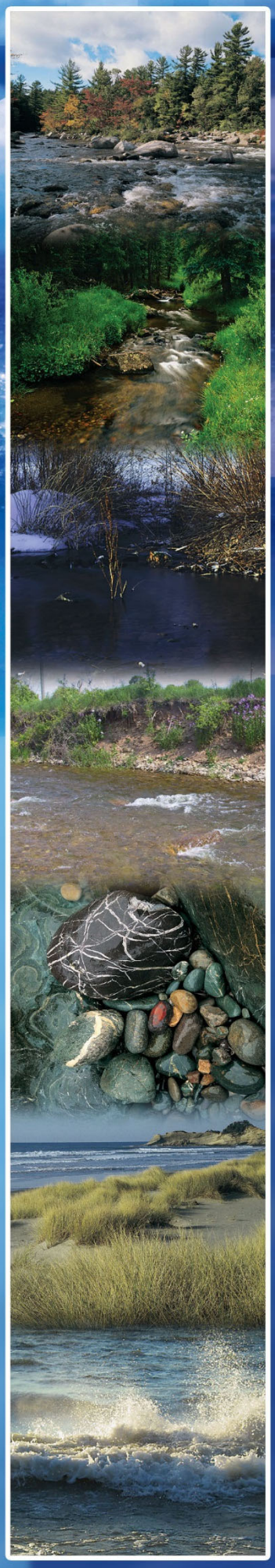


water's edge
ENVIRONMENTAL SOLUTIONS TEAM LTD.

Fifty Point Conservation Area

Stoney Creek, ON

Watercourse 11 Wetland Design and Modelling Report

Hamilton Conservation Authority

January 26, 2023

January 26, 2023
WE: 20036

Mr. Colin Oaks
Aquatic Ecologist
Hamilton Conservation Authority
838 Mineral Springs Rd.,
Ancaster, ON
L9G 4X1

Dear Mr. Oaks:

RE: Fifty Point Conservation Area, Stoney Creek, ON
Watercourse 11 Wetland Design and Modelling Report

1. INTRODUCTION

Water's Edge was authorized by the Hamilton Conservation Authority (HCA) to design the preferred alternative from the Class EA for Watercourse 11 (WC 11) within the Fifty Point Conservation Area. The watercourse has historically created flooding issues in its current alignment, and the Class EA that was completed in 2018 suggested that the watercourse be redirected into Fifty Point Pond and subsequently into Watercourse 12. In addition, as part of the realignment a wetland feature was to be incorporated into the Fifty Point Pond. Water's Edge has been engaged to complete the design of this channel realignment and wetland feature.

As noted, the Study Site is located in Fifty Point Conservation Area which is situated in Stoney Creek between the QEW and Lake Ontario (**Figure 1**). WC 11 travels from south to north across the QEW and along the access road within Fifty Point before discharging into Lake Ontario. WC 11 historically has flowed along the west side of Fifty Point Conservation Area while WC 12 flows roughly through the centre, along the east side of Fifty Point Pond. The length of the Study Reach for WC 11 is approximately 1.0 km.

Throughout the design phase Water's Edge has been in discussion with HCA staff regarding the overall design. Concepts of the channel realignment and wetland design were provided to HCA for comment and subsequent modifications were made. The final design package is presented and discussed in this report. In addition, the modelling of the redirected Watercourse 11 into Watercourse 12 is also presented.

Water's Edge completed topographic surveys and field investigations to inform the design of the watercourse and wetland. Geotechnical investigations were also carried out to determine the soil composition and chemical analysis of the soils.

2. EXISTING CONDITIONS

2.1 Geology and Physiography

Reviewing the site area's surficial materials is important to evaluate active channel processes. Stream channel form and sediment supply are controlled by the region's physiography and surficial geology. Watercourse 11 is located in the Iroquois Plain physiographic region and is a shale plane landform. The surficial geology of the Study Site is silty clay till that is derived from glaciolacustrine deposits or possibly shale. The borehole samples confirm the silty clay till that is present on site and notes that is stiff to very hard.

2.1 Channel and Site Conditions

The WC 11 channel through the upper reaches within Fifty Point are small roadside ditches that are vegetated with grasses and other herbaceous species. Through these reaches WC 11 runs on both sides of the access road until they eventually join through a road crossing culvert halfway through the site. It is at this culvert location where the proposed redirected channel will begin. WC 11 is an intermittent stream with flow typically occurring during storm events. Fish passage through these upper reaches of WC 11 is not a concern and not

incorporated into the design of the redirected channel, although fish habitat and passage are incorporated into the wetland design and trail crossing culvert. According to the EA the total drainage area for WC 11 is 15.27 ha while upstream of the proposed diversion is 10.59 ha.

Figure 1: Study Area Location

3. CHANNEL AND WETLAND DESIGN

3.1 Rationale

The existing WC 11 flow path has flooding issues in the residential area near Windermere Rd. and Shippee Ave. In order to mitigate this flooding a Class EA was completed that modelled and reviewed five alternatives. Out of these alternatives the preferred alternative of diverting the upper reaches of WC 11 into Fifty Pond and subsequently WC 12 was selected. As per the EA report this would result in a reduction of 67% of the total flow thereby significantly mitigating the flooding in the lower reaches. Hydraulic modelling to support the diversion of WC 11 into WC 12 is provided as part of this assessment.

In addition, it was suggested to incorporate a wetland adjacent to Fifty pond which would increase the ecological diversity within the pond. The existing pond was excavated as a borrow pit during the construction of the nearby highway and off ramps. The pond has been excavated into the native tills, which as per the boreholes completed at the site are stiff to hard silty clay till. The ecological diversity of the existing pond is very limited as vegetation is not able to establish on the steep side slopes of the old borrow pit. Adding a flat shallow area with habitat structures and native herbaceous and woody species will significantly increase the opportunities for aquatic dependent fauna to establish within the pond.

In addition, the area surrounding the proposed wetland and diversion channel is currently unmown grass with several trees lining it, particularly along the road. As part of the work this area will be regraded with berms added and revegetated with shrubs trees.

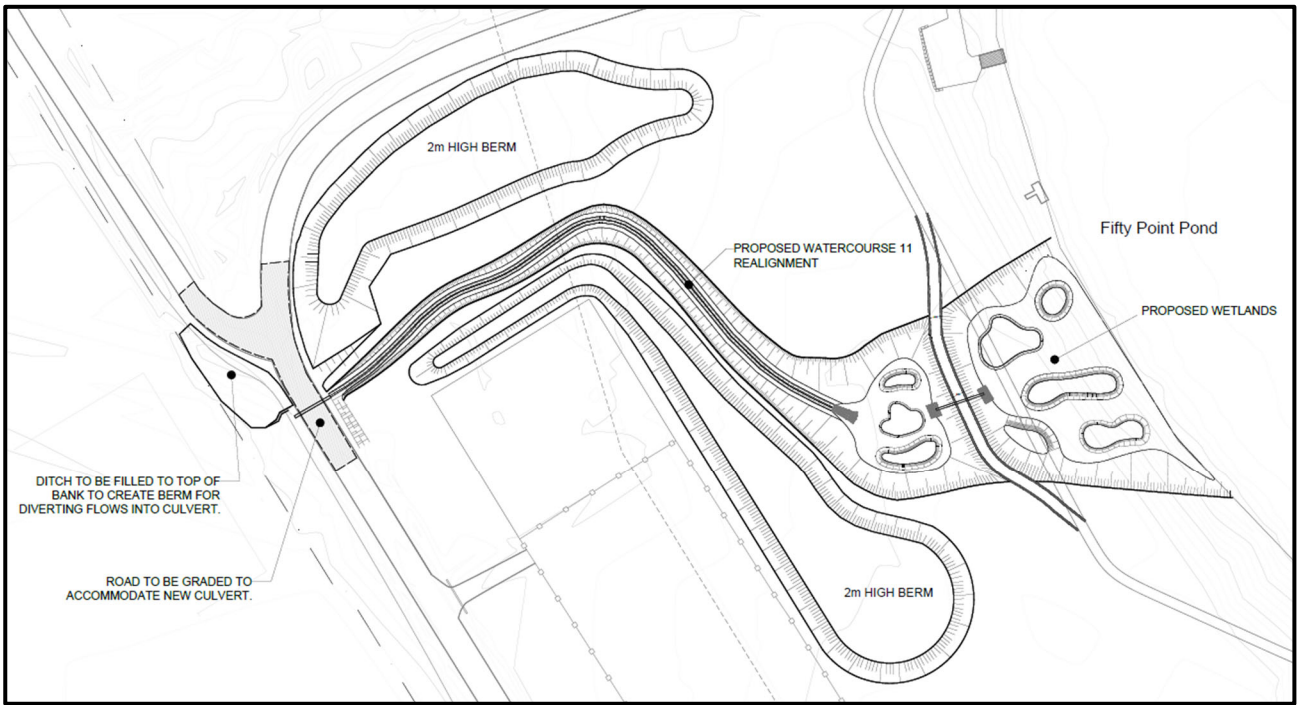


Figure 2: Proposed Diversion and Wetland Overview

3.2 Implementation

As noted, the preferred alternative from the Class EA was to divert the upper reaches (subcatchments SB1, SB2, SB3) of WC 11 into the Fifty Point Pond by using a berm in the existing channel and creating a new channel that travels at a 90-degree angle away from WC 11 and into the pond. The reaches downstream of the split will continue to collect runoff and drain into Lake Ontario through the existing WC 11 flow path in the Shippee and Windermere area.

Design plans are provided with this report as Water's Edge drawings EC1, OP, P&P1, P&P2, CS1, CS2, DET1, E&S, PP1, and SP1. References to plans, designs, or drawings are in reference to these Water's Edge drawings.

3.3 Channel Design

Starting at the upstream end of the diversion the existing WC 11 ditches on both sides of the road will be diverted into the proposed channel. To do this a large berm will be formed on the west side of the road just north of the existing culvert crossing. This location is the existing flow path for WC 11 and filling a section of the ditch in will stop flow from progressing to the Shippee and Windermere sections of the watercourse. The existing road crossing culvert at this location is a 600mm circular CSP. This culvert will be removed in favour of a larger 800 mm circular CSP to ensure the road is not overtopped during storm events. Hydraulic modelling has been used to confirm that the 800 mm culvert is sufficient to accommodate the largest storm events. To accommodate the increased culvert size and maintain sufficient cover over the culvert the road surface will be raised slightly and blended into the existing road gradient.

A gravel pedestrian path runs along the top of bank of Fifty Point Pond. The pathway is to be realigned to accommodate the proposed wetland which will dissect the wetland into two sections. The wetland will be connected with an 800 mm CSP that crosses through the pathway embankment. The pathway will be constructed using 50 mm limestone screenings. The top width of the embankment is a total of 4.0 m while the

side slopes are to be a maximum slope of 3H:1V. A beaver baffler will also be installed at this location to deter any beaver activity.

The diversion channel from the proposed culvert will be excavated into the existing open space. The diversion channel will be over-excavated and entrenched within the open space to bring the low-flow channel down to the required slope range. This creates a two-stage channel with the low flow channel at the bottom and the flood stage above it. Hydraulic modelling shows that the flood stage channel accommodates all return period events, while the low flow channel has been designed to approximately accommodate the 2-year event. The slope from the culvert inlet to the wetland outlet at Fifty Pond is very low at approximately 0.25%. Ideally the channel would be designed to consider an aesthetically pleasing sinuous flow path, however due to the low slope the channel sinuosity must be limited. The diversion channel has also been designed to accommodate a future expansion of the Fifty Point storage area on the south side of the channel, this creates an almost 90-degree bend halfway through the channel corridor.

Typically, natural channels are designed to have a bankfull channel that accommodates a 1 to 2 year return period flow as this is the dominant channel forming discharge. This can be guided by observing the existing natural channel and replicating the bankfull flow or by using available return period hydrology data. Since only the 100-yr return period data is available for WC 11 and there is no defined bankfull channel in the upstream area of WC 11 another method is required. Therefore, in order to size the low flow channel, the available 100-yr data is pro-rated by using the return period data from other nearby creeks (Fifty Creek (WC12), Redhill Creek, Stoney Creek, and Battlefield Creek). Using these, the 2-yr flow was averaged to be 42% of the 100-yr flow. Therefore, with a 100-yr flow of 0.59 m^3/s at the diversion location the resultant 2-yr discharge is 0.25 m^3/s.

The proposed low-flow channel is sized to the resultant 2-yr flow data. Using Manning's formula, a channel was iteratively sized to the 2-yr discharge that had a bottom width of 0.20 m, a top width of 1.80 m, a depth of 0.40 m. The channel will have a profile slope of 0.025 m/m, and side slopes of 2:1. Using these channel dimensions and a Manning's 'n' of 0.030 the resultant discharge is 0.25 m^3/s. The proposed channel dimensions are shown in **Table 1.**

Table 1: Proposed Channel Dimensions

Dimension	Low-flow Channel (m)
Bankfull Width	1.80
Bankfull Depth	0.40
Bottom Width	0.20
Side Slopes	2H:1V

The proposed channel will be covered with 300 mm of topsoil to the design elevation and covered with coir fabric to ensure interim stability until vegetation can establish. The channel will be seeded with native wetland seed mix OSC 8180. It is assumed since the channel is an intermittent channel that the channel will be dominated by non-woody herbaceous species such as sedges, bulrushes, and milkweeds.

3.4 Vegetated Channel Scour Protection

The proposed channel will be dominated by vegetation and is expected to provide the necessary scour protection. Based on the Manning's calculations the velocity of the proposed low-flow channel is 0.61 m/s. In addition, the highest shear stress from hydraulic model during the 100-yr event is 7.16 Pa while the highest velocity is 0.79 m/s. Based on Fischenich's work with permissible shear stress in channels, **Table 2** shows the permissible shear stress and velocities that select channel materials are capable of handling. The proposed vegetated channel is expected to have a retardance class of B, if not higher (Class A). Comparing the shear stress and velocities from the model to the Class B vegetation it can be seen that the existing vegetation is more than adequate as a natural bed protection material.

Table 2: Permissible Shear Stress

Channel Material		Critical Shear Stress (Pa)	Velocity (m/s)	Source
Established Grasses	Class A (>600mm, good stand)	177.2	0.8 to 2.4	Fischenich, C. (2001)
	Class B (250-600mm – good stand) (>600mm – fair stand)	100.6		
	Class C (150-250 mm – good stand) (250-600 mm – fair stand)	47.9		
	Class D (50-150 mm – good stand) (150-250 mm – fair stand)	28.7		
	Class E (<50 mm – good stand) (50-150 mm – fair stand)	16.8		
Stone Protection	Rock rip rap 150mm dia.	119.7	1.5-3.0	
	Rock rip rap 300mm dia.	244.2	3.0-4.0	

The tie in from the diversion channel to the wetland has a slightly higher slope however and the shear stress at this location increases to 12.28 Pa and the velocity is 1.02 m/s. To ensure there is no chance of bed scour this section will be lined with 100 mm riverstone, which can accommodate slightly higher velocities, even though the vegetation is likely sufficient based on the Fischenich research. The inlet and outlet of the pathway culvert will also be lined with the 100 mm riverstone, although once again there is not expected to be any excessive flow at these locations since the wetland has been designed to be continually inundated.

3.5 Wetland Area

The proposed wetland area is a total of 5,535 m^2. The wetland is designed to be continually backwatered by the Fifty Point Pond. The elevation that regulates the water level in the pond is the outlet channel o WC 12. The lowest invert elevation of this outlet channel is 75.88 m. It is assumed that WC 12 will continually provide flow to the pond as it is connected at both the north and south ends. The pond will then always maintain a minimum elevation of 75.88 m unless WC 12 ceases to provide input to the pond. The lowest elevations proposed in the wetland are 75.50 which in the worst-case scenario would leave over a foot of water in the wetland. In 2020 the water surface of the pond was surveyed and measured to be 76.20 m. This was believed to be a lower than typical water surface elevation for the pond and was therefore used as the conservative typical water surface for the design. The bottom of the proposed wetland area is set to be 0.70 m below the typical water surface. This is purposefully set to limit the growth of Phragmites within the wetland which grows in shallower water depths. Areas of high and mid elevation are also included in the wetland area for depth variation in supporting various flora and fauna species.

Within the wetland a few different types of habitat features will be used. These features are sunning logs, rock piles, and brush logs/piles. The sunning logs and brush piles will be sourced from the trees that will be removed on site. All trees that are to be removed to accommodate the berms will be used to create habitat features within the wetland area.

Photo 1: Existing Path Location and Open Space for Proposed Wetland

Photo 2: Proposed Lower Wetland Location

3.6 Wetland Cut and Berm Fill Quantity

To accommodate the significant removal of fill to create the diversion channel and wetland, several berms are proposed around the area. The berms are proposed to be a maximum of 2.0 m in height and have 3H:1V side slopes. A geotechnical report prepared by Soil Engineers Ltd. recommends that berms be constructed in lifts of 200 mm to a minimum of 98% SPMDD. Soil and organics should be removed from the silty clay fill sourced on site. The total cut for the diversion channel and the wetland is 13,500 m^3. As noted, the thin layer of soil and organics on the surface should be separated and used as top dressing where possible. The remainder of the fill will be placed and compacted to create the berms.

3.7 Vegetation

Shrubs and trees that are proposed for the vegetated riverstone are listed on the Planting Plan sheet. The shrubs are native and are on the approved HCA list. Plant stock will be potted shrubs in #3 containers. Shrubs are to be planted at 1 plant per 5 square metres in both the wetland area and in pockets outside of the wetland area. Over 1,000 shrubs are proposed for planting. Forty-two trees have also been proposed for planting outside of the wetland and diversion channel area.

Areas within the diversion channel and wetland will be covered with 300 mm of topsoil before being seeded with native seed mixes. The wetland and diversion channel low flow areas will be treated with the wetland seed mix, while the upper portion of the diversion channel banks will be treated with the native meadow seed mix, and the berms will be treated with a different meadow seed mix.

3.8 Erosion and Sediment Control

The construction erosion and sediment controls are detailed on the E&S drawing in the Water's Edge design package. The goal of the erosion and sediment control plan is to cordon off the work zone and restrict sediment laden water from entering the downstream of WC 11 as well as into Fifty Pond, as much as is possible. The controls to address on-site sediment concerns include construction timing, phasing of construction, unwatering measures, silt fence, staging and stockpiling area, and stabilization of exposed soils with seeding and plantings.

The main control to limit sediment laden water from entering Fifty Pond will be to complete the construction of the diversion channel and the majority of the wetland offline. Watercourse 11 will continue as is during the construction until such time that the channel and wetland have been completed. Once the channel and wetland have established and been backwatered the diversion berm can be placed, directing WC 11 into the constructed channel. Similarly, the entrance of the wetland to Fifty Pond will remain as a small berm that stops the pond from backwatering into the wetland. Once the wetland and channel have been completed a silt curtain will be placed in the pond and the berm will be slowly removed allowing water to settle into the wetland area before opening up the silt curtain. There is also the option to complete the majority of the work and allow vegetation in the channel and wetland to establish before introducing flow.

Unwatering may be required to remove seepage from the creek into the work zone. The geotechnical report notes that seepage is slow due to the compacted silty clay. However, if necessary, unwatering of the work zone will be completed by using a pump which will discharge to a silt bag. The silt bag will be placed in a grassed area a minimum of 15 m from the pond in a grassed area. This will allow for sediment laden water to slowly filter through the ground or surface vegetation.

Staging and stockpiling areas are noted on the plans. The stockpile area is in the open area where the future storage area will be located. Silt fence will be used around the stockpile area. All silt fence locations are shown on the plans.

Stabilization of exposed soils once the construction is completed will include shrub plantings and coir and seeding of exposed soils. In addition, the coir logs around the work zone will remain until the site is stabilized.

For detailed plans and notes of the bank restoration works, please refer to the Water's Edge drawing set.

4 HYDRAULIC MODELLING

Two scenarios were investigated for the hydraulic modelling. The first scenario is the existing condition with 100 yr Chicago flows into WC11 and 12. The second scenario includes modification to the road near the proposed diversion in order to capture the entire flow from WC11 and direct it into the pond and WC12. The two scenarios were all modeled using HEC RAS 2D modelling. WC 12 is modelled with three crossings for both scenarios. The original model for WC12 provided by HCA was a 1D HEC2 model, which was converted into 1D HEC RAS and later a 2D model was created with the same boundary conditions. Boundary conditions inside the model were matched with the HEC RAS model that was provided. In the model there were 5 cross sections with flow change through WC11. Out of these 5 locations 4 of them were located downstream of the diverted channel in our proposed condition. Therefore, the 4 flow change locations downstream of the diverted channel were eliminated.

Thus, the final boundary conditions are flow hydrographs at two locations along WC11 (one at the upstream location and one at around 200 m from upstream) and one flow hydrograph upstream of the WC12 and one stage hydrograph at downstream of both creeks where they reach Ontario Lake. The stage hydrograph at Lake Ontario is the same number for all the time steps. The stage was selected as the average water level elevation

recorded for Lake Ontario which is 73 m. Even though the original EA for Fifty Point used a 4hr Chicago, the HEC RAS model provided had a 24 hr Chicago flood, and therefore the 24 hr Chicago was used for both scenarios. All hydrographs are 24 hours long, and linear triangularly shaped. The modelling details for both scenarios are described below.

Existing Conditions

In this scenario, the terrain used is the existing condition without having the proposed wetland. WC11 was modelled with no culverts along the road side ditches as it was modelled originally in the HCA model. The road crossing downstream of Fifty Pond on WC 12 was modelled with the original configuration of 3 culverts. The results show that some spill is flowing to both the marina and the pond located in the study area. **Figure 3** shows the results of the 2D modelling for the existing conditions.

Proposed Conditions

For the proposed conditions model the road near the diversion was raised to a height that would restrict all spill into the downstream portion of WC 11. In addition, berms along the north side of the proposed watercourse were adjusted to keep water from flowing into the marina. In this scenario all the water from WC11 is directed into a newly designed channel and wetland before flowing into Fifty Pond and subsequently Fifty Creek (WC 12). Multiple iterations of the proposed model were required to determine the flow paths and spill locations in the model to eventually ensure that no spill was able to enter the downstream portion of WC 11. **Figure 4** shows the results of the 2D modelling for the proposed conditions.

The results of the modelling show that in order to divert all flows from the upstream subcatchments of WC 11 into Fifty Pond and Creek then the road and ditches near the diversion location will need to be increased to a minimum height of 78.10. This is reflected in the proposed conditions modelling as well as in the design package. Therefore, the recommendation from the WC 11 EA is fulfilled.

For comparison of results, 10 Cross sections were added to WC12 (shown in **Figure 3** and **4**). **Tables 3** and **4** show water surface elevations for both scenarios. A comparison of the existing conditions to the proposed conditions is provided in **Appendix B.**

Table 3: Water Surface elevations for both scenarios and cross sections on WC12

Scenarios	XS #1	XS #2	XS #3	XS #4	XS #5	XS #6	XS #7	XS #8	XS #9	XS #10
Existing	79.72	78.62	78.09	78.00	77.99	77.99	77.11	77.1	77.1	77.07
Proposed	79.73	78.62	78.09	78.01	78.00	77.99	77.12	77.1	77.1	77.07

Table 4: Water Surface elevations for cross sections downstream of WC11

Scenarios	XS #11	XS #12	XS #13	XS #14
Existing	77.08	76.45	76.44	76.43
Proposed	0	0	0	0

5 SUMMARY

The following is a summary of the assesment and proposed design for Watercourse 11 within Fifty Point Conservation Area.

- The Hamilton Conservation Authority has hired Water's Edge to complete the detailed design of the realignment of Watercourse 11 within Fifty Point Conservation Authority based on the recommendations from the Fifty Point Watercourse 11 EA,
- The redirection of the watercourse includes the construction of a diversion channel as well as a wetland feature adjacent to Fifty Point Pond,
- The cutting of the wetland and channel created excess fill which is being used to create contoured berms throught the area,
- A new culvert was required and the road is to be raised to accommodate the culvert and stop any flood spill into the downstream portion of WC 11,
- The redirection of the watercourse into Fifty Pond and subsequently into Fifty Creek (WC 12) was modelled to ensure it does not negatively affect WC 12 and that all flows from the upstream portion of WC 11 are redirected,
- The proposed conditions model was able to redirect all flow into WC 12 therefore the recommendation from the WC 11 EA was fulfilled, and
- A summary of the designed channel including channel sizing and wetland details are found within the report and the accompanying design package.

We trust the information provided in this design brief will address any questions or concerns regarding the design and construction of the Watercourse 11 redirection. If you should have any questions regarding the project, please contact the undersigned.

Respectfully submitted,

Ed Gazendam, Ph.D., P.Eng.,
President, Sr. Geomorphologist
Water's Edge Environmental Solutions Team Ltd.

Nik Gazendam, C.Tech. CAN-CISEC
Project Manager and Senior Technician

ATTACHMENTS:

Appendix A: HEC RAS Scenario Modelling Results and Figures
Appendix B: Geotechnical Report and Chemical Analysis

REFERENCES:

Chapman, L.J. and D.F. Putnam. 1984. Physiography of Southern Ontario: Ontario Geological Survey Special Volume 2.

Dunne, T. and L.B. Leopold. 1978. Water in Environmental Planning. W.H. Freeman and Company, New York

Komar, Paul D. 1987 Selective grain entrainment and the empirical evaluation of flow competence. Sedimentology, 34: 1165-1176.

Ontario Flow Assessment Tool III (2019). Digital data from Ministry of Natural Resources and Forestry.

U.S. Deportment of Transportation. 2005. Design of Roadside Channels with Flexible Linings. Hydraulic Engineering Circular No. 15, Third Edition. Publication No. FHWA-NHI-05-114.

APPENDIX A:

HEC RAS Modelling Cross Sections

water's edge ENVIRONMENTAL SOLUTIONS TEAM LTD.	Fifty Point Innundation Boundaries	Date: Oct. 24, 2022	Map 1
	Class EA Flood Remediation Project- Watercourse 11, Fifty point	Checked By: EG	Drawn By: AM

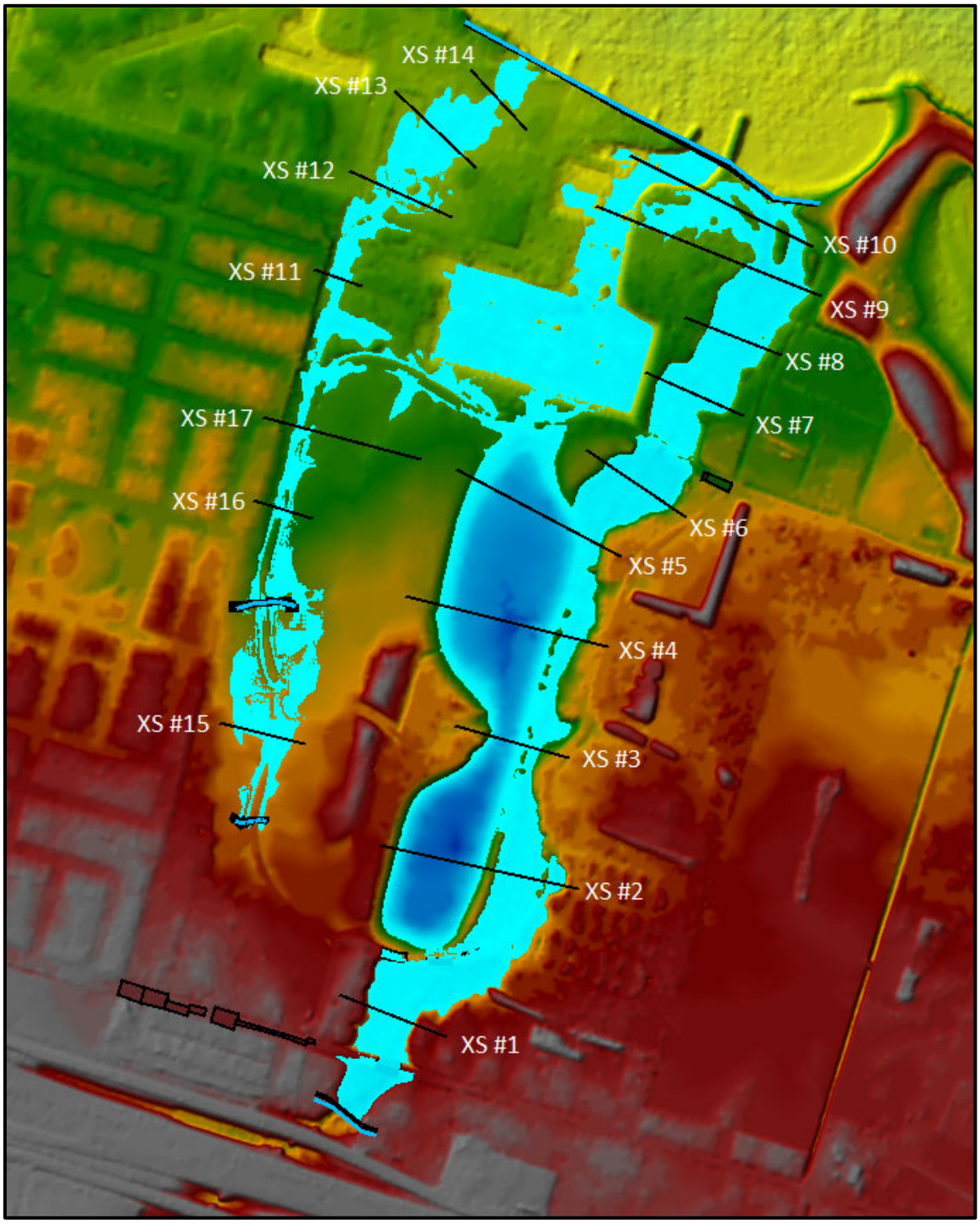


Figure 3: Existing Condition Floodline

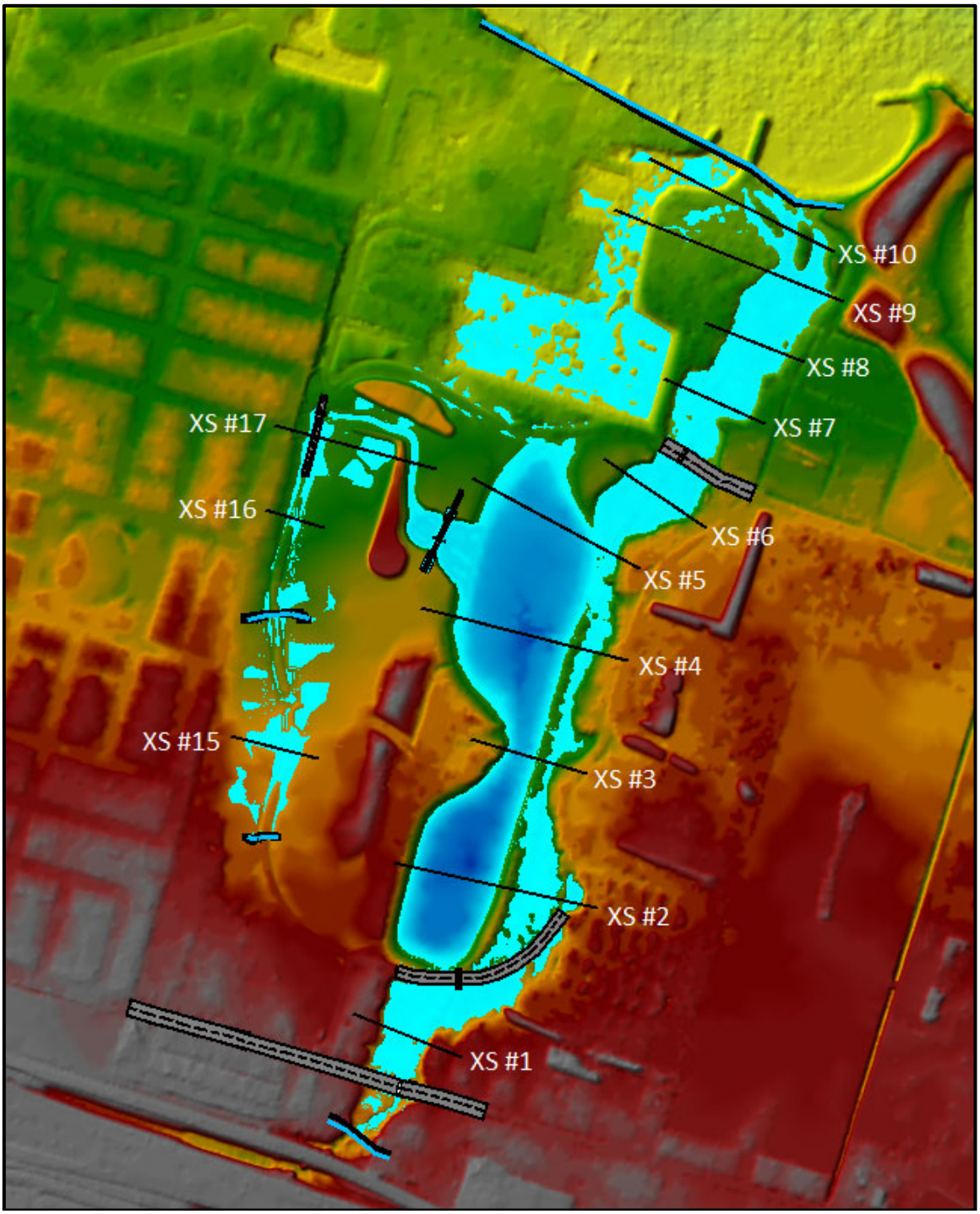
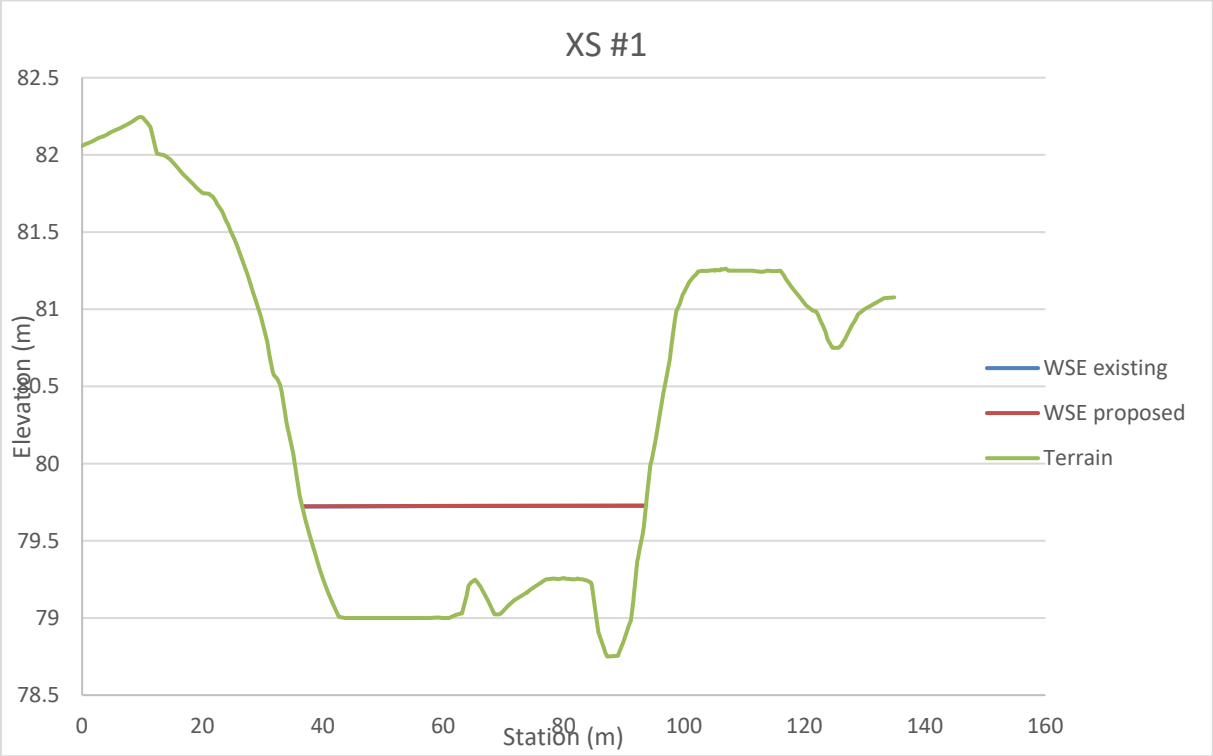


Figure 4: Proposed Condition Floodline

Cross Section 1



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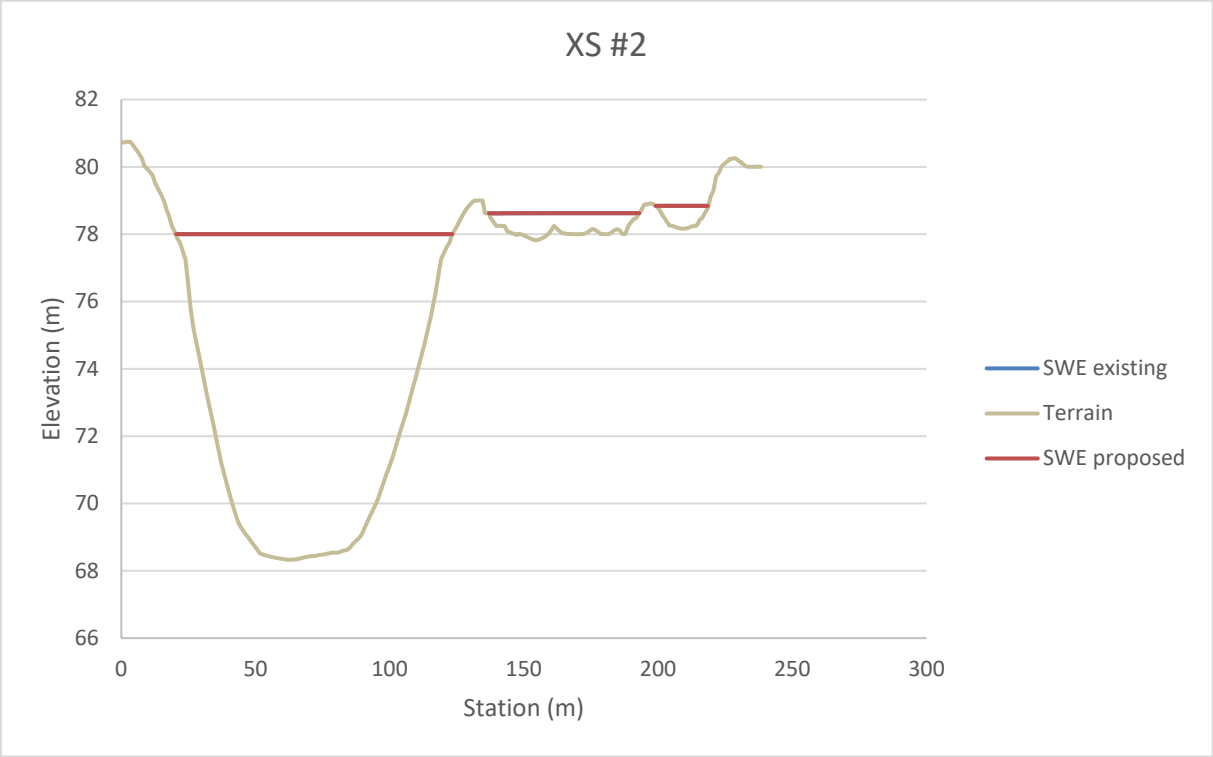

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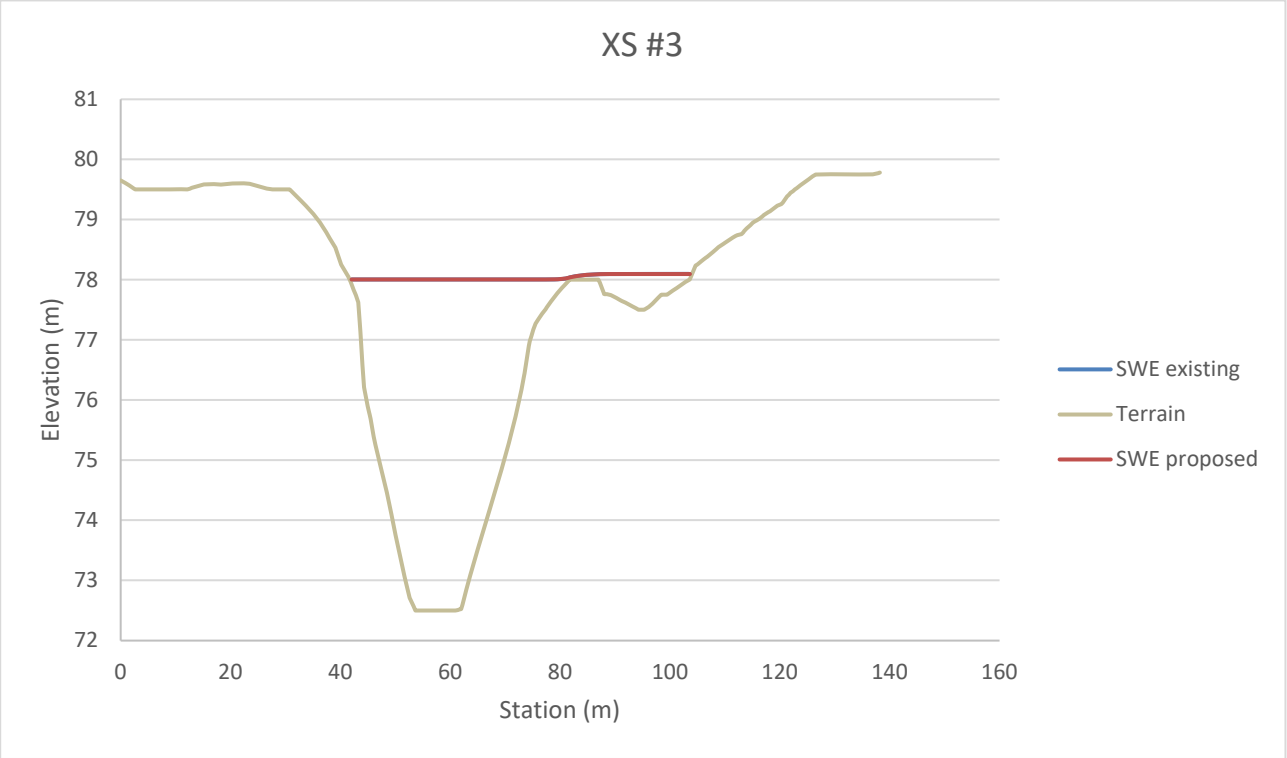

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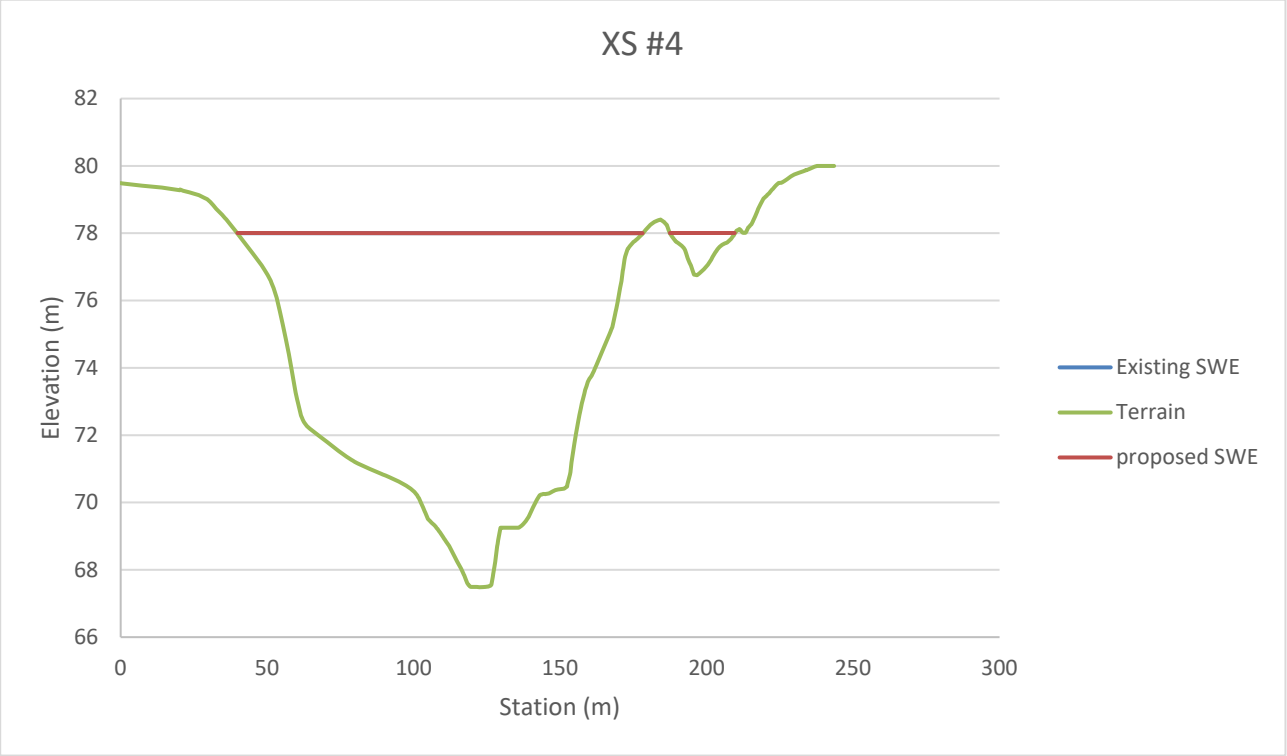

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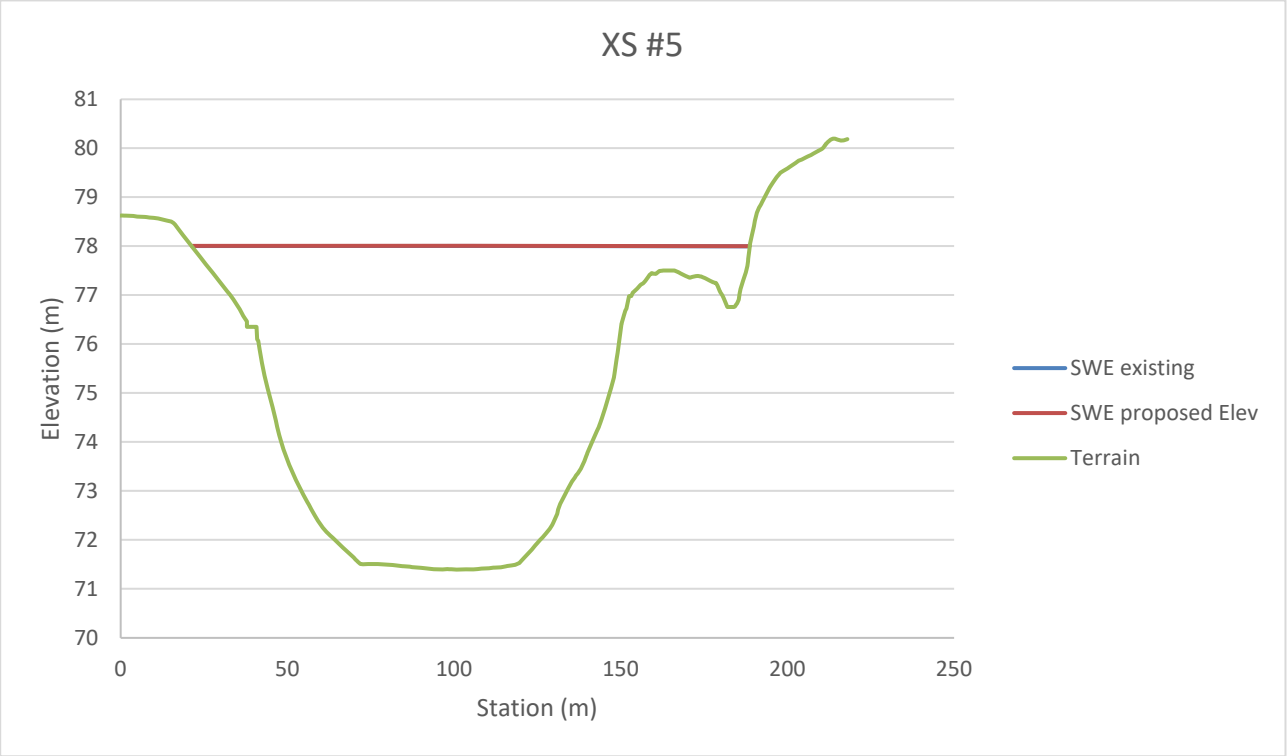

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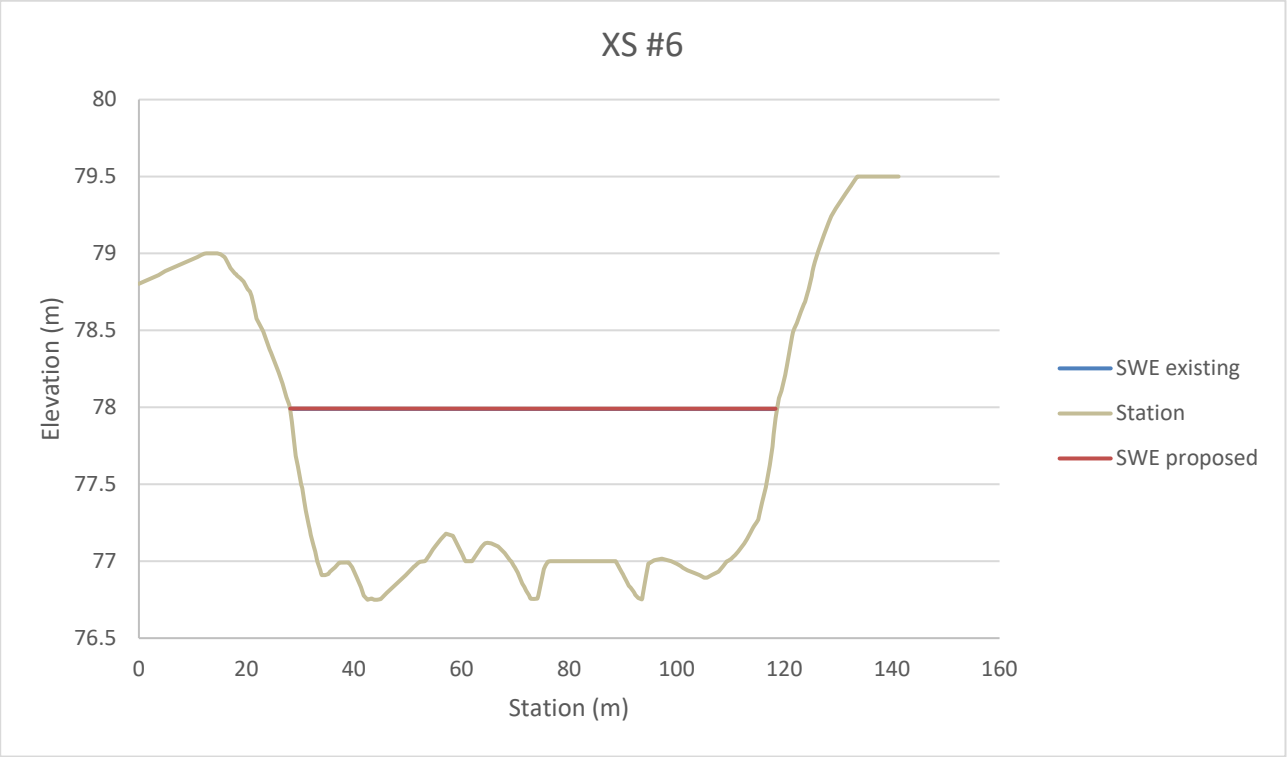

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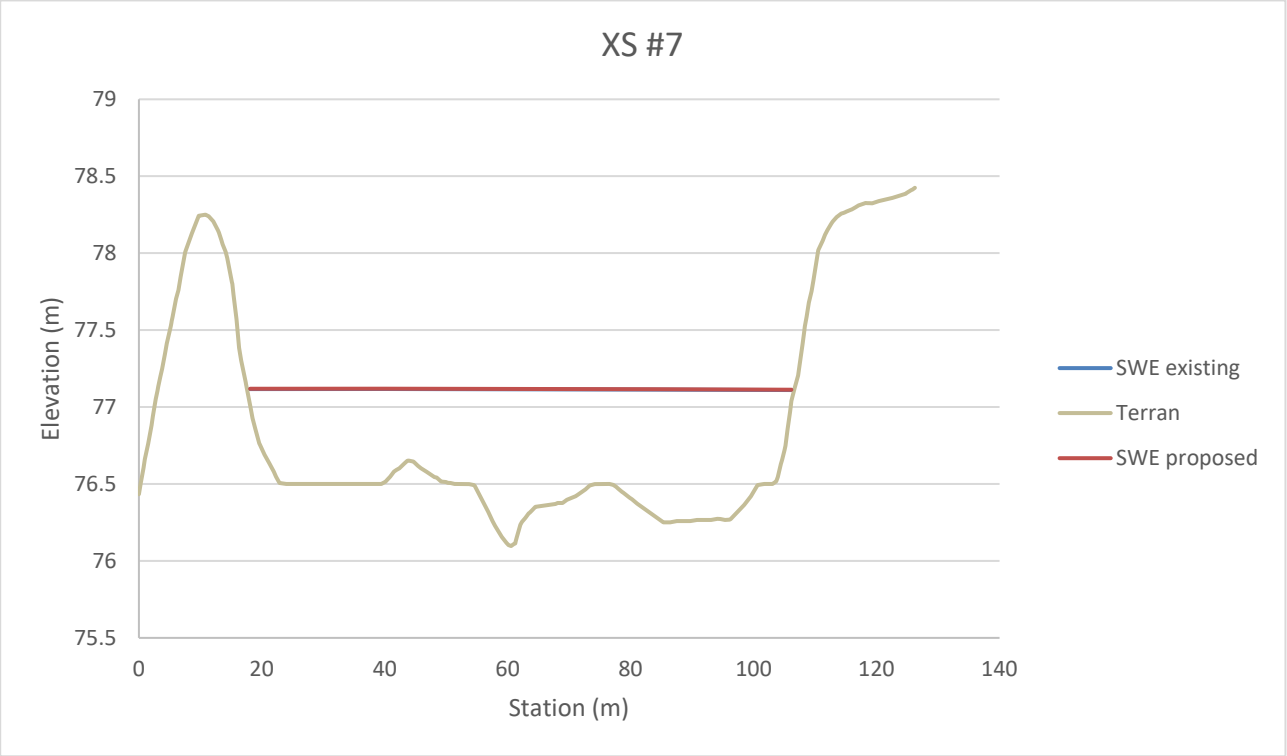

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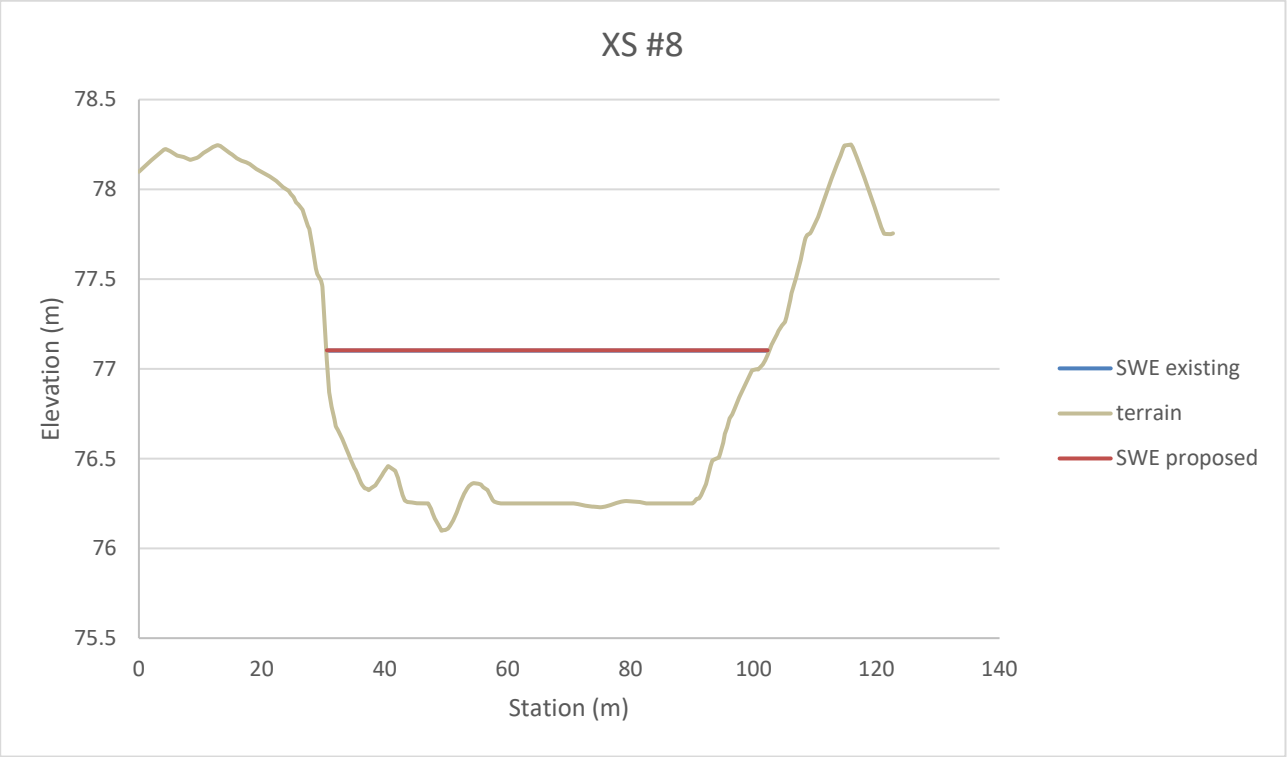

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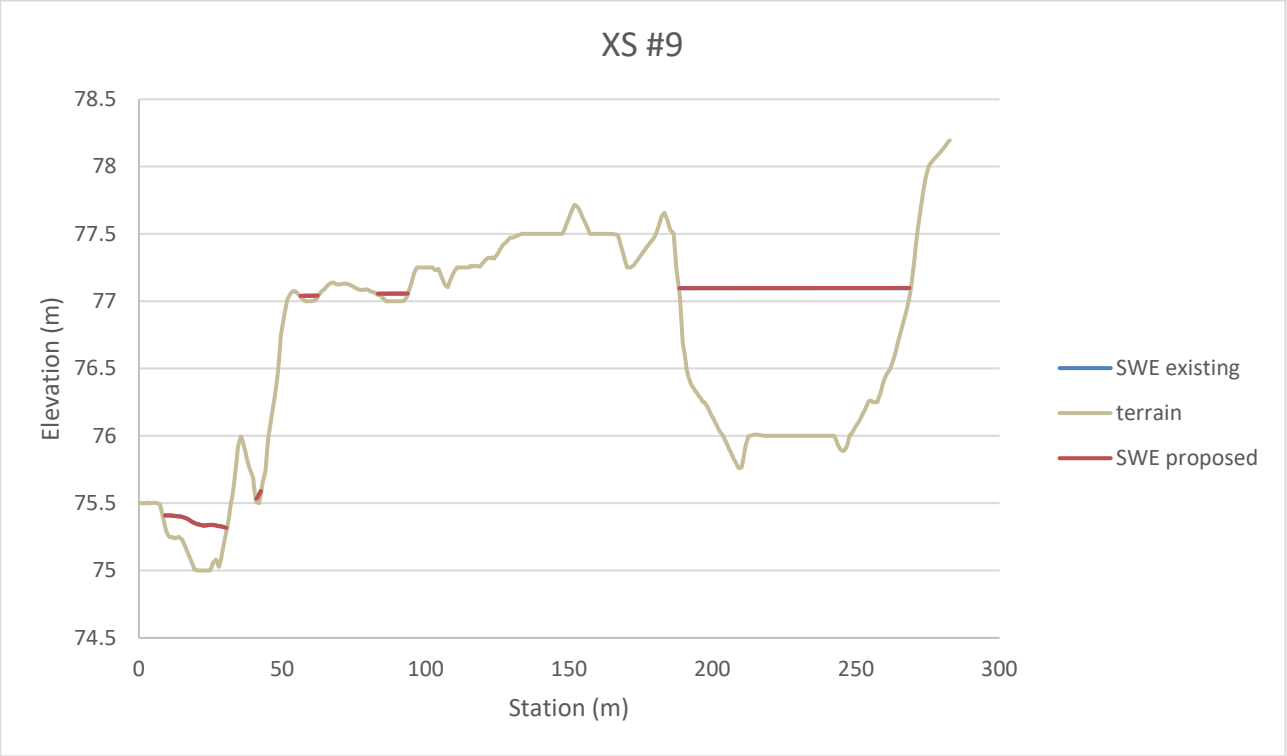

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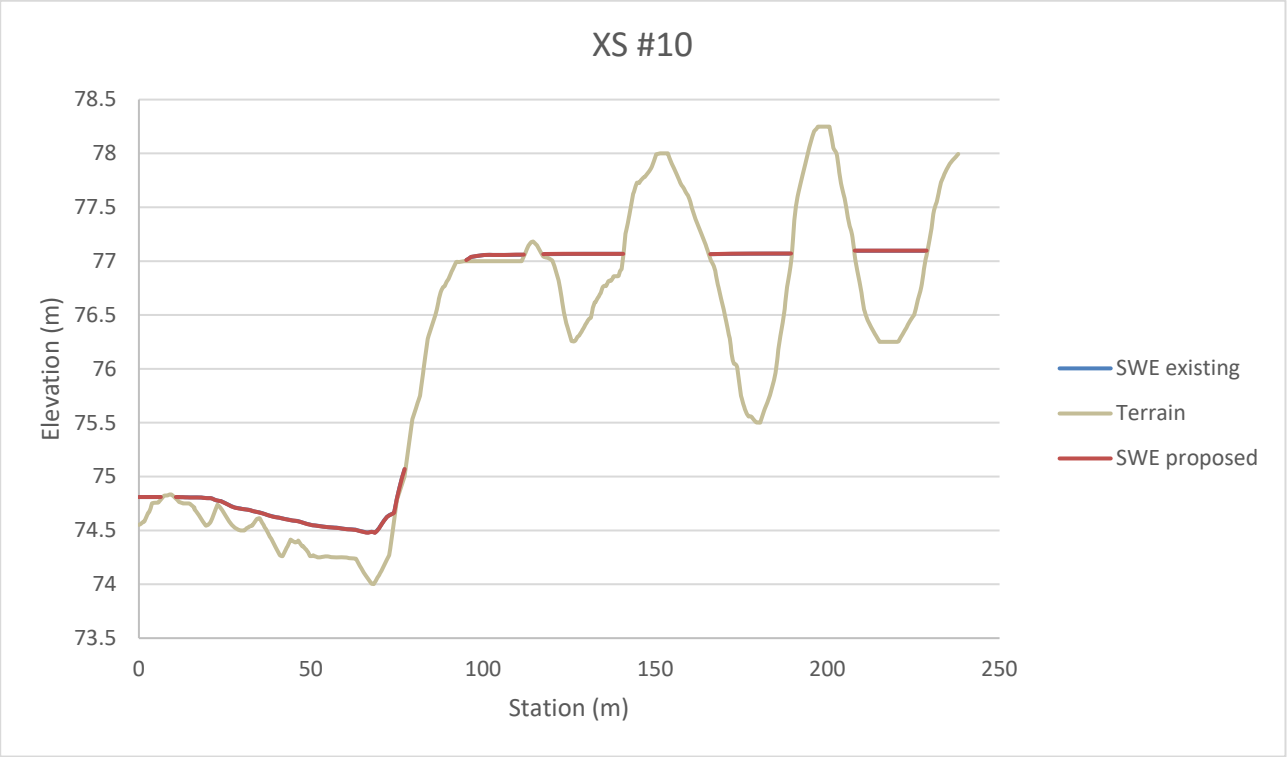

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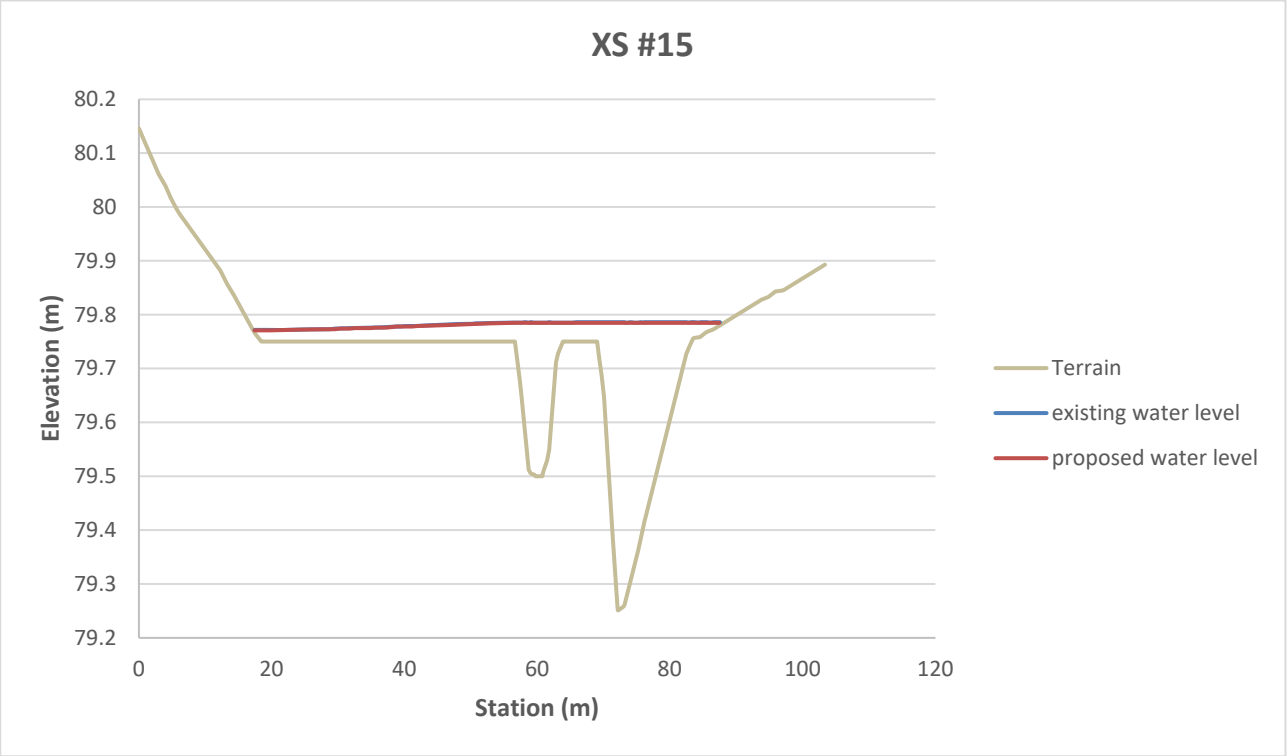

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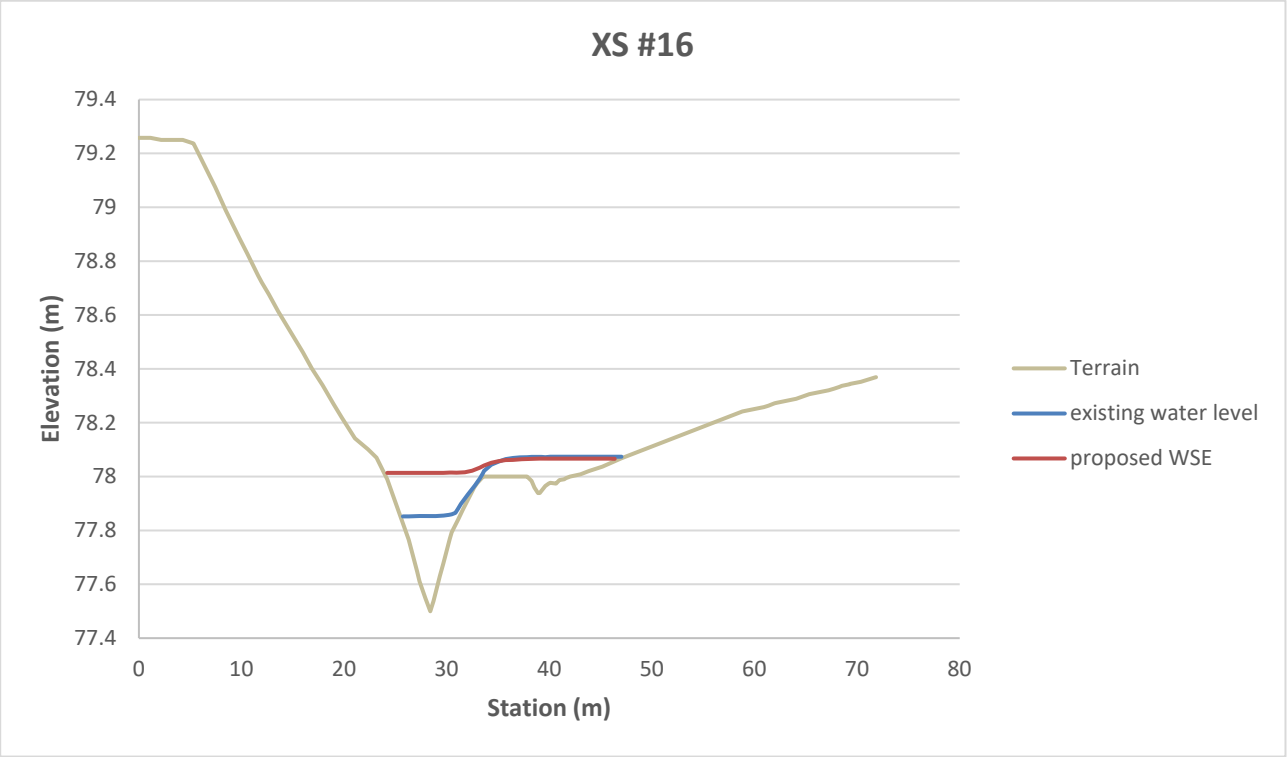
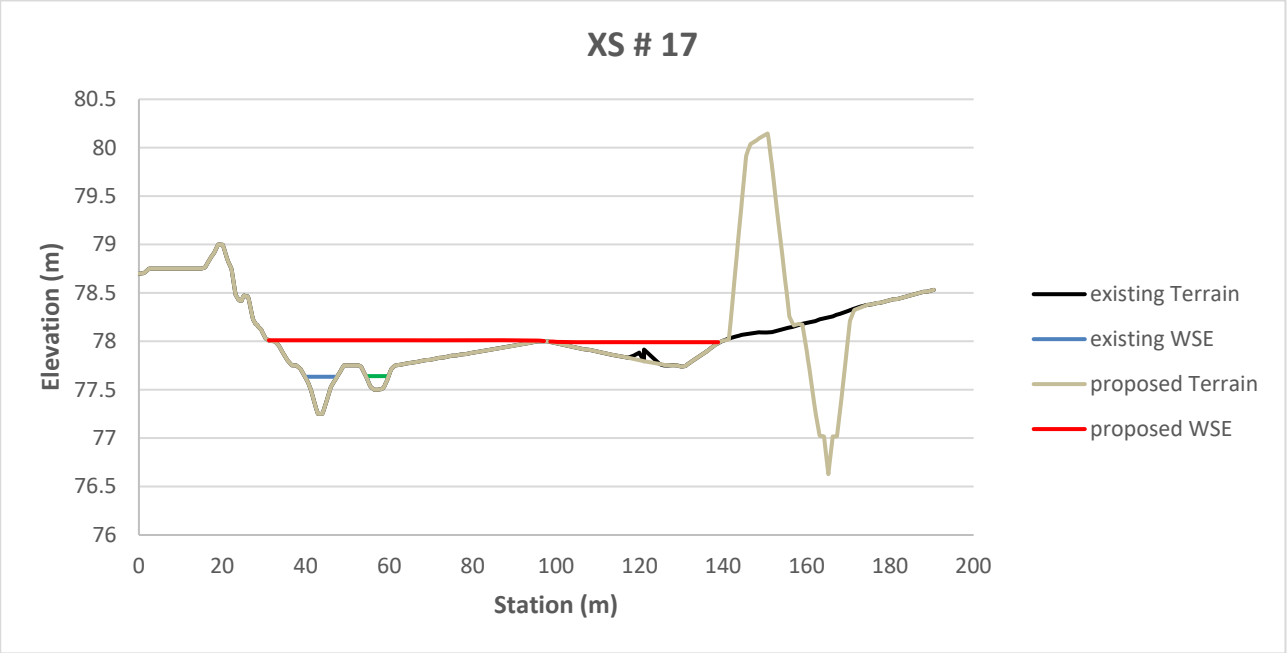


Cross Section 17



APPENDIX B:

Geotechnical Results

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
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A REPORT TO
WATER'S EDGE ENVIRONMENTAL SOLUTIONS TEAM LTD.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED WETLAND AND CHANNEL

FIFTY POINT CONSERVATION AREA
CITY OF HAMILTON (STONEY CREEK)

REFERENCE NO. 2103-S159

JULY 2021

DISTRIBUTION

3 Copies - Water's Edge Environmental Solutions Team Ltd.
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TABLES

ENCLOSURES

1.0 INTRODUCTION

In accordance with instruction and written authorization from Mr. Nik Gazendam, P.Eng., of Water's Edge Environmental Solutions Team Ltd., a geotechnical investigation was carried out in Fifty Point Conservation Area, in the City of Hamilton (Stoney Creek).

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for the design and construction of the proposed Wetland and Channel, for water storage and flood protection.

The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The City of Hamilton is located on Waterdown moraine where glacial tills dominate the soil stratigraphy. The tills extend onto dolomite bedrock of Amabel Formation. In places, the tills have been partly eroded by the water action of glacial Lake Whittlesey, filled with lacustrine sand, silt, clay and water-laid till.

The site of investigation is located inside Fifty Point Conservation Area in the City of Hamilton. The investigated site is currently a grass-covered park with tree lines along the edges. The grade at the site is relatively flat.

We understand that the area of investigation will be designed to create a wetland and channel for water storage and flood protection.

3.0 FIELD WORK

The field work, consisting of five (5) sampled boreholes, was performed on May 4, 2021, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The boreholes were advanced at intervals to the sampling depths by a track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed "List of Abbreviations and Terms", were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or 'N' values) of the subsoil. The relative density of the granular strata and the consistency of the cohesive strata are inferred from the 'N' values. Split-spoon samples were recovered for soil classification and laboratory testing. The field work was supervised and the findings were recorded by a Geotechnical Technician.

The ground elevation at each borehole location was established using a hand-held Trimble Geoexplorer 6000 Series Global Navigation Satellite System (GNSS) surveying equipment.

4.0 SUBSURFACE CONDITIONS

The investigation has disclosed that beneath a topsoil veneer the area of investigation is underlain by a stratum of silty clay till.

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 5, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (All Boreholes)

The revealed topsoil is 10 cm and 13 cm thick. It is dark brown in colour, indicating appreciable amounts of roots and humus. Buried topsoil will produce volatile gases and may generate an offensive odour under anaerobic conditions. The topsoil should only be used for landscaping purpose.

4.2 **Silty Clay Till** (All Boreholes)

The silty clay till was contacted beneath the topsoil in all boreholes, extending to at least the maximum investigated depths in the boreholes. It consists of a random mixture of soils and particle sizes range from clay to sand, with the clay fraction exerting the dominant influence on the soil properties. Grain size analysis was performed on 3 representative samples and the results are plotted on Figure 6.

The obtained 'N' values range from 8 to 60, with a median of 29 blows per 30 cm of penetration, from which the consistency of the clay till is inferred to be stiff to hard, being generally very stiff. Sample examinations disclose that the clay till near the ground surface is permeated with fissures, showing it has been fractured by the weathering process. The 'N' values decrease at intermittent depths, indicating the till has been reworked.

The Atterberg Limits of 2 representative samples and the natural water content values of all the clay till samples were determined; the results are plotted on the Borehole Logs and summarized below:

Liquid Limit	41% and 43%
Plastic Limit	21% and 22%
Natural Water Content	10% to 20% (median 14%)

The results show that the clay till is medium plasticity and the natural water content generally lies below its plastic limit, confirming its consistency as disclosed by the 'N' values.

The following engineering properties are deduced:

- High frost susceptibility low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, an estimated percolation rate of more than 80 min/cm, and runoff coefficients of:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- The shear strength is primarily derived from consistency which is inversely related to its moisture content, and is augmented by internal friction.
- It will be stable in a relatively steep cut; however, prolonged exposure will allow the sand seams to become saturated which may lead to localized sloughing.
- A poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3%.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 ohm·cm.

4.3 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Silty Clay Till	10 to 20 (median 14)	16	12 to 20

The silty clay till is generally suitable for a 95% or + Standard Proctor compaction. Wet or weathered soils will require aeration or mixing with drier soils prior to structural compaction.

The silty clay till should be compacted using a heavy-weight, kneading-type roller. When compacting the hard silty clay till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soils and be transmitted laterally into the soil mantle. Therefore, the lifts must be limited to 20 cm or less (before compaction).

The presence of boulders will prevent transmission of the compactive energy into the underlying material to be compacted. If an appreciable amount of boulders over 15 cm in size is mixed with the material, it must either be sorted or must not be used for structural backfill and engineered fill.

5.0 GROUNDWATER CONDITIONS

The groundwater level and occurrence of cave-in were recorded in the open boreholes upon completion of drilling and sampling. The data are plotted on the Borehole Logs.

The majority of the boreholes remained dry upon completion of the field work. Groundwater was recorded at a depth of 3.8 m from grade or (El. 75.6 m) in Borehole 5.

In excavation, any groundwater yield from the silty clay till due to percolation of surface water is expected to be slow in rate and limited in quantity.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a topsoil veneer, the area of investigation is underlain by a stratum of stiff to hard, generally very stiff silty clay till.

It is understood that the area of investigation will be designed to create a wetland and discharge channel for water storage and flood control. The basin of the proposed wetland and channel will be at El. 76.0± m and El. 77.0± m, respectively, and the side slopes will be graded at 1 vertical:3 horizontal.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 Wetland Construction

The excavation for the wetland will extend to El. 76.0± m. Based on the borehole findings, the invert and the walls of excavation is anticipated to consist of stiff to hard silty clay till. The clay till is a soil of low permeability and is suitable for water retention purpose.

All excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 2.

Table 2 - Classification of Soils for Excavation

Material	Type
Silty Clay Till	2

No groundwater is anticipated within the depth of investigation. The yield of groundwater in any excavation will probably be derived from the percolation of surface water. It can be removed by conventional pumping from sump pits.

The wetland is mainly constructed by excavation. Where earth berm is required, the on site, free to organics, silty clay till is suitable for the construction of the berms and embankment. It should be compacted in lifts not exceeding 200 mm, to a minimum of 98% of the Standard Proctor Maximum Dry Density (SPMDD), with the water content close to its optimum moisture content.

In preparation of the subgrade for embankment, topsoil and organics should be removed. The weathered soil shall be subexcavated and the ground should be proof-rolled. The fill placement and compaction should be inspected by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer under full-time basis.

The sides of the wet land should be sloped at 1 vertical:3+ horizontal in the dry zone and 1 vertical:4+ horizontal in the wet zone. All the exposed slopes must be vegetated or sodded to protect from erosion.

Service pipes in the earth embankment should be provided with anti-seepage collars or trench plugs (OPSD 802.095) in 25 m intervals, consisting of either clay or concrete plugs to protect the subsoils from water seepage through the bedding, which can result in loss of ground and creating a cavity in the embankment.

Slope stability analysis was carried out by "SLIDE", developed by Rocscience Inc. at a typical cross section of the wetland, using force-moment-equilibrium criteria of the Bishop method, and the results of the analyses are presented on Drawing Nos. 3 and 4. The results show that the FOS against deep seated slope failure satisfies the Ontario Ministry of Natural Resources and Forestry (OMNRF) Technical Guidelines with values exceeding 1.5.

6.2 Channel Construction

The excavation for the channel will extend to El. 77.0± m. The sides of channel should be slopped at 1 vertical:3+ horizontal for stability. Based on the borehole findings, the invert and the walls of excavation is anticipated to consist of silty clay till.

In order to prevent rainwash erosion, the channel sides must be sodded. The wet perimeter of the channel should be protected against erosion as shown in Table 3.

Table 3 - Protection against Flow Erosion

Drainage Flow (m/sec)	Protective Measures Against Flow Erosion
0.6 or less	Not Required
0.6 to 1.5	Sodded Gutter
1.5 to 2.1	Cobbled Gutter
2.1 to 4.5	30 cm of Paving Stone
4.5 +	Gabion Mat on Geofabric Filter

6.3 Pathway Construction

The recommended pavement structure to be placed on the proposed pathway is presented in Table 4.

Table 4 - Pavement Design (Pathway)

Course	Thickness (mm)	OPS Specifications
Asphalt	50	HL-3
Granular Base	150	OPS Granular 'A'
Granular Sub-base	200	OPS Granular 'B'

In preparation of the subgrade, the surface should be proof-rolled and any soft subgrade should be sub-excavated and replaced by properly compacted inorganic earth fill. The earth

fill within the zone of 1.0 m below the pavement must be compacted to 98% or + of the maximum Standard Proctor dry density, with the moisture content 2% to 3% drier than the optimum. In the lower zone, a 95% Standard Proctor compaction is considered adequate.

The granular bases should be compacted to 100% of their maximum Standard Proctor dry density.

The ground along the sides of the pathway must be graded to allow drainage away from the pathway surface.

6.4 Soil Parameters

The recommended soil parameters for the project design are given in Table 5.

Table 5 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**	**Estimated Bulk Factor**	
	Bulk	**Loose**	**Compacted**
Silty Clay Till	22.0	1.30	1.05
Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_o**	**Passive K_p**
Compacted Earth Fill	0.45	0.56	2.50
Silty Clay Till	0.35	0.48	3.00
Coefficients of Friction			
Between Concrete and Granular Base			0.50
Between Concrete and Sound Natural Soils			0.35

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Water's Edge Environmental Solutions Team Ltd., and for review by the designated consultants and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement.

The material in the report it reflects the judgement of Basim Al Ali, P.Eng., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on

it, are the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

SOIL ENGINEERS LTD.

Per

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BAA/BL

LICENSED PROFESSIONAL ENGINEER
July 19, 2021
B. P. Y. LEE
100104568
PROVINCE OF ONTARIO

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS Auger sample
CS Chunk sample
DO Drive open (split spoon)
DS Denison type sample
FS Foil sample
RC Rock core (with size and percentage recovery)
ST Slotted tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH Sampler advanced by static weight
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
NP No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0 Field vane test in borehole; the number denotes the sensitivity to remoulding

△ Laboratory vane test

□ Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

JOB NO.: 2103-S159

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Channel and Wetland

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

DRILLING DATE: May 4, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
78.2	Ground Surface							
0.0 / 0.1	**10 cm TOPSOIL**	1	DO	8	0		20	
	Stiff to hard							
	weathered	2	DO	50	1		13	
	SILTY CLAY TILL	3	DO	47			12	
	trace of gravel occ. sand seams, cobbles and boulders				2			
		4	DO	31			14	
		5	DO	24	3		14	
	brown grey				4			
		6	DO	24			13	
73.1 / 5.1	**END OF BOREHOLE**				5			Dry on completion
					6			
					7			
					8			
					9			
					10			

Soil Engineers Ltd.

JOB NO.: 2103-S159

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Channel and Wetland

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

DRILLING DATE: May 4, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
78.3	Ground Surface							
0.0	**13 cm TOPSOIL**				0			
0.1	Stiff to hard weathered	1	DO	10			18	
		2	DO	47	1		15	
	SILTY CLAY TILL trace of gravel occ. sand seams, cobbles and boulders	3	DO	60			12	
	brown grey				2			
		4	DO	25			12	
					3			
		5	DO	21			12	
					4			
		6	DO	23			14	
73.2					5			
5.1	**END OF BOREHOLE**							
					6			
					7			
					8			
					9			
					10			

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2103-S159

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Channel and Wetland

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

DRILLING DATE: May 4, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
79.0	Ground Surface							
0.0 / 0.1	**10 cm TOPSOIL**	1	DO	13	0		19	
	Stiff to hard							
	weathered	2	DO	38	1		13	
	SILTY CLAY TILL	3	DO	42	2		14	
	trace of gravel occ. sand seams, cobbles and boulders	4	DO	23			10	
		5	DO	22	3		15	
	brown grey	6	DO	29	4		18	
73.9 / 5.1	**END OF BOREHOLE**				5			
					6			
					7			
					8			
					9			
					10			

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2103-S159

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Channel and Wetland

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

DRILLING DATE: May 4, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
79.5	Ground Surface							
0.0 0.1	**10 cm TOPSOIL**	1	DO	11	0		19	Dry on completion
	Stiff to hard weathered	2	DO	29	1		13	
	SILTY CLAY TILL trace of gravel occ. sand seams, cobbles and boulders	3	DO	48	2		13	
		4	DO	36			14	
		5	DO	31	3		17	
	brown grey	6	DO	35	4		13	
74.4 5.1	**END OF BOREHOLE**				5			
					6			
					7			
					8			
					9			
					10			

Soil Engineers Ltd.

JOB NO.: 2103-S159

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

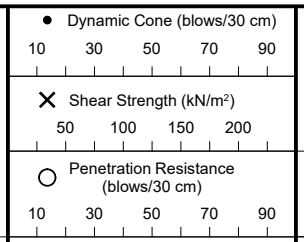
PROJECT DESCRIPTION: Proposed Channel and Wetland

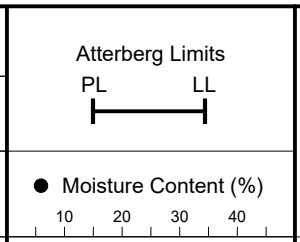
METHOD OF BORING: Flight-Auger

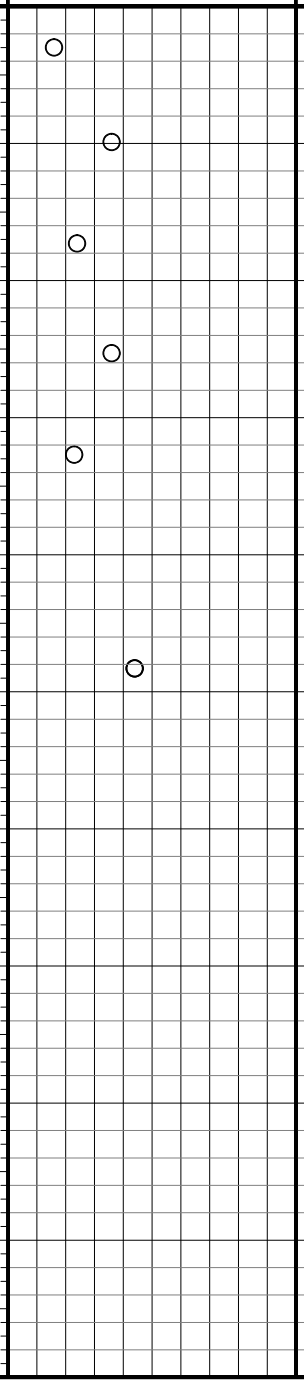
PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

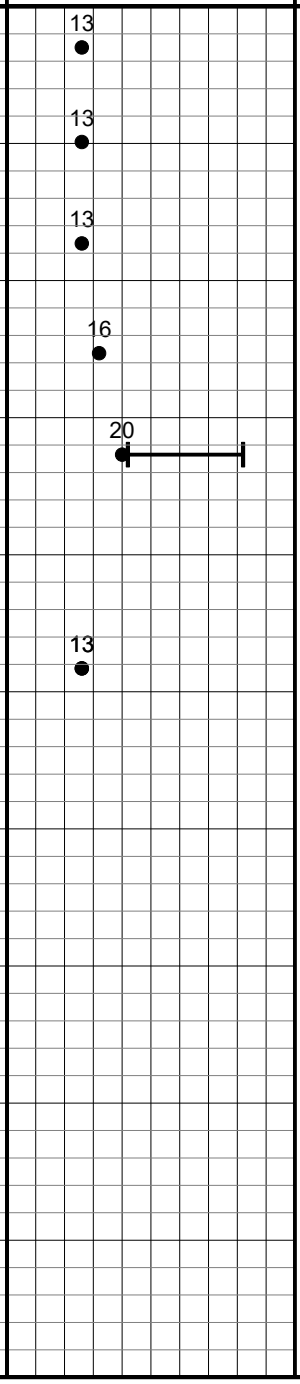
DRILLING DATE: May 4, 2021

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
79.4	Ground Surface				
0.0	**13 cm TOPSOIL**	1	DO	16	0
0.1	Stiff to hard				
	weathered	2	DO	36	1
	SILTY CLAY TILL	3	DO	24	
	trace of gravel				2
	occ. sand seams, cobbles and boulders	4	DO	36	
	brown grey	5	DO	23	3
					4
		6	DO	44	
74.3					5
5.1	**END OF BOREHOLE**				6
					7
					8
					9
					10









WATER LEVEL

W.L. @ El. 75.6 m on completion

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Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

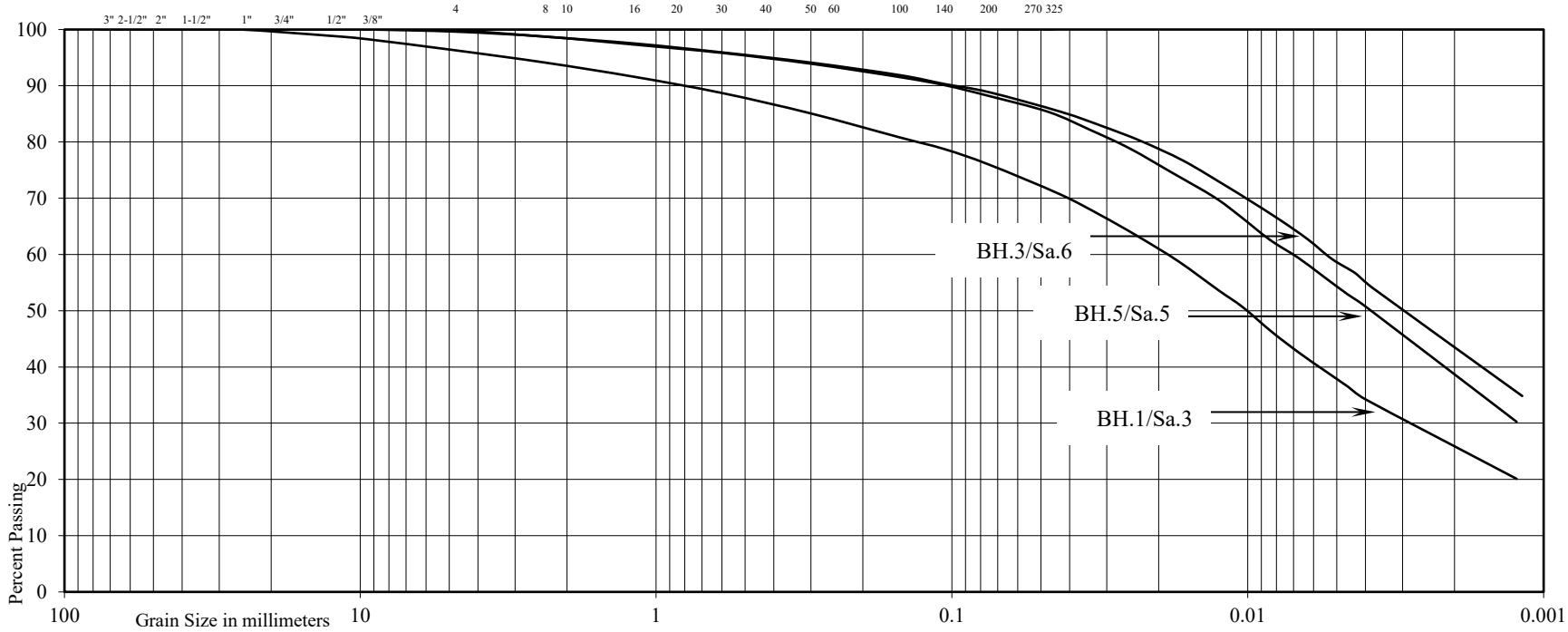
Reference No: 2103-S159

U.S. BUREAU OF SOILS CLASSIFICATION

GRAVEL		SAND				SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	V. FINE		

UNIFIED SOIL CLASSIFICATION

GRAVEL		SAND			SILT & CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Project: Proposed Channel and Wetland

Location: Fifty Point Conservation Area, City of Hamilton (Stony Creek)

Borehole No:	1	3	5
Sample No:	3	6	5
Depth (m):	-	-	-
Elevation (m):	-	-	-

BH./Sa.	1/3	3/6	5/5
Liquid Limit (%) =	-	43	41
Plastic Limit (%) =	-	22	21
Plasticity Index (%) =	-	21	20
Moisture Content (%) =	-	-	-
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

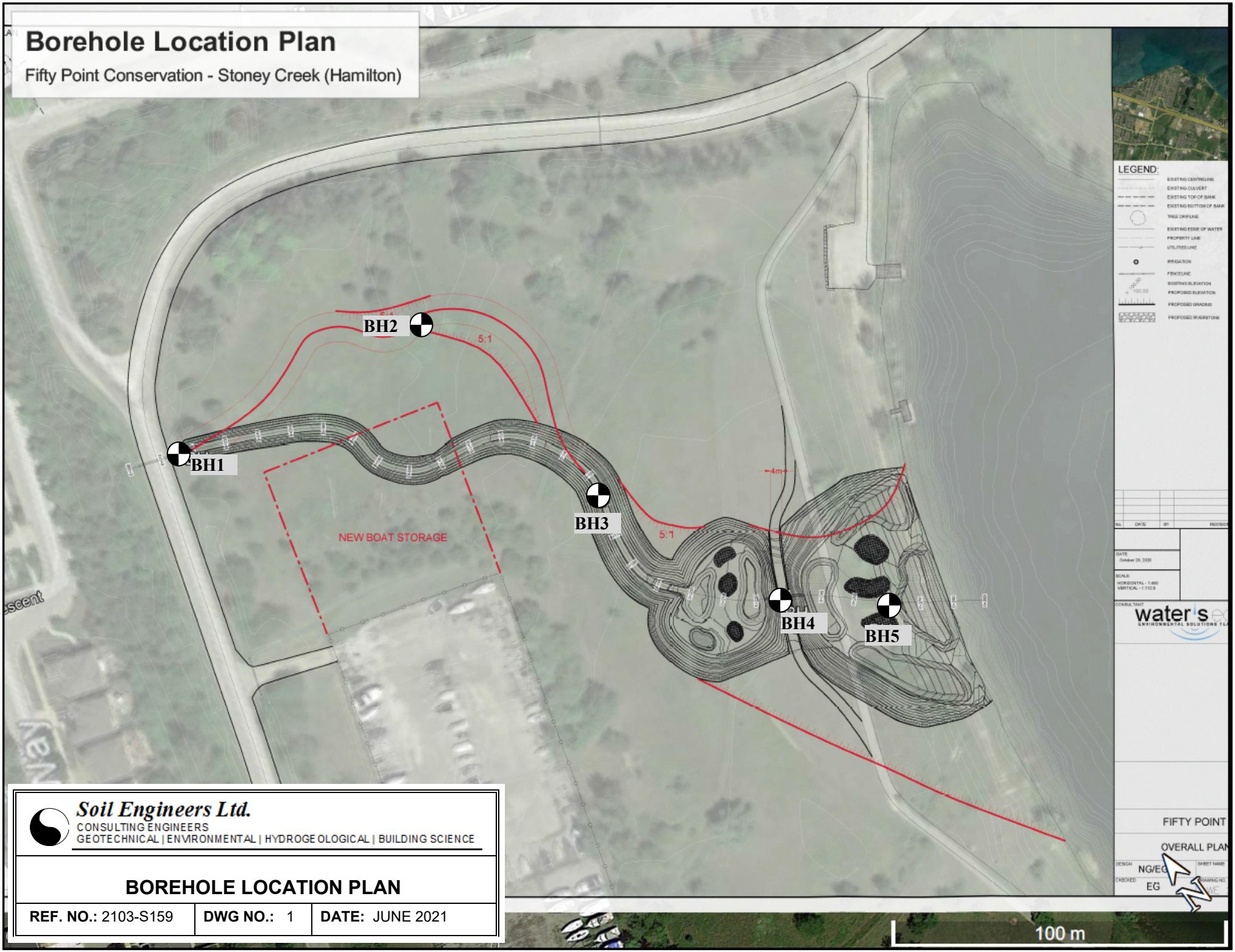
Classification of Sample [& Group Symbol]: BH.1/Sa.3 - SILTY CLAY TILL, some sand to sandy, a trace of gravel

BH.3/Sa.6 and BH.5/Sa.5 - SILTY CLAY, some sand

Figure: 6

Borehole Location Plan

Fifty Point Conservation - Stoney Creek (Hamilton)



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GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

BOREHOLE LOCATION PLAN

REF. NO.: 2103-S159	DWG NO.: 1	DATE: JUNE 2021

Soil Engineers Ltd.
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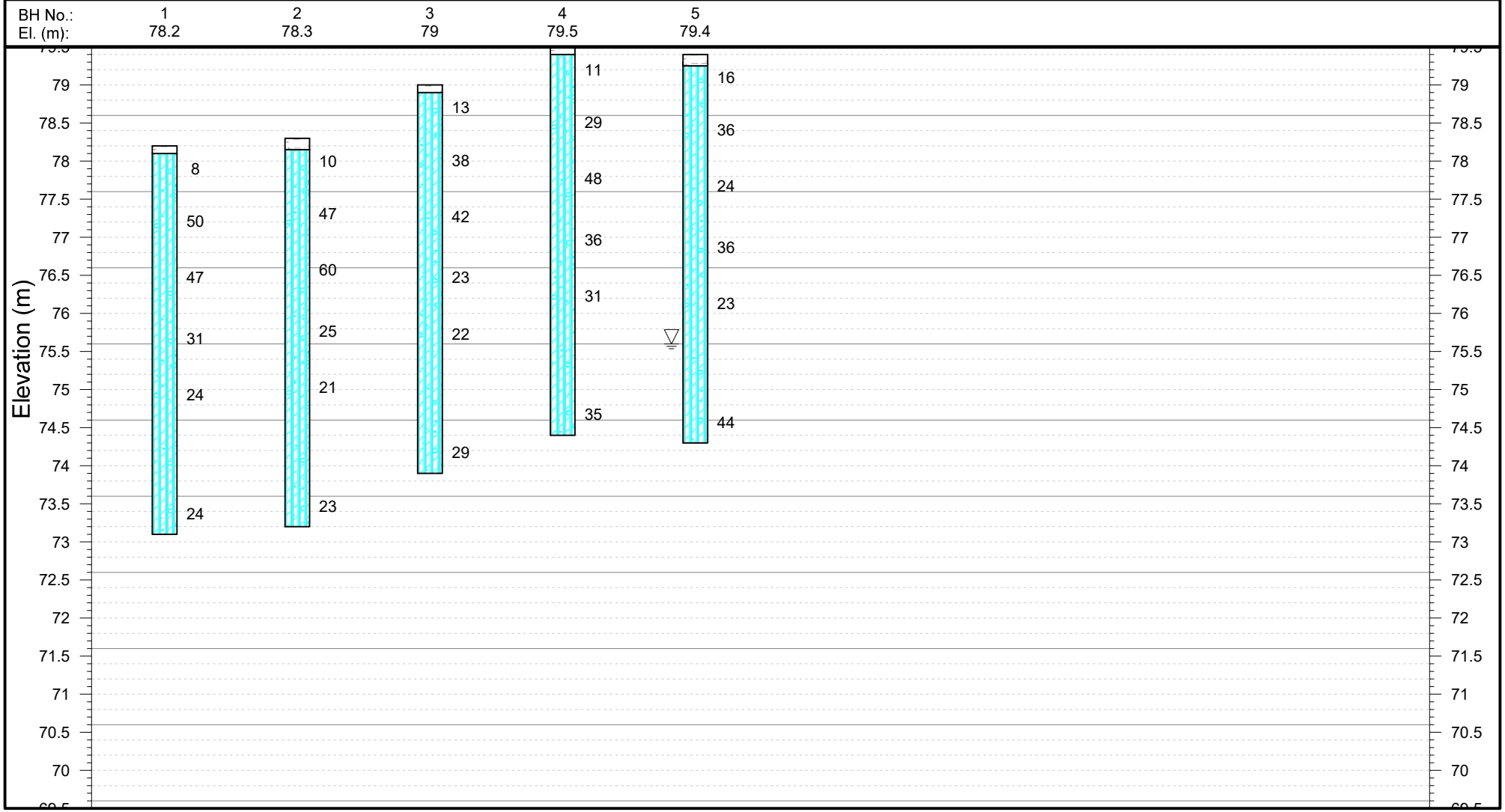
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2103-S159
REPORT DATE: June 2021
PROJECT DESCRIPTION: Proposed Channel and Wetland

PROJECT LOCATION: Fifty Point Conservation Area
City of Hamilton (Stoney Creek)

LEGEND
TOPSOIL
SILTY CLAY TILL
WATER LEVEL (END OF DRILLING)
CAVE-IN



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

August 3, 2021

Water's Edge Environmental Solutions Team Ltd.
25 Water Street South
Cambridge, Ontario
N1R 3C7

Attention: Mr. Nik Gazendam

Re: Results of Chemical Analysis of Soil Samples
Proposed Channel and Wetland
1479 Baseline Road
City of Hamilton (Stoney Creek)

Dear Sir:

As requested, we have completed the sampling and chemical analyses of soil samples collected from geotechnical boreholes drilled at the captioned project and herein present our findings and recommendations.

The investigation was conducted northeast of Baseline Road and Lockport Way in the City of Hamilton (Stoney Creek). The municipal address for the subject site is 1479 Baseline Road, City of Hamilton (Stoney Creek). It is understood that this investigation was carried out to determine the environmental quality of the soil at the captioned site.

Field Work

The field work, consisting of the drilling of five (5) boreholes at the subject site was conducted June 8, 2021. The boreholes were drilled to depth of ranging from 0.5 m to 5.1 m below ground surface. The borehole locations are shown on the borehole Location Plan, Drawing No. 1and 2.

The boreholes were drilled to the sampling depths by a drilling rig. Soil samples were retrieved from the boreholes using a split spoon, for soil classification and visual and olfactory observations. The sampling tool (i.e., split spoon) is decontaminated prior to initial use, between the sampling locations and at the completion of sampling activities. The sampling tool is manually scrubbed with a brush using a phosphate-free solution and washed to remove any adhered soils, foreign material and potential contaminants.

The field work was conducted by a Soil Engineers Ltd. environmental technician who recorded the findings and observations in the field.

Subsurface Condition

The investigation has disclosed that beneath of topsoil veneer and the area is underlain by silty clay till. Detailed descriptions of the subsurface conditions are presented on the Borehole Log Figure 1 to 5, inclusive.

Site Condition Standard

The analytical results of the soil samples were compared to the Ministry of the Environment Conservation and Parks (MECP) Standards:

- Table 1, Full Depth Background Site Condition Standards for Residential/Parkland/Institutional/ Industrial/Commercial/Community uses, in accordance with the "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" (EPA), April 15, 2011 (hereinafter referred to as "Table 1 Standards").

- Table 2, Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for Residential/Parkland/Institutional Property uses, for coarse textured soil, in accordance with the "Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act" (EPA), April 15, 2011 (hereinafter referred to as "Table 2 RPI Standards").

Soil Sampling and Soil Quality

Representative soil samples were retrieved from five (5) boreholes drilled at the captioned site. . No evidence of potential contamination was documented in any of the retrieved soil samples. Head space vapour screening was also conducted for the retrieved soil samples using combustible gas detector (RKI Eagle) in methane elimination mode, having a minimum detection of 2 ppm (parts per million by volume). Soil vapour measurements 0 ppm were recorded for the soil samples, indicating no combustible gases in the soil samples retrieved from the sampling locations.

Based on the vapour measurements and visual and olfactory observations, representative soil samples from the sampling locations were submitted to the laboratory for chemical analyses.

The samples were sent to AGAT Laboratories, accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA), for chemical analysis of Petroleum Hydrocarbons (PHCs), Polycyclic Aromatic Hydrocarbons (PAHs) and Metals and Inorganics (M&I) parameters.

The sampling program is as follows:

Borehole Number	Sample Number	Laboratory ID	Soil Type	Depth (*mbgs)	Gas Reading (**ppm)	Test Conducted
1	BH1/2	2597802	Silty Clay Till	0.8 - 1.2	0	PAHs
	BH1/3	2597803	Silty Clay Till	1.5 - 2.0	0	PHCs
	BH1/4	2597805	Silty Clay Till	2.3 - 2.8	0	M&I
2	BH2/1	2597806	Silty Clay Till	0.0 - 0.6	0	PAHs
	BH2/3	2597808	Silty Clay Till	1.5 - 2.0	0	M&I
	BH2/4	2597809	Silty Clay Till	2.3 - 2.8	0	PHCs
3	BH3/2	2597811	Silty Clay Till	0.8 - 1.2	0	PAHs
	BH3/4	2597812	Silty Clay Till	2.3 - 2.8	0	M&I, PHCs
4	BH4/2	2597819	Silty Clay Till	0.8 - 1.2	0	M&I, PHCs
	BH4/3	2597820	Silty Clay Till	1.5 - 2.0	0	PAHs
5	BH5/1	2597821	Silty Clay Till	0.8 - 1.2	0	M&I
	BH5/2	2597822	Silty Clay Till	1.5 - 2.0	0	PAHs
	BH5/4	2597825	Silty Clay Till	2.3 - 2.8	0	PHCs

*mbgs = meters below ground surface **ppm = part per million by volume

A review of the results of the soil samples indicates that the tested parameters at the tested locations meet Table 1 Standards with the exception of the following parameter:

Sample Name	Parameter	Unit	Table 1 Standards	Table 2 RPI Standards	Measured Value
BH3/4	Electrical Conductivity	mS/cm	0.57	0.7	0.629

A review of the results of the soil samples indicates that the tested parameters at the tested locations meet the Table 2 RPI Standards.

One must be aware that soil conditions at the subject site may vary between sampling locations. Please note that the acceptance of soil material along with the frequency of sampling and testing are at the discretion of the receiving site.

Should any queries arise, please feel free to contact this office.

Yours very truly,

SOIL ENGINEERS LTD.

Ahmed Hassan, P.Eng.
AH:ah

Enclosed

- Sample Location Plan (1 Page)
- Borehole Location Logs (5 Pages)
- Certificate of Analysis (15 Pages)

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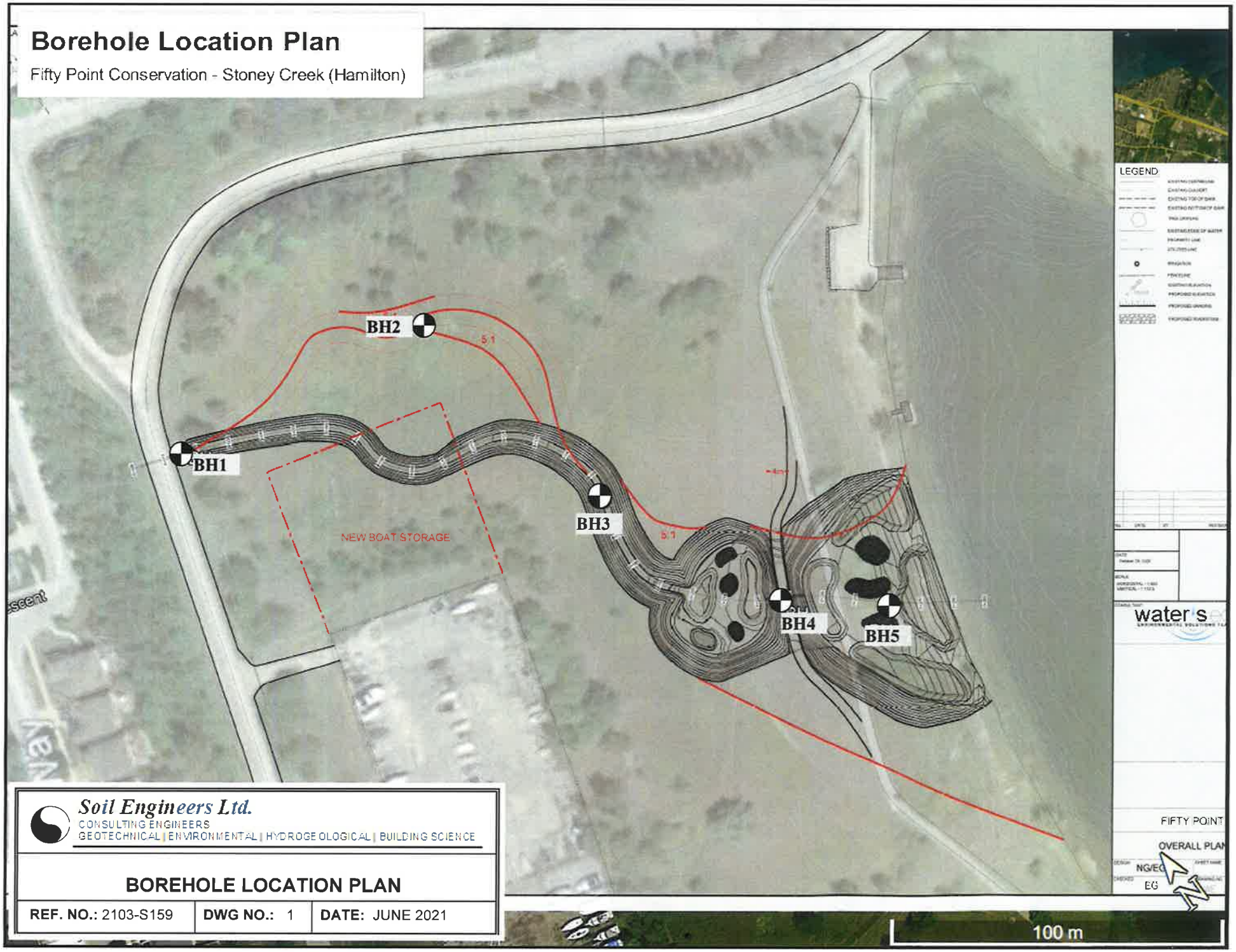
Sampling Location Plan

Borehole Location Plan

Fifty Point Conservation - Stoney Creek (Hamilton)



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BOREHOLE LOCATION PLAN

REF. NO.: 2103-S159	DWG NO.: 1	DATE: JUNE 2021

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Certificate of Analysis

AGAT Laboratories

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CLIENT NAME: SOIL ENGINEERS LIMITED
90 WEST BEAVER CREEK ROAD, UNIT 100
RICHMOND HILL , ON L4B 1E7
(416) 754-8515
ATTENTION TO: Ahmed Hassan
PROJECT: 2103-E159
AGAT WORK ORDER: 21T760179
SOIL ANALYSIS REVIEWED BY: Jacky Zhu, Spectroscopy Technician
TRACE ORGANICS REVIEWED BY: Oksana Gushyla, Trace Organics Lab Supervisor
DATE REPORTED: Jun 18, 2021
PAGES (INCLUDING COVER): 15
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.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *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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Certificate of Analysis

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

SAMPLING SITE:Hamilton

ATTENTION TO: Ahmed Hassan

SAMPLED BY:Edward Lai

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-06-11

DATE REPORTED: 2021-06-18

SAMPLE DESCRIPTION:				BH1/4	BH2/3	BH3/4	BH4/2	BH5/1
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2021-06-08	2021-06-08	2021-06-08	2021-06-08	2021-06-08
Parameter	Unit	G / S	RDL	2597805	2597808	2597812	2597819	2597821
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	5	6	6	7	7
Barium	µg/g	220	2.0	72.4	83.0	107	98.8	102
Beryllium	µg/g	2.5	0.4	0.7	0.7	0.8	0.8	0.8
Boron	µg/g	36	5	10	11	13	11	11
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.18	0.15	0.17	<0.10	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	5	23	23	25	24	24
Cobalt	µg/g	21	0.5	11.2	13.3	13.9	13.0	13.5
Copper	µg/g	92	1.0	36.6	35.4	34.5	60.0	35.4
Lead	µg/g	120	1	11	12	12	12	11
Molybdenum	µg/g	2	0.5	<0.5	0.5	0.5	<0.5	<0.5
Nickel	µg/g	82	1	22	26	27	26	26
Selenium	µg/g	1.5	0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Silver	µg/g	0.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	µg/g	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	µg/g	2.5	0.50	0.60	0.67	0.75	0.67	0.60
Vanadium	µg/g	86	0.4	32.3	33.1	37.1	34.9	35.6
Zinc	µg/g	290	5	66	68	70	69	63
Chromium, Hexavalent	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide, Free	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity (2:1)	mS/cm	0.57	0.005	0.182	0.256	**0.629**	0.409	0.143
Sodium Adsorption Ratio (2:1) (Calc.)	N/A	2.4	N/A	0.295	0.433	0.431	0.372	0.139
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.82	7.91	7.94	7.83	7.84

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

SAMPLING SITE:Hamilton

ATTENTION TO: Ahmed Hassan

SAMPLED BY:Edward Lai

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2021-06-11 **DATE REPORTED: 2021-06-18**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
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.

2597805-2597821 EC was determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. SAR is a calculated parameter.

Analysis perfomed at AGAT Toronto (unless marked by *)

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AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

SAMPLING SITE:Hamilton

ATTENTION TO: Ahmed Hassan

SAMPLED BY:Edward Lai

O. Reg. 153(511) - PAHs (Soil)

DATE RECEIVED: 2021-06-11

DATE REPORTED: 2021-06-18

SAMPLE DESCRIPTION:				BH1/2	BH2/1	BH3/2	BH4/3	BH5/2
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2021-06-08	2021-06-08	2021-06-08	2021-06-08	2021-06-08
Parameter	Unit	G / S	RDL	2597802	2597806	2597811	2597820	2597822
Naphthalene	µg/g	0.09	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthylene	µg/g	0.093	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthene	µg/g	0.072	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	µg/g	0.12	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene	µg/g	0.69	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/g	0.16	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	µg/g	0.56	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pyrene	µg/g	1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benz(a)anthracene	µg/g	0.36	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chrysene	µg/g	2.8	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b)fluoranthene	µg/g	0.47	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/g	0.48	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a)pyrene	µg/g	0.3	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-cd)pyrene	µg/g	0.46	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/g	0.1	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/g	0.68	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1 and 2 Methlynaphthalene	µg/g	0.59	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Moisture Content	%		0.1	12.7	18.6	12.0	12.2	14.6
Surrogate	**Unit**	**Acceptable Limits**						
Naphthalene-d8	%	50-140		90	73	86	121	107
Acenaphthene-d10	%	50-140		89	89	98	99	89
Chrysene-d12	%	50-140		85	85	85	101	85

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
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.

2597802-2597822 Results are based on the dry weight of the soil.
Note: The result for Benzo(b)Fluoranthene is the total of the Benzo(b)&j)Fluoranthene isomers because the isomers co-elute on the GC column.
2- and 1-Methyl Naphthalene is a calculated parameter. The calculated value is the sum of 2-Methyl Naphthalene and 1-Methyl Naphthalene.

Analysis perfomed at AGAT Toronto (unless marked by *)

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2021-06-11

DATE REPORTED: 2021-06-18

		SAMPLE DESCRIPTION:		BH1/3	BH2/4	BH3/4	BH4/2	BH5/4
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2021-06-08	2021-06-08	2021-06-08	2021-06-08	2021-06-08
Parameter	Unit	G / S	RDL	2597803	2597809	2597812	2597819	2597825
Benzene	µg/g	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Toluene	µg/g	0.2	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
m & p-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
o-Xylene	µg/g		0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Xylenes (Total)	µg/g	0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6 - C10)	µg/g	25	5	<5	<5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	<5	<5	<5	<5
F2 (C10 to C16)	µg/g	10	10	<10	<10	<10	<10	<10
F3 (C16 to C34)	µg/g	240	50	<50	<50	<50	<50	<50
F4 (C34 to C50)	µg/g	120	50	<50	<50	<50	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA	NA	NA	NA
Moisture Content	%		0.1	11.6	14.2	14.7	12.2	11.7
Surrogate	**Unit**	**Acceptable Limits**						
Toluene-d8	% Recovery	60-140		77	82	97	82	90
Terphenyl	%	60-140		112	103	100	90	83

Certified By:

AGAT Laboratories

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AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

O. Reg. 153(511) - PHCs F1 - F4 (Soil)

DATE RECEIVED: 2021-06-11

DATE REPORTED: 2021-06-18

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use
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.

2597803-2597825 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylene and o-Xylene.
C6–C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
The calculated parameters are non-accredited. The parameters that are components of the calculation are accredited.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contribution.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.

Analysis perfomed at AGAT Toronto (unless marked by *)

Certified By:

AGAT Laboratories

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Exceedance Summary

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

CLIENT NAME: SOIL ENGINEERS LIMITED

ATTENTION TO: Ahmed Hassan

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
2597812	BH3/4	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	mS/cm	0.57	0.629

AGAT Laboratories

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

Soil Analysis

RPT Date: Jun 18, 2021			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
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	2611462		<0.8	<0.8	NA	< 0.8	110%	70%	130%	109%	80%	120%	101%	70%	130%
Arsenic	2611462		1	1	NA	< 1	112%	70%	130%	111%	80%	120%	114%	70%	130%
Barium	2611462		27.7	25.4	8.7%	< 2.0	106%	70%	130%	104%	80%	120%	104%	70%	130%
Beryllium	2611462		<0.4	<0.4	NA	< 0.4	96%	70%	130%	105%	80%	120%	110%	70%	130%
Boron	2611462		<5	<5	NA	< 5	79%	70%	130%	98%	80%	120%	93%	70%	130%
Boron (Hot Water Soluble)	2611462		0.17	0.18	NA	< 0.10	87%	60%	140%	88%	70%	130%	99%	60%	140%
Cadmium	2611462		<0.5	<0.5	NA	< 0.5	91%	70%	130%	110%	80%	120%	110%	70%	130%
Chromium	2611462		11	10	NA	< 5	100%	70%	130%	106%	80%	120%	108%	70%	130%
Cobalt	2611462		2.7	2.7	0.0%	< 0.5	99%	70%	130%	107%	80%	120%	110%	70%	130%
Copper	2611462		3.4	3.4	NA	< 1.0	89%	70%	130%	112%	80%	120%	111%	70%	130%
Lead	2611462		7	7	0.0%	< 1	101%	70%	130%	98%	80%	120%	101%	70%	130%
Molybdenum	2611462		<0.5	<0.5	NA	< 0.5	118%	70%	130%	119%	80%	120%	118%	70%	130%
Nickel	2611462		4	4	NA	< 1	96%	70%	130%	107%	80%	120%	110%	70%	130%
Selenium	2611462		<0.8	<0.8	NA	< 0.8	135%	70%	130%	108%	80%	120%	113%	70%	130%
Silver	2611462		<0.5	<0.5	NA	< 0.5	104%	70%	130%	113%	80%	120%	110%	70%	130%
Thallium	2611462		<0.5	<0.5	NA	< 0.5	105%	70%	130%	105%	80%	120%	105%	70%	130%
Uranium	2611462		<0.50	<0.50	NA	< 0.50	108%	70%	130%	105%	80%	120%	105%	70%	130%
Vanadium	2611462		25.4	24.4	4.0%	< 0.4	105%	70%	130%	107%	80%	120%	106%	70%	130%
Zinc	2611462		27	26	3.8%	< 5	101%	70%	130%	113%	80%	120%	116%	70%	130%
Chromium, Hexavalent	2586120		<0.2	<0.2	NA	< 0.2	96%	70%	130%	98%	80%	120%	91%	70%	130%
Cyanide, Free	2586144		<0.040	<0.040	NA	< 0.040	100%	70%	130%	104%	80%	120%	100%	70%	130%
Mercury	2611462		<0.10	<0.10	NA	< 0.10	102%	70%	130%	101%	80%	120%	102%	70%	130%
Electrical Conductivity (2:1)	2597805	2597805	0.182	0.184	1.1%	< 0.005	103%	80%	120%						
Sodium Adsorption Ratio (2:1) (Calc.)	2597805	2597805	0.295	0.290	1.7%	NA									
pH, 2:1 CaCl2 Extraction	2605571		7.57	7.53	0.5%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.
For a multi-element scan for lab control standards and matrix spikes, up to 10% of analytes may exceed the quoted limits by up to 10% absolute and it is considered acceptable.

Certified By:

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Quality Assurance

CLIENT NAME: SOIL ENGINEERS LIMITED

PROJECT: 2103-E159

SAMPLING SITE:Hamilton

AGAT WORK ORDER: 21T760179

ATTENTION TO: Ahmed Hassan

SAMPLED BY:Edward Lai

Trace Organics Analysis

RPT Date: Jun 18, 2021			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
O. Reg. 153(511) - PAHs (Soil)															
Naphthalene	2598985		<0.05	<0.05	NA	< 0.05	101%	50%	140%	76%	50%	140%	84%	50%	140%
Acenaphthylene	2598985		<0.05	<0.05	NA	< 0.05	122%	50%	140%	85%	50%	140%	98%	50%	140%
Acenaphthene	2598985		<0.05	<0.05	NA	< 0.05	119%	50%	140%	87%	50%	140%	101%	50%	140%
Fluorene	2598985		<0.05	<0.05	NA	< 0.05	120%	50%	140%	88%	50%	140%	107%	50%	140%
Phenanthrene	2598985		<0.05	<0.05	NA	< 0.05	81%	50%	140%	64%	50%	140%	90%	50%	140%
Anthracene	2598985		<0.05	<0.05	NA	< 0.05	89%	50%	140%	110%	50%	140%	136%	50%	140%
Fluoranthene	2598985		<0.05	<0.05	NA	< 0.05	131%	50%	140%	98%	50%	140%	111%	50%	140%
Pyrene	2598985		<0.05	<0.05	NA	< 0.05	121%	50%	140%	91%	50%	140%	138%	50%	140%
Benz(a)anthracene	2598985		<0.05	<0.05	NA	< 0.05	89%	50%	140%	96%	50%	140%	87%	50%	140%
Chrysene	2598985		<0.05	<0.05	NA	< 0.05	85%	50%	140%	89%	50%	140%	131%	50%	140%
Benzo(b)fluoranthene	2598985		<0.05	<0.05	NA	< 0.05	101%	50%	140%	90%	50%	140%	83%	50%	140%
Benzo(k)fluoranthene	2598985		<0.05	<0.05	NA	< 0.05	110%	50%	140%	90%	50%	140%	61%	50%	140%
Benzo(a)pyrene	2598985		<0.05	<0.05	NA	< 0.05	85%	50%	140%	69%	50%	140%	88%	50%	140%
Indeno(1,2,3-cd)pyrene	2598985		<0.05	<0.05	NA	< 0.05	67%	50%	140%	57%	50%	140%	68%	50%	140%
Dibenz(a,h)anthracene	2598985		<0.05	<0.05	NA	< 0.05	61%	50%	140%	56%	50%	140%	70%	50%	140%
Benzo(g,h,i)perylene	2598985		<0.05	<0.05	NA	< 0.05	93%	50%	140%	71%	50%	140%	71%	50%	140%
O. Reg. 153(511) - PHCs F1 - F4 (Soil)															
Benzene	2595934		<0.02	<0.02	NA	< 0.02	85%	60%	140%	97%	60%	140%	72%	60%	140%
Toluene	2595934		<0.05	<0.05	NA	< 0.05	105%	60%	140%	99%	60%	140%	111%	60%	140%
Ethylbenzene	2595934		<0.05	<0.05	NA	< 0.05	106%	60%	140%	106%	60%	140%	101%	60%	140%
m & p-Xylene	2595934		<0.05	<0.05	NA	< 0.05	91%	60%	140%	107%	60%	140%	103%	60%	140%
o-Xylene	2595934		<0.05	<0.05	NA	< 0.05	99%	60%	140%	110%	60%	140%	120%	60%	140%
F1 (C6 - C10)	2595934		<5	<5	NA	< 5	76%	60%	140%	78%	60%	140%	80%	60%	140%
F2 (C10 to C16)	2597825	2597825	< 10	< 10	NA	< 10	111%	60%	140%	71%	60%	140%	74%	60%	140%
F3 (C16 to C34)	2597825	2597825	< 50	< 50	NA	< 50	109%	60%	140%	85%	60%	140%	86%	60%	140%
F4 (C34 to C50)	2597825	2597825	< 50	< 50	NA	< 50	102%	60%	140%	94%	60%	140%	85%	60%	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:

AGAT Laboratories

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QA Violation

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

ATTENTION TO: Ahmed Hassan

RPT Date: Jun 18, 2021			REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Sample Id	Sample Description	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
				Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)											
Selenium		BH1/4	135%	70%	130%	108%	80%	120%	113%	70%	130%

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.
Duplicate NA: results are under 5X the RDL and will not be calculated.
For a multi-element scan for lab control standards and matrix spikes, up to 10% of analytes may exceed the quoted limits by up to 10% absolute and it is considered acceptable.

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Method Summary

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Arsenic	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Barium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Beryllium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	modified from EPA 6010D and MSA PART 3, CH 21	ICP/OES
Cadmium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Cobalt	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Copper	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Lead	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Molybdenum	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Nickel	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Selenium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Silver	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Thallium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Uranium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Vanadium	MET-93-6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Zinc	MET 93 -6103	modified from EPA 3050B and EPA 6020B and ON MOECC	ICP-MS
Chromium, Hexavalent	INOR-93-6068	modified from EPA 3060 and EPA 7196	SPECTROPHOTOMETER
Cyanide, Free	INOR-93-6052	modified from ON MOECC E3015, SM 4500-CN- I, G-387	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	modified from EPA 7471B and SM 3112 B	ICP-MS
Electrical Conductivity (2:1)	INOR-93-6036	modified from MSA PART 3, CH 14 and SM 2510 B	EC METER
Sodium Adsorption Ratio (2:1) (Calc.)	INOR-93-6007	modified from EPA 6010D & Analytical Protocol	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER

AGAT Laboratories

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http://www.agatlabs.com

Method Summary

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Trace Organics Analysis			
Naphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Acenaphthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluorene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Phenanthrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benz(a)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Chrysene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(b)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(k)fluoranthene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(a)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Indeno(1,2,3-cd)pyrene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Dibenz(a,h)anthracene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Benzo(g,h,i)perylene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
1 and 2 Methlynaphthalene	ORG-91-5106	modified from EPA 3570 and EPA 8270E	GC/MS
Naphthalene-d8	ORG-91-5106	modified from EPA 3541 and EPA 8270E	GC/MS
Acenaphthene-d10	ORG-91-5106	modified from EPA 3541 and EPA 8270E	GC/MS
Chrysene-d12	ORG-91-5106	modified from EPA 3541 and EPA 8270E	GC/MS
Moisture Content	ORG-91-5009	CCME Tier 1 Method	BALANCE
Benzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Toluene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Ethylbenzene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
m & p-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
o-Xylene	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
Xylenes (Total)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/MS
F1 (C6 - C10)	VOL-91-5009	modified from CCME Tier 1 Method	(P&T)GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	modified from CCME Tier 1 Method	P&T GC/FID
Toluene-d8	VOL-91-5009	modified from EPA SW-846 5030C & 8260D	(P&T)GC/MS
F2 (C10 to C16)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F3 (C16 to C34)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID
F4 (C34 to C50)	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

AGAT Laboratories

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Method Summary

CLIENT NAME: SOIL ENGINEERS LIMITED

AGAT WORK ORDER: 21T760179

PROJECT: 2103-E159

ATTENTION TO: Ahmed Hassan

SAMPLING SITE:Hamilton

SAMPLED BY:Edward Lai

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Gravimetric Heavy Hydrocarbons	VOL-91-5009	modified from CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009	modified from CCME Tier 1 Method	GC/FID

1 M black

AGAT Laboratories

2625 Queens Corporate Drive
Mississauga, Ontario L4Y 1Y2
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www.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)

Report Information:

Company: Soil Engineers Limited
Contact: Ahmed Hassan
Address: 90 West Beaver Creek Road, Unit 100
Richmond Hill, Ontario, L4B 1E7
Phone: 416 754 8515 Fax:
Reports to be sent to:
1. Email: a.hassan@soilengineersltd.com , oleksandr.grabovskyy@
2. Email: arezoo.karimian@soilengineersltd.com

Project Information:

Project: 2103-E159
Site Location: Hamilton
Sampled By: Edward Lai
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:

Regulatory Requirements:

(Please check all applicable boxes)

☑ Regulation 153/04
Table 1 (Indicate One)
☐ Ind/Com
☑ Res/Park
☐ Agriculture
Soil Texture (Check One)
☑ Coarse
☐ Fine

☐ Excess Soils R406
Table (Indicate One)
Sample from APEC?
☐ Yes
☐ No
☐ Stockpile ☐ In-situ

☐ Regulation 558

☐ Sewer Use
☐ Sanitary ☐ Storm
Region
☐ CCME
☐ 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

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 21T760179
Cooler Quantity:
Arrival Temperatures: 3.4 4.1 4.6
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: FF22 ICE

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

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, Inc. EC/SAR	Metals - ICPMS, ☐ CrVI, ☐ Hg, ☐ HWSB	BTEX, F1-F4 PHCs, Analyze F4G if required ☐ Yes ☐ No	PAHs	PCBs	VOC	Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	Potentially Hazardous or High Concentration (Y/N)
BH1/2	June 8, 21	AM PM	1	SOIL						☑							
BH1/3	"	AM PM	2	"					☑								
BH1/4		AM PM	1				☑										
BH2/1		AM PM	1							☑							
BH2/3		AM PM	1				☑										
BH2/4		AM PM	2						☑								
BH3/2		AM PM	1							☑							
BH3/4		AM PM	3				☑		☑								
BH4/2		AM PM	3				☑		☑								
BH4/3		AM PM	1							☑							
BH5/1		AM PM	1	V			☑										

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Oleksandr Grabovskyy	June 10, 2021	5:00PM			

Page 1 of 2

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Refer to Page 1

AGAT Laboratories

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 #:

Cooler Quantity:

Arrival Temperatures:

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: Soil Engineers Limited

Contact: Ahmed Hassan

Address: 90 West Beaver Creek Road, Unit 100, Richmond Hill, Ontario, L4B 1E7

Phone: 416 754 8515 Fax:

Reports to be sent to:
1. Email: a.hassan@soilengineersltd.com , oleksandr.grabovskyy@
2. Email: arezoo.karimian@soilengineersltd.com

Regulatory Requirements:
(Please check all applicable boxes)

☑ Regulation 153/04 — Table 1 (Indicate One): ☐Ind/Com ☑Res/Park ☐Agriculture

Soil Texture (Check One): ☑Coarse ☐Fine

☐ Excess Soils R406 — Table ___ (Indicate One)

Sample from APEC? ☐Yes ☐No

☐Stockpile ☐In-situ

☐ Regulation 558

☐ Sewer Use ☐Sanitary ☐Storm — Region

☐CCME

☐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: 2103-E159

Site Location: Hamilton

Sampled By: Edward Lai

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)	Metals & Inorganics, inc. EC/SAR (O. Reg 153)	Metals - ICPMS, ☐ CrVI, ☐ Hg, ☐ HWSB	BTEX, F1-F4 PHCs / Analyze F4G if required ☐Yes ☐No	PAHs	PCBs	VOC	Landfill Disposal Characterization TCLP: TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR											Potentially Hazardous or High Concentration (Y/N)
BH5/2	June 8, 21	AM PM	1	SOIL						☑																	
BH5/4	↓	AM PM	2	↓					☑																		
		AM PM																									
		AM PM																									
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		AM PM																									
		AM PM																									
		AM PM																									
BH5/1		AM PM																									

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Oleksandr Grabovskyy [signature]	June 10, 2021	5:00PM	[signature]		
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

21 JUN 11

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Nº:

Pink Copy - Client I Yellow Copy - AGAT I White Copy- AGAT