FISHER ENVIRONMENTAL LTD.

ENGINEERING

Professional Engineers Ontario

LABORATORY

CALA
Canadian Association for Laboratory Accreditation Inc.

PRELIMINARY GEOTECHNICAL INVESTIGATION

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NEPEAN, ONTARIO

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Project No. FE-P16-7971 GEO

November 18, 2016

Issued to:	Dymon Group of Companies.
Contact:	Glen Luckman
	2-1830 Walkley Road, Ottawa, ON
Project Name:	Preliminary Geotechnical Investigation
Project Address:	1375 Clyde Avenue, Nepean, ON
Project Number:	FE-P-16-7972
Issued on:	November 18, 2016

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1. INTRODUCTION

Fisher Environmental Limited (Fisher) was commissioned by Dymon Group of Companies to carry out a preliminary Geotechnical Investigation at the property municipally addressed as 1375 Clyde Avenue, in the town of Nepean, Ontario, hereinafter referred to as the 'Site'.

The purpose of this investigation was to provide a geotechnical report in regards to the subject Site's subsurface soil and groundwater conditions and to outline geotechnical parameters and recommendations for the design of a proposed development.

The discussion of the findings and results of the geotechnical investigation is in accordance with the general terms of reference. This report was prepared specifically and solely for the purpose of assessing geotechnical conditions as they relate to the development of the site with respect to the proposed structures as detailed to Fisher at the time of the investigation.

2. SITE AND PROJECT DESCRIPTIONS

The Site is located on the east side of Clyde Avenue approximately 65 m east from the intersection of Baseline Road and Clyde Avenue. The Site is an irregular, "L" shaped property bounded by commercial buildings to the north and south, vacant land to the east and Clyde Avenue to the west.

The southern portion of the Site is occupied by a one-storey commercial building. The remaining portions of the Site are generally asphalt paved parking/driving areas. There are access driveways from both Baseline Road and Clyde Avenue. The ground grade across the Site generally sloped from the north to south and east to west.

Based on Site Plans provided to Fisher – Drive-In Self Storage Facility, Preliminary Site Study Option 4, completed by Fotenn, the proposed developments on Site consist of: two single storey commercial buildings located to the northwest corner and southeast portions of the property in addition to a multi-story building located in the north-east. The proposed buildings were understood to have no basements or below grade parking.

3. FIELD WORK

Site drilling work for the geotechnical investigation was carried out on October 24, 2016 and was conducted concurrently with a Phase 2 Environmental Site Assessment (ESA) which also performed by Fisher.

A total of fourteen (14) boreholes (BH1 to BH14) were drilled approximately at the locations identified on the attached Site Plan - Appendix A. Boreholes were advanced to varying depths of between 0.40 m to 3.85m below grade.

A CME-75 Truck mounted drilling rig equipped with hollow stem augers were used for all drilling work. Soil samples were taken at regular intervals using a split–spoon sampler advanced by means of the Standard Penetration Test (SPT) that was conducted in general accordance with ASTM specification D1586.

All recovered soil samples were placed in clear, sealable plastic bags and/or glass jars in the field and were transported back to Fisher Environmental Laboratories for further examination, characterization and laboratory analyses.

Two (2) 2" diameter PVC groundwater monitoring wells were installed in BH5 and BH11 to monitor groundwater levels and facilitate water sampling. The installation details of the wells, in addition to the description of the subsurface conditions encountered at each borehole location are presented in Appendix B - Log of Boreholes.

The ground surface elevations at each borehole location were surveyed by Fisher on October 25, 2016. Elevations obtained by Fisher were related to a local benchmark "finished floor elevation" of the existing building "Value Village", having an assumed elevation of 100m asl.

The soil samples recovered during the investigation will be stored in the laboratory for a period of thirty (30) days after submitting this report and will be discarded thereafter unless otherwise instructed by the client.

4. SUBSOIL CONDITIONS

Subsoil encountered at borehole locations are shown in Appendix B - Log of Boreholes and are summarized as follows:

- **PAVEMENT** – Asphalt pavement was encountered in all boreholes at the ground surface and underlain by a layer of granular base/fill materials. The fill materials consisted of sand and gravel with occasional clay, clayey silt and silty sand and extended to approximate depths from 0.3 to 0.6m.

- **FILL** – A layer of fill (included granular pavement bases) was encountered in all boreholes below the asphalt pavement. The fill materials were generally moist to dry in nature.

The fill in BH1 to BH5, which covered the northeast portion of the site, consisted of granular base in BH2, BH3 and BH4, and relative deeper fill in BH1 and BH5. The fill in BH1 and BH5 below the granular base consisted of brown to dark brown sand and gravel with occasional clay, organic inclusions and rootlets.

The fill in BH6 to BH9, which covered the east to south east portion of the site, was dominated by brown, dark brown sand and gravel and contained some to trace clay, and sandy silt with occasional brick and organic inclusions in the lower portions. SPT "N" values tested on the layers varied from 10 to 25 blows, indicative of a compact dense relative density.

In BH10 to BH14, which covered the northwest portion of the site, the fill included some clay pockets and organic inclusions below the granular base. These fill layers were light to dark brown in colour and in a dry to moist condition. SPT "N" values tested on the layer varied from 24 to 46 blows, indicative of a compact to dense, relative density.

Fill materials encountered in all boreholes extended to the depths ranging from 0.3 to 4m and were underlain by suspected bedrock with the exception of BH9 to BH14.

The general profile of each borehole with presented fill is presented in the Table 1, and the attached Log of Boreholes.

Table 1: Summary of Depth and Elevation of Fill

Borehole No.	BH1	BH2	BH3	BH4	BH5	BH6	BH7
Borehole Ground Elevation (m)	102.5	102.45	102.08	102.53	102.32	101.16	100.49
Depth of Borehole (m)	2.25	0.60	0.45	0.30	4.0	1.20	1.14
Depth of Fill (m)	2.25	0.60	0.45	0.30	4.0	1.20	1.14
Elev. at Bottom of Fill (m)	100.4	101.85	101.63	102.23	98.32	99.96	99.35
Depth of The Top of Suspected Bedrock (m)	2.25	0.60	0.45	0.30	4.0	1.20	1.14
Elev. at The Top of Suspected Bedrock (m)	100.4	101.85	101.63	102.23	98.32	99.96	99.35

Borehole No.	BH8	BH9	BH10	BH11	BH12	BH13	BH14
Borehole Ground Elevation (m)	99.92	100.06	99.72	99.7	99.67	99.62	97.14
Depth of Borehole (m)	0.91	1.26	2.28	2.75	2.05	1.20	1.90
Depth of Fill (m)	0.91	0.75	1.5	0.75	1.50	0.75	0.45
Elev. at Bottom of Fill (m)	99.01	99.31	98.22	98.95	98.17	98.87	96.69
Depth of The Top of Suspected Bedrock (m)	0.91	1.26	2.28	2.75	2.05	1.10	1.90
Elev. at The Top of Suspected Bedrock (m)	99.01	98.80	97.44	96.95	97.62	98.52	95.24

- **SANDY SILT**– Moist sandy silt was encountered in BH 9, BH12 and BH13 underneath the fill. The grey sandy silt contained trace of gravel and was in a compact state.

- **CLAYEY SILT** – Moist clayey silt was encountered in BH 10, BH 11, and BH 14. The bluish gray clayey silt contained trace gravel and was in a loose to compact state. In BH 11, hydrocarbon odours were noted at depths of approximately 2.3m.

- **BEDROCK** –Suspected bedrock was encountered in all boreholes underneath the fill layers and sandy silt deposit / clayey silt at depths ranging from 0.3 to 4.0m below the existing grade, with corresponding surface elevations varying from 102.23 to 95.24m. Based on the depths to bedrock it appears that the local bedrock surface generally slopes from the north towards the south and west. Refer to Table 2.

  From the Generalized Bedrock Geology Mapping of Ottawa – Hull the bedrock geology of the site is the Ottawa Formation, which consists of limestone with some shaly partings; and some sandstone in basal part. The suspected bedrock which was encountered in the drilling program appeared hard and constituted an obstacle which could not be advanced through during auger drilling. On site SPT testing on the suspected bedrock generally resulted in a spoon 'bounce' without any significant penetration.

  No bedrock coring was conducted on site at the time of the investigation and confirmation of the condition of the suspected bedrock could not be undertaken. An outcrop was observed immediately adjacent the properties eastern boundary where it was noted that the bedrock

primarily consisted of limestone interbedded with shale and displayed planar bedding and common fractures.

It should be noted that onsite bedrock depths revealed in the borehole investigation may be deepened by previous underground structures such as tank, and/or building excavations. Such deepening is expected in the locations of BH 1 and BH 5, where former fuel storage tanks / infrastructure were expected to have been located.

5. GROUNDWATER CONDITIONS

On October 25, 2016, groundwater levels were measured in installed wells (MW5 and MW11), in addition to four existing on-site wells, MWA, MWB, MWC and MWD. Refer to Appendix A for a Site Plan /Well Locations. Measured groundwater depths and elevations are summarized in Table 2, below.

Table 2: Groundwater Levels and Elevations

No.	Elev. at Ground (m)	Depth of Well (m)	Depth to Groundwater (m)	Groundwater Elevation (m)
			October 25, 2016	October 25, 2016
MW5	102.32	3.81	3.71	98.51
MW11	99.70	2.75	2.40	97.30
MWA	--	2.39	2.31	--
MWB	--	4.41	2.93	--
MWC	--	4.44	2.53	--
MWD	--	4.34	2.82	--

It is noted that groundwater levels are subject to seasonal fluctuations; consequently, definitive information on the long-term groundwater level could not be obtained at the present time.

6. FOUNDATION CONSIDERATIONS

Based on Site Plans provided to Fisher – Drive-In Self Storage Facility, Preliminary Site Study Option 4, completed by Fotenn, the proposed developments on Site consist of: two single storey commercial buildings located to the northwest corner and southeast portions of the property in

addition to a multi-story building located in the north-east. The proposed buildings were understood to have no basements or below grade parking.

As specific details of the proposed buildings on-site were unconfirmed, and no detailed architectural plans were available at the time of reporting, the investigations and recommendations presented herein should be considered preliminary. Upon review of finalized building Site and Foundation Plans, revisions to the presented recommendations and/or further site investigations may be required.

6.1 Spread/ Strip Footing Found on Bedrock

The stratigraphy at the Site generally consisted of fine to coarse graded fill material overlying relatively shallow depths of native sandy to clayey silt overburden and suspected bedrock. Based on the investigations completed the proposed site buildings may be supported on conventional spread/strip footings founded on bedrock.

Recommended approximate founding depths / elevations and corresponding factored bearing resistance for limit states (at ULS) are presented in the table, below.

Table 3: Foundation Design for Conventional Footings

Building/Borehole			Elev. of B.H. Ground (m)	Approx. Depth of Footings at or below (m)	Approx. Elevation of Footings at or below (m)	Bearing Resistance at ULS (KPa)
Proposed Single buildings and Multi-Story Building	BH1*	With No Basement	102.5	2.25	100.40	1000
	BH2		102.45	0.60	101.85	1000
	BH3		102.08	0.45	101.63	1000
	BH4		102.53	0.30	102.23	1000
	BH5*		102.32	4.0	98.32	1000
	BH6		101.16	1.20	99.96	1000
	BH7		100.49	1.14	99.35	1000
	BH8		99.92	0.91	99.01	1000
	BH9		100.06	1.26	98.80	1000
	BH10		99.72	2.28	97.44	1000
	BH11		99.70	2.75	96.95	1000

Building/Borehole			Elev. of B.H. Ground (m)	Approx. Depth of Footings at or below (m)	Approx. Elevation of Footings at or below (m)	Bearing Resistance at ULS (KPa)
	BH12		99.67	2.05	97.62	1000
	BH13		99.62	1.10	98.52	1000
	BH14		97.14	1.90	95.24	1000

Note: 1. '*' Location of suspected former excavation – localized deep fill

2. Serviceability Limit State Design is not typically applicable for footings founded on competent bedrock as settlements are expected to be negligible, and should not be greater than the elastic compression of the overlying concrete foundation.

6.2 General Comments about Footing Construction

Prior to the placement of footings directly on bedrock all overburden soils, and loose rock should be removed. Footings should be founded on sound bedrock which may mandate that some breaking and/or water jetting of the surface of the bedrock be conducted. The footing should ideally be founded on a relatively level rock surface, i.e., generally sloping at an angle of less than 10° from horizontal. For footings founded on sloped bedrock between 10° to 30° from horizontal, rock anchors are required to resist shear. The design of any anchoring system should be conducted by the project structural engineer following confirmation of founding rock surfaces. For rock surfaces sloping greater than 30°, the rock surfaces should be leveled to provide for a stepped footing base, or alternatively benching over the surface of the rock with concrete (25 MPa) may be more time and cost efficient.

Minimum footing widths for strip or spread footings must be in compliance with the requirements of the Ontario Building Code.

To limit the effects of frost penetration of perimeter footings, a minimum of at least 1.5 metres of earth cover should be provided for frost protection purposes in heated structures. Alternatively, the frost protection could be provided by means of a combination of earth cover and extruded polystyrene insulation.

More specific information, with respect to the bedrock depths, slope, rock integrity between and beyond the boreholes, will be available when the proposed construction is underway. To ensure that the subsoil conditions/bedrock at footing founding levels meet the design criteria, inspections should be conducted by engineering staff from Fisher prior to the placement of concrete.

7. EARTHQUAKE CONDITIONS

The building must be designed to resist a minimum earthquake force. The Ontario Building Code (2012) specifies that the building be designed to withstand a minimum lateral seismic force$\boldsymbol{V}$, which is assumed to act non-currently in any direction on the building as per the following expression:

$$\boldsymbol{V = S(Ta)MvIEW/(RdRo)}$$

Where S (Ta) should be calculated by Sa(Ta)Fa or Sa(Ta)Fv, depending on fundamental lateral period Ta. The term, which is relevant to the geotechnical conditions at the Site, are acceleration- based Site coefficient Fa and velocity – based Site coefficient Fv.

For the subject Site, the Site Classification for Seismic Site Response was determined using penetration resistance test (SPT) as set out in Table 4.1.8.4A of the OBC. Boreholes drilled/sampled at this time were advanced to a maximum depth of 4.0 m. Blow counts recorded in Standard Penetration Test (SPT) in all the boreholes ranged from 8 to over 100 blows/300mm. For seismic design purposes the weighted average penetration resistance was identified as $\tilde{N}_{60}$> 50 blows per 300mm for the upper 30 meters and as such the subject Site may be designated as “Class C”. On site Shear wave velocity measurements is recommended to be undertaken should possible application of a “Class B or A” designation be required.

8. DEWATERING

Groundwater levels were measured in the installed wells of MW5, MW1, and also in the existing wells MWA, MWB, MWC and MWD. Static groundwater levels were observed varying from 2.31 to 3.70m bgs., with the relative elevations varied from 98.51 to 97.30m (in boreholes 5 and 11).

Significant groundwater problems are not anticipated to be encountered within the estimated depths of the footing excavation.

Encountered groundwater together with the accumulation of seepage water from more permeable seams/lenses of fill and/or surface run-off should be able to be handled through conventional sump pit pumping methods.

It is noted that groundwater levels are subject to seasonal fluctuations. Consequently, definitive information on the long-term groundwater level could not be obtained at the present time.

9. EXCAVATION AND BACKFILL

No major problems should be encountered for the anticipated depth of excavations for footings and underground utilities within the overburden soil. For excavations advanced into bedrock, heavy hydraulic breakers, rock cutting / blasting, and water jetting may be required. The excavations for footings or underground services must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA).

For excavtions deeper than 1.2 m, the excavation sides should be sloped in accordance with requirements of the OHSA. If this condition cannot be met, a temporary shoring system should be introduced.

On site subsoils to be excavated were dominated by compacted sand and gravel, silty sand and clayey silt and can be classified as Type 3 in accordance with O. Reg. 213/91, S.226 (1).

The material to be used for backfill in service trenches should be suitable for compaction; i.e., free of organics and with moisture content within 2 percent of the optimum moisture value. The backfill material should be compacted by lifts no more than 200 mm in thickness to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD) in the upper 1.0 m from road subgrade or in settlement sensitive areas. Beyond these zones, a 95% SPMDD compaction criterion is considered acceptable.

Additionally, on Site granular fill materials and other fill can be used as backfill in service trenches, provided that the excavated materials are free of organic soils /construction debris and contain suitable moisture content. Excavated rock shall generally not be used for backfill.

For backfill against the subsurface foundation walls it is recommended that backfill materials consist of Granular Class ‘B’ aggregates. On-Site excavated materials may be acceptable subject to further Site inspection.

10. SLAB ON GRADE AND PERMANENT DRAINAGE

For proposed buildings with no basement, the floor slab can be constructed as slab on grade supported by bedrock, competent native soils, or engineered fill.

The prepared slab grade must be thoroughly proof-rolled, provided that contaminated soil/ organic soil / topsoil/ construction debris /underside utilities / fills (subject to onsite inspection) are removed and the base is approved by engineering staff from Fisher.

Furthermore, any soft spots revealed during proof-rolling should be sub-excavated, back filled with suitable materials in lifts with no more than 200 mm and compacted to 98% SPMDD.

Granular Class 'B' aggregates would be preferable for the subgrade construction as well as for the building pad build up, especially if this construction is carried out during the winter.

The exposed base prepared for engineered fill build up, engineered fill materials, compaction quality and constructed finished sub-grade, should be supervised, inspected and approved by engineering staff from Fisher. Engineered fill should be placed in lifts with no more than 200 mm and compacted to 98% SPMDD.

Upon completion of foundation work, the floor slab should rest on a well compacted bed of size 19 mm clear stone at least 200 mm thick. The stone bed would act as a barrier and prevent capillary rise of moisture from the subgrade to the floor slab.

A permanent perimeter drainage system for foundation walls must be provided. Refer to Appendix C for Drainage and Backfill Recommendations.

11. UNDERGROUND UTILITIES

Pipe bedding and backfill materials specifications and compaction criteria for water and sewer services should be in accordance with the pipe designer's recommendations and/or local municipal requirements.

If the excavation is deeper than 1.2 m, the excavation sides should be sloped in accordance with requirements of OHSA. If this condition cannot be met, a temporary shoring system or trench box should be introduced.

For the subject Site, granular Class 'B' aggregate is considered well suited to be used as bedding material and shall be dry, unfrozen, fine granular material all of which passes through a 9.5 mm sieve, and not more than 8% of which passes through a 75 um sieve. However, it should be noted, that the recommended type of bedding is to be placed on undisturbed sub-grade. If the construction methods will disturb the sub-grade i.e. piping, existing footing, boulder removal etc. or existence of excess hydrostatic pressure, then higher-class bedding may have to be used combined with a geotextile.

Selected on site excavated native soil, fill materials (subject to further site inspection) are considered to be suitable for re-use in trench backfilling, provided that organics / construction debris are sorted out and material are not allowed to be wet and moisture should be 2% within the optimum moisture content.

In normal sewer construction practice, the problem of road settlement largely occurs adjacent to manholes, catch basins and service crossings. In these areas, granular materials are generally required for backfill and compaction.

The backfill in the upper 1.0 m from road subgrade or in settlement sensitive areas should be placed in maximum 200 mm thick lift and compacted to 98 % SPMDD. Beyond these zones, a 95 % SPMDD compaction criterion is considered acceptable.

Water lines installed outside of heated areas should be provided with a minimum of 1.2 m soil cover or equivalent for frost protection.

12. PAVEMENT

It is expected that associated asphalt pavement of driveways and parking areas would be developed on the Site.

For the Site, pavement structures can be constructed on the native soils, engineered fill or possibly fill layers subject to further on Site inspection and finalized Site grades.

For asphalt pavement construction, the topsoil, organic soil and construction debris must be removed. The exposed base should be proof-rolled and supervised/approved by Fisher. Any soft spongy spots detected during proof-rolling should be sub-excavated and replaced with suitable materials and compacted to 98% of SPMDD. Engineered fill construction, if any, should be supervised and inspected by Fisher.

The finished subgrade must be contoured/graded, finally proof-rolled and approved by Fisher before placing upper granular materials.

Granular materials will be used in construction of asphalt pavement base. Compaction for granular bases should reach to 100 % of Standard Proctor Maximum Dry Density,

Perforated drains connected to sewer MHs/CBs should be provided under the entire length of curb and constructed in accordance with required local regulations.

Typical flexible pavement designs are as follows:

	Heavy Duty	**Medium Duty**	**Light Duty**
Asphaltic Concrete	40 mm HL3	40 mm HL3	50 mm HL3
	65 mm HL8	50 mm HL8	
19 mm Crushed Limestone	150 mm	150 mm	200 mm
Granular B Sub-base	300 mm	200 mm	

The pavement thickness should also meet the minimum local region Pavement Design Standards.

The foregoing design assumes that construction is carried out during dry period and the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather and heaving or rolling of the subgrade is encountered, additional thickness of granular materials may be required.

The asphalt material should meet the OPSS requirements for specified grade and be compacted to 92%-96.5% of their maximum relative density.

13. GENERAL COMMENTS

This report is limited in scope to those items specifically referenced in the text. The discussions and recommendations presented in this report are intended only as guidance for the client named and their design engineers.

The information on which these recommendations are based is subject to confirmation by engineering personnel at the time of construction.

The localized variations in the subsoil conditions may be presented between and beyond the boreholes on which have to be verified during construction. As more specific subsurface information becomes available during excavations on the subject Site, this report should be updated.

Contractors bidding on or undertaking the work should decide on their own investigations, as well as their own interpretations of the factual borehole results. This concern specifically applies to the classification of the subsurface soil and the potential reuse of these soils on/off Site.

The contractors must draw their own conclusions as to how the near surface and subsurface conditions may affect them.

APPENDIX A – SITE PLAN

Fisher Environmental Ltd.

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KEY PLAN

TRUE NORTH

PROJECT NORTH

LEGEND:

- Monitoring Well
- Borehole
- Existing Monitoring Well Drilled by Others

PROJECT NAME AND ADDRESS

Proposed Townhouse Development

1375 Clyde Avenue,
NEPEAN, ON

FIGURE 1:

PROJECT NO.	SHEET NO.
FE-P 16-7971	1
DATE: 24 OCTOBER 2016	
SCALE: NTS	

APPENDIX B – LOG OF BOREHOLES

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 1 SHEET. 1 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		102.5						
0	0	100 mm Asphalt FILL: Sand and gravel. Brown, Moist.								
3	1	FILL: Gravel and sand Dark grey, Moist. Compact.			1	SS	22			
6	2				2	SS	10			
7		Auger refusal @ 7' on suspected bedrock.		100.4						
10	3									
13	4									
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 2 SHEET. 2 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		102.45						
0	0	100 mm Asphalt FILL: Sand and gravel, trace clay. Black to dark brown, Moist.								
2				101.85						
		Auger refusal @ 2' on suspected bedrock.								
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 3 SHEET. 3 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		102.08						
0	0	75 mm Asphalt FILL: Sand and gravel. Dark brown, Moist.								
1				101.63						
2		Auger refusal @ 1'4" on suspected bedrock.								
3	1									
4										
5										
6	2									
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 4 SHEET. 5 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		102.53						
0	0	100 mm Asphalt								
1		FILL: Silty sand, trace gravel. Brown, Moist.		102.23						
2		Auger refusal @ 1' on suspected bedrock.								
3	1									
4										
5										
6	2									
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 5 SHEET. 5 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

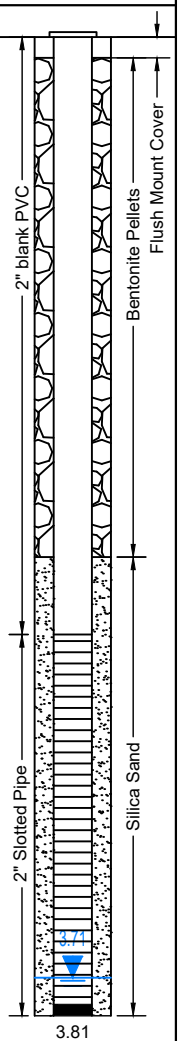
DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUE
0	0	GROUND SURFACE (m asl)		102.32			
		100 mm Asphalt FILL: Sand and gravel			1	SS	26
					2	SS	66
					3	SS	27
		Wet @10'.			4	SS	10
		Spoon refusal @ 13' on suspected bedrock.		98.32	5	SS	100+

PENETRATION TESTING (SPT) ▲ 20 40 60 80
SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80
MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on October 25, 2016: 3.21m.

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 6 SHEET. 6 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		101.16						
0	0	100 mm Asphalt FILL: Sand, some to trace gravel Brown, Moist, Compact.								
1										
2										
3	1				1	SS	29			
4				99.96						
5		Auger refusal @ 4' on suspected bedrock.								
6	2									
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 7 SHEET. 7 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		100.49						
0	0	100 mm Asphalt FILL: Gravel and sand, trace clay rootlets. light brown, Dry, Compact.			1	SS	25			
3	1				2	SS	+100			
4		Spoon refusal @ 3'8" on suspected bedrock.		99.35						
5	2									
10	3									
13	4									
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 8 SHEET. 8 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		99.92						
0	0	100 mm Asphalt FILL: Sand and gravel, some clay, trace gravel, brick, trace organic inclusions. Dark brown to brown, Moist, Compact.			1	SS	22			
2					2	SS	+100			
3	1	Spoon refusal @ 3' on suspected bedrock.		99.01						
4										
5										
6	2									
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 9 SHEET. 9 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
0	0	GROUND SURFACE (m asl)		100.06						
		100 mm Asphalt FILL: Sand and gravel Dark brown, Moist.								
3	1	Sandy silt, trace gravel, clay rootlets, organic inclusions.			1	SS	23			
4				98.80						
		Auger refusal @ 4'2" on suspected bedrock.								
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 10 SHEET. 10 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		99.72						
0	0	100 mm Asphalt FILL: Gravel and sand, trace Asphalt. Dark brown, Moist. Compact to dense. Some clay pockets Organics inclusions.								
3	1				1	SS	43			
5		Clayey silt, trace gravel Bluish grey, Moist.			2	SS	10			
7	2			97.44						
8		Auger refusal @ 7'6" on suspected bedrock.								
10	3									
13	4									
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 11 SHEET. 11 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUE
0	0	GROUND SURFACE (m asl)		99.70			
		100 mm Asphalt FILL: Gravel and sand light brown, Dry. dense.			1	SS	46
3	1	Clayey silt, trace gravel, organic inclusions bluish grey, Moist, Compact.			2	SS	11
6	2	Some organics @7½' Dark grey @7½' Hydrocarbon Odour @7½'			3	SS	11
8					4	SS	+100
9				96.95			
10	3	Spoon refusal @ 9' on suspected bedrock.					
13	4						
16	5						

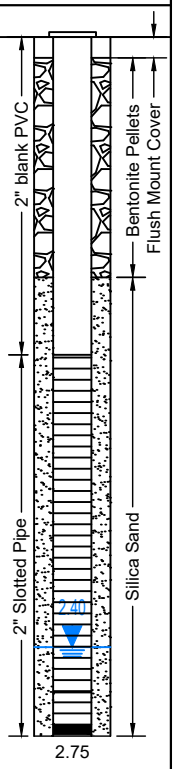
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ○ 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on 25 October 2016: 2.40m.

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 12 SHEET. 12 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
		GROUND SURFACE (m asl)		99.67						
0	0	100 mm Asphalt FILL: Gravel and sand, brown, Moist. Trace clay pockets.								
1		organic inclusion, compact.			1	SS	30			
2										
3	1	Spoon Refusal @3'8".			2	SS	24 50 5			
4										
5		SANDY SILT: Trace gravel, grey, Moist.			3	AS				
6	2									
7				97.62						
		Auger refusal @ 6'9" on suspected bedrock.								
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 13 SHEET. 13 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
0	0	GROUND SURFACE (m asl)		99.62						
		100 mm Asphalt FILL: Gravel, some sand, dark brown, Dry, Dense.			1	SS	36			
3	1	SANDY SILT: Trace gravel, grey, Moist.			2	SS	21 +100			
4				98.52						
		Spoon refusal @ 3'4". on suspected bedrock.								
5										
6	2									
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

FISHER ENVIRONMENTAL LTD.

LOG OF BOREHOLE NO. BH 14 SHEET. 14 of 14

PROJECT NO.: FE-P 16-7971

PROJECT NAME: Proposed Townhouse Development

LOCATION: 1375 Clyde Avenue, Nepean, Ontario

DRILLING METHOD: Hollow Stem

DRILLING DATE: 24 October 2016

DEPTH (feet)	DEPTH (metres)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	"N" VALUE	PENETRATION TESTING (SPT) ▲ 20 40 60 80 / SHEAR STRENGTH (Kpa) ✚ 40 80 120 160	VAPOUR READING (ppm) □ 20 40 60 80 / MOISTURE CONTENT (%) ○ 10 20 30 40	PIEZOMETER OR WELL CONSTRUCTION
0	0	GROUND SURFACE (m asl)		97.14						
1		100 mm Asphalt FILL: Gravel, some sand, brown.								
2		Clayey silt, trace gravel, some organics Dark grey, Moist, Loose.								
3	1				1	SS	8			
4										
5										
6					2	SS	11 +100			
	2	Spoon refusal @ 6'3" on suspected bedrock.		95.24						
7										
8										
9										
10	3									
11										
12										
13	4									
14										
15										
16	5									

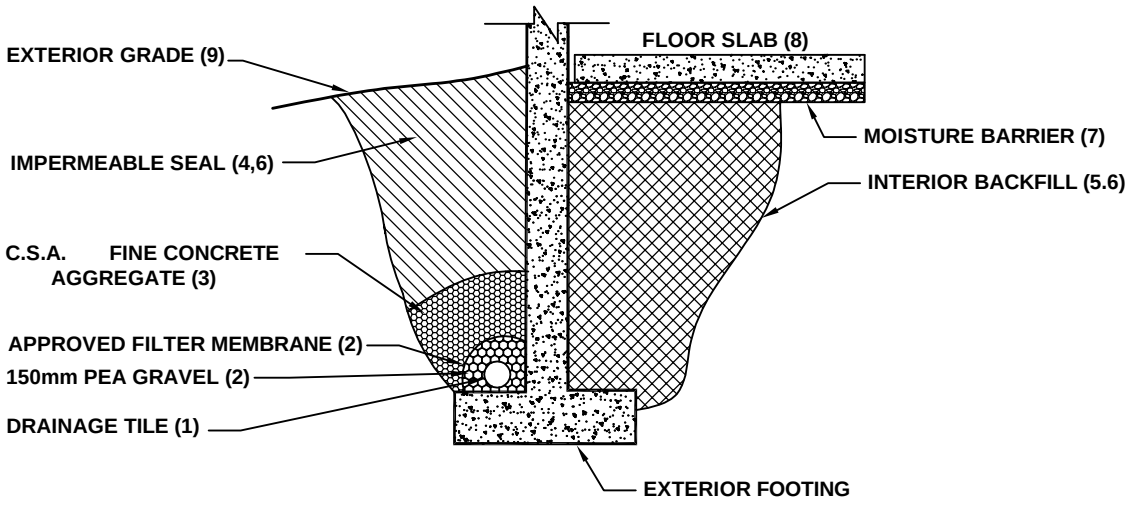
Groundwater Depth (m): On Completion: DRY

LOGGED: HU

CHECKED: FF

APPENDIX C – DRAINAGE AND BACKFILL RECOMMENDATIONS

FISHER ENVIRONMENTAL LTD.



NOTES:

(1) DRAINAGE TILE TO CONSIST OF 100mm (4") DIAMETER WEEPING TILE OR EQUIVALENT PERFORATED PIPE LEADING TO A POSITIVE SUMP OR OUTLET. INVERT TO BE A MINIMUM OF 150MM (6") BELOW UNDERSIDE OF FLOOR SLAB.

(2) PEA GRAVEL-150mm (6") TOP AND SIDE OF DRAIN. IF DRAIN IS NOT ON FOOTING, PLACE 100mm (4") OF PEA GRAVEL BELOW DRAIN. 20mm (3/4") CLEAR STONE IS AN ALTERNATIVE PROVIDED IT IS SURROUNDED BY AN APPROVED FILTER FABRIC (TERRAFIX 270R OR EQUIVALENT).

(3) C.S.A. FINE CONCRETE AGGREGATE TO ACT AS FILTER MATERIAL. MINIMUM 300mm (12") TOP AND SIDE OF TILE DRAIN. THIS MAY BE REPLACED BY AN APPROVED FILTER FABRIC AS INDICATED IN (2).

(4) IMPERMEABLE BACKFILL SEAL - COMPACTED CLAY, CLAYEY SILT OR EQUIVALENT. IF ORIGINAL SOIL IS FREE-DRAINING, SEAL MAY BE OMITTED.

(5) THE ENTIRE FILL MAY BE ANY CLEAN NON-ORGANIC SOIL WHICH CAN BE COMPACTED TO THE SPECIFIED IN THIS CONFINED SPACE.

(6) DO NOT USE HEAVY COMPACTION EQUIPMENT WITHIN 450mm (18") OF THE WALL. DO NOT FILL OR COMPACT WITHIN 1.8m(6') OF THE WALL UNLESS FILL IS PLACED ON BOTH SIDES SIMULTANEOUSLY.

(7) MOISTURE BARRIER TO BE AT LEAST 200mm (8") OF COMPACTED CLEAR 20mm (3/4") STONE.

(8) SLAB ON GRADE SHOULD NOT BE STRUCTURALLY CONNECTED TO THE WALL OR FOOTING.

(9) EXTERIOR GRADE TO SLOPE AWAY FROM BUILDING.

(10) THIS SYSTEM IS NOT NORMALLY REQUIRED IF THE FLOOR SLAB IS AT LEAST 300mm (1') ABOVE THE EXTERIOR GRADE.

DRAINAGE AND BACKFILL RECOMMENDATIONS

FOR SLAB ON GRADE CONSTRUCTION
(NOT TO SCALE)