GEOTECHNICAL INVESTIGATION

WOOLWICH BIO EN INC. FACILITY
ELMIRA, ONTARIO

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1.0 INTRODUCTION

Conestoga-Rovers & Associates (CRA) has prepared this Geotechnical Investigation Report for the proposed renewable energy generation facility to be located at 15 Martins Lane in the Town of Elmira, Ontario, known as the Woolwich Bio-En. Inc. Facility (Site). The Geotechnical Investigation Report is based on interpretation of data collected by Chung & Vander Doelen Engineering Ltd. (CVD) and CRA.

The Site development will include:

- Three lined, reinforced concrete digester tanks varying between 24 and 28 metres (m) in diameter. The base of the tanks will lie at an elevation of approximately 360.0 m above mean sea level (AMSL) and be constructed with 8.3-m tall concrete walls and domed "coverall" type roofs reaching to elevations between 375.5 to 377.5 m AMSL.
- Four 8-m diameter, 8.4-m tall, reinforced concrete pretreatment and water tanks and four 4.3-m diameter, ±14-m tall storage tanks will be constructed on the respective south and east sides of a ±43-m by ±29-m receiving/processing building which will be constructed north of the three large digester tanks. The base of the pretreatment and water tanks will lie at an elevation of approximately 360.0 m AMSL. The base of the other four storage tanks will lie at elevations of approximately 361.8 m AMSL. The finished floor level of the receiving/processing building will lie between elevations of approximately 362.4 and 363.0 m AMSL.
- An additional slab-on-grade service building (±32 m by ±10 m) will be constructed in the northeast corner of the development. The finished floor is proposed at an elevation of approximately 363.0 m AMSL.
- A storm water management (SWM) pond will be constructed in the southwest corner of the development Site. The bottom of the SWM pond is expected near an elevation of approximately 354.0 m AMSL.
- A 260-cubic-metre (m^3) capacity water reservoir for fire fighting will be constructed below grade in the southeast corner of the development.
- Asphalt pavement is proposed for the Site traffic routes.

Substantial re-grading is proposed for the development of the Site. Lowering of the existing Site grades by as much as 3 m is proposed in the north and central areas of the Site while up to 2 m of fill is proposed in the southern portion of the Site. The fill areas are anticipated to be constructed as engineered fill.

The proposed development is designated as being a Liquid Nutrient Storage Facility and, therefore, the various process and storage tanks will be constructed in accordance with the provisions established in Ontario Regulation 267/03 made under the Nutrient Management Act {2002).

The purpose of the geotechnical investigation was to characterize the footprint area of tanks associated with a liquid nutrient storage facility.

The report is structured as follows:

Section 1.0 Introduction
Section 2.0 Field Work
Section 3.0 Laboratory Testing
Section 4.0 Existing Site Conditions
Section 5.0 Subsurface Conditions
Section 6.0 Discussion and Recommendations
Section 7.0 Closing Remarks

2.0 FIELD WORK

The field work at the Site was completed in two events. The first event was completed by CVD between July 28 and August 3, 2011 in the field and laboratory. The second event was completed by CRA on October 6, 2011 in the field and Inspec-Sol Inc. in the laboratory.

Underground utility locates were completed prior to commencing the field work program.

During the first field event, ten boreholes were drilled and sampled to depths between 6.55 and 14.32 m below ground surface (bgs) during the period of July 28 to August 3, 2011. The locations of the boreholes are shown on Figure 1. A member of the CVD engineering team provided oversight for the investigation activities during this first field event. The CVD oversight logged the boreholes in the field, and collected appropriate subsurface soil samples.

The boreholes during the first field event were advanced to the sampling depths using a power auger drilling rig equipped with continuous flight hollow stem augers and standard soil sampling equipment. Standard Penetration Tests (SPTs) in accordance with ASTM Specification D 1586-99, were carried out at frequent intervals of depth. The un-drained shear strength of the cohesive soil deposits were determined on the slightly disturbed SPT samples using a field pocket penetrometer. In situ shear vane testing was also performed. These test results are shown on the Borehole Logs as Penetration Resistance or "N"-values and shear strengths. The compactness condition or consistency of the soil strata have been inferred from these test results.

Piezometer were installed at BH-3, BH-4, BH-5, and BH-6 within the fine-grained material of the Surficial Aquitard (SAT) to allow monitoring of the groundwater levels over time. The groundwater levels in the piezometer wells were measured on August 5, 11, and 17, 2011 and are reported on the respective borehole logs in Appendix A as well as in Table 1.

During the second field event, three boreholes were advanced in the vicinity of BH-3, BH-4, and BH-5, to collect samples for additional geotechnical parameters on October 6, 2011. The locations of the boreholes are shown on Figure 1. Drilling activities were performed by Altech Ltd. Drilling and Investigative Services from Elmira, Ontario under the supervision of CRA. Boreholes were advanced using Direct-push technologies (Geoprobe™) to produce a 97 millimeter diameter borehole and completed to the required depths. A member of CRA provided oversight for the investigation activities during this second field event. The CRA oversight collected subsurface soil samples from depths corresponding to elevations of 360 metres above mean sea level (m AMSL). One Shelby tube sample was collected from each location, BH-3, BH-4, and BH-5 at depths of 2.5 m, 3.5 m, 2.0 m, respectively. One soil sample was also collected at depths below the Shelby tube at each of the borehole locations BH-3, BH-4, and BH-5 and analyzed for grain size distribution including hydrometer to separate and quantify the amount silt and clay.

At completion of field work, the boreholes were backfilled in accordance with Ontario Regulation 903.

The locations of the boreholes were established after the first field event by CVD. The ground surface elevations were surveyed by CVD and were referenced to a geodetic datum.

Geologic cross-sections of the Site are included on Figures 1, 2, 3, and 4.

3.0 LABORATORY TESTING

Soil samples obtained from the in situ tests performed by CVD during the period of July 28 and August 3, 2011 were examined in the field and subsequently brought to the CVD laboratory for tactile examination and moisture content determination. Laboratory testing included four gradational analyses, two Standard Proctor tests, and two Atterberg Limit tests.

Soil samples obtained from the in situ tests performed by CRA on October 6, 2011 were examined in the field (by CRA) and subsequently brought to the Inspec-Sol laboratory in Waterloo, Ontario for tactile examination and moisture content determination. Additional laboratory testing included on all three samples were: triaxial permeability testing using ASTM D5084-03, grain size analyses including hydrometer using ASTM 422-63, and Atterberg Limit tests using ASTM D4318.

The results for the grain size distribution tests are provided in Table 2 and in Appendix B. The permeability test results are provided in Table 3 and in Appendix C. The Standard Proctor test results are provided in Table 4 and in Appendix D.

4.0 EXISTING SITE CONDITIONS

The Site is located on the north side of Martin's Lane at its east end and currently exists as a cornfield. A relatively small metal clad building and shed are located at the southwest corner of the Site.

The proposed development Site is generally bounded by cropland to the north, east and south. An industrial facility exists to the west side of the Site.

The Site is topographically high in the north portion of the Site at an approximate elevation of 365 m AMSL and generally slopes downwards to the southwest corner of the Site at an approximate elevation of 358 m AMSL.

A previous soil extraction area (bounded by suspected stripped topsoil piles) was apparent in the central east portion of the future development Site and extended to an approximate elevation of 361.5 m AMSL.

5.0 SITE GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

The subsurface conditions encountered at the Site are detailed on the borehole logs (BH-1 to BH-10), provided in Appendix A, and detailed in the Geologic Cross-Sections provided on Figures 1 to 4.

As shown on the geological cross-sections provided on Figures 1 to 4, the upper 15 m of overburden- is characterized as the Surficial Aquitard (SAT) which corresponds to the Tavistock Till comprised of primarily silt, and clayey silt deposits.

The Surficial Aquitard corresponds to the Tavistock Till and is comprised primarily of silt and clayey silt deposits with an upper part of coarser deposits of sandy silt and sand of local nature. The sandy silt and sand deposits are characterized as a brown, fine to medium grained sand/sandy silt with some clay, trace gravel, occasional gravel lenses, occasional cobles, and trace silt. It varies from loose to compact and from damp to saturated.

The silt deposits of the Surficial Aquitard lie directly beneath the sandy silt and sand deposits of local nature. It is characterized as a brown to grey silt with trace sand, and occasional clayey lenses. It varies across the Site from dense to compact and from moist to saturated. It is up to 4 m (BH-2) in thickness. These deposits have a large amount of silt and clay. The average clay content of the silt is 15 percent (%).

The clayey silt deposits of the Surficial Aquitard lie directly beneath the silt deposits. It is characterized as grey clayey silt with some sand, trace gravel and silt lenses. It varies across the Site from firm to very stiff, from damp to saturated and moist with wet seams in locations. The bottom of the clayey silt unit was not encountered during geotechnical investigations on Site but was a maximum thickness of 10 m (BH-3). The clay content of the clayey silt deposits is 15% or greater.

Therefore, the upper 15 m of the Site-Specific geology and hydrogeology is characterized as the Surficial Aquitard (SAT) which corresponds to the Tavistock Till comprised of primarily silt, and clayey silt deposits with an average clay content of 15% or greater. The average combined silt and clay content of the SAT beneath the Site is 97%.

5.1 GROUNDWATER CONDITIONS

The groundwater conditions were monitored during and at the completion of each individual borehole. Water levels were measured between 1.15 and 5.33 m bgs at seven of the ten borehole locations. BH-4, 5, and 10 remained dry at completion of sampling, however, cave-in occurred at BH-4 and 5 at respective depths of 11.58 and 9.15 m bgs.

Piezometers were installed at BH-3 and 6. Water levels were measured at these piezometers on August 5, 11, and 17, 2011 and results are presented in Table 1.

Based upon the water levels measured and the moisture contents of the various soil samples secured during the field investigation procedures, groundwater is found within the SAT under stagnant conditions, since this unit is an aquitard comprised primarily of fine-grained materials.

The groundwater conditions encountered at the boreholes do not constitute the in situ soil deposits as being the uppermost identified aquifer as defined in Part VIII of Ontario Regulation 267/03 pertaining to the *Nutrient Management Act, 2002* (Ministry of Agriculture Food & Rural Affairs).

The Upper Aquifer (UA) was not encountered as part of these investigations and must be at depths in excess of 15 m.

6.0 DISCUSSION AND RECOMMENDATIONS

A renewable energy generation facility is proposed to be constructed at the subject Site and the development of the facility will include:

- Three lined, reinforced concrete digester tanks varying between 24 and 28 m in diameter. The base of the tanks will lie at an approximate elevation of 360.0 m AMSL and be constructed with 8.3 m tall concrete walls and domed "coverall" type roofs reaching to elevations between 375.5 to 377.5 m AMSL.
- Four 8-m diameter, 8.4-m tall, reinforced concrete pretreatment and water tanks and four 4.3-m diameter, ±14-m tall storage tanks will be constructed on the respective south and east sides of a ±43-m by ±29-m receiving/processing building which will be constructed north of the three large digester tanks. The base of the pretreatment and water tanks will lie at an approximate elevation of 360.0 m AMSL. The base of the other four storage tanks will lie at an elevation of 361.8 m AMSL. The finished floor level of the receiving/processing building will lie between elevations of 362.4 and 363.0 m AMSL.
- An additional slab-on-grade service building (±32 m by ±10 m) will be constructed in the northeast corner of the development. The finished floor is proposed at an elevation of 363.0 m AMSL.
- A storm water management (SWM) pond will be constructed in the southwest corner of the development Site. The bottom of the SWM pond is expected at an approximate elevation of 354.0 m AMSL.
- A 260 m^3 capacity water reservoir for fire fighting will be constructed below grade in the southeast corner of the development.
- Asphalt pavement is proposed for the site traffic routes.

The proposed development is designated as being a Liquid Nutrient Storage Facility and, therefore, various process and storage tanks will be constructed in accordance with the provisions of Ontario Regulation 267/03 made under the Nutrient Management Act (2002).

6.1 SITE GRADING AND ENGINEERED FILL CONSTRUCTION

Substantial re-grading is proposed for the development of the Site. Lowering of the existing Site grades by as much as 3 m is proposed in the north and central areas of the Site while up to 2 m of fill is proposed in the southern portion of the Site. It is recommended that the fill areas be constructed as engineered fill to support the future building foundations, floor slabs, and various tank and pavement areas.

It is recommended that the engineered fill for the support of building foundations, floor slabs and various tank structures should specifically consist of the on-Site fine to gravelly sand deposits and/or imported OPSS Granular B Type I. On-Site sandy silt with some clay, silt, and clayey silt fill should be limited to use beneath pavement areas and non-structural areas of the Site.

The natural moisture content of the earth fills should be close to their respective optimum moisture contents for suitable compaction to occur. The grading work should be carried out during relatively dry weather as the finer grained soils are sensitive to wetting and will be difficult to handle when wet.

The native fine grained soil deposits of sandy silt with some clay, silt and clayey silt are frost-susceptible. Constructing engineered fill, backfilling footings, foundation walls and service trenches using the fine grained soils during the winter months is not advisable, unless strict procedures are followed and monitored on a full-time basis by the geotechnical engineer. The volumetric expansion of the fine grained soils resulting from exposure to freezing conditions will result in settlements after thawing. Backfilling local excavations (such as foundation walls, footings and trenches inside the building) should be performed using imported OPSS Granular B Type I or on-Site sand fill.

It is recommended that any proposed borrow source materials be tested prior to importing, in order to ensure that the environmental quality of the fill meets all environmental approval criteria and to ensure that the natural moisture content of the fill is suitable for compaction.

The native fine grained soil deposits are susceptible to softening and deformation when exposed to excessive moisture and construction traffic. As a result, it is recommended that the grading/filling operations are planned and maintained to direct surface water run-off to low points and then be positively drained by suitable means. During periods of wet weather, construction traffic should be directed along the designated construction routes so as not to disturb and rut the exposed subgrade soil. Temporary construction roads consisting of clear crushed material (such as crushed stone or recycled concrete) may be required during poor weather conditions such as wet Spring or Fall.

The engineered fill should be constructed in accordance with the following procedures in order to support building foundations, floor slabs, and pavement areas:

1. All topsoil, organic and deleterious materials should be stripped from building, tank and pavement areas.
2. The exposed subgrade surface is to be thoroughly re-compacted by large heavy compaction equipment (10-tonne compactor is recommended) and inspected by qualified geotechnical personnel. Any loose or soft areas identified should be excavated to the level of competent soil.
3. The required grades can then be achieved by placing OPSS Granular B Type I or on-Site fine to gravelly sand deposits in maximum 0.3-m thick loose lifts and compacting to a minimum of 100% Standard Proctor maximum dry density (SPMDD) in areas to support building foundation, floor slab and various tank structures. On-Site fine grained fill soil can be used beneath asphalt surfaced main entrance, access roads and parking areas. It can be placed in maximum 0.3-m thick loose lifts and compacted to at least 98% SPMDD. The moisture content of the fill materials must be within 3% of the optimum content in order to achieve the specified degree of compaction;
4. Engineered fill used to support future building foundations and tank structures (compacted to at least 100% SPMDD) must be placed such that the fill pad extends horizontally outwards from all footings at least the same distance as how thick the engineered fill pad will exist between the underside of future footings and the approved native earth subgrade;
5. Compaction above building footing foundations to the floor subgrade level (for the support of the floor slabs) and within pavement areas may be reduced to no less than 98% SPMDD; and
6. All fill placement and compaction operations must be supervised on a full-time basis by qualified geotechnical personnel to approve fill material and ensure the specified degrees of compaction have been achieved.

During construction, vibration could be generated from various construction equipment, such as compactors and rollers which could be harmful to surrounding structures and buildings. Peak particle velocity (PPV) of ground motion is widely accepted as the best descriptor of potential for vibration damage to structures. The safe vibration limit can be set to 10 to 20 millimetres per second (mm/s) PPV, depending on the sensitivity of surrounding structures to vibration.

Vibration monitoring can be carried out to measure the PPV of ground motion from vibration generated from typical compaction equipment at the beginning of the project in the potentially critical areas. This will set criteria and establish the type of equipment to be used for this project. It is also recommended that a pre-construction condition survey be conducted to document the condition of the existing structures within the possible zone of influence.

6.2 MAIN RECEIVING/PROCESSING AND SERVICE BUILDINGS

6.2.1 FOUNDATIONS

The main receiving/process and service buildings can be supported on footing foundations at the proposed founding elevations expecting to vary between ±361.6 and ±359.8 m AMSL. At these elevations, footings are expected to be constructed on the deposits of compact to dense sand and/or silt or approved granular engineered fill (constructed as per Section 6.1). Conventional spread and strip footing can be designed using a Geotechnical Reaction at SLS of 150 kPa (3,000 psf). The Factored Geotechnical Resistance at ULS is 250 kPa (5,000 psf).

It is noted that the competent footing founding level is expected to be lower in the area of BH-4 due to the presence of very loose sand.

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The total and differential settlement of footing foundations designed to the recommended soil bearing pressures will be less than 25 and 12 mm, respectively, and these are considered tolerable for the structures being contemplated. The majority of the settlements will take place during construction and the first loading cycle of the buildings.

Exterior footings and footings in unheated portions of the buildings should be provided with a soil cover of not less than 1.2 m, or equivalent thermal insulation for adequate frost protection. Adjacent footing steps should not be steeper than 10H:7V. The sub-grade soils are considered to be frost-susceptible and must be protected from frost penetration during winter construction.

It is recommended that the footing excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper sub-grade preparation. If the footing sub-grade soil base is wet or muddy at the time of excavation, placing a 75-mm thick concrete working mat is recommended to protect the integrity of the soil sub-grade from the construction traffic and the elements.

In accordance with The Ontario Building Code 2006 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8.

Based on the soils condition encountered at the boreholes and CVD's experience with the top 30 m of soil condition in the general area of the Site, the Site can be classified as a Site Class D as per OBC Table 4.1.8.4.A {Page B4-16).

6.2.2 SLAB-ON-GRADE CONCRETE FLOORS

The floor slabs for the two buildings can be constructed as conventional slab-on-grade on competent native deposits or approved engineered fill as described in Section 6.1. At the time of floor slab construction, the exposed sub-grade should be proof-rolled with a heavy roller in conjunction with an inspection by the geotechnical engineer. Any soft and/or unstable areas detected should be replaced with granular fill which should be compacted to at least 98% SPMDD.

Special consideration should be given to floor slabs within any unheated areas of the buildings. These floor slabs should be underlain by a minimum 1.2 m thickness of suitably compacted OPSS Granular B Type I in order to ensure that the underlying frost-susceptible soil does not cause differential heaving problems in the winter months. Positive drainage outlets should be provided for at all low points of the earth sub-grade to drain the supporting granular bases by installing a sub-drain system connected to a positive drainage outlet. Alternatively equivalent suitable thermal insulation can be provided beneath these areas.

Care should be taken to ensure that the backfill against foundation walls and around the interior columns are placed in thin layers and each layer compacted to at least 98% SPMDD, Reusing on-Site fine grained soils for this purpose must consider breaking down the large lumps to smaller pieces (less than 150-mm diameter) and pre-conditioning the moisture to within 3% of the optimum. Backfilling these types of confined areas with imported granular soils should be considered if the weather is not favourable and the work is being carried out in the winter months.

Following the proof rolling of the subgrade, it is recommended that a minimum 150-mm thick layer of OPSS Granular "A" be placed and compacted to at least 100% SPMDD beneath the concrete floor slabs to provide uniform support.

A modulus of subgrade reaction (k_s) of 25 MN/m^3 may be used for the design of the floor slab, assuming silt to clayey silt subgrade. If the engineered fill consists of OPSS Granular B Type I, a modulus of subgrade reaction (k_s) of 80 MN/m^3 may be used.
The floor slab should be separated structurally from the columns and foundation walls. Sawcut control joints should be provided at regular spacing (less than 30 times the

concrete slab thickness) and to depths between one-third to one-quarter of the slab thickness.

If the floor slab is situated at least 150 mm above the exterior grade and the ground surface slopes down and away from the building, perimeter drainage is not required. Similarly, under floor drains will not be required.

6.3 DIGESTER, PRETREATMENT AND STORAGE TANKS

6.3.1 FOUNDATIONS

The three 24- to 28-m diameter reinforced concrete digester tanks will not require lining as described in Section 6.3.2. The four 8-m diameter reinforced concrete pretreatment and water tanks, and the four 4.3-m diameter storage tanks will be constructed on reinforced concrete floating slabs.

The top of base slab for the three large diameter reinforced concrete digester tanks and the four reinforced concrete pretreatment and water tanks to be constructed south of the main receiving/processing building is proposed at an elevation of 363.0 m AMSL and the tanks will be ±8.4 m tall. The three digester tanks will also be domed with "coverall" type roofs reaching to elevations between 375.5 to 377.8 m AMSL.

The top of base slab for the four storage tanks to be constructed on the east side of the main receiving/processing building is proposed at an elevation of 361.78 m AMSL and the tanks will be ±14 m tall.

At the proposed founding elevations, floating slabs are expected to be constructed on the deposits of compact silt, stiff clayey silt and/or approved granular engineered fill (constructed as per Section 6.1). Conventional spread and strip footing can be designed using a Geotechnical Reaction at SLS of 150 kPa (3,000 psf). The Factored Geotechnical Resistance at ULS is 250 kPa (5,000 psf).

It is noted that the competent founding level is expected to be lower in the area of BH-4 due to the presence of very loose sand.

These soil bearing pressures can be achieved provided that the founding subgrade is undisturbed during construction. The total and differential settlement of footing foundations designed to the recommended soil bearing pressures will be less than 25 and 12 mm, respectively, and these are considered tolerable for the structures being contemplated. The majority of the settlements will take place during construction and the first loading cycle of the tanks.

If raft foundations are required to support the various tanks, a modulus of subgrade reaction of 25 MPa/m can be used for design, based on the upset fine grained subgrade condition expected.

Exterior footings and footings in unheated portions of the buildings should be provided with a soil cover of not less than 1.2 m, or equivalent thermal insulation for adequate frost protection. Adjacent footing steps should not be steeper than 10H:7V. The subgrade soils are considered to be frost-susceptible and must be protected from frost penetration during winter construction.

It is recommended that the founding excavations be inspected by the geotechnical engineer to ensure adequate soil bearing and proper subgrade preparation. It is recommended to place a 75 mm thick concrete working mat to protect the integrity of the soil subgrade from the construction traffic and the elements.

In accordance with The Ontario Building Code 2006 (OBC), the proposed structure should be designed to resist earthquake load and effects as per OBC Subsection 4.1.8. Based on the soils condition encountered at the boreholes and CVD's experience with the top 30 m of soil condition in the general area of the Site, the Site can be classified as a Site Class D as per OBC Table 4.1.8.4.A (Page B4-16).

6.3.2 SITE CHARACTERIZATION

Part VIII of Ontario Regulation 267/03 pertaining to the *Nutrient Management Act, 2002* (Ministry of Agriculture Food & Rural Affairs) was followed in characterizing the subsurface soils in the vicinity of the proposed digester, pretreatment and storage tanks for the purpose of nutrient management design.

Based upon the various native deposits of sand, silt and clayey silt as well as the granular engineered fill expected beneath the future digester and pretreatment tanks at elevations of 360 m AMSL, "hydraulically secure soils" (i.e., natural soil that is consistent in nature and able to meet a maximum saturated hydraulic conductivity of 1.0×10^{-6} centimetres per second [cm/sec]) will not fully be encountered throughout.

However, based on the grain size distribution results it is noted that the subsurface beneath the area intended for future digester and pretreatment tanks has at least 1.0 m of soil comprised of a clay content of at least 10% between the bottom of the proposed Tanks and the uppermost identified aquifer. It should be noted that during the geotechnical investigation the uppermost identified aquifer was not encountered to a maximum depth of 14.3 m bgs, and therefore additional protection will not be required in the design and construction of the tanks applicable to being constructed in accordance with the provisions of Ontario Regulation 267/03 made under the Nutrient Management Act (2002). These tanks do not require lining. The secondary digester and repository tank and one of the main digester tanks will require removal of the uppermost coarser-grained material of the predominantly fine-grained glacial deposits above the proposed base at about 360 m AMSL. Re-compacted fine-grained material from other areas of the Site can be used to replace the coarser-grained material which is removed.

The groundwater conditions encountered at the boreholes do not constitute the in situ soil deposits as being the uppermost identified aquifer as defined in Part VIII of Ontario Regulation 267/03 pertaining to the *Nutrient Management Act 2002* (Ministry of Agriculture Food & Rural Affairs).

6.4 BELOW GRADE WATER RESERVOIR

A 260 m^3 capacity water reservoir for fire fighting will be constructed below grade in the southeast corner of the development near BH-9. The plan dimensions will be in the order of 4 m by 13 m and therefore, the reservoir will be 5 m deep.

Review of the proposed Site grading indicates the finished grade in the vicinity of the 260 m^3 capacity water reservoir will be near an elevation of 361.4 m AMSL and therefore the founding grade of the reservoir is expected to extend to an elevation ±356.4 m AMSL.

The base of the excavation is expected to extend past the loose to compact sandy silt and compact saturated fine sand deposits and extend into the underlying competent deposit of brown to grey silt with occasional to frequent clayey silt seams which is deemed suitable to support the future water reservoir structure.

6.5 CONSTRUCTION AND EXCAVATION

Depending on the time of construction, the various excavations for construction could intercept groundwater within the predominantly fine-grained glacial deposits.

Dewatering of small amounts of groundwater (less than 20 litres per minute) can be expected to facilitate excavation and protect the integrity of the founding soils. Dewatering measures should be installed prior to excavation, and maintained during excavation and foundation construction. The magnitude of the dewatering measures depends on the depth of excavation and the time of the year.

It is recommended that excavation for the future development be done during the typically drier summer months when groundwater conditions would be expected to generate a minimum amount of groundwater.

Provided that groundwater is adequately controlled, the on-Site soils are classified as Type 3 Soils in accordance with the latest Occupational Health and Safety Act. Excavations in the Type 3 soils are expected to remain stable during the construction period provided that side slopes are cut to 1H: 1V throughout. The slope surface should be suitably protected from erosion processes. If the groundwater is not properly controlled, excavations are to be carried out with 3H : 1V side slopes.

6.6 LATERAL EARTH PRESSURE

There may be unbalanced pressure acting on the exterior of the digester tank and water reservoir foundation walls. The foundation walls should be designed for the following lateral pressure:

$$p = K\,(yh_1 + Y'h_2 + q) + y_w h_2$$

Where

P	=	lateral earth pressure, kPa
K	=	theoretical earth pressure coefficient (0.5 for level native excavated backfill)
Y	=	unit weight of backfill, kN/m^3
	=	21 kN/m^3 for native excavated backfill
γ'	=	submerged unit weight of backfill, kN/m^3
	=	11 kN/m^3 for native excavated backfill
Y_w	=	unit weight of water, 9.8 kN/m^3
h_1	=	depth below top of backfill to water table, m
h_2	=	depth below water table to bottom of wall, m
q	=	surcharge, kPa

It is assumed that the water level will rise to the top of the backfill of the walls within the backfill.

The submerged unit weight of the backfill should be used in calculating the earth pressure below the water level which can be assumed to rise to the ground surface during wet seasons.

Hydrostatic uplift forces may develop beneath the digester tank and water reservoir floors when the tanks are empty and this condition should be considered in the tank design. A drainage tile system could be constructed around and beneath the tank structures which could be monitored and positively drained into the tanks (when necessary) via exterior sump pit systems in order to relieve hydrostatic pressure which may build up beneath the slabs.

Based on the results of the field work, the earth subgrade materials at the Site will consist of varied soils expected to range in composition from clayey silt to fine sand. The flexible pavement structures are recommended based on an assumed CBR value of clayey silt, the observed groundwater conditions and the frost susceptibility of clayey silt subgrade soil. The recommended flexible pavement structure ranges are provided in Table 5.

At the time of pavement construction, the exposed inorganic subgrade soils should be thoroughly re-compacted and inspected. Any soft spots or incompactable materials should be removed and be replaced with suitable on-Site or imported materials. These materials should be placed in thin lifts and compacted to at least 98% SPMDD. Any additional fill required to raise the grade to subgrade level should be constructed in a similar manner.

The design considers that pavement construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

The base and subbase materials should meet the gradational requirements of OPSS 1010 and should be compacted to no less than 100% SPMDD. The asphaltic concrete should be placed and compacted in accordance with OPSS Form 310 and to between 92 and 96.5% of the Marshall Density (MRD). Frequent in situ density testing should be carried out to verify that the specified degree of compaction is being achieved and maintained.

The surface course of the asphaltic concrete should be placed at least 1 year after the base course is placed to allow minor settlements of the trench backfill to complete. The incomplete pavement structure may not be capable of supporting the anticipated traffic.

Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving the surface course asphaltic concrete.

The prepared earth subgrade and final pavement surfaces should be graded to direct water runoff away from buildings, sidewalks and other similar pertinent structures. Positive drainage outlets should be provided for at all low points of the earth subgrade to drain the granular bases by installing a sub-drain system connected to the catch-basins. The sub-drains should be at least 3 m long and radiating from the catch-basins.

6.7 STORMWATER MANAGEMENT POND

A stormwater management pond is proposed to be constructed in the southwest corner of the site in the vicinity of BH-6 and 10 and the base of the pond is proposed to extend to an elevation of approximately 354.0 m AMSL.

The results of geotechnical investigation generally delineated that stiff brown to grey clayey silt with occasional lenses of sand and silt exist in the area of the future storm water management pond. Based on the laboratory results and CVD's past experience, the coefficient of permeability and infiltration rate of the predominant encountered soil type are estimated and the material should be a clayey silt with a permeability value of at least 1.0×10^{-6} cm/sec and an infiltration rate of 0.036 mm/hr.

Excavation for construction of the pond is expected to lie above the groundwater table and therefore, extensive ground water control measures are not expected.

It is recommended to use on-Site excavated clayey silt to construct any required embankments of the proposed storm water management pond. The native fine sand and silt deposits are not considered suitable for reuse for this purpose.

When properly prepared, placed in thin lifts and suitably compacted to at least 98% standard Proctor maximum dry density (SPMDD), the onsite clayey silt is estimated to achieve a permeability of 1×10^{-7} cm/sec. The natural moisture content of the clayey silt excavated from the future pond area will likely be high and may require some drying before reuse.

The interior side slopes above the permanent water level as well as any exterior side slopes should be seeded to provide a vegetative cover to prevent surface erosion. Installation of any piping through the embankment must be carried out with caution to prevent leaking. The trench should be backfilled with similar soil which should be placed in 150-mm thick lifts and each lift compacted to at least 98% SPMDD to restore the integrity of the impermeable embankment. Seepage collars should be installed around any pipes.

7.0 CLOSING REMARKS

Therefore, based on the aforementioned geotechnical investigation and as specified in Section 65 and 67 of O. Reg. 267/03 under the Nutrient Management Act, there is a minimum of 1.0 m of soil comprised of at least 10% clay between the bottom of the proposed tanks and the uppermost identified aquifer.

As a result, the proposed Tanks structure will be made of unlined reinforced concrete.

All of Which is Respectfully Submitted,
CONESTOGA-ROVERS & ASSOCIATES

PROFESSIONAL GEOSCIENTIST
GARY I. LAGOS
PRACTISING MEMBER
1841
ONTARIO

Gary I. Lagos, M.Sc., P. Geo.

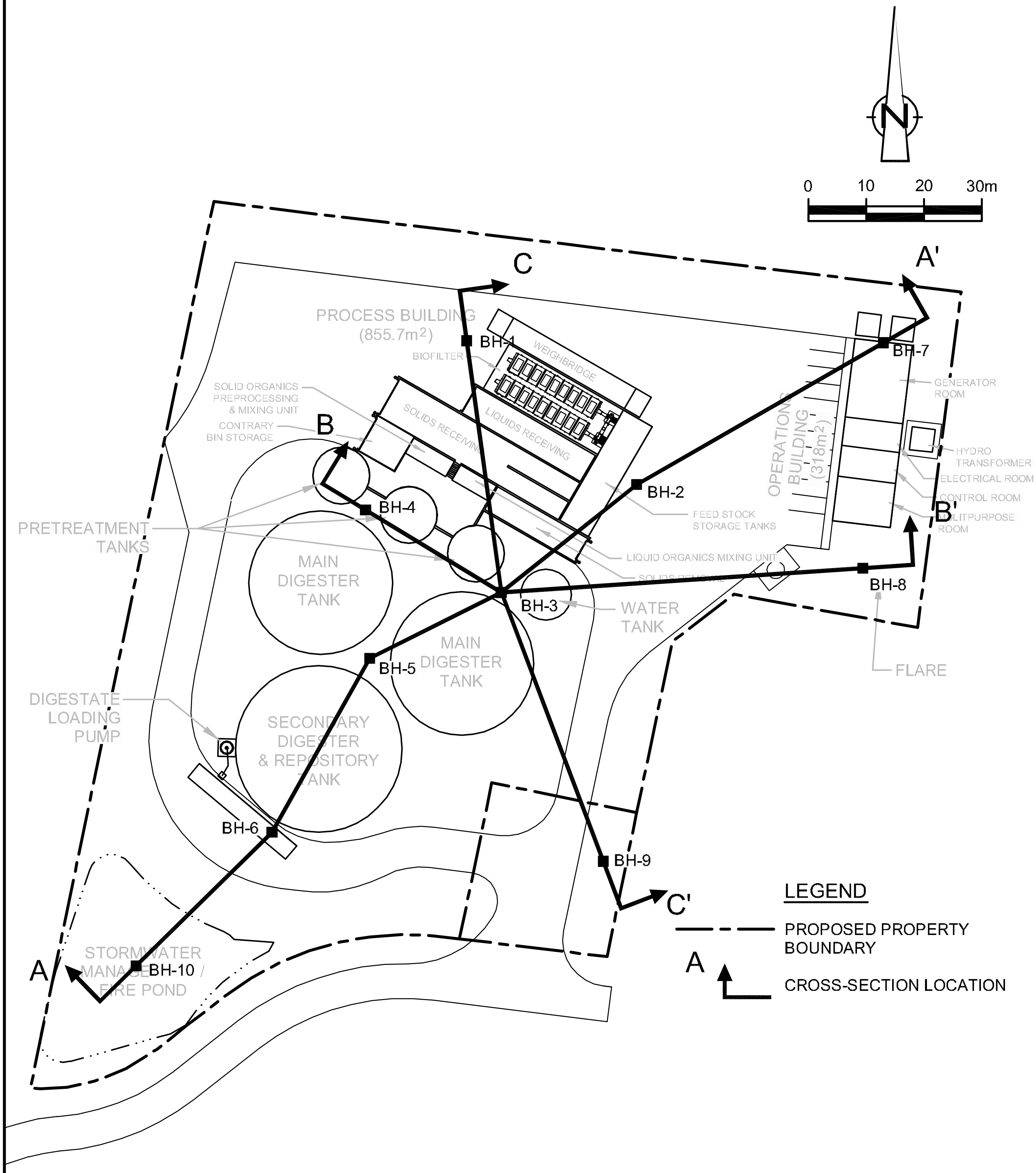
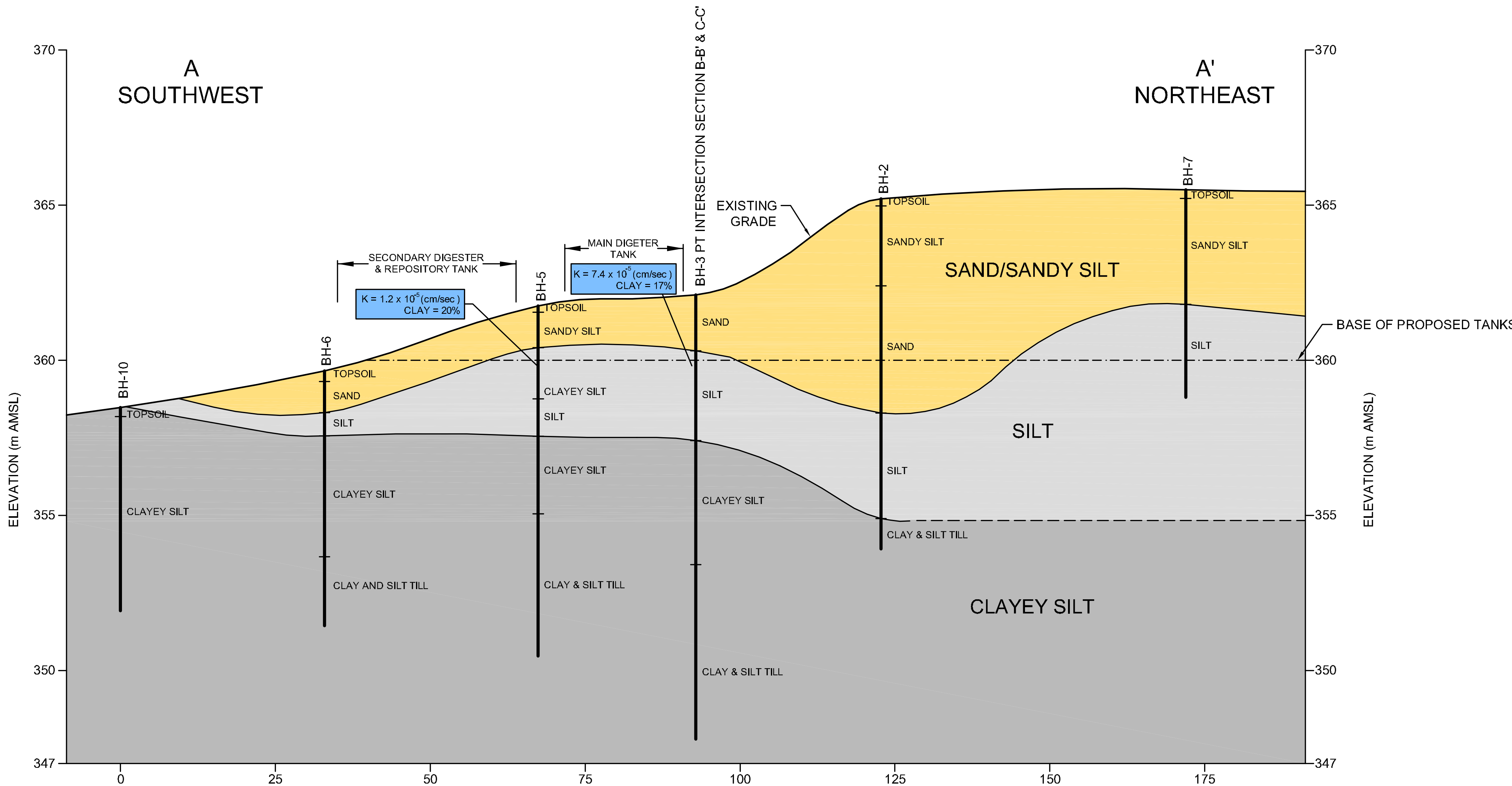


figure 1

GEOLOGIC CROSS-SECTION LOCATIONS
WOOLWICH BIO-EN FACILITY
Elmira, Ontario

46254-07(012)GN-WA001 NOV 30/2011



HORIZONTAL TO VERTICAL EXAGGERATION: 5: 1

figure 2

GEOLOGIC CROSS-SECTION A-A'
WOOLWHICH BIO-EN FACILITY
Elmira, Ontario

46254-07(012)GN-WA002 NOV 30/2011

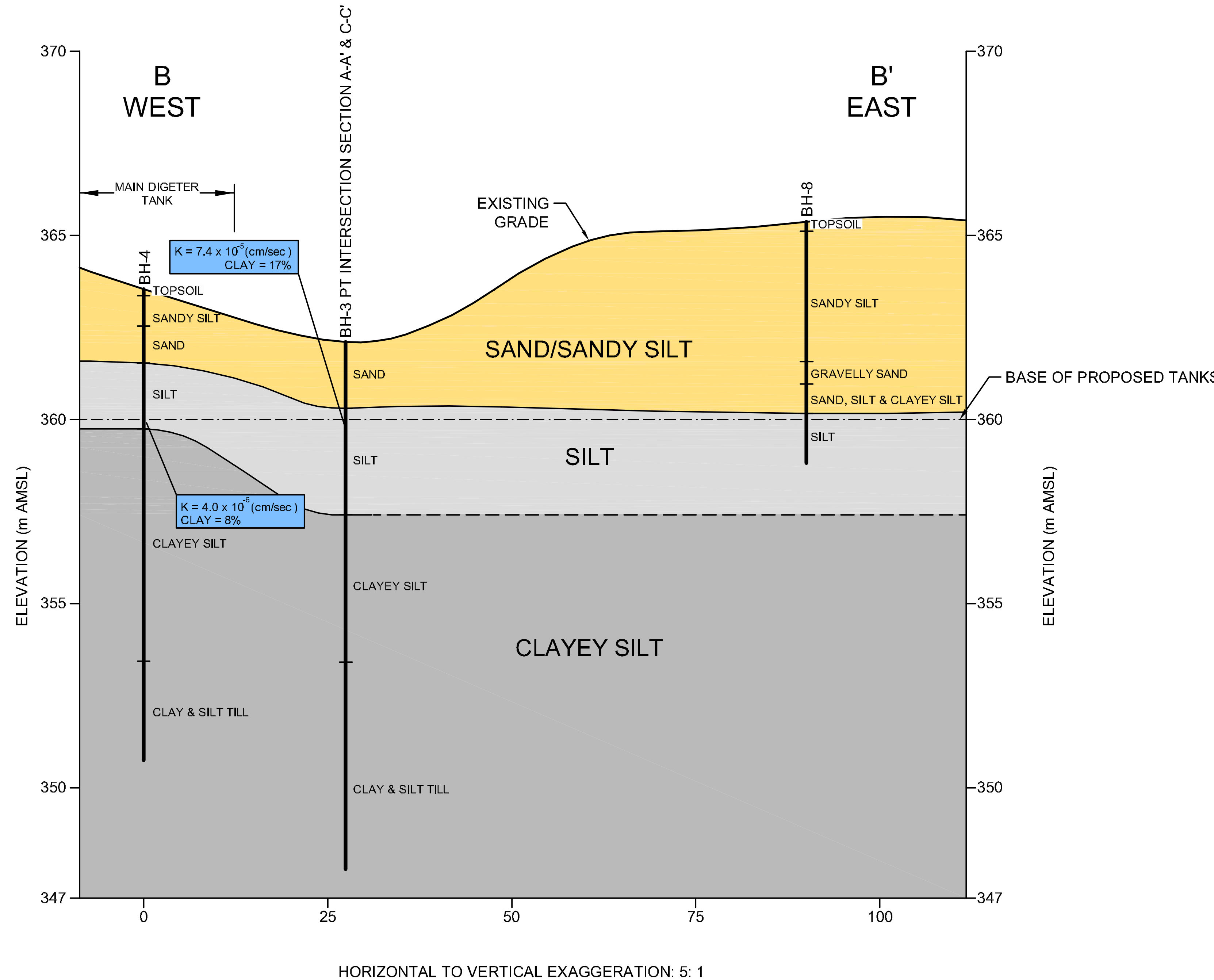


figure 3

GEOLOGIC CROSS-SECTION B-B'
WOOLWICH BIO-EN FACILITY
Elmira, Ontario

46254-07(012)GN-WA002 NOV 30/2011

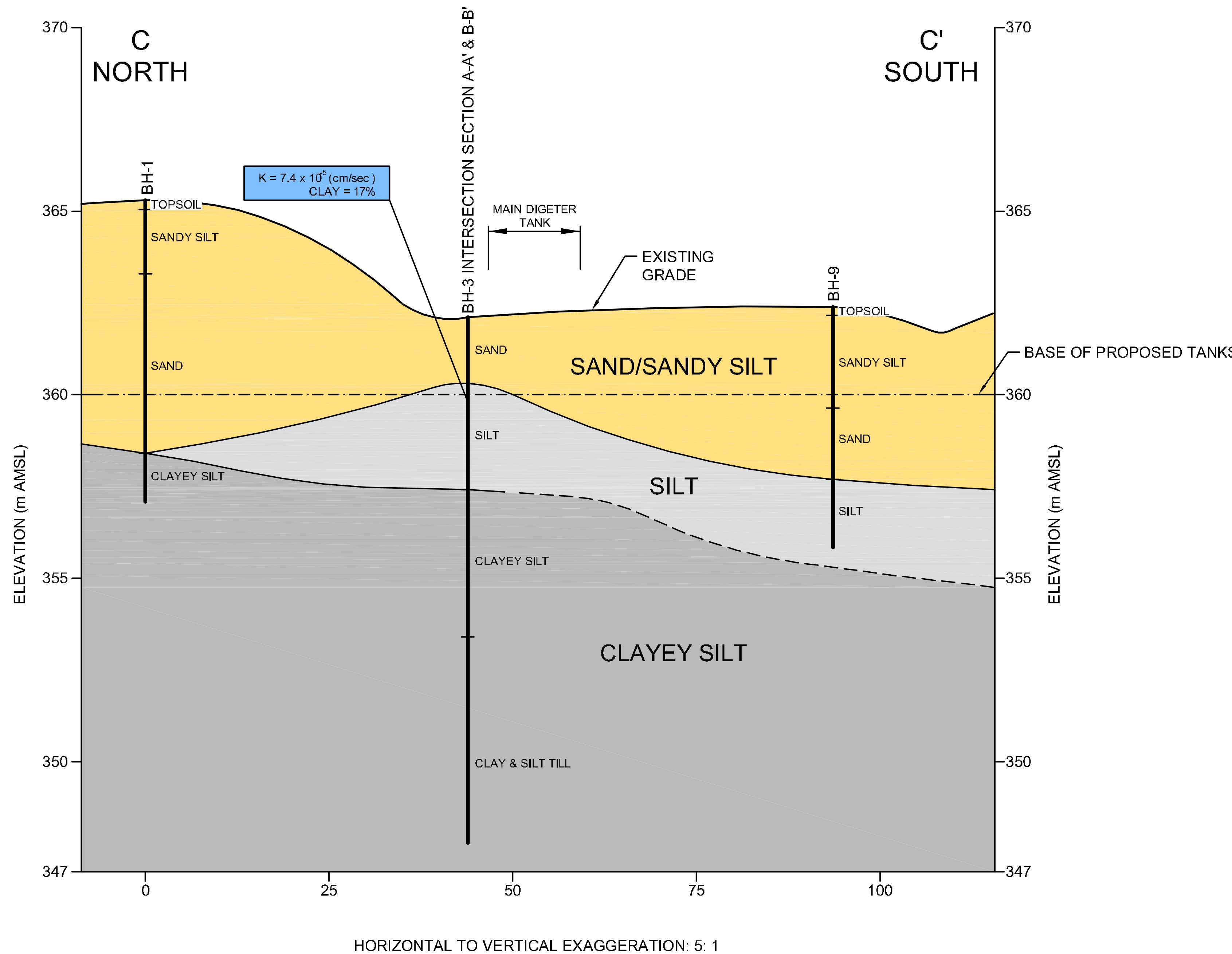


figure 4

GEOLOGIC CROSS-SECTION C-C'
WOOLWICH BIO-EN FACILITY
Elmira, Ontario

46254-07(012)GN-WA002 NOV 30/2011

TABLE 1

GROUNDWATER ELEVATION SUMMARY
GEOTECHNICAL INVESTIGATION
WOOLWICH BIO-EN FACILITY
ELMIRA, ONTARIO

		Water Depth/Elevation (m)					
	Ground Surface	*August 5, 2011*		*August 11, 2011*		*August 17, 2011*	
Borehole No.	*Elevation (m)*	*Depth*	*Elevation*	*Depth*	*Elevation*	*Depth*	*Elevation*
BH-3	362.11	1.44	360.67	1.46	360.65	1.57	360.54
BH-6	359.66	1.15	358.51	0.98	358.68	0.91	358.75

Notes:

m - metre

TABLE 2

PARTICLE SIZE DISTRIBUTION SUMMARY
GEOTECHNICAL INVESTIGATION
WOOLWICH BIO-EN FACILITY
ELMIRA, ONTARIO

Location	*Sample Date*	*Sample Summary*				*Sample Description*	*Notes*
		Gravel (%)	*Sand (%)*	*Silt (%)*	*Clay (%)*		
BH-5	7/29/2011	0	0.6	99.4		Silt, trace clay	3.05 - 3.50 m bgs
BH-5	7/29/2011	0	0	100		Clayey silt	4.55 - 5.00 m bgs
BH-10	7/29/2011	0	1.3	98.7		Clayey silt	2.25 - 2.70 m bgs
BH-6	8/3/2011	1.5	14.7	83.8		Clay and Silt Till, some sand, trace gravel	6.10 - 6.55 m bgs
BH-3	10/6/2011	0	1	82	17	Silt, some clay, trace sand	
BH-4	10/6/2011	0	0	92	8	Silt, trace clay	
BH-5	10/6/2011	0	2	78	20	Silt, some clay, trace sand	

Notes:

m bgs - metres below ground surface

TABLE 3

PERMEABILITY SUMMARY
GEOTECHNICAL INVESTIGATION
WOOLWICH BIO-EN FACILITY
ELMIRA, ONTARIO

Location	*Sample Date*	*Sample Parameters*					*Permeation Condtions*					*Hydraulic Conductivity*
		Diameter (cm)	*Length (cm)*	*Dry Density (kg/m^3)*	*Moisture (%) Initial*	*Moisture (%) Final*	*Cell Press. (kPa)*	*Head Press. (kPa)*	*Back Press. (kPa)*	*Volume [(1)] (cm^3)*	*Hydraulic gradient*	*(cm/sec)*
BH-3	10/6/2011	5.0	4.9	1788	19.9	20.6	300.0	288.6	284.5	4.86	8.5	7.4E-05
BH-4	10/6/2011	5.0	5.0	1627	21.1	17.6	300.0	287.8	281.8	6.01	12.2	4.0E-06
BH-5	10/6/2011	5.0	5.2	1803	22.5	17.1	300.0	288.0	281.0	8.28	13.7	1.2E-05

Notes:

(1) - Volume under Steady Flow.
cm - Centimetres.
kg/m^3 - Kilogram per cubic metre.
% - Percentage.
kPa - kilopascal
cm^3 - Cubic centimetres.
cm/sec - Centimetres per second.

TABLE 4

STANDARD PROCTOR TEST SUMMARY
GEOTECHNICAL INVESTIGATION
WOOLWICH BIO-EN FACILITY
ELMIRA, ONTARIO

Location	*Sample Date*	*Sample Depth*	*Maximum Dry Density* (kg/m^3)	*Optimum Water Content* (%)
BH-3	8/3/2011	0.60 - 1.80 m bgs	1894	12
BH-4	7/29/2011	2.40 - 3.60 m bgs	1874	12.5

Notes:

m bgs - metres below ground surface.
kg/m^3 - Kilogram per cubic metre.
% - Percentage.

TABLE 5

FLEXIBLE PAVEMENT STRUCTURES SUMMARY
GEOTECHNICAL INVESTIGATION
WOOLWICH BIO-EN FACILITY
ELMIRA, ONTARIO

Component	*Light Duty Pavement (mm)*	*Heavy Duty Pavement (mm)*
HL-3 Asphaltic Concrete	30	40
HL-8 Asphaltic Concrete	35	60
Granular "A" Base	150	150
Granular "B" Sub-base	350	450

Notes:

mm - millimetre

APPENDIX A

BOREHOLE LOGS

FILE No: 11-07-K01 BOREHOLE No. 1

CHUNG & VANDER DOELEN CVD ENGINEERING LTD.

Client:	Frey Building Contractors
Project:	Proposed Renewable Energy Generation Facility
Location:	15 Martins Lane, Elmira, Ontario

EQUIPMENT DATA

Machine:	D50T
Method:	Hollow Stem Auger
Size:	200
Date:	Jul 29 / 11 TO Jul 29 / 11

SOIL LITHOLOGY — Ground Elevation: 365.30 m

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)
WATER CONTENT (%): W_P W W_L (10, 20, 30)

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
365.05 / 0.25	250mm TOPSOIL				
363.30 / 2.00	Loose to compact brown SANDY SILT; some clay, trace gravel, occ. cobbles; moist	1	ss	9	
		2	ss	11	
358.40 / 6.90	Dense to compact brown Fine SAND; trace silt, occ. gravelly lenses; damp to saturated	3	ss	36	
		4	ss	31	
		5	ss	25	Water level at 4.42 m depth at completion of borehole
		6	ss	22	
	Stiff to very stiff grey CLAYEY SILT				

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0

PROJECT MANAGER: **RVD**

CHUNG & VANDER DOELEN
ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 11-07-K01

BOREHOLE No. 1

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client:	Frey Building Contractors
Project:	Proposed Renewable Energy Generation Facility
Location:	15 Martins Lane, Elmira, Ontario

EQUIPMENT DATA

Machine:	D50T
Method:	Hollow Stem Auger
Size:	200
Date:	Jul 29 / 11 TO Jul 29 / 11

SOIL LITHOLOGY / SAMPLE / SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □; 50, 100, 150, 200 / PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○; 20, 40, 60, 80 / WATER CONTENT (%): W_P W W_L; 10, 20, 30

ELEV./DEPTH (m)	DESCRIPTION (continued)	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH / PENETRATION RESISTANCE	WATER CONTENT	WELL DATA	DEPTH (m)	REMARKS
	Stiff to very stiff grey CLAYEY SILT moist	8.0		7	ss	23				8.0	
357.08 8.22	End of Borehole	8.5								8.5	
		9.0								9.0	
		9.5								9.5	
		10.0								10.0	
		10.5								10.5	
		11.0								11.0	
		11.5								11.5	
		12.0								12.0	
		12.5								12.5	
		13.0								13.0	
		13.5								13.5	
		14.0								14.0	
		14.5								14.5	

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 2

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client:	**Frey Building Contractors**
Project:	**Proposed Renewable Energy Generation Facility**
Location:	**15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine:	**D50T**
Method:	**Hollow Stem Auger**
Size:	**200**
Date:	**Jul 28 / 11** TO **Jul 28 / 11**

SOIL LITHOLOGY

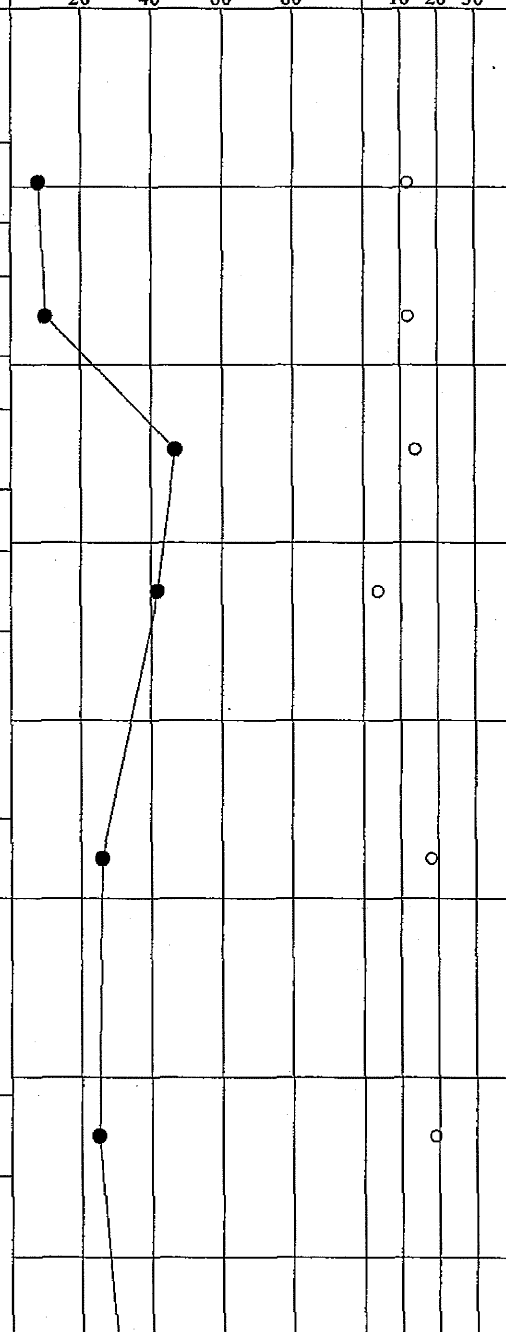
Ground Elevation: **365.20 m**

ELEV./ DEPTH (m)	DESCRIPTION
364.97 / 0.23	225mm TOPSOIL
362.40 / 2.80	Loose to compact brown SANDY SILT some clay, trace gravel occ. cobbles ------- dense moist
358.30 / 6.90	Dense to compact brown Fine SAND trace silt occ. gravel and cobbles damp to saturated
	Dense brown to grey SILT trace sand

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	ss	8
2	ss	10
3	ss	47
4	ss	42
5	ss	26
6	ss	25

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □; 50 100 150 200
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○; 20 40 60 80
WATER CONTENT (%): W_P W W_L; 10 20 30



WELL DATA

REMARKS: Water level at 4.55 m depth at completion of borehole

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 2

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client:	Frey Building Contractors
Project:	Proposed Renewable Energy Generation Facility
Location:	15 Martins Lane, Elmira, Ontario

EQUIPMENT DATA

Machine:	D50T
Method:	Hollow Stem Auger
Size:	200
Date:	Jul 28 / 11 TO Jul 28 / 11

SOIL LITHOLOGY

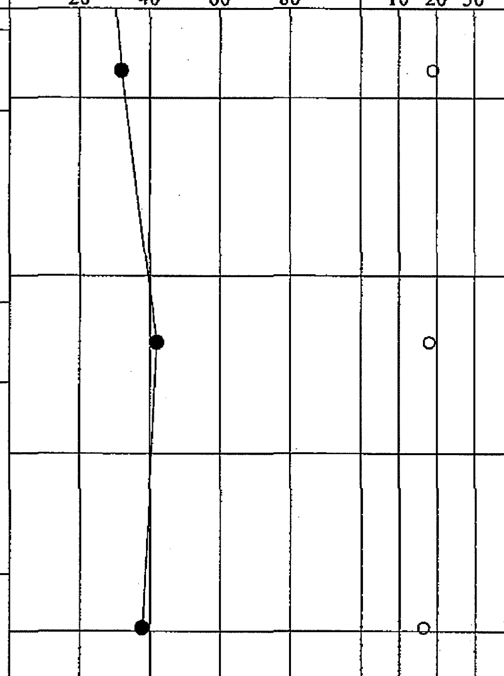
ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	SAMPLE ID	TYPE	N-VALUE
	Dense brown to grey SILT trace sand occ. clayey lenses very moist to wet	7	ss	32
		8	ss	42
354.90 10.30	Hard grey CLAY AND SILT TILL some sand trace gravel damp to moist	9	ss	38
353.92 11.28	End of Borehole			

Depth (m): 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5

SHEAR STRENGTH (kPa) — FIELD VANE: Peak ⊗ Rem. ✕ — LAB TEST: Unc. ■ P.P. □ — 50 100 150 200

PENETRATION RESISTANCE — STANDARD ● DYN. CONE ○ — 20 40 60 80

WATER CONTENT (%) — W_P W W_L — 10 20 30



WELL DATA | DEPTH (m) | REMARKS

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 3

CHUNG & VANDER DOELEN CVD ENGINEERING LTD.

Client:	**Frey Building Contractors**
Project:	**Proposed Renewable Energy Generation Facility**
Location:	**15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine:	**D50T**
Method:	**Hollow Stem Auger**
Size:	**200**
Date:	**Aug 03 / 11** TO **Aug 03 / 11**

SOIL LITHOLOGY / SAMPLE

Ground Elevation: **362.11 m**

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ✕; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)

PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)

WATER CONTENT (%): W_P W W_L (10, 20, 30)

ELEV./ DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	Compact brown Fine to Medium SAND trace silt occ. gravel and cobbles damp to saturated	1	ss	20	Monitor Well installed to 7.6 m depth
		2	ss	20	Water level at 1.44 m depth on August 5, 2011 Water level at 1.46 m depth on August 11, 2011 Water level at 1.57 m depth on August 17, 2011
360.31 1.80	Compact brown to grey SILT occ. sand and clayey lenses wet to saturated	3	ss	18	
		4	ss	16	
357.41 4.70	Firm to stiff grey CLAYEY SILT occ. silt lenses wet to saturated	5	ss	9	
		6	ss	11	

Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0

CVD BOREHOLE 11-07-K01.GPJ CVD_ENG.GDT 8/18/11

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 3

Client: **Frey Building Contractors**

Project: **Proposed Renewable Energy Generation Facility**

Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Aug 03 / 11** TO **Aug 03 / 11**

SOIL LITHOLOGY

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*
	Firm to stiff grey CLAYEY SILT; occ. silt lenses; wet to saturated
353.41 / 8.70	Hard grey CLAY AND SILT TILL some sand trace gravel; ---------- very stiff; damp
347.79 / 14.32	End of Borehole

SAMPLE

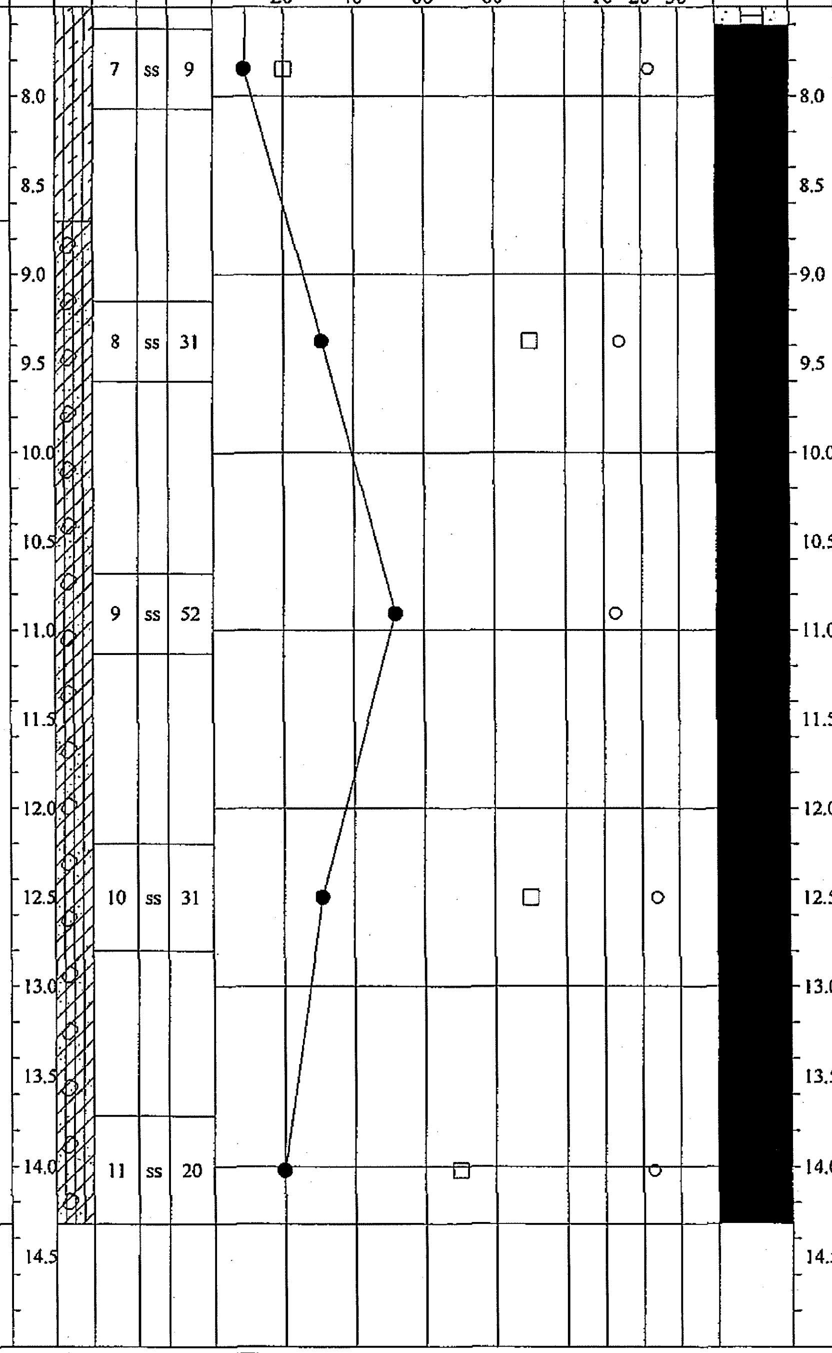
SAMPLE ID	TYPE	N-VALUE	DEPTH (m)
7	ss	9	~7.85
8	ss	31	~9.4
9	ss	52	~10.9
10	ss	31	~12.5
11	ss	20	~14.0

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ✕; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)

PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)

WATER CONTENT (%): W_P W W_L (10, 20, 30)

WELL DATA | DEPTH (m) | REMARKS



PROJECT MANAGER: **RVD**

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Enclosure No.: 4
Sheet 1 of 2

FILE No: 11-07-K01 BOREHOLE No. 4

CVD — CHUNG & VANDER DOELEN ENGINEERING LTD.

Client:	**Frey Building Contractors**
Project:	**Proposed Renewable Energy Generation Facility**
Location:	**15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine:	**D50T**
Method:	**Hollow Stem Auger**
Size:	**200**
Date:	**Jul 29 / 11** TO **Jul 29 / 11**

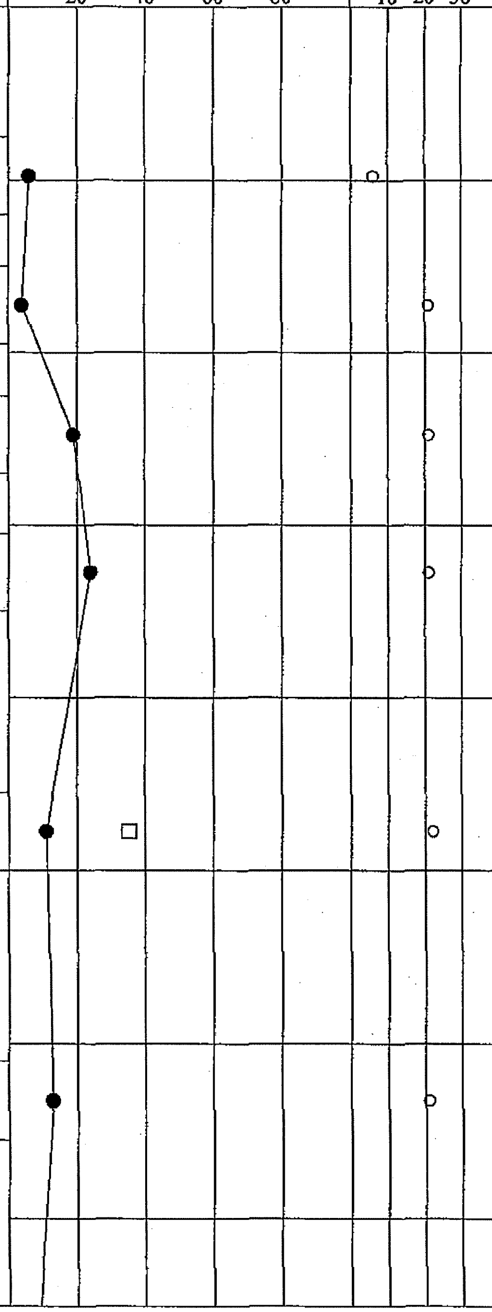
SOIL LITHOLOGY

Ground Elevation: **363.54 m**

ELEV./DEPTH (m)	DESCRIPTION
	175mm TOPSOIL
363.36 / 0.18	Loose brown SANDY SILT; some clay, trace gravel; moist
362.54 / 1.00	Very loose brown Fine SAND; trace silt; damp to moist
361.54 / 2.00	Compact brown SILT; occ. clayey lenses; moist to wet
359.74 / 3.80	Stiff grey CLAYEY SILT; occ. sand and silt lenses; moist with wet seams

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	ss	6
2	ss	4
3	ss	19
4	ss	24
5	ss	11
6	ss	13



WELL DATA | DEPTH (m) | REMARKS

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 4

CHUNG & VANDER DOELEN CVD ENGINEERING LTD.

Client: **Frey Building Contractors**

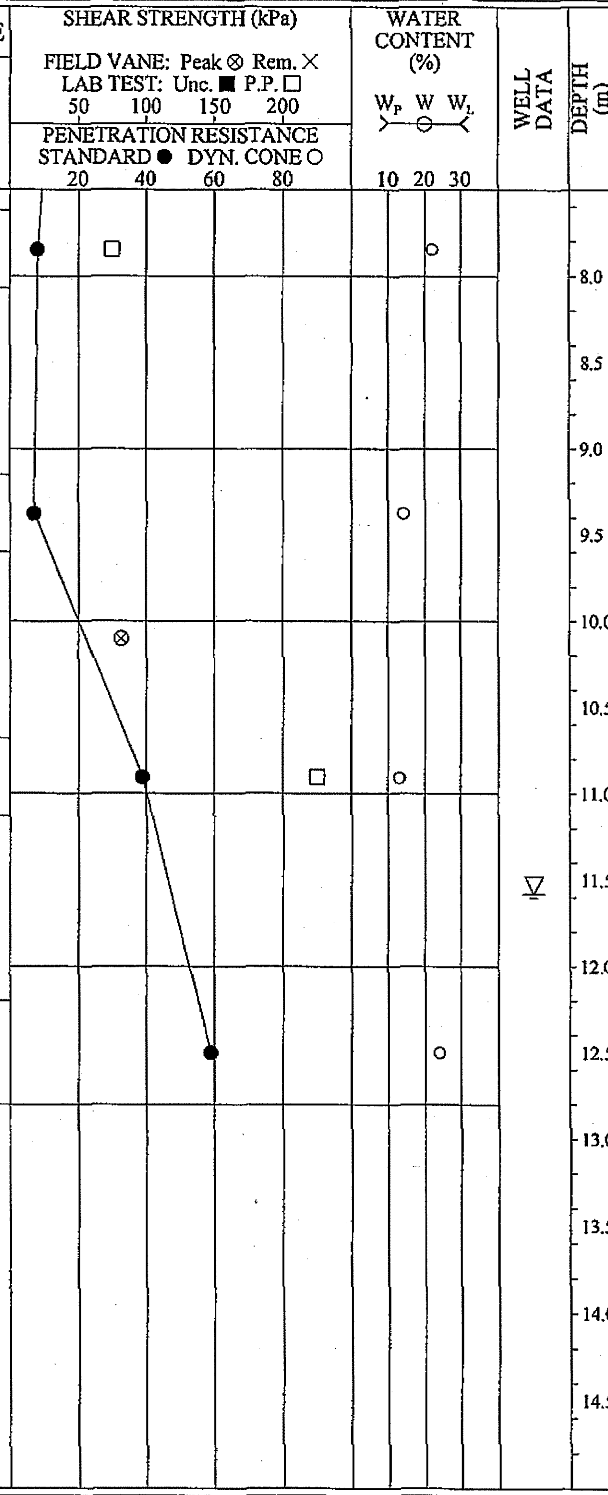
Project: **Proposed Renewable Energy Generation Facility**

Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Jul 29 / 11** TO **Jul 29 / 11**

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	SAMPLE ID	TYPE	N-VALUE	REMARKS
	Firm to stiff grey CLAYEY SILT occ. sand and silt lenses	7	ss	8	
	moist with wet seams	8	ss	7	
353.44 10.10	Hard grey CLAY AND SILT TILL some sand trace gravel	9	ss	39	
					Cave-in at 11.58 m depth at completion of borehole
	damp	10	ss	59	
350.74 12.80	End of Borehole				



PROJECT MANAGER: **RVD**

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311 Victoria Street North
Kitchener, Ontario N2H 5E1
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FILE No: 11-07-K01

BOREHOLE No. 5

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD)

Client: **Frey Building Contractors**
Project: **Proposed Renewable Energy Generation Facility**
Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Jul 29 / 11** TO **Jul 29 / 11**

SOIL LITHOLOGY

Ground Elevation: **361.75 m**

ELEV./ DEPTH (m)	DESCRIPTION
	200mm TOPSOIL
361.55 / 0.20	Very loose brown SANDY SILT, some clay, trace gravel, moist to wet
360.40 / 1.35	Stiff brown CLAYEY SILT, occ. silt lenses, moist to very moist; ------- grey, wet
358.75 / 3.00	Compact brown SILT, occ. clayey lenses, moist to wet
357.55 / 4.20	Stiff grey CLAYEY SILT, occ. silt lenses, moist with wet seams
355.05 / 6.70	Very stiff grey CLAY AND SILT TILL, some sand, trace gravel, damp to moist

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	ss	4
2	ss	13
3	ss	16
4	ss	10
5	ss	12
6	ss	13

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □; 50 100 150 200
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○; 20 40 60 80
WATER CONTENT (%): W_P W W_L; 10 20 30
WELL DATA | DEPTH (m) | REMARKS

PROJECT MANAGER: **RVD**

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 11-07-K01

BOREHOLE No. 5

Client:	Frey Building Contractors
Project:	Proposed Renewable Energy Generation Facility
Location:	15 Martins Lane, Elmira, Ontario

EQUIPMENT DATA

Machine:	D50T
Method:	Hollow Stem Auger
Size:	200
Date:	Jul 29 / 11 TO Jul 29 / 11

SOIL LITHOLOGY | SAMPLE | SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200) | PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80) | WATER CONTENT (%): W_P W W_L (10, 20, 30) | WELL DATA | REMARKS

ELEV./ DEPTH (m)	DESCRIPTION *(continued)*	DEPTH (m)	SAMPLE ID	TYPE	N-VALUE	REMARKS
	Very stiff grey CLAY AND SILT TILL some sand trace gravel	8.0	7	ss	26	
	----- hard	8.5				
		9.0				Cave-in at 9.15 m depth at completion of borehole
		9.5	8	ss	38	
		10.0				
	damp	10.5				
		11.0	9	ss	40	
350.47 11.28	End of Borehole	11.5				
		12.0				
		12.5				
		13.0				
		13.5				
		14.0				
		14.5				

PROJECT MANAGER: **RVD**

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ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 11-07-K01 BOREHOLE No. 6

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client: **Frey Building Contractors**

Project: **Proposed Renewable Energy Generation Facility**

Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Aug 03 / 11** TO **Aug 03 / 11**

SOIL LITHOLOGY

Ground Elevation: **359.66 m**

ELEV./ DEPTH (m)	DESCRIPTION
	350mm TOPSOIL
359.31 / 0.35	Compact brown Fine SAND, some silt to SILTY SAND; trace silt; occ. gravel and cobbles; moist to saturated
358.31 / 1.35	Compact brown to grey SILT; occ. clayey lenses; wet
357.56 / 2.10	Firm to stiff grey CLAYEY SILT; occ. silt lenses; very moist to wet
353.66 / 6.00	Stiff grey CLAY AND SILT TILL; some sand; trace gravel; ------- hard; damp to moist

SAMPLE

SAMPLE ID	TYPE	N-VALUE	Depth (m)
1	ss	23	1.0
2	ss	17	1.75
3	ss	15	2.5
4	ss	10	3.25
5	ss	6	4.0
6	ss	8	4.75
7	ss	11	6.25

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. × ; LAB TEST: Unc. ■ P.P. □ ; 50 100 150 200

PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ ; 20 40 60 80

WATER CONTENT (%): W_P W W_L ; 10 20 30

WELL DATA

REMARKS

- Monitor Well installed to 7.6 m depth
- Water level at 1.15 m depth on August 5, 2011
- Water level at 0.98 m depth on August 11, 2011
- Water level at 0.91 m depth on August 17, 2011

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01 — BOREHOLE No. 6

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client: **Frey Building Contractors**
Project: **Proposed Renewable Energy Generation Facility**
Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA
Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Aug 03 / 11** TO **Aug 03 / 11**

ELEV./ DEPTH (m)	SOIL LITHOLOGY: DESCRIPTION (continued)	DEPTH (m)	SYMBOL	SAMPLE ID	TYPE	N-VALUE	SHEAR STRENGTH (kPa) FIELD VANE: Peak ⊗ Rem. × LAB TEST: Unc. ■ P.P. □ 50 100 150 200 / PENETRATION RESISTANCE STANDARD ● DYN. CONE ○ 20 40 60 80	WATER CONTENT (%) W_P W W_L 10 20 30	WELL DATA	DEPTH (m)	REMARKS
	Hard grey CLAY AND SILT TILL some sand trace gravel damp	8.0		8	ss	84	●	○		8.0	
351.44 8.22	End of Borehole	8.5								8.5	
		9.0								9.0	
		9.5								9.5	
		10.0								10.0	
		10.5								10.5	
		11.0								11.0	
		11.5								11.5	
		12.0								12.0	
		12.5								12.5	
		13.0								13.0	
		13.5								13.5	
		14.0								14.0	
		14.5								14.5	

PROJECT MANAGER: **RVD**

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Enclosure No.: 7
Sheet 1 of 1

FILE No: 11-07-K01

BOREHOLE No. 7

CHUNG & VANDER DOELEN ENGINEERING LTD. CVD

Client: Frey Building Contractors
Project: Proposed Renewable Energy Generation Facility
Location: 15 Martins Lane, Elmira, Ontario

EQUIPMENT DATA
Machine: D50T
Method: Hollow Stem Auger
Size: 200
Date: Jul 28 / 11 TO Jul 28 / 11

SOIL LITHOLOGY

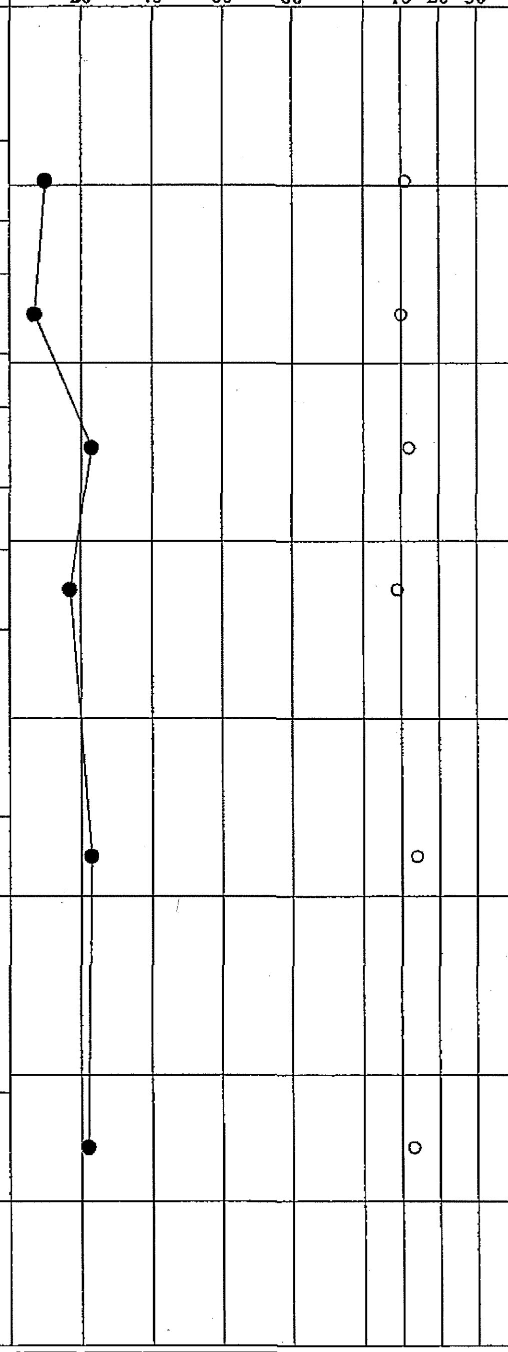
Ground Elevation: 365.50 m

ELEV / DEPTH (m)	DESCRIPTION
365.22 / 0.28	275mm TOPSOIL
361.80 / 3.70	Loose to compact brown SANDY SILT; some clay, trace gravel occ. cobbles; damp to moist
358.80 / 6.70	Compact brown to grey SILT; trace clay and sand; -occ. saturated sand and gravel lenses/pockets; moist to wet
	End of Borehole

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	ss	10
2	ss	7
3	ss	23
4	ss	17
5	ss	23
6	ss	22

SHEAR STRENGTH (kPa) — FIELD VANE: Peak ⊗ Rem. × ; LAB TEST: Unc. ■ P.P. □ ; 50 100 150 200
PENETRATION RESISTANCE — STANDARD ● DYN. CONE ○ ; 20 40 60 80
WATER CONTENT (%) — W_P W W_L ; 10 20 30



WELL DATA | DEPTH (m) | REMARKS

5.0 — Water level at 5.03 m depth at completion of borehole

PROJECT MANAGER: RVD

CHUNG & VANDER DOELEN ENGINEERING LTD.
311 Victoria Street North
Kitchener, Ontario N2H 5E1
ph. (519) 742-8979, fx. (519) 742-7739

FILE No: 11-07-K01

BOREHOLE No. 8

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD)

Client: **Frey Building Contractors**

Project: **Proposed Renewable Energy Generation Facility**

Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Jul 28 / 11** TO **Jul 28 / 11**

Ground Elevation: **365.37 m**

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □; 50 100 150 200
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○; 20 40 60 80
WATER CONTENT (%): W_P W W_L; 10 20 30

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
365.12 / 0.25	250mm TOPSOIL				
361.57 / 3.80	Compact brown SANDY SILT; some clay, trace gravel, occ. cobbles; ------ dense; damp to moist	1	ss	10	
		2	ss	11	
		3	ss	23	
		4	ss	34	
360.97 / 4.40	Compact brown GRAVELLY SAND; moist to wet	5	ss	22	
360.17 / 5.20	Compact interbedded SAND, SILT and CLAYEY SILT; wet to saturated	6	ss	18	
358.82 / 6.55	Compact brown to grey SILT; trace clay; wet	7	ss	23	Water level at 5.33 m depth at completion of borehole
	End of Borehole				

PROJECT MANAGER: **RVD**

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FILE No: 11-07-K01

BOREHOLE No. 9

CHUNG & VANDER DOELEN CVD ENGINEERING LTD.

Client: **Frey Building Contractors**
Project: **Proposed Renewable Energy Generation Facility**
Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA
Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Jul 29 / 11** TO **Jul 29 / 11**

SOIL LITHOLOGY — Ground Elevation: **362.39 m**

ELEV / DEPTH (m)	DESCRIPTION
362.16 / 0.23	225mm TOPSOIL
359.64 / 2.75	Loose to compact brown SANDY SILT; some clay, trace gravel, occ. cobbles; damp to moist
357.69 / 4.70	Compact brown Fine SAND; trace silt; saturated
355.84 / 6.55	Compact brown to grey SILT; occ. to frequent clayey silt seams; moist to wet
	End of Borehole

SAMPLE

SAMPLE ID	TYPE	N-VALUE
1	ss	7
2	ss	18
3	ss	15
4	ss	16
5	ss	26
6	ss	16

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)
WATER CONTENT (%): W_P W W_L (10, 20, 30)

WELL DATA / DEPTH (m) / REMARKS

- Water level at 1.83 m depth at completion of borehole
- Cave-in at 2.75 m depth at completion of borehole

PROJECT MANAGER: **RVD**

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Enclosure No.: 10
Sheet 1 of 1

FILE No: 11-07-K01 — BOREHOLE No. 10

CHUNG & VANDER DOELEN CVD ENGINEERING LTD.

Client: **Frey Building Contractors**
Project: **Proposed Renewable Energy Generation Facility**
Location: **15 Martins Lane, Elmira, Ontario**

EQUIPMENT DATA
Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **200**
Date: **Jul 29 / 11** TO **Jul 29 / 11**

Ground Elevation: **358.48 m**

SHEAR STRENGTH (kPa): FIELD VANE: Peak ⊗ Rem. ×; LAB TEST: Unc. ■ P.P. □ (50, 100, 150, 200)
PENETRATION RESISTANCE: STANDARD ● DYN. CONE ○ (20, 40, 60, 80)
WATER CONTENT (%): W_P W W_L (10, 20, 30)

ELEV./DEPTH (m)	DESCRIPTION	SAMPLE ID	TYPE	N-VALUE	REMARKS
	300mm TOPSOIL				
358.18 / 0.30	Stiff mottled brown CLAYEY SILT, occ. sand lenses, moist	1	ss	10	
		2	ss	14	
	grey, occ. silt lenses	3	ss	9	
	moist to wet	4	ss	8	
		5	ss	8	
		6	ss	10	
351.93 / 6.55	End of Borehole				Borehole dry and open at completion

PROJECT MANAGER: **RVD**

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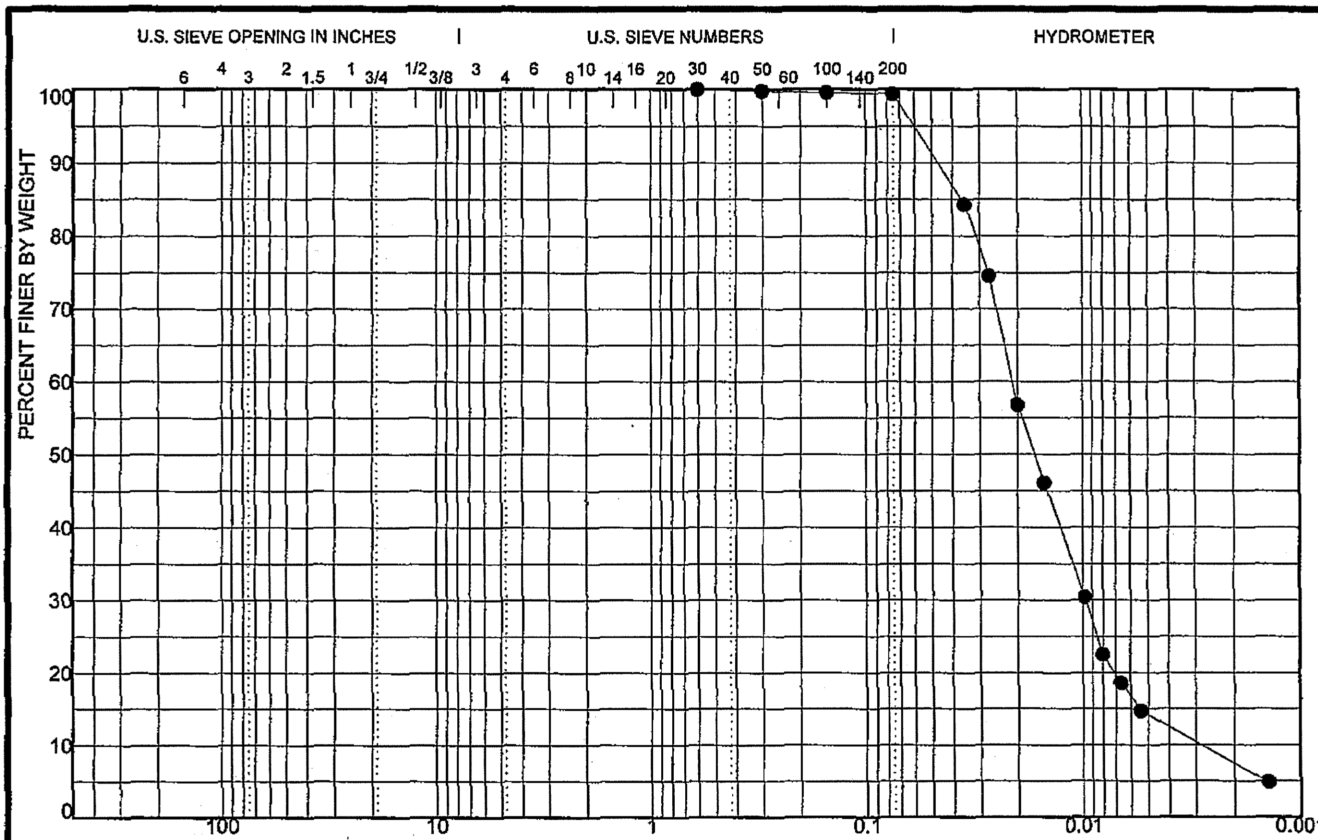
APPENDIX B

GRAIN SIZE DISTRIBUTION RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
LAB. NO.: 8403					1.58	7.47

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	0.6	0.021	0.01	0.003	0.0	0.6	99.4	

Type of Material: Silt, trace clay
Sample No. 4
Source:
Sampled From: BH-5, from 3.05 to 3.5 m depth
Date: 8/17/2011
Client: Frey Building Contractors
Contractor:
Sampled By: DM
Date Sampled: 7/29/2011
Tested By: DF
Date Tested: 8/8/2011

SIEVE SIZES mm	PERCENT PASSING	No Specifications

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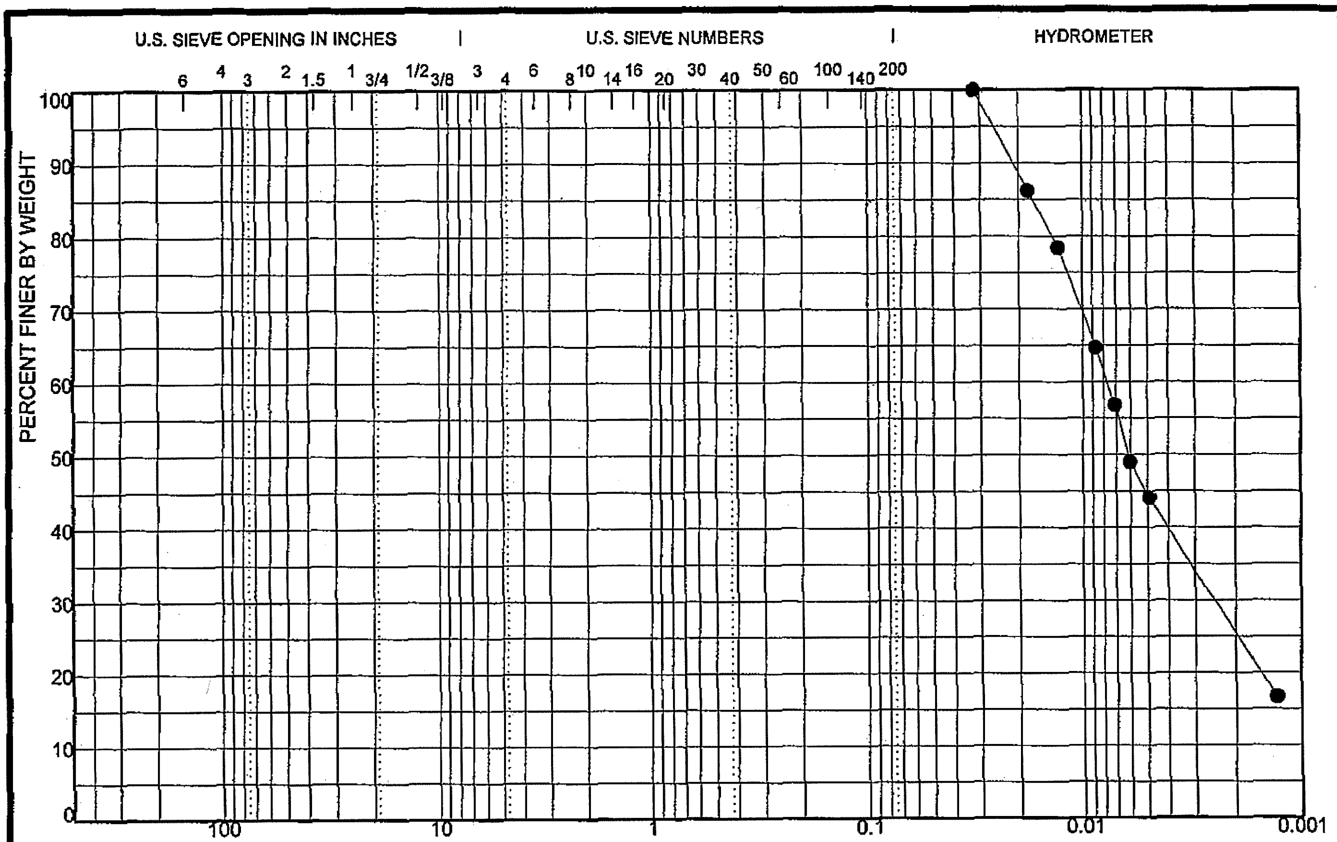
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: Proposed Renewable Energy Generation Facility
Location: 15 Martins Lane, Elmira, Ontario
File No.: 11-07-K01
Enclosure No.: 11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification			LL	PL	PI	Cc	Cu
LAB. NO.:	8404								

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	0.032	**0.008**	**0.002**		**0.0**	**0.0**		

Type of Material: Clayey Silt
Sample No. 5
Source:
Sampled From: BH-5, from 4.55 to 5.0 m depth
Date: 8/17/2011
Client: Frey Building Contractors
Contractor:
Sampled By: DM
Date Sampled: 7/29/2011
Tested By: DF
Date Tested: 8/8/2011

SIEVE SIZES mm	PERCENT PASSING	No Specifications

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Kitchener, Ontario N2H 5E1
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Fax: 519-742-7739
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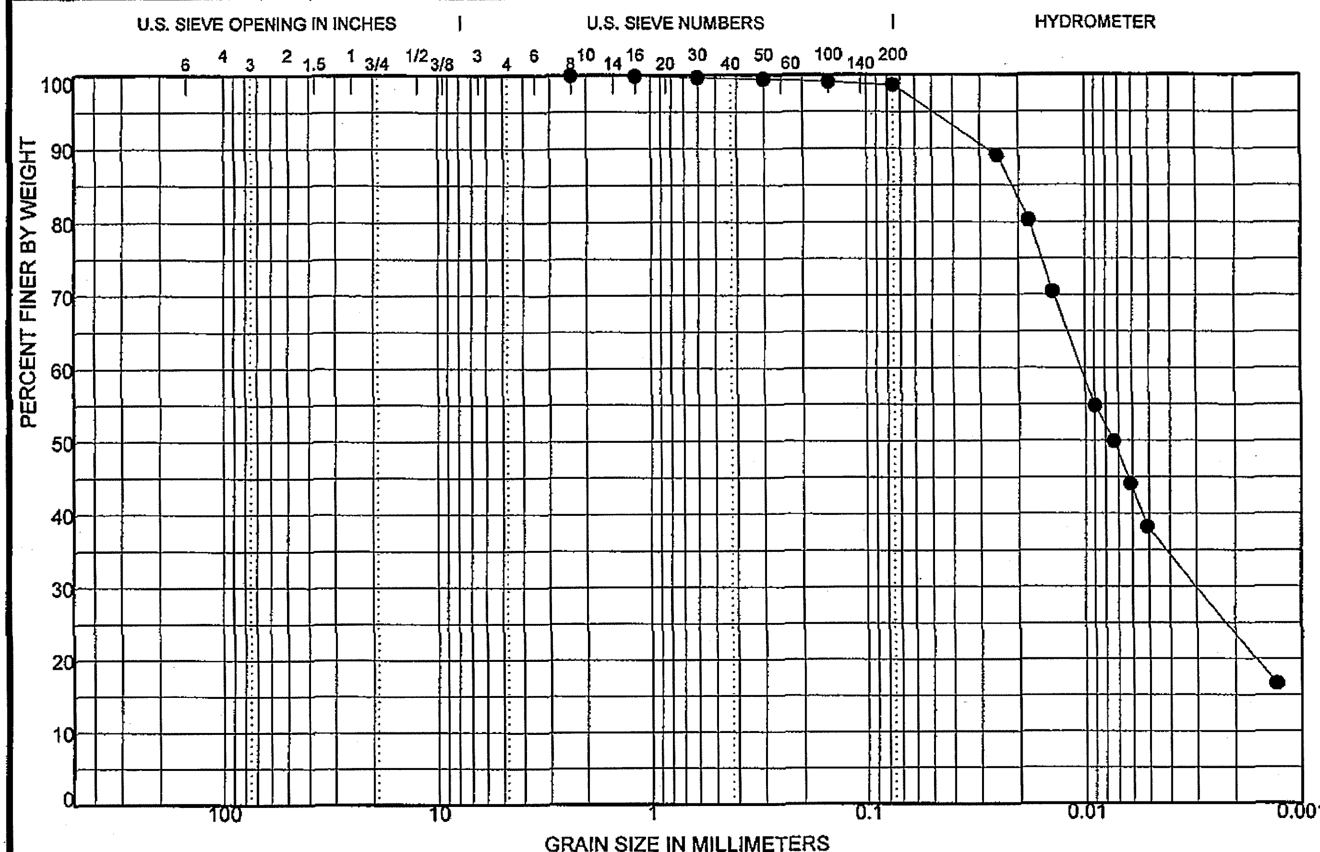
GRAIN SIZE DISTRIBUTION

Project: Proposed Renewable Energy Generation Facility
Location: 15 Martins Lane, Elmira, Ontario
File No.: 11-07-K01
Enclosure No.: 12



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification		LL	PL	PI	Cc	Cu
LAB. NO.:	8405							

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	2.36	0.01	0.003		0.0	1.3	98.7	

Type of Material: Clayey Silt
Sample No. 3
Source:
Sampled From: BH-10, from 2.25 to 2.7 m depth
Date: 8/17/2011
Client: Frey Building Contractors
Contractor:
Sampled By: DM
Date Sampled: 7/29/2011
Tested By: DF
Date Tested: 8/8/2011

SIEVE SIZES mm	PERCENT PASSING	No Specifications

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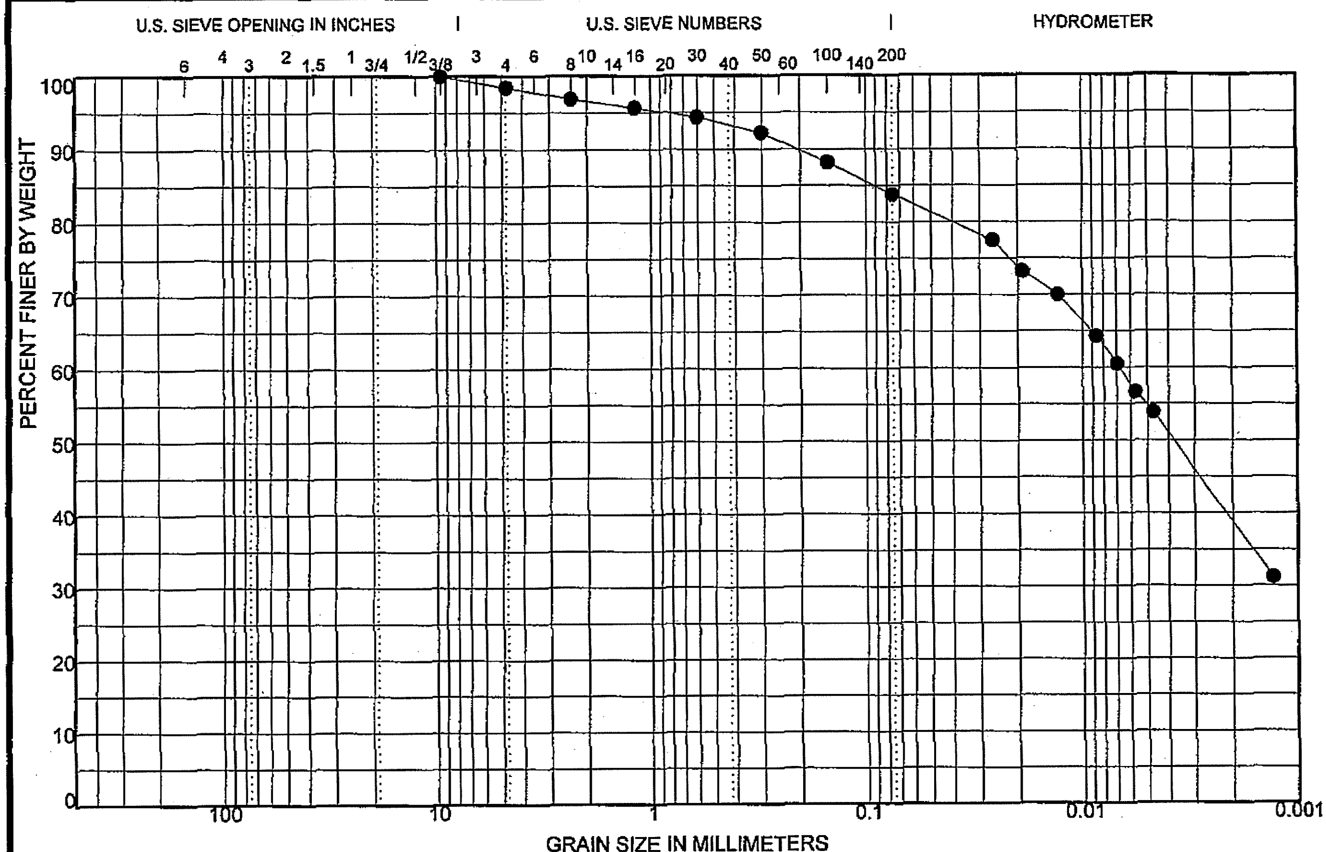
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: Proposed Renewable Energy Generation Facility
Location: 15 Martins Lane, Elmira, Ontario
File No.: 11-07-K01
Enclosure No.: 13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
LAB. NO.: 8415						

FM	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
	9.5	0.007			1.5	14.7	83.8	

Type of Material:	Clay and Silt Till, some sand, trace gravel
Sample No.	7
Source:	
Sampled From:	BH-6, from 6.1 to 6.55 m depth
Date:	8/18/2011
Client:	Frey Building Contractors
Contractor:	
Sampled By:	DM
Date Sampled:	8/3/2011
Tested By:	DF
Date Tested:	8/15/2011

SIEVE SIZES mm	PERCENT PASSING	No Specifications

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311 Victoria Street North
Kitchener, Ontario N2H 5E1
Telephone: 519-742-8979
Fax: 519-742-7739
e-mail: info@cvdengineering.com

GRAIN SIZE DISTRIBUTION

Project: Proposed Renewable Energy Generation Facility
Location: 15 Martins Lane, Elmira, Ontario
File No.: 11-07-K01
Enclosure No.: 14

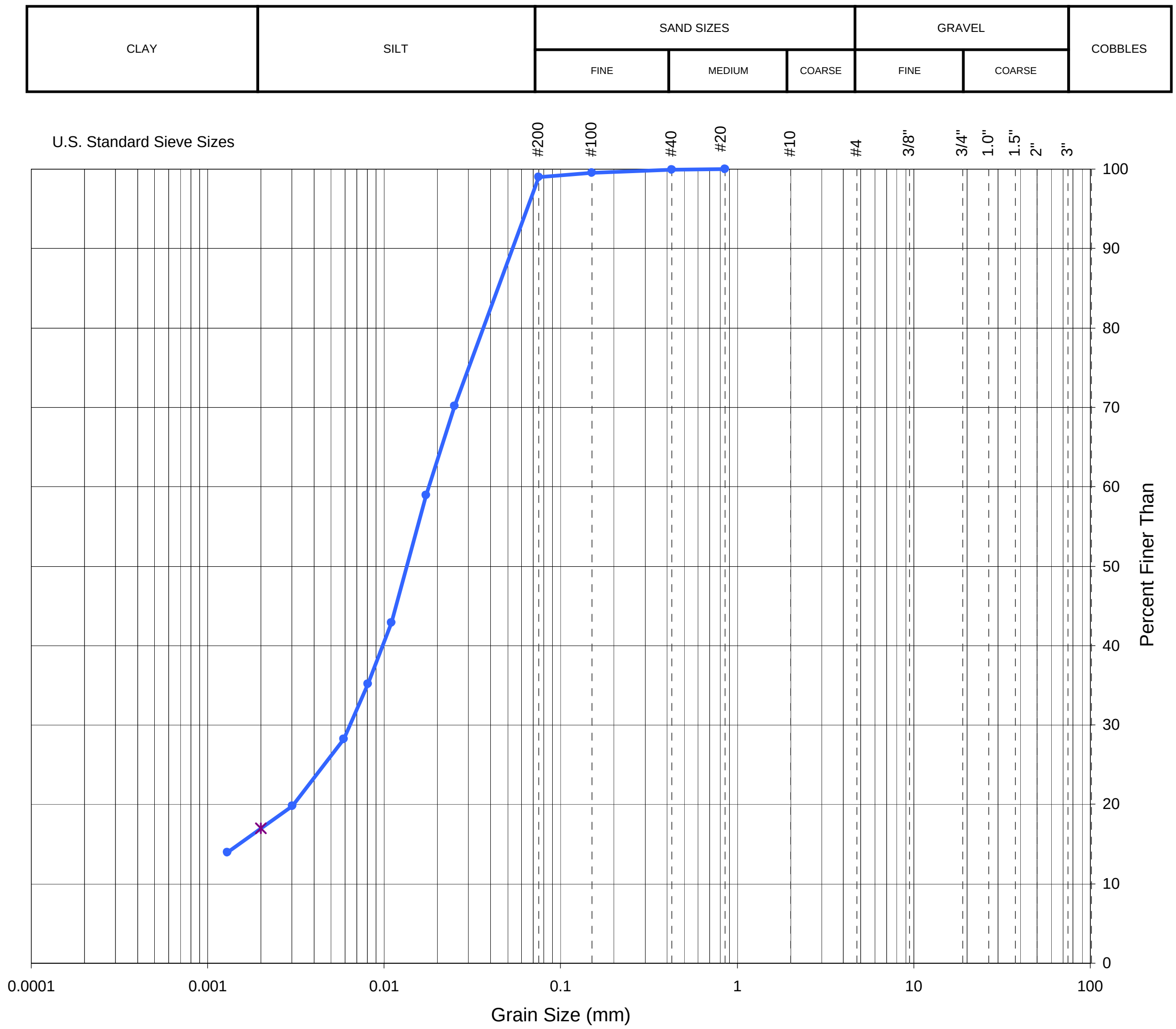
NO SPECIFICATIONS 11-07-K01 FREY BIO-EN.GPJ LAW LNDN.GDT 8/22/11

INSPEC-SOL

SAMPLE DATE: October 6, 2011
SAMPLE LOCATION: BH3
SAMPLE No.: -
SAMPLE DEPTH: -
SAMPLED BY: Roger Waller

PROJECT: Woolwich Bio Enrichment Facility
LOCATION: Elmira, Ontario
CLIENT : Conestoga Rovers and Associates
PROJECT NO.: T050123-B1

TEST DATE: October 18, 2011
TESTED BY: N. Krebs
LAB No. : WLA 0072-4



PARTICLE SIZE DISTRIBUTION

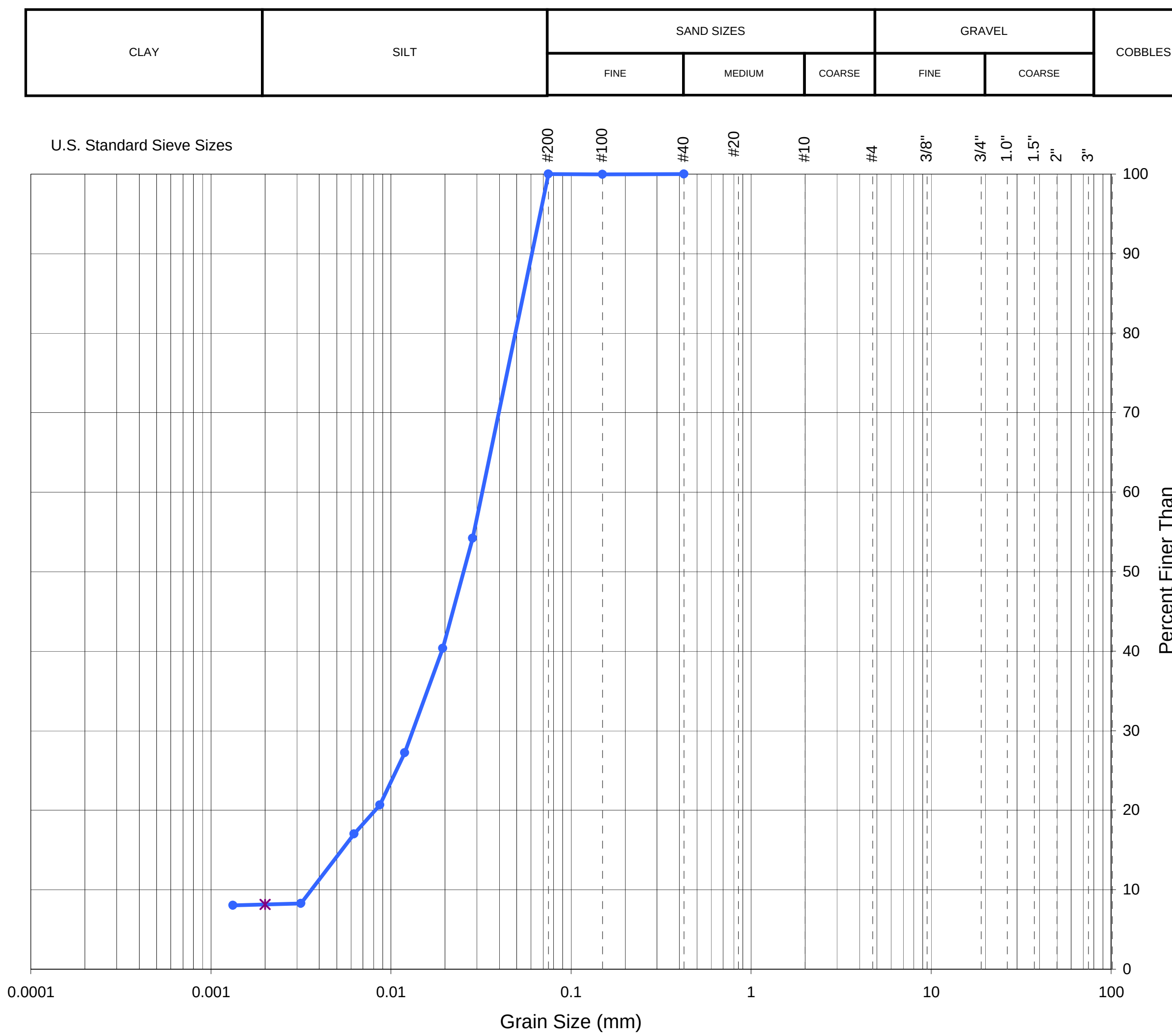
DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY		
Silt, some clay, trace sand	AND	36 - 50 %	GRAVEL	0	%
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	1	%
	SOME	11 - 20 %	SILT	82	%
	TRACE	1 - 10 %	CLAY	17	%

INSPEC-SOL

SAMPLE DATE: October 6, 2011
SAMPLE LOCATION: BH4
SAMPLE No.: -
SAMPLE DEPTH: -
SAMPLED BY: Roger Waller

PROJECT: Woolwich Bio Enrichment Facility
LOCATION: Elmira, ON
CLIENT : Conestoga Rovers and Associates
PROJECT NO.: T050123-B1

TEST DATE: October 18, 2011
TESTED BY: N. Krebs
LAB No. : WLA 0072-5



PARTICLE SIZE DISTRIBUTION

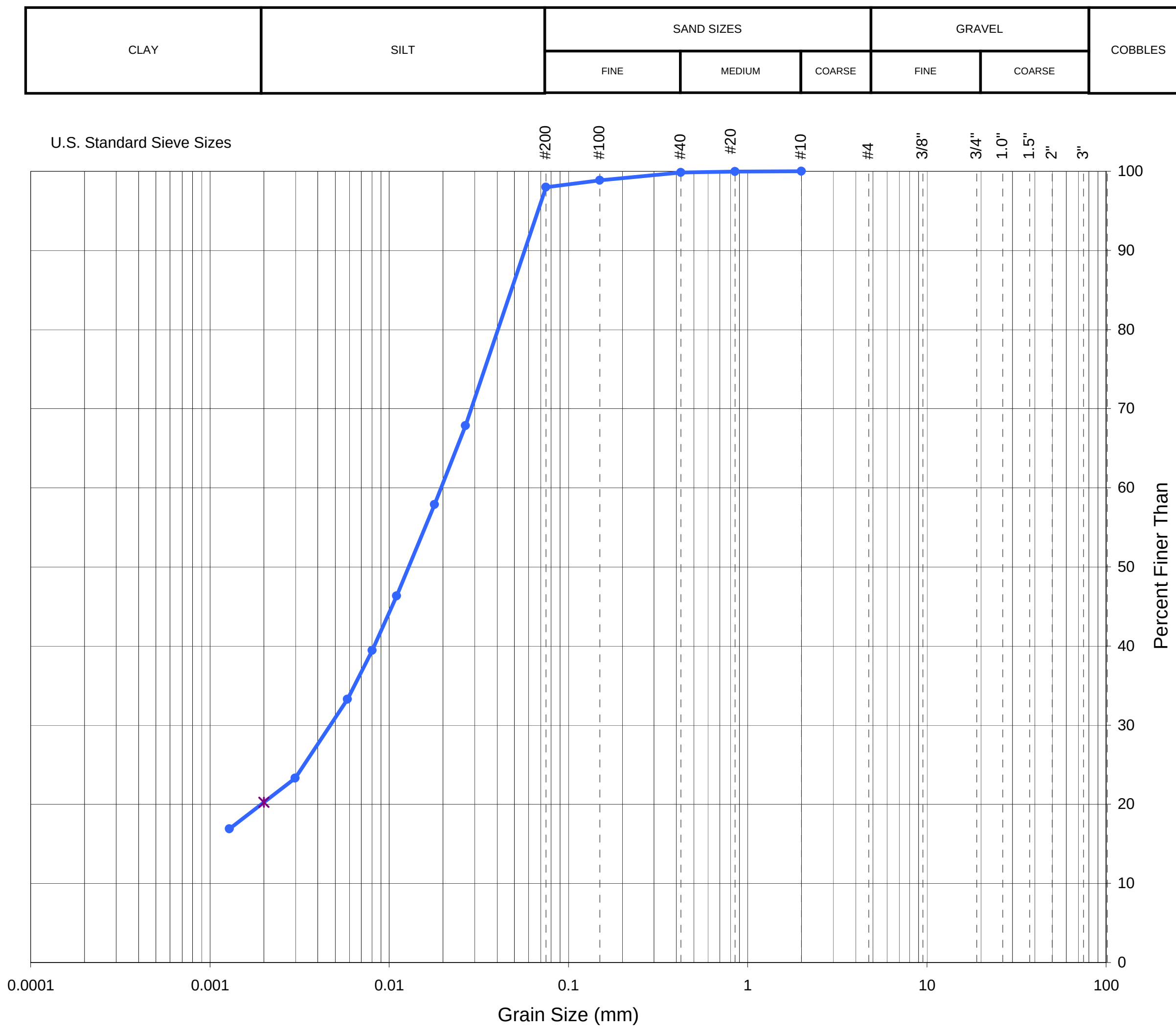
DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
Silt, trace clay	AND	36 - 50 %	GRAVEL	0 %
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	0 %
	SOME	11 - 20 %	SILT	92 %
	TRACE	1 - 10 %	CLAY	8 %

![INSPEC-SOL]

SAMPLE DATE: October 6, 2011
SAMPLE LOCATION: BH5
SAMPLE No.: -
SAMPLE DEPTH: -
SAMPLED BY: Roger Waller

PROJECT: Woolwich Bio En. Facility
LOCATION: Elmira, ON
CLIENT : Conestoga Rovers and Associates
PROJECT NO.: T050123-B1

TEST DATE: October 18, 2011
TESTED BY: N. Krebs
LAB No. : WLA 0072-6



PARTICLE SIZE DISTRIBUTION

DESCRIPTION	SOIL CLASSIFICATION DESCRIPTIVE MODIFIERS		SUMMARY	
Silt, some clay, trace sand	AND	36 - 50 %	GRAVEL	0 %
	ADJECTIVE (e.g. sandy)	21 - 35 %	SAND	2 %
	SOME	11 - 20 %	SILT	78 %
	TRACE	1 - 10 %	CLAY	20 %

APPENDIX C

PERMEABILITY TEST RESULTS

INSPEC-SOL ENGINEERING SOLUTIONS

Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)
(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 3 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-1**

Type of material	**Sandy SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	4.9	
Dry Density, kg/m^3	1788	
Moisture, %	19.9	20.6

Permeation Condition		
Cell pressure	kPa	*300.0*
Head pressure	kPa	*288.6*
Back pressure	kPa	*284.5*
Volume under steady flow	cm^3	*4.86*
Hydraulic gradient, I	-	*8.5*

Hydraulic Conductivity:	***cm/s***	***7.4E-05***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011

INSPEC-SOL ENGINEERING SOLUTIONS

Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)
(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 4 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-2**

Type of material	**Sandy SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	5.0	
Dry Density, kg/m^3	1627	
Moisture, %	21.1	17.6

Permeation Condition		
Cell pressure	kPa	*300*
Head pressure	kPa	*287.8*
Back pressure	kPa	*281.8*
Volume under steady flow	cm^3	*6.01*
Hydraulic gradient, I	-	*12.2*

Hydraulic Conductivity:	***cm/s***	***4.0E-06***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011

Measurement of Hydraulic Conductivity of Saturated Porous Material Using a Flexible Wall Permeameter

Falling Head Raising Tail (Method C)

(ASTM D-5084)

Project Name:	**CRA Lab Testing Services**
Project No.:	**T050123-B1 (CRA # 046254)**
Project Location:	**15 Martins Lane, Elmira, Ontario (Woolwich Bio-En Inc.)**
Client:	**Conestoga Rovers & Associates**

Sample Location and Type	**BH 5 Shelby Tube**
Date Sampled	**6-Oct-11**
Date Tested	**10/7/2011-10/14/2011**
Lab #	**WLA 0072-3**

Type of material	**Sandy SILT**

Sample Parameters	Initial	Final
Diameter, cm	5.0	
Length, cm	5.2	
Dry Density, kg/m^3	1803	
Moisture, %	22.5	17.1

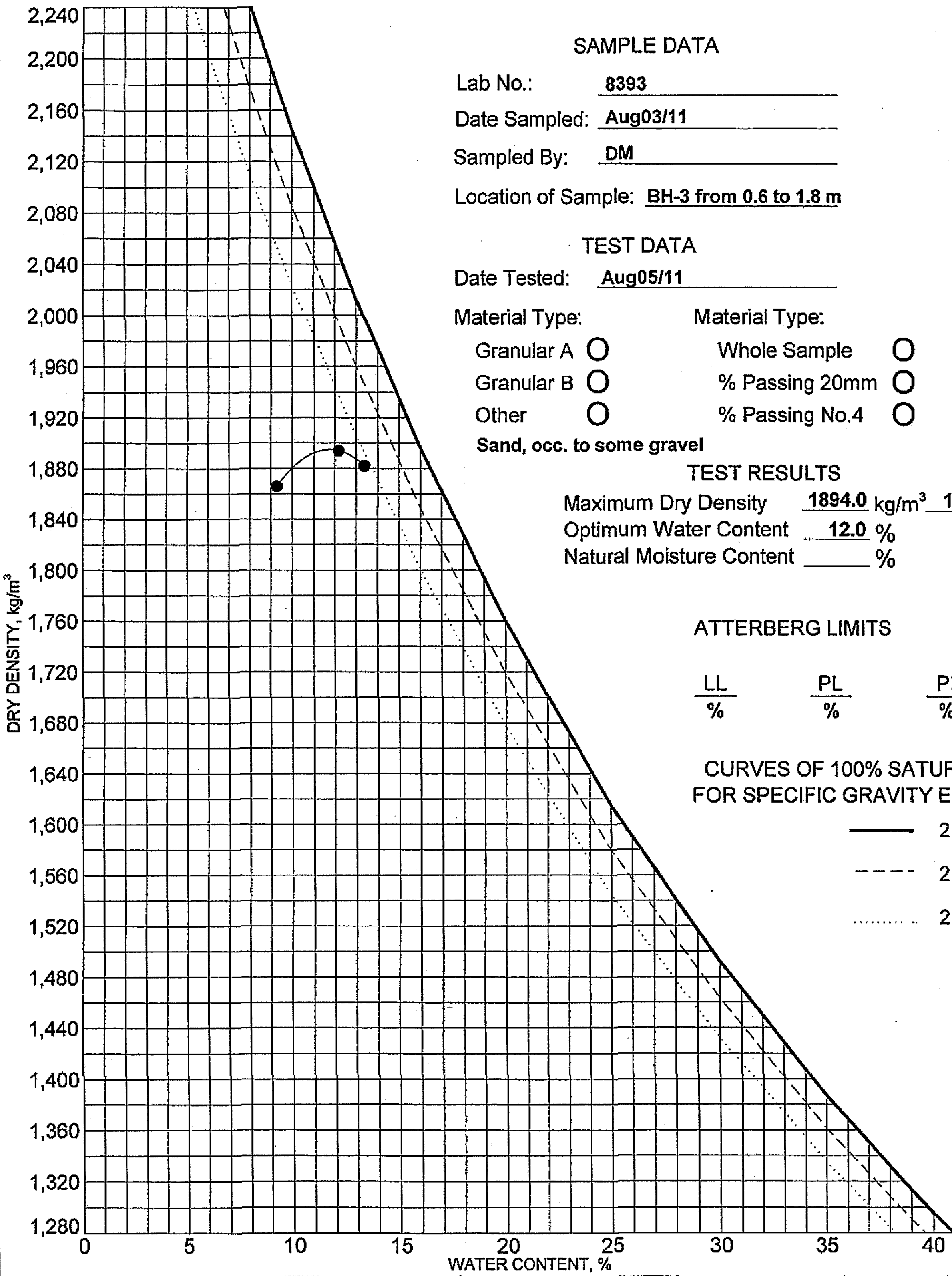
Permeation Condition		
Cell pressure	kPa	*300*
Head pressure	kPa	*288.0*
Back pressure	kPa	*281.0*
Volume under steady flow	cm^3	*8.28*
Hydraulic gradient, I	-	*13.7*

Hydraulic Conductivity:	***cm/s***	***1.2E-05***

REPORTED BY: Michael Braverman **DATE:** October 19, 2011
VERIFIED BY: Ali Nasseri-Moghaddam, Ph.D., P.Eng. **DATE:** October 19, 2011

APPENDIX D

STANDARD PROCTOR TEST RESULTS



SAMPLE DATA

Lab No.: 8393

Date Sampled: Aug03/11

Sampled By: DM

Location of Sample: BH-3 from 0.6 to 1.8 m

TEST DATA

Date Tested: Aug05/11

Material Type:		Material Type:	
Granular A	O	Whole Sample	O
Granular B	O	% Passing 20mm	O
Other	O	% Passing No.4	O

Sand, occ. to some gravel

TEST RESULTS

Maximum Dry Density **1894.0** kg/m³ **118.2** PCF

Optimum Water Content **12.0** %

Natural Moisture Content ______ %

ATTERBERG LIMITS

LL	PL	PI
%	%	%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

- ——— 2.80
- - - - - 2.70
- 2.60

CHUNG & VANDER DOELEN ENGINEERING LTD.
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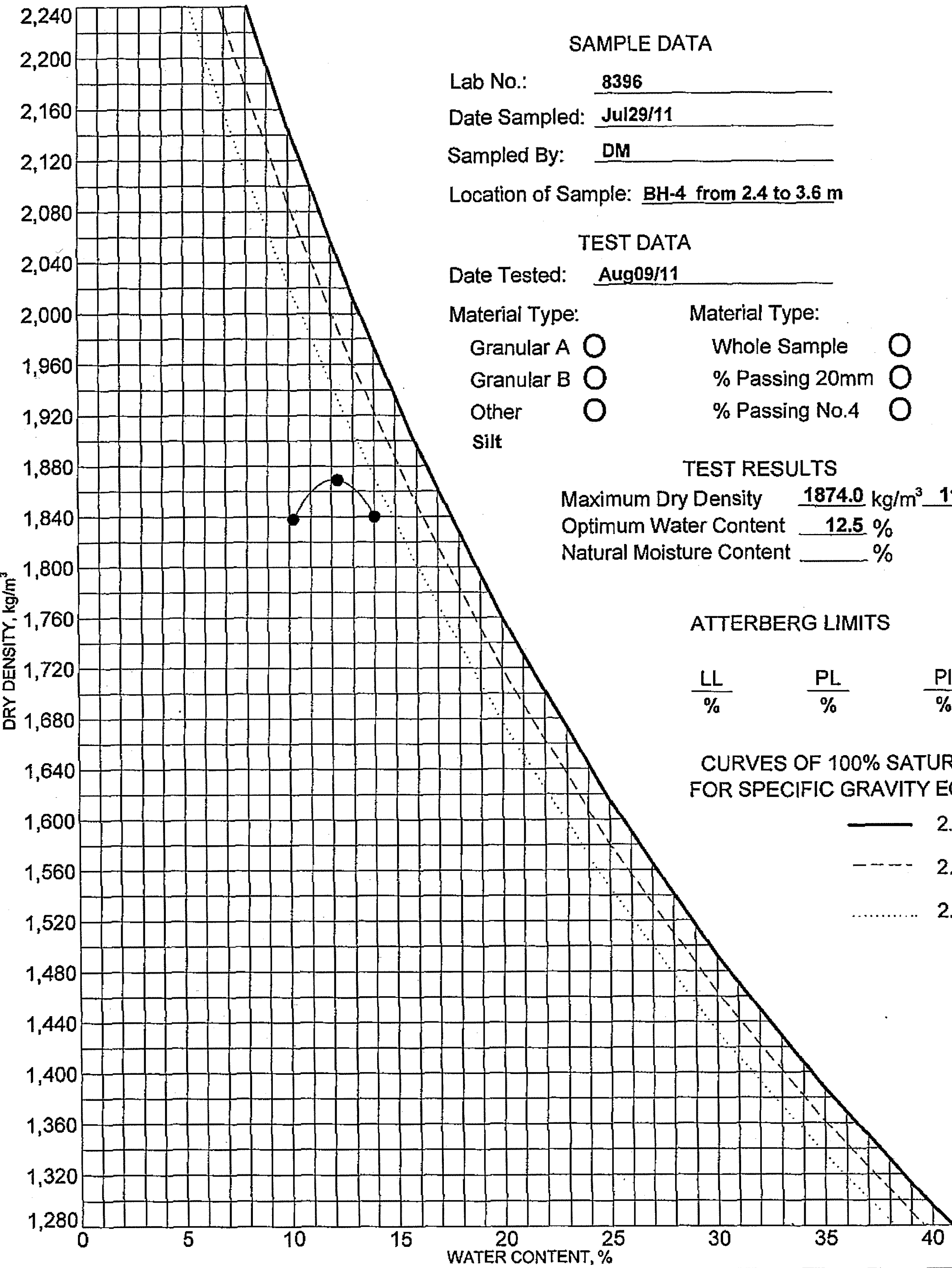
STANDARD PROCTOR TEST RESULTS

Project: **Proposed Renewable Energy Generation Facility**

Location: **15 Martins Lane, Elmira, Ontario**

File No.: **11-07-K01**

Enclosure No.: 15



SAMPLE DATA

Lab No.: 8396

Date Sampled: Jul29/11

Sampled By: DM

Location of Sample: BH-4 from 2.4 to 3.6 m

TEST DATA

Date Tested: Aug09/11

Material Type:
- Granular A O
- Granular B O
- Other O
- Silt

Material Type:
- Whole Sample O
- % Passing 20mm O
- % Passing No.4 O

TEST RESULTS

Maximum Dry Density 1874.0 kg/m³ 117.0 PCF

Optimum Water Content 12.5 %

Natural Moisture Content ____ %

ATTERBERG LIMITS

LL	PL	PI
%	%	%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

- ——— 2.80
- - - - 2.70
- 2.60

CAN COMPACTION 11-07-K01.GPJ LAW LNDN.GDT 8/17/11

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STANDARD PROCTOR TEST RESULTS

Project: Proposed Renewable Energy Generation Facility

Location: 15 Martins Lane, Elmira, Ontario

File No.: 11-07-K01

Enclosure No.: 16