THE REGIONAL MUNICIPALITY OF YORK

NORTH ROADS OPERATION CENTER
STORMWATER MANAGEMENT REPORT
2ND SUBMISSION

2024-001
JULY 26, 2024

RESILIENT CONSULTING CORPORATION
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Resilient Consulting

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Title: Project Engineer, Associate

Revision History

Revision	Identification	Date	Description
1	Draft Report	February 23, 2024	SWM Report
2	First Submission	April 1, 2024	SWM Report
3	Second Submission	July 26, 2024	SWM Report

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1 Introduction

Resilient Consulting Corporation (Resilient) was retained by Planmac Engineering Inc. (Planmac), who is a sub-consultant to the Regional Municipality of York (the Region) for the upgrades to the York Region North Roads Operations Centre in Georgina, Ontario. The property has two existing stormwater management (SWM) ponds, and the Region has received an Environmental Compliance Approval (ECA) to retrofit both ponds to provide enhanced Level water quality protection and erosion control, and quantity control up the 100-year storm event for the subject site. Resilient's scope is to verify that the retrofitted pond designs are adequate to provide the required SWM control for the site following the proposed upgrades to the facility.

2 Background Information

To capture a full understanding of the existing site conditions, the following were reviewed:

- LSRCA Technical Guidelines for Stormwater Management Submissions (April 2022)
- LSRCA Phosphorous Offsetting Policy (May 2023)
- LSRCA Water Balance Recharge Offsetting Policy (May 2023)
- York Region Road Design Guidelines (January 2023)
- Lake Simcoe Protection Plan (November 2023)
- Preliminary Site Plan prepared by Planmac (January 2024)
- North District Patrol Facility Storm Water Management Pond 100% Design prepared by Chisholm, Fleming & Associates (Dec 2022)
- North District Patrol Facility Storm Water Management Pond Drawings and Preliminary Design Brief prepared by Chisholm, Fleming & Associates (June 2022)
- North District Patrol Facility Storm Water Management Operation and Maintenance Manual prepared by Chisholm, Fleming & Associates (Dec 2022)
- Hydrogeological Assessment prepared by Harden Environmental (September 2022)
- Geotechnical Investigation prepared by Sola Engineering (March 2023)
- ECA #9763-CQ8NML (March 2023)

3 Stormwater Criteria

The site falls within Lake Simcoe Region Conservation Authority (LSRCA) jurisdiction, but the proposed works are not within a regulated area. The upgrades to the site represent a "major development" per the Lake Simcoe Protection Plan, and therefore requires a phosphorus budget and post to pre-development water balance assessment. LSRCA's Technical Guidelines for Stormwater Management Submissions, Phosphorus Offsetting Policy and Water Balance Recharge Offsetting Policy were referenced to verify the stormwater criteria listed below. Since the site discharges into a Region-owned roadside ditch along Baseline Road, more stringent quantity control criteria were applied on top of the LSRCA guidelines:

- Quantity Control: control post-development peak flow rates to 5-year pre-development levels at a runoff coefficient of 0.25 for all storms including the 5, 10, 25, 50, and 100-year events.
- Quality Control: provide Enhanced Level quality treatment by removing 80% Total Suspended Solids (TSS) from the site runoff.
- Volume Control: provide on-site retention of the 25 mm event. Filtration of the 25 mm is also acceptable in locations with poor subsurface conditions for infiltration.

- Water Balance: complete pre- and post-development water balance budgets including proposed mitigation measures through best management practices.
- Phosphorus Removal: control discharges phosphorus to pre-development levels. An offset fee will apply should pre-development levels be exceeded.
- Erosion Control: provide detention of the 25 mm event to be released over a minimum of 24-hours.

4 Existing Conditions

The subject site is located at 3525 Baseline Road in Georgina, Ontario near the intersection of Baseline Road and Kennedy Road. See **Figure 1** below for Site Location Plan.

Figure 1: Site Location, source: Google Earth

The site is operated by the Region and houses the Region's Roads Department – North Yard and the York Regional Police #3 District Headquarters. The site is bounded by agricultural properties on the north, south and east sides, and a boat repair shop and truck rental company to the west.

The site has two existing stormwater management ponds. The McMinnows Pond is located on the north end of the North Yard and treats water from a highly impervious 4.83 ha catchment. The approved pond retrofit works for the McMinnows Pond would increase the permanent pool volume to 1169 m^3. The extended detention area would provide an additional 283 m^3 of storage above the permanent pool at a total depth of 2.5 m. Outlet flows would be controlled by a 250 mm diameter reverse sloped pipe capped with a 75 mm diameter orifice plate. The retrofitted pond is designed to provide Enhanced Level water quality protection (80% TSS removal) before discharging flows to a ditch flowing north to the Baseline Pond. The McMinnows Pond has not

been designed to provide quantity control and therefore the downstream quantity control assessment does not consider this pond.

The Baseline Pond is located at the north end of the property, next to Baseline Road, and provides quantity control for a catchment area of 6.89 ha. Baseline Pond is a dry pond that receives runoff from the impervious area of the site, discharge from the McMinnows pond, and runoff from a neighbouring Regional facility. The approved retrofit works for the Baseline Pond would increase the maximum storage volume to 2656 m^3 at a maximum depth of 1.3 m. The outlet structure would consist of a 150 mm diameter orifice tube and a staged weir allowing a maximum discharge of 0.20 m^3/s during the 100-yr storm. The pond is designed to provide quantity control up to the 100-yr storm.

5 Proposed Conditions

The proposed upgrades to the facility include expanding the main building on site over a current parking area and paving approximately 0.35 ha of the west side of the yard previously covered with gravel. Although the proposed works are limited, the stormwater management assessment has been completed on the entire site, assuming grassed area under pre-development conditions. Refer to **Figure 2** below for the proposed works highlighted in yellow.

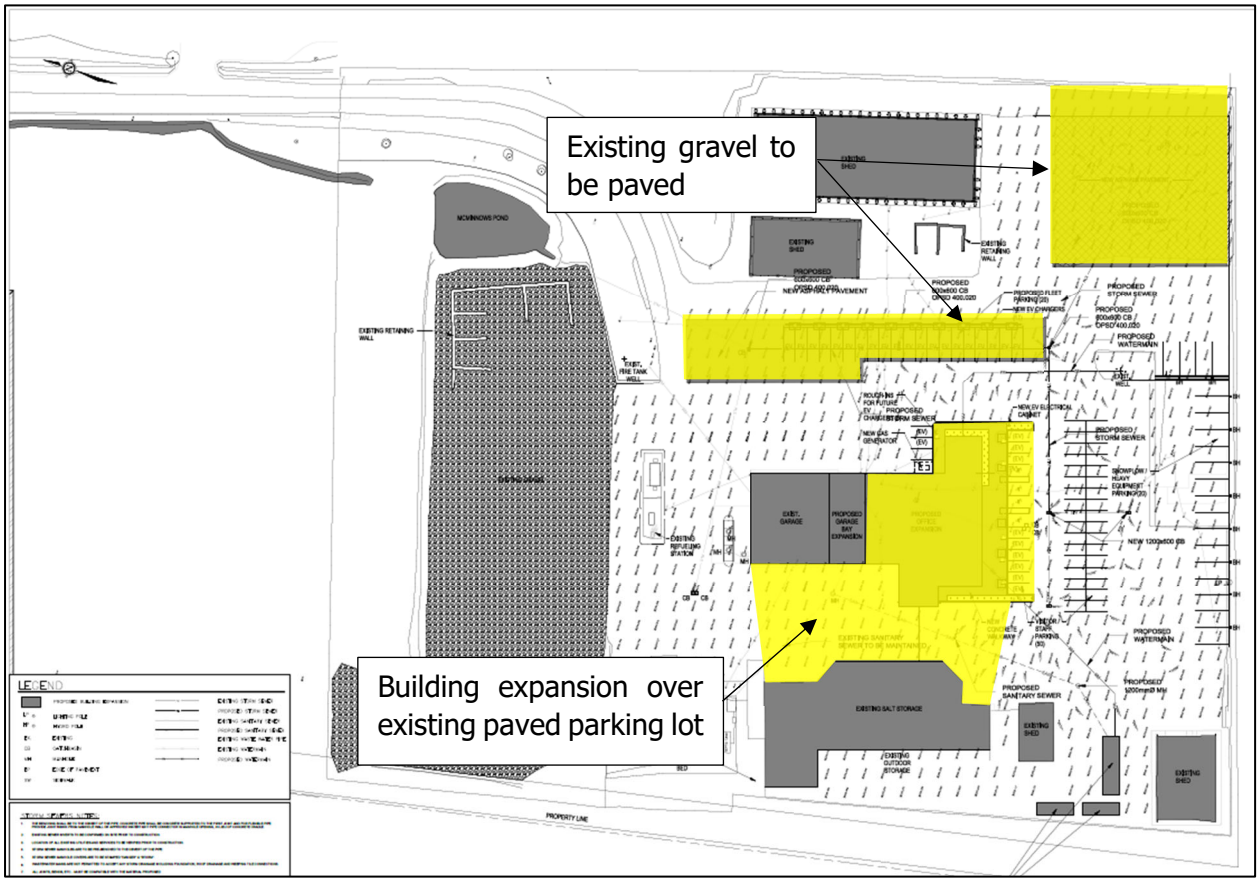


Figure 2: Proposed Works

5.1 Quantity Control

As outlined in the LSRCA SWM criteria, quantity control is required to achieve pre-development flows under post-development conditions. However, since the site discharges into a Region-owned roadside ditch, the quantity control must achieve the 5-year pre-development flows at a runoff coefficient of 0.25 for all post-development conditions up to 100-year event. Although Pre-development targets are outlined in the North District Patrol Facility Storm Water Management Preliminary Design Brief prepared by Chisholm, Fleming & Associates in June 2022, they were based on the City's IDF parameters. As such, the pre-development target flow rates have been re-defined using the Region's IDF parameters to remain consistent with proposed conditions and satisfy the Region's comments.

The drainage area plan included in the North District Patrol Facility Storm Water Management Pond 100% Design prepared by Chisholm, Fleming & Associates in December 2022 was reviewed and confirmed to be accurate. The drainage area plan assigned a composite runoff coefficient of 0.9 for all catchments. To confirm this, Resilient calculated a composite runoff coefficient for a 90% impervious catchment area using a value of 0.95 for impervious land coverage and 0.25 for vegetated land coverage to represent full site buildout conditions. This composite runoff coefficient was found to be 0.89. To complete the quantity control assessment, the more conservative runoff coefficient of 0.9 was carried through. Refer to Sheet S-01 in the North District Patrol Facility Storm Water Management Pond drawing set prepared by Chisholm, Fleming & Associates for the drainage area plan used for the assessment.

Although the subject site is limited to the North Roads Operation Centre property, the downstream quantity control pond receives flow from other area that must be considered in the design of the dry pond. An additional 2.06 ha of area is contributing to this facility at an assumed runoff coefficient of 0.90.

The Modified Rational Method was used to determine peak flows from the site during pre-development and proposed conditions and verify the capacity of the retrofitted Baseline Pond. The York Region Northern Quadrant Intensity-Duration-Frequency (IDF) parameters were applied to determine the storm intensity for the 5 through 100-year events. The minimum time of concentration of 10 minutes was applied for both pre- and post-development conditions. Refer to **Table 1** below for a summary of the existing and proposed catchment parameters used in the quantity control assessment of Baseline Pond.

Table 1: Summary of Catchment Parameters

Catchment ID	Catchment Description	Pre-Development			Post-Development		
		Area (ha)	Runoff Coefficient	Time of Conc. (mins)	Area (ha)	Runoff Coefficient	Time of Conc. (mins)
A1	North Roads Facility	6.89	0.25	10	4.83	0.90	10
A2	Access Road and Swale				0.34	0.90	10
A3	Police Facility				1.72	0.90	10

*Pre-development values based on existing SWM report prepared by Chisholm, Fleming & Associates

As the McMinnows Pond only provides quality control and extended detention, it was assumed that all flows from the site proceeded to the Baseline Pond with no upstream attenuation. A stage-storage-discharge curve was prepared for the Baseline Pond to model the flows out of the pond through the multi-stage outlet weir. The orifice flow equation with a coefficient of 0.8 to represent a piped orifice was used to determine the overall flow through the orifice. FlowMaster was used to calculate the flow through the staged-weir structure, using two broad-crested weirs. The previous design prepared by Chisholm, Fleming & Associates assumed post-development flow would be controlled to pre-development levels. Based on the review provided by the Region is 2024, quantity control criteria were changed to control post-development flows to pre-development levels during the 5-year event. As such, the proposed flow control structure needs to be revised to include a 150 mm orifice tube, a 140 mm width for the lower weir, and 240 mm width for the top weir. See **Table 2** below for a summary of the proposed quantity control.

Table 2: Quantity Control Summary

Storm Event	Pre-Dev. Target (m^3/s)	Post-Dev Flow (m^3/s)	Post-Dev Controlled Flow (m^3/s)	Storage Required (m^3)	Storage Provided (m^3)
5-Year	0.20	1.63	0.09	1716.3	2718
10-Year	0.20	1.93	0.11	1967.1	
25-Year	0.20	2.27	0.15	2251.6	
50-Year	0.20	2.51	0.18	2455.3	
100-Year	0.20	2.76	0.20	2663.2	

As demonstrated in the above table, the revised flow control structure of Baseline Pond provides adequate control to maintain 5-year pre-development flows to the Region's ditch network. Adequate quantity control storage is provided up to the 100-year event, based on the retrofit works designed by Chisholm, Fleming & Associates. retrofit to Baseline Pond. Refer to **Appendix B** for supporting calculations.

5.2 Quality Control

As outlined in the LSRCA SWM criteria, quality treatment is required to provide removal of 80% Total Suspended Solids (TSS), and to maintain pre-development Phosphorus loading levels. Should pre-development levels be exceeded, the LSRCA Phosphorus Offsetting Policy (POP) will apply. Further, pre-treatment of runoff from the site area, particularly the stockpile area beside the McMinnows Pond, is recommended in the existing ECA. As the wet pond provides the required quality control, the pre-treatment measures have been noted, but not included in the TSS removal calculations.

McMinnows Pond

Quality control for the York Region North Roads Operations Centre is provided by the McMinnnows pond. This catchment used for quality design is 4.83ha large and was assumed to be 90% impervious. The required permanent pool and extended detention storage volumes were calculated based on Table 3.2 in the MECP Stormwater Management Planning and Design Manual. For a 90% impervious site, 258.3 m^3/ha is required for a wet pond to achieve 80% TSS removal.

Of that, 40 m^3/ha is required for extended detention. Therefore, 218.3 m^3/ha was used to determine the required permanent pool volume and 40 m^3/ha for the required extended detention volumes. See **Table 3** below for a summary of the quality control capacity of the McMinnows pond, and **Appendix C** for supporting calculations.

Table 3: Quality Control Volume Assessment - TSS

Scenario	TSS % Removal	Permanent Pool Volume (m^3)	Extended Detention Volume (m^3)
Required	80	1055	193
Provided	80	1169	283

It is noted that proper maintenance of the McMinnows pond is required to ensure the facility is operating as designed. Inspections should be completed on an annual basis or after large storm events to check for erosion and ensure the inlets and outlet are not obstructed. Sediment removal from the pond should be completed at a ten-year interval. Refer to the Operation and Maintenance Manual for the facility prepared by Chisholm, Fleming & Associates in **Appendix C**.

In addition to the McMinnows Pond, an Up-Flo® Filter unit is proposed upstream of the pond at the entrance to the south forebay to satisfy other SWM criteria. An Oil Grit Separator (OGS) unit is also proposed on the west side of the pond. This OGS unit is for the pre-treatment requirement of the ECA for runoff from the stockpile area which includes a swale for conveyance, catch basin for capture, and outlet pipe. During large storm events, the flows will bypass the OGS unit and enter the pond directly via overland flow. As additional TSS removal is not required, the unit has not been included in the calculations. Refer to **Appendix C** for details pertaining to these units.

Total Phosphorus

Per the updated POP policy in May 2023, Total Phosphorus levels discharged from the site are to be at or below the pre-developed loading levels. As such, Phosphorus loading for existing and proposed conditions was assessed using the MECP Phosphorus Budget Tool. A treatment train approach with the Up-Flo® Filter, wet pond (McMinnows) and dry pond (Baseline) is proposed to maximize Phosphorus removal. Only a portion of the site area is conveyed through the filter unit, and therefore the remainder of the site is only credited with the wet pond and dry pond treatment. See a summary of this assessment in **Table 4** below.

Table 4: Quality Control Summary - TP

Condition	Areas (ha)		P load	Treated Area	Efficiency	P Load Reduction
	Sod	Commercial	(kg/yr)	(ha)	(%)	(kg/yr)
Pre-Development	4.83	--	1.65	-	--	
Post-Development	1.62	3.21	6.23	2.89	91%	3.03
				1.94	67%	2.04
With BMP						**0.79**
Post to Pre Difference (+/-)						**- 0.37**

As demonstrated in the above table, the proposed stormwater management scheme is capable of reducing the existing Phosphorus load from the site by 0.37 kg/year. As pre-development levels are maintained/improved, the Phosphorus offsetting policy does not apply. Refer to **Appendix C** for supporting calculations of the Phosphorus assessment as well as the Technical Bulletin - Up-Flo® Filter - Field Evaluation of Phosphorus Removal.

5.3 Volume Control

As outlined in the pre-consultation with the LSRCA, the proposed works are classified as a major development and therefore volume control criteria apply to the site. As required by LSRCA, retention or filtration of the 25 mm event on newly constructed impervious surface is required. This SWM report is intended to cover the entire site assuming grassed pre-development conditions, and therefore the newly impervious surface is the total impervious surface on site.

The Hydrogeological Assessment prepared by Harden Environmental in September 2022 indicates low infiltrating soils and high groundwater conditions which is not adequate for infiltration practices. Based on the seasonally high data collected in June 2022, groundwater elevations are expected within 1.0 m of the ground elevations, with a mean hydraulic conductivity of 9.5×10^{-7} m/s. Although partial retention may be provided through an irrigation system for the proposed building area, this does not fully satisfy volume control criteria and therefore additional measures are required. With the poor subsurface conditions, an Up-Flo® Filter is proposed at the storm sewer inlet to the McMinnows Pond to provide filtration of the 25 mm event. Refer to **Appendix C** for the Up-Flo® Filter details and the Hydrogeological Report in **Appendix D**.

5.4 Water Balance

Since the proposed changes to the site are classified as a major development by LSRCA, a pre- and post-development water balance assessment has been completed for the site. The Thornthwaite Mather Method was used to calculate the required water balance depth to ensure that pre-development infiltration rates are maintained for the 90% impervious post-development catchment. This approach was applied to the 4.83 ha catchment draining to the McMinnows Pond which contains all the proposed works.

Annual precipitation and evapotranspiration values for the site were taken from the Hydrogeological Assessment prepared by Harden Environmental in September 2022. An infiltration factor of 0.65 was determined based on the MECP Stormwater Management Planning and Design Manual Table 3.1. Canadian Climate Normals Data for Egbert, Ontario was used in the analysis.

The analysis found that a retention depth of 6.13 mm over the site's impervious area or a retention volume of 267 m^3 is required to provide the required annual infiltration. As previously noted, the subsurface soil and groundwater conditions are not suitable for infiltration practices. As such, best management practices have been explored to promote infiltration and retention on-site.

To satisfy LEED criteria, a rainwater irrigation system is being explored to capture roof runoff from the new building area. Although this will satisfy water balance requirements from the building area, the remainder of the site remains untreated. The retrofitted McMinnows pond provides 283 m^3 of storage which is sufficient to cover the deficit. Storage within the wet pond will also promote evaporation from the surface which acts as an added benefit to water balance.

Lastly, the channel from McMinnows Pond to Baseline Pond has a minimal slope of 0.8% and is equipped with straw hay bales to slow velocities and promote infiltration. As all impervious area is conveyed through this treatment train, is it argued that sufficient best management practices have been proposed to promote infiltration and evaporation to pre-development levels. Refer to **Appendix D** for supporting calculations.

5.5 Erosion Control

As required by the LSRCA, detention of the 25 mm event is required on-site and is to be released to the receiving system over a minimum of 24-hours. To satisfy this, the McMinnows Pond has been sized to provide the required erosion control volume, also known as extended detention. Based on a catchment area of 4.83 ha, a volume of 120.7 m^3 would be experienced during the 25 mm event. This is less than the 40 m^3/ha requirement from the MECP SWMP and therefore MECP sizing has been applied for extended detention design.

Based on MECP 40 m^3/ha requirement, a total erosion control volume of 193 m^3 is required, with 283 m^3 provided in the McMinnows Pond. This volume is provided above the ponds outlet invert and is in addition to the water quality volume provided for the site. A reversed slope pipe with a 75 mm orifice plate is provided as the outlet control of the McMinnows Pond. A 450 mm HDPE outlet pipe is provided downstream of the orifice plate and is elevated to the permanent pool elevation to maintain water elevations in the pond.

In addition to stream erosion control, erosion and sediment control during construction is recommended and has been outlined in the existing O&M manual. A detailed ESC plan for construction is to be provided by others. Refer to **Appendix C** for erosion control calculations.

6 Conclusions

In conclusion, this stormwater management assessment has been completed for the York Region North Roads Operations Centre to support the expansion of the existing facility. Although the facility currently exists, this assessment has been completed assuming grassed area for pre-development conditions as design drawings/reports for the existing ponds do not exist.

The subject property is located within LSRCA jurisdiction and is subject to the stormwater management criteria outlined by the Town of Georgina as well as the LSRCA. Since the site drains to a Region-owned roadside ditch, quantity control criteria were provided by the Region. These criteria are satisfied by:

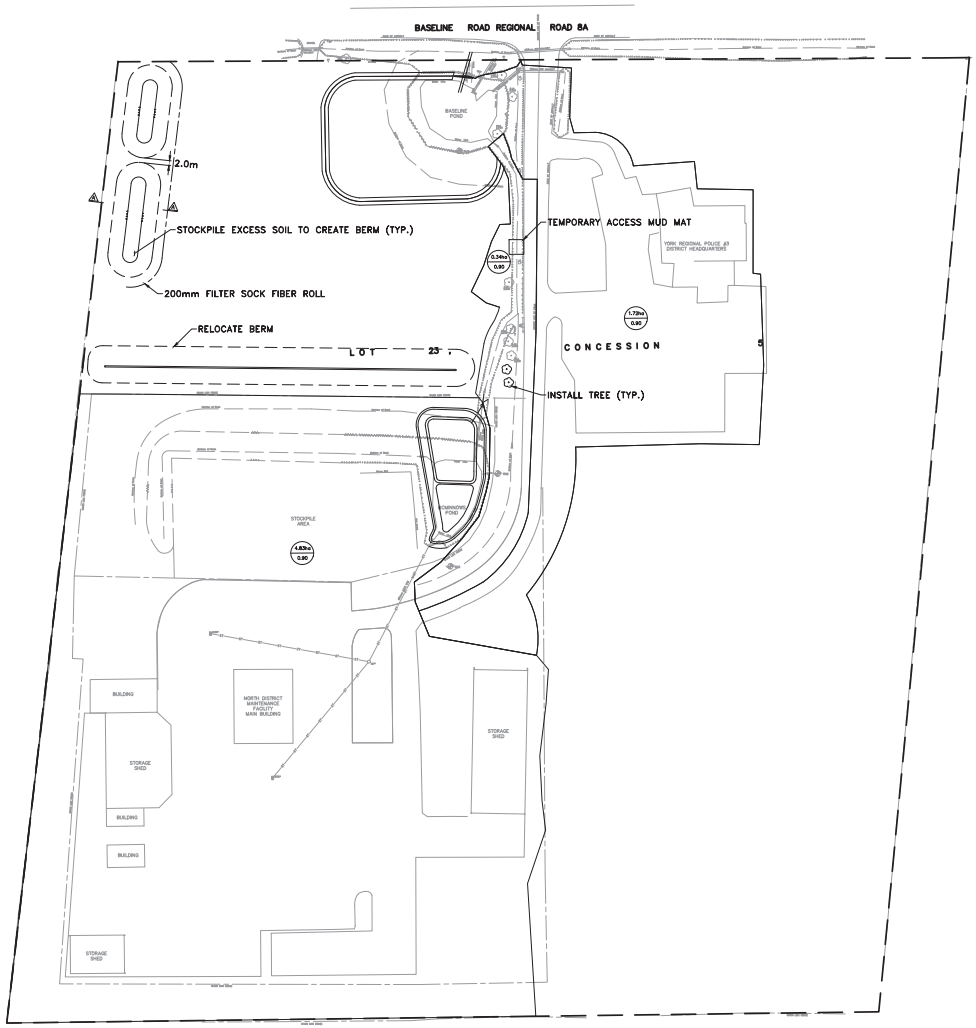
- Quantity Control: post-development peak flows are controlled to below pre-development 5-year levels at a runoff coefficient of 0.25 through the use of a 150mm orifice tube and staged-weir structure and active storage provided within Baseline Pond.
- Quality Control: 80% TSS removal is provided for the subject property through the permanent pool storage volume provided within McMinnows Pond. Additionally, an OGS unit has been included as pre-treatment for the runoff from the stockpile area west of the pond, and an Up-Flo filter for pre-treatment of the remaining site area, as recommended by the existing ECA.
- Phosphorus Control: Phosphorus loading is reduced under proposed conditions.
- Volume Control: filtration of the 25 mm storm event from the property is provided through an Up-Flo® Filter located upstream of McMinnows Pond.

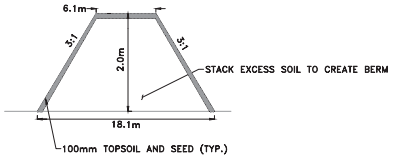
- Water Balance: best management practices are proposed to offset water balance impacts. Due to the Hydrogeological Report, groundwater elevations and soil conditions are not adequate for infiltration and therefore additional storage has been provided in the McMinnows Pond with additional BMP on the property.
- Erosion Control: detention of the 25 mm event is provided in the extended detention volume provided within the McMinnows Pond. A total volume of 193 m^3 is required with 283 m^3 provided.

APPENDIX A

Figures

METRIC





SECTION A–A
HORIZONTAL SCALE: 1:250
VERTICAL SCALE: 1:50

BENCH MARK

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE BM NO 0011961U3344 ELEVATION 244.699

SCALE

HORIZONTAL 1:1000

NOTES:
THE LOCATION OF UTILITIES IS APPROXIMATE ONLY. CONSULT THE RESPECTIVE MUNICIPAL AUTHORITIES AND UTILITY COMPANIES TO DETERMINE THE EXACT LOCATION OF THEIR UTILITIES. THE CONTRACTOR SHALL VERIFY THE LOCATION OF UTILITIES AND SHALL ADEQUATELY PROTECT AND SUPPORT THEM DURING CONSTRUCTION.

Chisholm, Fleming & Associates
Consulting Engineers

No.	DATE	REVISIONS	BY
1	SEPT/21	30% DESIGN SUBMISSION	SK
2	DEC/21	REVISED 30% DESIGN SUBMISSION	SK
3	APR/22	REVISED 30% DESIGN SUBMISSION	SK
4	SEPT/22	90% DESIGN SUBMISSION	SK
5	DEC/22	100% DESIGN SUBMISSION	SK

York Region Transportation and Works

DESIGN FF
DRAWN SK
CHECKED NM

NORTH DISTRICT PATROL FACILITY SWMP
SITE PLAN AND DRAINAGE AREA MAP
3525 BASELINE ROAD, TOWN OF GEORGINA

DWG. NO. TXX-XXXXXX
CONT. NO. XX-XXX
SHEET NO. S-01

APPENDIX B

Quantity Control

RESILIENT CONSULTING

Proj No. 2024-001
Date: 2024-07-24
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Modified Rational Method Calculations - Stormwater Management Requirements

Drainage Areas	Pre-Development	
Area (A1) =	**3.10**	ha
"C" =	**0.25**	
AC1=	**0.78**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
5Yr Flow Target =	**0.20**	m^3/s

Five Year Design Storm	York Region IDF
a=	2464
b=	16
c=	1.00
I =	(a/(b+t))*c

A1-2-3 Post - To Dry Pond

Drainage Areas	A1-2-3 Post	
Area =	**6.89**	ha
"C" =	**0.90**	
AC=	**6.20**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Max.Storage =	**1716.3**	m^3
Max Storage Depth=	**0.72**	m
Max Storage Elevation=	**250.02**	m
Max Discharge=	**0.09**	m^3/s

(1)	(2)	(5)	(6)	(7)	(8)	(9)
Time	**Rainfall Intensity**	**Storm Runoff (A1-2-3 Post)**	**Runoff Volume (A1-2-3 Post)**	**Allowable Release Volume (A1-2-3 Post)**	**Storage Volume (A1-2-3 Post)**	**Storage Depth (A1-2-3 Post)**
(min)	**(mm/hr)**	**(m^3/s)**	**(m^3)**	**(m^3)**	**(m^3)**	**m**
Tc+Time Increment	**(a/(b+t))*c**	**(5) = [(2)*AC1]/360**	**(6) = (5)*(1)*60**	**From SSD Curve**	**IF (6)>(7) then (8)=(6)-(7) IF not then (8)=0**	**From SSD Curve**
10.0	94.8	1.632	979.4	51.0	928.4	0.40
15.0	79.5	1.369	1232.2	76.5	1155.7	0.52
20.0	68.4	1.179	1414.7	102.0	1312.7	0.58
25.0	60.1	1.035	1552.8	127.5	1425.3	0.62
30.0	53.6	0.923	1660.8	153.0	1507.8	0.65
35.0	48.3	0.832	1747.6	178.5	1569.1	0.67
40.0	44.0	0.758	1819.0	204.0	1615.0	0.68
45.0	40.4	0.696	1878.6	229.5	1649.1	0.70
50.0	37.3	0.643	1929.2	255.0	1674.2	0.71
55.0	34.7	0.598	1972.7	280.5	1692.2	0.71
60.0	32.4	0.558	2010.4	306.0	1704.4	0.72
65.0	30.4	0.524	2043.5	331.5	1712.0	0.72
70.0	28.7	0.494	2072.8	357.0	1715.8	0.72
75.0	27.1	0.466	2098.8	382.5	1716.3	0.72
80.0	25.7	0.442	2122.1	408.0	1714.1	0.72
85.0	24.4	0.420	2143.1	433.5	1709.6	0.72
90.0	23.2	0.400	2162.2	459.0	1703.2	0.72
95.0	22.2	0.382	2179.5	484.5	1695.0	0.71
100.0	21.2	0.366	2195.3	510.0	1685.3	0.71
105.0	20.4	0.351	2209.8	535.5	1674.3	0.71
110.0	19.6	0.337	2223.2	561.0	1662.2	0.70
115.0	18.8	0.324	2235.5	586.5	1649.0	0.70
120.0	18.1	0.312	2247.0	612.0	1635.0	0.69
125.0	17.5	0.301	2257.6	637.5	1620.1	0.69
130.0	16.9	0.291	2267.5	663.0	1604.5	0.68
135.0	16.3	0.281	2276.7	688.5	1588.2	0.67
140.0	15.8	0.272	2285.4	714.0	1571.4	0.67
145.0	15.3	0.264	2293.5	739.5	1554.0	0.66
150.0	14.8	0.256	2301.1	765.0	1536.1	0.66
155.0	14.4	0.248	2308.3	790.5	1517.8	0.65
160.0	14.0	0.241	2315.0	816.0	1499.0	0.64
165.0	13.6	0.234	2321.4	841.5	1479.9	0.64

RESILIENT CONSULTING

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Modified Rational Method Calculations - Stormwater Management Requirements

Drainage Areas	Pre-Development	
Area (A1) =	**3.10**	ha
"C" =	**0.25**	
AC1=	**0.78**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
5Yr Flow Target =	**0.20**	m^3/s

Ten Year Design Storm	York Region IDF
a=	2464
b=	16
c=	1.18
I =	(a/(b+t))*c

A1-2-3 Post - To Dry Pond

Drainage Areas	A1-2-3 Post	
Area =	**6.89**	ha
"C" =	**0.90**	
AC=	**6.20**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Max.Storage =	**1967.1**	m^3
Max Storage Depth=	**0.81**	m
Max Storage Elevation=	**250.11**	m
Max Discharge=	**0.11**	m^3/s

(1)	(2)	(5)	(6)	(7)	(8)	(9)
Time	**Rainfall Intensity**	**Storm Runoff (A1-2-3 Post)**	**Runoff Volume (A1-2-3 Post)**	**Allowable Release Volume (A1-2-3 Post)**	**Storage Volume (A1-2-3 Post)**	**Storage Depth (A1-2-3 Post)**
(min)	**(mm/hr)**	**(m^3/s)**	**(m^3)**	**(m^3)**	**(m^3)**	**m**
Tc+Time Increment	**(a/(b+t))*c**	**(5) = [(2)*AC1]/360**	**(6) = (5)*(1)*60**	**From SSD Curve**	**IF (6)>(7) then (8)=(6)-(7) IF not then (8)=0**	**From SSD Curve**
10.0	111.8	1.926	1155.7	68.4	1087.3	0.46
15.0	93.8	1.616	1454.0	102.6	1351.4	0.59
20.0	80.8	1.391	1669.4	136.8	1532.6	0.66
25.0	70.9	1.222	1832.3	171.0	1661.3	0.70
30.0	63.2	1.089	1959.7	205.2	1754.5	0.73
35.0	57.0	0.982	2062.2	239.4	1822.8	0.76
40.0	51.9	0.894	2146.4	273.6	1872.8	0.77
45.0	47.7	0.821	2216.7	307.8	1908.9	0.79
50.0	44.1	0.759	2276.5	342.0	1934.5	0.79
55.0	41.0	0.705	2327.8	376.2	1951.6	0.80
60.0	38.3	0.659	2372.3	410.4	1961.9	0.80
65.0	35.9	0.618	2411.4	444.6	1966.8	0.81
70.0	33.8	0.582	2445.9	478.8	1967.1	0.81
75.0	32.0	0.550	2476.6	513.0	1963.6	0.80
80.0	30.3	0.522	2504.1	547.2	1956.9	0.80
85.0	28.8	0.496	2528.9	581.4	1947.5	0.80
90.0	27.4	0.472	2551.3	615.6	1935.7	0.80
95.0	26.2	0.451	2571.8	649.8	1922.0	0.79
100.0	25.1	0.432	2590.4	684.0	1906.4	0.79
105.0	24.0	0.414	2607.6	718.2	1889.4	0.78
110.0	23.1	0.397	2623.3	752.4	1870.9	0.77
115.0	22.2	0.382	2637.9	786.6	1851.3	0.77
120.0	21.4	0.368	2651.4	820.8	1830.6	0.76
125.0	20.6	0.355	2663.9	855.0	1808.9	0.75
130.0	19.9	0.343	2675.6	889.2	1786.4	0.74
135.0	19.3	0.332	2686.5	923.4	1763.1	0.74
140.0	18.6	0.321	2696.7	957.6	1739.1	0.73
145.0	18.1	0.311	2706.3	991.8	1714.5	0.72
150.0	17.5	0.302	2715.3	1026.0	1689.3	0.71
155.0	17.0	0.293	2723.8	1060.2	1663.6	0.70
160.0	16.5	0.285	2731.7	1094.4	1637.3	0.69
165.0	16.1	0.277	2739.3	1128.6	1610.7	0.68

RESILIENT CONSULTING

Proj No. 2024-001
Date: 2024-07-24
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Modified Rational Method Calculations - Stormwater Management Requirements

Drainage Areas	Pre-Development	
Area (A1) =	**3.10**	ha
"C" =	**0.25**	
AC1=	**0.78**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
5Yr Flow Target =	**0.20**	m^3/s

Twenty-Five Year Design Storm	York Region IDF
a=	2464
b=	16
c=	1.39
I =	(a/(b+t))*c

A1-2-3 Post - To Dry Pond

Drainage Areas	A1-2-3 Post	
Area =	**6.89**	ha
"C" =	**0.90**	
AC=	**6.20**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Max.Storage =	**2251.6**	m^3
Max Storage Depth=	**0.90**	m
Max Storage Elevation=	**250.20**	m
Max Discharge=	**0.15**	m^3/s

(1)	(2)	(5)	(6)	(7)	(8)	(9)
Time	**Rainfall Intensity**	**Storm Runoff (A1-2-3 Post)**	**Runoff Volume (A1-2-3 Post)**	**Allowable Release Volume (A1-2-3 Post)**	**Storage Volume (A1-2-3 Post)**	**Storage Depth (A1-2-3 Post)**
(min)	**(mm/hr)**	**(m^3/s)**	**(m^3)**	**(m^3)**	**(m^3)**	**m**
Tc+Time Increment	**(a/(b+t))*c**	**(5) = [(2)*AC1]/360**	**(6) = (5)*(1)*60**	**From SSD Curve**	**IF (6)>(7) then (8)=(6)-(7) IF not then (8)=0**	**From SSD Curve**
10.0	131.7	2.269	1361.4	90.6	1270.8	0.53
15.0	110.5	1.903	1712.8	135.9	1576.9	0.67
20.0	95.1	1.639	1966.5	181.2	1785.3	0.74
25.0	83.5	1.439	2158.4	226.5	1931.9	0.79
30.0	74.5	1.282	2308.5	271.8	2036.7	0.83
35.0	67.2	1.157	2429.2	317.1	2112.1	0.85
40.0	61.2	1.053	2528.4	362.4	2166.0	0.87
45.0	56.1	0.967	2611.3	407.7	2203.6	0.89
50.0	51.9	0.894	2681.6	453.0	2228.6	0.89
55.0	48.2	0.831	2742.0	498.3	2243.7	0.90
60.0	45.1	0.776	2794.5	543.6	2250.9	0.90
65.0	42.3	0.728	2840.5	588.9	2251.6	0.90
70.0	39.8	0.686	2881.1	634.2	2246.9	0.90
75.0	37.6	0.648	2917.3	679.5	2237.8	0.90
80.0	35.7	0.615	2949.7	724.8	2224.9	0.89
85.0	33.9	0.584	2979.0	770.1	2208.9	0.89
90.0	32.3	0.557	3005.4	815.4	2190.0	0.88
95.0	30.9	0.531	3029.5	860.7	2168.8	0.87
100.0	29.5	0.509	3051.5	906.0	2145.5	0.87
105.0	28.3	0.488	3071.6	951.3	2120.3	0.86
110.0	27.2	0.468	3090.2	996.6	2093.6	0.85
115.0	26.1	0.450	3107.4	1041.9	2065.5	0.84
120.0	25.2	0.434	3123.3	1087.2	2036.1	0.83
125.0	24.3	0.418	3138.0	1132.5	2005.5	0.82
130.0	23.5	0.404	3151.8	1177.8	1974.0	0.81
135.0	22.7	0.391	3164.6	1223.1	1941.5	0.80
140.0	22.0	0.378	3176.7	1268.4	1908.3	0.79
145.0	21.3	0.366	3187.9	1313.7	1874.2	0.77
150.0	20.6	0.355	3198.5	1359.0	1839.5	0.76
155.0	20.0	0.345	3208.5	1404.3	1804.2	0.75
160.0	19.5	0.335	3217.9	1449.6	1768.3	0.74
165.0	18.9	0.326	3226.8	1494.9	1731.9	0.73

RESILIENT CONSULTING

Proj No. 2024-001
Date: 2024-07-24
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Modified Rational Method Calculations - Stormwater Management Requirements

Drainage Areas	Pre-Development	
Area (A1) =	**3.10**	ha
"C" =	**0.25**	
AC1=	**0.78**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
5Yr Flow Target =	**0.20**	m^3/s

Fifty Year Design Storm	York Region IDF
a=	2464
b=	16
c=	1.54
I =	(a/(b+t))*c

A1-2-3 Post - To Dry Pond

Drainage Areas	A1-2-3 Post	
Area =	**6.89**	ha
"C" =	**0.90**	
AC=	**6.20**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Max.Storage =	**2455.3**	m^3
Max Storage Depth=	**0.97**	m
Max Storage Elevation=	**250.27**	m
Max Discharge=	**0.18**	m^3/s

(1)	(2)	(5)	(6)	(7)	(8)	(9)
Time	**Rainfall Intensity**	**Storm Runoff (A1-2-3 Post)**	**Runoff Volume (A1-2-3 Post)**	**Allowable Release Volume (A1-2-3 Post)**	**Storage Volume (A1-2-3 Post)**	**Storage Depth (A1-2-3 Post)**
(min)	**(mm/hr)**	**(m^3/s)**	**(m^3)**	**(m^3)**	**(m^3)**	**m**
Tc+Time Increment	**(a/(b+t))*c**	**(5) = [(2)*AC1]/360**	**(6) = (5)*(1)*60**	**From SSD Curve**	**IF (6)>(7) then (8)=(6)-(7) IF not then (8)=0**	**From SSD Curve**
10.0	145.9	2.514	1508.3	106.8	1401.5	0.58
15.0	122.4	2.108	1897.6	160.2	1737.4	0.73
20.0	105.4	1.816	2178.7	213.6	1965.1	0.81
25.0	92.6	1.594	2391.3	267.0	2124.3	0.86
30.0	82.5	1.421	2557.6	320.4	2237.2	0.90
35.0	74.4	1.282	2691.3	373.8	2317.5	0.92
40.0	67.8	1.167	2801.2	427.2	2374.0	0.94
45.0	62.2	1.071	2893.0	480.6	2412.4	0.95
50.0	57.5	0.990	2971.0	534.0	2437.0	0.96
55.0	53.4	0.921	3037.9	587.4	2450.5	0.97
60.0	49.9	0.860	3096.1	640.8	2455.3	0.97
65.0	46.8	0.807	3147.0	694.2	2452.8	0.97
70.0	44.1	0.760	3192.1	747.6	2444.5	0.96
75.0	41.7	0.718	3232.2	801.0	2431.2	0.96
80.0	39.5	0.681	3268.1	854.4	2413.7	0.95
85.0	37.6	0.647	3300.4	907.8	2392.6	0.95
90.0	35.8	0.617	3329.7	961.2	2368.5	0.94
95.0	34.2	0.589	3356.4	1014.6	2341.8	0.93
100.0	32.7	0.563	3380.8	1068.0	2312.8	0.92
105.0	31.4	0.540	3403.1	1121.4	2281.7	0.91
110.0	30.1	0.519	3423.7	1174.8	2248.9	0.90
115.0	29.0	0.499	3442.7	1228.2	2214.5	0.89
120.0	27.9	0.481	3460.3	1281.6	2178.7	0.88
125.0	26.9	0.464	3476.7	1335.0	2141.7	0.86
130.0	26.0	0.448	3491.9	1388.4	2103.5	0.85
135.0	25.1	0.433	3506.1	1441.8	2064.3	0.84
140.0	24.3	0.419	3519.5	1495.2	2024.3	0.83
145.0	23.6	0.406	3531.9	1548.6	1983.3	0.81
150.0	22.9	0.394	3543.7	1602.0	1941.7	0.80
155.0	22.2	0.382	3554.7	1655.4	1899.3	0.78
160.0	21.6	0.371	3565.2	1708.8	1856.4	0.77
165.0	21.0	0.361	3575.0	1762.2	1812.8	0.75

RESILIENT CONSULTING

Proj No. 2024-001
Date: 2024-07-24
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Modified Rational Method Calculations - Stormwater Management Requirements

Drainage Areas	Pre-Development	
Area (A1) =	**3.10**	ha
"C" =	**0.25**	
AC1=	**0.78**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
5Yr Flow Target =	**0.20**	m^3/s
	^From Chisholm Report	

Hundred Year Design Storm	York Region IDF
a=	2464
b=	16
c=	1.69
I =	(a/(b+t))*c

A1-2-3 Post - To Dry Pond

Drainage Areas	A1-2-3 Post	
Area =	**6.89**	ha
"C" =	**0.90**	
AC=	**6.20**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Max.Storage =	**2663.2**	m^3
Max Storage Depth=	**1.03**	m
Max Storage Elevation=	**250.33**	m
Max Discharge=	**0.20**	m^3/s

(1)	(2)	(5)	(6)	(7)	(8)	(9)
Time (min)	**Rainfall Intensity** (mm/hr)	**Storm Runoff (A1-2-3 Post)** (m^3/s)	**Runoff Volume (A1-2-3 Post)** (m^3)	**Allowable Release Volume (A1-2-3 Post)** (m^3)	**Storage Volume (A1-2-3 Post)** (m^3)	**Storage Depth (A1-2-3 Post)** m
Tc+Time Increment	**(a/(b+t))*c**	**(5) = [(2)*AC1]/360**	**(6) = (5)*(1)*60**	**From SSD Curve**	**IF (6)>(7) then (8)=(6)-(7) IF not then (8)=0**	**From SSD Curve**
10.0	160.2	2.759	1655.3	122.4	1532.9	0.63
15.0	134.3	2.314	2082.4	183.6	1898.8	0.78
20.0	115.7	1.992	2390.9	244.8	2146.1	0.87
25.0	101.6	1.749	2624.2	306.0	2318.2	0.92
30.0	90.5	1.559	2806.7	367.2	2439.5	0.96
35.0	81.7	1.406	2953.5	428.4	2525.1	0.99
40.0	74.4	1.281	3074.0	489.6	2584.4	1.01
45.0	68.3	1.176	3174.8	550.8	2624.0	1.02
50.0	63.1	1.087	3260.3	612.0	2648.3	1.03
55.0	58.7	1.010	3333.8	673.2	2660.6	1.03
60.0	54.8	0.944	3397.6	734.4	2663.2	1.03
65.0	51.4	0.886	3453.6	795.6	2658.0	1.03
70.0	48.4	0.834	3503.0	856.8	2646.2	1.03
75.0	45.8	0.788	3547.0	918.0	2629.0	1.02
80.0	43.4	0.747	3586.4	979.2	2607.2	1.02
85.0	41.2	0.710	3621.9	1040.4	2581.5	1.01
90.0	39.3	0.677	3654.1	1101.6	2552.5	1.00
95.0	37.5	0.646	3683.3	1162.8	2520.5	0.99
100.0	35.9	0.618	3710.1	1224.0	2486.1	0.98
105.0	34.4	0.593	3734.6	1285.2	2449.4	0.97
110.0	33.0	0.569	3757.2	1346.4	2410.8	0.95
115.0	31.8	0.548	3778.0	1407.6	2370.4	0.94
120.0	30.6	0.527	3797.3	1468.8	2328.5	0.93
125.0	29.5	0.509	3815.3	1530.0	2285.3	0.91
130.0	28.5	0.491	3832.0	1591.2	2240.8	0.90
135.0	27.6	0.475	3847.6	1652.4	2195.2	0.88
140.0	26.7	0.460	3862.3	1713.6	2148.7	0.87
145.0	25.9	0.446	3876.0	1774.8	2101.2	0.85
150.0	25.1	0.432	3888.8	1836.0	2052.8	0.83
155.0	24.4	0.419	3901.0	1897.2	2003.8	0.82
160.0	23.7	0.408	3912.4	1958.4	1954.0	0.80
165.0	23.0	0.396	3923.2	2019.6	1903.6	0.78

APPENDIX C

Quality Control

MECP 2003, Table 3.2 for Wet Ponds

Catchment Imperviousness	0.35	0.55	0.7	0.85
*Storage Volume (m^3/ha)(80% TSS Removal)	140	190	225	250
*Storage Volume (m^3/ha)(70% TSS Removal)	90	110	130	150

*40m3/ha of storage volume to be extended detention, remainder to be permanent pool

Site Imperviousness	0.9
Site Area	4.83
%TSS Removal	80%
Required Storage Volume (m^3/ha)	258.3
Required Permanent Pool Volume (m^3/ha)	218.3
Required Extended Detention Volume (m^3/ha)	40
Required Permanent Pool Volume (m^3)	1055
Required Extended Detention Volume (m^3)	193
Provided Permanent Pool Volume (m^3)	1169
Provided Extended Detention Volume (m^3)	283

RESILIENT CONSULTING

Location: Georgina, ON
File No. 2024-001
Computed By: Rebecca Turbitt
Date: February 21, 2024

York Region North Roads Operations Centre - Phosphorus Treatment Train

*As per 'New Jersey Stormwater Best Management Practices Manual' Equation 4-1 (February 2004) - see attached

$$R = A + B - [(A \times B) / 100] \qquad \text{(Equation 4-1)}$$

Where:

R = Total TSS Removal Rate
A = TSS Removal Rate of the First or Upstream BMP
B = TSS Removal Rate of the Second or Downstream BMP

Treatment Trail Approach

TSS Removal 1 (R1):		
Wet Pond (R2) =	63	%
Dry Pond (R3)	10	%
Removal of 1 (R1):		
R1 = Rate 2 + Rate 3 - [(Rate 2 x Rate 3)/100]		
R1 =	66.7	%

*removal rates per MECP Phosphorus Tool

Treatment Trail Approach

TSS Removal 4 (R4):		
Treatment Train (R1)	66.7	%
Filter Unit (R5)	72	%
Removal of 4 (R4):		
R1 = Rate 2 + Rate 3 - [(Rate 2 x Rate 3)/100]		
R1 =	90.7	%

*removal rates per MECP Phosphorus Tool and supplier information

Ontario
MINISTRY OF THE ENVIRONMENT

Database Version: V 2.0 Release Update
Update Date: 30-Mar-12

Project DEVELOPMENT Summary

DEVELOPMENT: North District Patrol Facility
Subwatershed: Georgina Creeks

Total Pre-Development Area (ha):	4.83	Total Pre-Development Phosphorus Load (kg/yr):	1.16

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Sod Farm / Golf Course	4.83	0.24	1.16

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Comm/Industrial	0.32	1.82	Other	67%	0.19
Impervious Area from A3 by-passing filter unit - wet pond and dry pond Treatment Train Approach					
High Intensity - Comm/Industrial	2.89	1.82	Treatment Train Approach	91%	0.47
Impervious Area from A3 discharging through filter unit and treatment train					
Sod Farm / Golf Course	1.62	0.24	Other	67%	0.13
Baseline Pond					

		P Load (kg/yr)
Post-Development Area Altered:	4.83	
Total Pre-Development Area:	4.83	
Unaffected Area:	0	
Pre-Development:		1.16
Post-Development:		6.23
Change (Pre - Post):		-5.07
438% Net Increase in Load		
Post-Development (with BMPs):		0.79
Change (Pre - Post):		0.37
32% Net Reduction in Load		

DEVELOPMENT: **North District Patrol Facility**
Subwatershed: **Georgina Creeks**

CONSTRUCTION PHASE LOAD

SUMMARY WITH IMPLEMENTATION OF BMPs	**P Load (kg/yr)**
Pre-Development:	**1.16**
Construction Phase Amortized Over 8 Years :	to be determined
Post-Development:	**0.79**
Post-Development + Amortized Construction:	**to be determined**
Pre-Development Load - Post-Development Load:	**0.37**
Conclusion:	**32% Reduction in Load**
Pre-Development Load - (Post-Development + Amortized Construction Load):	**to be determined**
Conclusion:	**to be determined**

Based on a comparison of Pre-Development and Post-Development loads, and in consideration of Construction Phase loads, the Ministry would encourage the Municipality to:

Hydroworks Sizing Summary

York Region North Roads Operation Centre
3525 Baseline Rd. Sutton West, ON

03-22-2024

Recommended Size: HydroDome HD 10

A HydroDome HD 10 is recommended to provide 80 % annual TSS removal based on a drainage area of 1.27 (ha) with an imperviousness of 90 % and Toronto Central, Ontario rainfall for the ETV/NJDEP particle size distribution.

The recommended HydroDome HD 10 treats 100 % of the annual runoff and provides 81 % annual TSS removal for the Toronto Central rainfall records and ETV/NJDEP particle size distribution.

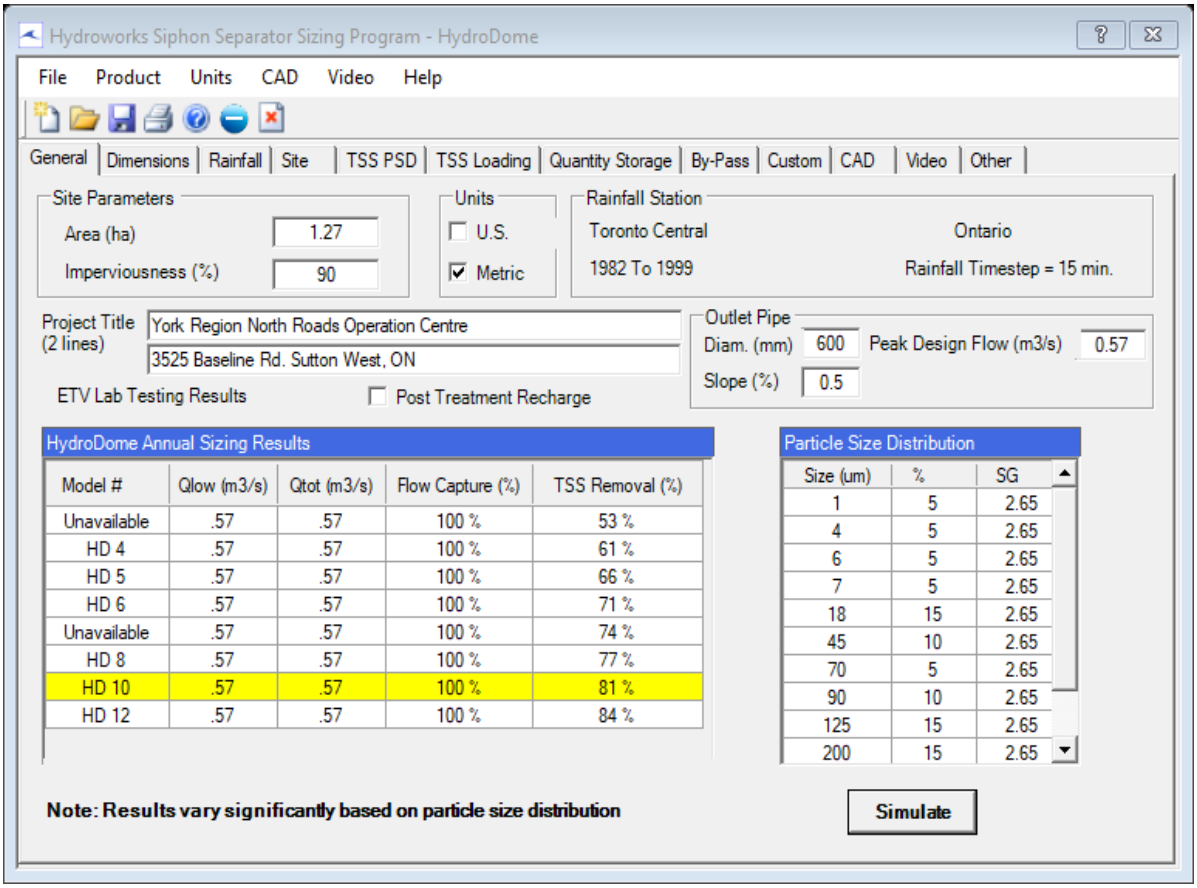
The HydroDome has a siphon which creates a discontinuity in headloss. The given peak flow of .57 (m3/s) is greater than the full pipe flow of .43 (m3/s) indicating the pipe will be surcharged during the peak flow. Full pipe flow was assumed for the headloss calculations. The pressure head in the pipe was not evaluated since this would require a hydraulic gradeline analysis. The headloss was calculated to be 435 (mm) above the crown of the 600 (mm) outlet pipe.

This summary report provides the main parameters that were used for sizing. These parameters are shown on the summary tables and graphs provided in this report.

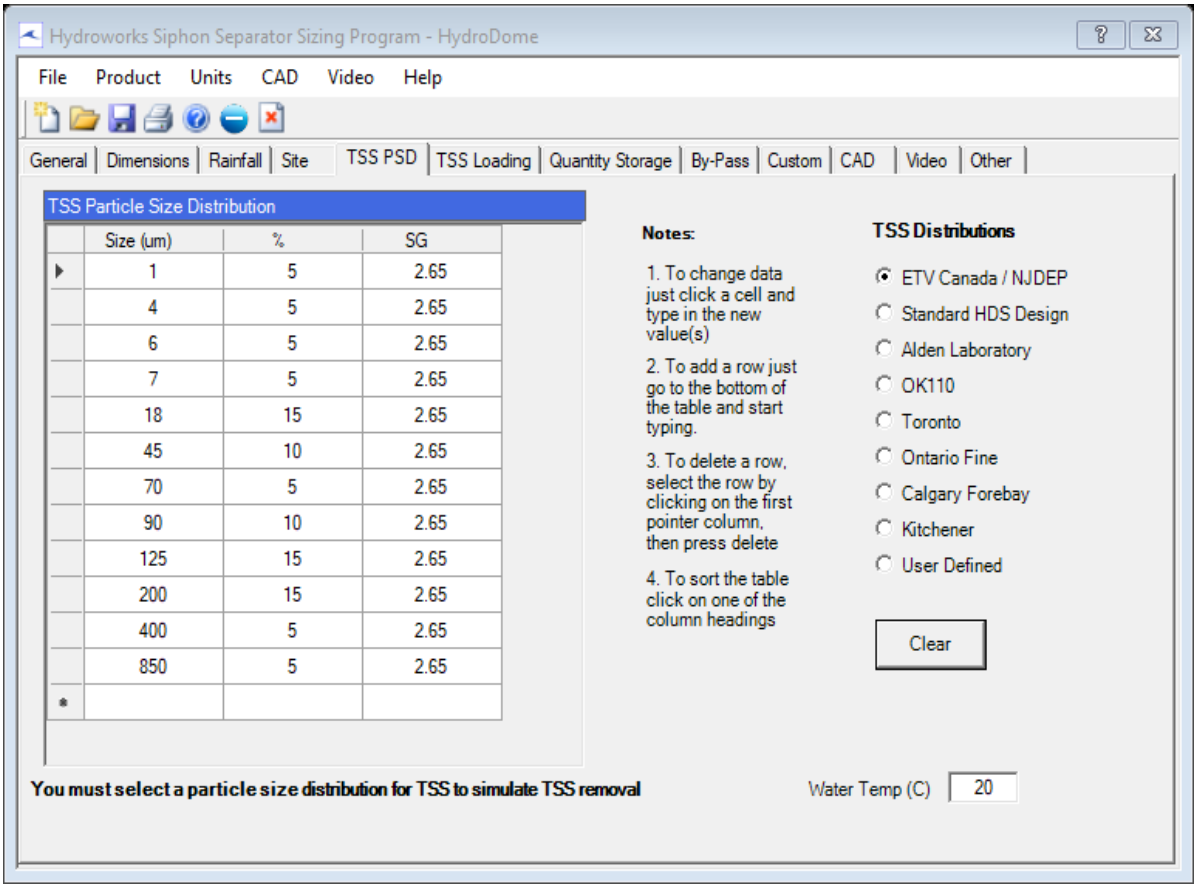
If you have any questions regarding this sizing summary please do not hesitate to contact Hydroworks at 888-290-7900 or email us at support@hydroworks.com.

The sizing program is for sizing purposes only and does not address any site specific parameters such as hydraulic gradeline, tailwater submergence, groundwater, soils bearing capacity, etc. Headloss calculations are not a hydraulic gradeline calculation since this requires a starting water level and an analysis of the entire system downstream of the HydroDome .

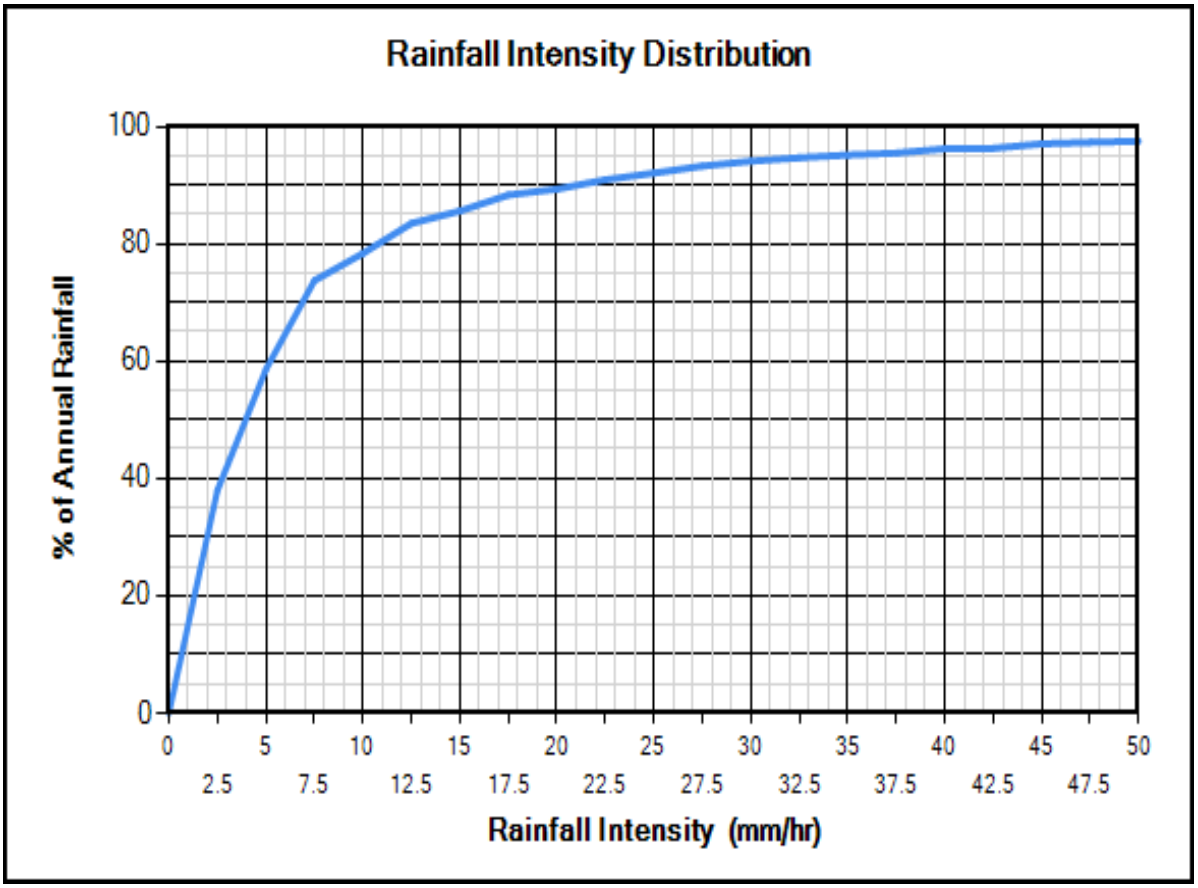
TSS Removal Sizing Summary



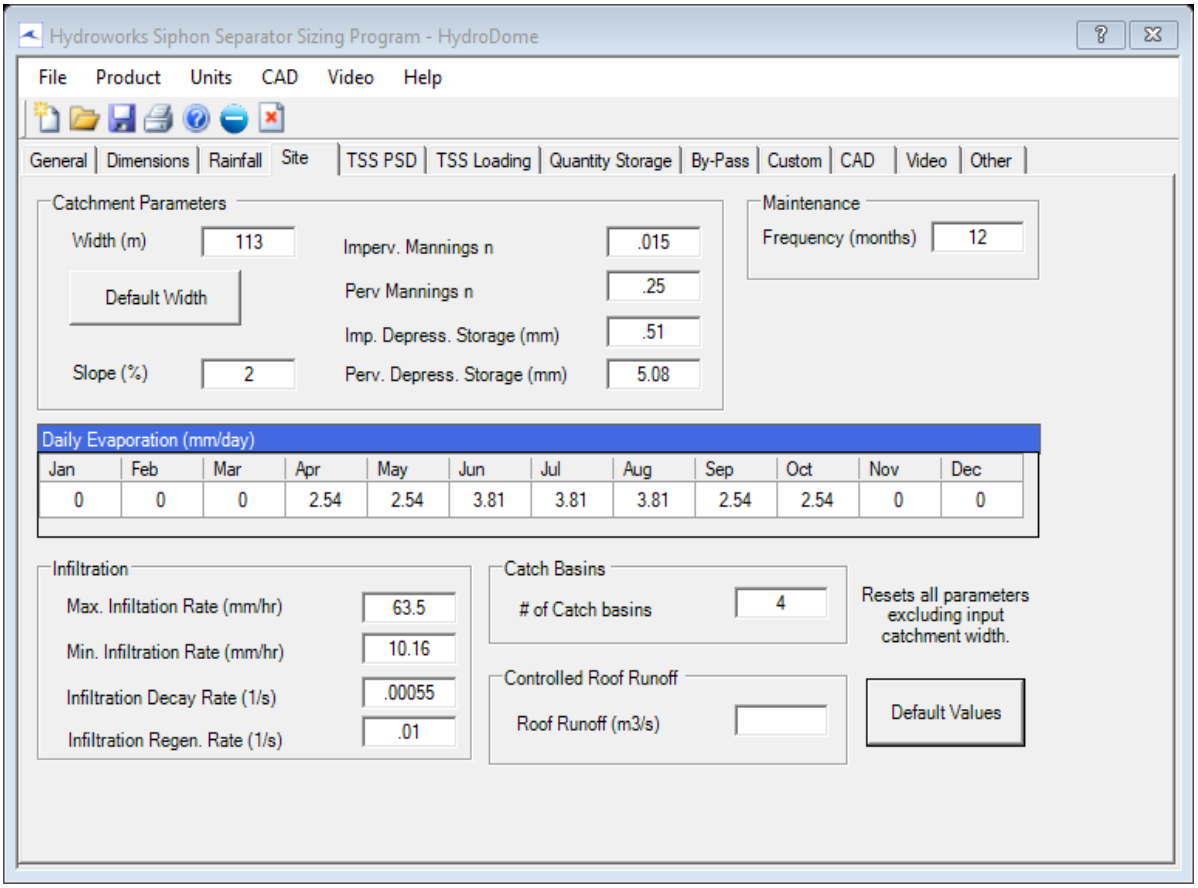
TSS Particle Size Distribution



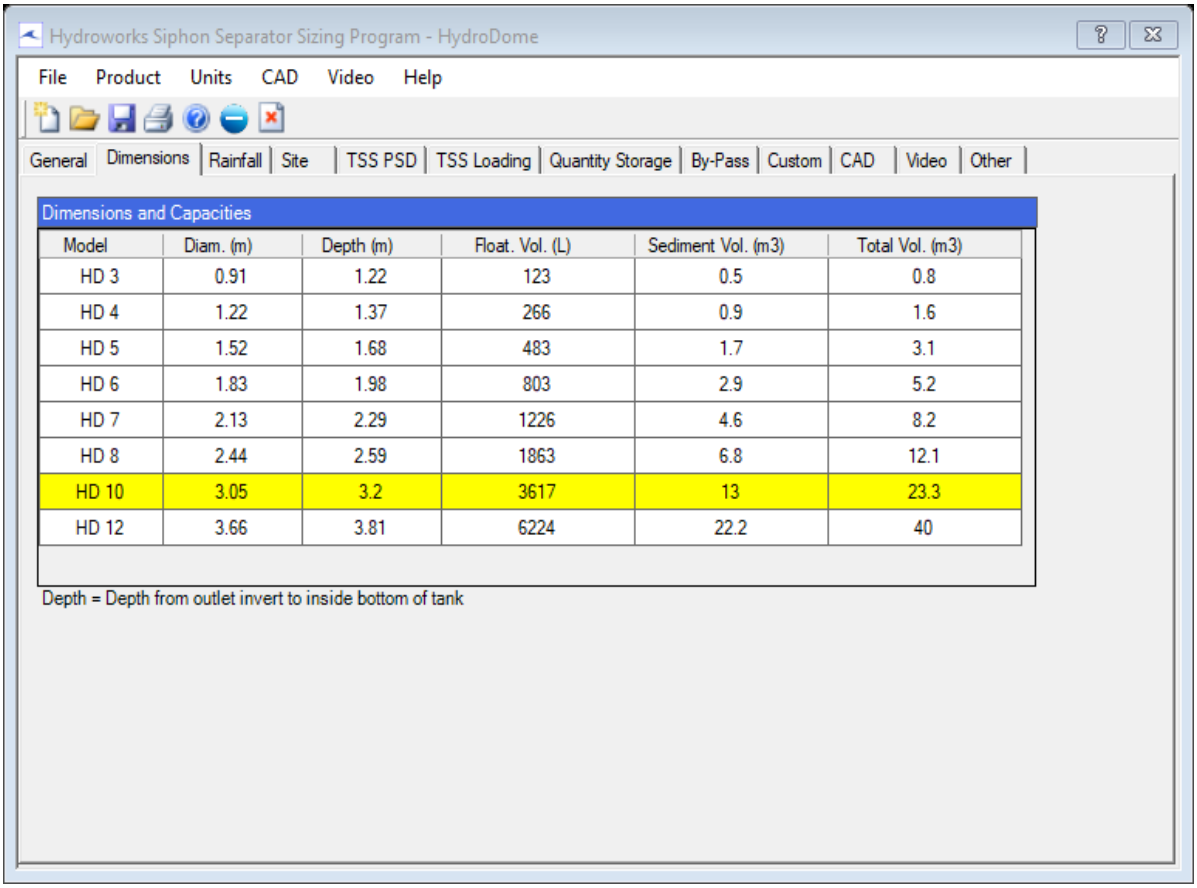
Rainfall Station - Toronto Central, Ontario(1982 To 1999)



Site Physical Characteristics



Dimensions And Capacities

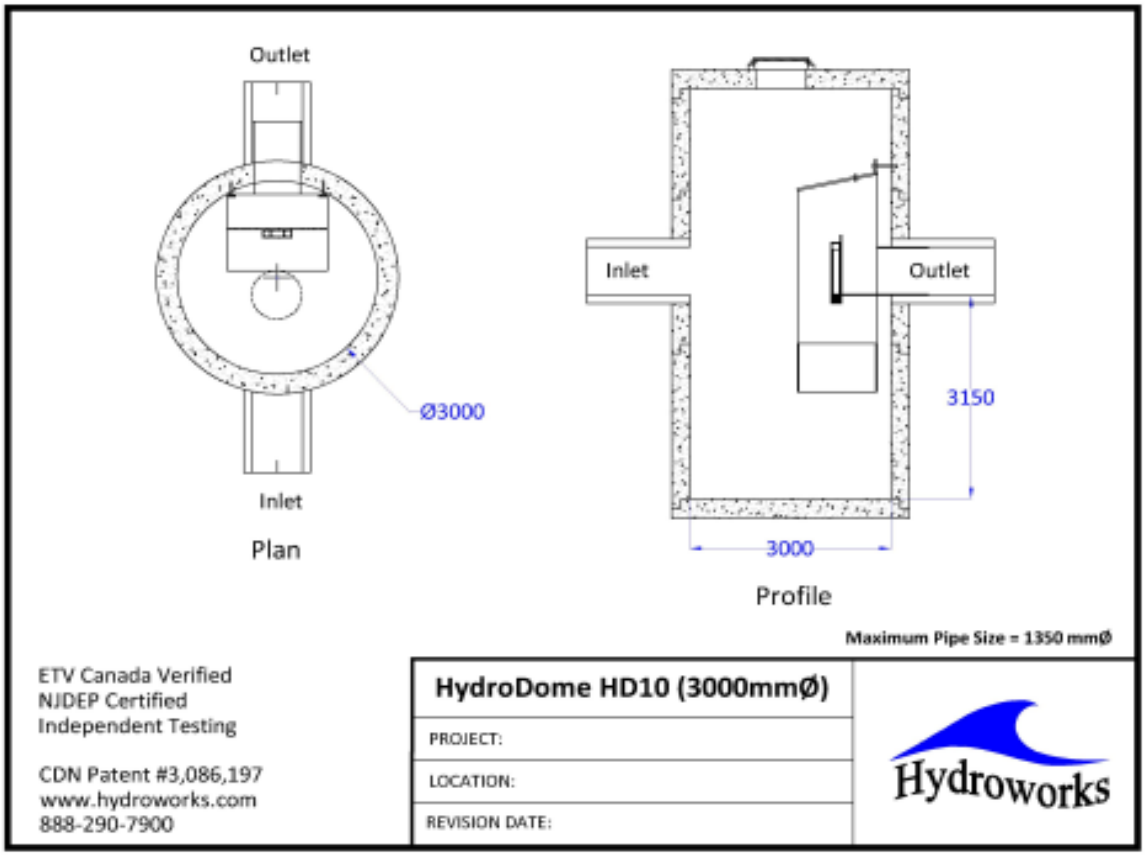


Dimensions and Capacities

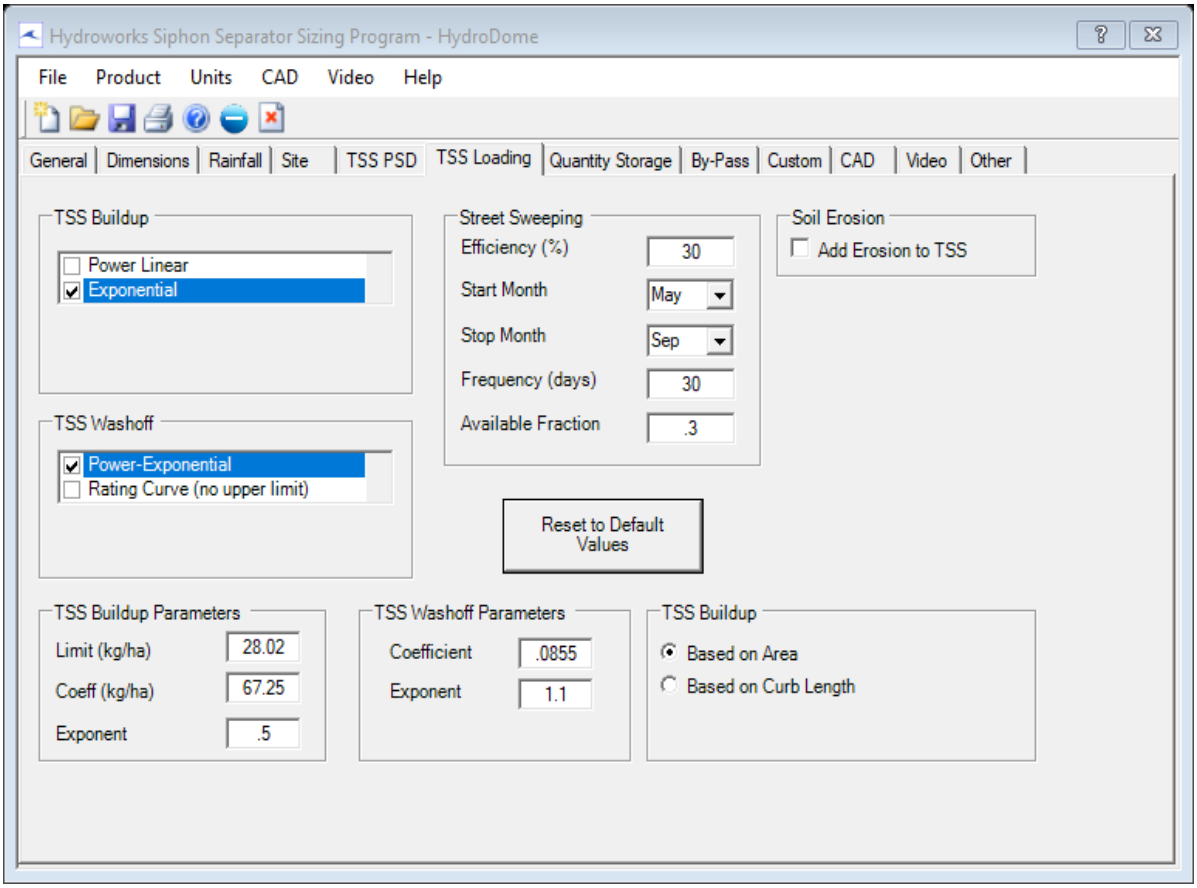
Model	Diam. (m)	Depth (m)	Float. Vol. (L)	Sediment Vol. (m3)	Total Vol. (m3)
HD 3	0.91	1.22	123	0.5	0.8
HD 4	1.22	1.37	266	0.9	1.6
HD 5	1.52	1.68	483	1.7	3.1
HD 6	1.83	1.98	803	2.9	5.2
HD 7	2.13	2.29	1226	4.6	8.2
HD 8	2.44	2.59	1863	6.8	12.1
HD 10	3.05	3.2	3617	13	23.3
HD 12	3.66	3.81	6224	22.2	40

Depth = Depth from outlet invert to inside bottom of tank

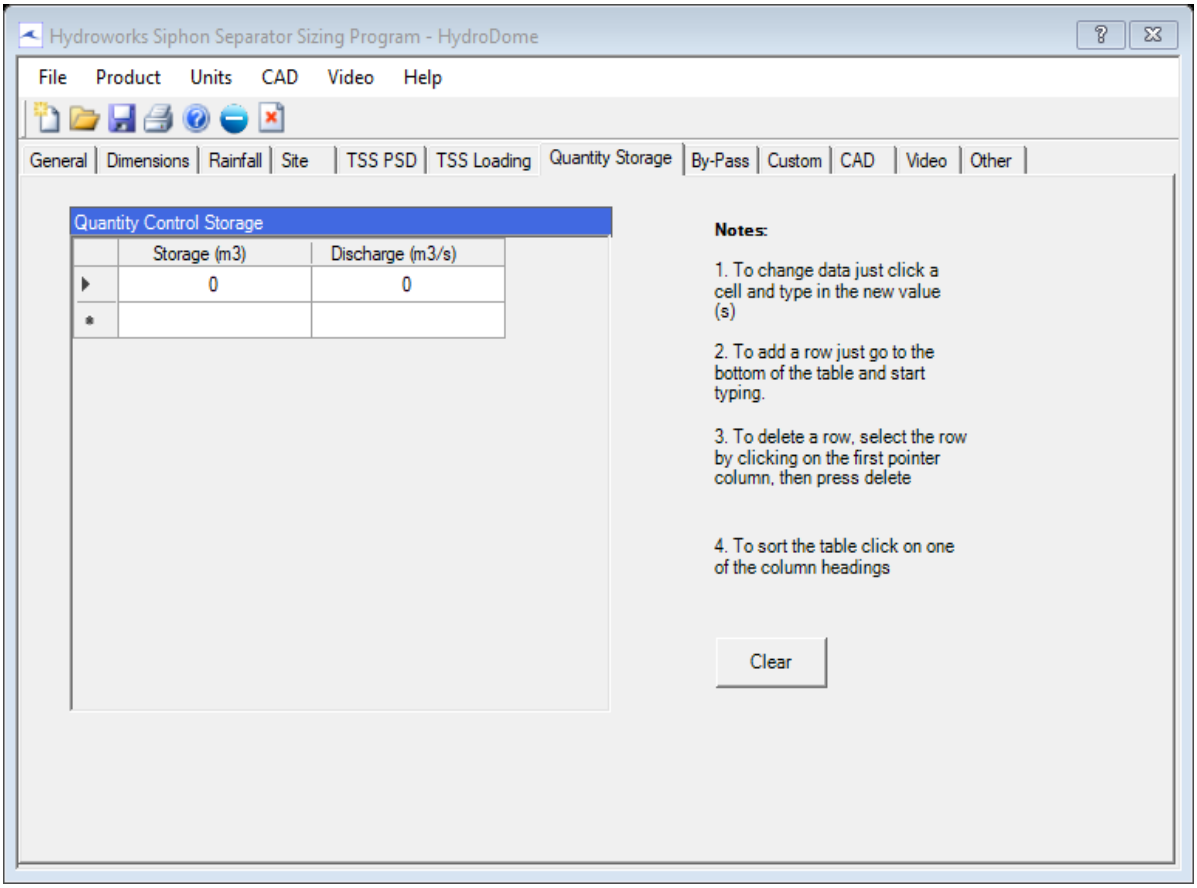
Generic HD 10 CAD Drawing



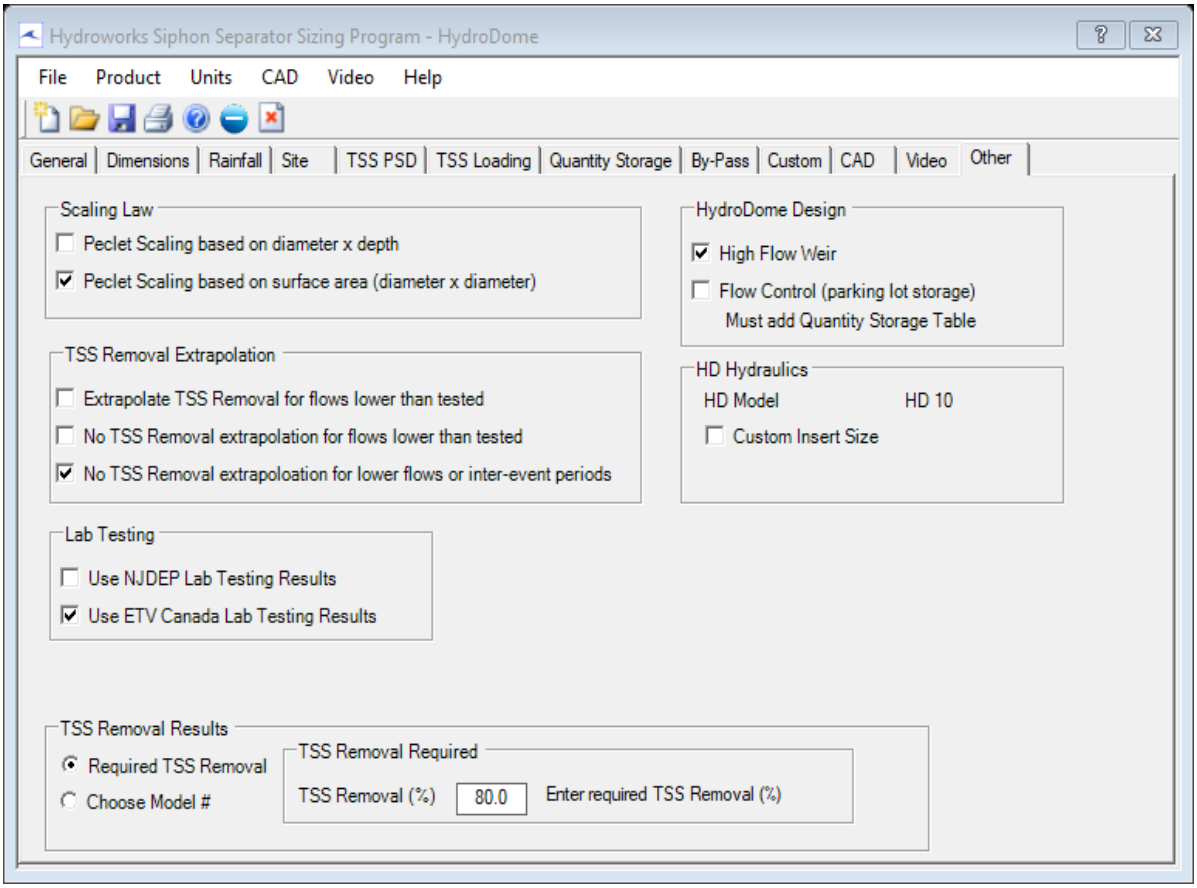
TSS Buildup And Washoff



Upstream Quantity Storage



Other Parameters



Flagged Issues

If there is underground detention storage upstream of the HydroDome please contact Hydroworks to ensure it has been modeled correctly.

Hydroworks Sizing Program - Version 5.8
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1-800-290-7900
www.hydroworks.com

February 23, 2024

ADS UFF Sizing Summary

Project Name: 3525 Baseline Road

Consulting Engineer: Resilient Consulting

Location: Georgina, ON

Sizing Completed By: C. Neath **Email:** cody.neath@adspipe.com

Recommended Unit	
Recommended Model:	UFF-34
TSS Removal Percentage:	81.1%
Total Site Volume Treated:	90.3%

Site Details	
Site Area:	2.92 ha
% Impervious:	90.0%
Rational C:	0.84
Rainfall Station:	Barrie, ONT
Particle Size Distribution:	ETV
Peak Storm Flowrate:	---

Unit Specifications:	
Number of Filter Modules:	34
Maximum Treatment Flowrate:	54.4 L/s
Inlet - Outlet Drop:	240 mm*
Maximum Pipe Diameter:	600 mm

* Drop across unit can be reduced when required.

Site Elevations:	
Rim Elevation:	200.00
Inlet Pipe Elevation:	198.24
Outlet Pipe Elevation:	198.00

Consult approved shop drawings for final elevations. Riser sections (and/or grade rings) may be required to reach final grade on site.

Rainfall Intensity	Fraction of Rainfall	Removal Efficiency	Weighted Net-Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.3%	92.2%	0.3%
1.00	25.7%	91.3%	23.5%
1.50	5.3%	90.3%	4.8%
2.00	13.4%	89.3%	11.9%
2.50	5.5%	88.4%	4.9%
3.00	3.7%	87.4%	3.3%
3.50	7.2%	86.4%	6.2%
4.00	3.4%	85.5%	2.9%
4.50	2.4%	84.5%	2.1%
5.00	4.3%	83.5%	3.6%
6.00	3.6%	81.6%	3.0%
7.00	4.3%	79.7%	3.4%
8.00	3.4%	77.7%	2.6%
9.00	1.6%	75.8%	1.2%
10.00	2.1%	73.9%	1.6%
20.00	8.9%	54.5%	4.8%
30.00	2.3%	35.2%	0.8%
40.00	1.0%	15.9%	0.2%
50.00	0.5%	0.0%	0.0%
100.00	0.7%	0.0%	0.0%
150.00	0.1%	0.0%	0.0%
200.00	0.0%	0.0%	0.0%
Net Annual Treatment:			81.1%
Total Runoff Volume Treated:			90.3%

Rainfall Data: 1978:2007, HLY03, Barrie, ONT, 6110557.

Notes:

Removal efficiencies are based on ETV results.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

TECHNICAL BULLETIN // **UP-FLO™ FILTER**

FIELD EVALUATION OF PHOSPHORUS REMOVAL

94 Hutchins Drive • Portland, ME 04102
Tel: 207.756.6200 • Fax: 207.756.6212
www.hydrointernational.biz

SW-UF-001-06

FIELD EVALUATION OF PHOSPHORUS REMOVAL

INTRODUCTION

Historically, the main pollutant of concern in stormwater runoff has been total suspended solids (TSS). However, there has been an increasing awareness of the environmental degradation caused by the array of secondary constituents found in stormwater runoff, such as nutrients, metals and organics. The issue of how to control secondary constituents has become a focus within the field of stormwater management. A study by leading stormwater researchers (Morquecho, et al., 2005[1]) showed a strong association between the removal of very fine Total Suspended Solids (TSS) with the removal of a broad range of secondary constituents. These findings were recently confirmed in an Up-Flo™ Filter study conducted by Dr. Robert Pitt's research team at the University of Alabama. The study concluded that the Up Flo™ Filter removed over 80% of TSS including the very fine material. It was also shown that the Up-Flo™ Filter removed 72% of Total Phosphorus by virtue of the association of phosphorus with very fine particle sizes in conformance with the earlier study by Morquecho, *et al.*

ASSOCIATION OF STORMWATER POLLUTANTS WITH DIFFERENT SIZE PARTICULATES

The study by Morquecho et al. (2005) assessed particulate matter found in stormwater runoff for its concentrations of various secondary constituents and found a strong correlation between particulate particle size and secondary constituent concentrations. The very fine particulate fractions were found to have the highest concentrations of particulate and particle-bound phosphorus. The report concluded that a reduction of fine particulate matter will lead to a reduction of Total Phosphorus. Specifically, the study showed that 71% of Phosphate and 68% of Total Phosphorus would be removed if all particles greater than 20 µm in diameter were removed. When considering the removal of all particulates down to 5 µm, removals of 78% of Phosphate and 82% of Total Phosphorus were observed.

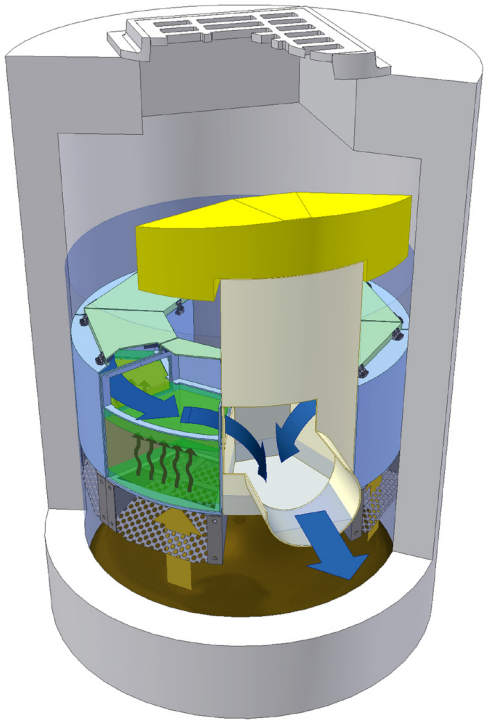

Figure 1: Up-Flo™ Filter Stormwater Treatment System

FIELD EVALUTATION OF THE UP-FLO™ FILTER

An Up-Flo™ Filter unit with CPZ Mix™ Media was installed in a catch basin at the Tuscaloosa City Hall parking lot in Tuscaloosa, Alabama in February 2005. The unit was monitored for Total Suspended Solids (TSS) removal efficiency over a 10-month period from March – November 2005. Sampling at the test site was conducted using two ISCO 6712 automatic samplers, one located in the inlet chamber of the Up-Flo™ Filter and the other located in the outlet pipe of the treatment unit. Two ISCO 4250 area-velocity meters were used to calculate flow rate in the inlet chamber and in the effluent pipe. The rainfall intensity and amount was measured using a standard tipping bucket rain gauge. YSI 6600 water quality sondes were used to measure the real time water quality data (temperature, dissolved oxygen, pH, ORP,

turbidity, conductivity, and water depth) of the influent and the effluent flows at 1-minute intervals during storm flows and at 5-minute intervals during inter-event periods.

A total of 31 rain events were sampled. The samples were divided using a Dekaport/USGS cone splitter and analyzed for Total Suspended Solids concentration using EPA Method 160.3 (SM 2540 D) and particle size distribution using a Coulter Counter/Multi Sizer III. The average influent TSS concentration for all samples taken by the ISCO 6712 automatic sampler was 64.7 mg/L, with a mean particle size of 30 µm. The average effluent TSS concentration for all samples taken by the automatic sampler was 19 mg/L with a mean particle size of 25 µm.

At the conclusion of the monitoring period, all the material captured in the sump was removed and analyzed. Contrary to the average particle size of particulate matter observed in the influent samples taken by the automatic sampler, the sump material contained a large amount of coarser particles. A particle size distribution analysis conducted on the sump material confirmed that the bulk of the material in the sump was coarse (in the 250 – 2000 µm range), as the finer materials were captured and stored within the filtration media. A summary of the particle size analysis of the sump material is shown in **Table 1**.

Particle Size Range (µm)	Particulate in Range	
	(kg)	(% Mass)
< 75	1.1	2.0
75 – 150	1.6	3.0
150 – 250	3.6	6.7
250 – 425	11.5	21.4
425 – 850	17.1	31.8
850 – 2000	10.5	19.6
2000 – 4750	4.8	8.9
>4750	3.5	6.5
Sum	53.7	100

Table 1: Particle size analysis of material captured in the Up-Flo™ Filter sump over the duration of the monitoring period

Figure 2 compares the TSS gradation of the sump material with the TSS gradations observed in the influent samples taken by the automatic samplers. As it is shown, the influent sampler data did not reflect the amount of coarse material captured in the sump.

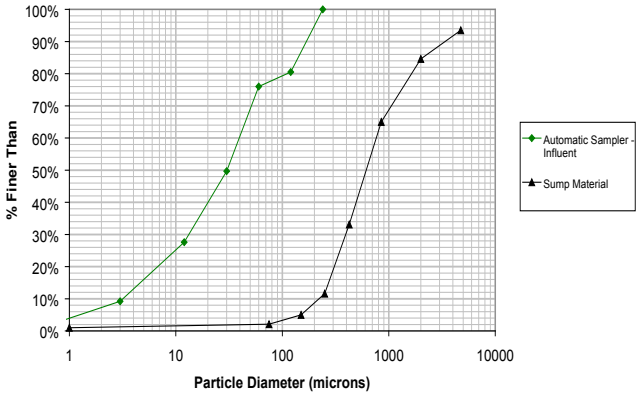

Figure 2: Average particle size distributions of all influent and effluent samples taken with the ISCO 6712 automatic samplers as compared to the particle size distribution of material captured within the sump

The total runoff volume treated by the Up-Flo™ Filter for the 10-month monitoring period was 1,570,000 liters (55,500 ft^3). The average influent and effluent TSS concentrations for all samples were determined to be 64.7 mg/L and 19.2 mg/L, respectively. To determine the total mass of material for the 0.45 – 3 µm, 3-12 µm, 12-30 µm, 30-60 µm, 60-120 µm and 120-240 µm particle size ranges, the average TSS concentrations in the range for the ISCO 6712 influent samples were used. For example, the total mass of material in the influent for the 0.45 - 3 µm range was determined using the following equation:

$$m_{\text{influent: 0.45 - 3 µm}} = 5.9 \text{ mg/L} \times 1.57\text{E}6 \text{ L} \times 1\text{kg}/1\text{E}6 \text{ mg}$$

$$= 9.3 \text{ kg}_{\text{0.45 - 3 µm material}}$$

$$m_{\text{influent: 0.45 - 3 µm}} = 9.3 \text{ kg}_{\text{0.45 - 3 µm material}}$$

Table 2 summarizes the mass of particulate material in the influent and effluent based on the samples collected by the automatic samplers.

Particle Size Range (µm)	Influent		Effluent	
	Avg Concentration of Automatic Sampler Samples (mg/L)	Total Mass in Range over Duration of Monitoring Period (kg)	Avg Concentration of Automatic Sampler Samples (mg/L)	Total Mass in Range over Duration Monitoring Period (kg)
0.45 – 3.0	5.9	9.3	1.8	2.8
3.0 – 12.0	11.9	18.7	4.1	6.4
12.0 – 30	14.3	22.4	4.9	7.7
30 – 60	17.0	26.7	4.3	6.8
60 – 120	2.9	4.6	1.1	1.8
120 – 240	12.6	19.7	2.7	4.3
> 240	0.0	0.0	0.0	0.0
Sum	**64.7**	**101.5**	**19.2**	**29.9**

Table 2:Total mass of particulate material in influent based on average TSS concentrations from automatic samplers for <240-micron particle size ranges

A composite gradation of all influent particulate material is shown in **Table 3**. Table 3 combines the 0 – 240 µm particle size ranges from Table 2 and the 250 – 4750 µm particle size ranges from Table 1. The influent automatic samplers picked up no material greater than 240 µm, yet there was a great deal of material greater than 250 µm in diameter captured within the sump. Thus, in estimating the total influent mass of coarser (>250 µm) particles for

Particle Size Range (µm)	Total Particulate Mass during Monitoring Period (kg)		% Reduction
	Influent	Effluent	
0.45 – 3.0	9.3	2.8	70
3.0 – 12.0	18.7	6.4	66
12.0 – 30	22.4	7.7	66
30 – 60	26.7	6.8	74
60 – 120	4.6	1.8	61
120 – 250	19.7	4.3	78
250 – 425	11.5	--*	100
425 – 850	17.1	--*	100
850 – 2000	10.5	--*	100
2000 – 4750	4.8	--*	100
>4750	3.5	--*	100
Sum	**149.1†**	**29.9**	**80**

Table 3: Mass balance calculation for net suspended solids removed during the monitoring period as reported by the University of Alabama research team

Based on the measured particle size distribution of particulate material in the effluent samplers shown in Figure 3, it is assumed that all material >250 µm is removed by the Up-Flo™ Filter system.

†Of the 149.1 kg total material removed by the Up-Flo™ Filter, Table 1 shows that 53.7 kg of coarse particulate material was removed by the sump. The remainder of the material was the fine fraction, which was removed by filtration within the filter media.

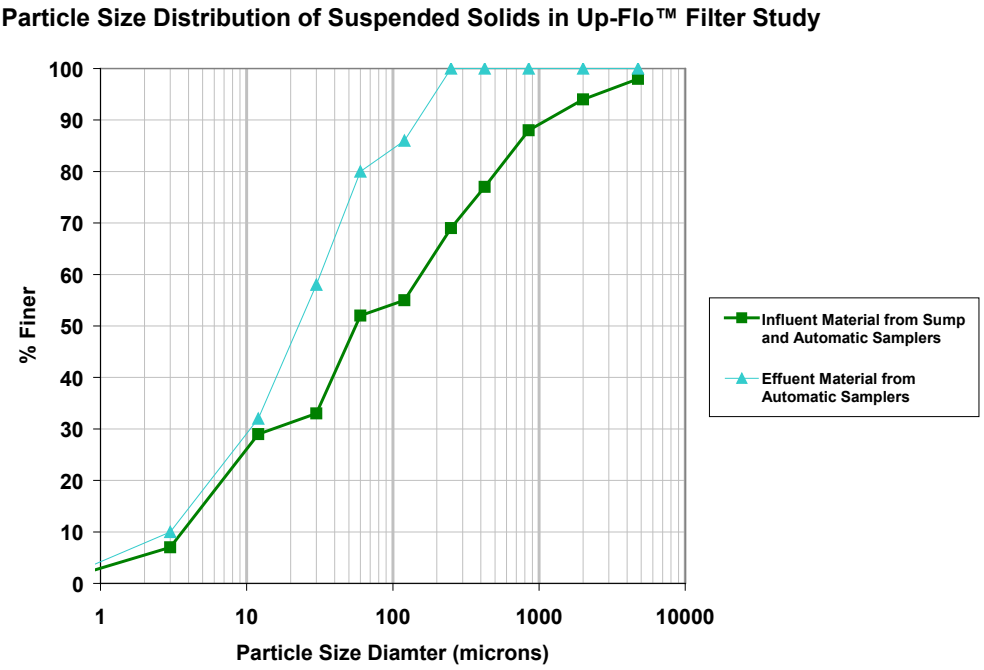

Figure 3: Particle size distributions of influent material considering all samples taken with ISCO 6712 automatic samplers and material captured in the sump

the monitoring period, only the mass of material from the sump collection was considered. The total mass of material for the 250 - 425 µm, 425 – 850 µm, 850 – 2000 µm, 2000 – 4750 µm and >4750 µm particle size ranges was taken directly from Table 1, above.

Based on the observed effluent particle size characterization shown in **Figure 3**, it is implicit that all particles greater than 250 µm in diameter are captured by the Up-Flo™ Filter. The particle size gradation for the composite influent material from Table 3 is shown graphically in Figure 3.

ANALYSIS FOR PHOSPHORUS CAPTURED BY THE UP-FLO™ FILTER

The sediment gradations from the sump analysis were then analyzed for their concentrations of phosphorus using EPA Method 365.2 (SM 4500-P B, 5 and P.E.). The sediment analysis indicated a strong correlation between the removal of very fine particulates and phosphorus removal. As shown in **Table 4**, the highest concentration of phosphorus is associated with the <75 µm particle size range.

Particle Size Range (µm)	Concentration of P (mg/kg)
< 75	3580
75 – 150	1620
150 – 250	511
250 – 425	315
425 – 850	496
850 – 2000	854
2000 – 4750	1400
>4750	1700

Table 4: Measured phosphorus concentrations associated with different gradations of particulate matter collected from the Up-Flo™ Filter sump as reported by the University of Alabama

TOTAL PHOSPHORUS REMOVAL WITH THE UP-FLO™ FILTER

The total mass of phosphorus in the influent and effluent was calculated by applying the phosphorus concentrations for each particle size range shown in Table 4 to the influent and effluent mass of total suspended solids for the influent and effluent given in Table 3 (refer to the example equation on the following page).

$$P_{influent\ 0.45 - 3\ \mu m} = 3580\ mg_P/kg_{Particulate\ Mass\text{-}Influent} \times 9.3\ kg_{Particulate\ Mass\text{-}Influent} \times 1\ gm_P/1000\ mg_P = 33.4\ gm$$

$$P_{Effluent\ 0.45 - 3\ \mu m} = 3580\ mg_P/kg_{Particulate\ Mass\text{-}Enfluent} \times 2.8\ kg_{Particulate\ Mass\text{-}Influent} \times 1\ gm_P/1000\ mg_P = 10.0\ gm$$

$$\%\ Reduction_{P\ 0.45 - 3\ \mu m} = [(33.4\ gm_{P\ influent\ 0.45 - 3\ \mu m} - 10.0\ gm_{P\ Effluent\ 0.45 - 3\ \mu m}) / 33.4\ gm_{P\ Influent\ 0.45 - 3\ \mu m}] \times 100 = 70\%$$

Based on the associations of phosphorus with the specified particle size gradations, the removal of Total Phosphorus for the 10-month monitoring period was determined to be 72%. The phosphorus removal evaluation by mass balance is shown in Table 5.

CONCLUSIONS

The results from Up-Flo™ Filter field study confirm earlier findings that certain secondary constituents, such as Total Phosphorus, can be reduced by reducing the overall concentration of particulate matter. Field monitoring results show that the Up-Flo™ Filter removed 80% of fine Total Suspended Solids from stormwater runoff over a 10-month monitoring program. Analysis of the sediment captured in the sump at the conclusion of the monitoring period showed that phosphorus is strongly associated with particulate in the <75 µm particle size range. The conservative mass balance evaluation shows with a high degree of confidence that the Up-Flo™ Filter removes 72% of Total Phosphorus from stormwater runoff. A full copy of the University of Alabama Field Verification Report for the Up-Flo™ Filter is available upon request.

Particle Size Range (µm)	P (mg/kg)	Influent		Effluent		P Captured in Sump (gm)	% Reduction
		Suspended Solids (kg)	$P_{influent}$ (gm)	Suspended Solids (kg)	$P_{effluent}$ (gm)		
0.45 – 3.0	3580	9.3	33.4	2.8	10.0	23.4	70
3.0 – 12.0	3580	18.7	66.9	6.4	22.9	44.0	66
12.0 – 30	3580	22.4	80.2	7.7	27.6	52.7	66
30 – 60	3580	26.7	95.6	6.8	24.3	71.1	74
60 – 120	1620	4.6	7.5	1.8	2.9	4.6	61
120 – 250	511	19.7	10.1	4.3	2.2	7.9	78
250 – 425	315	11.5	3.6	--	--	3.6	100
425 – 850	496	17.1	8.5	--	--	8.5	100
850 – 2000	854	10.5	9.0	--	--	9.0	100
2000 – 4750	1400	4.8	6.7	--	--	6.7	100
>4750	1700	3.5	6.0	--	--	6.0	100
Sum	**--**	**149.1**	**328.1**	**29.9**	**90.3**	**237.6**	**72**

Table 5: Mass balance calculation for net Phosphorus removed during the monitoring period as reported by the University of Alabama

1. Morquecho, R., R. Pitt, S. Clark. Pollutant Associations with Particulates in Stormwater. World Water & Environmental Resources Contress, ASCE/EWRI. Anchorage, Alaska. May 15 – 19, 2005. January 2005.

Stormwater Management Operation and Maintenance Manual

North District Patrol Facility Storm Water Management Pond

York Region
Project No. RO-21-13

December 2022

Chisholm, Fleming and Associates,
Consulting engineers

Table of Contents

List of Appendices

1 Introduction

Chisholm, Fleming and Associates (CFA) was retained by the Regional Municipality of York (Region) to design improvements for two stormwater management (SWM) ponds, located at the North District Road Maintenance Facility at 3525 Baseline Road, Sutton in the Town of Georgina. The proposed improvements are summarized in a report titled *Preliminary Design Brief*, prepared by CFA in June 2022.

The purpose of this *Stormwater Management Operation and Maintenance Manual* is to outline the operations and maintenance procedures for the two SWM facilities and associated features. This Manual outlines the siltation control requirements, inspection and monitoring requirements and maintenance procedures in accordance with the Stormwater Management Planning and Design Manual (Ministry of the Environment, March 2003) and the engineering design of the ponds, presented in the *Preliminary Design Brief*.

An application for Environmental Compliance Approval (ECA) from the Ministry of Environment, Conservation and Parks is required. The requirements of the ECA, once available, may extend the recommendation of this Manual.

2 SWM Pond Operation

As indicated in the *Preliminary Design Brief*, the two ponds are referred to as the Baseline Pond and McMinnows Pond, respectively. A description of each pond operation pond is provided below.

2.1 Baseline Pond

The Baseline Pond has been designed as a 'dry pond', i.e., without a permanent pool. The bottom of the pond is at the elevation of 249.30m. This facility is being provided with an emergency spillway set at the elevation of 250.35m and top of berm elevation of 250.60m. The available storage volume at the spillway elevation equals 2,718m^3.

The outlet structure is formed by a concrete wall, located in the north embankment. The outlet structure incorporates a 325mm dia. circular opening at the elevation of 249.27m and a staged weir starting at the elevation of 249.78m. The weir width starts at 0.18m at the elevation of 249.78m and increases to 0.31m at the elevation of 249.93m. The top of the weir extends to the emergency overflow elevation of 250.35m.

A 300mm high permeable berm has been installed immediately upstream of and around the outlet structure to provide extended detention during smaller storm events. The pond has been designed to provide peak flow attenuation for storm events up to the 100-year return period. Outflow from the pond is directed to the roadside ditch along Baseline Road by a channel between the pond outlet structure and the ditch.

2.2 McMinnows Pond

The McMinnows Pond has been designed as a 'wet pond', i.e., with a permanent pool. The bottom of the pond is at the elevation of 250.10m (forebay) and 250.35m (remainder of permanent pool), whereas the permanent (normal) pool level is at the elevation of 252.34m. The spill point of this facility is at the elevation of 252.60m with varying elevation of the top of berm. The permanent pool volume equals 1,232m^3. The available storage volume between the permanent pool and the spillway equals 283m^3.

The outlet structure is formed by a submerged outlet at the elevation of 251.5m, connected by a reverse-slope 250mm dia. PVC pipe to a concrete maintenance hole in the pond's north embankment at the permanent pool elevation of 252.35m. A 75mm dia. orifice plate is affixed to the inlet of the control manhole. The purpose of the submerged inlet and reverse-slope pipe is to prevent the outflow of

floatables (hydrocarbons, fuels, floating debris, etc.). The orifice plate has been sized to provide detention time (approximately 26 hours) to allow the settlement of suspended solids in the pond.

The outlet from the maintenance hole is directed to a 450mm dia. outletting culvert to the ditch which parallels the access road. The ditch conveys the flow to Baseline Pond.

The pond bottom is completed with an impermeable liner extending up the sides to elevation of 252.85m, i.e., 0.5m above the permanent pool, to minimize exfiltration thereby reducing drawdown of the permanent pool water level during dry periods.

3 Siltation Control

Erosion and sediment control (ESC) during any construction activities at the Site (including the SWM ponds) shall be in accordance with the ESC specifications, summarized below.

- A sediment control fence shall be erected around the perimeter of the site wherever runoff has the potential of leaving the site.
- Mud mats shall be installed at all construction entrances in order to reduce the transport of mud onto public roads or the adjacent commercial development by trucks leaving the site.
- All new and existing catchbasins and catch basin manholes on-site and in the adjacent development in the proximity of the subject development shall have the underside of the grate covered with Terrafix 240R non-woven geotextile during construction. The contractor shall regularly clean sediment and debris from these geotextile pieces.
- All silt control and sediment protection devices shall be in place prior to the commencement of construction.
- All sediment and erosion control works shall be inspected after each rainfall and repaired/maintained as necessary.

4 Inspection and Monitoring

The recommendations presented below are to be followed in conjunction with procedures followed by the Region in the preparation of Annual Inspection Reports, prepared by the Environmental Services Department, Water Resources Group, the latest of which is dated December 2021.

4.1 Baseline Pond

The recommended frequency of inspection for the Baseline Pond is as follows.

- After every significant rainfall (approximately 4 times per year) starting at the end of the pond construction (expansion) period and ending two years thereafter. If additional construction activities are carried out at the site, the two-year period starts after the completion of such activities.
- An annual inspection shall suffice after two-year period following the pond construction and site build-out.

The inspection checklist is provided in Appendix A. This checklist (or a similar version) shall be completed following each inspection as part of the requirements of the Environmental Compliance Approval (ECA) for the SWM Pond (copy will be included in Appendix C once available). Special attention should be taken to inspect the pond's outlet structure for blockage. If water levels in the pond are above the bottom of the opening for prolonged periods of time, check for debris blocking flow through the outlet structure.

A visual observation of the sediment depth can be made by comparing the top of the sediment with the bottom of the circular opening in the control structure.

4.2 McMinnows Pond

The recommended frequency of inspection for the McMinnows Pond is as follows.

- After every significant rainfall (approximately 4 times per year) starting at the end of the pond construction (expansion) period and ending two years thereafter. If additional construction activities are carried out at the site, the two-year period starts after the completion of such activities.
- An annual inspection shall suffice after two-year period following the pond construction and site build-out.

An inspection checklist is located in Appendix B. This checklist (or a similar version) shall be completed following each inspection as part of the requirements of the Environmental Compliance Approval (ECA) for the SWM Pond (copy will be included in Appendix C once available). Special attention should be taken to inspect the orifice plate in the pond's control manhole for blockage. If water levels in the pond are above the bottom of the orifice for prolonged periods of time, check for debris blocking flow through the orifice plate.

The sediment depth can be checked by the installation of a graduated pole with a flat plate attached to the bottom. A marker (pole, buoy) should be placed in the pond to indicate the spot(s) where the measurement should be made.

4.3 Overland Flow Routes

Inspections of the overland flow routes, including the grassed swale between the McMinnows and Baseline Ponds shall be carried out at the times when the ponds are being inspected. Any sediment buildup or debris should be removed and disposed off-site at an appropriate location. Slope failures, erosion, pooling, etc. should be remediated.

5 Maintenance Procedures

The recommendations presented below are to be followed in conjunction with inspection and maintenance procedures outside of the ponds, for example ensuring stockpiles are contained to prevent runoff into the pond and any other issues noted in the Region's Annual Inspection Report.

5.1 Baseline Pond

5.1.1 Sediment Removal Frequency

Since the Baseline Pond is not designed for runoff quality control, the deposition of sediments within the pond should be minimal. However, if the buildup of sediment within the pond is observed, the procedure indicated for the McMinnows Pond should be followed. A 10-year clean-out period is recommended.

5.1.2 Sediment Removal Operation

Please refer to Section 5.2.2 for details of the sediment removal operation.

5.1.3 Grass Cutting

Grass cutting within the pond embankment shall be done in accordance with the following practices:

- Grass shall only be cut between the top of the pond berm and bottom of the berm;
- The frequency of cutting should be restricted to a maximum of twice per year;
- The bottom of the pond shall be left unmanicured to maximize shading and nutrient uptake;
- Grass cuttings shall be directed towards the outside of the pond to reduce the potential for organic loading to the pond.

5.1.4 Weed Control

Weeding should be done by hand to prevent the destruction of surrounding vegetation and should be performed annually. The use of fertilizer with weed control shall be limited due to the potential nutrient loading to the downstream watercourse and shall not be used without approval from the Conservation Authority. Herbicides and insecticides shall not be used due to the potential downstream water quality concerns.

5.1.5 Plantings

Any replacement plantings required due to disturbance or die-out is to be recommended and installed at the direction of a Landscape Architect, experienced with the design of stormwater management ponds. Replacement plantings shall be approved by the Conservation Authority if they do not conform to the approved landscaping plan for the SWM Pond facility.

5.1.6 Litter / Debris Removal

Accumulated litter and debris within the facility (including in the proximity of the outlet structure and the downstream roadside ditch) should be removed by hand during the regular inspection periods.

5.1.7 Side Slope Revetment

Another minor but more involved maintenance item is in regards to side slope and revetment maintenance. Despite the fact that side slopes are designed to be stable (i.e., maximum of 3:1 side slopes), some sloughing or erosion may occur. This type of maintenance would require a small crew with a rubber tire backhoe or skid steer loader and a small dump trunk. The same work may apply to any maintenance required on rip rap or any other revetment.

5.2 McMinnows Pond

5.2.1 Sediment Removal Frequency

Based on information contained in the MOE Stormwater Management Planning and Design Manual (March 1994), the sediment frequency was calculated and the calculations are attached in Appendix D. Based on the two criteria set out in the MOE Manual (see Appendix D for details), the approximate required cleanout frequency for the pond will be the 7 years or earlier depending on the level of deposit in the pond.

5.2.2 Sediment Removal Operation

Calculations of anticipated sediment accumulation volume is not yet an exact science, and at best, the calculations will give an indication of the scale of potential sediment volume which the pond may receive. As shown in Appendix D (Criterion 2 worksheet), an approximate annual sediment deposition of $16m^3$ has been estimated. Based on a 7-year cleanout frequency period, the volume of sediment to be removed is estimated to be 52 m^3.

Given space restrictions, an adequate flat area for spreading and drying of the sediment may not be available. In addition, drying sediment may cause odours which may be undesirable. To access the pond for sediment removal, the pond should be dewatered with the use of portable pump prior to cleaning. The sediment can then be loaded by means of a long reach excavator onto sealed dump trucks to an approved disposal site. The use of polymer flocculants could reduce the trucking costs by significantly reducing the slump of the sediment.

The following procedure should be followed for cleanout of the sediment forebay:

1. Select a dry five-day window for the cleanout activity.

2. Take samples of sediment and have it tested for pollutants at an accredited facility. The sampling of sediment is typically conducted at three to five individual locations, ideally in a line extending from the inlet towards the outlet.
3. Install a pump into the pond and pump the permanent pool to the control manhole. The pump hose should be equipped with filter bags to avoid discharging sediment into the downstream conveyance system.
4. Allow a two-day dry-out period for the deposited sediment.
5. Using backhoe (or appropriate vehicle), remove the deposited sediment.
6. Present the results of sediment analysis with the Ministry of the Environment (MOE) and confirm the level of contamination and location for disposal.
7. Remove the excavated material from the site and, depending on the type of contamination, dispose either at a landfill site or at an approved MOE disposal area for contaminated material.
8. Restore the pond bottom material, if required. Ensure the clay liner at the bottom and sides of the pond has not been damaged or make any necessary repairs.

5.2.3 Grass Cutting

Grass cutting adjacent within the stormwater management facility shall be limited or eliminated in order to maintain a "natural" environment and increased water quality benefits (MOE Stormwater Management Planning and Design Manual, March 2003 page 6-4). If grass cutting is considered necessary, the following practices shall be followed:

- Grass shall only be cut between the top of the pond berm and the fence;
- The frequency of cutting should be restricted to a maximum of twice per year;
- The bottom of the pond shall be left unmanicured to maximize shading and nutrient uptake;
- Grass cuttings shall be directed towards the outside of the pond to reduce the potential for organic loading to the pond.

5.2.4 Weed Control

The need for weed control is not anticipated or recommended practice for this pond. If required, weeds shall be removed by hand where feasible. The use of fertilizer with weed control shall be limited due to the potential nutrient loading to the downstream watercourse and shall not be used without approval from the Conservation Authority. Herbicides and insecticides shall not be used due to the potential downstream water quality concerns.

5.2.5 Plantings

Any replacement plantings required due to disturbance or die-out is to be recommended and installed at the direction of a Landscape Architect, experienced with the design of stormwater management ponds. Replacement plantings shall be approved by the Conservation Authority if they do not conform to the approved landscaping plan for the SWM Pond facility.

5.2.6 Litter / Debris Removal

Accumulated litter and debris within the facility (including in the proximity and inside the outlet structure and the downstream grassed swale) should be removed manually during regular inspection periods.

5.2.7 Side Slope Revetment

Despite the fact that side slopes are designed to be stable (i.e., maximum of 3:1) some sloughing, or erosion can occur. On observing such condition repair expeditiously. Similar action may be required on rip-rap or any other revetment.

5.3 Connecting Ditch

Since the McMinnows Pond has been designed for runoff quality control, including sediment removal, the deposition of sediments within ditch connecting McMinnows Pond and Baseline Pond should be minimal. However, if the buildup of sediment within the ditch is observed, the procedure indicated for the McMinnows Pond should be followed. A 10-year clean-out period is recommended.

6 Unscheduled / Emergency Maintenance

Any failure of either pond or storm drainage system shall be rectified immediately.

7 Safety Consideration

Any installed safety signing, to notify the public of potential safety concerns associated with the permanent pool within the facility, should be repaired if damaged or cleared of any obstructions.

APPENDIX A

Baseline Pond Inspection Checklist

Baseline Pond Inspection/Monitoring Checklist

Inspection Date:_____

Inspector:_____

Recent Weather:_____**Current Weather**:_____

	Item	Maintenance Required (Y/N)	Comments
1	Outlet Blockage (Is the pond level higher than the bottom of the circular opening in the outlet structure more than 24 hours after a rainfall?)		
2	Inlet Blockage (Is there standing water in the swale upstream of the pond?)		
3	Aquatic Vegetation		
4	Shoreline & Flood Fringe Vegetation		
5	Upland Vegetation		
6	Hydrocarbon (oil) Build-up		
7	Sediment Depth (Is sediment visible at the bottom of the pond ?)		
8	Trash Build-up		
9	Berm Stability		
10	Inlet Structure		
11	Outlet Structure		
12	Maintenance Access		

APPENDIX B

McMinnows Pond Inspection Checklist

McMinnows Pond Inspection/Monitoring Checklist

Inspection Date:_____

Inspector:_____

Recent Weather:_____**Current Weather**:_____

	Item	Maintenance Required (Y/N)	Comments
1	Outlet Blockage (Is the pond level higher than the normal permanent pool level more than 24 hours after a rainfall?)		
2	Inlet Blockage (Is the pond level lower than the permanent pool elevation?)		
3	Aquatic Vegetation		
4	Shoreline & Flood Fringe Vegetation		
5	Upland Vegetation		
6	Hydrocarbon (oil) Build-up		
7	Sediment Depth (has minimum depth of 0.10 m been achieved at low point in the pond?)		
8	Trash Build-up		
9	Berm Stability		
10	Inlet Structure		
11	Outlet Structure		
12	Maintenance Access		

APPENDIX C

Environmental Compliance Approvals

APPENDIX D

McMinnows Pond Sediment Removal Frequency Calculations

Sediment Cleanout Frequency - Criterion 1

Sediment Cleanout Frequency Based on 5% TSS Removal Efficiency Reduction
(As per Section 6.4.1 of the MOE Design Manual)

MOE Design Manual, Table 6.3

Catchment Imperviousness	35%	55%	70%	85%	
Annual Loading	0.6	1.9	2.8	3.8	m^3/ha/year

Site Imperviousness	90%	
Annual Sediment Loading	4.13	m^3/ha/year

Site Area	4.83	ha
Annual Sediment Loading	19.96	m^3/year

Level 1	80%	TSS removal
5% reduction	75%	TSS removal

MOE Design Manual, Table 3.2

Catchment Imperviousness	35%	55%	70%	85%	
Storage Volume (80% TSS rem.)	140	190	225	250	m^3/ha
Storage Volume (70% TSS rem.)	90	110	130	150	m^3/ha
Storage Volume (75% TSS rem.)	115	150	177.5	200	m^3/ha

For 80% TSS removal and above site imperviousness, storage required =	258.3	m^3/ha
Required permanent pool volume =	218.3	m^3/ha
Required permanent pool volume =	1055	m^3
For 75% TSS removal and above site imperviousness, storage required =	207.5	m^3/ha
Required permanent pool volume =	167.5	m^3/ha
Required permanent pool volume =	809	m^3
Provided permanent pool volume =	1169	m^3
Sediment removal frequency =	18	years

Sediment removal frequency (max. 10 years) = 10 years

Sediment Cleanout Frequency - Criterion 2

Sediment Forebay Cleanout Frequency Based on 50% Forebay Volume Reduction

MOE Design Manual, Table 6.3

Catchment Imperviousness	35%	55%	70%	85%	
Annual Loading	0.6	1.9	2.8	3.8	m^3/ha/year

Site Imperviousness	90%	
Annual Sediment Loading	4.13	m^3/ha/year
Site Area	4.83	ha
Annual Sediment Loading	19.96	m^3/year
Level 1	80%	TSS removal
Annual Sediment Deposition	15.97	m^3/year
Forebay volume	104	m^3
50% of forebay volume	52	m^3
Sediment removal frequency =	7	years

Sediment removal frequency (max. 10 years) = 7 years

APPENDIX D

Water Balance

RESILIENT CONSULTING

Annual Hydrologic Budget
York Region North Roads Operation Centre
Planmac Engineering Inc.

Date: 2/22/2024
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Annual Water Balance on Entire Site

PRE-DEV			
Existing Landuse	Pasture and Shrubs		
Hydrologic Soil Group (HSG)	B		
Infiltration Factor	0.65		
Topography	Flat - 0.3		
Soils	Emily Loam - 0.25		
Cover	Cultivated Land - 0.1		
	Pervious	**Impervious**	**Total**
Area (ha)	4.8	0.0	4.8
Precipitation (mm)	878.0	878.0	-
ET (mm)	594.0	87.8	-
Surplus (mm)	284.0	790.2	-
Infiltration (mm)	184.6	0.0	-
Runoff (mm)	99.4	790.2	-
Volumes			
ET (m^3)	28690	0	28690
Infiltration (m^3)	8916	0	8916
Runoff(m^3)	4801	0	4801

POST-DEV			
Proposed Landuse	Impervious		
Hydrologic Soil Group (HSG)	B		
Infiltration Factor	0.65		
Topography	Flat - 0.3		
Soils	Emily Loam - 0.25		
Cover	Cultivated Land - 0.1		
	Pervious	**Impervious**	**Total**
Area (ha)	0.5	4.3	4.8
Precipitation (mm)	878.0	878.0	-
ET (mm)	594.0	87.8	-
Surplus (mm)	284.0	790.2	-
Infiltration (mm)	184.6	0.0	-
Runoff (mm)	99.4	790.2	-
Volumes			
ET (m^3)	2869	3817	6686
Infiltration (m^3)	892	0	892
Runoff(m^3)	480	34350	34830

POST-DEV WITH MITIGATION			
	Pervious	**Impervious**	**Total**
Area (ha)	0.5	4.3	4.8
Precipitation (mm)	878.0	878.0	-
ET (mm)	594.0	87.8	-
Surplus (mm)	284.0	790.2	-
Infiltration (mm)	184.6	185.0	-
Runoff (mm)	99.4	790.2	-
Volumes			
ET (m^3)	2869	3817	6686
Infiltration (m^3)	892	8042	8934
Runoff(m^3)	480	34350	34830

SUMMARY			
Scenario	**ET**	**Infiltration**	**Runoff**
Pre-Development (1)	28690	8916	4801
Post-Development (2)	6686	892	34830
Post-Development w Mitigation (3)	6686	8934	34830
Percent Difference (1 and 3)	-77%	0%	625%

* Sheet assumes 10% evapotranspiration on impervious surfaces

Egbert, Ontario Station- Normal Data 1991-2020

Storm Depth (mm)	Number of Days						
	April	**May**	**June**	**July**	**August**	**September**	**October**
0.2	10.90	13.10	11.60	11.80	11.80	12.80	14.40
5	3.10	5.00	4.10	4.60	4.60	4.90	3.80
10	1.80	2.10	3.00	2.60	2.90	2.60	1.70
25	0.38	0.44	0.69	0.81	0.56	0.38	0.44

RESILIENT CONSULTING

Annual Hydrologic Budget
York Region North Roads Operation Centre
Planmac Engineering Inc.

Date: 2/22/2024
Design By: J. Stevens
Review By: R. Turbitt, P.Eng.

Storm Depth (mm)	Total # of days/year	Incremental Precipitation (mm/year)	Cumulative Precipitation (mm/year)
0.2	86.40	17.28	17.3
5	30.10	150.50	167.8
10	16.70	167.00	334.8
25	3.7	92.50	427.3

Target Infiltration	185.00	mm/year
Contributing Area Runoff Coefficient	0.90	
Design Precipitation	205.56	mm/year
Retention Depth	**6.13**	**mm/year**
Retention Volume	266.47	m^3

HARDEN ENVIRONMENTAL SERVICES LIMITED

Hydrogeological Assessment

Storm Water Management Pond Retrofit

North District Road Maintenance Facility

3525 Baseline Road, Sutton, Ontario

Prepared For:

York Region:

Corporate Services Department and

Public Services Department

September 28, 2022

Harden Ref. No. 2220

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1.0 INTRODUCTION

1.1 BACKGROUND

The purpose of this report is to provide a hydrogeological assessment for a proposed storm water management pond retrofit at 3525 Baseline Road in Sutton, Ontario (Figure 1). There are two ponds located at the site as shown on Figure 2. McMinnows Pond will be excavated to increase depth of water storage and Baseline Pond will be enlarged through minor excavation and the construction of perimeter berms.

2.0 PHYSICAL SETTING

2.1 SITE DESCRIPTION AND SURROUNDING LAND USE

The Site is currently used by York Region as a maintenance yard. Surrounding land use is rural, mainly comprising cash crop farmland. The York Region Police have a facility east of the site and there is an outdoor storage business located west of the site. Environmental features in the area are shown on Figure 3. There are no provincially significant wetlands located near the site. Several small unevaluated wetlands are located near to the site both isolated and associated with small tributary. The site is located 2400 metres south of Lake Simcoe.

2.2 PHYSIOGRAPHY AND QUATERNARY GEOLOGY

Chapman and Putnam (1984) describe the area of the Site as being drumlinized till plains within the Simcoe Lowlands. This area is typified as being relatively flat laying plains and there are no prominent drumlins nearby. The Ontario Geological Survey (Figure 4) mapping has this area underlain by the silty sand to sandy silt Newmarket Till sheet.

2.3 TOPOGRAPHY AND DRAINAGE

The site elevations range from 255 m AMSL at the southwest end of the site to 249 m AMSL at the northeast end of the site along Baseline Road. A small tributary to Lake Simcoe is located along the southern and eastern edges of the site. There are roadside ditches along Baseline Road. Surface water flow in the ditch is eastward. The ditch was dry and grassy when inspected in July of 2022.

2.4 CLIMATE

Annual precipitation for this Site is estimated to be 878 mm/year and the evapotranspiration at this Site is estimated to be 594 mm/year as stated in the *Lake Simcoe Climate Data: A Reference Document to Support the Completion of Water Balance Assessments* prepared by the Lake Simcoe Region Conservation Authority.

The surplus water (Precipitation – Evapotranspiration) available for runoff or infiltration is therefore estimated to be 299 mm/year.

2.5 LAKE SIMCOE REGION CONSERVATION AUTHORITY (LSRCA) REGULATED AREAS

LSRCA Regulated areas are shown on Figure 5. The LSRCA regulates a portion of the southeastern boundary of the site but not the McMinnow Pond or Baseline Pond.

3.0 SITE INVESTIGATION

3.1 FIELD METHODOLOGY

The field work undertaken by Harden Environmental Services Ltd. included the following;

- the developing of three existing groundwater monitors by purging with Waterra pump,
- the hydraulic conductivity testing of the three groundwater monitors,
- measuring water levels of groundwater monitors
- obtaining water quality samples from BH1 and McMinnow Pond.

3.1.1 GEOLOGICAL INVESTIGATION

Three boreholes for geotechnical purposes with monitoring well installations were supervised by Sola Engineering in August 2021. The borehole logs are found in Appendix A. Table 1 summarizes the geological conditions. Monitoring locations are shown on Figure 6.

Table 1: Summary of Geological Observations in Boreholes

Borehole	Depth From (mbgs)	Depth To (mbgs)	Description
BH1	0	2.3	Probable Fill
	2.3	3.8	Clay Silt Till
	3.8	4.3	Sandy Silt Till
BH2	0	1.5	Probable Fill
	1.5	3.8	Clay Silt / Clay Silt Till
	3.8	4.3	Sandy Silt Till
BH3	0	1.1	Fill
	1.1	2.3	Clay Silt
	2.3	3.8	Sandy Silt Till
	3.8	4.3	Silt

The geological descriptions generally match that of the expected Newmarket Till.

3.1.2 GROUNDWATER MONITOR INSTALLATION AND WATER LEVEL MEASUREMENTS

51 mm PVC piezometers were installed in BH1, BH2, and BH3. Details of monitor installations are found in Table 2.

Table 2: Monitor Installation Details

Monitor	Ground Elevation (m AMSL)	Reference Point Elevation (m AMSL)	Piezometer Depth (mbtoc)	Piezometer Depth (mbgs)	Stick-up (m)	ID (mm)	Screen Length (m)
BH1	250.500	251.480	3.90	2.92	0.98	51	1.52
BH2	252.500	253.400	3.80	2.90	0.90	51	1.52
BH3	253.400	254.260	3.80	2.94	0.86	51	1.52

Water levels were recorded on two occasions using an electric water level tape as summarized in Table 3 and Table 4.

Table 3: Groundwater Levels below Ground Surface

Monitor	19-Aug-21	19-Jul-22
	m bgs	m bgs
BH1	1.43	1.06
BH2	0.95	0.80
BH3	1.12	0.93

Table 4: Groundwater Elevation (m AMSL)

Monitor	19-Aug-21	19-Jul-22
	m AMSL	m AMSL
BH1	249.07	249.44
BH2	251.55	251.70
BH3	252.28	252.48

In addition, York Region installed data loggers in BH1, BH2 and BH3 (designated as MW1, MW2 and MW3 by York Region) commencing April 12, 2022. The period of record is shown on the

hydrograph on Figure 7. The period of record includes the seasonal high occurring on June 12, 2022.

3.1.3 HYDRAULIC CONDUCTIVITY TESTING

Hydraulic conductivity tests were conducted in each of the three monitoring wells at the Site. The test conducted in BH2 did not produce acceptable results. Rising head tests were conducted in the groundwater monitors and evaluated using the Hvorslev analytical solution. Table 5 summarizes the results of the testing and recovery curves are found in Appendix B.

Table 5: Hydraulic Testing Results

Monitor	k (metres/second)
BH1	4.1×10^{-7}
BH3	2.2×10^{-6}

The hydraulic conductivity of the soils ranges from 2.2×10^{-6} m/s to 4.1×10^{-7} m/s and the range is indicative of the heterogeneous fill materials these monitors are completed in. The mean hydraulic conductivity is 9.5×10^{-7} m/s.

3.1.4 WATER QUALITY

Two water samples were obtained. Water samples were obtained from BH1 as representative of potential groundwater inflow to the pond and also from McMinnow Pond. The water samples were compared to the York Region Stormwater criteria listed in Bylaw 2021-56. The samples were obtained on July 19, 2022 and delivered the same day to AGAT Laboratories in Mississauga. The samples were kept cool enroute to the laboratory. The results are found in Appendix D.

Table 6: Water Quality Field Measurements July 19, 2022

Station	pH	Temperature C	TDS (mg/L)	EC(u S)
McMinnow Pond	8.31	31.0	1145	2302
BH1	6.06	15.1		>4000

It is found that the water in McMinnow Pond is suitable for discharge to a stormwater ditch. The groundwater obtained from BH1 is not suitable for direct discharge to a stormwater ditch. The groundwater exceeded the criteria for manganese, phenols and total suspended solids.

Manganese is a common element that is found in groundwater in a reduced state and often precipitates in aerobic environments. Thus, as groundwater discharges to the pond, it is likely that the manganese will precipitate out of solution. The total suspended solids in the borehole is due to agitation of water within the borehole and a result of poor overall development of the groundwater monitor. Any discharge from the pond will have to be filtered for suspended solids in any event. The concentration of Phenols is 0.009 mg/L compared to the criteria of 0.008 mg/L. Phenols were not detected in the pond water. Phenols are volatile and it is likely that as groundwater discharges to the pond that the phenols will volatilize.

4.0 DEWATERING

There are two aspects to the dewatering, first the initial draining of the pond and secondly the continuous inflow of groundwater.

The estimated pond volume is 675 m^3 (675,000 L) and as this volume is removed, the inflow of groundwater will increase.

It is proposed to excavate McMinnows Pond to an elevation of 249.90 m AMSL. The proposed permanent pool elevation in the pond is 252.10 m AMSL. This also happens to be the average groundwater elevation between BH2 and BH3 located upgradient and downgradient of the pond. The datalogger water level data obtained from BH2 and BH3 peak on June 12, 2022. The average high water level between BH2 (252.2 m AMSL) and BH3(253.2m AMSL) on that date is 252.70 m AMSL, therefore the potential high-water level in McMinnows Pond is 252.70 m AMSL. We will also assume that the pond will be dewatered to 1.0 metres below the final elevation of 249.90 m AMSL. Thus, the dewatered elevation will be 248.90 m AMSL. The pond presently has an area of approximately 450 m^2 and an average depth of 1.5 metres in springtime conditions.

The volume of groundwater seepage into the pond is estimated using the Dupuit-Forchheimer discharge formula (Bear, 1979);

$Q = k (H^2 - h^2) \ / \ 0.733 \ Log \ (R/R_e)$

Where

Q – groundwater inflow into the excavation (m^3/s)

k – hydraulic conductivity (m/s)

H – initial thickness of saturated soils above impermeable datum (m)

h – dewatered thickness of saturated soils above impermeable datum (m)

R – estimated radius of influence (m)

Re – equivalent radius of excavation

Radius of Influence from Edge of Excavation

The radius of influence is estimated using the Siechardt empirical formula of

$R_x = 3000\ h\ \sqrt{k}$

Equivalent Radius of Excavation

Groundwater Flow into the excavation using Equation (1) is radial and since excavations are generally square or rectangular, an equivalent circle of the same area of excavation is required. This is determined using;

$R_e = \sqrt{L\ x\ W/\pi}$

For the purpose of the estimate, we assumed that horizontal flow prevails. Furthermore, for the purpose of the calculations it was assumed that the thickness of the water bearing unit is 15 metres.

Final Radius of Influence

The radius of influence(R) used in Equation 1 is the sum of R_x and R_e.

Base of Aquifer

Radial groundwater flow into the pond occurs above an established datum. This datum is determined as an impermeable boundary within the till unit estimated to be 15 metres below the lowest level of dewatering.

Hydraulic Conductivity

The measured hydraulic conductivity of the fill material as high as 2.2×10^{-6} m/s.

In summary, the assumptions used for the Dupuit equation are as follows;

Length of Excavation (L) 30 m

Width of Excavation (W) 18 m

Hydraulic Conductivity (k) = 2.2×10^{-6} m/s

Initial saturated thickness above datum = 15 m (high water levels)

Final saturated thickness above datum = 10.8 m

Estimated radius of influence from edge of pond = 17 m

The estimated seasonal inflow from the sediments to the pond is estimated to be 92.6 m^3/day. Given the assumptions and including a safety factor of 3, the estimated long-term inflow of

groundwater along the perimeter walls will be 278 m^3/day. The calculation is shown in Appendix D.

5.0 DISCUSSION

An Environmental Activity Sector Registry will be suitable for the dewatering of the pond. The estimated discharge is less than 400,000 L/day. The estimated pond volume is 675 m^3 (675,000 L) and therefore in order to have a discharge of less than 400,000 L/day, the pond will initially have to be emptied over more than one day. During construction it is estimated that maintenance pumping of 278,000 L/day will be required.

Anticipated zone of influence

It is anticipated that the zone of influence will be less than 17 metres from the pond edge.

Analysis of potential impact of the soil settlement

During construction is must be anticipated that the edge of the pond will be unstable below an elevation of 252.7 m AMSL (high groundwater elevation). Given the relatively short period of time required for the retrofit (weeks to months) it is unlikely that the silty clay soils within 17 m of the pond will compress to any significant degree. Therefore, other than destabilizing conditions at the edge of the excavation, no soil settlement is anticipated.

Analysis of potential impact to other water users

The nearest private well is located at 3504 Baseline Road, immediately north of the site. This well is outside of the potential zone of influence of the dewatering. This farm is serviced by a well that is 27 metres deep with a static water level of three metres. Thus, there are more than twenty metres of available drawdown in the well. There are more than twenty metres of clay till above the well screen that protects the water supply. The dewatering of the McMinnow Pond will not affect quality or quantity of water in the well.

The on-site well and the well servicing the outdoor storage business west of the site are both 80 metres deep and thus will not be affected by the proposed dewatering. These wells are also beyond the potential zone of influence of the dewatering.

Contingency plan and includes measures to address all identified impacts

The proposed dewatering will occur 175 metres from Baseline Road and 200 metres from the tributary located in the southeast area of the site. There are no private residences within 220 m of the McMinnow Pond. All of these features are beyond the anticipated area of influence of the dewatering. No impacts are anticipated.

Protocol for providing written notice to other water users

There is no necessity to provide written notice to local private water well users as they are well beyond the area of influence of the water taking and their wells cannot be impacted either from water quality or quantity. We have provided a sample notification that should be sent to the Lake Simcoe Region Conservation Authority and the Town of Georgina (Appendix F).

Determination for the need of a water monitoring plan

There is no need for a water monitoring plan because there are no anticipated impacts to either private water well supply or the natural environment. The zone of influence is limited in distance and does not extend to any private well or natural feature. However, a nearby groundwater monitor (BH3) does have a data logger that will be maintained throughout the retrofit period. The data from the logger can be accessed and checked against historical conditions should a question of impacts arise.

Description of the water taking activity

A 450 m^2 pond located on York Region property will be emptied by mechanical means (pumped) and discharge water directed into a temporary holding area and then allowed to discharge into the municipal ditch on the south side of Baseline Road (Figure 8)

Description of the construction site and project activities

The construction site includes McMinnows Pond which is protected by a perimeter fence. The pond will be dewatered and deepened with an excavator. A discharge plan is included in Appendix F.

Summary of the qualifications and experience of the person preparing the report

This report was prepared by Stan Denhoed, a professional engineer in registered in Ontario and who is also a hydrogeologist with 36 years of experience. Mr. Denhoed's resume is found in Appendix G.

6.0 CONCLUSIONS

1) The rate of groundwater discharge into the pond is estimated to be 278,000 liters per day. An EASR should be registered with the Ministry of the Environment, Conservation and Parks. The dewatering rate in the EASR need not exceed 400,000 L/day.

2) There are no local residences or wells within the area of influence of the proposed dewatering. There will be no impact to quality or quantity of water available to any private well.

3) There will be no impact to any natural feature on or off-site.

4) The water quality is suitable for direct discharge to the municipal ditch, however, the concentration of suspended solids may increase during construction and measures to limit suspended solids in the discharge water must be considered.

7.0 STATEMENT OF LIMITATIONS

Harden Environmental Services Ltd. (HESL) conducted the work associated with this report in accordance with the scope of services, time and budget limitations imposed for this work. The work has been conducted according to reasonable and generally accepted local standards for an environmental consultant at the time of the work. No other warranty or representation, expressed or implied, is included or intended in this report.

It should be noted that subsurface conditions might vary at locations and depths other than those locations where borings, surveys or explorations were made by HESL or others. Should conditions, not observed during the work, become apparent, HESL should be immediately notified to assess the situation and conduct additional work, where required. The findings of this report are based on conditions as they were observed at the time of the work. No assurance is made regarding changes in conditions subsequent to the time of the work.

Regulatory statutes are subject to interpretation. These statutes and their interpretation may change over time, thus these issues should be reviewed with appropriate legal counsel.

HESL relied on information provided by others in this report. HESL cannot guarantee the accuracy, completeness and reliability of the information provided by others, although HESL staff attempted to seek clarification on information provided and verified authenticity, where practical. The report and its attachments were prepared for and made available for the sole use of the client. HESL will not be responsible for any use or interpretation of the information contained in this report by any other party without the prior expressed written consent of HESL.

8.0 REFERENCES AND OTHER SUPPORTING DOCUMENTS

Chapman, J.L. and Putman, D.F., 1984, The Physiography of Southern Ontario

Lake Simcoe Region Conservation Authority, April 2017. Lake Simcoe Climate Data: A reference Document to Support the Completion of Water Balance Assessments.

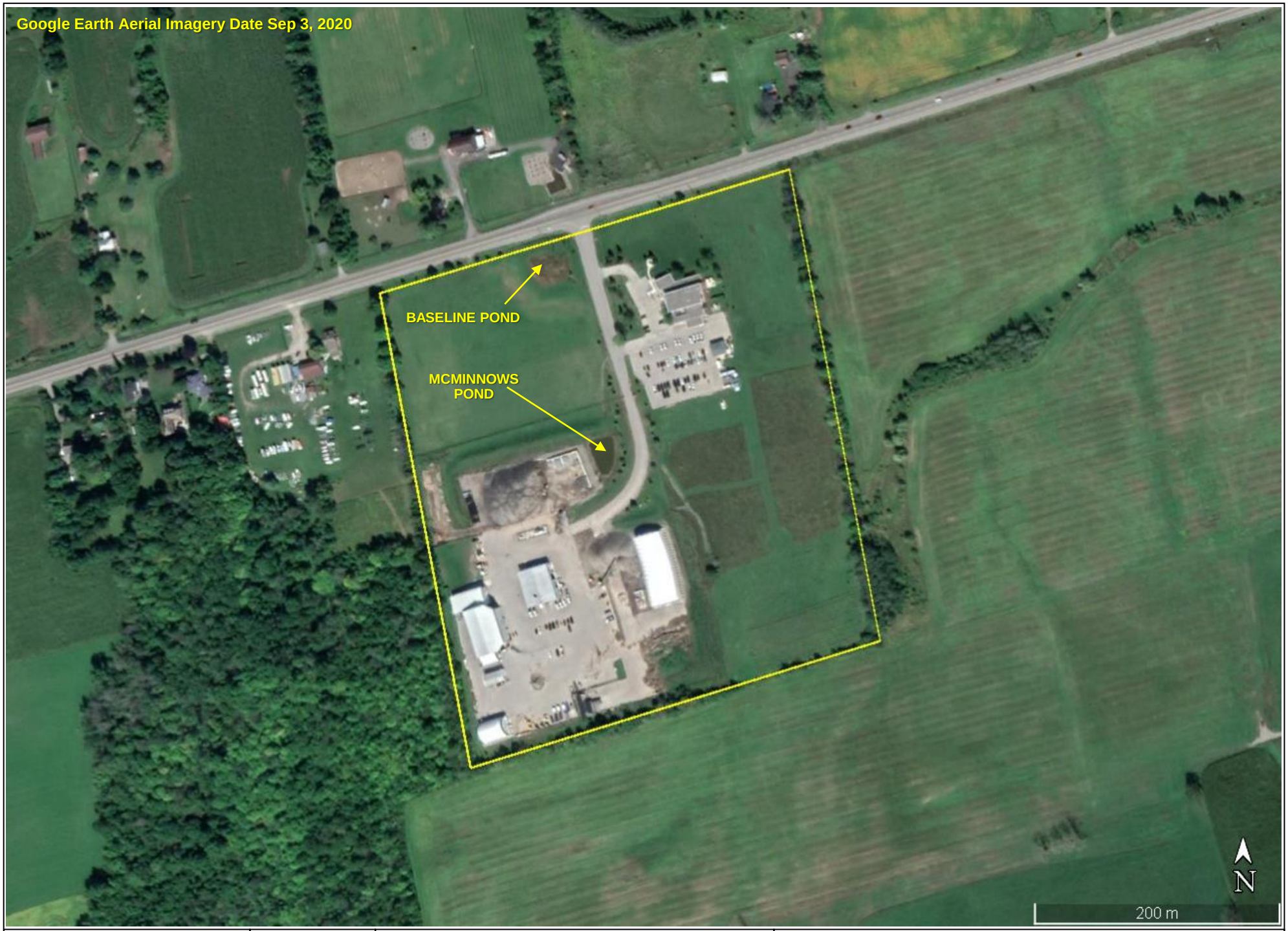
York Region Official Plan 2016 Map 6, Wellhead Protection Areas, www.york.ca

Sola Engineering, Geotechnical Investigation North District Patrol Facility Storm Water Management , Report No. 10868-S0221-GEO, dated November 19, 2021

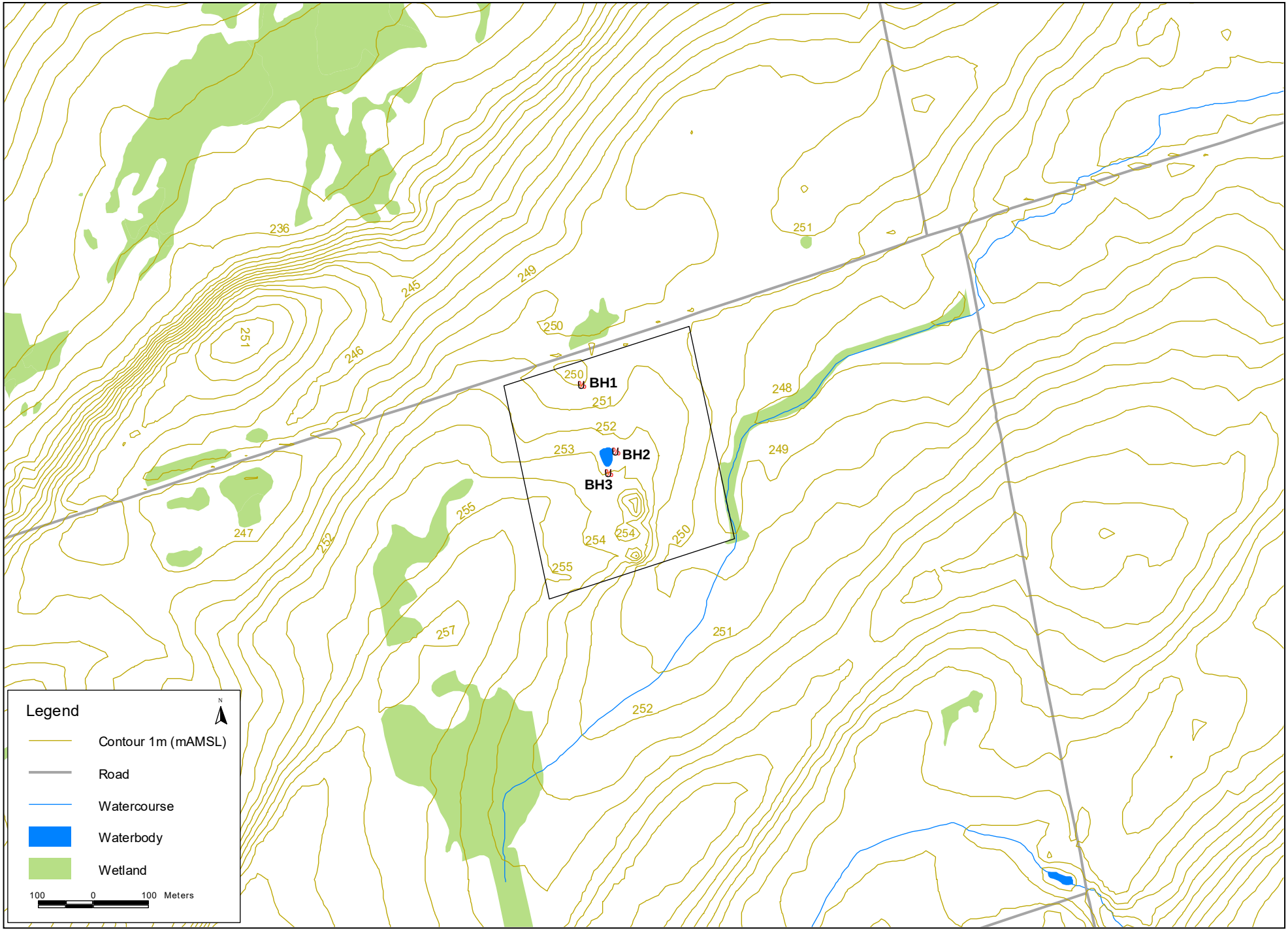
All of Which is Respectfully Submitted,
Harden Environmental Services Ltd.

Stan Denhoed, M.Sc., P. Eng.
Senior Hydrogeologist

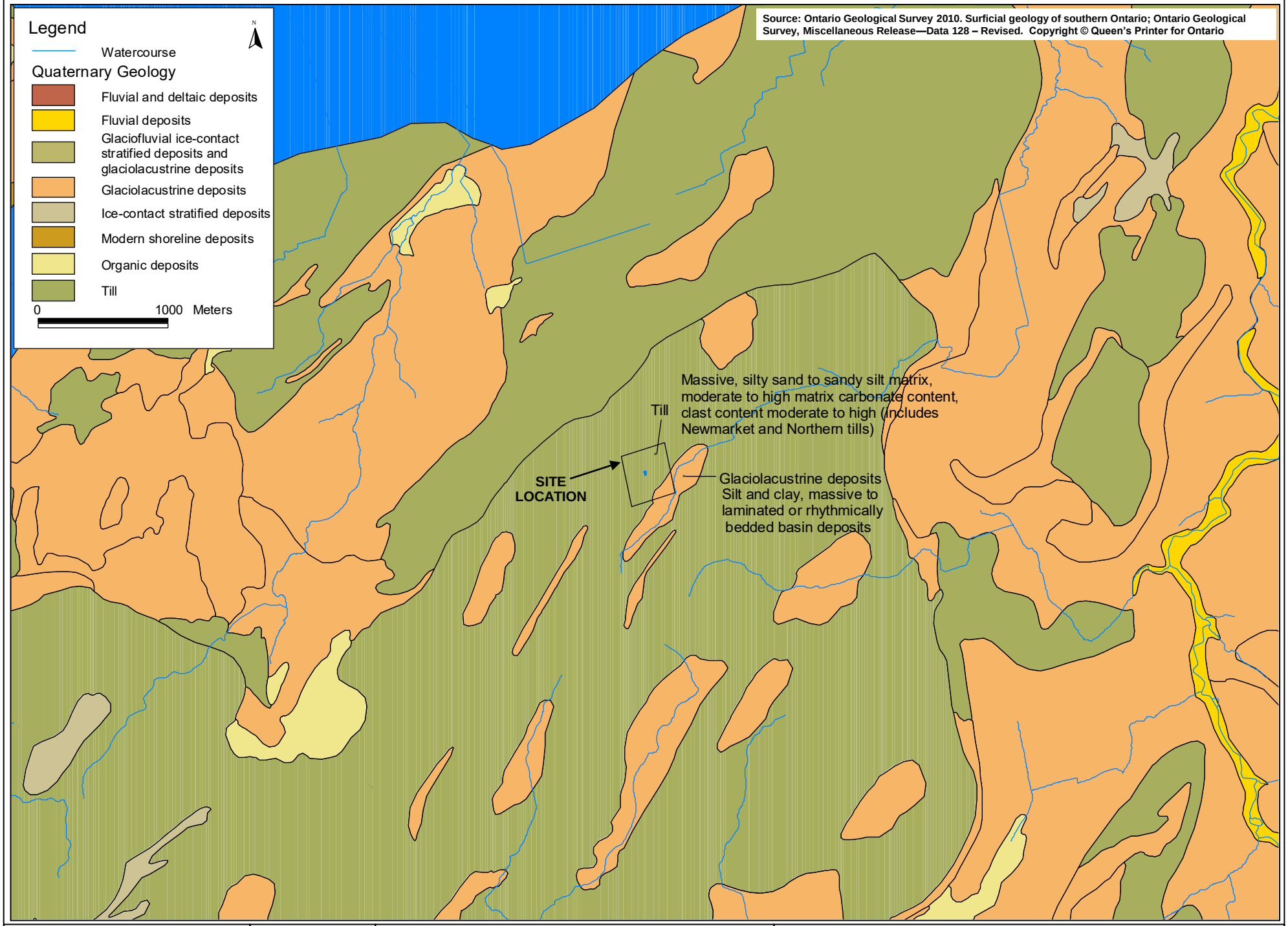
Harden Environmental Services Ltd.	**Project No:** 2220	Hydrogeological Assessment 3525 Baseline Road	**Figure 1: Site Location**
	Date: July 2022	Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	
	Drawn By: AR		



Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 2: Aerial Imagery**



Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 3: Environmental Features**



Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 4: Quaternary Geology**

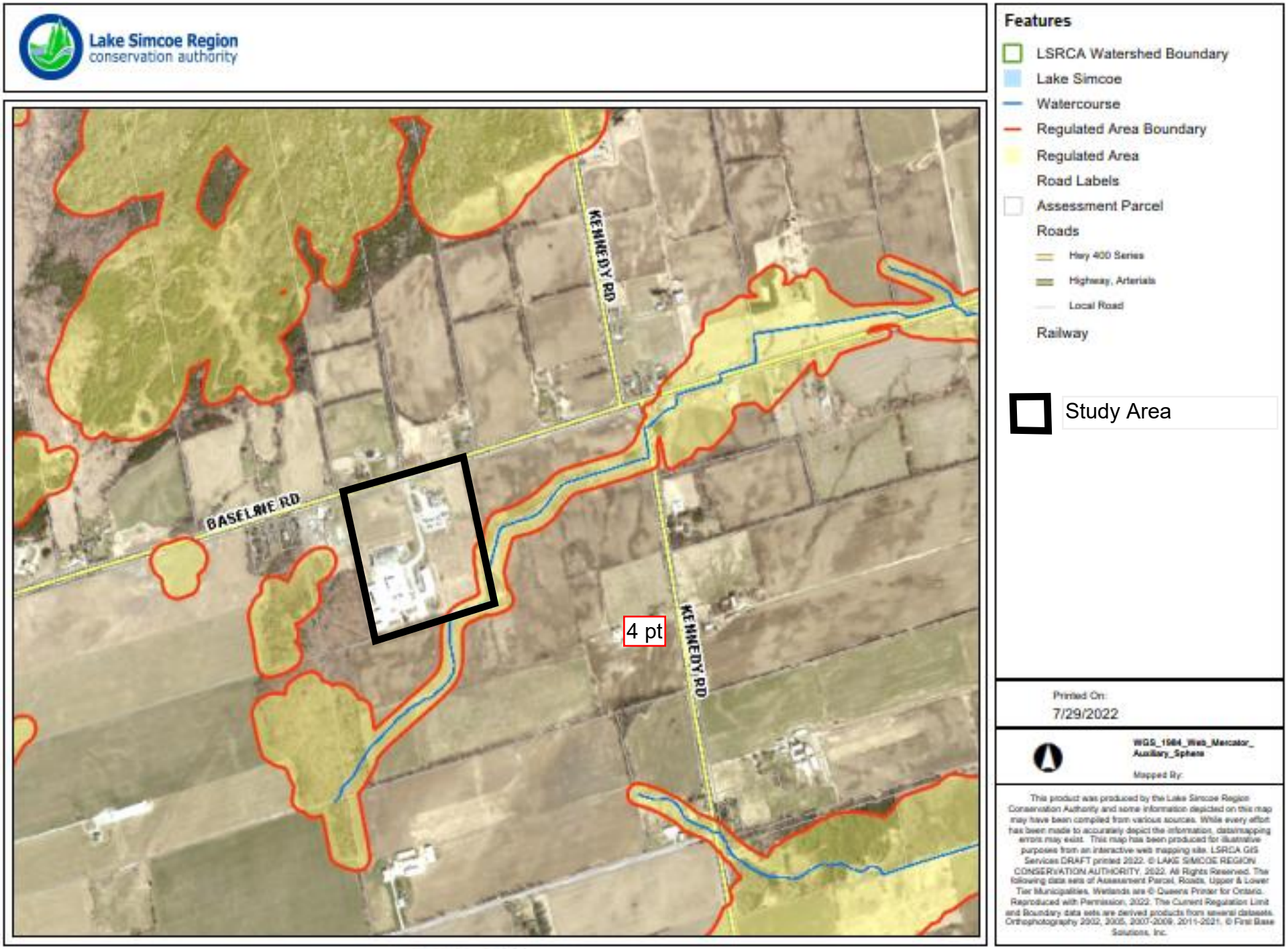
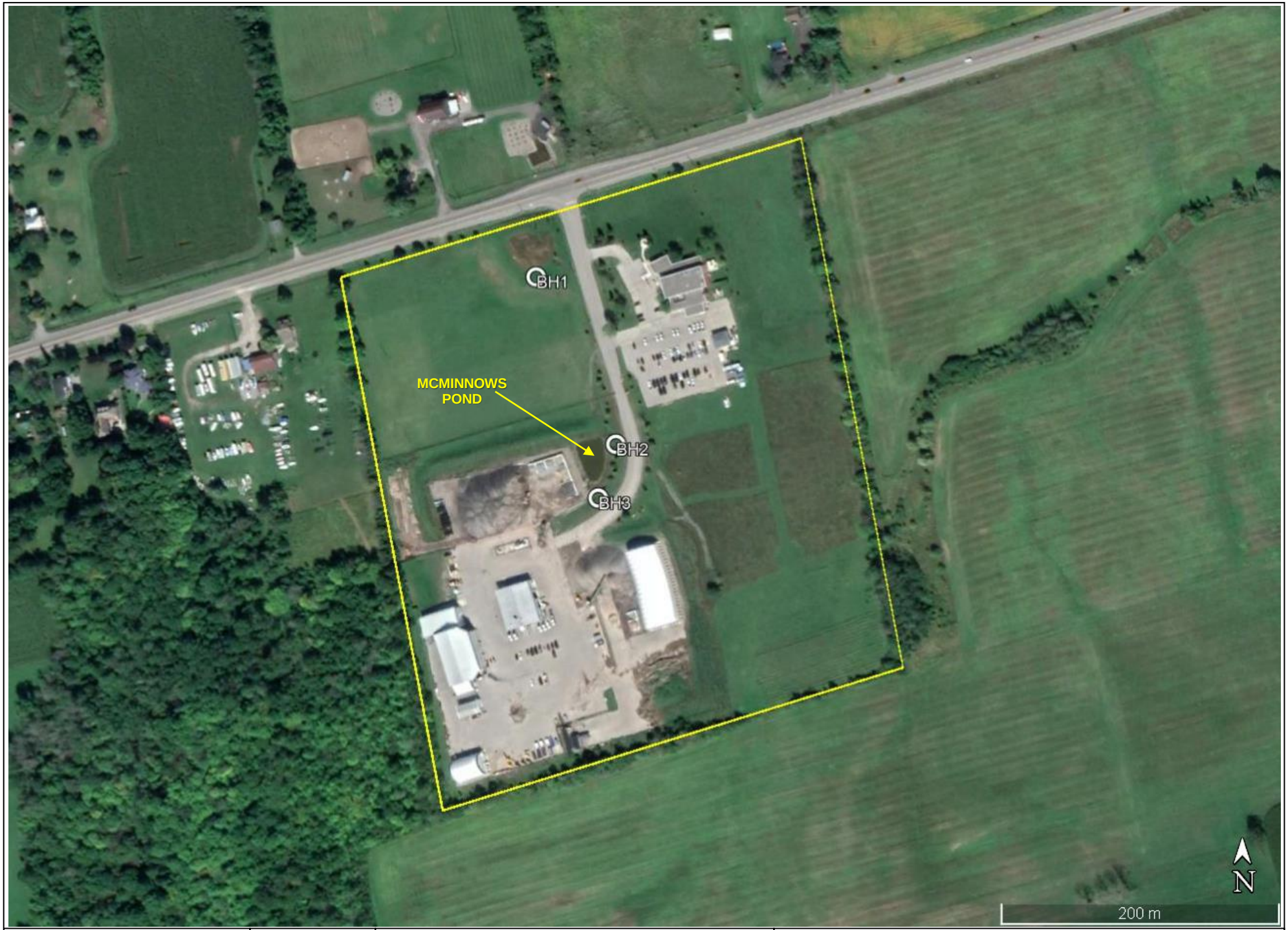
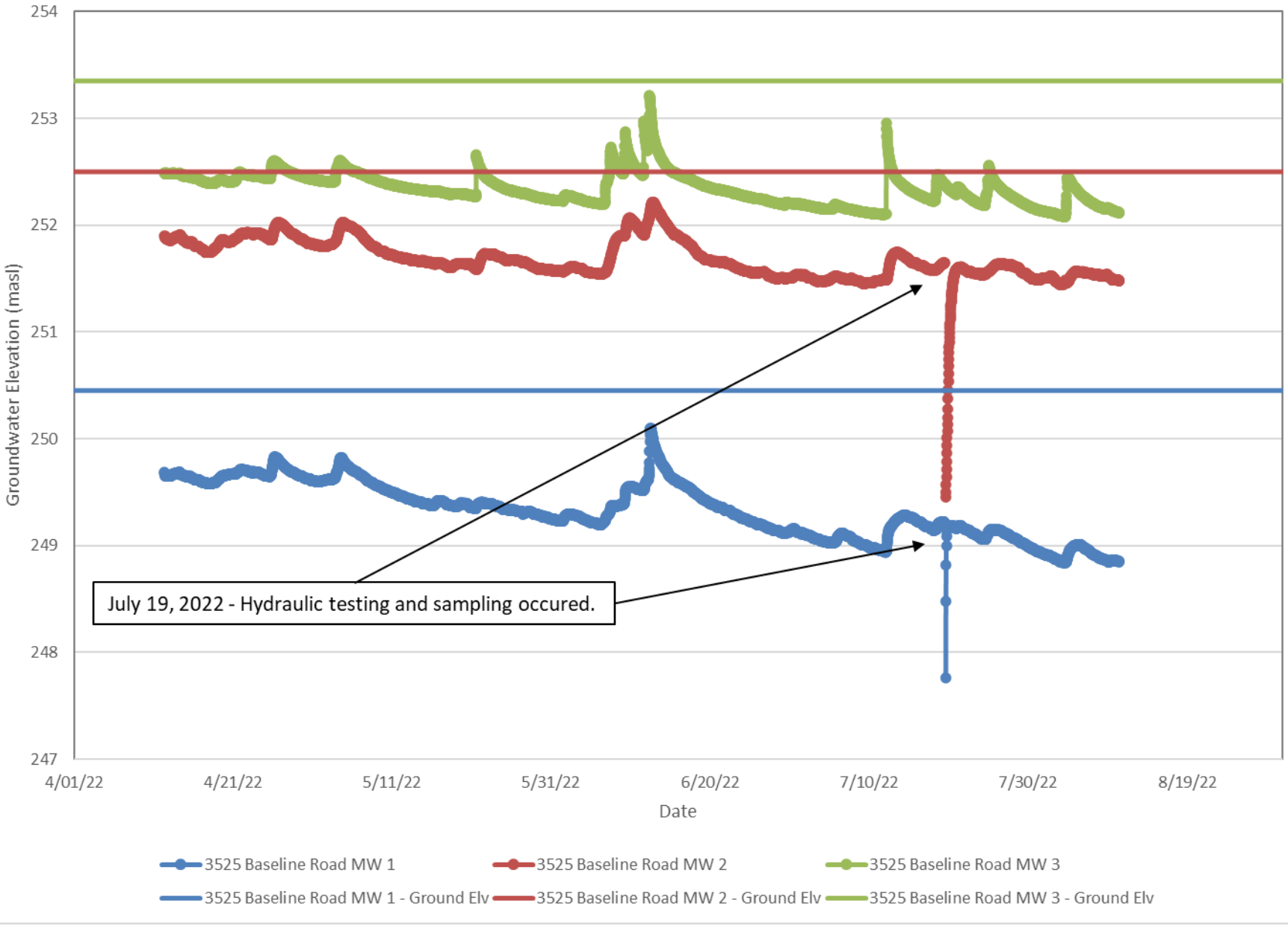


Figure 5: LSCRA Regulated Areas



Harden Environmental Services Ltd.	**Project No:** 2220	Hydrogeological Assessment 3525 Baseline Road	**Figure 6: Monitoring Locations**
	Date: July 2022	Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	
	Drawn By: AR		

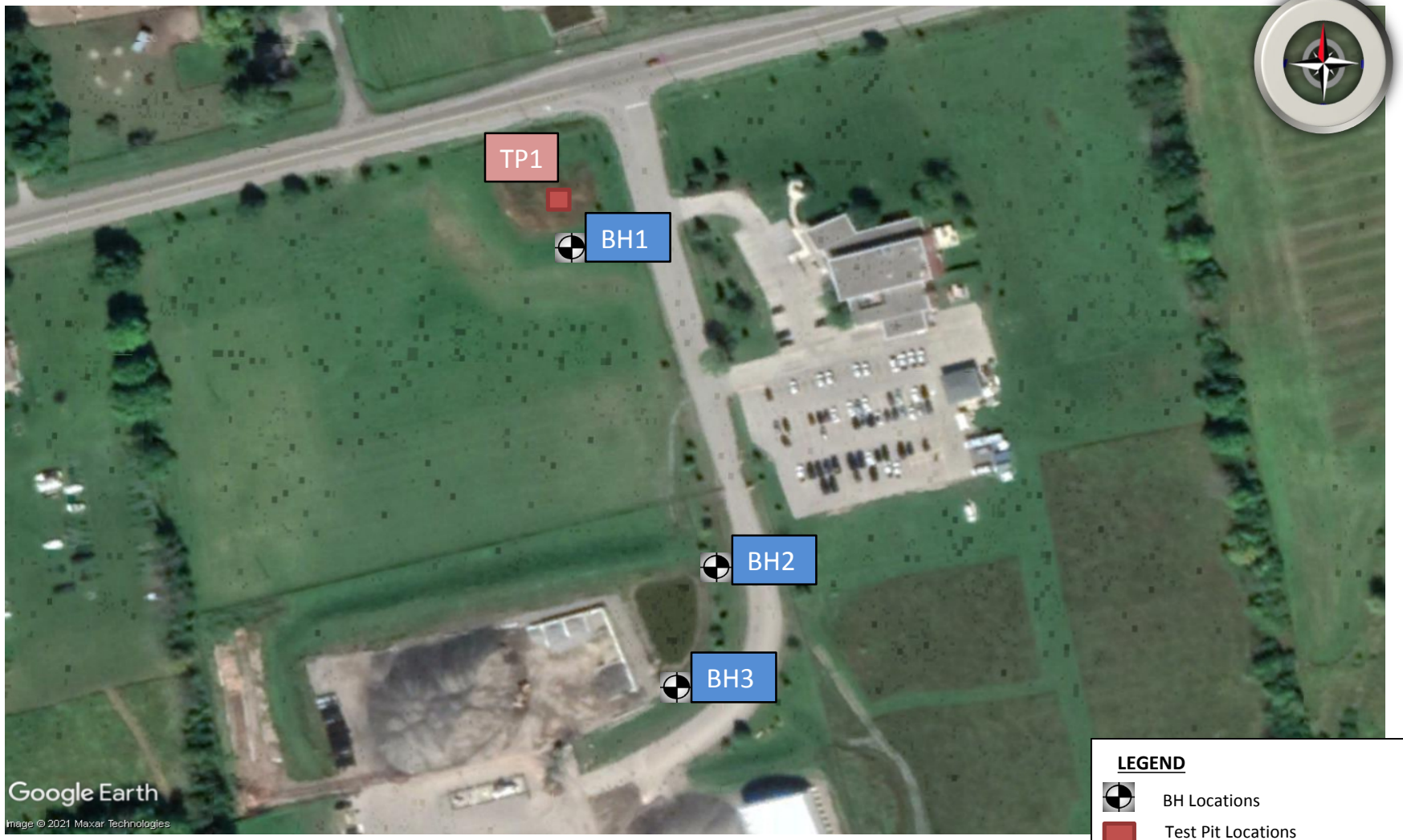
Figure 7: 3525 Baseline Road Monitoring Well Data



Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 7: Hydrographs**

Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 8: Discharge Plan and Location**

Appendix A Borehole and Water Well Records



SOLA ENGINEERING	File No.: 10868-S0221-GEO	**BH Location Plan**	The figure provided is for the intended purpose of presenting the approximate borehole locations. This figure should not be used for any other purposes including construction, architecture or for accuracy of dimensions and orientation of objects.	Enclosure No.: **1**
	Report Number: 2021-15922	**Proposed SWM Pond**		
		3525 Baseline Road, Sutton, Ontario		
	Date: November, 2021	**Chisholm, Fleming and Associates**		Not to Scale

SOLA ENGINEERING

ENCLOSURE No. 2

RECORD OF BOREHOLE No. BH1

1 OF 1

METRIC

PROJECT NUMBER 10868 | LOCATION 3525 Baseline Road, Sutton, Ontario | ORIGINATED BY JS

DIST ____ | HWY ____ | BOREHOLE TYPE Solid Stem Augers | COMPILED BY CC

DATUM ____ | DATE 2021.08.12 - 2021.08.12 | LATITUDE ____ | LONGITUDE ____ | CHECKED BY JS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS
250.5	Topsoil					
250.4 / 0.1	TOPSOIL - 100 mm thick					
0.1	FILL - sandy silt, trace clay, trace gravel, trace rootlets, brown, moist		1	SS	7	
249.7						
0.8	FILL - clayey silt, trace gravel, trace rootlets, trace organic, dark brown, moist		2	SS	10	
248.9						
1.5	PROBABLE FILL - clayey silt, trace gravel, pockets of sand, brown, very moist		3	SS	9	
248.2						
2.3	CLAYEY SILT TILL - trace gravel, brown, very stiff, very moist		4	SS	17	
			5	SS	19	
246.6						
3.8	SANDY SILT TILL - trace gravel, brown, dense, moist		6	SS	32	
246.2						
4.3	End of Borehole at Targeted Depth; Borehole was Open and Water was at 3.7 m Below Existing Ground Surface upon Completion of Drilling.					

ELEVATION SCALE: 250, 249, 248, 247

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

UNIT WEIGHT γ kN/m³

REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 3

RECORD OF BOREHOLE No. BH2

1 OF 1

METRIC

PROJECT NUMBER 10868 | LOCATION 3525 Baseline Road, Sutton, Ontario | ORIGINATED BY JS

DIST _____ HWY _____ | BOREHOLE TYPE Solid Stem Augers | COMPILED BY CC

DATUM _____ | DATE 2021.08.12 - 2021.08.12 | LATITUDE _____ | LONGITUDE _____ | CHECKED BY JS

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
252.5	Topsoil										
252.4 / 0.0	TOPSOIL - 150 mm thick										
0.2 / 251.7	FILL - silty sand, trace gravel, brown, moist		1	SS	7		252		○		
0.8 / 251.0	PROBABLE FILL - clayey silt, trace gravel, brown, moist		2	SS	18				○		
1.5 / 250.2	CLAYEY SILT - trace gravel, trace sand, brown, very stiff, moist		3	SS	23		251		○		
2.3 / 248.7	CLAYEY SILT TILL - trace gravel, grey, hard, moist		4	SS	46				○		
			5	SS	39		250		○		
3.8 / 248.2	SANDY SILT TILL - trace gravel, trace clay, containing stone fragments, grey, very dense, moist		6	SS	58		249		○		
4.3	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 4

RECORD OF BOREHOLE No. BH3

1 OF 1

METRIC

PROJECT NUMBER 10868 | LOCATION 3525 Baseline Road, Sutton, Ontario | ORIGINATED BY JS

DIST _____ HWY _____ | BOREHOLE TYPE Solid Stem Augers | COMPILED BY CC

DATUM _____ | DATE 2021.08.12 - 2021.08.12 | LATITUDE _____ | LONGITUDE _____ | CHECKED BY JS

SOIL PROFILE			SAMPLES											
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
253.4 Topsoil											
253.2	TOPSOIL - 150 mm thick										
0.2	FILL - sandy silt, trace gravel, trace rootlets, trace organic, containing brick fragments, brown, moist		1	SS	5		253		○		
252.3			2	SS	8				○		
1.1	CLAYEY SILT - trace gravel, trace sand, brown, firm to very stiff, moist		3	SS	19		252		○		
251.1											
2.3	SANDY SILT TILL - trace gravel, trace clay, brown, dense to very dense, moist		4	SS	50		251		○		
249.5			5	SS	54		250		○		
3.8	SILT - trace clay, grey, very dense, moist		6	SS	74				○		
249.1											
4.3	End of Borehole at Targeted Depth; Borehole Caved at 3.9 m and Water was at 3.7 m Below Existing Ground Surface upon Completion of Drilling.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

KEY TO SYMBOLS

Enclosure No.: 5

PROJECT NUMBER 10868

PROJECT NAME Proposed SWMP

LOCATION 145 Plains Road East, Burlington, Ontario

CLIENT Chisholm, Fleming and Associates

LITHOLOGIC SYMBOLS (Unified Soil Classification System)


CL-SL: clayey silt


CL-SL-TL: clayey silt till


FILL: TTC Fill (made ground)


SL: silt


SN-SL-TL: sandy silt till


TOPSOIL: Topsoil/peat/organics

SAMPLER SYMBOLS


Split Spoon Sample

WELL CONSTRUCTION SYMBOLS


Bentonite Seal: 1 pipe group, 1 pipe


Concrete: 1 pipe group, 1 pipe


Filter Pack: 1 pipe group, 1 pipe


Slotted Pipe: 1 pipe group, 1 pipe


Slough at bottom of hole

Notes:

Terms describing RELATIVE DENSITY, based on Standard Penetration Test "N"-Value for COURSE GRAINED soils (major portion retained on No. 200 seive):

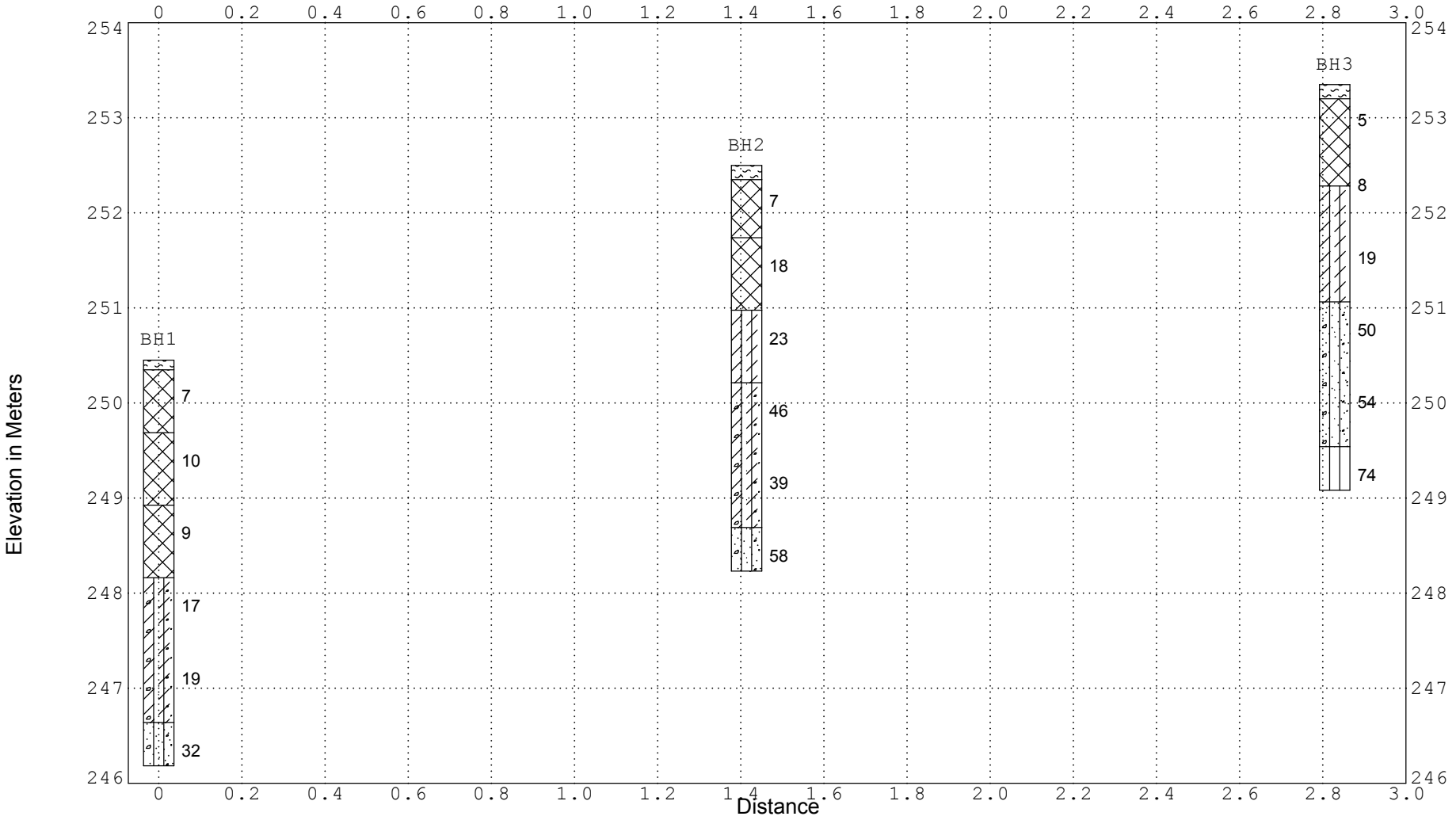
DESCRIPTIVE TERM ["N"-Value (blows/0.3m), Relative Density (%)]

- **Very Loose [less than 4, less than 15]**
- **Loose [4 to 10, 15 to 35]**
- **Compact or Medium [10 to 30, 35 to 65]**
- **Dense [30 to 50, 65 to 85]**
- **Very Dense [greater than 50, greater than 85]**

Terms describing CONSISTENCY, based on Standard Penetration Test "N"-Value for FINE GRAINED soils (major portion passing No. 200 sieve):

DESCRIPTIVE TERM [Unconfined Compressive Strength (kPa), "N"-Value (blows/0.3m)]

- **Very Soft [less than 25, less than 2]**
- **Soft [25 to 50, 2 to 4]**
- **Firm [50 to 100, 4 to 8]**
- **Stiff [100 to 200, 8 to 15]**
- **Very Stiff [200 to 400, 15 to 30]**
- **Hard [greater than 400, greater than 30]**



Plan View

SOLA ENGINEERING

SOLA ENGINEERING INC.

CONCEPTUAL SOIL PROFILE

Horizontal Scale:	Drawn By:	
Vertical Scale:	Approved By:	

Proposed SWMP
145 Plains Road East, Burlington, Ontario

Project Number: 10868

Enclosure No.: 6

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 — 6921554 — MUNICIP 69004 — CON. CON — 05

COUNTY OR DISTRICT: YORK
TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE: NORTH GWILLIMBURY
CON., BLOCK, TRACT, SURVEY, ETC.: CON 5
LOT: PART 23
[redacted] BASE 3411 LINE ROAD
DATE COMPLETED: DAY 3 MO 6 YR 91
UTM ZONE: 17 — NORTHING: 0509 0 — RC — ELEVATION: 254 — RC — BASIN CODE

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	CLAY	BOULDERS	HARD	0	21
BLUE	CLAY	BOULDERS	HARD	21	36
BROWN	SAND		LOOSE	36	37
BLUE	CLAY	BOULDERS	HARD DENSE	37	177
GRAY	SILT	STONES	CEMENTED	177	191
GRAY	CLAY	BOULDERS	HARD DENSE	191	257
GRAY	LIMESTONE		POUROUS	257	260

31
32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
257 260	1 ☑ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
15-18	1 ☐ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
20-23	1 ☐ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
25-28	1 ☐ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
30-33	1 ☐ FRESH 2 ☐ SALTY — 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5	1 ☑ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	188"	+2	257
17-18	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			20-23
24-25	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			27-30

SCREEN

SIZE(S) OF OPENING (SLOT NO.) 31-33	DIAMETER 34-38 INCHES	LENGTH 39-40 FEET
MATERIAL AND TYPE	DEPTH TO TOP OF SCREEN 41-44 FEET	80

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33 80	

71 PUMPING TEST

PUMPING TEST METHOD 10: 1 ☐ PUMP 2 ☑ BAILER
PUMPING RATE 11-14: 14 GPM
DURATION OF PUMPING 15-16 HOURS 20 17-18 MINS

STATIC LEVEL 19-21 FEET	WATER LEVEL END OF PUMPING 22-24 FEET	25 WATER LEVELS DURING: 1 ☐ PUMPING 2 ☐ RECOVERY	15 MINUTES 26-28 FEET	30 MINUTES 29-31 FEET	45 MINUTES 32-34 FEET	60 MINUTES 35-37 FEET
	90		109		122	135

IF FLOWING, GIVE RATE 38-41 GPM
PUMP INTAKE SET AT FEET
WATER AT END OF TEST 42: 1 ☑ CLEAR 2 ☐ CLOUDY
RECOMMENDED PUMP TYPE: ☐ SHALLOW ☑ DEEP
RECOMMENDED PUMP SETTING 43-45: 125 FEET
RECOMMENDED PUMPING RATE 46-49: 10 GPM
50-53

FINAL STATUS OF WELL 54

1 ☑ WATER SUPPLY; 2 ☐ OBSERVATION WELL; 3 ☐ TEST HOLE; 4 ☐ RECHARGE WELL; 5 ☐ ABANDONED, INSUFFICIENT SUPPLY; 6 ☐ ABANDONED, POOR QUALITY; 7 ☐ UNFINISHED; ☐ DEWATERING

WATER USE 55-56

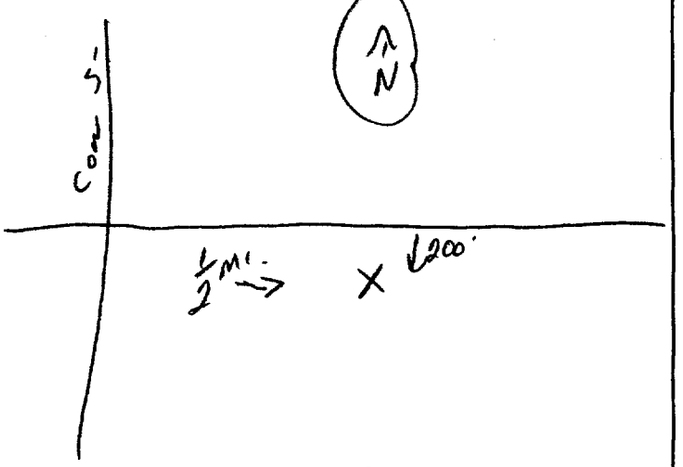
1 ☑ DOMESTIC; 2 ☐ STOCK; 3 ☐ IRRIGATION; 4 ☐ INDUSTRIAL; 5 ☐ COMMERCIAL; 6 ☐ MUNICIPAL; 7 ☐ PUBLIC SUPPLY; 8 ☐ COOLING OR AIR CONDITIONING; ☐ OTHER; 9 ☐ NOT USED

METHOD OF CONSTRUCTION 57

1 ☐ CABLE TOOL; 2 ☑ ROTARY (CONVENTIONAL); 3 ☐ ROTARY (REVERSE); 4 ☐ ROTARY (AIR); 5 ☐ AIR PERCUSSION; 6 ☐ BORING; 7 ☐ DIAMOND; 8 ☐ JETTING; 9 ☐ DRIVING; ☐ DIGGING; ☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



109 91050

68836

DRILLERS REMARKS

CONTRACTOR

NAME OF WELL CONTRACTOR: DOUGLAS TOWERS
WELL CONTRACTOR'S LICENCE NUMBER: 5019
ADDRESS: RR#1 SUTTON
NAME OF WELL TECHNICIAN: DOUG
WELL TECHNICIAN'S LICENCE NUMBER: 8119
SIGNATURE OF TECHNICIAN/CONTRACTOR
SUBMISSION DATE: DAY 3 MO 7 YR 91

OFFICE USE ONLY

DATA SOURCE 58
CONTRACTOR 59-62: 5019
DATE RECEIVED 63-68: AUG 09 1991
80
DATE OF INSPECTION
INSPECTOR
REMARKS

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

MINISTRY OF THE ENVIRONMENT

The Ontario Water Resources Act

WATER WELL RECORD

31 D/16 west

Ontario

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 6913322 | MUNICIP. 69004 | CON. CON | 09

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON., BLOCK, TRACT, SURVEY, ETC.	LOT 209
YORK	NORTH GWILLIMBURY	9	

[redacted] R3 SUTTON WEST ONT.

DATE COMPLETED 05 | DAY 13 | MO [illegible] | YR 76

UTM ZONE | NORTHING 4905200 | EC 5 | ELEVATION 0825 | EC 5 | SURVEY CODE 22

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BLACK	LOAM		SOFT	0	1
BROWN	SAND	CLAY	DENSE	1	3
BROWN	CLAY		DENSE	3	16
GREY	CLAY	PEBBLES	HARD	16	62
BLUE	CLAY		DENSE	62	86
BROWN	SAND	GRAVEL	POROUS	86	89
BROWN	CLAY	STONE	CEMENTED	89	90

31 0001180285 | 0003628056 6 | 0016605 66 | 0062205 1273 | 0086305 66 | 0089628 1180 | 1

32 0090605 1260

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
0089	1 ☒ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL
	1 ☐ FRESH 3 ☐ SULPHUR 2 ☐ SALTY 4 ☐ MINERAL

51 CASING & OPEN HOLE RECORD

INSIDE DIAM. - INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
5 1/4	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE	188	0	87
06				0087
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE			

SCREEN: SIZE(S) OF OPENING (SLOT NO.) 020 | DIAMETER 05-000 INCHES | LENGTH 04 FEET | MATERIAL AND TYPE JOHNSON STAINLESS | DEPTH TO TOP OF SCREEN 0086 FEET

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT - LEAD PACKER, ETC.)
0	81	K. PACKER TOP
		OF S' SCREEN
		NIPPLE

71 PUMPING TEST

PUMPING TEST METHOD: 1 ☒ PUMP 2 ☐ BAILER | PUMPING RATE 0005 GPM | DURATION OF PUMPING 04 HOURS 00 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING	WATER LEVELS DURING	15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
010 FEET	021 FEET	1 ☒ PUMPING 2 ☐ RECOVERY	018 FEET	021 FEET	FEET	021 FEET

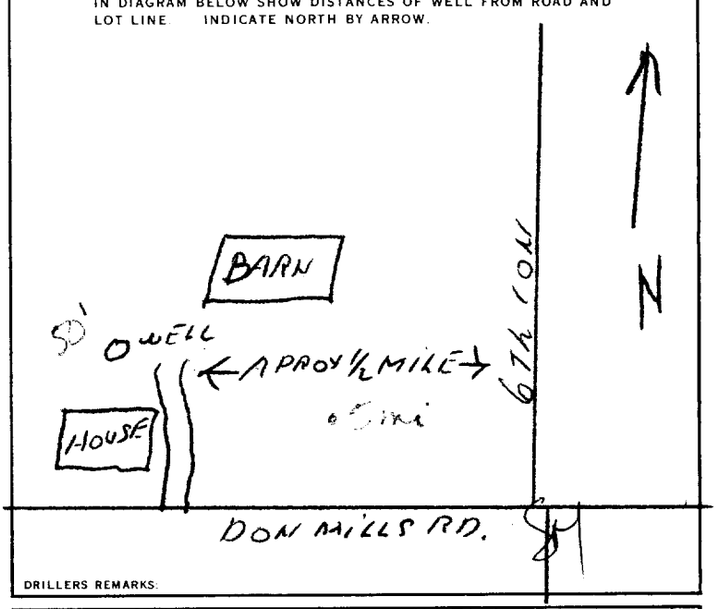
IF FLOWING, GIVE RATE: GPM | PUMP INTAKE SET AT 30 FEET | WATER AT END OF TEST: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP | RECOMMENDED PUMP SETTING 040 FEET | RECOMMENDED PUMPING RATE 0004 GPM

GPM./FT. SPECIFIC CAPACITY

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



DRILLERS REMARKS:

FINAL STATUS OF WELL 54: 1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED

WATER USE 55-56 / 12: 1 ☒ DOMESTIC 2 ☒ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

METHOD OF DRILLING 57 / 2: 1 ☐ CABLE TOOL 2 ☒ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☐ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING

CONTRACTOR

NAME OF WELL CONTRACTOR: ROGER BOADWAY ENT LTD | LICENCE NUMBER 1413

ADDRESS: BOX 397 SUTTON WEST ONT L0E 1R0

NAME OF DRILLER OR BORER: ROGER BOADWAY | LICENCE NUMBER

SIGNATURE OF CONTRACTOR: Roger Boadway | SUBMISSION DATE DAY 13 MO [illegible] YR 76

MINISTRY OF THE ENVIRONMENT COPY

OFFICE USE ONLY

DATA SOURCE 58: 1 | CONTRACTOR 59-62: 1413 | DATE RECEIVED 63-68: 070676

DATE OF INSPECTION | INSPECTOR

REMARKS: P June 27/77 S87 WI

FORM 7 MOE 07-091

Ministry of Environment and Energy
Ontario

The Ontario Water Resources Act
WATER WELL RECORD

Print only in spaces provided.
Mark correct box with a checkmark, where applicable.

11 (1 2) 6924628 Municipality 69004 (10 14) Con. CON (15) 05 (22 23 24)

County or District	Township/Borough/City/Town/Village	Con block tract survey, etc.	Lot (25-27)
YORK	GEORGINA	5	22

Owner's surname (28-47) First name	Address	Date completed (48-53) day month year
YORK REGIONAL POLICE	Baseline Rd. Sutton West, ON	24 09 98

21 (1 2) UTM Zone (10) Easting (12 17) Northing (18 24) RC (25) Elevation (26 30) RC Basin Code (31) ii iii iv (47)

LOG OF OVERBURDEN AND BEDROCK MATERIALS (see instructions)

General colour	Most common material	Other materials	General description	Depth – feet From	Depth – feet To
Brown	Soil		Soft	0	1
Brown	Clay	Stones	Soft	1	18
Grey	Clay	Sand, Gravel	Layered	18	76
Grey	Clay		Dense	76	228
Grey	Shale		Soft	228	256
Grey	Limestone		Bedrock	256	261

31 (10 14 15 21 32 43 54 65 75 80)
32

41 WATER RECORD

Water found at – feet	Kind of water
228-233	1 [X] Fresh 2 [ ] Salty 3 [ ] Sulphur 4 [ ] Minerals 6 [ ] Gas
257-261	1 [X] Fresh 2 [ ] Salty 3 [ ] Sulphur 4 [ ] Minerals 6 [ ] Gas
	1 [ ] Fresh 2 [ ] Salty 3 [ ] Sulphur 4 [ ] Minerals 6 [ ] Gas
	1 [ ] Fresh 2 [ ] Salty 3 [ ] Sulphur 4 [ ] Minerals 6 [ ] Gas
	1 [ ] Fresh 2 [ ] Salty 3 [ ] Sulphur 4 [ ] Minerals 6 [ ] Gas

51 CASING & OPEN HOLE RECORD

Inside diam inches	Material	Wall thickness inches	Depth – feet From	Depth – feet To
6¼	1 [X] Steel 2 [ ] Galvanized 3 [ ] Concrete 4 [ ] Open hole 5 [ ] Plastic	188	+3	233
6-1/8	1 [ ] Steel 2 [ ] Galvanized 3 [X] Concrete 4 [X] Open hole 5 [ ] Plastic		233	261
	1 [ ] Steel 2 [ ] Galvanized 3 [ ] Concrete 4 [ ] Open hole 5 [ ] Plastic			

SCREEN

Sizes of opening (Slot No.) (31-33)	Diameter (34-38) inches	Length (39-40) feet

Material and type	Depth at top of screen (41-44) feet

61 PLUGGING & SEALING RECORD

[X] Annular space [ ] Abandonment

Depth set at – feet From	To	Material and type (Cement grout, bentonite, etc.)
10-13	14-17	
18-21	22-25	
26-29 0	30-33 10	80 Benseal

71 PUMPING TEST

Pumping test method (10) 1 [ ] Pump 2 [X] Bailer: AIR
Pumping rate (11-14): 10 GPM
Duration of pumping (15-16 Hours, 17-18 Mins): 1 Hours

Static level (19-21)	Water level end of pumping (22-24)	Water levels during (25) 1 [X] Pumping 2 [ ] Recovery: 15 minutes (26-28)	30 minutes (29-31)	45 minutes (32-34)	60 minutes (35-37)
75 feet	226 feet	feet	feet	feet	226 feet

If flowing give rate (38-41)	Pump intake set at	Water at end of test (42)
GPM	220 feet	[X] Clear [ ] Cloudy

Recommended pump type	Recommended pump setting (43-45)	Recommended pump rate (46-49)
[ ] Shallow [X] Deep	220 feet	10 GPM

(50-53)

FINAL STATUS OF WELL (54)

1 [X] Water supply 2 [ ] Observation well 3 [ ] Test hole 4 [ ] Recharge well 5 [ ] Abandoned, insufficient supply 6 [ ] Abandoned, poor quality 7 [ ] Abandoned (Other) 8 [ ] Dewatering 9 [ ] Unfinished 10 [ ] Replacement well

WATER USE (55-56)

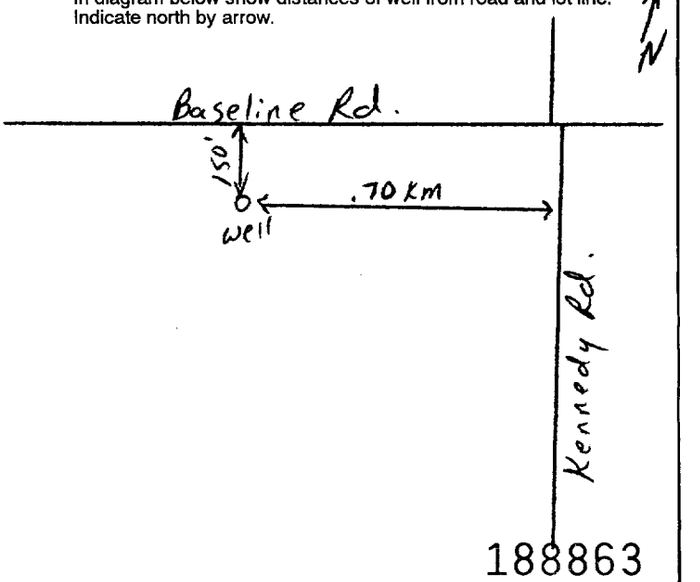
1 [ ] Domestic 2 [ ] Stock 3 [ ] Irrigation 4 [ ] Industrial 5 [X] Commercial 6 [ ] Municipal 7 [ ] Public supply 8 [ ] Cooling & air conditioning 9 [ ] Not used 10 [X] Other: Police Station

METHOD OF CONSTRUCTION (57)

1 [ ] Cable tool 2 [X] Rotary (conventional) 3 [ ] Rotary (reverse) 4 [ ] Rotary (air) 5 [ ] Air percussion 6 [ ] Boring 7 [ ] Diamond 8 [ ] Jetting 9 [ ] Driving 10 [ ] Digging 11 [ ] Other

LOCATION OF WELL

In diagram below show distances of well from road and lot line. Indicate north by arrow.



188863

Name of Well Contractor	Well Contractor's Licence No.
Roger Boadway Ent., Ltd.	1413

Address: Box 397 Sutton West, ON L0E 1R0

Name of Well Technician	Well Technician's Licence No.
Phil Brown	T0035

Signature of Technician/Contractor: Roger Boadway
Submission date: 24 09 98

2 - MINISTER OF ENVIRONMENT & ENERGY COPY

MINISTRY USE ONLY

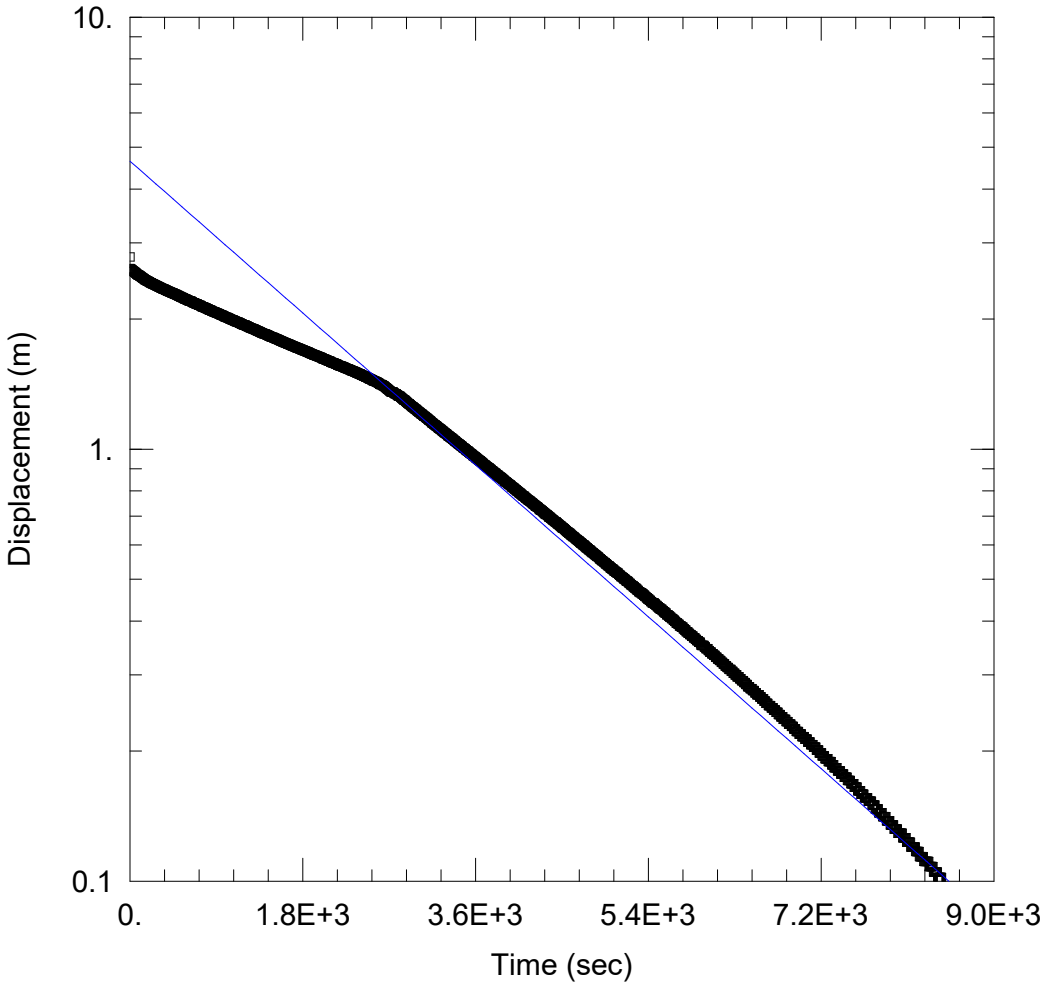
Data source (58)	Contractor (59-62)	Date received (63-68) (80)
	1413	OCT 26 1998

Date of inspection | Inspector

Remarks: CSS. ES9

0506 (07/94) Front Form 9

Appendix B Hydraulic Testing Graphs



NORTH PATROL YARD

Data Set: C:\Harden 2\Slug Test Results\northpatrolyard_BH1.aqt
Date: 07/27/22 Time: 12:47:50

PROJECT INFORMATION

Company: Harden Environmental
Client: York Region
Project: 2220
Location: 3525 Baseline Road
Test Well: BH1
Test Date: 07/19/22

AQUIFER DATA

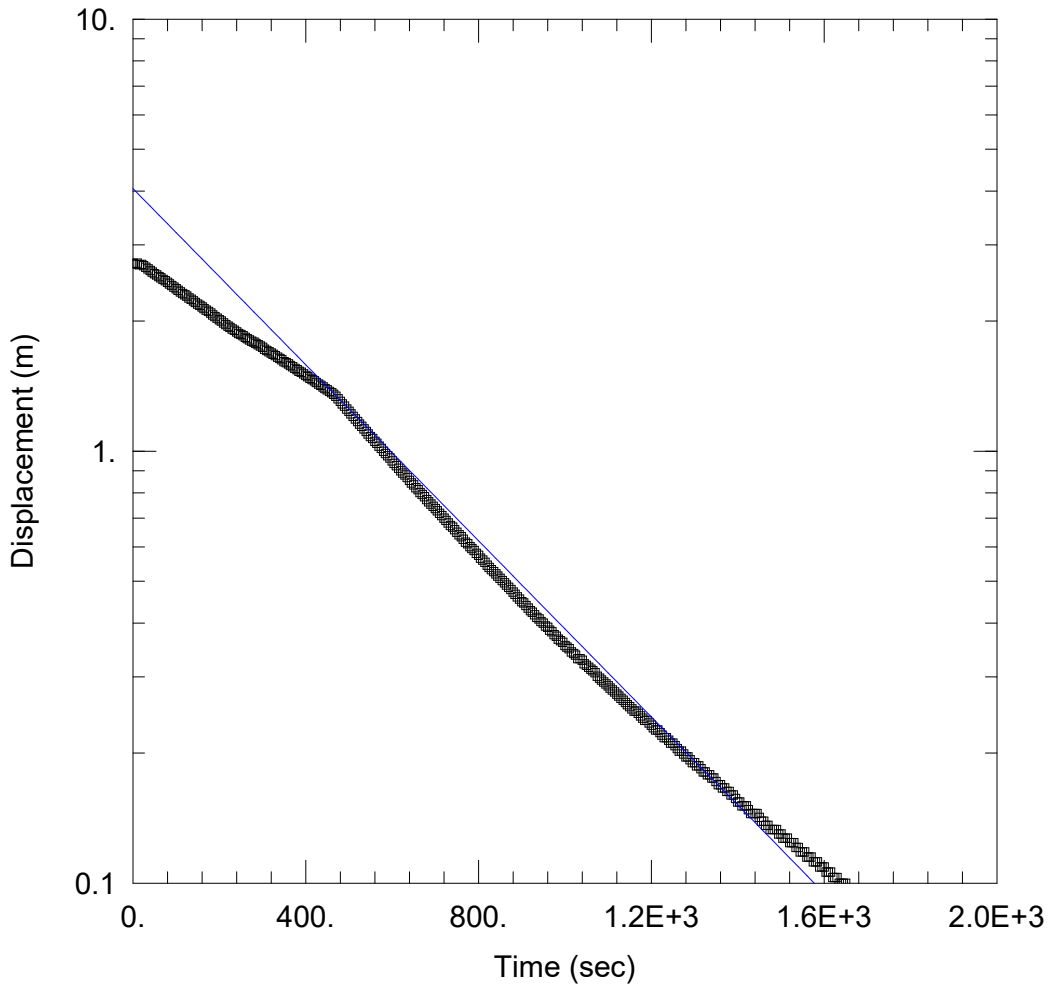
Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH1)

Initial Displacement: 2.787 m
Total Well Penetration Depth: 4.3 m
Casing Radius: 0.0254 m
Static Water Column Height: 3.24 m
Screen Length: 1.52 m
Well Radius: 0.0635 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.131E-7 m/sec
y0 = 4.642 m



NORTH PATROL YARD

Data Set: C:\Harden 2\Slug Test Results\northpatrolyard_BH3.aqt
Date: 07/27/22 Time: 12:48:46

PROJECT INFORMATION

Company: Harden Environmental
Client: York Region
Project: 2220
Location: 3525 Baselline Road
Test Well: BH3
Test Date: 07/19/22

AQUIFER DATA

Saturated Thickness: 10. m Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (BH3)

Initial Displacement: 2.719 m Static Water Column Height: 3.375 m
Total Well Penetration Depth: 4.3 m Screen Length: 1.52 m
Casing Radius: 0.0254 m Well Radius: 0.0635 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 2.155E-6 m/sec y0 = 4.051 m

Appendix C Water Quality

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
4622 NASSAGAWEYA PUSLINCH TOWNLINE
MOFFAT, ON L0P 1J0
519-826-0099

ATTENTION TO: Allan Rodie

PROJECT: 2220-North Patrol Yard

AGAT WORK ORDER: 22T922462

TRACE ORGANICS REVIEWED BY: Neli Popnikolova, Senior Chemist

WATER ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician

DATE REPORTED: Jul 28, 2022

PAGES (INCLUDING COVER): 11

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
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- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

York Region Sanitary - Organics

DATE RECEIVED: 2022-07-19

DATE REPORTED: 2022-07-28

		SAMPLE DESCRIPTION:		POND		BH1
		SAMPLE TYPE:		Water		Water
		DATE SAMPLED:		2022-07-19		2022-07-19 14:40
Parameter	Unit	G / S	RDL	4110316	RDL	4110317
Oil and Grease (animal/vegetable) in water	mg/L		0.5	0.90	0.5	<0.5
Oil and Grease (mineral) in water	mg/L		0.5	<0.5	0.5	<0.5
Methylene Chloride	µg/L	5.2	0.6	<0.6	0.3	<0.3
trans-1,3-Dichloropropene	µg/L	5.6	0.60	<0.60	0.30	<0.30
Methyl Ethyl Ketone	µg/L		1.8	<1.8	0.9	<0.9
cis- 1,2-Dichloroethylene	µg/L	5.6	0.4	<0.4	0.2	<0.2
Chloroform	µg/L	2.0	0.4	<0.4	0.2	<0.2
Benzene	µg/L	2.0	0.4	<0.4	0.2	<0.2
Trichloroethylene	µg/L	8.0	0.4	<0.4	0.2	<0.2
Toluene	µg/L	2.0	0.4	<0.4	0.2	<0.2
Tetrachloroethene	µg/L	4.4	0.2	<0.2	0.1	<0.1
Ethylbenzene	µg/L	2.0	0.2	<0.2	0.1	<0.1
1,1,2,2-Tetrachloroethane	µg/L	17.0	0.2	<0.2	0.1	<0.1
Styrene	µg/L		0.2	<0.2	0.1	<0.1
1,2-Dichlorobenzene	µg/L	5.6	0.2	<0.2	0.1	<0.1
1,4-Dichlorobenzene	µg/L	6.8	0.2	<0.2	0.1	<0.1
m & p-Xylene	µg/L		0.4	<0.4	0.2	<0.2
o-Xylene	µg/L		0.2	<0.2	0.1	<0.1
Xylenes (Total)	µg/L	4.4	0.2	<0.2	0.2	<0.2
PCBs	µg/L	0.4	0.2	<0.2	0.2	<0.2
Di-n-butyl phthalate	µg/L	15.0	0.5	<0.5	0.5	<0.5
Bis(2-Ethylhexyl)phthalate	µg/L	8.8	0.5	<0.5	0.5	<0.5

Certified By: N Popnikolof

AGAT Laboratories

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FAX (905)712-5122
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Certificate of Analysis

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

York Region Sanitary - Organics

DATE RECEIVED: 2022-07-19

DATE REPORTED: 2022-07-28

			SAMPLE DESCRIPTION:	POND	BH1
			SAMPLE TYPE:	Water	Water
			DATE SAMPLED:	2022-07-19	2022-07-19 14:40
Surrogate	Unit	Acceptable Limits		4110316	4110317
Toluene-d8	% Recovery	50-140		106 1	102
4-Bromofluorobenzene	% Recovery	50-140		102 1	100
Decachlorobiphenyl	%	50-140		107 1	90
2,4,6-Tribromophenol	%	50-140		97 1	96
2-Fluorophenol	%	50-140		77 1	88
Chrysene-d12	%	50-140		87 1	90
phenol-d6 surrogate	%	50-140		62 1	88

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to The Regional Municipality of York - Limits for Storm Sewer Discharge [BY-LAW NO.2011-56]
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

4110316 Dilution factor=2
The sample was diluted because it was foamy. The reporting detection limit has been corrected for the dilution factor used.
Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G.

4110317 Oil and Grease animal/vegetable is a calculated parameter. The calculated value is the difference between Total O&G and Mineral O&G.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By: N Popnikolof

AGAT Laboratories

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CANADA L4Z 1Y2
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FAX (905)712-5122
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Certificate of Analysis

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

CBOD5

DATE RECEIVED: 2022-07-19

DATE REPORTED: 2022-07-28

				SAMPLE DESCRIPTION:		POND
				SAMPLE TYPE:		Water
				DATE SAMPLED:		2022-07-19
Parameter	Unit	G / S	RDL	4110316	RDL	4110317
Biochemical Oxygen Demand, Carbonaceous	mg/L	15	2	6	6	<6

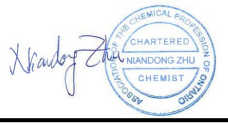
		BH1
		Water
		2022-07-19 14:40
		4110317

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to The Regional Municipality of York - Limits for Storm Sewer Discharge [BY-LAW NO.2011-56]
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

4110317 RDL for BOD is raised due to insufficient DO depletion at selected dilution levels.

Analysis performed at AGAT Halifax (unless marked by *)

Certified By:



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Certificate of Analysis

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

York Region Storm Sewer Use By-Law - Inorganics

DATE RECEIVED: 2022-07-19

DATE REPORTED: 2022-07-28

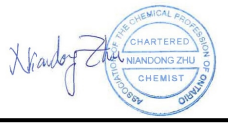
				SAMPLE DESCRIPTION:	POND	BH1
				SAMPLE TYPE:	Water	Water
				DATE SAMPLED:	2022-07-19	2022-07-19 14:40
Parameter	Unit	G / S	RDL		4110316	4110317
pH	pH Units	6.0-9.0	NA		7.64	7.43
Total Suspended Solids	mg/L	15	10		13	354
Total Kjeldahl Nitrogen	mg/L	1	0.10		0.75	0.26
Phenols	mg/L	0.008	0.004		0.008	0.009
Cyanide, SAD	mg/L	0.02	0.002		<0.002	0.003
Total Arsenic	mg/L	0.020	0.015		<0.015	<0.015
Total Cadmium	mg/L	0.008	0.005		<0.005	<0.005
Total Chromium	mg/L	0.080	0.020		<0.020	<0.020
Total Copper	mg/L	0.050	0.015		<0.015	<0.015
Total Lead	mg/L	0.120	0.020		<0.020	<0.020
Total Manganese	mg/L	0.150	0.020		0.064	0.188
Total Mercury	mg/L	0.0004	0.0002		<0.0002	<0.0002
Total Nickel	mg/L	0.080	0.015		<0.015	<0.015
Total Phosphorus	mg/L	0.400	0.02		0.07	0.13
Total Selenium	mg/L	0.020	0.002		<0.002	<0.002
Total Silver	mg/L	0.120	0.020		<0.020	<0.020
Total Zinc	mg/L	0.040	0.020		<0.020	<0.020

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to The Regional Municipality of York - Limits for Storm Sewer Discharge [BY-LAW NO.2011-56]
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

4110316-4110317 Dilution required, RDL has been increased accordingly.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:



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Exceedance Summary

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

ATTENTION TO: Allan Rodie

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
4110317	BH1	ON York SM	York Region Storm Sewer Use By-Law - Inorganics	Phenols	mg/L	0.008	0.009
4110317	BH1	ON York SM	York Region Storm Sewer Use By-Law - Inorganics	Total Manganese	mg/L	0.150	0.188
4110317	BH1	ON York SM	York Region Storm Sewer Use By-Law - Inorganics	Total Suspended Solids	mg/L	15	354

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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard
ATTENTION TO: Allan Rodie

SAMPLING SITE:
SAMPLED BY:AR

Trace Organics Analysis

RPT Date: Jul 28, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
York Region Sanitary - Organics															
Oil and Grease (animal/vegetable) in water	4111931		< 0.5	< 0.5	NA	< 0.5	101%	70%	130%	108%	70%	130%	107%	70%	130%
Oil and Grease (mineral) in water	4111931		< 0.5	< 0.5	NA	< 0.5	81%	70%	130%	81%	70%	130%	83%	70%	130%
Methylene Chloride	4110588		<0.3	<0.3	NA	< 0.3	71%	50%	140%	88%	60%	130%	115%	50%	140%
trans-1,3-Dichloropropene	4110588		<0.30	<0.30	NA	< 0.30	79%	50%	140%	119%	60%	130%	92%	50%	140%
Methyl Ethyl Ketone	4110588		<0.9	<0.9	NA	< 0.9	97%	50%	140%	111%	50%	140%	99%	50%	140%
cis- 1,2-Dichloroethylene	4110588		<0.2	<0.2	NA	< 0.2	72%	50%	140%	93%	60%	130%	92%	50%	140%
Chloroform	4110588		<0.2	<0.2	NA	< 0.2	78%	50%	140%	92%	60%	130%	104%	50%	140%
Benzene	4110588		<0.2	<0.2	NA	< 0.2	101%	50%	140%	85%	60%	130%	94%	50%	140%
Trichloroethylene	4110588		<0.2	<0.2	NA	< 0.2	80%	50%	140%	100%	60%	130%	98%	50%	140%
Toluene	4110588		<0.2	<0.2	NA	< 0.2	85%	50%	140%	111%	60%	130%	99%	50%	140%
Tetrachloroethene	4110588		<0.1	<0.1	NA	< 0.1	85%	50%	140%	113%	60%	130%	98%	50%	140%
Ethylbenzene	4110588		<0.1	<0.1	NA	< 0.1	87%	50%	140%	116%	60%	130%	103%	50%	140%
1,1,2,2-Tetrachloroethane	4110588		<0.1	<0.1	NA	< 0.1	118%	50%	140%	118%	60%	130%	101%	50%	140%
Styrene	4110588		<0.1	<0.1	NA	< 0.1	89%	50%	140%	115%	60%	130%	104%	50%	140%
1,2-Dichlorobenzene	4110588		<0.1	<0.1	NA	< 0.1	99%	50%	140%	99%	60%	130%	115%	50%	140%
1,4-Dichlorobenzene	4110588		<0.1	<0.1	NA	< 0.1	95%	50%	140%	92%	60%	130%	113%	50%	140%
m & p-Xylene	4110588		<0.2	<0.2	NA	< 0.2	84%	50%	140%	111%	60%	130%	100%	50%	140%
o-Xylene	4110588		<0.1	<0.1	NA	< 0.1	87%	50%	140%	113%	60%	130%	102%	50%	140%
PCBs	4110275		< 0.1	< 0.1	NA	< 0.2	101%	50%	140%	100%	50%	140%	82%	50%	140%
Di-n-butyl phthalate	4113885		<0.5	<0.5	NA	< 0.5	94%	50%	140%	101%	50%	140%	76%	50%	140%
Bis(2-Ethylhexyl)phthalate	4113885		<0.5	<0.5	NA	< 0.5	114%	50%	140%	100%	50%	140%	106%	50%	140%

Comments: When the average of the sample and duplicate results is less than 5x the RDL, the Relative Percent Difference (RPD) will be indicated as Not Applicable (NA).

Certified By: N Popnikolof

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.
AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard
ATTENTION TO: Allan Rodie

SAMPLING SITE:
SAMPLED BY:AR

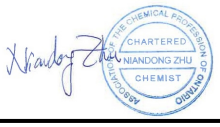
Water Analysis

RPT Date: Jul 28, 2022

PARAMETER	Batch	Sample Id	DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
			Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
York Region Storm Sewer Use By-Law - Inorganics															
pH	4110250		7.30	7.52	3.0%	NA	102%	90%	110%						
Total Suspended Solids	4109212		37	37	NA	< 10	96%	80%	120%						
Total Kjeldahl Nitrogen	4100106		0.40	0.41	NA	< 0.10	100%	70%	130%	100%	80%	120%	99%	70%	130%
Phenols	4102637		<0.001	<0.001	NA	< 0.001	106%	90%	110%	103%	90%	110%	91%	80%	120%
Cyanide, SAD	4082679		<0.002	<0.002	NA	< 0.002	96%	70%	130%	86%	80%	120%	101%	70%	130%
Total Arsenic	4110321		<0.015	<0.015	NA	< 0.015	95%	70%	130%	91%	80%	120%	90%	70%	130%
Total Cadmium	4110321		<0.005	<0.005	NA	< 0.005	99%	70%	130%	103%	80%	120%	92%	70%	130%
Total Chromium	4110321		<0.020	<0.020	NA	< 0.020	100%	70%	130%	97%	80%	120%	93%	70%	130%
Total Copper	4110321		<0.015	<0.015	NA	< 0.015	101%	70%	130%	104%	80%	120%	90%	70%	130%
Total Lead	4110321		<0.020	<0.020	NA	< 0.020	99%	70%	130%	92%	80%	120%	89%	70%	130%
Total Manganese	4110321		0.138	0.133	3.7%	< 0.020	104%	70%	130%	100%	80%	120%	97%	70%	130%
Total Mercury	4110316	4110316	<0.0002	<0.0002	NA	< 0.0002	102%	70%	130%	104%	80%	120%	100%	70%	130%
Total Nickel	4110321		<0.015	<0.015	NA	< 0.015	102%	70%	130%	95%	80%	120%	91%	70%	130%
Total Phosphorus	4119536		0.20	0.21	4.9%	< 0.02	99%	70%	130%	98%	80%	120%	NA	70%	130%
Total Selenium	4110321		<0.002	<0.002	NA	< 0.002	107%	70%	130%	93%	80%	120%	92%	70%	130%
Total Silver	4110321		<0.020	<0.020	NA	< 0.020	100%	70%	130%	93%	80%	120%	91%	70%	130%
Total Zinc	4110321		<0.020	<0.020	NA	< 0.020	99%	70%	130%	105%	80%	120%	93%	70%	130%
CBOD5															
Biochemical Oxygen Demand, Carbonaceous	4111032		203	198	2.5%	< 2	94%	70%	130%						

Comments: NA Signifies Not Applicable.
Duplicate NA: results are less than 5X the RDL and RPD will not be calculated.
Matrix spike: Spike level < native concentration. Matrix spike acceptance limits do not apply.

Certified By:



AGAT Laboratories

5835 COOPERS AVENUE
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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Oil and Grease (animal/vegetable) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	GRAVIMETRIC
Oil and Grease (mineral) in water	VOL-91-5011	EPA SW-846 3510C & SM 5520	GRAVIMETRIC
Methylene Chloride	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
trans-1,3-Dichloropropene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Methyl Ethyl Ketone	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
cis- 1,2-Dichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Chloroform	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Benzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Trichloroethylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Toluene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Tetrachloroethene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Ethylbenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
1,1,2,2-Tetrachloroethane	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
Styrene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
1,2-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
1,4-Dichlorobenzene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P & T) GC/MS
m & p-Xylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
o-Xylene	VOL-91-5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
Xylenes (Total)	VOL-91-5001	EPA SW-846 5230B & 8260	CALCULATION
Toluene-d8	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
4-Bromofluorobenzene	VOL-91- 5001	modified from EPA 5030B & EPA 8260D	(P&T)GC/MS
PCBs	ORG-91-5112	modified from EPA SW-846 3510 & 8082A	GC/ECD
Decachlorobiphenyl	ORG-91-5112	modified from EPA SW846 3510C & 8082A	GC/ECD
Di-n-butyl phthalate	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS
Bis(2-Ethylhexyl)phthalate	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS
2,4,6-Tribromophenol	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS
2-Fluorophenol	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS
Chrysene-d12	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS
phenol-d6 surrogate	ORG-91-5114	modified from EPA 3510C and EPA 8270E	GC/MS

AGAT Laboratories

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FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: HARDEN ENVIRONMENTAL SERVICES LTD.

AGAT WORK ORDER: 22T922462

PROJECT: 2220-North Patrol Yard

ATTENTION TO: Allan Rodie

SAMPLING SITE:

SAMPLED BY:AR

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Water Analysis			
Biochemical Oxygen Demand, Carbonaceous	INOR-121-6023	SM 5210 B	INCUBATOR
pH	INOR-93-6000	modified from SM 4500-H+ B	PC TITRATE
Total Suspended Solids	INOR-93-6028	modified from EPA 1684,ON MOECC E3139,SM 2540C,D	BALANCE
Total Kjeldahl Nitrogen	INOR-93-6048	modified from EPA 351.2 and SM 4500-NORG D	LACHAT FIA
Phenols	INOR-93-6072	modified from SM 5530 D	LACHAT FIA
Cyanide, SAD	INOR-93-6051	modified from MOECC E3015; SM 4500-CN- A, B, & C	TECHNICON AUTO ANALYZER
Total Arsenic	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Cadmium	MET -93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Chromium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Copper	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Lead	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Manganese	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Mercury	MET-93-6100	modified from EPA 245.2 and SM 3112 B	CVAAS
Total Nickel	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Phosphorus	INOR-93-6022	modified from SM 4500-P B and SM 4500-P E	SPECTROPHOTOMETER
Total Selenium	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Silver	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS
Total Zinc	MET-93-6103	modified from EPA 200.8, 3005A, 3010A & 6020B	ICP-MS

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only
Work Order #: 22T922462
Cooler Quantity: 1 blue large
Arrival Temperatures: 5.9 | 6.2 | 6.8
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: bagged ice

Report Information:
Company: HARDEN ENVIRONMENTAL SERVICES LTD.
Contact: Allan Rodie 519-400-7113
Address:
Phone: 519-826-0099 Fax:
Reports to be sent to:
1. Email: arodie@hardenv.com
2. Email: sdenhoed@hardenv.com

Regulatory Requirements:
(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Excess Soils R406
Table (Indicate One)

☐ Regulation 558

☐ CCME

☑ Sewer Use ☐ Sanitary ☑ Storm
YORK (Region)

☐ Prov. Water Quality Objectives (PWQO)

☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition**? ☐ Yes ☑ No

Report Guideline on *Certificate of Analysis* ☑ Yes ☐ No

Turnaround Time (TAT) Required:
Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
*TAT is exclusive of weekends and statutory holidays
For 'Same Day' analysis, please contact your AGAT CPM

Project Information:
Project: 2220 - NORTH PATROL YARD
Site Location:
Sampled By: AR
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:
Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend
B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	PAHs	PCBs	VOC	Aroclors	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	O. Reg 406: Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	O. Reg 406: Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Corrosivity: Include Moisture ☐ Sulphide ☐	YORK REGION - STORM	Potentially Hazardous or High Concentration (Y/N)
POND	7/19/22	1230 AM PM		SW		NO												✓	
BH1	7/19/22	240 AM PM		GW		NO												✓	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	
		AM PM																	

Samples Relinquished By (Print Name and Sign): Allan Rodie	Date: 7/19/22	Time: 4:18pm	Samples Received By (Print Name and Sign): Amber D.	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:

'22 JUL 19 4:22

Page 1 of 1

Nº: T - 134394

Appendix D Dewatering Calculations

Project: North Maintenance Yard York Region
Location: **3525 Baseline Road**
Date: 29-Jul-22
Project #: 2220

ESTIMATE OF DEWATERING July 2022 water levels

PARAMETERS		**Units**
Ground Surface Elevation	253	m AMSL
Initial Water Level	252.6	m AMSL
Lowest Water Level during Dewatering	249.4	m AMSL
Aquifer Bottom Elevation	237.6	m AMSL
Initial Head above datum (H)	15	metres
Dewatering head above datum (h)	11.8	metres
Hydraulic Conductivity (k)	2.20E-06	m/s
	0.19008000	m/day
Length of Site (L)	30	metres
Width of Site (W)	18	metres
Equivelent Radius r_e (Equation 1)	13	metres
Estimated Radius of Influence from Excavation (Rx) (Equation 2)	14	metres
Radius of Influence (R)	27	metres
Safety Factor	3	
Estimated Rate of Discharge (Equation 3)	209	m^3/day
	145.1	L/min
	2.42	L/sec
	31.96	Imp. Gall/min

Equation 1 $Re = \sqrt{L \times W / \pi}$

Equation 2 $R_x = 3000\ h \sqrt{k}$

Equation 3 $$Q = \frac{k(H^2 - h^2)}{.733 \log (R/r_e)}$$

HARDEN

Appendix E: Sample Notification Letter

HARDEN

4622 Nassagaweya-Puslinch Townline Moffat Ontario Canada L0P 1J0
Phone: 519.826.0099 fax: 519.826.9099 www.hardenv.com

Groundwater Studies

Geochemistry

Phase I / II

Regional Flow Studies

Contaminant Investigations

OMB Hearings

Water Quality Sampling

Monitoring

Groundwater Protection Studies

Groundwater Modelling

Groundwater Mapping

File: 2220

xxxxxxxxx

To Whom it May Concern:

Re: Commencement of Water Taking -3525 Baseline Road, Sutton

You are hereby notified that water taking has been approved for construction services at 3525 Baseline Road in Sutton. The owners have been issued an Environmental Activity Sector Registry for water taking; registration number xxxxxxxx.

Water taking under this EASR is approved from xxxxxx, 2022 to xxxxxx, 2022. Water taking will occur as needed.

Sincerely,

Harden Environmental Services Ltd.

Stan Denhoed, M.Sc., P.Eng.
Senior Hydrogeologist

Appendix F: Sample Discharge Plan

HARDEN ENVIRONMENTAL SERVICES LIMITED

WATER TAKING PLAN AND DISCHARGE PLAN

EASR Registration Number: xxxxxxxx

PREPARED FOR:

York Region

July 2022

REF. No. 2220

Table of Contents

Important Phone Numbers:

Ministry of the Environment Conservation and Parks Barrie District Office 1 800-890-8511

Ministry of the Environment Conservation and Parks 24 Hour Telephone Line

- Telephone: 416-325-3000
- Toll-free: 1-800-268-6060

York Region

Figures

Appendices

Preamble

York Region has been issued an Environmental Activity Sector Registry for the taking of up to 400,000 liters per day commencing xxxxx for a period of xxx days. The EASR Registration Number is xxxxxxx. The purpose of the dewatering is to retrofit a storm water pond.

The following water taking plan and discharge plan are requirements of the water taking.

1.0 Water taking plan

Please refer to Figure 1 for the Dewatering Plan.

1.1 Identification of the expected area of influence

Excavations in the shallow silty clay deposit will require dewatering surface water and/or groundwater during the pond retrofit. The maximum depth of excavation is estimated to be three metres below the water table. The high-water table is estimated, in the worst case, to be at an elevation of 252.6 m AMSL and the dewatering will lower the water table to 249.4 m AMSL. The estimated area of influence is approximately 15 metres.

1.2 Potential impact of the soil settlement

The water taking will be very temporary in nature and the soils are of a silty clay texture and not prone to consolidation upon dewatering for relatively short periods of time. No settlement of on-site or off-site buildings is anticipated.

1.3 Identification of measures to address the potential impact of the soil settlement

No measures are required.

1.4 Potential impact of water taking on other water users in the area of influence

There are no other users in the predicted area of influence of the temporary dewatering at the site. The nearest private residence is 220 m from the proposed area to be dewatered.

1.5 Mitigation Measures

There are no other users in the predicted area of influence of the temporary dewatering at the site. No mitigation measures are necessary.

1.6 Water Monitoring Program

Groundwater monitoring well BH3 will be installed on-site in the location shown on Figure 1. A data logger will be installed and maintained on-site for the duration of the dewatering.

1.7 Summary of Qualifications

The qualifications of Stan Denhoed, P.Eng, M.Sc. is included in Appendix B.

1.8 Date of Plan Preparation

This plan was prepared on xxxxx, 2022.

2.0 Discharge plan:

2.1 Discharge Locations

There is one discharge location that will be used. Discharge 1 is located on the west side of the entrance to the Patrol Yard at Baseline Road. The discharge location is a stormwater open ditch. The location is found on Figure 1.

The discharge location is not located within an area that is part of a wellhead protection area and that is identified as "WHPA-A" in a source protection plan approved by the Minister under the *Clean Water Act, 2006*

Location	Northing (UTM)	Easting(UTM)
Discharge 1	4905389	626099

2.2 Method of Water Transfer

The proposed transfer method is by mechanical pumping from McMInnows Pond to Baseline Pond and gravity from Baseline Pond to the roadside ditch. In the event of a one-hundred-year storm, groundwater and surface water will be discharged to the same locations at a rate not exceeding 400,000 liters per day.

2.3 Erosion and Sedimentation Measures

At Discharge 1, the discharge water will be pumped directly 3.5 x 5 m geotextile filter bag. The filter bag and discharge location will be inspected daily.

2.4 Water Quality and Turbidity Issues

There are no surface water bodies within 30 metres of discharge locations. Discharge occurs into a grass lined ditch. Nonetheless, should this occur, total suspended solid sampling is being conducted weekly.

The discharge water will inspected to not have a visible petroleum hydrocarbon sheen.

2.5 Impact to the Natural Environment

It is our opinion that there will be no negative impact on the natural environment from either a water quality impact or water quantity impact.

2.6 Water Temperature

Harden Environmental considered the temperature of the discharge water into location Discharge 1. The ditch is seasonally dry and does not contain any aquatic species sensitive to water temperature.

2.7 Summary of Qualifications

The qualifications of Stan Denhoed, P.Eng, M.Sc. are included in Appendix B.

2.8 Date of Plan Preparation

This plan was prepared on xxxxx, 2022.

3.0 Notification:

Written notice about the taking(s) has been given to the Town of Georgina, and the Lake Simcoe Region Conservation Authority This notification included the following information;

Person proposing to take and discharge the water	York Region
Dates on which the water will be taken	xxxx 2022 to xxxx 2022
Location of the discharge	See attached map

Specifically, the notification was provided to the following persons:

xxxxxxx

xxxxxx

4.0 Reporting

The volume of water taken daily will be reported to the Ministry on or before March 31 in each year, for each location from which water was taken in the previous calendar year. If no water is taken, then a “no taking” report will be entered.

The water takings will be reported online through the Regulatory Self-Reporting System (RSRS) which is accessed through the online account.

5.0 Complaints

If a complaint is received with respect to the taking of water and the complaint relates to the natural environment, the ministry shall be notified of the complaint immediately after the complaint is received.

Notification shall be to the Barrie District Office (800) 890-8511 of the ministry during normal business hours and after hours to the ministry’s Spills Action Centre by calling:

- Telephone: 416-325-3000
- Toll-free: 1-800-268-6060

A record of the complaint will be made and have the following minimal information:

- the date and time the complaint was received
- a copy of the complaint, if it is a written complaint
- a summary of the complaint, if it is not a written complaint
- a summary of measures taken, if any, to address the complaint

Sincerely,
Harden Environmental Services Ltd.

Harden Environmental Services Ltd.	**Project No:** 2220 **Date:** July 2022 **Drawn By:** AR	Hydrogeological Assessment 3525 Baseline Road Town of Georgina, Regional Municipality of York NORTH GWILLIMBURY CON 5 LOT 23	**Figure 8: Discharge Plan and Location**

Appendix A – Dewatering Calculations

Project: North Maintenance Yard York Region
Location: **3525 Baseline Road**
Date: 29-Jul-22
Project #: 2220

ESTIMATE OF DEWATERING July 2022 water levels

PARAMETERS		**Units**
Ground Surface Elevation	253	m AMSL
Initial Water Level	252.7	m AMSL
Lowest Water Level during Dewatering	248.9	m AMSL
Aquifer Bottom Elevation	233.9	m AMSL
Initial Head above datum (H)	18.8	metres
Dewatering head above datum (h)	15	metres
Hydraulic Conductivity (k)	2.20E-06	m/s
	0.19008000	m/day
Length of Site (L)	30	metres
Width of Site (W)	18	metres
Equivelent Radius r_e (Equation 1)	13	metres
Estimated Radius of Influence from Excavation (Rx) (Equation 2)	17	metres
Radius of Influence (R)	30	metres
Safety Factor	3	
Estimated Rate of Discharge (Equation 3)	278	m^3/day
	192.9	L/min
	3.21	L/sec
	42.49	Imp. Gall/min

Equation 1 $Re = \sqrt{L \times W / \pi}$

Equation 2 $R_x = 3000\ h \sqrt{k}$

Equation 3 $$Q = \frac{k(H^2 - h^2)}{.733 \log (R/r_e)}$$

HARDEN

Appendix B – Qualifications

Stan Denhoed, P.Eng., M.Sc.
Senior Hydrogeologist

Education:

Institute for Hydraulic Engineering, Delft, The Netherlands, 1994
Master of Science in Hydrological Engineering Degree

University of Waterloo, Waterloo, Ontario, 1986
Bachelor of Applied Science Degree, Geological Engineering

Professional Experience

Aggregate Licensing, Letters of Opinion and Level I/II Hydrogeological Reports

Environmental investigations to ascertain potential impacts from dewatering or extractive activities in bedrock and sand and gravel. Compliance monitoring of active quarries and pits. Development of detailed water balances for extractive operation. Groundwater flow studies related to extraction and dewatering. I have worked in the following geological environments in regards to pits and quarries; Aberfoyle Outwash Deposit, Paris Moraine, Galt Moraine, Oro Hills, Caledon Outwash, Amabel Formation, Guelph Formation, Eramosa Formation, Gull River Formation, Bobcaygeon Formation, Verulum Formation, Oak Ridges Moraine, Precambrian Shield, Bois Blanc Formation, Simcoe Uplands.

Surface Water / Groundwater Interactions
Evaluation of changing groundwater levels on wetlands and fisheries. Working with both the Ministry of Natural Resources and the Federal Department of Fisheries and Oceans on projects related to man-induced groundwater level changes and their real and potential impacts on cold water fisheries. Investigation of groundwater inflow component to wetlands to evaluate potential impacts of urbanization in recharge areas.

Ontario Municipal Board Experience

Representation of clients' interest at six OMB/LPAT hearings (Oro Hills, Penetanguishene, Sturgeon Falls, Uxbridge, Aikensville, Hidden Quarry, Erin Pit) related to gravel pit and quarry applications. Three OMB mediated hearings in relation to septic system impacts (Goderich), quarry application (Owen Sound) and large water taking application (Artemesia).

Source Water Protection/Groundwater Management Studies

Senior hydrogeologist for five-Township groundwater protection study (Artemesia, Melancthon, Osprey, Euphrasia and Town of Blue Mountains) including preparation of recharge/discharge maps, aquifer susceptibility maps, groundwater flow maps and geological maps. Senior hydrogeologist/Project Manager for groundwater management studies for Marathon, Blind River, Burk's Falls, St. Joseph's Island and Gogama (2002-2005). GUDI Study for Val Rita Harty (2018).

Peer reviewer of Tier One and Tier Two Source Water Protection Studies for the Ausable-Bayfield Coalition and the Maitland Valley Conservation Area. Peer reviewer of the Vulnerability Assessment reports for the Trent Conservation Authority and Upper Thames Regional Conservation Authority.

Stan Denhoed, P.Eng., M.Sc.
Senior Hydrogeologist

Supervision of Well Drilling and Water Sampling

Supervision of aquifer testing for water supply and for cone of influence of pumping wells or dewatering systems. Supervision of drilling contractors for the installation of pumping wells. Extensive experience with the evaluation of groundwater movement through fractured rock and the analysis of pumping test data related to confined and unconfined aquifers. Extensive experience in the sampling of well water and evaluation of water quality results.

Document Review/Peer Review

Review of mining applications, subdivisions, golf courses and septic system impacts on behalf of the Township of Puslinch, Grand River Conservation Authority and the County of Wellington. Evaluation of applications to gauge compliance with Ministry of the Environment policies and environmental guidelines developed by the Township and the County. Peer reviewer for the 2002 GUDI studies for nineteen communities in Ontario.

Groundwater and Surface Water Contaminant Experience

2011 Phase II Environmental Site Assessment for former wrecking yard in Hamilton, Ontario. Test pit soil samples obtained and tested for inorganic and organic contamination. Estimates of contaminated soils were prepared.

2009 Hydrocarbon contamination of former Township works yard in Puslinch, Ontario. Excavations were made and samples were obtained to determine potential for soil and groundwater contamination.

Evaluation of water quality results from the Marathon Landfill and preparation of annual monitoring reports from 2008 to 2010.

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2007 Sampling of 120 private wells in Coleman Township investigating the presence of arsenic in drinking water. Results of sampling was compared to locations of mine tailings and historical mining activity.

Groundwater, surface water and soil sampling in and near Puslinch Lake as related to dredging operation.

Employment History

1993- Present	Harden Environmental Services Ltd., Moffat, Ontario *President/Senior Hydrogeologist*
1991- 1992	Keewatin-Aski Ltd., Concord, Ontario *Manager of Hydrogeological Projects*
1987- 1990	M.M. Dillon Ltd., Toronto, Ontario *Project Hydrogeologist*
1986- 1987	Environment Canada, Burlington, Ontario *Research Hydrogeologist*

Stan Denhoed, P.Eng., M.Sc.

Senior Hydrogeologist

Associations, Licenses and Committee Participation

Professional Engineers of Ontario

Licensed Water Well Contractor/Technician in the Province of Ontario

Publications

Denhoed, S.E., 1994, *The Role of Sorption in the Accumulation of Arsenic by Peat in the Western Netherlands*, M.Sc. Thesis, Institute for Hydraulic Engineering, Delft, The Netherlands

Denhoed, S.E., Kell, R. and G. Parker.,1990, *Predictive Monitoring of Groundwater Quality at a Municipal Landfill Site*, Proceedings of Canadian Society for Civil Engineers, Annual Conference, Hamilton, Ontario, May 1990

Priddel, M., Jackson, R.E., Novakowski, K.S. and Denhoed, S.E., 1986, *Migration and Fate of Aldicarb in the sandstone Aquifer of Prince Edward Island*, Groundwater in Canada, Special Issue.

Harman, J., McLellan, J. Rudolph, D., Heagle, D, Piller, C. and S. Denhoed, 2001, *A proposed Framework for Managing the Impacts of Agriculture on Groundwater: A Report Prepared For the Sierra/Alert Coalition for Submission in Part 2 of the Walkerton Inquiry*.

Denhoed, S., Warkentin, A., Sarvas, P., 2007, Project Unit 06-031, *Investigation into the Relationship between Groundwater Quality and Geology in Coleman Township, North Eastern Ontario*, Summary of Field Work and Other Activities, Ontario Geological Survey, Open File Report 6213, p26-1 to 26-10.

Presentations

Source Water Protection Conference: Cornwall, Ontario, 2006: *Surface Water / Groundwater Interactions: Mill Creek Experience*

Source Water Protection Committee: Trent Coalition, July 2009: *Groundwater Modelling*

Ontario Research Fund April 2011: Sustainable Bedrock Water Supplies for Ontario Communities: *Compromised Aquitards – Unwelcome Transport Pathways*

Ontario Sand, Stone and Gravel Association, 2014, Impacts of Below-Water-Table Extraction in Unconsolidated Materials

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Appendix G Qualifications

Stan Denhoed, P.Eng., M.Sc.
Senior Hydrogeologist

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