The Regional Municipality of Niagara

2019-T-105 (Contract RN 19-05)

Reconstruction of Regional Road 98 (Montrose Road) From Regional Road 49 (McLeod Road) to Charnwood Avenue in the City of Niagara Falls

Addendum No. 4

I Directive

This addendum shall form an integral part of the plans and specifications for the above project and shall be read in conjunction therewith. This addendum shall, however, take precedence over all requirements of the previously issued drawings and specifications with which it may prove to be at variance, unless otherwise clarified by the Engineer.

This addendum must be signed by the Tenderer in the appropriate space and must be attached to the back of the Form of Tender and placed in the Envelope for submission at the time of tendering. **Tenders not including this addendum signed as requested shall be rejected as informal.**

II Revisions

1. Form of Tender FT-4 REVISED-ADDENDUM 4

Item 1.10 has been added to the Schedule of Tender Unit Prices on **FT-4**

1.10	Dewatering and Control of Groundwater	Unit – LS	Quantity – 1

Replace FT-4 Form of Tender REVISED-ADDENDUM 4 attached to this addendum.

Failure to submit the FT-4 Form of Tender REVISED-ADDENDUM 4 at the time of closing will result in automatic rejection.

2. Special Instruction To Bidders

Add the following

25. Prompt Payment

For the purposes of this contract, a “Proper Invoice” shall be an invoice that includes the following documentation:

(a) The Contractor’s name and address
(b) The date of the Proper Invoice and the period during which the ‘Services or Materials’ were supplied

(c) Information identifying the authority, whether in the Contract or otherwise, under which the 'Services or Materials' were supplied

(d) A description, including quantity where appropriate, of the 'Services or Materials' that were supplied, **in the form of a payment certificate**

(e) The amount payable for the 'Services or Materials' that were supplied, and the payment terms must be outlined **on a covering letter deemed as the "Proper Invoice", this amount must match the amount indicated on the attached, signed payment certificate**

(f) The name, title, telephone number and mailing address of the person to whom payment is to be sent

(g) A valid WSIB certificate

(h) A statutory declaration

(i) A payment certificate signed by the contract administrator and the contractor

As per the requirements of Bill 142, the Construction Lien Act amended 2017 the 28-day prompt payment time period will start upon the successful submission of the "Proper Invoice" including all items indicated in this specificiation.

3. Special Provisions - Supplementary Special Provisions

Add the following

SSP53 DEWATERING AND CONTROL OF GROUNDWATER

The provisions of OPSS.MUNI 517 shall apply except as amended or extended herein.

This item shall be used for the design, installation, operation, and removal of a dewatering system that is required over and above a conventional sump and pump dewatering system.

As identified in the geotechnical reports (Appendix A), boreholes 3, 4, 102, and 103 were recorded as wet at depths of 4.1m to 5.6m beneath existing ground surface. The static groundwater is estimated at depths between 4m and 5m.

The Contractor shall install a dewatering system within the road closure area between Sta. 0+280 (MacBain Centre north entrance) and Sta. 0+700 (Kinsmaen Court). The dewatering system shall be in place for the duration of the installation of deep municipal services in this area. It shall be the Contractor's responsibility to determine the exact dewatering requirements and duration of the dewatering operation.

Payment shall be full compensation for the design, installation, operation, and removal of a dewatering system to meet all of the requirements of OPSS.MUNI 517. Dewatering by conventional sump and pump methods will not be paid for under this item, and shall be included in the unit costs of the appropriate tender item.

III Questions and Answers

Question 1:
As a result of the test digs that were completed on Thursday March 28, the following was observed. The ground conditions that were encounter were Sandy Silt, which was unstable and could not support a trench at a depth of 3.5m. The Sandy Silt became putty like once it had and vibration or movement of the material. Based on our experience and observation of the test digs, we expect the existing sandy silt material to not stand vertically and will fail and put extreme lateral earth pressure against the trench boxes and make it difficult with excavators to move. Since we could not obtain the test dig depth of 8m we are still not sure what to expect from the Sandy Silt. Based on previous experience we expect ground water could be encountered the following could occur: A)Side Collapse against Trench Box B) Unable to Reach Depth constant UpLift or inflow of material in trench C) Pipe Flooding. Based on what we have observed this installation of this sanitary sewer will be extremely difficult, and to help control this risk to the project we feel the need for well pointing and dewatering of the saturated sandy silt. We therefore request a specific pay item to be added to the Sanitary Sewer Section Add 4.01 c) Well Pointing and Dewatering 1 Lump Sum.

Answer 1:
An item has been added to the Schedule of Tender Unit Prices. Please refer to Revisions 1 and 3 above.

Question 2:
Storm and Sanitary Sewer items include a description for Class "B" bedding and Granular "A" cover and backfill. Please confirm if all the granular requirements for the sewers will be paid under Section -2 - ROADS Item 2.02 - Granular 'A'

Answer 2:
All granular required under this tender will be paid for under Section -2 – ROADS Item 2.02 – Granular 'A'.

Question 3:
Would it be possible to get a separate download link of the soils report for this project?
Answer 3:
A separate copy of the geotechnical investigation report, and the supplemental geotechnical investigation report are attached to this addendum.

End of Addendum No. 4
No. of Pages: 60 (1 pg FT-4 Form of Tender REVISED-ADDENDUM 4 + 34 pg SM 166764-G + 21 SM 177726-G)

Date Issued: April 4, 2019

Signature: Vicki Lafford-Field
Purchasing Agent

The Tenderer Shall Adjust Their Bid Price According To The Changes Specified in this Addendum.

Name of Company: _____

Tenderer's Signature _____

Date: _____

SCHEDULE OF TENDER UNIT PRICES

ITEM NO.	SPEC NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
SECTION 1: GENERAL						
1.01	**A1**	**Bonding**	L.S.	1		$
1.02	**A2**	**Preconstruction Survey**	L.S.	1		$
1.03	**A3 SSP5**	**Site Office**	L.S	1		$
1.04	**A4 SSP6**	**Construction Layout**	L.S.	1		$
1.05	**A5**	**Clearing and Grubbing**				
		a) Remove existing brush & shrubs	m^2	2,200	$	$
		b) Trim existing tree branches	m	15	$	$
		c) Relocate / remove existing boulder	m^2	270	$	$
1.06	**A6**	**Tree Relocation**	ea	15	$	$
1.07	**A7 SSP7**	**Install, Maintain and Remove Silt Control Devices**				
		a) Rock check dam, OPSD 219.210	ea	1	$	$
		b) Light duty silt fence barrier, OPSD 219.110	m	210	$	$
1.08	**A8 SSP8**	**Construction Signs, Traffic Control, and Traffic Management Plan**	L.S.	1		$
1.09	**A9**	**Contingency Allowance**	L.S.	1		$ 500,000.00
1.10	**SSP53**	**Dewatering and Groundwater Control**	L.S.	1		$
					Total Section 1	**$**

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

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PROJECT NO.: SM 166764-G

October 12, 2016

PARSONS
4342 Queen Street – Unit 407
Niagara Falls, Ontario
L2E 7J7

Attention: Noris Bot, P.Eng.
Senior Project Manager – Road and Highway Division

GEOTECHNICAL INVESTIGATION
PROPOSED ROADWAY RECONSTRUCTION
MONTROSE ROAD
NIAGARA FALLS, ONTARIO

Dear Mr. Bot,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The investigation and reporting were undertaken in general accordance with our proposal P6039, dated January 22, 2016. Our comments and recommendations, based on our findings at the fourteen borehole locations are presented herein.

1. INTRODUCTION

We understand that the project will involve the urbanization of the existing asphalt paved roadway on Montrose Road between McLeod Road and Charnwood Avenue in Niagara Falls, Ontario. This will involve widening of the existing roadway, reconstruction of the existing asphalt pavement, possible reconstruction of sewers and watermains, and possible reconstruction of the existing culvert crossing just north of McLeod Road. The purpose of this geotechnical investigation work was to assess the existing pavement structure and subsurface soil conditions, and to provide our comments and recommendations with respect to the proposed roadway reconstruction and related earthworks, from a geotechnical point of view. This report is based on the above summarised project description and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project may void the recommendations given in this report.

2. PROCEDURE

A total of eleven [11] boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. At each of the six locations, a second shallow borehole was advanced through the road shoulder. The borings were advanced using solid stem continuous flight auger equipment on July 26, 2016 under the direction and supervision of a staff member of SOIL-MAT ENGINEERS & CONSULTANTS LTD. The boreholes were advanced using truck-mounted drill equipment to termination at depths of between approximately 0.5 and 5.0 metres below the existing pavement surface. It is noted that due to the presence of underground utilities, overhead clearance, and restrictions associated with lane closures close to an intersection, SOIL-MAT was unable to advance a borehole near the existing culvert north of McLeod Road. Upon completion of drilling the boreholes were backfilled in general accordance with Ontario Regulation 903 and the pavement surface reinstated with a pre-mixed asphaltic concrete product.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

In addition, six [6] representative samples of the subsurface soil recovered from the boreholes were submitted to AGAT Laboratories, an independent Canadian accredited analytical laboratory, for background environmental testing consisting of a standard panel of metal and inorganic parameters. Two [2] samples from Borehole No. 4were submitted for testing for the presence of petroleum hydrocarbons ['PHC'], based on olfactory evidence noted during the fieldwork.

The boreholes were located in the field by representatives of SOIL-MAT ENGINEERS. The ground surface elevation at each borehole location has been referenced to the existing roadway surface.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in the attached Borehole Log Nos. 1 through 6, inclusive, and the following paragraphs of this report. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The project area consists of the section of Montrose Road between McLeod Road and Charnwood Avenue in Niagara Falls, Ontario. The roadway is an asphalt paved rural cross section with gravelled shoulders and side ditches, surrounded by some low-density residential lands as well as commercial properties. The pavement structure was noted to be in relatively fair to poor condition, exhibiting frequent longitudinal and lateral cracking, occasional alligator cracking, as well as a significant amount of crack sealing and repair patches.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole Nos. 1 to 6 were advanced through the pavement structure of the existing roadway. The pavement structure encountered at each borehole location has been summarised as follows:

The pavement structure at the borehole locations has summarised in the following Table No. 1:

Borehole No.	1	2	3	4	5	6
Asphaltic Concrete (mm)	150	175	175	225	175	175
Granular Base (mm)	250	300	300	300	350	500

Sand and Gravel Fill

At each borehole location a second shallower borehole was advanced through the shoulder, with the exception of Borehole No. 1, due to restrictions with utility locates. These are noted as Borehole Nos. 2S to 6S. The surficial sand and gravel fill material encountered at the surface of the shallower boreholes advanced through the shoulder have been summarised in the following table. It is noted that due to the presence of existing unlocatable underground utilities, the depth of these boreholes were limited.

Borehole No.	2S	3S	4S	5S	6S
Granular Material (mm)	>600	500	650	650	575

Clayey Silt/Sandy Silt Fill

Clayey silt/sandy silt fill was encountered beneath the pavement structure and/or surficial sand and gravel fill material in Borehole Nos. 1, 4, 4S, 5, 5S, and 6. The clayey silt/sandy silt fill material contained trace to some gravel, occasional organic inclusions, and occasional construction debris. The fill material encountered was generally soft to stiff in consistency, and was proven to depths of up to approximately 1.5 to 3.8 metres beneath the existing ground surface.

Clayey Silt/Sandy Silt

Native clayey silt/sandy silt was encountered beneath the pavement structure and/or fill material at all borehole locations with the exception of Borehole Nos. 2S, 4S, 5S, which were terminated in the upper fill. The native soil encountered was reddish brown in colour, contained traces of gravel, and was generally firm to very stiff in consistency. The native clayey silt/sandy silt was proven to termination where encountered.

Groundwater Observations

All of the boreholes were recorded as 'dry' upon completion of drilling, with the exception of Borehole Nos. 3 and 4, which were recorded as 'wet' at depths of approximately 4.3 metres beneath the existing ground surface. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes during drilling. In fine grained to cohesive soils such as the clayey silt/sandy silt encountered, the static groundwater level generally coincides with the transition in colour from brown to grey. As such, based on our experience in the area and observations during drilling, the static groundwater level is estimated at depths of between approximately 4 and 5 metres, below the anticipated depths of construction.

4. EXCAVATIONS

Excavations for the potential reconstruction of sewers and watermains are expected to extend to depths of up to about 2 to 4 metres below the existing road surface. Excavations to depths above the static groundwater level are anticipated to be relatively straightforward. The sides of excavations in the clayey silt / sandy silt soils are expected to remain stable for the short construction period at 45 degrees to the horizontal, or steeper. Where excavations extend near to below the static groundwater elevation, where wet seams are encountered, or due to surface runoff, the sides of excavations in the granular soils may have a tendency to "slough in" to slopes as flat as 3 horizontal to 1 vertical, or flatter. Notwithstanding the above, all excavations must comply with the

current Occupational Health and Safety Act and Regulations for Construction Projects. Excavation slopes steeper than those required in the Safety Act must be supported or a trench box must be provided, and a senior geotechnical engineer from this office should supervise the work.

As noted above the static groundwater level is anticipated to be at a depth of approximately 4 to 5 metres, likely near or below the depths of construction. Some infiltration of groundwater through more permeable seams and from surface runoff should be anticipated. the rate of infiltration within the overburden soils should be relatively slow, even for excavations extending to or a short distance below the estimated groundwater level, such that it should be possible to adequately control groundwater in the short term using convention construction dewatering methods, pumping from sumps in the base of excavation. Additional pumping, and possibly more sophisticated groundwater controls, may be required for deeper excavations. Where a greater rate of groundwater infiltration is encountered the contractor should be prepared to undertake works 'in the wet', possibly resulting in wider excavations, requiring additional ballast stone, etc.

The base of excavations in the existing fill and native soils are generally expected to remain firm and stable. However, in deeper excavations, or isolated areas within 'softer' fill or native deposits, some localised base instability would be anticipated. Any such base instability would be addressed by stabilisation with coarse aggregate [i.e. 50mm clear stone, 'rip-rap' stone] 'punched' into the base of excavation, the use of additional bedding material, etc. Additional sumps will also likely be required to control groundwater infiltration.

Any utility poles, light poles, etc. located within 3 metres (horizontally) of the top of an excavation slope should be braced to ensure their stability. Likewise, temporary support might be required for other existing above and below ground structures, including existing underground services, depending on their proximity to the trench excavations. Special attention must be made to ensure that the existing roadway is not undermined during excavation of the sandy soils.

5. BACKFILL CONSIDERATIONS

The majority of excavated material will consist of the clayey silt/sandy silt encountered in the boreholes as described above. These soils are generally considered suitable for use as trench backfill, provided that they are free of organic or otherwise deleterious materials, and the moisture content can be controlled to within about 3 to 4 percent of optimum. Some selective sorting of portions of the existing fill materials may be

necessary. Proper handling of the soils based on the material's moisture content and prevailing weather conditions during construction will be important in achieving a successful compaction operation. The clayey silt/sandy silt soils are generally considered to be near to slightly 'wet' of the standard Proctor optimum moisture content. Some moisture conditioning may be required depending upon weather conditions at the time of construction.

The clayey silt/sandy silt soils encountered are sensitive to moisture absorption, and will become difficult to compact when they become wet due to weather or proximity to the groundwater level. Any 'wet' soils should be spread out and allowed to air dry until suitable for compaction. Where the fill materials are 'wet' of optimum, they will become increasingly difficult to compact, with the material becoming more unstable with continued vibration from compaction efforts. The contractor should be prepared to undertake remedial measures in the event of such conditions, such as allowing material to air dry, stabilisation with the placement of coarse crushed stone material ['rip-rap', 50-millimetre clear stone, OPSS Granular 'B', Type II, etc.], limited use of vibration, thinner lifts, etc. The need for such remedial measures will be generally less in the dry summer months, and greater in the wet spring and fall months of the year.

We note that where backfill material is placed near or slightly above its optimum moisture content, the potential for long-term settlements due to the ingress of groundwater and collapse of the fill structure is reduced. It is therefore very important that the placement moisture content of the backfill soils be within 3 per cent of its standard Proctor optimum moisture content during placement and compaction to minimise long term subsidence [settlement] of the fill mass. Any imported fill required in service trenches or to raise the subgrade elevation should have its moisture content within 3 per cent of its optimum moisture content and meet the necessary environmental guidelines.

The backfilling and compaction operations should be monitored by a representative of SOIL-MAT to confirm uniform compaction of the backfill material to project specification requirements. We recommend that the lower layers of service trench backfill should be compacted to a minimum of 95 per cent of the material's standard Proctor maximum dry density [SPMDD], and the upper one metre of backfill compacted to 100 per cent of its SPMDD. The backfill should be placed in loose lifts not exceeding 300 millimetres, and should be compacted with the heaviest possible equipment that will not damage the pipe installation. The appropriate compaction equipment should be employed based on soil type, i.e. pad-toe for cohesive soils and smooth drum/vibratory plate for granular soils. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs', and around manholes. A

method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

6. MANHOLES, CATCH BASINS AND THRUST BLOCKS

In the event that the manholes, catchbasins, valve chambers, etc. are founded on the native clayey silt or suitably engineered fill, stabilised where required, the bearing surfaces will be practically non-yielding under the anticipated loads. Where such below grade structures are to be supported in fill soils the need for additional base stabilisation measures should be anticipated. In addition, the pavement surfaces may rise around precast structures under frost action. To alleviate the potential for these types of differential movements, free-draining, non-frost susceptible material should be employed as backfill around the structures located within the paved roadway limits, and compacted to 100 per cent of its SPMDD.

The thrust blocks in the clayey silt/sandy silt may be conservatively sized as recommended by the applicable Ontario Provincial Standard Specification using a horizontal allowable bearing pressure of 150 kPa [~3,000 psf]. Any backfill required behind the blocks should be granular and should be compacted to 100 per cent of its standard Proctor maximum dry density.

7. CULVERT DESIGN CONSIDERATIONS

As noted above it is anticipated that the existing culvert crossing just north of McLeod Road may be reconstructed as part of the project. It was not feasible, based on road access permit with municipal staff not allowing for lane closure close to the intersection, to advance a borehole close to the culvert location.

The existing culvert structure is a concrete box section. It is anticipated that the reconstruction would involve a similar section, or perhaps a simple extension of the existing structure to accommodate road widening. It is recommended that the new box culvert sections may be designed on the basis of conservative bearing pressures of 100 kPa [~2,000 psf] SLS and 150 kPa [~3,000 psf] ULS. It is noted that it may be necessary to undertake some level of remedial measures to prepare a suitable bearing surface, depending on the presence of fill and/or 'soft' deposits. Such measures would involve removal of unsuitable material and replacement with quality crushed granular fill compacted to 100 per cent SPMDD.

8. PAVEMENT RECONSTRUCTION CONSIDERATIONS

As noted above, the existing pavement structure encountered at the borehole locations was found to consist of approximately 150 to 225 millimetres of asphaltic concrete overlying 250 to 550 millimetres of compact granular base. Given the relatively poor condition of the existing roadway, a full depth reconstruction is recommended as the preferred approach to achieve the longest lifespan and least maintenance requirements. A partial depth reconstruction with the provision of additional granular materials may be possible, however, it is noted that a partial depth reconstruction would have a reduced lifespan and increased maintenance costs.

PARTIAL DEPTH RECONSTRUCTION

As noted a partial depth reconstruction may be considered, however given the relatively limited thickness of the existing pavement structure this approach would require the finished grade of the roadway to be raised to accommodate the placement of additional granular base material.

Partial depth reconstruction of the pavement structure would typically consist of a 'peel and pave' method. This would involve the removal of the surficial asphalt, re-grading and compaction of the existing granular base material, and placement of additional granular material as required, then placement of new asphaltic concrete. Such a partial depth reconstruction would be expected to have a reduced lifespan and increased maintenance requirements, as noted above.

It is recommended that, after the existing asphalt layers have been removed, the existing granular base material graded and re-compacted, and evaluated via proof roll using a fully-loaded dump truck or in the presence of a representative of our office. Any areas of distress should be sub-excavated and replaced with quality granular material, compacted to 100 per cent of its standard Proctor maximum dry density.

Alternatively, the existing asphalt may be pulverised into the existing granular material in order to create a useable granular base material. It may be necessary to supplement the pulverised material with some new crushed aggregate [OPSS Granular A or B Type II] to achieve a suitable gradation and depth of granular base material. Laboratory sieve analyses would be required to assess the suitability of the pulverised/existing granular materials.

Where feasible, the existing grades should be raised as much as possible to accommodate additional granular materials and asphalt layers consistent with the pavement structure recommended below. The provision of additional depth of granular

base materials would serve to extend the lifespan of the pavement structure. The existing and any new granular base materials should be compacted to 100 per cent SPMDD. The new asphalt layers should conform to those outlined in the full depth reconstruction recommendations presented below. In the event that raising the grade via the addition of granular materials is not feasible, a full depth reconstruction may be warranted.

FULL DEPTH RECONSTRUCTION

Full depth reconstruction of the pavement structure would involve the removal of the existing asphaltic concrete mat and granular base materials to the design subgrade elevation. The existing asphaltic concrete mat could be pulverised into the existing granular base material, possibly mixed in with new imported granular fill material, to create a well-graded granular product that could be re-used on the project either as trench backfill or sub-base course material depending on the material gradation. Laboratory sieve analyses would be required to assess the suitability of the pulverised/existing granular materials. The subgrade level would then be lowered to accommodate the required depths of the new pavement structure and the exposed subgrade surface proof rolled.

The exposed subgrade should be proofrolled with 3 to 4 passes of a loaded tandem truck [over the same wheel path] in the presence of a representative of SOIL-MAT, immediately prior to the placement of the sub-base material. Any areas of distress revealed by this or other means should be sub-excavated and replaced with suitable backfill material, such as with suitable on-site granular materials or imported OPSS Granular 'B', Type II, compacted to 100 percent of standard Proctor maximum dry density. Alternatively, the soft areas may be repaired by 'punching' coarse aggregate, such as a 50 millimetre clear crushed stone, into the soft areas. The need for sub-excavation of softened subgrade materials will be reduced if construction is undertaken during the dry summer months of the year and careful attention is paid to the compaction operations.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water and to prevent softening of the subgrade material. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The most severe loading conditions on the subgrade typically occur during the course of construction. Therefore, precautionary measures may have to be taken to ensure that the subgrade is not unduly disturbed by construction traffic. SOIL-MAT should be given

the opportunity to review the final pavement structure design and subdrain scheme prior to construction to ensure that they are consistent with the recommendations of this report.

The new pavement structure should conform to the applicable Region of Niagara section. A typical pavement structure to support cars, large trucks, emergency vehicles, etc. for a rural or local semi-urban roadway would consist of a minimum of:

HL3 asphalt surface course	40 millimetres
HL8 asphalt binder course	80 millimetres
Base course granular [OPSS Granular 'A']	150 millimetres
Sub-base course granular [OPSS Granular 'B', Type II]	350 millimetres

It is our opinion, that this design is suitable for use on the subject roadway, provided that the subgrade has been prepared as detailed above before the sub-base course material is placed. If the subgrade is soft, remedial measures as discussed above may have to be implemented and/or the sub-base thickness may have to be increased. The granular sub-base and base courses should be compacted to 100 per cent of their SPMDD, and asphaltic concrete layers should be compacted to a minimum of 92 per cent of their Marshall maximum relative density [MRD], or Region of Niagara requirements. A program of in-place density testing must be carried out to monitor that compaction requirements are being met.

The outlined full depth pavement reconstruction may be expected to have an approximate 20 to 25 year service life, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

GENERAL ASPHALT PLACEMENT CONSIDERATIONS

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often, significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honey combed surface. As the spreader moves forward, a responsible member of the paving crew should monitor the pavement surface, to ensure a smooth uniform surface. Surface segregation can be mitigated by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

ROAD WIDENING CONSIDERATIONS

Where the roadway section is to be widened the areas should be cleared of all organic or unsuitable material, and quality engineered fill placed and compacted as required to the design subgrade level. The fill placement and compaction should be consistent with the Backfill Considerations section above. The new pavement structure should be consistent with the full depth reconstruction recommendations noted above.

9. ENVIRONMENTAL RESULTS

As noted above, a total of eight [8] selected samples were submitted for background analytical testing in order to assess the background environmental characteristics of the on-site soils and provide comments with respect to handling of surplus material for off-site disposal. The soil samples were submitted to AGAT Laboratories, a Canadian accredited independent testing laboratory, for background chemical analysis. The testing program consisted of a standard panel of Metals and Inorganic parameters for six [6] of the collected samples. Field screening of the recovered soil samples yielded evidence of potential impact (i.e. staining, petroleum odour, etc.) in Borehole No. 4. As such, two [2] samples from Borehole No. 4 were submitted for testing for petroleum hydrocarbons [PHCs].

The laboratory test results received were compared to the applicable standard from the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act*, as follows:

- **Table 1**: Full Depth Background Site Condition Standards Residential/Parkland/Institutional and Industrial/Commercial/Community land use.
- **Table 2**: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.
- **Table 3**: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.

The results of this laboratory testing are presented in the attached AGAT Certificate of Analysis [16H124085].

Based on SOIL-MAT'S field observations and the analytical test results from AGAT, SOIL-MAT offers the following comments:

1. Samples BH1 SS2, BH2 SS1, BH3 SS2, BH4 SS1, BH5 SS2, and BH6 SS1 were found to be within the Table 1 [ALL] Standards for the tested metal and inorganic parameters with the exception of Sodium Absorption Ratio [SAR] and Electrical Conductivity [EC].
2. Samples BH1 SS2, BH2 SS1, BH3 SS2, BH4 SS1, BH5 SS2, and BH6 SS1 were found to be within the Table 2 and 3 [RPI] Standards for the tested metal and inorganic parameters with the exception of Sodium Absorption Ratio [SAR] and/or Electrical Conductivity [EC].
3. Samples BH1 SS2, BH2 SS1, BH3 SS2, BH4 SS1, and BH5 SS2 were found to be within the Table 2 and 3 [ICC] Standards for the tested metal and inorganic parameters with the exception of Sodium Absorption Ratio [SAR] and/or Electrical Conductivity [EC].
4. It is noted that the presence of elevated levels of EC and SAR is often observed in the area of municipal roadways and parking lots and is largely the result of the use of salt for winter de-icing operations. EC and SAR are essentially aesthetic parameters that do not present a hazard to human or animal life. Rather they tend to render the soil environment un-supportive of plant growth and corrosive to buried grey or cast iron pipe.
5. Samples BH4 SS3 and BH4 SS4 were found to exceed the Table 1 [ALL] Standards for multiple tested petroleum hydrocarbon parameters including Benzene, Toluene, Ethylbenzene, Xylene Mixture, F2 (C10 to C16), and F3 (C16 to C36).
6. Samples BH4 SS3 and BH4 SS4 were found to exceed the Table 2 [RPI] Standards for multiple tested petroleum hydrocarbon parameters including Ethylbenzene, Xylene Mixture, and F3 (C16 to C36).
7. Samples BH4 SS3 and BH4 SS4 were found to exceed the Table 2 [ICC] Standards for multiple tested petroleum hydrocarbon parameters including Ethylbenzene and F3 (C16 to C36).
8. Samples BH4 SS3 and BH4 SS4 were found to exceed the Table 3 [RPI] Standards for multiple tested petroleum hydrocarbon parameters including Ethylbenzene, Xylene Mixture, and F3 (C16 to C36).
9. Samples BH4 SS4 was found to exceed the Table 3 [ICC] Standards for the petroleum hydrocarbon parameter F3 (C16 to C36).
10. The soil samples secured for analytical testing are believed to be representative of the soil conditions at the borehole locations only. If any significant changes are

noted, i.e., additional odours, staining etc., SOIL-MAT ENGINEERS & CONSULTANTS LTD. should be contacted to reassess the environmental characteristics of the soil.

Given the above test results the following disposal options are applicable under Regulation 153/04 [amended by Regulation 511/09 effective July 1, 2011].

- As the tested material has been shown to exceed the Table 1 Standards for one or more parameter, surplus material may not be accepted at an off-site property subject to a Record of Site Condition of MOE Certificate of Authorisation.
- As the tested material from the upper levels of the boreholes was shown to exceed the Table 2 and 3 [RPI and ICC] Standards for metal and inorganic parameters, strictly speaking, the material may not be accepted at an off-site RPI or ICC property. However, given the nature of the EC and SAR parameters, it may be reasonable to accept surplus material at an off-site RPI or ICC property, not subject to a Record of Site Condition, under the 'beneficial use' concept. Such a use would require assessment of the receiving property and approval of the receiving property owner, and depending on the location and nature of the property consultation with the local MOE District Engineer.
- As samples BH4 SS2 and/or BH4 SS3 were found to exceed the Table 2 and 3 RPI and ICC Standards for multiple hydrocarbon parameters, material from the area of Borehole No. 4 should not be accepted at an off-site RPI or ICC property in a potable or non-potable groundwater condition. The extent of the hydrocarbon impact within this area may be delineated through addition sampling either conducted through additional boreholes or over the course of construction. At present, based on field screening, the impact does not appear to extend to adjacent boreholes. Where required to be disposed off-site, surplus material from this area, exceeding for PHC parameters, would be required to be disposed of at a registered waste receiving facility. It would be necessary to conduct TCLP leachate toxicity testing to confirm the material as non-hazardous waste prior to acceptance by a registered facility.
- Excavated soil may be reused on the subject property.

10. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.



Kyle Richardson, P.Eng.
Project Engineer

Ian Shaw, P. Eng.
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Borehole Logs 1 to 6, inclusive
AGAT Certificate of Analysis [16H124085]

Distribution: Parsons [3, plus pdf]



Soil-Mat

Engineers & Consultants Ltd.

LEGEND

BH-# Borehole

NOTES:

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. report number SM 166764-G
2. Soil samples will be discarded after 3 months unless directed otherwise by client.
3. Borehole locations are approximate.

CLIENT

Parsons

PROJECT TITLE

Geotechnical Investigation
Proposed Road Reconstruction
Montrose Road
Niagara Falls, Ontario

DRAWING TITLE

Borehole
Location Plan

DRAWING No. 1

PROJECT No.	SM 166764-G
SCALE	NTS
DATE	September 2016
DRAWN	IS
CHECKED	-
FILENAME	SM 166764-G Borehole Location Plan.kcw

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 1

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
		-0.40	**Pavement Structure** — Approximately 150 millimetres of asphaltic concrete over 250 millimetres of compact granular base.
		-1.50	**Clayey Silt/Silty Sand Fill** — Brown, trace organics, stiff.
			Clayey Silt/Sandy Silt — Reddish brown, trace gravel, very stiff,
		-5.00	End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

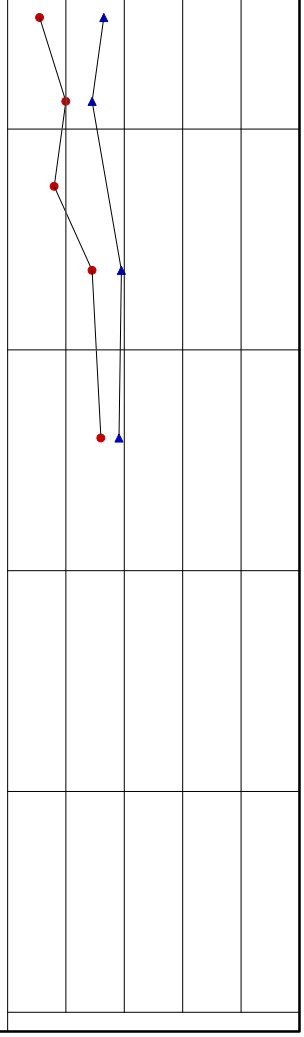
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	5,5,6	11			
SS	2	8,9,11	20			
SS	3	5,6,10	16			
SS	4	9,13,16	29			
SS	5	12,14,18	32			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 2

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: **::**

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		0.00		Ground Surface								
0	0	-0.47		***Pavement Structure*** Approximately 175 millimetres of asphaltic concrete over 300 millimetres of compact granular base.								
2		-0.70		***Clayey Silt/Sandy Silt*** Brown, reworked appearance.								
6	2			End of Borehole								
12	4											
18												
20	6											
26	8											
32												

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid-Stem Auger
Drill Date: July 26, 2016
Hole Size: 150mm
Drill Contractor: Elite Drilling

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Field Logged by: M. Brown
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Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 2S

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: **::**

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft)	Depth (m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
		0.00		Ground Surface								
0	0			***Sand and Gravel Fill***								
		-0.60		Grey, compact to dense.		SS	1	9,19,14,6	33			
2				End of Borehole								
4												
6	2											
8												
10												
12												
14	4											
16												
18												
20	6											
22												
24												
26	8											
28												
30												
32												

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 0.6 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Borehole was terminated at shallow depths due to potential conflict with existing utilities.

Drill Method: Solid-Stem Auger
Drill Date: July 26, 2016
Hole Size: 150mm
Drill Contractor: Elite Drilling

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Datum: Existing Road Surface
Field Logged by: M. Brown
Checked by: I. Shaw
Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 3

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
		-0.47	**Pavement Structure** Approximately 175 millimetres of asphaltic concrete over 300 millimetres of compact granular base
			Clayey Silt/Sandy Silt Reddish brown, trace gravel, stiff to firm.
		-5.00	End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Free groundwater was encountered at a depth of approximately 4.3 metres upon completion of drilling. Borehole was backfilled as per Ontario Regulation 903.

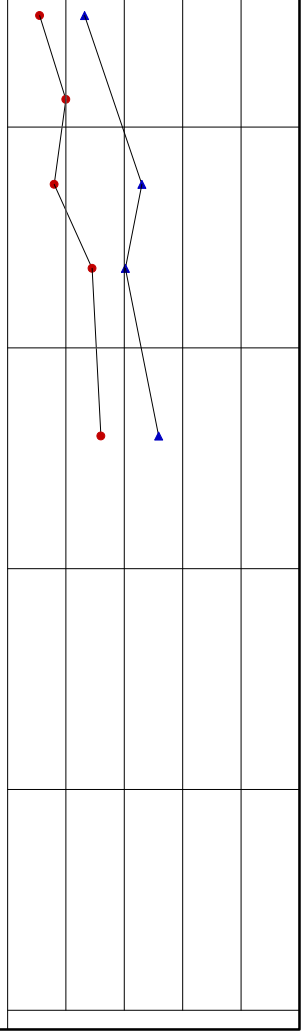
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	4,4,5	9			
SS	2	2,3,5	8			
SS	3	2,3,5	8			
SS	4	3,2,3	5			
SS	5	2,2,1 Wet Spoon	3			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 3S

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
			Sand and Gravel Fill
		-0.50	Grey, compact to dense.
			Clayey Silt/Sandy Silt
			Reddish brown, trace gravel, compact.
		-2.00	End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 2.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	6,6,7	13			
SS	2	5,5,5	10			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 4

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
		-0.53	**Pavement Structure** — Approximately 225 millimetres of asphaltic concrete over 300 millimetres of compact granular base.
			Clayey Silt and Gravel Fill — Brown, some sand, petroleum odour and staining below 2.2 metres, very stiff to hard
	2	-3.80	**Clayey Silt/Sandy Silt** — Reddish brown, trace gravel, firm.
		-5.00	End of Borehole
	4		
	6		
	8		

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Free groundwater was encountered at a depth of approximately 4.3 metres upon completion of drilling. Borehole was backfilled as per Ontario Regulation 903.

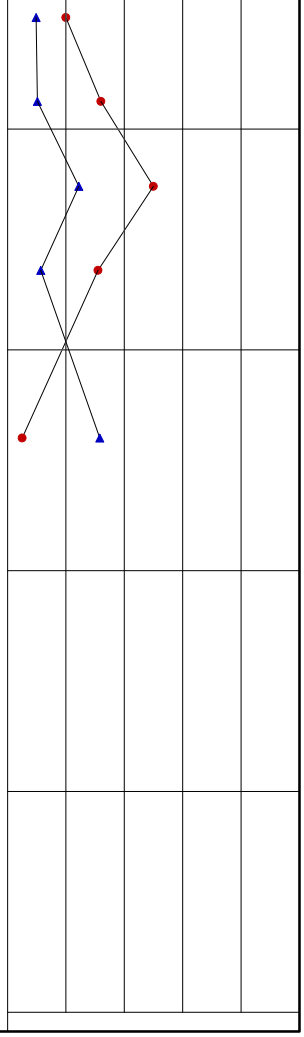
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	2,8,12	20			
SS	2	22,18,14	32			
SS	3	6,30,20 Wet Spoon	50			
SS	4	11,12,19 Wet Spoon	31			
SS	5	1,2,3 Wet Spoon	5			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 4S

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00		Ground Surface								
0 / 0			***Sand and Gravel Fill*** Grey, compact to dense.								
2 /	-0.65		***Clayey Silt/Sandy Silt Fill*** Brown, some gravel, occasional debris in the upper level, very stiff to hard		SS	1	10,12,18	30			
4 /											
6 / 2	-2.00		End of Borehole		SS	2	15,18,22	40			
8 /											
10 /											
12 / 4											
14 /											
16 /											
18 /											
20 / 6											
22 /											
24 /											
26 / 8											
28 /											
30 /											
32 /											

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 2.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 5

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
		-0.53	**Pavement Structure** — Approximately 175 millimetres of asphaltic concrete over 350 millimetres of compact granular base.
			Clayey Silt and Gravel Fill — Brown, some sand, trace rootlets, very stiff to stiff.
	2	-2.20	**Clayey Silt/Sandy Silt** — Reddish brown, trace gravel, loose
		-5.00	End of Borehole

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

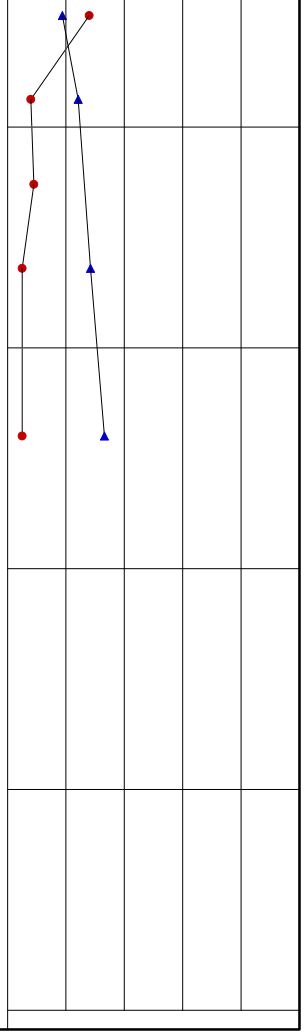
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	12,14,14	28			
SS	2	3,4,4	8			
SS	3	2,4,5	9			
SS	4	1,2,3	5			
SS	5	1,2,3	5			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 5S

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
	0.00		Ground Surface								
0	0.00		***Sand and Gravel Fill*** Grey, compact to dense.								
2	-0.65		***Clayey Silt/Sandy Silt Fill*** Brown to reddish brown, some gravel, occasional debris in the upper level, trace organics, stiff to hard.		SS	1	5,50/3"	100			
4											
6	-2.00				SS	2	3,4,5	9			
2			End of Borehole								
8											
10											
12											
4											
14											
16											
18											
20											
6											
22											
24											
26											
8											
28											
30											
32											

Moisture Content
w%
10 20 30 40

Standard Penetration Test
blows/300mm
20 40 60 80

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 2.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid-Stem Auger
Drill Date: July 26, 2016
Hole Size: 150mm
Drill Contractor: Elite Drilling

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Datum: Existing Road Surface
Field Logged by: M. Brown
Checked by: I. Shaw
Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 6

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

Depth (ft)	Depth (m)	Elevation [m]	Description
0	0	0.00	Ground Surface
		-0.53	**Pavement Structure** — Approximately 175 millimetres of asphaltic concrete over 500 millimetres of compact granular base.
			Clayey Silt/Sandy Silt Fill — Brown, some sand, trace rootlets, loose to compact.
	2	-2.20	
			Clayey Silt/Sandy Silt — Reddish brown, trace gravel,trace organics in the upper level, very loose to compact.
	4	-5.00	
			End of Borehole
	6		
	8		

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 5.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

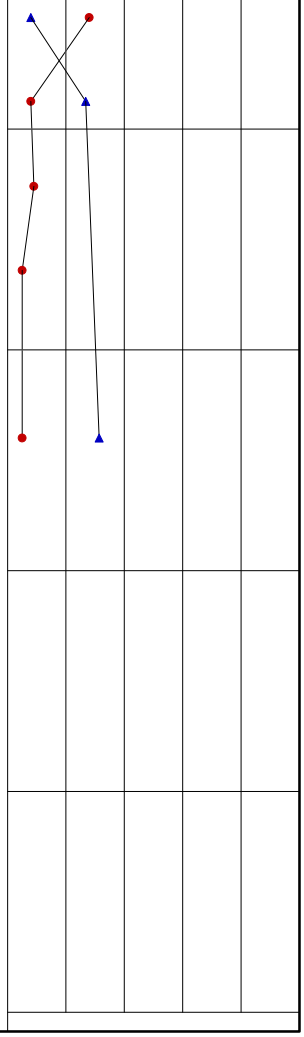
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

SAMPLE

Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
SS	1	12,14,14	9			
SS	2	3,4,4	11			
SS	3	2,4,5	2			
SS	4	1,2,3	5			
SS	5	1,2,3	28			

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)



Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

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Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

Project No: SM 166764-G

Project: Proposed Road Reconstruction

Location: Montrose Road, Niagara Falls

Client: Parsons

Log of Borehole No. 6S

Project Manager: Ian Shaw, P.Eng.

Borehole Location: See Drawing No. 1

: ::

Soil-Mat

SUBSURFACE PROFILE

SAMPLE

Depth (ft / m)	Elevation [m]	Symbol	Description	Well Data	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00		Ground Surface								
	-0.57		***Sand and Gravel Fill*** Grey, compact to dense.								
2			***Clayey Silt/Sandy Silt*** Reddish brown, trace to some gravel, stiff.		SS	1	2,4,7	11			
4											
6 / 2	-2.00				SS	2	3,4,6	10			
			End of Borehole								
8											
10											
12 / 4											
14											
16											
18											
20 / 6											
22											
24											
26 / 8											
28											
30											
32											

Moisture Content w% (10, 20, 30, 40)

Standard Penetration Test blows/300mm (20, 40, 60, 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on July 26, 2016 to termination at a depth of 2.0 metres.

2. Borehole was recorded as 'dry' upon completion of drilling and was backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid-Stem Auger

Drill Date: July 26, 2016

Hole Size: 150mm

Drill Contractor: Elite Drilling

SOIL-MAT ENGINEERS & CONSULTANTS LTD.
130 Lancing Drive, Hamilton, ON L8W 3A1
Phone: (905) 318-7440 Fax: (905) 318-7455
e-mail: info@soil-mat.on.ca

Datum: Existing Road Surface

Field Logged by: M. Brown

Checked by: I. Shaw

Sheet: 1 of 1

AGAT Laboratories

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

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT
130 LANCING DRIVE
HAMILTON, ON L8W3A1
(905) 318-7440

ATTENTION TO: Ian Shaw

PROJECT: 166764

AGAT WORK ORDER: 16H124085

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

TRACE ORGANICS REVIEWED BY: Gyulhan Yalamova, Report Reviewer

DATE REPORTED: Aug 15, 2016

PAGES (INCLUDING COVER): 8

VERSION*: 1

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

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers, Geologists and Geophysicists of Alberta (APEGGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

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Certificate of Analysis

AGAT WORK ORDER: 16H124085

PROJECT: 166764

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

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

DATE RECEIVED: 2016-08-08

DATE REPORTED: 2016-08-15

		SAMPLE DESCRIPTION:		BH1 SS2	BH2S SS1	BH3 SS2	BH4 SS1	BH5 SS2	BH6 SS1
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		7/26/2016	7/26/2016	7/26/2016	7/26/2016	7/26/2016	7/26/2016
Parameter	Unit	G / S	RDL	7757685	7757686	7757687	7757690	7757697	7757698
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	4	7	4	5	5	5
Barium	µg/g	220	2	104	24	96	72	109	131
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	0.6	<0.5	0.6	0.6
Boron	µg/g	36	5	7	9	8	14	10	12
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.16	0.49	0.27	0.72	0.57	0.46
Cadmium	µg/g	1.2	0.5	<0.5	0.7	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	17	10	20	15	22	22
Cobalt	µg/g	21	0.5	9.2	2.9	10.0	7.7	12.6	12.2
Copper	µg/g	92	1	14	10	17	20	22	18
Lead	µg/g	120	1	7	31	8	56	8	9
Molybdenum	µg/g	2	0.5	0.5	<0.5	<0.5	0.6	<0.5	0.6
Nickel	µg/g	82	1	19	7	22	17	26	26
Selenium	µg/g	1.5	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	0.2	<0.2	0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.6	<0.5	0.5	0.5	0.6	0.6
Vanadium	µg/g	86	1	23	7	29	19	30	27
Zinc	µg/g	290	5	42	167	51	164	59	62
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<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	0.14	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	**2.22**	**2.34**	**4.95**	**2.66**	**4.13**	**0.791**
Sodium Adsorption Ratio	NA	2.4	NA	**6.98**	**20.0**	**21.8**	**43.8**	**22.7**	**4.40**
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.99	8.15	7.94	8.00	7.99	8.03

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

7757685-7757698 EC & SAR were 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. Please note that samples were received and analyzed past hold time for Cyanide analysis.

Certified By: Amanjot Bhela

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Certificate of Analysis

AGAT WORK ORDER: 16H124085

PROJECT: 166764

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

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

DATE RECEIVED: 2016-08-08

DATE REPORTED: 2016-08-15

		SAMPLE DESCRIPTION:		BH4 SS3	BH4 SS4
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		7/26/2016	7/26/2016
Parameter	**Unit**	**G / S**	**RDL**	**7757691**	**7757694**
Benzene	µg/g	0.02	0.02	<0.02	**0.03**
Toluene	µg/g	0.2	0.08	**0.28**	**0.35**
Ethylbenzene	µg/g	0.05	0.05	**3.3**	**3.8**
Xylene Mixture	µg/g	0.05	0.05	**17**	**15**
F1 (C6 to C10)	µg/g		5	23	43
F1 (C6 to C10) minus BTEX	µg/g	25	5	<5	24
F2 (C10 to C16)	µg/g	10	10	<10	**22**
F3 (C16 to C34)	µg/g	240	50	**440**	**4100**
F4 (C34 to C50)	µg/g	120	50	<50	120
Gravimetric Heavy Hydrocarbons	µg/g	120	50	NA	NA
Moisture Content	%		0.1	12.2	14.5
Surrogate	**Unit**	**Acceptable Limits**			
Terphenyl	%	60-140		63	90

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

7757691-7757694 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
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 contributions.
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.

Certified By:



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Guideline Violation

AGAT WORK ORDER: 16H124085

PROJECT: 166764

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Ian Shaw

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7757685	BH1 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	2.22
7757685	BH1 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	6.98
7757686	BH2S SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	2.34
7757686	BH2S SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	20.0
7757687	BH3 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	4.95
7757687	BH3 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	21.8
7757690	BH4 SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	2.66
7757690	BH4 SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	43.8
7757691	BH4 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Ethylbenzene	0.05	3.3
7757691	BH4 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	F3 (C16 to C34)	240	440
7757691	BH4 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Toluene	0.2	0.28
7757691	BH4 SS3	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Xylene Mixture	0.05	17
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Benzene	0.02	0.03
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Ethylbenzene	0.05	3.8
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	F2 (C10 to C16)	10	22
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	F3 (C16 to C34)	240	4100
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Toluene	0.2	0.35
7757694	BH4 SS4	ON T1 S RPI/ICC	O. Reg. 153(511) - PHCs F1 - F4 (Soil)	Xylene Mixture	0.05	15
7757697	BH5 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	4.13
7757697	BH5 SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	22.7
7757698	BH6 SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	0.791
7757698	BH6 SS1	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	4.40

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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 16H124085

PROJECT: 166764

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Aug 15, 2016			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	7758240		<0.8	<0.8	NA	< 0.8	103%	70%	130%	97%	80%	120%	91%	70%	130%
Arsenic	7758240		2	2	NA	< 1	105%	70%	130%	100%	80%	120%	96%	70%	130%
Barium	7758240		106	115	8.1%	< 2	99%	70%	130%	102%	80%	120%	94%	70%	130%
Beryllium	7758240		<0.5	<0.5	NA	< 0.5	81%	70%	130%	101%	80%	120%	94%	70%	130%
Boron	7758240		6	6	NA	< 5	100%	70%	130%	107%	80%	120%	94%	70%	130%
Boron (Hot Water Soluble)	7758240		0.10	<0.10	NA	< 0.10	84%	60%	140%	101%	70%	130%	97%	60%	140%
Cadmium	7758240		<0.5	<0.5	NA	< 0.5	99%	70%	130%	104%	80%	120%	99%	70%	130%
Chromium	7758240		19	20	5.1%	< 2	91%	70%	130%	108%	80%	120%	90%	70%	130%
Cobalt	7758240		7.1	7.1	0.0%	< 0.5	97%	70%	130%	98%	80%	120%	94%	70%	130%
Copper	7758240		14	14	0.0%	< 1	89%	70%	130%	98%	80%	120%	91%	70%	130%
Lead	7758240		5	6	18.2%	< 1	121%	70%	130%	104%	80%	120%	95%	70%	130%
Molybdenum	7758240		<0.5	<0.5	NA	< 0.5	102%	70%	130%	100%	80%	120%	96%	70%	130%
Nickel	7758240		14	15	6.9%	< 1	92%	70%	130%	99%	80%	120%	97%	70%	130%
Selenium	7758240		<0.4	<0.4	NA	< 0.4	90%	70%	130%	103%	80%	120%	104%	70%	130%
Silver	7758240		<0.2	<0.2	NA	< 0.2	108%	70%	130%	110%	80%	120%	104%	70%	130%
Thallium	7758240		<0.4	<0.4	NA	< 0.4	82%	70%	130%	110%	80%	120%	100%	70%	130%
Uranium	7758240		<0.5	<0.5	NA	< 0.5	84%	70%	130%	87%	80%	120%	81%	70%	130%
Vanadium	7758240		28	28	0.0%	< 1	89%	70%	130%	105%	80%	120%	91%	70%	130%
Zinc	7758240		41	40	2.5%	< 5	98%	70%	130%	103%	80%	120%	102%	70%	130%
Chromium VI	7759370		<0.2	<0.2	NA	< 0.2	98%	70%	130%	96%	80%	120%	103%	70%	130%
Cyanide	7762942		<0.040	<0.040	NA	< 0.040	99%	70%	130%	97%	80%	120%	103%	70%	130%
Mercury	7758240		<0.10	<0.10	NA	< 0.10	109%	70%	130%	95%	80%	120%	88%	70%	130%
Electrical Conductivity	7762942		0.406	0.406	0.0%	< 0.005	99%	90%	110%	NA			NA		
Sodium Adsorption Ratio	7758240		0.166	0.156	6.2%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	7764550		11.8	11.9	0.8%	NA	101%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 16H124085

PROJECT: 166764

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date: Aug 15, 2016			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) - PHCs F1 - F4 (Soil)															
Benzene	7756576		< 0.02	< 0.02	NA	< 0.02	107%	60%	130%	90%	60%	130%	114%	60%	130%
Toluene	7756576		< 0.08	< 0.08	NA	< 0.08	99%	60%	130%	80%	60%	130%	100%	60%	130%
Ethylbenzene	7756576		< 0.05	< 0.05	NA	< 0.05	97%	60%	130%	81%	60%	130%	96%	60%	130%
Xylene Mixture	7756576		< 0.05	< 0.05	NA	< 0.05	98%	60%	130%	80%	60%	130%	98%	60%	130%
F1 (C6 to C10)	7756576		< 5	< 5	NA	< 5	76%	60%	130%	89%	85%	115%	87%	70%	130%
F2 (C10 to C16)	7752081		<10	<10	NA	< 10	100%	60%	130%	86%	80%	120%	71%	70%	130%
F3 (C16 to C34)	7752081		<50	<50	NA	< 50	103%	60%	130%	85%	80%	120%	70%	70%	130%
F4 (C34 to C50)	7752081		< 50	< 50	NA	< 50	88%	60%	130%	99%	80%	120%	100%	70%	130%

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:

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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 16H124085

PROJECT: 166764

ATTENTION TO: Ian Shaw

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Trace Organics Analysis			
Benzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Toluene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Ethylbenzene	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
Xylene Mixture	VOL-91-5009	EPA SW-846 5035 & 8260	P & T GC/MS
F1 (C6 to C10)	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F1 (C6 to C10) minus BTEX	VOL-91-5009	CCME Tier 1 Method	P & T GC/FID
F2 (C10 to C16)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F3 (C16 to C34)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
F4 (C34 to C50)	VOL-91-5009	CCME Tier 1 Method, EPA SW846 8015	GC / FID
Gravimetric Heavy Hydrocarbons	VOL-91-5009	CCME Tier 1 Method	BALANCE
Moisture Content	VOL-91-5009	CCME Tier 1 Method	BALANCE
Terphenyl	VOL-91-5009		GC/FID

Results relate only to the items tested and to all the items tested

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 intended for human consumption)

Laboratory Use Only

Work Order #: 16H124085

Cooler Quantity: sm cooler

Arrival Temperatures: 10.4 | 10.6 | 10.8
96 | 89 | 91

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: QW TCE

Report Information:

Company: Soil-Mat Engineers
Contact: Ian Shaw
Address: 130 Lancing Dr.
Hamilton, ON
Phone: 905-318-7440 Fax:
Reports to be sent to:
1. Email: Mike Brown
2. Email: Ian Shaw

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

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

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ (Indicate One)

☐ Regulation 558
☐ 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 ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: 16G764
Site Location: Montrose Rd., Niagara Falls
Sampled By: M. Brown
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 (Please Circle) Y / N	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ NO_3/NO_2 ☐ Hg ☐ pH ☐ SAR ☐ Total N	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH1 SS2	July 26/16		1	S			X														
BH2S SS1			1				X														
BH3 SS2			1				X														
BH4 SS1			1				X														
BH4 SS3			2											X							
BH4 SS4			2											X							
BH5 SS2			1				X														
BH6 SS1			1				X														

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Michael A Brown	Aug. 8/16	1:30pm	Daniella Jale	8/8/16	1:30pm
			Sima	16/8/9	906

Page 1 of 1

No: T 027635

SOIL-MAT ENGINEERS & CONSULTANTS LTD.

www.soil-mat.com info@soil-mat.on.ca TF: 800.243.1922

Hamilton: 130 Lancing Drive L8W 3A1 T: 905.318.7440 F: 905.318.7455
Milton: 20 - 348 Bronte Street South L9T 5B6 T: 905.875.3228 F: 905.875.4426

PROJECT NO.: SM 177726-G

October 18, 2017

PARSONS
4342 Queen Street – Unit 407
Niagara Falls, Ontario
L2E 7J7

Attention: Yonghui Weng, M.A.Sc., P.Eng.
Senior Municipal Engineer

SUPPLEMENTAL GEOTECHNICAL INVESTIGATION
PROPOSED MONTROSE ROAD RECONSTRUCTION
NIAGARA FALLS, ONTARIO

Dear Mr. Weng,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The investigation and reporting were undertaken in general accordance with our proposal P6884, dated June 26, 2017. Our comments and recommendations, based on our findings at the six [6] borehole locations are presented herein.

1. INTRODUCTION

We understand that the project will involve the urbanisation of the existing section of Montrose Road between McLeod Road and Charnwood Avenue in Niagara Falls, Ontario, including reconstruction/installation of sewers and watermains. The purpose of this geotechnical investigation work was to assess the existing pavement structure and subsurface soil conditions, and to provide our comments and recommendations with respect to the proposed roadway reconstruction and related earthworks, from a geotechnical point of view. This report is based on the above summarised project description and on the assumption that the design and construction will be performed in accordance with applicable codes and standards. Any significant deviations from the proposed project may void the recommendations given in this report.

It is noted that SOIL-MAT ENGINEERS undertook a geotechnical investigation along the subject roadway section in 2016, which has been reported under a separate cover [SM 166764-G, dated October 12, 2016]. This report should be read in conjunction with the findings of our initial geotechnical investigation.

2. PROCEDURE

A total of six [6] sampled boreholes were advanced at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. The boreholes were advanced using continuous flight power auger equipment on August 28 and 29, 2016 under the direction of a representative of SOIL-MAT ENGINEERS to depths of approximately 5 to 8 metres below the existing road surface. It is noted that Borehole No. 104 was initially attempted on the west side of Montrose, however encountered auger refusal at a depth of approximately 1.8 metres at multiple locations. As such, borehole No. 104 was located on the east side of Montrose Road. Upon completion of drilling the boreholes were backfilled in general accordance with Ontario Regulation 903, and the surface reinstated using a premixed asphaltic concrete product level with the existing road surface.

Representative samples of the subsoils were recovered from the borings at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests and hand penetrometer testing were performed on all soil samples recovered from the borings, with unit weight determinations conducted on selected cohesive samples.

In addition, a selected sample from each borehole was submitted for background analytical testing. The samples were submitted to AGAT Laboratories Limited, an accredited Canadian Environmental Laboratory for analytical testing for Inorganic and Metal Scans for comparison to the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act*. The results of this testing can be found appended to the end of this report.

The boreholes were located in the field by representatives of SOIL-MAT ENGINEERS, in general accordance with the drawing provided to our office. The ground surface elevation the borehole locations has been referenced to the existing roadway surface.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in the attached Borehole Log Nos. 101 through 106, inclusive. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The project area consists of the section of Montrose Road between McLeod Road and Charnwood Avenue in Niagara Falls, Ontario. The roadway is an asphalt paved rural cross section with gravelled shoulders and side ditches, surrounded by some low-density residential lands as well as commercial properties. The pavement structure was noted to be in relatively fair to poor condition, exhibiting frequent longitudinal and lateral cracking, occasional alligator cracking, as well as a significant amount of crack sealing and repair patches.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

Borehole Nos. 101 to 106 were advanced through the pavement structure of the existing roadway. The pavement structure encountered at each borehole location has been summarised as follows:

The pavement structure at the borehole locations has summarised as follows:

Borehole No.	101	102	103	104	105	106
Asphaltic Concrete (mm)	60	200	230	260	230	230
Granular Base (mm)	420	400	400	470	360	280

Clayey Silt/Sandy Silt Fill

Clayey silt/sandy silt fill was encountered beneath the pavement structure in Borehole Nos. 102 and 104. The clayey silt/sandy silt fill material contained trace to some gravel, occasional organic inclusions, and occasional construction debris. The fill material encountered was generally soft to very stiff in consistency, and was proven to depths of up to approximately 2.2 to 3.5 metres beneath the existing ground surface in Borehole Nos. 102 and 104, respectively.

Clayey Silt/Sandy Silt

Native clayey silt/sandy silt was encountered beneath the pavement structure and/or fill material in Borehole Nos. 101, 102, and 104. The native soil encountered was brown to reddish brown in colour, contained traces of gravel, and was generally stiff to very stiff in

consistency in Borehole Nos. 101 and 102, and soft to firm in Borehole No. 104. The native clayey silt/sandy silt was proven to termination where encountered.

Sandy Silt

Native sandy silt was encountered beneath the pavement structure in Borehole No. 103. The native sandy silt was reddish brown in colour, contained trace clay, and was generally in a loose state. The sandy silt encountered was noted to be moist to wet below a depth of approximately 3 metres. It is noted that the fine grained sandy silt is sensitive to disturbance during drilling activities, and as such may have yielded artificially low 'N' values (blows per foot) during drilling. Native sandy silt was proven to termination in Borehole No. 104.

Clayey Silt/Silty Clay

Native clayey silt/silty clay was encountered in Borehole Nos. 105 and 106. The native clayey silt/silty clay was brown to reddish brown in colour, contained trace gravel, and was generally soft to very stiff in consistency. A silt seam was noted at a depth of approximately 4.9 metres in Borehole No. 105. Native clayey silt/silty clay was proven to termination in Borehole Nos. 105 and 106.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicates the subsurface soils to consist of clay to silt-textured till. These conditions are consistent with our experience in the area and observations during drilling.

Groundwater Observations

All boreholes were recorded as 'dry', with the exception of Borehole Nos. 102 and 103 which were recorded as 'wet' at depths of approximately 5.6 and 4.1 metres upon completion of drilling, respectively. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes during drilling. In fine grained to cohesive soils such as the silty soils encountered, the static groundwater level typically coincides with the transition in colour from brown to grey. Based on our experience during drilling, the static groundwater level is estimated at depths of between approximately 3 and 5 metres, however some fluctuation between seasons should be anticipated.

4. DISCUSSION

The subsurface conditions encountered in the boreholes during this supplemental investigation work were generally consistent with the conditions encountered during our initial investigation work conducted in 2016. Conditions encountered during our investigation work suggest groundwater at depths of approximately 3 to 5 metres in some locations, likely due to seasonal fluctuations and weather conditions prior to drilling. In addition, the soils encountered have been noted to range from a clayey silt/silty clay, clayey silt/sandy silt, to sandy silt, rather than strictly clayey silt/sandy silt as indicated in our initial geotechnical report. As such, areas of more sandy material, as well as more clayey material, should be anticipated. In general, the comments and recommendations provided in our referenced initial geotechnical report would still be considered valid, and should be adhered to.

5. ENVIRONMENTAL RESULTS

As noted above, a total of four [4] selected samples were submitted for background analytical testing in order to assess the environmental characteristics of the on-site soil. The soil samples were submitted to AGAT Laboratories, a Canadian accredited independent testing laboratory, for a standard panel of metal and inorganic parameters. Field screening of the recovered soil samples yielded no evidence of potential hydrocarbon impact (i.e. staining, petroleum odour, etc.). The laboratory test results received were compared to the applicable standard from the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act*, as follows:

- **Table 1**: Full Depth Background Site Condition Standards Residential/Parkland/Institutional and Industrial/Commercial/Community land use.
- **Table 2**: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.
- **Table 3**: Full Depth Generic Site Condition Standards in a Non-Potable Ground Water Condition for a Residential/ Parkland/ Institutional property use, [RPI], as well as for an Industrial/ Commercial/ Community [ICC] property use.

The results of this laboratory testing are presented in the attached AGAT Certificate of Analysis [17H255807].

Based on SOIL-MAT'S field observations and the analytical test results from AGAT, SOIL-MAT offers the following comments:

1. The tested samples were found to meet the Table 1 [ALL] Standards for the parameters tested, with the exception of Samples BH102/SS2, BH105/SS2, and BH106/SS2, which were found to exceed the Standard for Electrical Conductivity [EC] and/or Sodium Absorption Ration [SAR].
2. The tested samples were found to meet the Table 2 and 3 [RPI] Standards for the parameters tested, with the exception of Samples BH102/SS2, BH105/SS2, and BH106/SS2, which were found to exceed the Standard for EC and/or SAR.
3. The tested samples were found to meet the Table 2 and 3 [RPI] Standards for the parameters tested, with the exception of Samples BH105/SS2 and BH106/SS2, which were found to exceed the Standard for EC.
4. It is noted that the presence of elevated levels of EC and SAR is often observed in the area of municipal roadways and parking lots and is largely the result of the use of salt for winter de-icing operations. EC and SAR are essentially aesthetic parameters that do not present a hazard to human or animal life. Rather they tend to render the soil environment un-supportive of plant growth and corrosive to buried grey or cast iron pipe.
5. The soil samples secured for analytical testing are believed to be representative of the soil conditions at the borehole locations only. If any significant changes are noted, i.e., additional odours, staining etc., SOIL-MAT ENGINEERS & CONSULTANTS LTD. should be contacted to reassess the environmental characteristics of the soil.

Given the above test results the following disposal options are applicable under Regulation 153/04 [amended by Regulation 511/09 effective July 1, 2011].

- As the tested material has been shown to exceed the Table 1 Standards for one or more parameter, surplus material may not be accepted at an off-site property subject to a Record of Site Condition of MOE Certificate of Authorisation.
- As the tested material was shown to exceed the Table 2 and 3 [RPI and ICC] Standards for EC and/or SAR, strictly speaking, the material may not be accepted at an off-site RPI or ICC property. However, given the nature of the EC and SAR parameters, it may be reasonable to accept surplus material at an off-site RPI or ICC property, not subject to a Record of Site Condition, under the 'beneficial use' concept. Such a use would require assessment of the receiving property and approval of the receiving property owner, and depending on the location and nature of the property consultation with the local MOE District Engineer.
- Excavated soil may be reused on the subject site.

6. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The subsoil descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

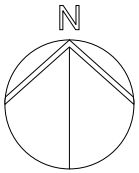


Kyle Richardson, P.Eng.
Project Engineer

Ian Shaw, P. Eng.
Senior Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Borehole Logs 101 to 106, inclusive
AGAT Certificate of Analysis [17H255807]

Distribution: Parsons [2, plus pdf]





LEGEND

2017 Borehole Location
BH#

2016 Borehole Location
BH#

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 177726-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Montrose Road
Reconstruction
Niagara Falls, Ontario

Borehole Location Plan A

Project No. SM 177726-G

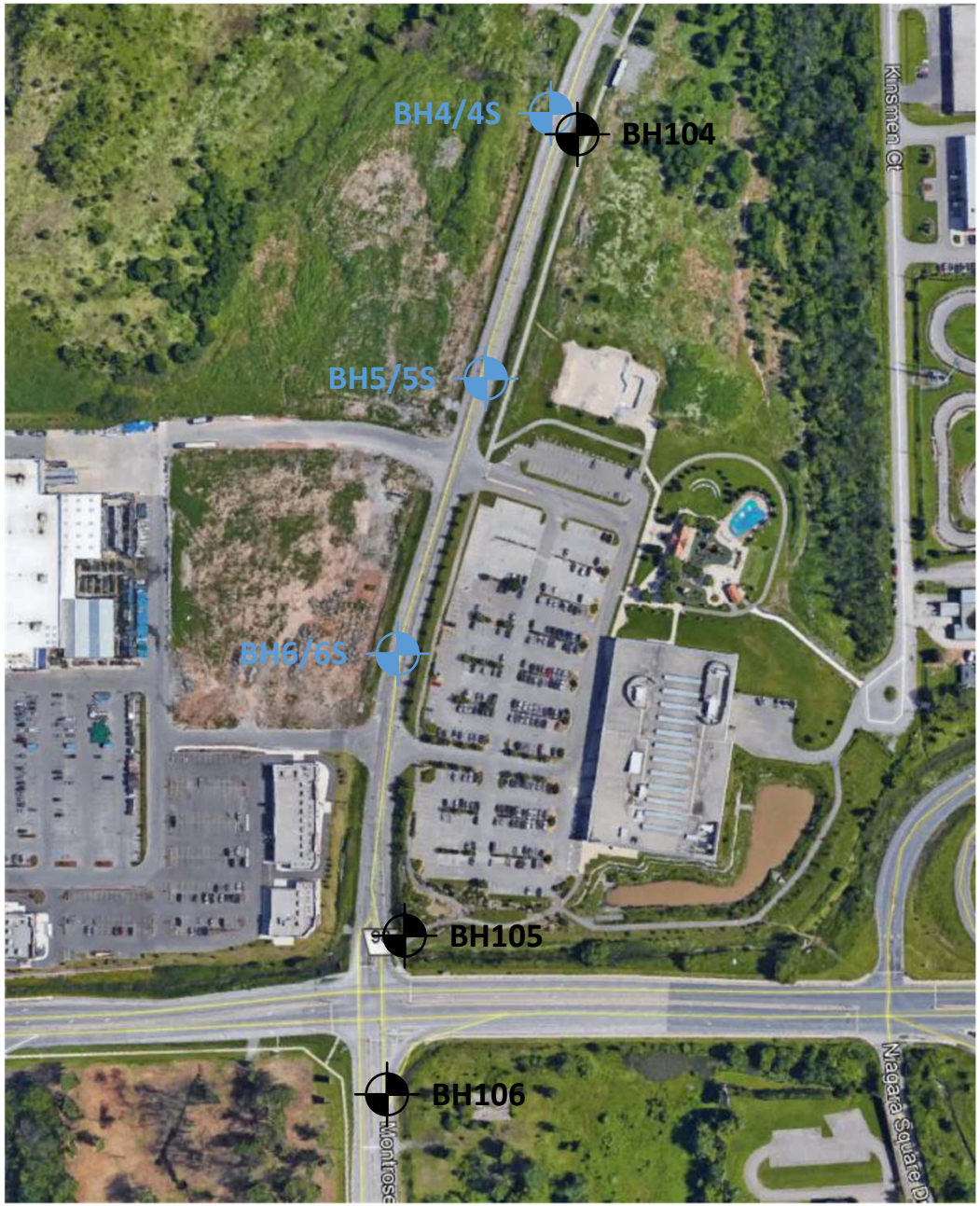
Date: September 2017

Drawn: KR	Checked: IS

SM 177726-G Borehole Location Plan A

Drawing No. 1

N



LEGEND

2017 Borehole Location
BH#

2016 Borehole Location
BH#

NOTES

1. This drawing should be read in conjunction with Soil-Mat Engineers & Consultants Ltd. Report No. SM 177726-G.

2. Borehole locations are approximate.

SOIL-MAT
ENGINEERS & CONSULTANTS LTD.

Geotechnical Investigation
Montrose Road
Reconstruction
Niagara Falls, Ontario

Borehole Location Plan B

Project No. SM 177726-G

Date: September 2017

Drawn: KR	Checked: IS

SM 177726-G Borehole Location Plan B

Drawing No. 2

Log of Borehole No. 106

Project No: SM 177726-G
Project Manager: Kyle Richardson, P.Eng.
Project: Proposed Montrose Rd. Reconstruction
Borehole Location: See Drawing No. 1
Location: Montrose Road, Niagara Falls, ON
UTM Coordinates - N:
Client: Parsons
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface							
	-0.51	**Pavement Structure** Approximately 230 millimetres of asphaltic concrete over 280 millimetres of compact granular base.							
3 / 1		**Clayey Silt/Silty Clay** Brown to reddish brown, trace sand and gravel, stiff to very soft.	SS	1	1,2,5,5	7			
6 / 2			SS	2	2,6,9,11	15			
9 / 3			SS	3	4,6,6,7	12			
11 / 4			SS	4	2,3,4,4	7			
16 / 5			SS	5	0,0,1,3	1			
21 / 6			SS	6	0,0,1,3	1			
26 / 8	-8.20		SS	7	0,2,3,5	5			
		End of Borehole							

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on August 28, 2017 to termination at a depth of 8.2 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 28, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 105

Project No: SM 177726-G
Project: Proposed Montrose Rd. Reconstruction
Location: Montrose Road, Niagara Falls, ON
Client: Parsons

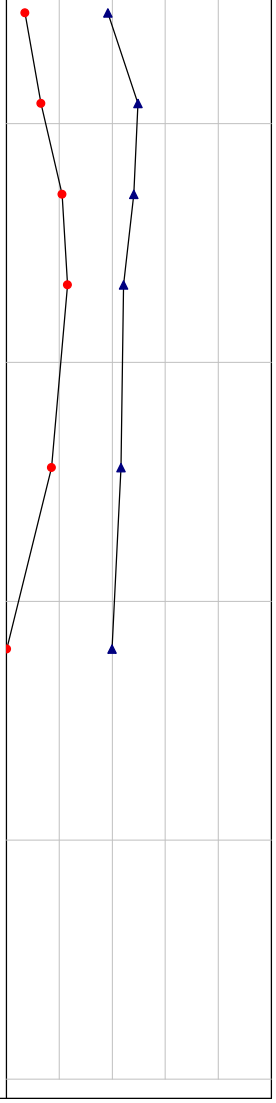
Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N:
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0		**Pavement Structure** Approximately 230 millimetres of asphaltic concrete over 360 millimetres of compact granular base.								
0 / 0	-0.59	**Clayey Silt/Silty Clay** Reddish brown, trace gravel, very stiff to stiff.		SS	1	0,3,4,5	7			
5 / 1				SS	2	4,5,8,12	13			
8 / 2				SS	3	4,8,13,18	21			
11 / 3				SS	4	5,11,12,15	23			
16 / 5	-4.90	Silt seam		SS	5	6,9,8,7	17			
20 / 6				SS	6	0,0,0,5	0			
22 / 7	-6.71	End of Borehole								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 28, 2017 to termination at a depth of 6.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 28, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 104

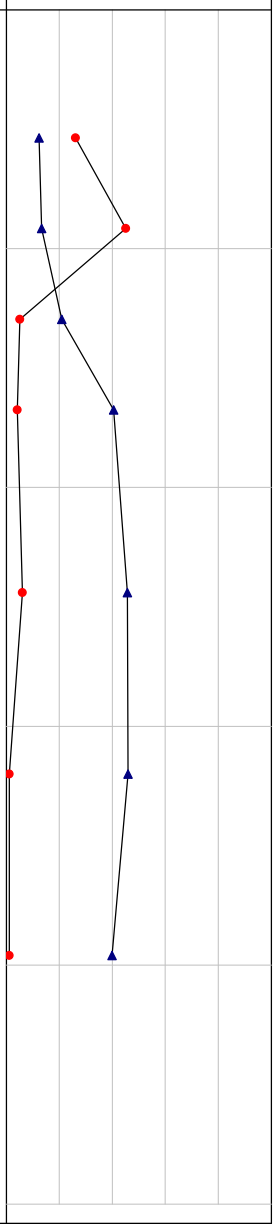
Project No: SM 177726-G
Project: Proposed Montrose Rd. Reconstruction
Location: Montrose Road, Niagara Falls, ON
Client: Parsons

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N:
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0–2 / 0–0.5	-0.73	**Pavement Structure** Approximately 260 millimetres of asphaltic concrete over 470 millimetres of compact granular base.								
2–11 / 0.5–3.5	-3.50	**Clayey Silt/Sandy Silt Fill** Brown, trace to some gravel, very stiff to soft.		SS	1	11,11,15,26	26			
				SS	2	16,24,21,18	45			
				SS	3	3,3,2,4	5			
				SS	4	3,2,2,2	4			
11–26 / 3.5–8	-8.23	**Clayey Silt/Sandy Silt** Reddish brown, trace gravel, firm to very soft.		SS	5	0,2,4,4	6			
				SS	6	0,0,1,2	1			
				SS	7	1,0,1,0	1			
26–33 / 8–9		End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 28, 2017 to termination at a depth of 8.2 metres.
2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 28, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 103

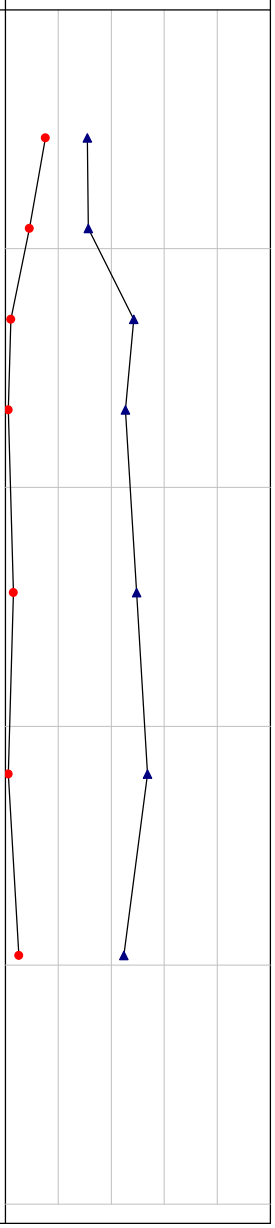
Project No: SM 177726-G
Project: Proposed Montrose Rd. Reconstruction
Location: Montrose Road, Niagara Falls, ON
Client: Parsons

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N:
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
	-0.63	**Pavemnet Structure** Approximately 230 millimetres of asphaltic concrete over 400 millimetres of compact granular base.								
3 / 1		**Sandy Silt** Reddish brown, trace clay, loose.		SS	1	5,7,8,5	15			
6 / 2				SS	2	4,4,5,4	9			
9 / 3				SS	3	1,1,1,1	2			
11 / 3				SS	4	1,0,1,2	1			
16 / 5				SS	5	0,1,2,1	3			
21 / 6				SS	6	0,0,1,0	1			
26 / 8				SS	7	2,2,3,7	5			
	-8.23	End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 29, 2017 to termination at a depth of 8.2 metres.
2. Borehole was recorded as open and 'wet' at a depth 4.1 metres upon completion, and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 29, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 102

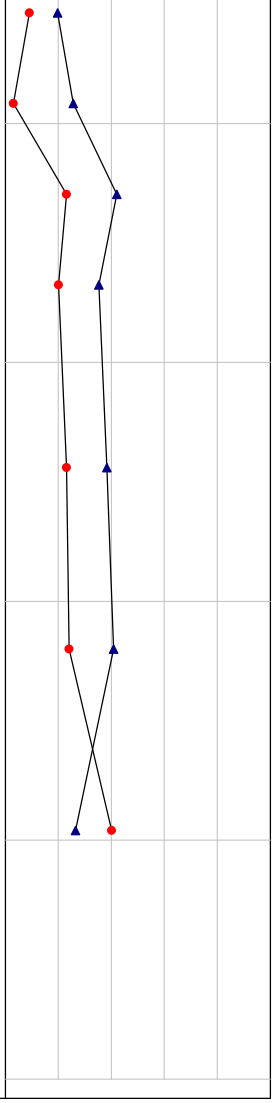
Project No: SM 177726-G
Project: Proposed Montrose Rd. Reconstruction
Location: Montrose Road, Niagara Falls, ON
Client: Parsons

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N:
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0–2 / 0–0.6	-0.60	**Pavement Structure** Approximately 200 millimetres of asphaltic concrete over 400 millimetres of compact granular base.								
2–7 / 0.6–2.2	-2.20	**Clayey Silt/Sandy Silt Fill** Brown, trace gravel, stiff to soft.		SS	1	6,4,5,7	9			
				SS	2	0,0,3,7	3			
7–26 / 2.2–8	-8.23	**Clayey Silt/Sandy Silt** Reddish brown, trace gravel, occasional sandy seam, very stiff to hard.		SS	3	5,10,13,16	23			
				SS	4	7,9,11,13	20			
				SS	5	12,12,11,13	23			
				SS	6	9,10,14,14	24			
				SS	7	8,18,22,17	40			
26–33 / 8–9		End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 29, 2017 to termination at a depth of 8.2 metres.
2. Borehole was recorded as open and 'wet' at a depth of 5.6 metres upon completion, and backfilled as per Ontario Regulation 903.
3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 29, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
130 Lancing Drive, Hamilton, ON L8W 3A1
T: 905.318.7440 F: 905.318.7455
E: info@soil-mat.ca

Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 101

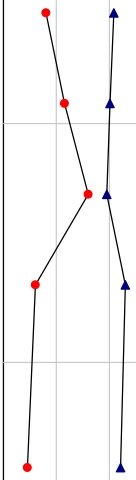
Project No: SM 177726-G
Project: Proposed Montrose Rd. Reconstruction
Location: Montrose Road, Niagara Falls, ON
Client: Parsons

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N:
E:

Soil-Mat

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0–3 / 0–1	-0.48	**Pavement Structure** Approximately 60 millimetres of asphaltic concrete over 420 millimetres of compact granular base.								
3–16 / 1–5	-5.18	**Clayey Silt/Sandy Silt** Reddish brown, trace gravel, very stiff to stiff.		SS	1	3,8,8,7	16			
				SS	2	8,11,12,16	23			
				SS	3	16,15,17,18	32			
				SS	4	5,8,4,4	12			
				SS	5	3,3,6,9	9			
16 / 5	-5.18	End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on August 29, 2017 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Augers
Drill Date: August 29, 2017
Hole Size: 200 millimetres
Drilling Contractor: DDSI

Soil-Mat Engineers & Consultants Ltd.
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Datum: Existing Road Surface
Field Logged by: SO
Checked by: KR
Sheet: 1 of 1

AGAT Laboratories

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

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT
130 LANCING DRIVE
HAMILTON, ON L8W3A1
(905) 318-7440

ATTENTION TO: Kyle Richardson

PROJECT: SM 177726

AGAT WORK ORDER: 17H255807

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Sep 08, 2017

PAGES (INCLUDING COVER): 6

VERSION*: 1

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

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.

Results relate only to the items tested and to all the items tested
All reportable information as specified by ISO 17025:2005 is available from AGAT Laboratories upon request

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 17H255807

PROJECT: SM 177726

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Kyle Richardson

SAMPLING SITE:Montrose Road

SAMPLED BY:SO

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

DATE RECEIVED: 2017-09-01

DATE REPORTED: 2017-09-08

		SAMPLE DESCRIPTION:		BH106/SS2	BH105/SS2	BH102/SS2	BH101/SS2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil
		DATE SAMPLED:		2017-08-30	2017-08-30	2017-08-30	2017-08-30
Parameter	Unit	G / S	RDL	8684375	8684377	8684378	8684379
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	5	4	5	3
Barium	µg/g	220	2	163	178	92	105
Beryllium	µg/g	2.5	0.5	1.0	1.0	0.8	<0.5
Boron	µg/g	36	5	17	18	16	6
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.14	0.16	0.17	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	33	31	26	11
Cobalt	µg/g	21	0.5	15.3	13.2	11.7	6.2
Copper	µg/g	92	1	29	20	20	8
Lead	µg/g	120	1	9	9	10	3
Molybdenum	µg/g	2	0.5	0.6	<0.5	0.6	0.7
Nickel	µg/g	82	1	31	28	26	12
Selenium	µg/g	1.5	0.4	0.4	0.4	0.5	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	0.8	0.7	0.9	<0.5
Vanadium	µg/g	86	1	46	44	38	16
Zinc	µg/g	290	5	62	53	63	28
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	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
Electrical Conductivity	mS/cm	0.57	0.005	1.72	3.76	0.773	0.303
Sodium Adsorption Ratio	NA	2.4	NA	3.03	9.56	2.26	1.61
pH, 2:1 CaCl2 Extraction	pH Units		NA	7.69	7.70	7.87	7.88

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.

8684375-8684379 EC & SAR were 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.

Certified By: Amanjot Bhela

Results relate only to the items tested and to all the items tested

AGAT Laboratories

Guideline Violation

AGAT WORK ORDER: 17H255807

PROJECT: SM 177726

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CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

ATTENTION TO: Kyle Richardson

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	UNIT	GUIDEVALUE	RESULT
8684375	BH106/SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	1.72
8684375	BH106/SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	3.03
8684377	BH105/SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	3.76
8684377	BH105/SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	NA	2.4	9.56
8684378	BH102/SS2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	mS/cm	0.57	0.773

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AGAT Laboratories

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MISSISSAUGA, ONTARIO
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Quality Assurance

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 17H255807

PROJECT: SM 177726

ATTENTION TO: Kyle Richardson

SAMPLING SITE:Montrose Road

SAMPLED BY:SO

Soil Analysis

RPT Date: Sep 08, 2017			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	8689794		<0.8	<0.8	NA	< 0.8	100%	70%	130%	92%	80%	120%	88%	70%	130%
Arsenic	8689794		3	3	NA	< 1	99%	70%	130%	98%	80%	120%	93%	70%	130%
Barium	8689794		115	115	0.0%	< 2	105%	70%	130%	103%	80%	120%	99%	70%	130%
Beryllium	8689794		0.7	0.7	NA	< 0.5	103%	70%	130%	101%	80%	120%	107%	70%	130%
Boron	8689794		9	10	NA	< 5	90%	70%	130%	113%	80%	120%	92%	70%	130%
Boron (Hot Water Soluble)	8687580		0.48	0.48	NA	< 0.10	97%	60%	140%	97%	70%	130%	97%	60%	140%
Cadmium	8689794		<0.5	<0.5	NA	< 0.5	97%	70%	130%	109%	80%	120%	101%	70%	130%
Chromium	8689794		24	24	0.0%	< 2	109%	70%	130%	103%	80%	120%	104%	70%	130%
Cobalt	8689794		7.8	7.5	3.9%	< 0.5	98%	70%	130%	103%	80%	120%	102%	70%	130%
Copper	8689794		16	15	6.5%	< 1	101%	70%	130%	120%	80%	120%	100%	70%	130%
Lead	8689794		18	17	5.7%	< 1	98%	70%	130%	105%	80%	120%	99%	70%	130%
Molybdenum	8689794		<0.5	<0.5	NA	< 0.5	101%	70%	130%	107%	80%	120%	102%	70%	130%
Nickel	8689794		15	14	6.9%	< 1	97%	70%	130%	102%	80%	120%	99%	70%	130%
Selenium	8689794		0.9	0.7	NA	< 0.4	98%	70%	130%	98%	80%	120%	104%	70%	130%
Silver	8689794		<0.2	<0.2	NA	< 0.2	97%	70%	130%	108%	80%	120%	87%	70%	130%
Thallium	8689794		<0.4	<0.4	NA	< 0.4	97%	70%	130%	100%	80%	120%	98%	70%	130%
Uranium	8689794		0.6	0.6	NA	< 0.5	107%	70%	130%	110%	80%	120%	102%	70%	130%
Vanadium	8689794		35	35	0.0%	< 1	103%	70%	130%	101%	80%	120%	101%	70%	130%
Zinc	8689794		66	64	3.1%	< 5	100%	70%	130%	119%	80%	120%	109%	70%	130%
Chromium VI	8693097		<0.2	<0.2	NA	< 0.2	101%	70%	130%	98%	80%	120%	101%	70%	130%
Cyanide	8682222		<0.040	<0.040	NA	< 0.040	90%	70%	130%	103%	80%	120%	102%	70%	130%
Mercury	8689794		<0.10	<0.10	NA	< 0.10	99%	70%	130%	89%	80%	120%	88%	70%	130%
Electrical Conductivity	8690866		1.14	1.17	2.6%	< 0.005	95%	90%	110%	NA			NA		
Sodium Adsorption Ratio	8689794		1.59	1.60	0.6%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	8689930		7.99	8.11	1.5%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

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AGAT Laboratories

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MISSISSAUGA, ONTARIO
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Method Summary

CLIENT NAME: SOIL MAT ENGINEERS & CONSULTANTS LT

AGAT WORK ORDER: 17H255807

PROJECT: SM 177726

ATTENTION TO: Kyle Richardson

SAMPLING SITE:Montrose Road

SAMPLED BY:SO

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

Results relate only to the items tested and to all the items tested

AGAT Laboratories

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

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only
Work Order #: 17H255507
Cooler Quantity: 1 BAG
Arrival Temperatures: 2.5 2.7 1.96
9.1 9.1 9.1
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes:

Report Information:
Company: Soil-Mat Engineers
Contact: Kyle Richardson
Address: 130 Lancing Drive, Hamilton, ON
Phone: 905-318-7440 Fax:
Reports to be sent to:
1. Email: Krichardson@soil-mat.ca, sergiu.onisoru@gmail.com
2. Email: ishaw@soil-mat.ca

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)

☑ Regulation 153/04 Table 1 (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine
☐ Sewer Use ☐ Sanitary ☐ Storm
Region (Indicate One)
☐ Regulation 558 ☐ 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 ☐ 1 Business Day
OR Date Required (Rush Surcharges May Apply): 5 days
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:
Project: SM 177726
Site Location: Montrose Road
Sampled By: Sergiu Onisoru
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	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	(Check Applicable) ORPs: ☐B-HWS ☐Cr ☐CN⁻ ☐Cr⁶⁺ ☐EC ☐FOC ☐NO_2/NO_3 ☐Total N ☐Hg ☐pH ☐SAR	Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3/NO_2	Volatiles: ☐VOC ☐BTEX ☐THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH1/SS2	30/08/17	PM	1			☑														
BH2/SS2	30/08/17	PM	1			☑														
BH5/SS2	30/08/17	PM	1			☑														
NH6/SS2	30/08/17	PM	1			☑														

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Ross Keller	Sept 1/17	2:05	Daniella Jaic	9/1/17	2:05pm
Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Daniella Jaic	9/1/17	2:30pm		9/1/17	2:40
	9/1/17	4:05			

Page 1 of 1
N°:

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