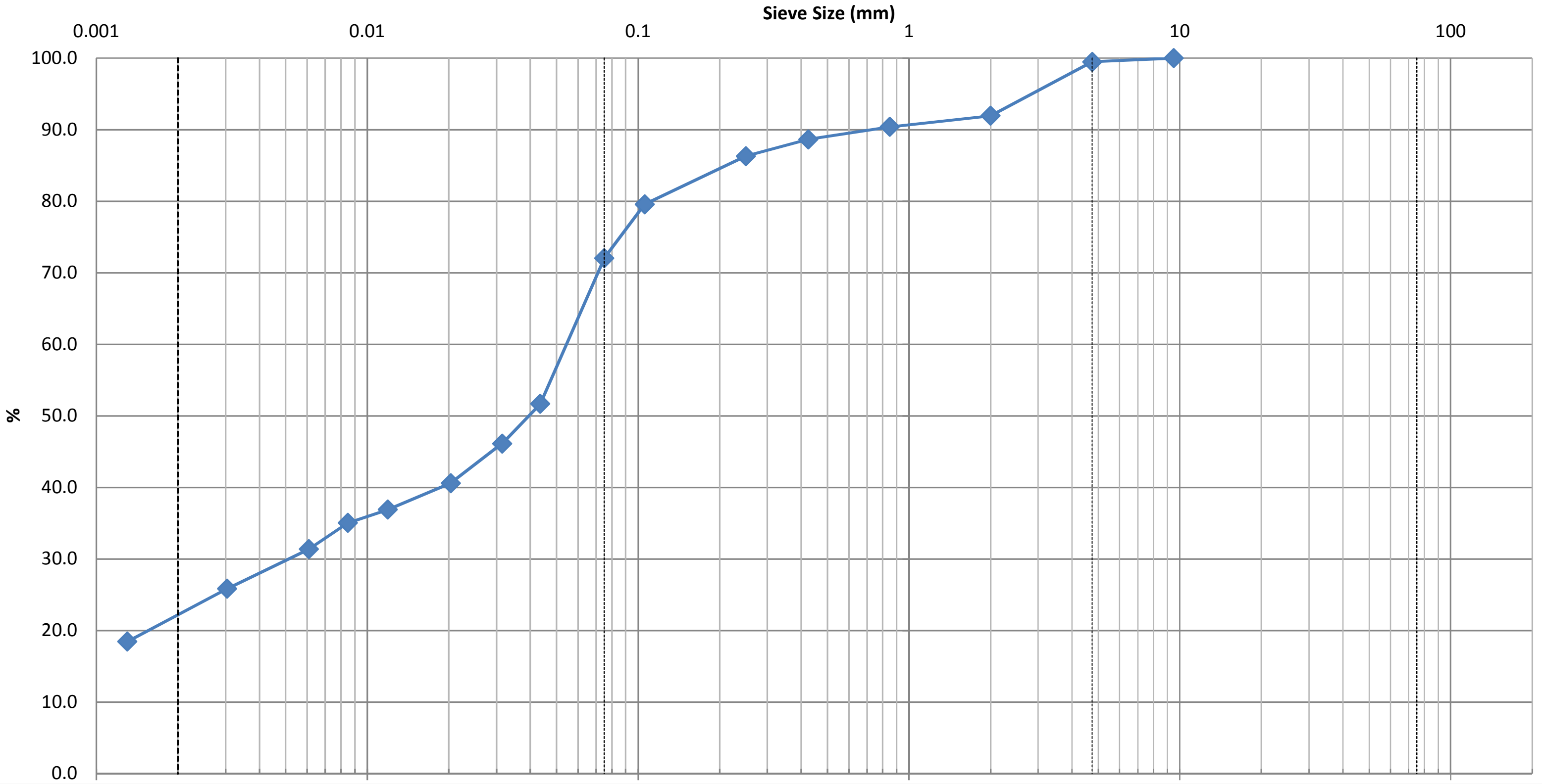
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:53	36.0	6.0	22.0	0.0419	64.0	64.0
2	9:54	33.0	6.0	22.0	0.0304	57.6	57.6
5	9:57	31.0	6.0	22.0	0.0195	53.3	53.3
15	10:07	27.0	6.0	22.0	0.0116	44.8	44.8
30	10:22	26.0	6.0	22.0	0.0083	42.6	42.6
60	10:52	24.0	6.0	22.0	0.0059	38.4	38.4
250	14:02	21.0	6.0	22.0	0.0030	32.0	32.0
1440	9:52	18.0	6.0	22.0	0.0013	25.6	25.6

COMMENTS

Moisture Content = 31.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	2.13 - 2.44	FILE NO:	PG2246
CONTRACT NO.:		BH OR TP No.:	TP8-18 - G2	LAB NO:	98984
PROJECT:	Half Moon Bay West	DESCRIPTION:	Silty Fine Sand to Sandy Silty, some Clay	DATE RECEIVED:	7-Mar-18
				DATE TESTED:	9-Mar-18
DATE SAMPLED:	6-Mar-18			DATE REPORTED:	12-Mar-18
SAMPLED BY:	N. Christie			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		18.7					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.5	27.5	49.5	22.5

Comments	

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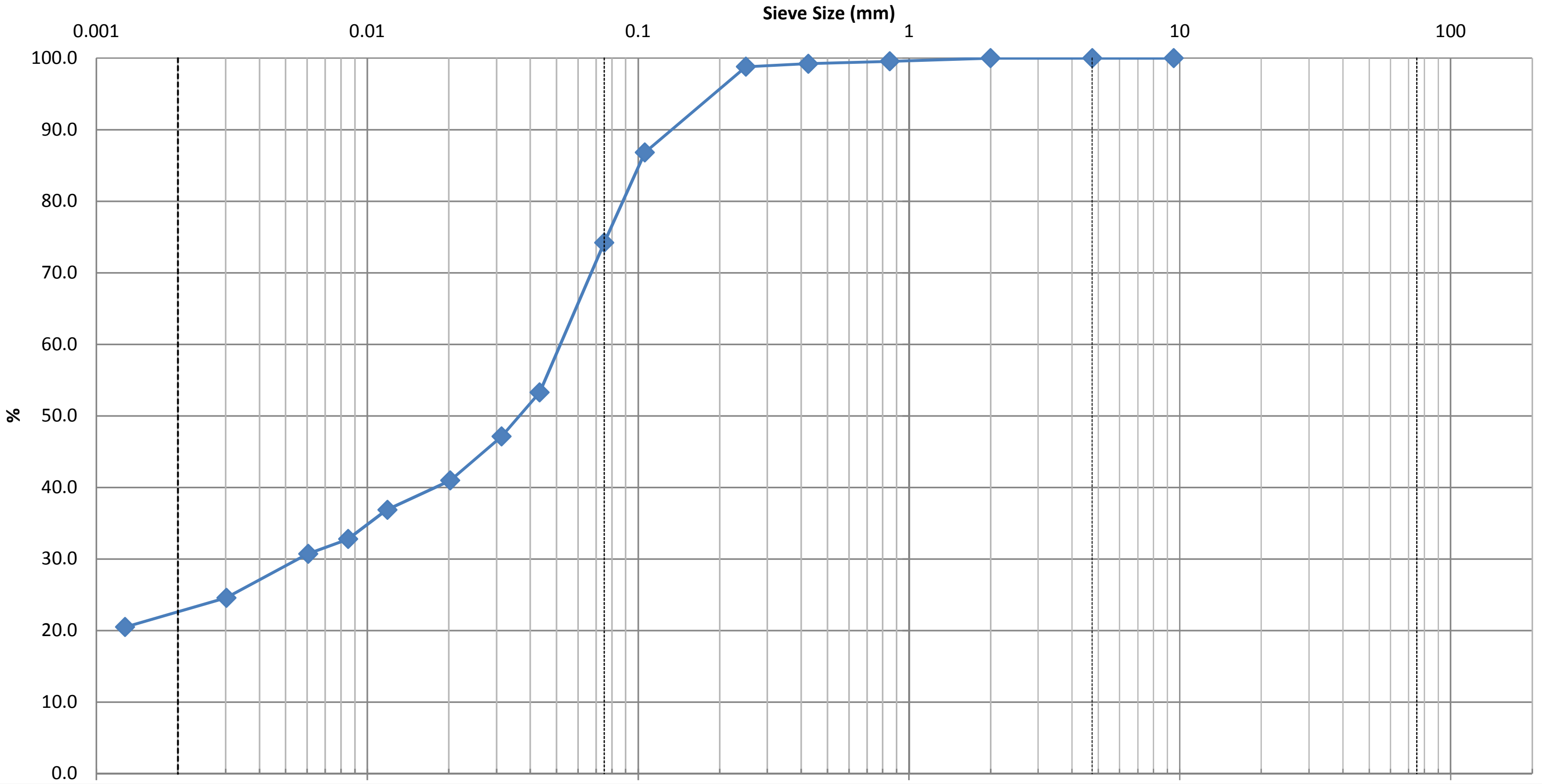
CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP8-18 - G3	LAB NO:	99148
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					28.2					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	25.8		52.0		22.2

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP8-18 - G3	DATE SAMPLED:	-
LAB No. :	99148	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	155.1	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	146.50	96.50
F=(Wo/Wa)	0.965	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	48.25	
Wt. AFTER WASH BACK SIEVE	13.75	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**155.1**		
0.850	**0.23**	0.5	99.5
0.425	**0.39**	0.8	99.2
0.250	**0.60**	1.2	98.8
0.106	**6.60**	13.2	86.8
0.075	**12.89**	25.8	74.2
Pan	**13.75**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:06	32.0	6.0	22.0	0.0433	53.3	53.3
2	10:07	29.0	6.0	22.0	0.0313	47.1	47.1
5	10:10	26.0	6.0	22.0	0.0203	41.0	41.0
15	10:20	24.0	6.0	22.0	0.0119	36.9	36.9
30	10:35	22.0	6.0	22.0	0.0085	32.8	32.8
60	11:05	21.0	6.0	22.0	0.0061	30.7	30.7
250	14:15	18.0	6.0	22.0	0.0030	24.6	24.6
1440	10:05	16.0	6.0	22.0	0.0013	20.5	20.5

COMMENTS

Moisture Content = 28.2%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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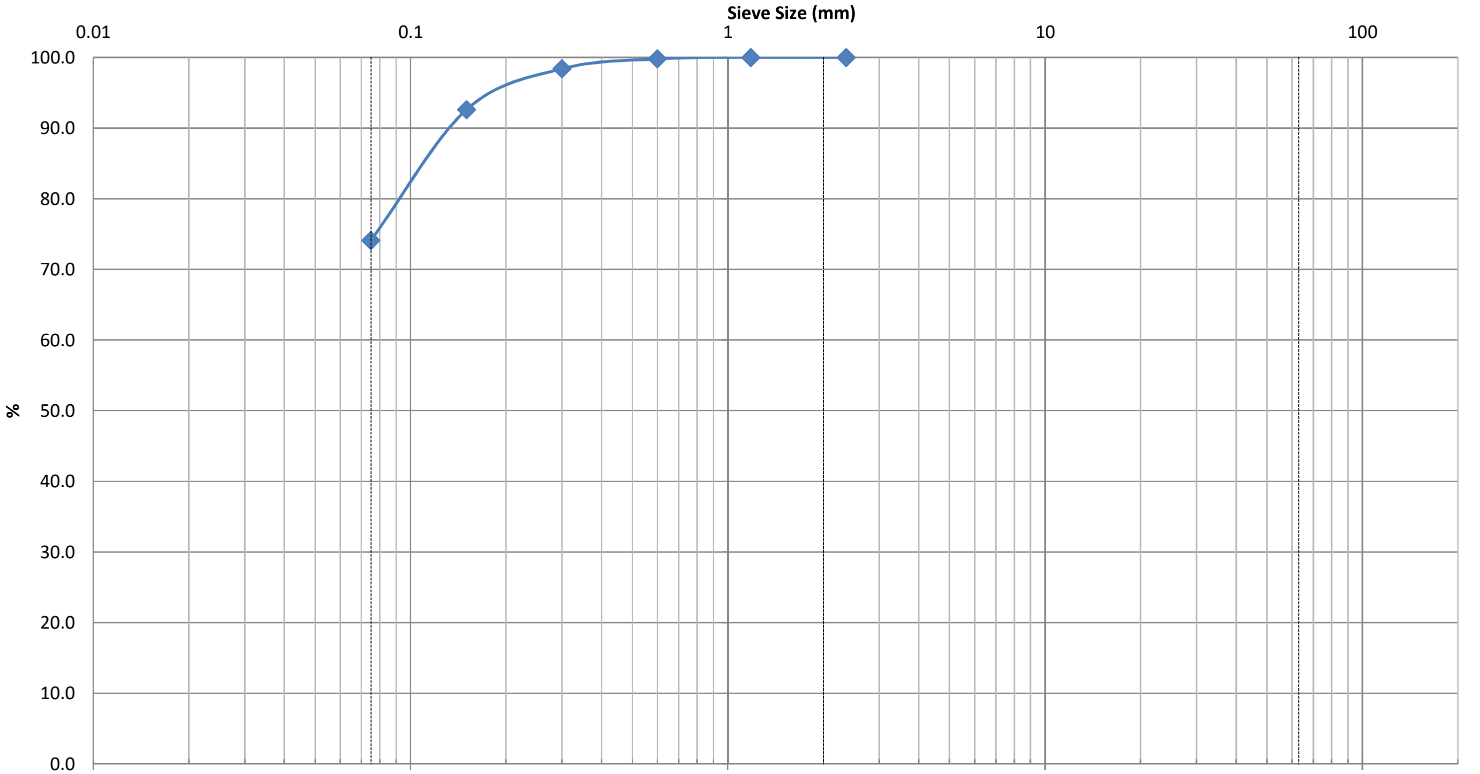
SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B



Silt and Clay	Sand			Gravel		Cobble
	Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**	**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
						0.65	3.0

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
2.5	0.045	0.021	0.015	0.0	25.9	74.1	

Comments	

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO.:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	255.5
WEIGHT AFTER WASH	A	B	A+B	100.4

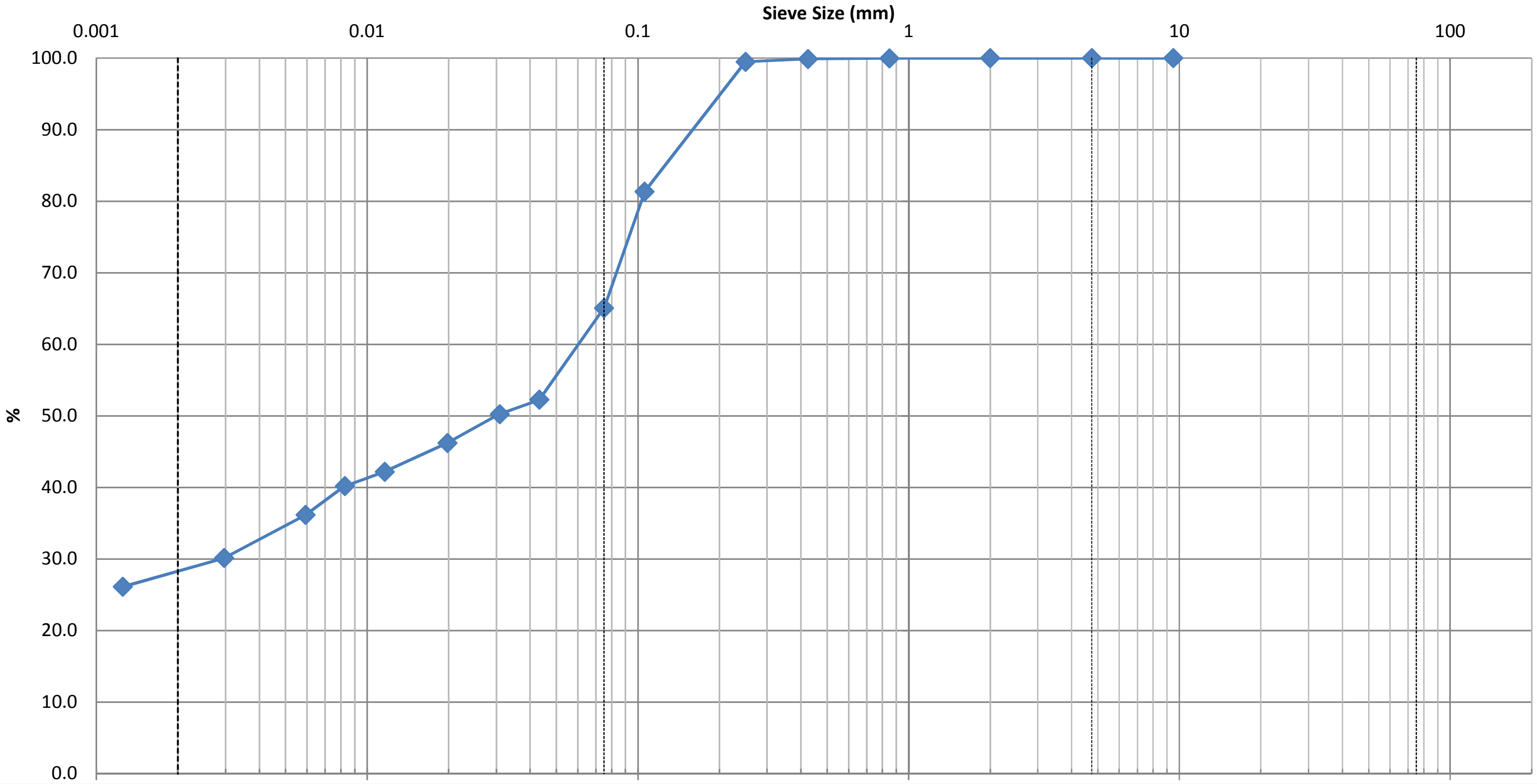
SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75						
2.36	**0.0**	0.0	**100.0**			
1.18	**0.1**	0.0	**100.0**			
0.6	**0.6**	0.2	**99.8**			
0.3	**4.0**	1.6	**98.4**			
0.15	**19.0**	7.4	**92.6**			
0.075	**66.3**	25.9	**74.1**			
PAN	**100.4**					

SIEVE CHECK FINE	0.00	0.3% max.	**REFERENCE MATERIAL**

OTHER TESTS	RESULT	LAB NO.	RESULT

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP9-18 - G4	LAB NO:	99149
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	**Soil Classification**				**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
					24.9					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	34.9		36.6		28.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 11'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP9-18 - G4	DATE SAMPLED:	-
LAB No. :	99149	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	164.6	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.40	98.40
F=(Wo/Wa)	0.984	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.20	
Wt. AFTER WASH BACK SIEVE	18.83	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.0**	0.0	100.0
2.0	**0.0**	0.0	100.0
Pan	**164.6**		
0.850	**0.02**	0.0	100.0
0.425	**0.06**	0.1	99.9
0.250	**0.26**	0.5	99.5
0.106	**9.34**	18.7	81.3
0.075	**17.47**	34.9	65.1
Pan	**18.81**		
SIEVE CHECK 0.1	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:20	32.0	6.0	22.0	0.0433	52.3	52.3
2	10:21	31.0	6.0	22.0	0.0309	50.2	50.2
5	10:24	29.0	6.0	22.0	0.0198	46.2	46.2
15	10:34	27.0	6.0	22.0	0.0116	42.2	42.2
30	10:49	26.0	6.0	22.0	0.0083	40.2	40.2
60	11:19	24.0	6.0	22.0	0.0059	36.2	36.2
250	14:29	21.0	6.0	22.0	0.0030	30.1	30.1
1440	10:19	19.0	6.0	22.0	0.0013	26.1	26.1

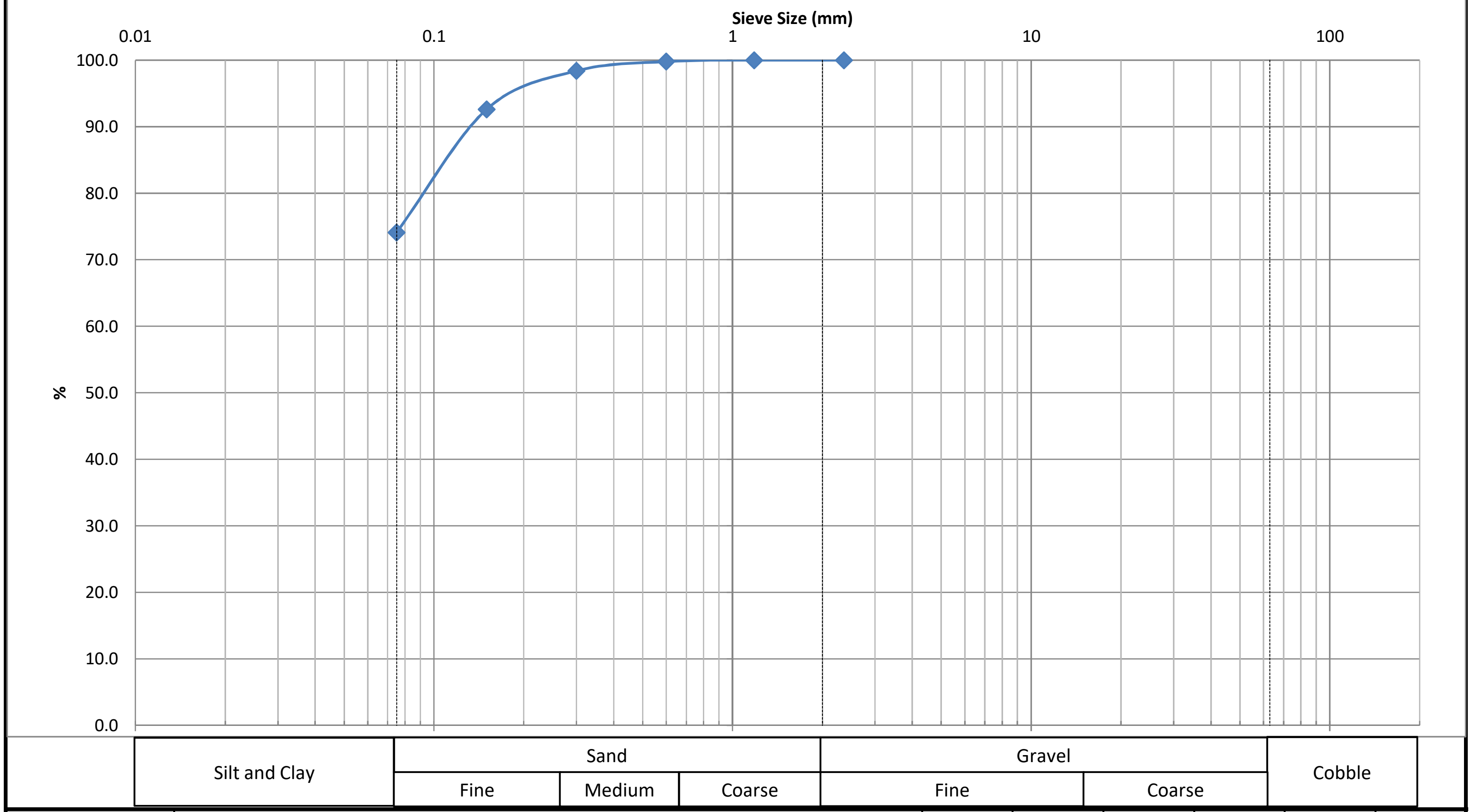
COMMENTS

Moisture Content = 24.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B



Identification	**Soil Classification**					**MC(%)**	**LL**	**PL**	**PI**	**Cc**	**Cu**
										0.65	3.0
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)	
	2.5	0.045	0.021	0.015	0.0	25.9		74.1			

Comments	

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Silty Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Silty Sand w Some Clay**	LAB NO.:	98985
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP9 - 18 G3	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	2.44 to 2.74	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	255.5
WEIGHT AFTER WASH	A	B	A+B	100.4

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75						
2.36	**0.0**	0.0	**100.0**			
1.18	**0.1**	0.0	**100.0**			
0.6	**0.6**	0.2	**99.8**			
0.3	**4.0**	1.6	**98.4**			
0.15	**19.0**	7.4	**92.6**			
0.075	**66.3**	25.9	**74.1**			
PAN	**100.4**					
SIEVE CHECK FINE		0.00	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	RESULT	LAB NO.	RESULT

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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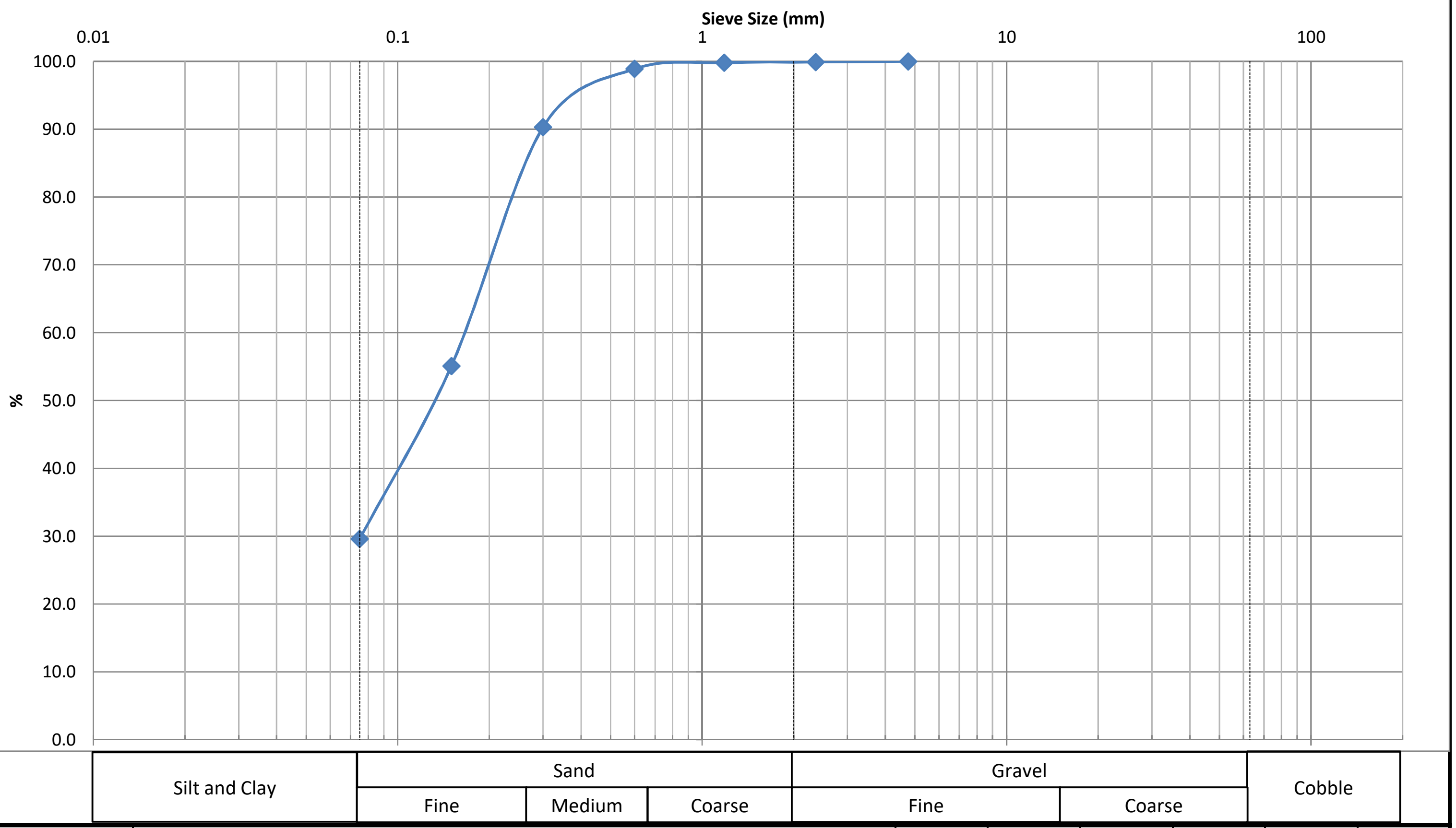
SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Sand	FILE NO:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Sand w Some Silt**	LAB NO:	98986
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE RECEIVED:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	6-Mar-18	SOURCE LOCATION:	TP10 - 18 G2	DATE REPORTED:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	0.76 to 1.07	TESTED BY:	D.B



Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
						0.95	4.9

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
4.9	0.17	0.075	0.035	0.0	70.4	29.6	

Comments	

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SIEVE ANALYSIS
ASTM C136

CLIENT:	Mattamy Homes	DESCRIPTION:	Sand	FILE NO.:	PG2246
CONTRACT NO.:	-	SPECIFICATION:	**Sand w Some Silt**	LAB NO.:	98986
PROJECT:	Half Moon Bay West	INTENDED USE:	-	DATE REC'D:	7-Mar-18
		PIT OR QUARRY:	-	DATE TESTED:	8-Mar-18
DATE SAMPLED:	06-Mar-18	SOURCE LOCATION:	TP10 - 18 G2	DATE REP'D:	9-Mar-18
SAMPLED BY:	Nathan Christie	SAMPLE LOCATION:	0.76 to 1.07	TESTED BY:	D.B

WEIGHT BEFORE WASH			A+B	281.4
WEIGHT AFTER WASH	A	B	A+B	215.9

SIEVE SIZE (mm)	WEIGHT RETAINED	PERCENT RETAINED	PERCENT PASSING	LOWER SPEC	UPPER SPEC	REMARK
150						
106						
75						
63						
53						
37.5						
26.5						
19						
16						
13.2						
9.5						
6.7						
4.75	**0.0**	0.0	**100.0**			
2.36	**0.2**	0.1	**99.9**			
1.18	**0.6**	0.2	**99.8**			
0.6	**3.0**	1.1	**98.9**			
0.3	**27.3**	9.7	**90.3**			
0.15	**126.3**	44.9	**55.1**			
0.075	**198.0**	70.4	**29.6**			
PAN	**215.5**					
SIEVE CHECK FINE		0.19	0.3% max.			**REFERENCE MATERIAL**

OTHER TESTS	**RESULT**	**LAB NO.**	**RESULT**

REVIEWED BY:	**Curtis Beadow**	**Joe Forsyth, P. Eng.**

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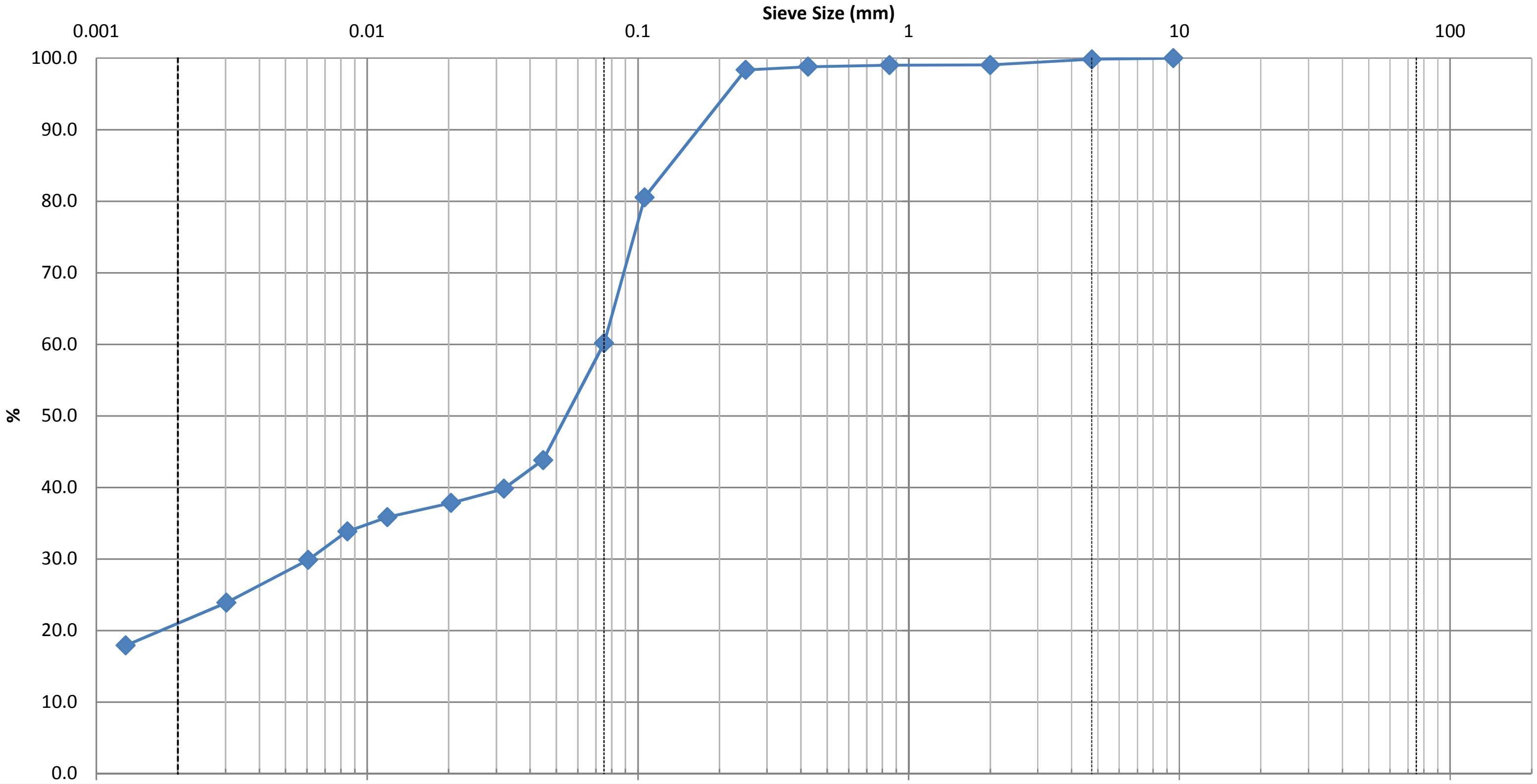
CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO:	PG2246/PG4073
CONTRACT NO.:		BH OR TP No.:	TP10-18 - G3	LAB NO:	99150
PROJECT:	Half Moon Bay West			DATE RECEIVED:	18-Apr-18
				DATE TESTED:	24-Apr-18
DATE SAMPLED:	-			DATE REPORTED:	26-Apr-18
SAMPLED BY:	Paterson Group			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					20.6					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.2	39.6		39.7	20.5	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	4' - 5'	FILE NO.:	PG2246/PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	TP10-18 - G3	DATE SAMPLED:	-
LAB No. :	99150	TESTED BY:	D. Bertrand	DATE RECEIVED:	18-Apr-18
SAMPLED BY:	Paterson Group	DATE REPT'D:	26-Apr-18	DATE TESTED:	24-Apr-18

SAMPLE INFORMATION

SAMPLE MASS	177	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.35	98.35
F=(Wo/Wa)	0.984	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.18	
Wt. AFTER WASH BACK SIEVE	21.13	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5	**0.0**	0.0	100.0
4.75	**0.3**	0.2	99.8
2.0	**1.7**	1.0	99.0
Pan	**175.3**		
0.850	**0.01**	1.0	99.0
0.425	**0.13**	1.2	98.8
0.250	**0.35**	1.7	98.3
0.106	**9.34**	19.5	80.5
0.075	**19.62**	39.8	60.2
Pan	**21.12**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:32	28.0	6.0	22.0	0.0447	44.2	43.8
2	10:33	26.0	6.0	22.0	0.0320	40.2	39.8
5	10:36	25.0	6.0	22.0	0.0204	38.2	37.8
15	10:46	24.0	6.0	22.0	0.0119	36.2	35.8
30	11:01	23.0	6.0	22.0	0.0084	34.2	33.9
60	11:31	21.0	6.0	22.0	0.0061	30.2	29.9
250	14:41	18.0	6.0	22.0	0.0030	24.1	23.9
1440	10:31	15.0	6.0	22.0	0.0013	18.1	17.9

COMMENTS

Moisture Content = 20.6%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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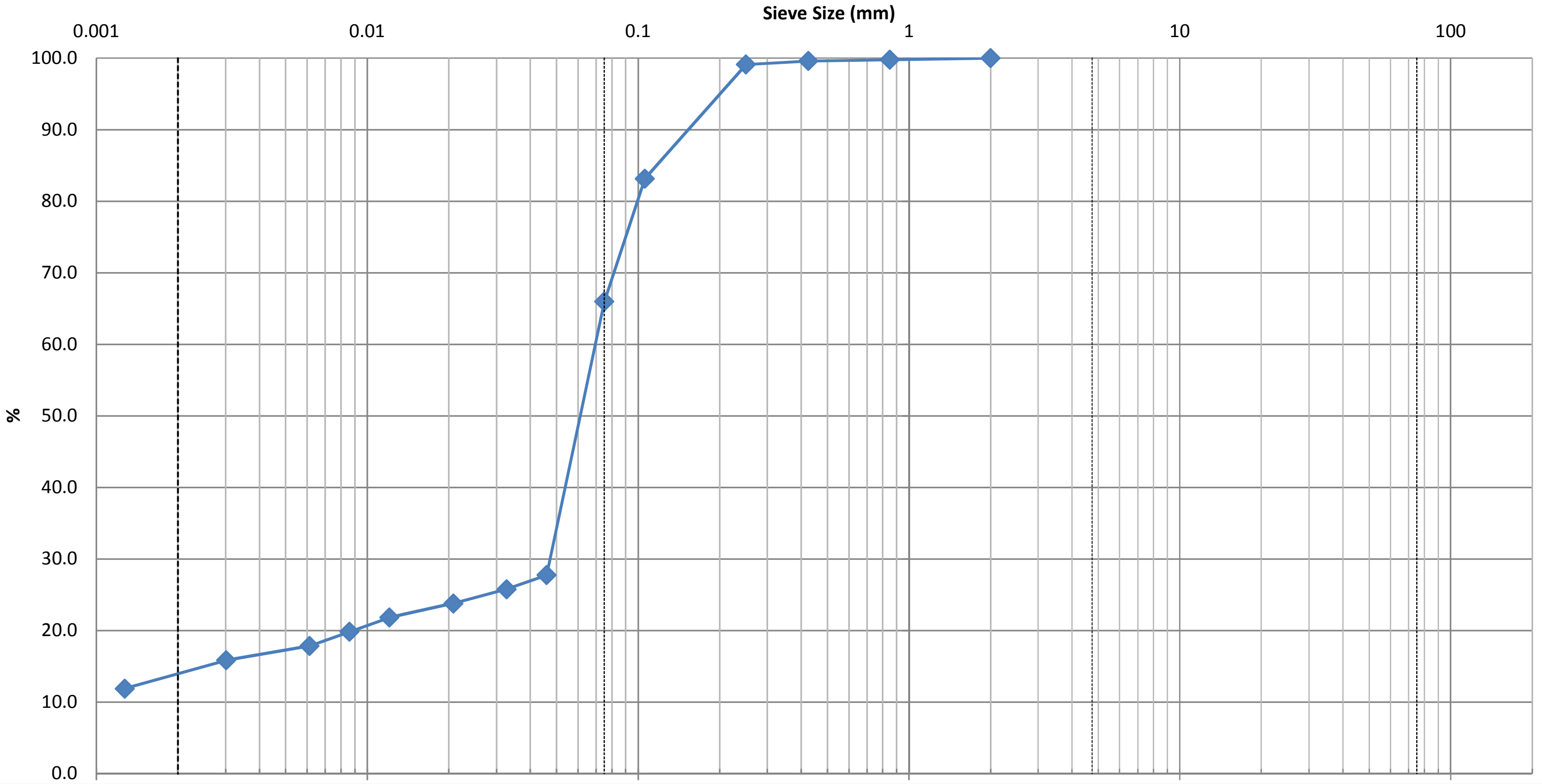
CLIENT:	Mattamy Homes	DEPTH:	7.6' - 9.6'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW17A - SS4	LAB NO:	2790
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	2-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		20.9					

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					0.0	34.0	52.0	14.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	7.6' - 9.6'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW17A - SS4	DATE SAMPLED:	26-Jun-18
LAB No. :	2790	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	02-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	175.2	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	149.70	99.70
F=(Wo/Wa)	0.997	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.85	
Wt. AFTER WASH BACK SIEVE	17.87	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**175.2**		
0.850	**0.11**	0.2	99.8
0.425	**0.20**	0.4	99.6
0.250	**0.45**	0.9	99.1
0.106	**8.42**	16.8	83.2
0.075	**17.01**	34.0	66.0
Pan	**17.87**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:46	19.0	5.0	25.0	0.0459	27.8	27.8
2	8:47	18.0	5.0	25.0	0.0327	25.8	25.8
5	8:50	17.0	5.0	25.0	0.0208	23.8	23.8
15	9:00	16.0	5.0	25.0	0.0121	21.8	21.8
30	9:15	15.0	5.0	25.0	0.0086	19.8	19.8
60	9:45	14.0	5.0	25.0	0.0061	17.9	17.9
250	12:55	13.0	5.0	25.0	0.0030	15.9	15.9
1440	8:45	11.0	5.0	25.0	0.0013	11.9	11.9

COMMENTS

Moisture Content = 20.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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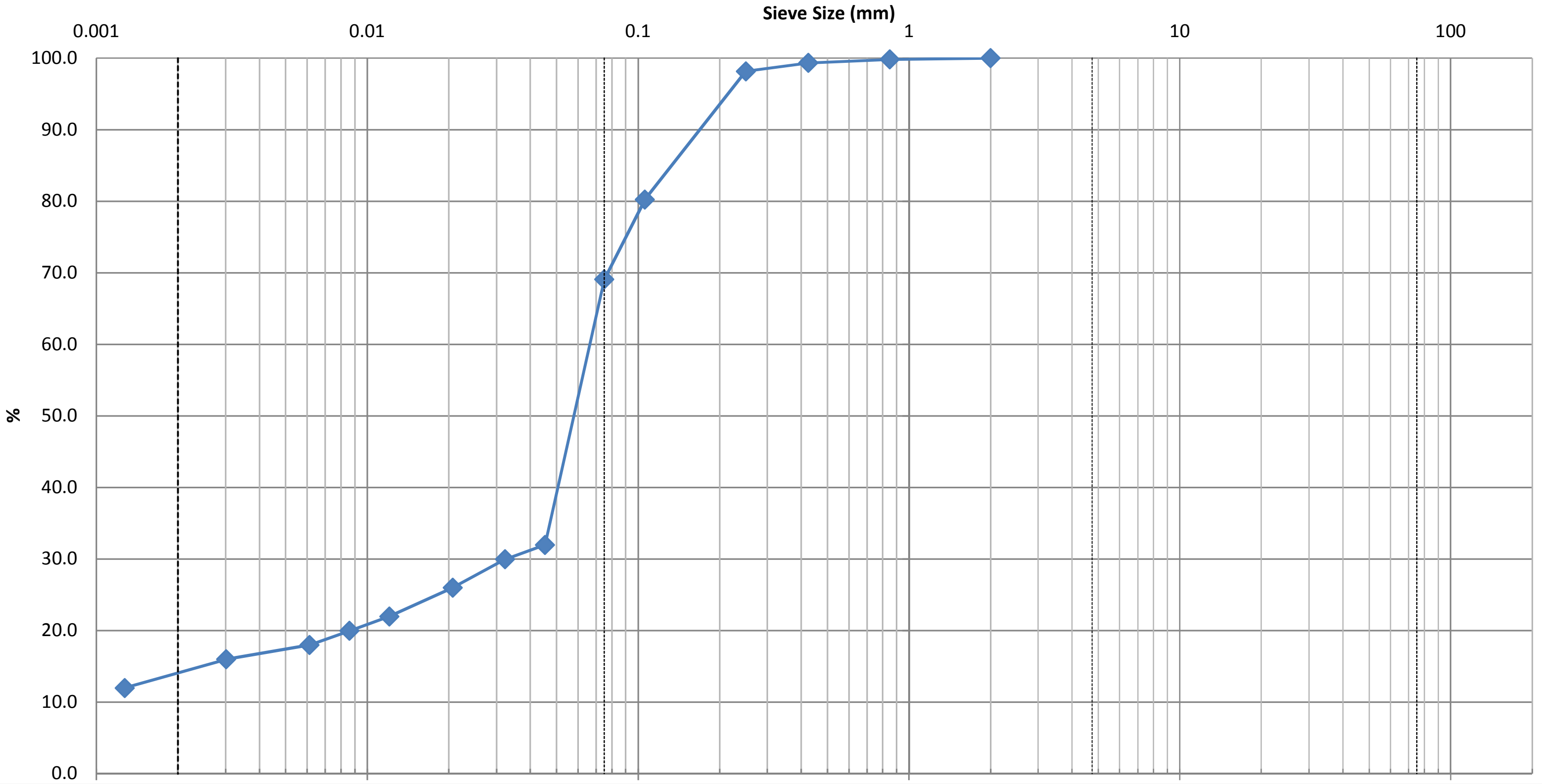
CLIENT:	Mattamy Homes	DEPTH:	2.6' - 4.6'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW18A - SS2	LAB NO:	2791
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	2-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		19.5					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	30.9	55.6	13.5

Comments

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	2.6' - 4.6'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW18A - SS2	DATE SAMPLED:	26-Jun-18
LAB No. :	2791	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	02-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	166.3	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	148.95	98.95
F=(Wo/Wa)	0.990	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.48	
Wt. AFTER WASH BACK SIEVE	16.19	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**166.3**		
0.850	**0.10**	0.2	99.8
0.425	**0.34**	0.7	99.3
0.250	**0.92**	1.8	98.2
0.106	**9.89**	19.8	80.2
0.075	**15.46**	30.9	69.1
Pan	**16.19**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	8:56	21.0	5.0	25.0	0.0453	32.0	32.0
2	8:57	20.0	5.0	25.0	0.0323	30.0	30.0
5	9:00	18.0	5.0	25.0	0.0207	26.0	26.0
15	9:10	16.0	5.0	25.0	0.0121	22.0	22.0
30	9:25	15.0	5.0	25.0	0.0086	20.0	20.0
60	9:55	14.0	5.0	25.0	0.0061	18.0	18.0
250	13:05	13.0	5.0	25.0	0.0030	16.0	16.0
1440	8:55	11.0	5.0	25.0	0.0013	12.0	12.0

COMMENTS

Moisture Content = 19.5%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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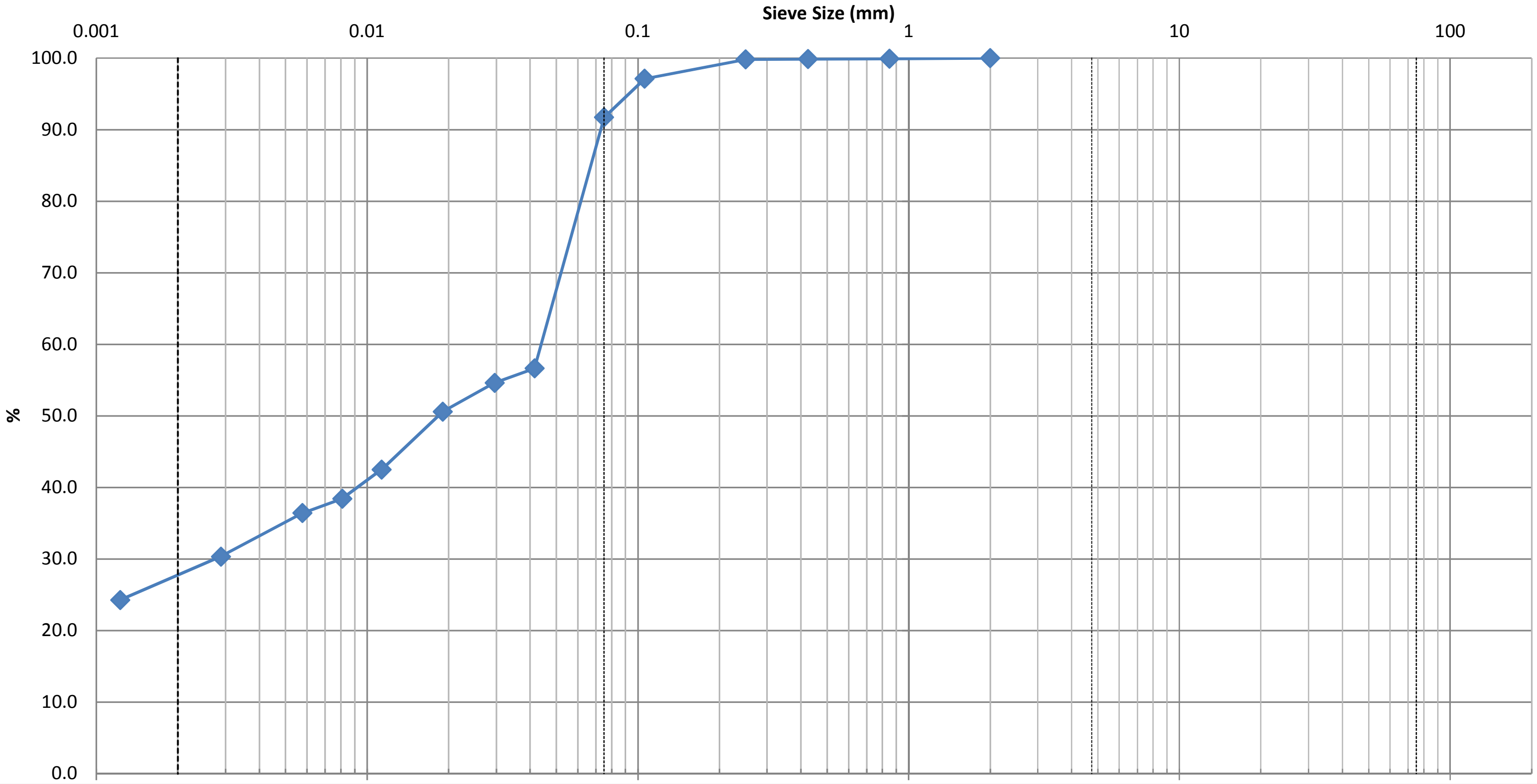
CLIENT:	Mattamy Homes	DEPTH:	10' - 12'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW18B - SS5	LAB NO:	2792
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	2-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		28.9					

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					0.0	8.3	64.2	27.5

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	10' - 12'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW18B - SS5	DATE SAMPLED:	26-Jun-18
LAB No. :	2792	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	02-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	175	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	147.75	97.75
F=(Wo/Wa)	0.978	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	48.88	
Wt. AFTER WASH BACK SIEVE	4.44	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**175**		
0.850	**0.05**	0.1	99.9
0.425	**0.07**	0.1	99.9
0.250	**0.09**	0.2	99.8
0.106	**1.44**	2.9	97.1
0.075	**4.14**	8.3	91.7
Pan	**4.44**		

SIEVE CHECK	0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:16	33.0	5.0	25.0	0.0415	56.6	56.6
2	9:17	32.0	5.0	25.0	0.0296	54.6	54.6
5	9:20	30.0	5.0	25.0	0.0190	50.6	50.6
15	9:30	26.0	5.0	25.0	0.0113	42.5	42.5
30	9:45	24.0	5.0	25.0	0.0081	38.4	38.4
60	10:15	23.0	5.0	25.0	0.0058	36.4	36.4
250	13:25	20.0	5.0	25.0	0.0029	30.3	30.3
1440	9:15	17.0	5.0	25.0	0.0012	24.3	24.3

COMMENTS

Moisture Content = 28.9%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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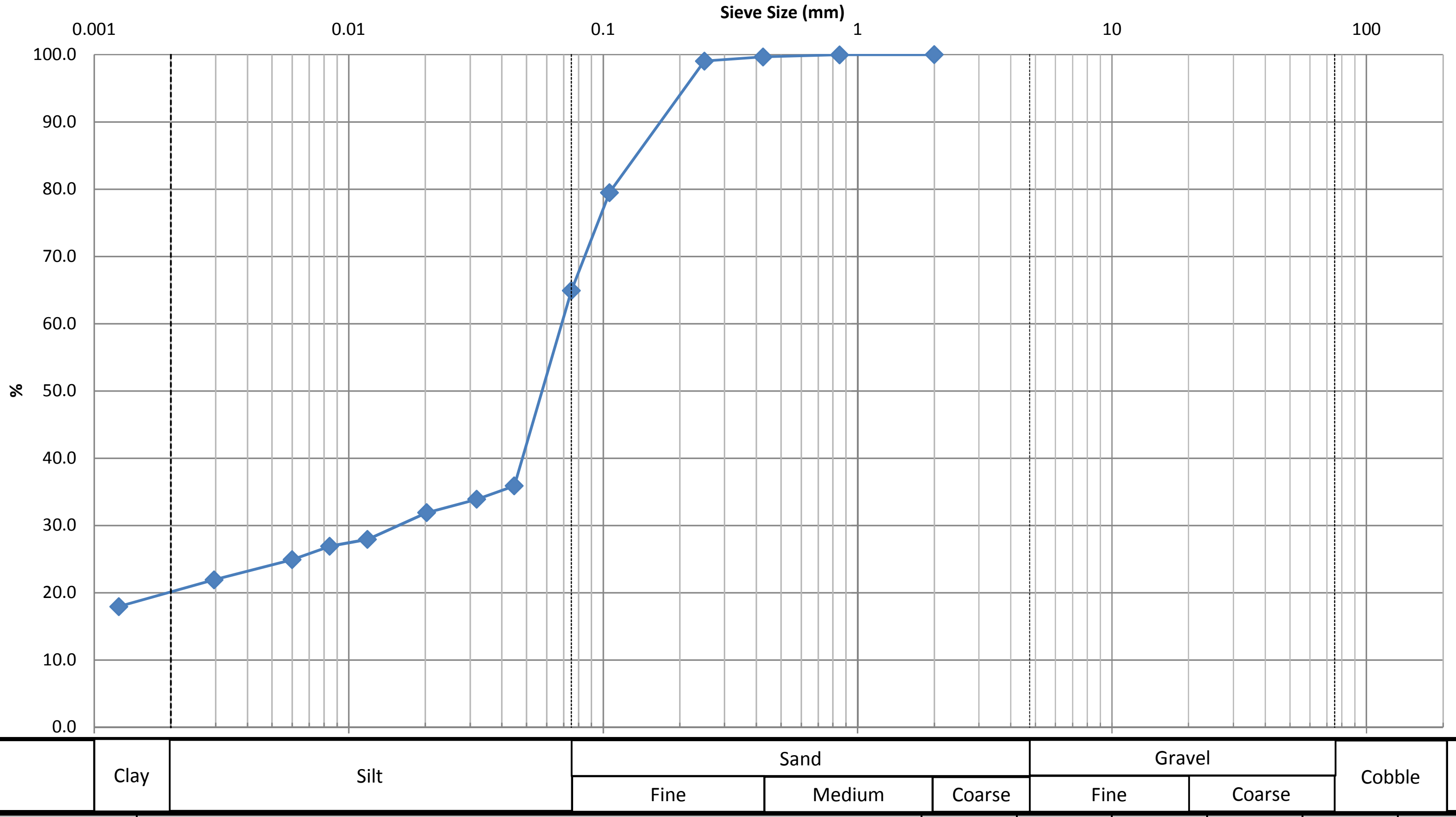
CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW19A - SS3	LAB NO:	2793
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	2-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					21.4					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)	Clay (%)	
					0.0	35.1		44.9	20.0	

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW19A - SS3	DATE SAMPLED:	26-Jun-18
LAB No. :	2793	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	02-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	194.2	50.00
SPECIFIC GRAVITY (Gs)	2.700	REMARKS
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	149.15	99.15
F=(Wo/Wa)	0.992	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	49.58	
Wt. AFTER WASH BACK SIEVE	17.83	
SOLUTION CONCENTRATION	40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**194.2**		
0.850	**0.02**	0.0	100.0
0.425	**0.17**	0.3	99.7
0.250	**0.48**	1.0	99.0
0.106	**10.26**	20.5	79.5
0.075	**17.53**	35.1	64.9
Pan	**17.83**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:26	23.0	5.0	25.0	0.0447	35.9	35.9
2	9:27	22.0	5.0	25.0	0.0318	33.9	33.9
5	9:30	21.0	5.0	25.0	0.0203	31.9	31.9
15	9:40	19.0	5.0	25.0	0.0119	27.9	27.9
30	9:55	18.5	5.0	25.0	0.0084	26.9	26.9
60	10:25	17.5	5.0	25.0	0.0060	24.9	24.9
250	13:35	16.0	5.0	25.0	0.0030	21.9	21.9
1440	9:25	14.0	5.0	25.0	0.0012	18.0	18.0

COMMENTS

Moisture Content = 21.4%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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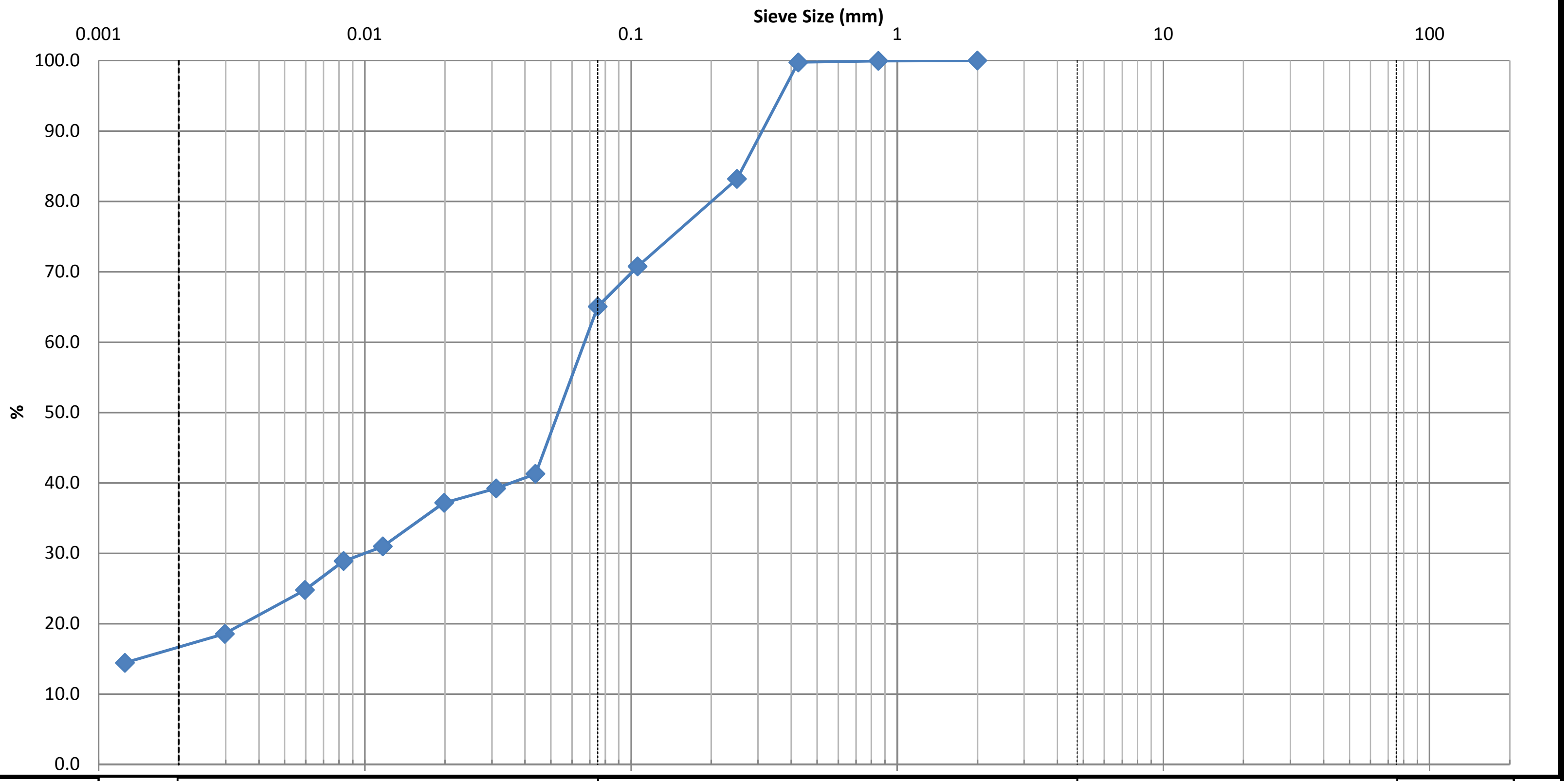
CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW20A - SS3	LAB NO:	2794
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	3-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		21.2					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	34.9	48.6	16.5

Comments

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW20A - SS3	DATE SAMPLED:	26-Jun-18
LAB No. :	2794	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	03-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	194.2	50.00
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	145.78	95.78
F=(Wo/Wa)	0.958	
INITIAL Wt. (Ma)	50.00	
Wt. CORRECTED	47.89	
Wt. AFTER WASH BACK SIEVE		19.18
SOLUTION CONCENTRATION		40 g / L

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**153.1**		
0.850	**0.03**	0.1	99.9
0.425	**0.13**	0.3	99.7
0.250	**8.41**	16.8	83.2
0.106	**14.63**	29.3	70.7
0.075	**17.47**	34.9	65.1
Pan	**19.18**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	9:59	26.0	6.0	25.0	0.0438	41.3	41.3
2	10:00	25.0	6.0	25.0	0.0312	39.2	39.2
5	10:03	24.0	6.0	25.0	0.0199	37.2	37.2
15	10:13	21.0	6.0	25.0	0.0117	31.0	31.0
30	10:28	20.0	6.0	25.0	0.0083	28.9	28.9
60	10:58	18.0	6.0	25.0	0.0060	24.8	24.8
250	14:08	15.0	6.0	25.0	0.0030	18.6	18.6
1440	9:58	13.0	6.0	25.0	0.0013	14.5	14.5

COMMENTS

Moisture Content = 21.2%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

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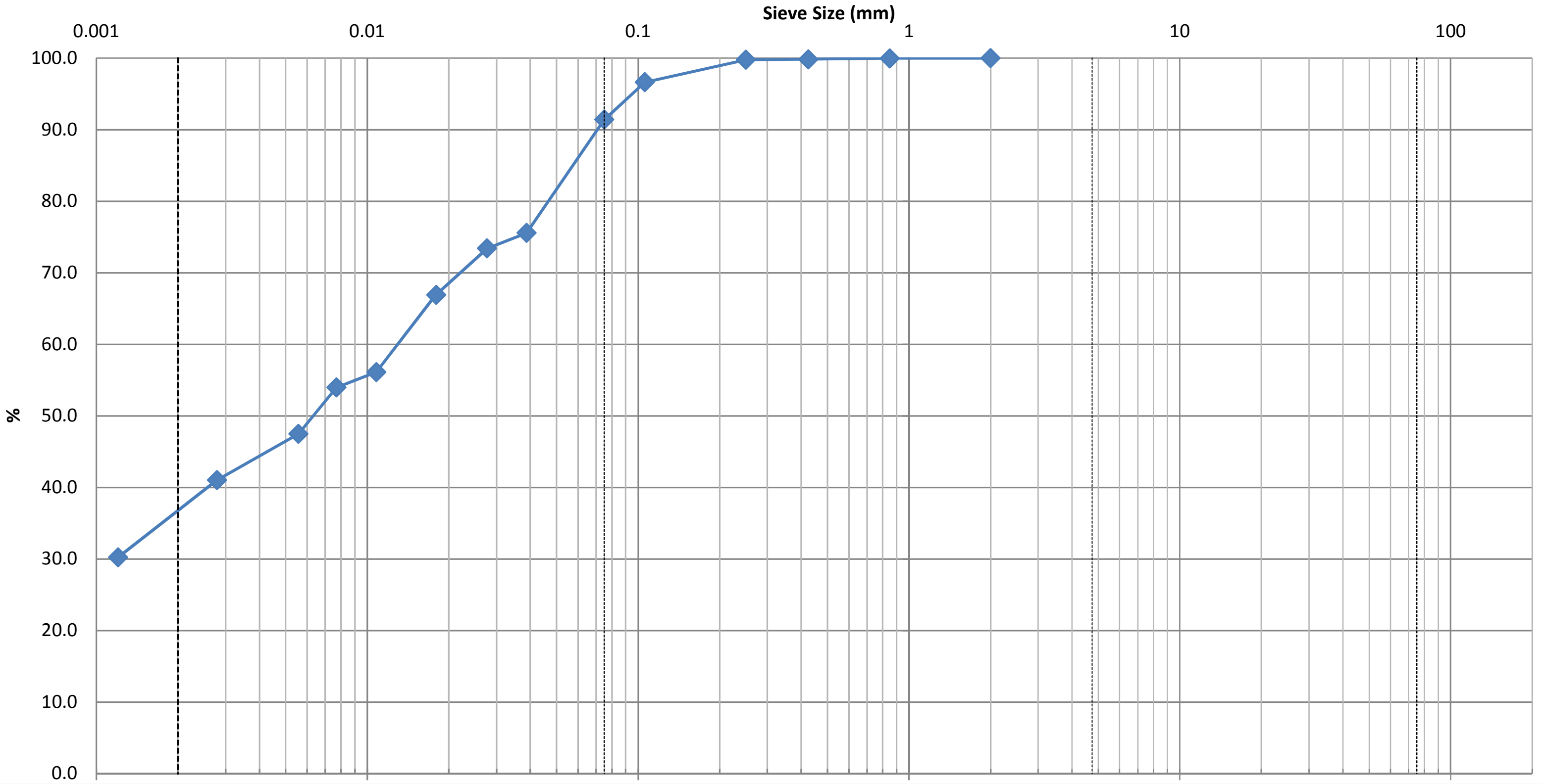
CLIENT:	Mattamy Homes	DEPTH:	12.6' - 14.6'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW20B - SS6	LAB NO:	2795
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	3-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		30.3					

D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
				0.0	8.6	55.4	36.0

Comments	

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HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	12.6' - 14.6'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW20B - SS6	DATE SAMPLED:	26-Jun-18
LAB No. :	2795	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	03-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	129.9		50.00
SPECIFIC GRAVITY (Gs)		2.700	REMARKS
HYGROSCOPIC MOISTURE		Tare No.	
TARE Wt.	50.00	ACTUAL Wt.	
AIR DRY (Wa)	150.00	100.00	
OVEN DRY (Wo)	141.60	91.60	
F=(Wo/Wa)	0.916		
INITIAL Wt. (Ma)	50.00		
Wt. CORRECTED	45.80		
Wt. AFTER WASH BACK SIEVE		4.61	
SOLUTION CONCENTRATION		40 g / L	

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**129.9**		
0.850	**0.02**	0.0	100.0
0.425	**0.08**	0.2	99.8
0.250	**0.12**	0.2	99.8
0.106	**1.68**	3.4	96.6
0.075	**4.30**	8.6	91.4
Pan	**4.61**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

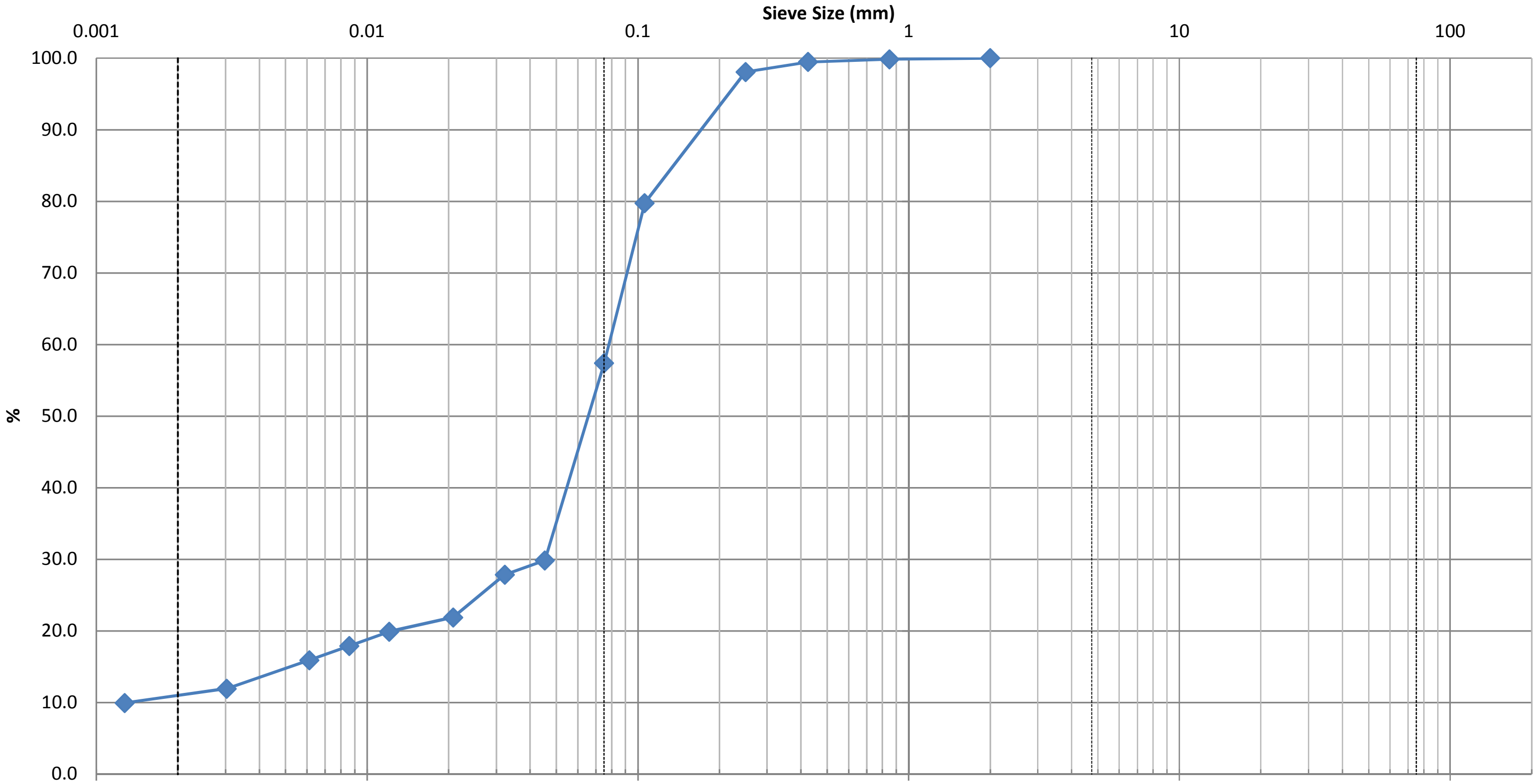
ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:14	41.0	6.0	25.0	0.0388	75.6	75.6
2	10:15	40.0	6.0	25.0	0.0277	73.4	73.4
5	10:18	37.0	6.0	25.0	0.0180	66.9	66.9
15	10:28	32.0	6.0	25.0	0.0108	56.1	56.1
30	10:43	31.0	6.0	25.0	0.0077	54.0	54.0
60	11:13	28.0	6.0	25.0	0.0056	47.5	47.5
250	14:23	25.0	6.0	25.0	0.0028	41.0	41.0
1440	10:13	20.0	6.0	25.0	0.0012	30.2	30.2

COMMENTS

Moisture Content = 30.3%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW21A - SS3	LAB NO:	2796
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	3-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



Clay	Silt	Sand			Gravel		Cobble
		Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification				MC(%)	LL	PL	PI	Cc	Cu
					17.6					
	D100	D60	D30	D10	Gravel (%)	Sand (%)		Silt (%)		Clay (%)
					0.0	42.6		46.9		10.5

Comments

patersongroup
consulting engineers

HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	5' - 7'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW21A - SS3	DATE SAMPLED:	26-Jun-18
LAB No. :	2796	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	03-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	139.5	50.02
SPECIFIC GRAVITY (Gs)	2.700	
HYGROSCOPIC MOISTURE	Tare No.	
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	149.30	99.30
F=(Wo/Wa)	0.993	
INITIAL Wt. (Ma)	50.02	
Wt. CORRECTED	49.67	
Wt. AFTER WASH BACK SIEVE	25.07	
SOLUTION CONCENTRATION	40 g / L	

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**139.5**		
0.850	**0.08**	0.2	99.8
0.425	**0.27**	0.5	99.5
0.250	**0.97**	1.9	98.1
0.106	**10.14**	20.3	79.7
0.075	**21.31**	42.6	57.4
Pan	**25.07**		

SIEVE CHECK	0.0	MAX = 0.3%

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (^{o}C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:26	21.0	6.0	25.0	0.0453	29.9	29.9
2	10:27	20.0	6.0	25.0	0.0323	27.9	27.9
5	10:30	17.0	6.0	25.0	0.0208	21.9	21.9
15	10:40	16.0	6.0	25.0	0.0121	19.9	19.9
30	10:55	15.0	6.0	25.0	0.0086	17.9	17.9
60	11:25	14.0	6.0	25.0	0.0061	15.9	15.9
250	14:35	12.0	6.0	25.0	0.0030	11.9	11.9
1440	10:25	11.0	6.0	25.0	0.0013	10.0	10.0

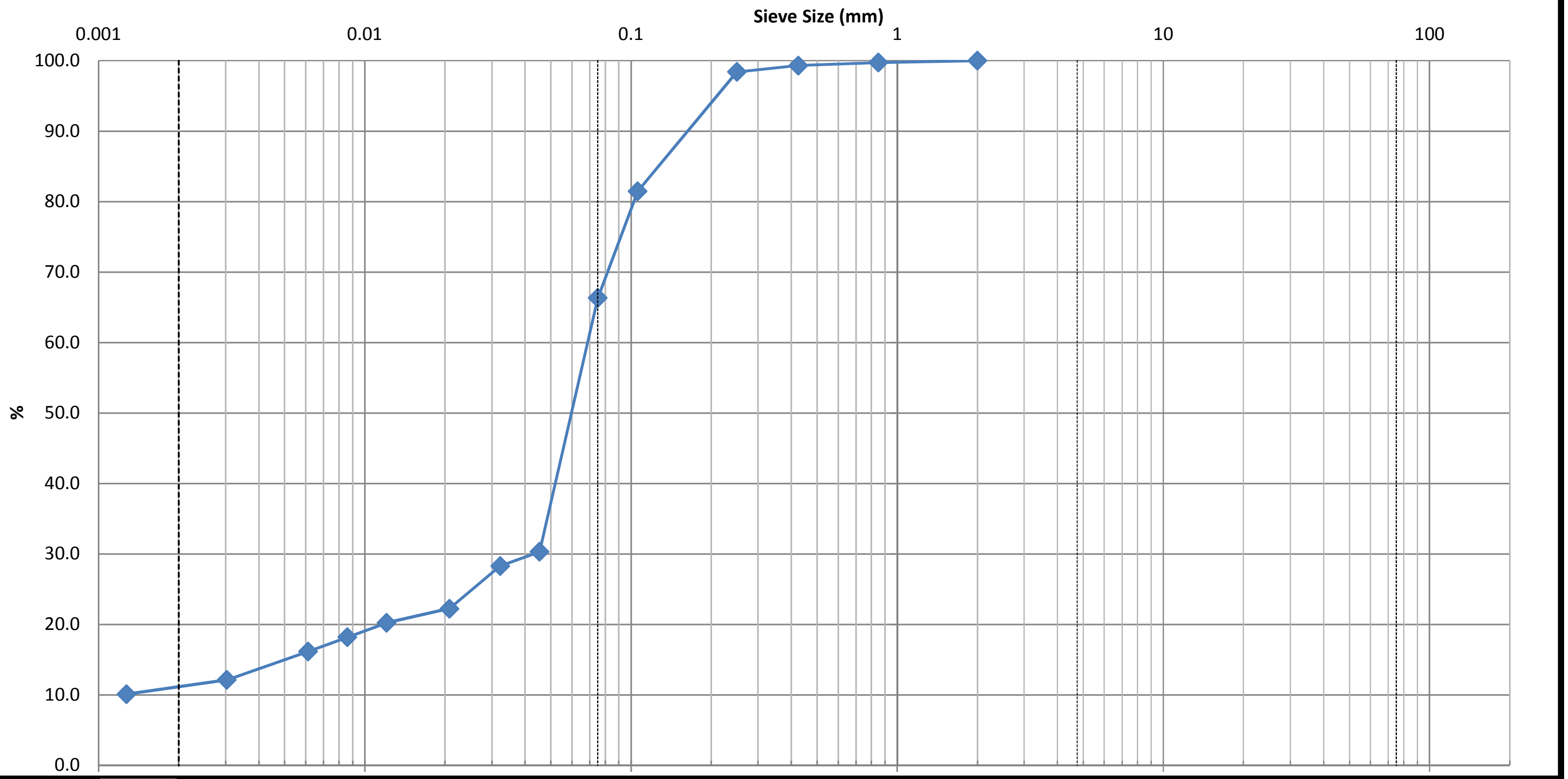
COMMENTS

Moisture Content = 17.6%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

patersongroup
consulting engineers

CLIENT:	Mattamy Homes	DEPTH:	2.6' - 4.6'	FILE NO:	PG4073
CONTRACT NO.:		BH OR TP No.:	MW23A - SS2	LAB NO:	2797
PROJECT:	Half Moon Bay West			DATE RECEIVED:	19-Jul-18
				DATE TESTED:	3-Aug-18
DATE SAMPLED:	26-Jun-18			DATE REPORTED:	7-Aug-18
SAMPLED BY:	N. Giamberardino			TESTED BY:	D. Bertrand



	Clay	Silt	Sand			Gravel		Cobble
			Fine	Medium	Coarse	Fine	Coarse	

Identification	Soil Classification	MC(%)	LL	PL	PI	Cc	Cu
		19					

	D100	D60	D30	D10	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
					0.0	33.7	55.8	10.5

Comments

patersongroup
consulting engineers

HYDROMETER
LS-702 ASTM-422

CLIENT:	Mattamy Homes	DEPTH:	2.6' - 4.6'	FILE NO.:	PG4073
PROJECT:	Half Moon Bay West	BH OR TP No.:	MW23A - SS2	DATE SAMPLED:	26-Jun-18
LAB No. :	2797	TESTED BY:	D. Bertrand	DATE RECEIVED:	19-Jul-18
SAMPLED BY:	N. Giamberardino	DATE REPT'D:	07-Aug-18	DATE TESTED:	03-Aug-18

SAMPLE INFORMATION

SAMPLE MASS	139.5	50.02
SPECIFIC GRAVITY (Gs)		2.700
HYGROSCOPIC MOISTURE		Tare No.
TARE Wt.	50.00	ACTUAL Wt.
AIR DRY (Wa)	150.00	100.00
OVEN DRY (Wo)	147.75	97.75
F=(Wo/Wa)	0.978	
INITIAL Wt. (Ma)	50.02	
Wt. CORRECTED	48.89	
Wt. AFTER WASH BACK SIEVE		17.56
SOLUTION CONCENTRATION		40 g / L

REMARKS

GRAIN SIZE ANALYSIS

SIEVE DIAMETER (mm)	WEIGHT RETAINED (g)	PERCENT RETAINED	PERCENT PASSING
63.0			
53.0			
37.5			
26.5			
19.0			
16.0			
13.2			
9.5			
4.75			
2.0	**0.0**	0.0	100.0
Pan	**148**		
0.850	**0.14**	0.3	99.7
0.425	**0.35**	0.7	99.3
0.250	**0.80**	1.6	98.4
0.106	**9.28**	18.6	81.4
0.075	**16.85**	33.7	66.3
Pan	**17.56**		
SIEVE CHECK 0.0	MAX = 0.3%		

HYDROMETER DATA

ELAPSED	TIME (24 hours)	Hs	Hc	Temp. (°C)	DIAMETER	(P)	TOTAL PERCENT PASSING
1	10:40	21.0	6.0	25.0	0.0453	30.3	30.3
2	10:41	20.0	6.0	25.0	0.0323	28.3	28.3
5	10:44	17.0	6.0	25.0	0.0208	22.2	22.2
15	10:54	16.0	6.0	25.0	0.0121	20.2	20.2
30	11:09	15.0	6.0	25.0	0.0086	18.2	18.2
60	11:39	14.0	6.0	25.0	0.0061	16.2	16.2
250	14:49	12.0	6.0	25.0	0.0030	12.1	12.1
1440	10:39	11.0	6.0	25.0	0.0013	10.1	10.1

COMMENTS

Moisture Content = 19.0%

REVIEWED BY:	**Curtis Beadow**	**APPROVED BY:**	**Joe Forsyth, P. Eng.**

Photo 1: Standing water near Test Fill Pile D in April 2017.

Photo 2: Standing water in east portion of Half Moon Bay West in April 2017.

Photo 3: Soil berms and standing water within south portion of HMB West in June 2017.

Photo 4: Standing water with fill and debris piles in central portion of HMB West on June 29, 2017.

Photo 5: Site conditions in southeast portion of site on June 29, 2017.

Photo 6: Water in drainage ditch at Cambrian Road crossing in July 2017.

Photo 9: Standing water near new settlement plate location in central-west portion of site on July 31, 2017.

LEGEND:

⊕	MONITORING WELL LOCATION, CURRENT INVESTIGATION
▨	SETTLEMENT PILE - PATERSON GROUP REPORT PG2246
⊕	MONITORING WELL LOCATION - PATERSON GROUP REPORT PG2246, 2017
■	TEST PIT LOCATION - PATERSON GROUP REPORT PG2246, 2018
⊕	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2246
○	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2099
⊞	TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG2099
⊕	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1914
●	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1618
⊞	TEST PIT LOCATION- PATERSON GROUP REPORT NO. PG0214
⊕	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG0177
⊞	TEST PIT LOCATION - PATERSON GROUP REPORT NO. PG0177
⊕	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. G9132
⊞	TEST PIT LOCATION - PATERSON GROUP REPORT NO. G9132

SCALE: 1:2500

0 25 50 75 100 125 150 175m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
1	REVISED AS PER LATEST CONCEPTUAL PLAN	25/08/2021	DJG

MATTAMY HOMES

GEOTECHNICAL INVESTIGATION
HALF MOON BAY WEST - CAMBRIAN ROAD
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Stamp:

Scale: 1:2500
Drawn by: RCG
Checked by: DJG
Approved by: DJG
Date: 08/2018

Report No.: PG4073
Drawing No.: PG4073-1
Revision No.: 1

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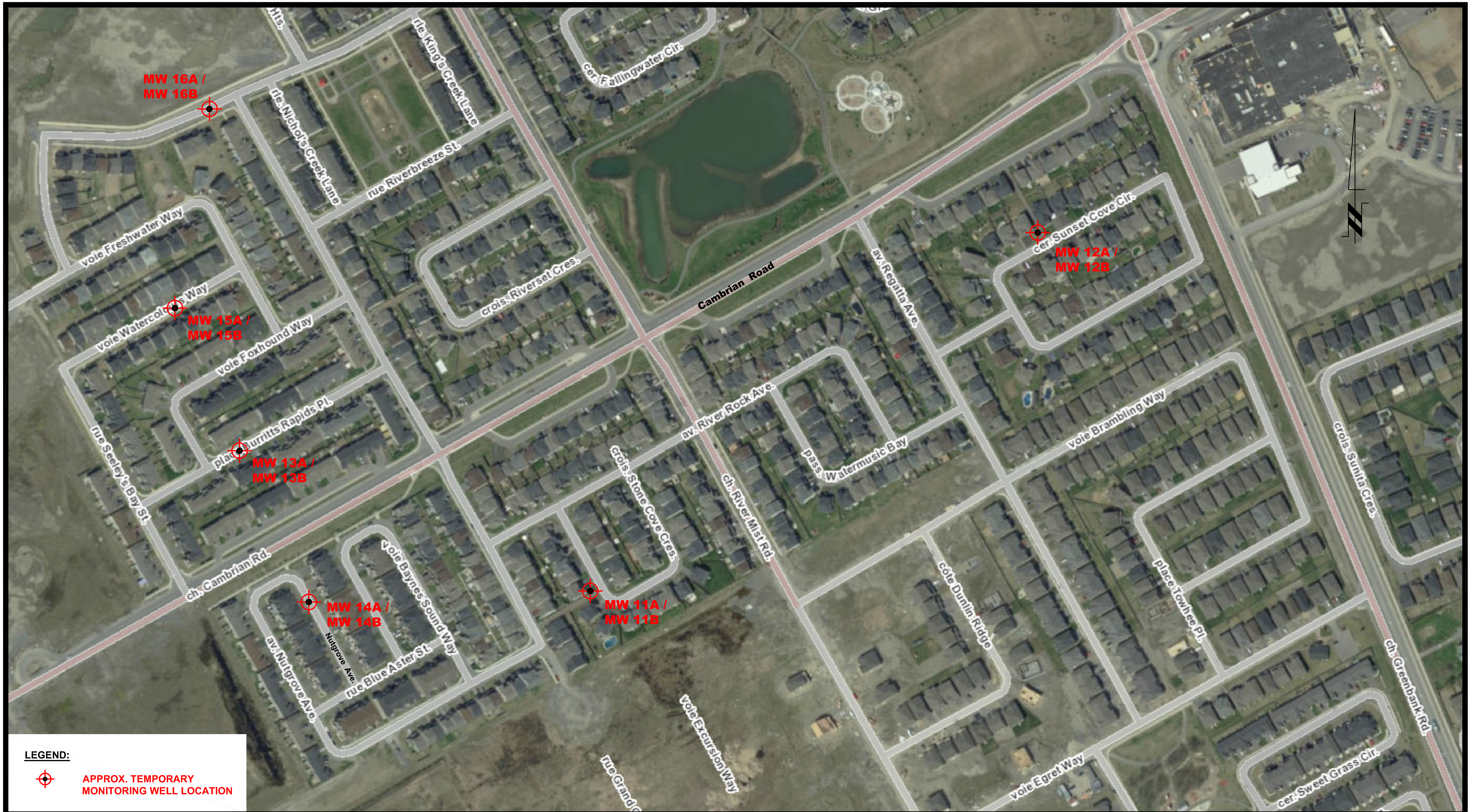

LEGEND:

⌖ APPROX. TEMPORARY MONITORING WELL LOCATION

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
3	MW 15A/15B & MW 16A/16B ADDED	25/04/2018	RG
2	PROPOSED MW 15A/15B & MW 16A/16B ADDED	22/03/2018	RG
1	MW 13A/13B & MW 14A/14B ADDED	25/01/2018	RG

MATTAMY HOMES
GROUNDWATER MONITORING PROGRAM
HALF MOON BAY SUBDIVISION
OTTAWA, ONTARIO

Title:
TEMPORARY MONITORING WELL LOCATION PLAN

Scale: 1:3000
Date: 04/2017
Drawn by: MPG
Report No.: PG4073-LET.03
Checked by: DJG
Dwg. No.: **PG4073-1**
Approved by: DJG
Revision No.: 3

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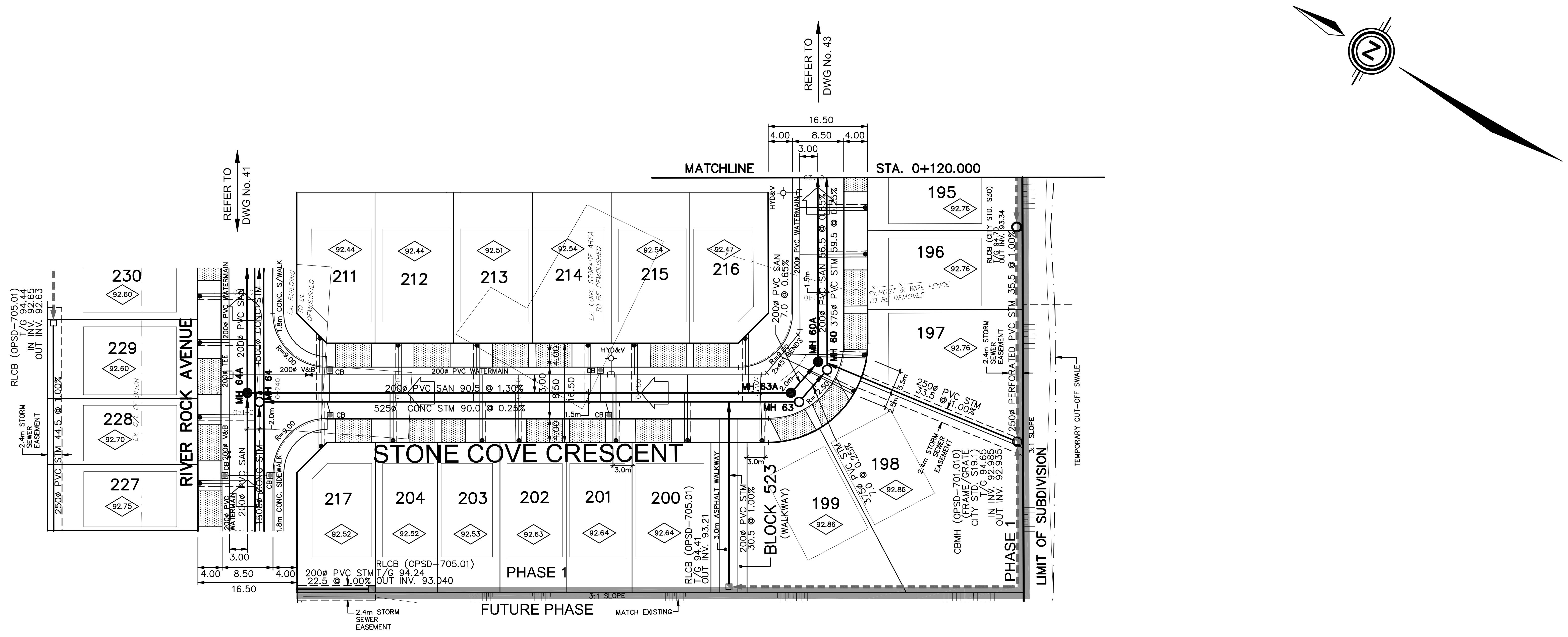
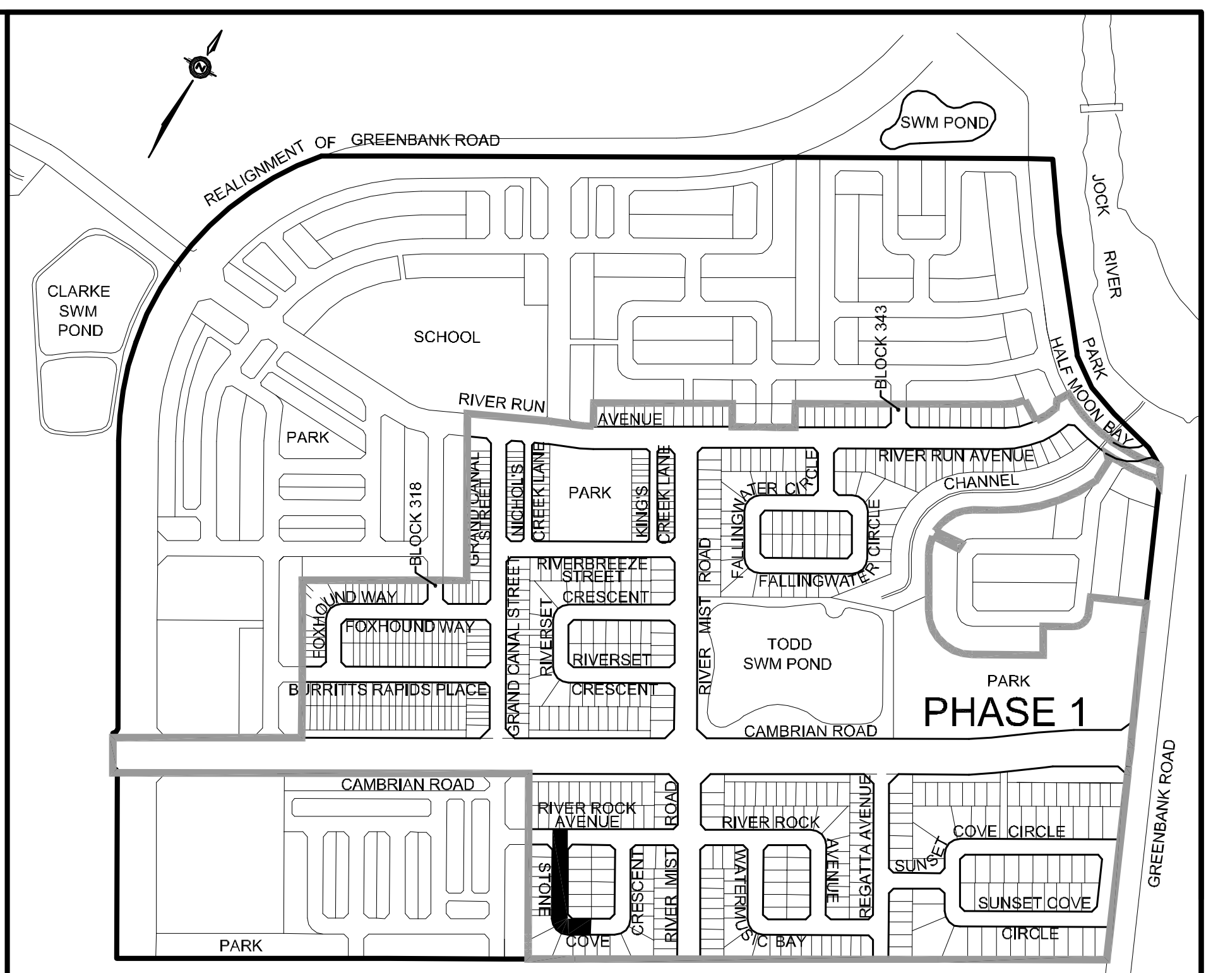
PAVEMENT DESIGN

40mm SUPERPAVE 12.5 ASPHALT CONCRETE
50mm SUPERPAVE 19.0 ASPHALT CONCRETE BINDER COURSE
150mm GRANULAR "A"
450mm GRANULAR "B" TYPE II

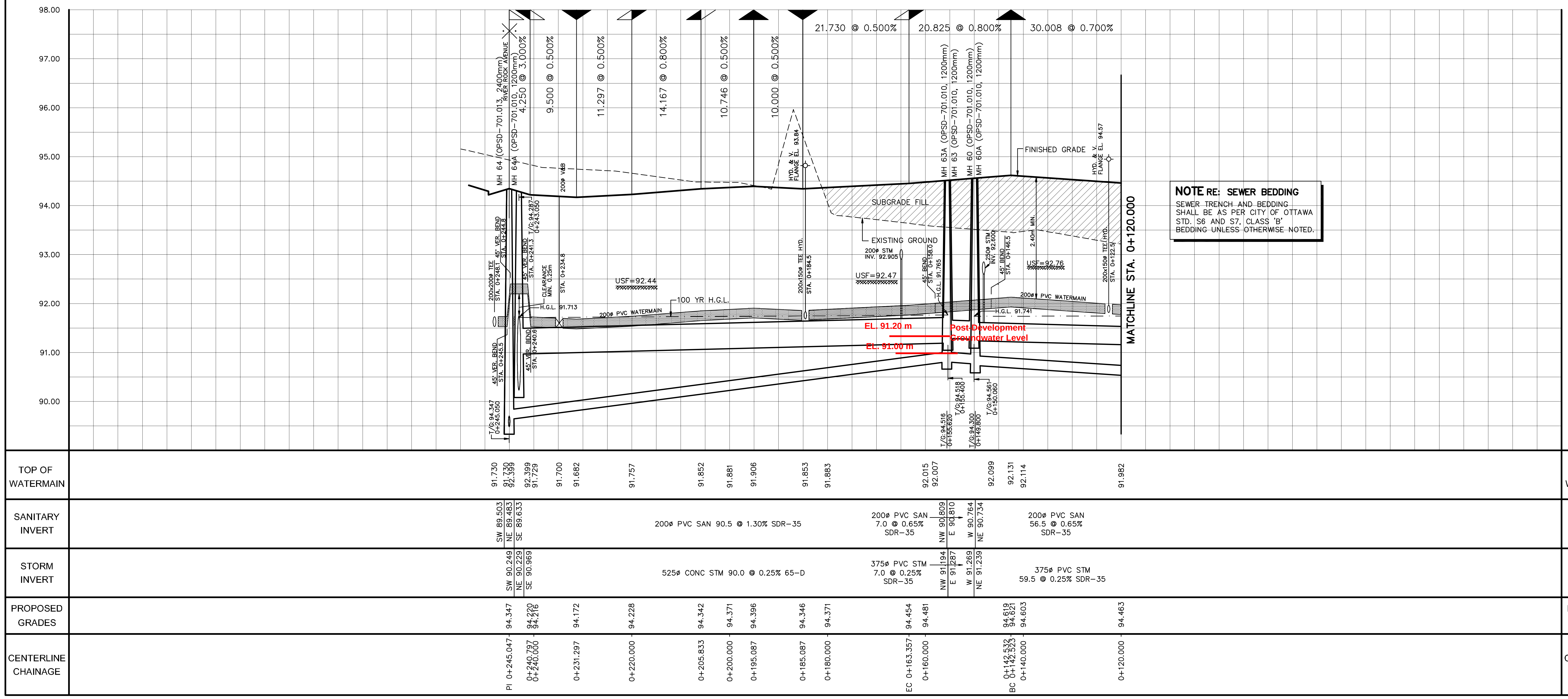




KEY PLAN
SCALE 1:8000

LEGEND

- ○ STORM MANHOLE
- ● SANITARY MANHOLE
- ○ STORM MANHOLE BY OTHERS
- ● SANITARY MANHOLE BY OTHERS
- ◘ CATCHBASIN MANHOLE
- ◦ RLCB – ELBOW SECTION (REFER TO CITY STD. S31)
- ◦ RLCB – 'T' SECTION (REFER TO CITY STD. S30)
- – – – SINGLE STORM HOUSE CONNECTION
- —— SINGLE SANITARY HOUSE CONNECTION
- •—— WATER CONNECTION
- HYDRANT
- TEE
- VALVE AND BOX
- VALVE & CHAMBER
- □ ◫ SINGLE/DOUBLE CATCHBASIN
- CATCHBASINS WITH INLET CONTROL DEVICE TYPE A (Q max = 21.0 l/s)
- CATCHBASINS WITH INLET CONTROL DEVICE TYPE B (Q max = 28.4 l/s)
- ⊞ CATCHBASINS WITH INLET CONTROL DEVICE TYPE D (Q max = 54.0 l/s)
- ☒ CATCHBASINS DENOTED AS 100YR INTAKES, WITH STANDARD LEADS UNLESS OTHERWISE NOTED
- • LS LIGHT STANDARD
- COMMUNITY MAILBOX AND PAD LOCATION
- ◇100.00 U/S FOOTING ELEVATION
- ▨ PHASE LINE
- ⇨ OVERLAND FLOW DIRECTION
- ⇨ EXTERNAL OVERLAND FLOW DIRECTION
- 2.0m HIGH ACOUSTIC FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
- 2.4m HIGH ACOUSTIC FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
- 1.2m HIGH DECORATIVE FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
- —x— 1.5m HIGH BLACK VINYL CHAIN LINK FENCE
- 1.8m HIGH WOOD PRIVACY FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
- 250ø PERFORATED PIPE (REFER TO CITY STD'S S29, S30 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY)
- □ BUILDING ENVELOPE
- ▬ CLAY SEAL (REFER TO CITY STD. S8, GENERAL NOTES. No.18. 19. ON DWG. No.1, AND GEOTECHNICAL CONSULTANT'S SPECIFICATIONS)
- ━ RETAINING WALL (SEE NOTES ON DWG. 1 AND STRUCTURAL DWGS FOR DETAILS)
- ▲ SLAB ON GRADE UNITS



NOTE RE: SEWER BEDDING
SEWER TRENCH AND BEDDING SHALL BE AS PER CITY OF OTTAWA STD. S6 AND S7, CLASS 'B' BEDDING UNLESS OTHERWISE NOTED.

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED,
PROJECT No. 06–10–675–00. SURVEY DATED OCTOBER 15, 2007.

LEGAL INFORMATION

CALCULATED M–PLAN PROVIDED BY J.D. BARNES LIMITED,
PROJECT No. 07–10–767–00–PHASE 1, SURVEY DATED MARCH 18, 2008.

BENCH MARK No. 00820010126

POINT IS LOCATED 1.65km NORTH OF BARNSDALE ROAD AND 5km SOUTH OF FALLOWFIELD ROAD ON HIGHWAY 416 NORTH OF KEMPTVILLE. THE POINT IS SET EAST OF THE NORTHBOUND LANE IN THE GRASSY SHOULDER.
ELEVATION = 96.923 m

No.	BY	DATE	DESCRIPTION	BY
5	Z.L.	08–04–30	REVISED AS PER CITY COMMENTS	
4	Z.L.	08–04–11	REVISED AS PER CITY COMMENTS	
3	Z.L.	08–02–08	3rd SUBMISSION	
2	Z.L.	07–10–16	2nd SUBMISSION	
1	Z.L.	07–08–28	1st SUBMISSION	

CITY OF OTTAWA

PROJECT No. 07–314

Z. LI
08-11-20

PLAN AND PROFILE OF
STONE COVE CRESCENT
(STA. 0+120.000 TO STA. 0+245.047)
© DSEL

MATTAMY
(HALF MOON BAY)
LIMITED

HALF MOON BAY SUBDIVISION
PHASE 1

david schaeffer engineering ltd

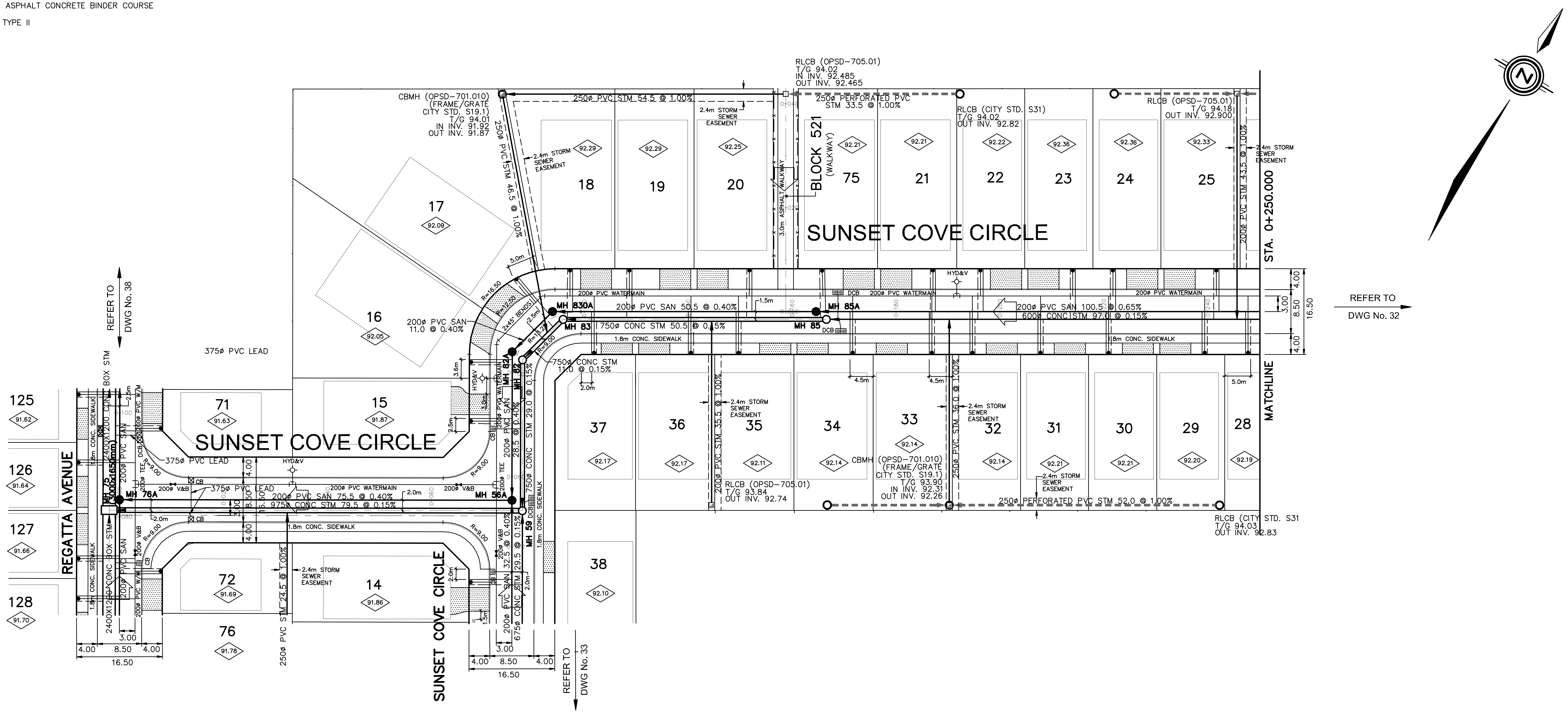
600 Alden Road, Suite 500
Markham, Ontario, L3R 0E7
Tel. (905) 475-3080
Fax. (905) 475-3081
www.DSEL.ca

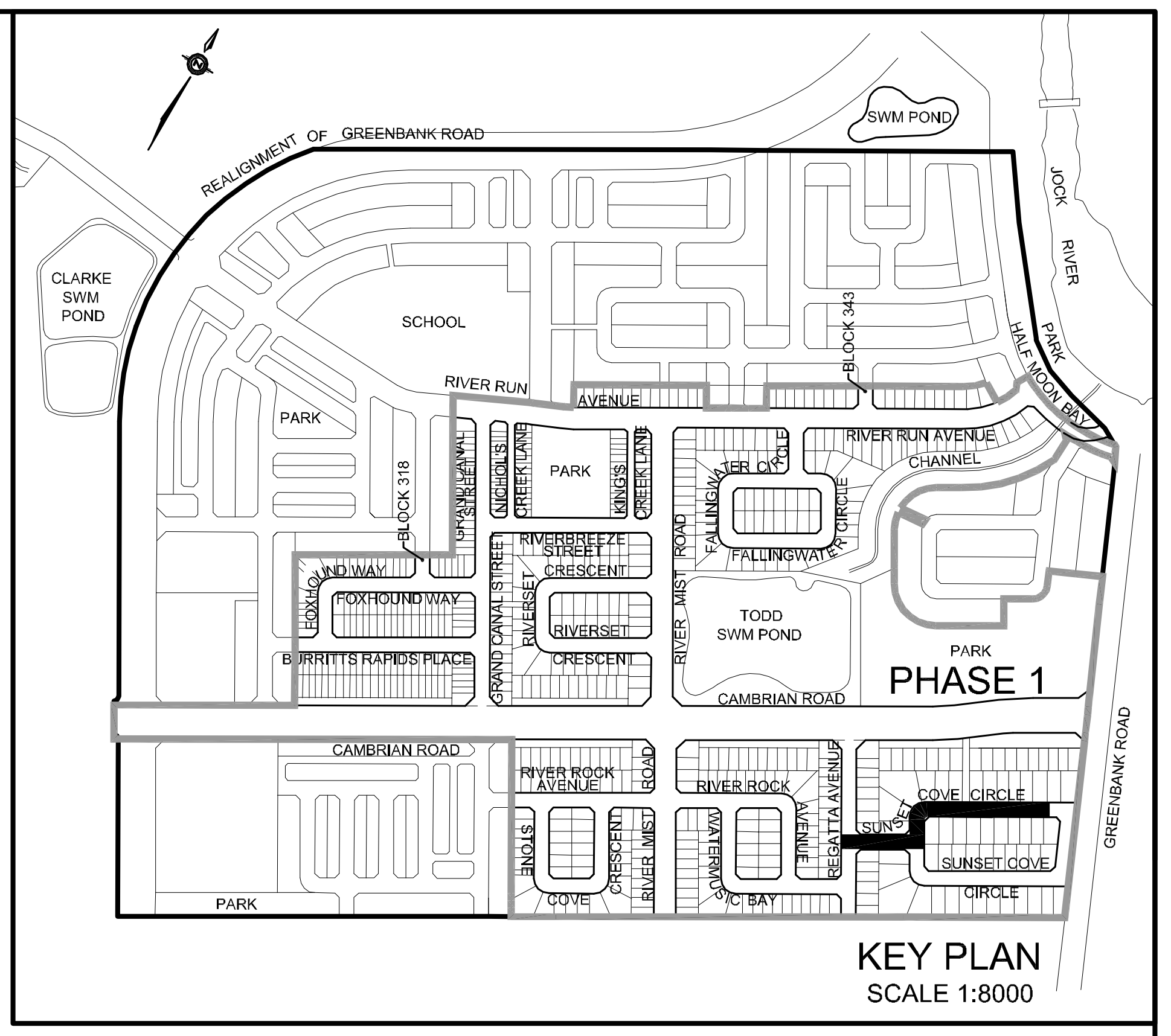
DRAWN BY: P.P./D.Z.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		42
SCALE: H1:500 ,V1:50	DATE: AUG. 2007		

K:\07314\Subm_4\Profiles\42_314PP_Ph1.dwg, 10/16/2009 4:41:46 PM, jyu, 1:1

PAVEMENT DESIGN

40mm SUPERPAVE 12.5 ASPHALT CONCRETE
50mm SUPERPAVE 19.0 ASPHALT CONCRETE BINDER COURSE
150mm GRANULAR "A"
450mm GRANULAR "B" TYPE II

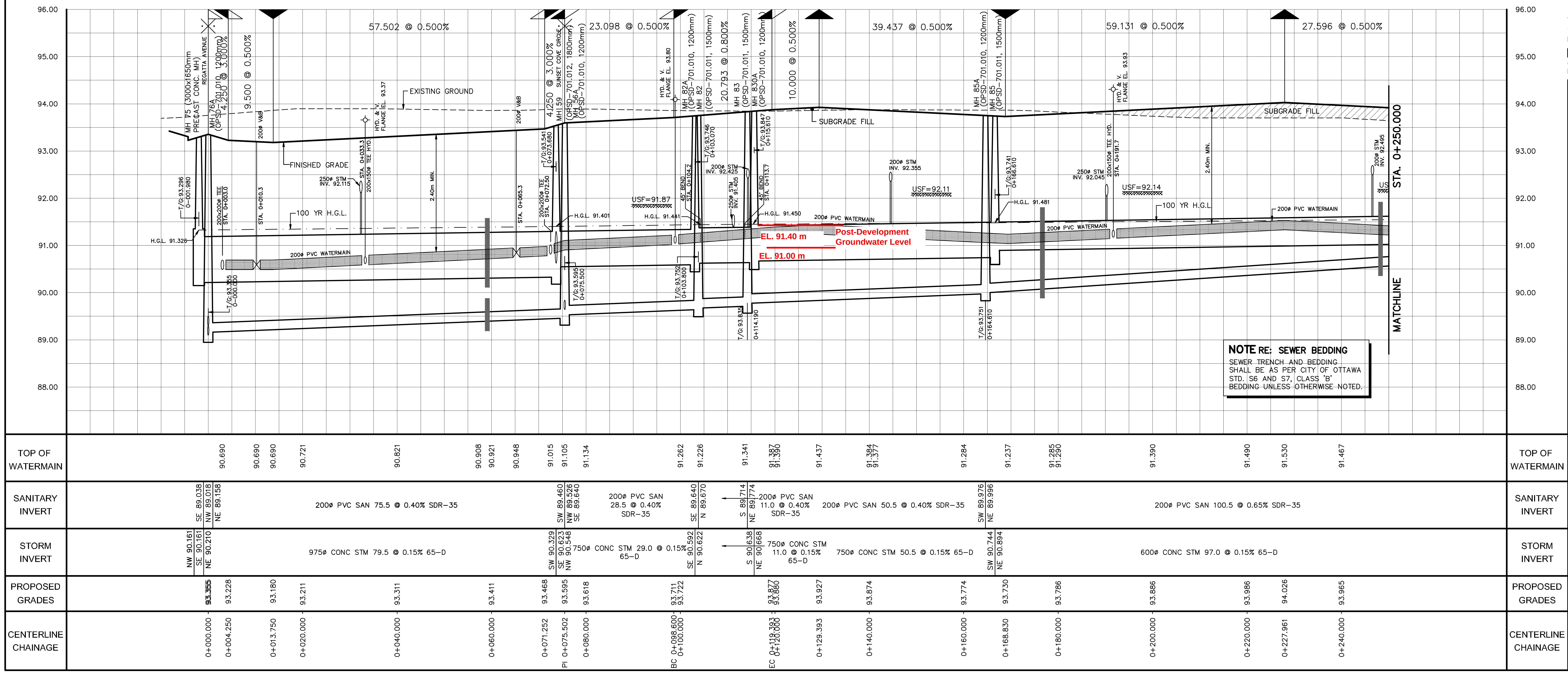




KEY PLAN
SCALE 1:8000

LEGEND

○	STORM MANHOLE
●	SANITARY MANHOLE
○	STORM MANHOLE BY OTHERS
●	SANITARY MANHOLE BY OTHERS
▢	CATCHBASIN MANHOLE
○	RLCB – ELBOW SECTION (REFER TO CITY STD. S31)
○	RLCB – 'T' SECTION (REFER TO CITY STD. S30)
– – –	SINGLE STORM HOUSE CONNECTION
——	SINGLE SANITARY HOUSE CONNECTION
•——	WATER CONNECTION
	HYDRANT
	TEE
	VALVE AND BOX
	VALVE & CHAMBER
□ □□	SINGLE/DOUBLE CATCHBASIN
◩	CATCHBASINS WITH INLET CONTROL DEVICE TYPE A (Q max = 21.0 l/s)
▣	CATCHBASINS WITH INLET CONTROL DEVICE TYPE B (Q max = 28.4 l/s)
⊞	CATCHBASINS WITH INLET CONTROL DEVICE TYPE D (Q max = 54.0 l/s)
☒	CATCHBASINS DENOTED AS 100YR INTAKES, WITH STANDARD LEADS UNLESS OTHERWISE NOTED
• LS	LIGHT STANDARD
	COMMUNITY MAILBOX AND PAD LOCATION
100.00	U/S FOOTING ELEVATION
▬	PHASE LINE
⇨	OVERLAND FLOW DIRECTION
⇨	EXTERNAL OVERLAND FLOW DIRECTION
— — —	2.0m HIGH ACOUSTIC FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
— · —	2.4m HIGH ACOUSTIC FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
— · —	1.2m HIGH DECORATIVE FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
—x—	1.5m HIGH BLACK VINYL CHAIN LINK FENCE
—··—··—	1.8m HIGH WOOD PRIVACY FENCE (SEE LANDSCAPE DRAWING FOR DETAILS)
- - ➔	250ø PERFORATED PIPE (REFER TO CITY STD'S S29, S30 FOR REAR YARD TRENCH AND PIPE DETAILS ONLY)
□	BUILDING ENVELOPE
▬	CLAY SEAL (REFER TO CITY STD. S8, GENERAL NOTES. No.18. 19. ON DWG. No.1, AND GEOTECHNICAL CONSULTANT'S SPECIFICATIONS)
▬	RETAINING WALL (SEE NOTES ON DWG. 1 AND STRUCTURAL DWGS FOR DETAILS)
▲	SLAB ON GRADE UNITS



NOTE RE: SEWER BEDDING

SEWER TRENCH AND BEDDING SHALL BE AS PER CITY OF OTTAWA STD. S6 AND S7, CLASS 'B' BEDDING UNLESS OTHERWISE NOTED.

TOPOGRAPHIC INFORMATION

TOPOGRAPHIC INFORMATION PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 06-10-675-00. SURVEY DATED OCTOBER 15, 2007.

LEGAL INFORMATION

CALCULATED M-PLAN PROVIDED BY J.D. BARNES LIMITED, PROJECT No. 07-10-767-00-PHASE 1, SURVEY DATED MARCH 18, 2008.

BENCH MARK No. 00820010126

POINT IS LOCATED 1.65km NORTH OF BARNSDALE ROAD AND 5km SOUTH OF FALLOWFIELD ROAD ON HIGHWAY 416 NORTH OF KEMPTVILLE. THE POINT IS SET EAST OF THE NORTHBOUND LANE IN THE GRASSY SHOULDER.
ELEVATION = 96.923 m

No.	BY	DATE	DESCRIPTION	BY
8	Z.L.	09-03-26	LOT 14 DRIVEWAY REVISED, LOT 15 DWY DIMENSION ADDED	
7	Z.L.	09-03-11	DRIVEWAYS AND SERVICES FOR LOTS 14,15 & 37 RELOCATED	
6	Z.L.	08-05-07	REVISED AS PER CITY COMMENTS	
5	Z.L.	08-04-30	REVISED AS PER CITY COMMENTS	
4	Z.L.	08-04-11	REVISED AS PER CITY COMMENTS	
3	Z.L.	08-02-08	3rd SUBMISSION	
2	Z.L.	07-10-16	2nd SUBMISSION	
1	Z.L.	07-08-28	1st SUBMISSION	

CITY OF OTTAWA

PROJECT No. 07-314

Z. LI
09-03-26

PLAN AND PROFILE OF
SUNSET COVE CIRCLE
(STA. 0+000.000 TO STA. 0+250.000)

MATTAMY
(HALF MOON BAY)
LIMITED

HALF MOON BAY SUBDIVISION
PHASE 1

david schaeffer engineering ltd
600 Alden Road, Suite 500
Markham, Ontario, L3R 0E7
Tel. (905) 475-3080
Fax. (905) 475-3081
www.DSEL.ca

DRAWN BY: P.P./D.Z.	CHECKED BY: K.M.	DRAWING NO.	SHEET NO.
DESIGNED BY: K.M.	CHECKED BY: Z.L.		31
SCALE: H1:500 ,V1:50	DATE: AUG. 2007		

K:\07314\Subm_4\Profiles\31_314PP_Ph1.dwg, 10/16/2009 5:01:07 PM, Jyu, 1:1

patersongroup **memorandum**
consulting engineers

re: **Geotechnical Review - Excavation Limits in Proximity to Artesian Point Sources**
Half Moon Bay West Residential Development - Phase 3
Cambrian Road - Ottawa

to: DSEL - **Mr. Anthony Temelini** - atemelini@dsel.ca
to: Mattamy Homes - **Mr. Reuben Noel** - reuben.noel@mattamycorp.com
date: July 28, 2021
file: PG2246-MEMO.72

Further to your request and authorization, Paterson Group (Paterson) prepared the current memorandum to summarize our review of the founding depths of the proposed infrastructure and buildings within proximity to previously recommended excavation limits. The following memorandum should be read in conjunction with Paterson Report PG2246-1 Revision 7 dated April 19, 2021 and Memorandum PG2246-MEMO.52 Revision 10 dated May 17, 2021 regarding our geotechnical review and recommendations for the Artesian Point Source Drainage System and Containment Cell Construction.

Background Information

Paterson reviewed the following grading plans prepared by DSEL for Phase 3 of the aforementioned residential development:

❑ General Plan - Half Moon Bay West Phase 3 - Sheet No. 8 - Project No. 19-1140 - Revision 1 dated June 4, 2021
❑ Watercolours Way - Half Moon Bay West Phase 3 - Sheet No. 10 - Project No. 19-1140 - Revision 1 dated June 4, 2021
❑ Grading Plan - Half Moon Bay West Phase 3 - Sheet No. 20 - Project No. 19-1140 - Revision 1 dated June 4, 2021
❑ Sanitary Drainage Plan - Half Moon Bay West Phase 3 - Sheet No. 23 - Project No. 19-1140 - Revision 1 dated June 4, 2021

Geotechnical Review

Based on our review, it is observed that the proposed excavations for the lots and service pipes within the recommended excavation limit zones are considered acceptable with respect to the previously provided recommendations.

Based on the spout locations and our observations within the area, the alignment of Watercolours Way to the north of the parkland and adjacent housing blocks are considered to be setback sufficiently to avoid any conflict between servicing and the artesian point sources based on our review of the available grading plan.

Conclusion and Recommendations

Based on our review, the recommendations previously provided in PG2246-MEMO.52 Revision 10 dated May 17, 2021 have been incorporated satisfactorily from a geotechnical perspective throughout the subject area. It is recommended that as-built subgrade elevations be obtained by the excavation contractor and reviewed at the time of construction by Paterson personnel during site servicing and building construction stages throughout the subject area. Reference should be made to the attached Drawing PG2246-6 - Artesian Excavation Limits denoting the lateral extent and maximum allowable depth of excavation throughout the subject area.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
July 28, 2021
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Drew Petahtegoose, B.Eng.

David J. Gilbert P.Eng.

Attachments

☐ Drawing PG2246-6 - Artesian Excavation Limits Plan

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

REMARKS

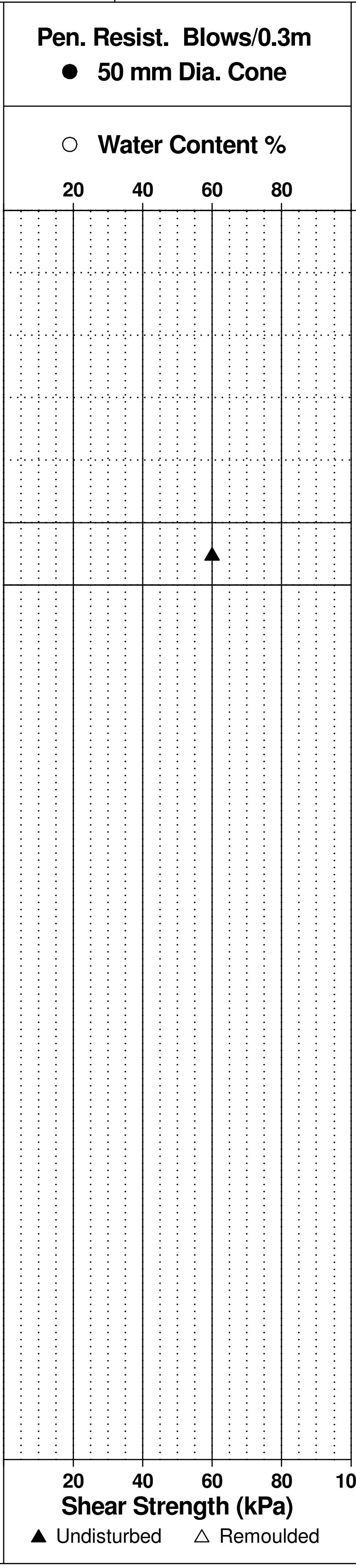
BORINGS BY Excavator

DATE 2021 April 5

FILE NO. PG2246

HOLE NO. TP 1-21

SOIL DESCRIPTION		STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	92.61
FILL: Brown silty clay with sand, gravel and organics	0.08							
Brown **SILTY SAND** with clay			G	1				
			G	2				
	1.00						1	91.61
Very stiff brown **SILTY CLAY**			G	3				
	1.20							
End of Test Pit (TP dry upon completion)								



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 April 5

FILE NO. PG2246

HOLE NO. TP 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	92.59		
FILL: Brown silty sand with clay and gravel 0.60		G	1						
Very stiff brown **SILTY CLAY** with sand 0.85		G	2						
Compact brown **SILTY SAND** some clay, trace gravel 1.19		G	3			1	91.59		
End of Test Pit (Open hole GWL @ 1.06 m depth)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 April 5

FILE NO. PG2246

HOLE NO. TP 3-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	92.15		
FILL: Brown silty clay, with sand and gravel		G	1						
0.60									
Brown **SILTY SAND** trace clay and gravel		G	2						
0.75									
End of Test Pit (TP dry upon completion)									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG2246

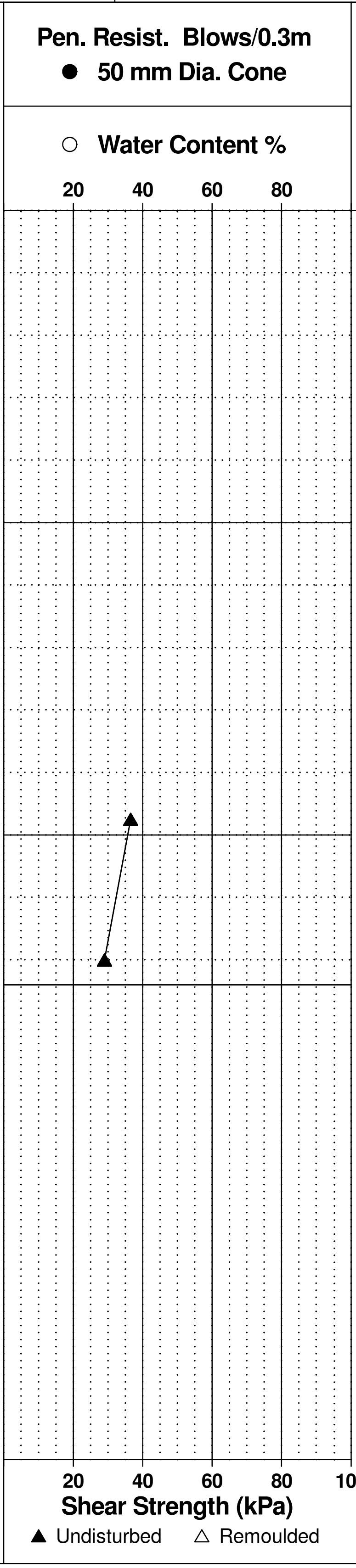
REMARKS

HOLE NO. TP 4-21

BORINGS BY Excavator

DATE 2021 April 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.48
FILL: Brown silty clay trace sand, gravel and organics		G	1				
0.78							
PEAT		G	2				
0.85							
Very stiff to stiff brown **SILTY CLAY** trace sand						1	91.48
		G	3				
1.64							
Firm grey **SILTY CLAY**		G	4			2	90.48
		G	5				
2.48							
End of Test Pit (Open hole GWL @ 1.64 m depth)							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

FILE NO. PG2246

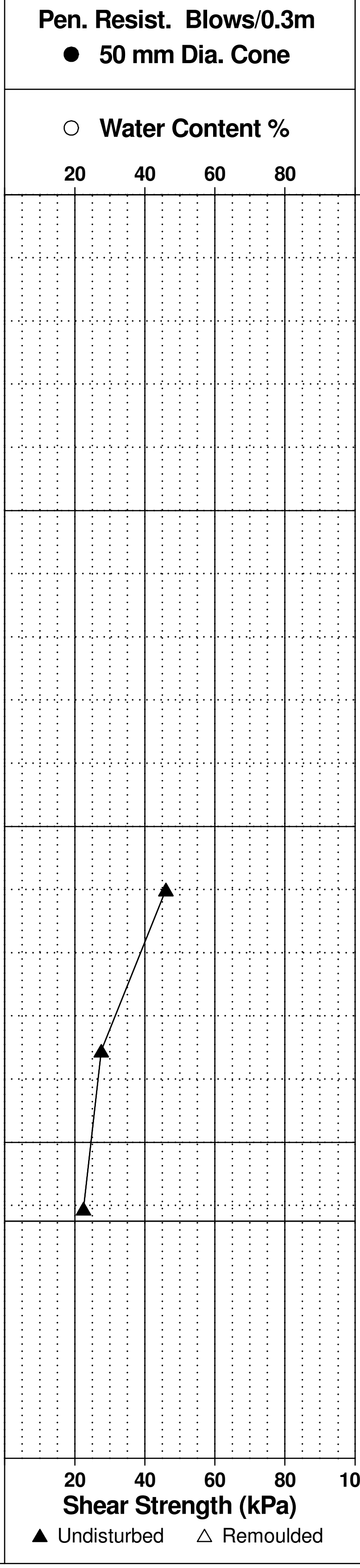
REMARKS

HOLE NO. TP 5-21

BORINGS BY Excavator

DATE 2021 April 5

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	93.14	
FILL: Brown silty clay with sand, some gravel, cobbles and boulders	▨	G	1					
	▨					1	92.14	
1.54 **FILL:** Grey to brown silty clay with sand, some cobbles and boulders	▨	G	2					
1.76 Stiff brown **SILTY CLAY** trace sand	▨	G	3					
	▨					2	91.14	
	▨	G	4					
- Firm to soft and grey by 2.2 m depth	▨							
	▨	G	5					
	▨					3	90.14	
	▨	G	6					
3.75 End of Test Pit (Open hole GWL @ 1.76 m depth)								



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Phase 3 - Watercolours Way
Ottawa, Ontario

DATUM Geodetic

REMARKS

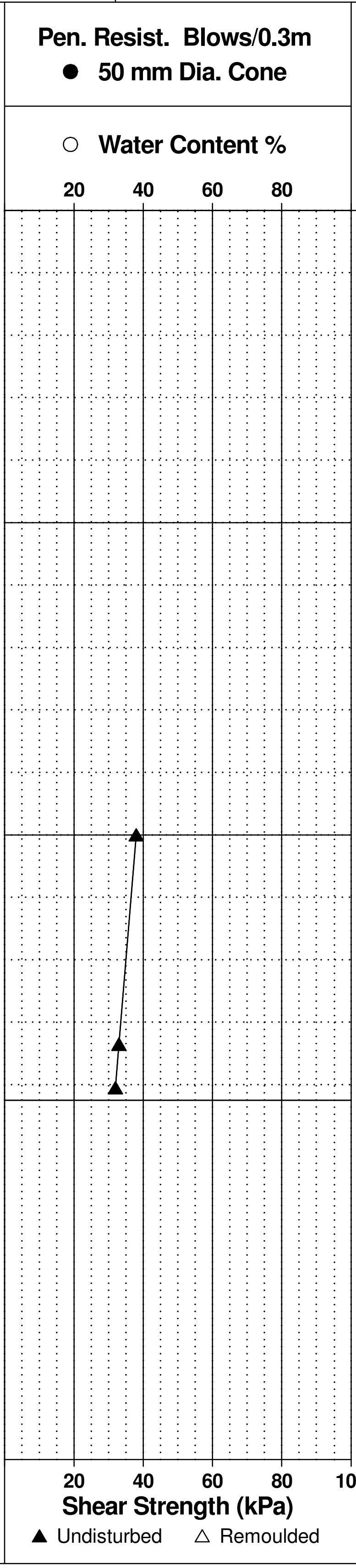
BORINGS BY Excavator

DATE 2021 April 5

FILE NO. PG2246

HOLE NO. TP 6-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.85
FILL: Brown silty clay some sand, trace cobbles and boulders							
		G	1			1	91.85
1.13		G	2				
Very stiff to stiff brown **SILTY CLAY** with sand							
1.93		G	3			2	90.85
Firm grey **SILTY CLAY** trace sand							
		G	4				
2.85							
End of Test Pit							



Piezometer Construction

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

REMARKS

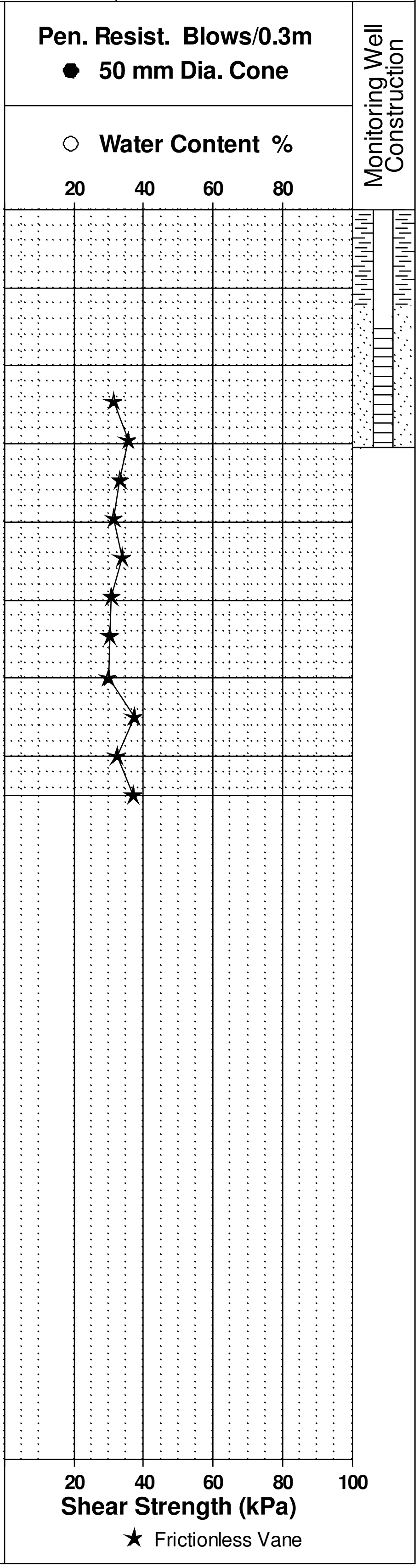
BORINGS BY CME 55 Power Auger

DATE March 1, 2012

FILE NO. PG2246

HOLE NO. BH 9-12

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	92.06
PEAT 0.25							
Loose, grey **SILTY SAND,** trace clay 0.80							
		SS	1		2	1	91.06
						2	90.06
						3	89.06
Firm, grey **SILTY CLAY**						4	88.06
						5	87.06
						6	86.06
						7	85.06
7.49 End of Borehole							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half-Moon Bay West - Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

REMARKS

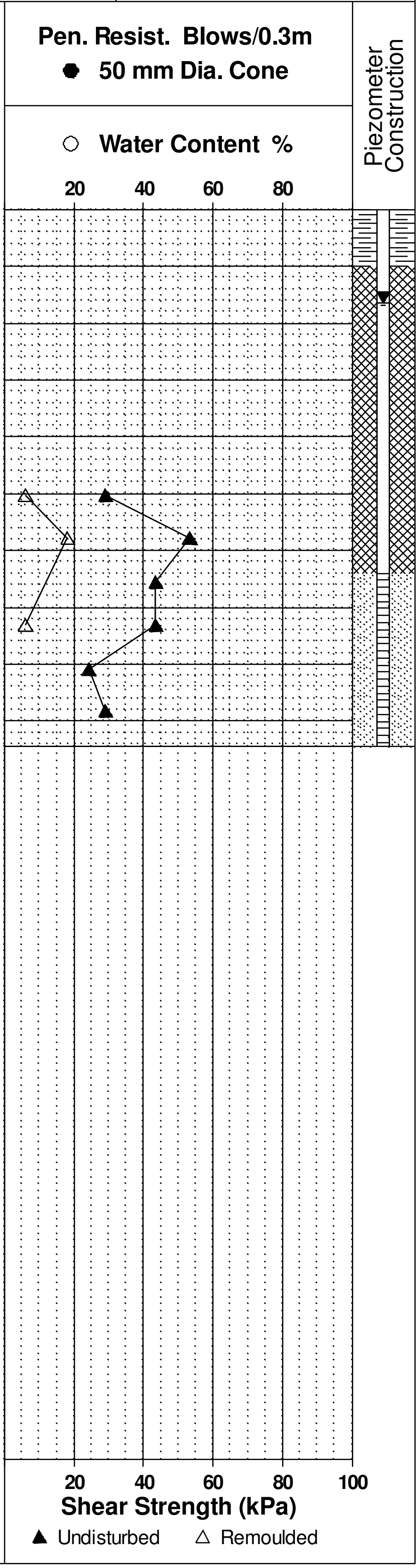
BORINGS BY CME 55 Power Auger

DATE November 15, 2010

FILE NO. PG2246

HOLE NO. BH13-10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
FILL: Brown silty clay with sand, gravel and cobbles, trace boulders		SS	1	42	2	0	93.14
		SS	2	12	1	1	92.14
2.10		SS	3	33	3	2	91.14
Firm to soft, brown **SILTY CLAY** with sand 2.97		SS	4	92	8	3	90.14
		SS	5	100	2	4	89.14
Firm, grey **SILTY CLAY** with sand		SS	6	100	W	5	88.14
						6	87.14
						7	86.14
						8	85.14
9.45		SS	7	100		9	84.14
End of Borehole (GWL @ 1.65m-Jan. 10/11)							



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28 Concourse Gate, Unit 1, Ottawa, ON K2E 7T7

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development-Half Moon Bay
Ottawa, Ontario

DATUM Ground surface elevation at borehole locations provided by JD Barnes.

FILE NO. **PG1618**

REMARKS

HOLE NO. **BH23-08**

BORINGS BY CME 55 Power Auger

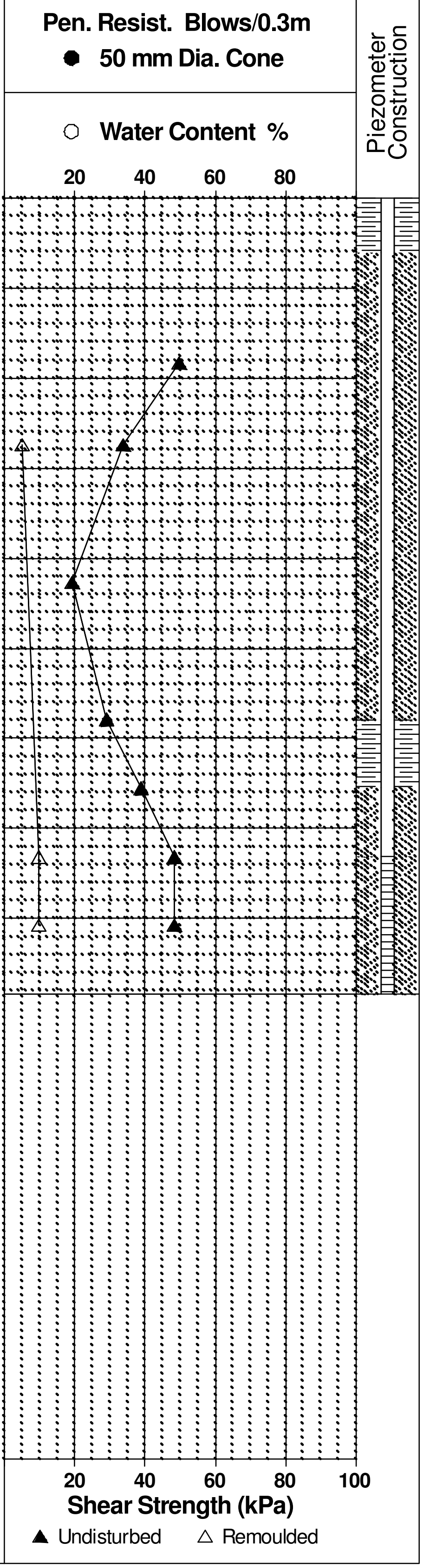
DATE 26 March 2008

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with gravel and clay 0.91	▨	AU	1		
Brown **SILTY SAND** with trace clay 1.68		SS	2	50	7
Grey **SILTY CLAY** 8.84	▨	SS	3	100	2
		TW	4	100	
		TW	5	100	

End of Borehole

(Surfical water surrounding borehole- April 9/08)

DEPTH (m)	ELEV. (m)
0	92.54
1	91.54
2	90.54
3	89.54
4	88.54
5	87.54
6	86.54
7	85.54
8	84.54



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Half Moon Bay West - Greenbank at Cambrian Road
Ottawa, Ontario

DATUM Ground surface elevations provided by ASL.

REMARKS

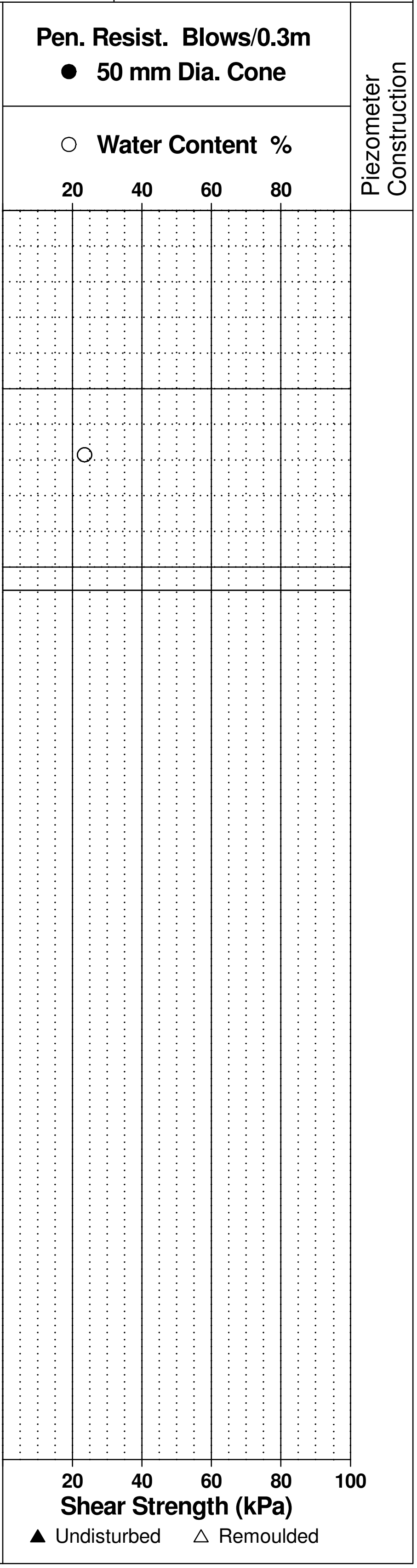
BORINGS BY Hydraulic Excavator

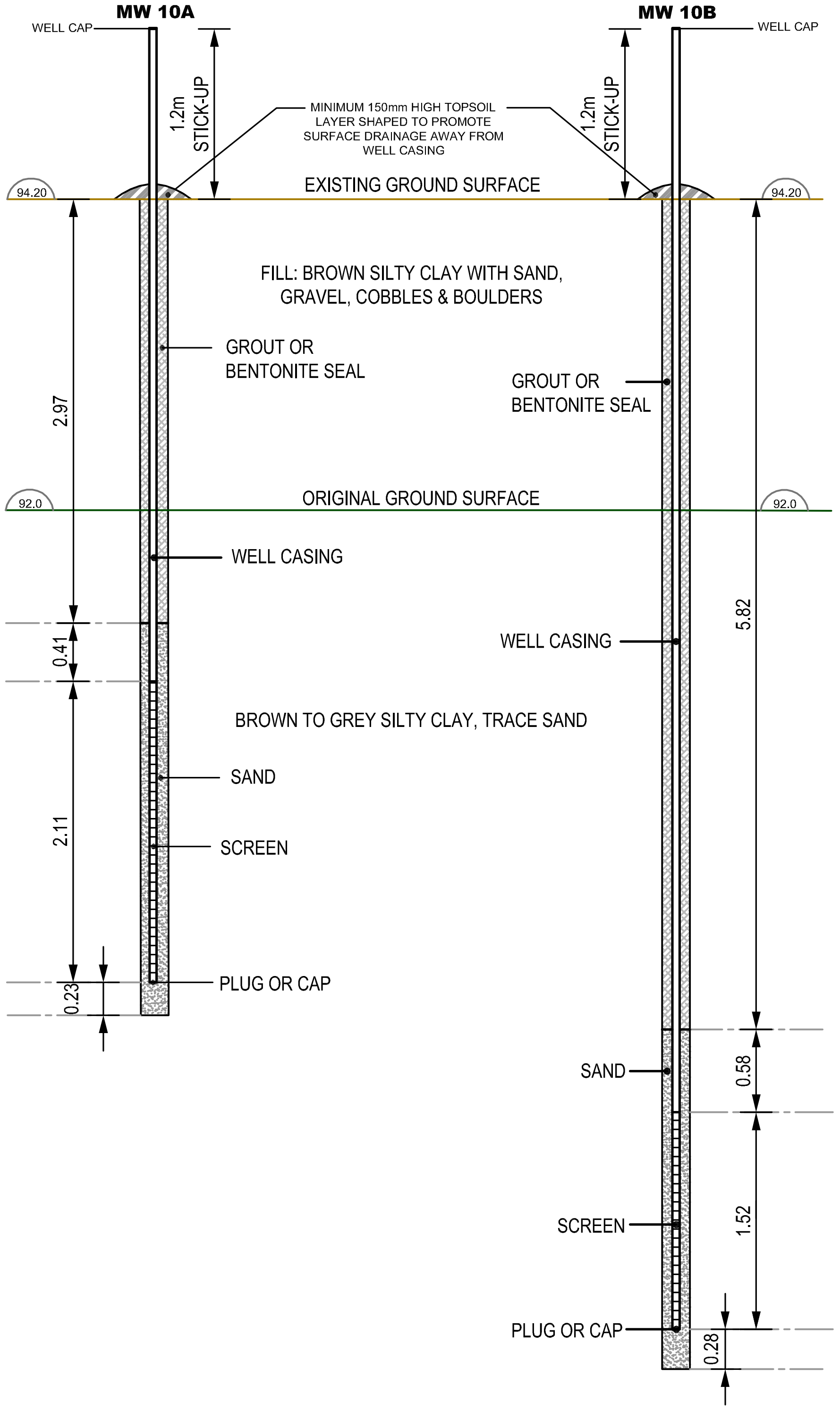
DATE March 6, 2018

FILE NO. PG2246

HOLE NO. TP10-18

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	92.34
TOPSOIL 0.05						
FILL: Brown sand and gravel, some cobbles, boulders, trace rootlets 0.61	G	1				
Compact, brown **SILTY FINE SAND to SANDY SILT,** trace clay	G	2			1	91.34
- clay content increasing with depth - grey by 1.2m depth 1.52	G	3				
Firm, grey **SILTY CLAY,** trace to some sand 2.13	G	4			2	90.34
End of Test Pit						





NOTE:

GROUND SURFACE ELEVATIONS PROVIDED BY ASL.

patersongroup
consulting engineers

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www.patersongroup.ca

MATTAMY HOMES

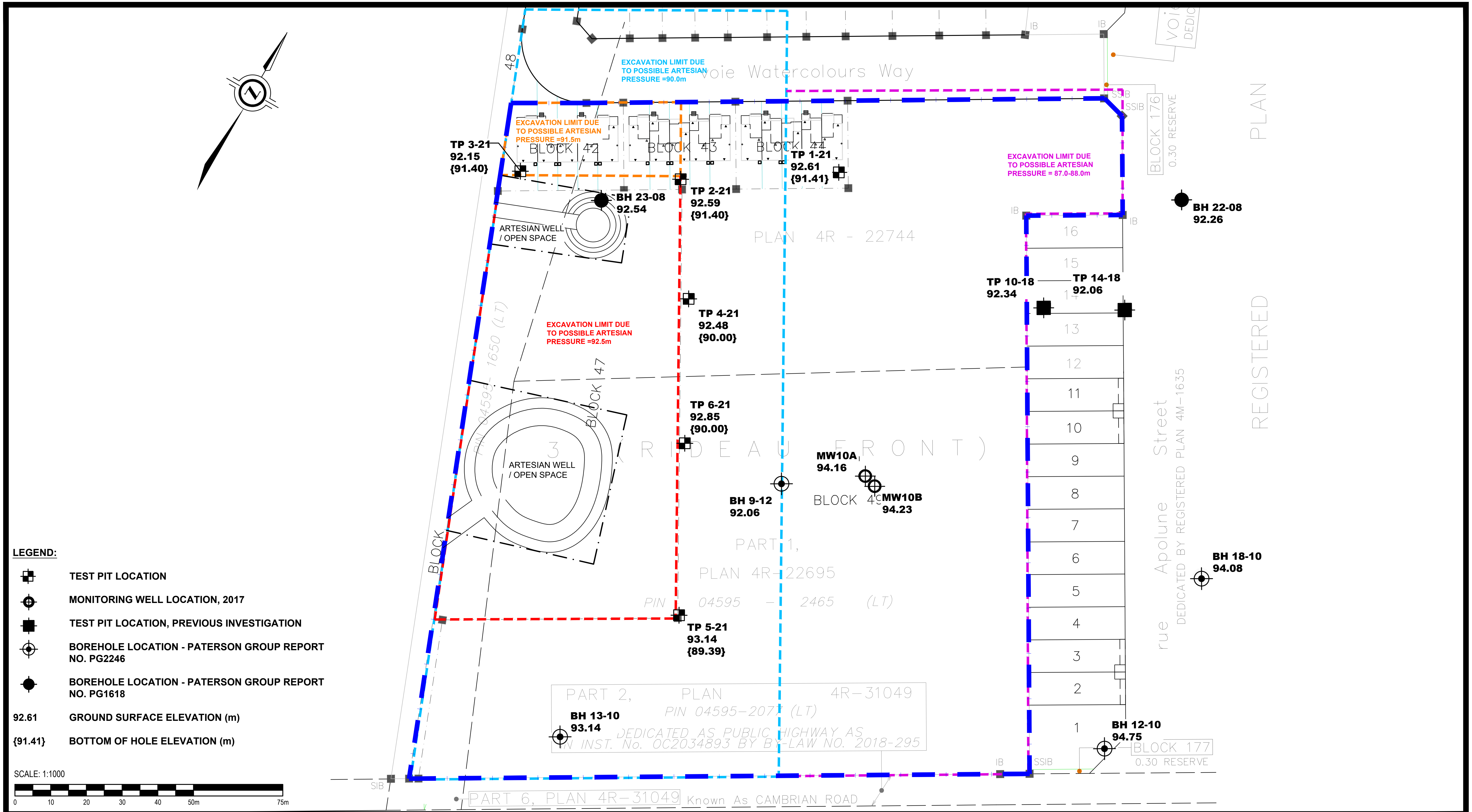
GROUNDWATER MONITORING PROGRAM
HALFMOON BAY WEST
OTTAWA, ONTARIO

Title:

MW 10A & MW 10B MONITORING WELL DETAILS

Date: **03/2018**	Report No.: **PG4073**
Scale: **1:50**	Drawing No.: **FIG. 10**
Drawn by: **MPG**	Checked by: **DJG**

p:\autocad drawings\geotechnical\pg40xx\pg4073\working monitoring wells.dwg



LEGEND:

⊞	TEST PIT LOCATION
⊕	MONITORING WELL LOCATION, 2017
■	TEST PIT LOCATION, PREVIOUS INVESTIGATION
⊕	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG2246
●	BOREHOLE LOCATION - PATERSON GROUP REPORT NO. PG1618
92.61	GROUND SURFACE ELEVATION (m)
{91.41}	BOTTOM OF HOLE ELEVATION (m)

SCALE: 1:1000

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consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
2	UPDATED TO NEW UNIT SITINGS	05/17/2021	OC
1	UPDATED TO NEW CONCEPTUAL PLAN	04/15/2021	OC

MATTAMY HOMES

GEOTECHNICAL INVESTIGATION
HALF MOON BAY WEST - PHASE III

OTTAWA, ONTARIO

Title:

ARTESIAN EXCAVATION LIMITS PLAN

Scale: 1:1000
Date: 04/2021
Drawn by: RCG
Report No.: PG2246-1
Checked by: OC
Dwg. No.: PG2246-6
Approved by: DJG
Revision No.: 2

p:\autocad drawings\geotechnical\pg22xx\pg2246\pg2246-6 april 2021.dwg

APPENDIX G

HYDRAULIC CAPACITY AND MODELING ANALYSIS (COMPLETED BY GEO ADVICE)

Hydraulic Capacity and Modeling Analysis Mattamy Half Moon Bay West Phase 3

Final Report

Prepared for:
David Schaeffer Engineering Ltd.
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

Prepared by:
GeoAdvice Engineering Inc.
Unit 203, 2502 St. John's Street
Port Moody, BC V3H 2B4

Submission Date: May 31, 2021

Contact: Mr. Werner de Schaetzen, Ph.D., P.Eng.
Project: 2021-033-DSE

Document History and Version Control

Revision No.	Date	Document Description	Revised By	Reviewed By
R0	May 11, 2021	Draft	Ben Loewen	Werner de Schaetzen
R1	May 25, 2021	Updated Draft	Ben Loewen	Werner de Schaetzen
R2	May 31, 2021	Final	Ben Loewen	Werner de Schaetzen

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Contents

1 Introduction

GeoAdvice Engineering Inc. ("GeoAdvice") was retained by David Schaeffer Engineering Ltd. ("DSEL") to size the proposed water main network for Phase 3 of the Mattamy Half Moon Bay West (HMBW) development ("Development") in the City of Ottawa, ON ("City").

Analysis for one (1) scenario of the Mattamy HMBW Phase 3 development was completed using boundary conditions provided by the City (Scenario 2 in **Appendix C**) and is discussed within this report. The analysis includes the demands for the following existing developments in addition to the proposed Mattamy HMBW Phase 3 demands:

- Mattamy HMBW Phases 1, 2, and 10, Flagstaff Phase 1 (Glenview Homes development)

The development will have two (2) connections to the City water distribution system along the realigned Greenbank Road:

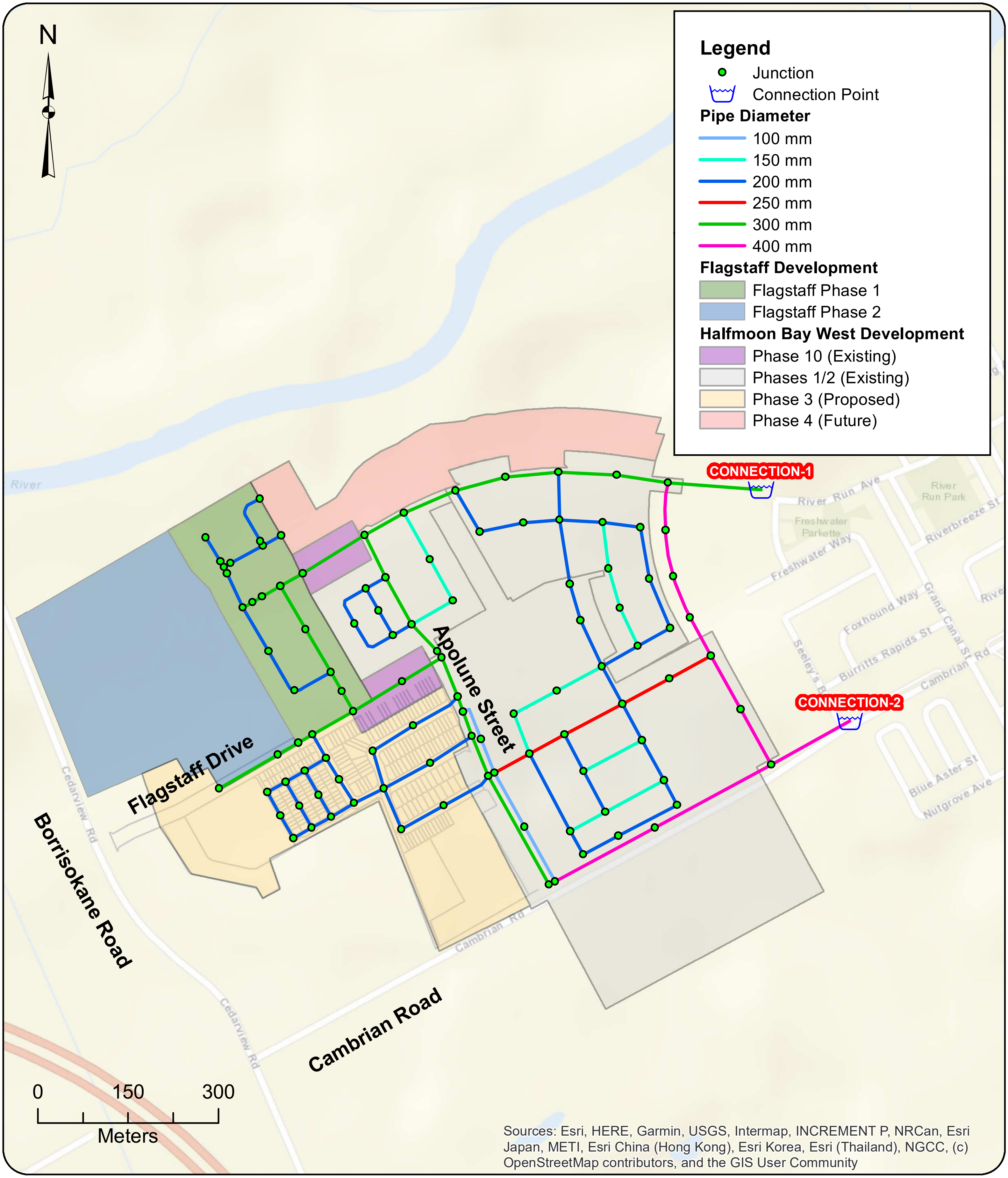
- Connection 1: Perseus Avenue
- Connection 2: Cambrian Road

HMBW Phase 3 will connect east to Apolune Street in Mattamy HMBW Phase 1 and north to Flagstaff Drive.

The development site is shown in **Figure 1.1** on the following page, with the final recommended pipe diameters.

This report describes the assumptions and results of the hydraulic modeling and capacity analysis using InfoWater (Innovyze), a GIS water distribution system modeling and management software application.

The results presented in this report are based on the analysis of steady state simulations. The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi at the hydrant. No extended period simulations were completed in this analysis to assess the water quality or to assess the hydraulic impact on storage and pumping.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Site Layout and Connection Points

Figure 1.1

2 Modeling Considerations

2.1 Water Main Configuration

The water main network was modeled based on drawings prepared by DSEL (16-10-100_M-Plan PH3 (April22-21).dwg) and provided to GeoAdvice on April 26th, 2021.

The 300 mm water main on Flagstaff Drive is expected to extend to Borrisokane Road as per the Barrhaven South Master Servicing Study. No analysis was conducted for the water main west of pipe P-102 shown in **Appendix D**.

2.2 Elevations

Elevations of the modeled junctions were assigned according to a preliminary site grading plan prepared by DSEL (2020-12-04_1140_grad_wcs.dwg) and provided to GeoAdvice on April 26th, 2021. The preliminary site grading plan provided was based on a different road alignment from that of the final road alignment of the development and as such, the allocation of the elevations was approximated using best judgement.

2.3 Consumer Demands

The existing residential demands (Mattamy HMBW Phases 1, 2, 10 and Flagstaff Phase 1) and the proposed residential demands for the Mattamy HMBW Phase 3 development were based on a demand rate of 280 L/cap/d as per City of Ottawa technical bulletin ISTB 2018-01. The park rate of 28,000 L/ha/d was assumed as per the City of Ottawa design guidelines and are consistent with similar previously completed developments within the City of Ottawa. Demand factors used for this analysis were taken according to the City of Ottawa 2010 Design Guidelines *Table 4.2 Consumption Rate for Subdivisions of 501 to 3,000 Persons*. Population densities were assigned according to *Table 4.1 Per Unit Populations* from the City of Ottawa Design Guidelines. A summary of these tables highlighting relevant data for this development is shown in **Table 2.1**.

Finally, the Mattamy HMBW Phase 3 water main network was also analyzed for an ultimate condition including the demands for the planned future Mattamy Phase 4 of the HMBW development and Flagstaff Phase 2 using boundary conditions provided by the City (Scenario 3 in **Appendix C**). The proposed water main network was confirmed to not require any changes in this ultimate condition.

Table 2.1: City of Ottawa Demand Factors

Demand Type	Amount	Units
Average Day Demand		
Residential	280	L/c/d
Park	28,000	L/ha/d
Maximum Daily Demand		
Residential	2.5 x avg. day	L/c/d
Park	1.5 x avg. day	L/ha/d
Peak Hour Demand		
Residential	2.2 x max. day	L/c/d
Park	1.8 x max. day	L/ha/d
Minimum Hour Demand		
Residential	0.5 x avg. day	L/c/d
Park	0.5 x avg. day	L/ha/d

Table 2.2 to **Table 2.3** summarize the water demand calculations for Mattamy HMBW Phase 3.

Table 2.2: Development Population and Demand Calculations – Mattamy HMBW Phase 3

Dwelling Type	Number of Units	Persons Per Unit*	Population	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Single Detached	23	3.4	87	0.28	0.70	1.55	0.14
Traditional Townhome	111	2.7	330	1.07	2.67	5.88	0.53
Back-to-Back Townhouse	94	2.7	280	0.91	2.27	4.99	0.45
Total	**228**		**697**	**2.26**	**5.65**	**12.42**	**1.13**

*City of Ottawa Design Guidelines.

Table 2.3: Non Residential Demand Calculations – Mattamy HMBW Phase 3

Land Use Type	Area (ha)	Average Day Demand (L/s)	Maximum Day Demand (L/s)	Peak Hour Demand (L/s)	Minimum Hour Demand (L/s)
Park	4.52	1.46	2.20	3.96	0.73

Demands were grouped into demand polygons then uniformly distributed to the model nodes located within each polygon. Detailed calculations of demands as well as the illustrated allocation areas are shown in **Appendix A**.

2.4 Fire Flow Demand

Fire flow calculations were completed in accordance with the Fire Underwriters Survey's (FUS) Water Supply for Public Fire Protection Guideline (1999) and City of Ottawa Technical Bulletin ISTB-2018-02. The required fire flow for single detached and traditional townhomes that meet Technical Bulletin ISTB-2018-02 requirements are to be capped at 10,000 L/min (167 L/s). For the townhouse units where the 10,000 L/min cap could not be applied, the FUS calculations yielded the following required fire flows:

- Block 40: 11,000 L/min (183 L/s)
- Block 33: 16,000 L/min (267 L/s)

The FUS calculations for the back-to-back townhouse blocks yielded the following required fire flows:

- 12-unit back-to-back townhouse: 14,000 L/min (233 L/s), accounts for one (1) firewall
- 10-unit back-to-back townhouse: 14,000 L/min (233 L/s), accounts for one (1) firewall
- 8-unit back-to-back townhouse: 16,000 L/min (267 L/s), no firewall accounted for

At this time, there is not enough information available to calculate the required fire flows of the park. As such, the following required fire flow was assumed, based on similar information from previously completed projects:

- Park: 167 L/s

Fire flow simulations were completed at each model node. The locations of nodes do not necessarily represent hydrant locations.

Detailed FUS fire flow calculations as well as the illustrated spatial allocation of the required fire flows are shown in **Appendix B**.

2.5 Boundary Conditions

The boundary conditions were provided by the City of Ottawa in the form of Hydraulic Grade Line (HGL) at the following locations:

- Connection 1: Perseus Avenue
- Connection 2: Cambrian Road

The above connection points are illustrated in **Figure 1.1**.

Boundary conditions were provided for Peak Hour (PHD), Maximum Day plus Fire (MDD+FF) and Minimum Hour (high pressure check, MHD) demand conditions.

Under existing conditions, the Mattamy HMBW development will be serviced by the Barrhaven pressure zone (zone BARR); however, in the future, it will be serviced by the South Urban Community (SUC) pressure zone. The future pressure realignment for the SUC pressure zone includes the previous 3C pressure zone, portions of the current adjacent pressure zones, and the portion of the BARR pressure zone where the Mattamy HMBW development is located. The future SUC pressure zone is expected to be serviced by additional pumps and storage tanks.

Boundary conditions were provided under the existing and future pressure zone configurations. As the timeline for the pressure zone realignment is unconfirmed at this time, a hybrid approach was used to ensure that the most conservative option was selected for each of the PHD, MDD+FF and MHD scenarios.

The results presented in this report are based on this hybrid approach, which uses the most conservative HGLs for the PHD, MDD+FF and MHD scenarios from both of the existing and future boundary conditions as outlined below:

- The HGLs provided by the City for the PHD and MHD scenarios under the existing condition are more conservative than those of the SUC Zone reconfiguration condition.
- The HGLs provided by the City for the MDD+FF scenarios are more conservative under the SUC Zone reconfiguration condition than those of the existing condition.

The City boundary conditions were provided to GeoAdvice on April 9, 2021 and can be found in **Appendix C**.

The demands from the Flagstaff Phase 1 and the Mattamy Half Moon Bay West Phases 1, 2, 3 and 10 were included in the boundary condition request as they are located downstream from the connection points used in the boundary conditions.

Table 2.4 summarizes the City of Ottawa boundary conditions used (Scenario 2) to size the water network.

Table 2.4: Boundary Conditions

Condition	Connection 1 HGL (m)	Connection 2 HGL (m)
Min Hour (max. pressure)	158.3*	158.3*
Peak Hour (min. pressure)	136.4*	136.4*
Max Day + Fire Flow (167 L/s)	140.5**	140.7**
Max Day + Fire Flow (183 L/s)	137.9**	138.3**
Max Day + Fire Flow (233 L/s)	137.0**	137.4**
Max Day + Fire Flow (267 L/s)	134.0**	134.5**

*Based on the existing boundary conditions provided by the City of Ottawa.

** Based on the SUC Zone reconfiguration boundary conditions provided by the City of Ottawa.

3 Hydraulic Capacity Design Criteria

3.1 Pipe Characteristics

Pipe characteristics of internal diameter (ID) and Hazen-Williams C factors were assigned in the model according to the City of Ottawa Design Guidelines for PVC water main material. Pipe characteristics used for the development are outlined in **Table 3.1** below.

Table 3.1: Model Pipe Characteristics

Nominal Diameter (mm)	ID PVC (mm)	Hazen Williams C-Factor (/)
150	155	100
200	204	110
250	250	110
300	297	120
400	400	120

3.2 Pressure Requirements

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). Pressure requirements are outlined in **Table 3.2.**

Table 3.2: Pressure Requirements

Demand Condition	Minimum Pressure		Maximum Pressure	
	(kPa)	(psi)	(kPa)	(psi)
Normal Operating Pressure (maximum daily flow)	350	50	480	70
Peak Hour Demand (minimum allowable pressure)	276	40	-	-
Maximum Fixture Pressure (Ontario Building Code)	-	-	552	80
Maximum Distribution Pressure (minimum hour check)	-	-	552	80
Maximum Day Plus Fire	140	20	-	-

4 Hydraulic Capacity Analysis

The proposed water mains within the development were sized to the minimum diameter which would satisfy the greater of maximum day plus fire and peak hour demand. Modeling was carried out for minimum hour, peak hour and maximum day plus fire flow using InfoWater.

Detailed pipe and junction model input data can be found in **Appendix D**.

4.1 Development Pressure Analysis

The modeling results indicate that the Mattamy HMBW Phase 3 development can be adequately serviced by the proposed water main layout shown in **Figure 1.1**. Modeled service pressures for the Mattamy HMBW Phase 3 development are summarized in **Table 4.1** below.

Table 4.1: Summary of Mattamy HMBW Phase 3 Available Service Pressures

Minimum Hour Demand Maximum Pressure	Peak Hour Demand Minimum Pressure
93 psi (640 kPa)	61 psi (418 kPa)

As outlined in the City of Ottawa Design Guidelines, the generally accepted best practice is to design new water distribution systems to operate between 350 kPa (50 psi) and 480 kPa (70 psi). The maximum pressure at any point in the distribution system in occupied areas outside of the public right-of-way shall not exceed 552 kPa (80 psi). As such, based on the City boundary conditions for the minimum hour demand, pressure reducing valves may be required throughout Mattamy HMBW Phase 3. In summary:

- Under the existing pressure zone conditions, any location with elevation lower than 102 m may experience high pressures (≥ 80 psi).
- Under the future pressure zone conditions, any location with the elevation lower than 91.5 m may experience high pressures (≥ 80 psi).

Detailed pipe and junction result tables and maps can be found in **Appendix E**.

4.2 Development Fire Flow Analysis

Summaries of the minimum available fire flows in Mattamy HMBW Phase 3 is shown in **Table 4.2**.

Table 4.2: Summary of the Mattamy HMBW Phase 3 Minimum Available Fire Flows

Required Fire Flow	Minimum Available Flow*	Junction ID
167 L/s	372 L/s	J-82
183 L/s	510 L/s	J-89
233 L/s	277 L/s	J-99
267 L/s	353 L/s	J-91

*The predicted available fire flows, as calculated by the hydraulic model, represent the flow available in the water main while maintaining a residual pressure of 20 psi at the hydrant. High available fire flows (>500 L/s) are theoretical values. Actual available fire flow is limited by the hydraulic losses through the hydrant lateral and hydrant port sizes.

As shown in **Table 4.2**, the fire flow requirements can be met at all junctions within the development.

Summaries of the residual pressures in Mattamy HMBW Phase 3 is shown below in **Table 4.3**. The minimum allowable pressure under fire flow conditions is 140 kPa (20 psi) at the location of the fire.

Table 4.3: Summary of the Mattamy HMBW Phase 3 Residual Pressures (MDD + FF)

Maximum Residual Pressure	Average Residual Pressure	Minimum Residual Pressure
59 psi (405 kPa)	45 psi (312 kPa)	32 psi (217 kPa)

As shown in **Table 4.3**, there is sufficient residual pressure at all the junctions within the development.

Detailed fire flow results and figures illustrating the fire flow results can be found in **Appendix F**.

5 Other Servicing Considerations

5.1 Water Supply Security

The City of Ottawa Design Guidelines allow single feed systems for developments up to a total average day demand of 50 m^3/day and require two (2) feeds if the development exceeds 50 m^3/day for supply security, according to Technical Bulletin ISDTB-2018-02.

The HMBW Phase 3 development services a total average day demand of 322 m^3/day; as such, two (2) feeds are required. Four (4) feeds to the Mattamy HMBW Phase 3 development from Apolune Street and Flagstaff Drive were modeled as part of the analysis.

5.2 Valves

No comment has been made in this report with respect to exact placement of isolation valves within the distribution network for the development other than to summarize the City of Ottawa Design Guidelines for number, location, and spacing of isolation valves:

- Tee intersection – two (2) valves
- Cross intersection – three (3) valves
- Valves shall be located 2 m away from the intersection
- 300 m spacing for 150 mm to 400 mm diameter valves
- Gate valves for 100 mm to 300 mm diameter mains
- Butterfly valves for 400 mm and larger diameter mains

Drain valves are not strictly required under the City of Ottawa Design Guidelines for water mains under 600 mm in diameter. The Guidelines indicate that “small diameter water mains shall be drained through hydrant via pumping if needed.”

Air valves are not strictly required under the City of Ottawa Design Guidelines for water mains up to and including 400 mm in diameter. The Guidelines indicate that air removal “can be accomplished by the strategic positioning of hydrant at the high points to remove the air or by installing or utilizing available 50 mm chlorination nozzles in 300 mm and 400 mm chambers.”

The detailed engineering drawings for the Mattamy HMBW Phase 3 development are expected to identify valves in accordance with the requirements noted above.

5.3 Hydrants

No additional comment has been made in this report with respect to exact placement of hydrants within the distribution network for the development other than to summarize the City of Ottawa Design Guidelines for maximum hydrant spacing:

- 125 m for single family unit residential areas on lots where frontage at the street line is 15 m or longer
- 110 m for single family unit residential areas on lots where frontage at the street line is less than 15 m and for residential areas zoned for row housing, doubles or duplexes
- 90 m for institutional, commercial, industrial, apartments and high-density areas

Additionally, based on the FUS document *Water Supply for Public Fire Protection (1999)*, the hydrant coverage areas for the following fire flows are:

- 167 L/s: 12,000 m^2 (radial coverage of 62 m)
- 183 L/s: 11,500 m^2 (radial coverage of 61 m)
- 233 L/s: 10,000 m^2 (radial coverage of 56 m)
- 267 L/s: 9,500 m^2 (radial coverage of 55 m)

The detailed engineering drawings for the Mattamy HMBW Phase 3 development are expected to identify hydrant locations in accordance with the requirements noted above.

5.4 Water Quality

The turnover rate of the water within the Mattamy HMBW Phase 3 development network, calculated from the connections to the development is about 5 hours (ADD is 322 m^3/day).

The above rate is based on the volume of the development network and the development average day demand.

6 Conclusions

The hydraulic capacity and modeling analysis of the Mattamy HMBW Phase 3 development yielded the following conclusions:

- The proposed water main network can deliver all domestic flows, with service pressures expected to range between 61 psi (418 kPa) and 93 psi (640 kPa).
- The proposed water main network is able to deliver fire flows at all junctions.
- Pressure reducing valves may be required, since maximum pressures are predicted to exceed the City of Ottawa Design Guidelines (> 80 psi).
    - Under the existing pressure zone conditions, any location with elevation lower than 102 m may experience high pressures (≥ 80 psi).
    - Under the future pressure zone conditions, any location with the elevation lower than 91.5 m may experience high pressures (≥ 80 psi).
- Hydraulic modeling was completed using a hybrid format of the boundary conditions provided, using the most conservative HGLs from the existing and SUC Zone reconfiguration conditions for the PHD, MDD+FF and MHD scenarios.
    - The HGLs for the PHD and MHD scenarios under the existing condition are more conservative than those of the SUC Zone reconfiguration condition.
    - The HGLs for the MDD+FF scenarios are more conservative under the SUC Zone reconfiguration condition than those of the existing condition.

Submission

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Approved by:

LICENSED PROFESSIONAL ENGINEER
May 31, 2021
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Appendix A Domestic Water Demand Calculations and Allocation

Consumer Water Demands

HMBW Phase 3 Residential Demands

Dwelling Type	Number of Units	Population*		Average Day Demand			Max Day	Fire Flow	Peak Hour	Min Hour
		Persons per Unit	Population Per Dwelling Type	(L/c/d)	(L/d)	(L/s)	2.5 x Avg. Day (L/s)	(L/s)	2.2 x Max Day (L/s)	0.5 x Avg. Day (L/s)
Single Detached	23	3.4	87	280	24,360	0.28	0.70		1.55	0.14
Traditional Townhome	111	2.7	330		92,400	1.07	2.67		5.88	0.53
Back-to-Back Townhome	94	2.7	280		78,400	0.91	2.27		4.99	0.45
Subtotal	**228**		**697**		**195,160**	**2.26**	**5.65**		**12.42**	**1.13**

HMBW Phase 3 Non Residential Demands

Property Type	Area (ha)		Average Day Demand			Max Day	Fire Flow	Peak Hour	Min Hour
			(L/ha/d)	(L/d)	(L/s)	1.5 x Avg. Day (L/s)	(L/s)	1.8 x Max Day (L/s)	0.5 x Avg. Day (L/s)
Park	4.52		28,000	126,560	1.46	2.20		3.96	0.73
Subtotal	**4.52**			**126,560**	**1.46**	**2.20**		**3.96**	**0.73**

Flagstaff	Number of Units	Population	Non Residential Area (ha)		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:	155	485			1.57	3.93	8.64	0.79

Half Moon Bay West	Number of Units	Population	Non Residential Area (ha)		**ADD**	**MDD**	**PHD**	**MHD**
Phase 1 Total Demand:	353	1,049	9.18		6.37	12.96	26.73	3.19
Phase 2A Total Demand:	156	502	1.00		1.95	4.55	9.82	0.98
Phase 2B Total Demand:	127	377			1.22	3.05	6.72	0.61
Phase 10 Total Demand:	60	171			0.55	1.39	3.05	0.28
Phase 3 Total Demand*:	228	697	4.52		3.72	7.84	16.38	1.86

Scenario Totals		**ADD**	**MDD**	**PHD**	**MHD**
Scenario 2	Flagstaff Phase 1, HMBW Phases 1, 2A, 2B, 3, 10	**15.40**	**33.73**	**71.34**	**7.70**

*10% increase applied to account for possible future refinements in concept plan, as per DSEL

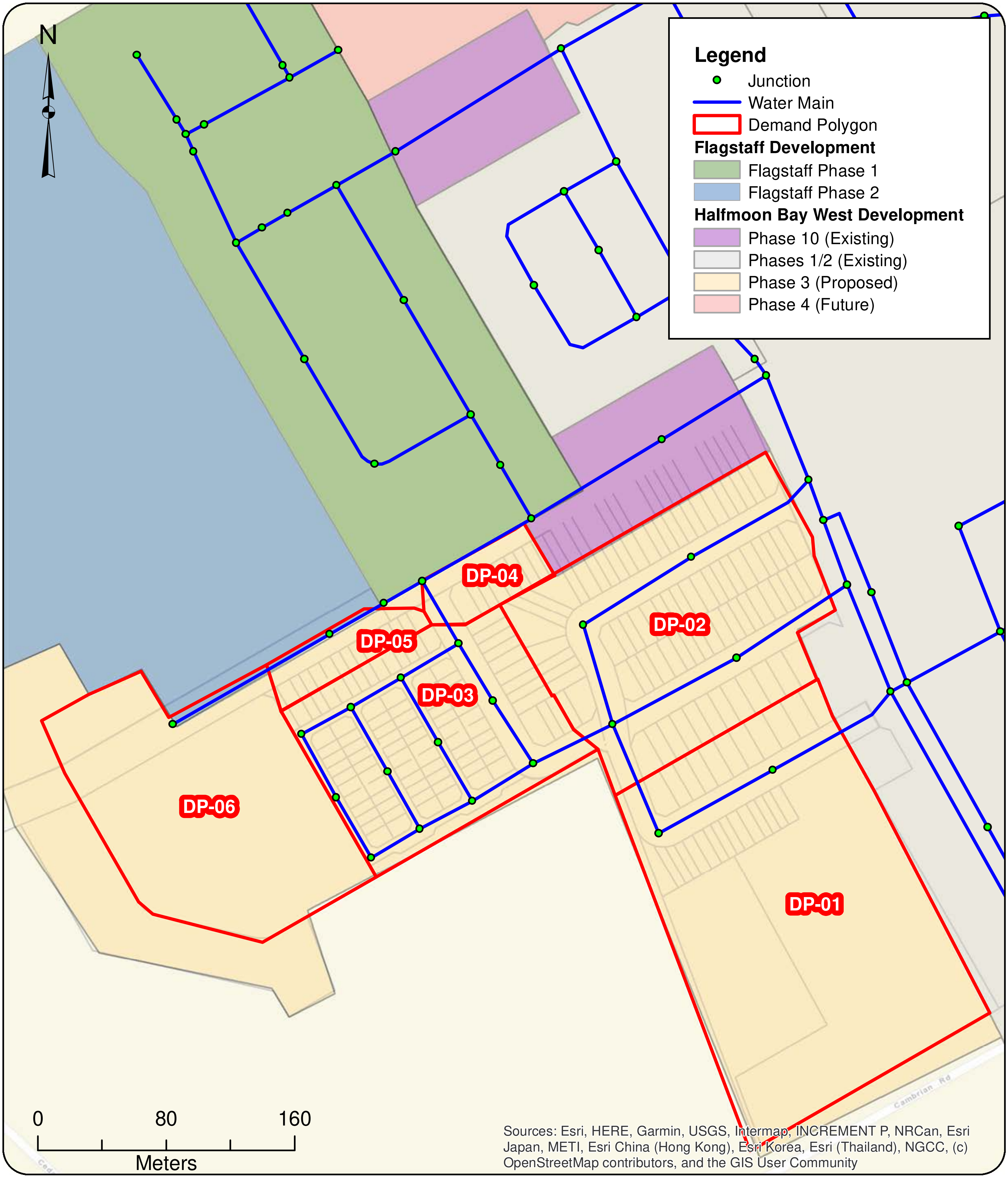
Domestic Demand Calculations and Allocation

HMBW Phase 3 Domestic Demands

Demand Polygon	Junction ID	Dwelling Type	Number of Units	Population	Average Day Demand			Max Day 2.5 x Avg. Day (L/s)	Peak Hour 2.2 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
					L/c/d	L/d	L/s			
1	J-87	Single Detached	11	42	280	12,068	0.14	0.35	0.77	0.07
	J-88	Traditional Townhouse	15	45	280	12,068	0.14	0.35	0.77	0.07
2	J-89	Single Detached	12	45	280	17,121	0.20	0.50	1.09	0.10
	J-90					17,121	0.20	0.50	1.09	0.10
	J-91	Traditional Townhouse	67	199	280	17,121	0.20	0.50	1.09	0.10
	J-92					17,121	0.20	0.50	1.09	0.10
3	J-93	Traditional Townhouse	12	36	280	6,393	0.07	0.18	0.41	0.04
	J-94					6,393	0.07	0.18	0.41	0.04
	J-95					6,393	0.07	0.18	0.41	0.04
	J-96					6,393	0.07	0.18	0.41	0.04
	J-97					6,393	0.07	0.18	0.41	0.04
	J-98					6,393	0.07	0.18	0.41	0.04
	J-99	Back-to-Back Townhouse	80	238	280	6,393	0.07	0.18	0.41	0.04
	J-100					6,393	0.07	0.18	0.41	0.04
	J-101					6,393	0.07	0.18	0.41	0.04
	J-102					6,393	0.07	0.18	0.41	0.04
	J-103					6,393	0.07	0.18	0.41	0.04
	J-104					6,393	0.07	0.18	0.41	0.04
4	J-105	Traditional Townhouse	9	27	280	7,492	0.09	0.22	0.48	0.04
5	J-107	Back-to-Back Townhouse	14	42	280	11,677	0.14	0.34	0.74	0.07
7	J-82	Traditional Townhouse	8	24	280	6,659	0.08	0.19	0.42	0.04
Total:			**228**	**697**		**195,160**	**2.26**	**5.65**	**12.42**	**1.13**

HMBW Phase 3 Non-Domestic Demands

Property Type	Junction ID	Phase	Area (ha)	Average Day Demand			Max Day 1.5 x Avg. Day (L/s)	Peak Hour 1.8 x Max Day (L/s)	Min Hour 0.5 x Avg. Day (L/s)
				(L/ha/d)	(L/d)	(L/s)			
Park	J-87	Phase 3	2.85	28,000	79,800	0.92	1.39	2.49	0.46
Park	J-82	Phase 3	1.67	28,000	46,760	0.54	0.27	0.49	0.09
Total:			**4.52**		**126,560**	**1.46**	**1.66**	**2.98**	**0.55**



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

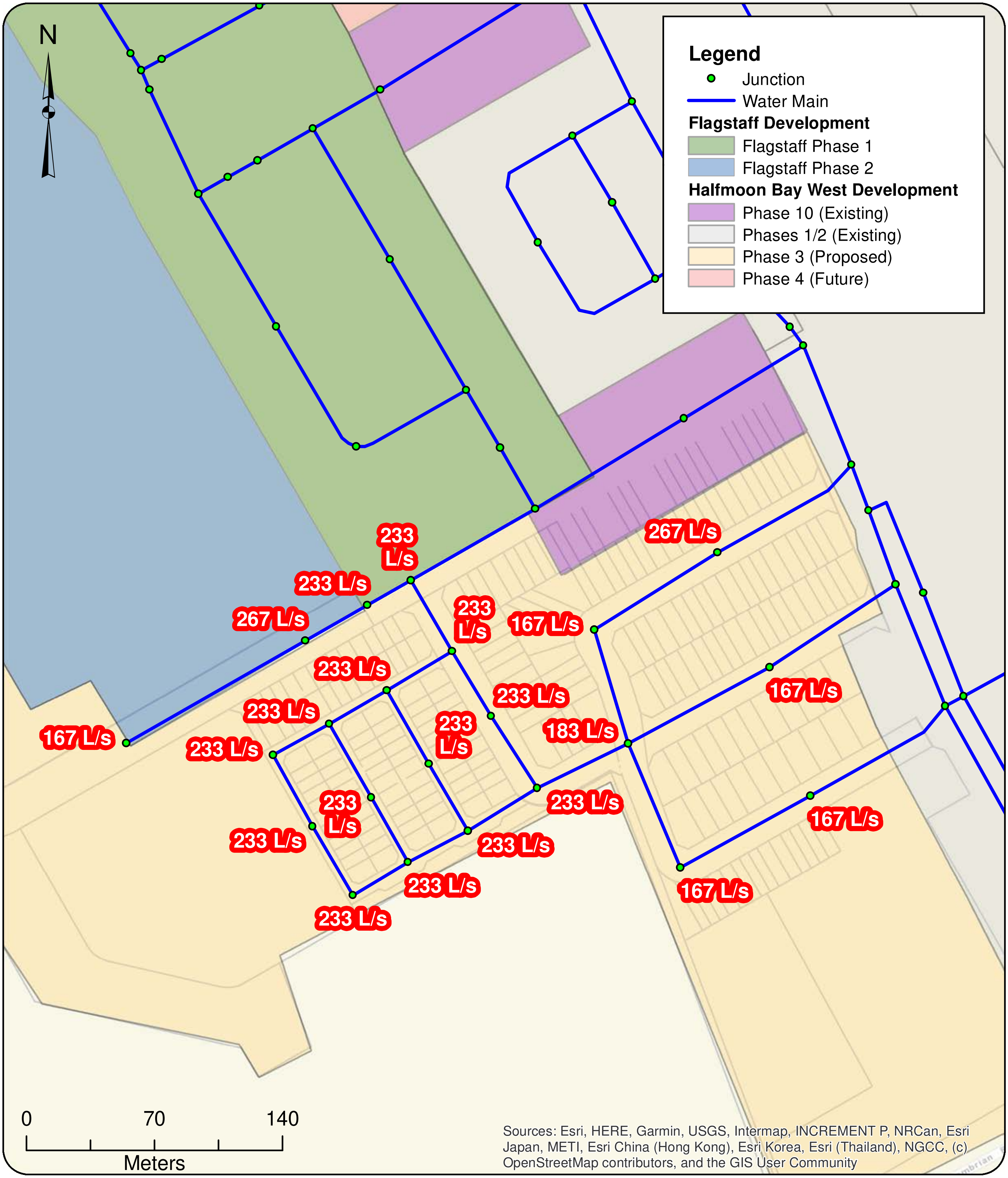
GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Demand Allocation

Figure A.1

Appendix B FUS Fire Flow Calculations and Allocation



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Required Fire Flow Flagstaff Phase 2

Figure B.1

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3
Zoning: Multi Family Residential
Date: May 10, 2021

Townhouse Block 40

Note: For other townhouse blocks that do not comply with the City of Ottawa Technical Bulletin ISDTB-2018-02 4.2, a similar fire flow as calculated below will be used (Block 37).

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 358 **m²**

C. Number of Storeys: 2

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction **C =** 1.5

A: Effective area **A =** 715 **m²**

The total floor area in m^2 in the building being considered

F = 8,826 L/min **D = 9,000 L/min***

E. Occupancy

Occupancy content hazard Limited Combustible -15 % of **D** **-1,350 L/min** **E = 7,650 L/min**

F. Sprinkler Protection

Automatic sprinkler protection None 0 % of **E** **0 L/min** **F = 7,650 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	30.1 to 45 m	31-60 m-storeys	Wood Frame or Non-Combustible	5%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
West	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
			Total	**47%**

% of **E** **+ 3,596 L/min** **G = 11,246 L/min**

H. Wood Shake Charge No **0 L/min** **H = 11,246 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**11,000**	**L/min****
	183	**L/s**
Required Duration of Fire Flow	**2.25**	**Hrs**
Required Volume of Fire Flow	**1,485**	**m³**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 Townhouse Block 33
Zoning: Multi Family Residential
Date: May 10, 2021

Note: For other townhouse blocks that do not comply with the City of Ottawa Technical Bulletin ISDTB-2018-02 4.2, a similar fire flow as calculated below will be used.

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 609 **m²**   Note: Block 33 has 7 units

C. Number of Storeys: 2

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction   **C =** 1.5

A: Effective area   **A =** 1218 **m²**

The total floor area in m^2 in the building being considered

F = 11,517 L/min   **D = 12,000 L/min***

E. Occupancy

Occupancy content hazard   Limited Combustible   -15 % of **D**   **-1,800 L/min**   **E = 10,200 L/min**

F. Sprinkler Protection

Automatic sprinkler protection   None   0 % of **E**   **0 L/min**   **F = 10,200 L/min**

G. Exposures

Side	**Separation Distance**	**Length-Height Factor - Adjacent Structure**	**Construction Type - Adjacent Structure**	**Exposure**
North	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
East	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
South	20.1 to 30 m	61-90 m-storeys	Wood Frame or Non-Combustible	9%
West	3.1 to 10 m	0-30 m-storeys	Wood Frame or Non-Combustible	17%
			Total	**57%**

% of E   **+ 5,814 L/min**   **G = 16,014 L/min**

H. Wood Shake Charge   No   **0 L/min**   **H = 16,014 L/min**

For wood shingle or shake roofs

Total Fire Flow Required   16,000   L/min**
267   L/s
Required Duration of Fire Flow   3.5   Hrs
Required Volume of Fire Flow   3,360   m³

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

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* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 — 12-unit Back-to-Back Townhouse
Zoning: Multi Family Residential — Firewall located in the middle of the block.
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 353 **m^2**

C. Number of Storeys: 3

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 1059 **m^2**

The total floor area in m^2 in the building being considered

F = 10,738 L/min — **D = 11,000 L/min***

E. Occupancy

Occupancy content hazard	Limited Combustible	-15	% of **D**	**-1,650**	**L/min**	**E = 9,350 L/min**

F. Sprinkler Protection

Automatic sprinkler protection	None	0	% of **E**	**0**	**L/min**	**F = 9,350 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	Firewall	61-90 m-storeys	Wood Frame or Non-Combustible	10%
East	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
South	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
West	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
			Total	**55%**

% of **E** **+ 5,143 L/min** — **G = 14,493 L/min**

H. Wood Shake Charge No — **0 L/min** — **H = 14,493 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**14,000**	**L/min****
	233	**L/s**
Required Duration of Fire Flow	**3**	**Hrs**
Required Volume of Fire Flow	**2,520**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

---

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

12-unit Back-to-Back Townhouse

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 10-unit Back-to-Back Townhouse
Zoning: Multi Family Residential Firewall located with 6 units on one side and 4 units on the other.
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 357 **m^2**

C. Number of Storeys: 3

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction **C =** 1.5
A: Effective area **A =** 1071 **m^2**
The total floor area in m^2 in the building being considered

F = 10,798 L/min **D = 11,000 L/min***

E. Occupancy
Occupancy content hazard Limited Combustible -15 % of **D** **-1,650 L/min** **E = 9,350 L/min**

F. Sprinkler Protection
Automatic sprinkler protection None 0 % of **E** **0 L/min** **F = 9,350 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
East	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
South	Firewall	61-90 m-storeys	Wood Frame or Non-Combustible	10%
West	10.1 to 20 m	31-60 m-storeys	Wood Frame or Non-Combustible	13%
			Total	**55%**

% of **E** **+ 5,143 L/min** **G = 14,493 L/min**

H. Wood Shake Charge No **0 L/min** **H = 14,493 L/min**
For wood shingle or shake roofs

Total Fire Flow Required	**14,000**	**L/min****
	233	**L/s**
Required Duration of Fire Flow	**3**	**Hrs**
Required Volume of Fire Flow	**2,520**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

---

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

10-unit Back-to-Back Townhouse

FUS Required Fire Flow Calculation

Calculations Based on "Water Supply for Public Fire Protection", Fire Underwriters Survey, 1999.

Client: David Schaeffer Engineering Ltd.
Project: 2021-033-DSE
Development: Half Moon Bay West Phase 3 — 8-unit Back-to-Back Townhouse
Zoning: Multi Family Residential — No Firewall
Date: May 10, 2021

A. Type of Construction: Wood Frame Construction

B. Ground Floor Area: 481 m^2

C. Number of Storeys: 3

Note: The exposure to the School block located to the North was taken at the property line to be conservative.

D. Required Fire Flow*: $F = 220C\sqrt{A}$

C: Coefficient related to the type of construction — **C =** 1.5

A: Effective area — **A =** 1444 m^2

The total floor area in m^2 in the building being considered

F = 12,538 L/min — **D = 13,000 L/min***

E. Occupancy

Occupancy content hazard — Limited Combustible — -15 % of **D** — **-1,950 L/min** — **E = 11,050 L/min**

F. Sprinkler Protection

Automatic sprinkler protection — None — 0 % of **E** — **0 L/min** — **F = 11,050 L/min**

G. Exposures

Side	Separation Distance	Length-Height Factor - Adjacent Structure	Construction Type - Adjacent Structure	Exposure
North	20.1 to 30 m	31-60 m-storeys	Wood Frame or Non-Combustible	8%
East	3.1 to 10 m	61-90 m-storeys	Wood Frame or Non-Combustible	19%
South	10.1 to 20 m	61-90 m-storeys	Wood Frame or Non-Combustible	14%
West	Beyond 45 m	0-30 m-storeys	Wood Frame or Non-Combustible	0%
			Total	**41%**

% of **E** — **+ 4,531 L/min** — **G = 15,581 L/min**

H. Wood Shake Charge — No — **0 L/min** — **H = 15,581 L/min**

For wood shingle or shake roofs

Total Fire Flow Required	**16,000**	**L/min****
	267	**L/s**
Required Duration of Fire Flow	**3.5**	**Hrs**
Required Volume of Fire Flow	**3,360**	**m^3**

*Rounded to the nearest 1,000 L/min

The Total Required Fire Flow for the Half Moon Bay West Phase 3 development should be reviewed when drawings and site plans have been finalized. The Total Required Fire Flow may be reduced or increased depending on area, construction, occupancy, exposures, and level of sprinkler protection. If any of these items change, the Total Required Fire Flow should be reviewed to determine the impact.

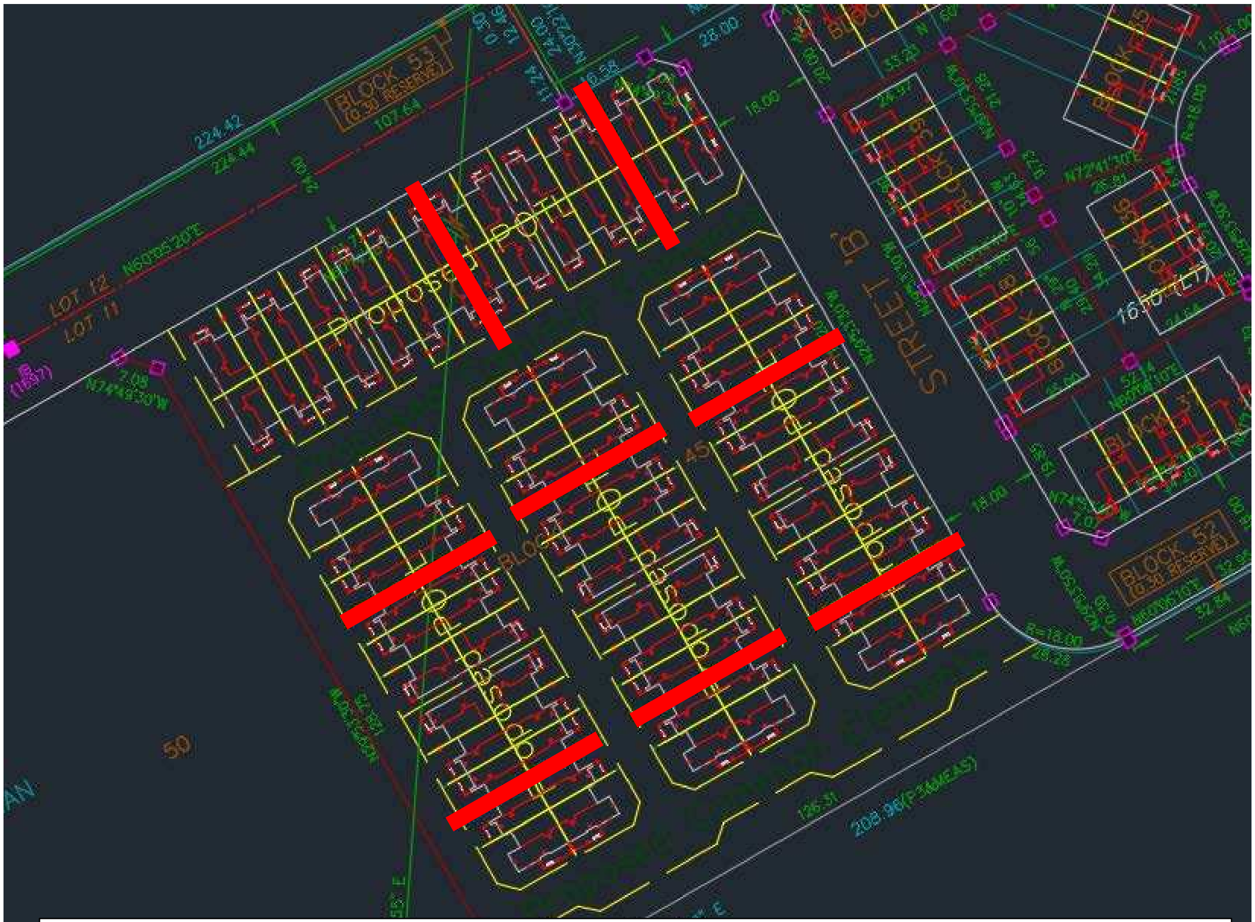
Consideration should be given for fire prevention during construction phases as the required fire flows during construction of buildings is substantially higher than after the buildings are occupied. This is due to exposed framing and inactive sprinkler systems. Fires starting in unprotected portion of buildings quickly become too strong for sprinkler systems in protected portion of buildings. As such, special precautions should be taken any time construction is occurring.

---

* The amount and rate of water application required in firefighting to confine and control the fires possible in a building or group of buildings which comprise essentially the same fire area by virtue of immediate exposure.

** Rounded to the nearest 1,000 L/min

Back-to-Back Townhouse Proposed Fire Wall Locations



Fire wall locations are based off the FUS calculations completed, which were the worst-case scenarios for each townhouse block type (8-unit, 10-unit, 12-unit). It is possible that by completing additional FUS calculations, the fire wall recommendations may not be the same for the other back-to-back townhouse blocks.

Appendix C Boundary Conditions

Boundary Conditions

Flagstaff and Mattamy’s Half Moon Bay West

Location

Scenario 1

Provided Information

Scenario 1	Demand	
	L/min	L/s
Average Daily Demand	403	6.71
Maximum Daily Demand	1,756	29.26
Peak Hour	3,708	61.80
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.0	89.6
Peak Hour	136.9	61.0
Max Day plus Fire 1	144.6	72.0
Max Day plus Fire 2	141.0	66.9
Max Day plus Fire 3	139.7	65.0
Max Day plus Fire 4	135.2	58.6

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	157.0	90.3
Peak Hour	136.9	61.8
Max Day plus Fire 1	144.9	73.1
Max Day plus Fire 2	141.4	68.2
Max Day plus Fire 3	140.1	66.3
Max Day plus Fire 4	135.7	60.1

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.3
Peak Hour	140.9	66.7
Max Day plus Fire 1	140.7	66.5
Max Day plus Fire 2	138.2	62.9
Max Day plus Fire 3	137.3	61.6
Max Day plus Fire 4	134.3	57.3

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.1
Peak Hour	140.9	67.5
Max Day plus Fire 1	140.9	67.6
Max Day plus Fire 2	138.6	64.2
Max Day plus Fire 3	137.7	62.9
Max Day plus Fire 4	134.8	58.9

Ground Elevation = 93.5 m

Scenario 2

Provided Information

Scenario 2	Demand	
	L/min	L/s
Average Daily Demand	491	8.19
Maximum Daily Demand	2,117	35.29
Peak Hour	4,456	74.26
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	158.3	91.4
Peak Hour	136.4	60.4
Max Day plus Fire 1	144.2	71.5
Max Day plus Fire 2	140.6	66.2
Max Day plus Fire 3	139.2	64.3
Max Day plus Fire 4	134.6	57.8

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	158.3	92.2
Peak Hour	136.4	61.1
Max Day plus Fire 1	144.5	72.6
Max Day plus Fire 2	140.9	67.5
Max Day plus Fire 3	139.6	65.6
Max Day plus Fire 4	135.2	59.4

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.3
Peak Hour	140.2	65.8
Max Day plus Fire 1	140.5	66.2
Max Day plus Fire 2	137.9	62.5
Max Day plus Fire 3	137.0	61.2
Max Day plus Fire 4	134.0	56.9

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	140.2	66.5
Max Day plus Fire 1	140.7	67.3
Max Day plus Fire 2	138.3	63.8
Max Day plus Fire 3	137.4	62.5
Max Day plus Fire 4	134.5	58.5

Ground Elevation = 93.5 m

Scenario 3

Provided Information

Scenario 3	Demand	
	L/min	L/s
Average Daily Demand	579	9.65
Maximum Daily Demand	2,499	41.65
Peak Hour	5,259	87.65
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	92.7
Peak Hour	135.1	58.4
Max Day plus Fire 1	143.8	70.9
Max Day plus Fire 2	140.1	65.6
Max Day plus Fire 3	138.7	63.6
Max Day plus Fire 4	134.1	57.1

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	93.4
Peak Hour	135.1	59.2
Max Day plus Fire 1	144.1	72.0
Max Day plus Fire 2	140.5	66.9
Max Day plus Fire 3	139.1	65.0
Max Day plus Fire 4	134.7	58.7

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.2
Peak Hour	139.5	64.7
Max Day plus Fire 1	140.3	65.8
Max Day plus Fire 2	137.7	62.2
Max Day plus Fire 3	136.7	60.8
Max Day plus Fire 4	133.6	56.4

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	139.5	65.5
Max Day plus Fire 1	140.5	66.9
Max Day plus Fire 2	138.0	63.4
Max Day plus Fire 3	137.1	62.2
Max Day plus Fire 4	134.2	58.0

Ground Elevation = 93.5 m

Scenario 4

Provided Information

Scenario 4	Demand	
	L/min	L/s
Average Daily Demand	613	10.21
Maximum Daily Demand	2,643	44.05
Peak Hour	5,563	92.72
Fire Flow Demand #1	10,000	166.67
Fire Flow Demand #2	13,000	216.67
Fire Flow Demand #3	14,000	233.33
Fire Flow Demand #4	17,000	283.33

Results – Existing Conditions

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	92.6
Peak Hour	134.5	57.7
Max Day plus Fire 1	143.7	70.7
Max Day plus Fire 2	139.9	65.4
Max Day plus Fire 3	138.5	63.4
Max Day plus Fire 4	133.9	56.8

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	159.1	93.4
Peak Hour	134.5	58.4
Max Day plus Fire 1	143.9	71.8
Max Day plus Fire 2	140.3	66.6
Max Day plus Fire 3	138.9	64.7
Max Day plus Fire 4	134.5	58.4

Ground Elevation = 93.5 m

Results – SUC Zone Reconfiguration

Connection 1 – Greenbank Road / Cambrian Road

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	76.2
Peak Hour	139.2	64.3
Max Day plus Fire 1	140.2	65.7
Max Day plus Fire 2	137.6	62.0
Max Day plus Fire 3	136.6	60.7
Max Day plus Fire 4	133.5	56.3

Ground Elevation = 94.0 m

Connection 2 – Greenbank Road / Perseus Avenue

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	147.6	77.0
Peak Hour	139.2	65.1
Max Day plus Fire 1	140.4	66.8
Max Day plus Fire 2	137.9	63.3
Max Day plus Fire 3	137.0	62.0
Max Day plus Fire 4	134.1	57.9

Ground Elevation = 93.5 m

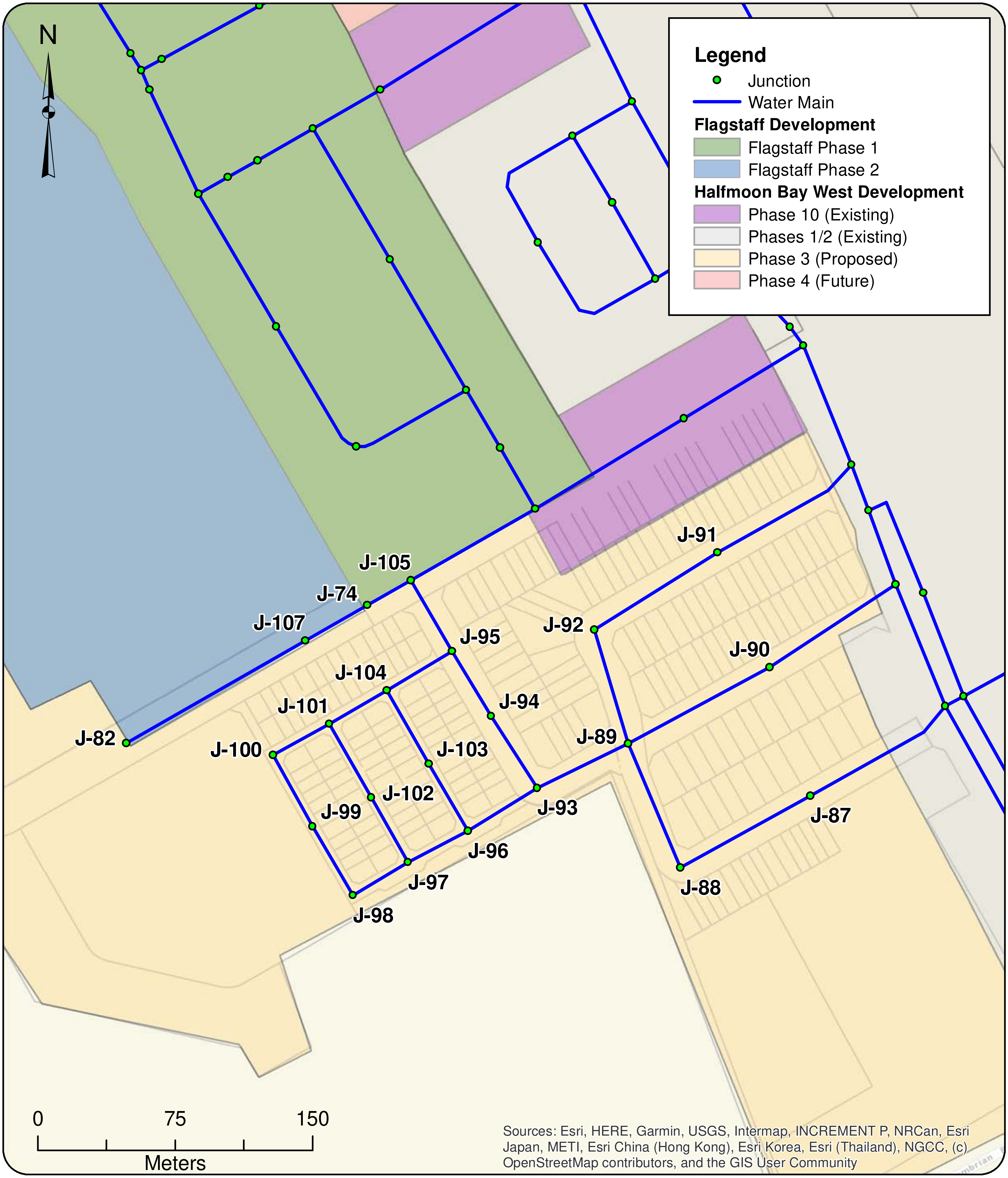
Notes

1. As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:
    a. If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
    b. Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

Disclaimer

The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Appendix D Pipe and Junction Model Inputs



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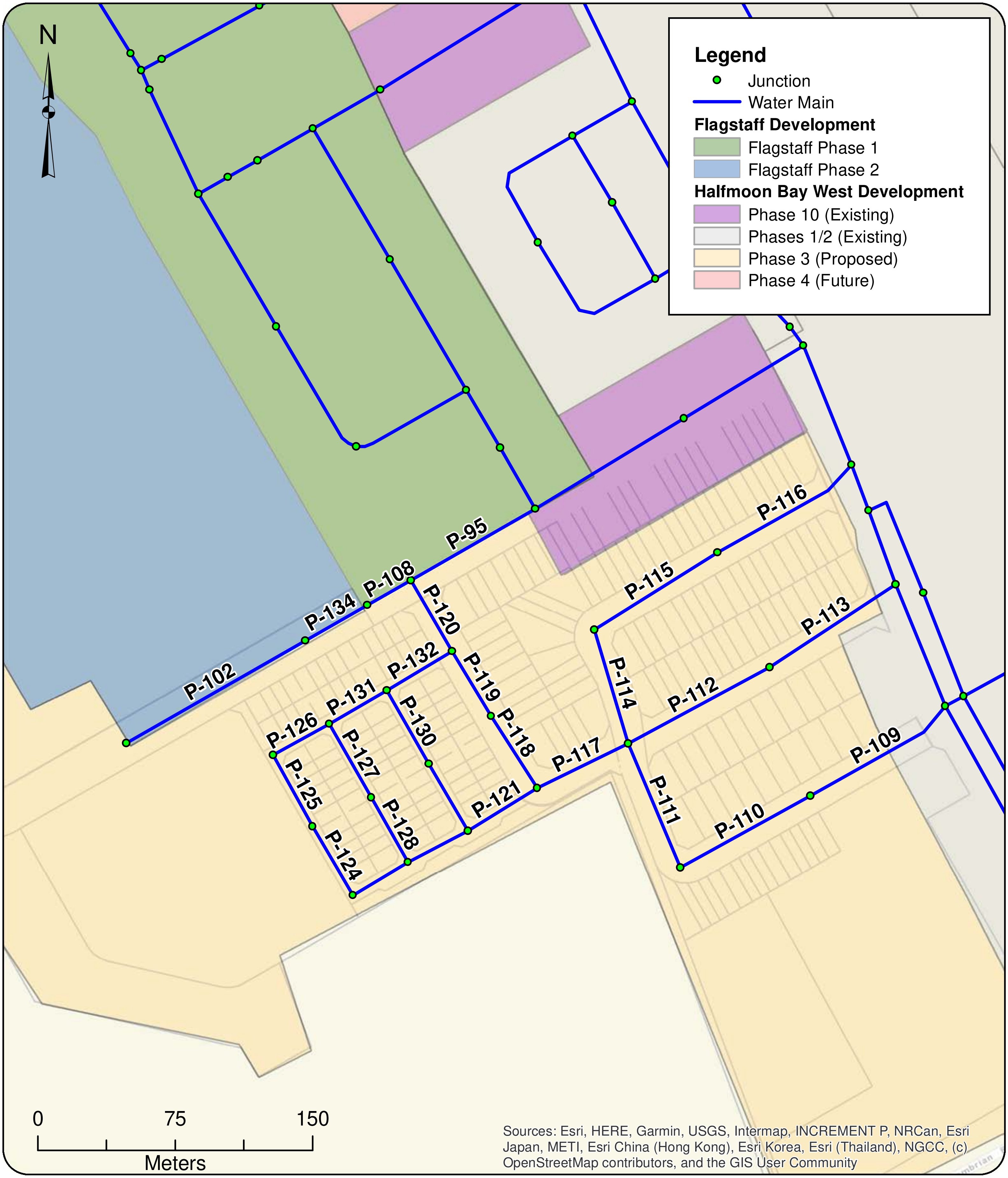
GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Junction IDs

Figure D.1



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Pipe IDs

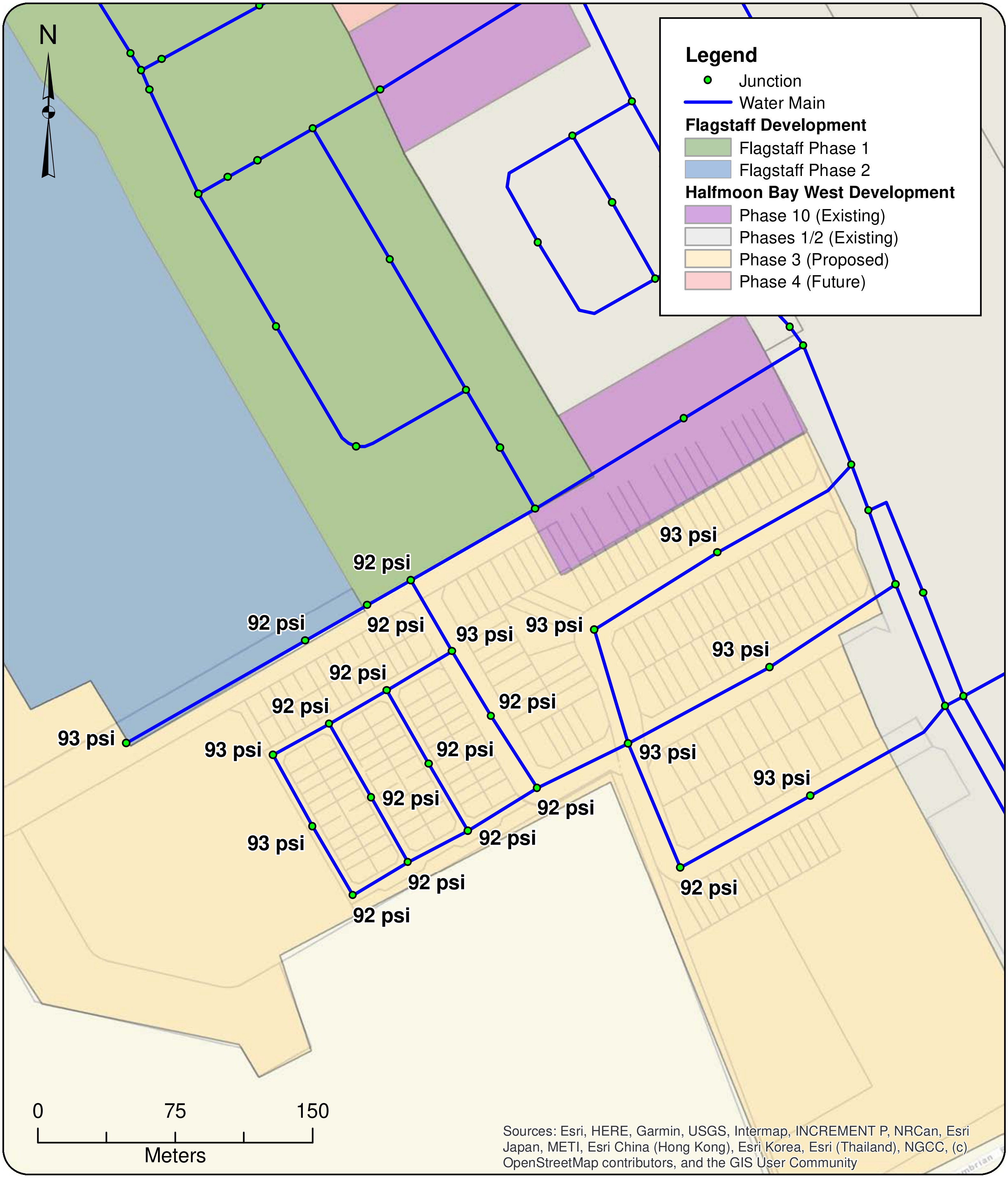
Figure D.2

Model Inputs

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness ()
P-102	J-82	J-107	112.76	297	120
P-108	J-105	J-74	27.31	297	120
P-109	J-14	J-87	89.29	204	110
P-110	J-87	J-88	81.18	204	110
P-111	J-88	J-89	73.64	204	110
P-112	J-89	J-90	87.69	204	110
P-113	J-90	J-13	82.42	204	110
P-114	J-89	J-92	64.70	204	110
P-115	J-92	J-91	79.40	204	110
P-116	J-91	J-19	88.28	204	110
P-117	J-89	J-93	55.19	204	110
P-118	J-93	J-94	46.56	204	110
P-119	J-94	J-95	41.31	204	110
P-120	J-95	J-105	44.98	204	110
P-121	J-93	J-96	44.58	204	110
P-122	J-96	J-97	37.02	204	110
P-123	J-97	J-98	35.03	204	110
P-124	J-98	J-99	43.48	204	110
P-125	J-99	J-100	44.77	204	110
P-126	J-100	J-101	35.00	204	110
P-127	J-101	J-102	46.13	204	110
P-128	J-102	J-97	40.79	204	110
P-129	J-96	J-103	42.30	204	110
P-130	J-103	J-104	46.37	204	110
P-131	J-104	J-101	36.29	204	110
P-132	J-104	J-95	41.56	204	110
P-134	J-107	J-74	39.00	297	120
P-95	J-73	J-105	78.42	297	120

ID	Elevation (m)
J-100	93.10
J-101	93.40
J-102	93.40
J-103	93.40
J-104	93.30
J-105	93.43
J-107	93.46
J-74	93.46
J-82	93.08
J-87	93.10
J-88	93.30
J-89	93.20
J-90	93.10
J-91	93.00
J-92	93.20
J-93	93.40
J-94	93.30
J-95	93.20
J-96	93.40
J-97	93.50
J-98	93.30
J-99	93.20

Appendix E MHD and PHD Model Results



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GeoAdvice Engineering Inc.

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Mattamy Half Moon Bay West Phase 3
2021-033-DSE
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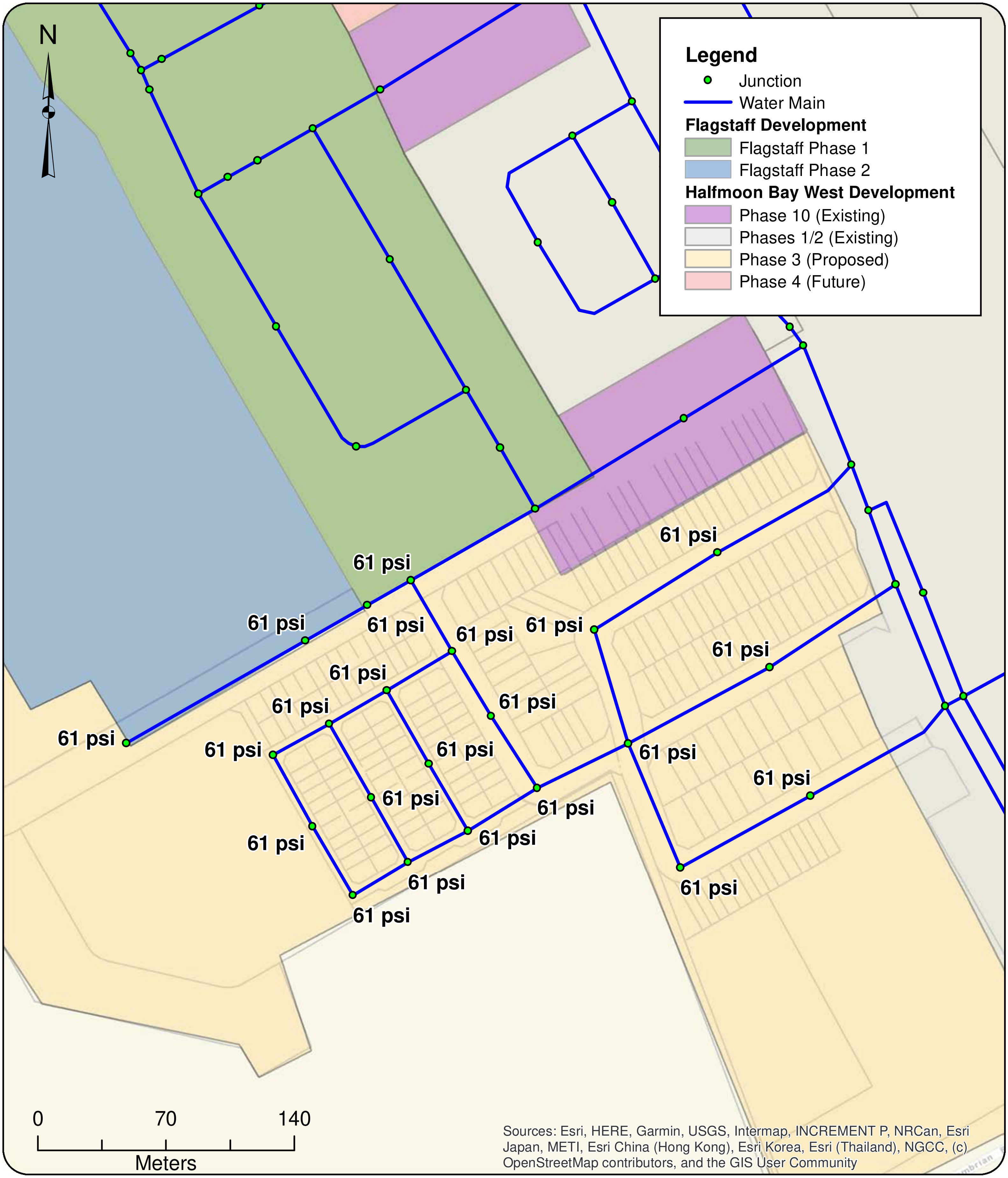
MHD Pressure Results
HMBW Phase 3

Figure E.1

Minimum Hour Demand Modeling Results - Half Moon Bay West Phase 3

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/k-m)
P-102	J-82	J-107	112.76	297	120	-0.13	0.00	0.00	0.00
P-108	J-105	J-74	27.31	297	120	0.25	0.00	0.00	0.00
P-109	J-14	J-87	89.29	204	110	0.63	0.02	0.00	0.01
P-110	J-87	J-88	81.18	204	110	0.10	0.00	0.00	0.00
P-111	J-88	J-89	73.64	204	110	0.03	0.00	0.00	0.00
P-112	J-89	J-90	87.69	204	110	-0.28	0.01	0.00	0.00
P-113	J-90	J-13	82.42	204	110	-0.38	0.01	0.00	0.00
P-114	J-89	J-92	64.70	204	110	-0.09	0.00	0.00	0.00
P-115	J-92	J-91	79.40	204	110	-0.18	0.01	0.00	0.00
P-116	J-91	J-19	88.28	204	110	-0.28	0.01	0.00	0.00
P-117	J-89	J-93	55.19	204	110	0.29	0.01	0.00	0.00
P-118	J-93	J-94	46.56	204	110	0.08	0.00	0.00	0.00
P-119	J-94	J-95	41.31	204	110	0.04	0.00	0.00	0.00
P-120	J-95	J-105	44.98	204	110	-0.15	0.01	0.00	0.00
P-121	J-93	J-96	44.58	204	110	0.18	0.01	0.00	0.00
P-122	J-96	J-97	37.02	204	110	0.11	0.00	0.00	0.00
P-123	J-97	J-98	35.03	204	110	0.06	0.00	0.00	0.00
P-124	J-98	J-99	43.48	204	110	0.02	0.00	0.00	0.00
P-125	J-99	J-100	44.77	204	110	-0.02	0.00	0.00	0.00
P-126	J-100	J-101	35.00	204	110	-0.06	0.00	0.00	0.00
P-127	J-101	J-102	46.13	204	110	0.02	0.00	0.00	0.00
P-128	J-102	J-97	40.79	204	110	-0.02	0.00	0.00	0.00
P-129	J-96	J-103	42.30	204	110	0.03	0.00	0.00	0.00
P-130	J-103	J-104	46.37	204	110	-0.01	0.00	0.00	0.00
P-131	J-104	J-101	36.29	204	110	0.11	0.00	0.00	0.00
P-132	J-104	J-95	41.56	204	110	-0.16	0.01	0.00	0.00
P-134	J-107	J-74	39.00	297	120	-0.20	0.00	0.00	0.00
P-95	J-73	J-105	78.42	297	120	0.45	0.01	0.00	0.00

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-100	0.04	93.10	158	93
J-101	0.04	93.40	158	92
J-102	0.04	93.40	158	92
J-103	0.04	93.40	158	92
J-104	0.04	93.30	158	92
J-105	0.04	93.43	158	92
J-107	0.07	93.46	158	92
J-74	0.06	93.46	158	92
J-82	0.13	93.08	158	93
J-87	0.53	93.10	158	93
J-88	0.07	93.30	158	92
J-89	0.10	93.20	158	93
J-90	0.10	93.10	158	93
J-91	0.10	93.00	158	93
J-92	0.10	93.20	158	93
J-93	0.04	93.40	158	92
J-94	0.04	93.30	158	92
J-95	0.04	93.20	158	93
J-96	0.04	93.40	158	92
J-97	0.04	93.50	158	92
J-98	0.04	93.30	158	92
J-99	0.04	93.20	158	93



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GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

PHD Pressure Results
HMBW Phase 3

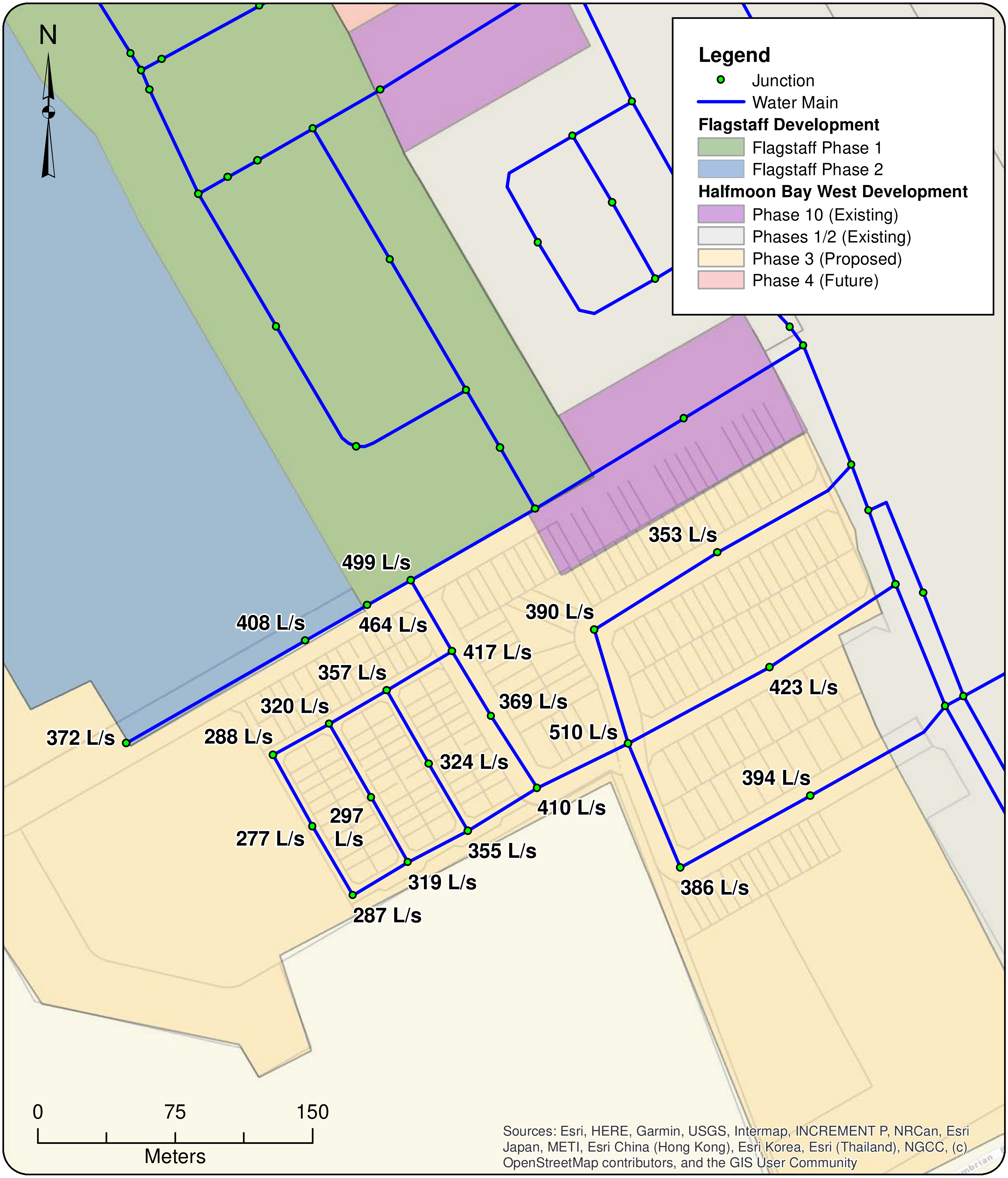
Figure E.2

Peak Hour Demand Modeling Results - Half Moon Bay West Phase 3

ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/k-m)
P-102	J-82	J-107	112.76	297	120	-0.91	0.01	0.00	0.00
P-108	J-105	J-74	27.31	297	120	2.28	0.03	0.00	0.01
P-109	J-14	J-87	89.29	204	110	5.68	0.17	0.03	0.28
P-110	J-87	J-88	81.18	204	110	2.42	0.07	0.01	0.06
P-111	J-88	J-89	73.64	204	110	1.65	0.05	0.00	0.03
P-112	J-89	J-90	87.69	204	110	-2.63	0.08	0.01	0.07
P-113	J-90	J-13	82.42	204	110	-3.72	0.11	0.01	0.13
P-114	J-89	J-92	64.70	204	110	-0.46	0.01	0.00	0.00
P-115	J-92	J-91	79.40	204	110	-1.54	0.05	0.00	0.03
P-116	J-91	J-19	88.28	204	110	-2.63	0.08	0.01	0.07
P-117	J-89	J-93	55.19	204	110	3.65	0.11	0.01	0.12
P-118	J-93	J-94	46.56	204	110	1.16	0.04	0.00	0.02
P-119	J-94	J-95	41.31	204	110	0.75	0.02	0.00	0.01
P-120	J-95	J-105	44.98	204	110	-1.24	0.04	0.00	0.02
P-121	J-93	J-96	44.58	204	110	2.08	0.06	0.00	0.04
P-122	J-96	J-97	37.02	204	110	1.26	0.04	0.00	0.02
P-123	J-97	J-98	35.03	204	110	0.62	0.02	0.00	0.01
P-124	J-98	J-99	43.48	204	110	0.21	0.01	0.00	0.00
P-125	J-99	J-100	44.77	204	110	-0.20	0.01	0.00	0.00
P-126	J-100	J-101	35.00	204	110	-0.60	0.02	0.00	0.01
P-127	J-101	J-102	46.13	204	110	0.17	0.01	0.00	0.00
P-128	J-102	J-97	40.79	204	110	-0.23	0.01	0.00	0.00
P-129	J-96	J-103	42.30	204	110	0.42	0.01	0.00	0.00
P-130	J-103	J-104	46.37	204	110	0.01	0.00	0.00	0.00
P-131	J-104	J-101	36.29	204	110	1.18	0.04	0.00	0.02
P-132	J-104	J-95	41.56	204	110	-1.58	0.05	0.00	0.03
P-134	J-107	J-74	39.00	297	120	-1.65	0.02	0.00	0.00
P-95	J-73	J-105	78.42	297	120	4.00	0.06	0.00	0.02

ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J-100	0.41	93.10	136	61
J-101	0.41	93.40	136	61
J-102	0.41	93.40	136	61
J-103	0.41	93.40	136	61
J-104	0.41	93.30	136	61
J-105	0.48	93.43	136	61
J-107	0.74	93.46	136	61
J-74	0.63	93.46	136	61
J-82	0.91	93.08	136	61
J-87	3.26	93.10	136	61
J-88	0.77	93.30	136	61
J-89	1.09	93.20	136	61
J-90	1.09	93.10	136	61
J-91	1.09	93.00	136	61
J-92	1.09	93.20	136	61
J-93	0.41	93.40	136	61
J-94	0.41	93.30	136	61
J-95	0.41	93.20	136	61
J-96	0.41	93.40	136	61
J-97	0.41	93.50	136	61
J-98	0.41	93.30	136	61
J-99	0.41	93.20	136	61

Appendix F MDD+FF Model Results



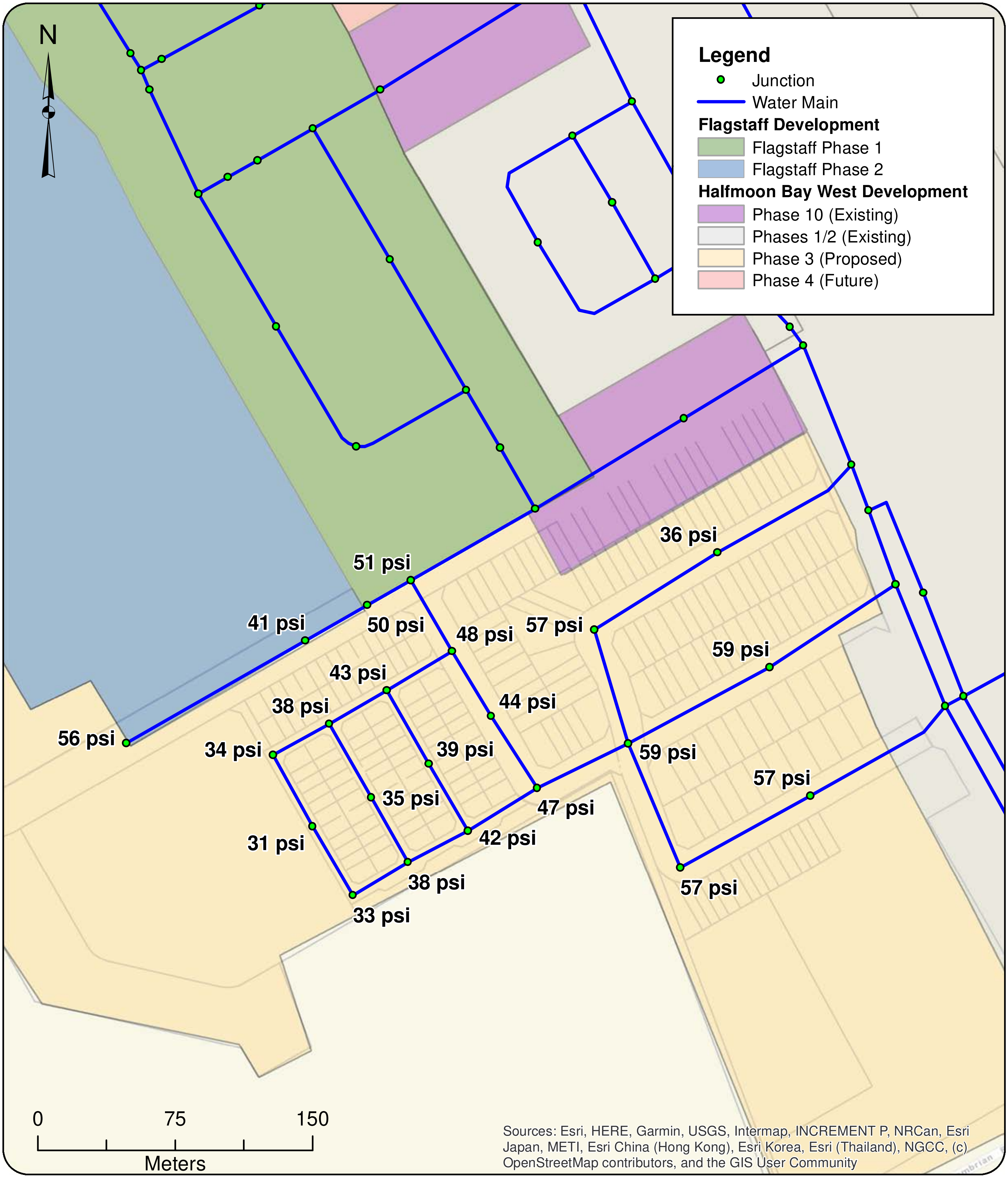
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 3
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

Available Fire Flow @ 20 psi HMBW Phase 3

Figure F.1



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

GeoADVICE
GeoAdvice Engineering Inc.

Project: **Hydraulic Capacity and Modeling Analysis**
Mattamy Half Moon Bay West Phase 2
2021-033-DSE
Client: **David Schaeffer Engineering Ltd.**
Date: **May 2021**
Created by: **BL**
Reviewed by: **WdS**

DISCLAIMER: GeoAdvice does not warrant in any way the accuracy and completeness of the information shown on this map. Field verification of the accuracy and completeness of the information shown on this map is the sole responsibility of the user.

Residual Pressure
@ Required Fire Flow
HMBW Phase 3

Figure F.2

Fire Flow Modeling Results - Half Moon Bay West Phase 3

ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (L/s)	Residual Pressure (psi)	Available Flow at Hydrant (L/s)	Available Flow Pressure (psi)
J-82	0.46	67	141	167	56	372	20
J-87	1.74	67	141	167	57	394	20
J-88	0.35	67	141	167	57	386	20
J-90	0.50	67	141	167	59	423	20
J-92	0.50	67	141	167	57	390	20
J-89	0.50	66	140	183	59	510	20
J-100	0.19	63	137	233	34	288	20
J-101	0.19	62	137	233	38	320	20
J-102	0.19	62	137	233	35	297	20
J-103	0.19	62	137	233	39	324	20
J-104	0.19	62	137	233	43	357	20
J-105	0.22	62	137	233	51	499	20
J-74	0.29	62	137	233	50	464	20
J-93	0.19	62	137	233	47	410	20
J-94	0.19	62	137	233	44	369	20
J-95	0.19	62	137	233	48	417	20
J-96	0.19	62	137	233	42	355	20
J-97	0.19	62	137	233	38	319	20
J-98	0.19	62	137	233	33	287	20
J-99	0.19	62	137	233	31	277	20
J-107	0.34	59	135	267	41	408	20
J-91	0.50	60	135	267	36	353	20

APPENDIX H

OTTAWA SERVICING REPORT CHECKLIST

Servicing study guidelines for development applications

4. Development Servicing Study Checklist

The following section describes the checklist of the required content of servicing studies. It is expected that the proponent will address each one of the following items for the study to be deemed complete and ready for review by City of Ottawa Infrastructure Approvals staff.

The level of required detail in the Servicing Study will increase depending on the type of application. For example, for Official Plan amendments and re-zoning applications, the main issues will be to determine the capacity requirements for the proposed change in land use and confirm this against the existing capacity constraint, and to define the solutions, phasing of works and the financing of works to address the capacity constraint. For subdivisions and site plans, the above will be required with additional detailed information supporting the servicing within the development boundary.

4.1 General Content

☐ Executive Summary (for larger reports only).

☒ Date and revision number of the report.

☒ Location map and plan showing municipal address, boundary, and layout of proposed development.

☒ Plan showing the site and location of all existing services.

☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.

☒ Summary of Pre-consultation Meetings with City and other approval agencies.

☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.

☒ Statement of objectives and servicing criteria.

☒ Identification of existing and proposed infrastructure available in the immediate area.

☐ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).

☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.

☐ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

☐ Proposed phasing of the development, if applicable.

☐ Reference to geotechnical studies and recommendations concerning servicing.

☒ All preliminary and formal site plan submissions should have the following information:
  - ◦ Metric scale
  - ◦ North arrow (including construction North)
  - ◦ Key plan
  - ◦ Name and contact information of applicant and property owner
  - ◦ Property limits including bearings and dimensions
  - ◦ Existing and proposed structures and parking areas
  - ◦ Easements, road widening and rights-of-way
  - ◦ Adjacent street names

4.2 Development Servicing Report: Water

☐ Confirm consistency with Master Servicing Study, if available

☒ Availability of public infrastructure to service proposed development

☐ Identification of system constraints

☐ Identify boundary conditions

☐ Confirmation of adequate domestic supply and pressure

☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter’s Survey. Output should show available fire flow at locations throughout the development.

☐ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.

☐ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

☐ Address reliability requirements such as appropriate location of shut-off valves

☐ Check on the necessity of a pressure zone boundary modification.

☒ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

☒ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.

☐ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.

☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

☐ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

4.3 Development Servicing Report: Wastewater

☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).

☐ Confirm consistency with Master Servicing Study and/or justifications for deviations.

☐ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.

☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.

☒ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)

☐ Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.

☒ Description of proposed sewer network including sewers, pumping stations, and forcemains.

☐ Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).

☐ Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.

☐ Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.

☐ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

☐ Special considerations such as contamination, corrosive environment etc.

4.4 Development Servicing Report: Stormwater Checklist

☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

☒ Analysis of available capacity in existing public infrastructure.

☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.

☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

☐ Set-back from private sewage disposal systems.

☐ Watercourse and hazard lands setbacks.

☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

☐ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).

☐ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.

☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.

☐ Any proposed diversion of drainage catchment areas from one outlet to another.

☐ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.

☐ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100 year return period storm event.

☐ Identification of potential impacts to receiving watercourses

☐ Identification of municipal drains and related approval requirements.

☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.

☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

☐ Inclusion of hydraulic analysis including hydraulic grade line elevations.

☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.

☐ Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.

☐ Identification of fill constraints related to floodplain and geotechnical investigation.

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

☐ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.

☐ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

☐ Changes to Municipal Drains.

☐ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

4.6 Conclusion Checklist

☒ Clearly stated conclusions and recommendations

☐ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.

☒ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

APPENDIX I

PRE-CONSULTATION SUMMARY

Pre-Application Consultation Meeting Notes

Property Address: 3555 Borrisokane
PC2023-0038,
February 23rd, 2023, MS Teams

Attendees:

Inwon Lee (Owner)
David Parker and Carlos (Architect)
Patrick McMahon (Transportation Project Manager, City of Ottawa)
Sami Rehman (Environmental Planner, Planner II, City of Ottawa)
Selma Hassan (Urban Designer, Planner II, City of Ottawa)
Jeannette Krabicka (Parks Planner, Planner II, City of Ottawa)
Bruce Bramah (Project Manager, City of Ottawa)
Stream Shen (File Lead, Planner III, City of Ottawa)
Adwoa Achireko (Student Planner, City of Ottawa)
Samuel Farkas (Student Planner, City of Ottawa)

Regrets:

- Eric Lalande (Planner, RVCA)
- Mark Richardson (Forester Planner, City of Ottawa)

Subject: 3555 Borrisokane – Korean Community Church

Meeting notes:

Opening & attendee introduction

- Introduction of meeting attendees
- Overview of proposal:
    - 1 storey building for a Korean Community Church
    - The class and office are accessory to the church.
    - Estimated highest attendance to be on Sunday at 500 people.
    - Weekday will be mostly empty.
    - Currently considering renting out part of the space as a day care.
    - Currently no trees on property.
    - There are currently no plan for the parcel north of the church.
    - The church will be building the road along the easterly property line connecting to Flagstaff.

Comments:

Planning (Shen, Stream Stream.Shen@ottawa.ca)

1. This is a pre-consultation for a Site Plan Control application, Complex threshold. Application form, information and fee can be found here. There is a proposed fee increase for April 1, 2023.

2. There will be impact to the site plan application process as a result of Bill 109 and Bill 23. Please review the engage Ottawa website for information and reach out to the file lead to confirm the updated process prior to submission.
3. Official Plan - Neighbourhood designation within the Suburban transect. Urban Natural Feature designation to the south.
4. Official Plan Annex 5 area specific policy 4 requires evidence that the owner is party to the barrhaven south cos t sharing agreement and that the owner has paid its share of any costs pursuant to the agreement as a condition of approval.
5. Barrhaven South Community Design Plan – Employment designation. Please review the CDP for any applicable policies.
6. Due to the location within the 500-metre influence area of the Trail Road Waste Facility, Conditions of development approval will include the provision of warning notices on title, noting the site's proximity to the landfill and the potential for odour and litter impacts; and the requirement for sealed, air-conditioned workplace units.
7. Zoning – Light Industrial, Exception 304 (IL[304]) which allows a place of warship as an additional permitted use.
8. Aisle width leading to parking spaces need to be a minimum of 6.7m.
9. Bicycle parking required at 1 per 1,500 m2 of gfa.
10. Vehicle parking required at 10 per 100m2 of gfa for the assembly area.
11. The City is working to implement the High Performance Development Standards by June 1, 2023. Detail information and submission requirements can be found in the attachment.
12. Please consult with the Ward Councillor (David Hill) prior to submission.

Urban Design (Hassan, Selma Selma.Hassan@ottawa.ca)

13. Design brief is required. Terms of reference is attached.
14. Please ensure the site is well landscaped, and new larger canopy trees are provided where possible, and
15. Please design the front of the building to have glazing and to address the front of the site appropriately.

Transportation (McMahon, Patrick patrick.mcmahon@ottawa.ca)

- Follow Traffic Impact Assessment Guidelines
    - Start this process as soon as possible.
    - The application will not be deemed complete until the submission of the draft step 1-4, including the functional draft RMA package (if applicable and/or monitoring report (if applicable). Collaboration and communication between development proponents and City staff are required at the end of every step of the TIA process.
- The right of way protection along Borrisokane Road is 37.5m, show this protection on the plan. A widening does not appear to be required.
- Noise Impact Studies required for the following:
    - Road (adjacent to Borrisokane and within 500m of Highway 416)
    - Stationary due to the proximity of an in-stream application for a car wash at the northern edge of the site. The car wash developer will not be responsible for any noise attenuation required.
- The clear throat length for this development along Borrisokane Road should be at least 15m from the edge of the right-of-way.
- Consider providing a pedestrian connection along the internal road to connect to Flagstaff.

- Consider ending the sidewalk along the frontage prior to the Borrisokane Road limits since there are no pedestrian facilities provided along Borrisokane Road.
- On site plan:
  - Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, accesses and/or sidewalks.
  - Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions).
  - Show all curb radii measurements; ensure that all curb radii are reduced as much as possible.
  - Show lane/aisle widths. Aisles must be 6.7m wide.
- As the proposed site is commercial/institutional/industrial and for general public use, AODA legislation applies.
- Consider using the City's Accessibility Design Standards.

Forestry (Richardson, Mark Mark.Richardson@ottawa.ca)

1. If trees >10cm in diameter will be impacted, a Tree Conservation Report (TCR) must be supplied for review along with the suite of other plans/reports required by the City
   a. an approved TCR is a requirement of Site Plan approval.
2. Any removal of privately-owned trees 10cm or larger in diameter, or city-owned trees of any diameter requires a tree permit issued under the Tree Protection Bylaw (Bylaw 2020 – 340); the permit will be based on an approved TCR and made available at or near plan approval.
3. The TCR must contain 2 separate plans:
   b. Plan/Map 1 - show existing conditions with tree cover information.
   c. Plan/Map 2 - show proposed development with tree cover information.
   d. Please ensure retained trees are shown on the landscape plan.
4. the TCR must list all trees on site, as well as off-site trees if the CRZ extends into the developed area, by species, diameter and health condition.
5. please identify trees by ownership – private onsite, private on adjoining site, city owned, co-owned (trees on a property line)
   e. Compensation may be required for the removal of city owned trees.
6. If trees are to be removed, the TCR must clearly show where they are, and document the reason they cannot be retained.
7. All retained trees must be shown, and all retained trees within the area impacted by the development process must be protected as per City guidelines available at Tree Protection Specification or by searching Ottawa.ca
   a. the location of tree protection fencing must be shown on the plan.
   b. show the critical root zone of the retained trees.
8. the City encourages the retention of healthy trees; if possible, please seek opportunities for retention of trees that will contribute to the design/function of the site.
9. For more information on the process or help with tree retention options, contact Mark Richardson mark.richardson@ottawa.ca or on City of Ottawa

Planning Forester LP tree planting requirements:

Please note that all process for reviewing and approving LP tree planting has changed at the City – in order to effectively review your submission in a timely manner the Planning Forester will need to ensure that all the bullets listed below have been addressed

1. Minimum Setbacks
    - Maintain 1.5m from sidewalk or MUP/cycle track or water service laterals.
    - Maintain 2.5m from curb
    - Coniferous species require a minimum 4.5m setback from curb, sidewalk or MUP/cycle track/pathway.
    - Maintain 7.5m between large growing trees, and 4m between small growing trees. Park or open space planting should consider 10m spacing, except where otherwise approved in naturalization / afforestation areas. Adhere to Ottawa Hydro's planting guidelines (species and setbacks) when planting around overhead primary conductors.
2. Tree specifications
    - Minimum stock size: 50mm tree caliper for deciduous, 200cm height for coniferous.
    - Maximize the use of large deciduous species wherever possible to maximize future canopy coverage
    - Tree planting on city property shall be in accordance with the City of Ottawa's Tree Planting Specification; and include watering and warranty as described in the specification (can be provided by Forestry Services).
    - Plant native trees whenever possible
    - No root barriers, dead-man anchor systems, or planters are permitted.
    - No tree stakes unless necessary (and only 1 on the prevailing winds side of the tree)
3. Hard surface planting
    - Curb style planter is highly recommended
    - No grates are to be used and if guards are required, City of Ottawa standard (which can be provided) shall be used.
    - Trees are to be planted at grade
4. Soil Volume
    - Please document on the LP that adequate soil volumes can be met:

Tree Type/Size	Single Tree Soil Volume (m3)	Multiple Tree Soil Volume (m3/tree)
Ornamental	15	9
Columnar	15	9
Small	20	12
Medium	25	15
Large	30	18
Conifer	25	15

Sensitive Marine Clay

- Please follow the City's 2017 Tree Planting in Sensitive Marine Clay guidelines

Engineering (Bramah, Bruce bruce.bramah@ottawa.ca)

Servicing

Please note the Trail Road Waste Facility is near this property. Comments from the Trail Road Facility will be provided once they are available.

Site servicing conditions/criteria shall be in accordance with HMBW Phase 4 servicing study.
Water and Sanitary service stubs off Flagstaff Drive within the existing servicing easement to be used.

Water

Boundary conditions:
Civil consultant must request boundary conditions from the City's assigned Project Manager prior to first submission.

- Water boundary condition requests must include the location of the service(s) and the expected loads required by the proposed developments. Please provide all the following information:
    - Location of service(s)
    - Type of development and the amount of fire flow required (as per FUS, 2020).
    - Average daily demand: ___ l/s.
    - Maximum daily demand: ___l/s.
    - Maximum hourly daily demand: ___ l/s.
- Fire protection (Fire demand, Hydrant Locations)
- A water meter sizing questionnaire (water data card) will have to be completed prior to receiving a water permit (water card will be provided post approval)

Sanitary Sewer

Is a monitoring manhole required on private property? ☒ Yes ☐ No

- The designer should be aware there may be limited capacity in the downstream sanitary sewer system. The sanitary demand needs to be coordinated with the City Planning Dept. to determine if the existing sanitary sewer system has sufficient capacity to support the proposed rezoning. Provide sanitary demands to the City project manager for coordination.

- Any premise in which there is commercial or institutional food preparation shall install a grease and oil inceptor on all fixtures.

Storm Sewer

- For concrete sewer pipe, maintenance holes shall be installed when the service is greater than 50% of the diameter of the mainline concrete pipe

- The Environmental Site Assessment (ESA) may provide recommendations where site contamination may be present. The recommendations from the ESA need to be coordinated with the servicing report to ensure compliance with the Sewer Use By-Law.

Stormwater Management

Quality Control:

- The Clarke storm water management pond does provide quality control for HMBW subdivision. The Rideau Valley Conservation Authority to provide any additional quality control requirements for the property.

Quantity Control:

- Provided by servicing study for HMBW Phase 4.

Ministry of Environment, Conservation and Parks (MECP)

All development applications should be considered for an Environmental Compliance Approval, under MECP regulations.

a. The consultants determine if an approval for sewage works under Section 53 of OWRA is required and determines what type of application. The City's project manager may help confirm and coordinate with the MECP as required.
b. The project will be either transfer of review (standard), transfer of review (additional), direct submission, or exempt as per O. Reg. 525/98.
c. Pre-consultation is not required if applying for standard or additional works (Schedule A of the Agreement) under Transfer Review.
d. Pre-consultation with local District office of MECP is recommended for direct submission.
e. Consultant completes an MECP request form for a pre-consultation. Sends request to moeccottawasewage@ontario.ca
f. ECA applications are required to be submitted online through the MECP portal. A business account required to submit ECA application. For more information visit https://www.ontario.ca/page/environmental-compliance-approval
g. It is unclear if the proposed development will remain as one property. An ECA will be required where the stormwater management services more than one property parcel.

NOTE: Site Plan Approval, or Draft Approval, is required before any Ministry of the Environment and Climate Change (MOECC) application is sent

General Service Design Comments

- The City of Ottawa requests that all new services be located within the existing service trench to minimize necessary road cuts.
- Monitoring manholes should be located within the property near the property line in an accessible location to City forces and free from obstruction (i.e. not a parking).
- Where service length is greater than 30 m between the building and the first maintenance hole / connection, a cleanout is required.
- The City of Ottawa Standard Detail Drawings should be referenced where possible for all work within the Public Right-of-Way.
- The upstream and downstream manhole top of grate and invert elevations are required for all new sewer connections.
- Services crossing the existing watermain or sewers need to clearly provide the obvert/invert elevations to demonstration minimum separation distances. A watermain crossing table may be provided.

Other

Are there are Capital Works Projects scheduled that will impact the application? ☐ Yes ☒ No

References and Resources

- As per section 53 of the Professional Engineers Act, O. Reg 941/40, R.S.O. 1990, all documents prepared by engineers must be signed and dated on the seal.
- All required plans are to be submitted on standard A1 size sheets (594mm x 841mm) sheets, utilizing a reasonable and appropriate metric scale as per City of Ottawa Servicing and Grading

Plan Requirements: title blocks are to be placed on the right of the sheets and not along the bottom. Engineering plans may be combined, but the Site Plans must be provided separately. Plans shall include the survey monument used to confirm datum. Information shall be provided to enable a non-surveyor to locate the survey monument presented by the consultant.

- All required plans & reports are to be provided in *.pdf format (at application submission and for any, and all, re-submissions)
- Please find relevant City of Ottawa Links to Preparing Studies and Plans below: https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans#standards-policies-and-guidelines
- To request City of Ottawa plan(s) or report information please contact the City of Ottawa Information Centre:
  InformationCentre@ottawa.ca<mailto:InformationCentre@ottawa.ca>
  (613) 580-2424 ext. 44455
- Geo-Ottawa
  http://maps.ottawa.ca/geoOttawa/

Environmental (Rehman, Sami Sami.Rehman@ottawa.ca)

The subject property is adjacent to an Urban Natural Feature (UNF), “Cambrian Road Woods”.

The City’s data also identifies a watercourse running through the property (across in west-east direction); what is the nature of the watercourse and will it be relocated?

As such, the proposed development will require an Environmental Impact Study (EIS), as per OP section 4.8.3. The EIS will need to address the following:

-consider the watercourse re-alignment and buffering the impacts to adjacent watercourse/amphibian corridor

-potential impacts of construction and operation of proposal

-some of the impacts include, but not limited to, stormwater, snow storage, noise, lighting, human presence on natural features (i.e. UNF and watercourse/amphibian corridor)

-potential impacts on significant habitat of threatened or endangered species

-adjacent significant woodlands

-adjacent significant wildlife habitat

-review and draw relevant recommendations from the Jock River Reach 1 Subwatershed Plan and Cambrian Wood’s Forest Management Plan

-given all the glass and potential design traps proposed with the buildings, review and incorporate design elements from the City’s Bird-Safe Design Guidelines into the proposal to avoid bird collisions

- review and draw best practices from the City’s Protocol for Wildlife Protection during Construction

- discuss potential impacts from landfill on the proposed development and vice versa; it might be worthwhile seeking input from Trail Rd facility

recommendations to enhance the adjacent natural features and contribute to the urban tree canopy

Please refer to the EIS requirements for further details: Environmental Impact Statement Guidelines (ottawa.ca)

If a Tree Conservation Report (TCR) is required, it can be combined with EIS to avoid duplications. I will default to the Forestry Planner to comment on the TCR requirement.

As for the proposed site plan, the City will be focusing on impacts on the realigned watercourse/amphibian corridor. Generally, we will be looking for a 10m setback. If there is interest in reducing that setback to 5m, then we'd be looking to naturalize the interface between the proposal and the corridor with locally appropriate native trees/shrubs/plants to mitigate impacts.

Staff are encouraged to hear that the proposed development admires the adjacent UNF but also have concerns with lighting and the patio facing the UNF. The proposal should be designed and operated to avoid impacts on the UNF, as well as, avoiding potential future wildlife-human conflicts. This maybe especially relevant if daycare is considered as a future use. Staff will be looking for the EIS to review potential impacts and provide recommendations and setbacks to demonstrate no negative impacts.

I would also recommend consulting with the Rideau Valley Conservation Authority to determine if any permits or approvals are required under their regulations.

Park (Krabicka, Jeannette Jeannette.Krabicka@ottawa.ca)

a. The amount of parkland dedication that is required is to be calculated as per the City of Ottawa Parkland Dedication By-law No 2022-280.
b. Parkland Dedication By-law, Section 11(2)(c) states: No conveyance of land or payment of cash-in-lieu under this by-law is required in the case of the development or redevelopment of:
    a. a place of worship, excluding any ancillary uses as defined by the Zoning By-law
c. "Ancillary Use" as defined by the Zoning By-law: Ancillary Use means a listed, permitted land use that is additional, secondary and complementary to a permitted principal use, but not accessory to the permitted principal use.
d. The potential ancillary uses identified during the pre-application consultation meeting included community rentals and day care. Both of these proposed uses are considered commercial uses; therefore, the spaces attributed to these uses are subject to parkland dedication.
e. However, Parkland Dedication By-law, Section 11(1) states:

    The conveyance of parkland or the payment of cash-in-lieu of parkland is not required for development or redevelopment where it is known, or can be demonstrated, that the required parkland conveyance or cash-in-lieu of parkland, or combination thereof, has been previously satisfied in accordance with the Planning Act, unless:

    a. there is a change in the proposed development or redevelopment that would increase the density providing a net dwelling unit gain;
    b. the proposed development or redevelopment increases the gross floor area of a nonresidential use; or

   c. land originally proposed for development or redevelopment for commercial or industrial purposes is now proposed for development or redevelopment for other purposes that have a higher conveyance requirement pursuant to the rates described herein.

f. The proposed development is located within a subdivision where the parkland dedication requirement was previously satisfied for the entirety of this parcel/block, calculated at the commercial use rate of 2%. Please refer to the Development Review file D07-16-19-0011 ph3. Furthermore, sub-sections a, b, and c of Section 11(1) do not apply to the proposed development.

g. Therefore, based on Section 11(1) of the By-law and the proposed use as presented in the Preapplication Consultation meeting, this potential Site Plan Application proposal may be considered exempt from a parkland dedication requirement.

h. Please note that the park comments are preliminary and will be finalized (and subject to change) upon receipt of the development application. Additionally, if the proposed land use changes then the parkland dedication requirement be re-evaluated accordingly.

City Surveyor

- The determination of property boundaries, minimum setbacks and other regulatory constraints are a critical component of development. An Ontario Land Surveyor (O.L.S.) needs to be consulted at the outset of a project to ensure properties are properly defined and can be used as the geospatial framework for the development.
- Topographic details may also be required for a project and should be either carried out by the O.L.S. that has provided the Legal Survey or done in consultation with the O.L.S. to ensure that the project is integrated to the appropriate control network.

Questions regarding the above requirements can be directed to the City's Surveyor, Bill Harper, at Bill.Harper@ottawa.ca

Submission requirements

- Plans are to be standard A1 size (594 mm x 841 mm) or Arch D size (609.6 mm x 914.4 mm) sheets, dimensioned in metric and utilizing an appropriate Metric scale (1:200, 1:250, 1:300, 1:400 or 1:500).
- All PDF submitted documents are to be unlocked and flattened.
- These pre-con comments are valid for one year. If you submit a development application(s) after this time, you may be required to meet for another pre-consultation meeting and/or the submission requirements may change. You are as well encouraged to contact us for a follow-up meeting if the plan/concept will be further refined.

APPENDIX J

CORRESPONDENCE WITH MECP

Nikhil Parmar

From:	Hook, Jordan (MECP) <Jordan.Hook@ontario.ca>
Sent:	October 6, 2023 9:02 AM
To:	Nicole Wells
Subject:	RE: ECA Application - 3555 Borrisokane Rd, Ottawa

Hi Nicole,

Thank you for the additional information. This will require an ECA.

Thanks,

Jordan

From: Nicole Wells <nwells@pearsoneng.com>
Sent: October 4, 2023 5:03 PM
To: Hook, Jordan (MECP) <Jordan.Hook@ontario.ca>
Subject: RE: ECA Application - 3555 Borrisokane Rd, Ottawa

CAUTION -- EXTERNAL E-MAIL - Do not click links or open attachments unless you recognize the sender.

Hi Jordan,

Please see my responses below in red. The building is a community church so it would be institutional. Zoning is light industrial with exception 304, which allows a place of worship. Let me know if you need any further info.

Thank you,

Nicole Wells, C.E.T.
Project Coordinator/Design Technologist

PEARSON
ENGINEERING

OTTAWA OFFICE
900 Morrison Drive, Unit 100
Ottawa, ON K2H 8K7
P: 613-416-1232 ext. 249
nwells@pearsoneng.com
pearsoneng.com

BARRIE	**GTA**	**OWEN SOUND**
705-719-4785	905-597-5572	226-256-2957

From: Hook, Jordan (MECP) <Jordan.Hook@ontario.ca>
Sent: Wednesday, October 4, 2023 2:34 PM

To: Nicole Wells <nwells@pearsoneng.com>
Subject: FW: ECA Application - 3555 Borrisokane Rd, Ottawa

Hi Nicole,

I was forwarded your email from Kyle. I am an EO at the Ottawa District Office and can answer your question.

I have a few questions for you to help me determine if an ECA is required.

1. Will there be a stormwater management facility (based on the attached plans I don't see one)? We are proposing a 300mm orifice tube with surface ponding for quantity control and an OGS for quality control. However, we are in the process of addressing city comments which may result in the addition of some additional underground tanks.
2. Is this a combined system or only stormwater being collected and discharged to the one pipe on Borrisokane Road? Only stormwater being discharged.
3. Could you confirm if this is one lot or if there are multiple lots that would be part of the one discharge? This is for 1 lot. the other lots would be under separate SPAs.

Thank you,

Jordan

From: Nicole Wells <nwells@pearsoneng.com>
Sent: September 25, 2023 2:53 PM
To: Straberger, Kyle (He/Him) (MECP) <Kyle.Straberger@ontario.ca>
Subject: ECA Application - 3555 Borrisokane Rd, Ottawa

Hi Kyle,

We have a site at 3555 Borrisokane Rd in Ottawa where we are discharging our site's stormwater to the municipal ditch along Borrisokane Rd (Servicing and Catchment plans attached for reference). Can you confirm if we will need an ECA for the proposed outlet and for the flows directed to adjacent properties?

Thank you,

Nicole Wells, C.E.T.
Project Coordinator/Design Technologist

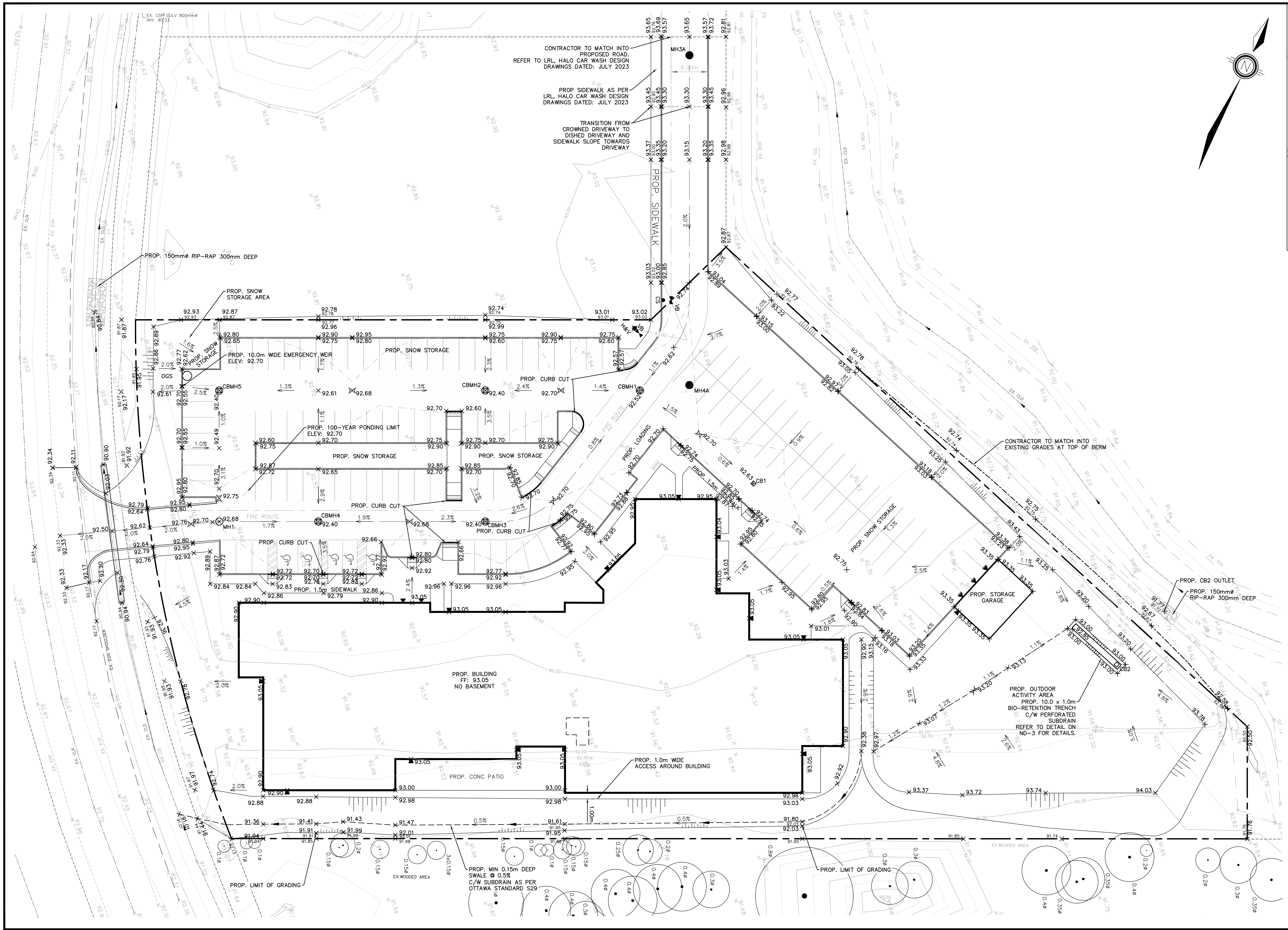
PEARSON ENGINEERING

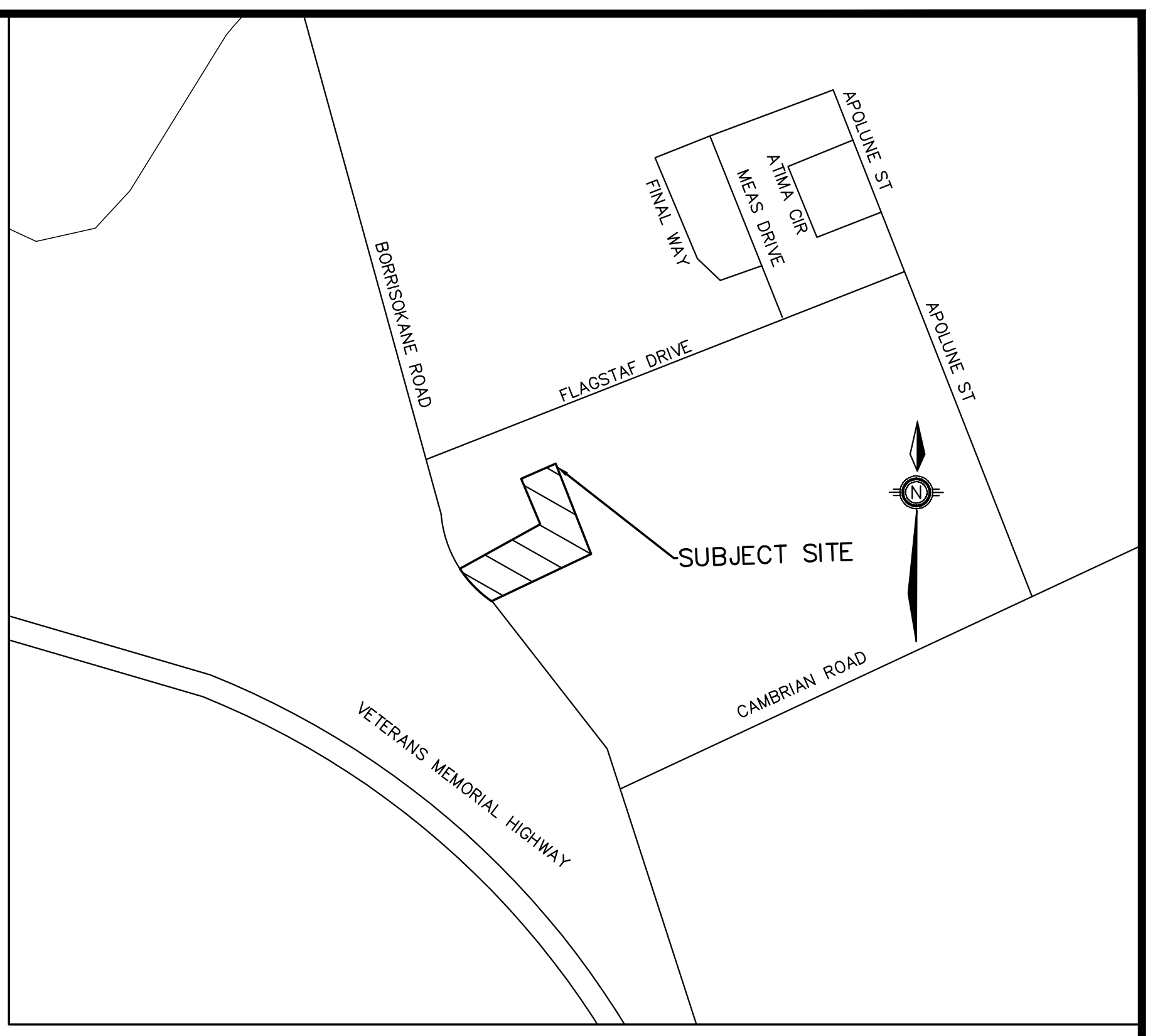
OTTAWA OFFICE
900 Morrison Drive, Unit 100
Ottawa, ON K2H 8K7
P: 613-416-1232 ext. 249
nwells@pearsoneng.com
pearsoneng.com

BARRIE 705-719-4785
GTA 905-597-5572
OWEN SOUND 226-256-2957

APPENDIX K

PEARSON ENGINEERING DRAWINGS





KEYMAP NTS

LEGEND

□ CB	CATCH BASIN
◫ DCB	DOUBLE CATCH BASIN
⊡ CBMH	CATCH BASIN
○ MH	STORM MANHOLE
● MH	SANITARY MANHOLE
⌐	SERVICE CAP
✦ H&V	FIRE HYDRANT
⋈ VB	WATER VALVE
• CS	CURB STOP W/ SERVICE
× 254.63 254.09	PROPOSED ELEVATION EXISTING ELEVATION
1.5% →	PROPOSED DIRECTION AND GRADE
═	BACK OF CURB EDGE OF PAVEMENT
▬	CURB CUT LOCATION
) (	HIGH POINT
‖‖‖‖	MAX 3:1
— - — -	MATCH LINE
▨	100-YEAR PONDING LIMIT ELEV: 92.70
▨	TACTILE PLATE
91.68	EX. TOPO ELEVATIONS
▲	OVERHEAD DOOR
▲	ENTRY LOCATION

SITE GRADING NOTES:

1. NO EXCESS DRAINAGE, DURING OR AFTER CONSTRUCTION TO BE DIRECTED TOWARDS NEIGHBORING PROPERTIES.
2. EXISTING DRAINAGE PATTERNS TO BE MAINTAINED.
3. ENSURE POSITIVE DRAINAGE AWAY FROM FOUNDATION
4. LANDSCAPE AREAS TO HAVE MINIMUM 2%, MAXIMUM 7% SLOPE UNLESS TERRACED AT 3:1 MAXIMUM.
5. NO ALTERATION TO EXISTING GRADES ON PROPERTY LINES.
6. USF TO BE MINIMUM 1.5m BELOW FINISHED GRADE OR INSULATION IS REQUIRED.
7. TOF TO BE MINIMUM 0.15m ABOVE FINISHED GRADE.
8. SUNKEN ENTRANCE DRAIN ANNOT CONNECT DIRECTLY TO WEEPING TILE. ANY WATER IN SUNKEN ENTRANCE TO DRAIN DOWN INTO PERMEABLE FILL WHERE IT WILL BE PICKED UP BY WEEPING TILE SYSTEM.
9. REFER TO LANDSCAPING PLAN FOR FENCING DETAILS

NO.	REVISION NOTE	DATE	BY
05.	UPDATED SNOW STORAGE	10/16/24	JM
04.	AS PER 3rd SUBMISSION COMMENTS	10/04/24	JM
03.	AS PER UPDATED SITE PLAN	07/04/24	JM
02.	AS PER 2nd SUBMISSION COMMENTS	02/12/24	JM
01.	AS PER 1st SUBMISSION COMMENTS	11/02/23	JM

BENCHMARK:
SPIKE IN UTILITY POLE LOCATED ON THE SE CORNER OF THE BORRISOKANE RD. AND PROMENADE FLAGSTAFF DR. INTERSECTION.
ELEV: 92.96

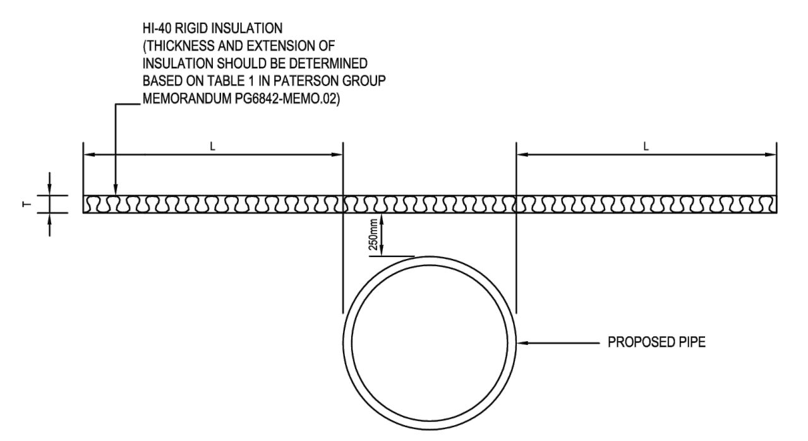
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

SITE GRADING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

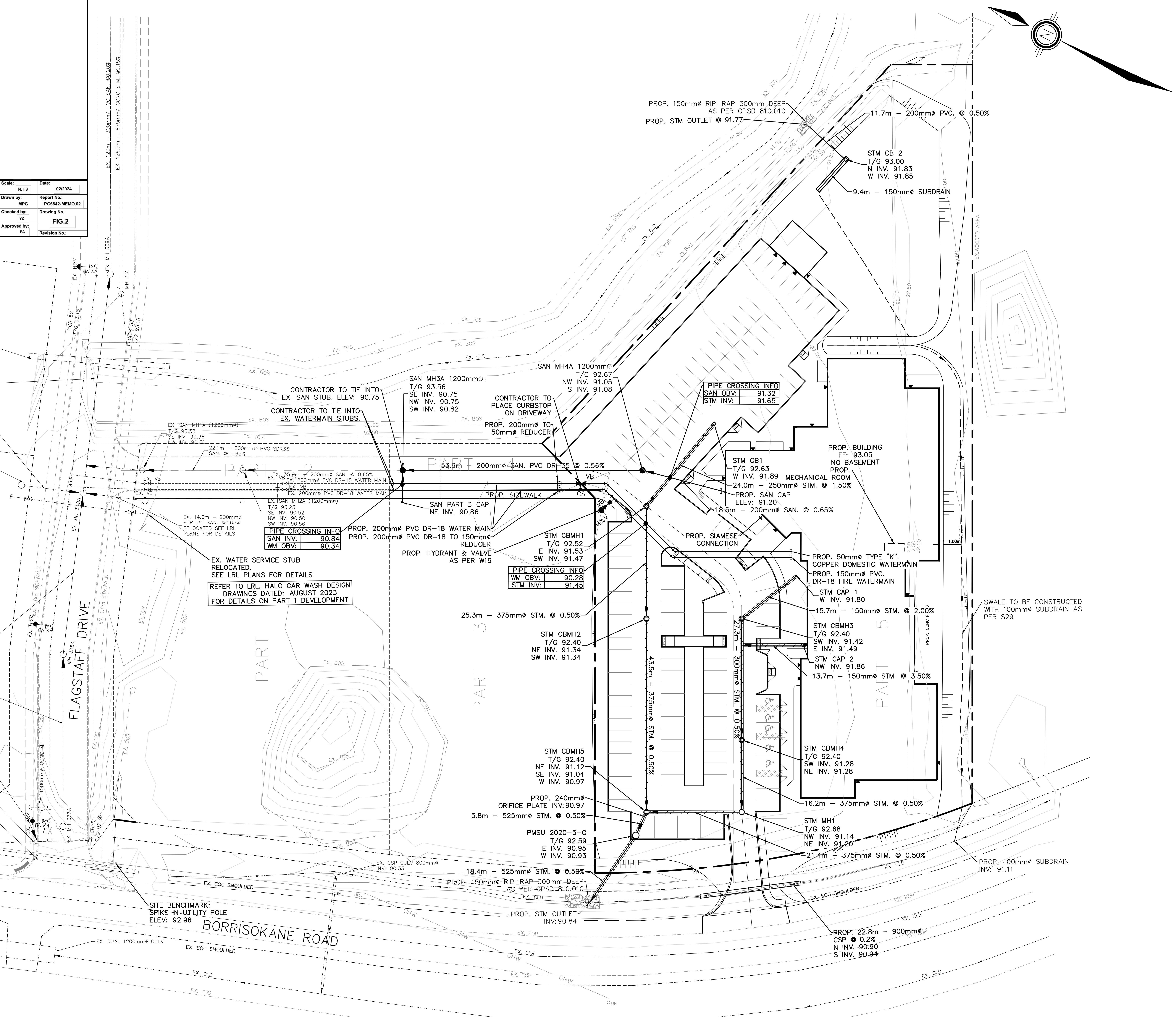
DESIGNED BY	NW/MWD	HORIZ SCALE	1:300	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	SG-1
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	5

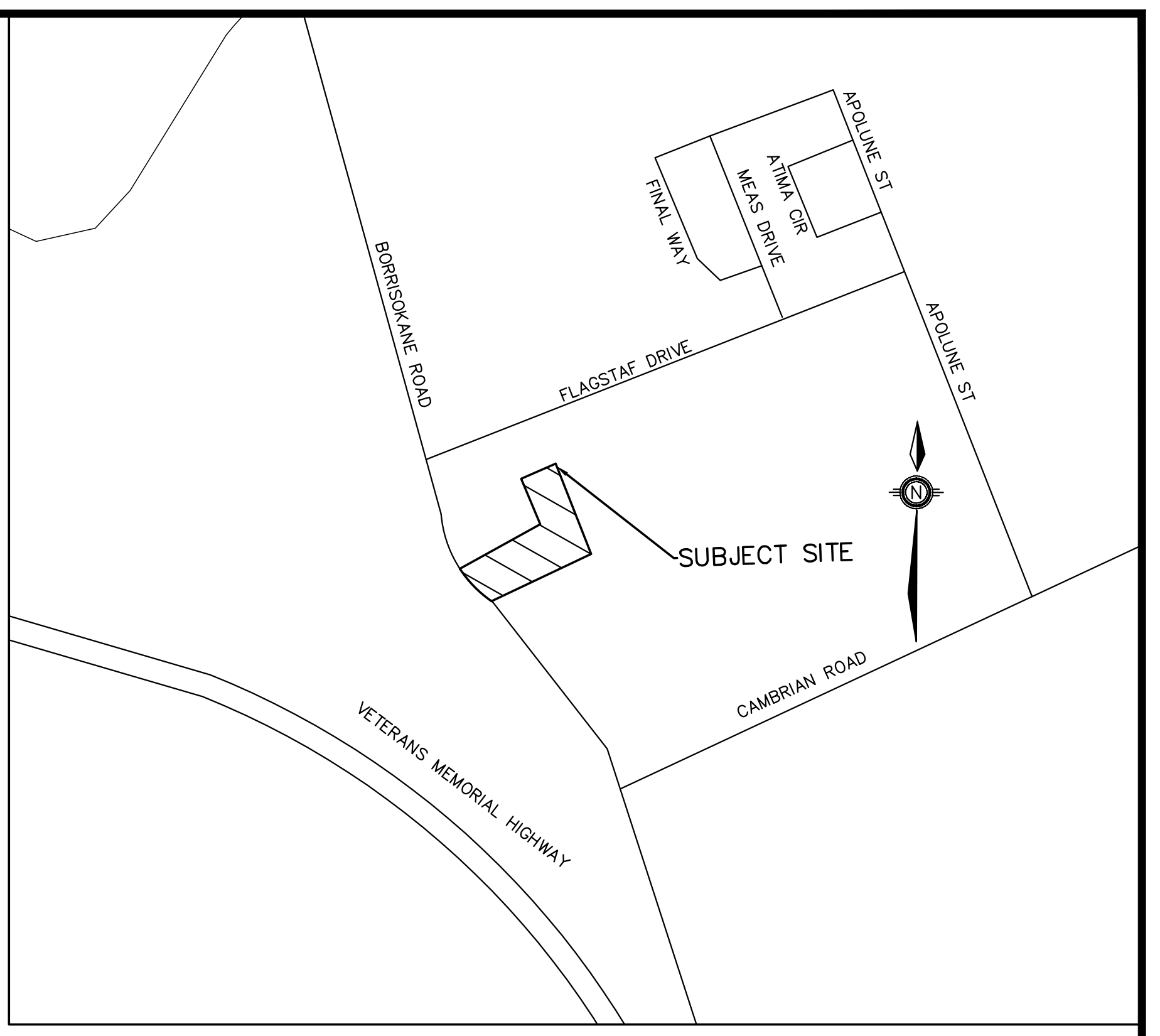


PATERSON GROUP
SOLUTION ORIENTED ENGINEERING

TYPICAL FROST INSULATION DETAIL

Scale:	N.T.S	Date:	02/2024
Drawn by:	MPG	Report No.:	PG6842-MEMO.02
Checked by:	YZ	Drawing No.:	FIG.2
Approved by:	FA	Revision No.:	





KEYMAP NTS

LEGEND

□ CB	CATCH BASIN
◫ DCB	DOUBLE CATCH BASIN
▣ CBMH	CATCH BASIN
○ MH	STORM MANHOLE
● MH	SANITARY MANHOLE
⊓	SERVICE CAP
✦ H&V	FIRE HYDRANT
⋈ VB	WATER VALVE
• CS	CURB STOP W/ SERVICE
× 254.63	PROPOSED ELEVATION
254.09	EXISTING ELEVATION
1.5% →	PROPOSED DIRECTION AND GRADE
═	BACK OF CURB
═	EDGE OF PAVEMENT
▬	CURB CUT LOCATION
) (	HIGH POINT
▨	PROPOSED PIPE INSULATION AS PER SS–1 DETAIL
◭	OVERHEAD DOOR
▲	ENTRY LOCATION

SITE SERVICING NOTES:

1. OBTAIN ALL NECESSARY PERMITS AND APPROVALS FROM CITY OF OTTAWA BEFORE COMMENCING WORK.
2. REFER TO CITY OF OTTAWA STANDARD R10 FOR ASPHALT TIE INS.
3. BACKWATER VALVES TO BE INSTALLED AS PER CITY OF OTTAWA STANDARD S14, AND S14.1 OR S14.2
4. EXISTING SERVICES TO BE BLANKED AT MAIN.
5. THERMAL INSULATION TO BE PROVIDED FOR WATER SERVICES LESS THAN 2.4m FROM OPEN STRUCTURES AS PER CITY OF OTTAWA STANDARD W23.
6. WATER SERVICE TO HAVE MORE THAN 2.4m OF COVER OR BE INSULATED AS PER CITY OF OTTAWA STANDARD DRAWING W22.
7. SUNKEN ENTRANCE DRAIN CANNOT CONNECT DIRECTLY TO WEEPING TILE. ANY WATER IN SUNKEN ENTRANCE TO DRAIN DOWN INTO PERMEABLE FILL WHERE IT WILL BE PICKED UP BY WEEPING TILE SYSTEM.

NO.	REVISION NOTE	DATE	BY
05.	UPDATED SNOW STORAGE	10/16/24	JM
04.	AS PER 3rd SUBMISSION COMMENTS	10/04/24	JM
03.	AS PER UPDATED SITE PLAN	07/04/24	JM
02.	AS PER 2nd SUBMISSION COMMENTS	02/12/24	JM
01.	AS PER 1st SUBMISSION COMMENTS	11/02/23	JM

BENCHMARK
SPIKE IN UTILITY POLE LOCATED ON THE SE CORNER OF THE BORRISOKANE RD. AND PROMENADE FLAGSTAFF DR. INTERSECTION.
ELEV: 92.96

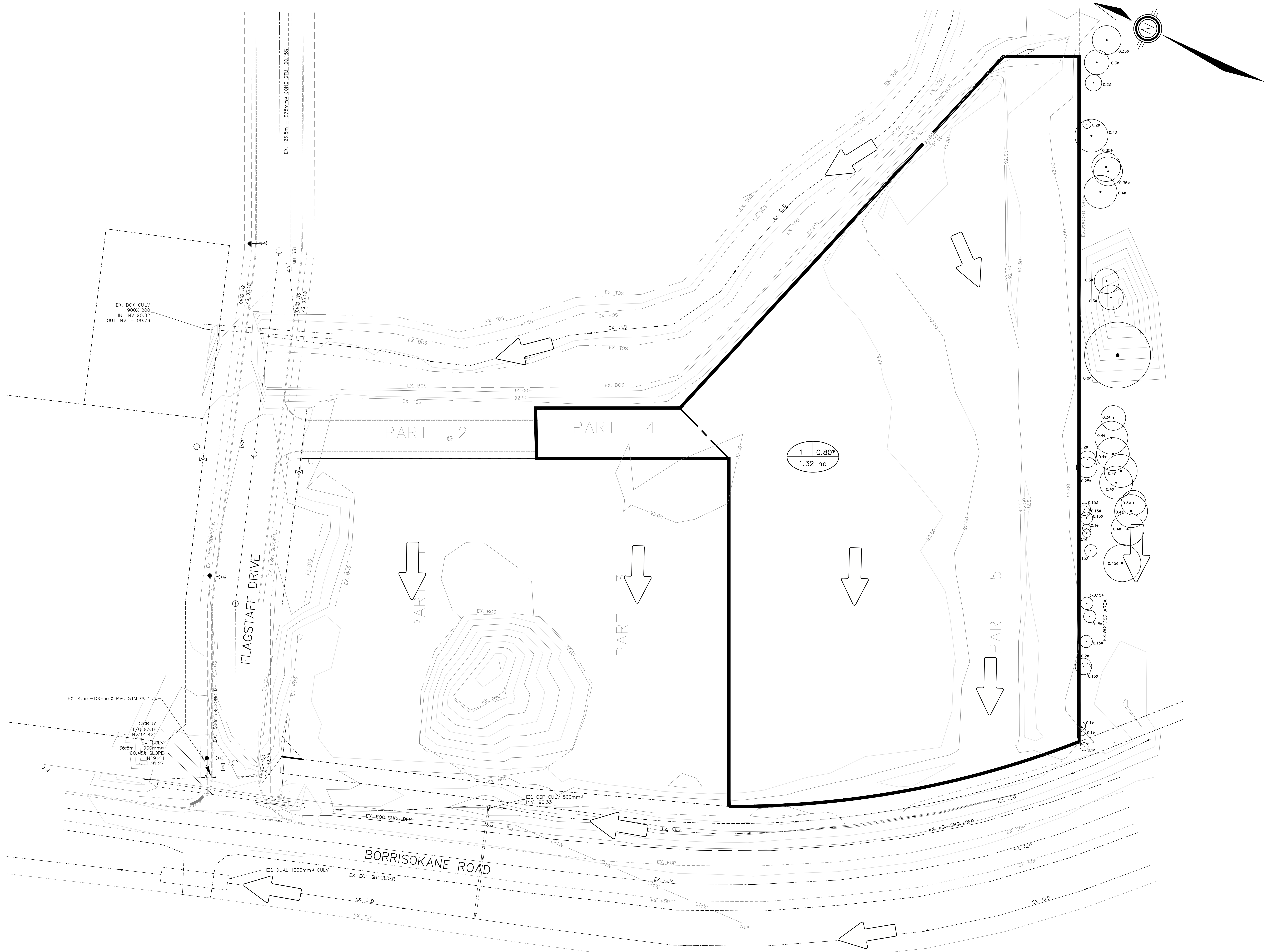
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

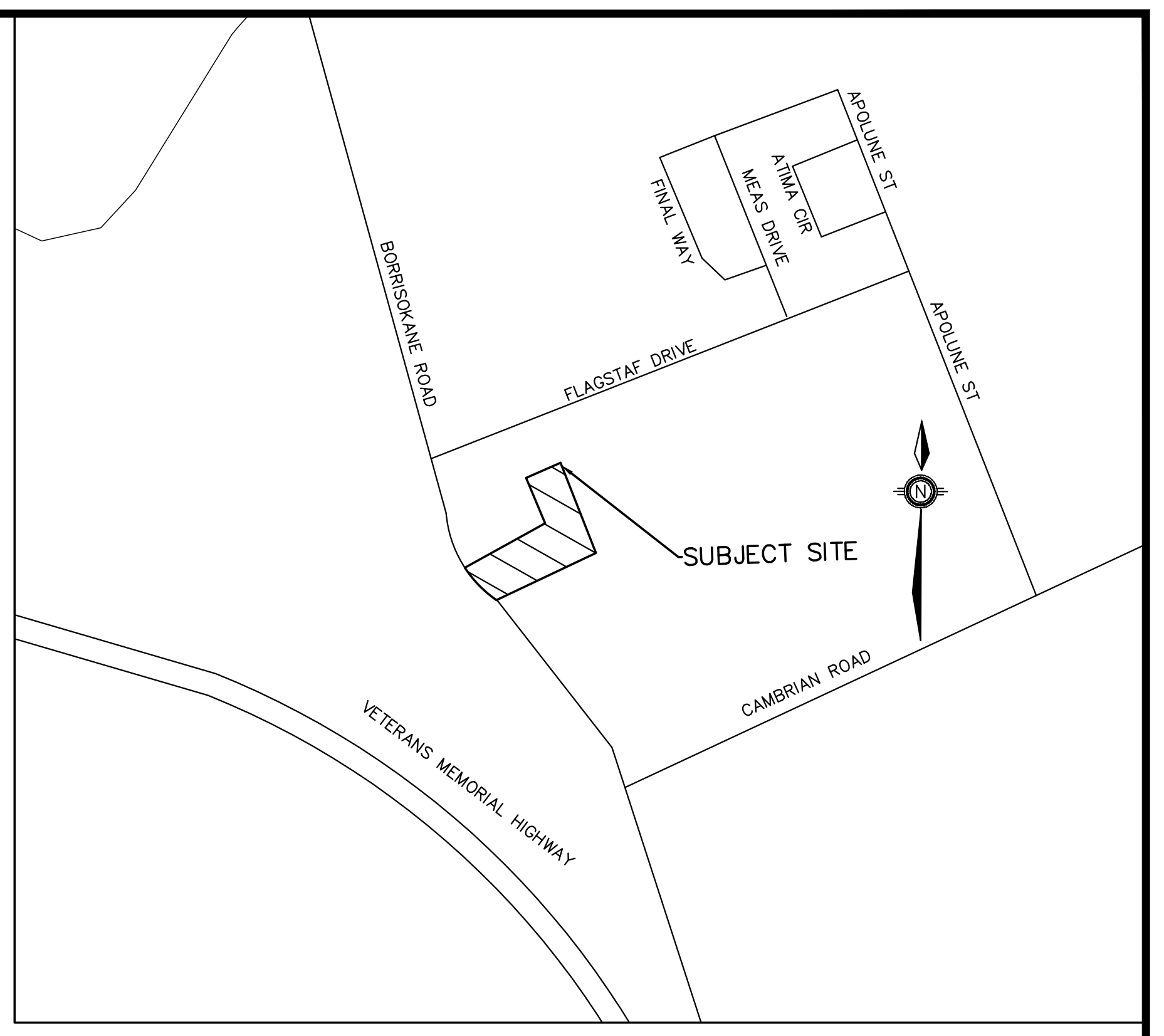
KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

SITE SERVICING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	NW/MWD	HORIZ SCALE	1:500	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	SS–1
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	5





KEYMAP NTS

LEGEND

⇨ OVERLAND FLOW DIRECTION

CATCHMENT AREA 1 | 0.75 RUNOFF COEFFICIENT
1.00 ha
AREA IN HECTARES

▬ CATCHMENT BOUNDARY

*ALLOWABLE RUNOFF TAKEN FROM
DSEL DESIGN BRIEF FOR THE
HALF MOON BAY WEST SUBDIVISION PH. 3
DATED NOVEMBER 18, 2021

NO.	REVISION NOTE	DATE	BY
05.	UPDATED SNOW STORAGE	10/16/24	JM
04.	AS PER 3rd SUBMISSION COMMENTS	10/04/24	JM
03.	AS PER UPDATED SITE PLAN	07/04/24	JM
02.	AS PER 2nd SUBMISSION COMMENTS	02/12/24	JM
01.	AS PER 1st SUBMISSION COMMENTS	11/02/23	JM

BENCHMARK
SPIKE IN UTILITY POLE LOCATED ON THE SE CORNER OF THE BORRISOKANE RD.
AND PROMENADE FLAGSTAFF DR. INTERSECTION.
ELEV: 92.96

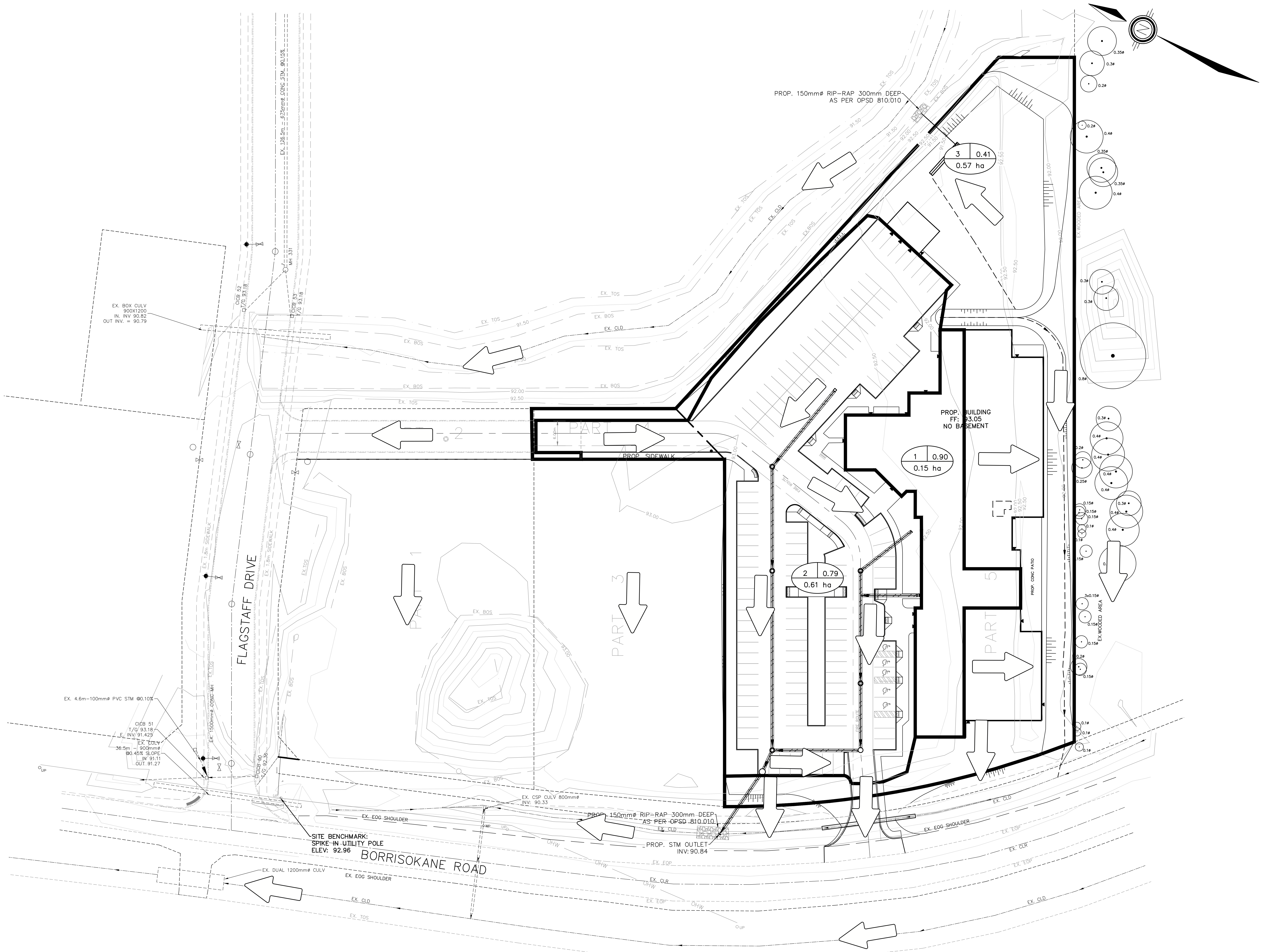
M.W. DEJEAN
Oct 16, 2024

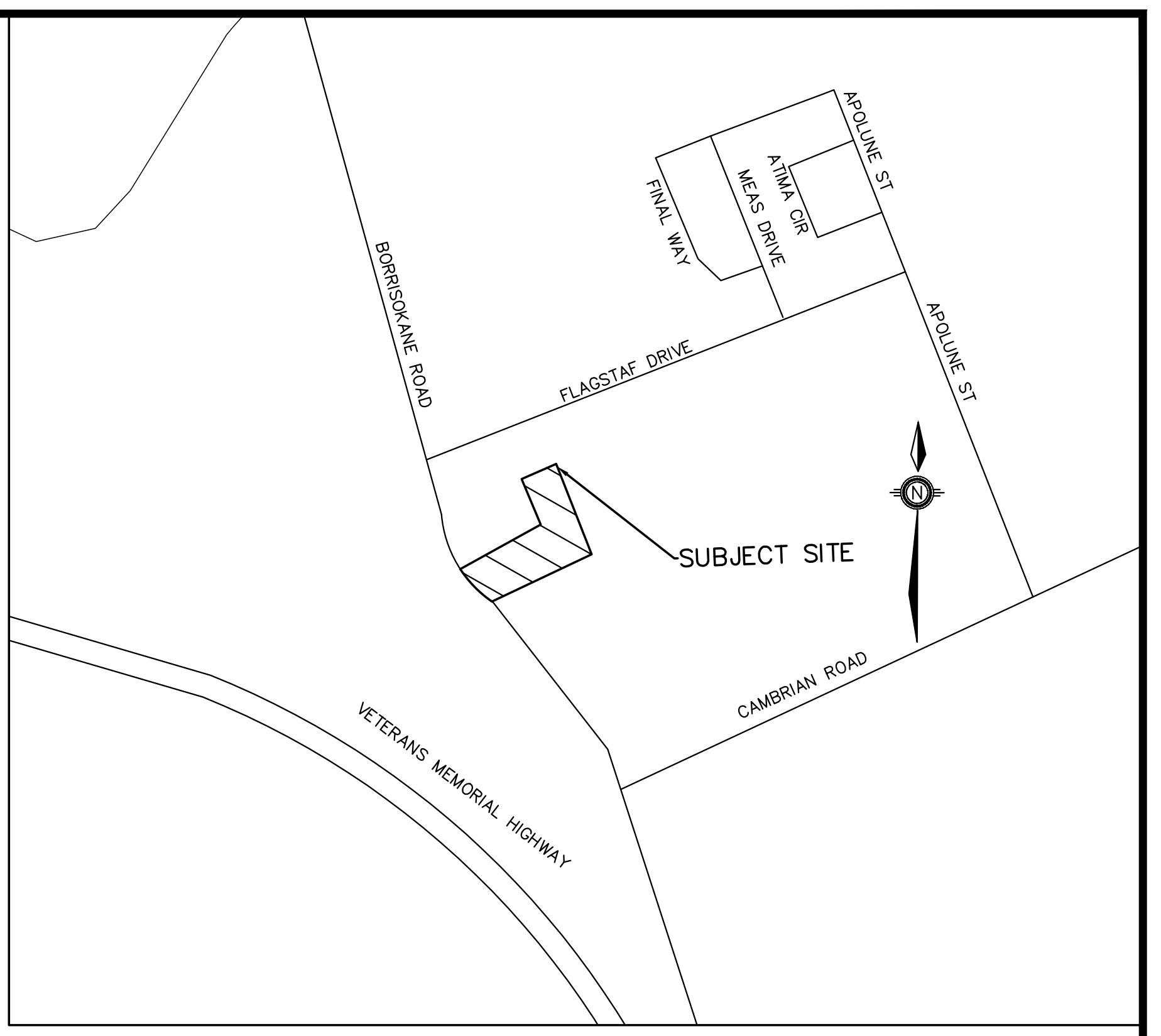
KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

PRE–DEVELOPMENT STORM
CATCHMENT PLAN

PEARSON
ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	NW/MWD	HORIZ SCALE	1:500	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	STM–1
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	5





KEYMAP NTS

LEGEND

OVERLAND FLOW DIRECTION

CATCHMENT AREA | 1 | 0.75 | RUNOFF COEFFICIENT
1.00 ha
AREA IN HECTARES

CATCHMENT BOUNDARY

NO.	REVISION NOTE	DATE	BY
05.	UPDATED SNOW STORAGE	10/16/24	JM
04.	AS PER 3rd SUBMISSION COMMENTS	10/04/24	JM
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BENCHMARK
SPIKE IN UTILITY POLE LOCATED ON THE SE CORNER OF THE BORRISOKANE RD. AND PROMENADE FLAGSTAFF DR. INTERSECTION.
ELEV: 92.96

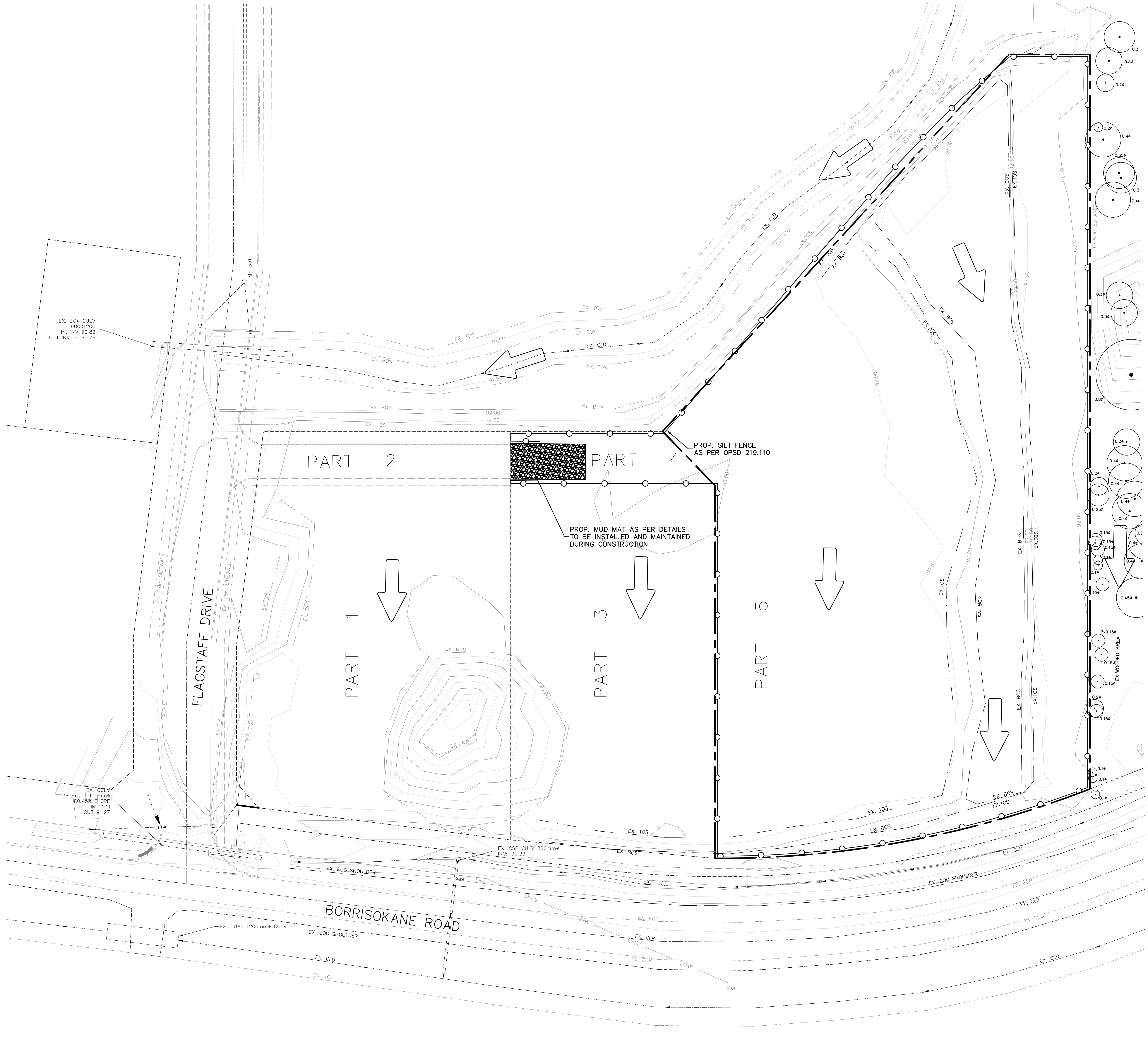
LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

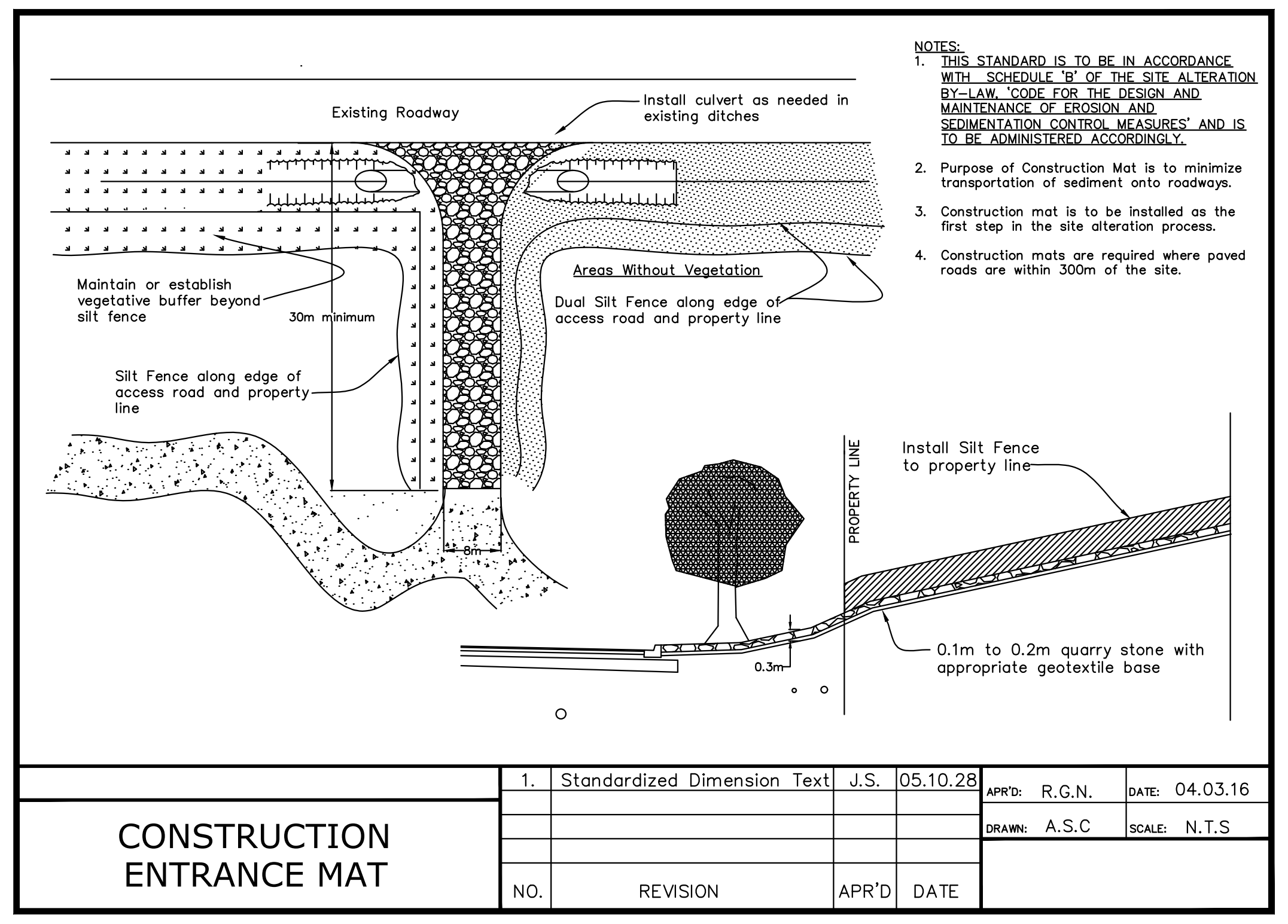
KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

POST–DEVELOPMENT STORM
CATCHEMENT PLAN

PEARSON
ENGINEERING
PEARSONENG.COM PH. 705.719.4785

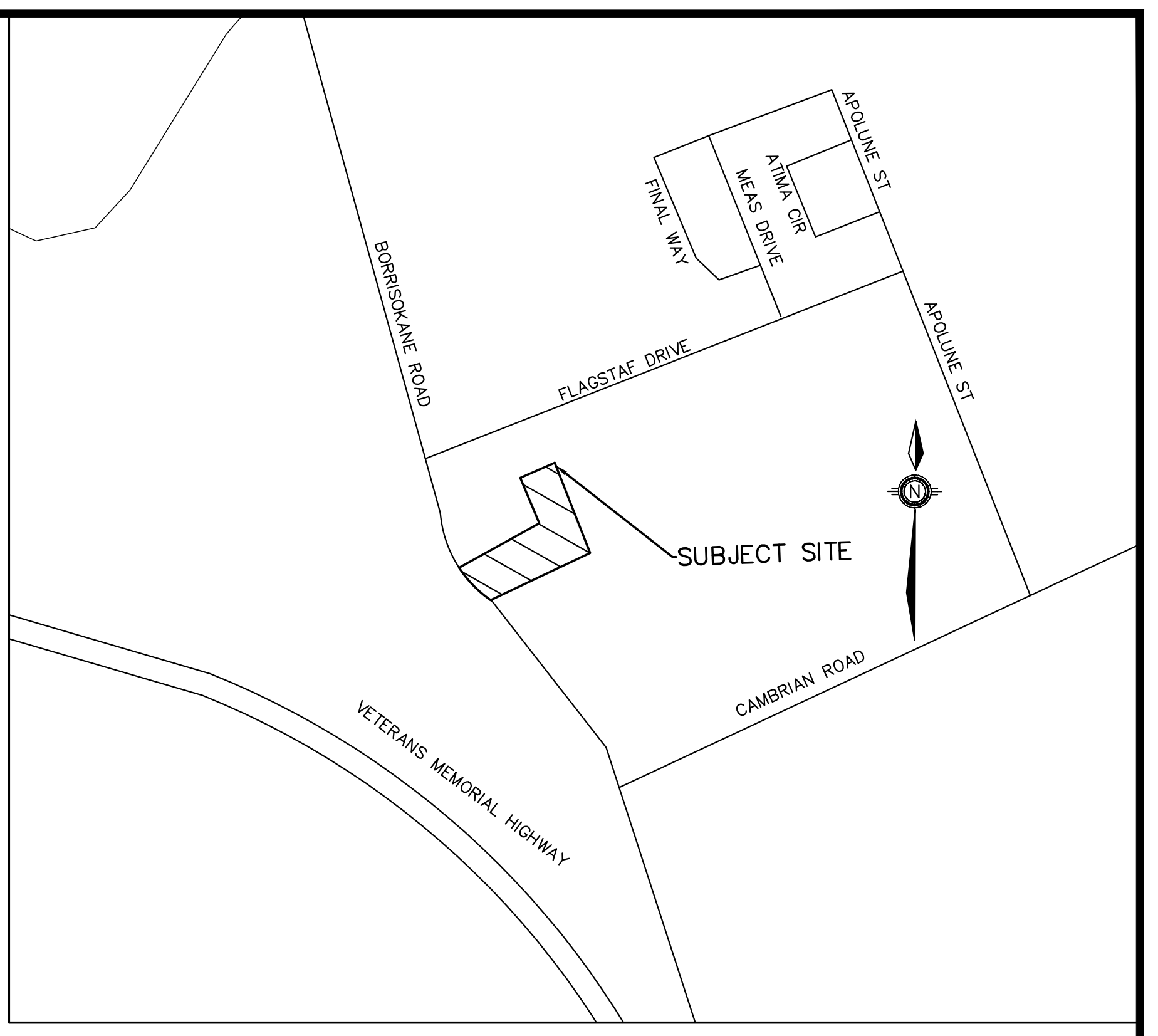
DESIGNED BY	NW/MWD	HORIZ SCALE	1:500	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	STM–2
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	5





NOTES:
1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE 'B' OF THE SITE ALTERATION BY-LAW, 'CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES' AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

CONSTRUCTION ENTRANCE MAT	NO.	REVISION	APR'D	DATE		
	1.	Standardized Dimension Text	J.S.	05.10.28	APR'D: R.G.N.	DATE: 04.03.16
					DRAWN: A.S.C	SCALE: N.T.S



KEYMAP NTS

LEGEND

- □ EX. CB
- ◫ EX. DCB
- ⊡ EX. CBMH
- ○ EX. MH
- ○ EX. MH
- ● HYD.
- ⋈ VB
- —○——○— PROP. SILT FENCE
- ▬ ▬ ▬ PROPERTY LINE
- ⇨ OVERLAND FLOW ROUTE

SEQUENCE OF CONSTRUCTION

1. ENGINEER TO BE NOTIFIED PRIOR TO INITIATION OF ANY ON SITE WORKS.
2. SILT FENCE AS PER OPSD 219.110
3. VEGETATION REMOVAL MAY COMMENCE AFTER ALL SILT FENCE IS INSTALLED AND APPROVED BY THE ENGINEER.
4. COMMENCE WITH EARTH WORKS AND SITE SERVICING.
5. INSTALLATION OF PROPOSED INFILTRATION FACILITIES TO THE TIME OF LANDSCAPING WORKS.
6. EROSION CONTROL MEASURES TO BE MAINTAINED AS DIRECTED BY THE ENGINEER DURING THE CONSTRUCTION PERIOD. ADDITIONAL CONTROL MEASURES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
7. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED WITH SEED, SOD, MULCH OR OTHER ADEQUATE COVERING, AS INSTRUCTED BY THE ENGINEER.

NOTES FOR SEDIMENT & EROSION CONTROL

1. DISTURBED AREAS THAT HAVE FAILED TO HAVE STABLE GROUND COVER ESTABLISHED BY OCTOBER 30TH SHALL BE PROTECTED WITH A SILTATION CONTROL FENCE OR STRAW MULCH ETC. AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION BECOMES ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
2. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE ADMINISTRATOR.
3. SILT FENCE SHALL BE PUT IN PLACE PRIOR TO AND MAINTAINED DURING ALL GRADING. SILT FENCE TO BE INSPECTED PRIOR TO COMMENCEMENT OF EARTH GRADING ACTIVITIES. SILT FENCE TO BE INSPECTED AND REPAIRED OR REPLACED IF DAMAGED AS DIRECTED BY THE SITE ADMINISTRATOR.SILT CONTROLS TO BE INSPECTED ON A REGULAR BASIS AND AFTER EVERY RAIN EVENT. INSTALLATION SHALL BE TO THE MANUFACTURER'S RECOMMENDED SPECIFICATIONS.
4. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE INSPECTED AT LEAST ONCE A WEEK, AND AFTER EVERY RAINFALL EVENT.
6. CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 577, CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES AS WELL AS ALL APPLICABLE MUNICIPAL STANDARDS.
7. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES. SUCH MEASURES SHOULD BE PRESENTED IN WRITING FOR APPROVAL OF THE SITE ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE MUNICIPALITY AND CONSERVATION AUTHORITY.
8. THE TOPS OF ALL FILTER FABRIC MUST BE A MINIMUM OF 1.0 METRES ABOVE THE GROUND LEVEL AND ATTACHED TO THE FENCE WITH A CONTINUOUS STEEL WIRE. ALTERNATIVELY, THE FILTER FABRIC MUST BE FOLDED OVER THE TOP OF THE FENCE AND ATTACHED TO THE FENCE WITH WIRE LOOPED THROUGH THE FABRIC ON BOTH SIDES OF THE FENCE. FILTER FABRIC IS TO BE TERRAFIX 270R OR EQUIVALENT.
9. ALL DISTURBED GROUND LEFT FOR MORE THAN 30 DAYS SHALL BE STABILIZED BY SEEDING, SODDING, MULCHING, OR COVERING OR OTHER EQUIVALENT CONTROL MEASURES. THIS PERIOD OF INACTIVITY SHALL BE AT THE DISCRETION OF THE CITY OF OTTAWA BUT SHALL NOT EXCEED THIRTY DAYS OR SUCH LONGER PERIOD DEEMED ADVISABLE BY THE CITY OF OTTAWA'S PLANNING, INFRASTRUCTURE AND ECONOMIC DEVELOPMENT DEPARTMENT.
10. CONTRACTOR RESPONSIBLE FOR MUD TRACKING, PREVENTION, AND MAINTENANCE ON BORRISOKANE RD.
11. ROADS TO BE LEFT IN A BROOM SWEPT CONDITION AT THE END OF EACH WORK DAY.
12. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALITIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.

NO.	REVISION NOTE	DATE	BY
05.	UPDATED SNOW STORAGE	10/16/24	JM
04.	AS PER 3rd SUBMISSION COMMENTS	10/04/24	JM
03.	AS PER UPDATED SITE PLAN	07/04/24	JM
02.	AS PER 2nd SUBMISSION COMMENTS	02/12/24	JM
01.	AS PER 1st SUBMISSION COMMENTS	11/02/23	JM

BENCHMARK
SPIKE IN UTILITY POLE LOCATED ON THE SE CORNER OF THE BORRISOKANE RD. AND PROMENADE FLAGSTAFF DR. INTERSECTION.
ELEV: 92.96

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

KOREAN COMMUNITY CHURCH
3555 BORRISOKANE ROAD
CITY OF OTTAWA

EROSION PROTECTION AND
REMOVALS PLAN

PEARSON
ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	NW/MWD	HORIZ SCALE	1:500	PROJECT #	22099
DRAWN BY	JM	VERT SCALE	N/A	DRAWING #	EPR–1
CHECKED BY	MWD	DATE	JUNE 2023	REVISION #	5