



August 15, 2007

File No. 07-0107-10

City of Winnipeg
Water and Waste Department
110-1199 Pacific Avenue
Winnipeg, Manitoba
R3E 3S8

ATTENTION: Mr. Darcy Strandberg, C.E.T.
Project Manager

RE: Site Investigation – Lake 6-14 Gate Chamber
2007 Outfall Gate Chamber Construction Program

Dear Mr. Strandberg:

This letter summarizes the results of KGS Group's geotechnical site investigation at the Lake 6-14 Gate Chamber including soil stratigraphy and groundwater monitoring. Information regarding lateral earth pressure coefficients, potential for blowout of the base of the excavation and suitable backfill soils are also included.

This information is submitted further to our letter of Proposal for Engineering Services dated June 21st, 2007.

1.0 BACKGROUND

It is our understanding that the new gate chamber at Lake 6-14 will incorporate new flap gates, positive gates and pump chambers and will be constructed at a depth of 5.5 m at this location.

2.0 SITE INVESTIGATION

On July 11th, 2007 KGS Group supervised the drilling of one test hole (TH07-03) at the site located approximately 20 m east of the existing gate chamber. The UTM coordinates of the test hole are noted on the test hole log, as measured by a handheld GPS unit. The test hole was drilled with the truck mounted Acker MP5-T drill rig operated by Paddock Drilling Ltd. of Brandon, Manitoba. The test hole was advanced using 125 mm solid stem augers to 17.68 m± below the existing ground surface. Representative soil samples were collected directly off auger flights at 1.5 m intervals or at changes in soil stratigraphy. All samples were visually inspected for material type and classified according to the Unified Soil Classification System. Clay samples were tested with a field Torvane to estimate undrained shear strength. Laboratory testing was performed on select soil samples and included moisture content

analyses and Atterberg Limit testing. Upon completion of the drilling, the test hole was examined for indications of squeezing and seepage. A Casagrande tip standpipe piezometer was installed in the till to measure piezometric levels.

A soil log incorporating all field observations and lab testing is attached to this letter.

3.0 STRATIGRAPHY

KGS Group's interpretation of the stratigraphy is based upon the test hole (TH07-03) drilled at the site and is outlined below. In general, the stratigraphy consisted of topsoil overlying clay of lacustrine origin and glacial till.

Topsoil

A thin layer of topsoil approximately 0.05 m± was encountered at the existing ground surface.

Lacustrine Clay

The topsoil was underlain by a layer of clay, which extended to 12.9 m± below grade. The clay was brown becoming grey below 6.5 m±, moist, firm to stiff and of high plasticity. A layer of silt was encountered within the clay at a depth of 1.7 m± to 1.8 m±. The silt was moist, loose, and contained trace amounts of clay and oxidation. The undrained shear strength of the clay, as estimated from the Field Torvane, ranged from 25 to 55 kPa, with an overall average of 43 kPa. Moisture content of the lacustrine clay ranged from 36% to 59%, with an overall average of 51%. Atterberg Limit testing from 7.3 m depth measured a Liquid Limit of 85% and a Plasticity Index of 63%, with the material being classified as CH based upon the results.

Till

A clay till was observed below the clay and extended to the end of the test hole at a depth of 17.7 m± where power auger refusal was encountered. The till was light grey, of intermediate plasticity, moist, compact and contained trace amounts of sand gravel and silt.

No sloughing or squeezing was noted during drilling. Upon completion of the test hole, water infiltration was observed from the till layer.

4.0 GROUNDWATER CONDITONS

The piezometric level in the till was measured a total of two (2) times. The water level was first read immediately after the piezometer was installed and the groundwater level was 9.14 m below ground surface. A subsequent groundwater level of 7.51 m below ground surface was read on July 24, 2007.

Groundwater levels vary seasonally and in response to precipitation such that future groundwater conditions at the site may vary from those reported herein.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Basal Heave and Blowout

Based upon a proposed excavation depth of 5.5 m for the proposed gate chamber and the measured groundwater conditions at this location, the estimated factor of safety against blowout for the base of the excavation is 2.2.

5.2 Lateral Earth Pressure Coefficients

Estimated lateral earth pressure coefficients of the soil are summarized in the table below for soils within the depth of the excavation of approximately 5.5 m.

Table 1 – Active, Passive and At-Rest Lateral Earth Pressure Coefficients

Soil Type	Estimated Friction Angle (Φ')	Ka	Kp	Ko
Clay	14°	0.61	1.64	0.76

Note : Ka = Active Earth Pressure
Kp = Passive Earth Pressure
Ko = Earth Pressure At-Rest

5.3 Backfill

Free draining granular backfill should be placed around the chamber walls for a minimum width of 0.6 m and covered with a low permeability clay cap at ground surface. All backfill should be placed in maximum 150 mm thick lifts and compacted to a minimum of 95% Standard Proctor maximum dry density (SPMDD).

6.0 SUMMARY

We have completed a geotechnical site investigation for the proposed gate chamber expansion at the Lake 6-14 Gate Chamber. The stratigraphy at the site generally consisted of topsoil overlying clay of lacustrine origin and glacial till. Construction Design considerations for basal heave and blowout, lateral earth pressure coefficients and backfill are included.

KGS Group thanks you for the opportunity to provide engineering services on this project. If you have any questions please contact the undersigned at 896-1209.

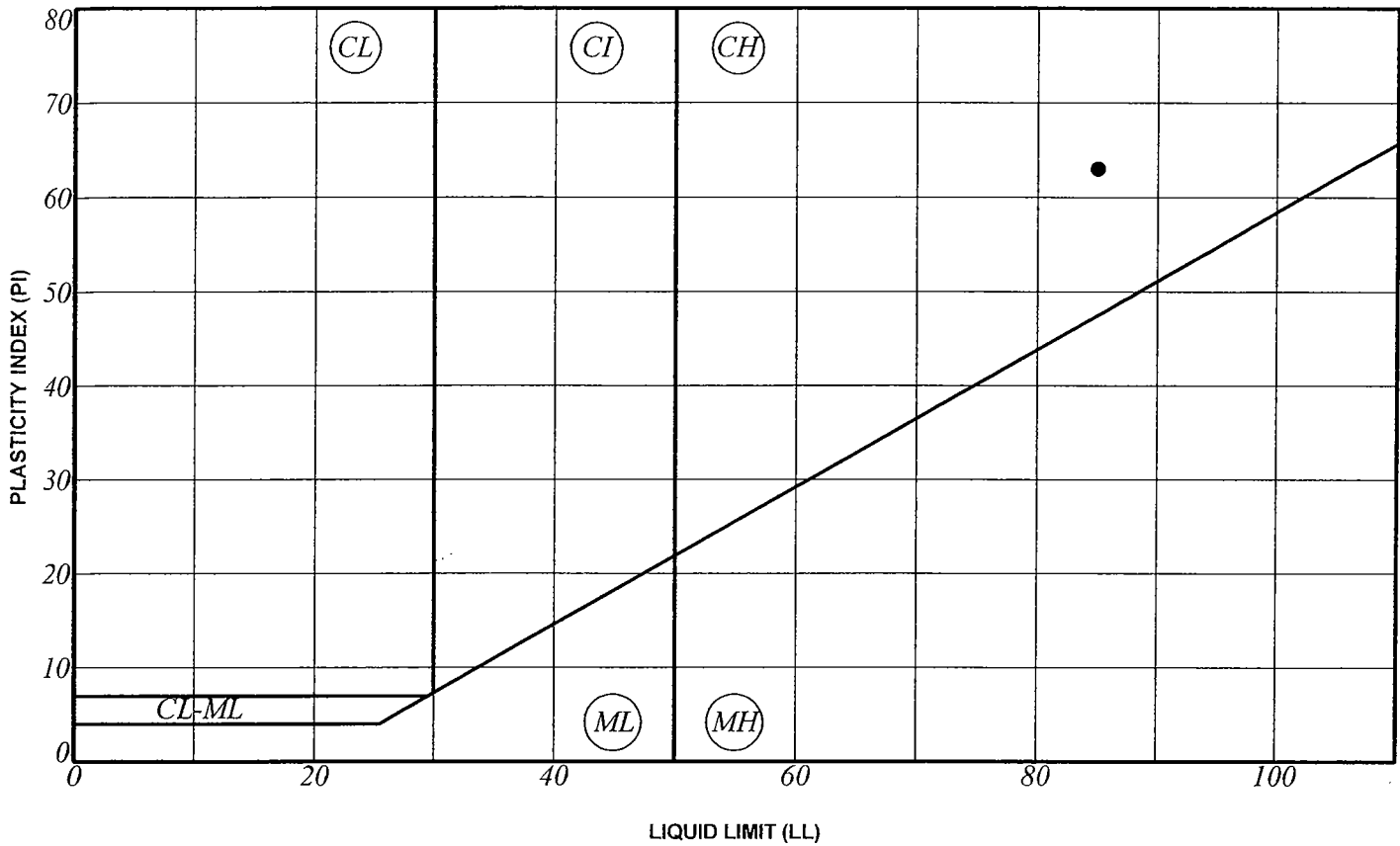
Yours truly,



David Anderson, M. Sc., P. Eng.
Geotechnical Engineer

RD/ja





SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH07-03	7.3		85	22	63				48.9	

Notes:
 ML - Low Plasticity Silt
 MH - High Plasticity Silt
 CL-ML - Silty Clay
 CL - Low Plasticity Clay
 CI - Intermediate Plasticity Clay
 CH - High Plasticity Clay
 LL - Liquid Limit
 PL - Plastic Limit
 PI - Plasticity Index
 MC - Moisture Content

KGS GROUP	CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT	
	2007 GATE CHAMBER UPGRADES	
A-LINE PLOT		
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CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT 2007 GATE CHAMBER UPGRADES
SITE Lake 6-14 Gate Chamber
LOCATION 20 m East of Existing Gate Chamber
DRILLING METHOD 125 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. 07-107-10
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 11-Jul-07
UTM (m) N 5,519,351
 E 630,015

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆			
									20	40	60	80
			TOPSOIL - Black, organics, trace rootlets.									
			CLAY (LACUSTRINE) (CH) - Brown, moist, firm, high plasticity, massive structure, fat clay, trace silt, trace oxidation.									
1						S1						
5												
	2		SILT (ML) - Brown, moist, soft, low plasticity, trace clay, trace oxidation.									
			CLAY (LACUSTRINE) (CH) - Brown mottled light brown, moist, firm, high plasticity, massive structure, fat clay, trace silt, trace oxidation.									
3	10		- Firm at 2.90 m.			S2						
4												
15			- Firm at 4.42 m. - Becoming softer with depth below 4.42 m.			S3						
5												
6	20		- Firm below 5.94 m.			S4						
7			- Grey below 6.55 m.									
25			- Firm at 7.47 m.			S5						
8												
9	30		- Firm at 8.99 m.			S6						

SPT & TORVANE 2 P.I. PROJECTS\2007\07-0107-10\GEOLOGS\07-107-10\LOGS.GPJ

SAMPLE TYPE Auger Grab Split Spoon

CONTRACTOR **Paddock Drilling Ltd.** INSPECTOR **D. ANDERSON**

APPROVED _____ DATE 13/8/07

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	PIEZ. LOG	DEPTH (m)	SAMPLE TYPE NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ DYNAMIC CONE (N) blows/ft △	POCKET PEN (kPa) ★ Cu TORVANE (kPa) ◆	
									PL	MC
35	11		- Soft to firm at 10.52 m. - Trace gravel below 10.97 m.							
40	12		- Soft to firm at 12.04 m.							
45	13		CLAY TILL - Light grey, wet, soft, intermediate plasticity, trace silt, trace coarse grained sand, trace clay.							
50	14		- Loose to compact based on SPT test conducted at 13.7 m.							
55	15									
60	16									
65	17									
70	18									
	19									
	20									
	21									

AUGER REFUSAL AT 17.68 m.

Note:
 1. Water level measured at 9.14 m below ground surface in standpipe after drilling.
 2. No sloughing and squeezing of test hole after drilling below 4.57 m.
 3. Installed Casagrande standpipe at 17.68 m with 0.98 m stickup.

SAMPLE TYPE Auger Grab Split Spoon

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APPROVED _____ DATE **13/8/07**

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