

## Memorandum

To	Keith Fitchett	Page	1
CC	Ray Bilevicious		
Subject	Miller Environmental Corporation Cell #2 and #3 Rehabilitation Geotechnical Assessment		
From	Faris Khalil		
Date	August 18, 2011	Project Number	60216914 (402.19)

### 1. Introduction

Miller Environmental is planning to rehabilitate the existing clay liner for Cell #2 and #3 at the Hazardous Waste Site near Letellier, Manitoba. The existing cells are now overgrown with vegetation.

This memorandum summarizes the results of the geotechnical investigation performed at the above referenced site and provides a geotechnical assessment related to the design and construction of the proposed Cell #2 and #3 rehabilitation works.

### 2. Geotechnical Investigation

Fourteen test holes (TH11-01 to TH 11-14) were drilled on June 7, 2011 at the locations shown on Figure 01. Seven test holes (TH11-01 to TH11-07) were drilled within the boundaries of Cell #2 and TH11-08 to TH11-14 were drilled within the boundaries of Cell #3. TH11-06 and TH11-07 were drilled at the dyke of Cell #2 and TH11-13 and TH11-14 were drilled at the dyke of Cell #3. The drilling was completed by Paddock Drilling Ltd. using a track mounted Acker RM 30 drill rig equipped with 125 mm solid stem augers. The test holes were advanced up to 3.0 m below the existing cell floor or the top of the existing dyke. Disturbed and relatively undisturbed soil samples (Shelby Tubes) were collected at regular intervals from these test holes. A total of eight Shelby Tube samples were collected from Cell #2 and #3. One Shelby Tube sample was collected from the dyke of each cell. All soils observed during drilling were logged and visually classified on site by AECOM personnel. Soil samples recovered were transported to AECOM's Materials Testing Laboratory in Winnipeg for further visual examination and testing.

Laboratory testing included the determination of moisture contents, Atterberg Limits, grain size hydrometer analysis and flexible wall permeability. A detailed test hole log has been prepared for each test hole to record the description and the relative position of the various soil strata, location of samples obtained, field and laboratory test results and other pertinent information. Test hole logs are attached.

### **3. Subsurface Conditions**

#### **3.1 Soil Profile**

The general soil profile in descending order is:

- Topsoil
- Clay/Clay and Silt

These soil units are described separately as follows:

##### **Topsoil**

Topsoil was encountered at the ground surface at some test holes and extended to depths up to 0.2 m. The topsoil consists of black, moist and soft organic matters. Ponding water approximately 0.2 m deep was observed at some test hole locations within the cell. The source of the water is most likely from surface runoff.

##### **Clay/Clay and Silt**

Clay/Clay and Silt deposit was encountered at the ground surface or below the topsoil in all test holes and extended to the maximum depth explored. The clay contains variable amounts of silt, trace organics, and silt inclusions. The deposit is moist to wet, firm to stiff and of intermediate to high plasticity.

### **4. Geotechnical Assessment**

Based on the site investigation completed within Cell #2 and #3, cohesive soil was encountered within the perimeter dykes and underneath the cells floor for depths ranging from 1.5 to 3.0 m. Moisture content has been determined for all disturbed and undisturbed samples and varies between 17 and 44 percent. Results from two Atterberg Limit tests indicate that the clay is of intermediate to high plasticity based on average liquid limit and plastic limit of 46 and 19 percent, respectively. Grain size distribution has been completed; the percent passing sieve No. 200 is more than 97 percent. A total of four hydraulic conductivity tests have been completed on undisturbed soil samples collected from test holes TH11-04, TH11-06, TH11-12 and TH11-14 at different depths. Table 01 summarizes the test results. The hydraulic conductivity values  $k$  vary between  $1.03 \times 10^{-7}$  to  $4.5 \times 10^{-9}$  cm/sec which fall within the anticipated range of hydraulic conductivity properties of clay. It is our opinion that the existing clay liner would provide satisfactory performance under the intended use subject to the following conditions:

1. Remove and strip the existing vegetation and topsoil;
2. Re-work and compact the top 300 mm to a minimum of 95 percent of standard proctor maximum dry density.

Table: Summary of Hydraulic Conductivity Test Results

Location	Test Hole	Depth (m)	Hydraulic Conductivity k cm/sec	Soil Type (Lab Test)
Cell#2 Floor	TH11-04	1.21	4.5 X 10 <sup>-9</sup>	Silt and Clay, some sand
Cell#2 Floor	TH11-06	1.52	4.5 X 10 <sup>-9</sup>	Clay
Cell#3 Floor/ Dyke Toe	TH11-12	0.9	1.03 X 10 <sup>-7</sup>	Clay and Silt, some sand
Cell#3 Floor	TH11-14	2.13	1.7 X 10 <sup>-9</sup>	Clay

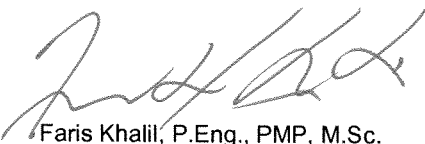
Please contact the undersigned if you have any questions regarding the subsurface investigation or recommendations found herein.

Sincerely,  
AECOM Canada Ltd.

Prepared By:

Reviewed By:

  
Mohammad Akhtar, P.Eng.  
Geotechnical Engineer

  
Faris Khalil, P.Eng., PMP, M.Sc.  
Manager, Geotechnical Engineering

MA:dh

## Memorandum

To Mohammad Akhtar Page 1

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CC

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Subject Miller Environmental – Cell 2 and 3 Rehabilitation

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From Stephen Petsche

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Date June 23, 2011 60216914

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Attached are testing results for the above noted project. The testing included thirty-five (35) Moisture Content tests, two (2) Atterberg Limits tests and two (2) Grain Size Distribution (hydrometer method) tests on samples submitted to the lab.

If you have any questions, please call.

Sincerely,



Stephen Petsche, C.E.T.  
Coordinator, Lab and Technical Services

Attach.

## MOISTURE CONTENT

JOB No.: 60216914  
 CLIENT: Miller Environmental  
 PROJECT: Cell 2 and 3 Rehabilitation

DATE: June 20, 2011

HOLE NO.	11-01	-	11-02	11-03	-	11-04
SAMPLE NO.	G1	G2	G3	G4	G5	G6
DEPTH (FT)	3.0	6.0	3.0	3.0	6.0	1.5
MOISTURE CONTENT %	25.6	23.3	26.7	26.4	23.9	35.8
HOLE NO.	11-04	11-05	-	11-06	-	11-07
SAMPLE NO.	G7	G8	G9	G10	G11	G12
DEPTH (FT)	6.5	3.0	5.0	3.0	6.0	3.0
MOISTURE CONTENT %	29.7	29.2	36.8	36.3	23.8	24.5
HOLE NO.	11-07	11-08	-	11-09	11-10	11-10
SAMPLE NO.	G13	G14	G15	G16	G17	G18
DEPTH (FT)	6.0	3.0	6.0	3.0	3.0	6.0
MOISTURE CONTENT %	40.3	28.5	30.3	29.6	33.7	30.7
HOLE NO.	11-10	11-11	11-12	11-13	-	-
SAMPLE NO.	G19	G20	G21	G22	G23	G24
DEPTH (FT)	9.0	5.0	5.0	3.0	6.0	9.0
MOISTURE CONTENT %	30.9	34.6	22.3	16.9	28.8	24.0

NOTES:



MATERIALS LABORATORY  
 AECOM

99 Commerce Drive, Winnipeg, MB R3P 0Y7 Canada  
 tel (204) 477-5381 fax (204) 284-2040

## MOISTURE CONTENT

JOB No.: 60216914  
 CLIENT: Miller Environmental  
 PROJECT: Cell 2 and 3 Rehabilitation

DATE: June 20, 2011

HOLE NO.	11-14	-	-	11-03	11-04	11-05
SAMPLE NO.	G25	G26	G27	T1	T2	T3
DEPTH (FT)	3.0	5.0	9.0	5.0	4	4
MOISTURE CONTENT %	37.5	31.4	21.1	28.3	24.5	43.4
HOLE NO.	11-06	11-09	11-11	11-12	11-14	
SAMPLE NO.	T4	T5	T6	T7	T8	
DEPTH (FT)	5	5	4	3	7	
MOISTURE CONTENT %	26.8	22.4	34.7	24.9	31.4	
HOLE NO.						
SAMPLE NO.						
DEPTH (FT)						
MOISTURE CONTENT %						
HOLE NO.						
SAMPLE NO.						
DEPTH (FT)						
MOISTURE CONTENT %						

NOTES:



MATERIALS LABORATORY  
 AECOM

99 Commerce Drive, Winnipeg, MB R3P 0Y7 Canada  
 tel (204) 477-5381 fax (204) 284-2040

**ATTERBERG**  
**(ASTM D4318-98)**



MATERIALS LABORATORY

AECOM

99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada

tel (204) 477-5381 fax (204) 284-2040

JOB No.: 60216914  
 CLIENT: Miller Environmental  
 PROJECT: Cell 2 and 3 Rehabilitation  
 LOCATION:

DATE: 22-Jun-11  
 TEST HOLE: TH11-04  
 SAMPLE: T2  
 DEPTH: 4'  
 TECH.: TN

**Liquid Limit**

**WATER CONTENT**

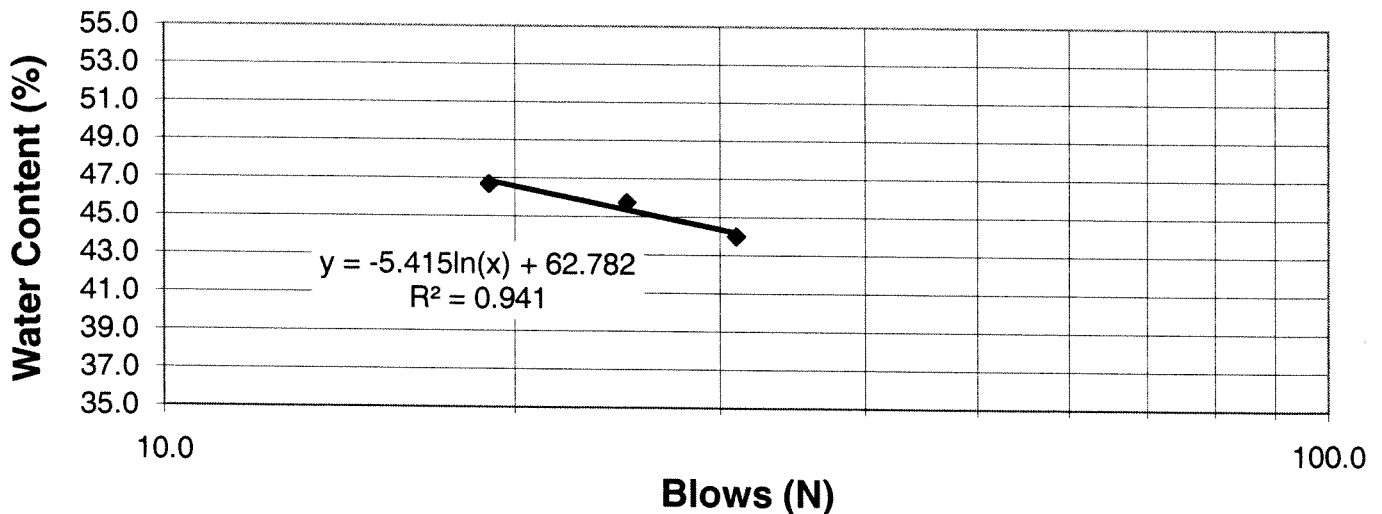
Blows	31	25	19		
WT. SAMPLE WET + TARE (gr)	145.941	144.052	145.850		
WT. SAMPLE DRY + TARE (gr)	135.354	133.385	135.071		
WT. TARE (gr)	111.278	110.062	111.975		
WT. WATER (gr)	10.587	10.667	10.779		
WT. DRY SOIL (gr)	24.076	23.323	23.096		
MOISTURE CONTENT (%)	43.973	45.736	46.670		

**Plastic Limit**

**WATER CONTENT**

WT. SAMPLE WET + TARE (gr)	119.545	121.050			
WT. SAMPLE DRY + TARE (gr)	118.625	119.895			
WT. TARE (gr)	113.789	113.865			
WT. WATER (gr)	0.920	1.155			
WT. DRY SOIL (gr)	4.836	6.030			
MOISTURE CONTENT (%)	19.024	19.154			

**LIQUID LIMIT**



Liquid Limit = 45.4

Plastic Limit = 19.1

Plasticity Index = 26.3

**ATTERBERG**  
**(ASTM D4318-98)**



MATERIALS LABORATORY

AECOM

99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada

tel (204) 477-5381 fax (204) 284-2040

JOB No.: 60216914  
 CLIENT: Miller Environmental  
 PROJECT: Cell 2 and 3 Rehabilitation  
 LOCATION:

DATE: 22-Jun-11  
 TEST HOLE: TH11-12  
 SAMPLE: T7  
 DEPTH: 3'  
 TECH.: TN

**Liquid Limit**

**WATER CONTENT**

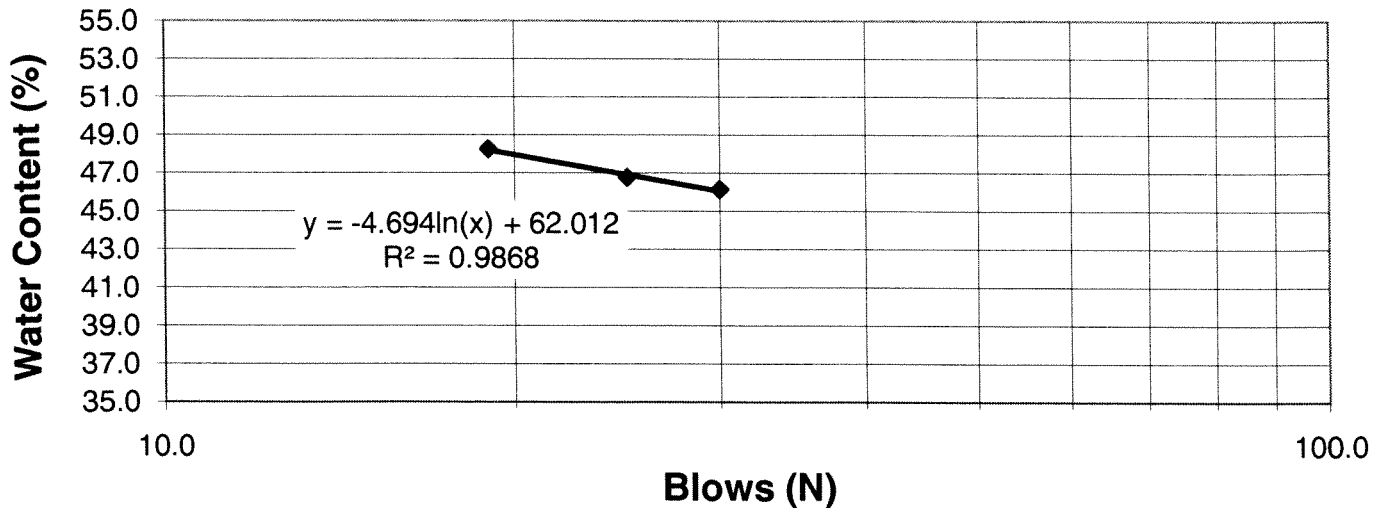
Blows	30	25	19		
WT. SAMPLE WET + TARE (gr)	139.925	146.959	144.405		
WT. SAMPLE DRY + TARE (gr)	130.772	136.290	135.256		
WT. TARE (gr)	110.932	113.474	116.294		
WT. WATER (gr)	9.153	10.669	9.149		
WT. DRY SOIL (gr)	19.840	22.816	18.962		
MOISTURE CONTENT (%)	46.134	46.761	48.249		

**Plastic Limit**

**WATER CONTENT**

WT. SAMPLE WET + TARE (gr)	119.771	122.344			
WT. SAMPLE DRY + TARE (gr)	118.810	121.023			
WT. TARE (gr)	113.751	114.157			
WT. WATER (gr)	0.961	1.321			
WT. DRY SOIL (gr)	5.059	6.866			
MOISTURE CONTENT (%)	18.996	19.240			

**LIQUID LIMIT**



Liquid Limit = 46.9

Plastic Limit = 19.1

Plasticity Index = 27.8



# GRAIN SIZE DISTRIBUTION



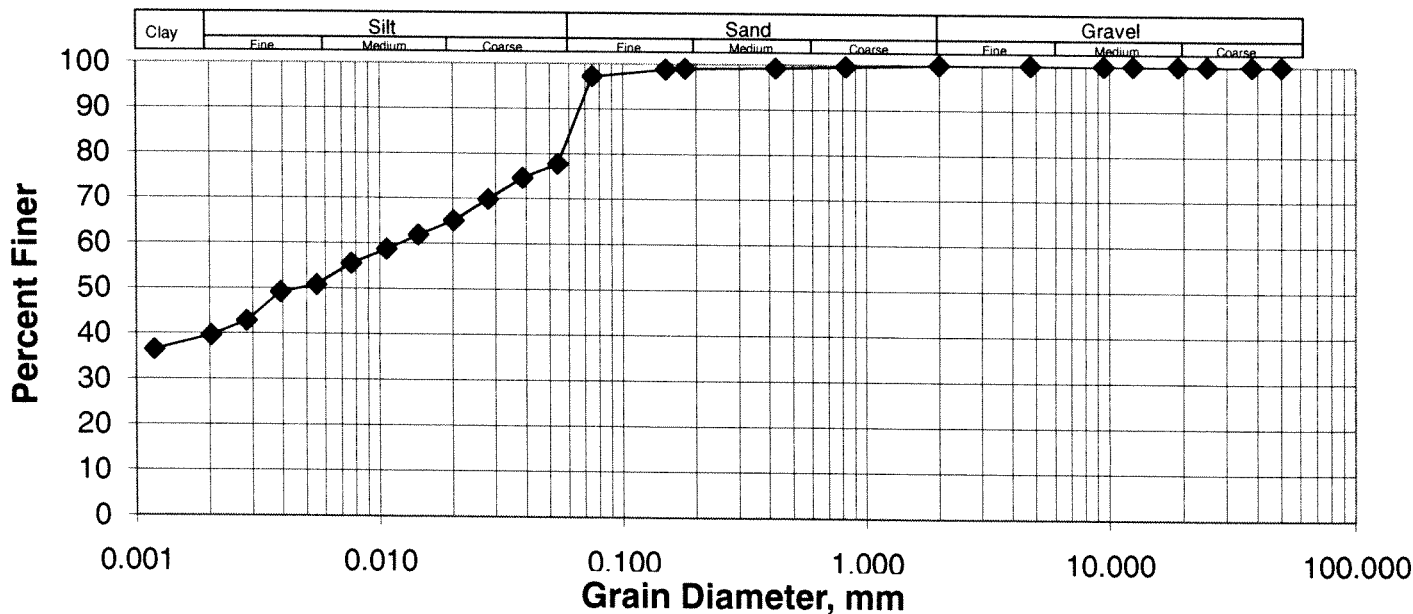
MATERIALS LABORATORY  
 AECOM  
 99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada  
 tel (204) 477-5381 fax (204) 284-2040

Job No.: 60216914  
 Client: MacKay OpCo  
 Project: Cell 2 and 3 Rehabilitation  
 Date Tested: 22-Jun-11  
 Tested By: \_\_\_\_\_

Hole No.: TH11-04  
 Sample No.: T2  
 Depth: 4.0'  
 Date Sampled: \_\_\_\_\_  
 Sampled By: \_\_\_\_\_

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	97.2
38.0	100.0	0.83	99.6	0.0540	77.8
25.0	100.0	0.43	99.2	0.0387	74.6
19.0	100.0	0.18	99.0	0.0280	69.8
12.5	100.0	0.15	98.8	0.0202	65.1
9.5	100.0	0.075	97.2	0.0145	61.9
4.75	100.0			0.0107	58.7
2.00	100.0			0.0077	55.5
				0.0055	50.8
				0.0039	49.2
				0.0028	42.8
				0.0020	39.6
				0.0012	36.5

## GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	43.8%
Sand	16.7%	Clay	39.5%

\*\* Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).

# GRAIN SIZE DISTRIBUTION



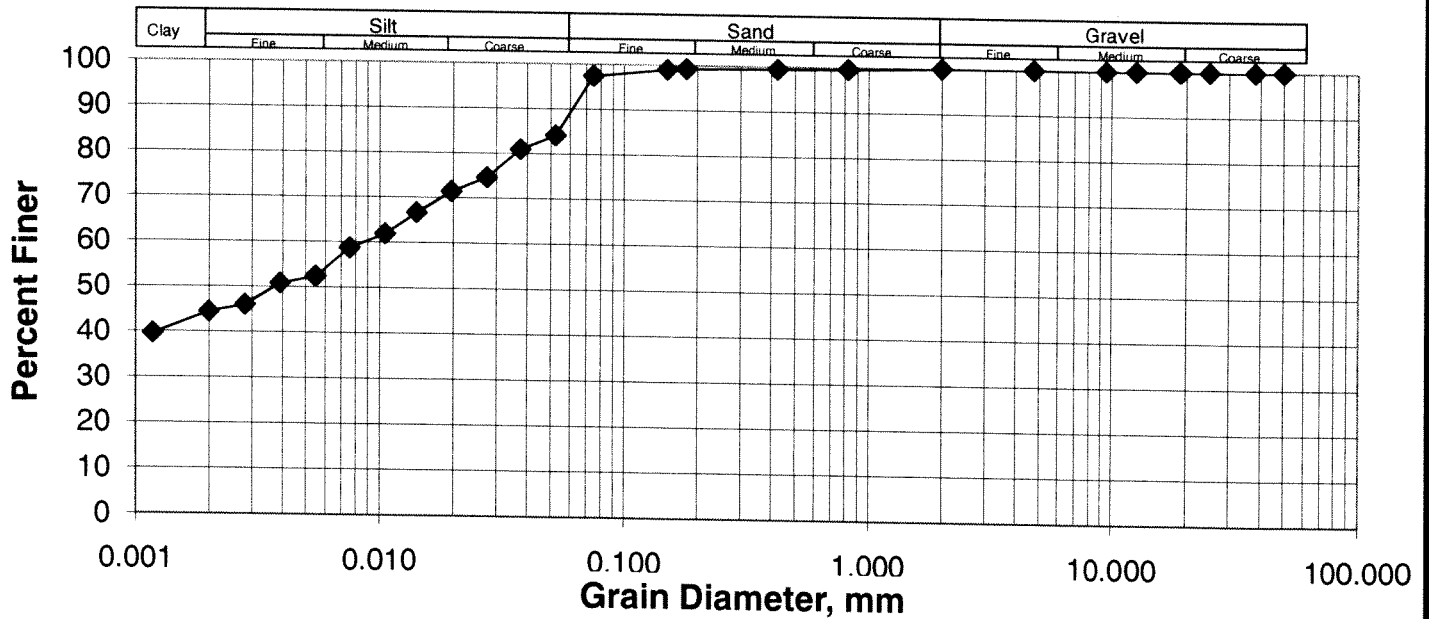
MATERIALS LABORATORY  
 AECOM  
 99 Commerce Dr., Winnipeg, MB R3P 0Y7 Canada  
 tel (204) 477-5381 fax (204) 284-2040

Job No.: 60216914  
 Client: Mackay OpCo  
 Project: Cell 2 and 3 Rehabilitation  
 Date Tested: 22-Jun-11  
 Tested By: \_\_\_\_\_

Hole No.: TH11-12  
 Sample No.: T7  
 Depth: 3.0'  
 Date Sampled: \_\_\_\_\_  
 Sampled By: \_\_\_\_\_

GRAVEL SIZES		SAND SIZES		FINES	
Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing	Grain Size (mm.)	Total Percent Passing
50.0	100.0	2.00	100.0	0.0750	97.4
38.0	100.0	0.83	99.6	0.0523	84.1
25.0	100.0	0.43	99.4	0.0376	80.9
19.0	100.0	0.18	99.2	0.0274	74.6
12.5	100.0	0.15	99.0	0.0196	71.4
9.5	100.0	0.075	97.4	0.0142	66.6
4.75	100.0			0.0106	61.9
2.00	100.0			0.0076	58.7
				0.0055	52.3
				0.0039	50.8
				0.0028	46.0
				0.0020	44.4
				0.0012	39.6

## GRAIN SIZE DISTRIBUTION CURVE



Gravel	0.0%	Silt	44.2%
Sand	11.4%	Clay	44.4%

\*\* Note: Soil Classification based on Grain Size from Canadian Foundation Engineering Manual, 3rd edition (1992).



#6 - 854 Marion Street, Winnipeg, Manitoba, R2J 0K4  
Phone: (204) 233-1694 Fax: (204) 235-1579  
E-mail: eng\_tech@mts.net  
www.eng-tech.ca

July 4, 2011

File No. 11-027-01

AECOM Canada Ltd.  
99 Commerce Drive  
Winnipeg, Manitoba  
R3P 0Y7

**ATTENTION:** Stephen Petsche, C.E.T.

**RE:** Hydraulic Conductivity Test – Miller Environmental Cell 2 & Cell 3 Rehabilitation

Dear Mr. Petsche,

ENG-TECH Consulting Limited (ENG-TECH) received a total four (4) soil samples on June 17, 2011. ENG-TECH prepared and tested the samples for hydraulic conductivity in accordance with ASTM D5084-03, *Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*. Testing on three (3) samples is complete and the remaining sample is being tested and the results will be presented in a following letter. The final hydraulic conductivity values ( $k_{20}$ ) of  $4.5 \times 10^{-9}$ ,  $4.5 \times 10^{-9}$  and  $1.03 \times 10^{-7}$  cm/sec were obtained for the samples identified as TH11-04 T2, TH11-06 T2, and TH11-12 T7, respectively. The hydraulic conductivity test data is outlined in Table 1, while graphical representations of the hydraulic conductivity versus elapsed time are shown on Figures 1, 2, and 3 attached.

ENG-TECH trusts this is all the information you require. If you have any questions or require additional information, please contact the undersigned.

Sincerely,  
ENG-TECH Consulting Limited

A handwritten signature in black ink, appearing to read "Clark Hryhoruk".

Clark Hryhoruk, M.Sc., P.Eng.  
Principal, Geotechnical Engineer

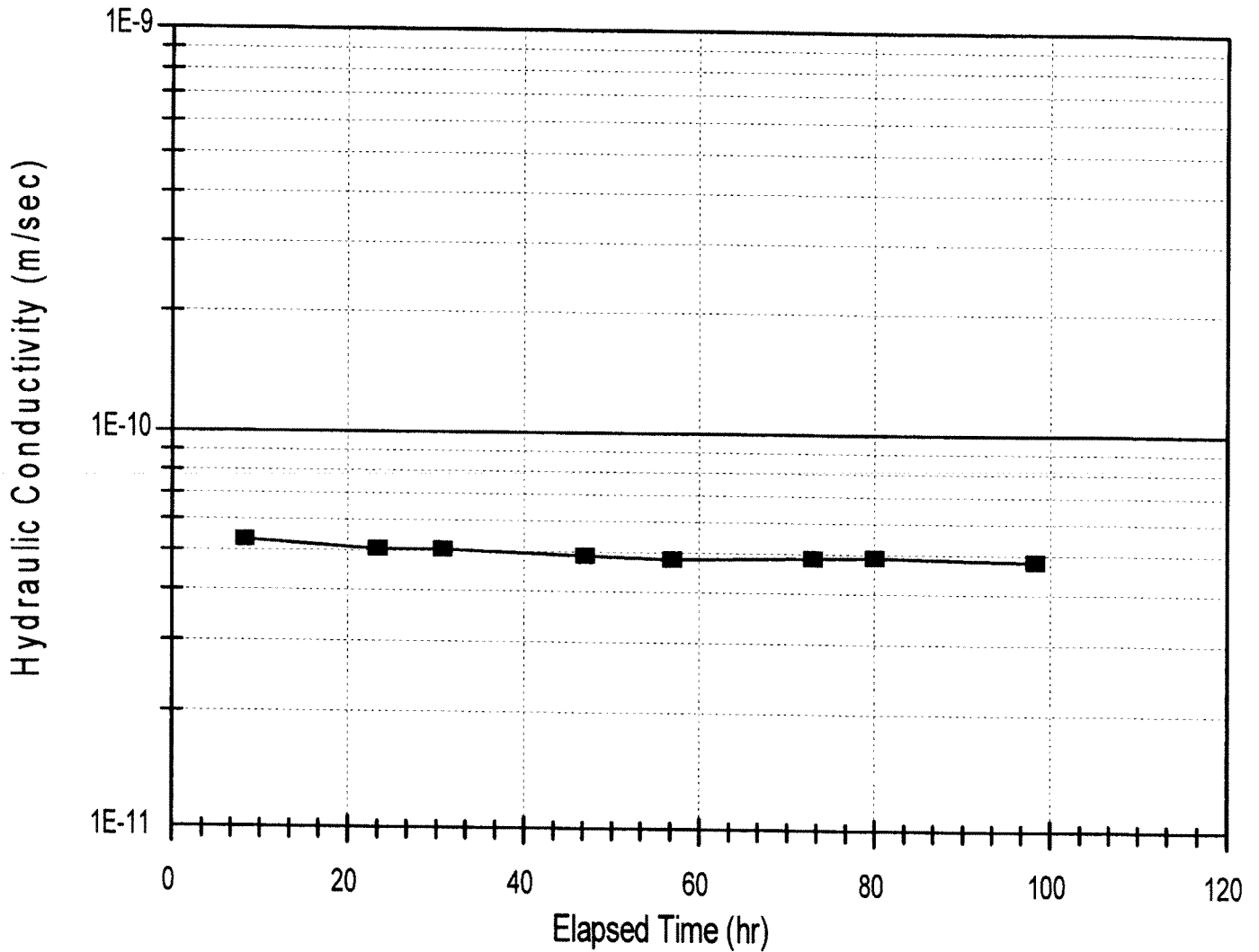
CDH/erm

Attachments: Table 1 - Hydraulic Conductivity Test Data  
Figure 1 - Hydraulic Conductivity Versus elapsed Time (TH11-04 T2)  
Figure 2 - Hydraulic Conductivity Versus elapsed Time (TH11-06 T2)  
Figure 3 - Hydraulic Conductivity Versus elapsed Time (TH11-12 T7)

**TABLE 1  
HYDRAULIC CONDUCTIVITY TEST DATA  
MILLER ENVIRONMENTAL CELL 2 & CELL 3 REHABILITATION**

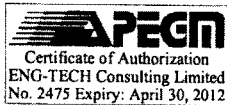
<b>SAMPLE IDENTIFICATION</b>	<b>TH11-04 T2</b>	<b>TH11-06 T2</b>	<b>TH11-12 T7</b>
<b>INITIAL VALUES</b>			
ENG-TECH Reference No.	11-27-1-6	11-27-1-7	11-27-1-8
Length of Sample in Tube (cm)	--	--	--
Length (cm)	6.19	6.21	6.18
Diameter (cm)	7.26	7.14	7.26
Area (cm <sup>2</sup> )	41.4	40.1	41.4
Volume (cm <sup>3</sup> )	256.4	248.8	255.8
Water Content (%)	25.1	25.6	21.8
Bulk Dry Density (kg/m <sup>3</sup> )	1597	1553	1692
Specific Gravity (G <sub>s</sub> ) (assumed)	2.70	2.70	2.70
Void Ratio	0.691	0.739	0.596
Degree of Saturation (%)	98.1	93.5	98.8
<b>FINAL VALUES</b>			
Length (cm)	6.22	6.30	6.18
Diameter (cm)	7.26	7.17	7.27
Area (cm <sup>2</sup> )	41.3	40.3	41.5
Volume (cm <sup>3</sup> )	257.0	254.1	256.0
Water Content (%)	25.5	29.3	21.2
Bulk Dry Density (kg/m <sup>3</sup> )	1606	1509	1715
Specific Gravity (G <sub>s</sub> ) (assumed)	2.70	2.70	2.70
Void Ratio	0.681	0.790	0.574
Degree of Saturation (%)	~100	~100	99.7
<b>CONSOLIDATION PHASE</b>			
Confining Pressure (kPa)	172.4	172.4	172.4
Pore Water Pressure (kPa)	137.9	137.9	137.9
Effective Stress (kPa)	34.5	34.5	34.5
<b>PERMEATION PHASE</b>			
Confining Pressure (kPa)	172.4	172.4	172.4
Pore Water Pressure (kPa)	137.9	137.9	137.9
Effective Stress (kPa)	34.5	34.5	34.5
Hydraulic Gradient	45.2	44.6	45.5
Permeant Fluid	Distilled Water	Distilled Water	Distilled Water
<b>HYDRAULIC CONDUCTIVITY at TEST TEMPERATURE OF 24 °C (cm/sec)</b>	$4.9 \times 10^{-9}$	$4.9 \times 10^{-9}$	$1.13 \times 10^{-7}$
<b>HYDRAULIC CONDUCTIVITY at TEMPERATURE OF 20 °C (K<sub>20</sub>) (cm/sec)</b>	$4.5 \times 10^{-9}$	$4.5 \times 10^{-9}$	$1.03 \times 10^{-7}$

# Hydraulic Conductivity



#6 - 854 Marion Street  
Winnipeg, MB R2J 0K4  
Phone: (204) 233-1694  
Fax: (204) 235-1579

ENG. STAMP:



CLIENT:  
MILLER ENVIRONMENTAL  
CELL 2 & CELL 3 REHABILITATION

DATE:  
JUNE 2011

DRAWN BY:  
ERM

FIGURE No.:  
1

REV.:

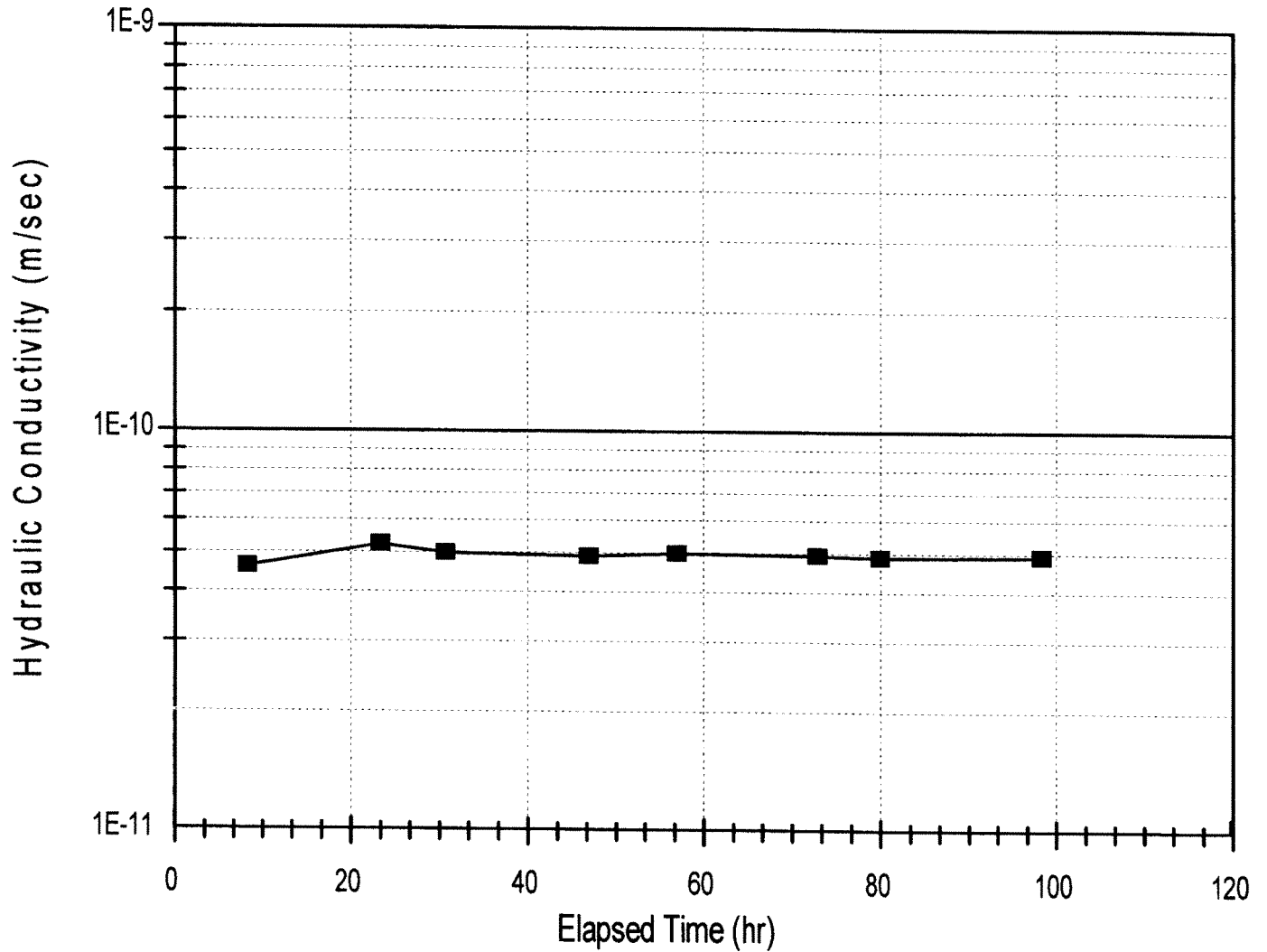
PROJECT:  
AECOM CANADA LTD.

FILE No.:  
11-027-01

SCALE:  
N/A

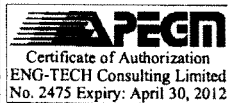
HYDRAULIC CONDUCTIVITY  
VERSUS ELAPSED TIME  
(TH11-04 T2)

# Hydraulic Conductivity



#6 - 854 Marion Street  
Winnipeg, MB R2J 0K4  
Phone: (204) 233-1694  
Fax: (204) 235-1579

ENG. STAMP:



Certificate of Authorization  
ENG-TECH Consulting Limited  
No. 2475 Expiry: April 30, 2012

CLIENT:

MILLER ENVIRONMENTAL  
CELL 2 & CELL 3 REHABILITATION

DATE:

JUNE 2011

DRAWN BY:  
ERM

FIGURE No.:  
2

REV.:

PROJECT:

AECOM CANADA LTD.

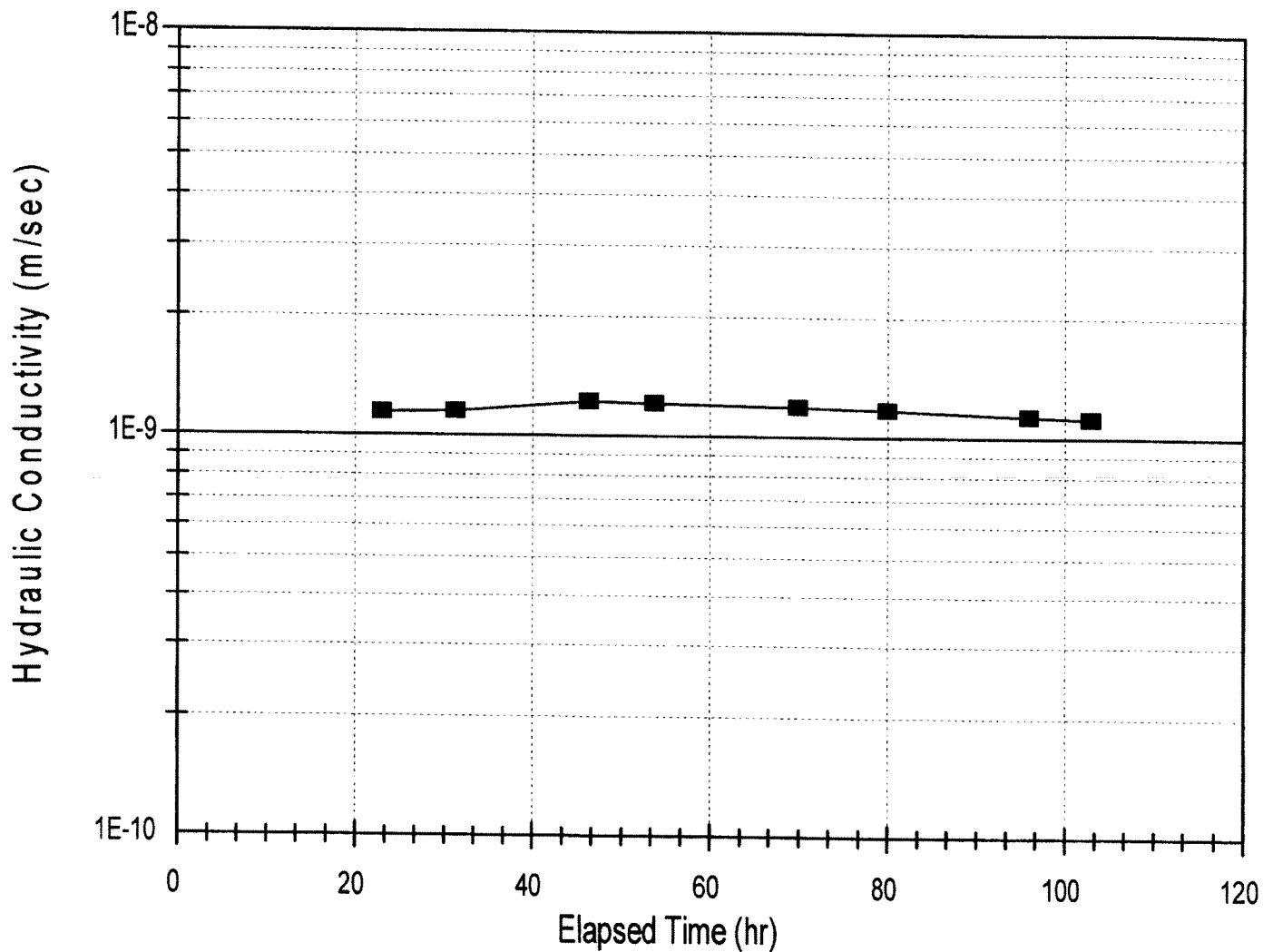
FILE No.:

11-027-01

SCALE:  
N/A

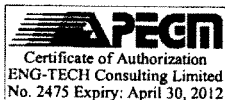
HYDRAULIC CONDUCTIVITY  
VERSUS ELAPSED TIME  
(TH11-06 T4)

# Hydraulic Conductivity



#6 - 854 Marlon Street  
Winnipeg, MB R2J 0K4  
Phone: (204) 233-1694  
Fax: (204) 235-1579

ENG. STAMP:



Certificate of Authorization  
ENG-TECH Consulting Limited  
No. 2475 Expiry: April 30, 2012

CLIENT:  
MILLER ENVIRONMENTAL  
CELL 2 & CELL 3 REHABILITATION

DATE:  
JUNE 2011

DRAWN BY:  
ERM

FIGURE No.:  
3

REV.:

PROJECT:  
AECOM CANADA LTD.

FILE No.:  
11-027-01

SCALE:  
N/A

HYDRAULIC CONDUCTIVITY  
VERSUS ELAPSED TIME  
(TH11-12 T7)



#6 - 854 Marion Street, Winnipeg, Manitoba, R2J 0K4  
Phone: (204) 233-1694 Fax: (204) 235-1579  
E-mail: eng\_tech@mts.net  
www.eng-tech.ca

July 6, 2011

File No. 11-027-01

AECOM Canada Ltd.  
99 Commerce Drive  
Winnipeg, Manitoba  
R3P 0Y7

**ATTENTION:** Stephen Petsche, C.E.T.

**RE:** Hydraulic Conductivity Test – Miller Environmental Cell 2 & Cell 3 Rehabilitation

Dear Mr. Petsche,

ENG-TECH Consulting Limited (ENG-TECH) completed the requested testing on the remaining sample from the above project. ENG-TECH prepared and tested the sample for hydraulic conductivity in accordance with ASTM D5084-03, *Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials using a Flexible Wall Permeameter*. The final hydraulic conductivity value ( $k_{20}$ ) of  $1.7 \times 10^{-9}$  cm/sec was obtained for the sample identified as TH11-14 T8. The hydraulic conductivity test data is outlined in Table 1, while a graphical representation of the hydraulic conductivity versus elapsed time is shown on Figure 1, attached.

ENG-TECH trusts this is all the information you require. If you have any questions or require additional information, please contact the undersigned.

Sincerely,  
ENG-TECH Consulting Limited

A handwritten signature in black ink that reads "Clark Hryhoruk".

Clark Hryhoruk, M.Sc., P.Eng.  
Principal, Geotechnical Engineer

CDH/erm

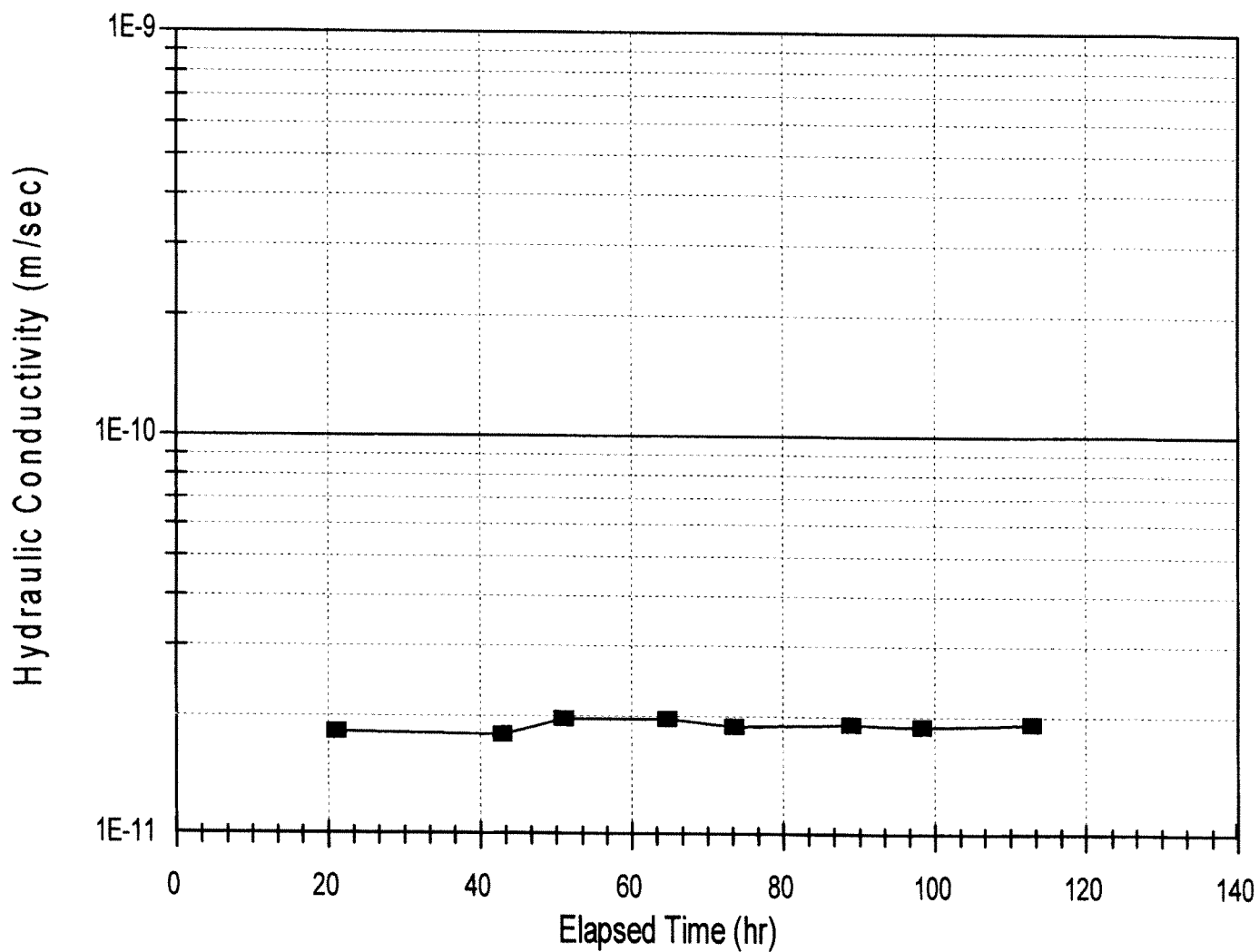
Attachments: Table 1 - Hydraulic Conductivity Test Data  
Figure 1 - Hydraulic Conductivity Versus elapsed Time (TH11-14 T8)



**TABLE 1**  
**HYDRAULIC CONDUCTIVITY TEST DATA**  
**MILLER ENVIRONMENTAL CELL 2 & CELL 3 REHABILITATION**

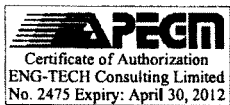
<b>SAMPLE IDENTIFICATION</b>	TH11-14 T7
<b>INITIAL VALUES</b>	
ENG-TECH Reference No.	11-27-1-9
Length of Sample in Tube (cm)	--
Length (cm)	6.36
Diameter (cm)	7.20
Area (cm <sup>2</sup> )	40.7
Volume (cm <sup>3</sup> )	258.9
Water Content (%)	28.3
Bulk Dry Density (kg/m <sup>3</sup> )	1520
Specific Gravity (G <sub>s</sub> ) (assumed)	2.70
Void Ratio	0.776
Degree of Saturation (%)	98.5
<b>FINAL VALUES</b>	
Length (cm)	6.40
Diameter (cm)	7.25
Area (cm <sup>2</sup> )	41.3
Volume (cm <sup>3</sup> )	264.2
Water Content (%)	30.5
Bulk Dry Density (kg/m <sup>3</sup> )	1483
Specific Gravity (G <sub>s</sub> ) (assumed)	2.70
Void Ratio	0.820
Degree of Saturation (%)	~100
<b>CONSOLIDATION PHASE</b>	
Confining Pressure (kPa)	172.4
Pore Water Pressure (kPa)	137.9
Effective Stress (kPa)	34.5
<b>PERMEATION PHASE</b>	
Confining Pressure (kPa)	172.4
Pore Water Pressure (kPa)	137.9
Effective Stress (kPa)	34.5
Hydraulic Gradient	43.9
Permeant Fluid	Distilled Water
<b>HYDRAULIC CONDUCTIVITY at TEST TEMPERATURE OF 26 °C (cm/sec)</b>	1.9 x 10 <sup>-9</sup>
<b>HYDRAULIC CONDUCTIVITY at TEMPERATURE OF 20 °C (K<sub>20</sub>) (cm/sec)</b>	1.7 x 10 <sup>-9</sup>

# Hydraulic Conductivity



#6 - 854 Marion Street  
Winnipeg, MB R2J 0K4  
Phone: (204) 233-1694  
Fax: (204) 235-1579

ENG. STAMP:



CLIENT:

AECOM CANADA LTD.

DATE:

JULY 2011

DRAWN BY:

ERM

FIGURE No.:

1

REV.:

PROJECT:

MILLER ENVIRONMENTAL  
CELL 2 & CELL 3 REHABILITATION

FILE No.:

11-027-01

SCALE:

N/A

HYDRAULIC CONDUCTIVITY  
VERSUS ELAPSED TIME  
(TH11-14 T8)

**AECOM Canada Ltd.**

**GENERAL STATEMENT**

**NORMAL VARIABILITY OF SUBSURFACE CONDITIONS**

The scope of the investigation presented herein is limited to an investigation of the subsurface conditions as to suitability for the proposed project. This report has been prepared to aid in the evaluation of the site and to assist the engineer in the design of the facilities. Our description of the project represents our understanding of the significant aspects of the project relevant to the design and construction of earth work, foundations and similar. In the event of any changes in the basic design or location of the structures as outlined in this report or plan, we should be given the opportunity to review the changes and to modify or reaffirm in writing the conclusions and recommendations of this report.

The analysis and recommendations presented in this report are based on the data obtained from the borings and test pit excavations made at the locations indicated on the site plans and from other information discussed herein. This report is based on the assumption that the subsurface conditions everywhere are not significantly different from those disclosed by the borings and excavations. However, variations in soil conditions may exist between the excavations and, also, general groundwater levels and conditions may fluctuate from time to time. The nature and extent of the variations may not become evident until construction. If subsurface conditions differ from those encountered in the exploratory borings and excavations, are observed or encountered during construction, or appear to be present beneath or beyond excavations, we should be advised at once so that we can observe and review these conditions and reconsider our recommendations where necessary.

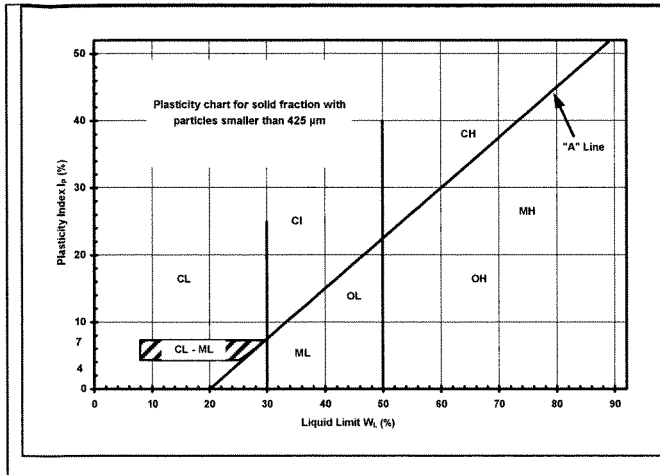
Since it is possible for conditions to vary from those assumed in the analysis and upon which our conclusions and recommendations are based, a contingency fund should be included in the construction budget to allow for the possibility of variations which may result in modification of the design and construction procedures.

In order to observe compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated, we recommend that all construction operations dealing with earth work and the foundations be observed by an experienced soils engineer. We can be retained to provide these services for you during construction. In addition, we can be retained to review the plans and specifications that have been prepared to check for substantial conformance with the conclusions and recommendations contained in our report.

## EXPLANATION OF FIELD & LABORATORY TEST DATA

Description		UMA Log Symbols	USCS Classification	Laboratory Classification Criteria					
				Fines (%)	Grading	Plasticity	Notes		
COARSE GRAINED SOILS	GRAVELS (More than 50% of coarse fraction of gravel size)	CLEAN GRAVELS (Little or no fines)	Well graded gravels, sandy gravels, with little or no fines		GW	0-5	$C_u > 4$ $1 < C_c < 3$	Dual symbols if 5-12% fines. Dual symbols if above "A" line and $4 < W_p < 7$  $C_u = \frac{D_{60}}{D_{10}}$ $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	
			Poorly graded gravels, sandy gravels, with little or no fines		GP	0-5	Not satisfying GW requirements		
		DIRTY GRAVELS (With some fines)	Silty gravels, silty sandy gravels		GM	> 12			Atterberg limits below "A" line or $W_p < 4$
			Clayey gravels, clayey sandy gravels		GC	> 12			Atterberg limits above "A" line or $W_p < 7$
	SANDS (More than 50% of coarse fraction of sand size)	CLEAN SANDS (Little or no fines)	Well graded sands, gravelly sands, with little or no fines		SW	0-5	$C_u > 6$ $1 < C_c < 3$		
			Poorly graded sands, gravelly sands, with little or no fines		SP	0-5	Not satisfying SW requirements		
		DIRTY SANDS (With some fines)	Silty sands, sand-silt mixtures		SM	> 12			Atterberg limits below "A" line or $W_p < 4$
			Clayey sands, sand-clay mixtures		SC	> 12			Atterberg limits above "A" line or $W_p < 7$
FINE GRAINED SOILS	SILTS (Below 'A' line negligible organic content)	$W_L < 50$	Inorganic silts, silty or clayey fine sands, with slight plasticity		ML		Classification is Based upon Plasticity Chart		
		$W_L > 50$	Inorganic silts of high plasticity		MH				
	CLAYS (Above 'A' line negligible organic content)	$W_L < 30$	Inorganic clays, silty clays, sandy clays of low plasticity, lean clays		CL				
		$30 < W_L < 50$	Inorganic clays and silty clays of medium plasticity		CI				
		$W_L > 50$	Inorganic clays of high plasticity, fat clays		CH				
	ORGANIC SILTS & CLAYS (Below 'A' line)	$W_L < 50$	Organic silts and organic silty clays of low plasticity		OL				
		$W_L > 50$	Organic clays of high plasticity		OH				
	HIGHLY ORGANIC SOILS		Peat and other highly organic soils		Pt	Von Post Classification Limit		Strong colour or odour, and often fibrous texture	
	Asphalt		Till			<b>AECOM</b>			
	Concrete		Bedrock (Undifferentiated)						
	Fill		Bedrock (Limestone)						

When the above classification terms are used in this report or test hole logs, the designated fractions may be visually estimated and not measured.



FRACTION	SEIVE SIZE (mm)		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
	Passing	Retained	Percent	Identifier
Gravel	Coarse	76	19	35-50 and
	Fine	19	4.75	
Sand	Coarse	4.75	2.00	20-35 "y" or "ey" *
	Medium	2.00	0.425	
	Fine	0.425	0.075	
Silt (non-plastic) or Clay (plastic)	< 0.075 mm		10-20	some
			1-10	trace

\* for example: gravelly, sandy clayey, silty

Definition of Oversize Material  
 COBBLES: 76mm to 300mm diameter  
 BOULDERS: >300mm diameter

**LEGEND OF SYMBOLS**

Laboratory and field tests are identified as follows:

- $q_u$  - undrained shear strength (kPa) derived from unconfined compression testing.
- $T_v$  - undrained shear strength (kPa) measured using a torvane
- $pp$  - undrained shear strength (kPa) measured using a pocket penetrometer.
- $L_v$  - undrained shear strength (kPa) measured using a lab vane.
- $F_v$  - undrained shear strength (kPa) measured using a field vane.
- $\gamma$  - bulk unit weight ( $kN/m^3$ ).
- SPT - Standard Penetration Test. Recorded as number of blows (N) from a 63.5 kg hammer dropped 0.76 m (free fall) which is required to drive a 51 mm O.D. Raymond type sampler 0.30 m into the soil.
- DPPT - Drive Point Pentrometer Test. Recorded as number of blows from a 63.5 kg hammer dropped 0.76 m (free fall) which is required to drive a 50 mm drive point 0.30 m into the soil.
- w - moisture content ( $W_L, W_P$ )

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

$S_u$ (kPa)	CONSISTENCY
<12	very soft
12 – 25	soft
25 – 50	medium or firm
50 – 100	stiff
100 – 200	very stiff
200	hard

The resistance (N) of a non-cohesive soil can be related to compactness condition as follows

N – BLOWS/0.30 m	COMPACTNESS
0 - 4	very loose
4 - 10	loose
10 - 30	compact
30 - 50	dense
50	very dense

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-01  
 LOCATION: Cell # 2 (Northing 5449728.0000/Easting 620230.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							Becker	Dynamic Cone	Torvane	QU		
0	OR		TOPSOIL - trace organics - black, moist, soft									
			CLAY - silty - brown to grey, moist, stiff - high plasticity									
1	CH		- trace rootlets		G1							
			- brown to grey - stiff to very stiff									
2			- grey to black		G2							
			END OF TEST HOLE AT 2.3m IN CLAY									
			NOTES: - No sloughing observed. - Hole is submerged under water - Backfilled with bentonite chips to surface.									
3												
4												
5												
6												

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 2.29 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-02  
 LOCATION: Cell # 2 (Northing 5449720.0000, Easting 620240.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE       GRAB       SHELBY TUBE       SPLIT SPOON       BULK       NO RECOVERY       CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
						SPT (N)	Total Unit Wt (kN/m <sup>3</sup> )	Lab Vane	Field Vane		
0	OR		TOPSOIL - trace organics - black, moist, soft								
			CLAY - silty - grey, moist, stiff - high plasticity - grey to brown								
1	CH		- silt inclusions (<10 mm)		G3	16	18				1
1.5			END OF TEST HOLE AT 1.5 m IN CLAY								
2			NOTES: - No Sloughing observed at 1.5m. - Hole is submerged under water - Backfilled with bentonite chips to surface.								2
3											3
4											4
5											5
6											6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 1.52 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation	CLIENT: Miller Environmental Corporation	TESTHOLE NO: TH 11-03
LOCATION: Cell # 2 (Northing 5449711.0000, Easting 620238.0000)		PROJECT NO.: 60216914
CONTRACTOR: Paddock Drilling Ltd	METHOD: RM 30, 125 mm SSA	ELEVATION (m):
SAMPLE TYPE	<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> SHELBY TUBE <input checked="" type="checkbox"/> SPLIT SPOON <input type="checkbox"/> BULK	<input checked="" type="checkbox"/> NO RECOVERY <input type="checkbox"/> CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS	UNDRAINED SHEAR STRENGTH	COMMENTS	DEPTH
0			CLAY - silty - brown, moist, stiff - high plasticity							
			- trace rootlets							
1			- silt inclusions (<10 mm)		G4		●			1
			- trace rootlets		T1		●			
	CH		- brown to black - stiff		G5		●			
2								△ +		2
3			END OF TEST HOLE AT 3.0 m IN CLAY							3
4			NOTES: - No Sloughing observed at 3.0 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.							4
5										5
6										6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

DRAFT



LOGGED BY: M.Akhtar	COMPLETION DEPTH: 3.05 m
REVIEWED BY: Faris Khalil	COMPLETION DATE: 6/11/11
PROJECT ENGINEER: Khalil Faris	Page 1 of 1



PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-04  
 LOCATION: Cell # 2 (Northing 5449701.0000, Easting 620232.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH	COMMENTS	DEPTH
							Becker	Dynamic Cone			
0	OR		TOPSOIL - trace decomposed organics - black, moist, soft  SILT and CLAY - some sand - brown to black, moist, stiff - intermediate plasticity - trace rootlets - dark brown		G6				+		
1	CLSI		- silt inclusions (<5 mm) - homogenous brown colour		T2		PL		△		1
2			END OF TEST HOLE AT 2.1 m IN CLAY  NOTES: - No Sloughing observed at 2.1 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.		G7						2
3											3
4											4
5											5
6											6

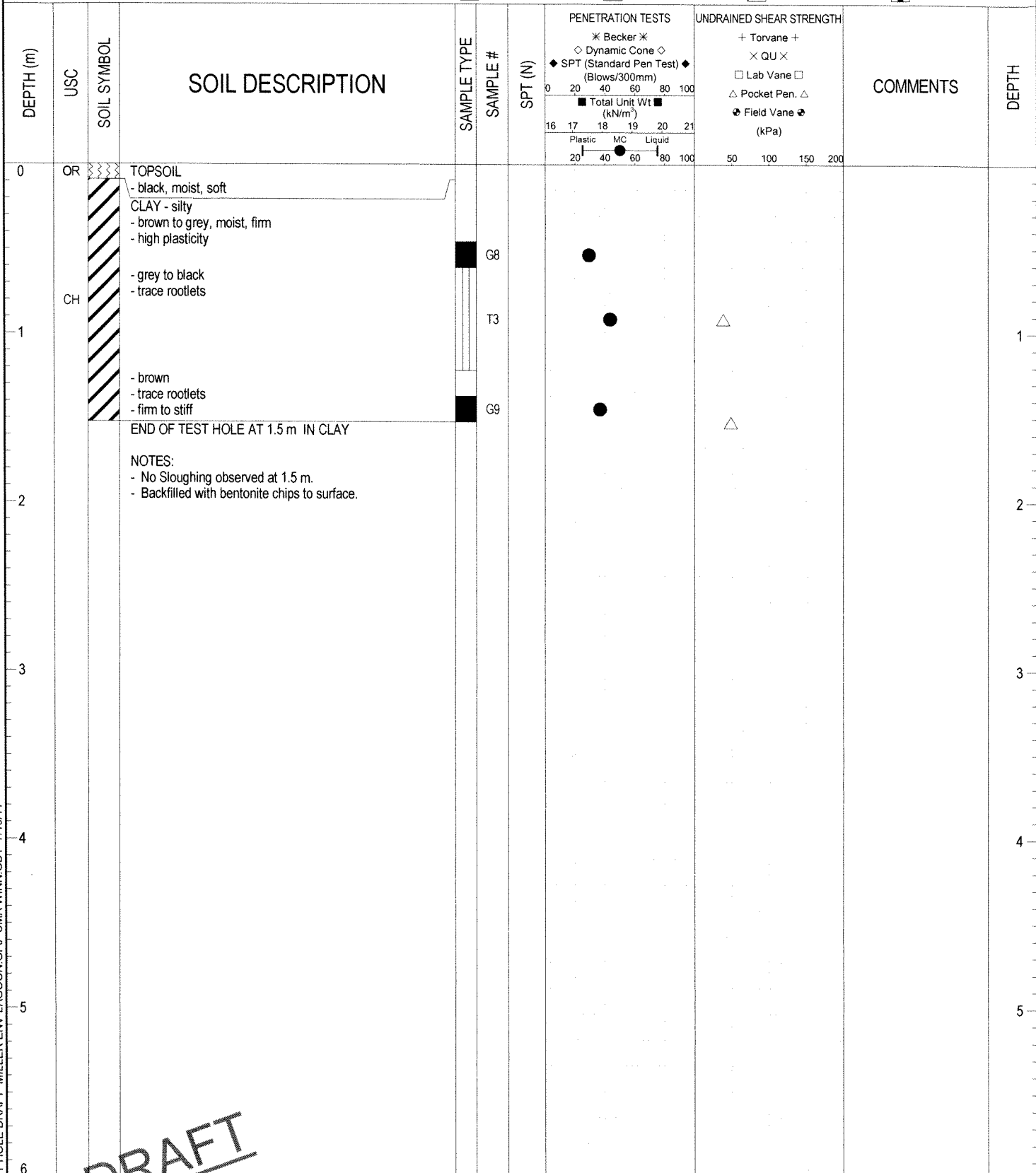
LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 2.13 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-05  
 LOCATION: Cell # 2 (Northing 5449695.0000, Easting 620237.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE



LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINNIGDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 1.52 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-06  
 LOCATION: Cell # 2 (Northing 5449697.0000, Easting 620246.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							Becker	Dynamic Cone	Torvane	QU		
0	OR		TOPSOIL - trace organics - black, moist, soft									
			CLAY - silty - brown, moist, stiff - high plasticity									
1			- trace rootlets - light grey to grey		G10							1
					T4							
	CH		- silt inclusions (<5 mm)									
2			- grey to brown		G11							2
			- dark brown									
3			END OF TEST HOLE AT 3.0 m IN CLAY									3
			NOTES: - No Sloughing observed at 3.0 m. - Backfilled with bentonite chips to surface.									
4												4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-07  
 LOCATION: Cell # 2 (Northing 5449724.0000, Easting 620223.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH (kPa)	COMMENTS	DEPTH
							* Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) ■ Total Unit Wt ■ (kN/m <sup>3</sup> )	+ Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ⊗ Field Vane ⊗			
0	OR		TOPSOIL - trace organics								
0			CLAY - silty - brown, moist, stiff - intermediate plasticity								
1			- brown to grey - trace rootlets		G12						1
2	CI		- silt inclusions (<10 mm)  - dark brown		G13						2
3			END OF TEST HOLE AT 3.0 m IN CLAY								3
4			NOTES: - No Sloughing observed at 3.0 m. - Backfilled with bentonite chips to surface.								4
5											5
6											6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-08  
 LOCATION: Cell # 3 (Northing 5449682.0000, Easting 620208.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH	COMMENTS	DEPTH
							Blows/300mm	(kN/m <sup>2</sup> )			
0	OR		TOPSOIL - trace organics								
0 - 1			CLAY - silty - brown, moist, stiff - intermediate plasticity		G14	●			△		1
1 - 2			- brown to grey - silt inclusions (<5 mm)								
2 - 3	CI		- dark brown - silt inclusions (<10 mm) - intermediate plasticity		G15	●			△		2
3 - 3.05			END OF TEST HOLE AT 3.0 m IN CLAY								3
3.05 - 6			NOTES: - No Sloughing observed at 3.0 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.								4 5 6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-09  
 LOCATION: Cell # 3 (Northing 5449687.0000, Easting 620189.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE     GRAB     SHELBY TUBE     SPLIT SPOON     BULK     NO RECOVERY     CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							Blows/300mm	Total Unit Wt (kN/m <sup>3</sup> )		(kPa)		
0	OR	XXXX	TOPSOIL - trace organics CLAY - silty - brown, moist, stiff - intermediate plasticity									
1	Cl		- trace rootlets - brown to grey - silt inclusions (<7 mm)		G16	●						1
					T5	●			△			
2			END OF TEST HOLE AT 1.5 m IN CLAY  NOTES: - No Sloughing observed at 3.0 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.									2
3												3
4												4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 1.52 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-10  
 LOCATION: Cell # 3 (Northing 5449701.0000, Easting 620196.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							Becker Dynamic Cone SPT (Standard Pen Test) (Blows/300mm)	Total Unit Wt (kN/m <sup>3</sup> )	Torvane QU Lab Vane Pocket Pen. Field Vane	(kPa)		
0	OR	TOPSOIL - trace organics - black, moist, soft										
0-1		CLAY - silty - brown, moist, stiff - high plasticity										
1	CH	- brown to black - trace rootlets			G17							1
1-2		CLAY - silty - brown, moist, stiff - intermediate plasticity - trace rootlets - silt inclusions (<5 mm)										
2					G18							2
2-3												
3	CI				G19							3
3-4												
3			END OF TEST HOLE AT 3 m IN CLAY									
4			NOTES: - No Sloughing observed at 3.0 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.									
4												4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-11  
 LOCATION: Cell # 3 (Northing 5449710.0000, Easting 620208.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):

SAMPLE TYPE     GRAB     SHELBY TUBE     SPLIT SPOON     BULK     NO RECOVERY     CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							* Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) 0 20 40 60 80 100 ■ Total Unit Wt ■ (kN/m <sup>3</sup> ) 16 17 18 19 20 21 Plastic MC Liquid 20 40 60 80 100	+ Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ⊗ Field Vane ⊗ (kPa) 50 100 150 200				
0	OR	XXXX	TOPSOIL - trace organics - black, moist, soft									
		////	CLAY - silty - brown, moist, stiff - high plasticity									
1	CH	////	- brown to grey - trace rootlets		T6		●		△			1
		////	- intermediate plasticity - silt inclusions (<5 mm) - stiff to firm		G20		●		△			
2			END OF TEST HOLE AT 1.8 m IN CLAY									2
3			NOTES: - No Sloughing observed at 3.0 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.									3
4												4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 1.83 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1



PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-12  
 LOCATION: Cell # 3 (Northing 5449728.0000, Easting 620193.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE       GRAB       SHELBY TUBE       SPLIT SPOON       BULK       NO RECOVERY       CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							* Becker * ◇ Dynamic Cone ◇ ◆ SPT (Standard Pen Test) ◆ (Blows/300mm) ■ Total Unit Wt ■ (kN/m <sup>3</sup> )	+ Torvane + × QU × □ Lab Vane □ △ Pocket Pen. △ ⊗ Field Vane ⊗ (kPa)				
0	OR		TOPSOIL - trace organics - grey to dark grey, moist, soft CLAY and SILT - some sand - brown to light grey, moist, firm - intermediate plasticity - dark grey - trace rootlets									
1	SICL		- brown to grey - trace rootlets - silt inclusions (<10 mm) - firm to stiff		T7						Gravel: 0%, Sand: 11.4%, Silt: 44.2%, Clay: 44.4%	1
1.5			END OF TEST HOLE AT 1.5 m IN CLAY		G21							
2			NOTES: - No Sloughing observed at 1.5 m. - Hole is submerged under water - Backfilled with bentonite chips to surface.									2
3												3
4												4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 1.52 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-13  
 LOCATION: Cell # 3 (Northing 5449721.0000, Easting 620177.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):  
 SAMPLE TYPE      GRAB      SHELBY TUBE      SPLIT SPOON      BULK      NO RECOVERY      CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS	UNDRAINED SHEAR STRENGTH	COMMENTS	DEPTH
0	OR		TOPSOIL - trace organics - grey, moist, soft							
			CLAY - silty - light grey to dark grey, moist, stiff - high plasticity							
1			- black		G22					1
	CH									
2			- trace rootlets - silt inclusions (<10 mm)		G23					2
3			- grey to brown - silt inclusions (<10 mm) - low plasticity		G24					3
			END OF TEST HOLE AT 3.0 m IN CLAY							
			NOTES: - No Sloughing observed at 3.0 m. - Backfilled with bentonite chips to surface.							

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

PROJECT: Cell #2 & 3 Rehabilitation      CLIENT: Miller Environmental Corporation      TESTHOLE NO: TH 11-14  
 LOCATION: Cell # 3 (Northing 5449703.0000, Easting 620216.0000)      PROJECT NO.: 60216914  
 CONTRACTOR: Paddock Drilling Ltd      METHOD: RM 30, 125 mm SSA      ELEVATION (m):

SAMPLE TYPE     GRAB     SHELBY TUBE     SPLIT SPOON     BULK     NO RECOVERY     CORE

DEPTH (m)	USC	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE #	SPT (N)	PENETRATION TESTS		UNDRAINED SHEAR STRENGTH		COMMENTS	DEPTH
							Becker	Dynamic Cone	Torvane	QU		
0	OR	XXXX	TOPSOIL - trace organics - dark grey, moist, soft CLAY - silty - dark grey, moist, stiff - high plasticity									
1			- trace rootlets - grey to brown		G25							1
2	CH		- intermediate plasticity - trace rootlets		G26							2
3			- silt inclusions (<10 mm) - grey to black		T8							3
3			END OF TEST HOLE AT 3.0 m IN CLAY		G27							3
4			NOTES: - No Sloughing observed at 3.0 m. - Backfilled with bentonite chips to surface.									4
5												5
6												6

LOG OF TEST HOLE DRAFT MILLER ENV-LAGOON.GPJ UMA WINN.GDT 7/19/11

**DRAFT**



LOGGED BY: M.Akhtar      COMPLETION DEPTH: 3.05 m  
 REVIEWED BY: Faris Khalil      COMPLETION DATE: 6/11/11  
 PROJECT ENGINEER: Khalil Faris      Page 1 of 1

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0 7.5 15 22.5 m SCALE 1:750  
IMAGE SOURCE: GOOGLE EARTH PRO 2011  
IMAGE DATE: APRIL 14, 2007



ABC  
ABC  
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Figure - 01