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Greystone Village Development
Building 2A and 2B
175 Main Street - Ottawa

Prepared For

Greystone Village Inc.
c/o EQ Homes

February 20, 2018

Report: PG4404-1

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Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by EQ Homes to prepare a geotechnical investigation report based on the available geotechnical borehole and testing information prepared by others for Building 2A and 2B as part of the Greystone Village Development located at 175 Main Street in the City of Ottawa (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

☐ Determine the subsoil and groundwater conditions at this site by means of boreholes conducted by others.

☐ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

It is our understanding that the proposed development consists of two adjacent multi-storey structures identified as Building 2A and Building 2B located within the west and east of portion of the site, respectively. Building 2A will consist of a 6-storey structure while Building 2B will be a 9-storey structure. Both buildings will share the underground parking level occupying the majority of the subject section of the development. For the parking garage, one or two levels are being contemplated.

It is further understood that the ground floor level of Building 2A and Building 2B will be occupied by commercial development while the remaining floors will be designated for residential use.

The majority of the subject site remains grass covered and undeveloped with the exception of a newly constructed sales centre and associated asphalt covered parking lot within the west portion of the site.

3.0 Available Geotechnical Information

Borehole Logs

Geotechnical information was available from boreholes drilled by others for the proposed development between November 16 and 28, 2016. At that time a total of 7 boreholes (BHs 16-201 to 16-207) were drilled to a maximum depth of 26 m below existing ground surface within the footprint of the proposed structures. In addition, one borehole completed during the initial geotechnical investigation on July 30 and 31, 2014 (identified as Borehole 14-208) was also included in the borehole logs in Appendix 1 of the current report. The locations of the boreholes are shown on Drawing PG4404-1 Test Hole Location Plan included in Appendix 2.

Overburden

Generally, the subsoil profile at the borehole locations consists of up to 2.3 m of fill material overlying a very stiff to stiff silty clay deposit extending to a depths varying between 9 to 13 m below the existing grade. The silty clay deposit is underlain by a relatively compact to dense interbedded sandy silt, silty sand which in turn is underlain by an inferred glacial till deposit. Overburden thickness was evaluated during the course of the site investigation by dynamic cone penetration testing (DCPT) and split spoon samples advanced in Boreholes 16-202, 16-203 and 16-207 at depths ranging between 24 and 26 m below the existing grade.

Bedrock

Based on available geological mapping, the bedrock in this area mostly consists of dark brown to black shale of the Billings Formation with an overburden drift thickness of 15 to 50 m depth.

Groundwater

As part of the geotechnical field investigations, a total of 5 staggered monitoring wells were installed in Boreholes 16-203 and 16-208. The groundwater levels within the 3 monitoring wells installed within the silty clay deposit varied between 2.4 and 4.1 m below the existing ground surface. However, the groundwater levels within the 2 monitoring wells installed within the underlying sandy silty, silty sand and sand layer was encountered at a depth of 6.8 and 7.3 m. It should be further noted that the groundwater level could vary at the time of construction. The laboratory test results completed by others on the various soil samples recovered during the geotechnical investigation are presented in Appendix 1 of the current report.

4.0 Discussion

4.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered satisfactory for the proposed development. It is expected that the proposed hi-rise building can be founded on a raft foundation while the parking garage portions extending beyond the raft foundation can be founded on conventional spread footing foundations if only one level of underground parking is considered.

In the event that a second underground parking level is incorporated in the design, consideration will have to be given to partially tanking the lower level which would include a raft foundation for the entire development area (buildings and garage). The purpose of the partial tanking is to avoid long term dewatering of adjacent areas.

The above and other considerations are further discussed in the following sections.

4.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under any building, paved areas, pipe bedding and other settlement sensitive structures.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath parking areas where settlement of the ground surface is of minor concern. In landscaped areas, these materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective

SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Concrete Mud Slab

For the raft slab portions of the overall foundation, a concrete mud slab will be required once the subgrade is exposed at the founding elevation. It is expected that a 75 mm thick concrete mud slab will be poured on an undisturbed silty clay subgrade using 15 MPa compressive strength lean concrete.

Pressure Relief Chamber

To prevent the long term dewatering of adjacent structures surrounding the site including mature trees, at the founding level, a pressure relief chamber will be installed along with collection pipes within excavated within the silty clay deposit. The collection pipe trenching should extend along the proposed building perimeter and lead to the pressure relief chamber. It is suggested that the pressure relief chamber be incorporated in the lowest section of the P2 level within a utility room in close proximity to the proposed sump pit(s). Figure 2 - Pressure Relief Chamber in Appendix 2 provides an example of the required pressure relief chamber. Once the pressure relief chamber and associated piping is installed, the proposed raft slab can be constructed. The purpose of the pressure relief chamber will be as follows:

❏ Manage any water infiltration along the founding surface during the excavation program.
❏ Manage the water infiltration during the pouring of the raft slab to prevent water flow in the fresh concrete.
❏ Manage water infiltration below the raft slab until sufficient load is applied to resist any potential hydrostatic uplift.
❏ Regulate the discharge valve to control water infiltration once the raft slab is in place and over the long term to manage the hydrostatic pressure to permit any repairs associated with any water infiltration.
❏ Once sufficient load is applied to the raft slab, the pressure relief valve will be fully closed to prevent any further dewatering.

Hydrostatic Pressure

With the fully closed valve within the pressure relief chamber and a perfectly watertight foundation, it is expected that a maximum hydrostatic pressure of **45 kPa** will be developed over the long term and should be incorporated in the design of the raft foundation and the foundation wall. Realistically, achieving a fully watertight is not always possible due to minor water infiltration and, therefore, a realistic long term hydrostatic pressure will be closer to 25 to 30 kPa.

4.3 Foundation Design

Bearing Resistance Values - Parking Garage P1 Level

Strip footings, up to 3 m wide, and pad footings, up to 6 m square, placed on the undisturbed stiff silty clay bearing surface can be designed using a bearing resistance value at SLS of **125 kPa** and a factored bearing resistance value at ULS of **225 kPa**.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed prior to the placement of concrete for footings.

The bearing resistance value at SLS given for footings will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to a stiff silty clay above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Raft Foundation - Buildings at P1 Level

For the building portions, a raft foundation is recommended. The following parameters may be used for raft design:

It is anticipated that the base of the raft foundation will be located between 5.3 to 5.5 m below the finished grade. It is expected that the underside of the raft will be placed between geodetic elevations of 59.5 to 60 m.

The amount of settlement of the raft slab will be dependent on the sustained raft contact pressure. The bearing resistance value at SLS (contact pressure) of **180 kPa** will be considered acceptable. The loading conditions for the contact pressure are based on sustained loads, that are generally taken to be 100% Dead Load and 50% Live Load. The contact pressure provided considers the stress relief associated with the soil removal required for proposed building. The factored bearing resistance (contact pressure) at ULS can be taken as **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

The modulus of subgrade reaction was calculated to be **5 MPa/m** for a contact pressure of **180 kPa**. The raft foundation design is required to consider the relative stiffness of the reinforced concrete slab and the supporting bearing medium.

Based on the following assumptions for the raft foundation, the proposed building can be designed using the above parameters with a total and differential settlement of 25 and 15 mm, respectively.

Raft Foundation - Buildings and Garage at P2 Level

For the building portions along with the entire garage portion, a raft foundation is recommended. The following parameters may be used for raft design:

It is anticipated that the base of the raft foundation will be located between 8.3 to 8.5 m below the finished grade. It is expected that the underside of the raft will be placed between geodetic elevations of 56.5 to 57 m.

The amount of settlement of the raft slab will be dependent on the sustained raft contact pressure. The bearing resistance value at SLS (contact pressure) of **225 kPa** will be considered acceptable. The loading conditions for the contact pressure are based on sustained loads, that are generally taken to be 100% Dead Load and 50% Live Load. The contact pressure provided considers the stress relief associated with the soil removal required for proposed building. The factored bearing resistance (contact pressure) at ULS can be taken as **350 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

The modulus of subgrade reaction was calculated to be **5 MPa/m** for a contact pressure of **180 kPa**. The raft foundation design is required to consider the relative stiffness of the reinforced concrete slab and the supporting bearing medium.

Based on the following assumptions for the raft foundation, the proposed building can be designed using the above parameters with a total and differential settlement of 25 and 15 mm, respectively.

Permissible Grade Raise Recommendations

Consideration must be given to potential settlements which could occur due to the presence of the silty clay deposit and the combined loads from the proposed footings, any groundwater lowering effects, and grade raise fill. The foundation loads to be considered for the settlement case are the continuously applied loads which consist of the unfactored dead loads and the portion of the unfactored live load that is considered to be continuously applied. A minimum value of 50% of the live load is often recommended by Paterson.

A permissible grade raise restriction of **1 m** is recommended for finished grading within 5 m of the proposed building. A post-development groundwater lowering of 1 m was considered in our permissible grade raise restriction calculations.

4.4 Design for Earthquakes

Foundations constructed at the subject site can be designed using a seismic site response **Class D** as defined in the Ontario Building Code 2012 (OBC 2012: Table 4.1.8.4.A). However, it is recommended that the site classification should be confirmed with a site-specific shear wave velocity test. The underlying stiff to very stiff silty clay and confined layer of compact to dense sandy silt, silty sand and sand underlying the site are not susceptible to liquefaction based on the fines content, compactness of the underlying layers and Ottawa seismic design peak ground acceleration as per OBC 2012.

4.5 Basement Slab

Basement Slab for P2 Level

The basement floor slab at the P2 Level will be placed over an OPSS Granular A material overlying the raft slab. The subfloor granular material within the footprint of the building will be placed in maximum 300 mm thick lifts of loose layers and compacted to at least 98% of the material's SPMDD.

An underfloor drainage system is required between the finished floor and the underlying raft slab to direct water infiltration to the building sump pit.

Basement Slab for P1 Level

The basement floor slab at the P1 Level overlying the raft foundation will be placed over an OPSS Granular A material overlying the raft slab. The subfloor granular material within the footprint of the building will be placed in maximum 300 mm thick lifts of loose layers and compacted to at least 98% of the material's SPMDD.

For the remainder of the P1 Level, it's expected that the basement area will be mostly parking and that a concrete slab topping with a subfloor granular layer will be incorporated in the design to accommodate services.

In storage or other uses of the lower level where a concrete floor slab will be used it is recommended that the upper 200 mm of sub-slab fill consists of 19 mm clear crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

4.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a bulk (drained) unit weight of 20 kN/m^3. The applicable effective (undrained) unit weight of the retained soil can be taken as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when using the effective unit weight.

Lateral Earth Pressures

The static horizontal earth pressure (p_o) can be calculated using a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire height of the wall should be added to the above diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be used in conjunction with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to maintain a minimum separation of 0.3 m from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}). The seismic earth force (ΔP_{AE}) can be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45-a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. Note that the vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions can be calculated using $P_o = 0.5\ K_o\ \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions noted above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3)+\Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

4.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and access lanes.

Table 1 - Recommended Pavement Structure - Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - HL 3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 2 - Recommended Pavement Structure - Access Lanes

Thickness (mm)	Material Description
40	**Wear Course -** Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. Weak subgrade conditions may be experienced over service trench fill materials. This may require the use of a geotextile, such as Terratrack 200 or equivalent, thicker subbase or other measures that can be recommended at the time of construction as part of the field observation program.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material’s SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be given to installing subdrains during the pavement construction. These drains should be installed at each catch basin, be at least 3 m long and should extend in four orthogonal directions or longitudinally when placed along a curb. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be shaped to promote water flow to the drainage lines.

5.0 Design and Construction Precautions

5.1 Foundation Drainage and Backfill

Foundation Drainage and Waterproofing

It is understood that the building foundation walls will be placed in close proximity to all the boundaries. It is expected that the foundation wall will be blind poured against a drainage system and waterproofing system fastened against the shoring system.

A waterproofing membrane will be required to lessen the effect of water infiltration for the lower P-2 basement level. The waterproofing membrane can be placed and fastened to the shoring system (soldier pile and timber lagging) and should extend to the bottom of the excavation at the founding level of the raft foundation.

It is recommended that the composite drainage system, such as Delta Drain 6000 or equivalent, extend from the exterior finished grade to the founding elevation (underside of raft slab). The purpose of the composite drainage system is to direct any water infiltration resulting from a breach of the waterproofing membrane to the building sump pit. It is recommended that 150 mm diameter sleeves at 3 m centres be cast in the foundation wall at the raft slab interface to allow the infiltration of water to flow to an interior perimeter underfloor drainage pipe. The perimeter drainage pipe should direct water to sump pit(s) within the lower basement area.

Foundation Raft Slab Construction Joints

It is expected that the raft slab will be poured in sections. For the construction joint at each pour should incorporate a rubber water stop along with a chemical grout (Xypex or equivalent) applied to the entire vertical joint of the raft slab. Furthermore, a rubber water stop should be incorporated in the horizontal interface between the foundation wall and the raft slab.

Underfloor Drainage

Underfloor drainage will be required to control water infiltration due to groundwater infiltration at the proposed founding elevation. For design purposes, we recommend that 150 mm in diameter perforated pipes be placed along the interior perimeter of the foundation wall and one drainage line within each bay. The spacing of the underfloor drainage system should be confirmed at the time of backfilling the floor completing the excavation when water infiltration can be better assessed.

Adverse Effects of Dewatering on Adjacent Properties

Since the proposed development will be founded below the long term groundwater level, a waterproofing membrane system has been recommended to lessen the effects of water infiltration. Any long term dewatering of the site will be minimal and should have no adverse effects to the surrounding buildings or structures. The short term dewatering during the excavation program will be managed by the excavation contractor and will be minimal due to the impervious nature of the silty clay deposit.

Foundation Backfill

Where space is available for conventional wall construction, backfill against the exterior sides of the foundation walls should consist of free-draining, non-frost susceptible granular materials. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose.

Pressure Relief Chamber

The purpose of the pressure relief chamber will be to control the groundwater infiltration and hydrostatic pressure created by fully or partially tanking the basement level. To avoid uplift on the raft foundation slab prior to having sufficient loading to resist uplift, it is recommended that the water infiltration be pumped via the pressure relief chamber during the construction program.

During the construction program, the valve of the pressure relief chamber can be gradually closed as the loading is applied to resist hydrostatic pressure. Once sufficient load is available to resist the full hydrostatic pressure, the valve of the pressure relief chamber can be adjusted and closed to minimize water infiltration volumes.

5.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum 1.5 m thick soil cover (or equivalent) should be provided in this regard.

A minimum of 2.1 m thick soil cover (or equivalent) should be provided for other exterior unheated footings.

5.3 Excavation Side Slopes

Unsupported Excavations

The side slopes of excavations in the soil and fill overburden materials should be either cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

Temporary Shoring

Temporary shoring may be required to complete the required excavations where insufficient room is available for open cut methods. The shoring requirements will depend on the depth of the excavation, the proximity of the adjacent buildings and underground structures and the elevation of the adjacent building foundations and underground services. Additional information can be provided when the above details are known.

For design purposes, the temporary system may consist of soldier pile and lagging system or interlocking steel sheet piling. Any additional loading due to street traffic, construction equipment, adjacent structures and facilities, etc., should be added to the earth pressures described below. These systems can be cantilevered, anchored or braced.

The earth pressures acting on the shoring system may be calculated using the following parameters.

Table 3 - Soil Parameters for Shoring System Design

Parameters	Values
Active Earth Pressure Coefficient (K_a)	0.33
Passive Earth Pressure Coefficient (K_p)	3
At-Rest Earth Pressure Coefficient (K_o)	0.5
Unit Weight (γ), kN/m^3	20
Submerged Unit Weight (γ), kN/m^3	13

Generally, it is expected that the shoring systems will be provided with tie-back rock anchors to ensure their stability. It is further recommended that the toe of the shoring be adequately supported to resist toe failure.

The geotechnical design of grouted rock anchors in sedimentary bedrock is based upon two possible failure modes. The anchor can fail either by shear failure along the grout/rock interface or by pullout of a 60 to 90 degree cone of rock with the apex of the cone near the middle of the bonded length of the anchor.

The anchor derives its capacity from the bonded portion, or fixed anchor length, at the base of the anchor. An unbonded portion, or free anchor length, is also usually provided between the rock surface and the start of the bonded length. A factored tensile grout to rock bond resistance value at ULS of **1.0 MPa**, incorporating a resistance factor of 0.3, can be used. A minimum grout strength of 40 MPa is recommended.

The design of the rock anchors for temporary shoring can be based on the values provided in Table 4. From a geotechnical perspective, the fixed anchor length will depend on the diameter of the drill holes.

Table 4 - Recommended Rock Anchor Lengths - Grouted Rock Anchor

Diameter of Drill Hole (mm)	Anchor Lengths (m)			Factored Tensile Resistance (kN)
	Bonded Length	Unbonded Length	Total Length	
75	4	1.2	5.2	250
	5.6	1.7	7.3	500
	7.9	2.4	10.3	1000
125	3.9	1.1	5	250
	5.3	1.6	6.9	500
	7.2	2.2	9.4	1000

It is recommended that the anchor drill hole diameter be within 1.5 to 2 times the rock anchor tendon diameter and the anchor drill holes be inspected by geotechnical personnel and should be flushed clean prior to grouting. The use of a grout tube to place grout from the bottom up in the anchor holes is further recommended.

The geotechnical capacity of each rock anchor should be proof tested at the time of construction. More information on testing can be provided upon request. Compressive strength testing is recommended to be completed for the rock anchor grout. A set of grout cubes should be tested for each day grout is prepared.

Soldier Pile and Lagging System

The active earth pressure acting on a soldier pile and lagging shoring system can be calculated using a rectangular earth pressure distribution with a maximum pressure of 0.65 $K \gamma H$ for strutted or anchored shoring or a triangular earth pressure distribution with a maximum value of $K \gamma H$ for a cantilever shoring system. H is the height of the excavation.

The active earth pressure should be used where wall movements are permissible while the at-rest pressure should be used if no movement is permissible.

The total unit weight should be used above the groundwater level while the submerged unit weight should be used below the groundwater level.

The hydrostatic groundwater pressure should be added to the earth pressure distribution wherever the submerged unit weights are used for earth pressure calculations should the level on the groundwater not be lowered below the bottom of the excavation. If the groundwater level is lowered, the total unit weight for the soil should be used full weight, with no hydrostatic groundwater pressure component.

5.4 Pipe Bedding and Backfill

The pipe bedding for sewer and water pipes should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located within the firm grey silty clay, the thickness of the bedding material should be increased to a minimum of 300 mm. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of the material's SPMDD. The bedding material should extent at least to the spring line of the pipe.

The cover material, which should consist of OPSS Granular A, should extend from the spring line of the pipe to at least 300 mm above the obvert of the pipe. The material should be placed in maximum 300 mm thick lifts and compacted to a minimum of 95% of the material's SPMDD.

It should generally be possible to re-use the moist (not wet) brown silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

5.5 Groundwater Control

Groundwater Control for Building Construction

Due to the relatively impervious nature of the silty clay and existing groundwater level, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations.

A temporary MOECC Category 3 permit to take water (PTTW) will be required for this project if more than 50,000 L/day are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MOECC.

The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Long-term Groundwater Control

Our recommendations for the proposed building's long-term groundwater control are presented in Subsection 5.1. Any groundwater which breaches the building's perimeter groundwater infiltration control system will be directed to the proposed building's sump pit. Provided the proposed groundwater infiltration control system and the tanked system are properly implemented and approved by the geotechnical consultant at the time of construction, it is expected that groundwater flow will be very low to negligible (less than 2,000 L/day). A more accurate estimate can be provided at the time of construction, once the pressure relief chamber valve is closed and full hydrostatic pressure is applied to the structure.

5.6 Winter Construction

The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions ice could form within the soil mass. Heaving and settlement upon thawing could occur. Precautions should be taken if winter construction is considered for this project.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner that will avoid the introduction of frozen materials into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. In addition, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure. Additional information could be provided, if required.

6.0 Recommendations

It is recommended that the following be carried out once the master plan and site development are determined:

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Inspection and approval of the installation of the pressure relief chamber.

☐ Inspection of the foundation waterproofing and all foundation drainage systems.

☐ Sampling and testing of the concrete and fill materials placed.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to determine the level of compaction achieved.

☐ Review detailed grading plan(s) from a geotechnical perspective.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by the geotechnical consultant.

7.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request permission to review the grading plan once available. Also, our recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request that we be notified immediately in order to permit reassessment of our recommendations.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Greystone Village Inc., EQ Homes or their agent(s) is not authorized without review by this firm for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Richard Groniger, C. Tech.

Carlos P. Da Silva, P.Eng., ing., QP_{ESA}

Report Distribution

❑ EQ Homes (3 copies)
❑ Paterson Group (1 copy)

APPENDIX 1

METHOD OF SOIL CLASSIFICATION

SYMBOLS AND TERMS

BOREHOLES LOGS BY OTHERS

ATTERBERG LIMITS TEST RESULTS BY OTHERS

CONSOLIDATION TEST RESULTS BY OTHERS

GRAIN SIZE DISTRIBUTION SHEETS BY OTHERS

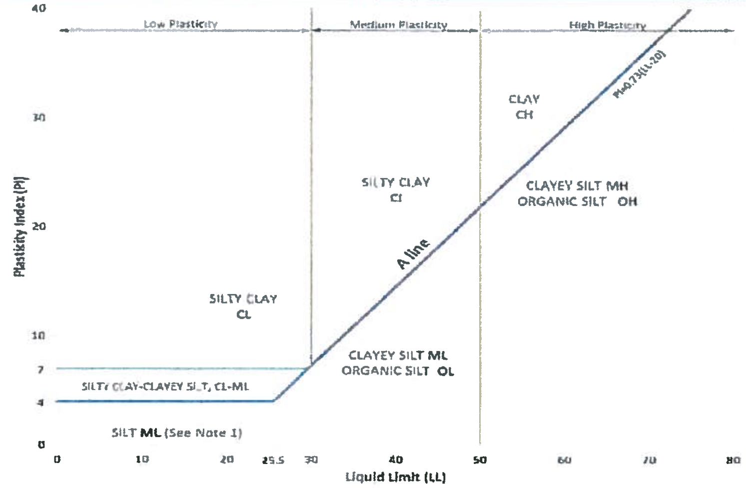
ANALYTICAL TESTING RESULTS

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators					Organic Content	USCS Group Symbol	Primary Name
				Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC ,SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% **(see Note 2)**	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.
Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.
For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.
For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.
A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to indicate a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH:	Sampler advanced by hydraulic pressure
PM:	Sampler advanced by manual pressure
WH:	Sampler advanced by static weight of hammer
WR:	Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
GS	Grab Sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1,2] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.
2. SPT 'N' values should be considered ONLY an approximate guide to consistency; for sensitive clays (e.g., Champlain Sea clays), the N-value approximation for consistency terms does NOT apply. Rely on direct measurement of undrained shear strength or other manual observations.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - u$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index $= (w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index $= (w - w_p) / I_p$
I_C	consistency index $= (w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index $= (e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio $= \sigma'_p / \sigma'_{vo}$

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction $= \tan\delta$
c′	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes:

1 $\tau = c' + \sigma' \tan\phi'$

2 shear strength = (compressive strength)/2

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* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-201

SHEET 1 OF 2

LOCATION: N 5030310.7 ;E 369140.2

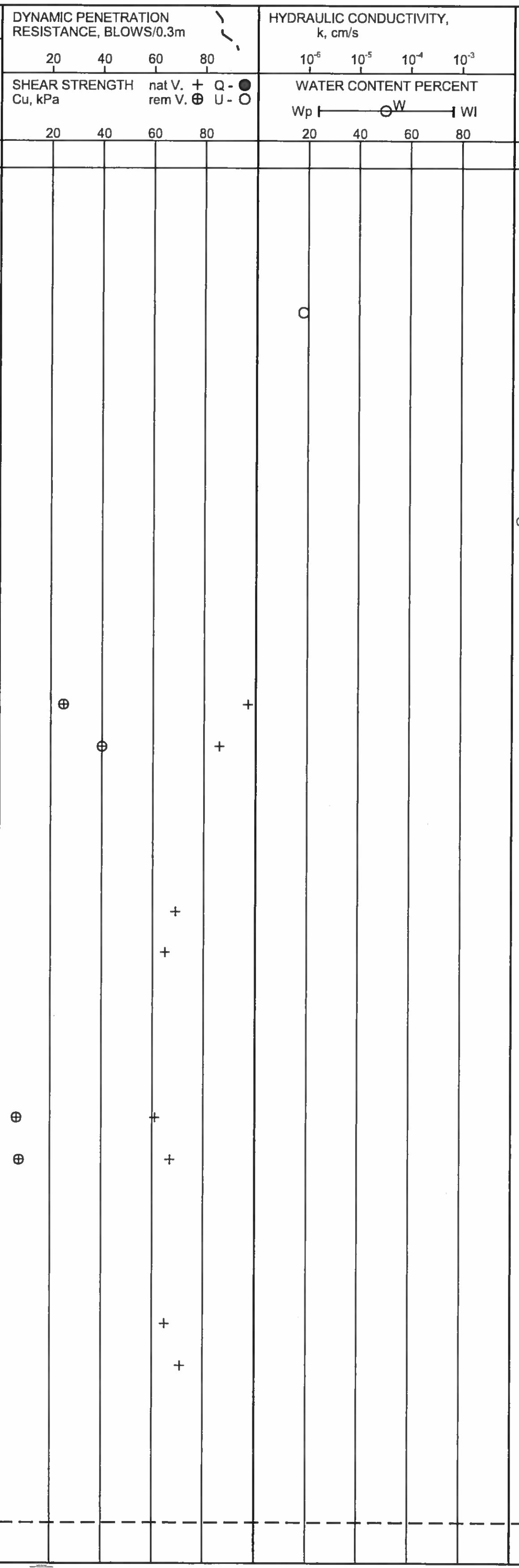
BORING DATE: November 22, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		64.65					
	Power Auger 200 mm Diam. (Hollow Stem)	FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00					
		FILL - (SM) SILTY SAND; brown; non-cohesive, moist, loose to very loose		64.40 0.25					
1					1	SS	7		
					2	SS	4		
2		(ML-CI/CH) SILTY CLAY to CLAYEY SILT, some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff		62.52 2.13					
					3	SS	1	CHEM	
3					4	SS	WH		
		(CL/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, stiff		60.99 3.66					
4									
5					5	SS	WH		
6					6	SS	WH		
7									
8					7	TP	PH		
9					8	SS	WH		
10		CONTINUED NEXT PAGE							



DEPTH SCALE

1 : 50

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-201

SHEET 2 OF 2

LOCATION: N 5030310.7 ;E 369140.2

BORING DATE: November 22, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - O (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp ⊢—O^W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —									
10	Power Auger 200 mm Diam. (Hollow Stem)	(CL/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, stiff	▨					+ +			
11					9	SS	WH				
								⊕ +			
				52.84 11.81							
12		(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, loose	⁘								
					10	SS	6		O	MH	
13											
14					11	SS	7				
				50.32 14.33							
		End of Borehole									
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-202

SHEET 1 OF 3

LOCATION: N 5030280.0 ;E 369146.9

BORING DATE: November 17 & 18, 2016

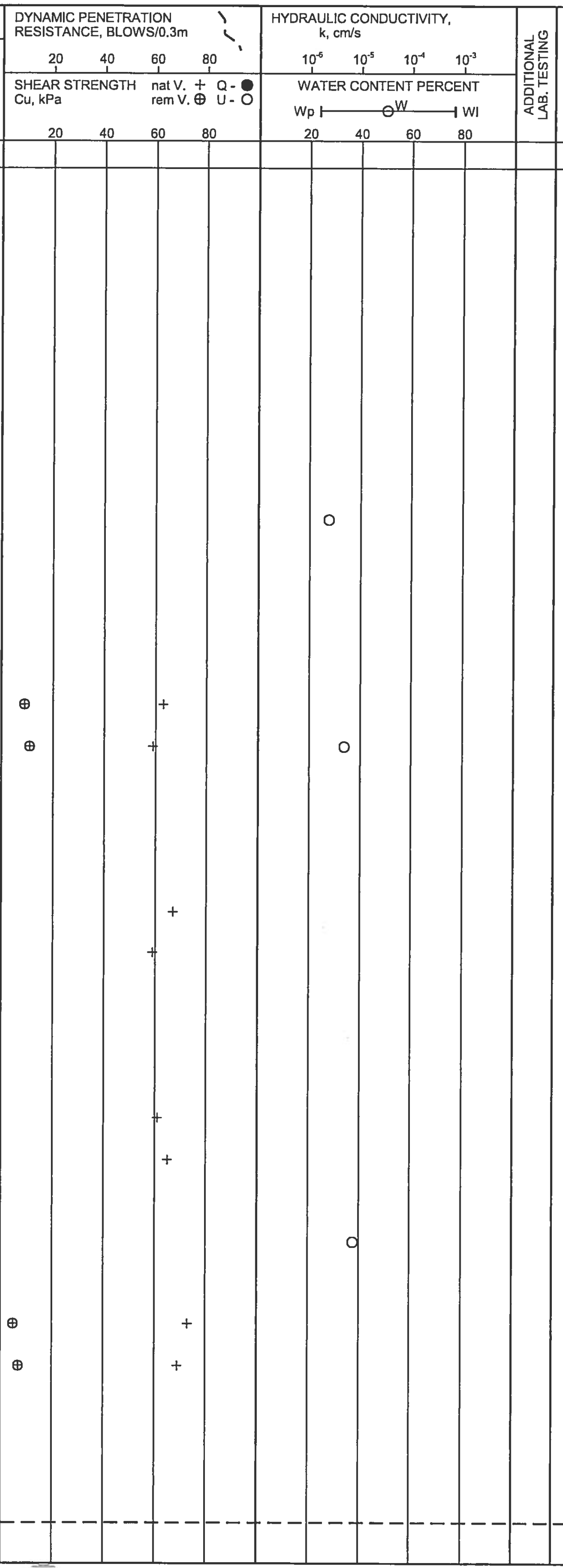
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
		GROUND SURFACE	64.73
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00
		FILL - (SM) SILTY SAND; brown to grey; non-cohesive, moist, loose	0.15
1.52		(CI/CI) SILTY CLAY; grey, with black organic mottling at depth; cohesive, w>PL, stiff to very stiff	63.21 1.52
10		CONTINUED NEXT PAGE	

SAMPLES NUMBER	TYPE	BLOWS/0.30m
1	SS	4
2	SS	9
3	SS	WH
4	SS	WH
5	SS	WH
6	SS	WH
7	SS	WH
8	TP	PH



PIEZOMETER OR STANDPIPE INSTALLATION

MIS-BHS 001 1524337.GPJ GAL-MIS.GDT 1/30/18 JEM/ZS

DEPTH SCALE

1 : 50

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-202

SHEET 2 OF 3

LOCATION: N 5030280.0 ;E 369146.9

BORING DATE: November 17 & 18, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + rem V. ⊕ Q - ● U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Power Auger 200 mm Diam. (Hollow Stem)	(CI/CI) SILTY CLAY; grey, with black organic mottling at depth; cohesive, w>PL, stiff to very stiff	▨					+ +			
11					9	SS	WH		○		
								>96 + >96 +			
12					10	SS	WH				
13	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, compact to very dense	▒	51.78 12.95	11	SS	10		○	M	
14					12	SS	16		○	M	
15					13	SS	22				
17					14	SS	35				
18					15	SS	15				
19					16	SS	39				
20		CONTINUED NEXT PAGE									

MIS-BHS 001 1524337.GPJ GAL-MIS.GDT 1/30/18 JEM/ZS

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-202

SHEET 3 OF 3

LOCATION: N 5030280.0 ;E 369146.9

BORING DATE: November 17 & 18, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80) SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}) WATER CONTENT PERCENT Wp ⊢ ⊖W ⊣ Wl (20, 40, 60, 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m				
		— CONTINUED FROM PREVIOUS PAGE —									
20	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, compact to very dense			16	SS	39				
21											
					17	SS	57				
22											
23					18	SS	56				
24											
					19	SS	69				
25											
				38.80 25.93	20	SS	>50				
26		End of Borehole Sampler Refusal									
27											
28											
29											
30											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-203

SHEET 1 OF 3

LOCATION: N 5030331.4 ;E 369187.5

BORING DATE: November 22-24, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

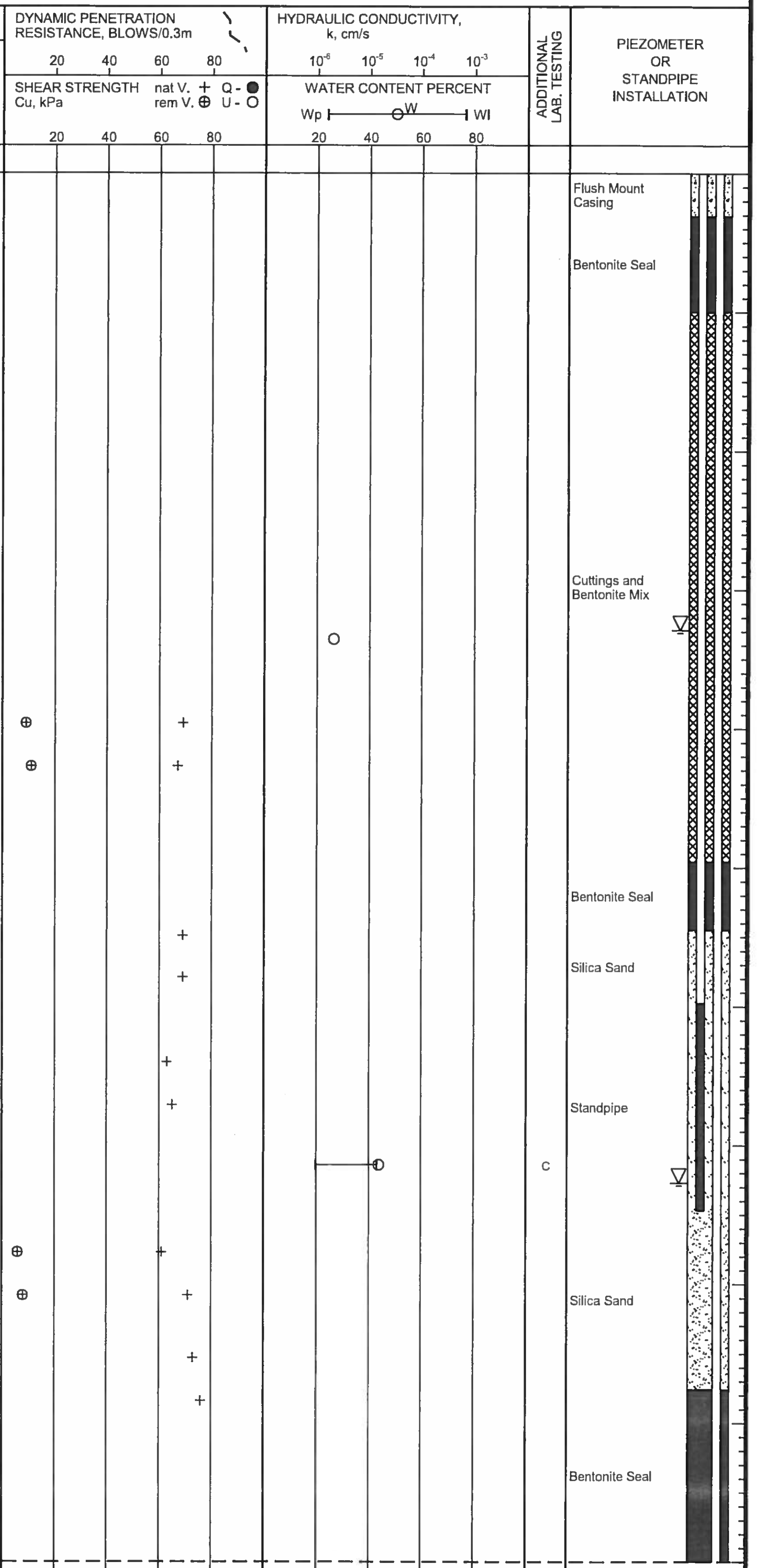
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES: 0 – 10

SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	65.01
ASPHALTIC CONCRETE	0.05
FILL - (SW) gravelly SAND, angular; grey (PAVEMENT STRUCTURE); non-cohesive, moist	64.78 0.23
FILL - (GW) sandy GRAVEL, angular; grey (PAVEMENT STRUCTURE); non-cohesive, moist	64.55 0.46
FILL - (SW) SILTY SAND; brown; non-cohesive, moist, compact	
(CL-ML) SILTY CLAY to CLAYEY SILT, some sand; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff	62.75 2.26
(CL/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, stiff	61.96 3.05

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	GRAB	-	
2	GRAB	-	
3	SS	12	
4	SS	13	
5	SS	WH	
6	SS	WH	
7	SS	WH	
8	TP	PH	C
8A	SS	-	
9	SS	WH	
10	SS	1	



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-203

SHEET 2 OF 3

LOCATION: N 5030331.4 ;E 369187.5

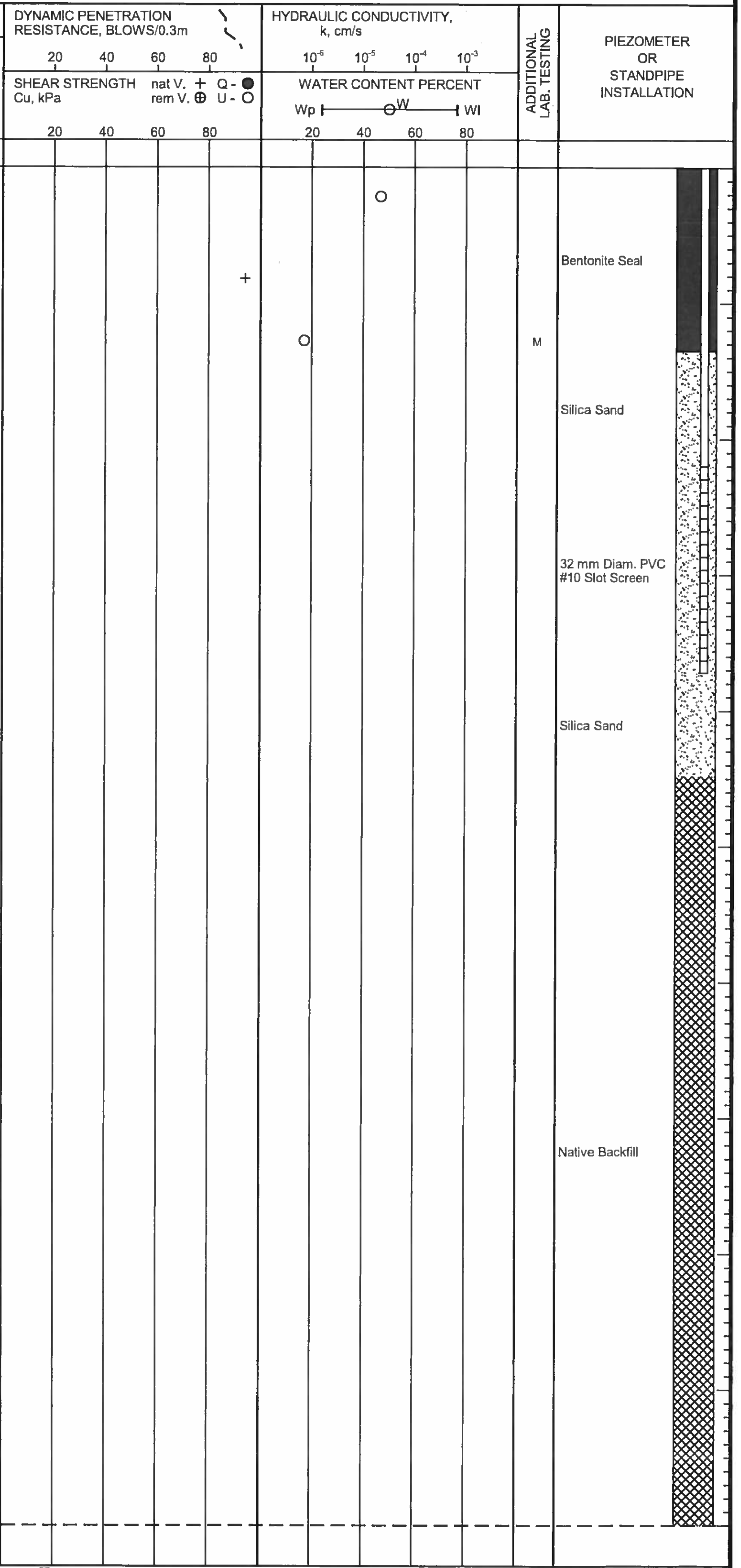
BORING DATE: November 22-24, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —						
10	Power Auger	(CL/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, stiff		10	SS	1		Bentonite Seal
			54.11 10.90					
11	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND, gravelly to 15.24 m depth; grey, contains silty clay seams; non-cohesive, wet, loose to dense		11	SS	12	M	Silica Sand
12				12	SS	29		32 mm Diam. PVC #10 Slot Screen
14				13	SS	33		Silica Sand
15				14	SS	40		
17				15	SS	32		Native Backfill
18				16	SS	40		
20				17	SS	10		
		CONTINUED NEXT PAGE						



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-203

SHEET 3 OF 3

LOCATION: N 5030331.4 ;E 369187.5

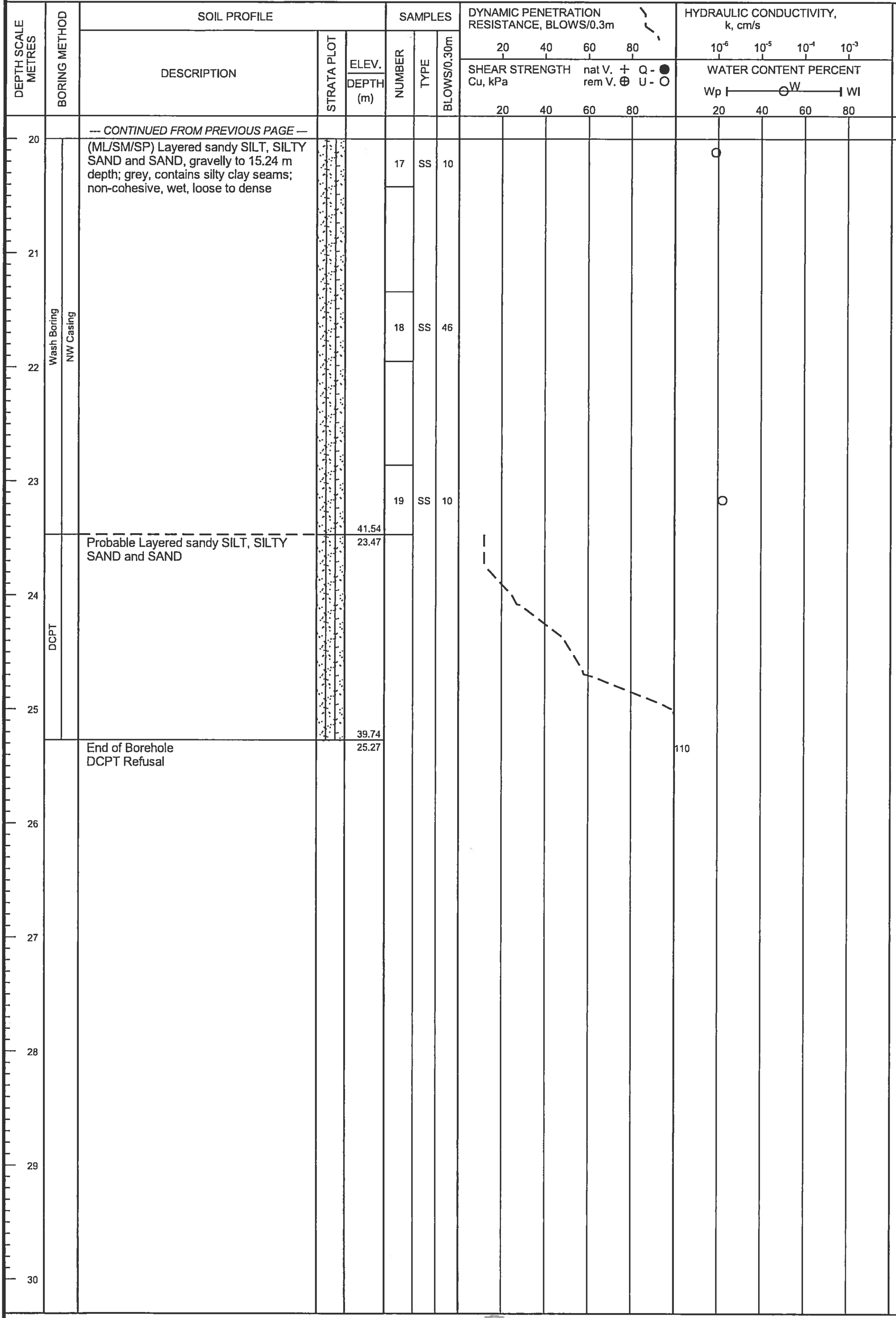
BORING DATE: November 22-24, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---							
20	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND, gravelly to 15.24 m depth; grey, contains silty clay seams; non-cohesive, wet, loose to dense			17	SS	10	M	
					18	SS	46		
					19	SS	10	M	Native Backfill
	DCPT	Probable Layered sandy SILT, SILTY SAND and SAND		41.54 23.47					
		End of Borehole DCPT Refusal		39.74 25.27					WL in Standpipe at Elev. 61.72 m on Dec. 21, 2016 WL in Screen at Elev. 57.74 m on Dec. 21, 2016



DEPTH SCALE

1 : 50

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-204

SHEET 1 OF 2

LOCATION: N 5030298.8 ;E 369197.3

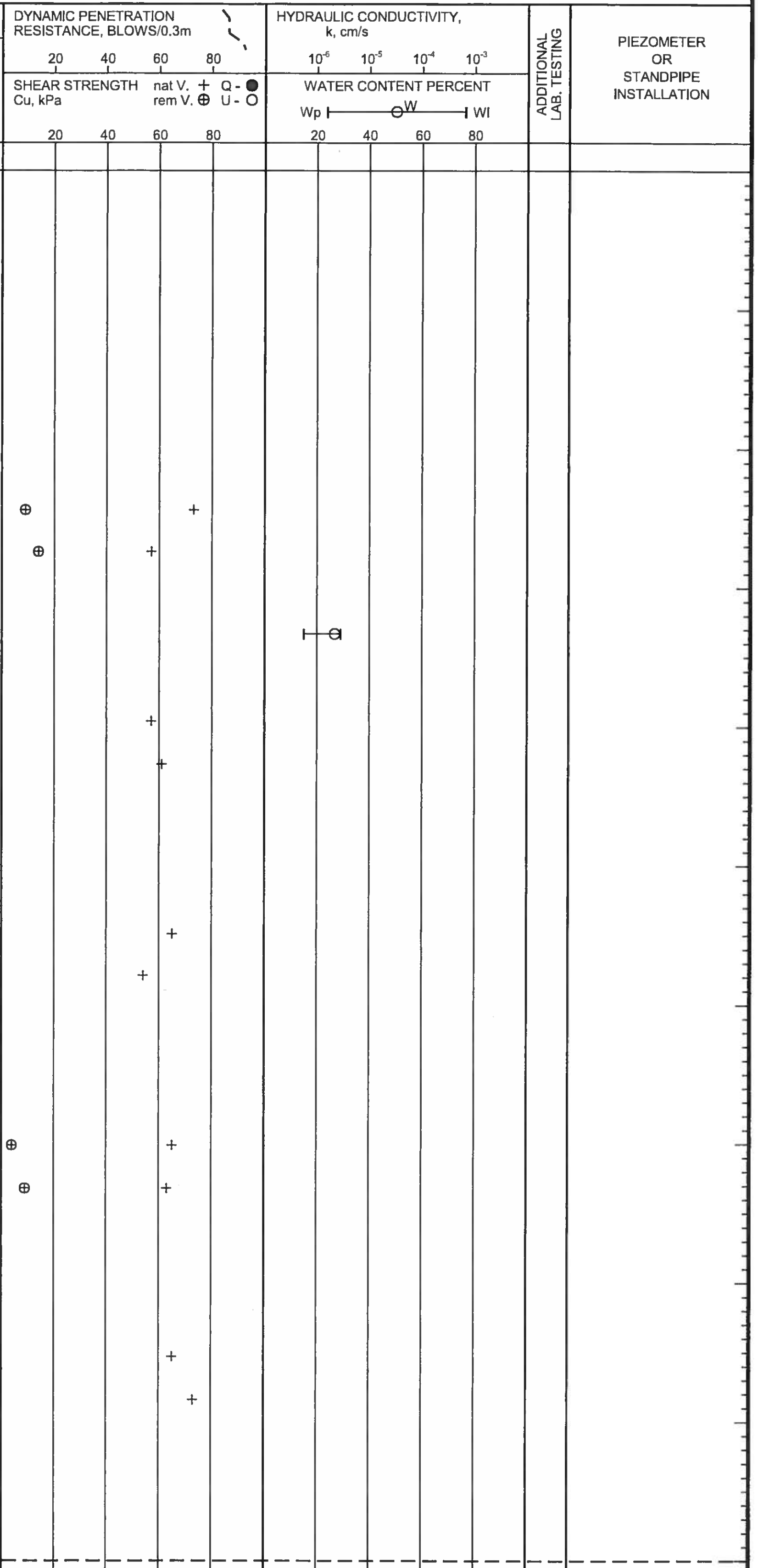
BORING DATE: November 16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m
		GROUND SURFACE	65.11			
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist	0.00			
		FILL - (SM) SILTY SAND; brown; non-cohesive, moist, loose	0.15			
1				1	SS	6
				2	SS	8
2		(CL/CI) SILTY CLAY; grey, with black organic mottling at depth; cohesive, w>PL, stiff	63.13 1.98			
3				3	TP	PH
4						
5				4	SS	WH
6				5	SS	WH
7						
8				6	SS	WH
9				7	SS	WH
10		*CONTINUED NEXT PAGE*				



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-204

SHEET 2 OF 2

LOCATION: N 5030298.8 ;E 369197.3

BORING DATE: November 16, 2016

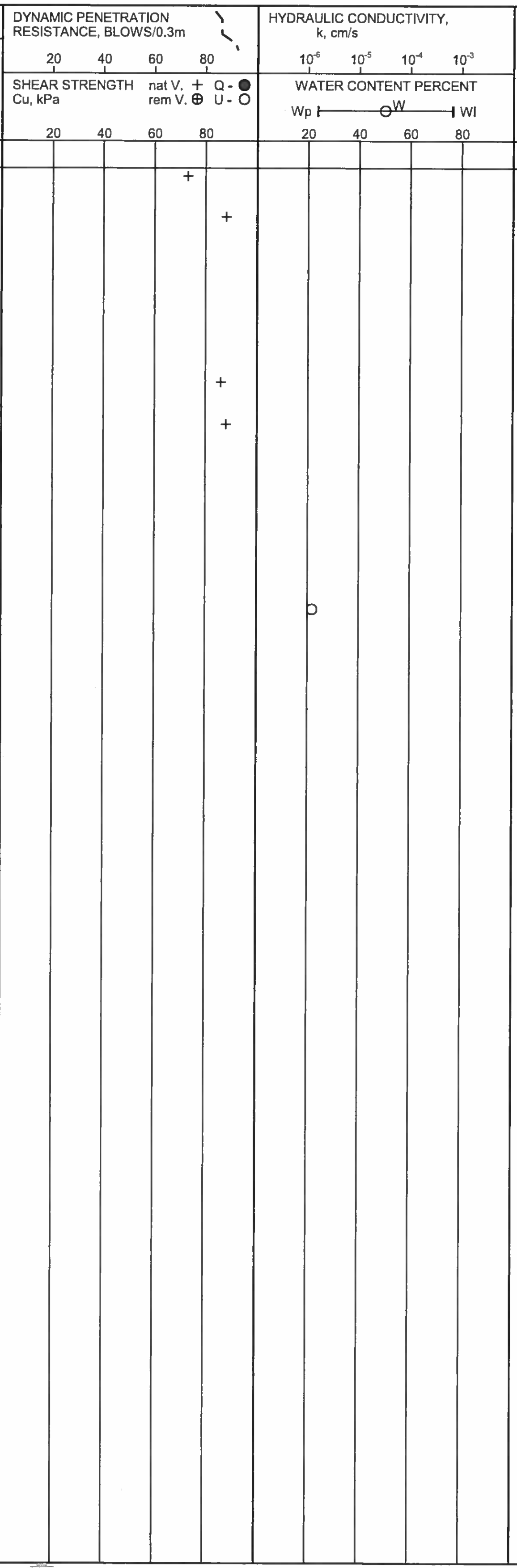
DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10	Power Auger 200 mm Diam. (Hollow Stem)	(CL/CI) SILTY CLAY; grey, with black organic mottling at depth; cohesive, w>PL, stiff	▨						
11					8	SS	WH		
12		(SP) SAND, trace non-plastic fines; grey; non-cohesive, wet, loose	░	53.07 12.04	9	SS	7		
13					10	SS	9	MH	
		End of Borehole		51.55 13.56					
14									
15									
16									
17									
18									
19									
20									



DEPTH SCALE
1 : 50

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-205

SHEET 1 OF 2

LOCATION: N 5030347.2 ;E 369213.0

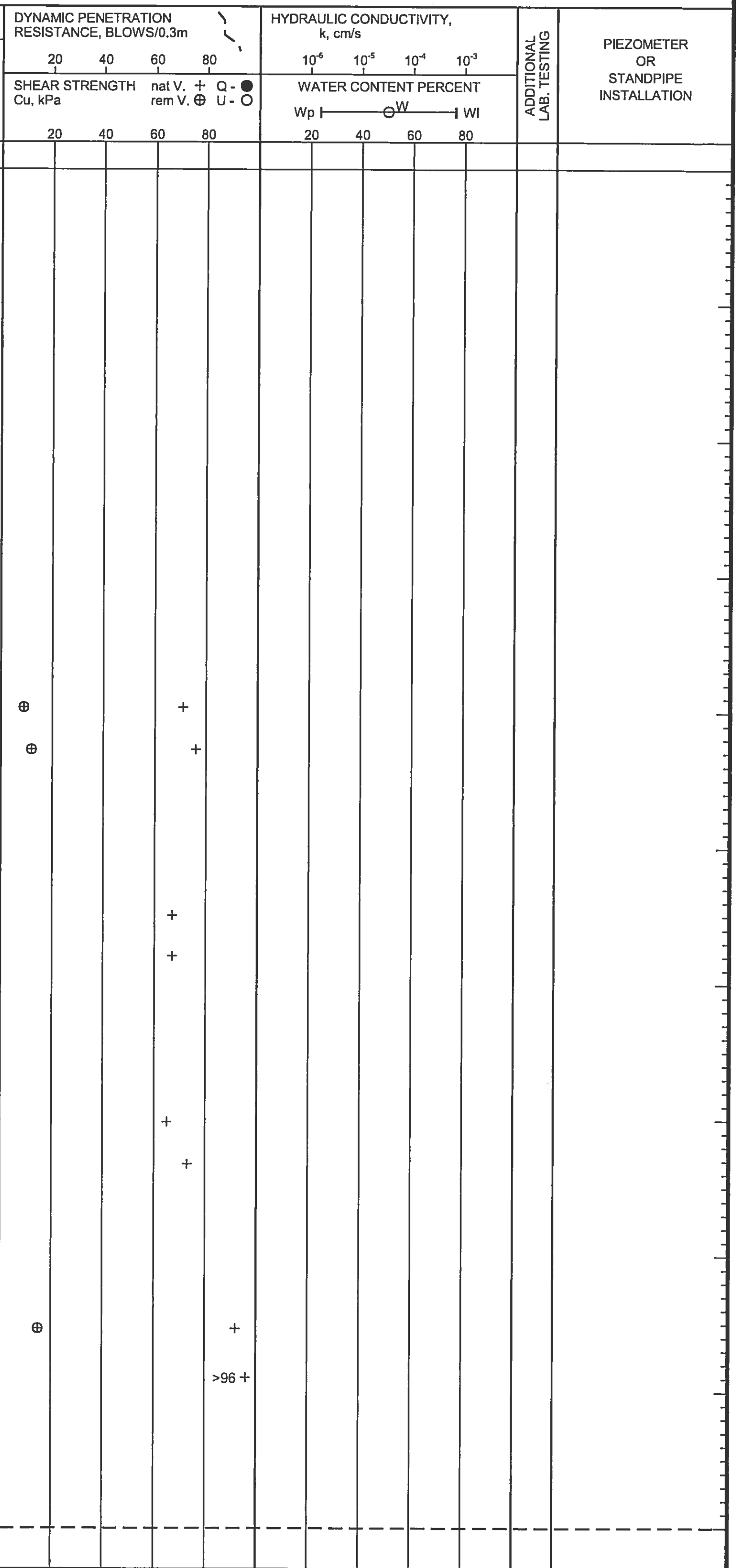
BORING DATE: November 16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m
0	Power Auger 200 mm Diam. (Hollow Stem)	GROUND SURFACE		64.86			
		FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist	▩	0.00			
		FILL - (SM) SILTY SAND; brown; non-cohesive, moist, compact	▩	0.15			
1					1	SS	14
					2	SS	11
2		(CL-ML) SILTY CLAY to CLAYEY SILT, some sand; brown to grey (WEATHERED CRUST); cohesive, w>PL, stiff	▨	62.88 1.98			
					3	SS	WH
3		(CL/CI) SILTY CLAY; grey with black organic mottling; cohesive, w>PL, stiff to very stiff	▨	61.81 3.05			
					4	SS	WH
4							
5					5	TP	PH
6					6	SS	WH
7							
8					7	SS	WH
9							
		(SP) SAND, trace non-plastic fines; grey; non-cohesive, wet, compact	░	55.72 9.14			
					8	SS	14
10					9	SS	11



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-205

SHEET 2 OF 2

LOCATION: N 5030347.2 ;E 369213.0

BORING DATE: November 16, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —									
10	Power Auger	(SP) SAND, trace non-plastic fines; grey; non-cohesive, wet, compact		54.34	9	SS	11		○	M	
		End of Borehole		10.52							
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-206

SHEET 1 OF 2

LOCATION: N 5030312.4 ;E 369233.5

BORING DATE: November 18 & 21, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m
0	GROUND SURFACE	64.82 0.00			
	FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist				
	FILL - (SM) SILTY SAND; brown to grey; non-cohesive, moist, compact	64.64 0.18			
1			1	SS	10
	(CL-ML) SILTY CLAY to CLAYEY SILT, some sand; grey; cohesive, w>PL, very stiff	63.30 1.52	2	SS	4
2	(CL/CI) SILTY CLAY, trace sand; grey, with black organic mottling at depth; cohesive, w>PL, stiff to very stiff	62.53 2.29	3	SS	1
4			4	TP	PH
6			5	SS	WH
8			6	SS	WH
9			7	SS	2
10		54.94 9.88			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

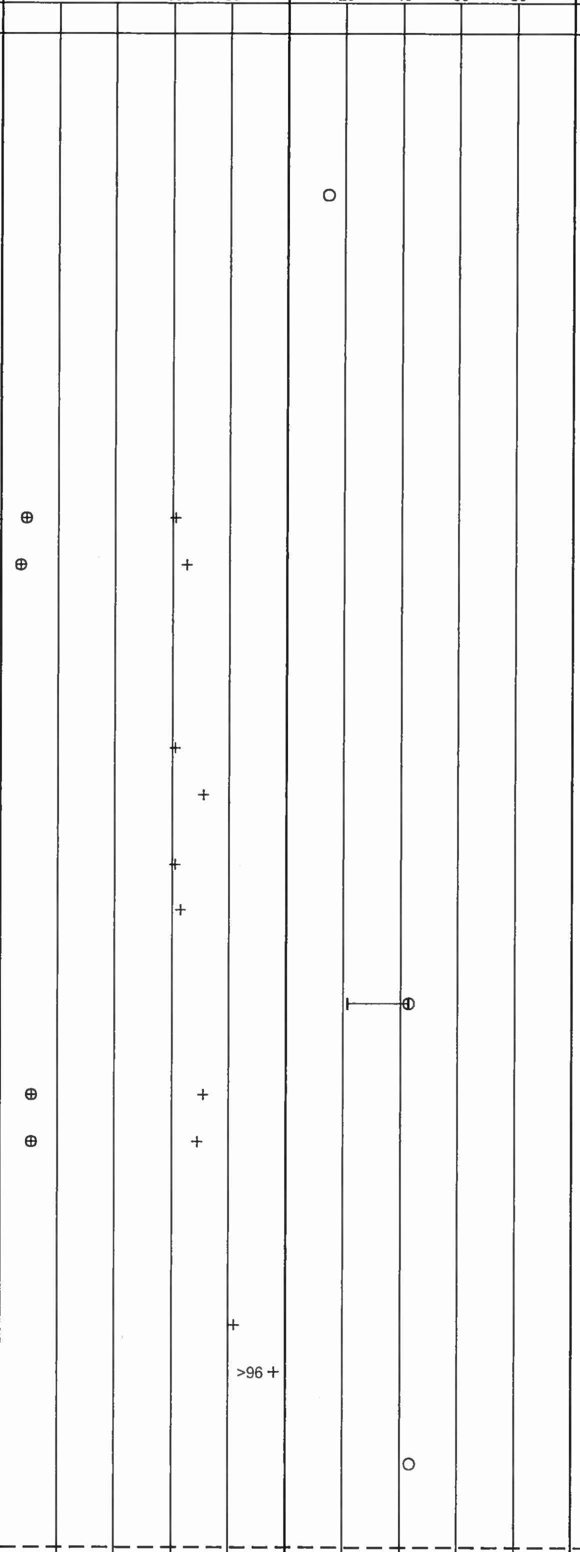
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



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DEPTH SCALE
1 : 50

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-206

SHEET 2 OF 2

LOCATION: N 5030312.4 ;E 369233.5

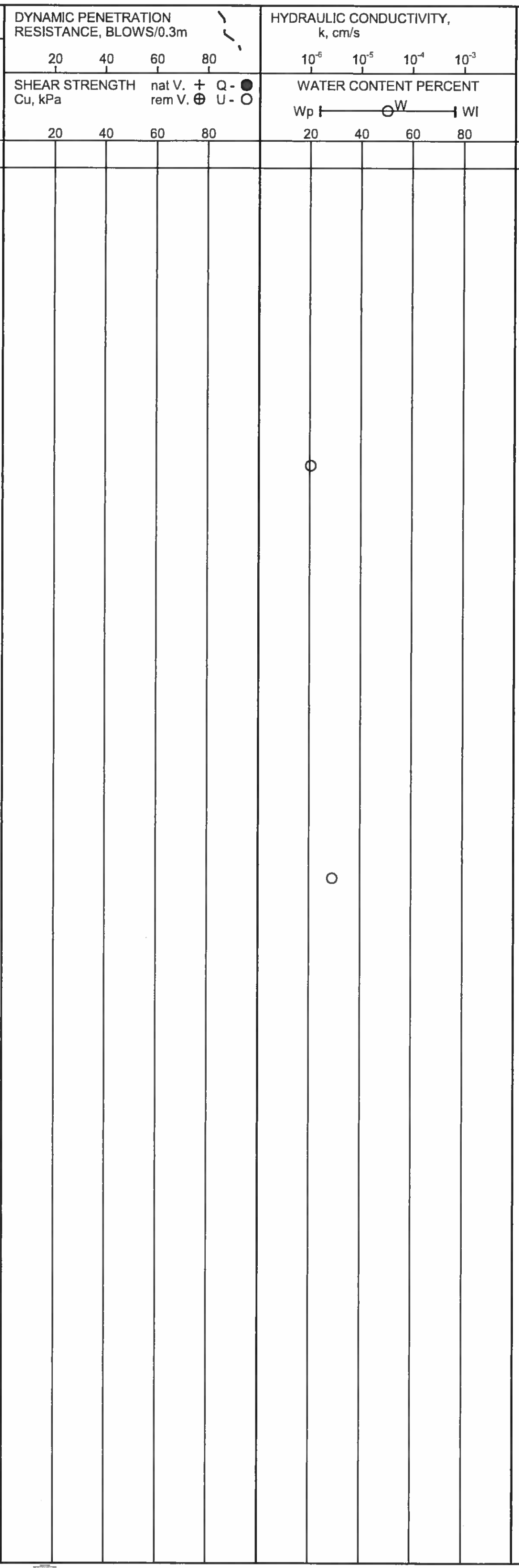
BORING DATE: November 18 & 21, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —						
10	Wash Boring BW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, loose to dense						
				8	SS	35		
11								
12				9	SS	29		
13								
				10	SS	18		
14								
15				11	SS	6	MH	
16								
		Probable Layered sandy SILT, SILTY SAND and SAND	48.36 16.46					
				12	SS	21		
17								
		End of Borehole	46.99 17.83					
18								
19								
20								



DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-207

SHEET 1 OF 3

LOCATION: N 5030352.9 ;E 369228.2

BORING DATE: November 24 & 28, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		64.95							
0	Power Auger 200 mm Diam. (Hollow Stem)	FILL/TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00							
		FILL - (SM) SILTY SAND; brown; non-cohesive, moist, loose to compact		64.67 0.28							
1					1	SS	6				
					2	SS	11				
2		(CL/CI) SILTY CLAY; grey, with black organic mottling; cohesive, w>PL, stiff to very stiff		62.88 2.07							
					3	SS	WH				
3					4	SS	WH				
4								⊕ +			
								⊕ +			
5					5	SS	WH				
								+			
								+			
6					6	TP	PH				
7								>96 +			
								>96 +			
8					7	SS	WH				
	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, compact to dense		56.47 8.48							
9					8	SS	19				
10											

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-207

SHEET 2 OF 3

LOCATION: N 5030352.9 ;E 369228.2

BORING DATE: November 24 & 28, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES			DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m 20 40 60 80 SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 20 40 60 80	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m				
		— CONTINUED FROM PREVIOUS PAGE —									
10	Wash Boring NW Casing	(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, compact to dense									
11					9	SS	25				
12											
					10	SS	24				
13											
14					11	SS	22				
15											
					12	SS	39				
16											
17					13	SS	35				
18											
					14	SS	39				
19											
				45.14 19.81	15	SS	3				
20											
		CONTINUED NEXT PAGE									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SAT

PROJECT: 1524337-5000

RECORD OF BOREHOLE: 16-207

SHEET 3 OF 3

LOCATION: N 5030352.9 ;E 369228.2

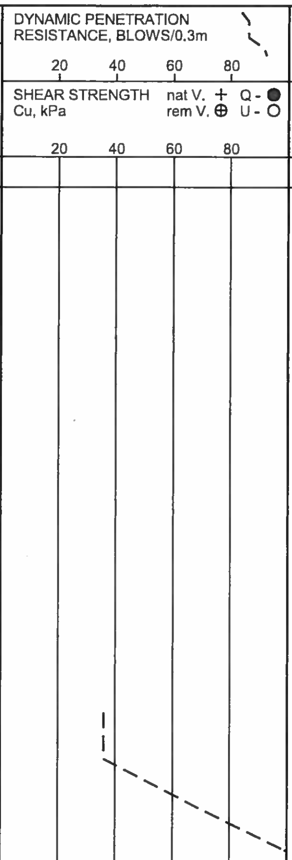
BORING DATE: November 24 & 28, 2016

DATUM: CGVD28

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		— CONTINUED FROM PREVIOUS PAGE —							
20	Wash Boring NW Casing	(ML/SM) SILT, some sand; grey; non-cohesive, wet, very loose		15	SS	3	O	M	
21		(ML/SM/SP) Layered sandy SILT, SILTY SAND and SAND; grey; non-cohesive, wet, very dense to compact	43.62 21.33	16	SS	67			
22–23				17	SS	24			
		Probable Layered sandy SILT, SILTY SAND and SAND	41.48 23.47						
24		End of Borehole DCPT Refusal	40.56 24.39						



HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—O^W—⊣ Wl: 20 40 60 80

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SAT

PROJECT: 14-1122-0005-5100

RECORD OF BOREHOLE: 14-208

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: July 30-31, 2014

DATUM: Geodetic

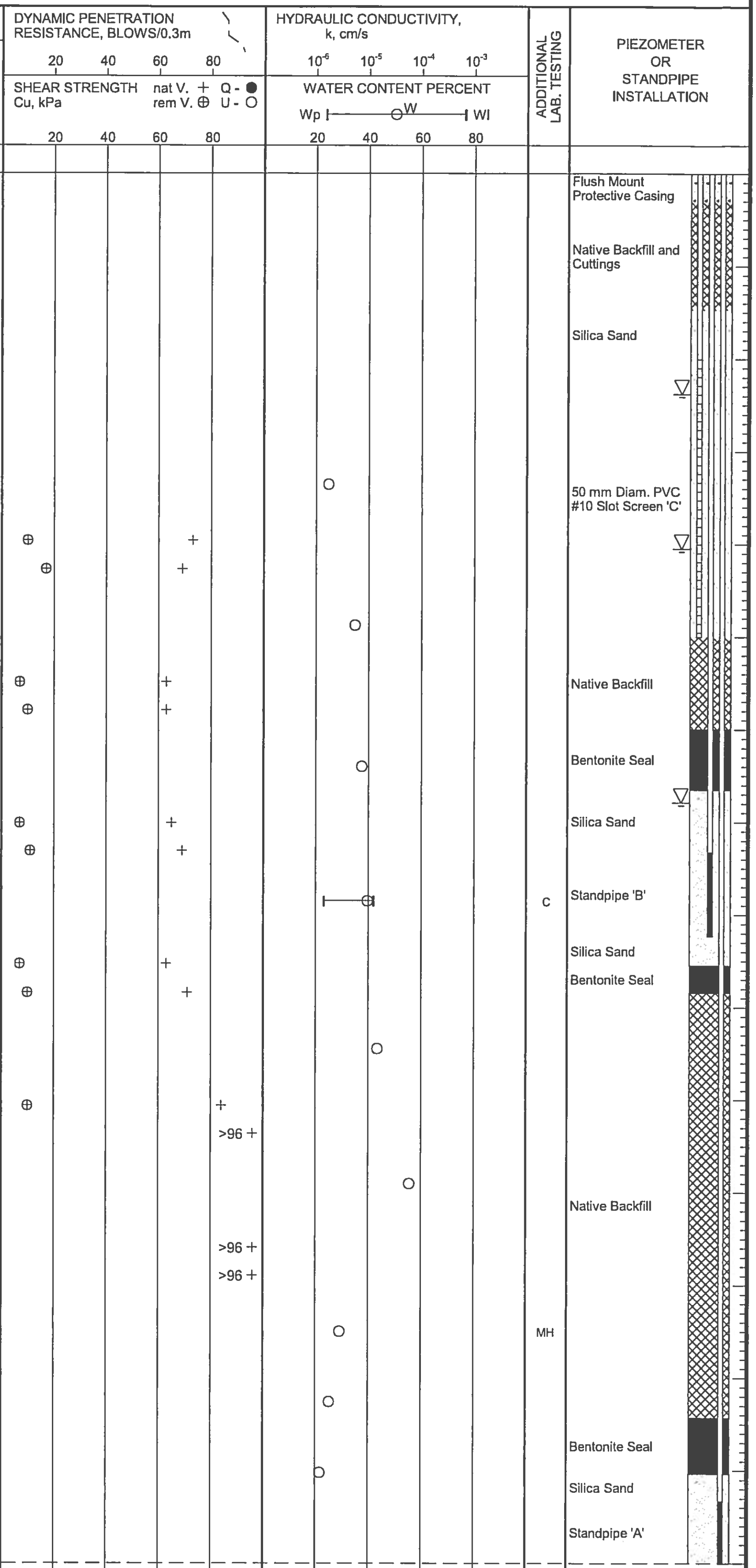
SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	64.97
FILL - (SM) SILTY SAND; brown; non-cohesive, dry, loose	0.00
FILL - (SM) SILTY SAND; light brown, with clayey silt seams; non-cohesive, moist, loose	64.36 0.61
(SM) SILTY SAND; brown; non-cohesive, moist to wet, loose	63.75 1.22
(CI/CL) SILTY CLAY; grey brown (WEATHERED CRUST); cohesive, w>PL, stiff	63.14 1.83
(CL-ML) SILTY CLAY to CLAYEY SILT; grey, with black mottling and streaks; cohesive, w>PL, stiff	62.53 2.44
(CI) SILTY CLAY; grey, with black mottling; cohesive, w>PL, stiff	60.40 4.57
(CI/CH) SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff	54.61 10.36
(SM) SILTY SAND, fine; grey, with clayey silt seams; non-cohesive, wet, very loose to loose	52.78 12.19
(SM) SILTY SAND, fine; grey; non-cohesive, wet, compact	51.25 13.72

SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	5	
2	SS	6	
3	SS	8	
4	SS	1	
5	SS	PM	
6	SS	PM	
7	SS	PM	
8	TP	PH	C
9	SS	PM	
10	TP	PH	
11	SS	PM	MH
12	SS	5	
13	SS	23	



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DEPTH SCALE 1 : 75

Golder Associates

LOGGED: DWM

CHECKED: CK

PROJECT: 14-1122-0005-5100

RECORD OF BOREHOLE: 14-208

SHEET 2 OF 2

LOCATION: See Site Plan

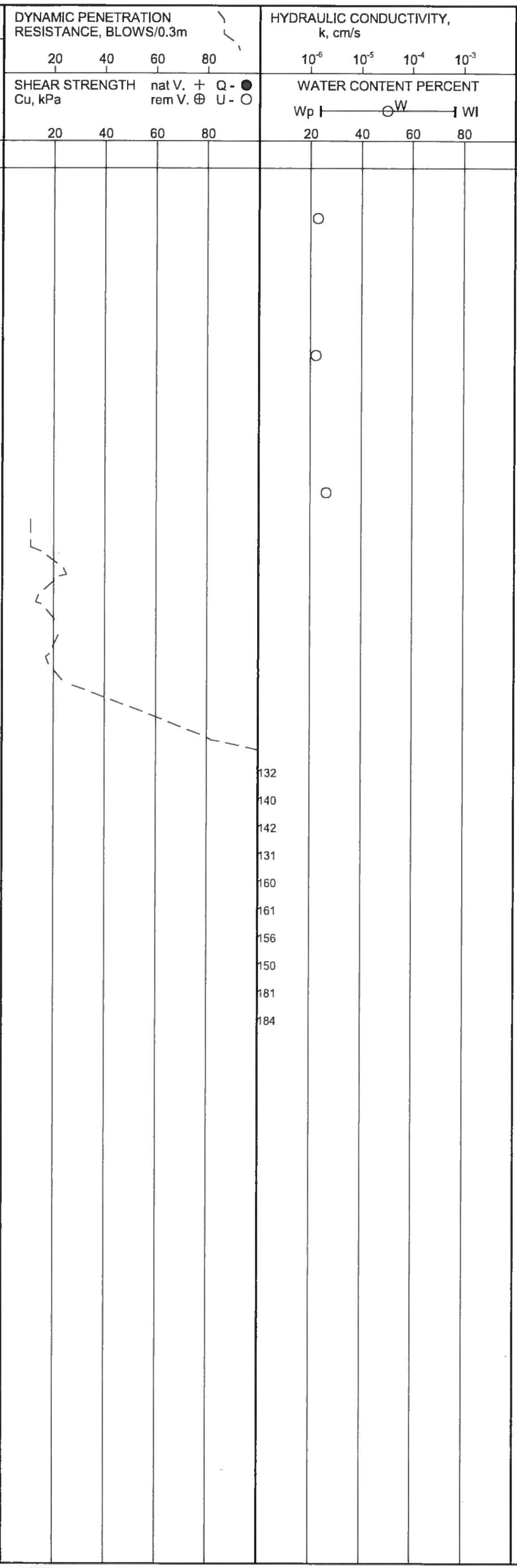
BORING DATE: July 30-31, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
		— CONTINUED FROM PREVIOUS PAGE —						
15	Power Auger 200 mm Diam. (Hollow Stem)	(SM) SILTY SAND, fine; grey; non-cohesive, wet, compact						
					14	SS	22	
17					15	SS	21	
18					16	SS	17	
19	DCPT	Possible Silty Sand		46.08 18.89				
21		Possible Glacial Till		44.24 20.73				
24		End of Borehole Dynamic Cone Penetration Test Refusal		40.59 24.38				



PIEZOMETER OR STANDPIPE INSTALLATION

Standpipe 'A'

Silica Sand

Bentonite Seal

Cave

WL in Standpipe 'A' at Elev. 58.18 m on Sept. 9, 2014

WL in Standpipe 'B' at Elev. 60.92 m on Sept. 9, 2014

WL in Screen 'C' at Elev. 62.59 m on Sept. 9, 2014

MIS-BHS 001 1411220005-5000.GPJ GAL-MIS.GDT 12/12/14 JM

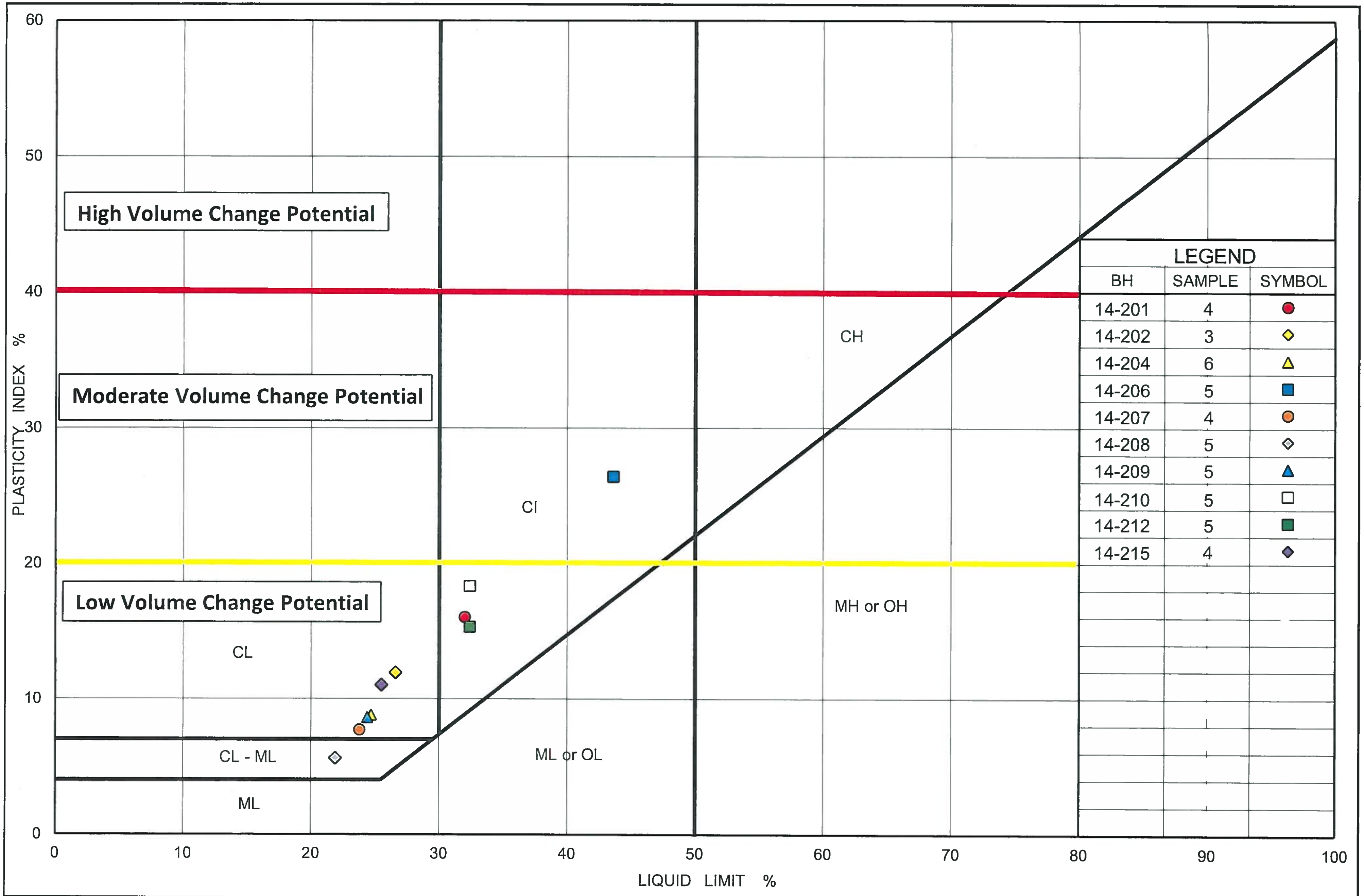
DEPTH SCALE

1 : 75

Golder Associates

LOGGED: DWM

CHECKED: CK



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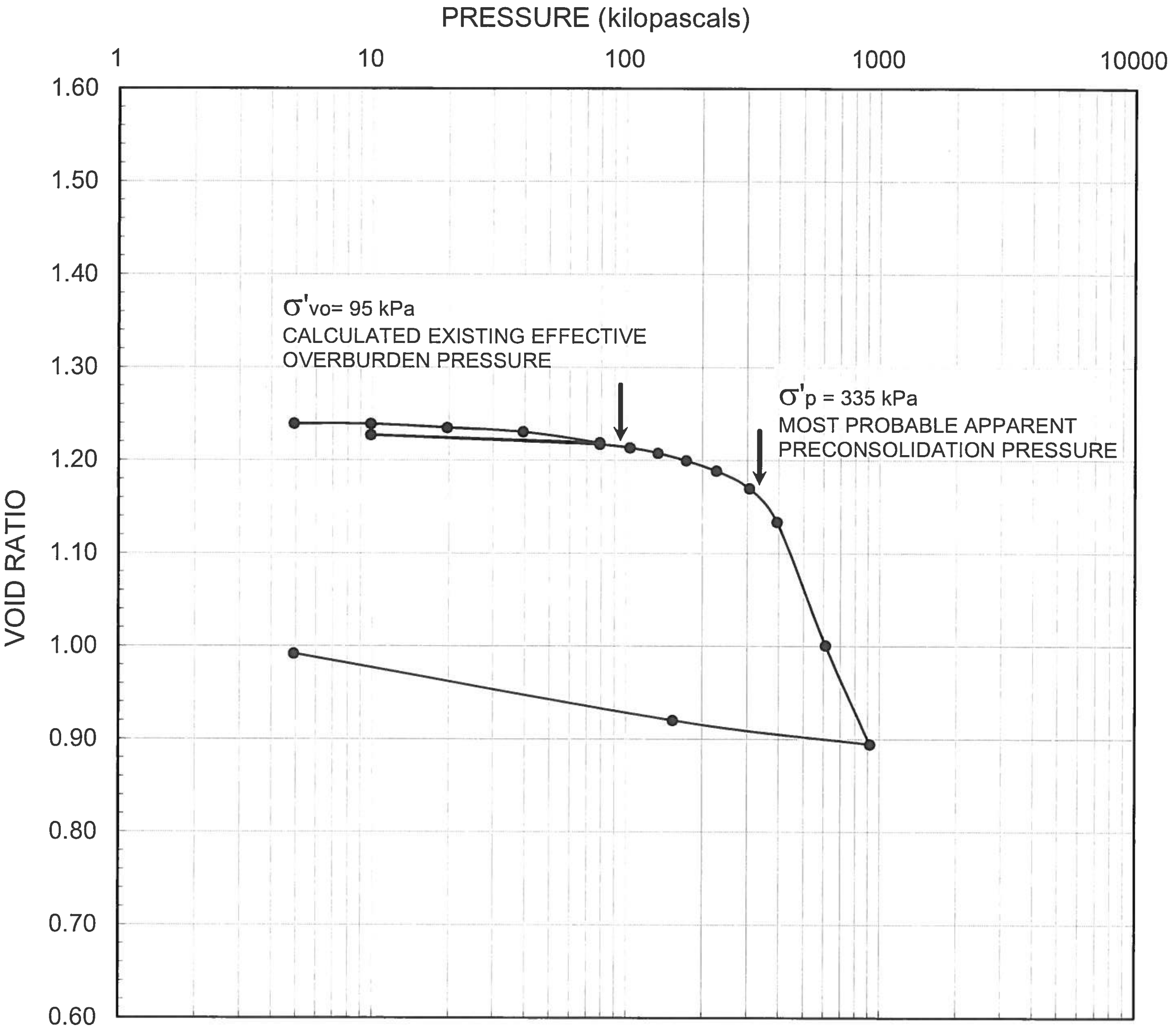
PLASTICITY CHART
Oblates Development

Figure No. 1

Project No. 14-1122-0005

Checked By: SAT

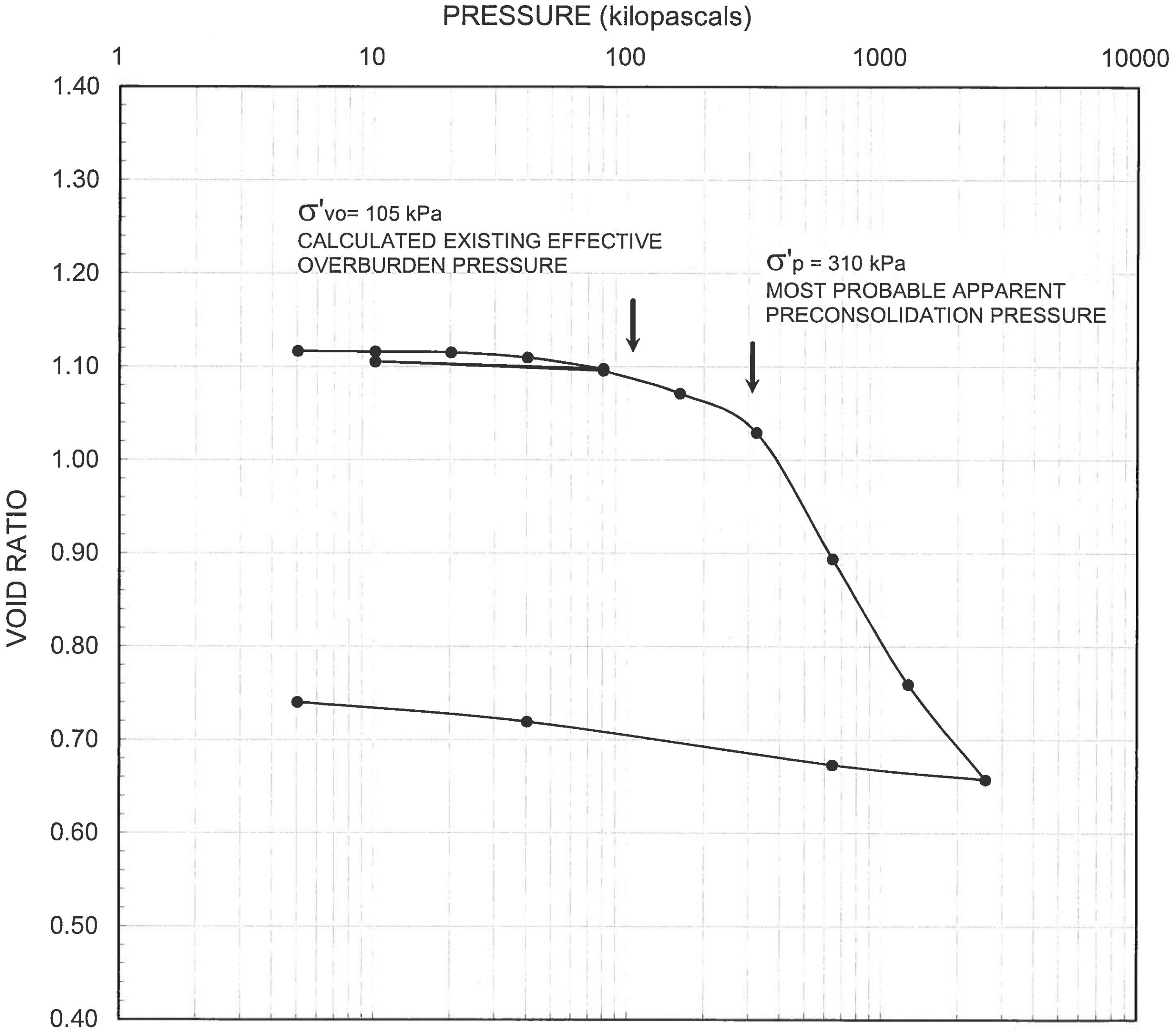


LEGEND

Borehole:	16-203	w_i = 44%	S_o = 99%	γ = 17.6 kN/m³
Sample:	8	w_f = 35%	e_o = 1.24	G_s = 2.80
Depth (m):	7.3	w_l = 43%	C_c = 0.69	
Elevation (m):	57.7	w_p = 20%	C_r = 0.011	

Golder Associates

SCALE	AS SHOWN	TITLE	
DATE	09/29/17		
CADD	N/A	**CONSOLIDATION TEST RESULTS**	
ENTERED	MI		
FILE No. Consolidation summary	CHECK	CNM	
PROJECT No. 1524337 /5000 REV. 1	REVIEW	SAT	FIGURE 2



LEGEND

Borehole: 14-208 w_i = 40% S_o = 98% γ = 17.9 kN/m³

Sample: 8 w_f = 27% e_o = 1.12 G_s = 2.78

Depth (m): 7.9 w_l = 42% C_c = 0.45

Elevation (m): 57.1 w_p = 23% C_r = 0.010

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SCALE AS SHOWN

DATE 12/10/14

CADD N/A

ENTERED CW

CHECK CNM

REVIEW CK

FILE No. Consolidation summary

PROJECT No. 14-1122-0005 REV. 2

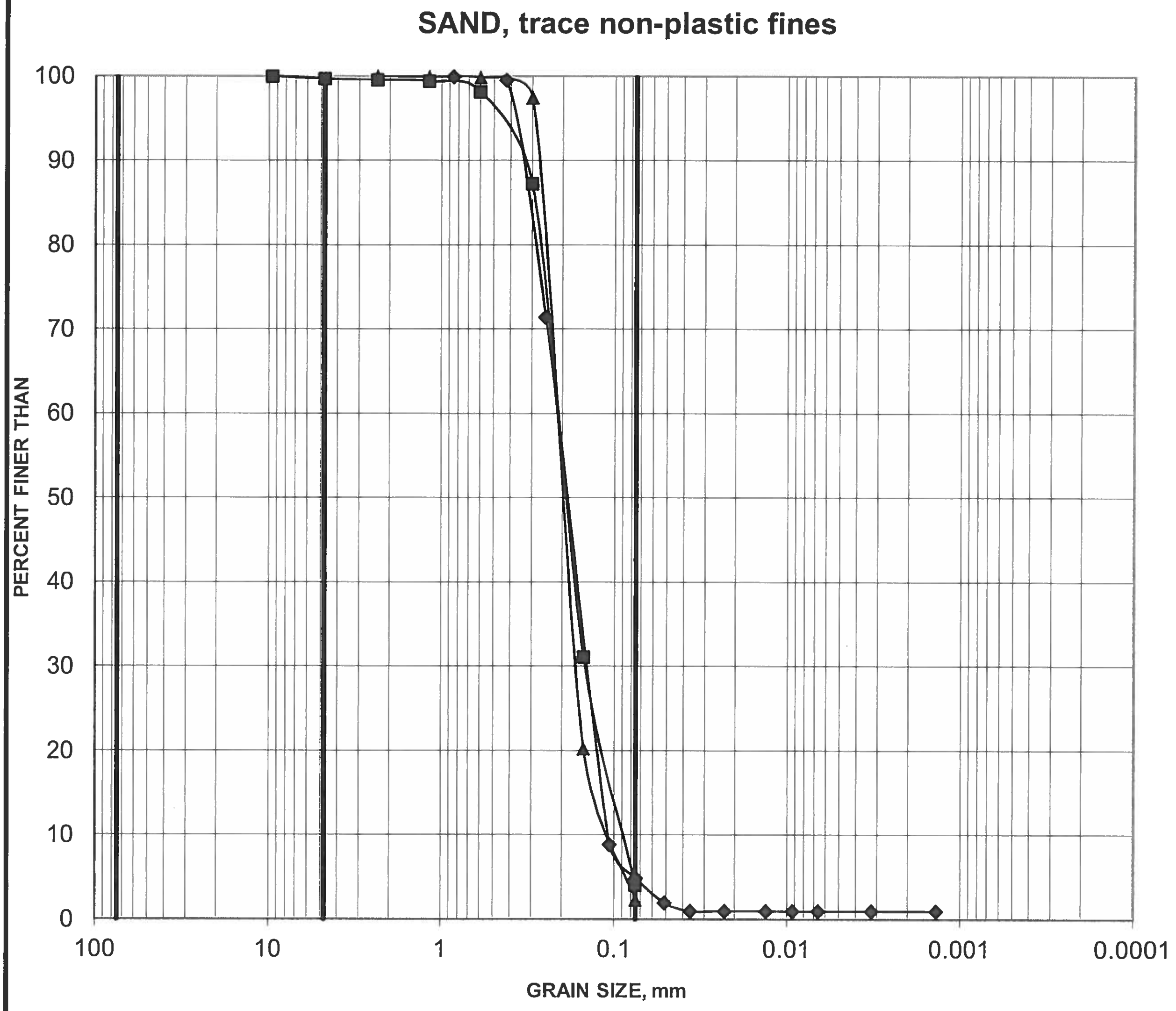
TITLE

CONSOLIDATION TEST RESULTS

FIGURE 7

GRAIN SIZE DISTRIBUTION

FIGURE 3



<table>
<tr><td>Cobble</td><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td><td rowspan="2">SILT AND CLAY</td></tr>
<tr><td>Size</td><td colspan="2">GRAVEL SIZE</td><td colspan="3">SAND SIZE</td></tr>
</table>

Borehole	Sample	Depth (m)
■ 16-202	12	13.72-14.33
◆ 16-204	10	12.95-13.56
▲ 16-205	9	9.91-10.52

Project: 1524337 /5000

Golder Associates

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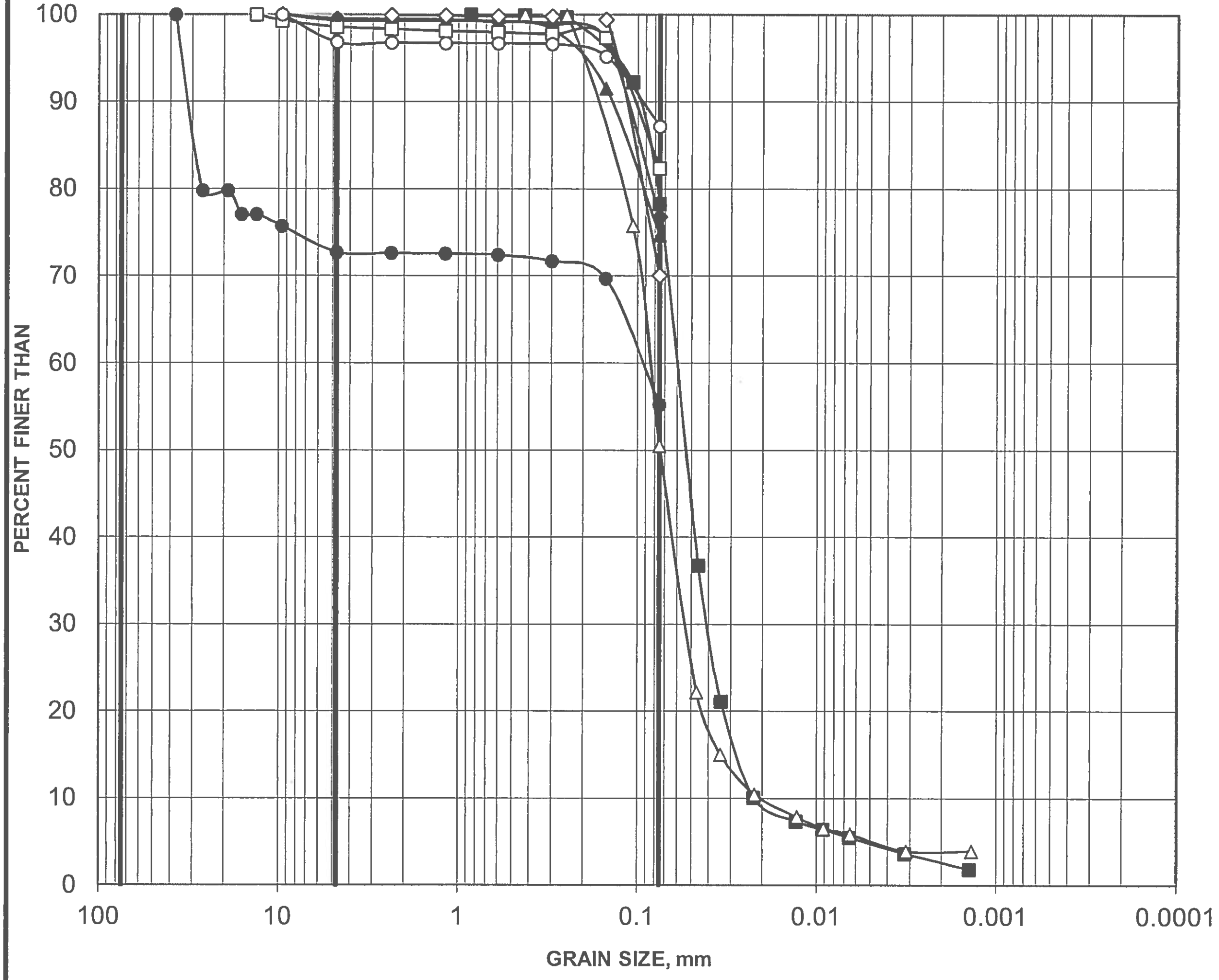
Checked by: CNM

GRAIN SIZE DISTRIBUTION

FIGURE 4

SANDY SILT to SILT, some sand



Cobble	coarse	fine	coarse	medium	fine	SILT AND CLAY
Size	GRAVEL SIZE		SAND SIZE			

Borehole	Sample	Depth (m)
■ 16-201	10	12.20-12.80
◆ 16-202	11	12.95-13.56
▲ 16-202	15	18.29-18.90
● 16-203	11	15.24-15.85
□ 16-203	17	19.81-20.42
◇ 16-203	19	22.86-23.47
△ 16-206	11	13.41-14.02
○ 16-207	15	19.81-20.42

Project: 1524337 /5000

Golder Associates

Created by: MI
Checked by: CNM

eurofins | Environment Testing

Certificate of Analysis

Client: Golder Associates Ltd. (Ottawa)
1931 Robertson Road
Ottawa, ON
K2H 5B7
Attention: Ms. Susan Trickey
PO#:
Invoice to: Golder Associates Ltd. (Ottawa)

Report Number: 1700269
Date Submitted: 2017-01-06
Date Reported: 2017-01-13
Project: 1524337
COC #: 814751

				Lab I.D.	1276618	1276619	1276620
				Sample Matrix	Soil	Soil	Soil
				Sample Type			
				Sampling Date	2016-11-22	2016-11-15	2016-11-10
				Sample I.D.	16-201 sa3	16-208 sa2	16-212 sa2
Group	**Analyte**	**MRL**	**Units**	**Guideline**			
Agri. - Soil	pH	2.0			7.1	7.9	7.3
General Chemistry	Cl	0.002	%		0.034	0.004	0.013
	Electrical Conductivity	0.05	mS/cm		0.78	0.17	0.36
	Resistivity	1	ohm-cm		1280	5880	2780
	SO4	0.01	%		0.01	<0.01	<0.01

Guideline = *** = Guideline Exceedence**

All analysis completed in Ottawa, Ontario (unless otherwise indicated by ** which indicates analysis was completed in Mississauga, Ontario).
Results relate only to the parameters tested on the samples submitted.
Methods references and/or additional QA/QC information available on request.

MRL = Method Reporting Limit, AO = Aesthetic Objective, OG = Operational Guideline, MAC = Maximum Acceptable Concentration, IMAC = Interim Maximum Acceptable Concentration, STD = Standard, PWQO = Provincial Water Quality Guideline, IPWQO = Interim Provincial Water Quality Objective, TDR = Typical Desired Range

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURE 2 - PRESSURE RELIEF CHAMBER

DRAWING PG4404-1 - TEST HOLE LOCATION PLAN

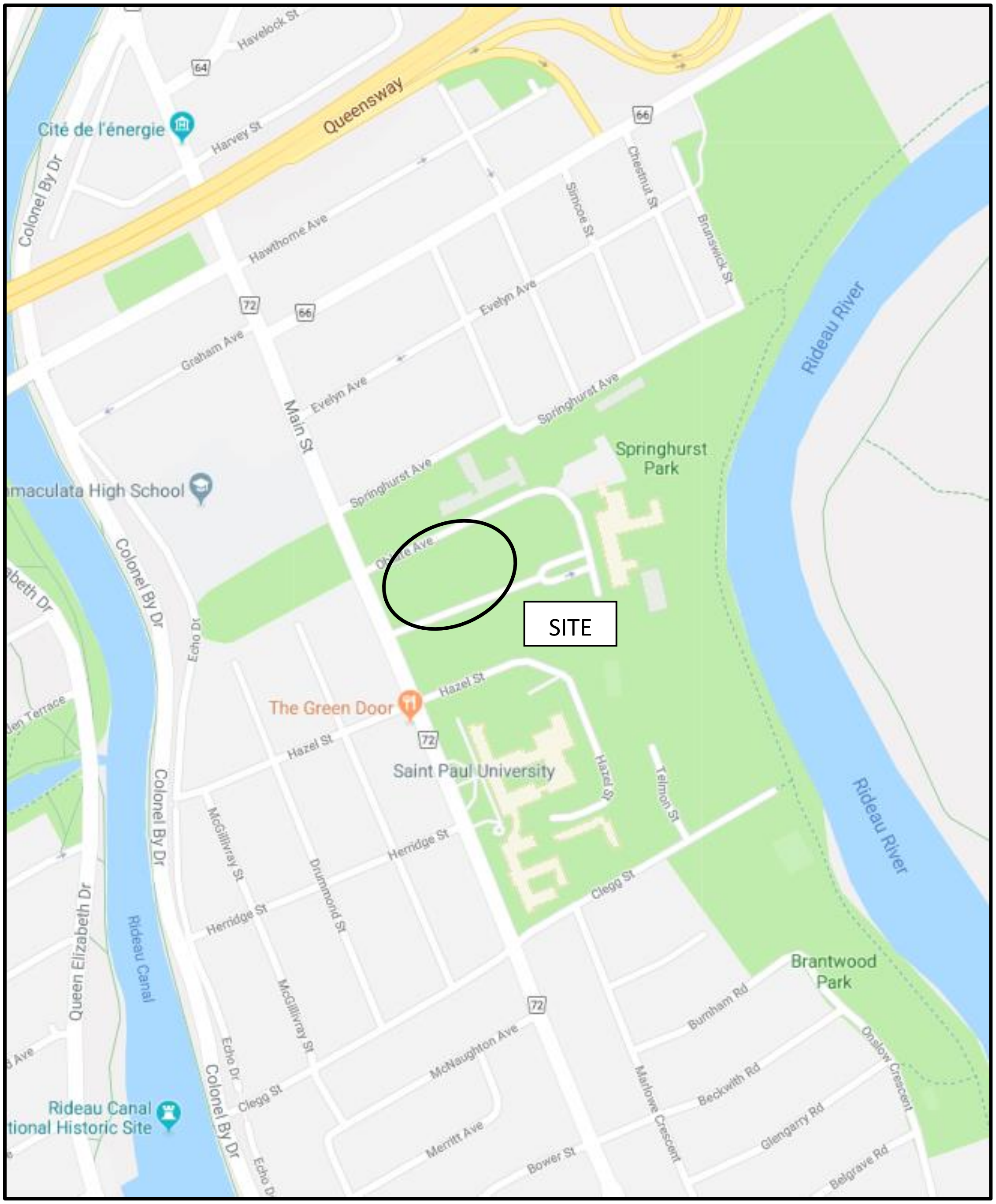


FIGURE 1

KEY PLAN

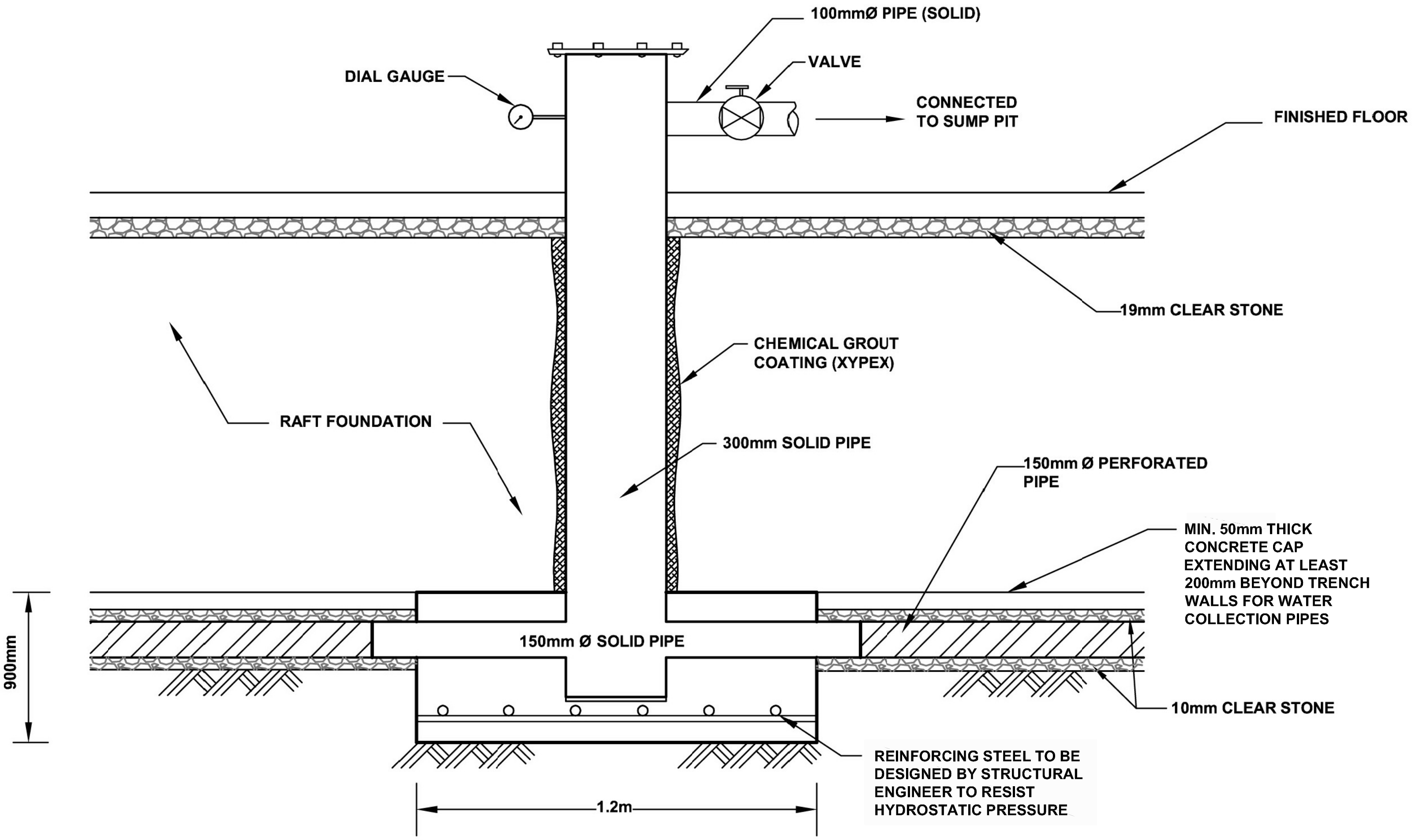


FIGURE 2 - PRESSURE RELIEF CHAMBER

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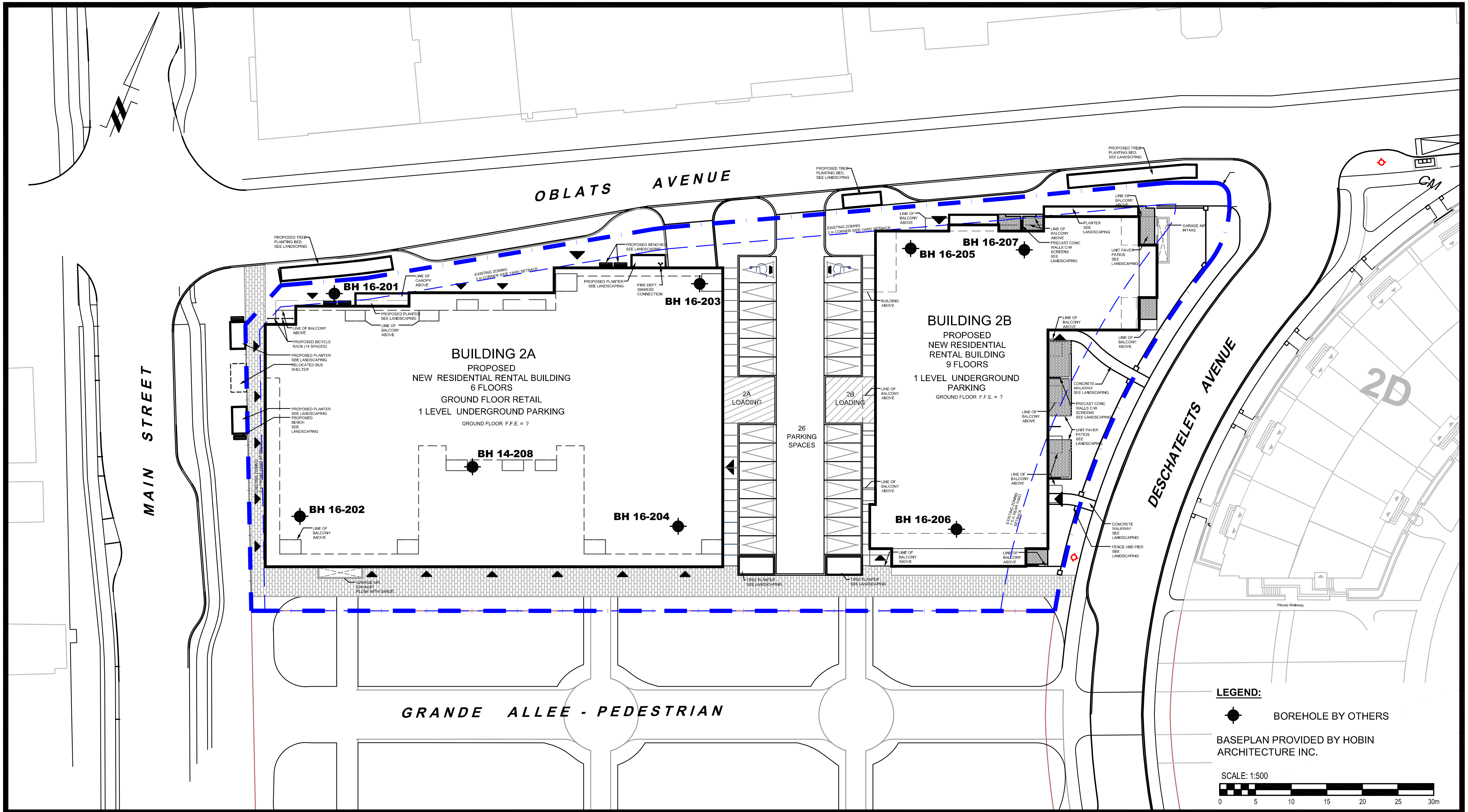
consulting engineers

p:\autocad drawings\details\pressure relief chamber.dwg



LEGEND:

● BOREHOLE BY OTHERS

BASEPLAN PROVIDED BY HOBIN ARCHITECTURE INC.

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
0			

GREYSTONE VILLAGE DEVELOPMENT

GEOTECHNICAL INVESTIGATION
BUILDING 2A AND 2B - 175 MAIN STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 02/2018
Drawn by: RCG	Report No.: PG4404-1
Checked by: RG	Dwg. No.: PG4404-1
Approved by: DJG	Revision No.: 0

drawing1.dwg