APPENDIX A – GEOTECHNICAL REPORT

TREK GEOTECHNICAL Quality Engineering | Valued Relationships

Brady Road Leaf and Yard Waste and Pilot Biosolids Composting

Final Report
September 19, 2012

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Table of Contents

List of Figures

List of Appendices

1.0 Introduction

This report summarizes the results of the geotechnical investigation completed by TREK Geotechnical Inc. (TREK) for the Leaf and Yard Waste Composting Facility and Pilot Biosolids Composting Facility at the Brady Road Resource Management Facility in Winnipeg, Manitoba. The terms of reference for the investigation are included in our subconsultant agreement with CH2MHILL that was effective June 15, 2012. The scope of work includes a sub-surface investigation, laboratory testing, and the provision of recommendations for the design and construction of foundations, liners and pavements.

2.0 Background and Existing Information

The proposed facility will consist of the following components:

Leaf and Yard Waste Pad: This will be a clay lined pad for storage and windrowing of leaf and yard waste. The pad is required to support daily truck traffic and loaders for moving materials on-site. A 0.5 m thick compacted clay liner is proposed below the traffic pad. Various surface treatments options for the top of the pad are under consideration including: wood chips only, lean mix concrete, or a cement stabilized pad.

Pond in Wetlands Area: A relatively shallow pond (about 4 m deep) will be developed in the proposed wetlands area located immediately south east of the site. This area will also be used as a borrow source for imported clay fill for the project.

Aerated Static Pile Bunkers: This area will consist of a concrete slab on-grade. Dry stack retaining walls e.g. Lock-Block® will be placed at several locations along the slab. At these locations the slab will be thickened to support the additional static load from the wall load. The slab will be subjected to loading by construction equipment such as loaders.

Biofilter: The biofilter will be a large concrete slab with aeration pipes running through it at regularly spaced intervals. The pad will be subject to heavy equipment loading on an annual basis e.g. loader.

Mixing and Receiving Building: This building will consist of a steel truss frame with a canvas cover. There will be a grade supported concrete floor slab throughout.

Leachate Tank: A 2.4 m diameter by 7.5 m long tank will be installed at about 3 m below grade.

All of the above components will be unheated.

3.0 Field Program

3.1 Subsurface Investigation

A subsurface investigation was undertaken on June 27 to July 5, 2012 under the supervision of TREK personnel to determine the soil stratigraphy and groundwater conditions across the site. Test holes were drilled using a CME-850 track mounted drill rig equipped with 125 mm solid stem augers. Subsurface soils observed during the drilling were visually classified using the Unified Soil Classification System (USCS). Other pertinent information such as drilling, groundwater and backfill conditions were also recorded. Samples retrieved during drilling included disturbed grab samples, relatively undisturbed Shelby tubes, and disturbed split spoon samples; all samples were transported to TREK's testing laboratory in Winnipeg, Manitoba. Laboratory testing consisted

of moisture content determination on all samples. Atterberg limit, grain size analysis (hydrometer and mechanical), and undrained shear strength testing (pocket penetrometer, torvane and unconfined compression) testing was performed on select samples. A summary of the soil units encountered including laboratory testing results are included on the test hole logs in Appendix A.

Thirty-four test holes (TH12-01 to TH12-34) were drilled at the locations shown on Figure 01. Thirty test holes were drilled to relatively shallow depth (between 3 and 5 m) to assess near surface conditions. Two test holes were drilled to 6 to 7 m depth (TH12-31 and TH12-32) to assess conditions below the future pond, and two test holes (TH12-29 and TH12-30) were advanced to power auger refusal to evaluate foundation conditions for the mixing and receiving building.

Test hole logs are attached in Appendix A and include a description, the elevation of soil units encountered and other pertinent information such as groundwater levels and sloughing conditions. Test hole locations and elevations were surveyed by TREK personnel on July 5, 2012. The locations for test holes 12-11 and 12-16 could not be surveyed as the stakes used to identify the test hole locations had been removed by others. The approximate locations of these two test holes are shown on Figure 01.

3.2 Soil Stratigraphy

The sub-surface stratigraphy in descending order from ground surface consists of:

- Fill/Organic Clay (Topsoil)
- Silt
- Clay
- Silt (Till)

A brief description of the soil units are provided as follows:

Fill / Organic Clay (Topsoil)

Either fill or organic clay was encountered in all test hole locations. The fill was encountered in TH12-14, TH12-15, TH12-16, TH12-20, TH12-21, TH12-22, TH12-23, and TH12-24. The fill extended from surface to a maximum depth of 1.8 m. The fill was generally variable and contained trace to some waste materials including refuse, wood, and compost. In some instances the fill was underlain by organic clay (topsoil).

Organic clay (topsoil) was encountered at surface in all remaining test holes and extended to a maximum depth of 0.8 m. The organic clay is silty, contains some rootlets (<5 mm diam.), trace oxidation, trace silt inclusions (<2 mm diam.), is black to brown, dry to moist, stiff, with low to high plasticity.

Silt

A silt layer ranging in thickness from 0.2 to 1.8 m was encountered in most test holes at depths ranging from 0.4 to 2.4 m from ground surface. A comparison of test hole logs indicates the silt layer across the site is highly variable in elevation, thickness and aerial extent. The silt generally contains some clay to clayey, trace sand, trace organics (rootlets < 1 mm diam.), trace oxidation, is medium brown, moist to wet, soft, and of low plasticity. Moisture contents range from 21% to 32%.

Clay

A clay layer underlies the fill and topsoil units to a maximum observed depth of 12.0 m in TH12-29. Near surface the clay is silty and contains trace organics, trace silt inclusions and is brown to grey, stiff, moist, and of high plasticity. With depth the clay transitioned to a grey colour and a soft to firm consistency. Moisture contents tended to increase with depth ranging from 26% to 64%. Bulk unit weights range from 16.2 to 17.4 kN/m^3.

Silt (Till)

A silt till layer was encountered below the clay at a depths of 11.8 m and 12.0 m in TH12-29 and TH12-30 respectively. The silt till is sandy, contains trace to some gravel, trace clay, and is light grey. The upper 2.6 to 3.1 m of the till, referred to locally as putty till, is compact with moisture contents ranging from 9 % to 25 %, with an average of 13 %. The putty till is underlain by dense to very dense glacial silt till with moisture contents ranging from 6% to 8%. Power auger refusal in the dense till was reached at depths of 15.6 m and 15.7 m. Standard Penetration Tests (SPT) conducted in the dense silt till had blow counts of 60 (over 150 mm) and 100 (over 300 mm) at depths of 15.6 m and 15.7 m depth, respectively.

3.2.1 Groundwater Conditions

Seepage, sloughing, and groundwater conditions observed during drilling are shown on the test hole logs. Seepage was observed on occasion from within near surface fill and silt layers and no seepage was encountered from the silt till unit. Standpipe piezometers were installed within the till layer in THs 12-29 and 12-30 to measure short term groundwater levels. Groundwater levels ranging from El. 227.5 m and 227.8 were measured on July 25 and August 1, 2012. These observations are short term and should not be considered reflective of stabilized (static) groundwater levels. It is also important to note that groundwater conditions may change seasonally, annually, or as a result of construction activities.

4.0 Geotechnical Recommendations

4.1 Clay Liners

Clay liners are planned below all areas of the proposed facility. The clay liners will be constructed using imported clay fill from the proposed wetlands area being constructed immediately south east of the site. To assess the suitability of the imported clay for liner construction two test holes were drilled within the borrow area (TH12-33 and TH12-34). Atterberg limits and hydrometer grain size analyses were performed on two samples of the clay and pertinent results are summarized in Table 1 below.

Table 1 - Summary of Atterberg Limits/Grain Size Analysis in TH12-34

Sample Depth	Moisture Content	Liquid Limit	Plastic Limit	Clay Content
0.8 – 0.9 m	30%	58%	16%	54%
2.4 – 2.6 m	49%	86%	24%	73%

Based on the engineering properties shown in Table 1, both samples are considered suitable for use in constructing a clay liner. Although not measured, it is anticipated that hydraulic conductivities of the compacted clay will be well below $1x10^{-7}$ cm/sec. Clay fill will need to be chosen selectively to avoid surficial organic soils and the silt layer that was observed in both test holes.

The following procedures should be followed for construction of the clay liner:

1. Organic and fill soils should be stripped prior to construction of the clay liner. Excavation should proceed in a way that limits disturbance to the subgrade soils, the subgrade should be protected from inundation, drying, and freezing conditions.

   The need to excavate the silt will depend on the elevation of the surface of the silt layer across the site relative to the design subgrade elevation and the final design grades. Silt encountered within 1.5 m of final grade should be excavated and replaced with compacted clay fill. A non-woven geotextile (Geotex 801 or equivalent) should be placed on top of any remaining silt prior to bridging with a layer of compacted clay fill. Depending on the consistency of the silt layer, it may be necessary to use light weight equipment for placing and compacting the initial bridging layer.

   Clay subgrade that will be incorporated into the liner should be scarified to a depth of 0.3 m and recompacted to 95% of Standard Proctor Maximum Dry Density (SPMDD). If the liner will be supporting settlement sensitive structures the compaction requirement should be increased to 98% SPMDD. If the subgrade will not be incorporated into the clay liner scarification and compaction will not be required, in this case the subgrade should be protected from disturbance, inundation, drying and freezing. The subgrade should be proof-rolled with a fully loaded tandem truck or other equipment of similar weight to determine the location of any localized soft areas. Soft areas should be repaired and treated as per direction by a geotechnical engineer.

2. Clay should be placed in loose lift thicknesses that do not exceed 200 mm and compacted to 95% of SPMDD at a moisture content within 2 % of optimum. If the liner will be supporting settlement sensitive structures the compaction requirement should be increased to 98% SPMDD. Based on the in-situ moisture contents of the clay soil which are expected to be well above optimum for compaction, drying will likely be required. Frozen clay or other deleterious material such as organics, silt, or refuse should not be used as fill.

3. Prior to placement of an additional clay lift, the upper 50 mm of the existing surface should be scarified to promote bonding between the clay fill layers.

4.2 Leaf and Yard Waste Pad

The leaf and yard waste pad is to be constructed above a 0.5 m thick compacted clay liner and will be subject to daily truck and construction equipment loading. The pad will be gravel surfaced although there has been some consideration of surface treatment to prevent migration of gravel into the compost material. In considering the above requirements TREK recommends that crushed limestone be used at the site. The recommended minimum cross section present in descending order from the final surface is provided in Table 2.

Table 2 – Proposed Granular Section in Leaf and Yard Waste Pad

Material Gradation	Proposed Depth
20 mm down	0-100 mm
50 mm down	100 - 250 mm
100 mm down	250 - 450 mm

* Crushed rock should meet specifications identified in CW3110

The following recommendations are provided for construction of the granular pad:

1. A non-woven geotextile (Geotex 801 or equivalent) should be placed on top of the clay fill subgrade prior to granular fill placement. To provide additional reinforcement to the granular section, a woven geotextile such as a Geotex 315ST (or equivalent) could be used in place of the non-woven geotextile. The geotextile should be placed according to manufacturer specifications.
2. All granular fill should be placed in 150 mm (compacted thickness) lifts. The granular fill should be compacted to 98% SPMDD. Fill should be placed in an unfrozen condition.
3. If a rougher travelling surface is acceptable for end-use, the 20 mm down may be replaced with 50 mm down crushed limestone.

Surface treatments for the granular pad that have been discussed include lean mix concrete and cement stabilization. If a cement stabilized pad is selected, the layer of 20 mm down crushed limestone should be increased to 150 mm and mixed with a minimum 5% by weight of Normal Portland cement (type GU). The cement should be mixed uniformly with the crushed limestone prior to compaction to 98% SPMDD. The cement content may be reduced through the use of additives such as fly-ash however the exact mix would need to be optimized through a laboratory testing program to confirm that performance is not compromised.

4.3 Foundations

Foundations are required to support the Mixing and Receiving building. It is our understanding that the proposed building is a steel framed structure with canvas walls. The building will be unheated. Provided the building can tolerate some seasonal movement, shallow footings or a thickened edge slab are considered suitable at this site. If seasonal movements are not tolerable, TREK can provide recommendations on either end bearing or friction piles.

4.3.1 Shallow Footings

Shallow footings founded below 2.5 m depth on undisturbed *in situ* clay can be designed using an allowable bearing capacity of 80 kPa. The maximum settlement form this loading is expected to be 25 mm although shallow foundations may also be subject to additional vertical movement associated with seasonal shrinkage and swelling of the clay subgrade.

Additional considerations for the design and construction of shallow footings are provided below:

1. Footings should have a minimum based width of 0.6 m.
2. Excavate to the design subgrade elevation while further ensuring that all fill soils and otherwise unsuitable material is removed. Excavation should be completed with a backhoe equipped with a smooth bladed

bucket operating from the edge of the excavation. Care should be taken not to over-excavate and to minimize the subgrade disturbance at all times.

3. After excavation, the subgrade should be reviewed by qualified geotechnical personnel. The exposed subgrade surface should be protected from freezing, inundation and disturbance. As such, it may be necessary for the contractor to sequence construction so that only a small portion of the subgrade remains open at a given time and that excavations are backfilled as soon as possible.
4. Where soft or weak areas are identified by the geotechnical personnel, these areas should be repaired as directed by the geotechnical engineer. If silt is encountered at the foundation elevation the geotechnical engineer should be notified immediately so that a remediation design can be provided.
5. Fill required to raise grades or for levelling should consist of 20 mm down crushed limestone placed in maximum 150 mm thick lifts and compacted to 98% SPMDD.
6. Grade supported structures such as floor slabs should be isolated from the footings to limit differential stresses.

4.3.2 Thickened Edge Slab

A thickened edge slab could also be considered appropriate to support the Mixing and Receiving building. An allowable bearing capacity of 80 kPa should be used for design. In addition to the movements described in Section 4.3.1 the thickened edge slab would also be subject to movements associated with freeze/thaw (frost heave) and settlement of any fill soils, such as the compacted clay liner, placed below the thickened edge. To minimize the effects of frost heave, near surface silts should be excavated from below the base of the thickened edge, frost heave can be further minimized by insulating the footings. TREK can provide design recommendations for insulation on request. For clay and crushed limestone compacted to 98% SPMDD settlements of up to 2% and 0.5% respectively of the layer thickness can be anticipated.

Additional considerations for the design and construction of the thickened edge are provided below. Specific recommendations for design and construction of grade supported floor slabs can be found in Section 4.4.

1. Thickened edges should have a minimum based width of 0.6 m.
2. Excavate to the design subgrade elevation while further ensuring that all organics, silts, and un-compacted fill soils and otherwise unsuitable material is removed. Excavation should be completed with a backhoe equipped with a smooth bladed bucket operating from the edge of the excavation. Care should be taken not to over-excavate and to minimize the subgrade disturbance at all times. It is anticipated that the subgrade below the thickened edge will consist of either the compacted clay liner or compacted crushed rock.
3. After excavation, the subgrade should be reviewed by qualified geotechnical personnel. The exposed subgrade surface should be protected from freezing, inundation and disturbance. As such, it may be necessary for the contractor to sequence construction so that only a small portion of the subgrade remains open at a given time and that excavations are backfilled as soon as possible.
4. Where soft or weak areas are identified by the geotechnical personnel, these areas should be repaired as directed by the geotechnical engineer.
5. Fill required to raise grades or for levelling should consist of 20 mm down crushed limestone placed in maximum 150 mm thick lifts and compacted to 98% SPMDD.

If increased bearing capacity is required beneath the thickened edge, a compacted granular pad may be constructed below the base of the slab or thickened edge to distribute the contact load to maintain a bearing pressure of 80 kPa on the clay. In plan, the compacted granular pad should extend beyond the thickened edge by at least the gravel thickness. The allowable bearing pressure on the gravel pad can be calculated using the following formulae:

$$\mathbf{q_a = 80\ (w+d)/w}$$

where: q_a = allowable bearing pressure (kPa)

w = width of thickened edge slab (m)

d = depth of gravel below thickened edge slab (m)

As an example, to accommodate an allowable load of 130 kPa on a 0.6 m wide thickened edge the granular pad would need to be 0.4 m thick, the granular pad would also need to extend at least 0.4 m beyond the thickened edge in all directions. The granular pad should be constructed using 50 mm down crushed limestone with the upper 100 mm of the granular pad constructed using 20 mm down crushed limestone as a levelling course. The crushed limestone should be compacted to a minimum of 98% SPMDD. Some settlement of the compacted granular fill should be expected as identified earlier in this section.

4.4 Grade Supported Concrete Slabs

Grade supported concrete slabs will be subjected to loading from heavy construction equipment such as loaders. Some vertical deformation of grade supported slabs should be expected due to moisture and volume changes of the underlying soil, frost effects and settlement from underlying compacted fill soils. It is our understanding that the concrete slabs will be placed above the compacted clay liner discussed in Section 4.1. The following recommendations are provided to reduce or accommodate potential movements of the slab:

1. The sub-grade should be unfrozen and free of any deleterious material such as organics, debris, etc. prior to placement of granular fill.
2. Precautions should be taken to prevent desiccation of the sub-grade during construction. If drying of the sub-grade occurs it should be dampened, scarified and re-compacted to a minimum of 98% SPMDD.
3. The floor slab should be placed on a granular pad constructed of 200 mm of 50 mm down crushed limestone underlying 100 mm of 20 mm down crushed limestone. The crushed limestone should be placed in lift thickness not exceeding 150 mm and compacted to 98% SPMDD. If there is a desire to increase the granular thickness to protect the clay liner this should be done by increasing the 50 mm down layer thickness.
4. To minimize changes in soil moisture beneath grade supported floor slabs, the discharge from roof leaders and run-off from exposed slabs should be directed away from the structures.
5. To accommodate slab movements, it may be desirable to provide control joints to reduce random cracking and isolation joints to separate the slab from other structure elements. Allowances should be made to accommodate vertical movements of light partitions, etc. bearing on the slab.
6. Consideration should be given to providing a sub-floor drainage system consisting of a perimeter weeping tile drain, as well as interior lateral drains for larger areas.

4.5 Recommendations for Leachate Collection Tank

It is understood that a buried leachate collection tank (2.4 m diameter x 7.5 m long) will be installed at a depth of at least 3 m below grade. The tank should be founded on undisturbed *in situ* clay soils. Silts, fills, or organic soils should be removed from below the base of the tank and replaced with 20 mm down crushed limestone compacted to 98% of SPMDD. The tank should be backfilled according to the manufacturer's specifications. The tank base should also be design to resist buoyancy forces assuming that backfill material becomes completely saturated.

4.6 Containment Ponds

It is understood that a containment pond, located on the southeast corner of the site in the vicinity of TH12-33 and TH12-34 to a depth of no more than 4 m. The stratigraphy in the area of the ponds generally consists of topsoil overlying highly plastic lacustrine clay. Silt was encountered in TH 12-33 from 1.5 to 1.8 m, and in TH 12-34 from 1.3 to 2.2 m.

The natural highly plastic clay soils at this site are extensive and may be suitable as a natural *in situ* liner depending on the level of containment required and regulatory compliance. Natural liners will require that the upper silt layer (where encountered) be excavated and replaced with a minimum of 1 m of compacted clay. We estimate that at depth, the hydraulic conductivity of the undisturbed clay to be $1x10^{-7}$ cm/s or less although higher values may occur near the surface where seasonal environmental effects may result in a more pervious stratum. Scarification of the upper 300 mm and compaction should therefore be carried out to minimize the effects of construction disturbance and any environmental effects such as fissuring. If an engineered liner is required for the pond it could consist of compacted clay or a synthetic material *e.g.* high density polyethylene (HDPE).

Clay soil from on-site excavations should be suitable for a compacted clay liner if broken up and recompacted in thin lifts. In this regard, loose lifts should not exceed 150 mm and the clay should be compacted to achieve a minimum of 95% of SPMDD. Recommendations for synthetic liner installation can be provided if requested.

Ponds constructed with natural or engineered clay liners should have internal side slopes no steeper than 4H:1V for a maximum depth (measured from the dyke crest to the floor) of 4 m and 5H:1V for ponds up to a maximum depth of 5 m. Recommendations for ponds greater than 5 m depth can be provided if requested. Where applicable, external side slopes for dykes should be constructed no steeper than 4H:1V. Erosion is expected to be minimal for ponds less than 300 x 300 m in aerial extent with maximum side slopes of 4H:1V and with grass cover. Ponds great than 300 x 300 m in aerial extent should have flatter side slopes and/or be provided with stone armouring or rip rap. The recommended pond geometry is based on the ponds remaining full; flatter slopes may be required in rapid drawdown conditions. TREK should be contacted if this operating case is expected or if recommendations for acceptable rates of drawdown are needed.

4.7 Excavations

Temporary excavations at the site should meet Workplace Health and Safety regulations. It may be necessary to excavate open excavation side slopes flatter than 1 horizontal to 1 vertical if saturated silts are encountered.

4.8 Foundation Concrete

Based on local experience the degree of exposure for concrete subjected so sulphate attack in Winnipeg is classified as severe according to CSA A23.1-09. Sulphate resistant (CSA Type HS) cement is recommended for

all below grade concrete works or concrete in contact with soil. Accordingly, all concrete in contact with the native soil should be made with high sulphate-resistant cement (HS or HSb). Furthermore, the concrete should have a minimum specified 56 day compressive strength of 32 MPa and have a maximum water to cement ratio of 0.45 in accordance with CSA A23.1-09. Concrete which may be exposed to freezing and thawing should be adequately air entrained to improve freeze-thaw durability in accordance with this same standard.

5.0 Closure

The geotechnical information provided in this report is in accordance with current engineering principles and practices (Standard of Practice). The findings of this report were based on information provided (field investigation, laboratory testing, geometries). Soil conditions are natural deposits that can be highly variable across a site. If subsurface conditions are different than the conditions previously encountered on-site or those presented here, we should be notified to adjust our findings if necessary.

All information provided in this report is subject to our standard terms and conditions for engineering services, a copy of which is provided to each of our clients with the original scope of work or standard engineering services agreement. If these conditions are not attached, and you are not already in possession of such terms and conditions, contact our office and you will be promptly provided with a copy.

Figures

TREK GEOTECHNICAL

C.O.W. Leaf and Yard Waste Composting Facility

Brady Road Landfill
Winnipeg, Manitoba

ANSI full bleed B (11.00 x 17.00 Inches)

PLOT: 03/08/2012 9:59:44 AM

FILE NAME: 0068 002 00 F_RD.dwg

0 50 100 150 200m

SCALE : 1:4000 (279mmx432mm)

LEGEND :

- SURVEYED TEST HOLE LOCATIONS
- APPROXIMATED TEST HOLE LOCATIONS

Figure 01
Test Hole location Plan

Appendix A

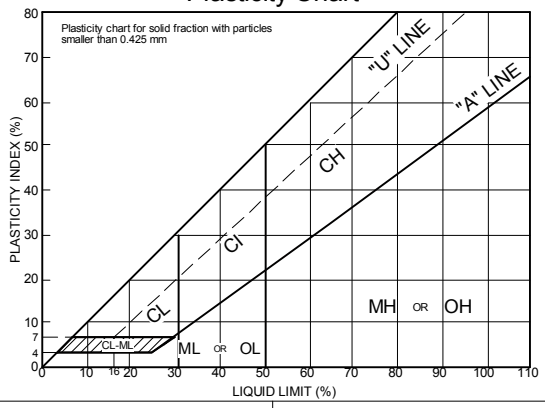
Test Hole Logs

EXPLANATION OF FIELD AND LABORATORY TESTING

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and include consistency, moisture, and color. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.
2. Descriptions on these test hole logs apply only at the specific test hole locations and at the time the test holes were drilled. Variability of soil and groundwater conditions may exist between test hole locations.
3. When the following classification terms are used in this report or test hole logs, the primary and secondary soil fractions may be visually estimated.

Major Divisions			USCS Classification	Symbols	Typical Names	Laboratory Classification Criteria
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than 4.75 mm)	Clean gravel (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain size curve, depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows: Less than 5 percent..... GW, GP, SW, SP; More than 12 percent..... GM, GC, SM, SC; 6 to 12 percent..... Borderline case4s requiring dual symbols*
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
		Gravel with fines (Appreciable amount of fines)	GM		Silty gravels, gravel-sand-silt mixtures	Not meeting all gradation requirements for GW
			GC		Clayey gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line or P.I. greater than 7 / Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
	Sands (More than half of coarse fraction is smaller than 4.75 mm)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			SP		Poorly-graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW
		Sands with fines (Appreciable amount of fines)	SM		Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4 / Atterberg limits above "A" line or P.I. greater than 7 / Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
			SC		Clayey sands, sand-clay mixtures	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Silts and Clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock floor, silty or clayey fine sands or clayey silts with slight plasticity	Plasticity Chart
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL		Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or distomaceous fine sandy or silty soils, organic silts	
			CH		Inorganic clays of high plasticity, fat clays	
			OH		Organic clays of medium to high plasticity, organic silts	
	Highly Organic Soils		Pt		Peat and other highly organic soils	Von Post Classification Limit: Strong colour or odour, and often fibrous texture



Particle Size	Material	ASTM Sieve sizes	mm
	Sand		
	Coarse	#10 to #4	2.00 to 4.75
	Medium	#40 to #10	0.425 to 2.00
	Fine	#200 to #40	0.075 to 0.425
	Silt or Clay	< #200	< 0.075

Particle Size	Material	ASTM Sieve Sizes	mm
	Boulders	> 12 in.	> 300
	Cobbles	3 in. to 12 in.	75 to 300
	Gravel		
	Coarse	3/4 in. to 3 in.	19 to 75
	Fine	#4 to 3/4 in.	4.75 to 19

* Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example; GW-GC, well-graded gravel-sand mixture with clay binder.

Other Symbol Types

	Asphalt		Bedrock (undifferentiated)		Cobbles
	Concrete		Limestone Bedrock		Boulders and Cobbles
	Fill		Cemented Shale		Silt Till
			Non-Cemented Shale		Clay Till

EXPLANATION OF FIELD AND LABORATORY TESTING

LEGEND OF ABBREVIATIONS AND SYMBOLS

LL - Liquid Limit (%)
PL - Plastic Limit (%)
PI - Plasticity Index (%)
MC - Moisture Content (%)
SPT - Standard Penetration Test
RQD - Rock Quality Designation
Qu - Unconfined Compression
Su - Undrained Shear Strength
VW - Vibrating Wire Piezometer
SI - Slope Inclinometer

▽ Water Level at Time of Drilling

▼ Water Level at End of Drilling

▼ Water Level After Drilling as Indicated on Test Hole Logs

FRACTION OF SECONDARY SOIL CONSTITUENTS ARE BASED ON THE FOLLOWING TERMINOLOGY

TERM	EXAMPLES	PERCENTAGE
and	and CLAY	35 to 50 percent
"y" or "ey"	clayey, silty	20 to 35 percent
some	some silt	10 to 20 percent
trace	trace gravel	1 to 10 percent

TERMS DESCRIBING CONSISTENCY OR COMPACTION CONDITION

The Standard Penetration Test blow count (N) of a non-cohesive soil can be related to compactness condition as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very loose	< 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	> 50

The Standard Penetration Test blow count (N) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	SPT (N) (Blows/300 mm)
Very soft	< 2
Soft	2 to 4
Firm	4 to 8
Stiff	8 to 15
Very stiff	15 to 30
Hard	> 30

The undrained shear strength (Su) of a cohesive soil can be related to its consistency as follows:

Descriptive Terms	Undrained Shear Strength (kPa)
Very soft	< 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	> 200

Sub-Surface Log

Test Hole TH12-01
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513455.763, E-629974.108
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.35 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
232.9	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey - moist, stiff - high plasticity		G01	
232.4	0.5		SILT - trace clay, trace fine sand, trace organics (rootlets <1 mm diam.) - medium brown - moist to wet, soft - low plasticity		G02	
	1.0		CLAY - silty, trace oxidation - light grey - moist, stiff - high plasticity		G03	
	1.5					
	2.0		-silt inclusions (<5 mm diam.) below 1.8 m		G04	
	2.5		-firm below 2.3 m		G05	
230.3	3.0		END OF TEST HOLE AT 3.1 m IN CLAY			

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

Notes:
1) Test hole was squeezing in at 0.6 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 0.6 m below ground surface.
3) Test hole was backfilled with cuttings to 0.3 m below ground surface. One bag of bentonite was used in the test hole from 0.3m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-02

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513417.699, E-629901.578
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.48 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.0	0.0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), trace oxidation, trace silt inclusions (<2 mm diam.) - mottled black and grey - dry to moist, stiff, high plasticity		G06	
	0.5		CLAY - silty, trace silt inclusions (<2 mm diam.) trace oxidation - light grey - moist, stiff - high plasticity		G07	
	1.0					
	1.5				G08	
	2.0					
	2.5		-firm below 2.3 m		G09	
230.4	3.0				G10	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 0.6 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 0.6 m below ground surface.
3) Test hole was backfilled with cuttings to 0.3 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-03

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513377.282, E-629833.332
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.62 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.3	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey - moist, stiff, high plasticity		G11	
232.7	0.5		CLAY - silty, trace coarse sand, trace organics (rootlets <10 mm diam.) - medium grey - moist, stiff - high plasticity		G12	
232.2	1.0		SILT - some clay, trace fine sand, trace organics (rootlets <1 mm diam.) - medium brown - moist to wet, soft - low plasticity		G13	
	1.5		CLAY - silty, trace medium sand, trace precipitates - light grey - moist, stiff - high plasticity		T14	
230.6	3.0				G15	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.2 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.2 m below ground surface.
3) Water level was 1.0 m below ground approximately one day after drilling.
4) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-04
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513358.49, E-629746.183
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.81 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey - moist, stiff, high plasticity		G16	
233.2	0.5		CLAY - silty, trace organics (rootlets <1 mm diam.), trace oxidation, trace silt inclusions (<10 mm diam.) - dark grey, moist, stiff,high plasticity		G17	
232.9			SILT AND CLAY LAYERS - 3 clay layers 50-75 mm thick - 2 silt layers l25 mm thick		G18	
	1.0		SILT - some clay, trace fine sand, trace organics (rootlets <1 mm diam.) - medium brown, dry, soft, low plasticity -moist below 1.1 m		G19	
232.3	1.5		CLAY - silty, trace medium sand, trace precipitates - light grey - moist, stiff - high plasticity		G20	
	2.0		-firm below 2.3 m			
	2.5					
230.8	3.0				G21	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 0.6 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 0.6 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-05
1 of 1

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513281.784, E-629792.118
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.60 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
233.2	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey - dry, stiff, high plasticity		G22		●	
	0.5		SILT - some clay, trace oxidation - medium brown - moist to wet, firm - low plasticity		G23		●	
			-soft below 0.6 m		G24		●	
232.2	1.0							
	1.5		CLAY - silty, trace medium sand, trace precipitates (<2 mm diam.) - light grey - moist, stiff - high plasticity					
	2.0				G25		●	△ ✿
			-firm below 2.3 m					
230.6	2.5							
	3.0				G26		●	△✿

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 0.8 m below ground surface.
2) Test hole was dry approximately 1 day after drilling and open to 0.8 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-06

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513321.603, E-629865.741
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.62 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), mottled black and grey, dry, stiff, high plasticity		G27	
			CLAY - silty, trace medium sand, trace precipitates (<2 mm diam.) - mottled grey and brown - moist, stiff - high plasticity			
	0.5				G28	
	1.0					
	1.5				T29	
	2.0					
	2.5		-firm below 2.3 m		G30	
230.6	3.0				G31	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was dry approximately 1 day after drilling and open to 3.1 m below ground surface.
2) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-07

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513359.058, E-629939.286
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.60 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
232.8	0.0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black - dry, stiff - low plasticity			
	0.5			G	G32	
	1.0		CLAY - silty, trace medium sand, trace precipitates (<2 mm diam.) - brown - moist, stiff - high plasticity	G	G33	
	1.5					
	2.0			G	G34	
	2.5		-firm below 2.3 m			
230.6	3.0			G	G35	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.7 m below ground surface.
2) Test hole was dry approximately 1 day after drilling and open to 1.7 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-08

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513398.822, E-630011.454
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.18 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.0	0	ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), mottled black and grey, moist, stiff, high plasticity		G36	
	0.5	CLAY - silty, trace medium sand - light grey - moist, stiff - high plasticity			
	1.0	-trace precipitates (< 50 mm diam.) below 0.8 m		G37	
	1.5			T38	
	2.0				
	2.5	-firm below 2.3 m -trace silt inclusions (<25 mm diam.) at 2.5 m		G39	
230.1	3.0			G40	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.7 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.7 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-09

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513439.396, E-630081.824
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.61 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.3	0.0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey - moist, stiff, high plasticity		G41	
	0.5		CLAY - silty, trace coarse sand, trace organics (rootlets <10 mm diam.) - dark grey - dry to moist, stiff - intermediate plasticity		G42	
232.5	1.0					
	1.5		SILT - some clay, trace fine sand, trace organics (rootlets <1 mm diam.) - medium brown - moist, soft - low plasticity		G42A	
231.9						
	2.0		CLAY - silty, trace medium sand, trace precipitates - brown - moist, stiff - high plasticity		G43	
	2.5					
230.6	3.0				G44	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-10

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513497.273, E-630048.068
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.51 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.2	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - black - moist, stiff, high plasticity		G45	
	0.5		CLAY - silty, trace coarse sand, trace organics (rootlets <10 mm diam.) - mottled brown and grey - dry to moist, very stiff - high plasticity			
	1.0				G46	
	1.5				T47	
	2.0		-firm below 2.1 m			
	2.5				G48	
230.5	3.0				G49	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.4 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.4 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-11

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513341.377, E-629760.574
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	Not Surveyed
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), black, moist, stiff, low plasticity		G50		●	
		CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace silt inclusions (<5 mm diam.) - medium brown - moist, stiff - high plasticity					
0.5				G51		●	△ ✪
1.0		-increasing silt content and low plasticity from 1.1 to 1.2 m		G52		●	
		-trace medium sand, trace precipitates (<5 mm diam.), and mottled grey and brown below 1.2 m					
1.5				G53		●	△ ✪
2.0				G54		●	✪
		-firm below 2.3 m					
2.5							
3.0				G55		●	✪ △

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 0.9 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 0.9 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.
4) Test hole location based off of GPS coordinates.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-12

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513482.51, E-630156.562
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.51 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 27, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.4	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), mottled black and grey, moist, stiff, low plasticity			
			CLAY - silty, trace organics (rootlets <10 mm diam.) - black - dry, stiff - high plasticity			
	0.5			G	G56	
	1.0		-dark grey and moist below 1.1 m			
			-trace precipitates below 1.2 m	G	G57	
	1.5			T	T58	
	2.0					
				G	G59	
	2.5					
230.5	3.0			G	G60	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.5 m below ground surface.
2) Test hole was dry approximately 1 day after drilling and open to 1.5 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-13

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513390.878, E-630118.593
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.14 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
232.8	0		ORGANIC CLAY (Topsoil) - silty, trace coarse sand, some rootlets (<5 mm diam.) - dark grey, moist, stiff, low plasticity	Grab	G61	
	0.5		CLAY - silty, trace organics (rootlets <10 mm diam.), trace silt inclusions (<5 mm diam.) - mottled brown and grey - moist, stiff - high plasticity			
	1.0			Grab	G62	
	1.5					
	2.0			Shelby Tube	G63	
	2.5		-firm below 2.3 m	Grab	G64	
230.1	3.0			Grab	G65	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.5 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.5 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-14

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513432.31, E-630191.694
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	234.81 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.5		CLAY (Fill) - silty, trace to some sand, trace coarse gravel, trace rootlets (<5 mm diam.), trace oxidation, trace glass - mottled grey and brown - moist, firm - high plasticity		G66	
	1.0					
233.3	1.5				G67	
233.1			ORGANIC CLAY (Topsoil) - silty, some organics (rootlets <5 mm diam.), mottled black and grey, moist, stiff, high plasticity		G68	
	2.0		CLAY - silty, trace coarse sand, trace organics (rootlets <10 mm diam.) - dark grey - moist, stiff - high plasticity		G69	
	2.5					
	3.0				G70	
	3.5					
	4.0				G71	
230.2	4.5				G72	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:

1) Test hole was squeezing in at 3.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 3.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-15
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513342.445, E-630049.451
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	234.70 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
234.2	0.0		CLAY (Fill) - silty, trace to some sand, trace coarse gravel, trace organics (rootlets <5 mm diam.), trace oxidation, trace glass - mottled grey and brown - moist, firm, high plasticity			
	0.5		WOOD			
233.3	1.0			G	G73	
232.7	1.5		CLAY - silty, trace coarse sand, trace organics (rootlets <10 mm diam.) - dark grey - moist, stiff - high plasticity	G	G74	
232.1	2.0		SILT - some clay, trace fine sand, trace organics (rootlets <1 mm diam.), trace oxidation - medium brown - moist, firm - low plasticity	G	G75	
	2.5		CLAY - silty, trace medium sand, trace precipitates - brown - moist, stiff - high plasticity	G	G76	
	3.0			T	T77	
	3.5					
	4.0			G	G78	
230.1	4.5					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 3.5 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 3.5 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-16
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513341.996, E-630046.535
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	Not Surveyed
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
0.5		CLAY (Fill) - silty, trace to some sand, trace coarse gravel, trace to some organics (roots <50 mm diam.), trace oxidation, trace glass - mottled grey and brown - moist, firm - high plasticity			
1.0				G79	
1.5		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), mottled black and grey, moist, stiff, high plasticity		G80	
2.0		CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace precipitates (<1 mm diam.) - black - dry to moist, stiff - high plasticity		G81	
2.5		SILT - trace to some clay, trace fine sand, trace organics (rootlets <1 mm diam.), trace oxidation - medium brown - moist, firm, low plasticity		G82	
3.0		CLAY - silty, trace medium sand, trace precipitates - brown - moist, stiff - high plasticity			
3.5				G83	
4.0					
4.5				G84	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 2.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 2.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.
4) Test hole location based off of GPS coordinates.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-17

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513248.71, E-629907.973
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.60 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.), black, dry moist, stiff, high plasticity			
			CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace silt inclusions (<3 mm diam.), trace precipitates (<1 mm diam.) - mottled dark grey and brown - moist, stiff - high plasticity	Grab	G85	
	1.0			Grab	G86	
	1.5			Shelby Tube	T87	
	2.0		-firm below 2.3 m			
	2.5			Grab	G88	
230.6	3.0					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.8 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.8 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-18
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513202.276, E-629839.114
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.52 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.2	0.0		ORGANIC CLAY (Topsoil) - silty, some organics (rootlets <5 mm diam.) - mottled black and grey - dry to moist, stiff, high plasticity		G89	
	0.5		CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace precipitates (<1 mm diam.) - black - dry to moist, stiff - high plasticity		G90	
232.1	1.0					
231.8	1.5		CLAY - silty, trace fine sand, trace organics (rootlets <1 mm diam.), trace oxidation - medium brown, moist, soft, low plasticity		G91	
	2.0		CLAY - silty, trace medium sand, trace precipitates - brown - moist, stiff - high plasticity		G92	
	2.5					
230.5	3.0		-firm below 2.9 m		G93	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was dry approximately 15 minutes after drilling and open to 3.1 m below ground surface.
2) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-19

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513130.536, E-629881.317
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.67 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.4	0		ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - mottled black and grey, dry to moist, stiff, high plasticity		G94	
	0.5		CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace silt inclusions (<3 mm diam.) - mottled dark grey and brown - moist, stiff - high plasticity		G95	
	1.0					
	1.5		-trace precipitates (<1 mm diam.) below 1.5 m		G96	
	2.0					
	2.5		-firm below 2.6 m		G97	
230.6	3.0					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 2.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 2.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-20

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513177.989, E-629950.647
Contractor: Paddock Drilling Ltd.
Ground Elevation: 234.84 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21 / Particle Size (%) 0 20 40 60 80 100 / PL MC LL	Undrained Shear Strength (kPa) 0 50 100 150 200 250 / Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○
	0.5		CLAY (Fill) - silty, trace to some sand, trace coarse gravel, trace to some organics (wood mulch <75 mm diam.), trace glass, trace silt inclusions (<25 mm diam.) - mottled grey and brown - moist, firm - high plasticity		G98		●	
233.5	1.0				G99		●	
	1.5		CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace precipitates (<1 mm diam.) - black - dry to moist, stiff - high plasticity		G100		●	△ ✤
	2.0		-brown below 2.1 m		G101		●	△ ✤
232.2	2.5		CLAY - silty, trace fine sand, trace organics (rootlets <1 mm diam.), trace oxidation - medium brown, moist, soft, low plasticity		G102		●	
231.9	3.0		CLAY - silty, trace medium sand, trace precipitates (<5 mm diam.) - mottled brown and grey - moist, stiff - high plasticity					
	3.5				G103		●	△ ✤
	4.0							
230.3	4.5				G104		●	△ ✤

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 2.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 2.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-21
1 of 1

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513217.892, E-630031.794
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	235.09 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.0	CLAY (Fill) - silty, some municiple waste (compost), trace to some sand, trace coarse gravel - mottled grey and brown, moist, soft to firm, high plasticity			
	0.5	-wet below 0.6 m	G	G105	
234.0	1.0		G	G106	
233.9		CLAY - silty, trace fine sand, trace organics (rootlets <1 mm diam.), trace oxidation, medium brown, moist, soft, low plasticity	G	G107	
	1.5	CLAY - silty, trace medium sand, trace precipitates - light to dark grey - moist, firm to stiff - high plasticity	G	G108	
233.3		SILT - clayey, trace organics (rootlets <1 mm diam.) trace oxidation - medium brown - moist, soft - low plasticity	G	G109	
	2.0				
	2.5		G	G110	
232.3					
232.1		CLAY - silty, trace medium sand, trace precipitates, light to dark grey, moist, firm, high plasticity			
	3.0	SILT - clayey, trace organics (rootlets <1 mm diam.) trace oxidation - medium brown - moist, soft - low plasticity	G	G111	
231.5	3.5				
		CLAY - silty, trace medium sand, trace precipitates - mottled brown and grey - moist, firm - high plasticity -25 cm silt seam at 3.7 m			
	4.0		G	G112	
230.5	4.5				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 2.1 m below ground surface.
2) Seepage was observed at 0.6 m below ground surface on completion of drilling.
3) Test hole was open to 2.1 m below ground surface.
4) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-22

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513270.403, E-630092.392
Contractor: Paddock Drilling Ltd.
Ground Elevation: 235.07 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0		REFUSE (Fill) - clayey, trace to some sand, trace coarse gravel, trace to some organics (wood mulch <75 mm diam.), trace glass, trace to some municiple waste (plastics, scrap metals, compost) - mottled grey and brown - moist, soft -wet below 0.5 m		G113	
234.0	1.0		CLAY (Fill) - silty, trace to some sand, trace coarse gravel, trace to some organics - mottled grey and brown - moist, firm - high plasticity		G114	
233.2	1.5		CLAY - silty, trace medium sand, trace organics (rootlets <1 mm diam.), trace precipitates - black - moist, stiff - high plasticity -mottled brown and grey below 2.0 m		G115	
	2.5				G116	
	3.5				G117	
230.5	4.5		-firm to stiff below 4.4 m		G118	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.2 m below ground surface.
2) Seepage was observed at 0.6 m below ground surface on completion of drilling.
3) Test hole was open to 2.1 m below ground surface.
4) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

Sub-Surface Log

Test Hole TH12-23

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513329.156, E-630168.928
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	234.24 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.0		CLAY (Fill) - silty, trace to some sand, trace coarse gravel (<25 mm diam.), trace to some organics (wood mulch <75 mm diam.), trace glass, trace silt inclusions (<25 mm diam.) - mottled black and brown - moist, stiff - intermediate plasticity			
	0.5			G	G119	
233.0	1.0					
			CLAY - silty, trace organics (rootlets <10 mm diam.), trace oxidation, trace precipitates (<1 mm diam.) - black - moist, stiff - high plasticity -mottled brown and grey below 1.4 m	G	G120	
	1.5			G	G121	
	2.0			G	G122	
231.6	2.5					
231.5			CLAY - some silt, trace fine sand, trace oxidation, medium brown, moist, soft, low plasticity	G	G123	
			CLAY - silty, trace medium sand, trace precipitates - mottled brown and grey - moist, firm to stiff - high plasticity	G	G124	
	3.0					
	3.5					
	4.0			G	G125	
229.7	4.5					

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 3.1 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 3.1 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-24

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513366.386, E-630232.246
Contractor: Paddock Drilling Ltd.
Ground Elevation: 234.30 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: June 28, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.8	0.0		SAND and GRAVEL (Fill) - clayey - black, dry, loose, subangular, well graded coarse sand to medium gravel (<50 mm diam.)	G	G126	
	0.5		CLAY (Fill) - silty, trace sand, trace coarse gravel, trace to some organics (wood mulch <75 mm diam.), trace glass, trace silt inclusions (<25 mm diam.) - dark grey - moist, stiff - high plasticity	G	G127	
	1.0					
	1.5					
232.5						
232.2	2.0		CLAY - silty - dark grey, moist, stiff, high plasticity	G	G128	
232.0			CLAY - silty, trace fine sand, trace oxidation - medium brown, moist, soft, low plasticity	G	G129	
	2.5		CLAY - silty, trace medium sand, trace precipitates - mottled brown and grey - moist, stiff - high plasticity	G	G130	
	3.0			G	G131	
	3.5					
	4.0					
229.7	4.5			G	G132	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 4.6 m IN CLAY

Notes:
1) Test hole was squeezing in at 2.4 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 2.4 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-25
1 of 1

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513119.687, E-630131.593
Contractor: Paddock Drilling Ltd.
Ground Elevation: 234.19 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: July 3, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	0.0		CLAY (Fill) - silty, trace sand, trace coarse gravel, trace to some organics (compost <20 mm diam.), trace glass, trace silt inclusions (<25 mm diam.) - brown - moist, soft - high plasticity			
	0.5			G	G133	
	1.0		-mottled black and brown below 0.9 m	G	G134	
233.0						
	1.5		CLAY - silty, trace silt inclusions (<5 mm diam.) - mottled black and brown - moist, stiff, high plasticity	G	G135	
232.1	2.0					
232.0			CLAY - silty, trace oxidation, medium brown, moist, soft, low plasticity	G	G136	
	2.5		CLAY - silty, trace medium sand, trace precipitates - mottled brown and grey - moist, stiff - high plasticity	G	G137	
231.1	3.0					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.8 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.8 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-26

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5512890.969, E-630027.945
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.62 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 3, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5	0		ORGANIC CLAY (Topsoil) - trace rootlets (<5 mm diam.), grey, moist, firm, high plasticity	G	G138	
	0.5		CLAY - silty, trace organics (<1 mm diam.) - brown - moist, stiff - high plasticity			
	1.0			G	G139	
	1.5					
	2.0			G	G140	
	2.5					
230.6	3.0			G	G141	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100; PL MC LL; 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:

1) Test hole was squeezing in at 1.8 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.8 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-27

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5512946.115, E-630005.796
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.68 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: July 3, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.5	0		ORGANIC CLAY (Topsoil) - trace rootlets (<5 mm diam.) - grey, moist, firm, high plasticity		G142	
233.2			CLAY - silty, trace organics (rootlets <5 mm diam.) - mottled black and brown, moist, firm, high plasticity		G143	
232.9	0.5		SILT - clayey, trace oxidation - medium brown - moist, soft, low plasticity		G144	
			CLAY - silty - mottled brown and grey - moist, stiff - high plasticity		G145	
	1.0					
	1.5					
	2.0				G146	
	2.5		-trace precipitates (<5 mm diam.) below 2.4 m		G147	
230.6	3.0					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.5 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.8 m below ground surface.
3) Test hole was backfilled with cuttings to 1.5 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-28

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513079.099, E-630048.457
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.52 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: July 3, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.0	0.0		ORGANIC CLAY (Topsoil) - trace rootlets (<5 mm diam.) - grey - moist, firm - high plasticity	Grab	G148	
232.8	0.5		SILT - some clay, trace fine sand, trace oxidation - medium brown, dry to moist, soft, low plasticity	Grab	G149	
	1.0		CLAY - silty, trace precipitates (<5 mm diam.) - mottled brown and grey - moist, firm to stiff - high plasticity			
			-50 mm thick silt seam at 1.2 m	Grab	G150	
	1.5			Shelby Tube	T151	
	2.0					
	2.5					
230.5	3.0		-firm to stiff below 2.9 m	Grab	G152	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 3.1 m IN CLAY

Notes:
1) Test hole was squeezing in at 1.5 m below ground surface.
2) Test hole was dry approximately 15 minutes after drilling and open to 1.5 m below ground surface.
3) Test hole was backfilled with cuttings to 1.2 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-29

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513037.651, E-629994.321
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.78 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 3, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite Seal | Filter Pack Sand | Slotted Pipe | Blank Casing

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.2	0.0	ORGANIC CLAY (Topsoil) - silty, some rootlets (<5 mm diam.) - black - dry, firm - high plasticity -moist below 0.3 m	G	G153	
232.7	1.0	SILT - clayey, trace oxidation - medium brown - dry to moist, soft - low plasticity	G	G154	
	1.0	CLAY - silty, lamitated (<2mm thick) - mottled brown and grey - moist, stiff - high plasticity -10 mm thick silt seam at 1.4 m	G	G155	
	2.0	-trace precipitates (<5 mm diam.) below 1.8 m			
	2.6	-firm below 2.6 m	G	G156	
	3.0		T	T157	
	4.0		G	G158	
	5.0				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa) — Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○ — 0 50 100 150 200 250

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-29

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	6.0	-becomes grey below 5.5 m		G159	
	6.5			T160	
	7.0				
	7.5	-soft below 7.3 m		G161	
	8.0				
	8.5			G162	
	9.0				
	9.5			T163	
	10.0				
	10.5			G164	
	11.0				
	11.5	-trace silt till inclusions (<20 mm diam.) with trace sand and gravel below 11.3 m		G165	
222.0		TRANSITION ZONE INTO TILL			
221.7	12.0	SILT (Till) - sandy, trace to some gravel, trace clay - light grey		G166	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-29

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	12.5	- moist, compact - subrounded to rounded gravel -mottled brown and grey below 12.5 m		SP167	22
	13.0	-wet below 13 m		SP168	16
	13.5				
	14.0			SP169	15
	14.5				
219.1		SILT (Till) - sandy, trace to some gravel, trace clay - light grey - dry to moist, dense to very dense - subrounded to rounded gravel		SP170	34
	15.0				
218.2	15.5			SP171	60 / 183 mm

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL

0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type
△ Torvane △
✪ Pocket Pen. ✪
☒ Qu ☒
○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 15.6 m IN SILT TILL

Notes:
1) Power Auger Refusal (PAR) at 15.6 m below ground surface.
2) Test hole was dry 20 minutes after drilling.
3) Test hole stayed open to 15.5 m below ground surface.
4) Standpipe Piezometer (TH12-29) installed to 15.6 m below ground on completion of drilling.
5) Water level was 12.4 m below ground surface 2 days after drilling.
6) Water level was 6.16 m below ground surface on July 25, 2012.
7) Water level was 6.24 m below ground surface on August 1, 2012.
8) Test hole was back filled with sand below 13.6 m. Bentonite was backfilled from 13.6 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-30

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513039.323, E-629944.993
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.64 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 3, 2012 - July 5, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Backfill Legend: Bentonite Seal | Filter Pack Sand | Sand at Bottom | Slough Backfill | Slotted Pipe | Blank Casing

Elevation (m)	Depth (m)	Material Description	Sample Type	Sample Number	SPT (N)
233.4	0	ORGANIC CLAY (Topsoil) - silty, some rootlets (<5mm diam.) - black, moist, firm, high plasticity	G	G172	
	0.5	CLAY - silty, trace precipitates inclusions (<5 mm diam.) - grey - moist, stiff - high plasticity	G	G173	
	1.0				
	1.5	-low plasticity from 1.3 to 1.5 m	G	G174	
		-trace silt inclusions (<10 mm diam.) below 1.5 m	T	T175	
	2.0				
	2.5	-firm below 2.6 m	G	G176	
	3.0				
	3.5				
	4.0		G	G177	
	4.5		T	T178	
	5.0				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa) — Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○ — 0 50 100 150 200 250

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

Sub-Surface Log

Test Hole TH12-30

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	6.0	-soft below 5.6 m		G179	
	7.0			G180	
	7.5	-moist to wet below 7.6 m			
	8.0			T181	
	8.5			G182	
	9.0				
	9.5			G183	
	10.0				
	10.5			T184	
	11.0				
	11.5				
221.8	12.0	SILT (Till) - sandy, trace to some gravel, trace clay - light grey - moist, compact - subrounded to rounded gravel		G186	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

Sub-Surface Log

Test Hole TH12-30

Elevation (m)	Depth (m)	Soil Symbol	Standpipe	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
	12.5						
	13.0					SP187	20
	13.5						
	14.0					SP188	31
	14.5						
218.7						SP189	33
	15.0			SILT (Till) - sandy, trace to some gravel, trace clay - light grey - dry to moist, dense to very dense - subrounded to rounded gravel			
	15.5					SP190	29
217.9						SP191	100

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa)

Test Type: △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○

0 50 100 150 200 250

END OF TEST HOLE AT 15.7 m IN SILT TILL

Notes:

1) Power Auger Refusal (PAR) at 15.7 m below ground surface.
2) Test hole squeezed in at 11.4 m below ground surface.
3) Test hole was dry 20 minutes after drilling.
4) Standpipe Piezometer (TH12-30) installed to 15.6 m below ground on completion of drilling.
4) Water level was 5.89 m below ground surface on July 25, 2012.
5) Water level was 5.96 m below ground surface on August 1, 2012.
6) Test hole was back filled with sand below 13.6 m. Bentonite was backfilled from 13.6 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-31

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513508.6, E-630210.85
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.79 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 5, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.6	0		ORGANIC CLAY (Topsoil) - silty, trace to some sand, trace organics (rootlets <5 mm diam.), black and brown, dry to moist, very stiff, low plasticity	G	G213	
	0.5		CLAY - silty, trace coarse sand, trace precipitates (<25 mm diam.) - medium grey, - dry, very stiff - high plasticity	G	G214	
	1.0		-moist and stiff below 0.9 m			
	1.5			G	G215	
232.0						
231.7	2.0		CLAY - silty, trace oxidation - medium brown, moist, soft, low plasticity	G	G216	
			CLAY - silty, trace precipitates inclusions (<25 mm diam.) - mottled brown and grey - moist, stiff - high plasticity	T	T217	
	2.5					
	3.0					
	3.5			G	G218	
	4.0			T	T218A	
	4.5					
	5.0			G	G219	

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-31

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21	Particle Size (%) 0 20 40 60 80 100	PL MC LL 0 20 40 60 80 100	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
227.7	6.0		END OF TEST HOLE AT 6.1 m IN CLAY		T220					

Notes:
1) Test hole was dry approximately 15 minutes after drilling
2) Test hole was open to 6.1 m below ground surface.
3) Test hole was backfilled with Bentonite from 6.1 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-32

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513574.173, E-630167.543
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.29 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 5, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.1	0.0	ORGANIC CLAY (Topsoil) - silty, trace to some sand, trace organics (rootlets <5 mm diam.), black and brown, dry to moist, firm, intermediate plasticity	G	G203	
	0.5	CLAY - silty - medium grey, moist, firm, high plasticity			
	1.0		G	G204	
232.0	1.3	CLAY - silty, trace oxidation - medium brown, moist, soft, low plasticity	G	G205	
231.7	1.5	CLAY - silty, trace precipitates inclusions (<5 mm diam.) - mottled brown and grey - moist, firm to stiff - high plasticity			
	2.0		G	G206	
	2.5	-firm below 2.3 m	G	G207	
	3.0		T	T208	
	3.5				
	4.0	-trace silt inclusions (<10 mm diam.) below 4.0 m	G	G209	
	4.5		T	T210	
	5.0				

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100 — PL MC LL — 0 20 40 60 80 100

Undrained Shear Strength (kPa) — Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○ — 0 50 100 150 200 250

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-32

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)	Bulk Unit Wt (kN/m³) 16 17 18 19 20 21	Particle Size (%) 0 20 40 60 80 100 PL MC LL	Undrained Shear Strength (kPa) Test Type △ Torvane △ ✤ Pocket Pen. ✤ ☒ Qu ☒ ○ Field Vane ○ 0 50 100 150 200 250
226.6	6.0				G211				
	6.5				T212				

END OF TEST HOLE AT 6.7 m IN CLAY

Notes:

1) Test hole was dry approximately 15 minutes after drilling
2) Test hole was open to 6.7 m below ground surface.
3) Test hole was backfilled with Bentonite from 6.7 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-33

Client: CH2MHILL
Project Number: 0068 002 00
Project Name: Waste Composting Facility Brady Road
Location: UTM 14 N-5513198.622, E-630388.312
Contractor: Paddock Drilling Ltd.
Ground Elevation: 233.26 m Existing Ground
Method: 125 mm Solid Stem Auger, CME-850 Track Mount
Date Drilled: July 5, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.0	0		ORGANIC CLAY (Topsoil) - silty, trace roots (<5 mm diam.) - black, moist, firm, high plasticity		G192	
	0.5		CLAY - silty, trace organics (rootlets <5 mm diam.) - light grey - moist, stiff - high plasticity		G193	
	1.0					
231.7	1.5		-firm below 1.4 m			
231.5			SILT - some clay - medium brown, moist, soft, low plasticity		T194	
	2.0		CLAY - silty, trace precipitate inclusions (<3 mm diam.) - mottled brown and grey - moist, stiff - high plasticity			
	2.5				G195	
	3.0				T196	
229.6	3.5					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21
Particle Size (%): 0 20 40 60 80 100
PL MC LL: 0 20 40 60 80 100
Undrained Shear Strength (kPa): 0 50 100 150 200 250
Test Type: △ Torvane △ ✪ Pocket Pen. ✪ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.7 m IN CLAY

Notes:
1) Test hole was dry approximately 15 minutes after drilling
2) Test hole was open to 3.7 m below ground surface.
3) Test hole was backfilled with cuttings to 1.5 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12

Sub-Surface Log

Test Hole TH12-34

Client:	CH2MHILL	**Project Number:**	0068 002 00
Project Name:	Waste Composting Facility Brady Road	**Location:**	UTM 14 N-5513261.496, E-630610.877
Contractor:	Paddock Drilling Ltd.	**Ground Elevation:**	233.25 m Existing Ground
Method:	125 mm Solid Stem Auger, CME-850 Track Mount	**Date Drilled:**	July 5, 2012

Sample Type: Grab (G) | Shelby Tube (T) | Split Spoon (SS) | Split Barrel (SB) | Core (C)

Particle Size Legend: Fines | Clay | Silt | Sand | Gravel | Cobbles | Boulders

Elevation (m)	Depth (m)	Soil Symbol	MATERIAL DESCRIPTION	Sample Type	Sample Number	SPT (N)
233.0	0.0		ORGANIC CLAY (Topsoil) - silty, trace organics (roots <5 mm diam.) - black, moist, firm, high plasticity		G197	
	0.5		CLAY - silty, some fine sand, trace oxidation - mottled brown and grey - moist, stiff - high plasticity		G198	
232.0	1.0		-25 mm fine sand seam			
231.9	1.5		SAND - silty, brown, moist, loose, fine sand		G199	
			SILT - some clay, some sand - medium brown - moist to wet, soft - low plasticity		T200	
231.0	2.0		CLAY - silty, trace fine sand, trace precipitate inclusions (<3 mm diam.) - mottled brown and grey - moist, firm - high plasticity		G201	
	2.5					
	3.0				T202	
229.6	3.5					

Bulk Unit Wt (kN/m³): 16 17 18 19 20 21

Particle Size (%): 0 20 40 60 80 100

PL MC LL: 0 20 40 60 80 100

Undrained Shear Strength (kPa): 0 50 100 150 200 250

Test Type: △ Torvane △ ✿ Pocket Pen. ✿ ☒ Qu ☒ ○ Field Vane ○

END OF TEST HOLE AT 3.7 m IN CLAY

Notes:

1) Water level was 3.4 m below ground surface approximately 15 minutes after drilling
2) Test hole was open to 3.7 m below ground surface.
3) Test hole was backfilled with cuttings to 1.5 m below ground surface. One bag of bentonite was used in the test hole from 0.3 m to the surface.

Logged By: Tom Hildahl **Reviewed By:** Kent Bannister **Project Engineer:** Kent Bannister

SUB-SURFACE LOG GINT LOGS REVA.GPJ TREK GEOTECHNICAL.GDT 8/3/12