APPENDIX 1
2024 GEOTECHNICAL REPORT

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November 18, 2024

City of Winnipeg – Water and Waste Department
1120 Waverley Street
Winnipeg, Manitoba R3T 0P4

Attention: Andrew Sinclair, Eng.L., C.E.T.
Supervisor of Support Services

Re: Detailed Design Emergency Cell D
Brady Road Resource Management Facility, Winnipeg, Manitoba
Geotechnical Data Report – FINAL Rev 0

Dear Mr. Sinclair:

This letter summarizes Kontzamanis Graumann Smith MacMillan Inc. (KGS Group) geotechnical investigation within the existing Area D at the Brady Road Resource Management Facility (BRRMF) in Winnipeg, Manitoba. The results of the geotechnical laboratory and investigations are contained herein.

1.0 INTRODUCTION

KGS Group was retained to complete a geotechnical investigation for the addition of provision of conceptual design for new area for MSW disposal at BRRMF. In June 2024, the geotechnical investigation was completed consisting of 17 test holes. The investigation and laboratory testing was completed to determine the stratigraphy beneath existing cells 9-1978 and 10-1978, in particular whether the extents and properties of in-situ clay soil would be equivalent or better than a 1 m thick clay liner, constructed to achieve a hydraulic conductivity (k_{20}) of $1.0x10^{-07}$ cm/s. A summary of the tasks that were completed and the results are presented below.

1.1 Scope of Services

The scope of this assignment included the following:

- **Utility Clearances** – Prior to undertaking any drilling activities, KGS Group connected with the landfill operations team and obtained a drawing of their known underground utilities. No utilities were located within the drilling locations.

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- **Geotechnical Investigation** – A geotechnical investigation was completed to determine the soil conditions beneath two (2) existing cells from the 1970's. The geotechnical investigation included 17 test holes ranging in depth from 2.7 m (9 ft) to 15.5 m (51 ft).
- **Laboratory Testing** – Laboratory testing was performed on select soil samples for correlation to relevant engineering properties. Testing included grain size analysis, Atterberg limits, moisture content, and hydraulic conductivity tests.

2.0 GEOTECHNICAL INVESTIGATION

2.1 Test Hole Drilling

A drilling and sampling program consisting of 17 test holes (TH24-01 to TH24-17) were advanced to depths of ranging from 2.7 to 15.5 m (9 to 51 ft). Drilling services were provided by Maple Leaf Drilling Ltd. of Winnipeg, Manitoba. All test holes were drilled using Mobile B37X track mounted drill rig equipped with 125 mm solid stem auger. The approximate locations of the test holes are shown on the attached Figure 1. The UTM coordinates (Zone 14) and elevations for the test holes are provided on Table 1 below.

TABLE 1: TEST HOLE COORDINATES

Test Hole ID	Elevation (m)	UTM Coordinates[1]	
		Northing (m)	Easting (m)
TH24-01	233.33	5,513,127.70	629,350.10
TH24-02	236.14	5,512,979.15	629,398.30
TH24-03	233.45	5,512,809.39	629,490.95
TH24-04	233.25	5,513,077.82	629,479.07
TH24-05	233.20	5,513,181.21	629,524.64
TH24-06	233.72	5,513,099.36	629,574.34
TH24-07	233.62	5,513,021.36	629,624.30
TH24-08	233.70	5,512,923.47	629,683.82
TH24-09	235.05	5,513,289.30	629,680.42
TH24-10	233.41	5,513,175.61	629,814.49
TH24-11	233.77	5,513,041.66	629,884.47
TH24-12	232.85	5,513,074.18	629,314.15

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TABLE 1: TEST HOLE COORDINATES, CONT.

Test Hole ID	Elevation (m)	UTM Coordinates[1]	
		Northing (m)	Easting (m)
TH24-13	235.78	5,513,011.00	629,366.59
TH24-14	237.15	5,512,934.33	629,348.79
TH24-15	237.01	5,512,880.71	629,392.16
TH24-16	237.40	5,512,868.63	629,449.19
TH24-17	233.81	5,513,306.16	629,723.72

Notes: Test hole locations were obtained after drilling by the City of Winnipeg using a survey grade GPS unit with an accuracy of ± 25 mm.

Representative disturbed soil samples were obtained from all test holes at 1.5 m (5 ft) intervals, or at any change in soil strata. Soil samples were collected directly off the auger flights or by Shelby tube sampler and visually classified in the field in general accordance with the modified Unified Soil Classification System (USCS). Clay samples were tested using a field Torvane to estimate the undrained shear strength.

Upon completion of drilling, test holes were examined for indications of sloughing and seepage, and then backfilled to grade with auger cuttings and bentonite chips. Test holes TH24-02 and TH24-09 encountered buried waste and were subsequently advance through the clay down to the underlying till. These two (2) test holes were backfilled with grout comprised of 1 part cement, 0.3 to 0.7 parts bentonite, and 4.7 to 6.6 parts water.

Summary test hole logs incorporating all field observations are provided in Appendix A.

2.2 Laboratory Testing

Laboratory testing was completed on select representative soil samples to determine index properties and hydraulic conductivity of the in-situ clay beneath the existing buried garbage. Laboratory testing included 13 moisture contents, 12 Atterberg limits, six (6) particle size distribution, and six (6) hydraulic conductivity tests. Laboratory testing was completed at a Canadian Council of Independent Laboratories (CCIL) certified lab in Winnipeg, Manitoba. Testing was completed in general accordance with American Society for Testing and Materials (ASTM) standards and the results are provided in Appendix B and on Table 2 below.

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TABLE 2: LABORATORY TEST RESULTS

Test Hole ID	Sample Depth (m)	Moisture Content (%)	Atterberg Limits			Hydraulic Conductivity, k_{20} (cm/s)
			Liquid Limit	Plastic Limit	Plasticity Index	
TH24-01	9.4	54	72	26	46	$1.37x10^{-08}$
TH24-03	7.0	59	71	33	38	-
TH24-03	10.1	56	80	32	48	-
TH24-05	8.1	50	78	26	52	$1.24x10^{-08}$
TH24-06	7.3	46	70	30	40	-
TH24-07	9.6	60	95	31	64	$2.00x10^{-08}$
TH24-09	6.2	53	87	31	56	$9.55x10^{-09}$
TH24-09	8.8	49	80	34	46	-
TH24-09	11.7	64	89	36	53	-
TH24-10	5.8	38	-	-	-	-
TH24-11	6.2	45	74	27	47	$1.16x10^{-08}$
TH24-13	7.9	60	92	29	63	-
TH24-16	9.4	53	89	33	56	$1.16x10^{-08}$

2.3 Stratigraphy

In general, the subsurface stratigraphy at the site was interpreted by KGS Group to consist of surficial clay or clay fill above shallow granular fill or silt, overlying interbedded buried garbage and clay fill, underlain by silt till. Buried garbage was encountered in seven (7) of the test holes. Cross-sections of the stratigraphy encountered across the site are attached as Figures 2 thru 5 for sections A-A' to D-D'. Locations of the section lines are shown in Figure 1, Test Hole Location Plan.

Clay (CH) – Clay was encountered from ground surface in test holes TH24-01, TH24-03 to TH24-08, TH24-11 and TH24-17; and below the silt or buried garbage/clay fill in test holes TH24-01 to TH24-02, TH24-04, TH24-06, TH24-08 to TH24-09 and TH24-13 to TH24-16. The approximate thickness of the surficial clay ranged from 0.9 to 12.9 m± and from 8.7 to 12.2m± for the clay extending below the silt or buried garbage/clay fill. The clay was greyish brown changing to grey in colour, moist, stiff decreasing to soft with depth, of high plasticity with trace rootlets near ground surface and contained trace to some silt nodules.

The shear strength of the clay, estimated from field Torvane, ranged from 15 to >100 kPa. The moisture content ranged from 38 to 64% as measured from 13 tests. The 12 Atterberg limits completed on samples from TH24-01, TH24-03, TH24-05 to TH24-07, TH24-09, TH24-11, TH24-13 and TH24-16 measured liquid limits of 70 to 95, plastic limits of 26 to 36, and a plasticity index of 38 to 64, indicating that the material as high plasticity. Six (6)

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particle size analysis tests were completed on the clay samples indicating 0 to 1% gravel, 0 to 4% sand, 24 to 53% silt, and 47 to 74% clay. Six (6) hydraulic conductivity tests were completed on the clay samples with results ranging from $1.16x10^{-08}$ to $9.55x10^{-09}$ cm/s. Elevations of the hydraulic conductivity tests ranged from 223.9 to 228.8 m.

Clay Fill – Clay fill was encountered at ground surface in TH24-02, TH24-09 and TH24-10, TH24-12 and TH24-14 to TH24-16 that ranged in thickness from 0.15 to 2.4 m±. Additional clay fill was encountered above and below buried garbage with varying thicknesses and depths. The clay fill was greyish brown to grey in colour, damp to moist, firm to stiff, of intermediate to high plasticity and contained trace to some silt, trace silt nodules, trace medium to coarse sand and fine gravel.

The shear strength of the clay fill, estimated from field Torvane, ranged from 37 to >100 kPa.

Silt (ML) – A layer of silt was encountered below the clay in TH24-01, TH24-06, and TH24-08. Silt was noted at depths ranging from 0.9 m (at TH24-01) to 1.9 m (at TH24-06) below grade and ranged in thickness from 0.4 m (at TH24-08) to 0.7 m (at TH24-06). The silt was light brown in colour, moist, soft in consistency and of low to no plasticity. The silt also contained trace to some clay with trace oxidation.

Granular Fill – The granular fill was encountered at the surface of TH24-13 to a depth of 0.2 m. A second granular fill layer was encountered from 0.5 to 1.1 m below grade in the same test hole. The granular fill was brown to light grey in colour, damp to moist, loose to compact, poorly graded, contained medium to coarse sand, fine gravel and some coarse gravel.

Buried Garbage – Buried garbage was encountered beneath various layers of clay fill in TH24-02, TH24-09, and TH24-12 to TH24-16. The buried garbage was noted at depths ranging from 0.5 m (at TH24-14) to 9.1 m (at TH24-15) below grade. The thickness of various layers ranged from 0.2 m (at TH24-14) to 2.8 m (at TH24-02). The buried garbage was black in colour, moist to wet and contained varying amounts of wood, plastic and paper.

Silt Till – Silt till was encountered below the native clay in TH24-01 and TH24-03 to TH24-11. The silt till was generally light grey to brown, damp to moist, loose to dense, and contained varying amounts of clay, some to with sand and trace to with gravel.

Standard Penetration Tests (SPT) were completed within the silt till layer. Uncorrected N-values ranged from 7 to > 100, classifying the silt till as loose to very dense in terms of relative density, and generally increased with depth.

2.4 Groundwater Conditions

Upon completion of drilling, all test holes were monitored for groundwater seepage. Groundwater levels ranged from 1.1 to 14.8 m below ground surface. The shallow groundwater measurements were due to test hole sloughing near the surface. Sloughing/squeezing was encountered in 14 of 17 test holes so water levels couldn't be properly measured. Groundwater levels may differ from those provided in this report in response to seasonal conditions and following heavy precipitation or spring snow melt events; hence, the actual water level at the time of construction could differ from those reported in this report.

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3.0 CONCLUSION AND CLOSURE

The Standards for Landfills in Manitoba states that the soil conditions at prospective sites be analysed by deploying an investigation and testing program. The work performed as part of this assignment meets these requirements, in that both visual and laboratory confirmed soil classifications (by Atterberg limits and particle size analysis), moisture contents, and hydraulic conductivity tests were completed (at an accredited laboratory). The results are reported herein on the test hole logs and laboratory test reports. In particular, the Standards for Landfills states that "The soils laboratory should also be asked to provide a professional assessment, based upon the analysis and the testing, as to whether the soil samples could achieve a permeability of $1x10^{-07}$ cm/s or less in their in-situ and reworked states." Based on the investigations, in-situ sampling and laboratory permeability testing, completed as part of this assignment, it is reasonable to conclude that the properties of the clay soil that underlies the footprint of the existing/proposed waste site exceeds the requirements of a constructed clay liner, as described within the Standards for Landfills in Manitoba. Note that the permeability testing performed as part of this program returned results for six (6) well distributed in-situ clay samples ranging from approximately $2.0x10^{-08}$ and $9.6 x10^{-09}$ cm/s, exceeding the provincial requirement of $1x10^{-07}$ cm/s stated in the Standards for Landfills.

Should you have any questions regarding the enclosed information or require additional information, please contact the undersigned.

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for the City of Winnipeg in accordance with the agreement between KGS Group and the City of Winnipeg (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to the City of Winnipeg by KGS Group. Unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

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Any use a third party makes of this report or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

Geotechnical Investigation Statement of Limitations

The geotechnical investigation findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practice. The findings and recommendations are based on the results of field and laboratory investigations, combined with an interpolation of soil and groundwater conditions found at and within the depth of the test holes drilled by KGS Group at the site at the time of drilling. If conditions encountered during construction appear to be different from those shown by the test holes drilled by KGS Group or if the assumptions stated herein are not in keeping with the design, KGS Group should be notified in order that the recommendations can be reviewed and modified if necessary.

Prepared By:

Caleb Friesen, C.E.T.
Civil Technologist

Approved By:

Taunya Ernst, P.Eng., P.E., P.G
Civil Geotechnical Department Head

CAF/TE/CS
Attached

FIGURES

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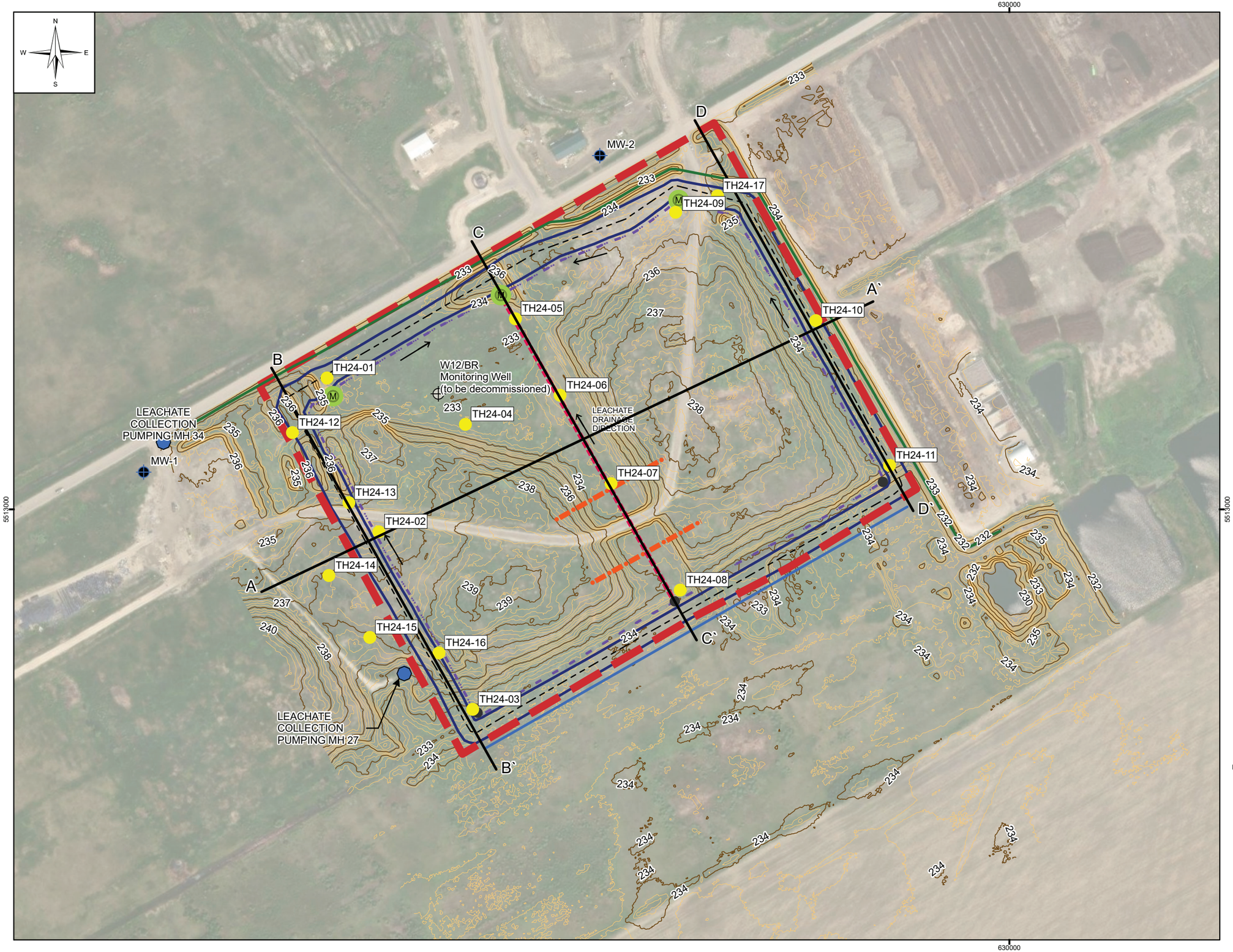
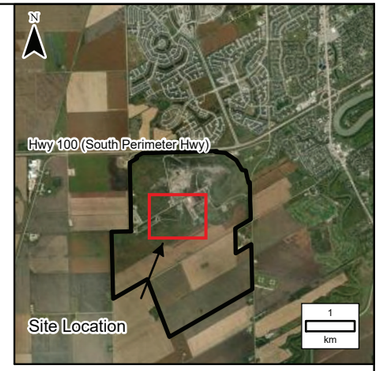




LEGEND:

2020 LiDAR
- 0.25m Contours
- 1m Contours

Proposed Works
- Clean Out
- Manhole
- Monitoring Well
- 10" Perforated Pipe (French Drains cut into existing waste bodies for leachate drainage control)
- Proposed Ditch
- Emergency Cell Area 2024
- Berm CL
- Berm Limits
- Leachate Trench with 10" Perforated Pipe
- Leachate Trench with 8" Perforated Pipe

Existing
- City of Winnipeg Manhole
- Groundwater Well
- Existing Ditch
- Approximate Test Hole Locations

NOTES:
1. All units are metric and in metres unless otherwise specified. Transverse Mercator Projection, NAD 1983 CSRS, Zone 14. Elevations are in metres above sea level (MSL) CGVD28.
2. For W12 stratigraphy, see attached log.
3. KGS Group referenced GHD drawing (11102893-00(005)CI-WA002) to aide in defining the cell area.

30 0 30 60 90 120
Metres

SCALE: 1:3,500 METRIC 11"x17"

NO.	YY/MM/DD	DESCRIPTION	ISSUED BY	CHECK BY
A	24/09/24	ISSUED WITH GEOTECH REPORT	TK	IH

REVISIONS / ISSUE

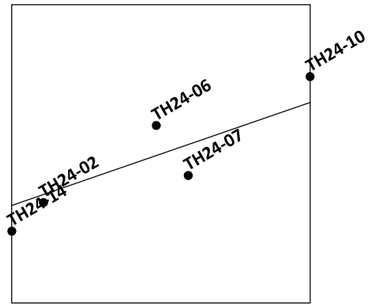
KGS GROUP — Winnipeg

BRRMF
EMERGENCY CELL

TEST HOLE LOCATION PLAN

SEPTEMBER 2024	FIGURE 01	REV: 0

FileName: P:\Projects\2015\15-0107-014\Design\GIS\DataArcPro\15-0107-014 Cap design\15-0107-014 Cap design_r3.aprx 15-0107-014_Fig01
11"x17" PLOT SCALE 1:1



SW
A

NE
A'

TH24-14
237.15 m

TH24-02
236.14 m

TH24-06
233.72 m

TH24-07
233.62 m

TH24-10
233.41 m

k_{20} = 2.00x10^{-08} cm/s

ELEVATION (m)

DISTANCE ALONG PROFILE (metres)

Horizontal Scale (meters)
Vertical Exaggeration: 10x

Lithology Graphics

- Topsoil
- Fill
- Garbage/Debris
- Clay (CH, high plasticity)
- Silt (ML)
- Silt Till

Legend

- Test Hole ID (e.g. TH24-02)
- Test Hole Lithology
- Water Level During Drilling
- Water Level Upon Completion
- Water Level Static/Remeasured
- SPT, N-Value
- DCPT Value
- > > values greater than 100
- Torvane Cu (kPa)
- Moisture Content (%)

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CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

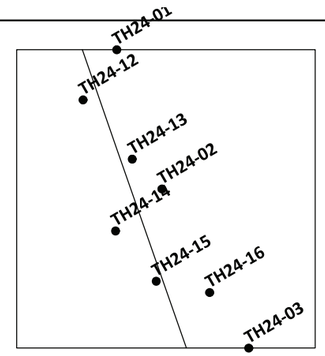
Detailed Design of Emergency Cell D

A-A'

Sep 2024

Figure 2

FENCE W/O WELL DATA PLOT U:\FMS\15-0107-014\BRRMF AREA D.GPJ



NW
B

SE
B'

ELEVATION (m)

TH24-01
233.33 m

TH24-12
232.85 m

TH24-13
235.78 m

TH24-02
236.14 m

TH24-14
237.15 m

TH24-15
237.01 m

TH24-16
237.40 m

TH24-03
233.45 m

k_{20} = 1.37x10^{-08} cm/s

k_{20} = 1.16x10^{-08} cm/s

DISTANCE ALONG PROFILE (metres)

Horizontal Scale (meters)
Vertical Exaggeration: 7.5x

Lithology Graphics

- Topsoil
- Fill
- Clay (CH, high plasticity)
- Garbage/Debris
- Silt (ML)
- Silt Till

Legend

- Test Hole ID (e.g. TH24-01)
- Test Hole Lithology
- Water Level During Drilling
- Water Level Upon Completion
- Water Level Static/Remeasured
- SPT, N-Value
- DCPT Value
- > > values greater than 100
- Torvane Cu (kPa)
- Moisture Content (%)

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CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

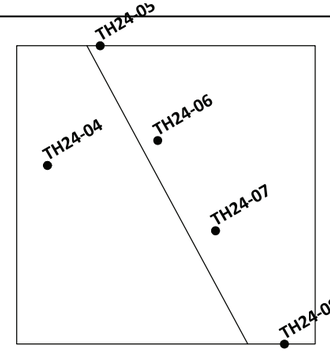
Detailed Design of Emergency Cell D

B-B'

Sep 2024

Figure 3

FENCE W/O WELL DATA PLOT U:\FMS\15-0107-0141\BRRMF AREA D.GPJ



NW
C

SE
C'

ELEVATION (m)

TH24-05
233.20 m

TH24-04
233.25 m

TH24-06
233.72 m

TH24-07
233.62 m

TH24-08
233.70 m

k_{20} = 1.24x10^{-08} cm/s

k_{20} = 1.24x10^{-08} cm/s

DISTANCE ALONG PROFILE (metres)

Horizontal Scale (meters)
Vertical Exaggeration: 6.5x

Lithology Graphics

- Topsoil
- Clay (CH, high plasticity)
- Silt Till
- Silt (ML)

Legend

- TH24-04 — Test Hole ID
- Test Hole Lithology
- Water Level During Drilling
- Water Level Upon Completion
- Water Level Static/Remeasured
- SPT, N-Value
- DCPT Value
- > > values greater than 100
- Torvane Cu (kPa)
- Moisture Content (%)

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CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

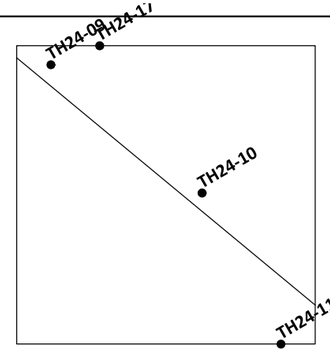
Detailed Design of Emergency Cell D

C-C'

Sep 2024

Figure 4

FENCE W/O WELL DATA PLOT U:\FMS\15-0107-014\BRRMF AREA D.GPJ



NW
D

SE
D'

ELEVATION (m)

TH24-09
235.05 m

TH24-17
233.81 m

TH24-10
233.41 m

TH24-11
233.77 m

k_{20} = 9.55x10^{-09} cm/s

k_{20} = 1.16x10^{-08} cm/s

DISTANCE ALONG PROFILE (metres)

Horizontal Scale (meters)
Vertical Exaggeration: 7.5x

Lithology Graphics

- Fill
- Topsoil
- Garbage/Debris
- Clay (CH, high plasticity)
- Silt Till

Legend

- Test Hole ID (TH24-09)
- Test Hole Lithology
- Water Level During Drilling
- Water Level Upon Completion
- Water Level Static/Remeasured
- SPT, N-Value
- DCPT Value
- >> values greater than 100
- Torvane Cu (kPa)
- Moisture Content (%)

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CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT

Detailed Design of Emergency Cell D

D-D'

Sep 2024

Figure 5

FENCE W/O WELL DATA PLOT U:\FMS\15-0107-014\BRRMF AREA D.GPJ

APPENDIX A

Test Hole Logs

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TEST HOLE LOG

HOLE NO.
TH24-01

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.33 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	NW Corner of Area D	**UTM (m)**	N 5,513,127.7
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,350.1 Zone 14
METHOD(S)	0.0 m to 15.5 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233				**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist to wet, loose, some rootlets.	233.3			S1			
	1.0			**CLAY (CH)** - Dark greyish brown, moist, stiff, high plasticity, trace rootlets and silt nodules and medium sand.	232.4						
232		5		- No rootlets, no sand below 0.5 m.	231.8	- Sloughing and squeezing around 1.2 m upon completion of drilling.		S2			
	2.0			**SILT (ML)** - Light brown, moist, soft, trace clay and oxidation.				S3			
231								S4			
	3.0	10		**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace silt nodules.							
230				- Mottled grey/brown below 1.8 m.							
	4.0			- Firm, intermediate to high plasticity, some silt from 2.4 m to 2.7 m.				S5			
229		15		- Firm below 4.6 m.							
	5.0			- Trace oxidation from 5.2 m to 5.6 m.							
228								S6			
	6.0	20									
227				- Grey below 6.7 m.				S7			
	7.0										
226		25		- No recovery in shelby tube at 7.6 m.					0		
	8.0										
225				- Increased silt nodules from 8.5 m to 8.8 m.				S8			
	9.0	30		- HC (k20) = 1.37x10-08 cm/s at 9.1 m.				S9	71		
224				- Poor recovery on augers from 9.1 m to 10.7 m.							
	10.0			- LL=72, PL=26, PI=46 at 9.1 m.							
223		35		- Increased moisture content, soft below 9.1 m.				S10			
	11.0			- Firm from 11.0 m to 12.2 m.		- Sloughing and squeezing around 10.7 m during drilling.					
222								S11			
	12.0	40		- Trace medium to coarse sand below 12.2 m.							
221											
	13.0										
220					219.6			S12			
	14.0	45		**SILT TILL** - Light grey, moist, loose, some fine to coarse sand and clay, trace fine gravel.				S13			
219											
	15.0	50		- Dry to damp, dense, some fine gravel, trace coarse gravel, no clay below 14.6 m.	217.9			S14			
218								S15	84	43 50/ 90mm	+100
	16.0			Notes: 1. End of test hole at 15.5 m. 2. Test hole caved to 1.2 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.							
217		55									
	17.0										
216											

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-02

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	236.14 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/3/2024
DESCRIPTION	West Edge of Area D, Centered North/South	**UTM (m)**	N 5,512,979.15
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,398.3 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEV (m)	DEPTH (m)	DEPTH (ft)	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %
236			**TOPSOIL/ORGANICS FILL** - 52 mm, Black, moist to wet, loose, some rootlets, trace sand and gravel.	236.1				
235	1.0	5	**CLAY FILL** - 1701 mm, Greyish brown, damp to moist, stiff, high plasticity, some sand, trace fine gravel. - Some black below 1.4 m. - Some silt below 1.4 m.	234.4	▼		S1 S2	
234	2.0		**GARBAGE** - 2819 mm, Black, moist to wet, wood, plastics.		▽		S3	
233	3.0	10	- Paper/roots, some thin clay layers below 3.0 m.				S4	
232	4.0			231.6				
231	5.0	15	**CLAY FILL** - 1829 mm, Greyish brown, moist, stiff, high plasticity, trace silt nodules.				S5	
230	6.0	20	- Water encountered after drilling to 6.1 m.	229.7			S6	71
			STRAW - 533 mm, Brown, moist, manure odour.	229.2				
229	7.0		**GARBAGE** - 686 mm, Grey and black, moist to wet, wood.	228.5				
		25	**CLAY FILL** - 305 mm, Grey, moist, stiff, high plasticity.	228.2			S7	
228	8.0		**GARBAGE** - 762 mm, Black, moist, wood and paper.	227.5				
227	9.0	30	**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace silt nodules. - Firm below 9.4 m.				S8	
226	10.0	35	- Brown below 10.4 m.				S9	
225	11.0		- Grey below 11.6 m.				S10	
224	12.0	40						
223	13.0	45					S11	
222	14.0							
221	15.0	50	- Some silt nodules below 14.6 m.	220.9			S12	
220	16.0	55						
219	17.0							

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

Notes:
1. End of test hole at 15.2 m.
2. Test hole caved to 2.4 m upon completion of drilling/digging.
3. Test hole backfilled with grout.
4. Grout mix consisted of 1 part cement, 0.3 part bentonite, 4.7 part water.

WATER LEVELS
▽ **During Drilling/Digging** 1.52 m
▼ **Upon Completion** 1.22 m

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-03

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.45 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/3/2024
DESCRIPTION	SW Corner of Area D	**UTM (m)**	N 5,512,809.39
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,490.95 Zone 14
METHOD(S)	0.0 m to 14.9 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %
233				**TOPSOIL/ORGANICS FILL** - 52 mm, Black, moist, loose, some rootlets.	233.4				
	1.0	5		**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace silt nodules and rootlets. - Dark grey from 0.3 m to 0.5 m. - Brown below 0.5 m. - No rootlets below 0.6 m. - Some silt from 1.5 m to 1.7 m.				S1	
232	2.0								
231	3.0	10		- Firm below 3.0 m.				S2	
230	4.0							S3	
229	5.0	15		- Mottled brown/grey, stiff below 4.6 m.				S4	100
228	6.0	20		- Firm below 5.8 m.				S5	
227	7.0	25		- Grey below 6.7 m. - LL=71, PL=33, PI=38 at 7.0 m. - PSA: 0% gravel, 0% sand, 53% silt, 47% clay at 7.0 m.				S6	
226	8.0								
225	9.0	30						S7	
224	10.0	35		- LL=80, PL=32, PI=48 at 10.1 m. - PSA: 0% gravel, 4% sand, 29% silt, 67% clay at 10.1 m. - Trace fine to medium sand below 10.4 m. - Soft below 10.7 m.				S8	
223	11.0							S9	
222	12.0	40		- Some silt pockets, trace fine gravel and coarse sand below 11.9 m.					
221	13.0	45			220.5			S10	
220	14.0			**SILT TILL** - Light brown, damp to moist, compact, some gravel and sand. - Damp, dense below 14.0 m.				S11	
219	15.0	50			218.5			S12	
218	16.0			Notes: 1. End of test hole at 14.9 m. 2. Test hole remained open to 14.9 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.					
217	17.0	55							
216									

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
During Drilling/Digging Dry
Upon Completion None Encountered

CONTRACTOR **Maple Leaf Drilling Ltd.**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-04

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.25 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/4/2024
DESCRIPTION	North of Cell 9-1978	**UTM (m)**	N 5,513,077.82
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,479.07 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE	PL MC LL; Cu TORVANE (kPa) ◆; qu POCKET PEN (kPa) ★; SPT (N) BLOWS/0.30 m ▲ 20 40 60 80
233			**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	233.2								
232	1.0 5		**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace silt nodules and rootlets. - No rootlets below 0.3 m. - Light brown, soft, intermediate plasticity, with silt, some clay from 1.4 m to 1.6 m. - Mottled grey/brown, stiff, high plasticity below 1.6 m. - Trace oxidation, trace silt from 2.4 m to 2.7 m.		- Sloughing and squeezing around 1.5 m during drilling.			S1 S2				
231	2.0											
230	3.0 10							S3				
229	4.0 15							S4				
228	5.0		- Some gypsum pockets from 5.0 m to 5.3 m. - Grey below 5.6 m.			▼		S5				
227	6.0 20							S6				
226	7.0		- Firm below 6.9 m.					S7				
225	8.0 25		- Mottled grey/brown, stiff below 7.8 m.									
224	9.0 30		- Grey, soft below 9.1 m.					S8				
223	10.0		- Firm below 9.8 m.					S9				
222	11.0 35											
221	12.0 40		- Some silt nodules below 11.6 m.	221.1				S10				
220	13.0		**SILT TILL** - Light grey, moist, loose, some to with clay, some sand, trace gravel. - Damp to moist, compact, some gravel, trace clay below 13.1 m. - Dry to damp, dense below 13.7 m.					S11 S12	60	50/ 130mm	+100	>>▲
219	14.0 45											
218	15.0 50			218.0				S13				
217	16.0		Notes: 1. End of test hole at 15.2 m. 2. Test hole caved to 8.2 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.									
216	17.0 55											

WATER LEVELS ▽ **During Drilling/Digging** None Encountered
▼ **Upon Completion** 5.18 m

CONTRACTOR **Maple Leaf Drilling Ltd.**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-05

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.20 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/4/2024
DESCRIPTION	North End of Area D, Centered East/West	**UTM (m)**	N 5,513,181.21
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,524.64 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233				**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	233.1							
232	1.0	5		**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace silt nodules and rootlets. - No rootlets below 0.3 m. - Firm, with silt from 1.5 m to 1.6 m. - Mottled grey/brown below 1.6 m.					S1			
231	2.0								S2			
230	3.0	10		- Trace gypsum nodules from 3.4 m to 3.7 m. - Trace oxidation below 3.4 m.					S3			
229	4.0	15							S4			
228	5.0								S5			
227	6.0	20		- Grey, firm, no oxidation below 5.8 m.					S6			
226	7.0	25		- Some silt from 7.3 m to 7.4 m. - HC (k20) = 1.24x10-08 cm/s at 7.6 m. - LL=78, PL=26, PI=52 at 7.6 m.					S7	96		
225	8.0			- Trace gravel below 8.2 m. - Some silt nodules below 8.7 m.					S8			
224	9.0	30		- No gravel below 9.1 m.								
223	10.0	35							S9			
222	11.0			- Till transition, some silt, trace sand and gravel below 10.7 m.								
221	12.0	40			221.0				S10			
220	13.0			**SILT TILL** - Light brown, moist, compact, with fine gravel, some coarse gravel and sand. - Dense below 13.1 m.					S11			
219	14.0	45		- Dry to damp below 13.7 m.		- Hard drilling below 13.7 m.			S12	65	49 50/ 100mm	+100
218	15.0	50			218.0		▼		S13			
217	16.0			Notes: 1. End of test hole at 15.2 m. 2. Test hole caved to 14.9 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.								
216	17.0	55										

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

>>▲

WATER LEVELS
▽ **During Drilling/Digging** None Encountered
▼ **Upon Completion** 14.83 m

CONTRACTOR **Maple Leaf Drilling Ltd.**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 11/18/2024

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TEST HOLE LOG

HOLE NO.
TH24-06

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.72 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/4/2024
DESCRIPTION	North of Mid Point of Area D, Centered East/West	**UTM (m)**	N 5,513,099.36
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,574.34 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233	0		**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	233.6				S1			
	1.0 5		**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt and rootlets. - No rootlets below 0.3 m.	232.5		▼		S2			
232	2.0		- Trace silt nodules below 0.9 m.	231.8	- Seepage around 1.9 m during drilling.	▽		S3			
231	3.0 10		**SILT (ML)** - Light brown, moist, soft, non-plastic, some clay, trace fine sand and oxidation. - Trace clay below 1.5 m.					S4			
230	4.0		**CLAY (CH)** - Mottled grey/brown, moist, stiff, high plasticity, trace silt nodules.								
229	5.0 15		- Grey below 4.6 m. - Firm below 5.2 m.					S5 S6			
228	6.0 20										
227	7.0							S7	92		
226	8.0 25		- LL=70, PL=30, PI=40 at 7.3 m. - PSA: 0% gravel, 2% sand, 44% silt, 54% clay at 7.3 m.					S8			
225	9.0 30							S9			
224	10.0										
223	11.0 35							S10			
222	12.0 40		- Some silt nodules below 11.6 m. - Trace medium to coarse sand below 12.2 m.					S11			
221	13.0		- Till transition, some silt below 12.5 m.	220.6				S12			
220	14.0 45		**SILT TILL** - Light grey, damp to moist, dense, with fine gravel and coarse sand, some fine to medium sand, trace coarse gravel. - Dry to damp below 13.7 m.		- Augers grinding below 14.3 m during drilling.			S13 S14	 100	 50/ 130mm	 +100
219	15.0 50			218.5				S15			
218	16.0		Notes: 1. End of test hole at 15.2 m. 2. Test hole caved to 2.4 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.								
217	17.0 55										
216											

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling/Digging** 1.91 m
▼ **Upon Completion** 1.07 m

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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TEST HOLE LOG

HOLE NO.
TH24-07

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.62 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/4/2024
DESCRIPTION	South of Mid Point of Area D, Centered East/West	**UTM (m)**	N 5,513,021.36
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,624.3 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233	1.0	5		**TOPSOIL/ORGANICS FILL** - Black, moist, loose, some rootlets.	233.5	- Seepage from 0.0 m to during drilling.		S1			
232	2.0			**CLAY (CH)** - Greyish brown, moist, stiff, high plasticity, trace rootlets. - No rootlets below 0.3 m. - Trace silt nodules below 1.5 m.				S2			
231	3.0	10		- Some silt from 2.3 m to 2.7 m.		- Augers hanging up at 3.0 m during drilling.		S3			
230	4.0			- Firm below 3.8 m.				S4			
229	5.0	15		- Trace gypsum nodules from 4.6 m to 5.5 m.				S5			
228	6.0	20						S6			
227	7.0			- Grey below 6.7 m. - Some silt nodules from 6.7 m to 7.2 m.				S7	0		
226	8.0	25		- No recovery in shelby tube at 7.6 m.				S8	96		
225	9.0	30		- HC (k20) = 2.00x10-08 cm/s at 9.1 m. - LL=95, PL=31, PI=64 at 9.1 m.				S9			
224	10.0			- Increased moisture content, soft below 10.1 m. - Trace medium to coarse sand below 10.7 m.				S10			
223	11.0	35			221.7			S11			
222	12.0	40		**SILT TILL** - Light grey, moist, compact, some gravel and sand, trace clay.				S12	61	7 13 51	64
221	13.0			- Damp to moist below 13.1 m.				S13			
220	14.0	45		- Dense, no clay below 13.7 m.							
219	15.0	50		- Hard drilling, with coarse sand and fine gravel below 14.5 m.	218.4						
218	16.0			Notes: 1. End of test hole at 15.2 m. 2. Test hole caved to 8.5 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.							
217	17.0	55									
216											

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-08

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.70 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/3/2024
DESCRIPTION	South End of Area D, Centered East/West	**UTM (m)**	N 5,512,923.47
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,683.82 Zone 14
METHOD(S)	0.0 m to 14.9 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m) (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233	0.0		**TOPSOIL/ORGANICS FILL** - 101 mm, Black, moist, loose, some rootlets.	233.6			S1			
	1.0 5		**CLAY (CH)** - Dark grey, moist, stiff, intermediate to high plasticity, trace rootlets. - No rootlets below 0.3 m.	232.6 / 232.2			S2			
232	2.0		**SILT (ML)** - Light brown, moist, soft, trace clay.		- Seepage around 1.4 m during drilling.					
			CLAY (CH) - Mottled grey/brown, moist, stiff, high plasticity, trace silt nodules.				S3			
231	3.0 10		- Some silt from 2.6 m to 2.7 m.							
			- Trace oxidation below 2.9 m.							
230	4.0		- Trace gypsum nodules below 3.0 m.				S4			
229	15									
	5.0		- Grey, firm, no oxidation below 4.9 m.				S5			
228										
	6.0 20		- No gypsum below 6.1 m.				S6	100		
227										
	7.0						S7			
226	25									
	8.0									
225							S8			
	9.0 30									
224										
	10.0		- Coarse gravel piece around 9.8 m.				S9			
223	35		- Trace fine to medium sand below 10.7 m.							
	11.0									
222			- Soft, increased moisture content below 11.6 m.				S10			
	12.0 40									
221				221.1						
	13.0		**SILT TILL** - Light brown, moist, compact, some sand and gravel.				S11			
220	45									
	14.0		- Damp, dense, with fine gravel below 13.9 m.				S12			
219				218.8			S13	89	29 47 55	102
	15.0 50		Notes: 1. End of test hole at 14.9 m. 2. Test hole backfilled with auger cuttings and bentonite chips.							
218										
	16.0									
217	55									
	17.0									
216										

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS

CONTRACTOR **Maple Leaf Drilling Ltd.**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-09

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	235.05 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/6/2024
DESCRIPTION	NE Corner of Area D	**UTM (m)**	N 5,513,289.3
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,680.42 Zone 14
METHOD(S)	0.0 m to 15.2 m: 125 mm ø SSA		

ELEV (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
234	1.0	5		**CLAY FILL** - 1676 mm, Brown, moist, stiff, high plasticity, trace fine gravel and sand and silt and silt nodules. - Some silt from 0.3 m to 0.5 m. - Brownish grey, some coarse sand, trace rootlets below 0.8 m.	233.4		▽		S1			
233	2.0			**GARBAGE** - 2591 mm, Black, wet, plastic, glass, fibrous. - Fine wood shred from 2.7 m to 2.8 m. - Grass from 3.2 m to 3.5 m.	230.8		▼					
232	3.0	10							S2			
231	4.0			**CLAY FILL** - 305 mm, Greyish brown, moist, firm, intermediate to high plasticity, some silt, trace medium to coarse sand.	230.5	- Water encountered to 5' after drilling to 4.6 m.			S3			
230	5.0	15		**CLAY (CH)** - Greyish brown, moist, firm, high plasticity, trace silt nodules. - Some silt from 4.9 m to 5.0 m. - Mottled brown/grey below 5.2 m. - HC (k20) = 9.55x10-09 cm/s at 5.9 m. - LL=87, PL=31, PI=56 at 5.9 m. - Grey, increased moisture content below 7.3 m.					S4	100		
229	6.0	20				- Gases bubbling in groundwater after pushing shelby tube to 6.6 m.						
228	7.0								S5			
227	8.0	25										
226	9.0	30		- LL=80, PL=34, PI=46 at 8.8 m. - PSA: 1% gravel, 2% sand, 39% silt, 58% clay at 8.8 m.					S6			
225	10.0											
224	11.0	35							S7			
223	12.0	40		- LL=89, PL=36, PI=53 at 11.7 m. - PSA: 1% gravel, 1% sand, 24% silt, 74% clay at 11.7 m. - Till transition, medium grey, soft, with silt, some medium to coarse sand, trace fine gravel below 12.2 m.	221.8				S8			
222	13.0			**SILT TILL** - Light grey, moist, compact, Some sand and fine gravel. - Damp, dense, with fine gravel, trace coarse gravel below 14.3 m.	219.8				S9			
221	14.0	45										
220	15.0	50							S10			
219	16.0								S11	100	52/ 130mm	+100
218	17.0	55										

Notes:
1. End of test hole at 15.2 m.
2. Test hole caved to 14.9 m upon completion of drilling/digging.
3. Test hole backfilled with grout.
4. Grout mix consisted of 1 part cement, 0.7 part bentonite, 6.6 part water.

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS	▽ **During Drilling/Digging**	1.52 m
	▼ **Upon Completion**	1.83 m

CONTRACTOR **Maple Leaf Drilling Ltd.**
INSPECTOR **C. FRIESEN**
APPROVED T. ERNST
DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-10

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.41 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/6/2024
DESCRIPTION	East of Area D, Centered North/South	**UTM (m)**	N 5,513,175.61
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,814.49 Zone 14
METHOD(S)	0.0 m to 15.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233				**CLAY FILL** - 152 mm, Dark grey, moist, soft, intermediate to high plasticity, some rootlets, trace silt, trace wood.	233.3			S1			
	1.0			**CLAY (CH)** - Grey, moist, stiff, high plasticity, trace silt nodules and coarse sand.							
232		5		- Brown, firm, with silt from 1.0 m to 1.1 m.				S2			
	2.0			- Mottled brown/grey below 1.1 m.							
231											
	3.0	10		- Trace gypsum nodules from 2.7 m to 3.0 m.				S3			
230											
	4.0			- Firm below 4.0 m.				S4			
229		15		- Grey below 4.3 m.				S5	94		
	5.0			- Mottled grey/brown, stiff below 4.9 m.							
228				- Trace oxidation from 5.0 m to 5.8 m.							
	6.0	20		- Firm below 5.5 m.				S6			
227				- PSA: 0% gravel, 1% sand, 40% silt, 59% clay at 5.8 m.							
	7.0			- Grey below 6.1 m.							
226		25		- Coarse gravel piece around 7.0 m.				S7			
	8.0										
225				- Some silt nodules below 8.2 m.							
	9.0	30						S8			
224											
	10.0										
223		35						S9			
	11.0			- Till transition, light grey, soft, some silt, trace sand and fine gravel below 11.0 m.	221.8			S10			
222				**SILT TILL** - Light grey, moist, compact, some clay and medium to coarse sand, trace gravel.							
	12.0	40						S11	44	2 3 4	7
221											
	13.0			- Damp to moist, some fine gravel below 12.8 m.							
220								S12		9	
	14.0	45		- Some coarse gravel below 13.7 m.				S13	67	10 13	23
219											
	15.0	50			218.3			S14			
218				Notes: 1. End of test hole at 15.1 m. 2. Test hole caved to 14.3 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.							
	16.0										
217		55									
	17.0										
216											

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling/Digging** — Dry
▼ **Upon Completion** — None Encountered

CONTRACTOR: **Maple Leaf Drilling Ltd.**
INSPECTOR: **C. FRIESEN**
APPROVED: T. ERNST
DATE: 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-11

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.77 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/6/2024
DESCRIPTION	SE Corner of Area D	**UTM (m)**	N 5,513,041.66
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,884.47 Zone 14
METHOD(S)	0.0 m to 15.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %	BLOWS/0.15 m	N-VALUE
233	0.0	0		**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	233.7			S1			
	1.0	5		**CLAY (CH)** - Grey and black, moist, stiff, high plasticity, trace silt nodules and rootlets.							
232				- Brown, no rootlets below 0.3 m.				S2			
	2.0			- Light brown, firm, intermediate to high plasticity, with silt from 1.2 m to 1.7 m.							
231	3.0	10		- Mottled brown/grey below 1.7 m.				S3			
				- Trace gypsum nodules from 2.3 m to 3.4 m.							
230	4.0	15		- Trace oxidation from 3.7 m to 4.6 m.				S4			
229	5.0										
228								S5			
	6.0	20		- HC (k20) = 1.16x10-08 cm/s at 5.9 m.				S6	100		
227				- LL=74, PL=27, PI=47 at 5.9 m.							
	7.0			- Some silt nodules below 6.9 m.				S7			
226		25		- Grey, firm, increased moisture content below 7.6 m.							
	8.0										
225				- Coarse gravel piece around 8.4 m.				S8			
	9.0	30		- Trace coarse sand below 9.1 m.							
224											
	10.0							S9			
223		35									
	11.0			- Coarse gravel piece around 11.0 m.							
				- Some silt, trace fine gravel below 11.0 m.	222.0			S10			
222	12.0	40		**SILT TILL** - Light brown, moist, loose, some clay and medium to coarse sand, trace gravel and fine sand.							
221								S11			
	13.0			- Damp to moist, compact, some gravel, no clay below 13.1 m.							
220		45		- Dense below 13.4 m.				S12	50	14 23 25	48
	14.0			- Hard drilling below 13.7 m.							
219				- Damp, trace coarse gravel below 14.6 m.	218.7			S13			
	15.0	50		Notes: 1. End of test hole at 15.1 m. 2. Test hole caved to 8.7 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.							
218	16.0										
217		55									
	17.0										
216											

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling/Digging** — Dry
▼ **Upon Completion** — None Encountered

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-12

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	232.85 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	East of Cell 7-1976	**UTM (m)**	N 5,513,074.18
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,314.15 Zone 14
METHOD(S)	0.0 m to 4.6 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER
232	1.0	5		**TOPSOIL/ORGANICS FILL** - 52 mm, Black, moist, loose, some rootlets.	232.8			S1	
231	2.0			**CLAY FILL** - 2387 mm, Brown, moist, stiff, high plasticity, trace sand and rootlets. - No rootlets below 0.5 m. - Some silt from 0.6 m to 0.7 m. - Blackish grey below 0.9 m. - Brown/grey, some silt below 1.5 m. - Black/grey, no silt below 2.0 m.	230.4		▼	S2	
230	3.0	10		**GARBAGE** - 2134 mm, Black, moist, plastic and paper. - Brownish black, wood at 2.7 m. - Clay layer (CH) from 2.8 m to 3.0 m. - Clay layer (CH) from 4.0 m to 4.1 m. - Wood from 4.1 m to 4.3 m. - Black, crumbly, possible shingles below 4.3 m.	228.3	- Water encountered to 1.5 m after drilling to 4.6 m.			
229	4.0	15		Notes: 1. End of test hole at 4.6 m. 2. Test hole caved to 3.0 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.					
228	5.0								
227	6.0	20							
226	7.0								
225	8.0	25							
224	9.0	30							
223	10.0								
222	11.0	35							
221	12.0	40							
220	13.0								
219	14.0	45							
218	15.0	50							
217	16.0								
216	17.0	55							
215									

PL MC LL

Cu TORVANE (kPa) ◆

qu POCKET PEN (kPa) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion** 1.52 m

CONTRACTOR **Maple Leaf Drilling Ltd.**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-13

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	235.78 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	North of TH24-02 on North Side of Road	**UTM (m)**	N 5,513,011
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,366.59 Zone 14
METHOD(S)	0.0 m to 8.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	SAMPLE TYPE	NUMBER	RECOVERY %
235	1.0	5		**SAND WITH GRAVEL FILL** - 204 mm, Brown, moist, loose, medium to coarse, some fine gravel, trace rootlets.	235.6				
				CLAY FILL - 253 mm, Greyish brown, moist, stiff, high plasticity, trace medium sand and silt nodules.	235.3				
				SAND WITH GRAVEL FILL - 610 mm, Light brown to grey, damp, compact, medium to coarse, fine gravel, some coarse gravel, trace fine sand.	234.7				
234	2.0			**CLAY FILL** - 1524 mm, Greyish brown, moist, stiff, high plasticity, trace sand and silt nodules. - 25mm thick plastic layer at 1.2 m. - Dark brown/black below 1.4 m. - Black/grey, some gravel, trace coarse sand below 1.5 m.	233.2				
233	3.0	10		**GARBAGE** - 457 mm, Brown, wet, plastics and paper.	232.7				
232	4.0			**CLAY (CH)** - Mottled grey/brown, moist, stiff, high plasticity, trace silt nodules. - Firm below 5.2 m. - Some silt, trace oxidation from 5.5 m to 5.9 m.		- Water encountered after drilling to 4.6 m.			
231	5.0	15							
230	6.0	20							
229	7.0								
228	8.0	25		- Grey below 7.6 m. - LL=92, PL=29, PI=63 at 7.9 m.	227.7				
227	9.0	30							
226	10.0								
225	11.0	35							
224	12.0								
223	13.0	40							
222	14.0	45							
221	15.0								
220	16.0	50							
219	17.0	55							
218									

Notes:
1. End of test hole at 8.1 m.
2. Test hole remained open to 8.1 m upon completion of drilling/digging.
3. Test hole backfilled with auger cuttings and bentonite chips.

S1 S2 S3 S4 S5 S6

RECOVERY: S6 = 100

PL MC LL

Cu TORVANE (kPa) ◆

qu POCKET PEN (kPa) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-14

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	237.15 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	West of Area D, Centered North/South	**UTM (m)**	N 5,512,934.33
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,348.79 Zone 14
METHOD(S)	0.0 m to 9.1 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER
237				**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	237.1			
				CLAY FILL - 457 mm, Greyish brown, moist, stiff, high plasticity, trace silt nodules and rootlets.	236.6			S1
236	1.0	5		**GARBAGE** - 7696 mm, Black, moist, wood debris, some clay.		▼		S2
	2.0			- Clay layer (greyish brown, moist, stiff, high plasticity, trace silt nodules and rootlets) from 0.9 m to 1.2 m.				
235				- Wood and plastics below 1.2 m.				S3
	3.0	10		- Wet, shredded wood, leachate odour below 1.5 m.				
234				- Paper/insulation below 2.7 m.				
	4.0			- Clay layer (greyish brown, moist, firm, high plasticity, trace silt nodules and sand) from 2.8 m to 3.0 m.				
233		15		- Clay layer (Greyish brown, moist, firm, high plasticity, trace silt nodules and sand) from 3.7 m to 4.0 m.				S4
	5.0			- Clay Layer (black, wet, stiff, intermediate to high plasticity, some wood debris, trace sand) from 4.1 m to 4.6 m.				
232				- Moist to wet, wood debris with straw/manure below 4.6 m.				
	6.0	20		- Clay layer (brown, moist, stiff, high plasticity, trace silt nodules and sand) from 5.7 m to 6.1 m.				S5
231				- Wet, strong leachate odour below 6.1 m.				
	7.0			- Clay layer (brown, moist, stiff, high plasticity, trace silt nodules and sand) from 6.5 m to 7.3 m.				S6
230		25		- Wet, shredded wood below 7.3 m.				
	8.0				228.9			
229				**CLAY (CH)** - Brown, moist, stiff, high plasticity, trace silt nodules.				
				- Firm below 8.7 m.	228.0			S7
228	9.0	30		Notes:				
				1. End of test hole at 9.1 m.				
227	10.0			2. Test hole caved to 1.4 m upon completion of drilling/digging.				
		35		3. Test hole backfilled with auger cuttings and bentonite chips.				
226	11.0							
	12.0	40						
225								
224	13.0							
		45						
223	14.0							
	15.0							
222		50						
221	16.0							
		55						
220	17.0							

PL MC LL

Cu TORVANE (kPa) ◆

qu POCKET PEN (kPa) ★

SPT (N) BLOWS/0.30 m ▲

20 40 60 80

WATER LEVELS ▼ **Upon Completion** 1.37 m

CONTRACTOR **Maple Leaf Drilling Ltd.**	INSPECTOR **C. FRIESEN**
APPROVED T. ERNST	DATE 11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-15

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	237.01 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	West of Area D, North of Leachate Collection MH 27	**UTM (m)**	N 5,512,880.71
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,392.16 Zone 14
METHOD(S)	0.0 m to 12.2 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER
				TOPSOIL/ORGANICS FILL - 76 mm, Black, moist, loose, some rootlets.	236.9				S1
236	1.0	5		**CLAY FILL** - 1524 mm, Greyish brown, moist, stiff, high plasticity, trace sand and fine gravel and rootlets/roots. - No rootlets/roots below 0.3 m. - No gravel below 0.6 m. - With medium sand, trace plastic below 1.3 m. - Wet at 1.5 m.	235.4		▼ ▽		S2
235	2.0								
234	3.0	10		**GARBAGE** - 7468 mm, Black, wet, shredded wood, trace plastics. - Clay layer (grey, moist, stiff, CH, some silt) from 1.8 m to 2.1 m. - Clay layer (greyish brown, moist, stiff, high plasticity, trace silt) from 2.9 m to 3.9 m. - 50mm thick plastic layer at 3.2 m. - Some fibrous material, trace coarse sand below 3.4 m. - Straw, paper, fibrous below 3.9 m. - Clay layer (greyish brown, moist, firm, high plasticity, some garbage, trace silt nodules) from 4.8 m to 5.0 m. - Wood and paper below 5.0 m. - Some plastic below 5.5 m. - Clay layer (brown, moist, stiff, high plasticity, trace silt nodules) from 6.6 m to 7.3 m. - Some garbage from 7.2 m to 7.3 m. - Wood, paper, some plastics below 7.3 m. - Clay layer (greyish brown, moist, stiff, high plasticity, trace silt and garbage) from 7.8 m to 8.2 m. - Paper and plastic below 8.2 m.		- Gases bubbling in groundwater after drilling to 6.1 m.		S3
233	4.0								
232	5.0	15							S4
231	6.0	20							
230	7.0								S5
229	8.0	25							S6
228	9.0	30			227.9				
227	10.0			**CLAY (CH)** - Greyish brown, moist, soft, high plasticity, trace silt nodules and oxidation. - No oxidation below 9.4 m.					S7
226	11.0	35							
225	12.0	40			224.8				S8
224	13.0			Notes: 1. End of test hole at 12.2 m. 2. Test hole caved to 1.4 m upon completion of drilling/digging. 3. Test hole backfilled with auger cuttings and bentonite chips.					
223	14.0	45							
222	15.0	50							
221	16.0								
220	17.0	55							

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling/Digging** 1.83 m
▼ **Upon Completion** 1.37 m

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

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KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-16

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	237.40 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/5/2024
DESCRIPTION	West Limit of Area D, East of Leachate Collection MH 27	**UTM (m)**	N 5,512,868.63
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,449.19 Zone 14
METHOD(S)	0.0 m to 9.8 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	DRILLING/ DIGGING REMARKS	WATER LEVEL	SAMPLE TYPE	NUMBER	RECOVERY %
237				**TOPSOIL/ORGANICS FILL** - 76 mm, Black, moist, loose, some rootlets.	237.3					
	1.0			**CLAY FILL** - 738 mm, Greyish brown, moist, stiff, high plasticity, trace sand and rootlets and garbage.	236.6				S1	
236		5		**GARBAGE** - 6501 mm, Black, moist, wood and plastic.			▼		S2	
	2.0			- Clay layer (brown, moist, stiff, high plasticity, trace silt nodules) from 1.1 m to 1.2 m.						
235				- Paper and plastic below 1.2 m.			▽			
	3.0	10		- Clay layer (brown, moist, stiff, high plasticity, some wood and plastic) from 1.5 m to 1.8 m.						
234				- Wet, paper, wood, plastics, leachate odour below 1.8 m.						
	4.0			- Clay layer (grey and black, moist, stiff, high plasticity, trace silt nodules) from 3.0 m to 3.4 m.					S3	
233		15		- Wood and paper below 3.4 m.						
	5.0			- Clay layer (black, moist, stiff, high plasticity, trace silt nodules) from 3.9 m to 4.9 m.					S4	
232				- Brown below 4.0 m.						
	6.0	20		- Grey, trace garbage below 4.6 m.						
231				- Plastics below 4.9 m.						
	7.0			- Clay layer (grey, moist, stiff, high plasticity, some garbage) from 5.1 m to 5.3 m.						
230		25		- Grey, paper, wood and plastics below 5.3 m.	230.1				S5	
	8.0			- Clay layer (greyish brown, moist, stiff, high plasticity, trace silt nodules) from 5.8 m to 6.1 m.						
229				- Grey and black below 6.1 m.						
				- Clay layer (CH) from 6.6 m to 6.7 m.					S6	
	9.0	30		**CLAY (CH)** - Mottled grey/brown, moist, stiff, high plasticity, trace silt nodules and wood.						
228				- No wood below 7.5 m.		- Water on augers to 9' after drilling to 30.			S7	100
	10.0			- Firm below 7.6 m.	227.6					
227		35		- HC (k20) = 1.16x10-08 cm/s at 9.1 m.						
	11.0			- LL=89, PL=33, PI=56 at 9.1 m.						
226				Notes:						
	12.0	40		1. End of test hole at 9.8 m.						
225				2. Test hole caved to 1.2 m upon completion of drilling/digging.						
	13.0			3. Test hole backfilled with auger cuttings and bentonite chips.						
224		45								
	14.0									
223										
	15.0	50								
222										
	16.0									
221		55								
	17.0									
220										

PL MC LL
Cu TORVANE (kPa) ◆
qu POCKET PEN (kPa) ★
SPT (N) BLOWS/0.30 m ▲
20 40 60 80

WATER LEVELS
▽ **During Drilling/Digging** 2.74 m
▼ **Upon Completion** 1.22 m

CONTRACTOR
Maple Leaf Drilling Ltd.

INSPECTOR
C. FRIESEN

APPROVED
T. ERNST

DATE
11/18/2024

KGS_LOG_U:\FMS\15-0107-014\BRRMF AREA D.GPJ

KGS GROUP

TEST HOLE LOG

HOLE NO.
TH24-17

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT	**BRRMF Detailed Design of Emergency Cell D**	**SURFACE ELEV.**	233.81 m
LOCATION	Winnipeg, Manitoba	**START DATE**	6/6/2024
DESCRIPTION	NE Corner of Area D, East of TH24-09	**UTM (m)**	N 5,513,306.16
DRILL RIG / HAMMER	Mobile B37X Track Mounted Drill Rig with Auto-Hammer		E 629,723.72 Zone 14
METHOD(S)	0.0 m to 2.7 m: 125 mm ø SSA		

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEV (m)	WATER LEVEL	SAMPLE TYPE	NUMBER	PL MC LL; Cu TORVANE (kPa) ◆; qu POCKET PEN (kPa) ★; SPT (N) BLOWS/0.30 m ▲ (20 40 60 80)
233	1.0	5		**TOPSOIL/ORGANICS FILL** - 52 mm, Black, moist, loose, some rootlets.	233.8			S1	◆
				CLAY - Brown, moist, stiff, high plasticity, trace medium to coarse sand and silt nodules and rootlets.				S2	
232	2.0			- No rootlets below 0.3 m.				S3	◆ ◆ ◆
				- Grey, no sand below 0.8 m.					
				- Brown, firm, with silt from 1.4 m to 1.5 m.					
231	3.0	10		- Mottled brown below 1.5 m.				S4	◆
					231.1				
230	4.0	15		Notes:					
				1. End of test hole at 2.7 m.					
229	5.0			2. Test hole remained open to 2.7 m upon completion of drilling/digging.					
228	6.0	20		3. Test hole backfilled with auger cuttings.					
227	7.0								
226	8.0	25							
225	9.0	30							
224	10.0								
223	11.0	35							
222	12.0	40							
221	13.0								
220	14.0	45							
219	15.0	50							
218	16.0								
217	17.0	55							
216									

WATER LEVELS
- ▽ **During Drilling/Digging** — Dry
- ▼ **Upon Completion** — None Encountered

CONTRACTOR: **Maple Leaf Drilling Ltd.**
INSPECTOR: **C. FRIESEN**
APPROVED: T. ERNST
DATE: 11/18/2024

KGS_LOG_U:\FMS\15-0107-014\BRRMF AREA D.GPJ

KEY TO SYMBOLS

LITHOLOGIC SYMBOLS


Clay (CH, high plasticity)


Fill


Garbage/Debris


Silt (ML)


Silt Till


Topsoil

SAMPLER SYMBOLS


Auger Grab


Shelby Tube


SPT Split Spoon

WELL CONSTRUCTION SYMBOLS

ABBREVIATIONS

LL - Liquid Limit
PL - Plastic Limit
PI - Plastic Index
MC - Moisture Content
DD - Dry Density
NP - Non-Plastic
-200 - Percent Passing No. 200 Sieve
TV - Torvane (kPa)
PP - Pocket Penetrometer (kPa)
PSA - Particle Size Analysis
TOC - Top Of Casing

PN - Pneumatic Piezometer
VW - Vibrating Wire Piezometer
PID - Photoionization Detector
ppm - Parts Per Million
▽ Water Level During Drilling
▼ Water Level Upon Completion of Drilling
▼ Water Level Remeasured/Static

KGS GROUP

CLIENT CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT **PROJECT NO.** 15-0107-014
PROJECT NAME Detailed Design of Emergency Cell D **LOCATION** Winnipeg, MB

APPENDIX B

Laboratory Test Results

KGS GROUP

SUMMARY OF INDEX TESTS

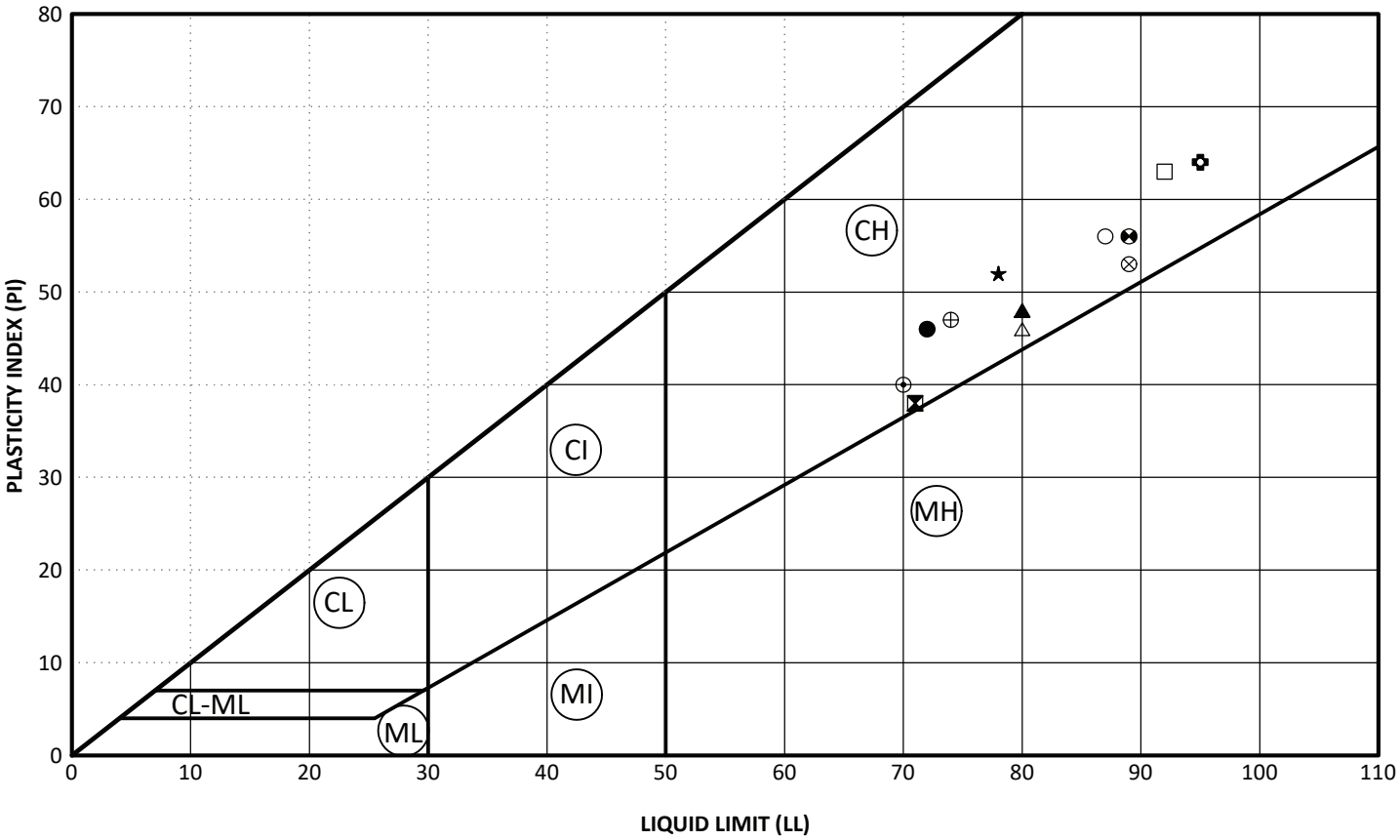
Test Hole ID	Sample No.	Sample Depth (m)	Class-ification	Hydraulic Conduc-tivity (cm/s)	Clay Thickness (mm)	Silt (%)	Clay (%)	Liquid Limit	Plastic Limit	Plas-ticity Index	Moisture Content (%)	Dry Density (kN/m3)	Specific Gravity	Satur-ation (%)	Void Ratio
TH24-01	S9	9.1	CH	1.37E-08				72	26	46	54	1107.0			
TH24-03	S6	7.0	CH			53	47	71	33	38	59				
TH24-03	S8	10.1	CH			29	67	80	32	48	56				
TH24-05	S7	7.6	CH	1.24E-08				78	26	52	50	1167.0			
TH24-06	S8	7.3	CH			44	54	70	30	40	46				
TH24-07	S8	9.1	CH	2E-08				95	31	64	60	1065.0			
TH24-09	S4	5.9	CH	9.55E-09				87	31	56	53	1114.0			
TH24-09	S6	8.8	CH			39	58	80	34	46	49				
TH24-09	S8	11.7	CH			24	74	89	36	53	64				
TH24-10	S6	5.8	CH			40	59				38				
TH24-11	S6	5.9	CH	1.16E-08				74	27	47	45	1207.0			
TH24-13	S6	7.9	CH					92	29	63	60				
TH24-16	S7	9.1	CH	1.16E-08				89	33	56	53	1089.0			

* Moisture conditioned and remolded sample.
** Assumed specific gravity.

KGS GROUP

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT NAME	Detailed Design of Emergency Cell D	**LOCATION**	Winnipeg, MB
TESTED BY	Stantec	**DATE TESTED**	July 17, 2024

ATTERBERG LIMITS



	HOLE	DEPTH (m)	SAMPLE #	LL	PL	PI	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	MC (%)	CLASSIFICATION
●	TH24-01	9.1	S9	72	26	46					54	CH
⊠	TH24-03	7.0	S6	71	33	38	0	53	47	100	59	CH
▲	TH24-03	10.1	S8	80	32	48	4	29	67	96	56	CH
★	TH24-05	7.6	S7	78	26	52					50	CH
⊙	TH24-06	7.3	S8	70	30	40	2	44	54	98	46	CH
✿	TH24-07	9.1	S8	95	31	64					60	CH
○	TH24-09	5.9	S4	87	31	56					53	CH
△	TH24-09	8.8	S6	80	34	46	2	39	58	97	49	CH
⊗	TH24-09	11.7	S8	89	36	53	2	24	74	97	64	CH
⊕	TH24-11	5.9	S6	74	27	47					45	CH
□	TH24-13	7.9	S6	92	29	63					60	CH
⊛	TH24-16	9.1	S7	89	33	56					53	CH

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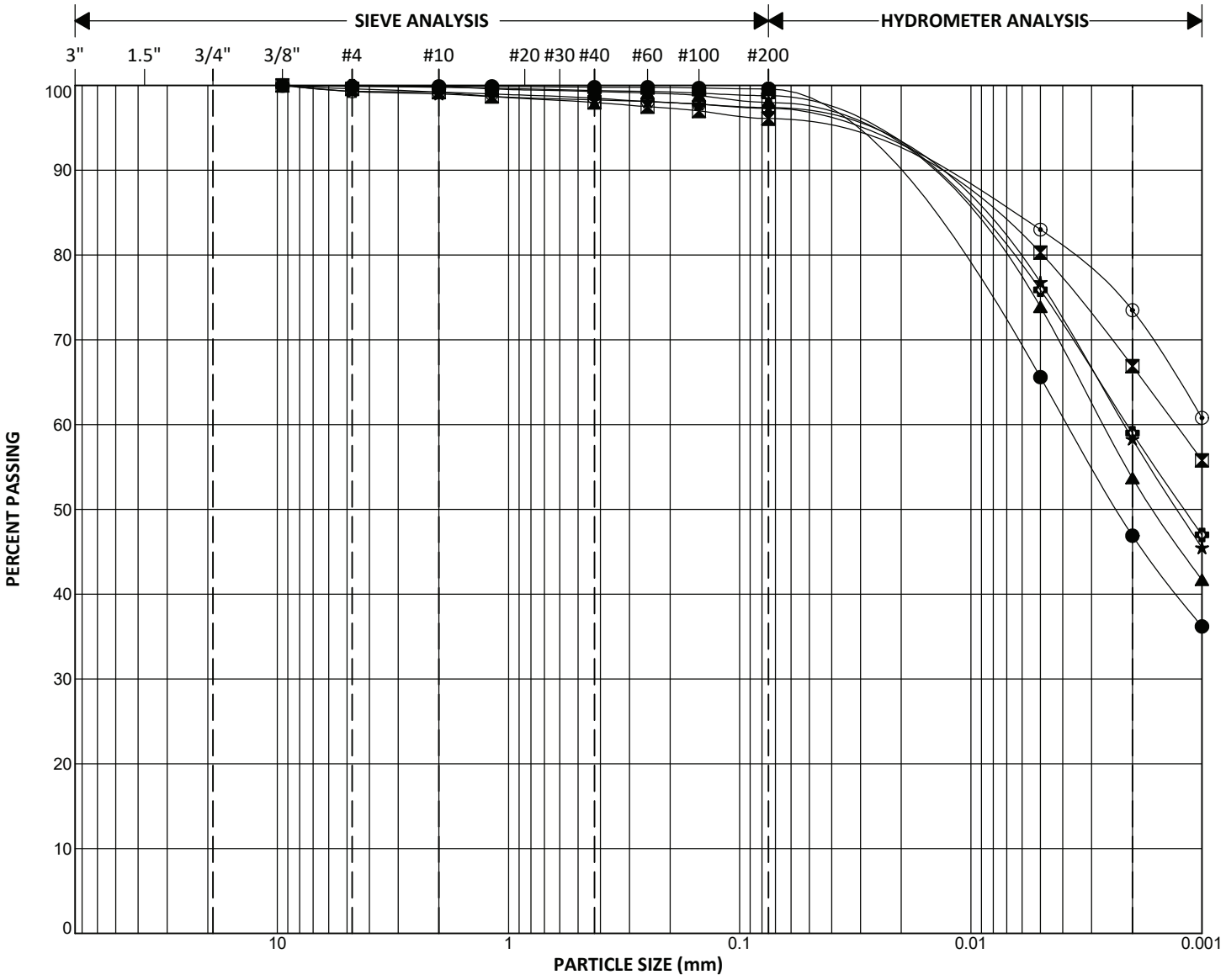
KGS GROUP

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT NAME	Detailed Design of Emergency Cell D	**LOCATION**	Winnipeg, MB
TESTED BY	Stantec	**DATE TESTED**	June 28, 2024

GRAIN SIZE DISTRIBUTION



GRAVEL		SAND			SILT	CLAY
coarse	fine	coarse	medium	fine		

	HOLE	DEPTH (m)	SAMPLE #	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	SILT & CLAY (%)	Cu	Cc	CLASSIFICATION
●	TH24-03	7.0	S6	0	0	53	47	100			CH
⊠	TH24-03	10.1	S8	0	4	29	67	96			CH
▲	TH24-06	7.3	S8	0	2	44	54	98			CH
★	TH24-09	8.8	S6	1	2	39	58	97			CH
⊙	TH24-09	11.7	S8	1	2	24	74	97			CH
✿	TH24-10	5.8	S6	0	1	40	59	99			CH

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KGS GROUP

CLIENT	**CITY OF WINNIPEG - WATER AND WASTE DEPARTMENT**	**PROJECT NO.**	15-0107-014
PROJECT NAME	Detailed Design of Emergency Cell D	**LOCATION**	Winnipeg, MB
TESTED BY	Stantec	**DATE TESTED**	July 17, 2024

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 1

DATE SAMPLED: 2024.Jun.04
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jun.24
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-01, S9, 30'-32'
SAMPLE TYPE Shelby Tube sample

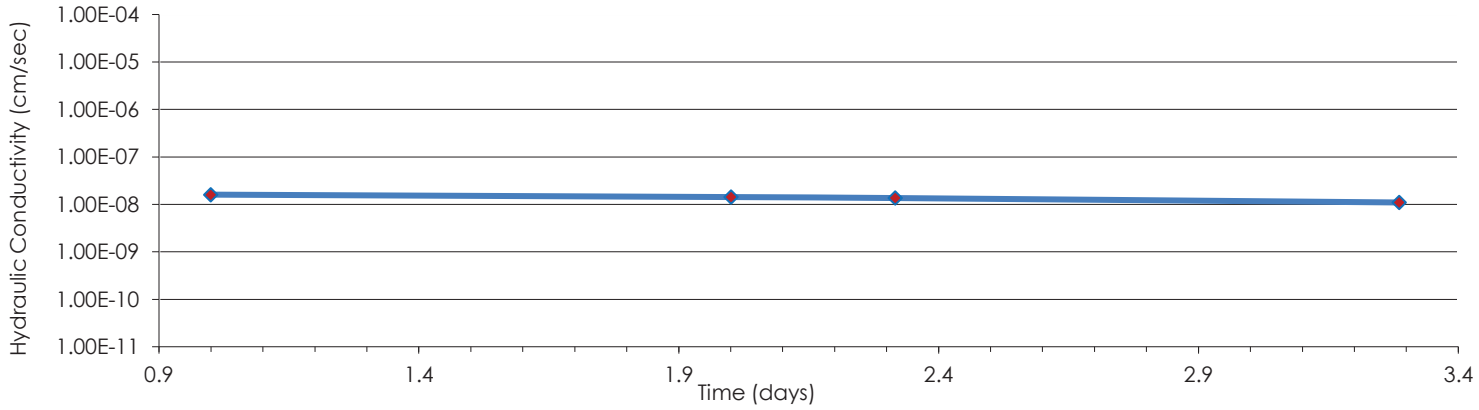
STANTEC SAMPLE NO. 4334
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Clay, grey, stiff, moist, high plasticity, trace silt

CONFINING PRESSURE (kPa): 155.1
EFFECTIVE SATURATION STRESS (kPa): 51.7
HYDRAULIC GRADIENT: 19.3

TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.43E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 1.37E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.46	71.14	524.43	1.107	53.9	59.6	100.8
FINAL READING	76.66	70.53	519.48	1.135	52.8	59.9	103.1



COMMENTS
Shelby Tube recovered 48 cm of soil. Test sample portion taken from 20 cm to 30 cm from bottom end of tube.

REPORT DATE 2024.Jul.18

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 2

DATE SAMPLED: 2024.Jun.04
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jun.24
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-05, S7, 25'-27'
SAMPLE TYPE Shelby Tube sample

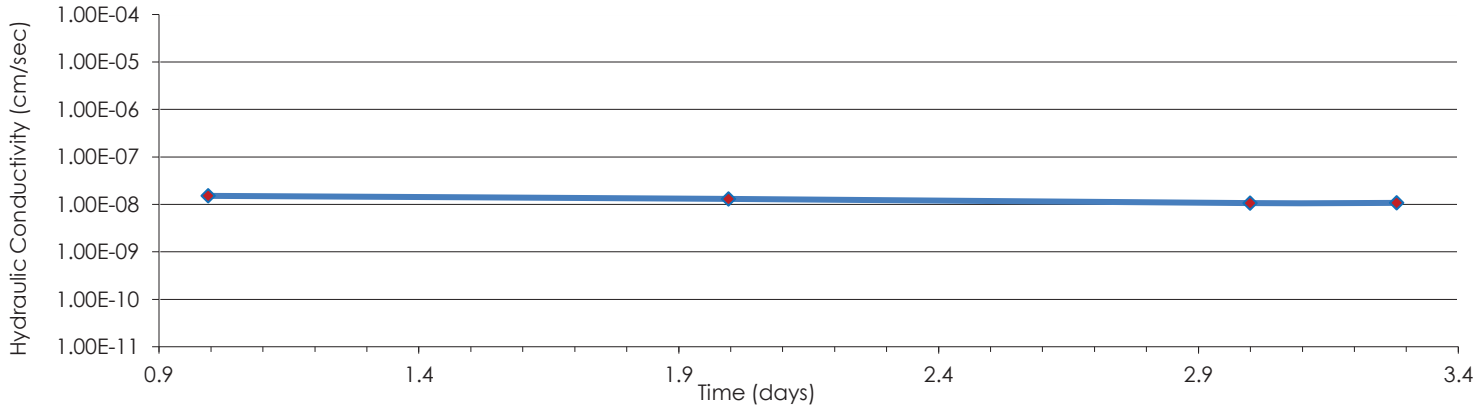
STANTEC SAMPLE NO. 4335
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Clay, grey, stiff, moist, high plasticity, trace silt

CONFINING PRESSURE (kPa): 151.7
EFFECTIVE SATURATION STRESS (kPa): 34.5
HYDRAULIC GRADIENT: 19.0

TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.29E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 1.24E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.45	71.43	542.21	1.167	49.7	58.0	101.8
FINAL READING	78.27	72.27	549.37	1.127	51.9	58.5	100.1



COMMENTS
Shelby Tube recovered 54 cm of soil. Test sample portion taken from 15 cm to 25 cm from bottom end of tube.

REPORT DATE 2024.Jul.18

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 3

DATE SAMPLED: 2024.Jun.04
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jun.24
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-07, S8, 30'-32'
SAMPLE TYPE Shelby Tube sample

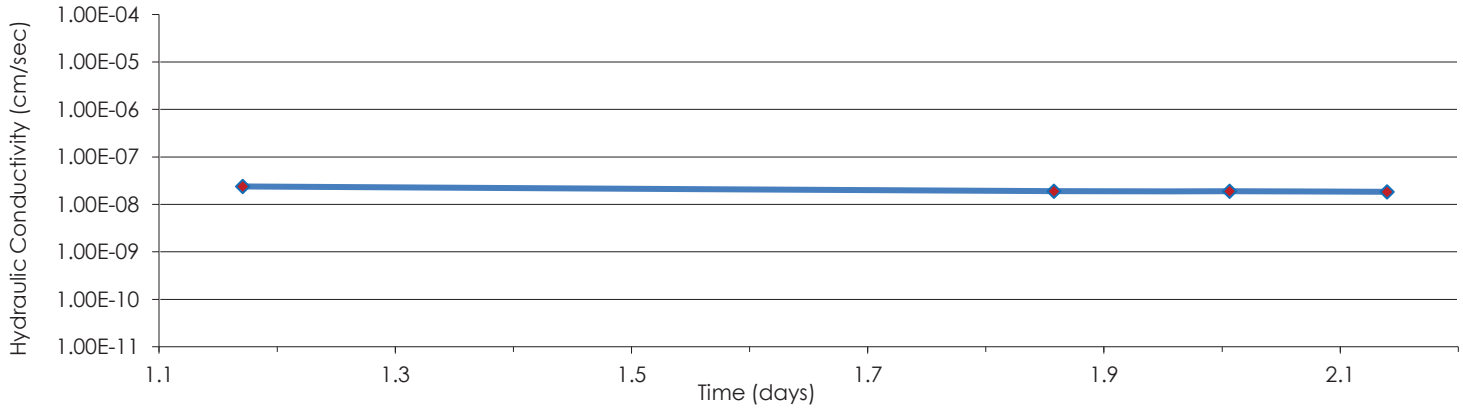
STANTEC SAMPLE NO. 4336
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Clay, grey, stiff, moist, high plasticity, trace silt

CONFINING PRESSURE (kPa): 151.7
EFFECTIVE SATURATION STRESS (kPa): 34.5
HYDRAULIC GRADIENT: 18.8

TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 2.09E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 2.00E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.40	71.45	529.54	1.065	60.1	64.1	105.6
FINAL READING	79.04	72.15	540.99	1.060	58.0	61.4	100.9



COMMENTS
Shelby Tube recovered 56 cm of soil. Test sample portion taken from 15 cm to 25 cm from bottom end of tube.

REPORT DATE 2024.Jul.18

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 4

DATE SAMPLED: 2024.Jun.06
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jul.15
TESTED BY: Larry Presado

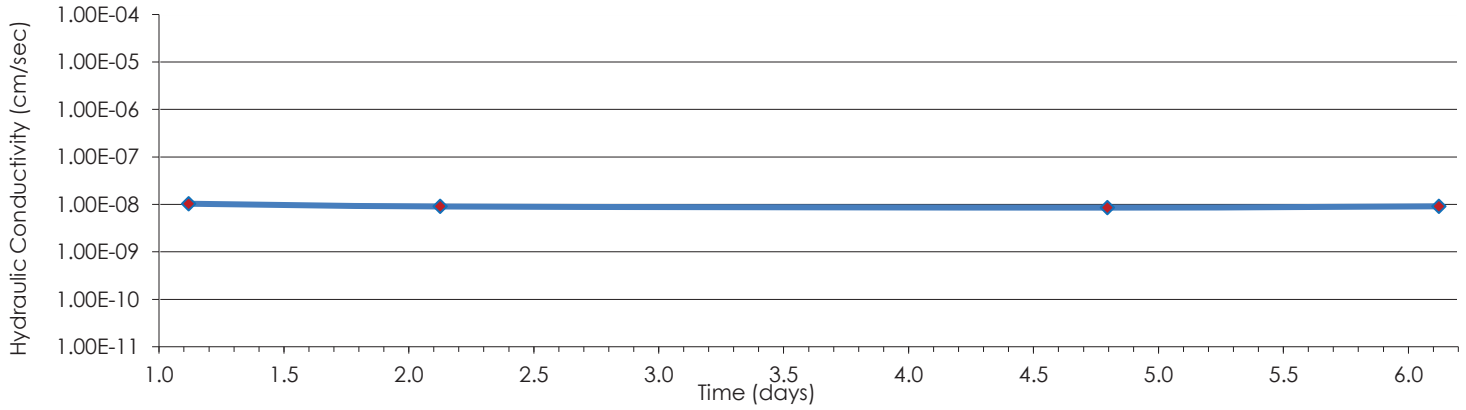
MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-09, S4, 19.5'-21.5'
SAMPLE TYPE Shelby Tube sample
STANTEC SAMPLE NO. 4337
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Silty clay, brown, firm, moist, high plasticity, trace organic materials, trace plastic bag (Fill Material)

CONFINING PRESSURE (kPa): 151.7
EFFECTIVE SATURATION STRESS (kPa): 48.3
HYDRAULIC GRADIENT: 19.1
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.02E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 9.55E-09

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.66	71.25	528.91	1.114	53.3	59.4	100.8
FINAL READING	77.80	72.18	527.34	1.070	54.8	58.7	96.9



COMMENTS
Shelby Tube recovered 60 cm of soil. Test sample portion taken from 25 cm to 40 cm from bottom end of tube.

REPORT DATE 2024.Jul.26

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 5

DATE SAMPLED: 2024.Jun.06
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jul.15
TESTED BY: Larry Presado

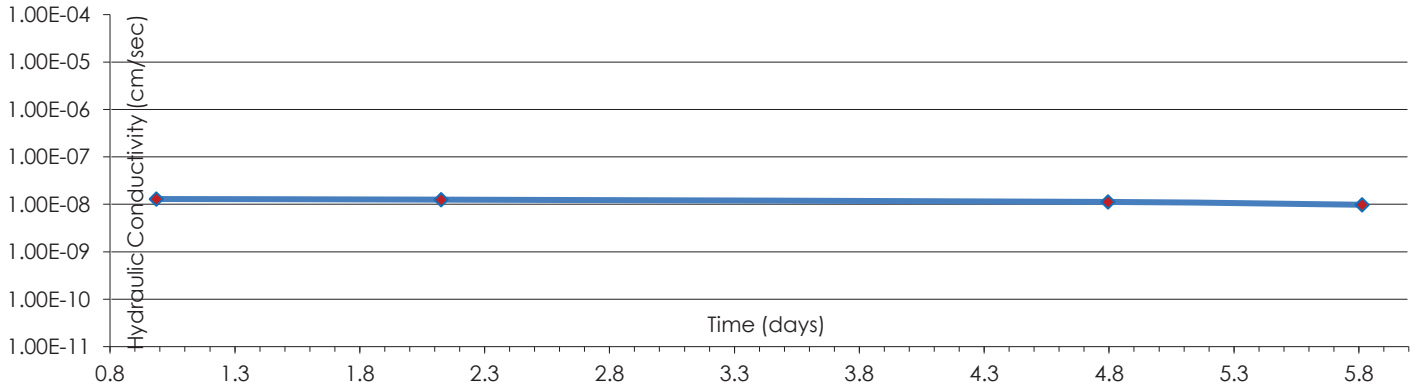
MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-11, S6, 19.5'-21.5'
SAMPLE TYPE Shelby Tube sample
STANTEC SAMPLE NO. 4338
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Silty clay, brown, stiff, moist, high plasticity, trace silt

CONFINING PRESSURE (kPa): 151.7
EFFECTIVE SATURATION STRESS (kPa): 48.3
HYDRAULIC GRADIENT: 19.0
TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.21E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 1.16E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.92	71.86	551.65	1.207	44.5	53.8	97.0
FINAL READING	78.22	71.76	555.55	1.199	46.4	55.7	99.9



COMMENTS
Shelby Tube recovered 57 cm of soil. Test sample portion taken from 27 cm to 37 cm from bottom end of tube.

REPORT DATE 2024.Jul.26

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services

Stantec Consulting Ltd.
199 Henlow Bay, Winnipeg, MB R3Y 1G4
Tel: (204) 488-6999

ASTM D5084 - MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER

TO KGS Group Inc.
3rd Floor - 865 Waverley Street
Winnipeg, Manitoba
R3T 5P4

ATTN Caleb Friesen

PROJECT BRRMF Emergency Cell Area D (15-0107-014)

PROJECT NO. 123317158

REPORT NO. 6

DATE SAMPLED: 2024.Jun.05
SAMPLED BY: KGS Group Inc.

DATE RECEIVED: 2024.Jun.20
SUBMITTED BY: KGS Group Inc.

DATE TESTED: 2024.Jul.15
TESTED BY: Larry Presado

MATERIAL IDENTIFICATION

CLIENT FIELD ID TH24-16, S7, 30'-32'
SAMPLE TYPE Shelby Tube sample

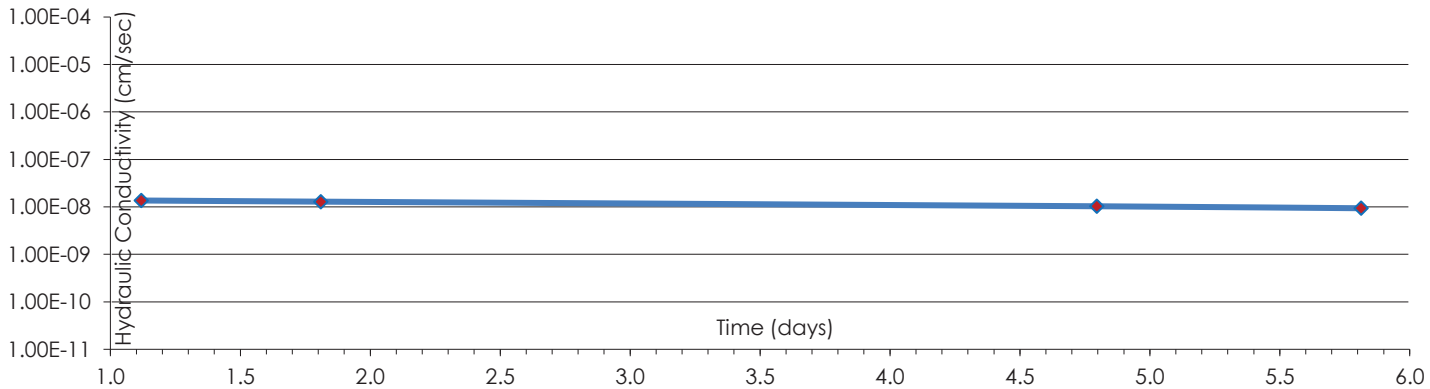
STANTEC SAMPLE NO. 4339
ASSUMED SPECIFIC GRAVITY 2.71

VISUAL CLASSIFICATION Silty clay, grey, stiff, moist, high plasticity, trace silt

CONFINING PRESSURE (kPa): 151.7
EFFECTIVE SATURATION STRESS (kPa): 48.3
HYDRAULIC GRADIENT: 19.1

TYPE OF PERMEANT LIQUID: De-aired Water
HYDRAULIC CONDUCTIVITY, "k" (cm/s): 1.21E-08
HYDRAULIC CONDUCTIVITY, "k20" (cm/s): 1.16E-08

	Height (mm)	Diameter (mm)	Wet Mass (g)	Dry Density (g/cm^3)	Water Content (% by Mass)	Water Content (% by Volume)	Saturation (%)
INITIAL READING	77.46	72.61	535.16	1.089	53.2	57.9	96.9
FINAL READING	77.76	72.35	537.41	1.086	54.8	59.5	99.3



COMMENTS
Shelby Tube recovered 59 cm of soil. Test sample portion taken from 30 cm to 40 cm from bottom end of tube.

REPORT DATE 2024.Jul.26

REVIEWED BY Guillaume Beauce, P.Eng.
Geotechnical Engineer - Materials Testing Services