KGS GROUP

KONTZAMANIS ▪ GRAUMANN ▪ SMITH ▪ MACMILLAN INC.
CONSULTING ENGINEERS & PROJECT MANAGERS

COPY

June 13, 2008

File No. 08-0107-07

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 – Wildwood Park at North Drive Outfall Gate Chamber
2008 Outfall Gate Chamber Upgrading Program

Dear Mr. Strandberg:

This letter report summarizes the results of KGS Group's geotechnical site investigation at the Wildwood Park at North Drive Outfall 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 May 13th, 2008.

1.0 BACKGROUND

It is our understanding that the new gate chamber at the Wildwood Park at North Drive Outfall will incorporate new flap gates, positive gates and pump chambers and will be constructed at a proposed depth of 7.0 m at this location.

2.0 SITE INVESTIGATION

On June 5th, 2008 KGS Group supervised the drilling of one test hole (TH08-02) at the site located approximately 4 m from the proposed gate chamber location. 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 contracted from Paddock Drilling Ltd. of Brandon, MB. The test hole was advanced using 125 mm solid stem augers to 13.41 m± below 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. 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 glacial till to measure piezometeric

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levels. Laboratory testing was performed on select soil samples and included moisture content analyses and Atterberg Limit testing.

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

3.0 STRATIGRAPHY

KGS Group's interpretation of the stratigraphy is based upon the test hole (TH08-02) drilled at the site. In general, the stratigraphy consists of topsoil over high plastic silt clay over a deposit of silty clay of alluvial and lacustrine origins underlain by glacial till.

Topsoil

A layer of topsoil approximately 0.07 m± thick was found at the existing ground surface.

Silty Clay

Silty clay of high plasticity extended 3.0 m± below the topsoil. The silty clay was dark brown in colour, moist, firm to stiff, of high plasticity and contained trace amounts of silt pockets, organics and oxidation. Moisture contents in this layer ranged from 33% to 40% with an overall average of 36%.

Silty Clay (Alluvial Origins)

Underlying the high plastic silty clay was silty clay of alluvial origins, which extended to a depth of 9.8 m± below ground surface. The clay was grey in colour, moist, of intermediate plasticity, firm to soft, with undrained shear strengths ranging from 20 kPa to 45 kPa (overall average of 32 kPa). The clay contained some amounts of silt trace amounts of fine grained sand, silt pockets, organics and wood pieces. Moisture contents ranged from 43% to 45% with an overall average of 44%. Atterberg Limit testing at 5.9 m measured a Liquid Limit of 65% and a Plasticity Index of 38% with the material being classified as CH based upon the results.

Silty Clay (Lacustrine Origins)

Underlying the alluvial silty clay was silty clay of lacustrine origins, which extended to a depth of 11.3 m± below ground surface. The clay was grey in colour, moist, of high plasticity, firm to soft, with undrained shear strength of 20 kPa. The clay contained trace amounts of fine grained sand and silt. Moisture content of a sample from this layer was 51%. Atterberg Limit testing at 10.5 m measured a Liquid Limit of 84% and a Plasticity Index of 59% with the material being classified as CH based upon the results.

Silt Till

The lacustrine clay was underlain by silt till which extended to a depth of 13.41 m±. The silt till was brown in colour, moist, dense, of low plasticity, and contained some amounts of coarse sand and trace amounts of clay and gravel. Moisture content of the till was measured to be 16%.

Squeezing of the test hole was noted at a depth of 3.0 m± below ground surface. Water infiltration into the test hole was also noted at a depth of 3.0 m± during drilling and upon completion of the test hole water infiltration was noted from within the underlying till material.

4.0 GROUNDWATER CONDITIONS

The groundwater level in the till was measured a total of two (2) times. The water level was first read immediately after the installation of the piezometer and the groundwater level was 12.76 m below ground surface. A subsequent groundwater reading of 1.86 m below ground surface was observed on June 12, 2008.

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 depth of excavation of 7.0 m for the proposed gate chamber and the measured groundwater conditions at this location, the estimated factor of safety against blowout of the base of the excavation is 0.8. In order to achieve a factor of safety of 1.5 against blowout of the base of the excavation the groundwater level in the till needs to be 6.34 m below ground surface.

Squeezing and water infiltration into the test hole was noted below a depth of 3.0 m± during drilling. Difficult conditions should be anticipated during excavation below this depth as water infiltration and/or squeezing of the excavation walls and/or significant softening or blowout of the base of the excavation may occur. Conventional pumping equipment and sheet piling should control potential water infiltration and squeezing.

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 7.0 m.

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

Soil Type	Estimated Friction Angle (Φ')	Ka	Kp	Ko
Alluvial Clay	18°	0.53	1.89	0.69
Lacustrine 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

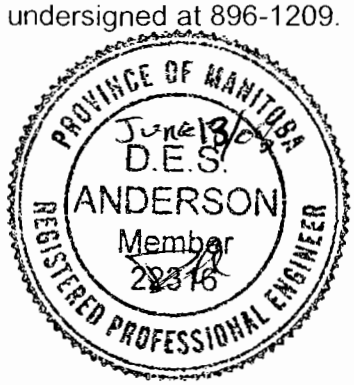
Free draining granular backfill should be placed around the chamber walls for a minimum width of 0.6 m and covered with a low permeability clay cap at ground surface. All backfill should be placed in maximum 150 mm thick lifts and compacted to a minimum of 95% Standard Proctor maximum dry density (SPMDD).

6.0 SUMMARY

We have completed a geotechnical site investigation for the proposed gate chamber expansion at the Wildwood Park at North Drive Gate Chamber. The stratigraphy at the site generally consisted of topsoil over high plastic silty clay underlain by silty clay of alluvial and lacustrine origins over 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

DA/

TEST HOLE LOG

KGS GROUP

SUMMARY LOG

HOLE NO. **TH08-02**

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT
PROJECT 2008 GATE CHAMBER INVESTIGATIONS
SITE WILDWOOD GATE CHAMBER
LOCATION NORTH DRIVE IN WILDWOOD GOLF CLUB PARK
DRILLING METHOD 150 mm ø Solid Stem Auger, Acker MP5-T

JOB NO. 08-107-07
GROUND ELEV.
TOP OF PVC ELEV.
WATER ELEV.
DATE DRILLED 5-Jun-08
UTM (m) N 5,523,611
E 633,866

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
	0			TOPSOIL					
				SILTY CLAY - Dark brown, moist, firm, stiff, high plasticity, trace silt pockets, trace organics, trace oxidation.					
	1	5				S1			
	2								
	3	10				S2			
				SILTY CLAY - Grey, moist to wet, firm to soft, intermediate plasticity, some to with silt, silt pockets, trace sand. (Alluvial clay)					
	4	15				S3			
	5								
	6	20		- Increased fine grained sand, trace organics, trace wood pieces below 6.10 m.		S4			
	7	25				S5			
	8								
	9	30				S6			
				SILTY CLAY - Grey, moist, firm to soft, high plasticity, trace fine grained sand,					

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.
INSPECTOR D. ANDERSON
APPROVED
DATE 12/6/08

SPT & TORVANE 2 P:\PROJECTS\2008\08-0107-07\DESIGN\GEOLOGS\2008 GATE CHAMBER INVESTIGATIONS 5-JUN-08.GPJ

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SUMMARY LOG

HOLE NO.
TH08-02

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	SAMPLE TYPE	NUMBER	RECOVERY %	SPT (N) blows/0.15 m ▲ / DYNAMIC CONE (N) blows/ft △	Cu POCKET PEN (kPa) ★ / Cu TORVANE (kPa) ◆ / PL MC LL %
	11	35		trace silt. (Lacustrine clay)		S7		20 40 60	20 40 60 80
	12	40		**SILT TILL** - Brown, moist, dense, low plasticity, some coarse grained sand, trace gravel, trace clay.		S8			
	13								
		45		**END OF HOLE AT 13.41 m.**					
	14			Notes: 1. Hole squeezing below 3.05 m. Water infiltration into hole at 3.05 m. 2. Installed till standpipe with Casagrande tip at 13.41 m with stickup of 1.03 m. 3. Water level observed at 12.76 m below ground surface on June 5, 2008.					
	15	50							
	16								
		55							
	17								
	18	60							
	19								
		65							
	20								
	21	70							

SAMPLE TYPE Auger Grab

CONTRACTOR Paddock Drilling Ltd.

INSPECTOR D. ANDERSON

APPROVED DEL DATE 12/6/08