
February 12, 2024
Project No.: 5555-21-HC

Man Holdings Ltd.
174 Dinnick Crescent
Toronto, Ontario
M4N 1M3

Attention: Mr. Sam Arabi

**Re : Groundwater Mounding Study
Proposed Development – 181 Toronto Street South, Uxbridge, Ontario**

Toronto Inspection Ltd. was authorized by Man Holdings Ltd. (the Client) to conduct a Groundwater Mounding Assessment at 181 Toronto Street South in Uxbridge, Ontario (hereinafter referred to as “the Site”).

1.1 Site Condition

The Site, approximately 0.52 ha in area and approximately parallelogram in shape, is located immediately east of Toronto Street South, west of Fred Barnaud Way, and approximately 50 m south of the intersection of these two roads.

The Site is currently vacant and covered by shrubs, trees, and vegetation. The Site gradually slopes upwards towards the northeast from 277 to 279 meters above sea level (masl).

The location of the Site is presented in **Figure 1**.

2.1 Infiltration Rate

A Low Impact Development (LID) consisting of an infiltration trench along the southern boundary is proposed at the Site. An unfactored infiltration rate of 61 mm/hr was recommended for the bottom of the LID as noted in the Infiltration Testing Program Report issued by Toronto Inspection Ltd. on August 25, 2023.

3.1 Groundwater Mounding

Groundwater mounding at the proposed LID location is of concern to nearby residents. As such a simulation of groundwater mounding beneath test pits 23TP-1 and 23TP-2 using the dimensions of the proposed LID, was conducted. The Hantush USGS spreadsheet as per the guidelines set out in the specific investigations report prepared by the USGS and altered by the Toronto and Region Conservation Authority in 2017 was used to evaluate the groundwater

mounding at the simulated LID for 24 hours using the 2-year and 100-year rainfall Storm Intensity Curves from Uxbridge, ON.

Based on the Site conditions the following assumptions were made for the Hantush analysis for groundwater mounding:

- The scenario considers the 2-year and 100-year storm event, which is approximately 58 mm and 128 mm of precipitation in 24 hours, respectively, based on the Intensity-Duration-Frequency (IDF) curves for Uxbridge (Ministry of Transportation, 2010). These values translate to a recharge rate of 0.058 m/day and 0.128 m/day for the 2-year and 100-year scenario, respectively.
- The specific yield was determined using values for predominantly sand and silty sand from analysis by Morris and Johnson in their 1967 paper.
- Estimates of hydraulic conductivity from each monitoring well were calculated using the Hvorslev (1951) method. A geomean of 7.7×10^{-7} m/s was used as the hydraulic conductivity as the screened soil type was representative of the soil at the proposed depth of the infiltration trench. The hydraulic conductivity analyses are attached in **Appendix A**.
- The duration of infiltration was based on the 24-hour precipitation from the IDF curves for Uxbridge, ON. An infiltration duration of 1 day was used.
- A groundwater level of 2.72 meters below ground surface (mbgs) was inferred based on hydrological data collected at 21BH-1 (MW) as the well is in close proximity to the proposed LID.
- The saturated thickness of the aquifer used was assumed to be 5 m based on mapping from the ORMGP at the location of the proposed LID, as well as borehole logs for the Site (**Appendix B**) and previous MECP Water Well Records near the Site.
- The groundwater mounding from the center of the infiltration trench for the 2-year and 100-year storm events are attached in **Appendix C**.

The following parameters were used in the mounding simulation for a 2-year storm event:

Parameter	Input Value
Recharge Rate	0.058 m/day
Specific Yield	0.250 (dimensionless)
Horizontal Hydraulic Conductivity	0.066 m/day
1/2 Length of Basin	9.9 m
1/2 Width of Basin	0.9 m
Duration of Infiltration	1 day
Initial Thickness of Saturated Zone	5.0 m

The result of the analysis for the 2-year storm event provided the following output:

Distance from Center of Infiltration Trench (m)	Groundwater Mounding (m)
0	0.15
1	0.15
2.5	0.15
5	0.15
7.5	0.14
10	0.07
12.5	0.00
15	0.00
17.5	0.00
20	0.00

The lowest finished grade of the LID is proposed to be 278.31 masl. Based on an inferred groundwater depth of 2.72 mbgs, the groundwater is simulated to mound to a depth of 2.57 mbgs, or 275.74 masl within the footprint of the simulated LID. The lowest elevation of the LID is proposed to be 277.05 masl which leaves a 1 m separation between the highest groundwater mound and the lowest infiltration trench invert.

The following parameters were used in the mounding simulation for a 100-year storm event:

Parameter	Input Value
Recharge Rate	0.128 m/day
Specific Yield	0.250 (dimensionless)
Horizontal Hydraulic Conductivity	0.066 m/day
1/2 Length of Basin	9.9 m
1/2 Width of Basin	0.9 m
Duration of Infiltration	1 day
Initial Thickness of Saturated Zone	5.0 m

The result of the analysis for the 100-year storm event provided the following output:

Distance from Center of Infiltration Trench (m)	Groundwater Mounding (m)
0	0.32
1	0.32
2.5	0.32
5	0.32
7.5	0.32
10	0.15
12.5	0.00
15	0.00
17.5	0.00
20	0.00

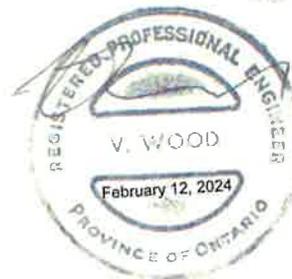
Based on an inferred groundwater depth of 2.72 mbgs, the groundwater is simulated to mound to a depth of 2.40 mbgs, or 275.91 masl within the footprint of the simulated LID. The lowest elevation of the LID is proposed to be 277.05 masl which leaves a 1 m separation between the highest groundwater mound and the lowest infiltration trench invert.

We trust this report meets your requirements, should you have any questions please do not hesitate to contact the undersigned.

Sincerely,
TORONTO INSPECTION LTD.



Sanjay Goel, B.E.S.
 Environmental Scientist
 Vice-President



Victor Wood, P.Eng.
 Principal Engineer



Toronto Inspection Ltd.

FIGURES



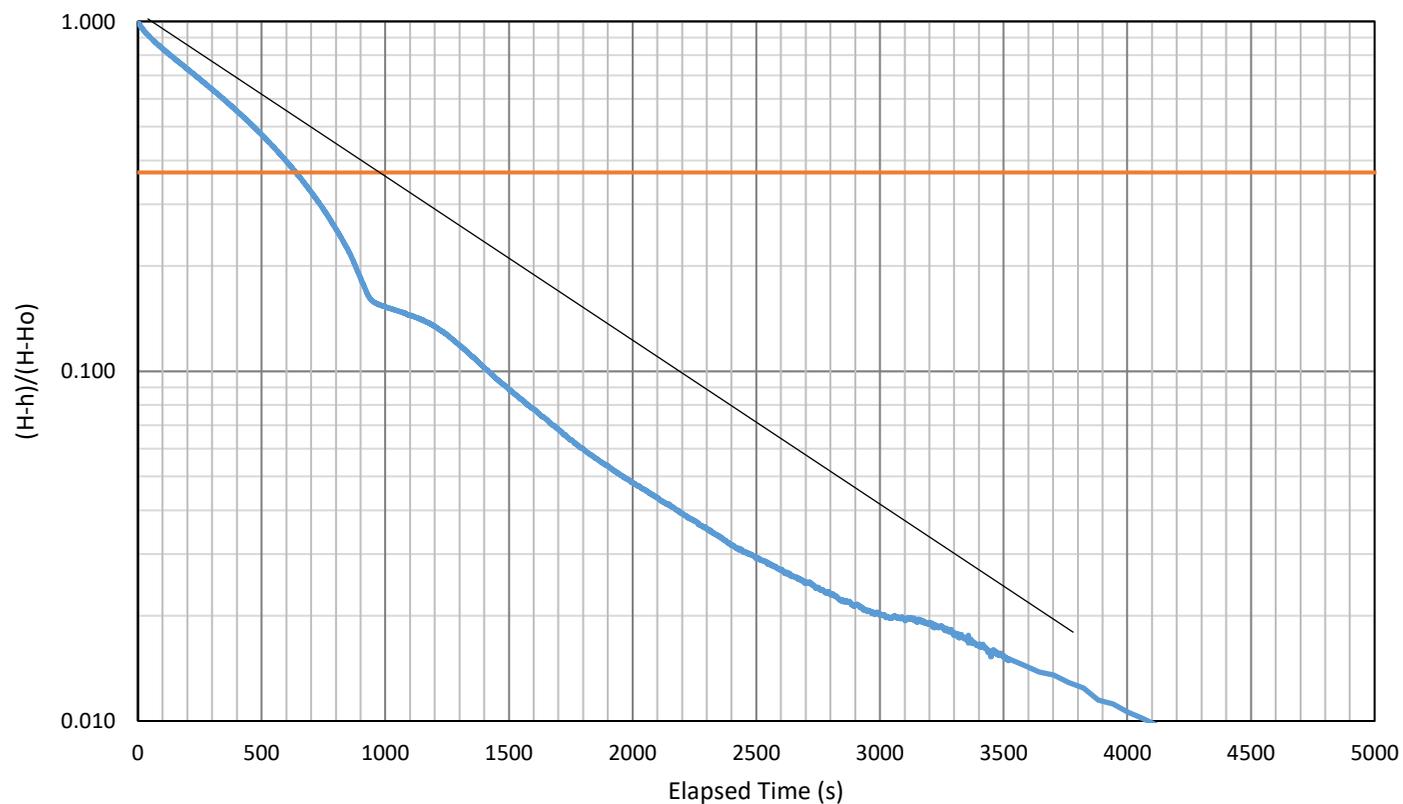
Toronto Inspection Ltd.

APPENDIX A

Hydraulic Conductivity Analysis

In-Situ Hydraulic Conductivity Analyses: 21BH-1(MW)

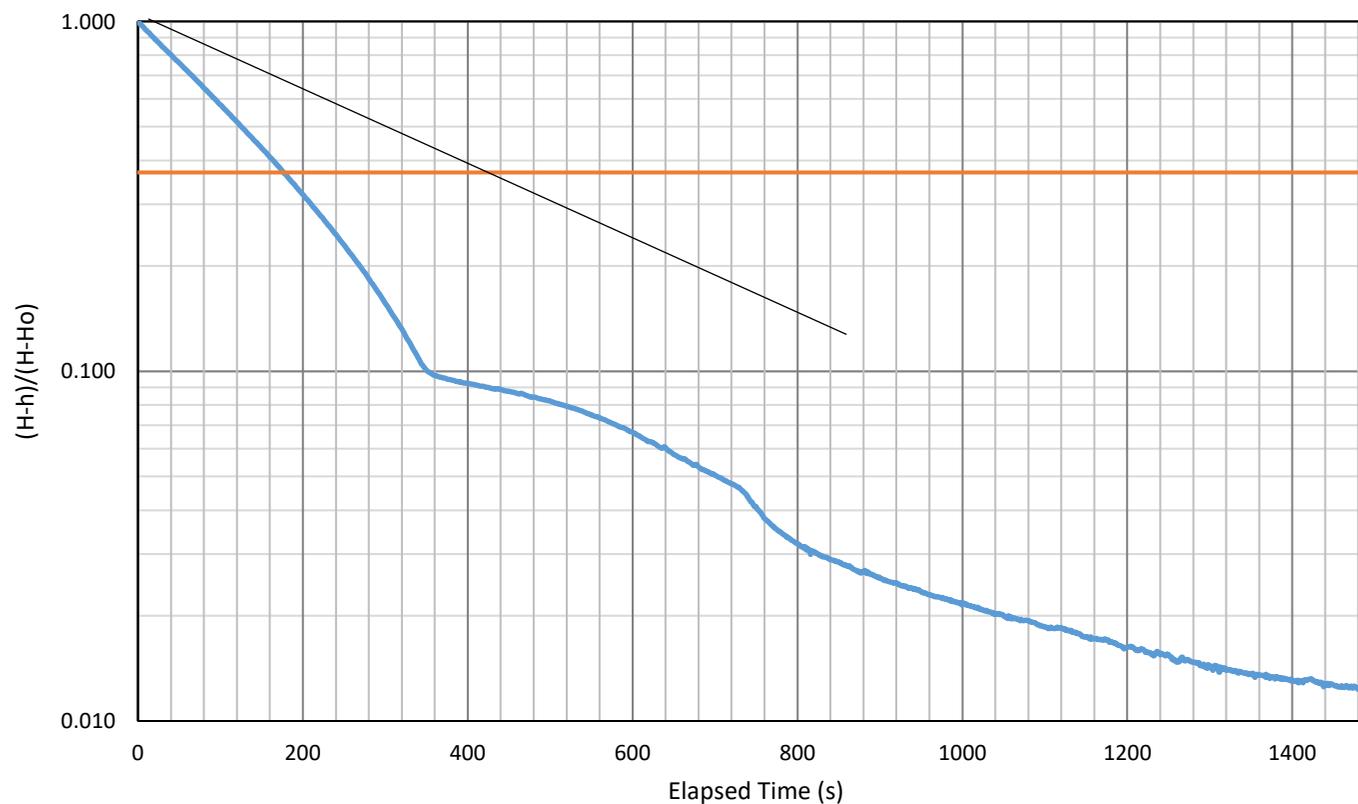
Company:	TIL
Client:	Man Holdings Ltd
Project:	5555
Location:	181 Toronto Street South, Uxbridge
Test Well:	21BH-1(MW)
Test Date:	October 29, 2021
Test Conducted By:	PG
Test Analyzed By:	YL



Effective Well Depth (mbgs):	6.10	Screened Unit:	Silty Sand
Initial Water Level (mbgs) (H):	2.92	Screen Length (m) (L_e):	1.524
Available Drawdown (m):	3.18	Head at Time = 0 (m) (H_o):	2.73
Borehole Radius (m) (R_b):	0.0762	Monitoring Well Radius (m) (R_c):	0.026
Solution Method:	Hvorslev (1951) ▼	Recovery (%):	66%
Early K (m/s)	NA	Early T_o (s):	NA
Mid K (m/s)	6.7E-07	Mid T_o (s):	950
Late K (m/s)	NA	Late T_o (s):	NA

In-Situ Hydraulic Conductivity Analyses: 21BH-4(MW)

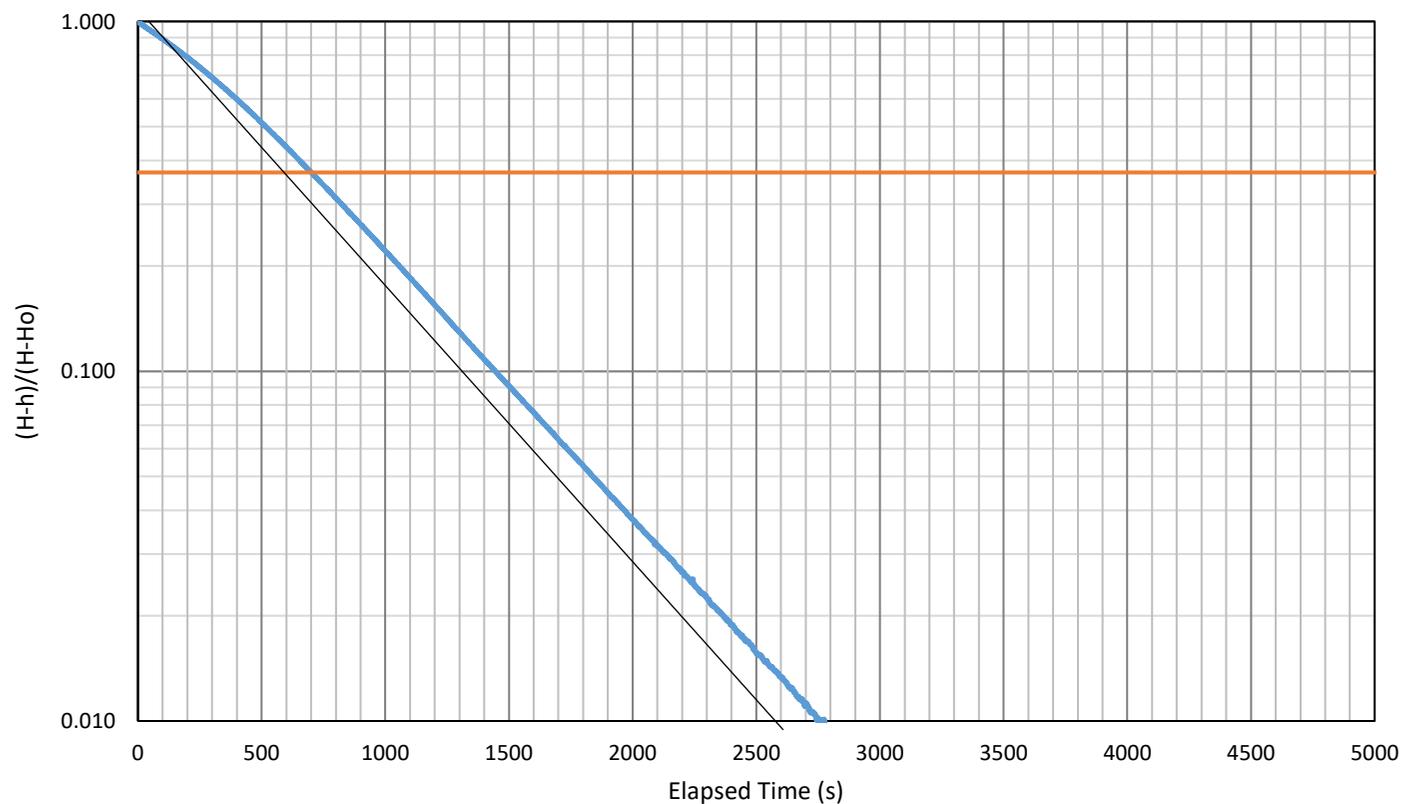
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Client:	Man Holdings Ltd
Project:	5555
Location:	181 Toronto Street South, Uxbridge
Test Well:	21BH-4(MW)
Test Date:	October 29, 2021
Test Conducted By:	PG
Test Analyzed By:	YL



Effective Well Depth (mbgs):	6.10	Screened Unit:	Sand
Initial Water Level (mbgs) (H):	2.82	Screen Length (m) (L_e):	3.048
Available Drawdown (m):	3.28	Head at Time = 0 (m) (H_o):	2.77
Borehole Radius (m) (R_b):	0.0762	Monitoring Well Radius (m) (R_c):	0.026
Solution Method:	Hvorslev (1951) ▼	Recovery (%):	66%
Early K (m/s)	NA	Early T_o (s):	NA
Mid K (m/s)	9.4E-07	Mid T_o (s):	420
Late K (m/s)	NA	Late T_o (s):	NA

In-Situ Hydraulic Conductivity Analyses: 21BH-8(MW)

Company:	TIL
Client:	Man Holdings Ltd
Project:	5555
Location:	181 Toronto Street South, Uxbridge
Test Well:	21BH-8(MW)
Test Date:	October 29, 2021
Test Conducted By:	PG
Test Analyzed By:	YL



Effective Well Depth (mbgs):	6.10	Screened Unit:	Silty Sand
Initial Water Level (mbgs) (H):	2.54	Screen Length (m) (L_e):	3.048
Available Drawdown (m):	3.56	Head at Time = 0 (m) (H_o):	3.26
Borehole Radius (m) (R_b):	0.0762	Monitoring Well Radius (m) (R_c):	0.026
Solution Method:	Hvorslev (1951) ▼	Recovery (%):	71%
Early K (m/s)	NA	Early T_o (s):	NA
Mid K (m/s)	7.2E-07	Mid T_o (s):	550
Late K (m/s)	NA	Late T_o (s):	NA



Toronto Inspection Ltd.

APPENDIX B

Borehole Logs

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



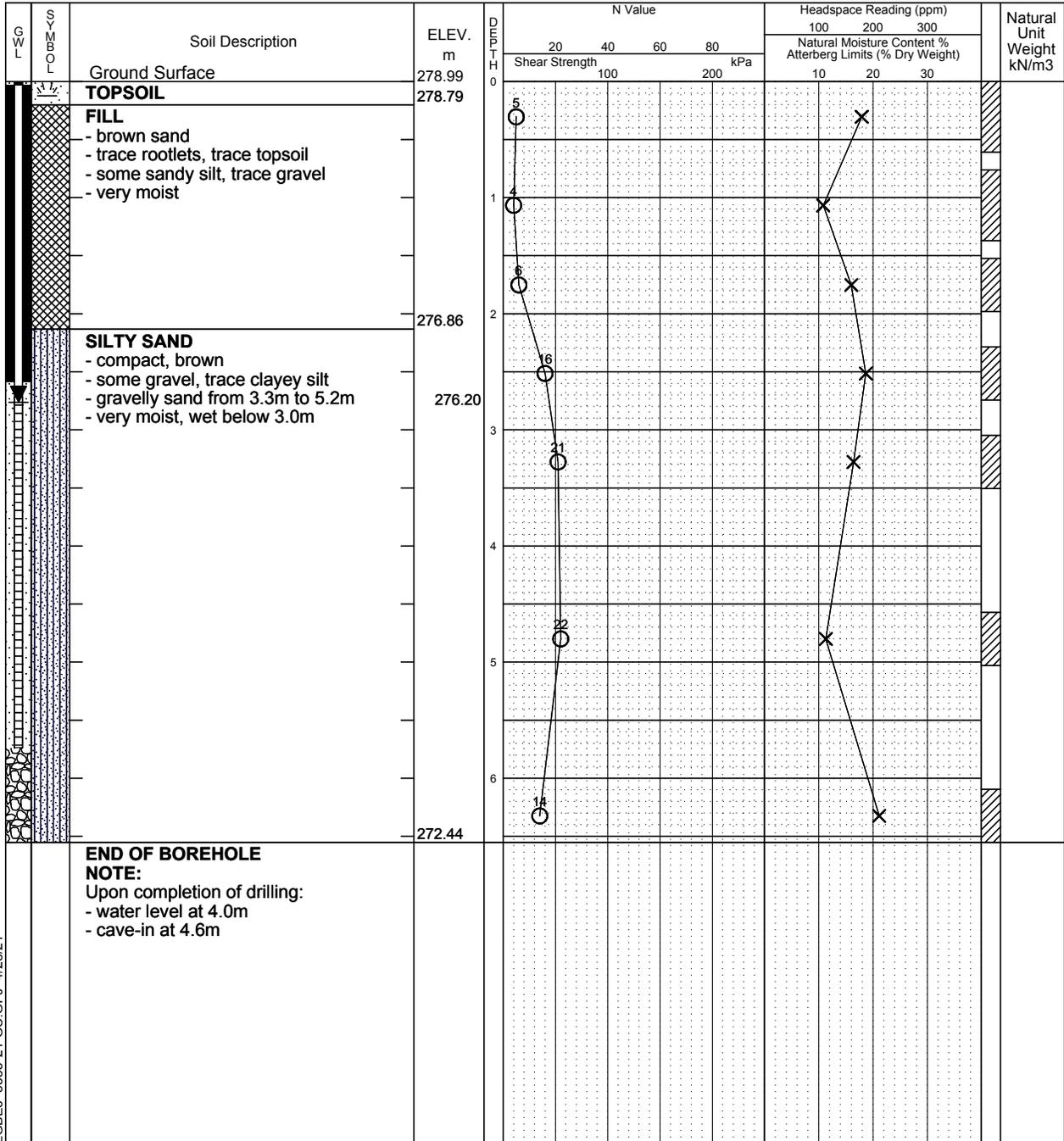
Field Vane Test



% Strain at Failure



Penetrometer



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
April 16, 2021	2.8m	

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



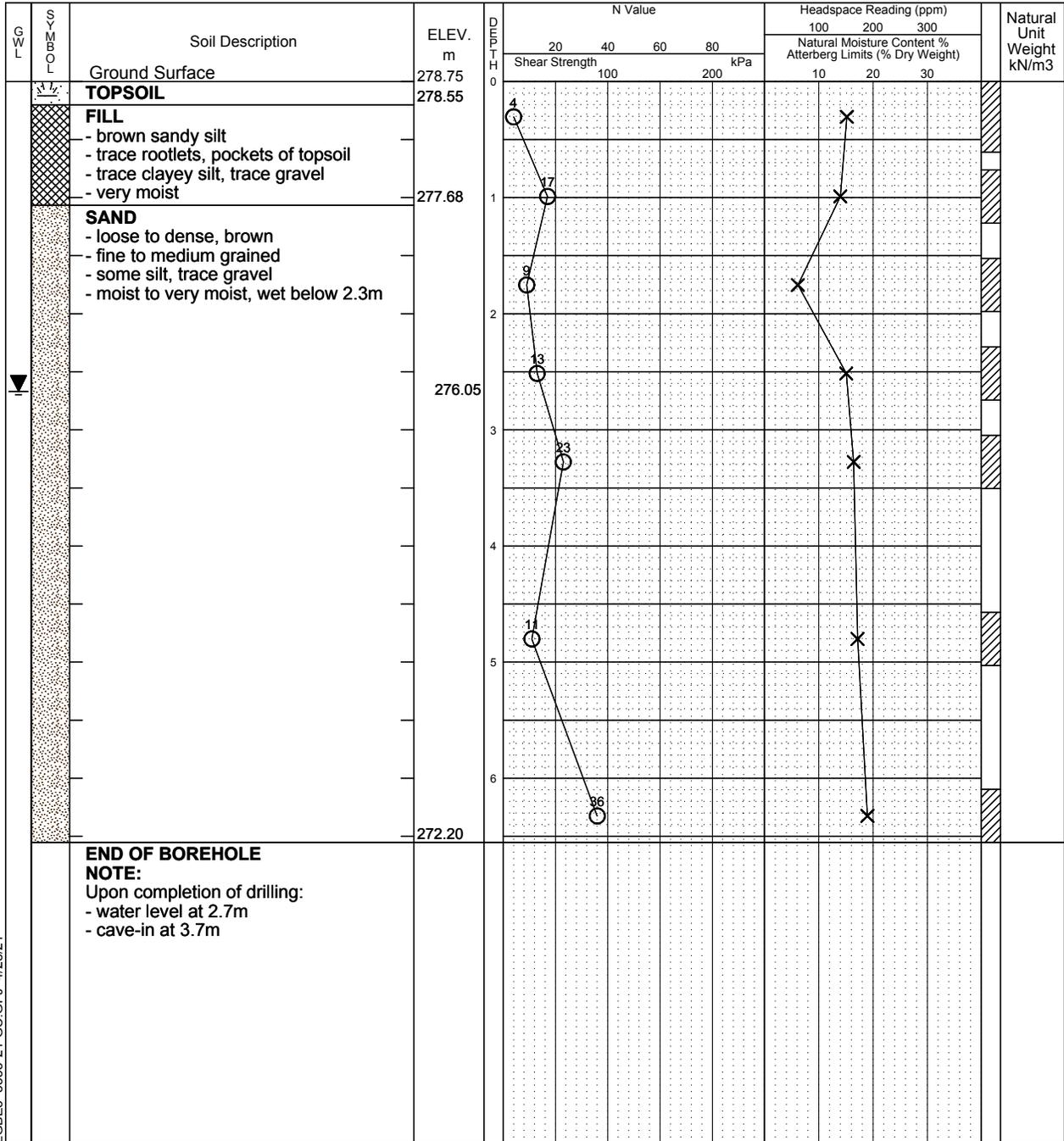
Field Vane Test



% Strain at Failure



Penetrometer



LGBE3 5555-21-GC.GPJ 4/28/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



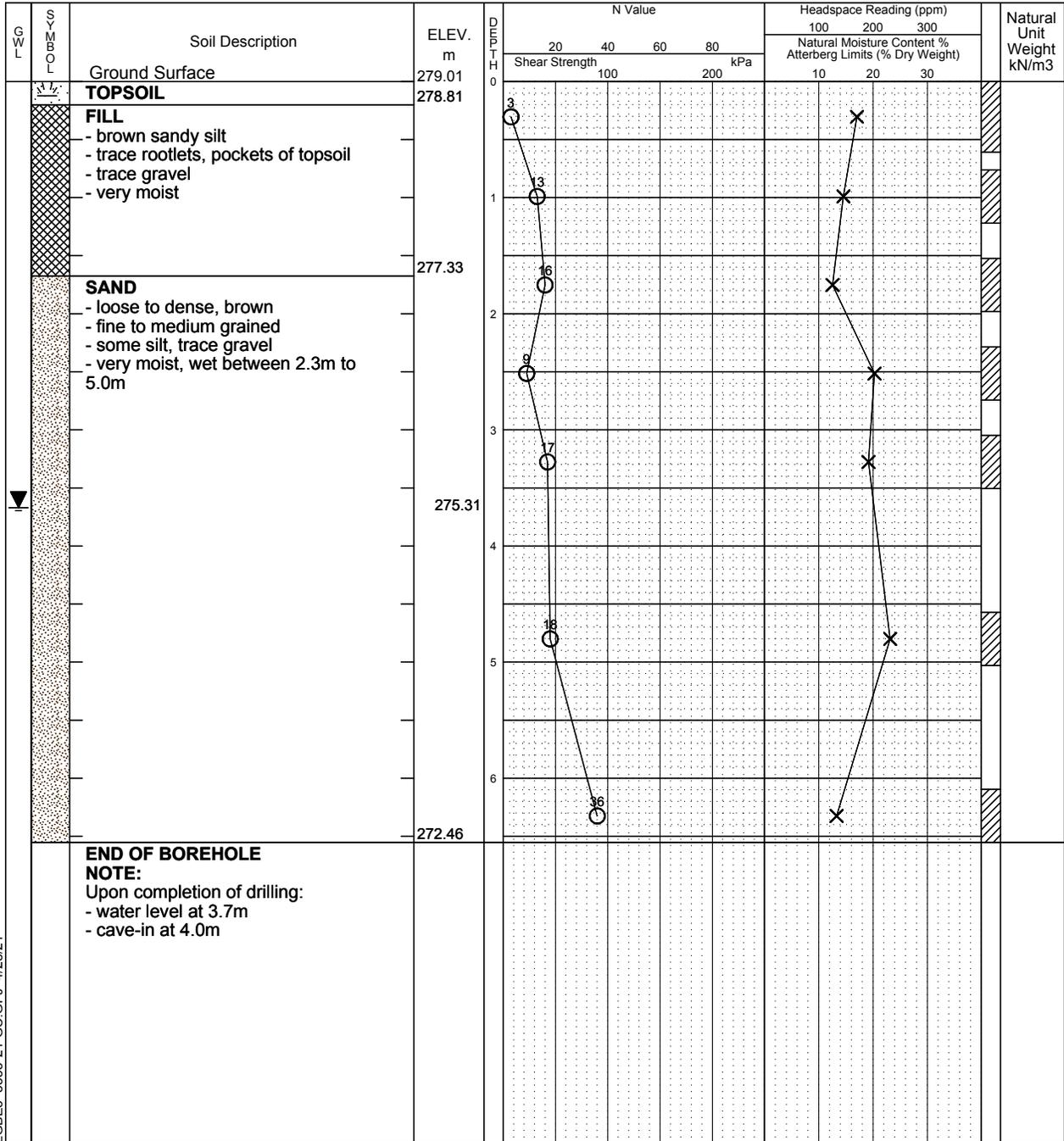
Field Vane Test



% Strain at Failure



Penetrometer



LGBE3 5555-21-GC.GPJ 4/28/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Date Drilled: 4/9/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



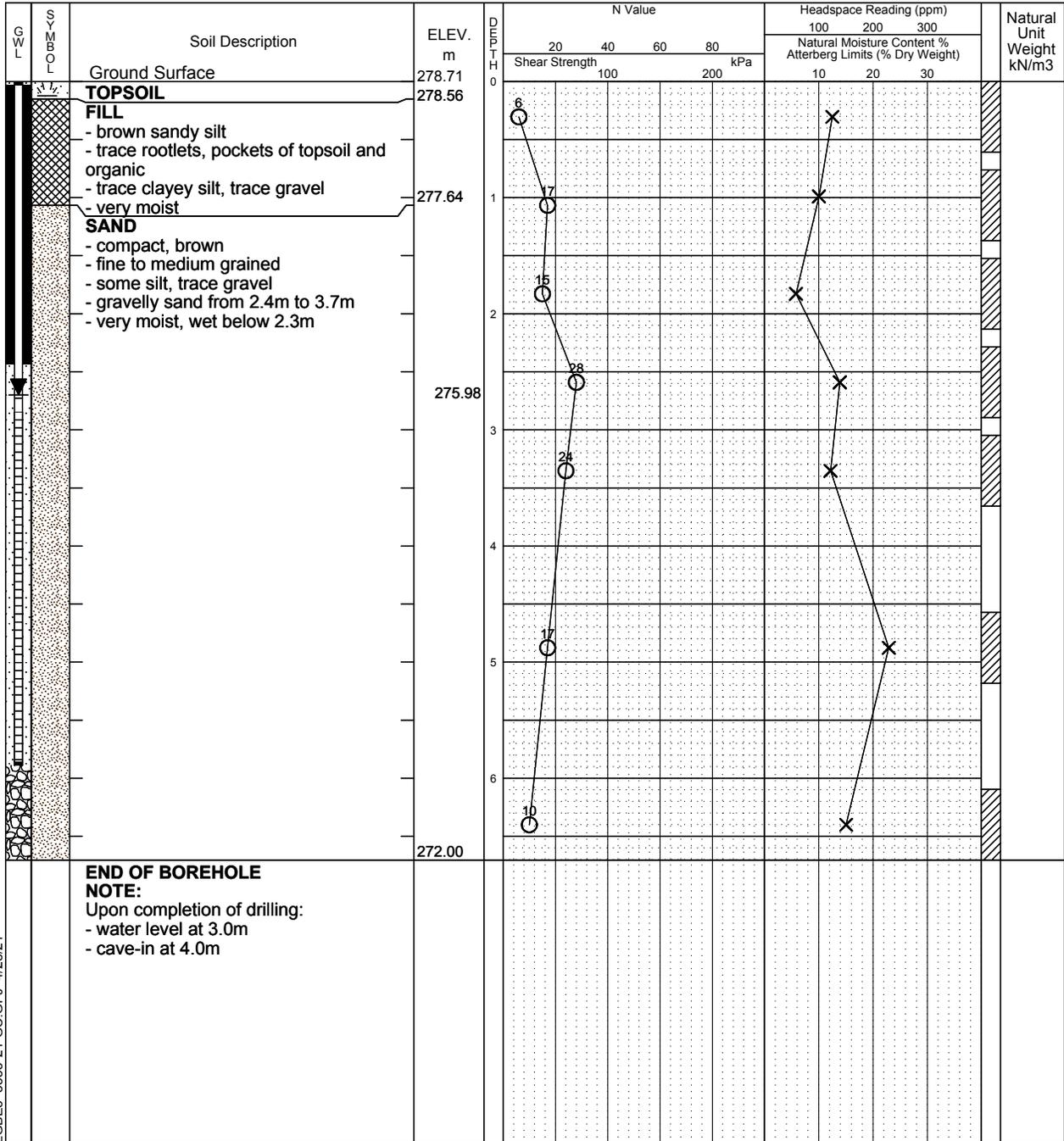
Field Vane Test



% Strain at Failure



Penetrometer



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Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
April 16, 2021	2.7m	

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



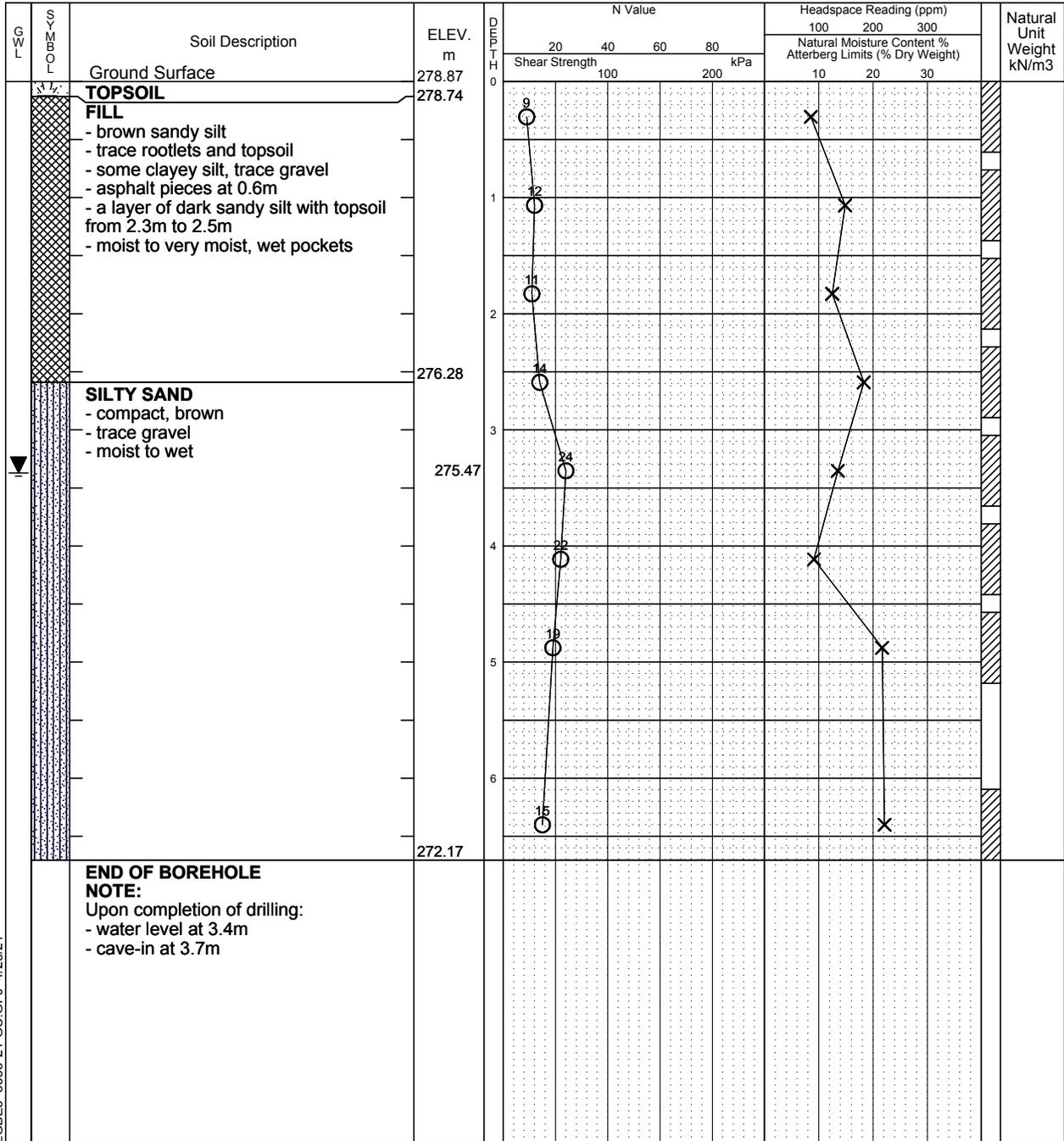
Field Vane Test



% Strain at Failure



Penetrometer



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Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Date Drilled: 4/9/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



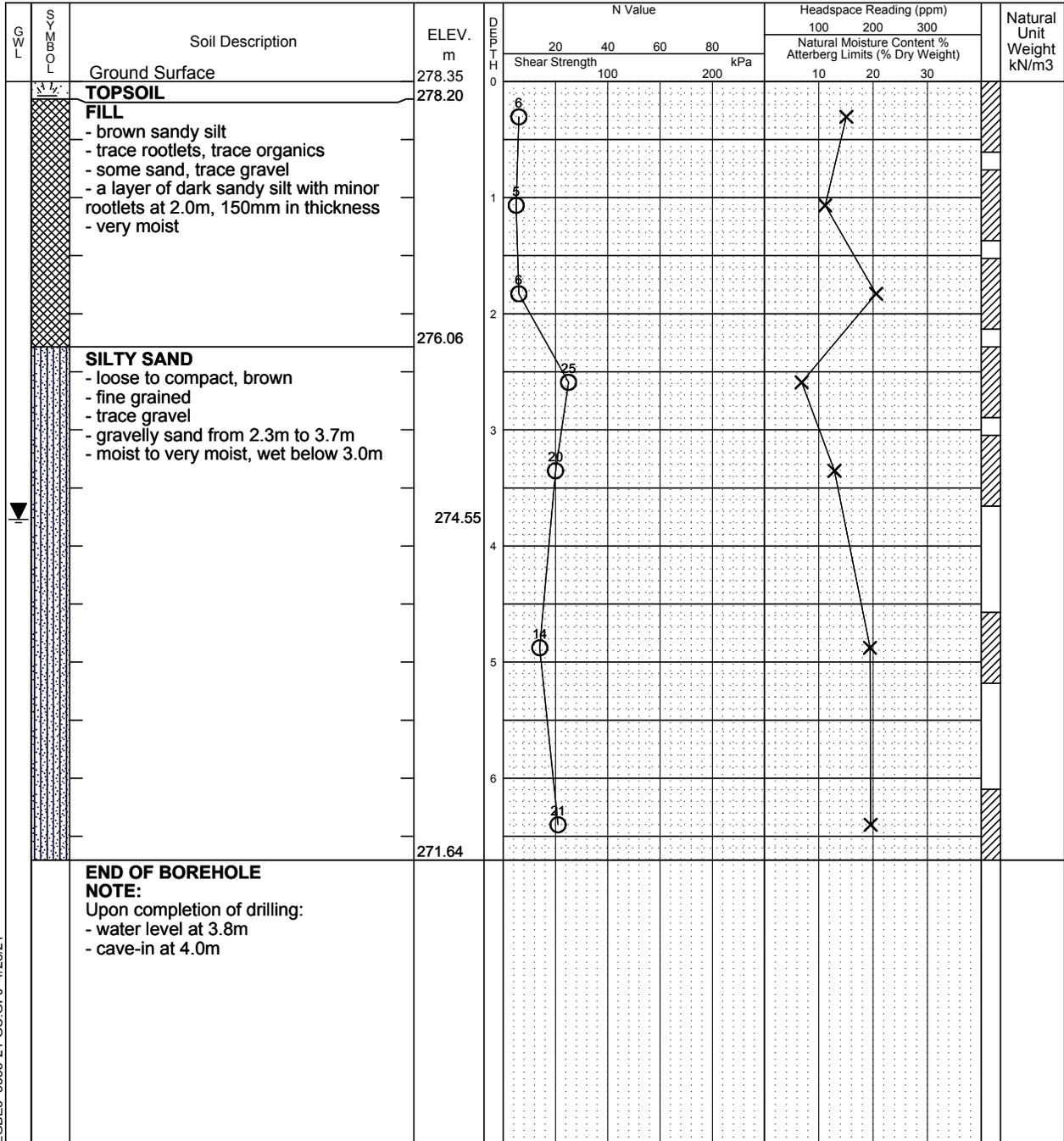
Field Vane Test



% Strain at Failure



Penetrometer



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Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



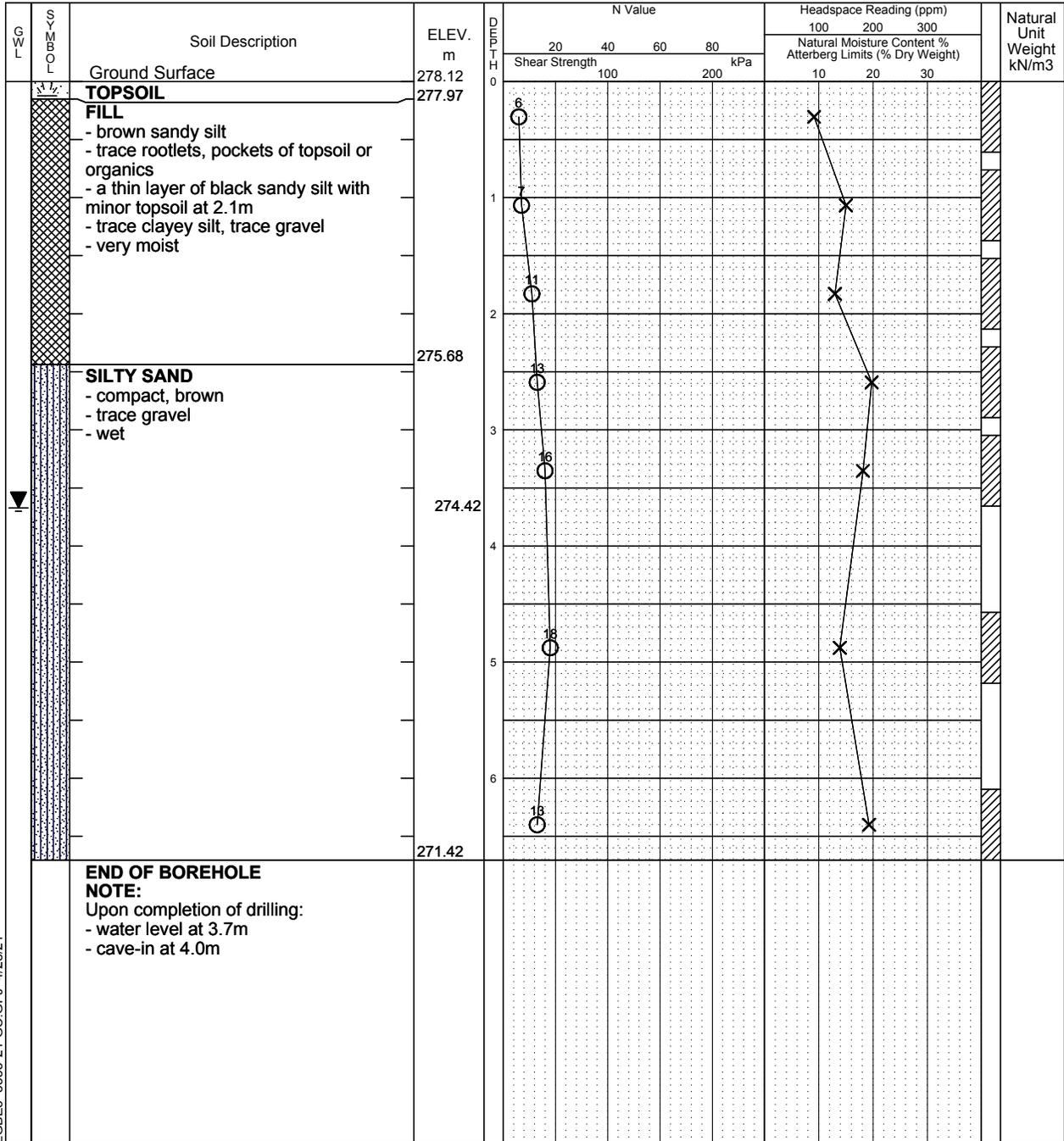
Field Vane Test



% Strain at Failure



Penetrometer



LGBE3 5555-21-GC.GPJ 4/28/21

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Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Date Drilled: 4/8/21

Auger Sample



Headspace Reading (ppm)



Drill Type: Track Mounted Drill Rig

SPT (N) Value



Natural Moisture



Datum: Geodetic

Dynamic Cone Test



Plastic and Liquid Limit



Shelby Tube



Unconfined Compression



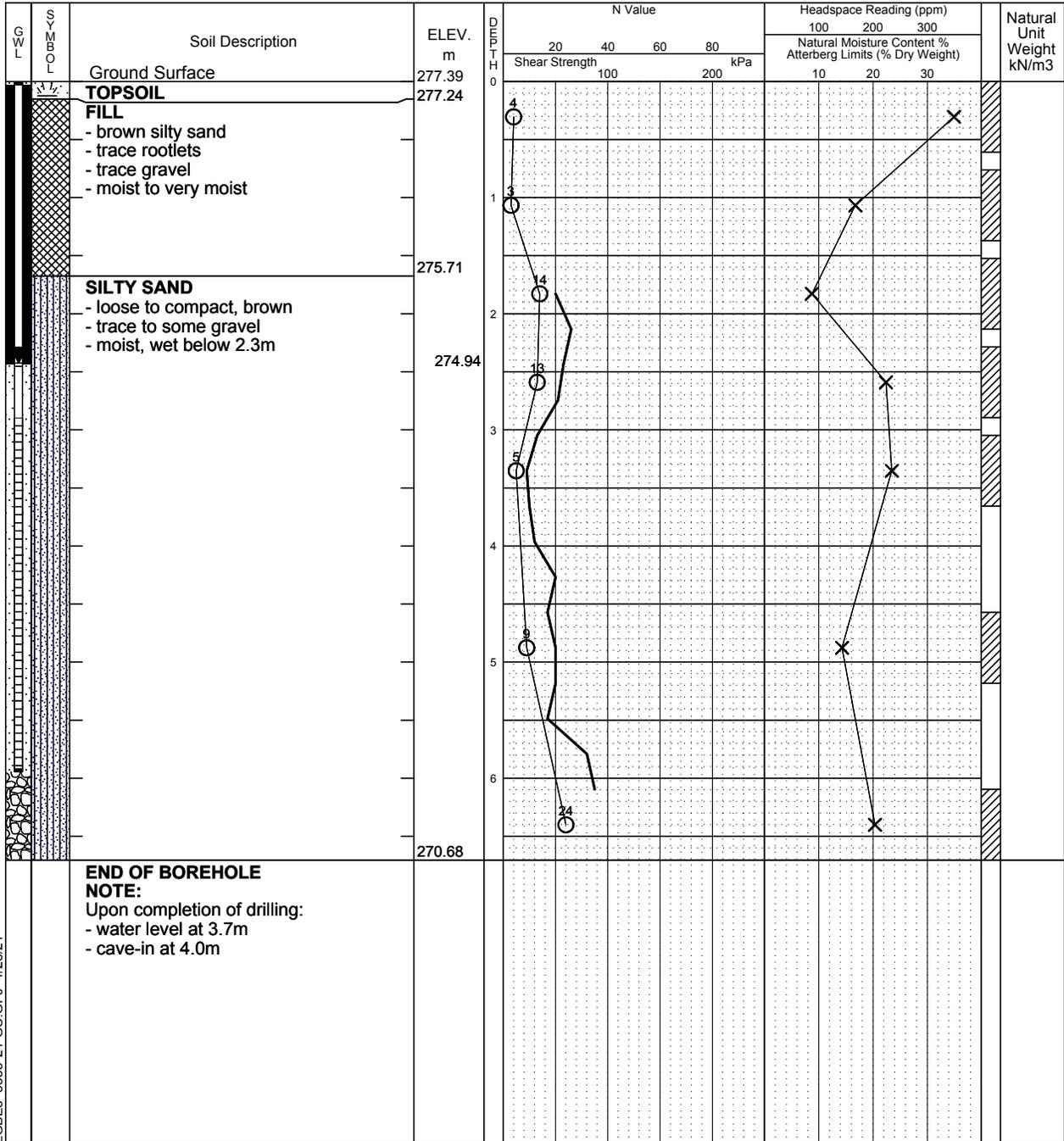
Field Vane Test



% Strain at Failure



Penetrometer



NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)
April 16, 2021	2.4m	

Project No. 5555-21-GC

Log of Borehole 21P-1

Dwg No. 10

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 181 Toronto Street South, Uxbridge, Ontario

Date Drilled: 4/9/21

Auger Sample

Headspace Reading (ppm) ●

SPT (N) Value ○

Natural Moisture X

Dynamic Cone Test

Plastic and Liquid Limit

Shelby Tube

Unconfined Compression

Field Vane Test

% Strain at Failure ⊗

Penetrometer ▲

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

G W L	SOIL LOG	Soil Description	ELEV. m	D I P T H m	N Value				Headspace Reading (ppm)			Natural Unit Weight kN/m ³	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					20	40	60	80	100	200	300		10
		Ground Surface NO SAMPLING	278.54	0									
			277.32	1									
		SAND - loose, brown - fine to medium grained - gravelly - trace silt - moist END OF BOREHOLE NOTE: Upon completion of drilling:	276.87	5					X				

LGBE3 5555-21-GC.GPJ 4/28/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)

Project No. 5555-21-GC

Log of Borehole 21P-2

Dwg No. 11

Project: Geotechnical Investigation

Sheet No. 1 of 1

Location: 181 Toronto Street South, Uxbridge, Ontario

Date Drilled: 4/8/21

Auger Sample

Headspace Reading (ppm) ●

SPT (N) Value ○

Natural Moisture X

Dynamic Cone Test —

Plastic and Liquid Limit ———

Shelby Tube ■

Unconfined Compression ⊗

Field Vane Test ⚡

% Strain at Failure ⊗

Penetrometer ▲

Drill Type: Track Mounted Drill Rig

Datum: Geodetic

G W L	SOIL LOG	Soil Description	ELEV. m	D E P T H m	N Value				Headspace Reading (ppm)			Natural Unit Weight kN/m ³	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					20	40	60	80	100	200	300		10
		Ground Surface NO SAMPLING	277.72	0									
			275.89	1									
		SAND - dense, brown - some gravel, some silt - moist	275.43	2					34			X	
		END OF BOREHOLE NOTE: Upon completion of drilling:											

LGBE3 5555-21-GC.GPJ 4/28/21

NOTE: THE BOREHOLE DATA NEEDS INTERPRETATION ASSISTANCE BY TORONTO INSPECTION LTD. BEFORE USE BY OTHERS

Toronto Inspection Ltd.

Time	Water Level (m)	Depth to Cave (m)



Toronto Inspection Ltd.

APPENDIX C

Groundwater Mounding Curves

2-year Storm Event

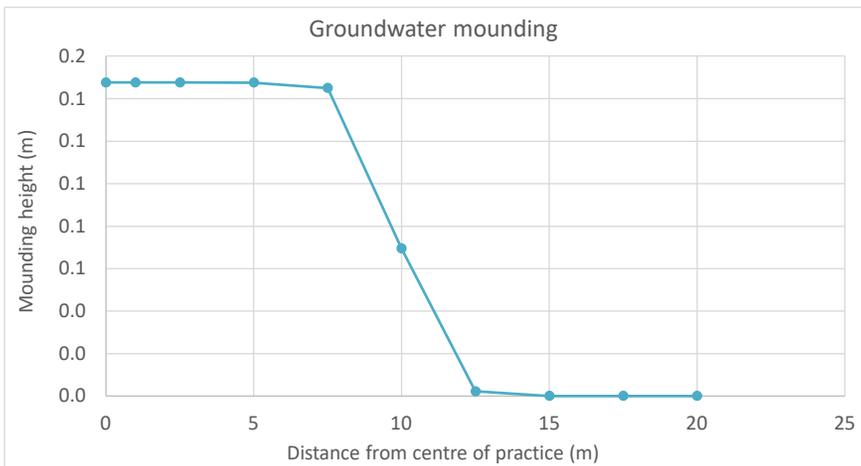
This spreadsheet will calculate the height of a groundwater mound beneath an stormwater infiltration BMP.

More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102

"Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

[Go to the USGS report](#)

Input Values		
Recharge (infiltration) rate (m/day)	0.058	R
Specific yield, S_y (dimensionless)	0.250	S_y
Horizontal hydraulic conductivity, K_h (m/day)	0.066000	K_h
1/2 length of basin (x direction, in m)	9.9	x
1/2 width of basin (y direction, in m)	0.9	y
Duration of infiltration period (days)	1	t
Initial thickness of saturated zone (m)	5.0	$h_i(0)$



Distance from center of infiltration BMP (m)	Ground-water mounding (m)
0	0.15
1	0.15
2.5	0.15
5	0.15
7.5	0.14
10	0.07
12.5	0.00
15	0.00
17.5	0.00
20	0.00

IF YOU CHANGE THE SCALE OF THE DISTANCE MEASUREMENTS (OR ANY OTHER PARAMETER), YOU MUST RECALCULATE!!

100-year Storm Event

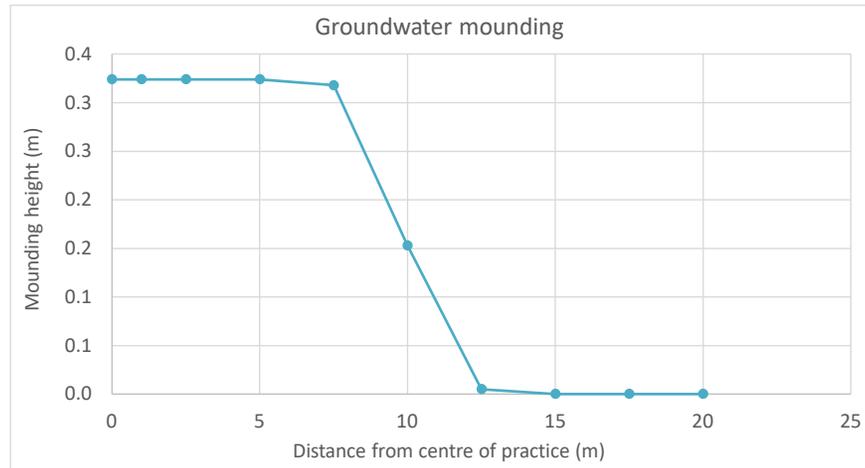
This spreadsheet will calculate the height of a groundwater mound beneath an stormwater infiltration BMP.

More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102

"Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

[Go to the USGS report](#)

Input Values		
Recharge (infiltration) rate (m/day)	0.128	R
Specific yield, S_y (dimensionless)	0.250	S_y
Horizontal hydraulic conductivity, K_h (m/day)	0.066000	K_h
1/2 length of basin (x direction, in m)	9.9	x
1/2 width of basin (y direction, in m)	0.9	y
Duration of infiltration period (days)	1	t
Initial thickness of saturated zone (m)	5.0	$h_i(0)$



Distance from center of infiltration BMP (m)	Ground-water mounding (m)
0	0.32
1	0.32
2.5	0.32
5	0.32
7.5	0.32
10	0.15
12.5	0.00
15	0.00
17.5	0.00
20	0.00

**IF YOU CHANGE THE SCALE OF THE
 DISTANCE MEASUREMENTS
 (OR ANY OTHER PARAMETER),
 YOU MUST RECALCULATE!!**