REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION – DIAM PROPERTY
DUNDAS STREET EAST, OAKVILLE, ONTARIO

PREPARED FOR:

ARGO DEVELOPMENT CORPORATION

PREPARED BY:

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DS Project No : 18-518-10
Date : April 17, 2018

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1. INTRODUCTION

DS Consultants Limited (DSCL) was retained by Argo Development Corporation to undertake a geotechnical investigation for the construction of proposed residential subdivision and a proposed culvert located at Diam Property on Dundas Street East, Oakville, Ontario.

It is understood that the proposed subdivision will consists of low-rise residential/commercial buildings with one level of basement. In addition to these single homes, a storm water management pond and a network of underground utilities and roads will also be constructed as a part plan for this project.

The finish floor elevation of the proposed construction, and the invert of the site services is not known to us at the time of writing this report.

The purpose of this geotechnical investigation was to obtain information about the subsurface conditions at boreholes locations and from the findings in the boreholes to make recommendations pertaining to the geotechnical design of underground utilities, roads and to comment on the foundation conditions for the building construction.

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 Argo Development Corporation and its architect and designers. Third party use of this report without DSCL consent is prohibited.

2. FIELD AND LABORATORY WORK

A total of thirty-six boreholes (BH-AR1 through BH-AR36, see Drawing 1 for borehole locations) were drilled at the subject site to depths ranging from 3.2 to 12.5m. The initial scope of work was drilling of fourteen (14) boreholes. Additional twenty-two (22) boreholes were added by client at later stage.

The drilling work was completed in two different stages between January 30 and March 16, 2018. Boreholes BH-AR1 through BH-AR5, BH-AR7 through BH-AR14, BH-AR22, BH-AR23 and BH-AR25 through BH-AR36 were drilled for the proposed houses, underground services and roads. Boreholes BH-AR6, BH-AR16 through BH-AR20, BH-AR21 and BH-AR-24 were drilled at the location of the proposed storm water management pond and BH-AR15 was drilled at the location of proposed culvert. These boreholes were drilled with solid and hollow stem continuous flight augers equipment

by a drilling sub-contractor under the direction and supervision of DSCL 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 DSCL laboratory for detailed examination by the project engineer and for laboratory testing.

As well as visual examination in the laboratory, all soil samples from geotechnical boreholes were tested for moisture contents. Grain size analyses of three (3) selected soil samples were conducted and the results are presented in **Drawing 38**.

Water level observations were made during and upon completion of drilling. Seven (7) monitoring wells of 50mm diameter were installed for the long-term groundwater monitoring in Boreholes BH-AR2, BH-AR6, BH-AR9, BH-AR10, BH-AR11, BH-AR12(D) and BH-AR12(S).

The surface elevations at the borehole locations were surveyed by client and were provided to DSCL.

3. SUBSURFACE CONDITIONS

The borehole location plans are shown on Drawing 1. General notes on sample description are provided on Drawing 1A. The subsurface conditions in the boreholes are presented in the individual borehole logs presented on **Drawings 2 to 37**.

The subsurface conditions are detailed below for each separate areas of the project.

3.1 PROPOSED HOUSES, UNDERGROUND SERVICES AND ROADS

Boreholes BH-AR1 through BH-AR5, BH-AR7 through BH-AR14, BH-AR22, BH-AR23 and BH-AR25 through BH-AR36 were drilled for the proposed houses, underground services and roads.

The subsoil conditions at the borehole locations are described in the attached borehole logs.

Topsoil: A surficial layer of topsoil of 100mm to 275mm thick was found in all boreholes except at BH-AR11, where a 460mm thick layer of topsoil was encountered. 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.

CLAYEY SILT (Weathered/Disturbed) Below the topsoil, clayey silt was found in all boreholes, extending to depths varying from generally 0.4 to 0.9m below ground surface. This material was found to be weathered/disturbed due to ploughing activities in the past and was found to be in a firm to stiff consistency, with occasional very stiff layers, with measured SPT 'N' values ranging from 5 to 14 blows per 300mm penetration.

CLAYEY SILT Below the weathered and disturbed soils in Boreholes BH-AR33, a cohesive deposit of clayey silt was encountered, extending to a depth of 1.4m below ground surface. This deposit was found to have a firm consistency, with measured SPT 'N' values of 6 blows per 300 mm of penetration.

SILTY CLAY TILL/CLAYEY SILT TILL Below the weathered/ disturbed soils and clayey silt, cohesive deposits of silty clay till/clayey silt till were encountered. These deposits were found to have generally a very stiff to hard consistency with occasional stiff layers, with measured SPT 'N' values ranging from 10 to more than 50 blows per 300 mm of penetration.

Grain size analysis of two silty clay till samples (BH-AR1/SS2 and BH-AR14/SS2) were conducted and the results are presented in **Drawing 38**, with the following fractions:

Clay: 25 to 32%

Silt: 62 to 72%

Sand: 3 to 5%

Gravel: 0 to 1%

Atterberg limits tests of two (2) silty clay till samples (BH-AR1/SS2 and BH-AR14/SS2) were conducted. The results are shown on the respective borehole logs and are summarized as follows:

Liquid limit (WL): 25-32%

Plastic limit (WP): 16-18%

Plasticity index (PI): 9-14

The soil is classified as inorganic silty clay (CL).

SILTY CLAY TILL / SHALE COMPLEX Below the silty clay till/clayey silt till and weathered soils, a deposit of silty clay till / shale complex was found overlying shale bedrock at BH-AR7, BH-AR8, BH-AR12 (D), BH-AR14, BH-AR16, BH-AR19, BH-AR22, BH-AR25, BH-AR27, BH-AR29 and BH-AR33. This deposit was found to have generally a hard consistency, with occasional very stiff layers, with measured SPT 'N' values ranging from 22 to more than 50 blows per 300 mm of penetration. Traces of rock fragments were present in this deposit.

SILTY SAND / SAND AND GRAVEL / SAND Below the silty clay till/clayey silt till in Boreholes BH-AR13 and BH-AR36, cohesionless deposits of silty sand, sand and gravel and sand were encountered and extended to the termination depths of these boreholes. These deposits were found in a dense to very dense state, with occasional compact layers, with measured SPT 'N' values ranging from 11 to more than 50 blows per 300 mm of penetration. These deposits were found wet below depths ranging from 4.3 to 7.3m below existing ground surface.

Grain size analysis of one silty sand sample (BH-AR13/SS6) was conducted and the result is presented in **Drawing 38**, with the following fractions:

Clay: 6%
Silt: 19%
Sand: 73%
Gravel: 2%

SHALE BEDROCK Shale bedrock of Queenston/Georgian Bay Formation was found in all boreholes except BH-AR22, BH-AR33, BH-AR35 and BH-AR36 at depths ranging from 1.5 to 9.0 m below the

exiting grade, corresponding to elevations varying from 157.6 to 161.0m as listed on Table 1. Shale bedrock was not proven by rock coring. The depth and elevation of the shale bedrock surface in the boreholes are listed on **Table 1**.

Table 1: Approximate Depth and Elevation of Bedrock Surface

Borehole No.	Depth of Bedrock Surface below Existing Ground (m)	Approximate Elevation of Bedrock Surface (m)	Notes
BH-AR1	2.3	165.7	Augered
BH-AR2	1.8	164.2	Augered
BH-AR3	2.6	169.4	Augered
BH-AR4	1.5	169.5	Augered
BH-AR5	4.6	158.4	Augered
BH-AR7	6.4	157.6	Augered
BH-AR8	2.3	164.7	Augered
BH-AR9	3.1	165.9	Augered
BH-AR10	6.1	158.9	Augered
BH-AR11	4.6	162.4	Augered
BH-AR12 (D)	9.0	161.0	Augered
BH-AR14	2.3	163.7	Augered
BH-AR15	2.1	159.9	Augered
BH-AR18	2.2	161.8	Augered
BH-AR19	6.0	159.0	Augered
BH-AR20	4.4	159.6	Augered
BH-AR21	3.0	164.0	Augered
BH-AR23	4.4	159.6	Augered
BH-AR24	2.2	164.8	Augered
BH-AR25	7.3	157.7	Augered
BH-AR26	2.2	164.8	Augered
BH-AR27	3.0	166.0	Augered
BH-AR28	5.9	161.1	Augered
BH-AR29	3.0	165.0	Augered
BH-AR30	3.2	166.8	Augered
BH-AR31	7.4	159.6	Augered
BH-AR32	4.9	163.1	Augered
BH-AR34	5.9	161.1	Augered

Because of the method of drilling and sampling, the surface elevations of the bedrock can be different than indicated on the borehole logs. With augering, the auger may penetrate some of the more weathered shale and the coring may therefore begin below the bedrock surface. Commonly the overburden overlying the shale contains slabs of limestone which would give a false indication of the bedrock level. Similarly the depth of weathering cannot be determined accurately due to the presence of limestone layers.

The shale bedrock generally contains layers of siltstone, limestone and dolostone. Typically the hard layers comprise about 15 to 20 percent of the unit. However, higher concentrations of hard layers can be present. The hard layers are usually less than 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at other sites. The layers are actually lenses and they can vary significantly in thickness over short distance.

Methane gas is anticipated in the bedrock. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly for caissons. Stress relief features such as folds and faults are common in the shale bedrock. **Appendix A** presents more details and general comments about the shale bedrock.

3.1.1 Groundwater Conditions

Short term groundwater levels were found to be in the range of 3.0 to 7.6m below ground surface during drilling.

Groundwater levels measured in the monitoring wells on February 13 and March 22, 2018 were at generally depths ranging from 0.1 to 2.6m in the monitoring wells except at BH-AR12 (D) and BH-AR12 (S) where the groundwater was found 4.1 to 8.5m, corresponding to Elev. 161.5m to 167.5m below ground surface. **Table 2** summarizes the depth and elevation of water level readings in monitoring wells.

Table 2: Groundwater Levels Observed in Monitoring Wells

BH No.	Ground Surface Elev. (m)	Date of Drilling	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH-AR2	166.0	Jan. 30, 2018	Feb. 13, 2018	2.6	163.4
			March 21, 2018	2.6	163.4
BH-AR9	169.0	Jan. 31, 2018	Feb. 13, 2018	1.9	167.1
			March 21, 2018	1.5	167.5
BH-AR10	165.0	Feb. 01, 2018	Feb. 13, 2018	1.4	163.6
			March 21, 2018	0.9	164.1
BH-AR11	167.0	Feb. 01, 2018	Feb. 13, 2018	0.4	166.6
			March 21, 2018	0.1	166.9
BH-AR12	170.0	Jan. 31, 2018	March 21, 2018	8.5	161.5
BH-AR12 (S)	170.0	Jan. 31, 2018	March 21, 2018	4.1	165.9

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

3.2 STORM WATER MANAGEMENT POND (SWMP)

A storm water management pond was also proposed to be constructed for the residential subdivision. Eight boreholes BH-AR6, BH-AR16 to BH-AR21 and BH-AR24 were drilled to depths ranging from 3.2 to 6.2m below ground surface at the location of the proposed pond as shown on **Drawing 1**. The subsoil conditions at the borehole locations are described in the attached borehole logs **(Drawings 7, 17 to 22 and 25)**.

TOPSOIL A surficial layer of topsoil of 100mm to 200mm thick was found in all boreholes. 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.

CLAYEY SILT (Weathered/ Disturbed) Below the topsoil in Boreholes, clayey silt was found, extending to depths ranging from 0.5 to 0.8m below ground surface. These materials were found to be weathered/disturbed due to ploughing activities in the past and was found to have a firm to stiff consistency, with measured SPT 'N' value ranging from 6 to 11 blows per 300mm penetration.

SILTY CLAY TILL/CLAYEY SILT TILL Below the weathered/ disturbed soils and clayey silt, cohesive deposits of silty clay till/clayey silt till were encountered. These deposits were found to have generally a very stiff to hard stiff consistency, with measured SPT 'N' values ranging from 16 to 43 blows per 300 mm of penetration.

SILTY CLAY TILL / SHALE COMPLEX Below the silty clay till/clayey silt till in Boreholes BH-AR16 and BH-AR19 a deposit of silty clay till / shale complex was found overlying shale bedrock. This deposit was found to have generally a hard consistency, with occasional very stiff layers, with measured SPT 'N' values of more than 50 blows per 300 mm of penetration. Traces of rock fragments were present in this deposit.

SHALE BEDROCK Shale bedrock of Queenston/Georgian Bay Formation was found in all boreholes except BH-AR16 at depths ranging from 2.2 to 6.0 m below the exiting grade, corresponding to elevations varying from 158.6 to 164.8m as listed on **Table 3**. Shale bedrock was not proven by rock coring. The depth and elevation of the shale bedrock surface in the boreholes are listed on Table 3.

Table 3: Approximate Depth and Elevation of Bedrock Surface

Borehole No.	Depth of Bedrock Surface below Existing Ground (m)	Approximate Elevation of Bedrock Surface (m)	Notes
BH-AR6	2.3	162.7	Augered
BH-AR17	4.4	158.6	Augered
BH-AR18	2.2	161.8	Augered

BH-AR19	6.0	159.0	Augered
BH-AR20	4.4	159.6	Augered
BH-AR21	3.0	164.0	Augered
BH-AR24	2.2	164.8	Augered

Because of the method of drilling and sampling, the surface elevations of the bedrock can be different than indicated on the borehole logs. With augering, the auger may penetrate some of the more weathered shale and the coring may therefore begin below the bedrock surface. Commonly the overburden overlying the shale contains slabs of limestone which would give a false indication of the bedrock level. Similarly the depth of weathering cannot be determined accurately due to the presence of limestone layers.

The shale bedrock generally contains layers of siltstone, limestone and dolostone. Typically the hard layers comprise about 15 to 20 percent of the unit. However, higher concentrations of hard layers can be present. The hard layers are usually less than 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at other sites. The layers are actually lenses and they can vary significantly in thickness over short distance.

Methane gas is anticipated in the bedrock. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly for caissons. Stress relief features such as folds and faults are common in the shale bedrock. **Appendix A** presents more details and general comments about the shale bedrock.

3.2.1 Groundwater Conditions

Short term groundwater levels were found to be in the range of 2.7 to 4.6m below ground surface during drilling.

Groundwater levels measured on February 13 and March 22, 2018 in the monitoring well installed in BH-AR6 was at depths ranging from 0.8 to 1.0m, corresponding to Elev. 164.0 to 164.2m below ground surface. **Table 4** summarizes the depth and elevation of water level readings in monitoring wells.

Table 4: Groundwater Levels Observed in Monitoring Wells

BH No.	Ground Surface Elev. (m)	Date of Drilling	Date of Observation	Depth of Groundwater (m)	Elevation of Groundwater (m)
BH-AR6	165.0	Jan. 31, 2018	Feb. 13, 2018	1.0	164.0
			March 22, 2018	0.8	164.2

It should be noted that the groundwater levels can vary and are subject to seasonal fluctuations in response to major weather events.

3.3 PROPOSED CULVERT

A new culvert will also be constructed at the proposed site and BH-AR15 was drilled in the vicinity of the proposed culvert location to a depth of 3.2m below ground surface as shown on **Drawing 1**. The subsoil conditions at the borehole locations are described in the attached borehole log **(Drawing 16)**.

TOPSOIL A surficial layer of topsoil of 250mm to 200mm thick was found in borehole. 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.

CLAYEY SILT (Weathered/ Disturbed) Below the topsoil in Boreholes, clayey silt was found, extending to depth of 0.7m below ground surface. This material was found to be weathered/disturbed due to ploughing activities in the past and was found to have a firm consistency, with measured SPT 'N' value of 4 blows per 300mm penetration.

CLAYEY SILT TILL Below the weathered/ disturbed soils, cohesive deposit of clayey silt till was encountered. This deposit was found to have a very stiff consistency, with measured SPT 'N' values ranging from 18 to 23 blows per 300 mm of penetration.

SHALE BEDROCK Shale bedrock of Queenston Formation was found in boreholes at a depth of 2.1m below exiting grade, corresponding to elevation of 159.9m as listed on Table 4. Shale bedrock was not proven by rock coring. The depth and elevation of the shale bedrock surface in the borehole are listed on **Table 5**.

Table 5: Approximate Depth and Elevation of Bedrock Surface

Borehole No.	Depth of Bedrock Surface below Existing Ground (m)	Approximate Elevation of Bedrock Surface (m)	Notes
BH-AR15	2.1	159.9	Augered

4. DISCUSSION AND RECOMMENDATIONS

It is proposed to develop the site as a residential subdivision. The lots will therefore be serviced by a network of roads, storm and sanitary sewers and watermains.

4.1 ROADS

The investigation has shown that the predominant subgrade soil, after stripping the topsoil and any other organic and otherwise unsuitable subsoil, will generally consist of clayey silt till, clayey silt, clayey silt till shale complex and shale bedrock.

Based on the above and assuming that traffic usage will be residential/commercial collector road, the following minimum pavement thickness is recommended for roads to be constructed within the development:

40 mm HL3 Asphaltic Concrete

80 mm HL8 Asphaltic Concrete

150 mm Granular 'A'

300 mm Granular 'B'

These values may need to be adjusted according to the City of Oakville Standards. 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.

4.1.1 STRIPPING, SUB-EXCAVATION AND GRADING

The site should be stripped of all topsoil and any organic, weathered or otherwise unsuitable soils to the full depth of the roads, both in cut and fill areas. Following stripping, the site should be graded to the subgrade level and approved. The subgrade should then be proof-rolled, in the presence of the Geotechnical Engineer, by at least several passes of a heavy compactor having a rated capacity of at least 8 tonnes. Any soft spots thus exposed should be removed and replaced by select fill material, similar to the existing subgrade soil and approved by the Geotechnical Engineer. The subgrade should then be re-compacted from the surface to at least 98% of its Standard Proctor Maximum Dry Density (SPMDD). The final subgrade should be cambered or otherwise shaped properly to facilitate rapid drainage and to prevent the formation of local depressions in which water could accumulate.

Owing to the clayey (i.e. impervious) nature of some subsoils at the site, proper cambering and allowing the water to escape towards the sides (where it can be removed by means of subdrains) is considered to be beneficial for this project. Otherwise, any water collected in the granular sub-base materials could be trapped thus causing problems due to softened subgrade, differential frost heave, etc. For the same reason damaging the subgrade during and after placement of the granular

materials by heavy construction traffic should be avoided. If the moisture content of the local material cannot be maintained at ±2% of the optimum moisture content, imported granular material may need to be used.

Any fill required for re-grading the site or backfill should be select, clean material, free of topsoil, organic or other foreign and unsuitable matter. The fill should be placed in thin layers and compacted to at least 95% of its SPMDD. The degree of compaction should be increased to 98% within the top 1.0 m of the subgrade, or as per Township Standards. The compaction of the new fill should be checked by frequent field density tests.

4.1.2 CONSTRUCTION

Once the subgrade has been inspected and approved, the granular base and sub-base course materials should be placed in layers not exceeding 200 mm (uncompacted thickness) and should be compacted to at least 100% of their respective SPMDD. The grading of the material should conform to current OPS Specifications.

The placing, spreading and rolling of the asphalt should be in accordance with OPS Specifications or, as required by the local authorities.

Frequent field density tests should be carried out on both the asphalt and granular base and sub-base materials to ensure that the required degree of compaction is achieved.

4.1.3 DRAINAGE

The City of Oakville may require the installation of full-length subdrains on all 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 catch-basins. As discussed in Section 4.1.1, by means of good planning any water trapped in the granular sub-base materials should be drained rapidly towards subdrains or other interceptors.

4.2 SEWERS

As a part of the site development, a network of new storm and sanitary sewers is to be constructed. It is assumed that the trenches are generally within 4 to 5 m below the existing grade.

4.2.1 TRENCHING

Based on the boreholes, the trenches in most of the boreholes will be dug mainly through in silty clay till, clayey silt till, clayey silt till/shale complex and shale bedrock. In Boreholes BH-AR13 and BH-AR36, where wet to saturated deposits of silty sand, sand and gravel and sand are present below the depths ranging from 4.3 to 7.3m below ground surface. The excavation will be dug out through these wet to saturated sandy deposits. Any excavation in silty sand, sand and gravel and sand deposits below groundwater table will require positive dewatering using well points/eductors. Otherwise, it will result in an unstable base and flowing sides.

The sides of excavations in the natural strata can be expected to be temporarily stable at relatively steep side slopes for short periods of time but they should be cut back at slopes no steeper than 1:1 in order to comply with the safety regulations. Where wet sand layers in the till are encountered, flattened slopes will be required.

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, The very stiff to hard clayey soils can be classified as Type 2 Soil above groundwater and Type 3 Soil below groundwater. The fill and cohesionless soils (silty sand/sand and gravel, sand) and the firm to stiff silty clay to clayey silt can be classified as Type 3 Soil above groundwater and Type 4 Soil below the water table.

4.2.2 ANTI-SEEPAGE COLLARS

Anti-seepage collars are provided to reduce the seepage effects from wet to saturated sandy and silty deposits for watermains and sewer installation and normally provided 150m apart. For the details of anti-seepage collars please refer to OPSD 802.095.

4.2.3 BEDDING

Provided water pressures are controlled such that heave of the base of lowest excavation formed in sandy or clayey soils and bedrock at the base of trench is lowered to atleast 0.5 m below the excavation base at all the times, both of these types of materials will provide adequate support for the sewer pipes and allow the use of normal Class B type bedding.

The recommended minimum thickness of granular bedding below the invert of the pipes is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or in accordance with local standards or if wet or weak subgrade conditions are encountered, especially when the soil at the trench base level consists of wet, dilatant silt. The bedding material should consist of well graded granular material such as Granular 'A' or equivalent. After installing the pipe on the bedding, a granular surround of approved bedding material, which extends at least 300 mm above the obvert of the pipe, or as set out by the local Authority, should be placed.

To avoid the loss of soil fines from the subgrade, uniformly graded clear stone should not be used unless, below the granular bedding material, a suitable, approved filter fabric (geotextile) is placed. The geotextile should extend along the sides of the trench and should be wrapped all around the poorly graded bedding material.

4.2.4 BACKFILLING OF TRENCHES

Based on visual and tactile examination, the on-site excavated inorganic native soils are considered to be suitable for re-use as backfill in the service trenches provided their moisture contents at the time of construction are within 2 percent of their optimum moisture content. Significant aeration of the wet sandy and silty soils will be required prior to their use as backfill material.

The clayey till especially when its consistency is hard is likely to be excavated in cohesive chunks or blocks and will be difficult to compact in confined areas. For use as backfill, the clayey material will

have to pulverized and placed in thin layers. The clayey soils will have to be compacted using heavy equipment suitable for these soils which may be difficult to operate in the narrow confines of the trenches. Unless the clayey materials are properly pulverized and compacted in sufficiently thin lifts post-construction settlements could occur. Their use in narrow trenches such as laterals (where heavy compaction equipment cannot be operated) may not be feasible.

Selected inorganic fill and the native soils free from topsoil and organics can be used as general construction backfill where it can be compacted with sheep's foot type compactors. Loose lifts of soil, which are to be compacted, should not exceed 200 mm. Depending on the time of construction and weather, some excavated material may be too wet to compact and will require aeration prior to its use.

Imported granular fill, which can be compacted with hand held equipment, should be used in confined areas.

Underfloor fill should be compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

The excavated soils are not considered to be free draining. Where free draining backfill is required, imported granular fill such as OPSS Granular B should be used.

The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content and each layer should be compacted to at least 95% SPMDD. In the upper 1.0 m, underneath the road base, the compaction should be increased to 98% SPMDD. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc. should not be used for backfilling.

The on-site excavated soils and especially the clayey soils should not be used in confined areas (e.g. around catch-basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of imported granular fill together with an appropriate frost taper would be preferable in confined areas and around structures, such as catch-basins.

It should be noted that the excavated soils are subject to moisture content increase during wet weather which would make these materials too wet for adequate compaction. Stockpiles should be compacted at the surface or be covered with tarpaulins to minimize moisture uptake.

The topsoil encountered at the site can be used for landscaping fill to raise the grades. Topsoil cannot be reused as foundation and trench backfill material.

4.3 ENGINEERED FILL

In the areas where earth fill is required for site grading purposes, an engineered fill may be constructed below house foundations, roads, boulevards, etc.

Based on the borehole information, 0.4 to 0.9m of reworked/disturbed soils must be removed. The base must be thoroughly proof-rolled. The stripped native subgrade must be examined and approved by a DSCL engineer prior to placement of fill.

General guidelines for the placement and preparation of engineered fill are presented on **Appendix B**. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS can be used on engineered fill, provided that all requirements on **Appendix B** are adhered to. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

The following is a recommended procedure for an engineered fill:

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 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 DSCL. Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. 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 DSCL engineer prior to placement of fill.

5. The approved engineered fill must be compacted to 100% Standard Proctor Maximum Dry Density throughout. Granular Fill preferred. Engineered fill should not be placed (where it will support footings) 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.

6. Full-time geotechnical inspection by DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL representative.

7. The fill must be placed such that the specified geometry is achieved. Refer to 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. Bearing capacity values of 150 kPa at SLS and 225 kPa at ULS may be used provided that all conditions outlined above are adhered to. A minimum footing width of 500 mm (20 inches) is suggested and footings should 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 pad a second contractor may be selected to install footings. All excavations must be backfilled under full time supervision by DSCL 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 DSCL.

11. After completion of compaction, the surface of the pad must be protected from disturbance from traffic, rain and frost.

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.

The inorganic clayey silt (till), sandy silt and silt are considered suitable for use as engineered fill, provided that their moisture contents at the time of construction are at or near optimum. As mentioned before in Section 4.2.3 of this report, the clayey tills are likely to be excavated in cohesive chunks or blocks and will be difficult to compact. They should be pulverized and placed in thin layers not exceeding 150 to 200 mm and compacted using heavy equipment suitable for these types of soils (e.g. heavy sheepsfoot compactors).

4.4 FOUNDATION CONDITIONS

It is understood that the proposed subdivision will consist of single homes with one level basement. The finish floor elevations of these proposed singles are not known to us at the time of writing this report.

The proposed singles homes with one level basement can be supported by spread and strip footings founded on the undisturbed native soils/bedrock below weathered/disturbed soils for a bearing capacity of 150 kPa at SLS (Serviceability Limit State), and for a factored geotechnical resistance of 225 kPa at ULS (Ultimate Limit State). All footings must be founded below the weathered/disturbed soils and any loose or soft soils and 0.3m into the native undisturbed soils

It should be noted that at Borehole BH1-AR33, the clayey silt encountered below a depth of 0.7m, extended to 1.4m below ground surface was found to be in a firm consistency with measured SPT ‘N’ value of 6 blows per 300mm penetration. The foundations on native soils at this location must be lowered to a depth of 1.5m below ground surface.

The proposed houses can also be supported by spread and strip footings founded on engineered fill for a bearing capacity of 150 kPa at the serviceability limit states (SLS) and for a factored geotechnical resistance of 225 kPa at the ultimate limit states (ULS), provided all requirements on **Appendix B** are adhered to. Prior to the placement of the engineered fill, all of the existing fill and surficially softened native soils must be removed and the exposed surface proof rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered. The engineered fill consisting of approved inorganic material must be compacted to 100% Standard Proctor Maximum

Dry Density throughout. To reduce the risk of improperly placed engineered compacted fill, full-time supervision of the contractor is essential.

Foundations designed to the specified bearing capacities at the serviceability limit states (SLS) are expected to settle less than 25 mm total and 19 mm differential.

Where it is necessary to place footings at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line drawn up from the base of the lower footing. The lower footing must be installed first to help minimize the risk of undermining the upper footing.

It should be noted that the recommended bearing capacities have been calculated by DSCL from the borehole information for the preliminary design stage only. The investigation and comments are necessarily on-going as new information of the underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field inspections provided by DSCL to validate the information for use during the construction stage.

4.4.1 EARTH PRESSURES

The lateral earth pressures acting on foundation and basement walls may be calculated from the following expression:

$$p = k(\gamma h + q)$$

where, p = Lateral earth pressure in kPa acting at depth h

K = Earth pressure coefficient, assumed to be 0.40 for vertical walls and horizontal backfill for permanent construction

□ = Unit weight of backfill, a value of 21 kN/m3 may be assumed

h = Depth to point of interest in metres

q = Equivalent value of surcharge on the ground surface in kPa

The above expression assumes that the perimeter drainage system prevents the build up of any hydrostatic pressure behind the wall.

5. STORMWATER MANAGEMENT POND

It is understood that a storm water management pond will be constructed for the proposed subdivision and eight boreholes BH-AR6, BH-AR16 to BH-AR21 and BH-AR24 were drilled to depths ranging from 3.2 to 6.2m below ground surface at the location of the proposed pond.

It is also understood that the design of the pond is still at a preliminary stage and the design drawings including the depth of the pond, side slopes and permanent pool level is not available to us at the time of writing this report.

Based on the borehole information, the excavated soils for both pond will mainly consist of silty clay till/clay silt till, clayey silt till shale complex and bedrock.

Short term groundwater levels at the pond location were found to be in the range of 2.7 to 4.6m below ground surface during drilling. Groundwater levels measured in the monitoring well installed in BH-AR6 was in the range of 0.8 to 1.0m, corresponding to Elev. 164.0 to 164.2m below ground surface

Excavation of the overburden material can be carried out with heavy hydraulic backhoe. Major problems with groundwater are not anticipated for installation of watermain, sanitary sewer and watermain re-lining to a depth of about 3 m and any seepage, from the fill material and during wet periods can also be removed by pumping from sumps.

It should be noted that the till is a non-sorted sediment and therefore may contain boulders. Possible large obstructions such as buried concrete pieces are also anticipated in the fill material. Provisions must be made in the excavation contract for the removal of possible boulders in the till or obstructions in the fill material.

Excavation in shale bedrock will require the use of hoe-ram or jack hammers to penetrate the limestone layers within the shale bedrock.

5.1 SITE PREPARATION

The embankment/berm founding area should be stripped and prepared within the footprint of the embankment/berm. All vegetation, topsoil, boulders over 100 mm, soft or loose earth fill, and other unsuitable soils should be removed from the proposed pond and embankment/berm envelope. After stripping, the exposed subgrade should be proof-rolled. Any soft spots revealed during proof rolling must be sub-excavated and re-engineered in the presence of a qualified geotechnical personnel.

5.2 EMBANKMENT FILL

In order to retain water in the pond and to limit seepage/piping and groundwater intrusion into the embankment, the embankment fill should consist of inorganic low permeability material (silty clay). Earth fill for the embankment should be placed in loose lifts not exceeding 150 mm. Each lift should be uniformly compacted to at least 98 % of the material's Standard Proctor Maximum Dry Density (SPMDD). The embankment fill should contain minimum 20% clay (finer than 0.002 mm) and have a plasticity index (PI) of minimum 7.0. Any cobbles or boulders greater than 100 mm in size should be excluded from the earth embankment fill. The materials shall be placed and compacted at a water content of between 2 percent dry and 3 percent wet of the optimum moisture content. This is required to ensure that the material is compacted to a homogenous mass, and does not remain as distinct "clods" or "clumps".

Embankment construction should be in accordance with OPSS 501 and to the satisfaction of the geotechnical engineer. The fill must be placed and compacted under the supervision of qualified geotechnical personnel. It is recommended that a test section be incorporated in the embankment

during construction. Field tests should be performed on the test section and field compaction curves developed for the equipment used.

Under no condition should frozen materials be placed in the embankment. If construction proceeds under winter conditions, then adequate protection against frost penetration must be provided (e.g. straw bales, tarping, heating).

During the first 2 to 3 years the embankment surface cover of topsoil and seeding may require periodic maintenance on slopes (due to surface erosion), until the vegetation becomes well established. Erosion netting or mulch could reduce the amount of maintenance.

5.3 LINER CONSIDERATIONS

The embankment/berm should consist of silty clay fill as per the requirements presented in Section 5.2 of this report. Clay liner is required at the bottom and sides of the pond.

Due to the relatively high permeability of the cohesionless deposits at the bottom and sides of the pond slopes, any water in the pond will gradually infiltrate into the cohesionless deposits if a liner is not installed. It is recommended that a liner be constructed to limit seepage/piping and groundwater intrusion into the pond.

The liner may consist of a clay liner or a synthetic membrane liner (such as a High Density Polyethylene, Geo-synthetic Clay Liner, or PVC).

Prior to placing the clay liner/GCL, the subgrade will need to be prepared in the full time presence of a geotechnical engineer, as stated in Section 5.2.

Manufacturer's specifications and recommendations must be referred for the design and construction, in case a synthetic liner is elected for this project.

5.4 OHSA SOIL CLASSIFICATION

All excavations must be carried out in accordance with the most recent Occupational Health and Safety Act (OHSA). In accordance with OHSA, The very stiff to hard clayey soils can be classified as Type 2 Soil above groundwater and Type 3 Soil below groundwater. The fill and the firm to stiff silty clay to clayey silt can be classified as Type 3 Soil above groundwater and Type 4 Soil below the water table.

5.5 EMERGENCY SPILLWAY

The proposed design incorporates an emergency spillway associated with the wet cell of the pond. The spillway elevation is below the crest of the embankment, to allow the safe release and conveyance of water in the event of overtopping.

In the event that there is flow through the emergency spillway, then the spillway must be inspected immediately following the event. There may be a requirement for maintenance or repair to the spillway following a discharge event.

5.6 MAINTENANCE DRAWDOWN

It is understood that the SWM pond will be periodically emptied for maintenance purposes. Under normal working conditions, the external hydrostatic head resulting from groundwater table on the liner will generally be balanced by the normal (or higher) water level condition of the pool, resulting a minimal effective hydrostatic pressure on the liner.

During the construction maintenance event, water from the pond will be removed resulting in an unbalanced groundwater table pressure on the liner. This unbalanced pressure may be detrimental to the stability of the liner, and DSCL recommends providing perimeter drainage to the pond dropping into a wet well which will be pumped out just prior to and during the construction maintenance event. The perimeter drains should consist of concrete sand fine aggregate in a cross-sectional area of 1.0m x 1.0m encapsulated by filter fabric Terrafix 270R or equivalent, embedded with 150 mm diameter perforated and geo-socketed PVC subdrains. The perimeter drains should be spaced 2.0 m vertically with the first drain at bottom of pond.

5.7 SLOPE PROTECTION

Wave and ice action have the potential to cause damage of the slopes of the embankment if these areas are unprotected. The proposed design provides for a topsoil and vegetation cover on the slopes.

Given the short fetch of the pond, there will be no significant wave or ice action. The proposed vegetation cover is sufficient to protect the slopes. There will be a requirement for regular inspection and maintenance of the slopes, particularly until the vegetation is properly established.

5.8 TRENCH CLAY PLUGS & CUTOFF COLLARS

Where pipes enter or exit the pond, a concrete collar should be provided and then be backfilled with a relatively impermeable material (such as clayey silt or silty clay) to minimize the potential for the pipe to become a preferential flow path through pipe bedding, and to avoid internal erosion in the embankment.

Clay plugs or other suitable seepage control is also required around all pipes or underground utilities installed in the vicinity of the pond. This is necessary to prevent internal erosion in the embankment due to contact between dissimilar materials. Clay or concrete plugs should be placed in the trenches at 15 m intervals along any buried utility within 50 m of the pond. The plug should be a minimum of 1 m thick measured along the pipe. Clay plugs must be compacted to 98% SPMDD. Material used for the clay plugs should contain not less than 20% particles finer than 2 microns and should have a coefficient of permeability less than 10-6 cm/s.

Vertical trenching through the embankment material to place the pipes is not acceptable and should not be allowed under any circumstance. Trench side slopes should be laid back in steps at a 2 Horizontal : 1 Vertical slope minimum.

5.9 STABILITY ANALYSES OF POND SLOPES

It is understood that the design of the ponds is still at a preliminary stage and the design drawings including the depth of the pond, side slopes and permanent pool level is not available to us at the time of writing this report. A slope stability study of the pond embankment must be carried out once the final design is available.

6. CULVERT FOUNDATIONS

One Borehole BH-AR15 was drilled in the vicinity of the proposed culvert to a depth of 3.2m below ground surface. Based on the information obtained from the borehole, the culvert founded on the undisturbed native very stiff clayey silt till deposit can be designed for bearing capacity value of 250 kPa at SLS and 375 kPa at ULS. The bearing value and the corresponding founding elevation at the borehole location are summarized on **Table 6** below.

Table 6: Bearing Value and Founding Level of Culvert

BH No.	Founding Soil	Bearing Capacity at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)	Minimum Depth below Existing Ground (m)	Founding Level At or Below Elevation (m)
BH-AR15	Clayey Silt Till	250	375	1.0	161.0

7. GENERAL COMMENTS AND LIMITATIONS OF REPORT

DS Consultants Limited (DSCL) 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, DSCL will assume no responsibility for interpretation of the recommendations in the report.

This report is intended solely for the Client named. The material in it reflects our best judgment in light of the information available to DSCL at the time of preparation. Unless otherwise agreed in writing by DSCL, 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.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of test holes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices.

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. DSCL accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

We trust that the information contained in this report is satisfactory. Should you have any questions, please do not hesitate to contact this office.

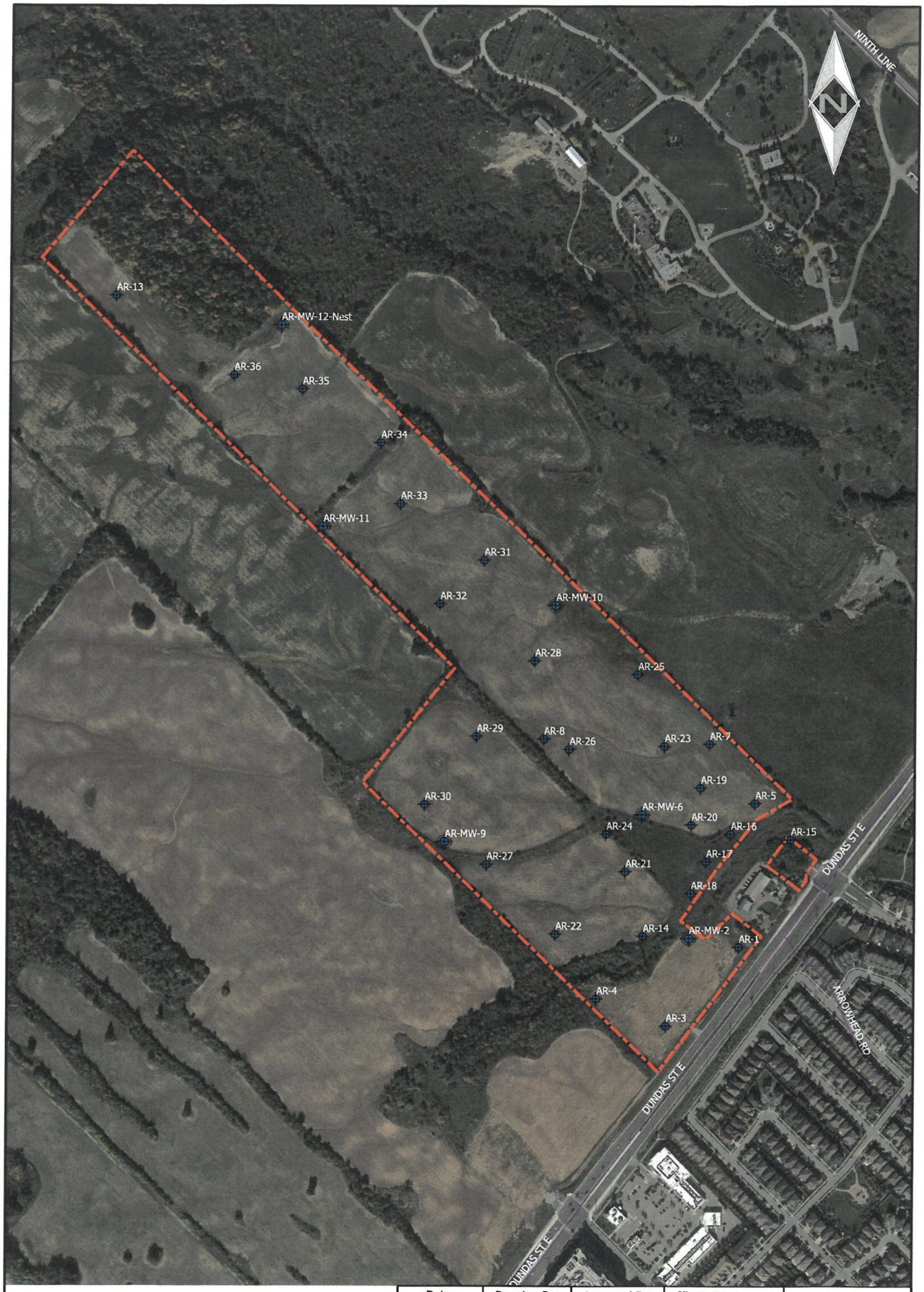
DS CONSULTANTS LIMITED

LICENSED PROFESSIONAL ENGINEER
N. EHSAN
100169975
April 19, 2018
PROVINCE OF ONTARIO

Naeem Ehsan, M.Eng., P.Eng.

Alka Sangar, M.Eng., P.Eng.

Drawings



Legend

- Site Boundary
- Borehole Location (DSCL, 2018)
- Monitoring Well (DSCL, 2018)

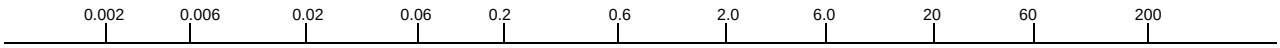
Date: Jan 2018	Drawing By: SW	Approved By: BD	Client: Argo (Joshua Creek) Ltd.	Figure # 1
Original: Tabloid	50 0 50 100 m		Project # 18-518-10	
DS CONSULTANTS LTD. Geotechnical · Environmental · Materials · Hydrogeology			Figure Name: Borehole and Monitoring Well Location Map	
			Project: Geotechnical Investigation - Diam Property, Oakville, ON	

Drawing 1A: Notes On Sample Descriptions

1. All sample descriptions included in this report generally follow the Unified Soil Classification. Laboratory grain size analyses provided by DSCL also follow the same system. Different classification systems may be used by others, such as the system by the International Society for Soil Mechanics and Foundation Engineering (ISSMFE). Please note that, with the exception of those samples where a grain size analysis and/or Atterberg Limits testing have been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional preliminary geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

LOG OF BOREHOLE BH-AR1

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-30-2018

REF. NO.: 518-10
ENCL NO.: 2

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
168.0						
168.0 0.0	**TOPSOIL:** 125mm					
0.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)	1	SS	6		
167.1						
1 0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard	2	SS	57	167	1 5 62 32
166.5 1.5						
2	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard	3	SS	50/ 100mm	166	
165.7 2.3	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist	4	SS	50/ 75mm		
3		5	SS	50/ 100mm	165	
4					164	
	wet below 4.6m	6	SS	50/ 50 mm		wet spoon
5					163	
6						
161.8 6.2	auger refusal at 6.2m	7	SS	50/ 75mm	162	
	END OF BOREHOLE					

Notes:
1) Water level at 4.9m upon completion of borehole.

SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
DYNAMIC CONE PENETRATION RESISTANCE PLOT
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

DS CONSULTANTS LTD.

LOG OF BOREHOLE BH-AR2

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jan-30-2018

REF. NO.: 518-10
ENCL NO.: 3

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
166.0												
166.0	**TOPSOIL:** 125mm											
0.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	7							
165.2												
0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	44		165					
			3	SS	50/ 75 mm							
164.2												
1.8	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist		4	SS	50/ 100mm		164					
						▽		W. L. 163.4 m Mar 21, 2018				
			5	SS	50/ 100 mm		163					
	wet below 4.6m		6	SS	50/ 125 mm		162					
							161					
159.8							160					
6.2	**END OF BOREHOLE**		7	SS	50/ 50 mm							

Notes:
1) Auger refusal at 6.2m.
2) 50mm dia. monitoring well installed upon completion.
3) Water Level Readings

Date	Water Depth (mbgs)
March 21, 2018	2.6
February 13, 2018	2.6

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR3

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-30-2018

REF. NO.: 518-10
ENCL NO.: 4

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
172.0							
172.0 / 0.0	**TOPSOIL:** 125mm						
0.1 / 171.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	6		
0.9 / 170.5	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	83/ 250mm		171
1.5 / 169.4	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		3	SS	63		170
2.6 / 165.8	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist		4	SS	74		169
			5	SS	50/ 75 mm		168
			6	SS	50/ 75mm		167
	auger refusal at 6.2m		7	SS	50/ 75mm		166
6.2	**END OF BOREHOLE**						

Notes:
1) Auger refusal at 6.2m.
2) Water level at 5.5m upon completion of borehole.

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

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

WATER CONTENT (%): 10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

REMARKS AND GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR4

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-30-2018

REF. NO.: 518-10
ENCL NO.: 5

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
171.0							
170.9	**TOPSOIL:** 150mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	6		
170.1							
1 0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	29		170
169.5							
1.5	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist		3	SS	74		
2			4	SS	50/ 100mm		169
3			5	SS	50/ 125mm		168
4							167
	wet below 4.6m		6	SS	50/ 125 mm		
5							166
6							
164.8	auger refusal at 6.2m		7	SS	50/ 75 mm		165
6.2	**END OF BOREHOLE**						

Notes:
1) Water level at 3.7m upon completion of borehole.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR5

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 6

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
163.0												
162.8	**TOPSOIL:** 175mm											
0.2 / 162.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	9							
0.9 / 158.4	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	28		162					
			3	SS	36		161					
			4	SS	33		160					
			5	SS	49		159					
4.6 / 156.8	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist auger refusal at 6.2m		6	SS	50/ 125mm		158 157					
			7	SS	50/ 50mm							
6.2	**END OF BOREHOLE** Notes: 1) Water level at 4.3m upon completion of borehole.											

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

LOG OF BOREHOLE BH-AR6

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Hollow Stem Augers
Diameter: 200mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 7

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
165.0												
164.8 0.0	**TOPSOIL:** 150mm											
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	7							
164.2 0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	33	▽	W. L. 164.2 m Mar 21, 2018					
			3	SS	33		163					
162.7 2.3	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist		4	SS	50/ 75mm							
			5		50/ 50mm		162					wet spoon
							161					
			6		50/ 50mm		160					
159.8 5.2	**END OF BOREHOLE**											

Notes:
1) Auger refusal at 5.2m.
2) 50mm dia. monitoring well installed upon completion.
3) Water Level Readings

Date	Water Depth (mbgs)
March 21, 2018	0.8
February 13, 2018	1.0

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε_f=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR7

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 8

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
164.0							
163.9 0.1	**TOPSOIL:** 100mm						
	CLAYEY SILT: trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	10		
163.1 0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	35		163
			3	SS	23		162
			4	SS	46		
			5	SS	57		161
			6	SS	27		160
158.2							159
5.8	**TILL/SHALE COMPLEX:** silty clay till mixed with shale, reddish brown, moist, hard		7	SS	93/ 275mm		158
157.6							
157.4 6.6	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist						
	END OF BOREHOLE						

Notes:
1) Borehole open and dry upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR8

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Feb-01-2018

REF. NO.: 518-10
ENCL NO.: 9

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
167.0							
166.8 0.0	**TOPSOIL:** 200mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	7		
166.2 0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	47		166
165.5 1.5	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		3	SS	91/ 225mm		165
164.7 2.3	**SHALE:** Queenston Formation, highly weathered, reddish brown		4	SS	50/ 50mm		
			5	SS	50/ 75mm		164
			6	SS	50/ 50mm		163
							162
160.8 6.2	auger refusal at 6.2m **END OF BOREHOLE** Notes: 1) Water level at 6.0m upon completion of borehole.		7	SS	50/ 25m		161

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR9

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 10

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
169.0							
169.0	**TOPSOIL:** 150mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	9		
168.1							
0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	32		168
			3	SS	36	W. L. 167.5 m Mar 21, 2018	167
			4	SS	50/ 125mm		
165.9							166
3.1	**SHALE:** Queenston Formation, highly weathered, reddish brown		5	SS	50/ 125mm		
							165
164.1			6	SS	50/ 75mm		
4.9	**END OF BOREHOLE** Notes: 1) Auger refusal at 4.9m. 2) 50mm dia. monitoring well installed upon completion. 3) Water Level Readings Date — Water Depth (mbgs) March 21, 2018 — 1.5 February 13, 2018 — 1.9						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR10

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Feb-01-2018

REF. NO.: 518-10
ENCL NO.: 11

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
165.0						
164.8 0.0	**TOPSOIL:** 150mm					
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)	1	SS	8		
164.2 0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard	2	SS	23	W. L. 164.1 m Mar 21, 2018	
		3	SS	30		163
		4	SS	45		
		5	SS	46		162
		6	SS	39		161
						160
158.9						159
158.8 6.2	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist	7	SS	50		
	END OF BOREHOLE					

Notes:
1) 50mm dia. monitoring well installed upon completion.
2) Water Level Readings

Date	Water Depth (mbgs)
March 21, 2018	0.9
February 13, 2018	1.4

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR11

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Feb-01-2018

REF. NO.: 518-10
ENCL NO.: 12

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
167.0							
0.0 / 166.5	**TOPSOIL:** 460mm		1	SS	14	W. L. 166.9 m Mar 21, 2018	
0.5 / 166.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, very stiff to hard		2	SS	28		166
			3	SS	29		165
			4	SS	50/ 75mm		
			5	SS	50/ 125mm		164
162.4							163
4.6	**SHALE:** Queenston Formation, highly weathered, reddish brown		6	SS	50/ 100mm		162
160.6			7	SS	50/ 100mm		161
6.4	**END OF BOREHOLE**						

Notes:
1) Auger refusal at 6.4m
2) 50mm dia. monitoring well installed upon completion.
3) Water Level Readings

Date	Water Depth (mbgs)
March 21, 2018	0.1
February 13, 2018	0.4

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

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

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR12 (D)

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 13

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
170.0							
169.8 0.0	**TOPSOIL:** 175mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, very stiff (weathered/disturbed)		1	SS	17		
169.1 0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	27		169
			3	SS	26		168
			4	SS	53		167
			5	SS	38		166
			6	SS	37		165
			7	SS	25		164
162.4 7.6	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		8	SS	50/ 125mm		163
						W. L. 161.5 m Mar 21, 2018	162
161.0							
160.8 9.2	**SHALE:** Queenston Formation, highly weathered, reddish brown, moist		9	SS	50/ 75mm		161
	END OF BOREHOLE						

Notes:
1) 50mm dia. monitoring well installed upon completion.
2) Water Level Readings

Date	Water Depth (mbgs)
March 21, 2018	8.5

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR12 (S)

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Jan-31-2018

REF. NO.: 518-10
ENCL NO.: 13A

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" BLOWS / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa): ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
170.0												
0.0	Staright augered to 4.6m without soil sampling to install a shallow monitoring well adjacent to BH-AR12 (D)											
1							169					
2							168					
3							167					
4							166					
165.4							W. L. 166.0 m Mar 21, 2018					
4.6	**END OF BOREHOLE** Notes: 1) 50mm dia. monitoring well installed at 4.6m, adjacent to BH-AR12 (D). 2) Water Level Readings Date — Water Depth (mbgs) March 21, 2018 — 4.1											

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR13

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Feb-01-2018

REF. NO.: 518-10
ENCL NO.: 14

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
171.0												
170.8	**TOPSOIL:** 175mm											
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	4							
170.1												
1 0.9	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	25		170					
			3	SS	29		169					
2												
			4	SS	39							
3							168					
			5	SS	38							
4							167					
166.7												
4.3	**SILTY SAND:** occasional layers/interbeds of silt, trace clay, grey, wet, very dense		6	SS	90		166					2 73 19 6
5												
6							165					
			7	SS	54							
7							164					
163.1			8	SS	44							
8 7.9	**SAND & GRAVEL:** trace silt, grey, wet, very dense						163					
162.8												
8.2	**END OF BOREHOLE** Notes: 1) Water level at 4.3m upon completion of borehole.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR14

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Feb-02-2018

REF. NO.: 518-10
ENCL NO.: 15

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
166.0												
165.9	**TOPSOIL:** 125mm											
0.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	5							
165.2												
0.8	**SILTY CLAY TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, trace shale fragments, reddish brown, moist, hard		2	SS	54		165					0 3 72 25
164.5												
1.5			3	SS	50/ 125mm							
	TILL/SHALE COMPLEX: silty clay till mixed with shale fragments, reddish brown, moist, hard						164					
163.7												
2.3	**SHALE:** Queenston Formation, highly weathered, reddish brown		4	SS	50/ 100mm							
			5	SS	50/ 125mm		163					
							162					
			6	SS	50/ 75mm							
							161					
159.8							160					
6.2	**END OF BOREHOLE**		7	SS	50/ 125mm							

Notes:
1) Water level at 6.1m upon completion of borehole.

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR15

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-16-2018

REF. NO.: 518-10
ENCL NO.: 16

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
162.0							
0.0 / 161.8	**TOPSOIL:** 250mm		1	SS	4		
0.3 / 161.3	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
0.7 / 1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff		2	SS	18		161
			3	SS	23		
2 / 159.9							160
2.1 / 3	**SHALE:** Queenston Formation, highly weathered, reddish brown		4	SS	50/ 50mm		
158.8			5	SS	50/ 50mm		159
3.2	**END OF BOREHOLE** Notes: 1) Water level at 3.0m upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR16

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-16-2018

REF. NO.: 518-10
ENCL NO.: 17

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
162.0							
160.0	**TOPSOIL:** 150mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)		1	SS	11		
161.3							
0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff		2	SS	22		161
1			3	SS	28		
2							160
159.6							
2.4	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		4	SS	50/ 150mm		
3							159
158.5			5	SS	70		
3.5	**END OF BOREHOLE**						

Notes:
1) Water level at 3.4m upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED
● QUICK TRIAXIAL
+ FIELD VANE & Sensitivity
× LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR17

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-16-2018

REF. NO.: 518-10
ENCL NO.: 18

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
163.0							
162.8 0.0	**TOPSOIL:** 175mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	6		
162.3 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	16		162
			3	SS	32		161
			4	SS	36		160
			5	SS	31		159
158.6							
4.4 158.3	**SHALE:** Queenston Formation, highly weathered, reddish brown		6	SS	50/ 75mm		
4.7	**END OF BOREHOLE**						

Notes:
1) Water level at 4.6m upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR18

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 19

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
164.0							
164.0 / 0.0	**TOPSOIL:** 150mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	6		
163.3 / 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	16		163
			3	SS	35		
161.8 / 2.2	**SHALE:** Queenston Formation, highly weathered, reddish brown		4	SS	50/ 100mm		162
160.8 / 3.2	**END OF BOREHOLE**		5	SS	50/ 75mm		161

Notes:
1) Borehole open and dry upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

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

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR19

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 20

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
165.0							
164.9 0.1	**TOPSOIL:** 125mm		1	SS	7		
164.3 0.7	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	20		164
			3	SS	31		163
2			4	SS	38		
3			5	SS	41		162
4							161
160.7 4.3	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		6	SS	98		
5							160
159.0 6.0	**SHALE:** Queenston Formation, highly weathered, reddish brown		7	SS	50/ 50mm		159
158.8 6.2	**END OF BOREHOLE**						
6	Notes: 1) Borehole open and dry upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

LOG OF BOREHOLE BH-AR20

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 21

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION
164.0							
164.0 0.1	**TOPSOIL:** 125mm		1	SS	9		
163.5 0.5	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)						
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	21		163
			3	SS	24		
2							162
			4	SS	33		
3							161
			5	SS	26		
4							160
159.6 4.4	**SHALE:** Queenston Formation, highly weathered, reddish brown		6	SS	50/ 125mm		
159.3 4.7	**END OF BOREHOLE**						

Notes:
1) Borehole open and dry upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR21

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 22

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
167.0							
166.9 0.1	**TOPSOIL:** 100mm		1	SS	7		
166.3 0.7	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	24		166
			3	SS	39		
2							165
			4	SS	43		
3 164.0							
163.8 3.2	**SHALE:** Queenston Formation, highly weathered, reddish brown		5	SS	50/ 75mm		164
	END OF BOREHOLE						
	Notes: 1) Borehole open and dry upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE BH-AR22

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 23

ELEV / DEPTH (m)	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" / 0.3 m	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (10 20 30)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
169.0												
169.0 / 0.0	**TOPSOIL:** 125mm											
168.9 / 0.1	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	5				○			
168.3 / 0.7	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		2	SS	28		168		○			
1			3	SS	73				○			
2			4	SS	50/ 125mm		167		○			
165.8 / 3			5	SS	50/ 50mm		166					
3.2	**END OF BOREHOLE** Notes: 1) Water level at 3.1m upon completion.											

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; ○ ε=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR23

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 24

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
164.0					
163.8 0.0	**TOPSOIL:** 175mm				
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)	1	SS	7	
163.3 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard	2	SS	16	163
1		3	SS	23	
2		4	SS	36	162
3	grey to reddish brown at 3.1m	5	SS	45	161
4					160
159.6					
159.4 4.4	**SHALE:** Queenston Formation, highly weathered, reddish brown	6	SS	50/ 50mm	
4.6	**END OF BOREHOLE**				

Notes:
1) Water level at 4.5m upon completion.

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR24

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 25

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
167.0					
166.8	**TOPSOIL:** 200mm				
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown,	1	SS	5	
166.3	moist, firm (weathered/disturbed)				
0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff	2	SS	25	166
1		3	SS	29	
2					
164.8					165
2.2	**SHALE:** highly weathered, grey	4	SS	50/ 125mm	
3					
163.8	grey to reddish brown at 3.0m	5	SS	50/ 75mm	164
3.2	**END OF BOREHOLE**				

Notes:
1) Water level at 2.7m upon completion.

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED
● QUICK TRIAXIAL
+ FIELD VANE & Sensitivity
× LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR25

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-14-2018

REF. NO.: 518-10
ENCL NO.: 26

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
165.0							
164.9 0.1	**TOPSOIL:** 100mm						
	CLAYEY SILT: trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)		1	SS	8		
164.2 0.8	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	28		164
			3	SS	24		163
			4	SS	47		162
			5	SS	39		161
			6	SS	16		160
159.4 5.6	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, grey to reddish brown, moist, hard		7	SS	50/ 125mm		159
157.7 7.3	**SHALE:** Queenston Formation, highly weathered, reddish brown						158
157.3 7.7	**END OF BOREHOLE**		8	SS	50/ 75mm		

Notes:
1) Water level at 7.6m upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR26

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-14-2018

REF. NO.: 518-10
ENCL NO.: 27

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
167.0							
166.9 0.1	**TOPSOIL:** 125mm						
166.6 0.4	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	7		
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown to brown, moist, very stiff to hard		2	SS	21		166
			3	SS	20		
2 164.8							165
2.2	**SHALE:** highly weathered, grey to reddish brown		4	SS	31		
3			5	SS	52		164
4							163
162.3			6	SS	50/ 75mm		
4.7	**END OF BOREHOLE**						

Notes:
1) Borehole dry and open upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR27

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 28

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS "N" 0.3 m	GROUND WATER CONDITIONS	ELEVATION
169.0							
169.0 / 0.0	**TOPSOIL:** 175mm						
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)		1	SS	5		
168.3 / 0.7	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, very stiff to hard		2	SS	22		168
			3	SS	50/ 150mm		
							167
			4	SS	50/ 150mm		
166.0							
169.0 / 3.0	**SHALE:** highly weathered, grey to reddish brown		5	SS	50/ 150mm		166
3.2	**END OF BOREHOLE**						

Notes:
1) Borehole dry and open upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR28

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 29

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
167.0						
166.8 0.2	**TOPSOIL:** 150mm					
166.6 0.4	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)	1	SS	8		
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff	2	SS	20		166
2		3	SS	26		165
3		4	SS	24		164
4	grey at 4.6m	5	SS	18		163
5		6	SS	29		162
161.1						
6 5.9	**SHALE:** Queenston Formation,	7	SS	50/ 25mm		161
166.9 6.1	highly weathered, reddish brown					
	END OF BOREHOLE					
	Notes: 1) Borehole dry and open upon completion.					

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR29

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-14-2018

REF. NO.: 518-10
ENCL NO.: 30

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
168.0					
167.8 / 0.0	**TOPSOIL:** 200mm				
0.2 / 167.3	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)	1	SS	8	
0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard	2	SS	18	167
1		3	SS	32	
2 / 165.8					166
2.2	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard	4	SS	72	
3 / 165.0					
2.9 / 164.8	**SHALE:** highly weathered, grey to reddish brown	5	SS	50/ 125mm	165
3.2	**END OF BOREHOLE**				

Notes:
1) Borehole dry and open upon completion.

GROUND WATER CONDITIONS

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED
● QUICK TRIAXIAL
+ FIELD VANE & Sensitivity
× LAB VANE
20 40 60 80 100

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

WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR30

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-15-2018

REF. NO.: 518-10
ENCL NO.: 31

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
170.0							
169.8	**TOPSOIL:** 150mm		1	SS	5		
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
169.3							
0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	16		169
1							
			3	SS	24		
2							168
			4	SS	39		
3							167
166.8							
3.2	**SHALE:** highly weathered, grey to reddish brown		5	SS	81		
166.6							
3.4	**END OF BOREHOLE**						

Notes:
1) Borehole dry and open upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR31

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 32

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
167.0							
166.9 0.1	**TOPSOIL:** 125mm		1	SS	8		
	CLAYEY SILT: trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)						
166.3 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	24		166
			3	SS	20		165
			4	SS	41		164
			5	SS	34		163
			6	SS	22		162
			7	SS	26		161
159.6							160
159.4 7.6	**SHALE:** highly weathered, grey to reddish brown		8	SS	50/ 25mm		
	END OF BOREHOLE						
	Notes: 1) Borehole dry and open upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE

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

WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

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

LOG OF BOREHOLE BH-AR32

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 33

(m) ELEV / DEPTH	DESCRIPTION	NUMBER	TYPE	BLOWS 0.3 m "N"	ELEVATION
168.0					
167.8 0.2	**TOPSOIL:** 175mm				
	CLAYEY SILT: trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)	1	SS	7	
167.3 0.7					
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard	2	SS	20	167
		3	SS	27	
2					166
		4	SS	54	
3					165
		5	SS	42	
4					164
163.1	grey at 4.6m	6	SS	73	
5 4.9	**SHALE:** highly weathered, grey to reddish brown				163
6 161.9	reddish brown at 6.0m	7	SS	50/ 25mm	162
6.1	**END OF BOREHOLE**				

Notes:
1) Borehole dry and open upon completion.

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)
SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE
PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES: $+^3$, $\times^3$: Numbers refer to Sensitivity; $\circ^{\varepsilon_f}$ ε_f=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR33

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-12-2018

REF. NO.: 518-10
ENCL NO.: 34

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
166.0							
0.0 / 165.7	**TOPSOIL:** 275mm		1	SS	9		
0.3 / 165.3	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
0.7 / 164.6	**CLAYEY SILT:** trace sand, trace gravel, brown, moist, firm		2	SS	6		165
1.4	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		3	SS	36		164
			4	SS	40		
161.6			5	SS	26		163
4.4	**TILL/SHALE COMPLEX:** silty clay till mixed with shale fragments, reddish brown, moist, hard		6	SS	50/ 50mm		162
			7	SS	50/ 125mm		161
158.4			8	SS	50/ 25mm		160
7.6	**END OF BOREHOLE** Notes: 1) Borehole dry and open upon completion.						159

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE BH-AR34

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 35

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS / 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
167.0							
166.9 0.1	**TOPSOIL:** 125mm		1	SS	8		
	CLAYEY SILT: trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)						
166.3 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	18		166
			3	SS	24		165
			4	SS	30		164
			5	SS	42		163
			6	SS	34		162
161.1							
5.9 160.8	**SHALE:** Queenston Formation, highly weathered, reddish brown		7	SS	50/ 5mm		161
6.2	**END OF BOREHOLE** Notes: 1) Borehole dry and open upon completion.						

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)
REMARKS AND GRAIN SIZE DISTRIBUTION (%) — GR SA SI CL

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
+ 3, × 3: Numbers refer to Sensitivity
○ 8=3% Strain at Failure

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR35

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 36

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
170.0								
169.8 0.0	**TOPSOIL:** 175mm							
0.2	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, stiff (weathered/disturbed)		1	SS	7			
169.3 0.7	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, reddish brown, moist, very stiff to hard		2	SS	22		169	
1			3	SS	50/ 75mm			hit boulder at 1.5m
2			4	SS	19		168	
3			5	SS	18		167	
4	stiff at 4.6m		6	SS	13		166	
5							165	
6			7	SS	21		164	
7							163	
8 162.0			8	SS	39		162	
8.0	**END OF BOREHOLE** Notes: 1) Borehole dry and open upon completion.							

DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)

SHEAR STRENGTH (kPa) (20 40 60 80 100)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30)

POCKET PEN. (Cu) (kPa)
NATURAL UNIT WT (kN/m³)

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

LOG OF BOREHOLE BH-AR36

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 37

(m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION
171.0							
170.8 0.2	**TOPSOIL:** 175mm		1	SS	6		
170.3 0.7	**CLAYEY SILT:** trace topsoil/organics, trace to some sand, trace gravel, reddish brown, moist, firm (weathered/disturbed)						
1	**CLAYEY SILT TILL:** some sand to sandy, trace gravel, occasional cobble/boulder, brown, moist, very stiff to hard		2	SS	23		170
			3	SS	22		
2							169
			4	SS	30		
3	reddish brown below 3.0m						168
			5	SS	26		
4							167
	grey and stiff at 4.6m		6	SS	10		
5							166
6							165
	grey to reddish brown at 6.1m		7	SS	49		
7							164
163.7 7.3	**SILTY SAND:** grey, wet, dense						
8			8	SS	43		163
162.2 8.8	**SAND:** grey, wet, compact to dense						
9			9	SS	39		162
10							161
11			10	SS	disturbed		160
12							

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH (kPa)
○ UNCONFINED + FIELD VANE & Sensitivity
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30

POCKET PEN. (Cu) (kPa)

NATURAL UNIT WT (kN/m³)

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

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

Continued Next Page

GROUNDWATER ELEVATIONS
Measurement 1st ▽ 2nd ▼ 3rd ▼ 4th ▼

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

LOG OF BOREHOLE BH-AR36

PROJECT: Geotechnical Investigation- Diam Property
CLIENT: Argo Development Corporation
PROJECT LOCATION: Dundas Street East, Oakville, ON
DATUM: Geodetic
BH LOCATION: See Drawing 1

DRILLING DATA
Method: Solid Stem Augers
Diameter: 150mm
Date: Mar-13-2018

REF. NO.: 518-10
ENCL NO.: 37

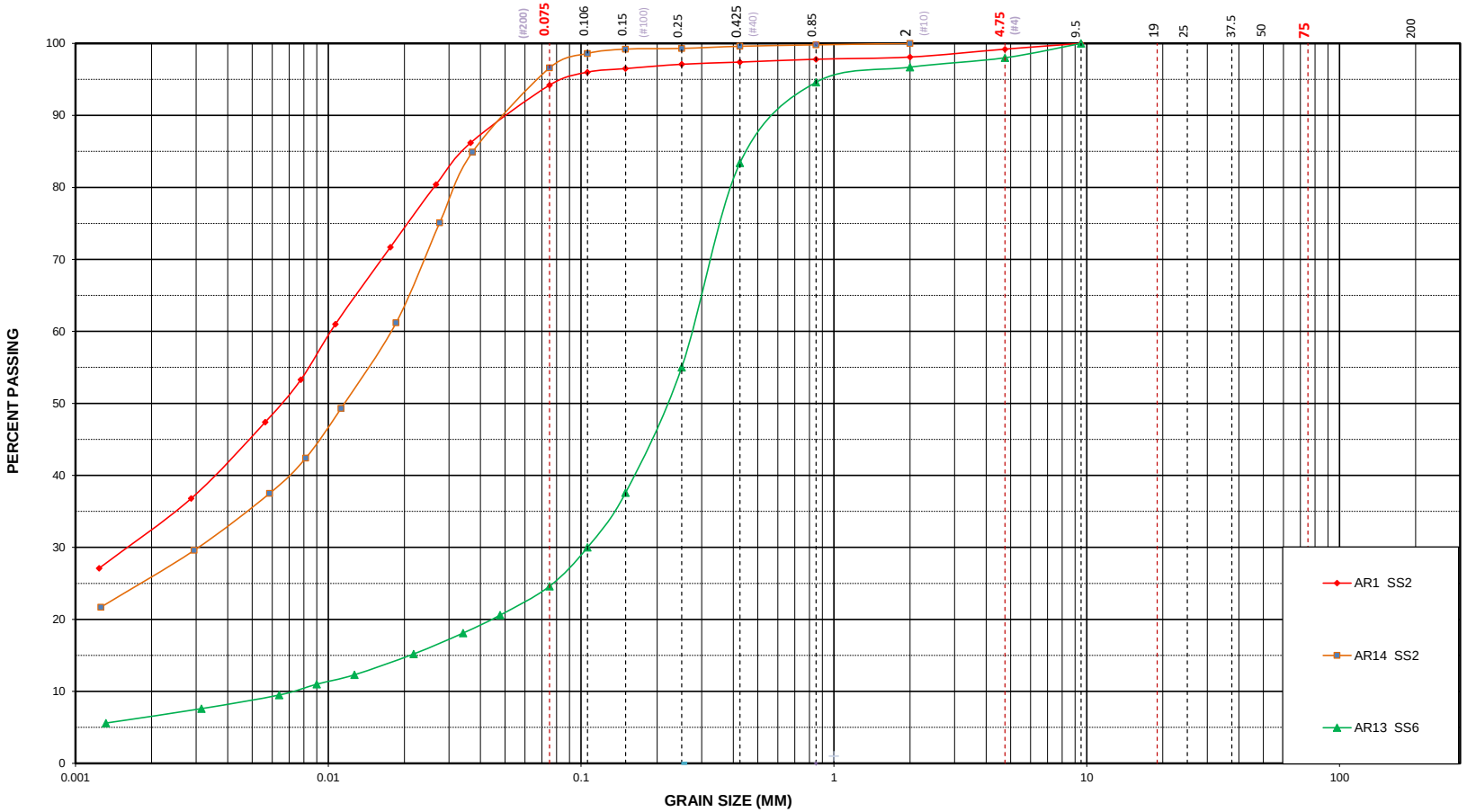
SOIL PROFILE (m) ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS 0.3 m "N"	GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH (kPa) ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE & Sensitivity × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 10 20 30	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
158.5	**SAND:** grey, wet, compact to dense(Continued)		11	SS	11				○		
12.5	**END OF BOREHOLE** Notes: 1) Water level at 6.1m upon completion.										

DS SOIL LOG DIAM PROPERTY- DUNDAS ST E,OAKVILLE-ARGO.GPJ DS.GDT 18-4-19

GROUNDWATER ELEVATIONS
Measurement 1st 2nd 3rd 4th

GRAPH NOTES
$+^3$, $\times^3$: Numbers refer to Sensitivity
○ $^{\varepsilon_f}$=3% Strain at Failure

Particle Size Distribution (ASTM-D421/D422)



Silt and Clay		Sand			Gravel		Cobble +
Clay	Silt	Fine	Medium	Coarse	Fine	Coarse	

Specification and Comments:

DS Consultants Ltd
Geotechnical • Enviromental • Materials • Hydrogeology

Project:	**Diam Property ,OakVille**	Project No.:	**18-518-10**
Client:	**ARGO**	Date:	March-19-2018
Location:	**Oakville,ON.**	Drawing No.	38

Appendix A

General Comments on Bedrock in Toronto Area

General Comments – Bedrock in Greater Toronto Area

The bedrock that makes spread footings or caissons a popular choice for high-rise foundation support is a shale or shale limestone composition. The highest member, the Queenston Formation, is generally found west of Toronto, while the Georgian Bay Formation underlies most of Metro Toronto, with the Collingwood and Whitby Formations east of Toronto. The Queenston is, relatively speaking, the weaker of the four formations that are likely to support caissons or footings.

The Georgian Bay as well as the Queenston and Collingwood/Whitby Formation are of Middle Ordovician Age. It is defined as the rock unit that overlies the bluish grey shales of the Collingwood Formation and is in turn overlain by the red shale of the Queenston Formation. The Georgian Bay Formation consists of bluish and grey shale with interbeds of sandstone, limestone and dolostone. Towards the west where the Georgian Bay formation underlies the Queenston Formation, the limestone content increases significantly and limestone and/or sandstone may comprise as much as 70 to 90 percent of the bedrock. The hard layers are usually less than about 100 to 150 mm thick but some layers are much thicker. The thicker layers have been observed to be as much as 750 to 900 mm at some sites. The layers are actually lenses and they can vary significantly in thickness over short distances.

The upper portion of the bedrock is commonly weathered for a depth of 600 to 1000 mm and within this weathered zone hard limestone layers or lenses are common. These hard limestone layers can result in contractual problems for augers, and can provide misleading bedrock elevations. Where the weathering is more extensive a shale till layer may be found above the bedrock. In the sound bedrock, the limestone, sandstone, dolostone is hard to very hard.

Stress relief features such as folds and faults are common in the bedrock. In these features, the rock is heavily fractured and sheared, and contains layers of shale rubble and clay. Weathering is much deeper than the surrounding rock in these features and often there is a lateral migration of the stress relief features resulting in sound unweathered bedrock overlying fractured and weather bedrock. The stress relief features are usually in the order of 4 to 6 m wide, but the depth can vary from 4 to 5 m to in excess of 10 m. These features occur randomly.

The bedrock contains significant high locked in horizontal stresses. These stresses can impose significant loads on tunnel walls but the slower rate of construction for basements allows for a relaxation of these stresses and they are not normally a problem for basement construction.

Groundwater seepage below the top 1000 mm is generally small, however, at several locations in Toronto and Mississauga large quantities have been encountered.

Bedding joints in the bedrock are very close-to-close, smooth planar in the shale and rough planar in the limestone. Significant vertical jointing is common.

Where the bedrock was cored, a detailed description of the rock core is appended to the borehole log.

Design features related to the bedrock are discussed in other sections of this report, and these general comments must be considered with these comments.

Methane gas exists in the bedrock, normally below the top 1000 mm and more concentrated with depth. Appropriate care and monitoring is essential in all confined bedrock excavations, particularly caissons and tunnels.

Appendix B

Engineered Fill Guidelines

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 DS Consultants Ltd (DSCL). Without this confirmation no responsibility for the performance of the structure can be accepted by DSCL. 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 DSCL 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 DSCL during placement of engineered fill is required. Work cannot commence or continue without the presence of the DSCL 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.

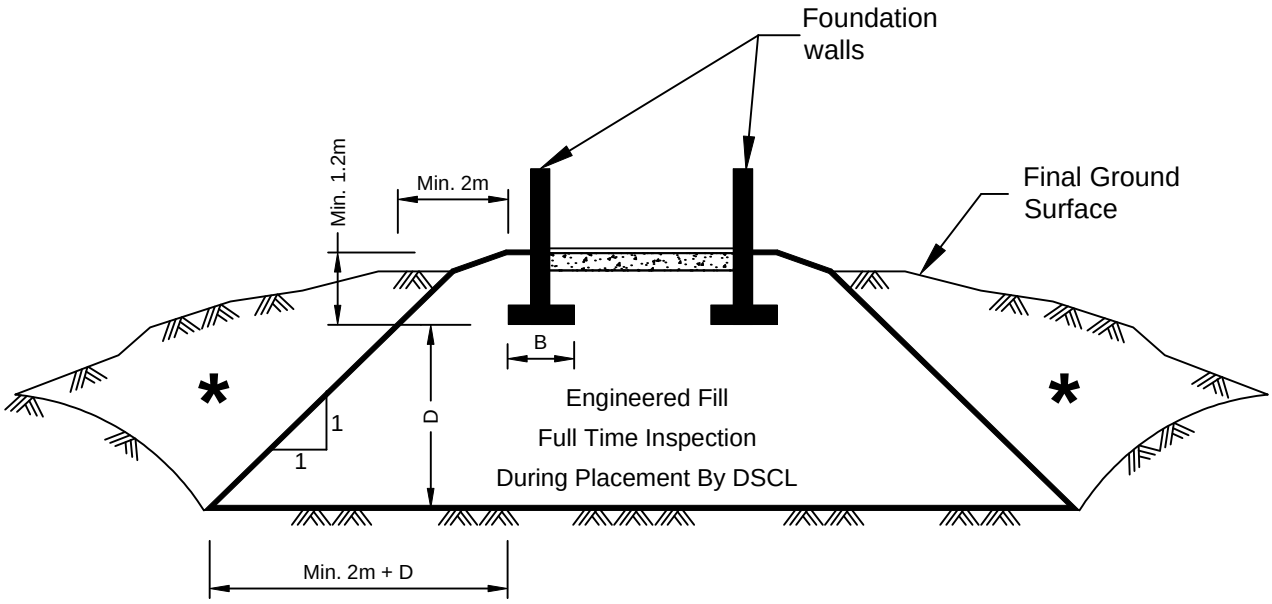
10. After completion of the engineered fill pad a second contractor may be selected to install footings. The prepared footing bases must be evaluated by engineering staff from DSCL prior to footing concrete placements. All excavations must be backfilled under full time supervision by DSCL to the same 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 DSCL.

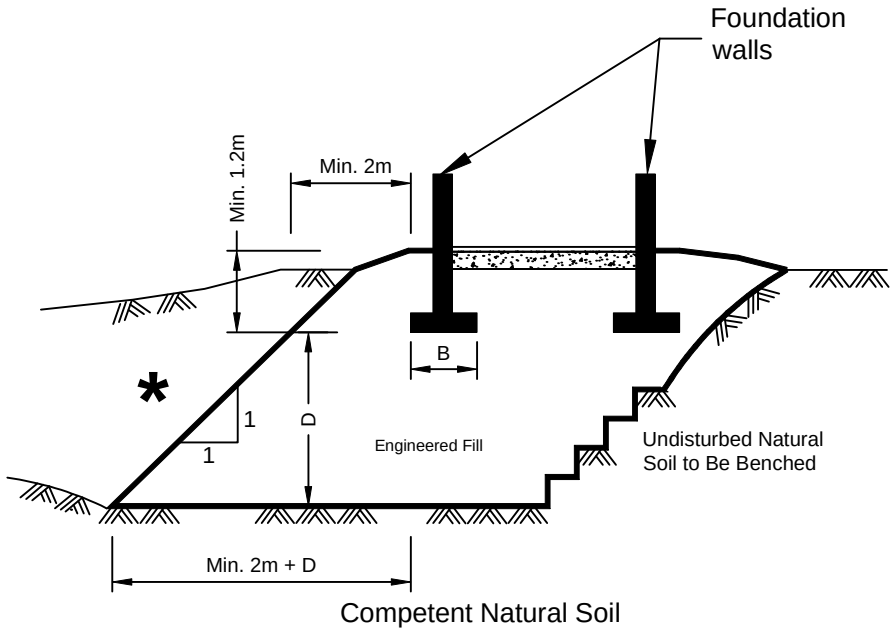
11. After completion of compaction, the surface of the engineered fill pad must be protected from disturbance from traffic, rain and frost. During the course of fill placement, the engineered fill must be smooth-graded, proof-rolled and sloped/crowned at the end of each day, prior to weekends and any 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 DS Consultants Ltd report attached.





* Backfill in this area to be as per the DSCL report.