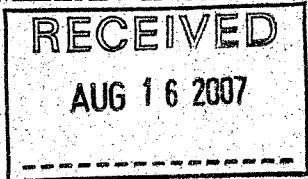




KONTZAMANIS ■ GRAUMANN ■ SMITH ■ MACMILLAN INC.  
CONSULTING ENGINEERS & PROJECT MANAGERS



August 15, 2007

File No. 07-0107-10

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

Received	
WINNIPEG	
AUG 20 2007	
<input type="checkbox"/> PMS	_____
<input type="checkbox"/> RST	_____
<input type="checkbox"/> BW	_____
<input type="checkbox"/> Other	_____
<input type="checkbox"/> Other	_____
<input type="checkbox"/> Other	_____
<input type="checkbox"/> File	_____

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

RE: Site Investigation – Dugald Pump Station  
2007 Outfall Gate Chamber Construction Program

Dear Mr. Strandberg:

This letter summarizes the results of KGS Group's geotechnical site investigation at the proposed location of the Dugald Pump Station 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 21<sup>st</sup>, 2007.

**1.0 BACKGROUND**

It is our understanding that Dugald Pump Station will be constructed at the southeast corner of Dugald Road and Mazenod Road and will be constructed at a proposed depth of 10.0 m at this location.

**2.0 SITE INVESTIGATION**

On July 11<sup>th</sup>, 2007 KGS Group supervised the drilling of one test hole (TH07-02) at the proposed Dugald Pump Station located southeast of the intersection of Dugald Road and Mazenod Road. 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 17.4 m± where power auger refusal was encountered. 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 laboratory testing is attached to this letter.

### **3.0 STRATIGRAPHY**

KGS Group's interpretation of the stratigraphy is based upon the test hole (TH07-02) drilled at the site and is outlined below. In general, the stratigraphy consisted of topsoil over clay fill, clay of lacustrine origin, silty sand and silt till.

#### ***Topsoil***

A thin layer of topsoil approximately 0.05 m± was encountered at the existing ground surface. The topsoil was black and contained organics and trace rootlets.

#### ***Clay Fill***

The topsoil was underlain by a layer of clay fill, which extended to 2.1 m± below grade. The clay fill was black to grey in colour, moist, of intermediate to high plasticity, stiff in consistency with an undrained shear strength of 90 kPa. The clay fill contained trace amounts of sand, gravel and rootlets.

#### ***Lacustrine Clay***

The clay fill was underlain by a layer of clay of lacustrine origin extending from 2.1 to 15.5 m± below grade. The clay was brown, moist, soft to stiff, of high plasticity, and contained trace silt nodules and oxidation. The undrained shear strength of the lacustrine clay, as estimated from the field Torvane, ranged from 15 to 85 kPa, with an overall average of 38 kPa. Moisture content ranged from 38% to 60%, with an overall average of 49%. Atterberg Limit testing at 10.4 m measured a Liquid Limit of 87% and a Plasticity Index of 67%, with the material being classified as CH based upon the results.

#### ***Silty Sand***

A 0.7 m thick silty sand layer was encountered below the clay layer at 15.5 to 16.2 m± below grade. The silty sand was light grey to pink in colour, wet, poorly graded, fine to medium grained sand and contained trace amounts of silt and clay.

#### ***Silt Till***

The silty sand was underlain by silt till, which extended to a depth of 17.4 m± where power auger refusal was encountered. The silt till was pink in color, moist, compact and contained trace amounts of gravel, coarse sand and clay.

No sloughing or squeezing was noted during drilling. Upon completion of the test hole, water infiltration was observed from within the till and or silty sand layer near the bottom of the test hole. The measured water level at the end of drilling prior to installation of the piezometer was 9.60 m below grade.

#### 4.0 GROUNDWATER CONDITONS

The groundwater level was measured a total of two (2) times within the till. The water level was first read immediately after the installation of the piezometer and the groundwater level was 11.73 m below ground surface. A subsequent groundwater level of 10.00 m below ground surface was read on July 30, 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 depth of excavation of 10 m and the measured groundwater conditions at this location, the estimated factor of safety against blowout of the base of the excavation is 1.7.

##### 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.

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

Soil Type	Estimated Friction Angle ( $\Phi'$ )	Ka	Kp	Ko
Clay Fill	18°	0.53	1.89	0.69
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).

Page 4  
Mr. Strandberg

## 6.0 SUMMARY

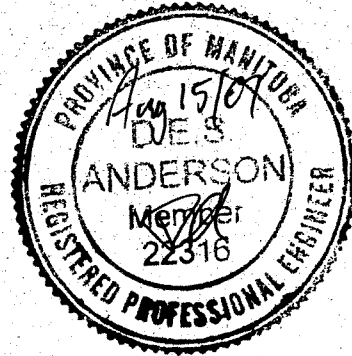
We have completed a geotechnical site investigation for the proposed Dugald Pump Station. The stratigraphy at the site generally consisted of topsoil over clay fill, clay of lacustrine origin, silty sand and silt till. Construction Design considerations for basal heave and blowout, lateral earth pressure 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.

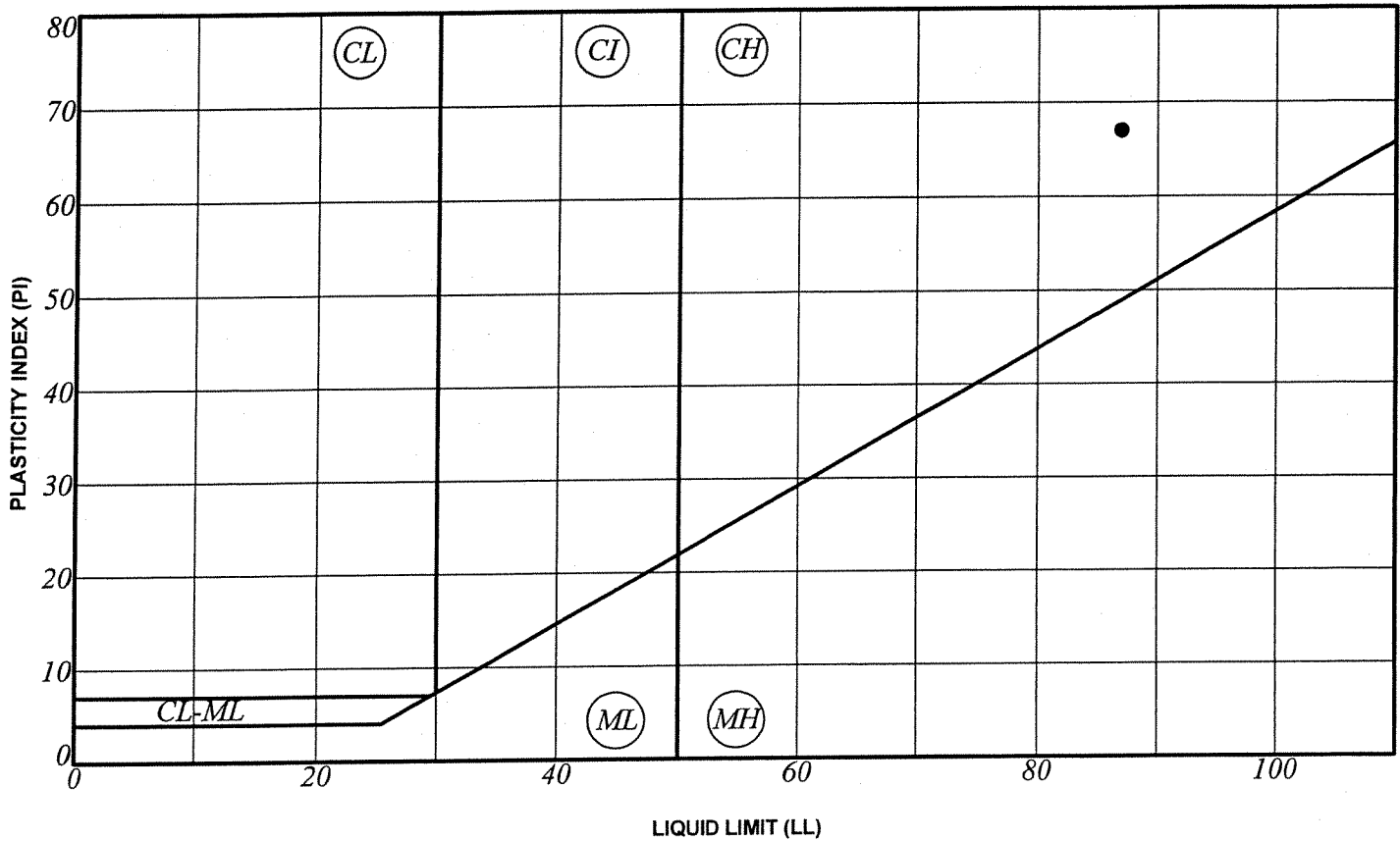
Yours truly,



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



RD/ja



SYMBOL	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	% SAND	% SILT	% CLAY	% MC	CLASSIFICATION
●	TH07-02	10.4		87	20	67				52.9	

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


<b>KGS GROUP</b>	<b>CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT</b>	
	2007 GATE CHAMBER UPGRADES	
<b>A-LINE PLOT</b>		
Aug 2007	Figure 1	Page 1 of 1

A-LINE PLOT (MAY 2004) 07-107-10LOGS.GPJ GEN\_FT\_M.GDT 15/8/07

**CLIENT** CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT  
**PROJECT** 2007 GATE CHAMBER UPGRADES  
**SITE** Dugald Pumping Station  
**LOCATION** Southeast of Intersection of Dugald Road and Mazenod Road  
**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 5,527,730  
 E 640,146

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	20 40 60 80
			<b>TOPSOIL</b> - Black, organics, trace rootlets. <b>CLAY FILL (CI-CH)</b> - Black to grey, moist, stiff, intermediate to high plasticity, trace sand, trace gravel, trace rootlets, trace oxidation.							
1	5					S1				
2			<b>CLAY (LACUSTRINE) (CH)</b> - Brown, moist, firm to stiff, high plasticity, trace silt, trace silt nodules, trace oxidation.			S2				
3	10					S3				
4	15		- Firm at 4.42 m.			S4				
5	20		- Firm at 5.94 m.			S5				
6	25		- Firm at 7.47 m.			S6				
7			- Grey below 7.92 m.							
8			- Trace gravel, trace stones (<76 mm in diameter) below 8.23 m.							
9	30		- Soft to firm at 8.99 m.							
			- Trace till inclusions below 9.75 m.							

SAMPLE TYPE  Auger Grab

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	[Hatched pattern]	- Soft to firm at 10.52 m.							
40	12	[Hatched pattern]	- Soft to firm at 12.04 m.							
45	13	[Hatched pattern]	- Soft to firm at 13.56 m.							
50	14	[Hatched pattern]	- Soft to firm at 15.09 m.							
15.5	15.7	[Dotted pattern]	<b>SILTY SAND (SM)</b> - Light grey to pink, wet, loose, poorly graded fine to medium grained sand, trace clay, trace silt.		15.5	S7				
16	16.5	[Vertical lines pattern]	<b>SILT TILL</b> - Pink, moist, compact, trace clay, trace coarse grained sand, trace gravel.		15.7	S12				
17	17.4	[Circular pattern]	- In the SPT (from 16.76 to 17.22 m): 152 mm of sand, 25 mm of gravel, 76 mm of silt till, 76 mm of limestone gravel.		16.5	S11				
17	17.4	[Circular pattern]	- In the SPT (from 16.76 to 17.22 m): 152 mm of sand, 25 mm of gravel, 76 mm of silt till, 76 mm of limestone gravel.		17.4	S13				
17	17.4	[Circular pattern]	<b>AUGER REFUSAL ON SUSPECTED BEDROCK OR BOULDER AT 17.37 m.</b>		72	S13				
18	18		Note: 1. Water level measured at 11.73 m below ground surface in standpipe after drilling. 2. Water infiltration from till at 9.60 m after drilling. 3. Installed Casagrande standpipe at 16.46 m with 1.08 m stickup.							

SAMPLE TYPE Auger Grab

CONTRACTOR **Paddock Drilling Ltd.**

INSPECTOR **D. ANDERSON**

APPROVED \_\_\_\_\_

DATE **13/8/07**