

**Geotechnical Investigation
Cambridge Street and Third Street Extension
Town of Collingwood, Ontario.**

Prepared For:
Dunn Capital Corporation

SPL Project No.: 10000820
Report Date: April 8, 2015

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1. INTRODUCTION

SPL Consultants Limited (SPL) was retained by Dunn Capital Corporation to undertake a geotechnical investigation for the proposed extension and reconstruction of Cambridge Street and Third Street in the Town of Collingwood, Ontario.

The purpose of the investigation was to determine the existing geotechnical conditions in the area of roadways within the study area, and from the findings in the boreholes to make geotechnical engineering recommendations for the proposed watermains, sanitary and storm sewers installation, and pavement structure. It is our understanding that the geotechnical investigation for the commercial blocks will be carried out at a later time, during individual site plan application.

As per the concept plan provided to SPL, it is understood that the proposed improvements will comprise of an extension of Cambridge Street to the south, an extension of Third Street to the west and north, and extension of the roadway access to the Home Depot parking lot to the west, and a roundabout at the intersection of the extensions of Cambridge Street, Third Street and the roadway access to the Home Depot parking lot. There is a proposal for the relocation of traffic lights from its current position (intersection of Home Depot entrance and High Street) to a new location at the intersection of Third Street/Cambridge Street and High Street.

The proposed extension and reconstruction will include installation of services including watermains, sanitary and storm sewers along Cambridge Street and Third Street. The preliminary design indicates that the sanitary services will be installed with invert elevations ranging from 178.63 m at Third Street and High Street to 181.36 m to the west, and ranging from 180.29 m to 179.08 m in the area of the proposed roundabout, i.e. at depths ranging up to 4 m below the existing grades. It is understood that watermains, sanitary and storm sewers will be installed using open cut techniques.

At present, a warehouse structure is located along the proposed alignment of Cambridge Street Extension. It is our understanding that the existing building would be demolished to facilitate construction of the Cambridge Street extension, ensuring that no part of the demolished building will be left on-site that will protrude into the subbase.

This report is provided on the basis of the terms of reference presented above and on the assumption that the design will be in accordance with the applicable codes and standards. If there are any changes in the design features relevant to the geotechnical analyses, or if any questions arise concerning the geotechnical aspects of the codes and standards, this office should be contacted to review the design. It may then be necessary to carry out additional borings and reporting before the recommendations of this office can be relied upon.

The site investigation and recommendations follow generally accepted practice for geotechnical consultants in Ontario. The format and contents are guided by client specific needs and economics and do not conform to generalized standards for services. Laboratory testing for most part follows ASTM or CSA Standards or modifications of these standards that have become standard practice.

This report has been prepared for the Dunn Capital Corporation and its designers. Third party use of this report without SPL Consultants Limited consent is prohibited.

2. FIELD AND LABORATORY WORK

Fifteen boreholes (BH14-01 to BH14-15) were drilled and/or cored as part of the investigation. Boreholes were advanced as outlined below:

- BH14-01 to BH14-03: along Cambridge Street extension;
- BH14-04: at the location of roundabout;
- BH14-05 to BH14-07, BH14-09 and BH14-10: along Third Street extension;
- BH14-08: for internal driveway
- BH14-11 to BH14-15: along High Street

The overburden in Boreholes BH14-01 to BH14-15 was drilled to depths varying between 0.7 m to 2.3 m below existing grade with solid stem continuous flight auger equipment by a drilling sub-contractor under the direction and supervision of SPL Consultants Limited personnel. Samples were retrieved at regular intervals with a 50 mm O.D. split-barrel sampler driven with a hammer weighing 624 N and dropping 760 mm in accordance with the Standard Penetration Test (SPT) method. The samples were logged in the field and returned to the SPL Consultants Limited laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples were tested for moisture contents.

The bedrock was cored at seven borehole locations (BH14-01 to BH14-07) along Cambridge Street and Third Street, using a HQ and NQ-size core barrel to depths varying between 1.3 m and 5.1 m below the bedrock surface. The recovered rock cores were visually examined and described in the field. In addition, the following index properties were noted and recorded:

- Total Core Recovery (TCR)
- Solid Core Recovery (SCR)
- Rock Quality Designation (RQD)

Water level observations were made during drilling and in the open boreholes at the completion of the drilling operations. Stabilized ground water levels were measured in monitoring wells installed in BH14-01, BH14-04, and BH14-07, and are included in a nine month water level monitoring program that was initiated in January 2015.

The borehole elevations were estimated from the topographic survey plan of Part of the South half of Lot 44, Concession 10, Part of the North half Lot 43, Concession 10, and Lots 1, 2, 10, 12, 14, 16 and 18 to 32 both inclusive, and Dundonald Street and Part of Third Street and Part of the Lanes adjacent thereto, Registered Plan 484, Town of Collingwood, County of Simcoe. This drawing was prepared by Zubec, Emo, Patten and Thomsen Limited, OLS, bears Job No. 67-67, dated September 24, 2014. It should be noted that the borehole surface elevations as noted on the enclosed borehole logs are approximate only, for the purpose of relating borehole soil stratigraphy.

3. SUBSURFACE CONDITIONS

Fifteen boreholes (BH14-01 through BH14-15) were advanced between August 24, 2014 and September 4, 2014 along Cambridge Street, Third Street and High Street in the Town of Collingwood, Ontario. The borehole locations are shown on Drawing 1. The subsurface conditions at the borehole locations (BH14-01 to BH14-15) are presented on the individual borehole logs (Drawings 1 through 15, Appendix A). The subsurface conditions at the boreholes are summarized in the following paragraphs.

3.1 Soil Conditions

3.1.1 Cambridge Street, Home Depot Entrance and Third Street (BH14-01 through BH14-10)

Pavement Structure: A pavement structure was encountered at ground surface at borehole locations BH14-01 and BH14-06 through BH14-10. The pavement structure consisted of an asphaltic concrete layer varying in thickness from 25 mm to 130 mm, underlain by a 0.1 to 0.4 m thick granular base/sub-base material. A granular layer, about 200 mm thick was encountered at ground surface at borehole location BH14-05. Asphalt core photographs are enclosed in Appendix C.

Four (4) samples of the granular fill were subjected to grain size analysis. The grain size distribution curves for the samples are presented in Appendix B and are shown on the borehole logs, with the following fractions:

Fines (Clay+Silt): 3 to 15%
Sand: 52 to 91%
Gravel: 5 to 40%

It should be noted that the asphalt and granular material thicknesses provided here are confirmed at the borehole locations only, and may vary beyond the boreholes.

Topsoil: In the boreholes BH14-02 through BH14-04, topsoil ranging from 100 mm to 200 mm in thickness was found at the ground surface. It should be noted that the thickness of the topsoil explored at the borehole locations may not be representative for the site and should not be relied on to calculate the amount of topsoil at the site.

Fill: Underlying the pavement structure, topsoil and surficial granular layer, fill was encountered at each borehole location. The thickness of fill was varying from 0.4 m to 1.3 m. The fill was heterogeneous, generally consisting of sandy silt, silty sand, sand, and sand and gravel. Fill was generally moist and in a dense to very dense state.

Native Soils: Underlying the fill, native soils generally consisting of sandy silt, silty sand, and sand and gravel overlies the bedrock in boreholes BH14-03 through BH14-07 and BH14-09. The native soils were in a moist to very moist state and dense to very dense relative density/very stiff to hard consistency.

3.1.2 High Street (BH14-11 through BH14-15)

Pavement Structure/Concrete: A pavement structure was encountered at ground surface at borehole locations BH14-11 through BH14-13. The pavement structure consisted of an asphaltic concrete layer, about 180 mm in thickness, underlain by a 0.5 m thick layer of granular base/sub-base material. At borehole locations BH14-14 and BH14-15, a 200mm thick concrete was encountered at ground surface. Asphalt core photographs are enclosed in Appendix C.

Two (2) samples of the granular fill were subjected to grain size analysis. The grain size distribution curves for the samples are presented in Appendix B and are shown on the borehole logs, with the following fractions:

Fines (Clay+Silt): 6 and 8%
Sand: 52 and 59%
Gravel: 35 and 40%

It should be noted that the asphalt, concrete and granular material thicknesses provided here are confirmed at the borehole locations only, and may vary beyond the boreholes.

Fill: Underlying the pavement structure and concrete, fill was encountered at each borehole location. The thickness of fill was varying from 0.5 m to 0.8 m. The fill was heterogeneous, generally consisting of sand, and sand and gravel. Fill was generally moist and in a compact to very dense state.

Native Soils: Underlying the fill, native soils generally consisting of sandy silt, and sand overlying the inferred bedrock were encountered in boreholes BH14-14 and BH14-15. The native soils were in a moist to very moist state, and compact to very dense relative density.

3.2 Bedrock Characterization

Auger refusal was encountered on assumed bedrock surface at each borehole location (BH14-01 through BH14-15). The bedrock in boreholes BH14-01 through BH14-07 was core drilled to depths between 1.3 m and 5.1 m below bedrock surface, and core logs are enclosed as Drawings 1 through 7 in Appendix A. Bedrock rock core photographs are enclosed in Appendix D. The following table (Table 3.2.1) summarizes the inferred bedrock elevations interpreted from the borehole data.

Table 3.2.1: Approximate Depth and Elevation of Assumed Bedrock Surface

| Borehole No. | Approximate Depth of Bedrock Surface (m) | Approximate Elevation of Bedrock Surface (m) | Notes |
|--------------|--|--|---|
| BH14-01 | 0.9 | 180.6 | Core sampled to 5.1 m below bedrock surface |
| BH14-02 | 1.5 | 180.5 | Core sampled to 2.4 m below bedrock surface |
| BH14-03 | 1.4 | 180.4 | Core sampled to 4.9 m below bedrock surface |
| BH14-04 | 1.5 | 180.1 | Core sampled to 4.5 m below bedrock surface |
| BH14-05 | 1.3 | 180.7 | Core sampled to 4.8 m below bedrock surface |
| BH14-06 | 1.2 | 181.1 | Core sampled to 4.7 m below bedrock surface |
| BH14-07 | 2.3 | 179.7 | Core sampled to 1.3 m below bedrock surface |
| BH14-08 | 0.9 | 180.9 | Auger refusal on assumed bedrock surface |
| BH14-09 | 1.3 | 180.8 | Auger refusal on assumed bedrock surface |
| BH14-10 | 0.7 | 181.4 | Auger refusal on assumed bedrock surface |
| BH14-11 | 0.9 | 180.8 | Auger refusal on assumed bedrock surface |
| BH14-12 | 1.2 | 180.6 | Auger refusal on assumed bedrock surface |
| BH14-13 | 1.6 | 180.3 | Auger refusal on assumed bedrock surface |
| BH14-14 | 1.5 | 181.1 | Auger refusal on assumed bedrock surface |
| BH14-15 | 2.1 | 181.8 | Auger refusal on assumed bedrock surface |

Because of the method of drilling and sampling and variations at the bedrock surface, the surface elevation of the bedrock between the boundary can be different from those indicated on the borehole logs.

Detailed information of the core logs are shown on the borehole Log of Rock Core appended to this report. The rock was visually identified as limestone, and based on published literature belongs to the Simcoe Group Limestone of the Middle Ordovician Lindsay Formation.

The descriptive terms used on the record of rock cores and throughout this report are explained on the "Explanation of Terms Used in the Bedrock Core Log" sheet attached in Appendix A. In general, the conventions of the International Society for Rock Mechanics (ISRM) are adopted herein. Detailed descriptions of the index properties are presented in the following paragraphs.

Total Core Recovery (TCR)

The total core recovery indicates the total length of rock core recovered expressed as a percentage of the actual length of the core run. The total core recovery was generally good, with values ranging from 71 to 100% with an average of 92%.

Solid Core Recovery (SCR)

The solid core recovery is the total length of solid, full diameter rock core that was recovered, expressed as a percentage of the length of the core run. Solid core recovery ranged from 0 to 96% with an average of 68%.

Rock Quality Designation (RQD)

The rock quality designation index is obtained by measuring the total length of recovered rock core pieces which are longer than 100mm and expressing their sum total length as a percentage of the length of the core run. RQD is a function of the frequency of joints, bedding plane partings and fractures in the rock cores. On the basis of the recorded RQD values which range between 0 and 100%, the rock quality is estimated to be "very poor" to "excellent", and the average value of approximately 61% suggests a rock of generally "fair" quality.

3.3 Groundwater Conditions

Water was encountered in BH14-15 upon completion of drilling at 2 m (El.: 182.0 m) below existing grade. Remaining boreholes (BH14-01 through BH14-14) were observed dry during and upon completion of drilling.

Water levels were measured on September 22, 2014 and December 12, 2014 in the monitoring wells installed at BH14-01, BH14-04 and BH14-07. The groundwater table was at depths varying between 1.00 m and 3.45 m below grade (El.: 180.90 m to 178.05 m), as summarized in Table 3.3.1 below.

Table 3.3.1: Groundwater Levels Observed in Monitoring Wells

| BH No. | Date of Drilling / Bedrock Coring | Date of Water Measurement | Depth of Groundwater below existing ground (m) | Elevation of Groundwater (m) |
|---------|-----------------------------------|---------------------------|--|------------------------------|
| BH14-01 | Aug. 25, 2014 / Sept. 2, 2014 | September 22, 2014 | 3.45 | 178.05 |
| | | December 12, 2014 | 3.26 | 178.24 |
| BH14-04 | Aug. 25, 2014 / Aug. 27, 2014 | September 22, 2014 | 1.00 | 180.70 |
| | | December 12, 2014 | 1.07 | 180.63 |
| BH14-07 | Aug. 25, 2014 / Aug. 27, 2014 | September 22, 2014 | 2.81 | 179.19 |
| | | December 12, 2014 | 2.93 | 179.07 |

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events. To further assess groundwater conditions, a nine month water level monitoring program was initiated in January 2015.

4. DISCUSSION AND RECOMMENDATIONS

Based on the concept plan provided to SPL, it is understood that the proposed roadway improvements will comprise of the following:

- An extension of the Cambridge Street to the south to join with Third Street;
- An extension of Third Street to the west, curving northwards to join with the Cambridge Street extension;
- An extension westward of the roadway access to the Home Depot parking lot;
- A roundabout at the intersection of the Cambridge Street extension, Third Street extension and the roadway access to the Home Depot parking lot extension; and
- There is a proposal for the relocation of traffic lights from its current position (intersection of Home Depot entrance and High Street) to a new location at the intersection of Third Street and High Street.

The proposed extension and reconstruction will include installation of services including watermains, sanitary and storm sewers along Cambridge Street and Third Street.

The preliminary design drawings provided to SPL (Appendix F) describes the details for the installation of storm sewer and sanitary sewers. For the storm sewer, the design drawing illustrates installing a 900 mm diameter pipe along the Cambridge Street extension, and a 975 mm diameter pipe along the Third Street extension. For the sanitary sewer, the design drawing illustrates installing a 250 mm diameter pipe along the eastern portion of Third Street extension, as well as to north of the roundabout.

Seven boreholes (BH14-01 to BH14-07) drilled/cored along the extension sections of Cambridge Street and Third Street, indicates that beneath the pavement structure and overburden, the inferred bedrock surface varies between geodetic elevations 181.1 m and 179.7 m i.e. 0.9 m and 2.3 m below existing grade. An analysis of proposed sanitary sewer pipe invert with respect to the founding medium and its position relative to the groundwater level is presented in Table 4.1.

Table 4.1: Position of Pipe Invert w.r.t. Bedrock Surface and Groundwater Level

| Borehole No. | Depth of Bedrock Surface (m) | Geodetic Elev. of Bedrock Surface (m) | Geodetic Elev. of Sewer Invert (m) | Sanitary Sewer Founding Medium | Highest GWL* | Position of Pipe Invert w.r.t. GWL* |
|--------------------------|------------------------------|---------------------------------------|------------------------------------|--------------------------------|-----------------------------|-------------------------------------|
| Storm Sewer | | | | | | |
| BH14-01 | 0.9 | 180.6 | 179.7 | Bedrock | 178.1 | 1.6 m above GWL* |
| BH14-04 | 1.5 | 180.1 | 181.0 | Fill | 180.7 | 0.3 m above GWL* |
| BH14-07 | 2.3 | 179.7 | 180.0 | Very Dense Sand and Gravel | 179.2 | 0.8 m above GWL* |
| Sanitary Sewer | | | | | | |
| BH14-04 | 1.5 | 180.1 | 180.9 | Very Dense Sandy Silt | 180.7 | 0.3 m above GWL* |
| BH14-06 | 1.2 | 181.1 | 179.5 | Bedrock | 179.2 (Based on BH14-07) | 0.3 m above GWL* |
| GWL* = Groundwater Level | | | | | | |

Table 4.1 demonstrate that the invert of sanitary/storm sewer will be founded in fill, very dense soils, and bedrock. Bedrock and very dense soils are considered competent to support the sewers. Fill where encountered should be proofrolled to determine any loose or weak areas. Any loose areas must be sub-excavated and replaced with fill to 98% SPMDD. We understand that open cut excavation and/or blasting of the bedrock will be utilized to construct the sewer services.

Design details of the proposed watermain not available at this time. However, it is anticipated that the invert levels will be installed at elevations higher than the sanitary services.

It is understood that the existing building on way off the proposed extension of Cambridge Street will be demolished, and no remnants of the building will penetrate the subbase of the pavement structure.

4.1 Trenching, Excavation, Trench Support, and Dewatering

No major groundwater problem is anticipated for the installation of watermain, sanitary and storm sewers. It is expected that any seepage, which occurs during wet periods, can be removed by pumping from sumps. Also, groundwater levels may fluctuate in response to major weather events. Contractor should be prepared to employ more elaborate dewatering procedures if the groundwater level extends above the pipe invert levels.

Where the existing fill is in loose to compact state, the side slopes in these sections may have to be flattened. If steep side slopes are required, the sides should be supported by braced skeleton or close sheeting. If existing fill extends below the proposed invert level, some loose sub-excavation will be necessary so that the bedding material can be placed on the compacted soil.

Any granular soils including the granular fills should be dewatered; otherwise much flatter side slopes will be required.

Excavation of the overburden soil can be carried out with heavy hydraulic backhoes. In the fill and natural sandy deposits for short term construction, the trench walls are expected to be temporarily stable at 1:1 slopes above the water table. The sides of excavations in the overburden can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they must be cut back at slopes no steeper than 1:1 in order to comply with the safety regulations. Flatter side slopes will be required below the water table. If steep side slopes are required, the sides should be supported by braced skeleton or close sheeting. Excavations into the bedrock can be cut to a nearly vertical face. The face of the excavation, however, should be scaled of any loose rock to protect the workers working in the excavation. Fractures in the bedrock cause the formation of slabs, wedges or blocks of unstable rock which will require removal and can lead to overbreak beyond the intended excavation cut line. It may be necessary to secure the rock face with wire-mesh and spot bolting.

For excavations in the bedrock, it may be possible that the fractured zones of the limestone can be excavated with a rock hoe ram. Below the fractured zone and in confined areas, excavation to the required depth in the bedrock may require blasting.

All excavations should be carried out in accordance with the Construction Safety Act of the Province and excavation should conform to the Ontario Reg. 213/91 for Construction projects. The native sandy soils can be classified as Type 2 soils above the groundwater table and Type 4 Soils below the groundwater table. Fill soils can be classified as Type 3 soils.

In the planning of the trenches' shoring and excavation, the presence of any adjacent existing buried service pipes should be considered. In addition to the stability of these existing adjacent pipes, which must be maintained without detrimental settlements, the backfill in these trenches and especially the granular bedding surrounding the existing service pipes, manholes, etc. may be a source of water, which, if encountered, must be dealt with.

Any form of soil stabilization and/or dewatering to facilitate construction must be designed and performed being cognizant of the fact that dewatering may induce settlements of existing structures in the vicinity, including existing service pipes.

For all these reasons, it would be prudent to open the trenches in relatively short sections and carry out the laying of the pipe and backfilling expeditiously in order to reduce the length of time the trench would be open.

The earth pressure acting on the sheeting and bracing can be evaluated by the following formula:

$$\text{Above groundwater table: } p = K (\gamma z + q)$$

$$\text{Below groundwater table: } p = K \{ \gamma h_1 + \gamma_1 (z - h_1) + q \} + p_w$$

where p = Lateral earth and water pressure in kPa acting at depth z ;

z = Depth below ground surface, in metres;

K = Earth pressure coefficient, $K=0.33$;

γ = Unit weight of soil above groundwater table, assuming 20 kN/m^3 ;

γ_1 = Submerged unit weight of soil below water table, assuming 10 kN/m^3 ;

h_1 = Thickness of soil above groundwater table, in metres;

q = Value of surcharge in kPa;

p_w = Hydrostatic water pressure.

Sloughing of the granular roadbase fill will tend to occur and it may be necessary to saw-cut back the asphaltic concrete say 0.5 m to 1m from the edge of the trench wall in order to reinstate and re-compact new granular fill within this zone.

4.2 Bedding

Class 'B' type bedding is recommended. The bedding should consist of well-graded OPSS Granular 'A' material compacted to 98 percent Standard Proctor Maximum Dry Density (SPMDD). The dimensions of bedding material should conform to the Municipality's current standards. This bedding and granular cover should extend to about 0.3 m above the overt of the pipe. Since the performance of the pipe is dependent on good compaction of the bedding material, the compaction at the bottom of the pipe and adjacent to the pipe must be stringently carried out.

4.3 Backfilling

In general, most of the clean, inorganic native soils may be re-used as trench backfill, if desired. As will be discussed later in this section of the report, however, the use of some of these materials may not be practical in narrow trenches. The blasted rock can be re-used as granular backfill if it can be crushed to meet the gradations of OPSS 1010 to be used as base or sub base. If used as fill, it should be crushed so that no particle is greater than 150mm in size in order to obtain proper compaction in the fill without arching or bridging of voids by large particles.

It is preferable that the native soils be re-used from approximately the position at which they are excavated so that frost response characteristics of the soils after construction remain essentially similar to presently existing.

Consideration may also be given to backfilling trenches with a well graded, compacted granular soil such as Granular 'B' material. The use of such material, if thoroughly compacted, would reduce the post construction settlements to a negligible amount and may also expedite the compaction process. In this instance, however, frost response characteristics of non-frost susceptible granular fill and the frost susceptible indigenous soils would be different giving rise to differential frost. In this case, it would be prudent to use as backfill the onsite excavated, naturally occurring soils to match the existing conditions within the frost zone (i.e. within about 1.5 m below the finished grade elevation) as well as to provide a frost taper zone (i.e. to provide a zone of taper to prevent a sudden change in frost heave characteristics to reduce the effects of frost heave).

The backfill should be placed in maximum 200 mm thick layers at or near ($\pm 2\%$) their optimum moisture content. In any case the degree of compaction of the trench backfill should be at least 95% of the material's Standard Proctor Maximum Dry Density (SPMDD). This value should be increased to at least 98% within 1.5 m of the road surface. The granular pavement sub-base and base materials should be compacted to at least 100% of their respective SPMDD.

4.4 Pavement Design

The subgrade is expected to consist of native soils or clean earth fill materials. The earth fill materials encountered on the site may be utilized for subgrade preparation provided they are environmentally acceptable and do not contain excessive amounts of organics and deleterious materials, as well as their in-situ moisture content is within 2 percent of the optimum moisture content. The pavement subgrade should be proof-rolled; and any loose, soft, wet or unstable areas should be sub-excavated, and backfilled with clean earth fill placed in 150 mm thick lifts and compacted to a minimum of 98 percent SPMDD. Local sub-excavation may be required in areas where incompetent (loose/firm) subgrade conditions and significant organic/topsoil inclusions are encountered. Removal of all fill materials is not necessary, provided the subgrade is proof-rolled to detect soft areas. The entire pavement subgrade should be compacted to a minimum of 98 percent SPMDD prior to the granular sub-base placement. The general requirements for placing the fill are presented in Appendix-E.

Based on the above and assuming that traffic usage will be Urban Local Residential, Urban Local Divided Road or Urban Collector, the following minimum pavement thickness is recommended:

Table 4.4.1: Recommended Minimum Pavement Structure Thickness

| Pavement Layer | Compaction Requirements | Minimum Thickness (Urban Local Residential, Urban Local Divided Road or Urban Collector) |
|--------------------------|--------------------------------------|---|
| Asphaltic Concrete | 92 to 96.5% Maximum Relative Density | 50 mm OPSS HL 3 70 mm OPSS HL 8 |
| OPSS Granular A Base | 100% SPMDD** | 150 mm |
| OPSS Granular B Sub-base | 100% SPMDD | 300 mm |

* Use high stability mix, 100 % virgin crushed aggregates for heavy duty parking areas

** Denotes Standard Proctor Maximum Dry Density, ASTM-D698

The subgrade must be compacted to 98% SPMDD for at least the upper 300 mm unless accepted by SPL

The existing pavement thickness along the Cambridge Street generally ranges between 100 mm and 130 mm, and along High Street was about 180 mm. Based on this, and our experience in the area, the pavement design provided in Table 4.4.1 is considered adequate. It should be noted that the pavement design provided in Table 4.4.1 exceeds the requirements of City standards.

The long term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

The site subgrade and weather conditions (i.e. if wet) at the time of construction may necessitate the placement of thicker granular sub-base layer in order to facilitate the construction. Furthermore, heavy construction equipment may have to be kept off the newly constructed roads before the placement of asphalt and/or immediately thereafter, to avoid damaging the weak subgrade by heavy truck traffic.

The granular materials should be placed in lifts 150 mm thick or less and be compacted to a minimum of 100 percent and 98 percent SPMDD for granular base and granular sub-base, respectively. Asphalt materials should be rolled and compacted as per OPSS 310. The granular and asphalt pavement materials and their placement should conform to OPSS Forms 310, 501, 1010 and 1150 and Town of Collingwood specifications.

Installation of full-length subdrains is required on roads. The subdrains should be properly filtered to prevent the loss of (and clogging by) soil fines. All paved surfaces should be sloped to provide satisfactory drainage towards catchbasins. As discussed above, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

Additional comments on the construction of pavement subgrade are as follows:

1. As part of the subgrade preparation, the road should be stripped of existing asphaltic pavement and/or loose fill (if any) and other obvious objectionable material. Fill required to raise the grades to design elevations should conform to backfill requirements outlined in previous sections of this report. The subgrade should be properly shaped, crowned then proof-rolled in the full time presence of a representative of this office. Soft or spongy subgrade areas should be sub-excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD. To achieve the required density, the on-site moist sandy soils especially during dry season may require adding sufficient water to bring their soil moisture content within $\pm 2\%$ optimum moisture (determined from proctor test). Contractor(s) should be prepared to add water to sandy soils (if required) by sprinkler or water truck with sprayer in a uniform manner.
2. The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as restricted access lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.
3. It is recommended that SPL be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations of this report.

5. GENERAL COMMENTS AND LIMITATIONS OF REPORT

SPL Consultants Limited should be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, SPL Consultants Limited will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole and test pit results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to SPL Consultants Limited at the time of preparation. Unless otherwise agreed in writing by SPL Consultants Limited, it shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. No portion of this report may be used as a separate entity, it is written to be read in its entirety.

The conclusions and recommendations given in this report are based on information determined at the test hole locations. The information contained herein in no way reflects on the environment aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site

investigation. The benchmark and elevations used in this report are primarily to establish relative elevation differences between the test hole locations and should not be used for other purposes, such as grading, excavating, planning, development, etc.

The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. SPL Consultants Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

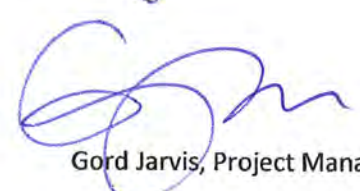
Thank you for the opportunity to be of service to you. Should you have any questions or require further clarification on any aspect of this report, please do not hesitate to contact this office.

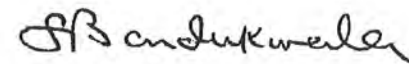
Yours very truly,

SPL CONSULTANTS LIMITED


Kulbir Singh, M.Eng., P.Eng.

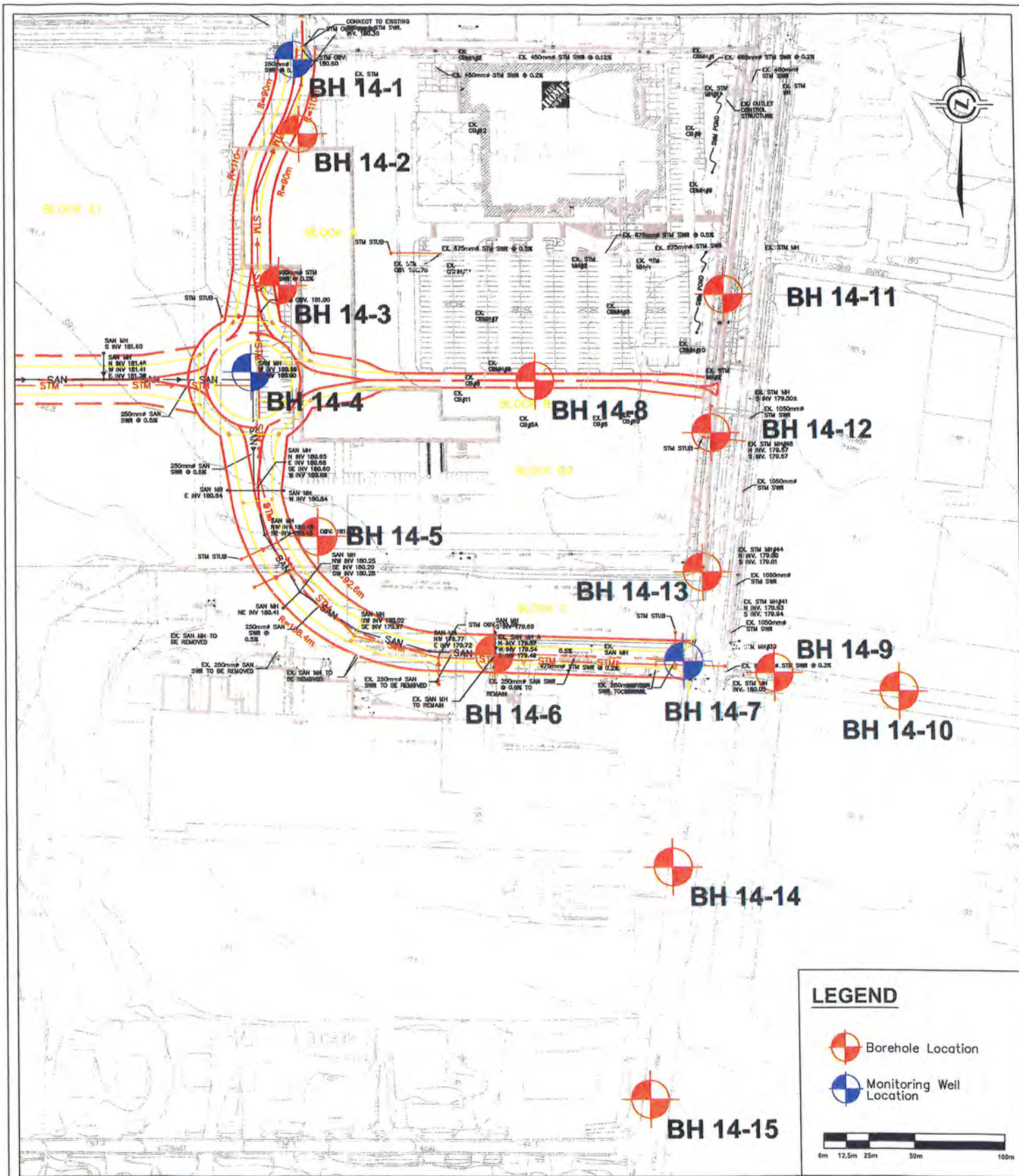



Gord Jarvis, Project Manager


Shabbir Bandukwala, P.Eng.

DRAWING
BOREHOLE LOCATION PLAN





| | | | | | | |
|----------------|--------------------------------|-----------|--------------|--|--------------|---|
| Client: | C.F. CROZIER & ASSOCIATES INC. | | Project No.: | 10000820 | Drawing No.: | 1 |
| Drawn: | MV | Approved: | GJ | Title: Borehole Location Plan | | |
| Date: | December, 2014 | Scale: | As Shown | Project: Cambridge Street Extension - Geotechnical Investigation | | |
| Original Size: | Tabloid | Rev: | N/A | | | |

APPENDIX A
BOREHOLE LOGS (ENCL. NOS. 1 TO 15)



PROJECT: Geotechnical Investigation

CLIENT: 2204604 Ontario Inc.

PROJECT LOCATION: Cambridge Street Extension, Collingwood

DATUM: Geodetic

BH LOCATION: Cambridge Street

DRILLING DATA

Method: Solid Stem Auger

Diameter: 150mm

Date: Aug/25/2014

REF. NO.: 10000820

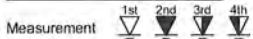
DRG. NO.: 1

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | POCKET PEN. (Cp) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|----------------|---|-------------|--------|------|-------------------------|-----------|--|----------------------|--|------------------------|--------------------------------------|---|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | N° BLOWS / 0.3 m | SHEAR STRENGTH (kPa) | | | | |
| 181.5 | | | | | | | | | | | | |
| 180.9 | ASPHALT: 100mm | | | | | | | | | | | |
| 181.3 | GRANULAR BASE/SUBBASE: 150mm | | | | | | | | | | | |
| 0.3 | FILL: sand and gravel, brown, moist, dense | | 1 | SS | 33 | | | | | | | GR 30 SA 65 (15) CL |
| 180.8 | | | | | | | | | | | | |
| 0.8 | FILL: sandy silt, trace clay, dark brown/black, moist, very dense | | 2 | SS | 58/200mm | | | | | | | |
| 180.6 | | | | | | | | | | | | |
| 0.9 | AUGER REFUSAL/SPOON BOUNCING: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | | |
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SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/12/15

W. L. 178.3 m
Dec 12, 2014
W. L. 178.1 m
Sep 22, 2014

GROUNDWATER ELEVATIONS



GRAPH NOTES

+ 3 , X 3 : Numbers refer to Sensitivity
 ○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014

REF. NO.: 10000820
 DRG. NO.: 1

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | RQD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa)* | POINT LOAD TEST UCS DIAMETRAL (MPa)* | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) | | |
|----------------------|--|---|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|------------------------------------|-------------------------------------|---|-------------------------------|---|--|--|
| | | | NUMBER | SIZE | | | | | | | | | | | | | | |
| 180.6 | Rock Surface | | | | | | | | | | | | | | | | | |
| 180.0 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | [Diagram showing groundwater conditions: a vertical line with a downward arrow at 178.3m and an upward arrow at 178.1m] | 1 | HQ | 100 | 71 | | 42 | >25 | | | | | | | | | |
| 179.9 | | | | | | | | | | 11 | | | | | | | | |
| 179.9 | | | | | | | | | | 1 | | | | | | | | |
| 179.9 | | | | | | | | | | 5 | | | | | | | | |
| 179.9 | | | | | | | | | | 1 | | | | | | | | |
| 179.9 | | | | | 2 | HQ | 100 | 97 | | 97 | 4 | | | | | | | |
| 179.9 | | | | | | | | | | | 3 | | | | | | | |
| 179.9 | | | | | | | | | | | 0 | | | | | | | |
| 178.3 | | | | | | | | | | | 1 | | | | | | | |
| 178.3 | | | | | | | | | | | 1 | | | | | | | |
| 178.3 | | | 3 | HQ | 100 | 93 | | 83 | 2 | | | | | | | | | |
| 178.3 | | | | | | | | | 1 | | | | | | | | | |
| 178.3 | | | | | | | | | 6 | | | | | | | | | |
| 176.8 | Soft Layer for 10mm | [Diagram showing soft layer from 176.8m to 175.5m] | | | | | | | 4 | | | | | | | | | |
| 176.8 | | | | | | | | | 0 | | | | | | | | | |
| 176.8 | | | | | 4 | HQ | 94 | 88 | | 84 | 2 | | | | | | | |
| 176.8 | | | | | | | | | | | 0 | | | | | | | |
| 175.5 | | | | | | | | | 0 | | | | | | | | | |
| 6.0 | END OF BOREHOLE Notes: 1. Bedrock cored on September 2, 2014. 2. Borehole caved to 1.2m below grade and was dry upon completion 3. 50 mm dia. monitoring well was installed upon completion, screened from 4.5m to 6.0m. 4- Water Level Measurements in Monitoring Well (surface elev. m) Date W.L. Depth (m) W.L. Elev. (m) Sept. 22, 2014 3.45 178.05 Dec. 12, 2014 3.26 178.24 | | | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
 *: UCS [Mpa] ≈ 24 I_{s(50)}



LOG OF BOREHOLE BH14-02

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 2

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | | |
|----------------------|---|-------------|--------|------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------|---|----|----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | "N" BLOWS 0.3 m | 20 | | | | | | | 40 | 60 |
| 181.9 0.0 | TOPSOIL: 200mm | | | | | | | | | | | | | | | |
| 181.7 0.2 | FILL: silty sand, trace to some gravel, brown, moist, dense to very dense | | 1 | SS | 44 | | | | | | | | | | | |
| 181.2 0.8 | spoon bounced | | 2 | SS | 50/0mm | | | | | | | | | | | |
| 180.5 1.5 | AUGER REFUSAL/SPOON BOUNCING: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT_1/12/15

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES +³, X³: Numbers refer to Sensitivity ○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014

REF. NO.: 10000820
 DRG. NO.: 2

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | RQD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa)* | POINT LOAD TEST UCS DIAMETRAL (MPa)* | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) | |
|----------------------|---|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|------------------------------------|-------------------------------------|---|-------------------------------|---|--|
| | | | NUMBER | SIZE | | | | | | | | | | | | | |
| 180.5 | Rock Surface | | | | | | | | | | | | | | | | |
| 180.5 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | | 1 | HQ | 92 | 38 | | 38 | 15 | | | | | | | | |
| 180.2 | | | | | | | | | | | | | | | | | |
| 1.8 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 178.8 | | | | | | | | | | | | | | | | | |
| 3.1 | | | | | | | | | | | | | | | | | |
| 178.1 | | | | | | | | | | | | | | | | | |
| 3.8 | END OF BOREHOLE Notes: 1. Bedrock cored on September 4, 2014. 2. Borehole was open and dry upon completion | | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014_10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
 * UCS [MPa] = 24 I_{50/50}

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 3

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT. (M _{unit}) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | | | | |
|----------------|---|-------------|--------|------|-------------------------|-----------|--|----|---------------|--------------------------|--------------|------------------------|---------------------------------------|---|----|----|----|-----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | "N" BLOWS 0.3 m | 20 | | | | | | | 40 | 60 | 80 | 100 |
| 181.7 | TOPSOIL: 150mm | | 1 | SS | 58/275mm | | | | | | | | | | | | | |
| 181.9 | FILL: silty sand and gravel, trace cobble, brown, damp to moist, very dense | | | | | | | | | | | | | | | | | |
| 180.9 | CLAYEY SILT: trace limestone pieces, grey, moist, hard | | 2 | SS | 98/200mm | | | | | | | | | | | | | |
| 180.4 | AUGER REFUSAL: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/12/15

GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES

+ 3, x 3. Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF ROCK CORE BH14-03

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014

REF. NO.: 10000820
 DRG. NO.: 3

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | RQD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa)* | POINT LOAD TEST UCS DIAMETRAL (MPa)* | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) | | |
|----------------------|---|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|------------------------------------|-------------------------------------|---|-------------------------------|---|--|--|
| | | | NUMBER | SIZE | | | | | | | | | | | | | | |
| 180.4 | Rock Surface | | | | | | | | | | | | | | | | | |
| 180.4 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | | 1 | HQ | 100 | 92 | | 92 | >25 | | | | | | | | | |
| 180.1 | | | | | | | | | | 1 | | | | | | | | |
| 1.7 | | | | | | | | | | 2 | | | | | | | | |
| | | | | | | | | | | 3 | | | | | | | | |
| | | | | | | | | | | 5 | | | | | | | | |
| | | | | | | | | | | 2 | | | | | | | | |
| | | | | | | | | | | 0 | | | | | | | | |
| 178.5 | | | | | | | | | | 2 | | | | | | | | |
| 3.3 | | | | | | | | | | 0 | | | | | | | | |
| | | | | | | | | | | 4 | | | | | | | | |
| | | | | | | | | | | 0 | | | | | | | | |
| | | | | | | | | | | 3 | | | | | | | | |
| 176.9 | | | | | | | | | | 5 | | | | | | | | |
| 4.8 | | | | | | | | | | 1 | | | | | | | | |
| | | | | | | | | | | 3 | | | | | | | | |
| | | | | | | | | | | 1 | | | | | | | | |
| | | | | | | | | 0 | | | | | | | | | | |
| 175.5 | | | | | | | | 96 | | | | | | | | | | |
| 6.3 | END OF BOREHOLE Notes: 1. Bedrock cored on September 2, 2014. 2. Borehole was open and dry upon completion | | | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014, 10000820 - BOREHOLE LOGS.GPJ, SPL.GDT, 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
 *: UCS [Mpa] ≈ 24 ¹/₃ E

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street/Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 4

| SOIL PROFILE | | SAMPLES | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|----------------------|--|---------|------|-------------------------|-----------|--|-----------------|---|------------------------|--------------------------------------|---|
| (m) ELEV DEPTH | DESCRIPTION | NUMBER | TYPE | | | "N" BLOWS 0.3 m | 20 40 60 80 100 | | | | |
| 181.7 | | | | | | | | | | | |
| 181.6 | TOPSOIL: 100mm | | | | | | | | | | |
| 181.6 | FILL: sand and gravel, trace silt, trace cobble, light brown, damp, very dense | 1 | SS | 70/275mm | | | | | | | |
| 180.9 | | | | | | | | | | | |
| 180.8 | SANDY SILT: trace clay, trace gravel, greyish brown, moist, very dense | 2 | SS | 81/250mm | | | | | | | |
| 180.1 | AUGER REFUSAL: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | |

W. L. 180.7 m
 Sep 22, 2014¹
 Dec 12, 2014

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/12/15

GROUNDWATER ELEVATIONS
 Measurement

GRAPH NOTES + ³, X ³. Numbers refer to Sensitivity ○ ■=3% Strain at Failure

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Cambridge Street/Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014

REF. NO.: 10000820
 DRG. NO.: 4

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | ROD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (m/sec) | POINT LOAD TEST UCS AXIAL (MPa) | POINT LOAD TEST UCS DIAMETRAL (MPa) | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) |
|----------------------|--|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|-----------------------------------|------------------------------------|--|-------------------------------|---|
| | | | NUMBER | SIZE | | | | | | | | | | | | |
| 180.1 | Rock Surface | | | | | | | | | | | | | | | |
| 180.5 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey Soft Layer for 30mm | | | | | | | | 20 | | | | | | | |
| | Soft Layer for 10mm | | 1 | NQ | 100 | 92 | | 86 | 2 | | | | | | | |
| | Soft Layer for 10mm | | | | | | | | 3 | | | | | | | |
| | | | | | | | | | 5 | | | | | | | |
| 178.9 | | | | | | | | | 1 | | | | | | | |
| 2.8 | | | | | | | | | 7 | | | | | | | |
| | | | 2 | NQ | 100 | 79 | | 71 | 2 | | | | | | | |
| | | | | | | | | | 1 | | | | | | | |
| 178.0 | | | | | | | | | 5 | | | | | | | |
| 3.7 | | | | | | | | | 1 | | | | | | | |
| | | | 3 | NQ | 100 | 82 | | 70 | 7 | | | | | | | |
| | | | | | | | | | 11 | | | | | | | |
| 177.2 | | | | | | | | | 3 | | | | | | | |
| 4.5 | | | | | | | | | 2 | | | | | | | |
| | Soft Layer for 50mm Soft Layer for 60mm | | 4 | NQ | 100 | 77 | | 70 | >25 | | | | | | | |
| | | | | | | | | | >25 | | | | | | | |
| 175.6 | | | | | | | | | <25 | | | | | | | |
| 6.1 | END OF BOREHOLE Notes: 1. Bedrock cored on August 27, 2014. 2. Borehole was open and dry upon completion 3. 50 mm dia. monitoring well was installed upon completion , screened from 4.5m to 6.0m. 4- Water Level Measurements in Monitoring Well(surface elev. m) Date W.L. Depth (m) W.L. Elev. (m) Sept. 22, 2014 1.00 180.70 Dec. 12, 2014 1.07 180.63 | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014 -10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
 * UCS [Mpa] = 24 I₅₍₅₀₎



LOG OF BOREHOLE BH14-05

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 5

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL |
|----------------------|---|-------------------------|---------|------|--------------------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------------------------|--------------------------------------|--|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | |
| 181.9 0.0 | GRANULAR: 200mm | [Cross-hatched pattern] | | | | | | | | | | | | | |
| 181.7 0.2 | FILL: sand and gravel, trace silt, brown, moist, very dense | [Cross-hatched pattern] | 1 | SS | 50/ 25mm | | | | | | | | | | |
| 181.1 0.9 | SAND AND GRAVEL: pockets of clayey silt, grey, damp, very dense | [Dotted pattern] | 2 | SS | 87/ 200mm | | | | | | | | | | |
| 180.7 1.3 | AUGER REFUSAL: Bedrock Coring: See Rock Core Log, Page 2. | [Blank] | | | | | | | | | | | | | |
| | | | | | | | 181 | | | | | | | | |
| | | | | | | | 180 | | | | | | | | |
| | | | | | | | 179 | | | | | | | | |
| | | | | | | | 178 | | | | | | | | |
| | | | | | | | 177 | | | | | | | | |
| | | | | | | | 176 | | | | | | | | |

SPL SOIL LOG - 10000820 - BOREHOLE LOGS.GPJ SPLGDT 1/12/15

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

REF. NO.: 10000820

LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

DRG. NO.: 5

DATUM: Geodetic

Date: Aug/25/2014

BH LOCATION: Third Street

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | DRILLING DATA | | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa)* | POINT LOAD TEST UCS DIAMETRAL (MPa)* | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) | | | | | | | | |
|----------------------|---|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------------|-------------------------------|-----------------|------------------|------------------------------------|-------------------------------------|---|-------------------------------|---|--|--|--|--|--|--|--|--|
| | | | NUMBER | SIZE | | | | RQD (%) | FRACTURE INDEX (per 0.3 m) | | | | | | | | | | | | | | | |
| 180.7 | Rock Surface | | | | | | | | | | | | | | | | | | | | | | | |
| 180.3 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | | 1 | HQ | 0 | 0 | 0 | NA | NA | | | | | | | | | | | | | | | |
| 180.3 | | | | | | | | 0 | | | | | | | | | | | | | | | | |
| 1.7 | | | | | | | | 5 | | | | | | | | | | | | | | | | |
| | | | | | | | | 2 | HQ | 100 | 92 | 75 | 2 | | | | | | | | | | | |
| | | | | | | | | 3 | | | | | | | | | | | | | | | | |
| | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| 178.7 | | | | | | | | | | | | | | | 0 | | | | | | | | | |
| 3.2 | | | | | | | | | | | | | | | 0 | | | | | | | | | |
| | | | | | | | | 3 | HQ | 100 | 98 | 94 | 1 | | | | | | | | | | | |
| | | | | | | | | 0 | | | | | | | | | | | | | | | | |
| | 4 | | | | | | | | | | | | | | | | | | | | | | | |
| 177.3 | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.7 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 9 | | | | | | | | | | | | | | | | |
| | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| | | | | | | | | 3 | | | | | | | | | | | | | | | | |
| | | | | | | | | 1 | | | | | | | | | | | | | | | | |
| 175.9 | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.0 | END OF BOREHOLE Notes: 1. Bedrock cored on September 3, 2014. 2. Borehole was open and dry upon completion | | | | | | | | | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014_10000820 - BOREHOLE LOGS.GPJ SPL_GDT_1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered θ = angle to the core axis

E = Modulus of Elasticity
* UCS [Mpa] = 24 I_{50/50}

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 6

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w_p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L | POCKET PEN. (C_u) (kPa) | NATURAL UNIT WT (γ_{sat}) (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|----------------------|--|-------------|--------|------|----------------------------|-----------|---|----------------------|---------------------------|---------------------------------------|--------------------------|--------------------------------|--|---|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | "N" BLOWS 0.3 m | SHEAR STRENGTH (kPa) | | | | | | |
| 182.3 | ASPHALT: 25mm | | | | | | | | | | | | | |
| 182.1 | GRANULAR BASE/SUBBASE: 100mm | | | | | | | | | | | | | |
| 181.7 | FILL: fine to medium sand, some gravel, orangish brown, moist, dense | | 1 | SS | 37 | | | | o | | | | | |
| 181.4 | SANDY SILT: some gravel, some clay, grey, moist, dense to very dense | | 2 | SS | 77/ 225mm | | | | o | | | | | |
| 181.1 | trace limestone pieces | | | | | | | | | | | | | |
| 181.1 | AUGER REFUSAL: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/12/15

GROUNDWATER ELEVATIONS
 Measurement ∇ 1st ∇ 2nd ∇ 3rd ∇ 4th

GRAPH NOTES
 +³, X³: Numbers refer to Sensitivity
 o = 3% Strain at Failure



LOG OF ROCK CORE BH14-06

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

REF. NO.: 10000820

LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

DRG. NO.: 6

DATUM: Geodetic

Date: Aug/25/2014

BH LOCATION: Third Street

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | RQD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa) | POINT LOAD TEST UCS DIAMETRAL (MPa)* | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) |
|----------------------|--|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|------------------------------------|------------------------------------|---|-------------------------------|---|
| | | | NUMBER | SIZE | | | | | | | | | | | | |
| 181.1 | Rock Surface | | | | | | | | | | | | | | | |
| 181.2 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | | 1 | HQ | 100 | 29 | | 19 | >25 | | | | | | | |
| 180.5 | | | | | | | | | 10 | | | | | | | |
| 1.8 | Soft Layer for 10mm | | 2 | HQ | 100 | 70 | | 59 | 7 | | | | | | | |
| | | | | | | | | | >25 | | | | | | | |
| | | | | | | | | | 0 | | | | | | | |
| | Soft Layer for 50mm | | 3 | HQ | 100 | 70 | | 58 | 3 | | | | | | | |
| | | | | | | | | | >25 | | | | | | | |
| | | | | | | | | | 12 | | | | | | | |
| | | | | | | | | | 8 | | | | | | | |
| 179.2 | | | 4 | HQ | 100 | 82 | | 82 | 0 | | | | | | | |
| 3.1 | | | | | | | | | 3 | | | | | | | |
| | | | | | | | | | 1 | | | | | | | |
| | END OF BOREHOLE | | | | | | | | 3 | | | | | | | |
| | | | | | | | | | 1 | | | | | | | |
| 177.6 | Notes: 1. Bedrock cored on September 3, 2014. 2. Borehole was open and dry upon completion | | | | | | | | 3 | | | | | | | |
| 4.7 | | | | | | | | | 1 | | | | | | | |
| 176.4 | | | | | | | | | 3 | | | | | | | |
| 5.9 | | | | | | | | | 1 | | | | | | | |

SPL ROCK CORE-2014_10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered. θ = angle to the core axis

E = Modulus of Elasticity
* UCS [Mpa] = 24 I_{S(50)}



LOG OF BOREHOLE BH14-07

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/25/2014
 REF. NO.: 10000820
 DRG. NO.: 7

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT W _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | | | | | | | | |
|----------------------|--|-------------|---------|------|--------------------|----------------------------|-----------|---|----|------------------------------------|-------------------------------------|-----------------------------------|--|---|---|----|----|-----|----|----|----|----|-----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | | 60 | 80 | 100 | 20 | 40 | 60 | 80 | 100 |
| 182.0 | ASPHALT: 100mm | | | | | | | | | | | | | | | | | | | | | | |
| 181.8 | GRANULAR BASE/SUBBASE: 150mm | | 1 | SS | 83/ 250mm | | | | | | | | | | | | | | | | 30 | 67 | (3) |
| 181.3 | FILL: sand and gravel, trace silt, trace cobble, brown, moist, very dense | | | | | | | | | | | | | | | | | | | | | | |
| 181.3 | SAND AND GRAVEL: trace clay, trace silt, trace limestone pieces, grey, moist, very dense | | 2 | SS | 61/ 275mm | | | | | | | | | | | | | | | | | | |
| 179.7 | AUGER REFUSAL: Bedrock Coring: See Rock Core Log, Page 2. | | | | | | | | | | | | | | | | | | | | | | |

W. L. 179.2 m
 Sep 22, 2014
 Dec 12, 2014

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/12/15

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, X 3. Numbers refer to Sensitivity ○ = 3% Strain at Failure

| | | |
|---|--------------------------|--------------------|
| PROJECT: Geotechnical Investigation | DRILLING DATA | |
| CLIENT: 2204604 Ontario Inc. | Method: Solid Stem Auger | REF. NO.: 10000820 |
| LOCATION: Cambridge Street Extension, Collingwood | Diameter: 150mm | DRG. NO.: 7 |
| DATUM: Geodetic | Date: Aug/25/2014 | |
| BH LOCATION: Third Street | | |

| (m) ELEV DEPTH | ROCK DESCRIPTION | GROUND WATER CONDITIONS | CORE SAMPLE | | TOTAL CORE RECOVERY (%) | SOLID CORE RECOVERY (%) | HARD LAYER (%) | RQD (%) | FRACTURE INDEX (per 0.3 m) | DISCONTINUITIES | Weathering Index | HYDRAULIC CONDUCTIVITY (cm/sec) | POINT LOAD TEST UCS AXIAL (MPa) | POINT LOAD TEST UCS DIAMETRAL (MPa) | UNIAXIAL COMPRESSION (MPa) | DENSITY (g/cm ³) E (GPa) | |
|----------------------|--|----------------------------|----------------|------|----------------------------|----------------------------|----------------|---------|-------------------------------|-----------------|------------------|------------------------------------|------------------------------------|--|-------------------------------|---|--|
| | | | NUMBER | SIZE | | | | | | | | | | | | | |
| 179.7 | Rock Surface | | | | | | | | | | | | | | | | |
| 178.3 | LIMESTONE: slightly weathered to fresh, fine- to coarse-grained, fossiliferous, argillaceous, grey | | 1 | NQ | 74 | 10 | 0 | >25 | | | | | | | | | |
| 178.9 | | | | | | | | | | | | | | | | | |
| 3.1 | | | | | | | | | | | | | | | | | |
| 178.7 | | | 2 | NQ | 100 | 0 | 0 | >25 | | | | | | | | | |
| 3.4 | | | | | | | | | | | | | | | | | |
| 178.4 | | | 3 | NQ | 100 | 0 | 0 | >25 | | | | | | | | | |
| 3.6 | END OF BOREHOLE Notes: 1. Bedrock cored on August 27, 2014. 2. Borehole was open and dry upon completion 3. 50 mm dia. monitoring well was installed upon completion, screened from 4.5m to 6.0m. 4- Water Level Measurements in Monitoring Well(surface elev. m) Date W.L. Depth (m) W.L. Elev. (m) Sept. 22, 2014 2.81 179.19 Dec. 12, 2014 2.93 179.07 | | | | | | | | | | | | | | | | |

SPL ROCK CORE-2014 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/12/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered 0 = angle to the core axis E = Modulus of Elasticity
 *: UCS [Mpa] = 24 f_{s(50)}



LOG OF BOREHOLE BH14-08

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

PROJECT LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

REF. NO.: 10000820

DATUM: Geodetic

Date: Aug/25/2014

DRG. NO.: 8

BH LOCATION: Third Street

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------------|---|-----------------|--------|------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------|---|----|----|-----------|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | "N" BLOWS 0.3 m | 20 | | | | | | | 40 | 60 | 80 |
| 181.8 | ASPHALT: 130mm | | | | | | | | | | | | | | | | |
| 180.9 | GRANULAR BASE/SUBBASE: 400mm | | | | | | | | | | | | | | | | |
| 181.3 | FILL: sand and gravel, trace silt, trace cobble, brown, moist, very dense | [Cross-hatched] | 1 | SS | 50/75mm | | | | | | | | | | | | 35 58 (7) |
| 180.9 | | | 2 | SS | 50/60mm | 181 | | | | | | | | | | | |
| 0.9 | AUGER REFUSAL: 1. borehole was open and dry upon completion | | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/26/2014
 REF. NO.: 10000820
 DRG. NO.: 9

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | |
|----------------------|--|-------------|---------|------|--------------------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------|---|----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | | 60 |
| 182.1 | ASPHALT: 100mm | | | | | | | | | | | | | | | |
| 182.0 | GRANULAR BASE/SUBBASE: 180mm | | | | | | | | | | | | | | | |
| 181.8 | FILL: medium sand, trace gravel, reddish brown, moist, dense | | 1 | SS | 32 | | | | | | | | | | | |
| 181.2 | CLAYEY SILT: trace sand, some gravel, trace limestone piece at bottom, brown, some grey, moist, very stiff | | 2 | SS | 23 | | | | | | | | | | | |
| 180.8 | AUGER REFUSAL: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, X 3. Numbers refer to Sensitivity
 ○ = 3% Strain at Failure



LOG OF BOREHOLE BH14-10

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: Third Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/26/2014
 REF. NO.: 10000820
 DRG. NO.: 10

| SOIL PROFILE | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | | | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | |
|----------------------|---|-------------|--------|------|-------------------------|-----------|--|----|----|----|----|---------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------|---|----------|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | | | "N" BLOWS 0.3 m | 20 | 40 | 60 | 80 | | | | | | | 100 |
| 182.0 | ASPHALT: 130mm | | | | | | | | | | | | | | | | | |
| 181.8 | GRANULAR BASE/SUBBASE: 130mm | | 1 | SS | 65/200mm | | | | | | | | | | | | | 5 91 (4) |
| 181.4 | FILL: medium sand, trace silt, reddish brown, some black, moist, very dense | | | | | | | | | | | | | | | | | |
| 181.4 | AUGER REFUSAL/SPOON BOUNCING: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 × 3 Numbers refer to Sensitivity
 ○ = 3% Strain at Failure



LOG OF BOREHOLE BH14-11

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

PROJECT LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

REF. NO.: 10000820

DATUM: Geodetic

Date: Aug/26/2014

DRG. NO.: 11

BH LOCATION: High Street

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT W _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT W _L | POCKET PEN. (Cu) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | |
|----------------------|---|-------------|---------|------|--------------------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|------------------------|--------------------------------------|---|----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | | 60 |
| 181.7 | ASPHALT: 180mm | | | | | | | | | | | | | | | |
| 181.5 | | | | | | | | | | | | | | | | |
| 0.2 | GRANULAR BASE/SUBBASE: 500mm | | 1 | SS | 82 | | | | | | | | | | | |
| 181.0 | | | | | | | | | | | | | | | | |
| 0.7 | FILL: sand and gravel, brown, moist, very dense | | | | | | | | | | | | | | | |
| 180.8 | | | | | | | | | | | | | | | | |
| 0.9 | AUGER REFUSAL/SPOON BOUNCING: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH14-12

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

PROJECT LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

REF. NO.: 10000820

DATUM: Geodetic

Date: Aug/26/2014

DRG. NO.: 12

BH LOCATION: High Street

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | | | |
|----------------|--|-------------|---------|------|-----------------|-------------------------|-----------|--|----|---------------|--------------------------|--------------|-------------------------------------|--------------------------------------|---|----|----|-----------|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | | 60 | 80 | 100 |
| 181.8 0.0 | ASPHALT: 180mm | | | | | | | | | | | | | | | | | |
| 181.6 0.2 | GRANULAR BASE/SUBBASE: 560mm, very dense | | 1 | SS | 50/100mm | | | | | | | | | | | | | 40 52 (8) |
| 181.0 0.7 | FILL: sand, some gravel, some silt, brown, moist, dense | | 2 | SS | 42 | | | | | | | | | | | | | |
| 180.6 1.2 | AUGER REFUSAL: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES

+ 3, x 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure



LOG OF BOREHOLE BH14-13

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: High Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/26/2014
 REF. NO.: 10000820
 DRG. NO.: 13

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT w _p | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w _L | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) | |
|----------------------|--|-------------|---------|------|--------------------|-------------------------|-----------|--|----|---------------------------------|-------------------------------|--------------------------------|-------------------------------------|--------------------------------------|---|----|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | | 60 |
| 181.9 | ASPHALT: 180mm | | | | | | | | | | | | | | | |
| 0.0 181.7 | | | | | | | | | | | | | | | | |
| 0.2 | GRANULAR BASE/SUBBASE: 500mm | | 1 | SS | 43 | | | | | | | | | | | |
| 181.2 | | | | | | | | | | | | | | | | |
| 0.7 | FILL: sand, some silt, some gravel, borwn, moist, compact | | 2 | SS | 17 | | | | | | | | | | | |
| 180.4 | | | | | | | | | | | | | | | | |
| 180.5 | very dense | | 3 | SS | 50/ | | | | | | | | | | | |
| 1.6 | SPOON REFUSAL: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3 x 3. Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation

DRILLING DATA

CLIENT: 2204604 Ontario Inc.

Method: Solid Stem Auger

PROJECT LOCATION: Cambridge Street Extension, Collingwood

Diameter: 150mm

REF. NO.: 10000820

DATUM: Geodetic

Date: Aug/26/2014

DRG. NO.: 14

BH LOCATION: High Street

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT | NATURAL MOISTURE CONTENT | LIQUID LIMIT | POCKET PEN. (C _u) (kPa) | NATURAL UNIT WT (k/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|----------------|--|-------------|---------|------|-----------------|-------------------------|-----------|--|----|---------------|--------------------------|--------------|-------------------------------------|-------------------------------------|---|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 | 40 | | | | | | |
| 182.7 | CONCRETE: 200mm | | | | | | | | | | | | | | |
| 182.5 | FILL: sand, trace silt, some gravel, borwn, moist, dense | | 1 | SS | 33 | | | | | | | | | | |
| 182.0 | SANDY SILT: some clay, some gravel, grey, moist, dense | | 2 | SS | 43 | | | | | | | | | | |
| 181.1 | 1.5 SPOON BOUNCING: 1. Borehole was open and dry upon completion | | | | | | | | | | | | | | |

SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL.GDT 1/5/15

GROUNDWATER ELEVATIONS

Measurement

GRAPH NOTES

+³, X³: Numbers refer to Sensitivity

○ #=3% Strain at Failure



LOG OF BOREHOLE BH14-15

PROJECT: Geotechnical Investigation
 CLIENT: 2204604 Ontario Inc.
 PROJECT LOCATION: Cambridge Street Extension, Collingwood
 DATUM: Geodetic
 BH LOCATION: High Street

DRILLING DATA
 Method: Solid Stem Auger
 Diameter: 150mm
 Date: Aug/26/2014
 REF. NO.: 10000820
 DRG. NO.: 15

| SOIL PROFILE | | | SAMPLES | | | GROUND WATER CONDITIONS | ELEVATION | DYNAMIC CONE PENETRATION RESISTANCE PLOT | | PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT | POCKET PEN. (Cu) (MPa) | NATURAL UNIT WT (kN/m ³) | REMARKS AND GRAIN SIZE DISTRIBUTION (%) |
|----------------------|--|-------------|---------|------|--------------------|-------------------------|----------------------------------|--|-----------------|---|------------------------|--------------------------------------|---|
| (m) ELEV DEPTH | DESCRIPTION | STRATA PLOT | NUMBER | TYPE | "N" BLOWS 0.3 m | | | 20 40 60 80 100 | 20 40 60 80 100 | | | | |
| 184.0 | CONCRETE: 200mm | [Pattern] | | | | | | | | | | | |
| 183.8 | | | | | | | | | | | | | |
| 0.2 | FILL: sand and gravel, trace silt, dark brown/black, moist, compact | [Pattern] | | | | | | | | | | | |
| 183.5 | | | | | | | | | | | | | |
| 0.5 | FILL: medium sand, brown, moist, compact | [Pattern] | 1 | SS | 21 | | | | | | | | 35 59 (6) |
| 183.0 | | | | | | | | | | | | | |
| 1.0 | SAND: fine, some silt, grey, wet, compact | [Pattern] | 2 | SS | 29 | | | | | | | | |
| 182.4 | | | | | | | | | | | | | |
| 1.5 | very dense | [Pattern] | | | | | | | | | | | |
| | | | 3 | SS | 73 | | | | | | | | |
| 181.8 | | | | | | | | | | | | | |
| 2.1 | END OF BOREHOLE: 1. water level was 2.0m below grade and open upon completion | | | | | | 182 | | | | | | |
| | | | | | | | W. L. 182.0 m Upon Completion | | | | | | |

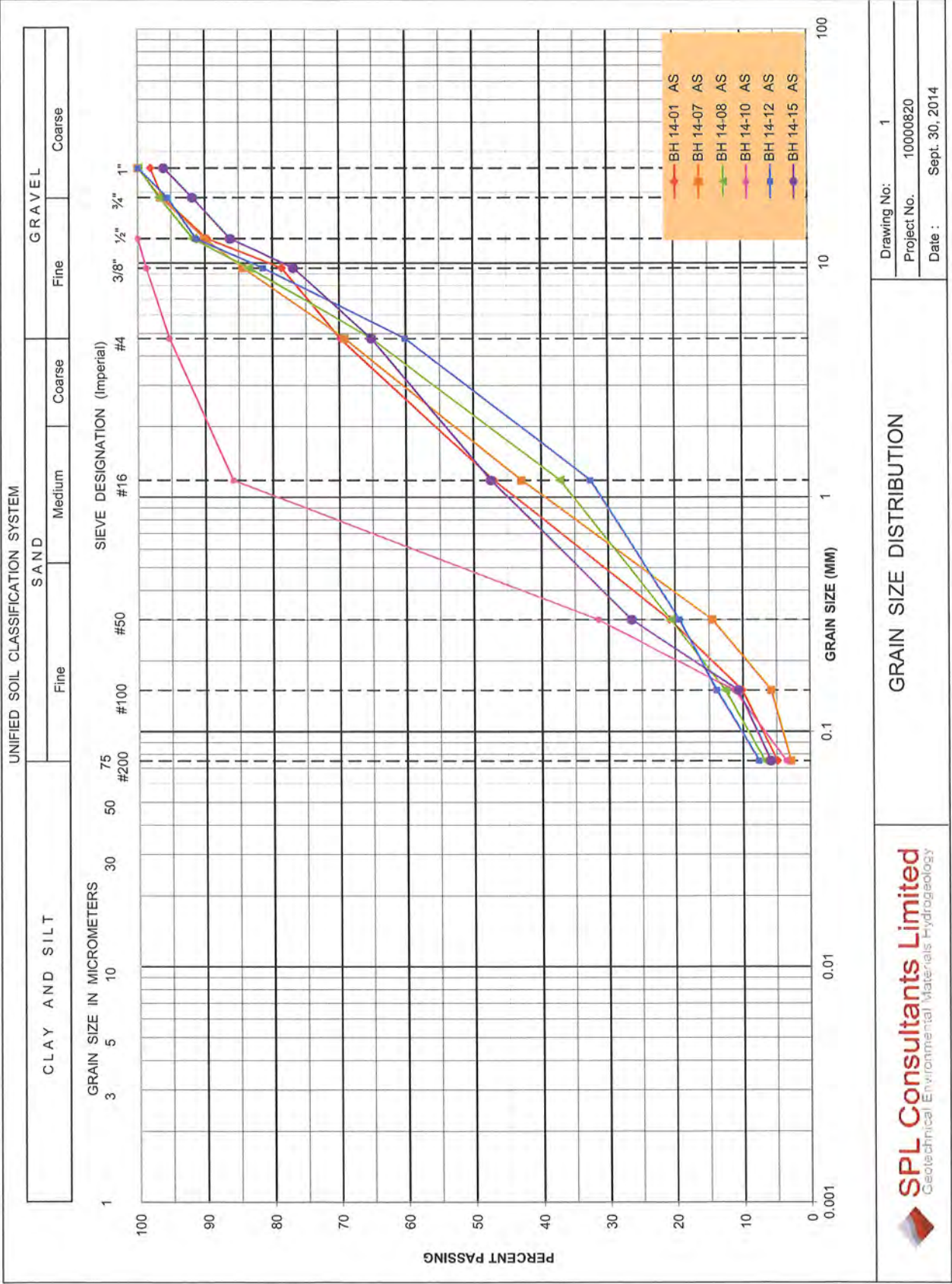
SPL SOIL LOG 10000820 - BOREHOLE LOGS.GPJ SPL_GDT 1/5/15

GROUNDWATER ELEVATIONS
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, X 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure

APPENDIX B GRADATION CURVES





Drawing No: 1
 Project No: 10000820
 Date: Sept. 30, 2014

GRAIN SIZE DISTRIBUTION

APPENDIX C

ASPHALT CORE PHOTOGRAPHS





Figure # 1: Borehole 14-1 – Cambridge St., Collingwood, Ontario



Figure # 2: Borehole 14-8 – Home Depot Parking Lot, Collingwood, Ontario



Figure # 3: Borehole 14-9 – Third St., Collingwood, Ontario



Figure # 4: Borehole 14-11 – High St., Collingwood, Ontario



Figure # 5: Borehole 14-13 – High St., Collingwood, Ontario



Figure # 6: Borehole 14-15 – High St., Collingwood, Ontario

APPENDIX D

BEDROCK CORE PHOTOGRAPHS





Figure # 1: Borehole 14-1 - Runs 1, 2, 3 and 4



Figure # 2: Borehole 14-2 – Runs 1, 2 and 3



Figure # 3: Borehole 14-3 – Runs 1, 2 and 3



Figure # 4: Borehole 14-3 – Runs 3 and 4



Figure # 5: Borehole 14-4 – Runs 1, 2, 3 and 4

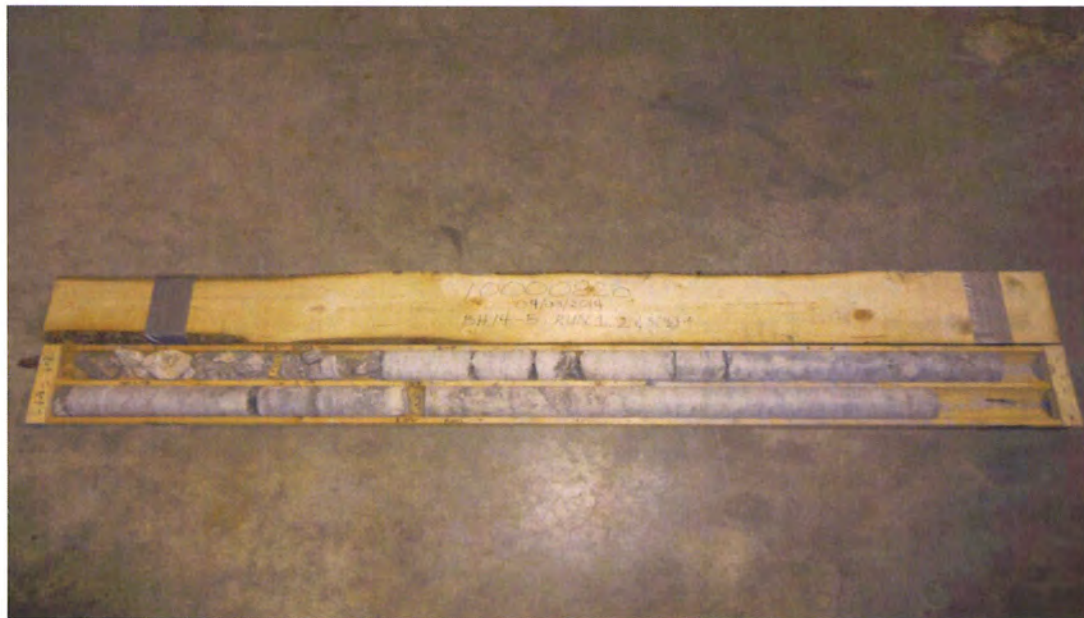


Figure # 6: Borehole 14-5 – Runs 1, 2, and 3

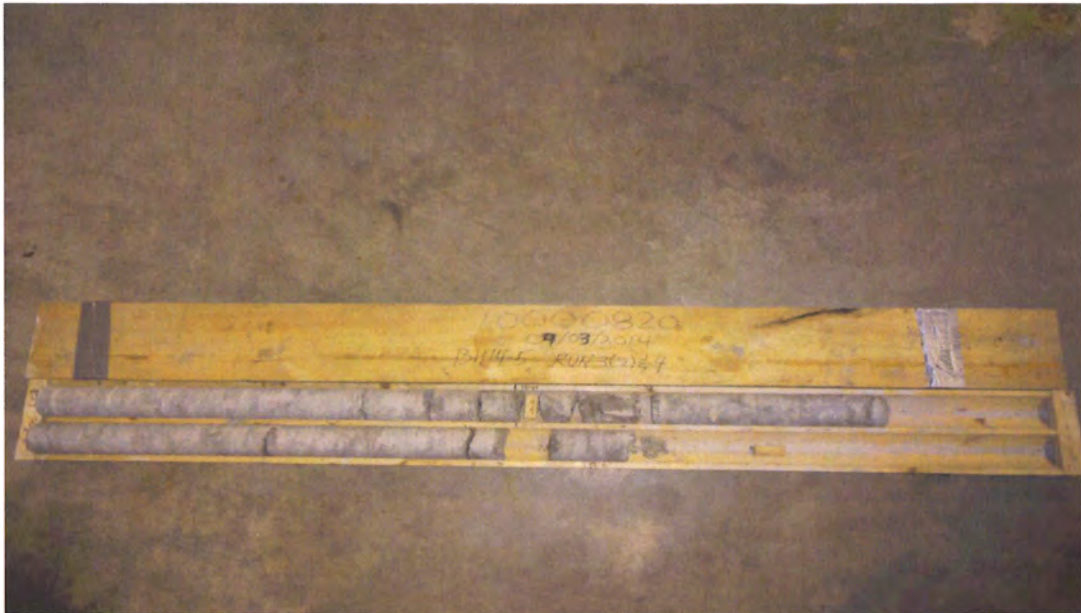


Figure # 7: Borehole 14-5 – Runs 3 and 5



Figure # 8: Borehole 14-6 – Runs 1, 2, 3 and 4



Figure #10: Borehole 14-7 – Runs 1, 2 and 3

APPENDIX E GENERAL REQUIREMENTS FOR ENGINEERED FILL



GENERAL REQUIREMENTS FOR ENGINEERED FILL

Compacted imported soil that meets specific engineering requirements and is free of organics and debris and that has been continually monitored on a full-time basis by a qualified geotechnical representative is classified as engineered fill. Engineered fill that meets these requirements and is bearing on suitable native subsoil can be used for the support of foundations.

Imported soil used as engineered fill can be removed from other portions of a site or can be brought in from other sites. In general, most of Ontario soils are too wet to achieve the 100% Standard Proctor Maximum Dry Density (SPMDD) and will require drying and careful site management if they are to be considered for engineered fill. Imported non-cohesive granular soil is preferred for all engineered fill. For engineered fill, we recommend use of OPSS Granular 'B' sand and gravel fill material.

Adverse weather conditions such as rain make the placement of engineered fill to the required degree of density difficult or impossible; engineered fill cannot be placed during freezing conditions, i.e. normally not between December 15 and April 1 of each year.

The location of the foundations on the engineered fill pad is critical and certification by a qualified surveyor that the foundations are within the stipulated boundaries is mandatory. Since layout stakes are often damaged or removed during fill placement, offset stakes must be installed and maintained by the surveyors during the course of fill placement so that the contractor and engineering staff are continually aware of where the engineered fill limits lie. Excavations within the engineered fill pad must be backfilled with the same conditions and quality control as the original pad.

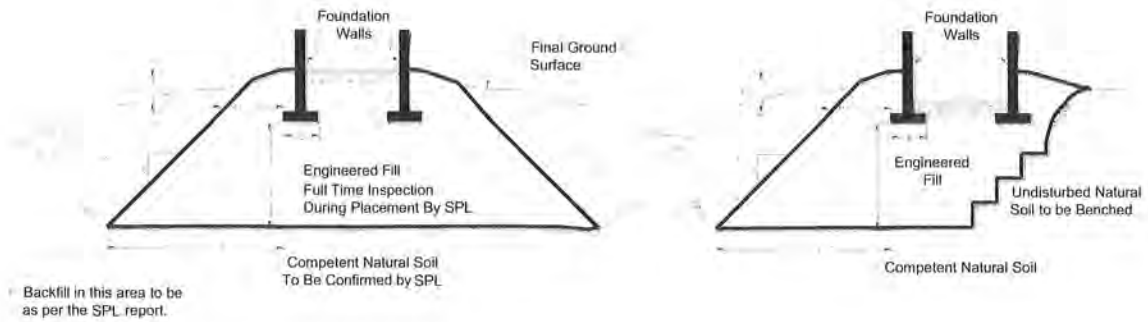
To perform satisfactorily, engineered fill requires the cooperation of the designers, engineers, contractors and all parties must be aware of the requirements. The minimum requirements are as follows, however, the geotechnical report must be reviewed for specific information and requirements.

1. Prior to site work involving engineered fill, a site meeting to discuss all aspects must be convened. The surveyor, contractor, design engineer and geotechnical engineer must attend the meeting. At this meeting, the limits of the engineered fill will be defined. The contractor must make known where all fill material will be obtained from and samples must be provided to the geotechnical engineer for review, and approval before filling begins.
2. Detailed drawings indicating the lower boundaries as well as the upper boundaries of the engineered fill must be available at the site meeting and be approved by the geotechnical engineer.
3. The building footprint and base of the pad, including basements, garages, etc. must be defined by offset stakes that remain in place until the footings and service connections are all constructed. Confirmation that the footings are within the pad, service lines are in place, and that the grade conforms to drawings, must be obtained by the owner in writing from the surveyor and SPL Consultants Limited. Without this confirmation no responsibility for the performance of the structure can be accepted by SPL Consultants Limited. Survey drawing of the pre and post fill location and elevations will also be required.

-
4. The area must be stripped of all topsoil and fill materials. Subgrade must be proof-rolled. Soft spots must be dug out. The stripped native subgrade must be examined and approved by a SPL Consultants Limited engineer prior to placement of fill.
 5. The approved engineered fill material must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Engineered fill should not be placed during the winter months. Engineered fill compacted to 100% SPMDD will settle under its own weight approximately 0.5% of the fill height and the structural engineer must be aware of this settlement. In addition to the settlement of the fill, additional settlement due to consolidation of the underlying soils from the structural and fill loads will occur and should be evaluated prior to placing the fill.
 6. Full-time geotechnical inspection by SPL Consultants Limited during placement of engineered fill is required. Work cannot commence or continue without the presence of the SPL Consultants Limited representative.
 7. The fill must be placed such that the specified geometry is achieved. Refer to the attached sketches for minimum requirements. Take careful note that the projection of the compacted pad beyond the footing at footing level is a minimum of 2 m. The base of the compacted pad extends 2 m plus the depth of excavation beyond the edge of the footing.
 8. A bearing capacity of 150 kPa at SLS (225 kPa at ULS) can be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings must be provided with nominal steel reinforcement.
 9. All excavations must be done in accordance with the Occupational Health and Safety Regulations of Ontario.
 10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from SPL Consultants Limited prior to footing concrete placements. All excavations must be backfilled under full time supervision by SPL Consultants Limited to the same degree as the engineered fill pad. Surface water cannot be allowed to pond in excavations or to be trapped in clear stone backfill. Clear stone backfill can only be used with the approval of SPL Consultants Limited.
 11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any stoppage in work in order to promote rapid runoff of rainwater and to avoid any ponding surface water. Any stockpiles of fill intended for use as engineered fill must also be smooth-bladed to promote runoff and/or protected from excessive moisture take up.
 12. If there is a delay in construction, the engineered fill pad must be inspected and accepted by the geotechnical engineer. The location of the structure must be reconfirmed that it remains within the pad.
 13. The geometry of the engineered fill as illustrated in these General Requirements is general in nature. Each project will have its own unique requirements. For example, if perimeter

sidewalks are to be constructed around the building, then the projection of the engineered fill beyond the foundation wall may need to be greater.

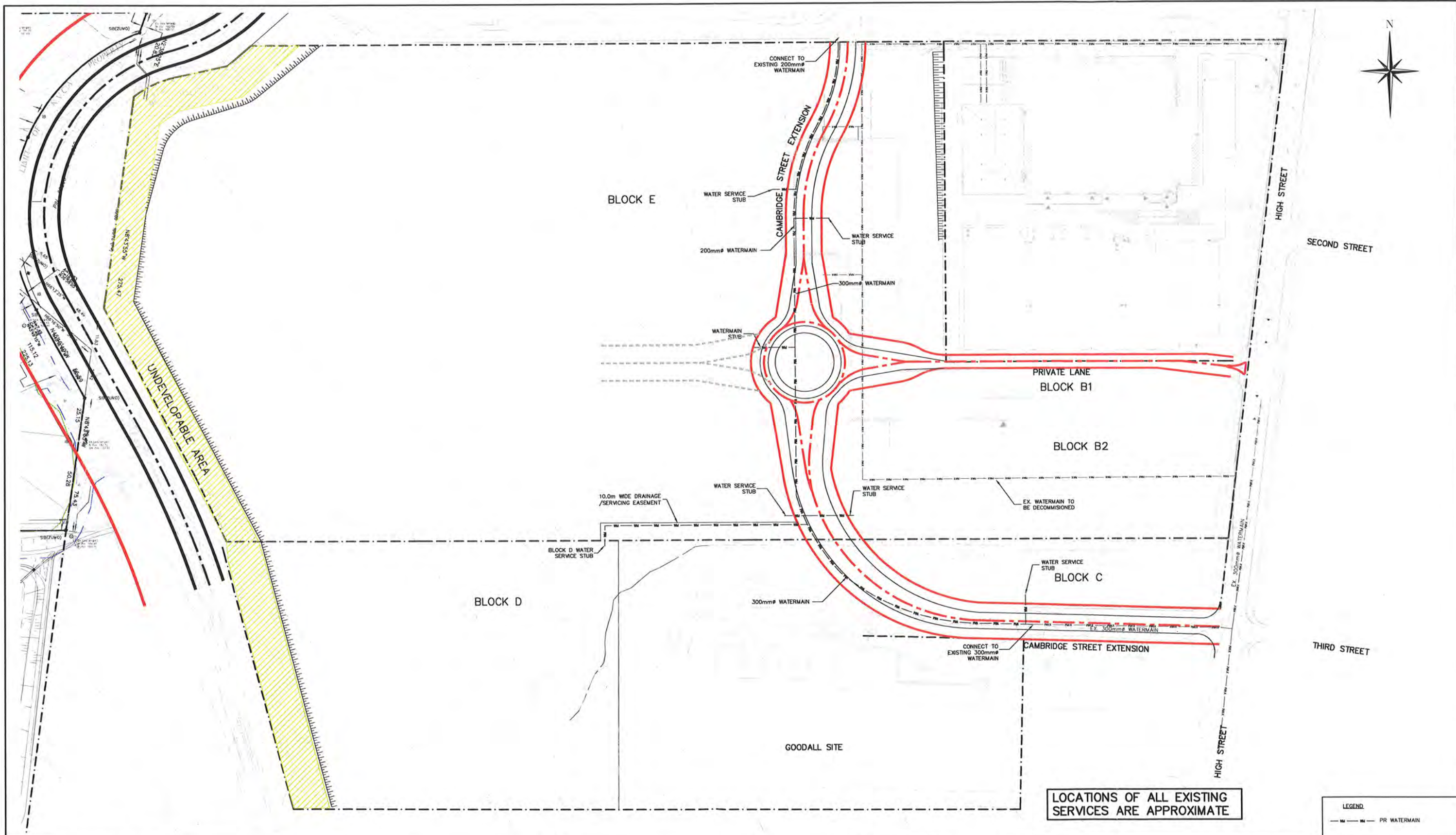
14. These guidelines are to be read in conjunction with SPL Consultants Limited report attached.



APPENDIX F

SANITARY SERVICING PLAN





LOCATIONS OF ALL EXISTING SERVICES ARE APPROXIMATE

LEGEND
 --- PR WATERMAIN

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| | | |

Engineer
 D.M. TONE
 100115132
 LICENSED PROFESSIONAL ENGINEER
 PROVINCE OF ONTARIO

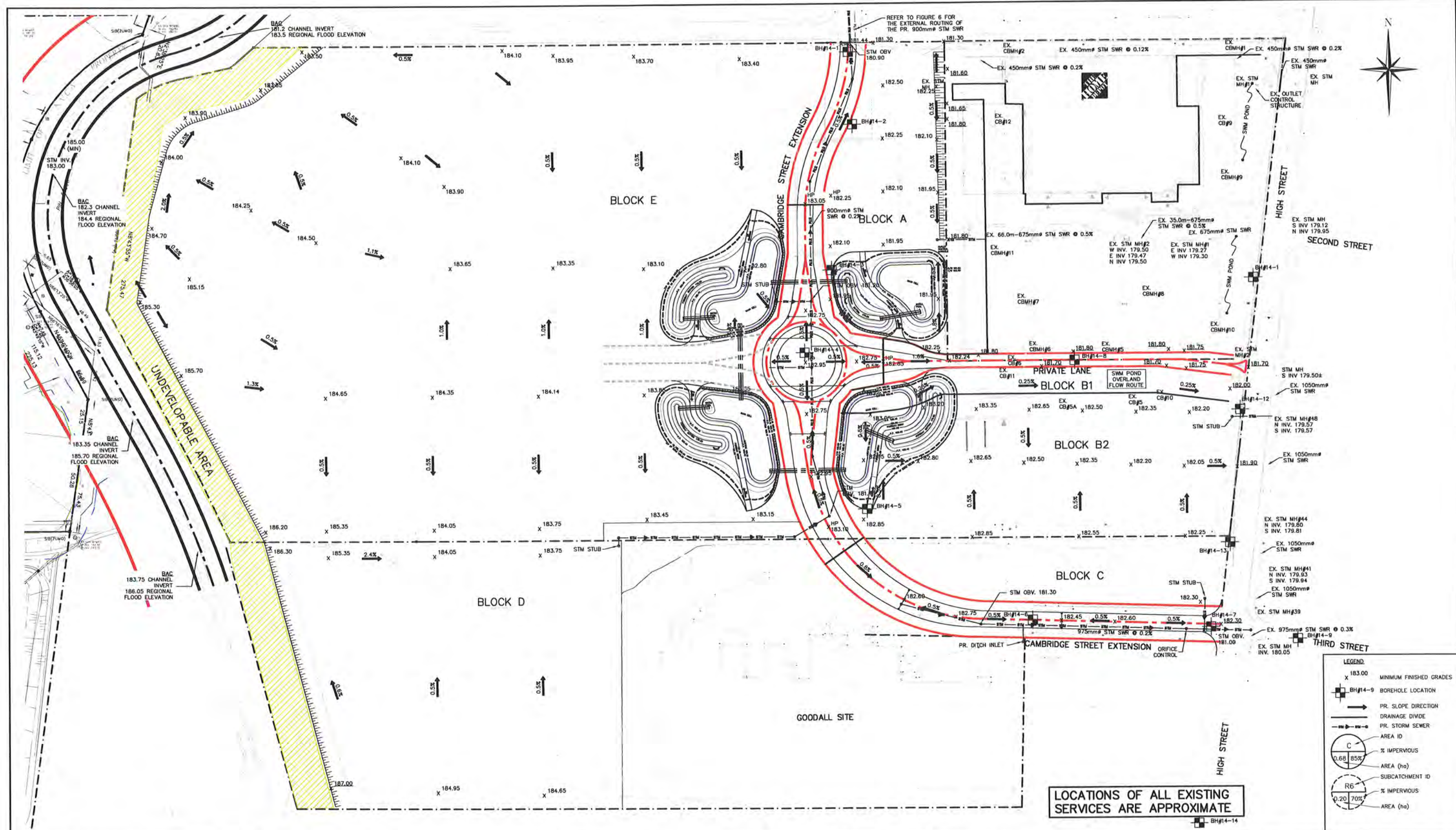
Project: **THIRD AND HIGH STREET DEVELOPMENT
 TOWN OF COLLINGWOOD**
 Drawing: **PRELIMINARY WATER
 DISTRIBUTION PLAN**

CROZIER & ASSOCIATES
 Consulting Engineers

THE HARBOUREDGE BUILDING,
 40 HURON STREET, SUITE 301,
 COLLINGWOOD, ON L9Y 4R3
 705 446-3510 T
 705 446-3520 F
 WWW.CFCROZIER.CA
 INFO@CFCROZIER.CA

Drawn By: L.W. Design By: L.W. Project: **183-2697**
 Scale: 1:1000 Date: 08/01/2014 Check By: D.T. Drawing: **FIG. 4**

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LEGEND

- X 183.00 MINIMUM FINISHED GRADES
- BH#14-9 BOREHOLE LOCATION
- PR. SLOPE DIRECTION
- DRAINAGE DIVIDE
- PR. STORM SEWER
- C AREA ID
- 6.68 85% % IMPERVIOUS
- AREA (ha)
- R6 SUBCATCHMENT ID
- 0.20 70% % IMPERVIOUS
- AREA (ha)

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Engineer

D.M. TONE
100115132
LICENSED PROFESSIONAL ENGINEER
PROVINCE OF ONTARIO

Project: **THIRD AND HIGH STREET DEVELOPMENT**
TOWN OF COLLINGWOOD

Drawing: **PRELIMINARY GRADING AND DRAINAGE PLAN**
OPTION 1 - DOWNLOAD SWM

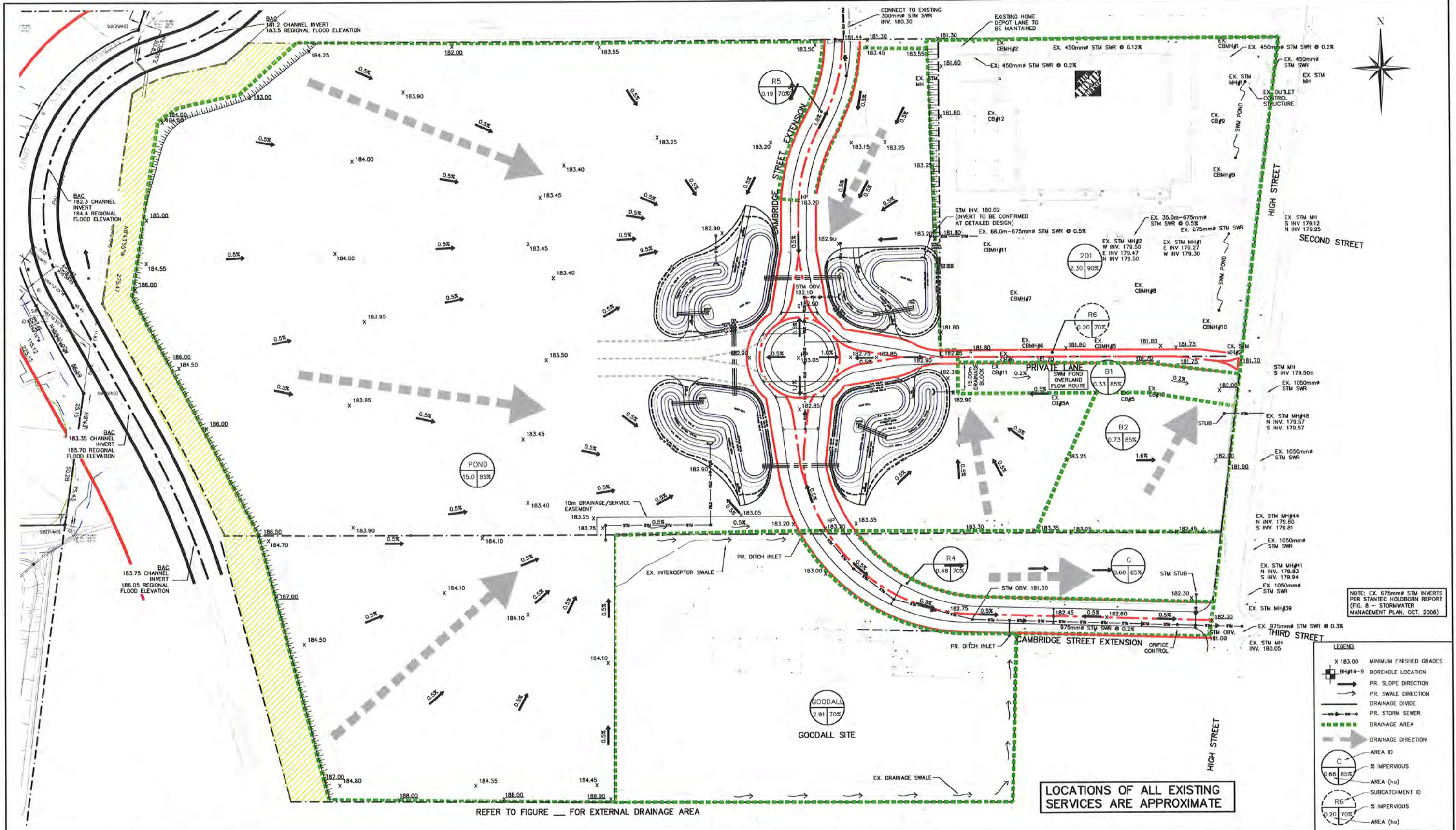
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Consulting Engineers

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COLLINGWOOD, ON L9Y 4R3
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705-446-3520 F
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Drawn By: L.W. Design By: L.W. Project: **183-2697**

Scale: 1:1000 Date: 08/01/2014 Check By: D.T. Drawing: **FIG. 5B**

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REFER TO FIGURE ___ FOR EXTERNAL DRAINAGE AREA

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Project

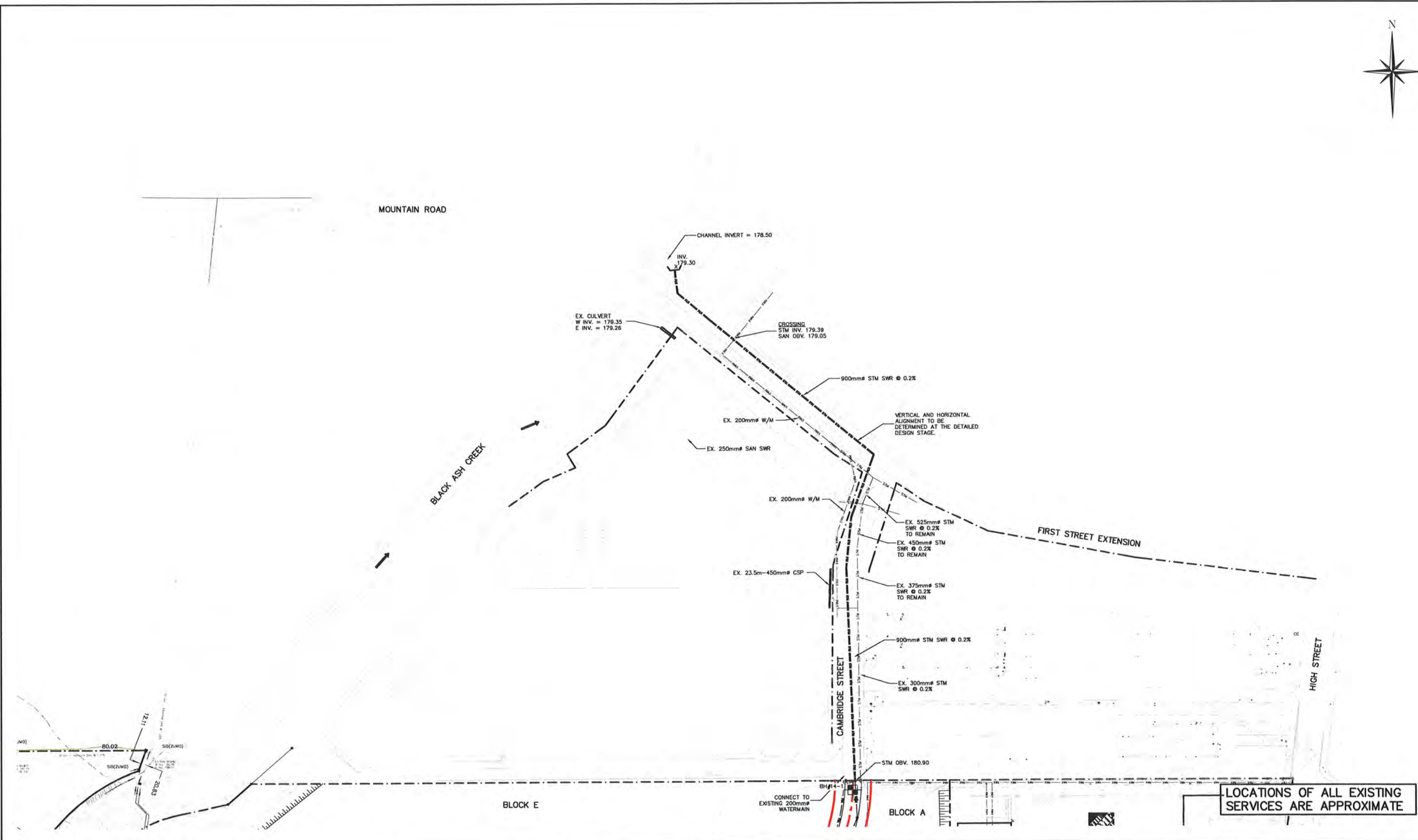
THIRD AND HIGH STREET DEVELOPMENT
 TOWN OF COLLINGWOOD

Preliminary Grading and Drainage Plan
 Regional SWM Facility

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Drawn By: L.W. Design By: L.W. Project: 183-2697
 Scale: 1:1000 Date: 08/01/2014 Check By: D.T. Drawing: FIG. 7

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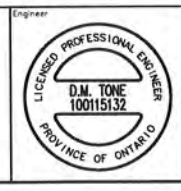
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| | | |
|----------|----------|--|
| Engineer | Engineer | Project |
| | | THIRD AND HIGH STREET DEVELOPMENT TOWN OF COLLINGWOOD |
| | | Drawing |
| | | SWM OPTION 1: EXTERNAL STORM SEWER ROUTING PLAN |



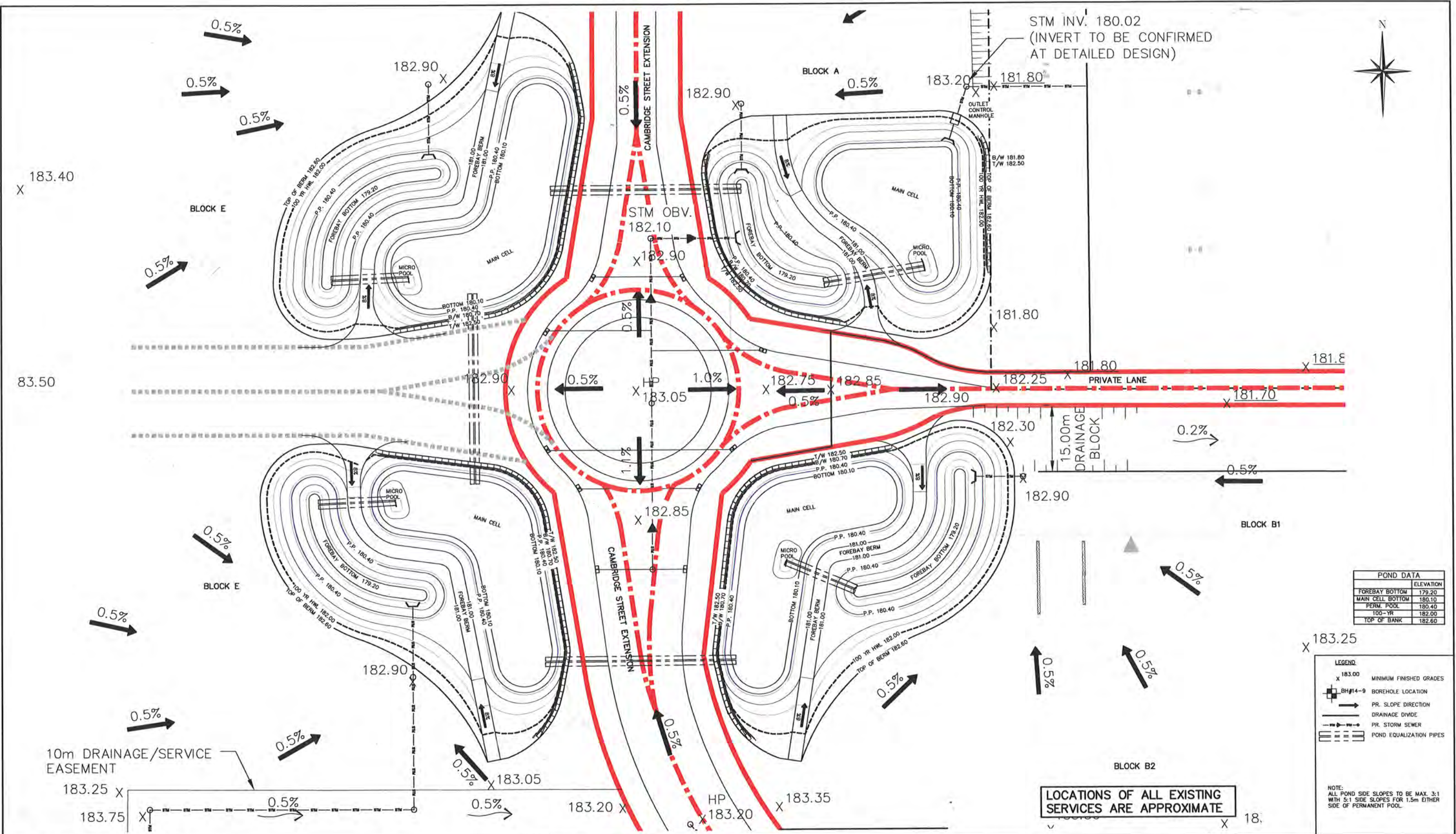
| | | | | | |
|----------|--------|-----------|------------|----------|----------|
| Drawn By | L.W. | Design By | L.W. | Project | 183-2697 |
| Scale | 1:1000 | Date | 08/01/2014 | Check By | D.T. |

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705 446-3510 T
705 446-3520 F
WWW.CFCROZIER.CA
INFO@CFCROZIER.CA

FIG. 8

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| POND DATA | |
|------------------|-----------|
| | ELEVATION |
| FOREBAY BOTTOM | 179.20 |
| MAIN CELL BOTTOM | 180.10 |
| PERM. POOL | 180.40 |
| 100-YR | 182.00 |
| TOP OF BANK | 182.60 |

| LEGEND | |
|-----------|-------------------------|
| x 183.00 | MINIMUM FINISHED GRADES |
| ⊕ BH#14-9 | BOREHOLE LOCATION |
| → | PR. SLOPE DIRECTION |
| — | DRAINAGE DIVIDE |
| — | PR. STORM SEWER |
| — | POND EQUALIZATION PIPES |

NOTE:
ALL POND SIDE SLOPES TO BE MAX. 3:1 WITH 5:1 SIDE SLOPES FOR 1.5m EITHER SIDE OF PERMANENT POOL.

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| Engineer | Project |
|---|--|
| D.M. TONE 100115132 LICENSED PROFESSIONAL ENGINEER PROVINCE OF ONTARIO | THIRD AND HIGH STREET DEVELOPMENT TOWN OF COLLINGWOOD |

| Project | Drawing |
|--|--|
| THIRD AND HIGH STREET DEVELOPMENT TOWN OF COLLINGWOOD | STORMWATER MANAGEMENT FACILITY PLAN |

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Scale: 1:400 Date: 08/01/2014 Check By: D.T. Drawing: **POND**

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