Appendix A WATER SUPPLY SERVICING

A.1 DOMESTIC WATER DEMAND ESTIMATE

5731 Hazeldean Road Development - Domestic Water Demand Estimates

- Based on Wellings of Stittsville Site Phase 2 (160401511)

Building ID	Area (m^2)	Population	Daily Rate of Demand [1]	Avg Day Demand		Max Day Demand [2,3]		Peak Hour Demand [2,3]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
BLDG A and BLDG C									
Residential	-	354	350	86.1	1.43	215.2	3.59	473.5	7.89
Commercial	1033.67	-	28,000	2.0	0.03	3.0	0.05	5.4	0.09
BLDG B									
Commercial	513	-	28,000	1.0	0.02	1.5	0.02	2.7	0.04
BLDG D									
Residential	-	306	350	74.4	1.24	185.9	3.10	408.9	6.82
Total Site :				**163.4**	**2.72**	**405.6**	**6.76**	**890.5**	**14.84**

1. 28,000 L/gross ha/day is used to calculate water demand for retail, restaurants and office space.
2. The City of Ottawa water demand criteria used to estimate peak demand rates for commercial space are as follows:
   maximum day demand rate = 1.5 x average day demand rate
   maximum hour demand rate = 1.8 x maximum day demand rate
3. The City of Ottaw water demand criteria used to estimate peak demand rates for residential areas are as follows:
   maximum day demand rate = 2.5 x average day demand rate
   maximum hour demand rate = 2.2 x maximum day demand rate

A.2 FIRE FLOW REQUIREMENTS PER FUS

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401317
Project Name: 20 Cedarow Court
Date: 11/7/2019
Fire Flow Calculation #: 1
Description: Building A (Phase 2 and 3)

Notes: 6 storey building with horizontal firewalls between each floor

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Non-Combustible Construction						0.8	-
2	Determine Ground Floor Area of One Unit	-						4760	-
	Determine Number of Adjoining Units	-						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						1	-
4	Determine Required Fire Flow	(F = 220 x C x A$^{1/2}$). Round to nearest 1000 L/min						-	12000
5	Determine Occupancy Charge	Limited Combustible						-15%	10200
6	Determine Sprinkler Reduction	Conforms to NFPA 13						-30%	-4080
		Standard Water Supply						-10%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						100%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	10.1 to 20	30	6	> 120	Wood Frame or Non-Combustible	15%	3978
		East	20.1 to 30	82	2	> 120	Wood Frame or Non-Combustible	10%	
		South	> 45	123	1	> 120	Wood Frame or Non-Combustible	0%	
		West	10.1 to 20	82	1	61-90	Wood Frame or Non-Combustible	14%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							10000
		Total Required Fire Flow in L/s							166.7
		Required Duration of Fire Flow (hrs)							2.00
		Required Volume of Fire Flow (m^3)							1200

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401317
Project Name: 20 Cedarow Court
Date: 11/7/2019
Fire Flow Calculation #: 1
Description: Building B (Phase 4)

Notes: 6 storey building with horizontal firewalls between each floor

<table>
<tr><th>Step</th><th>Task</th><th colspan="6">Notes</th><th>Value Used</th><th>Req'd Fire Flow (L/min)</th></tr>
<tr><td>1</td><td>Determine Type of Construction</td><td colspan="6">Non-Combustible Construction</td><td>0.8</td><td>-</td></tr>
<tr><td rowspan="2">2</td><td>Determine Ground Floor Area of One Unit</td><td colspan="6">-</td><td>3321</td><td>-</td></tr>
<tr><td>Determine Number of Adjoining Units</td><td colspan="6">-</td><td>1</td><td>-</td></tr>
<tr><td>3</td><td>Determine Height in Storeys</td><td colspan="6">Does not include floors >50% below grade or open attic space</td><td>1</td><td>-</td></tr>
<tr><td>4</td><td>Determine Required Fire Flow</td><td colspan="6">($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min</td><td>-</td><td>10000</td></tr>
<tr><td>5</td><td>Determine Occupancy Charge</td><td colspan="6">Limited Combustible</td><td>-15%</td><td>8500</td></tr>
<tr><td rowspan="5">6</td><td rowspan="5">Determine Sprinkler Reduction</td><td colspan="6">Conforms to NFPA 13</td><td>-30%</td><td rowspan="5">-3400</td></tr>
<tr><td colspan="6">Standard Water Supply</td><td>-10%</td></tr>
<tr><td colspan="6">Not Fully Supervised or N/A</td><td>0%</td></tr>
<tr><td colspan="6">% Coverage of Sprinkler System</td><td>100%</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Determine Increase for Exposures (Max. 75%)</td><td>Direction</td><td>Exposure Distance (m)</td><td>Exposed Length (m)</td><td>Exposed Height (Stories)</td><td>Length-Height Factor (m x stories)</td><td>Construction of Adjacent Wall</td><td>-</td><td>-</td></tr>
<tr><td>North</td><td>> 45</td><td>122</td><td>1</td><td>> 120</td><td>Wood Frame or Non-Combustible</td><td>0%</td><td rowspan="4">2125</td></tr>
<tr><td>East</td><td>30.1 to 45</td><td>54</td><td>5</td><td>> 120</td><td>Wood Frame or Non-Combustible</td><td>5%</td></tr>
<tr><td>South</td><td>10.1 to 20</td><td>122</td><td>5</td><td>> 120</td><td>Wood Frame or Non-Combustible</td><td>15%</td></tr>
<tr><td>West</td><td>30.1 to 45</td><td>28</td><td>1</td><td>0-30</td><td>Wood Frame or Non-Combustible</td><td>5%</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">Determine Final Required Fire Flow</td><td colspan="7">Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min</td><td>7000</td></tr>
<tr><td colspan="7">Total Required Fire Flow in L/s</td><td>116.7</td></tr>
<tr><td colspan="7">Required Duration of Fire Flow (hrs)</td><td>2.00</td></tr>
<tr><td colspan="7">Required Volume of Fire Flow (m^3)</td><td>840</td></tr>
</table>

A.3 **BOUNDRY CONDITIONS**

Boundary Conditions - 20 Cedarow Court

Date Provided October-19

Scenario	Demand	
	L/min	L/s
Average Daily Demand	156	2.60
Maximum Daily Demand	388	6.46
Peak Hour	850	14.17
Fire Flow Demand #1	16,020	267

# of connections 2

Location:

Results:

Connection 1 - Cedarow Crescent

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.1	80.3
Peak Hour	157.7	75.5
Max Day plus Fire 1	150.2	64.8

[1] Ground Elevation = 104.6m

Connection 2 - Wellings Pvt

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	161.1	80.3
Peak Hour	157.7	75.4
Max Day plus Fire 1	149.6	63.9

[1] Ground Elevation = 104.7m

Notes:

1. Pressure reducing valve is required since the maximum pressure exceeds 80 psi.
2. Looping of the watermain is required to decrease vulnerability of the water system in case of breaks.
3. Confirm the ownership of the watermain on Wellings Private.

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 B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN

SUBDIVISION:

Nautical Lands Group - Wellings of Stittsville Senior's Living and Extendicare L.T.C.

SANITARY SEWER DESIGN SHEET

(City of Ottawa)

DATE: 5/20/2020
REVISION: 1
DESIGNED BY: TR
CHECKED BY: DT

FILE NUMBER: 1604-01511

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 L/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 L/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 L/ha/day	MANNINGS n	0.013
PEAKING FACTOR (COMM., INST.):	1.5	INDUSTRIAL (LIGHT)	35,000 L/ha/day	BEDDING CLASS	B
STUDIO APARTMENT	1.4	INSTITUTIONAL	28,000 L/ha/day	MINIMUM COVER	2.50 m
1 BEDROOM	1.4	INFILTRATION	0.33 L/s/ha		
2 BEDROOM	2.1				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	Studio	Single 1 Bedroom Units	2 Bedroom	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)	AREA (ha)	ACCU. AREA (ha)	AREA (ha)	ACCU. AREA (ha)	PEAK FLOW (L/s)	TOTAL AREA (ha)	ACCU. AREA (ha)	INFILT. FLOW (L/s)	FLOW (L/s)	LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
Wellings of Stittsville Ph2																																		
ENTIRE SITE	STUB	MAIN	2.14	41	309	81	660	2.14	660	3.91	8.4	0.15	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.1	2.29	2.29	0.8	9.2	23.1	300 675	PVC	SDR 35	0.40	60.7	**15.14%**	0.86	0.51

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET AND ROOF STORAGE CALCULATIONS

Wellings of Stittsville Ph 2- 20 Cedarow Court

DATE: 2019-11-08
REVISION: 1
DESIGNED BY: TR
CHECKED BY: -

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: **160401511**

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013
BEDDING CLASS = B
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																								PIPE SELECTION												
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
ROOF 1, ROOF 2, UGPK 1 TO UGPK - 11	28	27	0.80	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.718	0.718	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	40.8	40.8	194.0	2.0	450	450	CIRCULAR	CONCRETE	-	1.00	297.4	**65.23%**	1.81	1.68	0.02
																				10.02									450	450									
	26	1000	0.80	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.718	0.718	0.000	0.000	0.000	0.000	0.000	0.000	10.02	76.73	104.09	122.02	178.38	0.0	0.0	153.1	2.4	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**115.08%**	0.81	0.81	0.05
	1000	STC 300	0.80	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.718	0.718	0.000	0.000	0.000	0.000	0.000	0.000	10.07	76.54	103.83	121.71	177.93	0.0	0.0	152.7	2.4	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**114.80%**	0.81	0.81	0.05
	STC 300	24	0.80	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.718	0.718	0.000	0.000	0.000	0.000	0.000	0.000	10.12	76.35	103.57	121.41	177.48	0.0	0.0	152.3	25.6	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**114.52%**	0.81	0.81	0.53
																				10.64									675	675									

Note:

ICD and weir are proposed to be constructed in MH 1000 prior to flows discharging to approved outlet, therefore a 450mm diameter pipe is sufficient as flows will be restricted.

Stormwater Management Calculations

File No: **160401195**
Project: **5731 Hazeldean**
Date: **21-May-20**

SWM Approach:
Post-development to Pre-development flows

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	**Sub-catchment Area ID / Description**		**Area (ha) "A"**		**Runoff Coefficient "C"**		**"A x C"**	**Overall Runoff Coefficient**
Roof	ROOF 1	Hard	0.47		0.9	0.425		
		Soft	0.00		0.2	0.000		
		Subtotal		0.472			0.425	0.900
Roof	ROOF 2	Hard	0.34		0.9	0.302		
		Soft	0.00		0.2	0.000		
		Subtotal		0.336			0.302	0.900
Total				**0.808**			**0.727**	
Overall Runoff Coefficient= C:								**0.90**

Total Roof Areas	**0.808**	**ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**0.000**	**ha**
Total Tributary Area to Outlet	**0.808**	**ha**
Total Uncontrolled Areas (Non-Tributary)	**0.000**	**ha**
Total Site	**0.808**	**ha**

Stormwater Management Calculations

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

2 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	732.951
b =	6.199
c =	0.81

t (min)	I (mm/hr)
10	76.81
20	52.03
30	40.04
40	32.86
50	28.04
60	24.56
70	21.91
80	19.83
90	18.14
100	16.75
110	15.57
120	14.56

2 YEAR Modified Rational Method for Entire Site

Subdrainage Area: ROOF 1
Area (ha): 0.47
C: 0.90

Roof
Maximum Storage Depth: 150 mm

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	76.81	90.70	23.02	67.68	40.61	88.1	0.00
20	52.03	61.45	23.91	37.53	**45.04**	91.6	0.00
30	40.04	47.29	23.47	23.82	42.87	89.9	0.00
40	32.86	38.81	22.65	16.16	38.79	86.7	0.00
50	28.04	33.11	21.72	11.39	34.18	83.2	0.00
60	24.56	29.00	20.79	8.21	29.57	79.6	0.00
70	21.91	25.88	19.89	5.98	25.13	76.2	0.00
80	19.83	23.42	18.88	4.54	21.80	72.3	0.00
90	18.14	21.43	17.87	3.56	19.23	68.4	0.00
100	16.75	19.78	16.96	2.82	16.92	64.9	0.00
110	15.57	18.39	16.14	2.25	14.83	61.8	0.00
120	14.56	17.20	15.40	1.80	12.95	59.0	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
2-year Water Level	91.57	0.09	23.91	45.04	188.80	0.00

Subdrainage Area: ROOF 2
Area (ha): 0.34
C: 0.90

Roof
Maximum Storage Depth: 150 mm

tc (min)	I (2 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	76.81	64.57	16.26	48.31	28.98	88.2	0.00
20	52.03	43.74	16.91	26.83	**32.20**	91.7	0.00
30	40.04	33.66	16.61	17.06	30.70	90.1	0.00
40	32.86	27.63	16.03	11.60	27.83	87.0	0.00
50	28.04	23.57	15.38	8.19	24.58	83.4	0.00
60	24.56	20.64	14.73	5.92	21.31	79.9	0.00
70	21.91	18.42	14.10	4.32	18.16	76.5	0.00
80	19.83	16.67	13.40	3.27	15.71	72.7	0.00
90	18.14	15.25	12.68	2.57	13.87	68.8	0.00
100	16.75	14.08	12.04	2.04	12.22	65.3	0.00
110	15.57	13.09	11.46	1.63	10.74	62.2	0.00
120	14.56	12.24	10.94	1.30	9.39	59.3	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
2-year Water Level	91.72	0.09	16.91	32.20	134.40	0.00

Project #160401195, 5731 Hazeldean
Modified Rational Method Calculatons for Storage

100 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
10	178.56
20	119.95
30	91.87
40	75.15
50	63.95
60	55.89
70	49.79
80	44.99
90	41.11
100	37.90
110	35.20
120	32.89

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: ROOF 1
Area (ha): 0.47
C: 1.00

Roof
Maximum Storage Depth: 150 mm

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	234.30	33.56	200.74	120.44	128.5	0.00
20	119.95	157.39	35.66	121.73	146.08	136.6	0.00
30	91.87	120.55	36.14	84.40	**151.93**	138.4	0.00
40	75.15	98.60	36.00	62.60	150.24	137.9	0.00
50	63.95	83.92	35.58	48.34	145.03	136.2	0.00
60	55.89	73.34	35.00	38.34	138.03	134.0	0.00
70	49.79	65.33	34.35	30.98	130.12	131.6	0.00
80	44.99	59.04	33.67	25.37	121.77	128.9	0.00
90	41.11	53.94	32.97	20.98	113.27	126.3	0.00
100	37.90	49.73	32.17	17.57	105.40	123.2	0.00
110	35.20	46.19	31.30	14.89	98.30	119.9	0.00
120	32.89	43.16	30.46	12.70	91.46	116.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	138.41	0.14	36.14	151.93	188.80	0.00

Subdrainage Area: ROOF 2
Area (ha): 0.34
C: 1.00

Roof
Maximum Storage Depth: 150 mm

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	166.79	23.70	143.09	85.85	128.6	0.00
20	119.95	112.04	25.19	86.85	104.22	136.7	0.00
30	91.87	85.81	25.54	60.27	**108.49**	138.6	0.00
40	75.15	70.19	25.45	44.74	107.38	138.1	0.00
50	63.95	59.74	25.15	34.58	103.75	136.5	0.00
60	55.89	52.21	24.75	27.46	98.84	134.3	0.00
70	49.79	46.51	24.30	22.21	93.27	131.8	0.00
80	44.99	42.03	23.82	18.20	87.38	129.2	0.00
90	41.11	38.40	23.33	15.07	81.37	126.6	0.00
100	37.90	35.40	22.79	12.62	75.70	123.6	0.00
110	35.20	32.88	22.18	10.71	70.66	120.3	0.00
120	32.89	30.73	21.59	9.14	65.81	117.1	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	138.56	0.14	25.54	108.49	134.40	0.00

Project #160401195, 5731 Hazeldean
Roof Drain Design Sheet, Area ROOF 1
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0065	1	0.025	105	1	1	0.025
0.050	0.0008	0.0131	7	0.050	420	6	7	0.050
0.075	0.0012	0.0196	24	0.075	944	17	24	0.075
0.100	0.0015	0.0261	56	0.100	1678	32	56	0.100
0.125	0.0019	0.0326	109	0.125	2622	53	109	0.125
0.150	0.0023	0.0392	189	0.150	3776	80	189	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
6.1	468.6	6.1	0.13018
22.7	848.0	16.6	0.36573
55.1	1238.5	32.3	0.70977
108.4	1633.5	53.3	1.16353
187.9	2030.8	79.5	1.72763

Rooftop Storage Summary

Total Building Area (sq.m)		4720
Assume Available Roof Area (sq.	80%	3776
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		17
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		189
Estimated 100 Year Drawdown Time (h)		1.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.024	0.036	-
Depth (m)	0.092	0.138	0.150
Volume (cu.m)	45.0	151.9	188.8
Draintime (hrs)	0.6	1.5	

Project #160401195, 5731 Hazeldean
Roof Drain Design Sheet, Area ROOF 3
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
						Volume (cu. m)		
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Increment	Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0046	1	0.025	75	1	1	0.025
0.050	0.0008	0.0092	5	0.050	299	4	5	0.050
0.075	0.0012	0.0138	17	0.075	672	12	17	0.075
0.100	0.0015	0.0184	40	0.100	1195	23	40	0.100
0.125	0.0019	0.0230	78	0.125	1867	38	78	0.125
0.150	0.0023	0.0276	134	0.150	2688	57	134	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
4.4	472.6	4.4	0.13128
16.2	855.2	11.8	0.36883
39.2	1249.0	23.0	0.71579
77.2	1647.4	38.0	1.17339
133.8	2048.0	56.6	1.74227

Rooftop Storage Summary

Total Building Area (sq.m)		3360
Assume Available Roof Area (sq.	80%	2688
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		12
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		134
Estimated 100 Year Drawdown Time (h)		1.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

* Note: Number of drains can be reduced if multiple-notch drain used.

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.017	0.026	-
Depth (m)	0.092	0.139	0.150
Volume (cu.m)	32.2	108.5	134.4
Draintime (hrs)	0.6	1.5	

Stantec

Wellings of Stittsville Ph 2- 20 Cedarow Court

DATE: 2019-11-11
REVISION: 1
DESIGN BY: TR
CHECKED BY: -

FILE NUMBER: **160401511**

STORM SEWER DESIGN SHEET
(City of Ottawa)

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min
BEDDING CLASS = B

LOCATION			DRAINAGE AREA																							
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)
UNC-4	CB509	104	0.00	0.11	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.000	0.000	0.048	0.048	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	13.8

AREA ID NUMBER	PIPE SELECTION											
	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
UNC-4	21.3	250	250	CIRCULAR	CONCRETE	-	0.50	42.7	**32.42%**	0.86	0.64	0.55

C.2 SAMPLE PCSWMM MODEL INPUT (12HR 100YR SCS)

```
[TITLE]


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           LPS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO
START_DATE           07/23/2009
START_TIME           00:00:00
REPORT_START_DATE    07/23/2009
REPORT_START_TIME    00:00:00
END_DATE             07/24/2009
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:05:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         1
RULE_STEP            00:00:00
INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              4

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
```

```
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
RG1              INTENSITY 0:15   1.0    TIMESERIES 100SCS

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
EXT-1            RG1              CB509-S          0.0688   38.571   95       1.5      0

ROOF_1           RG1              ROOF-1-S         0.4718   100      244      1.5      0

ROOF_2           RG1              ROOF-2-S         0.3362   100      136      1.5      0

UGPK_1           RG1              TANKS            0.0189   100      30       10       0

UGPK_10          RG1              TANKS            0.0178   100      16       2        0

UGPK_11          RG1              TANKS            0.0972   100      58       2        0

UGPK_2           RG1              TANKS            0.1089   100      51       2        0

UGPK_3           RG1              TANKS            0.0969   100      50       2        0

UGPK_4           RG1              TANKS            0.139068 100      60       2        0

UGPK_5           RG1              TANKS            0.0427   100      58       2        0

UGPK_6           RG1              TANKS            0.0726   100      31.4     2        0

UGPK_7           RG1              TANKS            0.07235  100      37       2        0

UGPK_8           RG1              TANKS            0.0202   100      23       10       0

UGPK_9           RG1              TANKS            0.0762   100      41.2     2        0

UNC-1            RG1              OF1              0.0718   61.429   78       2        0

UNC-2            RG1              OF2              0.5355   17.143   25       1        0

UNC-3            RG1              OF3              0.0701   51.429   122      2        0

UNC-4            RG1              CB509-S          0.045061 21.429   90       2        0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
```

```
EXT-1            0.013      0.2        1.57       4.67       0          PERVIOUS   100
ROOF_1           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
ROOF_2           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_1           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_10          0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_11          0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_2           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_3           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_4           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_5           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_6           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_7           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_8           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UGPK_9           0.013      0.2        1.57       4.67       0          IMPERVIOUS 100
UNC-1            0.013      0.2        1.57       4.67       0          PERVIOUS   100
UNC-2            0.013      0.2        1.57       4.67       0          PERVIOUS   100
UNC-3            0.013      0.2        1.57       4.67       0          PERVIOUS   100
UNC-4            0.013      0.2        1.57       4.67       0          PERVIOUS   100

[INFILTRATION]
;;Subcatchment   MaxRate    MinRate    Decay      DryTime    MaxInfil
;;-------------- ---------- ---------- ---------- ---------- ----------
EXT-1            76.2       13.2       4.14       7          0
ROOF_1           76.2       13.2       4.14       7          0
ROOF_2           76.2       13.2       4.14       7          0
UGPK_1           76.2       13.2       4.14       7          0
UGPK_10          76.2       13.2       4.14       7          0
UGPK_11          76.2       13.2       4.14       7          0
UGPK_2           76.2       13.2       4.14       7          0
UGPK_3           76.2       13.2       4.14       7          0
UGPK_4           76.2       13.2       4.14       7          0
UGPK_5           76.2       13.2       4.14       7          0
UGPK_6           76.2       13.2       4.14       7          0
UGPK_7           76.2       13.2       4.14       7          0
UGPK_8           76.2       13.2       4.14       7          0
UGPK_9           76.2       13.2       4.14       7          0
UNC-1            76.2       13.2       4.14       7          0
UNC-2            76.2       13.2       4.14       7          0
UNC-3            76.2       13.2       4.14       7          0
UNC-4            76.2       13.2       4.14       7          0

[JUNCTIONS]
;;               Invert     Max.       Init.      Surcharge  Ponded
;;Name           Elev.      Depth      Depth      Depth      Area
;;-------------- ---------- ---------- ---------- ---------- ----------
100              99.4       2.735      0          0          0

[OUTFALLS]
```

```
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
HEADWALL         98.7       FREE                          NO
OF1              0          FREE                          NO
OF2              0          FREE                          NO
OF3              0          FREE                          NO
OF4              101.87     FIXED        102.17           NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                                  Evap.
;;Name           Elev.    Depth    Depth    Curve      Params                                 Frac.
Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- --------
----------------------
1000             99.92    4.22     0        FUNCTIONAL 1.13     0        0        0        0
CB509-S          102.56   2.23     0        FUNCTIONAL 0        0        0        0        0
ROOF-1-S         114      0.15     0        TABULAR    ROOF1                      0        0
ROOF-2-S         114      0.15     0        TABULAR    ROOF2                      0        0
TANKS            99.95    4.19     0        FUNCTIONAL 0        0        222      0        0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.
Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow
Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ----------
----------
C1               CB509-S          OF4              21.3       0.013      102.56     102.45     0          0

C2               1000             100              25.6       0.013      99.92      99.83      0          0

Pipe_13          100              HEADWALL         11.135     0.013      99.548     99.52      0          0


[ORIFICES]
;;               Inlet            Outlet           Orifice      Crest      Disch.     Flap Open/Close
;;Name           Node             Node             Type         Height     Coeff.     Gate Time
;;-------------- ---------------- ---------------- ------------ ---------- ---------- ---- ----------
CISTERN-O        TANKS            1000             SIDE         99.95      0.61       NO   0

[WEIRS]
;;               Inlet            Outlet           Weir         Crest      Disch.     Flap End      End

;;Name           Node             Node             Type         Height     Coeff.     Gate Con.     Coeff.
  Surcharge  RoadWidth  RoadSurf   Coeff. Curve
;;-------------- ---------------- ---------------- ------------ ---------- ---------- ---- --------
---------- ---------- ---------- ---------- ----------------
```

```
W1               TANKS            1000             TRANSVERSE   102.47     1.67       NO   0        0
  YES

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet           Qcoeff/
Flap
;;Name           Node             Node             Height     Type             QTable           Qexpon
Gate
;;-------------- ---------------- ---------------- ---------- ---------------- ---------------- ----------
----
ROOF1-O          ROOF-1-S         TANKS            114        TABULAR/HEAD     ROOF-1-O
NO
ROOF2-O          ROOF-2-S         TANKS            114        TABULAR/HEAD     ROOF-2-O
NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
C1               CIRCULAR     0.25             0          0          0          1
C2               CIRCULAR     0.45             0          0          0          1
Pipe_13          CIRCULAR     0.9              0          0          0          1
CISTERN-O        CIRCULAR     0.075            0          0          0
W1               RECT_OPEN    1                0.5        0          0

[TRANSECTS]

NC 0.013    0.013    0.013
X1 Overland         5        0.15     6.85     0.0       0.0       0.0      0.0      0.0
GR 0.15     0        0        0.15     0        6.85     0.15     7        0.15     7

;[LE: 0][RE: 7]
NC 0.013    0.013    0.013
X1 Overland(orig)   4        0.15     6.85     0.0       0.0       0.0      0.0      0.0
GR 0.15     0        0        0.15     0        6.85     0.15     7

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
C2               0          0.14       0          NO         0

[INFLOWS]
;;                                                Param    Units    Scale    Baseline Baseline
;;Node           Parameter        Time Series      Type     Factor   Factor   Value    Pattern
;;-------------- ---------------- ---------------- -------- -------- -------- -------- --------
100              FLOW             100yrHydrograph  FLOW     1.0      1        0

[CURVES]
;;Name           Type       X-Value    Y-Value
```

```
;;-------------- ---------- ---------- ----------
BIOSWALE_BASEFLOW Rating     0          0
BIOSWALE_BASEFLOW            0.01       0.3
BIOSWALE_BASEFLOW            10         0.3

ROOF-1-O         Rating     0          0
ROOF-1-O                    0.025      6.5
ROOF-1-O                    0.05       13.1
ROOF-1-O                    0.075      19.6
ROOF-1-O                    0.1        26.1
ROOF-1-O                    0.125      32.6
ROOF-1-O                    0.15       39.2

ROOF-2-O         Rating     0          0
ROOF-2-O                    0.025      4.61
ROOF-2-O                    0.05       9.22
ROOF-2-O                    0.075      13.82
ROOF-2-O                    0.1        18.43
ROOF-2-O                    0.125      23.04
ROOF-2-O                    0.15       27.65

ROOF1            Storage    0          0
ROOF1                       0.025      105.6
ROOF1                       0.05       422.2
ROOF1                       0.075      950
ROOF1                       0.1        1688.9
ROOF1                       0.125      2638.9
ROOF1                       0.15       3800

ROOF2            Storage    0          0
ROOF2                       0.025      73.3
ROOF2                       0.05       293.3
ROOF2                       0.075      660
ROOF2                       0.1        1173.3
ROOF2                       0.125      1833.3
ROOF2                       0.15       2640

TANK             Storage    0          560.7
TANK                        0.026      560.7
TANK                        0.051      560.7
TANK                        0.077      560.7
TANK                        0.102      559.44
TANK                        0.127      559.44
TANK                        0.153      558.18
TANK                        0.178      556.92
TANK                        0.204      555.66
TANK                        0.229      554.4
TANK                        0.254      551.88
```

```
TANK                        0.28       549.36
TANK                        0.305      546.84
TANK                        0.331      543.06
TANK                        0.356      539.28
TANK                        0.381      534.24
TANK                        0.407      527.94
TANK                        0.432      521.64
TANK                        0.458      514.08
TANK                        0.483      505.26
TANK                        0.508      495.18
TANK                        0.534      483.84
TANK                        0.559      478.8
TANK                        0.585      464.94
TANK                        0.61       449.82
TANK                        0.635      434.7
TANK                        0.661      419.58
TANK                        0.686      403.2
TANK                        0.712      383.04
TANK                        0.737      360.36
TANK                        0.762      347.76
TANK                        0.796      335.16
TANK                        0.813      320.04
TANK                        0.839      304.92
TANK                        0.864      289.8
TANK                        0.889      272.16
TANK                        0.915      258.3
TANK                        0.94       244.44
TANK                        0.965      233.1
TANK                        0.991      221.76
TANK                        1.016      211.68
TANK                        1.041      201.6
TANK                        1.067      192.78
TANK                        1.092      185.22
TANK                        1.118      180.18
TANK                        1.143      176.4
TANK                        1.168      172.62
TANK                        1.194      170.1
TANK                        1.219      167.58
TANK                        1.245      165.06
TANK                        1.27       163.8
TANK                        1.295      162.54
TANK                        1.321      162.54
TANK                        1.346      162.54
TANK                        1.372      161.28
TANK                        1.397      161.28
TANK                        1.422      161.28
TANK                        1.448      161.28
TANK                        1.473      161.28
```

```
TANK                        1.499      161.28
TANK                        1.524      161.28
TANK                        1.549      161.28
TANK                        1.575      161.28
TANK                        1.6        161.28
TANK                        1.626      161.28
TANK                        1.651      161.28
TANK                        1.676      161.28
TANK                        1.702      161.28
TANK                        1.727      161.28
TANK                        1.753      161.28
TANK                        1.778      161.28
TANK                        1.803      161.28
TANK                        1.829      161.28
TANK                        1.83       0
TANK                        5          0

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;MTO Distribution, 15min intervals
002SCS                      0:00       0
002SCS                      0:15       1.08
002SCS                      0:30       1.08
002SCS                      0:45       1.08
002SCS                      1:00       1.08
002SCS                      1:15       1.08
002SCS                      1:30       1.08
002SCS                      1:45       1.08
002SCS                      2:00       1.296
002SCS                      2:15       1.296
002SCS                      2:30       1.296
002SCS                      2:45       1.296
002SCS                      3:00       1.728
002SCS                      3:15       1.728
002SCS                      3:30       1.728
002SCS                      3:45       1.728
002SCS                      4:00       2.592
002SCS                      4:15       2.592
002SCS                      4:30       3.456
002SCS                      4:45       3.456
002SCS                      5:00       5.184
002SCS                      5:15       5.184
002SCS                      5:30       20.736
002SCS                      5:45       57.024
002SCS                      6:00       7.776
002SCS                      6:15       7.776
002SCS                      6:30       3.456
```

```
002SCS                      6:45       3.456
002SCS                      7:00       2.592
002SCS                      7:15       2.592
002SCS                      7:30       2.592
002SCS                      7:45       2.592
002SCS                      8:00       1.512
002SCS                      8:15       1.512
002SCS                      8:30       1.512
002SCS                      8:45       1.512
002SCS                      9:00       1.512
002SCS                      9:15       1.512
002SCS                      9:30       1.512
002SCS                      9:45       1.512
002SCS                      10:00      0.864
002SCS                      10:15      0.864
002SCS                      10:30      0.864
002SCS                      10:45      0.864
002SCS                      11:00      0.864
002SCS                      11:15      0.864
002SCS                      11:30      0.864
002SCS                      11:45      0.864
002SCS                      12:00      0

005SCS                      0:00:00    0
005SCS                      0:15:00    1.44
005SCS                      0:30:00    1.44
005SCS                      0:45:00    1.44
005SCS                      1:00:00    1.44
005SCS                      1:15:00    1.44
005SCS                      1:30:00    1.44
005SCS                      1:45:00    1.44
005SCS                      2:00:00    1.728
005SCS                      2:15:00    1.728
005SCS                      2:30:00    1.728
005SCS                      2:45:00    1.728
005SCS                      3:00:00    2.304
005SCS                      3:15:00    2.304
005SCS                      3:30:00    2.304
005SCS                      3:45:00    2.304
005SCS                      4:00:00    3.456
005SCS                      4:15:00    3.456
005SCS                      4:30:00    4.608
005SCS                      4:45:00    4.608
005SCS                      5:00:00    6.912
005SCS                      5:15:00    6.912
005SCS                      5:30:00    27.648
005SCS                      5:45:00    76.032
005SCS                      6:00:00    10.368
```

```
005SCS                      6:15:00    10.368
005SCS                      6:30:00    4.608
005SCS                      6:45:00    4.608
005SCS                      7:00:00    3.456
005SCS                      7:15:00    3.456
005SCS                      7:30:00    3.456
005SCS                      7:45:00    3.456
005SCS                      8:00:00    2.016
005SCS                      8:15:00    2.016
005SCS                      8:30:00    2.016
005SCS                      8:45:00    2.016
005SCS                      9:00:00    2.016
005SCS                      9:15:00    2.016
005SCS                      9:30:00    2.016
005SCS                      9:45:00    2.016
005SCS                      10:00:00   1.152
005SCS                      10:15:00   1.152
005SCS                      10:30:00   1.152
005SCS                      10:45:00   1.152
005SCS                      11:00:00   1.152
005SCS                      11:15:00   1.152
005SCS                      11:30:00   1.152
005SCS                      11:45:00   1.152
005SCS                      12:00:00   0

010SCS                      0:00:00    0
010SCS                      0:15:00    1.68
010SCS                      0:30:00    1.68
010SCS                      0:45:00    1.68
010SCS                      1:00:00    1.68
010SCS                      1:15:00    1.68
010SCS                      1:30:00    1.68
010SCS                      1:45:00    1.68
010SCS                      2:00:00    2.02
010SCS                      2:15:00    2.02
010SCS                      2:30:00    2.02
010SCS                      2:45:00    2.02
010SCS                      3:00:00    2.69
010SCS                      3:15:00    2.69
010SCS                      3:30:00    2.69
010SCS                      3:45:00    2.69
010SCS                      4:00:00    4.03
010SCS                      4:15:00    4.03
010SCS                      4:30:00    5.38
010SCS                      4:45:00    5.38
010SCS                      5:00:00    8.06
010SCS                      5:15:00    8.06
010SCS                      5:30:00    32.26
```

C.3 SAMPLE PCSWMM MODEL OUTPUT (12HR 100YR SCS)

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.013)
--------------------------------------------------------------


*************
Element Count
*************
Number of rain gages ...... 1
Number of subcatchments ... 18
Number of nodes ........... 11
Number of links ........... 7
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                     Data       Recording
Name                 Data Source                     Type       Interval 
-------------------------------------------------------------------------
RG1                  100SCS                          INTENSITY   15 min.   


********************
Subcatchment Summary
********************
Name                       Area     Width   %Imperv    %Slope Rain Gage            Outlet              

-----------------------------------------------------------------------------------------------------------
EXT-1                      0.07     95.00     38.57    1.5000 RG1                  CB509-S             
ROOF_1                     0.47    244.00    100.00    1.5000 RG1                  ROOF-1-S            
ROOF_2                     0.34    136.00    100.00    1.5000 RG1                  ROOF-2-S            
UGPK_1                     0.02     30.00    100.00   10.0000 RG1                  TANKS               
UGPK_10                    0.02     16.00    100.00    2.0000 RG1                  TANKS               
UGPK_11                    0.10     58.00    100.00    2.0000 RG1                  TANKS               
UGPK_2                     0.11     51.00    100.00    2.0000 RG1                  TANKS               
UGPK_3                     0.10     50.00    100.00    2.0000 RG1                  TANKS               
UGPK_4                     0.14     60.00    100.00    2.0000 RG1                  TANKS               
UGPK_5                     0.04     58.00    100.00    2.0000 RG1                  TANKS               
UGPK_6                     0.07     31.40    100.00    2.0000 RG1                  TANKS               
UGPK_7                     0.07     37.00    100.00    2.0000 RG1                  TANKS               
UGPK_8                     0.02     23.00    100.00   10.0000 RG1                  TANKS               
UGPK_9                     0.08     41.20    100.00    2.0000 RG1                  TANKS               
UNC-1                      0.07     78.00     61.43    2.0000 RG1                  OF1                 
UNC-2                      0.54     25.00     17.14    1.0000 RG1                  OF2                 
UNC-3                      0.07    122.00     51.43    2.0000 RG1                  OF3                 
```

```
UNC-4                      0.05     90.00     21.43    2.0000 RG1                  CB509-S             


************
Node Summary
************
                                           Invert      Max.    Ponded    External
Name                 Type                   Elev.     Depth      Area    Inflow  
-------------------------------------------------------------------------------
100                  JUNCTION               99.40      2.73       0.0    Yes
HEADWALL             OUTFALL                98.70      1.72       0.0
OF1                  OUTFALL                 0.00      0.00       0.0
OF2                  OUTFALL                 0.00      0.00       0.0
OF3                  OUTFALL                 0.00      0.00       0.0
OF4                  OUTFALL               101.87      0.83       0.0
1000                 STORAGE                99.92      4.22       0.0
CB509-S              STORAGE               102.56      2.23       0.0
ROOF-1-S             STORAGE               114.00      0.15       0.0
ROOF-2-S             STORAGE               114.00      0.15       0.0
TANKS                STORAGE                99.95      4.19       0.0


************
Link Summary
************
Name             From Node        To Node          Type            Length    %Slope Roughness
---------------------------------------------------------------------------------------------
C1               CB509-S          OF4              CONDUIT           21.3    0.5164    0.0130
C2               1000             100              CONDUIT           25.6    0.3516    0.0130
Pipe_13          100              HEADWALL         CONDUIT           11.1    0.2515    0.0130
CISTERN-O        TANKS            1000             ORIFICE
W1               TANKS            1000             WEIR
ROOF1-O          ROOF-1-S         TANKS            OUTLET
ROOF2-O          ROOF-2-S         TANKS            OUTLET


*********************
Cross Section Summary
*********************
                                        Full     Full     Hyd.     Max.   No. of     Full
Conduit          Shape                 Depth     Area     Rad.    Width  Barrels     Flow
---------------------------------------------------------------------------------------
C1               CIRCULAR               0.25     0.05     0.06     0.25        1    42.74
C2               CIRCULAR               0.45     0.16     0.11     0.45        1   169.06
Pipe_13          CIRCULAR               0.90     0.64     0.23     0.90        1   907.85
```

```
****************
Transect Summary
****************

Transect Overland
Area:
            0.0196     0.0392     0.0588     0.0784     0.0980
            0.1177     0.1374     0.1571     0.1768     0.1965
            0.2162     0.2360     0.2558     0.2756     0.2954
            0.3152     0.3351     0.3550     0.3748     0.3947
            0.4147     0.4346     0.4546     0.4745     0.4945
            0.5145     0.5346     0.5546     0.5747     0.5947
            0.6148     0.6350     0.6551     0.6752     0.6954
            0.7156     0.7358     0.7560     0.7762     0.7965
            0.8168     0.8371     0.8574     0.8777     0.8980
            0.9184     0.9388     0.9592     0.9796     1.0000
Hrad:
            0.0208     0.0415     0.0622     0.0829     0.1036
            0.1242     0.1448     0.1653     0.1858     0.2063
            0.2268     0.2472     0.2676     0.2879     0.3083
            0.3285     0.3488     0.3690     0.3892     0.4094
            0.4295     0.4496     0.4697     0.4897     0.5097
            0.5297     0.5496     0.5695     0.5894     0.6093
            0.6291     0.6489     0.6686     0.6884     0.7081
            0.7277     0.7474     0.7670     0.7865     0.8061
            0.8256     0.8451     0.8646     0.8840     0.9034
            0.9228     0.9421     0.9614     0.9807     1.0000
Width:
            0.9580     0.9589     0.9597     0.9606     0.9614
            0.9623     0.9631     0.9640     0.9649     0.9657
            0.9666     0.9674     0.9683     0.9691     0.9700
            0.9709     0.9717     0.9726     0.9734     0.9743
            0.9751     0.9760     0.9769     0.9777     0.9786
            0.9794     0.9803     0.9811     0.9820     0.9829
            0.9837     0.9846     0.9854     0.9863     0.9871
            0.9880     0.9889     0.9897     0.9906     0.9914
            0.9923     0.9931     0.9940     0.9949     0.9957
            0.9966     0.9974     0.9983     0.9991     1.0000

Transect Overland(orig)
Area:
            0.0196     0.0392     0.0588     0.0784     0.0980
            0.1177     0.1374     0.1571     0.1768     0.1965
            0.2162     0.2360     0.2558     0.2756     0.2954
            0.3152     0.3351     0.3550     0.3748     0.3947
            0.4147     0.4346     0.4546     0.4745     0.4945
            0.5145     0.5346     0.5546     0.5747     0.5947
            0.6148     0.6350     0.6551     0.6752     0.6954
```

```
            0.7156     0.7358     0.7560     0.7762     0.7965
            0.8168     0.8371     0.8574     0.8777     0.8980
            0.9184     0.9388     0.9592     0.9796     1.0000
Hrad:
            0.0208     0.0415     0.0622     0.0829     0.1036
            0.1242     0.1448     0.1653     0.1858     0.2063
            0.2268     0.2472     0.2676     0.2879     0.3083
            0.3285     0.3488     0.3690     0.3892     0.4094
            0.4295     0.4496     0.4697     0.4897     0.5097
            0.5297     0.5496     0.5695     0.5894     0.6093
            0.6291     0.6489     0.6686     0.6884     0.7081
            0.7277     0.7474     0.7670     0.7865     0.8061
            0.8256     0.8451     0.8646     0.8840     0.9034
            0.9228     0.9421     0.9614     0.9807     1.0000
Width:
            0.9580     0.9589     0.9597     0.9606     0.9614
            0.9623     0.9631     0.9640     0.9649     0.9657
            0.9666     0.9674     0.9683     0.9691     0.9700
            0.9709     0.9717     0.9726     0.9734     0.9743
            0.9751     0.9760     0.9769     0.9777     0.9786
            0.9794     0.9803     0.9811     0.9820     0.9829
            0.9837     0.9846     0.9854     0.9863     0.9871
            0.9880     0.9889     0.9897     0.9906     0.9914
            0.9923     0.9931     0.9940     0.9949     0.9957
            0.9966     0.9974     0.9983     0.9991     1.0000


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... LPS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Infiltration Method ...... HORTON
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
```

```
  Starting Date ............ 07/23/2009 00:00:00
  Ending Date .............. 07/24/2009 00:00:00
  Antecedent Dry Days ...... 0.0
  Report Time Step ......... 00:05:00
  Wet Time Step ............ 00:05:00
  Dry Time Step ............ 00:05:00
  Routing Time Step ........ 1.00 sec
  Variable Time Step ....... NO
  Maximum Trials ........... 8
  Number of Threads ........ 1
  Head Tolerance ........... 0.001500 m


  **************************        Volume         Depth
  Runoff Quantity Continuity     hectare-m            mm
  **************************     ---------       -------
  Total Precipitation ......         0.226        95.520
  Evaporation Loss .........         0.000         0.000
  Infiltration Loss ........         0.050        21.018
  Surface Runoff ...........         0.174        73.566
  Final Storage ............         0.003         1.183
  Continuity Error (%) .....        -0.258


  **************************        Volume        Volume
  Flow Routing Continuity        hectare-m      10^6 ltr
  **************************     ---------     ---------
  Dry Weather Inflow .......         0.000         0.000
  Wet Weather Inflow .......         0.174         1.738
  Groundwater Inflow .......         0.000         0.000
  RDII Inflow ..............         0.000         0.000
  External Inflow ..........         0.183         1.828
  External Outflow .........         0.353         3.533
  Flooding Loss ............         0.000         0.000
  Evaporation Loss .........         0.000         0.000
  Exfiltration Loss ........         0.000         0.000
  Initial Stored Volume ....         0.000         0.000
  Final Stored Volume ......         0.003         0.032
  Continuity Error (%) .....         0.005


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.


  *************************
```

```
  Routing Time Step Summary
  *************************
  Minimum Time Step           :     1.00 sec
  Average Time Step           :     1.00 sec
  Maximum Time Step           :     1.00 sec
  Percent in Steady State     :     0.00
  Average Iterations per Step :     2.00
  Percent Not Converging      :     0.00


  ***************************
  Subcatchment Runoff Summary
  ***************************

------------------------------------------------------------------------------------------------------------
------------------
                            Total      Total      Total      Total     Imperv       Perv      Total
Total     Peak  Runoff
                           Precip      Runon       Evap      Infil     Runoff     Runoff     Runoff
Runoff   Runoff   Coeff
  Subcatchment                 mm         mm         mm         mm         mm         mm         mm    10^6
ltr      LPS
------------------------------------------------------------------------------------------------------------
------------------
  EXT-1                     95.52       0.00       0.00      52.83      36.25      42.60      42.60
0.03    22.65   0.446
  ROOF_1                    95.52       0.00       0.00       0.00      94.20       0.00      94.20
0.44   166.07   0.986
  ROOF_2                    95.52       0.00       0.00       0.00      94.26       0.00      94.26
0.32   118.33   0.987
  UGPK_1                    95.52       0.00       0.00       0.00      93.97       0.00      93.97
0.02     6.65   0.984
  UGPK_10                   95.52       0.00       0.00       0.00      94.06       0.00      94.06
0.02     6.27   0.985
  UGPK_11                   95.52       0.00       0.00       0.00      94.13       0.00      94.13
0.09    34.21   0.985
  UGPK_2                    95.52       0.00       0.00       0.00      94.19       0.00      94.19
0.10    38.33   0.986
  UGPK_3                    95.52       0.00       0.00       0.00      94.17       0.00      94.17
0.09    34.11   0.986
  UGPK_4                    95.52       0.00       0.00       0.00      94.21       0.00      94.21
0.13    48.95   0.986
  UGPK_5                    95.52       0.00       0.00       0.00      94.01       0.00      94.01
0.04    15.03   0.984
  UGPK_6                    95.52       0.00       0.00       0.00      94.21       0.00      94.21
0.07    25.55   0.986
```

```
  UGPK_7                    95.52       0.00       0.00       0.00      94.17       0.00      94.17
0.07    25.47   0.986
  UGPK_8                    95.52       0.00       0.00       0.00      93.98       0.00      93.98
0.02     7.11   0.984
  UGPK_9                    95.52       0.00       0.00       0.00      94.16       0.00      94.16
0.07    26.82   0.986
  UNC-1                     95.52       0.00       0.00      43.11      57.73      51.75      51.75
0.04    24.25   0.542
  UNC-2                     95.52       0.00       0.00      68.97      16.18      26.45      26.45
0.14    45.38   0.277
  UNC-3                     95.52       0.00       0.00      48.05      48.33      46.94      46.94
0.03    23.42   0.491
  UNC-4                     95.52       0.00       0.00      58.02      20.15      37.93      37.93
0.02    14.55   0.397


  ******************
  Node Depth Summary
  ******************

  ---------------------------------------------------------------------------------
                                 Average  Maximum  Maximum  Time of Max    Reported
                                   Depth    Depth      HGL   Occurrence   Max Depth
  Node                 Type       Meters   Meters   Meters  days hr:min      Meters
  ---------------------------------------------------------------------------------
  100                  JUNCTION     0.24     0.43    99.83     0  06:46        0.43
  HEADWALL             OUTFALL      0.00     0.00    98.70     0  00:00        0.00
  OF1                  OUTFALL      0.00     0.00     0.00     0  00:00        0.00
  OF2                  OUTFALL      0.00     0.00     0.00     0  00:00        0.00
  OF3                  OUTFALL      0.00     0.00     0.00     0  00:00        0.00
  OF4                  OUTFALL      0.30     0.30   102.17     0  00:00        0.30
  1000                 STORAGE      0.09     0.25   100.17     0  06:24        0.25
  CB509-S              STORAGE      0.00     0.18   102.74     0  06:15        0.18
  ROOF-1-S             STORAGE      0.02     0.14   114.14     0  06:19        0.14
  ROOF-2-S             STORAGE      0.02     0.14   114.14     0  06:19        0.14
  TANKS                STORAGE      1.19     2.73   102.68     0  06:24        2.73


  *******************
  Node Inflow Summary
  *******************

  -------------------------------------------------------------------------------------------------
                                  Maximum  Maximum                  Lateral       Total        Flow
                                  Lateral    Total  Time of Max      Inflow      Inflow     Balance
                                   Inflow   Inflow   Occurrence      Volume      Volume       Error
  Node                 Type           LPS      LPS  days hr:min    10^6 ltr    10^6 ltr     Percent
  -------------------------------------------------------------------------------------------------
```

```
  100                  JUNCTION    136.19   230.08     0  06:46        1.83        3.28       0.009
  HEADWALL             OUTFALL       0.00   230.08     0  06:46           0        3.27       0.000
  OF1                  OUTFALL      24.25    24.25     0  06:15      0.0372      0.0372       0.000
  OF2                  OUTFALL      45.38    45.38     0  06:15       0.142       0.142       0.000
  OF3                  OUTFALL      23.42    23.42     0  06:15      0.0329      0.0329       0.000
  OF4                  OUTFALL       0.00    37.17     0  06:15           0      0.0464       0.000
  1000                 STORAGE       0.00   101.24     0  06:24           0        1.45       0.015
  CB509-S              STORAGE      37.19    37.19     0  06:15      0.0464      0.0464      -0.001
  ROOF-1-S             STORAGE     166.07   166.07     0  06:10       0.444       0.444      -0.001
  ROOF-2-S             STORAGE     118.33   118.33     0  06:10       0.317       0.317      -0.001
  TANKS                STORAGE     268.51   329.46     0  06:15       0.718        1.48       0.001


  **********************
  Node Surcharge Summary
  **********************

  No nodes were surcharged.


  *********************
  Node Flooding Summary
  *********************

  No nodes were flooded.


  **********************
  Storage Volume Summary
  **********************

  --------------------------------------------------------------------------------------------------
                         Average     Avg  Evap Exfil       Maximum     Max    Time of Max    Maximum
                          Volume    Pcnt  Pcnt  Pcnt        Volume    Pcnt     Occurrence    Outflow
  Storage Unit           1000 m3    Full  Loss  Loss       1000 m3    Full    days hr:min        LPS
  --------------------------------------------------------------------------------------------------
  1000                     0.000       2     0     0         0.000       6       0  06:24     101.24
  CB509-S                  0.000       0     0     0         0.000       0       0  00:00      37.17
  ROOF-1-S                 0.011       5     0     0         0.164      85       0  06:19      37.11
  ROOF-2-S                 0.008       6     0     0         0.117      87       0  06:19      26.41
  TANKS                    0.265      28     0     0         0.607      65       0  06:24     101.24


  ***********************
  Outfall Loading Summary
  ***********************

  -----------------------------------------------------------
```

```
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       LPS       LPS    10^6 ltr
-----------------------------------------------------------
HEADWALL              94.79     39.99    230.08       3.275
OF1                   12.67      3.39     24.25       0.037
OF2                   12.05     13.61     45.38       0.142
OF3                    7.66      4.97     23.42       0.033
OF4                    6.33      8.49     37.17       0.046
-----------------------------------------------------------
System                26.70     70.45     37.17       3.533


********************
Link Flow Summary
********************

-----------------------------------------------------------------------------
                               Maximum  Time of Max   Maximum    Max/    Max/
                                |Flow|   Occurrence   |Veloc|    Full    Full
Link                 Type          LPS  days hr:min     m/sec    Flow   Depth
-----------------------------------------------------------------------------
C1                   CONDUIT     37.17     0  06:15      1.07    0.87    0.67
C2                   CONDUIT    101.24     0  06:24      1.21    0.60    0.52
Pipe_13              CONDUIT    230.08     0  06:46      1.36    0.25    0.31
CISTERN-O            ORIFICE     18.94     0  06:23                      1.00
W1                   WEIR        82.31     0  06:24                      0.21
ROOF1-O              DUMMY       37.11     0  06:19
ROOF2-O              DUMMY       26.41     0  06:19


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
Conduit                Length    Dry  Dry   Dry   Crit  Crit  Crit  Crit  Ltd   Ctrl
-------------------------------------------------------------------------------------
C1                       1.00   0.24  0.00  0.00  0.00  0.00  0.00  0.76  0.00  0.00
C2                       1.00   0.04  0.00  0.00  0.00  0.00  0.00  0.96  0.00  0.00
Pipe_13                  1.00   0.05  0.00  0.00  0.00  0.00  0.00  0.95  0.00  0.00


*************************
Conduit Surcharge Summary
*************************
```

```
No conduits were surcharged.


Analysis begun on:  Wed May 20 11:35:48 2020
Analysis ended on:  Wed May 20 11:35:48 2020
Total elapsed time: < 1 sec
```

C.4 OIL/GRIT SEPARATOR SIZING CALCULATIONS

Detailed Stormceptor Sizing Report – WOS PH2 20 Cedarow Crt

Project Information & Location			
Project Name	WOS PH2	**Project Number**	20349
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	11/4/2019
Designer Information		**EOR Information (optional)**	
Name	thakshika rathnasooriya	**Name**	
Company	stantec	**Company**	
Phone #	613-724-4081	**Phone #**	
Email	thakshika.rathnasooriya@stantec.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WOS PH2 20 Cedarow Crt
Recommended Stormceptor Model	STC 300
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	80
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 300	80
STC 750	85
STC 1000	85
STC 1500	85
STC 2000	86
STC 3000	87
STC 4000	88
STC 5000	89
STC 6000	90
STC 9000	92
STC 10000	92
STC 14000	94
StormceptorMAX	Custom

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).

Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	982.0
Elevation (ft)	370	**Total Infiltration (mm)**	10341.2
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	9654.9

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (ha)	1.60
Imperviousness %	50.60

Up Stream Storage	
Storage (ha-m)	**Discharge (cms)**
0.000	0.000
0.030	0.007
0.060	0.015
0.090	0.022

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	126.00
Water Quality Flow Rate (L/s)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	**Distribution %**	**Specific Gravity**
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WOS PH2 20 Cedarow Crt

Site Details

Drainage Area

Total Area (ha)	1.60
Imperviousness %	50.60

Surface Characteristics

Width (m)	253.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (lps)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

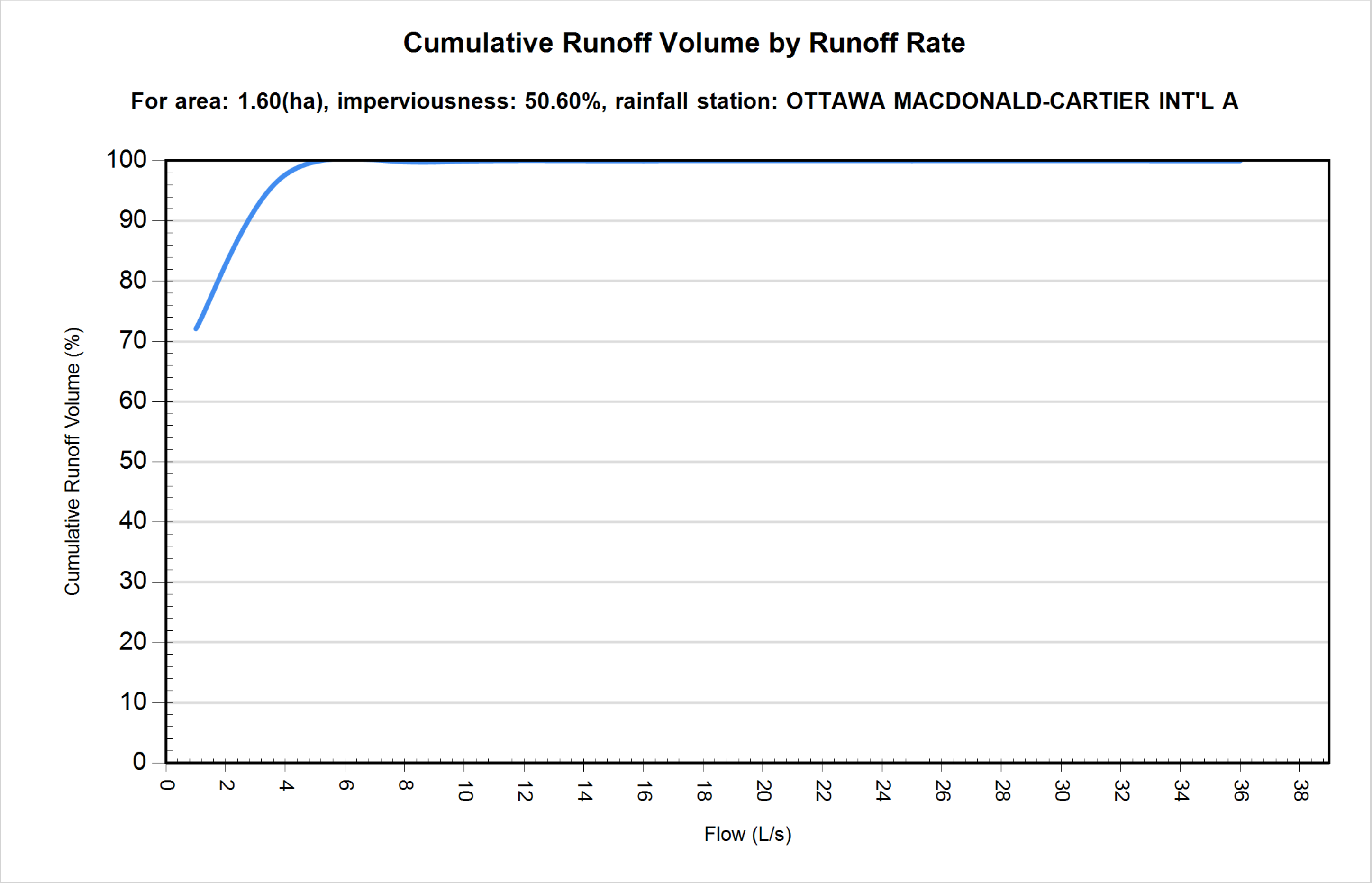
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters

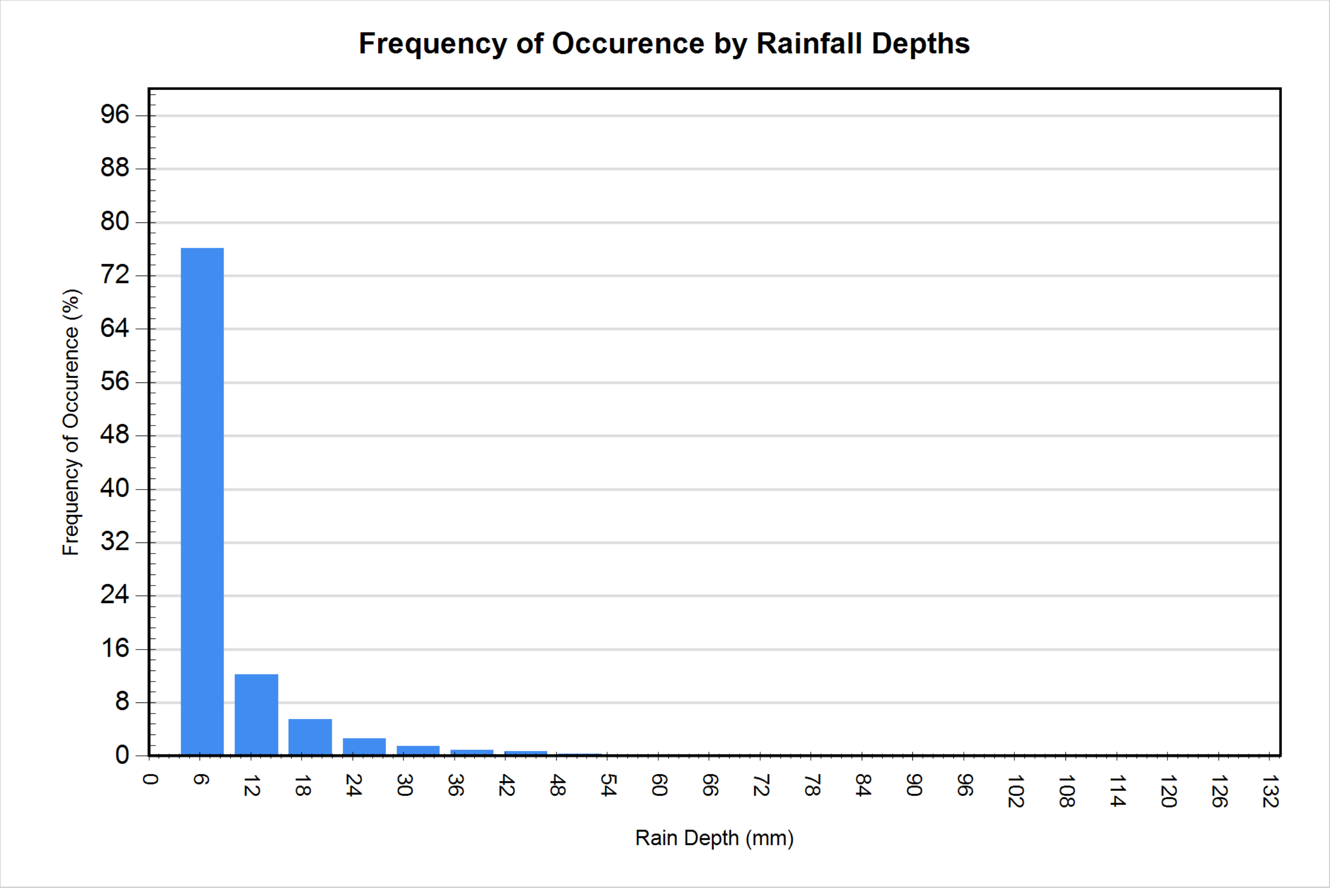
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m³)**	**Volume Over (m³)**	**Cumulative Runoff Volume (%)**
1	111983	43648	72.1
4	151637	3654	97.7
9	154907	370	99.8
16	155201	73	100.0
25	155273	0	100.0
36	155273	0	100.0



Rainfall Event Analysis

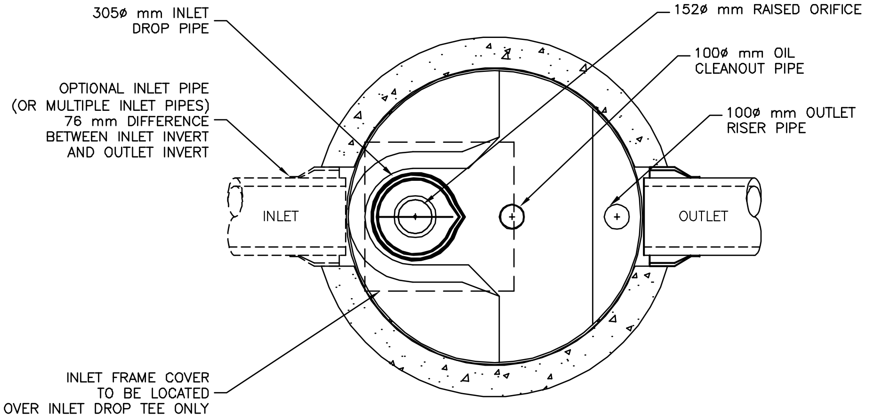
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	5.5
50.80	12	0.3	557	2.7
57.15	7	0.2	378	1.8
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0



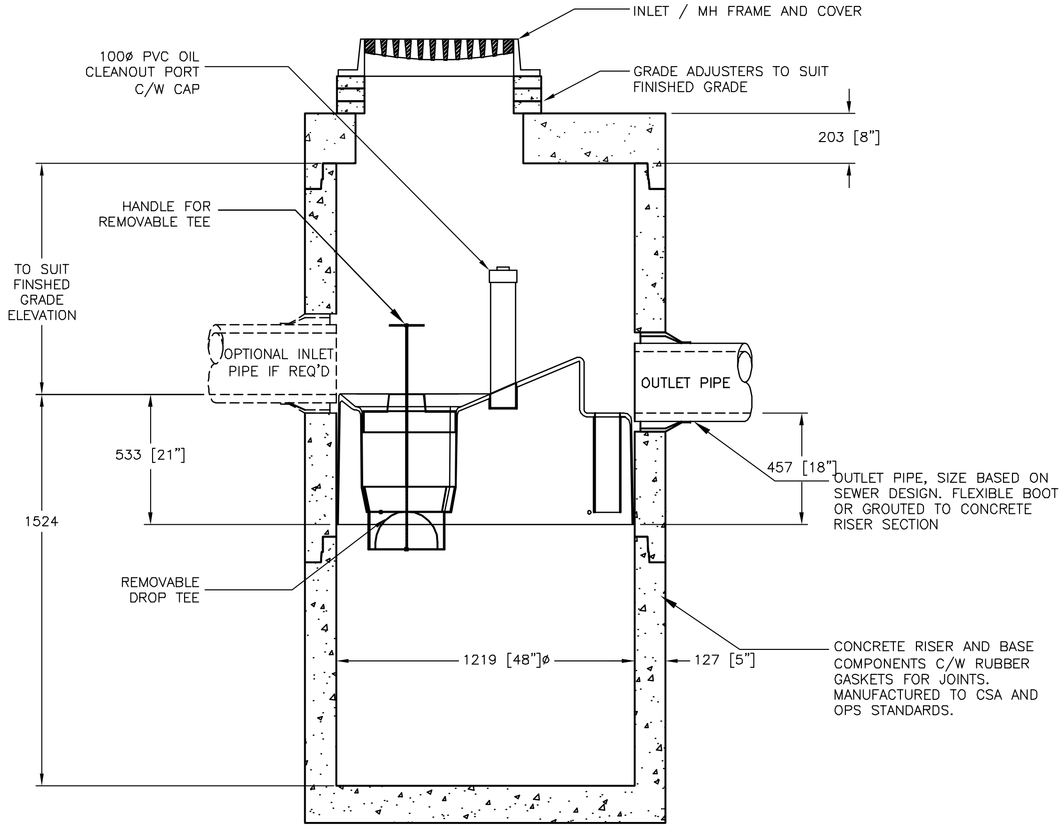
For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

DRAWING NOT TO BE USED FOR CONSTRUCTION

THE STORMCEPTOR SYSTEM IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS:
United States Patent No. 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690 • 7,582,216 • 7,666,303 | Australia Patent No. 693,164 • 707,133 • 729,096 • 779,401 • 289,647 • 2008,279,378 • 2008,288,900 |
Canadian Patent No. 2,009,280 • 2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 | Indonesian Patent No. 007058 | Japan Patent No. 3581233 • 9-11476 |
Korea Patent No. 10-1451593 • 0519212 | Malaysia Patent No. 118987 | New Zealand Patent No. 314,646 • 583,583 • 583,008 | South African Patent No. 2010/00683 • 2010/01796 |



PLAN VIEW



SECTION VIEW

Stormceptor®

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STC 300i
STANDARD MODEL

####

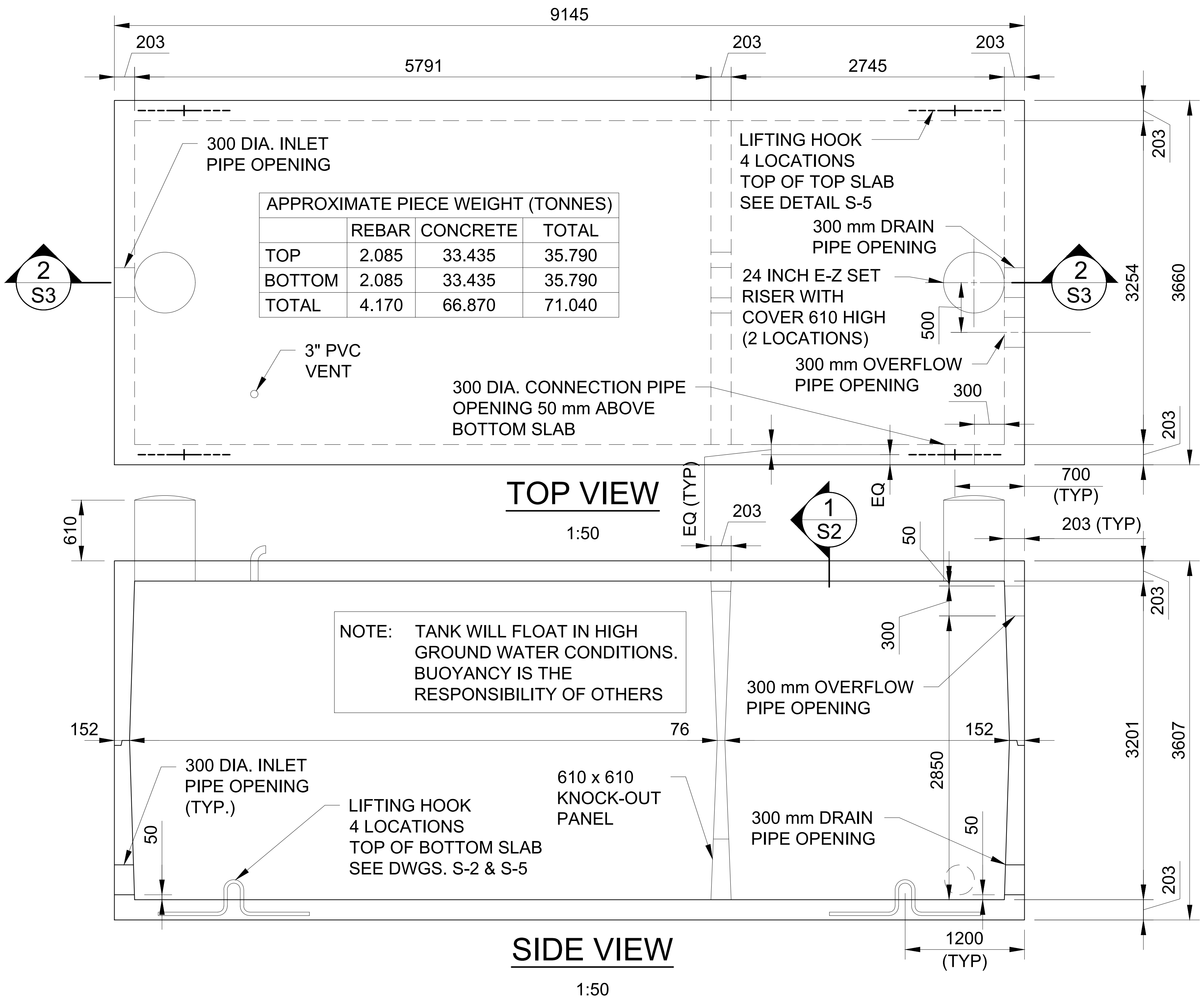
REV #	DATE	REVISION DESCRIPTION	BY

SHEET NUMBER
1
OF 1

DATE: ########
SCALE: 30
PROJECT No.: #####
DRAWN: ###
CHECKED: ###

I:\IMBRIUM\PRODUCTS\STORMCEPTOR\STORMCEPTOR STC\40 DRAWINGS & DETAILS\STANDARD DETAILS\METRIC\STC 300I.DWG 4/12/2019 1:21 PM

C.5 TANK SPECIFICATIONS



APPROXIMATE PIECE WEIGHT (TONNES)			
	REBAR	CONCRETE	TOTAL
TOP	2.085	33.435	35.790
BOTTOM	2.085	33.435	35.790
TOTAL	4.170	66.870	71.040

NOTE: TANK WILL FLOAT IN HIGH GROUND WATER CONDITIONS. BUOYANCY IS THE RESPONSIBILITY OF OTHERS

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.
2. PRECAST CONCRETE TANK DESIGNED TO 2012 ONTARIO BUILDING CODE CSA B66-16. BEDDING, WATERPROOFING, BACKFILL, AND ALL OTHER SITE WORK BY OTHERS.
3. CONCRETE WORK TO BE IN ACCORDANCE WITH CAN/CSA A23.1 CONCRETE MATERIALS AND METHODS OF CONCRETE CONSTRUCTION, AND CAN/CSA A23.4 PRECAST CONCRETE MATERIALS AND CONSTRUCTION.
4. BOX DESIGNED FOR A MAXIMUM FILL HEIGHT OF 760 mm WITH 12 kPa LIVE LOAD. DESIGN FILL COVER ON THIS TANK IS 610 mm.
5. CONCRETE TO BE 45 MPa SCC WITH 600 mm ±70 mm SLUMP.
6. CONCRETE COVER AS NOTED, WITH ±10 mm TOLERANCE.
7. REINFORCING STEEL TO BE GRADE 400W BLACK DEFORMED BARS CONFORMING TO CAN/CSA G30.18.
8. DO NOT LIFT UNITS UNTIL CONCRETE HAS REACHED A MINIMUM STRENGTH OF 25 MPa, AS DETERMINED BY COMPRESSIVE TESTING OF CONCRETE CYLINDERS CURED IN SIMILAR CONDITIONS.
9. GROUT TO BE NON-SHRINK CEMENTITIOUS GROUT WITH MINIMUM COMPRESSIVE STRENGTH OF 45 MPa.
10. JOINT SEAL TO BE CONSEAL CS-102 BUTYL RUBBER SEALANT (CONFORMS TO AASHTO M-198B AND ASTM C-990-91). STORE, HANDLE AND APPLY JOINT SEALS IN STRICT ACCORDANCE WITH MANUFACTURER PRODUCT DATA SHEETS.
11. IT IS STRUCTURALLY IMPORTANT THAT THE SEALS IN THE HORIZONTAL JOINTS BE INSTALLED CORRECTLY. TOP PIECES MUST BE INSTALLED WITHOUT SLIDING THE PIECES ON THE SEALS.
12. DESIGN BASED ON GRANULAR BEDDING AND BACKFILL COMPACTED TO 95% SPDD.
13. LIFTING INSERTS TO BE GROUTED ON SITE BY OTHERS.
14. DELIVERY IS MADE BY CRANE-EQUIPPED TRUCKS.
15. EXCAVATION MUST BE READY, SAFE AND ACCESSIBLE FOR UNLOADING FROM THE REAR OF THE TRUCK.
16. MINIMUM OVERHEAD CLEARANCE OF 18 FT. IS REQUIRED.
17. ALL UNITS MUST BE HANDLED WITH PROPER LIFTING EQUIPMENT (i.e. SPREADER BARS).

MORRISON HERSHFIELD

POWER PRECAST SOLUTIONS

5598 POWER ROAD
OTTAWA, ONTARIO
TEL: 613-822-1488

Version	Description	YYYY-MM-DD
1	ISSUED FOR REVIEW	2018-08-31

Stamp
B.D. MACMASTER
100084361
08/31/18

WELLINGS OF STITTSVILLE

PPS JOB NO.: 2018-0803
MH JOB NO.: 2170737.34

TANK DIMENSIONS

Scale
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DWG No.	Version	Date
S-1	1	2018-08-28

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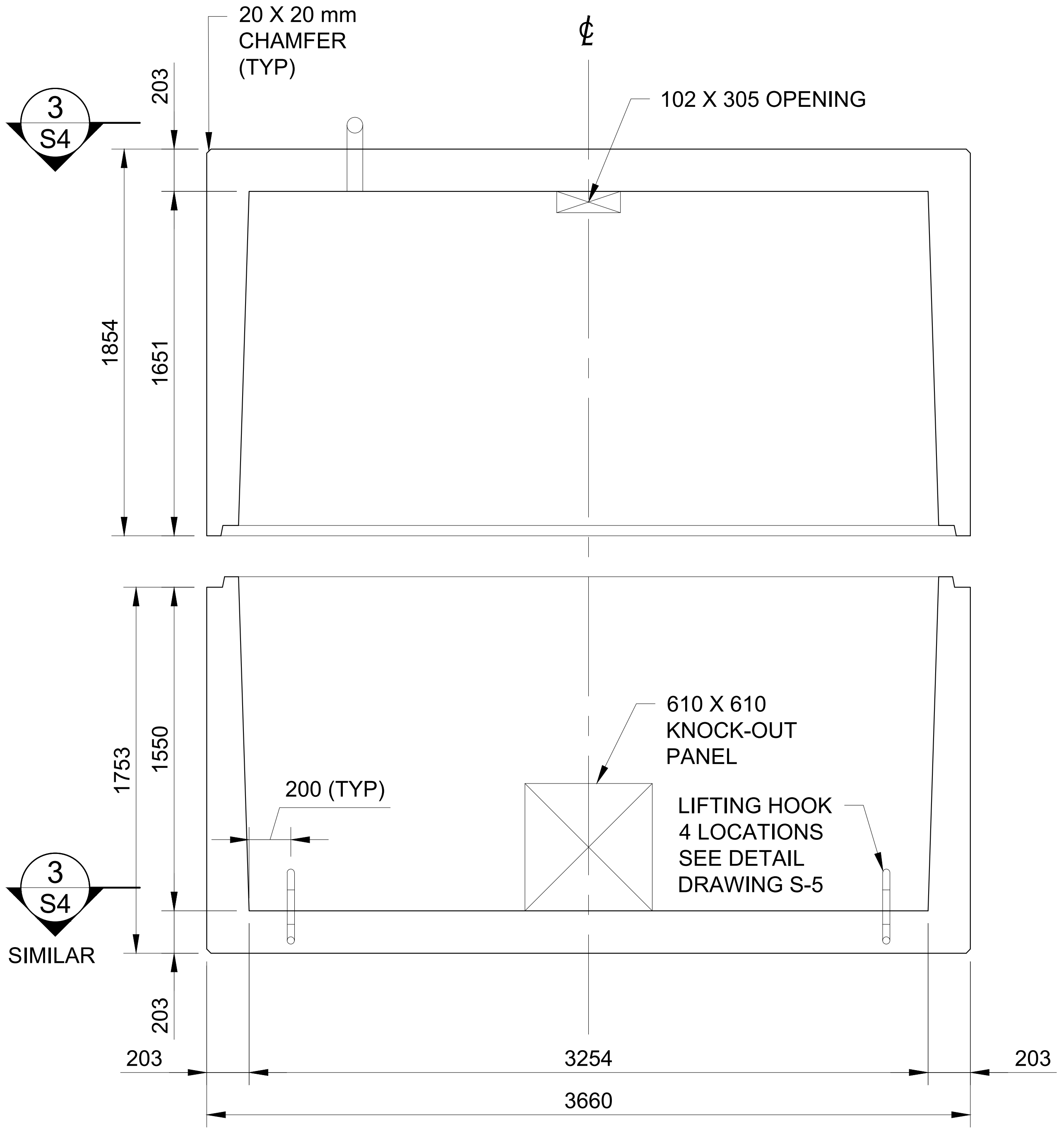

END VIEW

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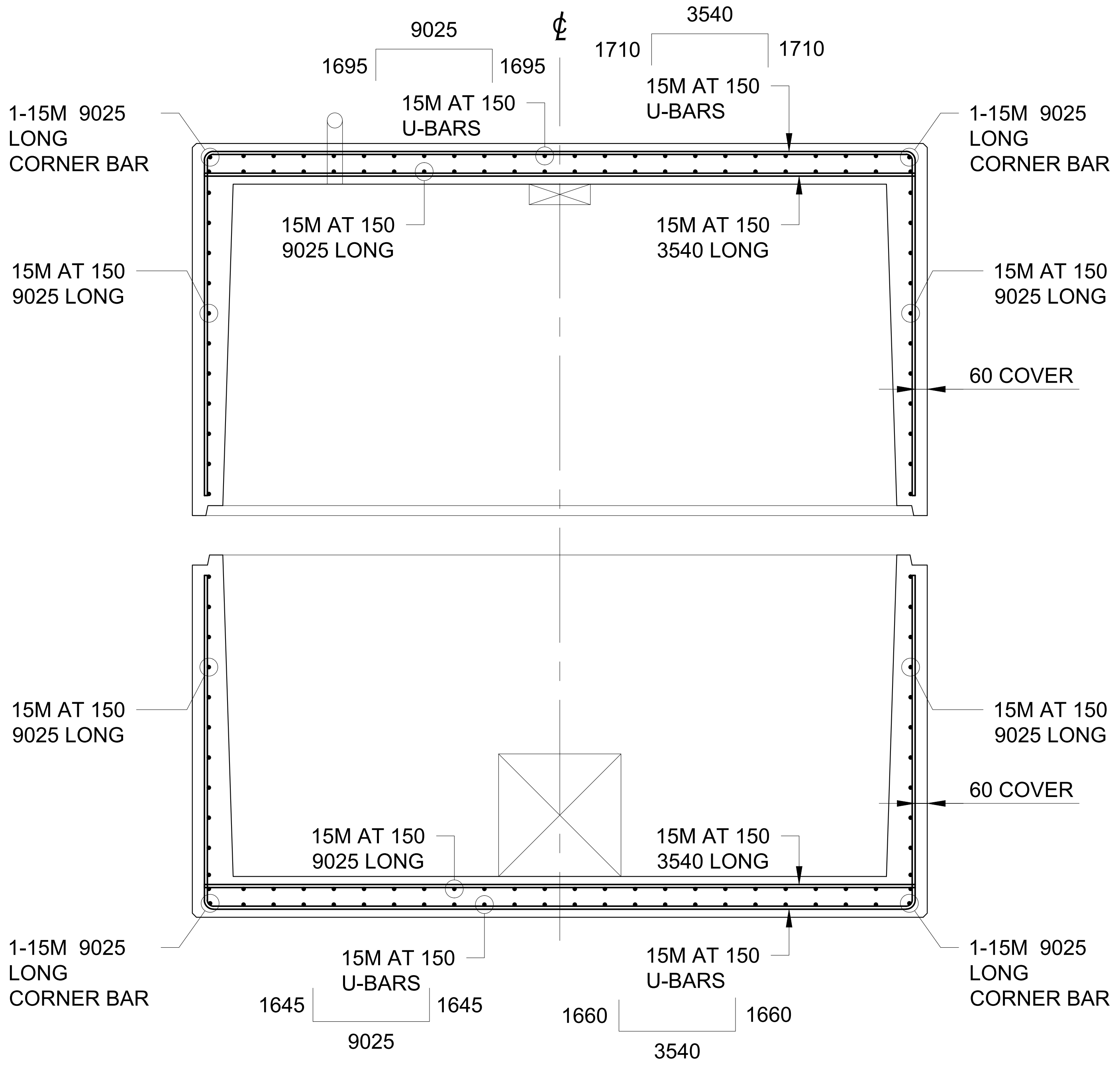

SECTION 1 S-1

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MORRISON HERSHFIELD

POWER PRECAST SOLUTIONS

5598 POWER ROAD
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1	ISSUED FOR REVIEW	2018-08-31
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B.D. MACMASTER
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WELLINGS OF STITTSVILLE

PPS JOB NO.: 2018-0803
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SECTIONS

Scale
AS NOTED

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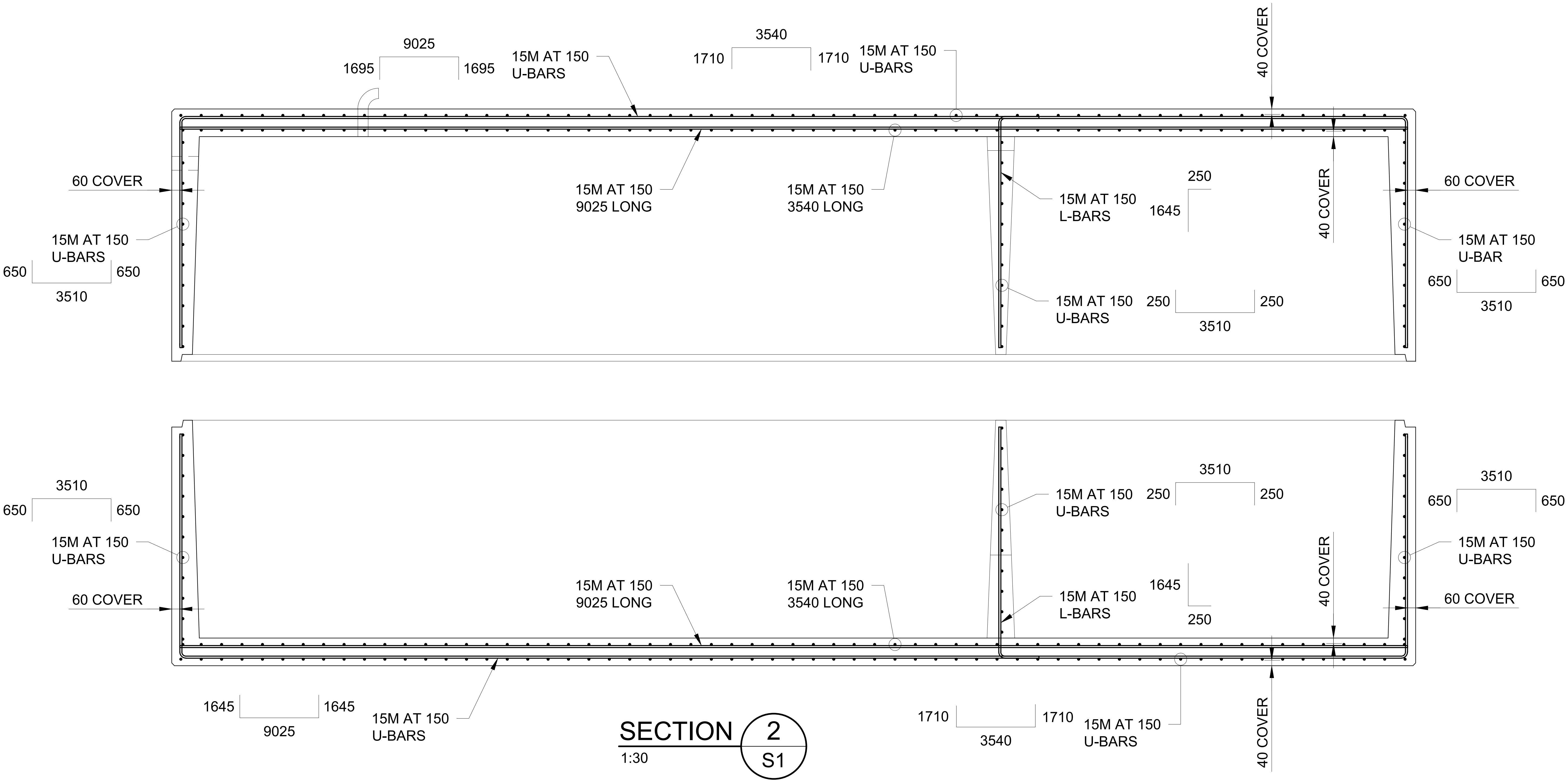

SECTION 2
S1
1:30

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WELLINGS OF STITTSVILLE

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SECTIONS

Scale
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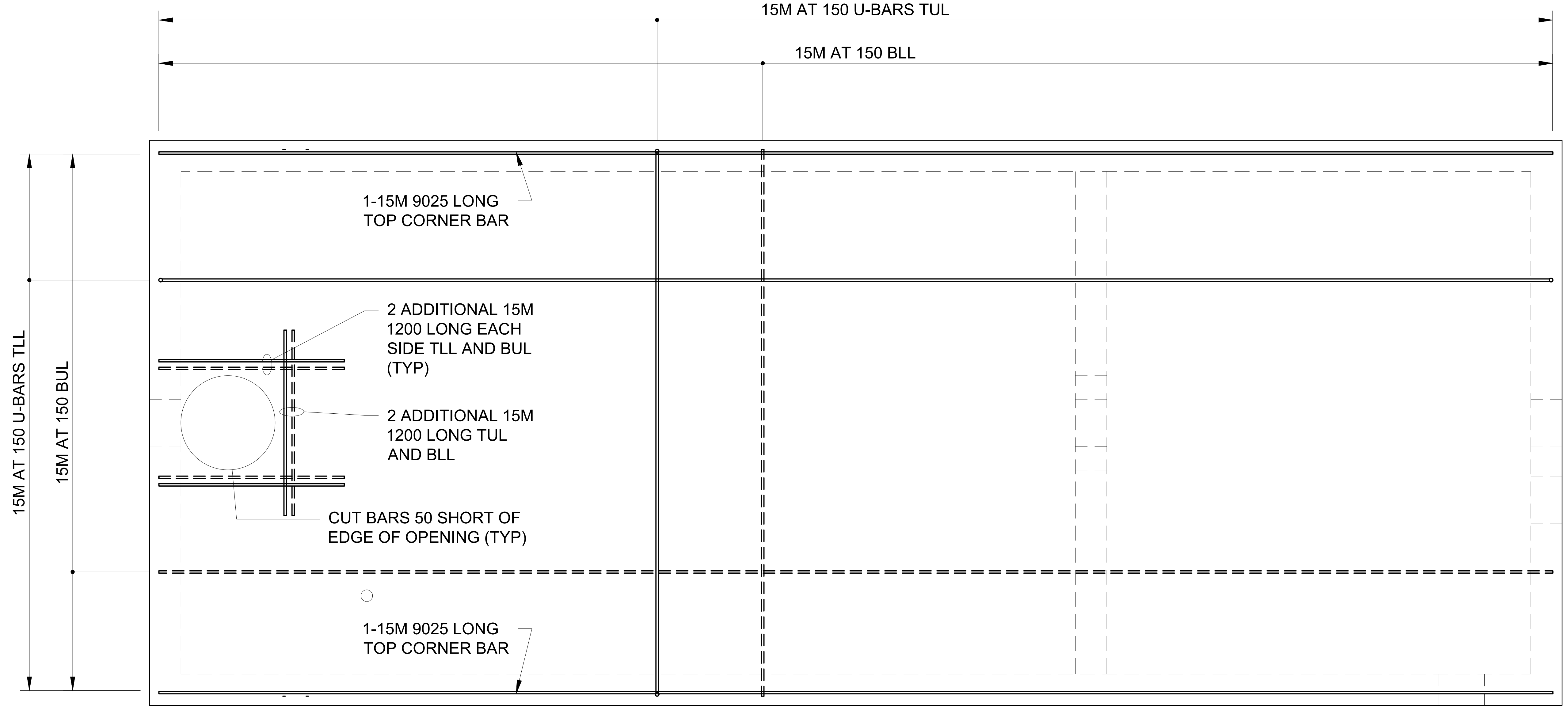

SECTION 3/S2

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LEGEND

━━━━	DENOTES TOP MAT BARS	TUL	TOP UPPER LAYER
		TLL	TOP LOWER LAYER
		BUL	BOTTOM UPPER LAYER
‒ ‒ ‒ ‒	DENOTES BOTTOM MAT BARS	BLL	BOTTOM LOWER LAYER

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SECTIONS

Scale
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DWG No.	Version	Date
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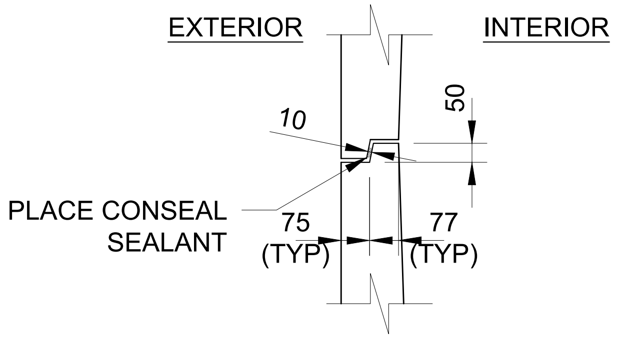

TYPICAL WALL JOINT DETAIL

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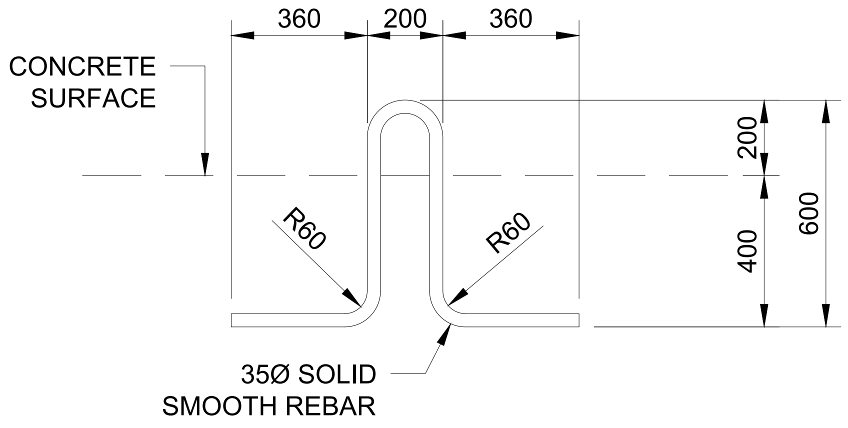
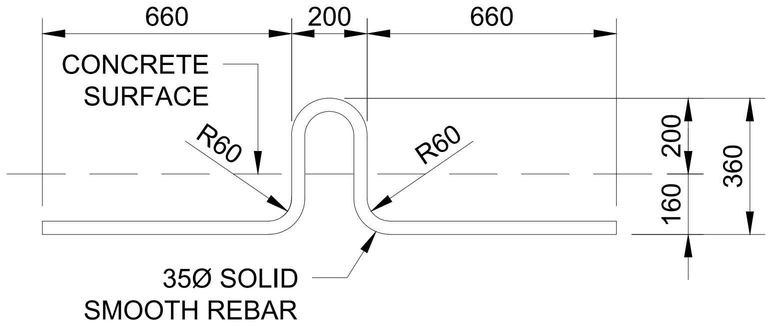


TOP LIFTING HOOK DETAIL

1:20



BOTTOM LIFTING HOOK DETAIL

1:20

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MH JOB NO.: 2170737.34

DETAILS

Scale
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DWG No.	Version	Date
S-5	1	2018-08-28

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Appendix D GEOTECHNICAL INVESTIGATION

patersongroup

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Mixed-Use Development
Wellings of Stittsville - Phase 2
20 Cedarow Court
Ottawa, Ontario

Prepared For

Nautical Lands Group

March 7, 2019

Report PG4772-1

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Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Nautical Lands Group to conduct a geotechnical investigation for the proposed mixed-use development to be located at 20 Cedarow Court in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2).

The objectives of the current investigation were to:

☐ Determine the subsurface conditions by means of boreholes.

☐ Provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project. This report contains geotechnical findings and includes recommendations pertaining to the design and construction of the proposed development as understood at the time of writing this report.

2.0 Proposed Development

Based on the available drawings, it is our understanding that the proposed development will consist of four, five (5) storey mixed-use buildings with a shared underground parking level occupying the majority of the footprint of the subject site. The buildings are understood to include retail, office space and residential units. A one (1) storey restaurant building is also proposed within the centre of the site. At-grade parking areas, access lanes and landscaped areas are also anticipated a part of the development. It is anticipated that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was carried out from January 14, 2019 to January 18, 2019. At that time, 29 boreholes were drilled to a maximum depth of 4 m below existing grade. The borehole locations were distributed in a manner to provide general coverage of the proposed development. The locations of the boreholes are shown on Drawing PG4772-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were drilled using a track-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel with the direction of a senior engineer. The drilling procedure consisted of augering to the required depths at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

Soil samples were recovered from a 50 mm diameter split-spoon or the auger flights. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. All samples were transported to our laboratory. The depths at which the split-spoon and auger samples were recovered from the boreholes are presented as SS and AU, respectively, on the Soil Profile and Test Data sheets.

Standard Penetration Tests (SPT) were conducted and recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sample 300 mm into the soil after the initial penetration of 150 mm using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength tests were conducted in cohesive soils with a field vane apparatus.

The subsurface conditions observed in the boreholes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1.

Groundwater

Flexible polyethylene standpipes were installed in the majority of the boreholes to permit groundwater results subsequent to the sampling program completion. Monitoring wells were installed in BH 4, BH 9, BH 15, BH 22, and BH 27 to provide general site coverage as part of our hydrogeological study. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data Sheets in Appendix 1.

Sample Storage

All samples will be stored in the laboratory for a period of one month after issuance of this report at which time the samples will be discarded unless otherwise directed.

3.2 Field Survey

The borehole locations were selected by Paterson taking in consideration site features. The ground surface at the test pit locations was located and surveyed by Annis, O'Sullivan, Vollebekk LTD. It is understood that the ground surface elevations at the borehole locations were referenced to a geodetic datum. The locations and ground surface elevation at the boreholes are presented on Drawing PG4772-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples recovered from the subject site were visually examined in our laboratory to review the field logs. All samples will be stored in the laboratory for a period of one month after the issuance of this report. They will then be discarded unless we are otherwise directed.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the potential for exposed ferrous metals and the sulphate potential against subsurface concrete structures. The results are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently undeveloped and grass covered with a tree-line located along the west boundary line of Cedarow Court. The ground surface across the site is relatively flat and approximately 1 m lower than adjacent properties and Hazeldean Road. Poole Creek ravine runs along the western border of the subject site approximately 3 m below the subject site.

The subject site is bordered by an active construction site for Phase 1 of the Wellings of Stittsville development along the north, Hazeldean Road along the east, and commercial buildings at the edge of Cedarow Court along the south.

4.2 Subsurface Profile

Overburden

The subsurface profile at the borehole locations consists of topsoil overlying a hard to very stiff silty clay crust followed by a grey, very stiff to stiff silty clay layer. Glacial till was encountered below the silty clay layer consisting of compact silty sand to sandy silt with clay, gravel, cobbles and boulders. A deposit of very stiff to hard clayey silt was encountered below the topsoil in BH 17, BH 18, BH 24, BH 25, BH 26, and BH 27. Practical refusal to augering on inferred bedrock was encountered in all boreholes at depths ranging between 1.6 to 4.0 m. Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets provided in Appendix 1.

Bedrock

Based on available geological mapping, the subject site consists of interbedded dolostone and limestone of the Gull River formation and an approximate drift thickness of 2 to 15 m.

4.3 Groundwater

The measured groundwater levels at the borehole locations are presented in Table 1. Groundwater readings recorded in flexible piezometers could be influenced by surface water infiltrating the backfilled boreholes. The long-term groundwater level can also be estimated based on observations of the recovered soil samples, such as the moisture level, soil consistency and colouring. Based on these observations, the long-term groundwater level is anticipated at a depth ranging between 2.5 to 3.5 m below existing grade. Groundwater levels are subject to seasonal fluctuations and could vary at the time of construction.

Table 1 - Groundwater Readings Summary

Test Hole Number	Ground Elevation (m)	Groundwater Levels (m)		Recording Date
		Depth	Elevation	
BH 1	104.37	DRY	n/a	January 29, 2019
BH 2	103.59	3.05	100.54	January 29, 2019
BH 3	103.55	1.81	101.74	January 29, 2019
BH 4	103.28	3.05	100.23	January 29, 2019
BH 5	103.45	3.05	100.40	January 29, 2019
BH 6	103.49	3.04	100.45	January 29, 2019
BH 7	103.41	DRY	n/a	January 29, 2019
BH 8	103.46	DRY	n/a	January 29, 2019
BH 9	103.42	3.17	100.25	January 29, 2019
BH 10	103.31	2.18	101.13	January 29, 2019
BH 11	103.44	DRY	n/a	January 29, 2019
BH 12	103.58	DRY	n/a	January 29, 2019
BH 13	103.55	DRY	n/a	January 29, 2019
BH 14	104.18	DRY	n/a	January 29, 2019
BH 15	103.65	2.92	100.73	January 29, 2019
BH 16	103.66	DRY	n/a	January 29, 2019
BH 17	104.19	DRY	n/a	January 29, 2019
BH 18	104.15	DRY	n/a	January 29, 2019
BH 19	103.78	DRY	n/a	January 29, 2019
BH 20	103.59	DRY	n/a	January 29, 2019
BH 21	103.58	DRY	n/a	January 29, 2019
BH 22	103.65	DRY	n/a	January 29, 2019
BH 23	103.87	2.62	101.25	January 29, 2019
BH 24	104.04	2.55	101.49	January 29, 2019
BH 25	104.07	1.68	102.39	January 29, 2019
BH 26	104.30	DRY	n/a	January 29, 2019
BH 27	103.97	DRY	n/a	January 29, 2019
BH 28	103.78	DRY	n/a	January 29, 2019
BH 29	103.71	DRY	n/a	January 29, 2019

Note: The ground surface elevation at the borehole locations was provided by Annis, O’Sullivan, Vollebekk Ltd.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is suitable for the proposed development. The proposed structures will be founded on conventional shallow foundations placed on an undisturbed, hard to very stiff silty clay, compact to dense glacial till and/or clean, surface sounded bedrock bearing surface. Alternatively, conventional shallow footings can be placed over a near vertical, zero entry, concrete in-filled trenches extending to a clean, surface sounded bedrock bearing surface.

Permissible grade raise restriction areas are also required due to the silty clay deposit. A permissible grade raise restriction of **2 m** is recommended for areas where settlement sensitive structures are founded over the silty clay deposit.

Depending on the extent of the underground parking garage and potential grade raise, the bedrock may be encountered during excavation and construction. All contractors should be prepared for bedrock removal within the subject site.

Prior to considering blasting operations, if required, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

The above and other considerations are discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any buildings, paved areas, pipe bedding, and other settlement sensitive structures.

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in proximity of the blasting operations should be completed prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries/claims related to the blasting operations.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing structures.

The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Excavation side slopes in sound bedrock can be excavated almost vertical side walls. A minimum 1 m horizontal ledge, should remain between the overburden excavation and the bedrock surface. The ledge will provide an area to allow for potential sloughing or a stable base for the overburden shoring system.

Vibration Considerations

Construction operations are the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels as much as possible should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipments could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz). The guidelines are for current construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended be completed to minimize the risks of claims during or following the construction of the proposed buildings.

Fill Placement

Fill placed for grading beneath the structure(s) or other settlement sensitive areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The engineered fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where surface settlement is a minor concern. The backfill materials should be spread in thin lifts and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If the non-specified backfill is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values (Shallow Foundation)

Footings for the proposed buildings can be designed with the following bearing resistance values presented in Table 2.

Table 2 - Bearing Resistance Values

Bearing Surface	Bearing Resistance Value at SLS (kPa)	Factored Bearing Resistance Value at ULS (kPa)
Very stiff to hard silty clay	150	250
Compact to dense glacial till	200	300
Lean Concrete In-filled Trenches	**-**	**1,500**
Clean, Surface Sounded Limestone Bedrock	-	1,500

Note: Strip footings, up to 3 m wide, and pad footings, up to 8 m wide, placed over an undisturbed, silty clay bearing surface can be designed using the abovenoted bearing resistance values.

- A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

The above-noted bearing resistance values at SLS for soil bearing surfaces will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively. Footings bearing on an acceptable bedrock bearing surface and designed for the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

The bearing resistance values are provided on the assumption that the footings are placed on undisturbed soil bearing surfaces. An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Lean Concrete Filled Trenches

Where bedrock is encountered below the design underside of footing elevation, consideration should be given to excavating vertical trenches to expose the underlying bedrock surface and backfilling with lean concrete (**15 MPa** 28-day compressive strength). Typically, the excavation sidewalls will be used as the form to support the concrete. The additional width of the concrete poured against an undisturbed trench sidewall will suffice in providing a direct transfer of the footing load to the underlying bedrock.

The effectiveness of this operation will depend on the ability of maintaining vertical trenches until the lean concrete can be poured. It is suggested that once the bottom of the excavation is exposed, an assessment should be completed to determine the water infiltration and stability of the excavation sidewalls extending to the bedrock surface.

The trench excavation should be at least 300 mm wider than all sides of the footing at the base of the excavation. The excavation bottom should be relatively clean using the hydraulic shovel only (workers will not be permitted in the excavation below a 1.5 m depth). Once approved by the geotechnical engineer, lean concrete can be poured up to the proposed founding elevation.

Bedrock/Soil Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also, at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the sub-excavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to an engineered fill, stiff silty clay or glacial till above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Permissible Grade Raise Restriction

Based on the current borehole information, a **permissible grade raise restriction of 2 m** is recommended for the proposed buildings and settlement sensitive structures where founded over a silty clay deposit. A post-development groundwater lowering of 0.5 m was assumed for our calculations.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered at this site. However, a higher site class, such as Class A or B can be provided if a site specific shear wave velocity test is completed to confirm the seismic site classification. The soils underlying the subject site are not susceptible to liquefaction. Refer to the latest revision of the Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

The basement area for the proposed project will be mostly parking and the recommended pavement structure noted in Subsection 5.7 will be applicable. However, if storage or other uses of the lower level where a concrete floor slab will be constructed, the upper 200 mm of sub-slab fill is recommended to consist of 19 mm clear crushed stone. The upper 200 mm of sub-slab fill is recommended to consist of OPSS Granular A crushed stone for slab on grade construction. All backfill material within the footprint of the proposed building(s) should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material prior to placing any fill. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab. All backfill material within the footprint of the proposed building(s) should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

A subfloor drainage system, consisting of lines of perforated drainage pipe subdrains connected to a positive outlet, should be provided in the clear stone under the lower basement floor (discussed in Subsection 6.1).

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the proposed structure's basement walls. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m^3.

The foundation wall is anticipated to be provided with a perimeter drainage system; therefore, the retained soils should be considered drained. For the undrained conditions, the applicable effective unit weight of the retained soil can be designed with13 kN/m^3. A hydrostatic pressure should be added to the total static earth pressure when calculating the effective unit weight. The total earth pressure (P_{AE}) includes both the static earth pressure component (P_o) and the seismic component (ΔP_{AE}).

Two distinct conditions, static and seismic, should be reviewed for design calculations. The parameters for design calculations for the two conditions are presented below.

Static Conditions

The static horizontal earth pressure (p_o) could be calculated with a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure with a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above formula for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure should only be applicable for static analyses and not be calculated in conjunction with the seismic loading case. Actual earth pressures could be higher than the "at-rest" case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Conditions

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) could be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45 - a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero. The earth force component (P_o) under seismic conditions could be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and access lanes, if required.

Table 3 - Recommended Flexible Pavement Structure - At-Grade Parking Areas

Thickness (mm)	Material Description
50	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Table 4 - Recommended Flexible Pavement Structure - Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
	SUBGRADE - In situ soil, or OPSS Granular B Type I or II material placed over in situ soil

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be sub-excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the SPMDD.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended to be provided for the proposed structures. The composite drainage system (such as Miradrain G100N, Delta Drain 6000 or an approved equivalent) is recommended to extend to the footing level. Sleeves, 150 mm diameter, at 3 m centres are recommended to be placed in the footing or at the foundation wall/footing interface for blind sided pours to allow the infiltration of water to flow to the interior perimeter drainage pipe. The perimeter drainage pipe and underfloor drainage system should direct water to sump pit(s) within the lower basement area.

Underfloor Drainage

Underfloor drainage is recommend to control water infiltration for the proposed structures. For design purposes, Paterson recommends 150 mm diameter PVC, corrugated, perforated pipes be placed at 3 to 6 m centres. The spacing of the underfloor drainage system should be confirmed at the time of completing the excavation when water infiltration can be better assessed.

Adverse Effects of Dewatering on Adjacent Properties

Due to the low permeability of the subsoils profile, any minor dewatering will be considered relatively minor due to the proposed building. Therefore, adverse effects to the surrounding buildings or properties are not expected with respect to any groundwater lowering.

Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls where frost heave sensitive structures, such as a concrete sidewalk, will be placed. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material may be used for this purpose. A composite drainage system, such as Delta Drain 6000, Miradrain G100 or an approved equivalent, should be placed against the foundation wall to promote drainage toward the perimeter drainage pipe.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be protected against the deleterious effects of frost action. A minimum of 1.5 m of soil cover alone, or a combination of soil cover and foundation insulation should be provided.

Exterior unheated footings, such as isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

The parking garage should not require protection against frost action due to the founding depth. Unheated structures, such as the access ramp wall footings, may be required to be insulated against the deleterious effect of frost action. A minimum of 2.1 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided.

6.3 Excavation Side Slopes

Temporary Side Slopes

The temporary excavation side slopes should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled.

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be excavated at 1H:1V or shallower. The shallower slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation sides.

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.

A trench box is recommended to be installed at all times to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not be remain exposed for extended periods of time.

Temporary Shoring

Temporary shoring may be required for the overburden soil to complete the required excavations where insufficient room is available for open cut methods. The shoring requirements designed by a structural engineer specializing in those works will depend on the excavation depths, the proximity of the adjacent structures and the elevation of the adjacent building foundations and underground services. The design and implementation of these temporary systems will be the responsibility of the excavation contractor and their design team. Inspections and approval of the temporary system will also be the responsibility of the designer. Geotechnical information provided below is to assist the designer in completing a suitable and safe shoring system. The designer should take into account the impact of a significant precipitation event and designate design measures to ensure that a precipitation will not negatively impact the shoring system or soils supported by the system. Any changes to the approved shoring design system should be reported immediately to the owner's structural designer prior to implementation.

The temporary system could consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be included to the earth pressures described below. These systems could be cantilevered, anchored or braced. Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure their stability. The shoring system is recommended to be adequately supported to resist toe failure and inspected to ensure that the sheet piles extend well below the excavation base. It should be noted if consideration is being given to utilizing a raker style support for the shoring system that lateral movements can occur and the structural engineer should ensure that the design selected minimizes these movements to tolerable levels.

The earth pressures acting on the shoring system may be calculated with the following parameters.

Table 6 - Soil Parameters

Parameters	Values
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Dry Unit Weight (γ), kN/m^3	20
Effective Unit Weight (γ), kN/m^3	13

The active earth pressure should be calculated where wall movements are permissible while the at-rest pressure should be calculated if no movement is permissible. The dry unit weight should be calculated above the groundwater level while the effective unit weight should be calculated below the groundwater level.

The hydrostatic groundwater pressure should be included to the earth pressure distribution wherever the effective unit weight are calculated for earth pressures. If the groundwater level is lowered, the dry unit weight for the soil/bedrock should be calculated full weight, with no hydrostatic groundwater pressure component.

For design purposes, the minimum factor of safety of 1.5 should be calculated.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications and Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of a 150 mm layer of OPSS Granular A crushed stone should be placed for pipe bedding for sewer and water pipes for a soil subgrade. The bedding thickness should be increased to 300 mm for areas where the subgrade consists of bedrock. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe should consist of OPSS Granular A. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 95% of the SPMDD.

The site excavated material may be placed above cover material if the excavation operations are completed in dry weather conditions and the site excavated material is approved by the geotechnical consultant. All cobbles greater than 200 mm in the longest dimension should be removed prior to the site materials being reused.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD. Within the frost zone (1.8 m below finished grade), non frost susceptible materials should be used when backfilling trenches below the original bedrock level.

Clay seals are recommended for the subject site. The seals should be a minimum of 1.5 m long (in the trench direction) and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the SPMDD. The clay seals should be placed at the site boundaries, roadway intersections and at a maximum distance of every 50 m in the service trenches.

6.5 Groundwater Control

Groundwater Control for Building Construction

It is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes, being pumped during the construction phase, between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be provided if winter construction is considered for this project. Where excavations are completed in proximity of existing structures which may be adversely affected due to the freezing conditions. In particular, where a shoring system is constructed, the soil behind the shoring system will be subjected to freezing conditions and could result in heaving of the structure(s) placed within or above frozen soil. Provisions in the contract documents should be provided to protect the excavation walls from freezing, if applicable.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the installation of straw, propane heaters and tarpaulins or other suitable means. The excavation base should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be considered if such activities are to be completed during freezing conditions. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement (Type GU) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity in indicative of a low to moderate corrosive environment.

6.8 Limit of Hazard Lands

Field Observations

Paterson conducted a site visit on January 13, 2019 to review the slope located along the west boundary of the subject site, assess the current slope conditions and confirm the grades provided in the existing topographic mapping. A section of Poole Creek is located within the west portion of the site and shown in Drawing PG4772-1 - Test Hole Location Plan.

Three (3) slope cross-sections were reviewed in the field as the worst case scenarios. The cross section locations are presented on Drawing PG4772-1 - Test Hole Location Plan in Appendix 2. Generally, the riverbanks along both sides of Poole Creek are currently well vegetated and were observed in an acceptable condition. Poole Creek was observed within a 20 to 40 m wide flood plain. The slope along the east side of Poole Creek ranged in height between 3 and 5 m with an inclination ranging between 2.3H:1V and 3.3H:1V. The upper slope was observed to be well vegetated with little to no signs of active surficial erosion.

Slope Stability Analysis

Limit of Hazard Lands

The slope condition was reviewed based on available topographic mapping along the east side slopes of Poole Creek within the west portion of the subject development. A total of 3 slope cross-sections were assessed as the worst case scenarios. The cross section locations are presented on Drawing PG4772-1 - Test Hole Location Plan in Appendix 2.

A slope stability assessment was carried out to determine the required stable slope allowance setback from the top of slope based on a factor of safety of 1.5. A toe erosion and 6 m erosion access allowances were also included in the determination of limits of hazard lands and are discussed below. The proposed limit of hazard lands (as shown on Drawing PG4772-1 - Test Hole Location Plan) includes:

☐ a geotechnical slope stability allowance with a factor of safety of 1.5
☐ a toe erosion allowance
☐ a 6 m erosion access allowance and top of slope

Slope Stability Analysis

The analysis of the stability of the slope sections was carried out using SLIDE, a computer program which permits a two-dimensional slope stability analysis using several methods including the Bishop's method, which is a widely used and accepted analysis method. The program calculates a factor of safety, which represents the ratio of the forces resisting failure to those favoring failure. Theoretically, a factor of safety of 1.0 represents a condition where the slope is stable. However, due to intrinsic limitations of the calculation methods and the variability of the subsoil and groundwater conditions, a factor of safety greater than one is usually required to ascertain than the risks of failure are acceptable. A minimum factor of safety of 1.5 is generally recommended for conditions where the failure of the slope would endanger permanent structures.

An analysis considering seismic loading was also completed. A horizontal acceleration of 0.16G was considered for the sections for the seismic loading condition. A factor of safety of 1.1 is considered to be satisfactory for stability analyses including seismic loading.

The cross-sections were analysed taking into account a groundwater level at ground surface, which represents a worse-case scenario that can be reasonably expected to occur in cohesive soils. The stability analysis assumes full saturation of the soil with groundwater flow parallel to the slope face. Subsoil conditions at the cross-sections were inferred based on the findings at borehole locations along the top of slope and general knowledge of the area's geology.

Stable Slope Allowance

The results of the stability analysis for static conditions at Sections A through C are presented in Figures 2A to 4A in Appendix 2. All the reviewed slope sections along the subject creek were noted to be shaped to at least a 2.3H:1V. Based on the soil conditions observed and the results of the slope stability analysis, the slope stability factor of safety was calculated to be 1.5 or greater for all the slope sections which indicates that a stable slope allowance is not required for the subject slope.

The results of the analyses including seismic loading are shown in Figures 2B to 4B for the slope sections. The results indicate that the factor of safety for the sections are greater than 1.1.

It should be noted that the existing vegetation on the slope face should not be removed as it contributes to the stability of the slope and reduces erosion. If the existing vegetation needs to be removed, it is recommended that a 100 to 150 mm of topsoil mixed with a hardy seed and/or topped with an erosion control blanket be which can be placed across the exposed slope face.

Toe Erosion and Erosion Access Allowance

The toe erosion allowance for the valley corridor wall slope was based on the cohesive nature of the top layers of the subsoils, the observed current erosional activities and the width and location of the current watercourse. It should be noted that if the flood plain is measured to be greater than 20 m, no toe erosion will be required. Therefore, based on the above factors, no toe erosion allowance is considered for the subject slope.

An erosion access allowance of 6 m is required from the top of slope to ensure access is provided should future maintenance to the slope face is required. The limit of hazard lands, which includes these allowances, is indicated on Drawing PG4772-1 - Test Hole Location Plan in Appendix 2.

6.9 Landscaping Considerations

Tree Planting Restrictions

According to the City of Ottawa Guidelines for tree planting, where a sensitive silty clay deposit is present within the vicinity of the site, tree planting restrictions should be determined. However, for this site, based on the founding medium of the underground parking level which will occupy the majority of the site, tree planting restrictions are not required from a geotechnical perspective.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ☐ Review detailed grading plan(s) from a geotechnical perspective.
- ☐ Review groundwater conditions at the time of construction to determine if waterproofing is required.
- ☐ Observation of all bearing surfaces prior to the placement of concrete.
- ☐ Sampling and testing of the concrete and fill materials used.
- ☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ☐ Observation of all subgrades prior to backfilling.
- ☐ Field density tests to determine the level of compaction achieved.
- ☐ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming that the construction work has been conducted in general accordance with the above recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided in the report are in accordance with Paterson's present understanding of the project. Paterson request permission to review the recommendations when the drawings and specifications are completed.

A geotechnical investigation is a limited sampling of a site. Should any conditions encountered during construction differ from the borehole locations, Paterson requests immediate notification to permit reassessment of the recommendations provided herein.

The recommendations provided should only be used by the design professionals associated with this project. The recommendations are not intended for contractors bidding on or constructing the project. The latter should evaluate the factual information provided in the report. The contractor should also determine the suitability and completeness for the intended construction schedule and methods. Additional testing may be required for the contractors purpose.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Nautical Lands Group or their agent(s) is not authorized without review by Paterson for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Faisal I. Abou-Seido, P.Eng.

LICENSED PROFESSIONAL ENGINEER
Mar 7, 2019
F. I. ABOU-SEIDO
100156744
PROVINCE OF ONTARIO

David J. Gilbert, P.Eng.

Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG4772**

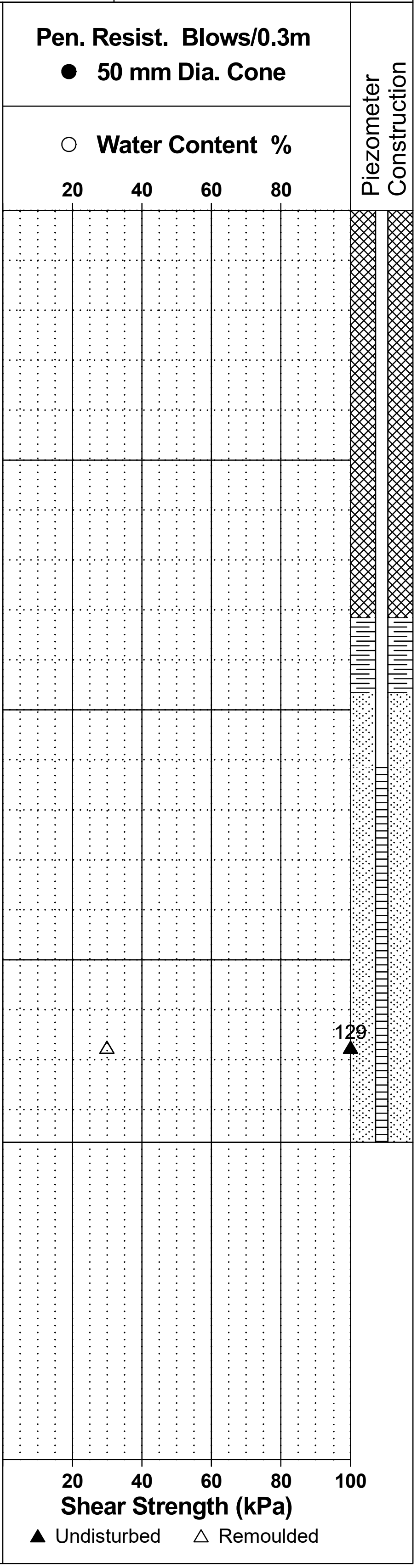
REMARKS

HOLE NO. **BH 1**

BORINGS BY CME 55 Power Auger

DATE 2019 January 14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.37
FILL: Compact brown silty sand, some gravel	AU	1				
	SS	2	38	15	1	103.37
1.52						
Very stiff, brown **SILTY CLAY,** trace gravel	SS	3	42	7		
					2	102.37
	SS	4	58	4		
					3	101.37
3.73						
End of Borehole Practical refusal to augering at 3.73m depth (BH dry - Jan 29/19)						



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Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 14

FILE NO. PG4772

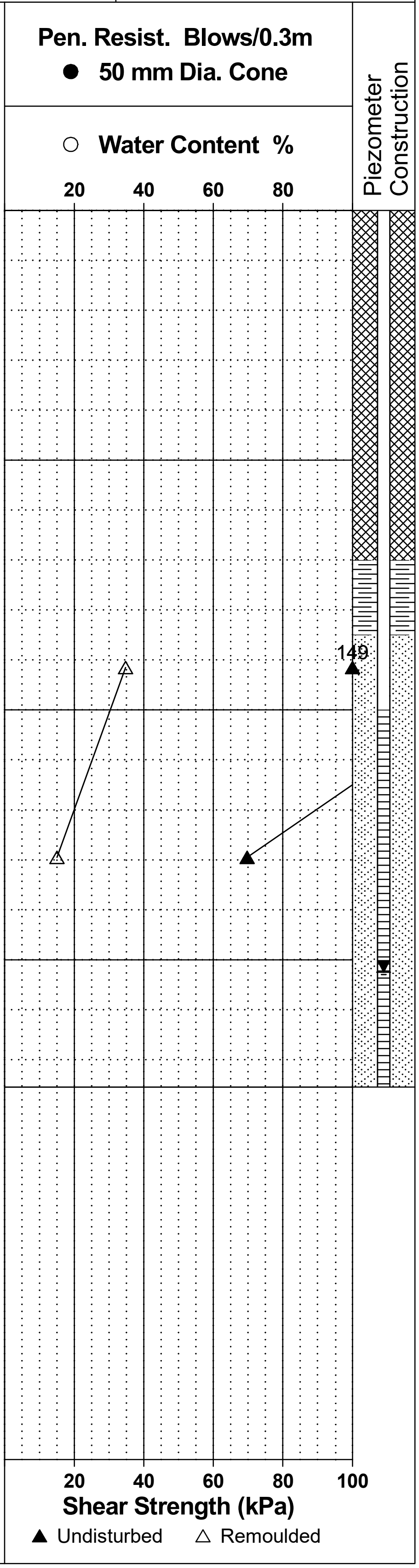
HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	103.59
FILL: Brown silty sand, some gravel	▨	AU	1				
0.66							
Very stiff to stiff, brown **SILTY CLAY**	▨	SS	2	33	4	1	102.59
						2	101.59
- grey and trace gravel by 3.0m depth						3	100.59
		SS	3		50+		
3.51							

End of Borehole

Practical refusal to augering at 3.51m depth

(GWL @ 3.05m depth - Jan 29/19)



SOIL PROFILE AND TEST DATA

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Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG4772**

REMARKS

HOLE NO. **BH 3**

BORINGS BY CME 55 Power Auger

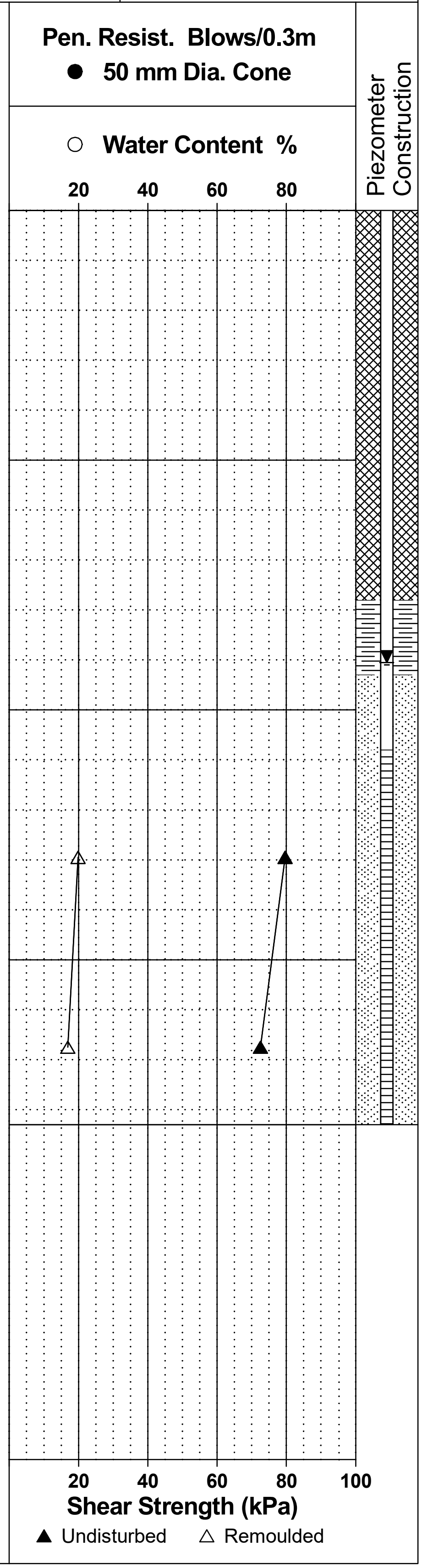
DATE 2019 January 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	103.55
TOPSOIL 0.33		AU	1				
		SS	2	21	7	1	102.55
Very stiff to stiff, brown **SILTY CLAY**		SS	3	62	7	2	101.55
- grey by 2.3m depth						3	100.55
3.66							

End of Borehole

Practical refusal to augering at 3.66m depth

(GWL @ 1.81m depth - Jan 29/19)



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Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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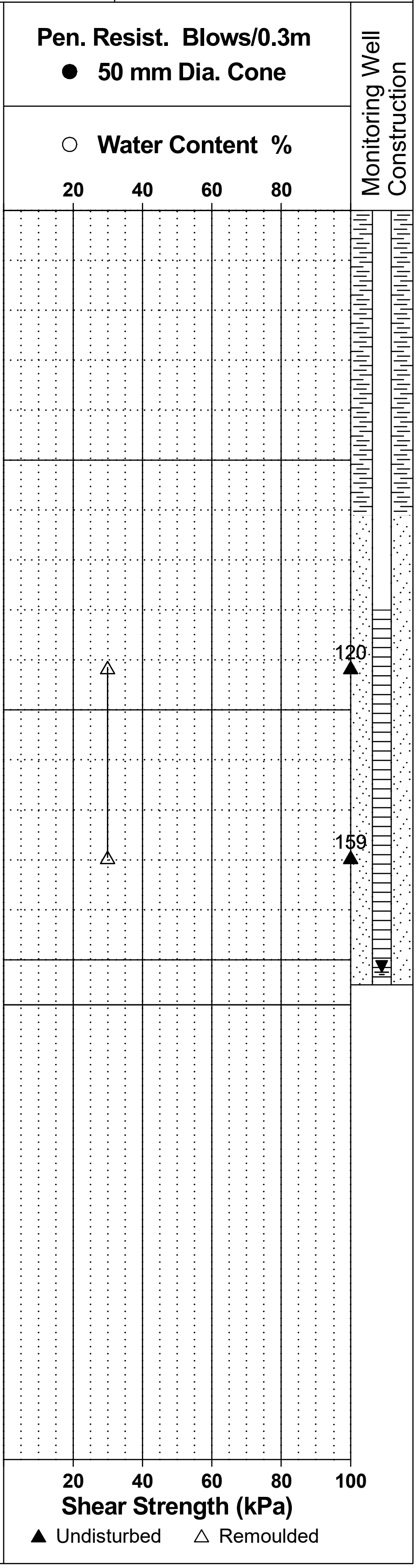
FILE NO. **PG4772**

REMARKS

HOLE NO. **BH 4**

BORINGS BY CME 55 Power Auger **DATE** 2019 January 14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.28
TOPSOIL						
0.30	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	25	6	1	102.28
					2	101.28
- grey by 2.4m depth						
- trace sand and gravel by 3.0m depth					3	100.28
3.18	SS	3	100	50+		
End of Borehole Practical refusal to augering at 3.18m depth (GWL @ 3.05m depth - Jan 29/19)						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
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Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG4772**

REMARKS

HOLE NO. **BH 5**

BORINGS BY CME 55 Power Auger

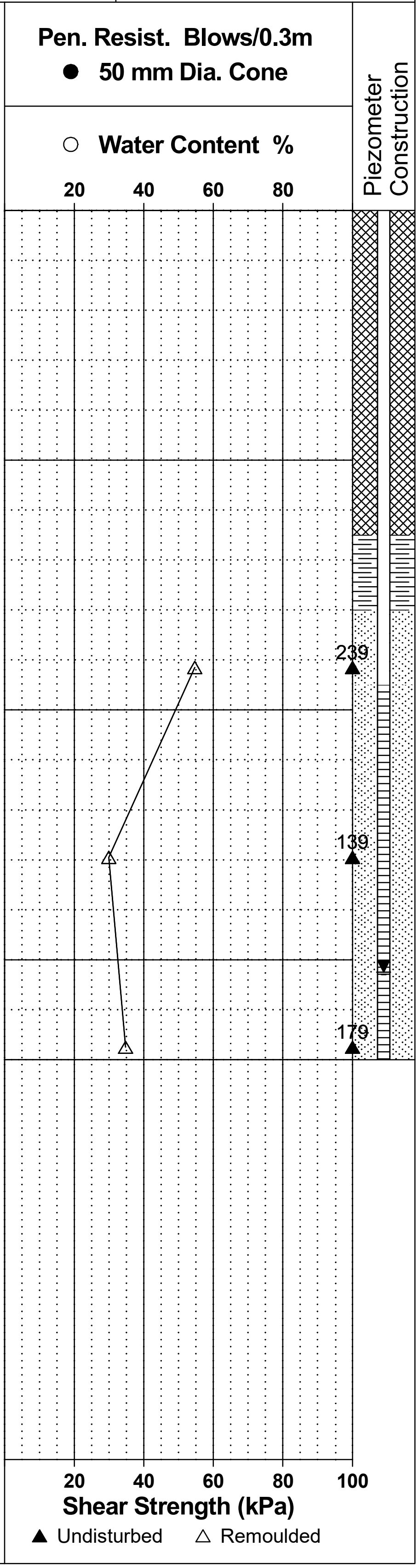
DATE 2019 January 14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.45
TOPSOIL	AU	1				
0.36						
Hard to very stiff, brown **SILTY CLAY**	SS	2	38	6	1	102.45
- grey by 2.1m depth					2	101.45
					3	100.45
3.40						

End of Borehole

Practical refusal to augering at 3.40m depth

(GWL @ 3.05m depth - Jan 29/19)



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Ottawa, Ontario

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REMARKS

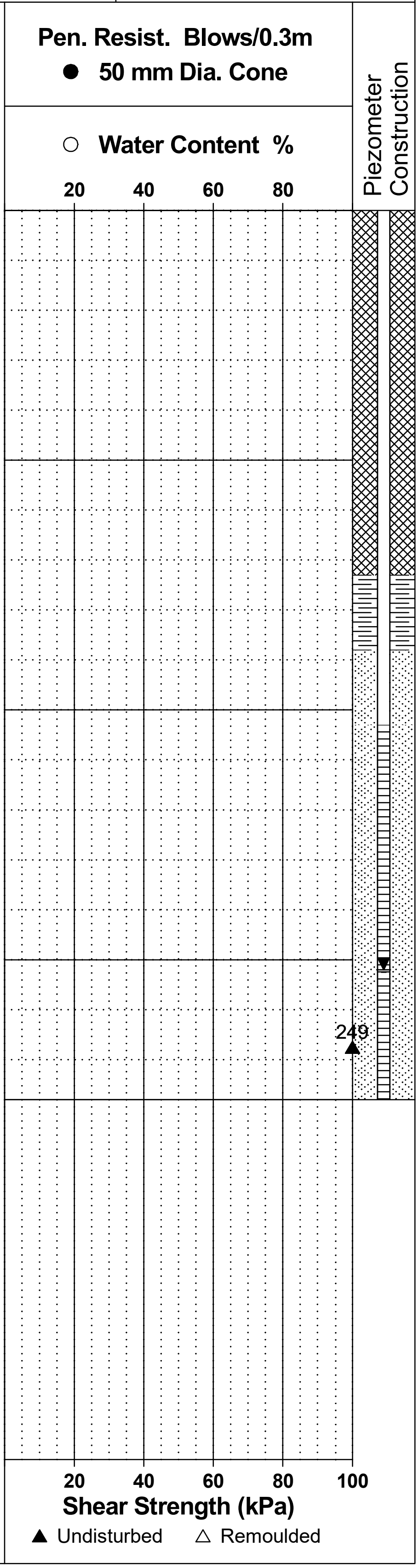
BORINGS BY CME 55 Power Auger

DATE 2019 January 14

FILE NO. PG4772

HOLE NO. BH 6

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.49
TOPSOIL 0.38	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	58	8	1	102.49
- grey by 2.0m depth	SS	3	71	9	2	101.49
	SS	4	100	5		
3.56					3	100.49
End of Borehole Practical refusal to augering at 3.56m depth (GWL @ 3.04m depth - Jan 29/19)						



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REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 14

FILE NO. PG4772

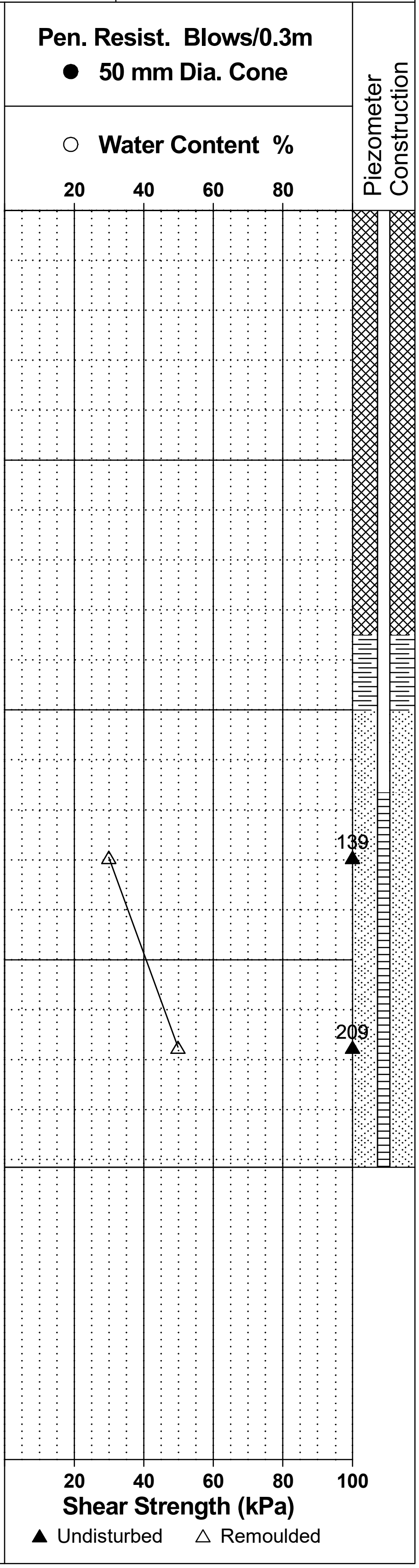
HOLE NO. BH 7

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.41
TOPSOIL 0.43		AU	1				
Very stiff to hard, brown **SILTY CLAY**		SS	2	58	7	1	102.41
- grey by 1.8m depth		SS	3	92	6	2	101.41
						3	100.41
3.83							

End of Borehole

Practical refusal to augering at 3.83m depth

(BH dry - Jan 29/19)



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FILE NO. **PG4772**

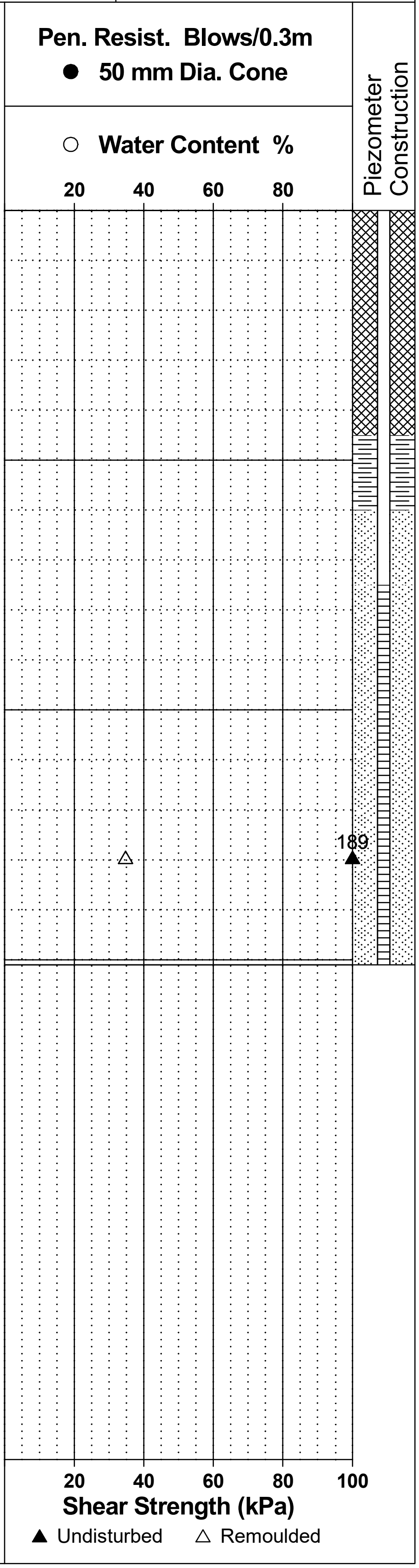
REMARKS

HOLE NO. **BH 8**

BORINGS BY CME 55 Power Auger

DATE 2019 January 14

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.46
TOPSOIL		AU	1				
0.41							
Very stiff, brown **SILTY CLAY**		SS	2	67	7	1	102.46
		SS	3	92	6		
- grey by 2.0m depth						2	101.46
3.02						3	100.46
End of Borehole Practical refusal to augering at 3.02m depth (BH Dry - Jan 29/19)							



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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH 9**

BORINGS BY CME 55 Power Auger

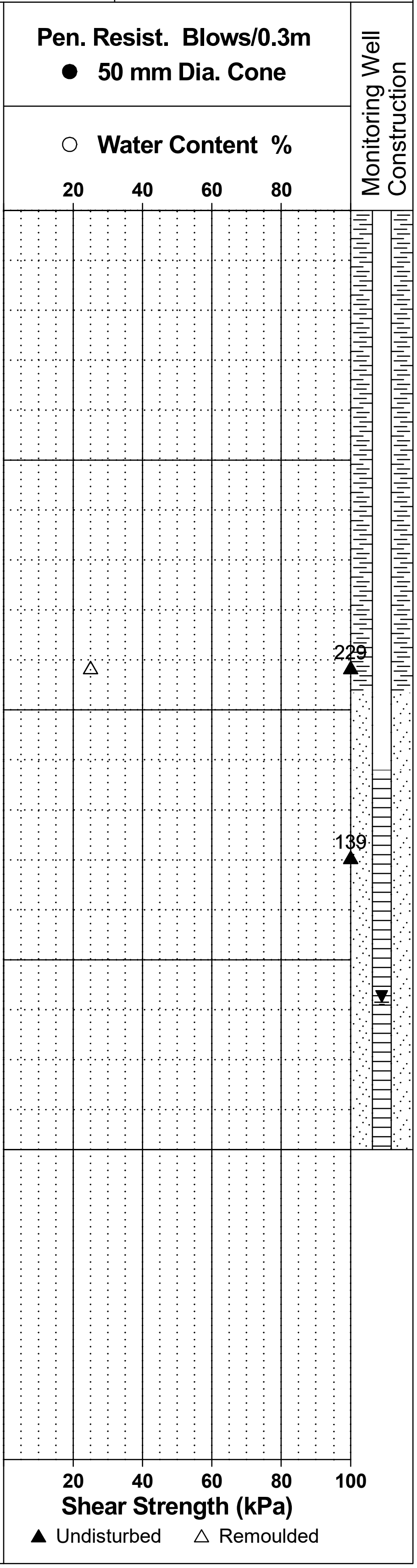
DATE 2019 January 15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.42
TOPSOIL 0.38	AU	1				
Hard to very stiff, brown **SILTY CLAY**	SS	2	71	4	1	102.42
					2	101.42
					3	100.42
3.76	SS	3	71	14		

End of Borehole

Practical refusal to augering at 3.76m depth

(GWL @ 3.17 m depth - Jan 29/19)



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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH10**

BORINGS BY CME 55 Power Auger

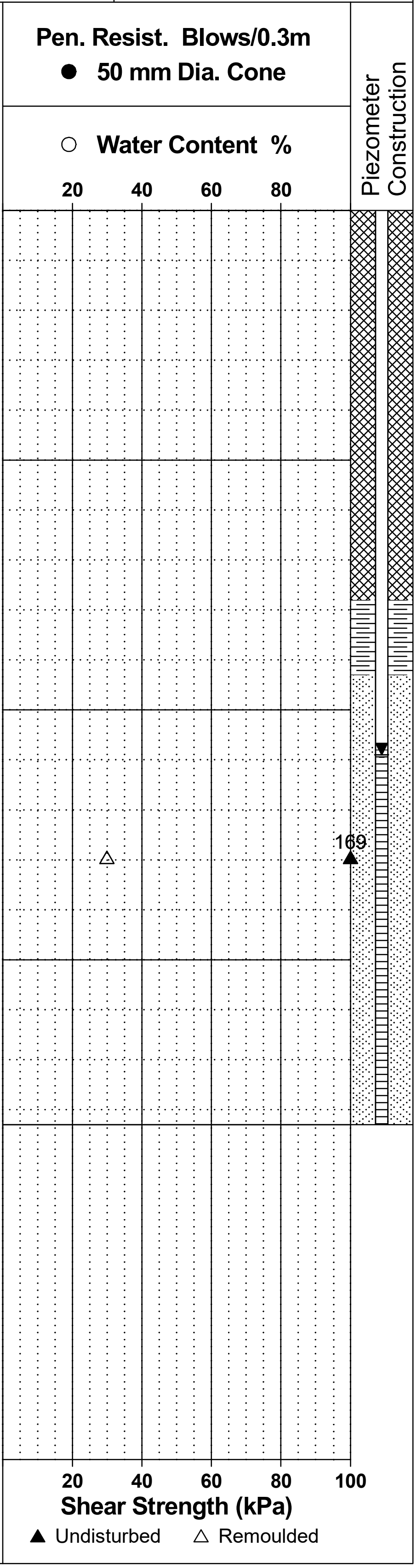
DATE 2019 January 15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.31
TOPSOIL	AU	1				
0.41						
Very stiff, brown **SILTY CLAY**	SS	2	67	9	1	102.31
	SS	3	75	6	2	101.31
- grey by 2.1m depth						
3.05					3	100.31
GLACIAL TILL: Compact, brown sandy silt, trace clay and gravel, occasional cobbles and boulders	SS	4	83	19		
3.66						

End of Borehole

Practical refusal to augering at 3.66m depth

(GWL @ 2.18m depth - Jan 29/19)



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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH11**

BORINGS BY CME 55 Power Auger

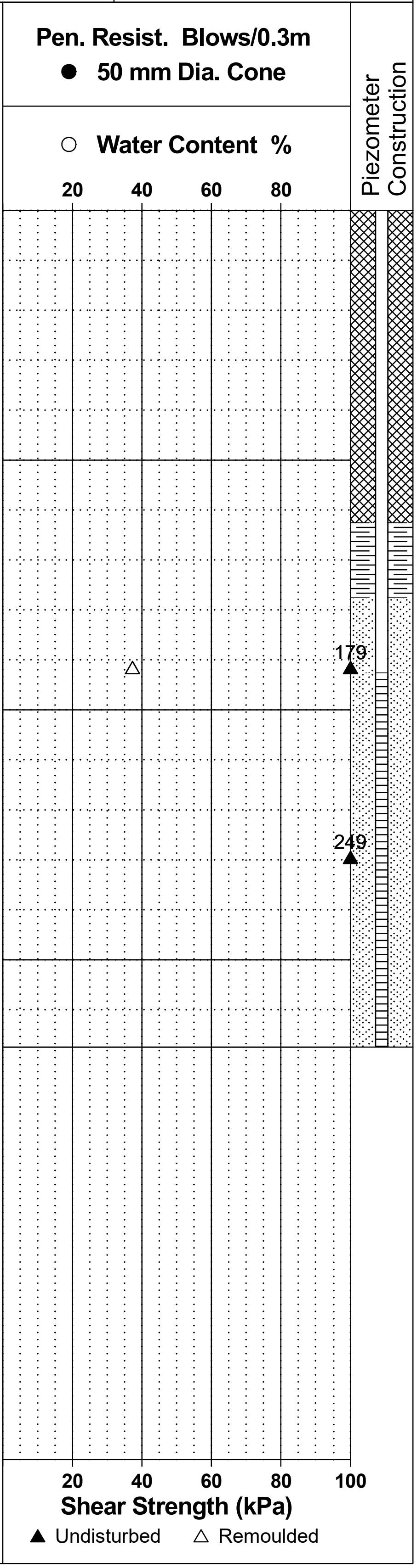
DATE 2019 January 15

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.44
TOPSOIL 0.38		AU	1				
Very stiff, brown **SILTY CLAY**		SS	2	71	4	1	102.44
						2	101.44
3.05						3	100.44
GLACIAL TILL: Very dense brown to grey sandy silt, trace clay and gravel, occasional cobbles and boulders 3.35		SS	3	100	50+		

End of Borehole

Practical refusal to augering at 3.35m depth

(BH Dry - Jan 29/19)



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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH12**

BORINGS BY CME 55 Power Auger

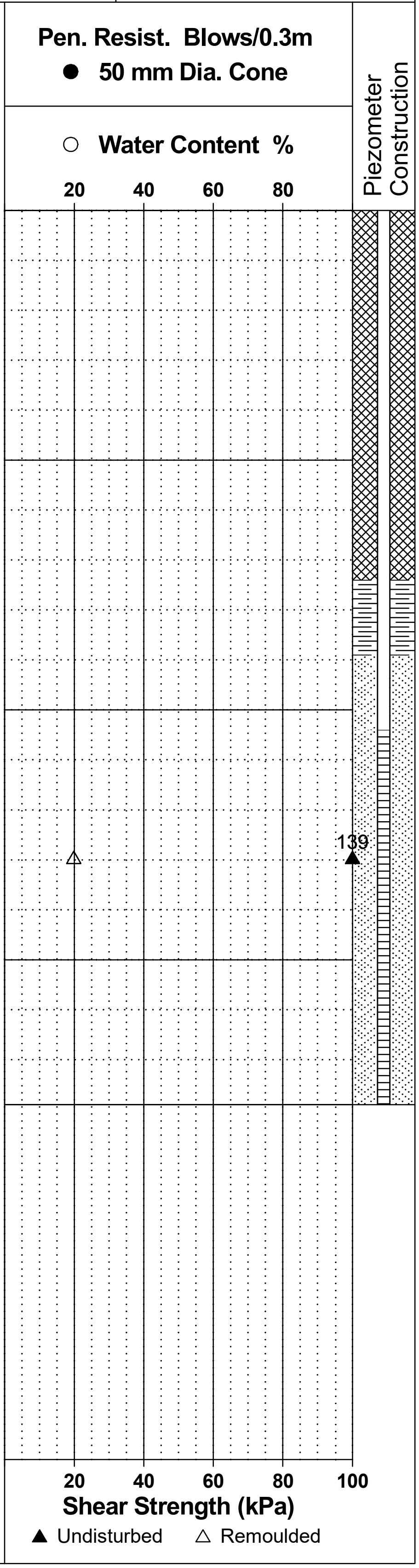
DATE 2019 January 15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.58
TOPSOIL (to 0.38)	AU	1				
Very stiff, brown **SILTY CLAY** (0.38 to 3.05)	SS	2	88	6	1	102.58
	SS	3	96	5	2	101.58
					3	100.58
GLACIAL TILL: Compact, brown to grey clayey silt, some sand, trace gravel, occasional cobbles and boulders (3.05 to 3.58)	SS	4	90	11		

End of Borehole

Practical refusal to augering at 3.58m depth

(BH Dry - Jan 29/19)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 15

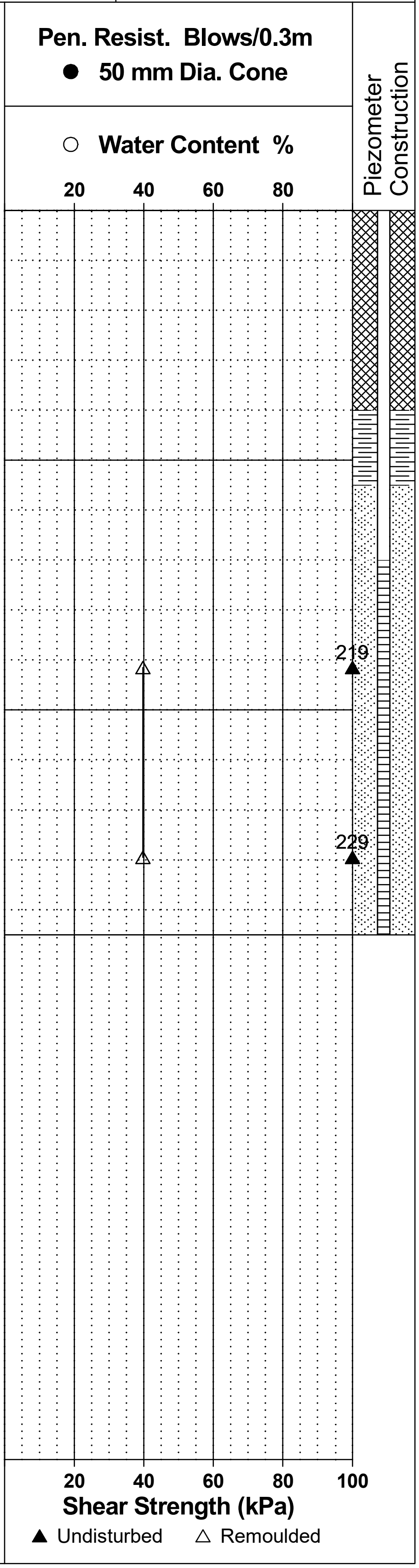
FILE NO. PG4772

HOLE NO. BH13

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.55
TOPSOIL (to 0.36)	AU	1				
Hard, brown **SILTY CLAY** (0.36 to 2.90)	SS	2	88	4	1	102.55
					2	101.55
End of Borehole (2.90)						

Practical refusal to augering at 2.90m depth

(BH Dry - Jan 29/19)



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REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 15

FILE NO. PG4772

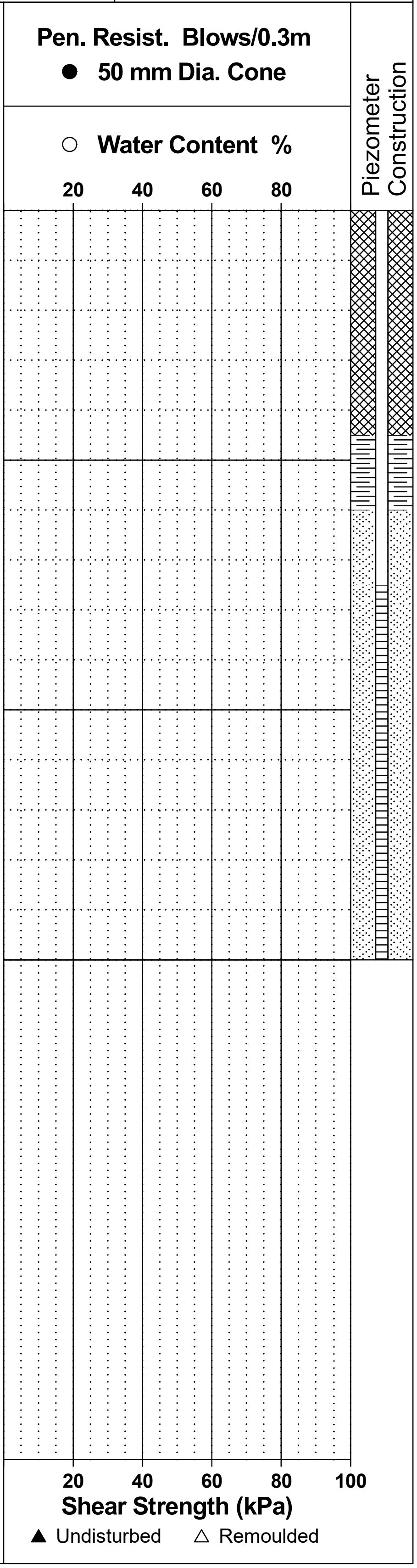
HOLE NO. BH14

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.18
TOPSOIL (to 0.41)	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	67	7	1	103.18
	SS	3	96	6		
- grey by 2.0m depth (to 2.29)					2	102.18
GLACIAL TILL: Grey silty clay, trace sand and gravel, occasional cobbles and boulders (to 3.00)					3	101.18

End of Borehole

Practical refusal to augering at 3.00m depth

(BH Dry - Jan 29/19)



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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH15**

BORINGS BY CME 55 Power Auger

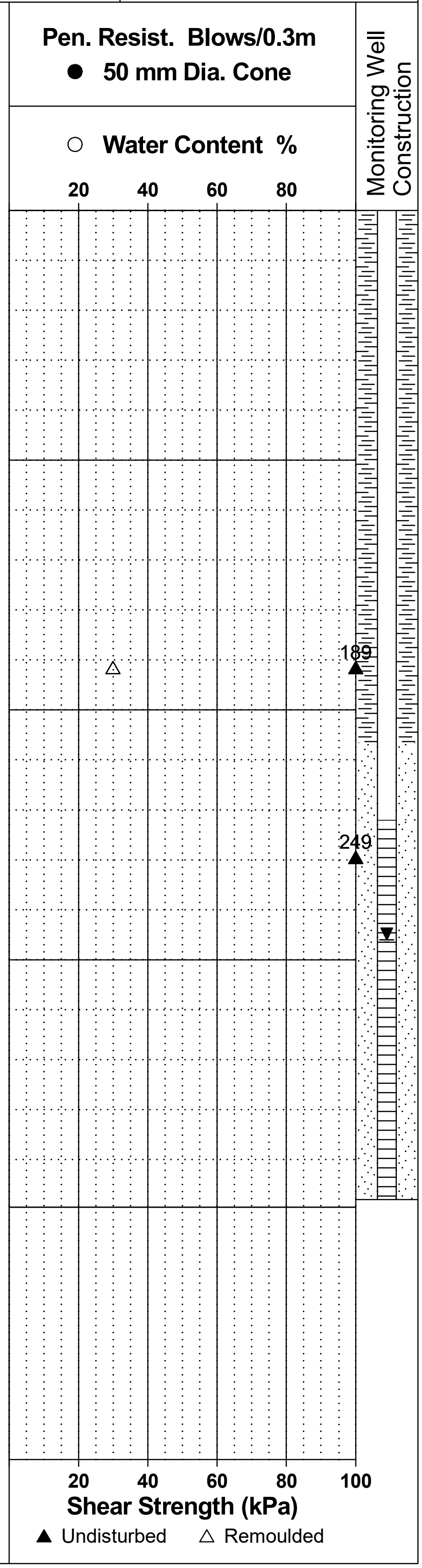
DATE 2019 January 15

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.65
TOPSOIL 0.36	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	71	6	1	102.65
2.29					2	101.65
Hard, brown **CLAYEY SILT** 3.05					3	100.65
GLACIAL TILL: Compact to very dense, grey clayey silt, some sand, trace gravel, occasional cobbles and boulders	SS	3	79	24		
3.99	SS	4	100	50+		

End of Borehole

Practical refusal to augering at 3.99m depth

(GWL @ 2.92m depth - Jan 29/19)



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FILE NO. PG4772

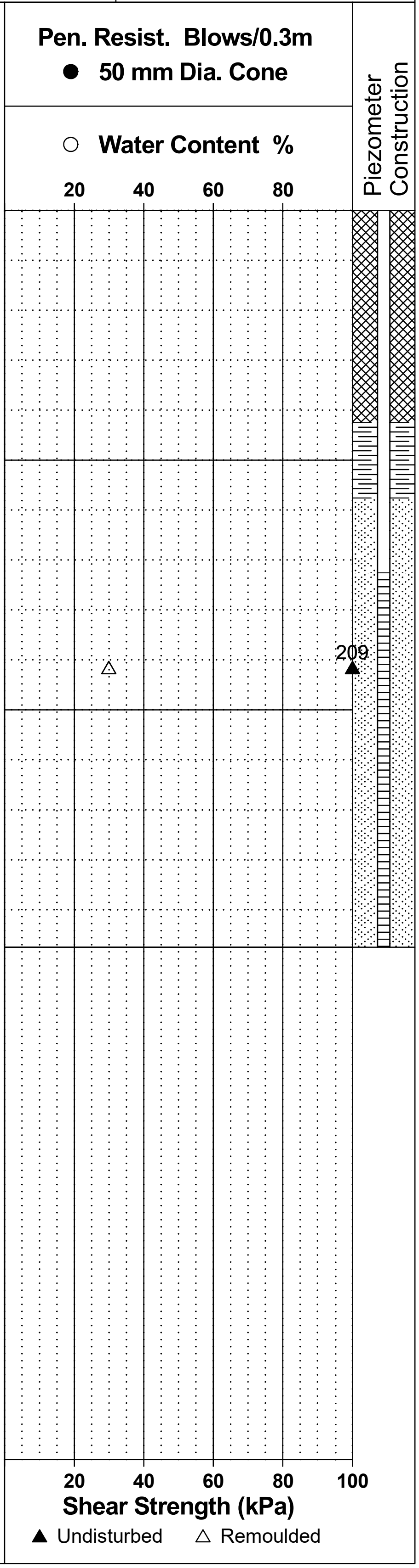
REMARKS

HOLE NO. BH16

BORINGS BY CME 55 Power Auger

DATE 2019 January 15

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.66
TOPSOIL 0.33	AU	1				
Hard, brown **SILTY CLAY**	SS	2	75	4	1	102.66
					2	101.66
2.29 **GLACIAL TILL:** Dense, brown to grey clayey silt, some sand, gravel, cobbles and boulders	SS	3	46	31		
2.95 End of Borehole Practical refusal to augering at 2.95m depth (BH Dry - Jan 29/19)						



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FILE NO. **PG4772**

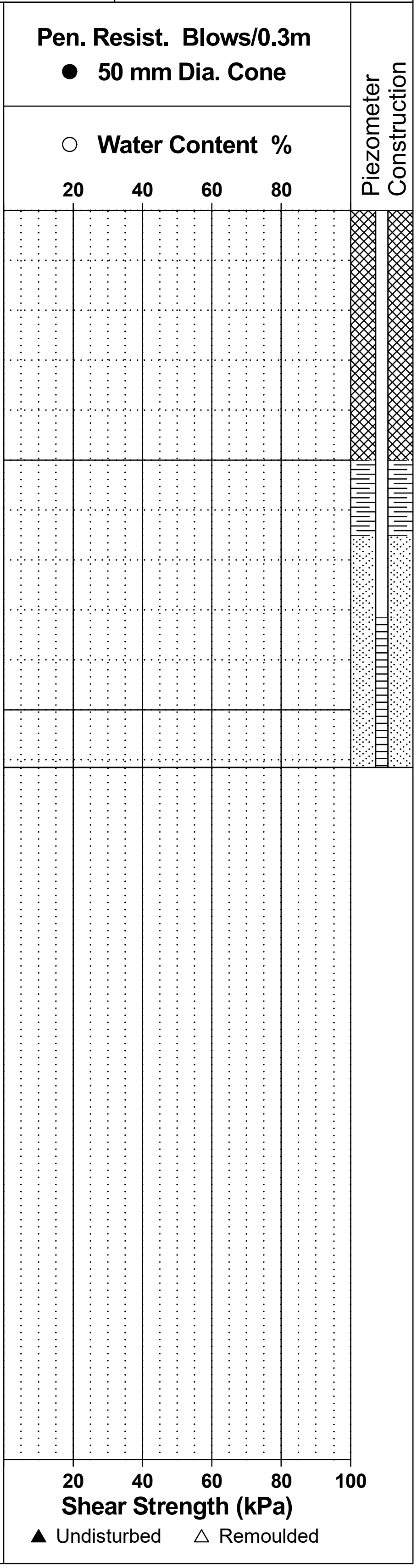
REMARKS

HOLE NO. **BH17**

BORINGS BY CME 55 Power Auger

DATE 2019 January 16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	104.19
TOPSOIL		AU	1				
0.38							
Very stiff to hard, brown **CLAYEY SILT**		SS	2	79	7	1	103.19
- grey by 1.8m depth		SS	3	100	55	2	102.19
2.23							
End of Borehole Practical refusal to augering at 2.23m depth (BH Dry - Jan 29/19)							



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Ottawa, Ontario

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FILE NO. **PG4772**

REMARKS

HOLE NO. **BH18**

BORINGS BY CME 55 Power Auger

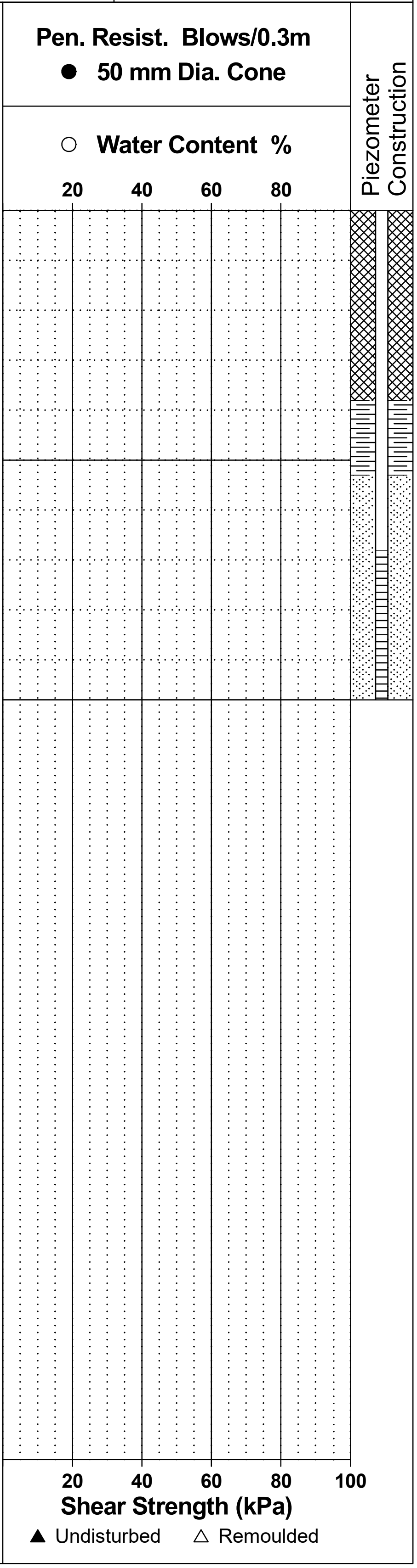
DATE 2019 January 16

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.15
TOPSOIL (to 0.33)	AU	1				
Hard, brown **CLAYEY SILT**	SS	2	88	11	1	103.15
- grey by 1.8m depth (to 1.96)	SS	3	88	50+		

End of Borehole

Practical refusal to augering at 1.96m depth

(BH Dry - Jan 29/19)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

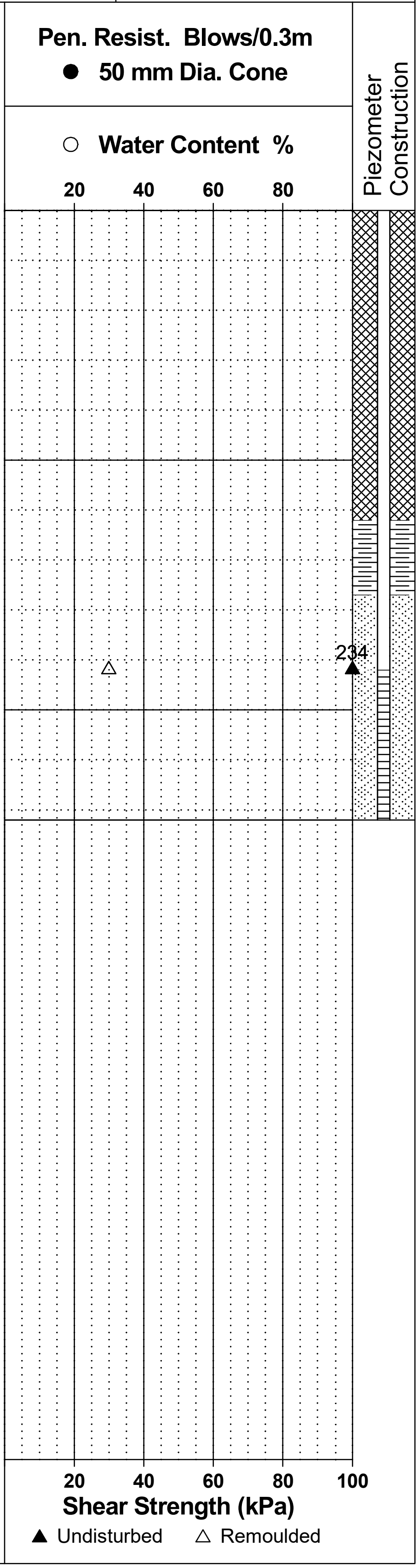
BORINGS BY CME 55 Power Auger

DATE 2019 January 16

FILE NO. PG4772

HOLE NO. BH19

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.78
TOPSOIL		AU	1				
0.36							
		SS	2	88	3	1	102.78
Hard, brown to grey **SILTY CLAY**							
						2	101.78
2.44		SS	3	100	50+		
End of Borehole Practical refusal to augering at 2.44m depth (BH Dry - Jan 29/19)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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REMARKS

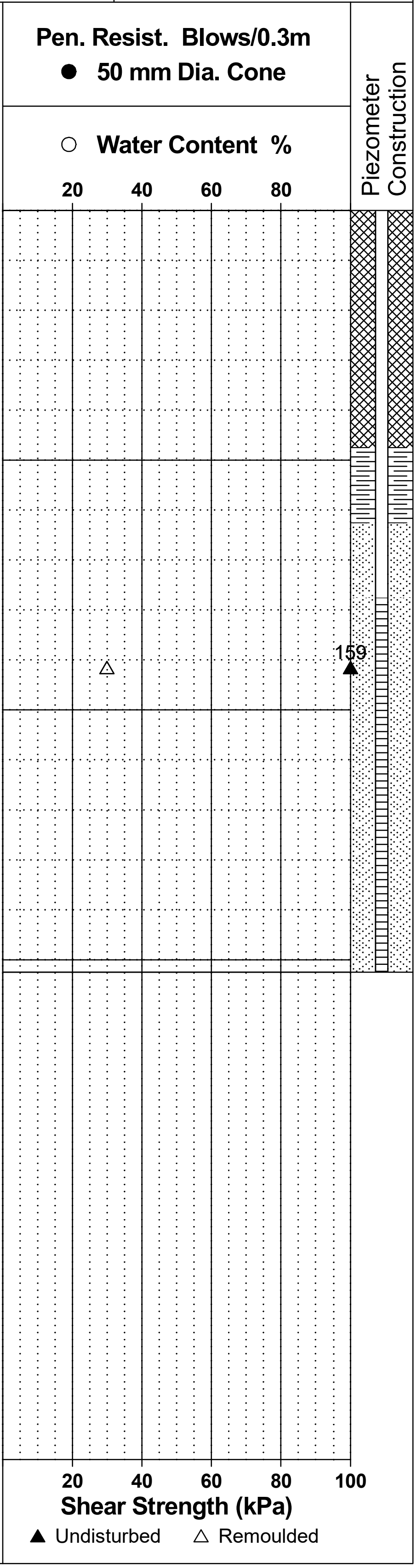
BORINGS BY CME 55 Power Auger

DATE 2019 January 16

FILE NO. **PG4772**

HOLE NO. **BH20**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.59
TOPSOIL 0.33		AU	1				
Very stiff, brown **SILTY CLAY**		SS	2	83	4	1	102.59
- grey by 1.8m depth						2	101.59
2.30							
Loose, grey **CLAYEY SILT,** trace sand and gravel		SS	3	83	9		
3.05						3	100.59
End of Borehole Practical refusal to augering at 3.05m depth (BH Dry - Jan 29/19)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 16

FILE NO. PG4772

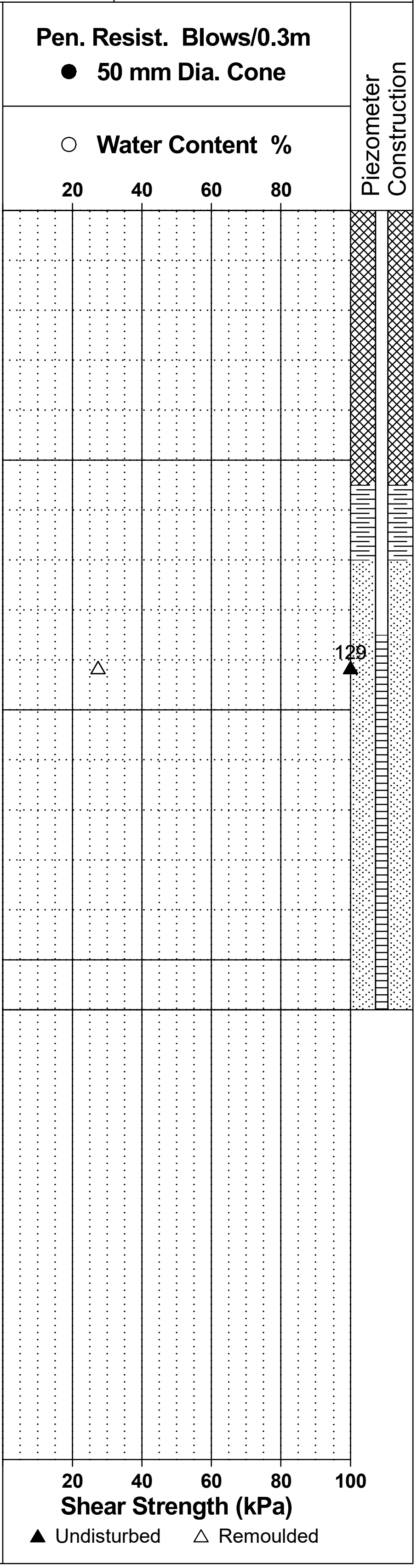
HOLE NO. BH21

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.58
TOPSOIL 0.33	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	79	5	1	102.58
- grey by 1.8m depth					2	101.58
2.29						
GLACIAL TILL: Compact to very dense, brown to grey sandy silt, some clay, gravel, cobbles and boulders	SS	3	71	13		
					3	100.58
3.20	SS	4	100	50+		

End of Borehole

Practical refusal to augering at 3.20m depth

(BH Dry - Jan 29/19)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG4772**

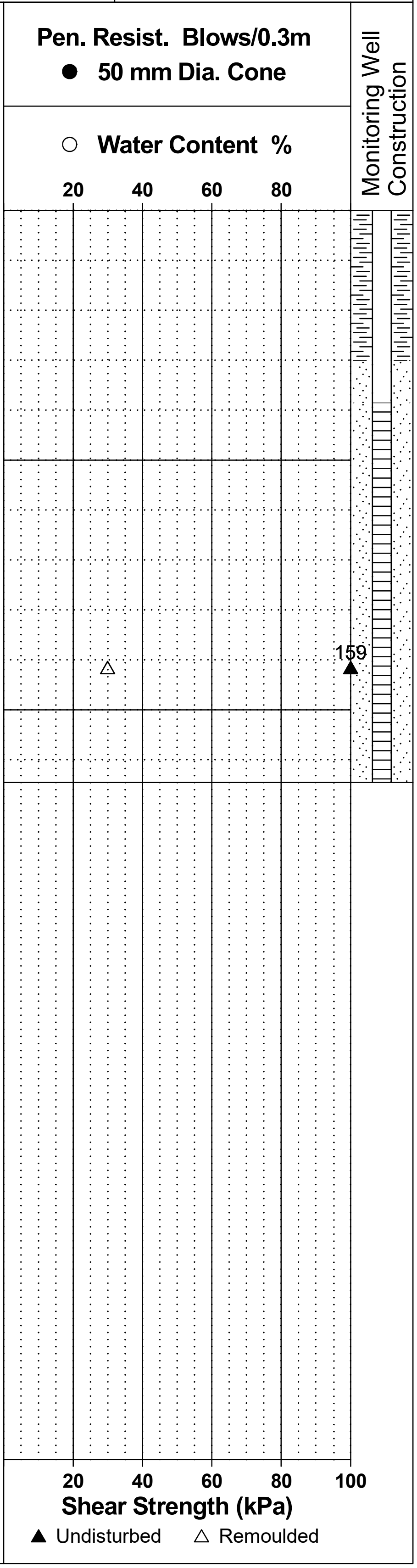
REMARKS

HOLE NO. **BH22**

BORINGS BY CME 55 Power Auger

DATE 2019 January 16

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.65
TOPSOIL 0.25		AU	1				
Very stiff, brown **SILTY CLAY**		SS	2	71	5	1	102.65
- grey by 2.0m depth 2.29						2	101.65
End of Borehole Practical refusal to augering at 2.29m depth (BH Dry - Jan 29/19)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 16

FILE NO. PG4772

HOLE NO. BH23

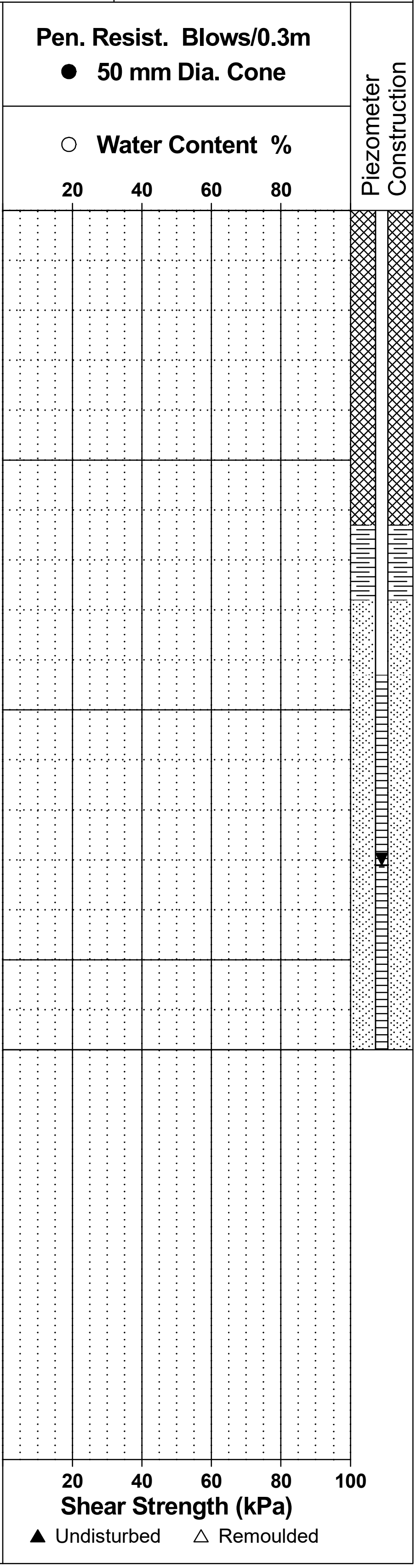
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL (0.30)	AU	1		
Very stiff, brown **SILTY CLAY**, some sand (1.52)	SS	2	0	6
GLACIAL TILL: Dense to very dense, grey silty sand with clay, gravel, cobbles and boulders	SS	3	83	11
	SS	4	75	36
(3.36)	SS	5	31	50+

DEPTH (m)	ELEV. (m)
0	103.87
1	102.87
2	101.87
3	100.87

End of Borehole

Practical refusal to augering at 3.36m depth

(GWL @ 2.62m depth - Jan 29/19)



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Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

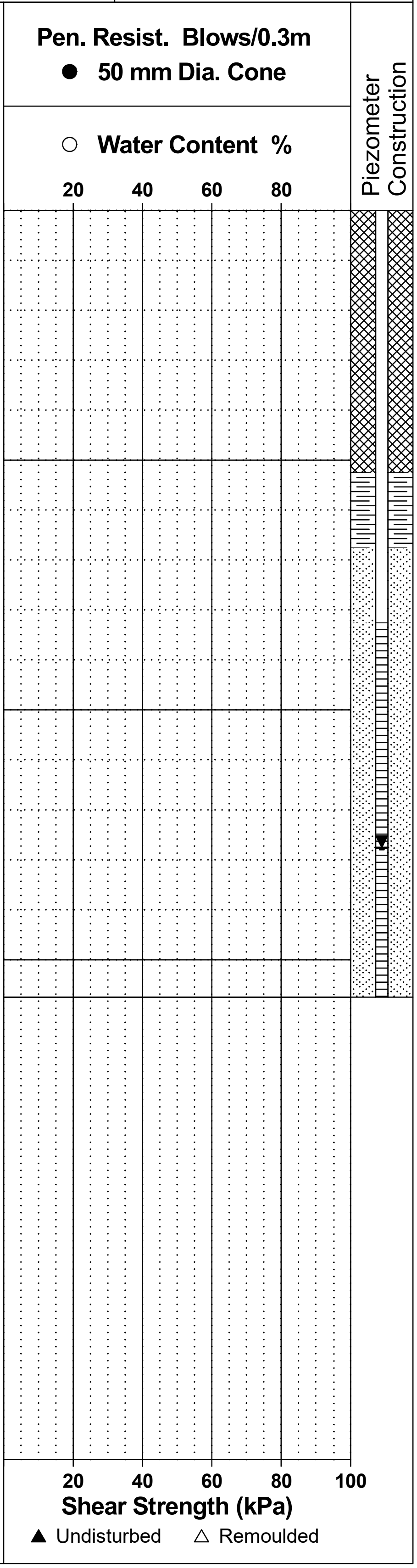
DATE 2019 January 16

FILE NO. PG4772

HOLE NO. BH24

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.36	AU	1		
Very stiff, brown to grey **CLAYEY SILT**	SS	2	67	10
	SS	3	79	29
2.29				
GLACIAL TILL: Compact to very dense, brown clayey silt, some sand, gravel, cobbles and boulders	SS	4	58	23
3.15	SS	5	100	50+
End of Borehole Practical refusal to augering at 3.15m depth (GWL @ 2.55m depth - Jan 29/19)				

DEPTH (m)	ELEV. (m)
0	104.04
1	103.04
2	102.04
3	101.04



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 16

FILE NO. PG4772

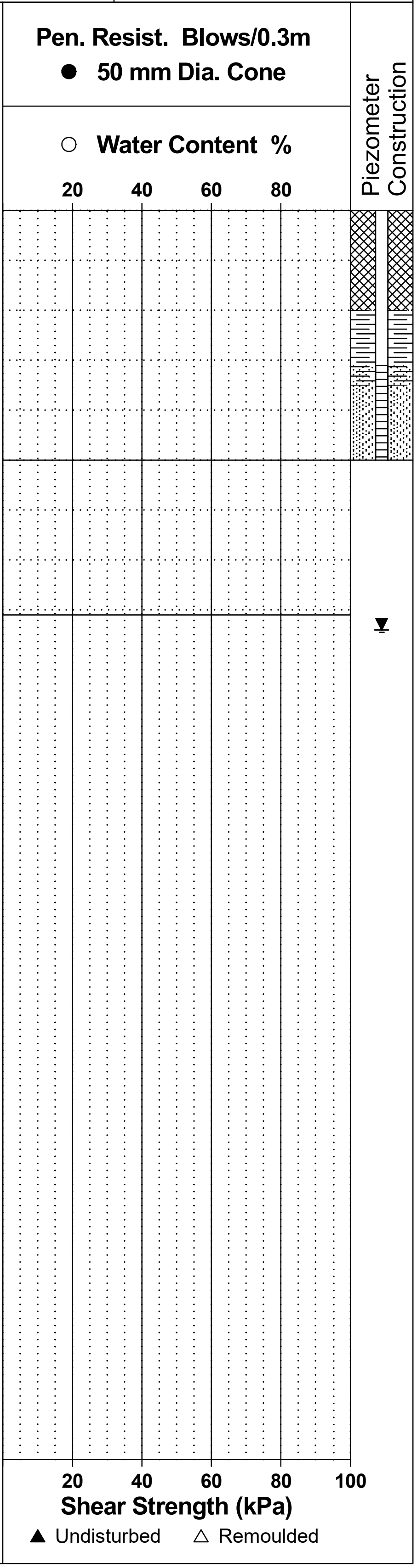
HOLE NO. BH25

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.07
TOPSOIL (to 0.38)	AU	1				
Very stiff, brown **CLAYEY SILT** (0.38 to 1.52)	SS	2	75	11	1	103.07
GLACIAL TILL: Very dense, grey clayey silt with sand, gravel, cobbles, boulders (1.52 to 1.62)	SS	3	75	50+		

End of Borehole

Practical refusal to augering at 1.62m depth

(GWL @ 1.68m depth - Jan 29/19)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 17

FILE NO. PG4772

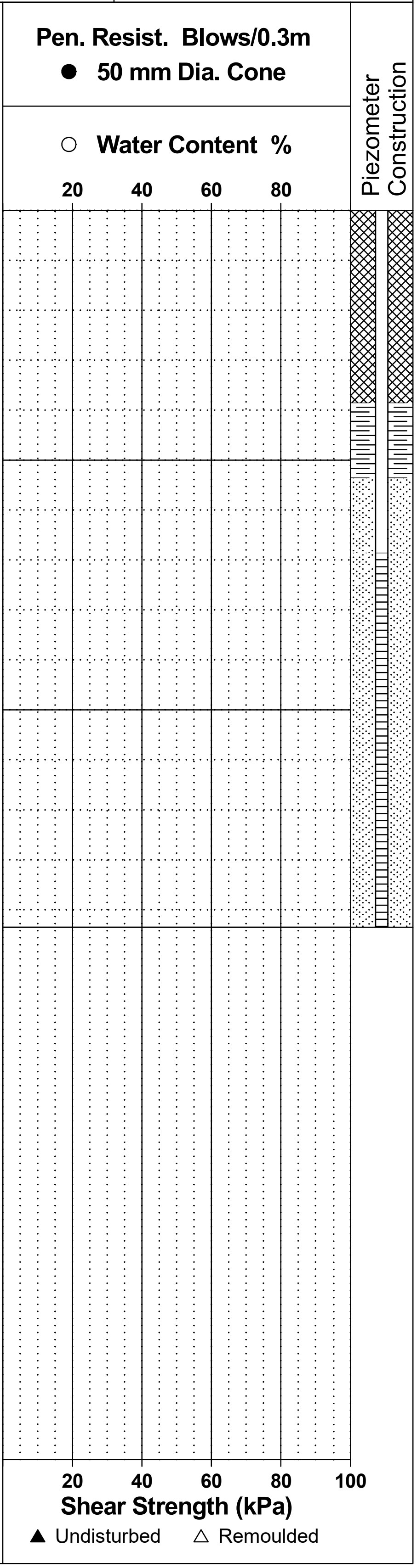
HOLE NO. BH26

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	104.30
TOPSOIL 0.38	AU	1				
Very stiff, brown **CLAYEY SILT**	SS	2	75	9	1	103.30
1.83	SS	3	50	19		
GLACIAL TILL: Compact to dense, grey silty clay with gravel, cobbles and boulders					2	102.30
2.87	SS	4	100	46		

End of Borehole

Practical refusal to augering at 2.87m depth

(BH Dry - Jan 29/19)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

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REMARKS

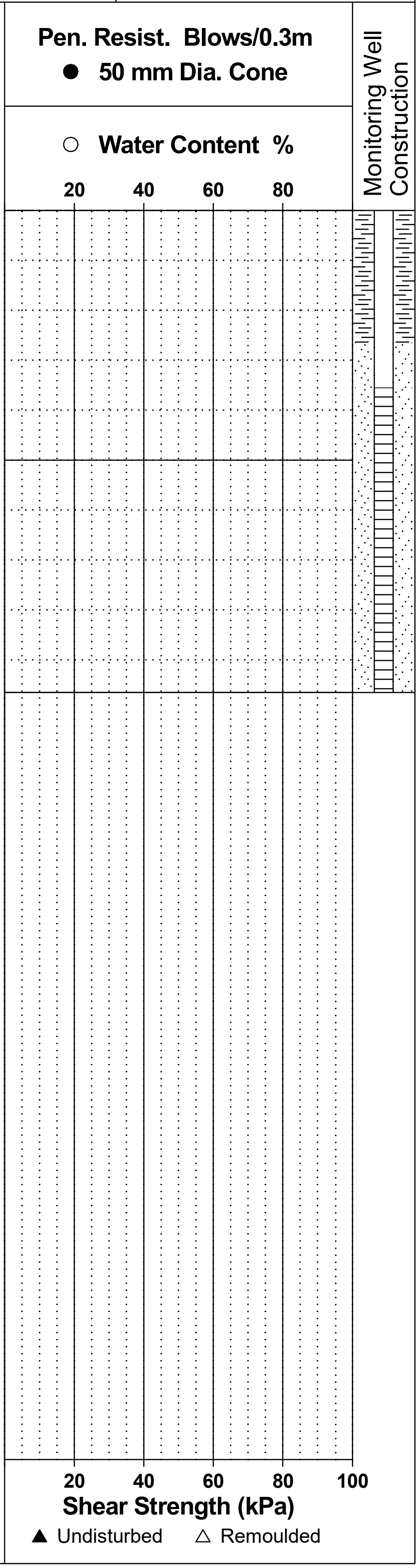
BORINGS BY CME 55 Power Auger

DATE 2019 January 17

FILE NO. PG4772

HOLE NO. BH27

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	103.97
TOPSOIL 0.33		AU	1				
Very stiff, brown **CLAYEY SILT**		SS	2	71	8	1	102.97
- grey by 1.7m depth 1.93		SS	3	88	50+		
End of Borehole Practical refusal to augering at 1.93m depth (BH Dry - Jan 29/19)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG4772**

REMARKS

HOLE NO. **BH28**

BORINGS BY CME 55 Power Auger

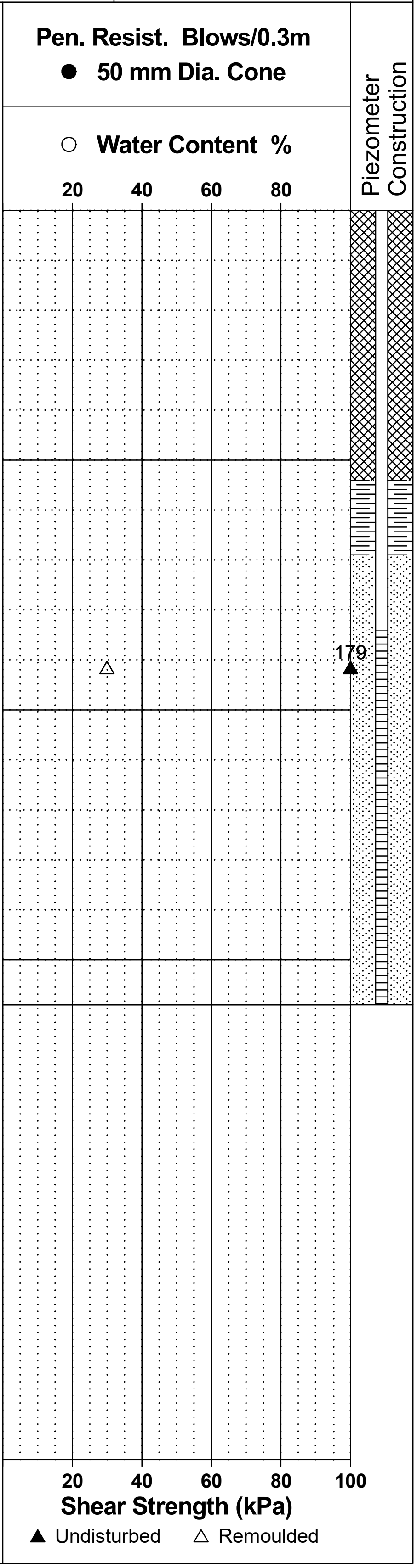
DATE 2019 January 17

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.78
TOPSOIL	AU	1				
0.36						
Very stiff, brown **SILTY CLAY**	SS	2	38	6	1	102.78
					2	101.78
2.29						
GLACIAL TILL: Loose to very dense, grey silty clay with sand, gravel, cobbles and boulders	SS	3	8	2		
					3	100.78
	SS	4	0	50+		
3.18						

End of Borehole

Practical refusal to augering at 3.18m depth

(BH Dry - Jan 29/19)



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Mixed-Use Development - 20 Cedarow Ct.
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE 2019 January 17

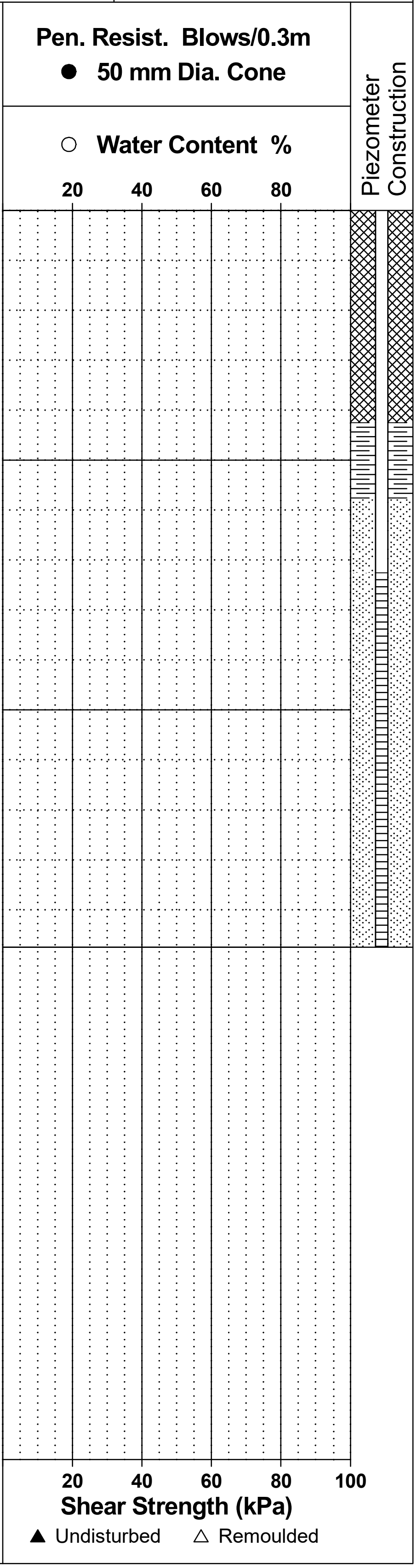
FILE NO. PG4772

HOLE NO. BH29

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	103.71
TOPSOIL 0.38	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	50	7	1	102.71
	SS	3	71	4	2	101.71
2.29 **GLACIAL TILL:** Loose, grey silty clay with sand, gravel, cobbles and boulders	SS	4	17	7		
2.95 End of Borehole						

Practical refusal to augering at 2.95m depth

(BH Dry - Jan 29/19)



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	ROCK QUALITY
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube
PS	-	Piston sample
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

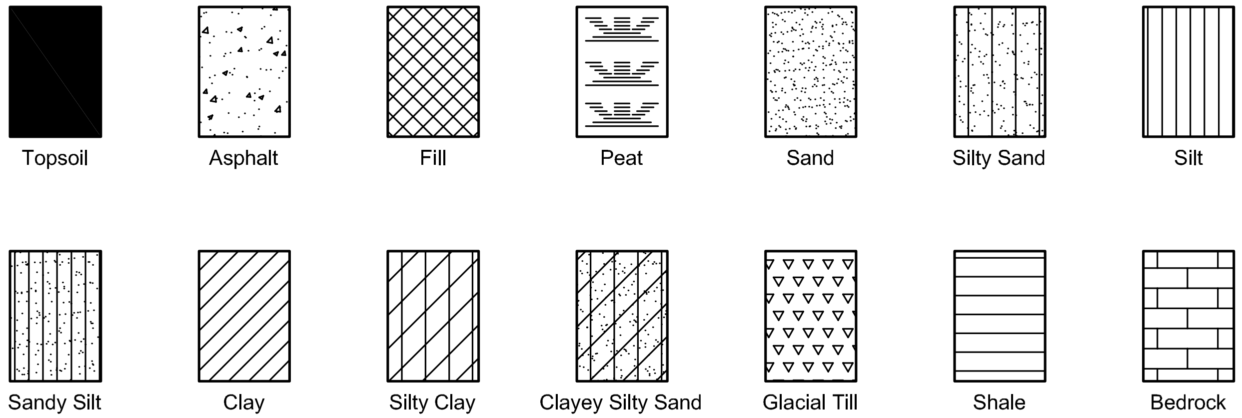
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

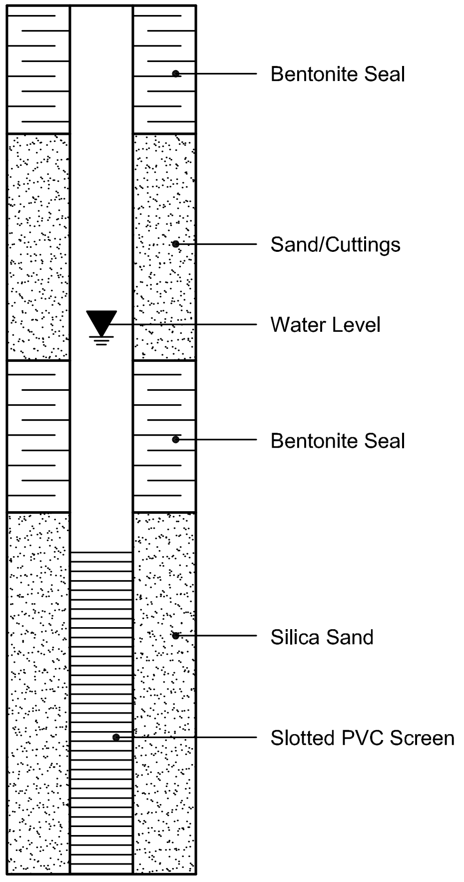
SYMBOLS AND TERMS (continued)

STRATA PLOT

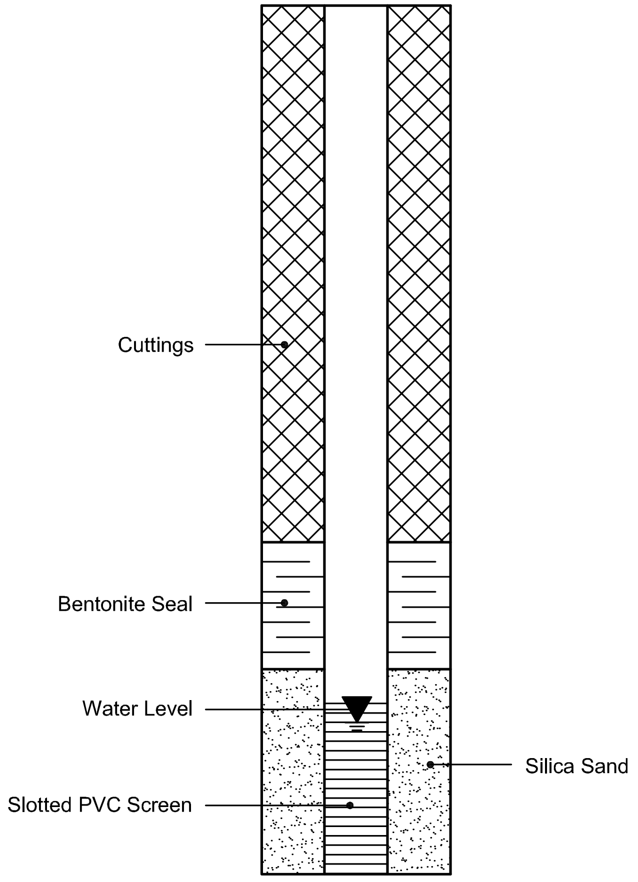


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 25648

Report Date: 22-Jan-2019

Order Date: 16-Jan-2019

Project Description: PG4772

Client ID:		BH#16-19 SS#3	-	-	-
Sample Date:		01/15/2019 09:00	-	-	-
Sample ID:		1903309-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	85.8	-	-	-
General Inorganics					
pH	0.05 pH Units	7.80	-	-	-
Resistivity	0.10 Ohm.m	76.2	-	-	-
Anions					
Chloride	5 ug/g dry	6	-	-	-
Sulphate	5 ug/g dry	6	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 TO 4 - SLOPE STABILITY ANALYSIS SECTIONS

DRAWING PG4772-1 - TEST HOLE LOCATION PLAN

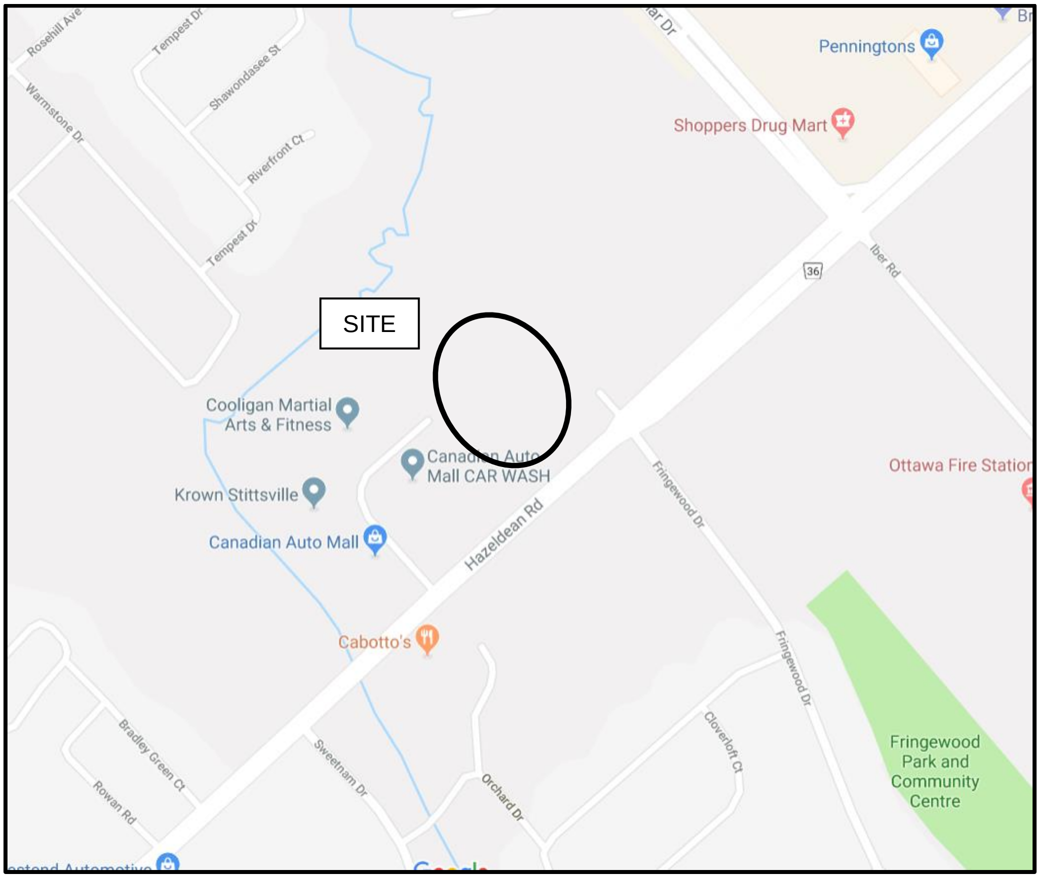


FIGURE 1

KEY PLAN

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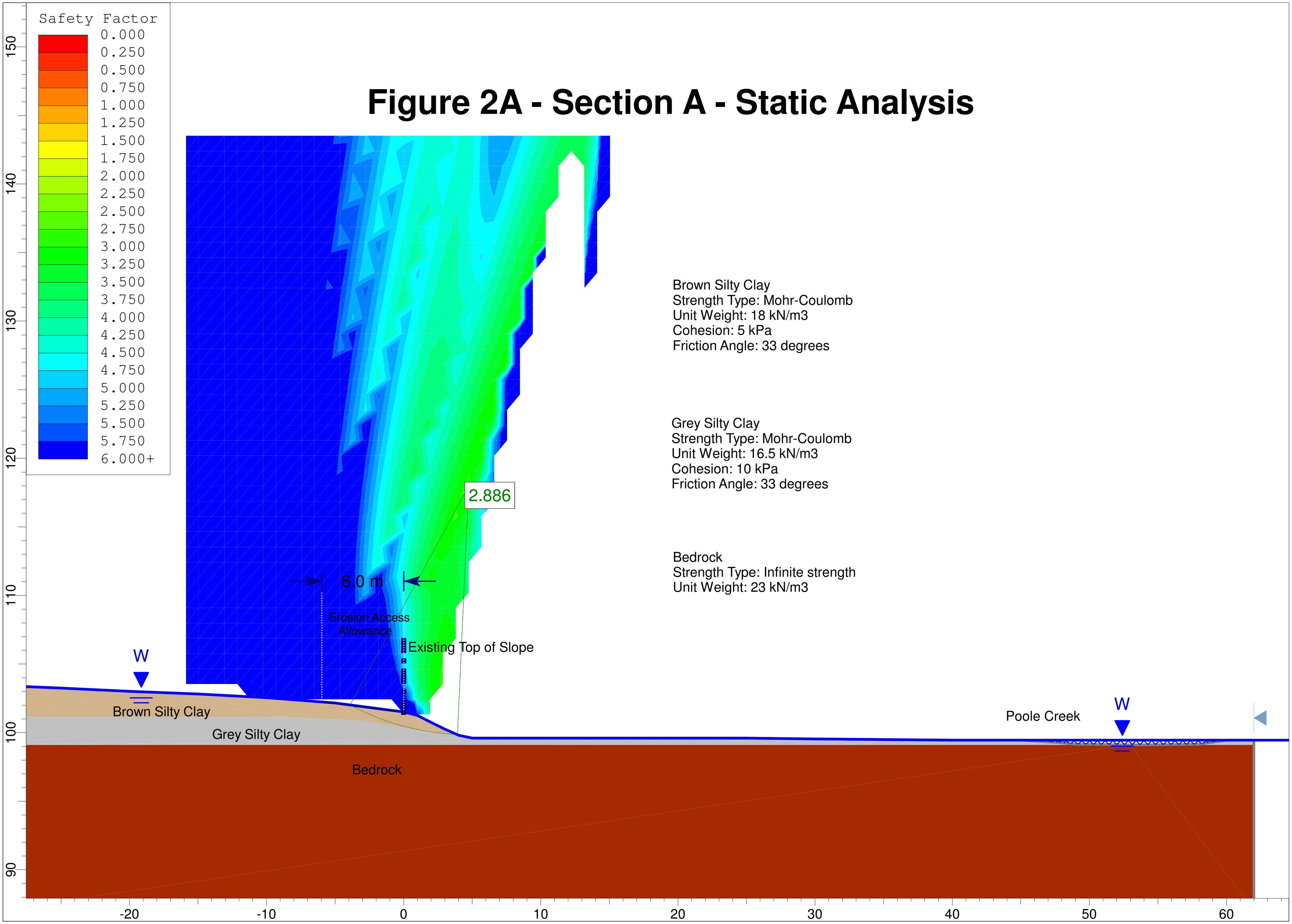
Figure 2A - Section A - Static Analysis



Brown Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 18 kN/m3
Cohesion: 5 kPa
Friction Angle: 33 degrees

Grey Silty Clay
Strength Type: Mohr-Coulomb
Unit Weight: 16.5 kN/m3
Cohesion: 10 kPa
Friction Angle: 33 degrees

Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3

Figure 2B - Section A - Seismic Loading

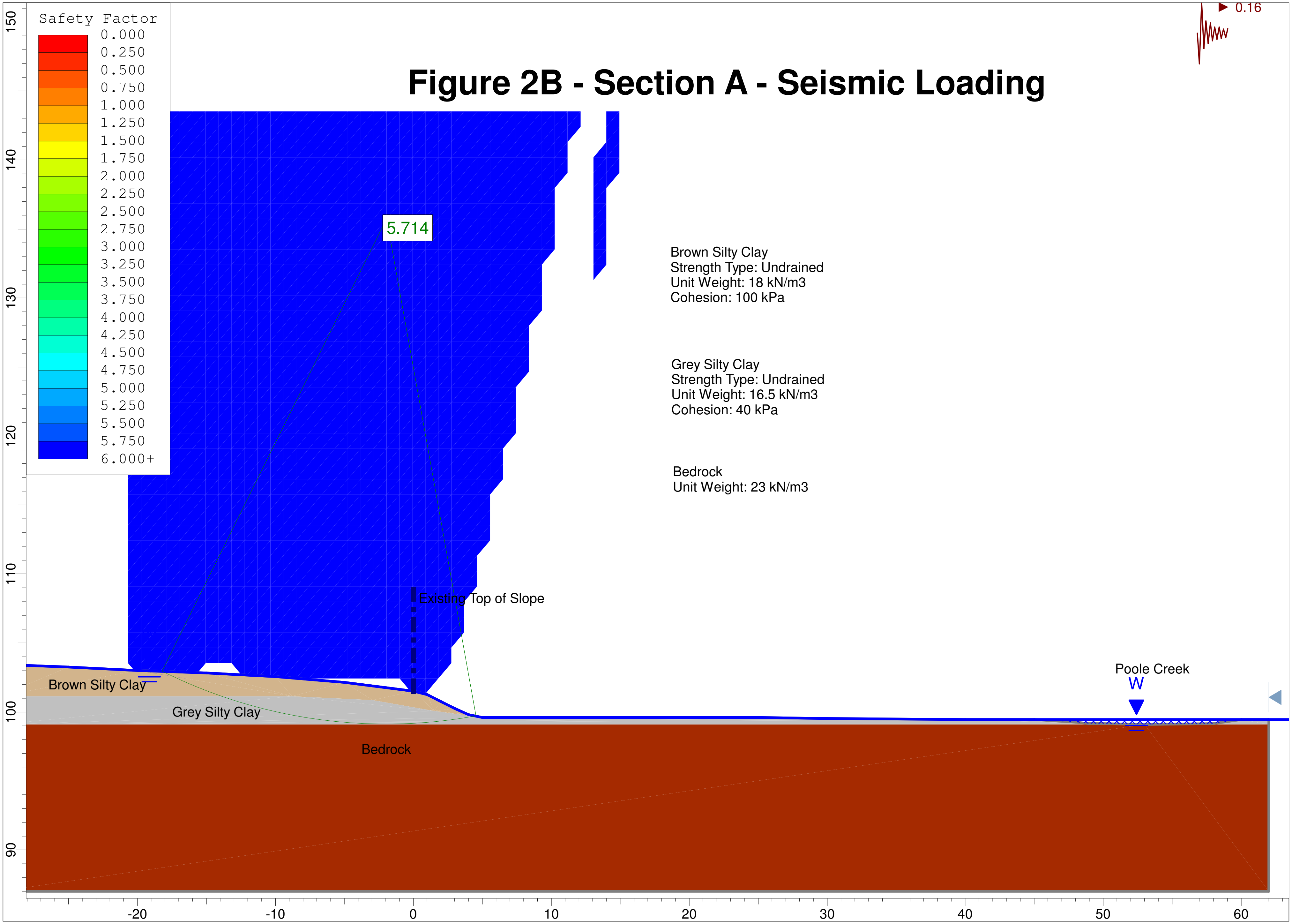


Figure 3A - Section B - Static Analysis

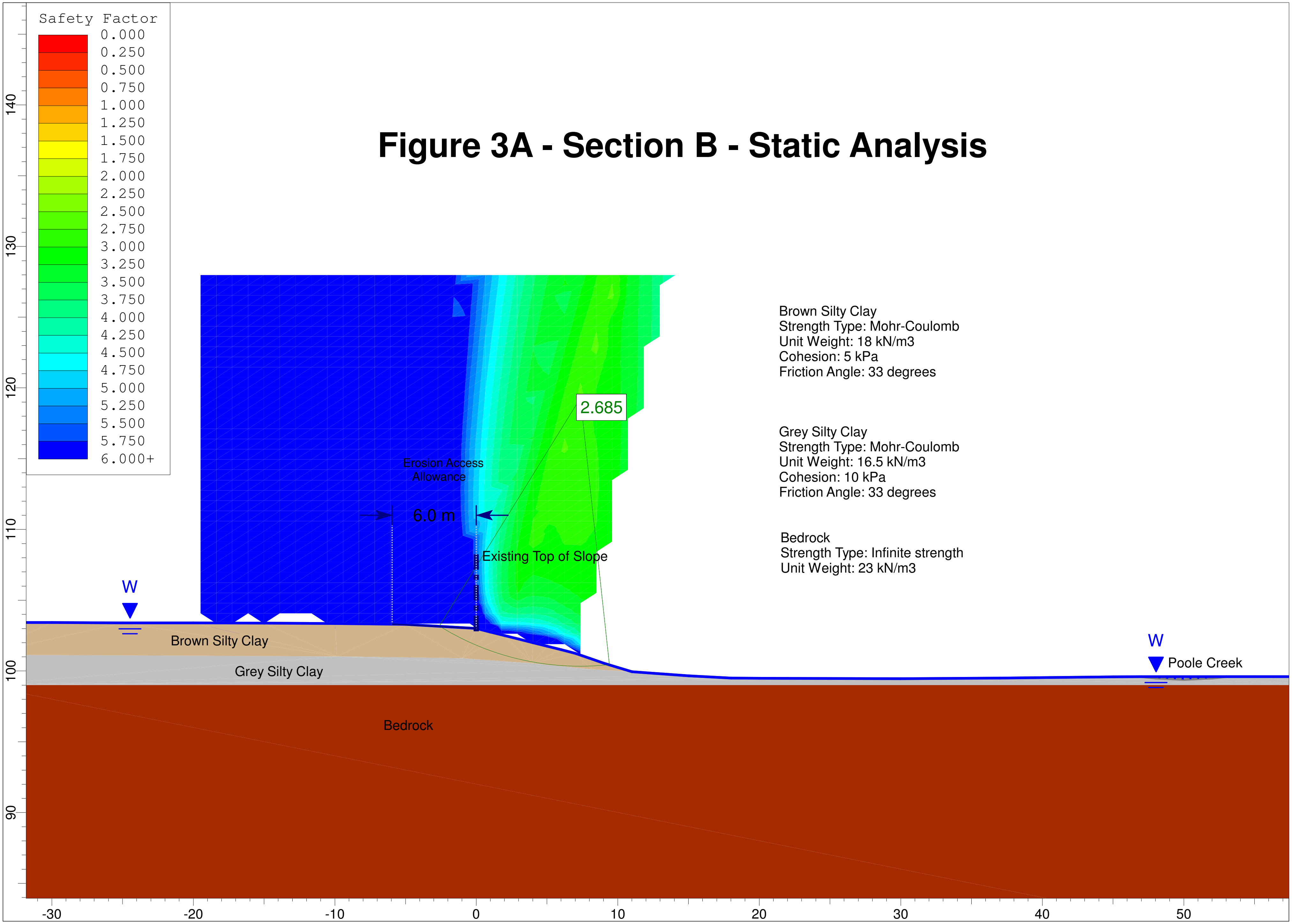
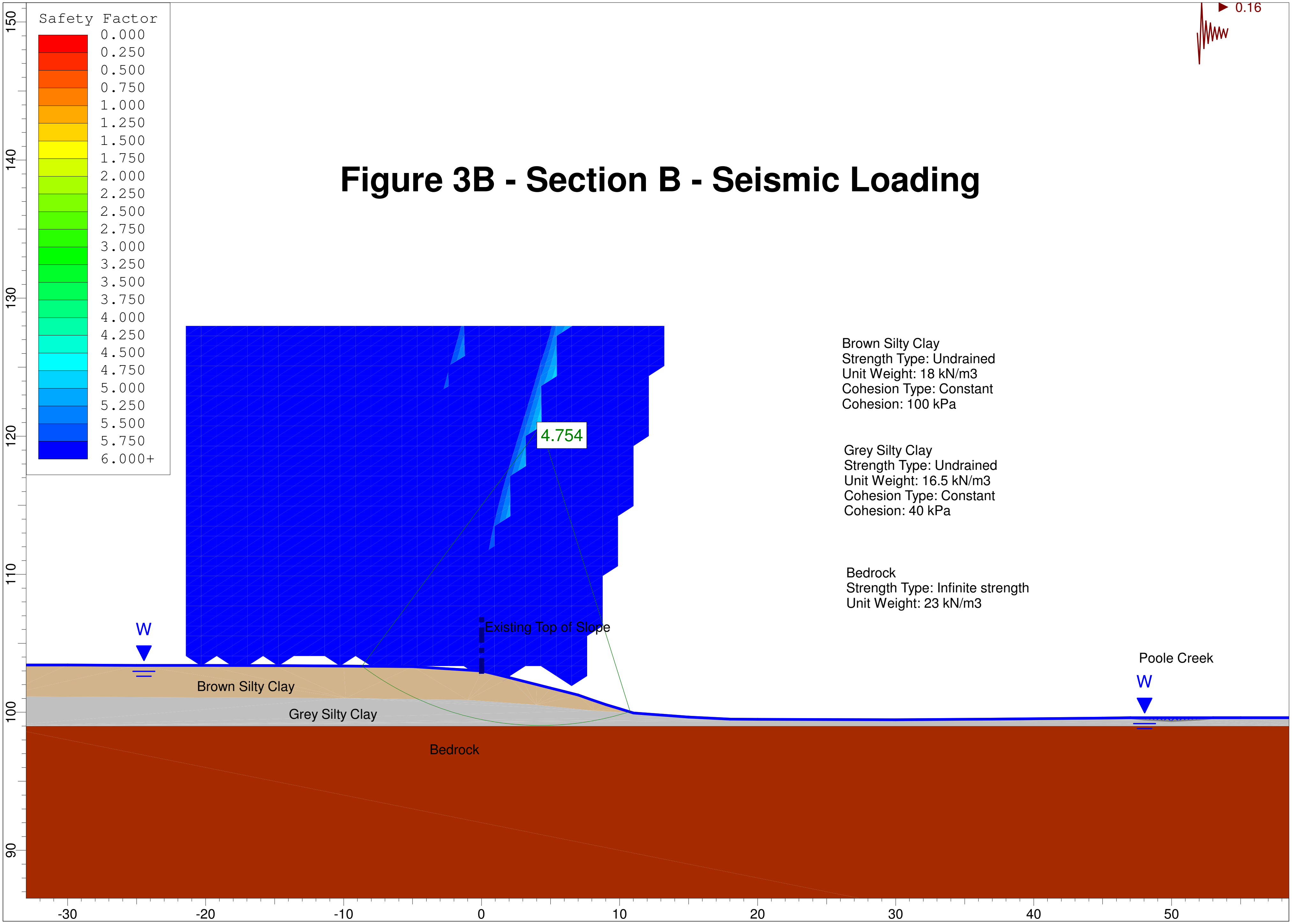


Figure 3B - Section B - Seismic Loading



Brown Silty Clay
Strength Type: Undrained
Unit Weight: 18 kN/m3
Cohesion Type: Constant
Cohesion: 100 kPa

Grey Silty Clay
Strength Type: Undrained
Unit Weight: 16.5 kN/m3
Cohesion Type: Constant
Cohesion: 40 kPa

Bedrock
Strength Type: Infinite strength
Unit Weight: 23 kN/m3

Figure 4A - Section C - Static Analysis

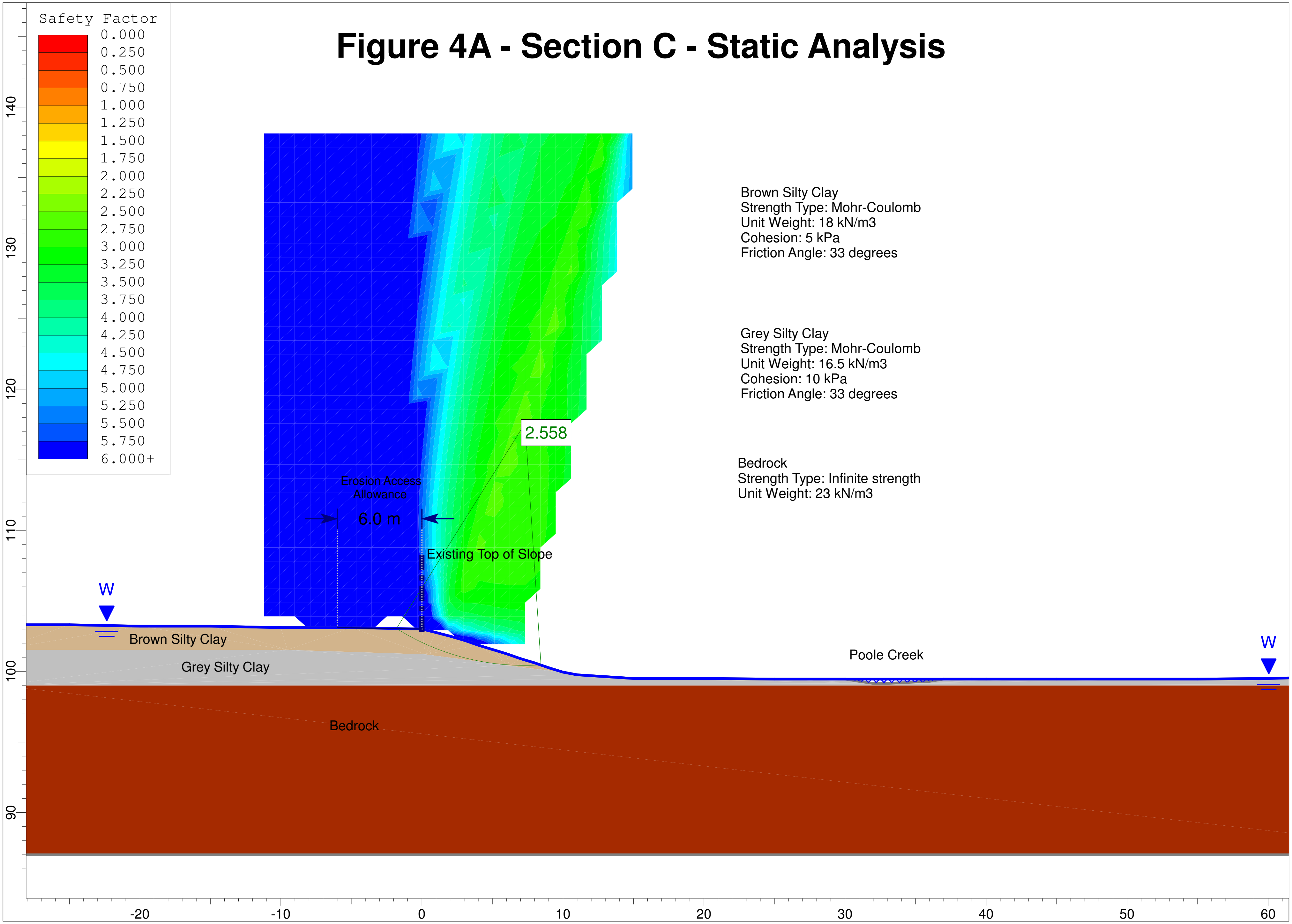
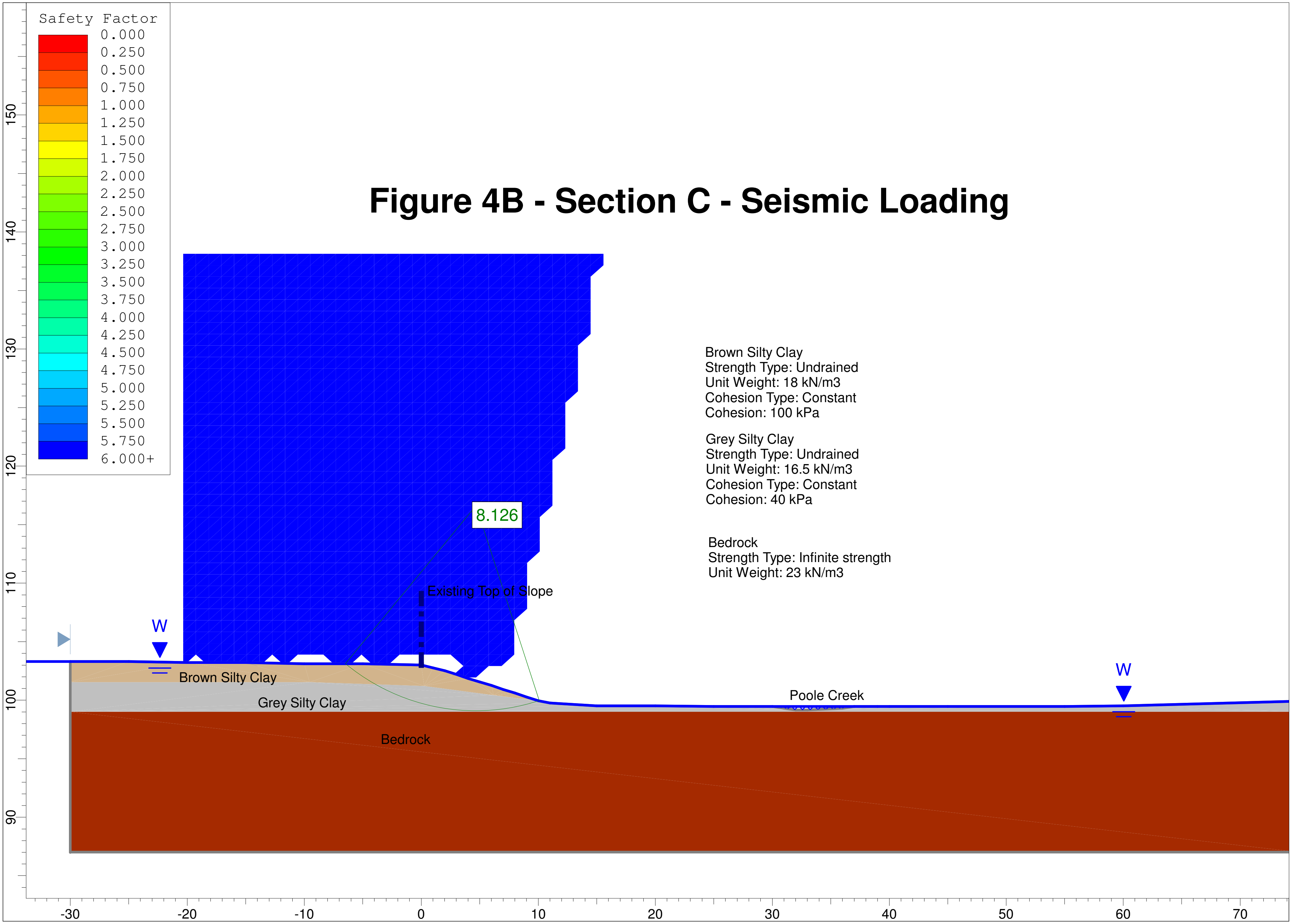
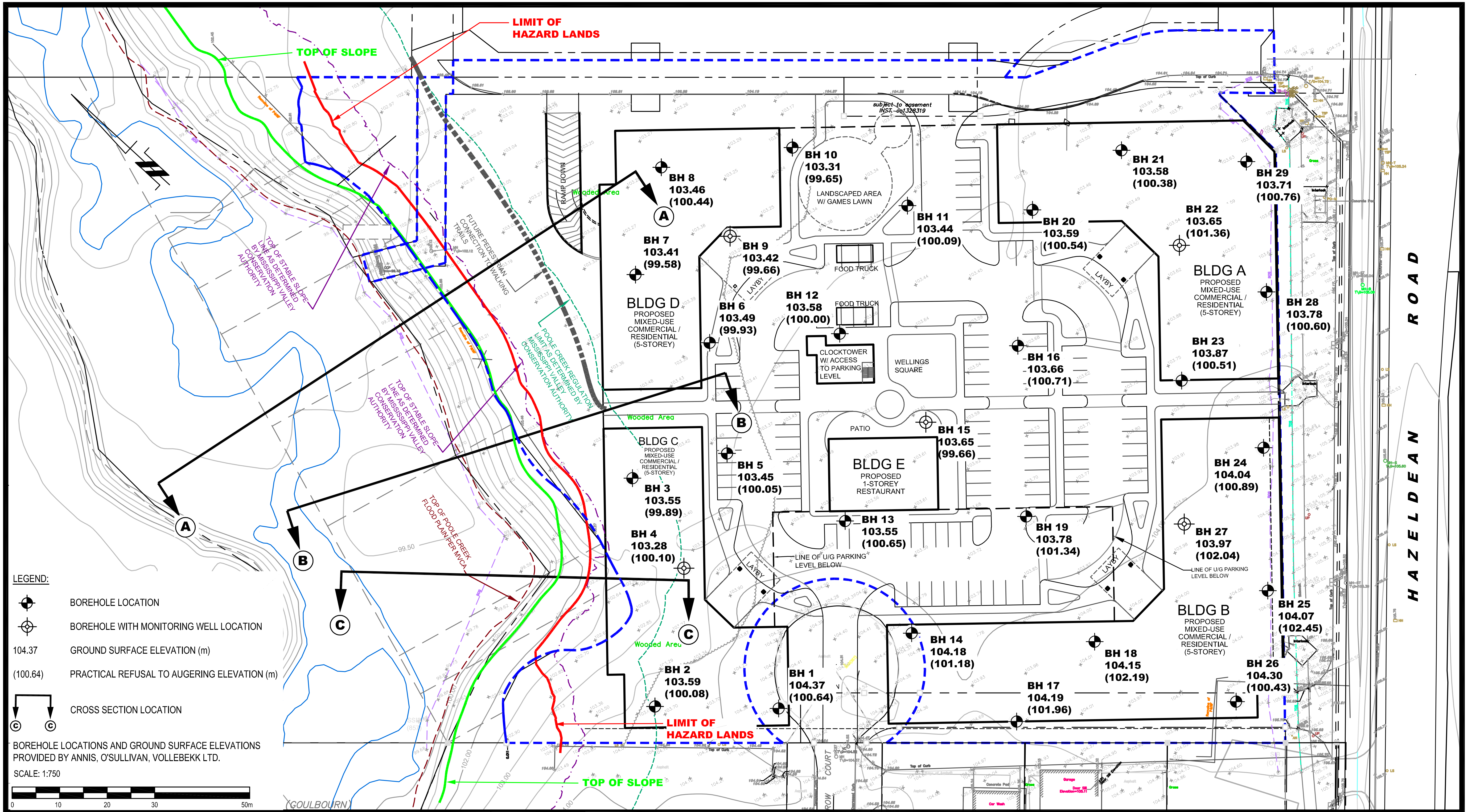


Figure 4B - Section C - Seismic Loading





LEGEND:

⌖	BOREHOLE LOCATION
⊕	BOREHOLE WITH MONITORING WELL LOCATION
104.37	GROUND SURFACE ELEVATION (m)
(100.64)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)
Ⓒ Ⓒ	CROSS SECTION LOCATION

BOREHOLE LOCATIONS AND GROUND SURFACE ELEVATIONS PROVIDED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD.

SCALE: 1:750

0 10 20 30 50m

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NO.	REVISIONS	DATE	INITIAL
1	LIMIT OF HAZARD LANDS REVISED	28/02/2019	FA

NAUTICAL LANDS GROUP

GEOTECHNICAL INVESTIGATION

PROP. MIXED-USE DEVELOPMENT - WELLINGS OF STITTSVILLE PHASE 2 - 20 CEDAROW CT.

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:750
Date: 01/2019
Drawn by: MPG
Report No.: PG4772-1
Checked by: FA
Dwg. No.: PG4772-1
Approved by: DJG
Revision No.: 1

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Appendix E DRAWINGS