

Hydrogeological Assessment - 1854 Liverpool Road, Pickering, Ontario



2019-07-31

Prepared for:
Grant Morris Associates Ltd. on behalf of Mr.
Alireza Adjedani

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1.0 INTRODUCTION

Cambium Inc. (Cambium) was retained by Grant Morris Associates Ltd. on behalf of Mr. Alireza Adjedani (Client) to complete a hydrogeological assessment in support of the design and construction of 16-storey mixed use building located at 1854 and 1858 Liverpool Road in Pickering, Ontario (Site).

The City of Pickering requested that a Hydrogeological Study be prepared for the proposed development. The Hydrogeological Assessment characterizes the on-site conditions, based on the geotechnical investigation completed by Cambium, as well as provide dewatering calculations for the required excavation of the subsurface levels in the proposed building.

1.1 Site Description

The Site is located approximately 200 m north of intersection of Kingston Road and Liverpool Road in Pickering, Ontario. The proposed development area encompasses two single dwelling residential properties, identified as 1854 and 1858 Liverpool Road. The Site is located in a fairly developed area of the City, surrounding by single dwelling residential properties with large commercial properties nearby. The area is municipally serviced for water and wastewater. The Site is relatively flat, with no more than 1 m of elevation variance in surface elevation across the properties.



2.0 METHODOLOGY

2.1 Drilling Program

As part of the geotechnical investigation undertaken by Cambium, a drilling program was completed at the Site on June 7, 2019. A total of three boreholes, designated as BH (MW)101-19 through BH (MW)103-19, were advanced into the subsurface throughout the Site. BH101-19 and BH102-19 were terminated at depths of 14.2 m below ground surface (bmgs). BH103-19 was terminated at depth of 12.6 mbgs. One additional borehole (BH104-19) was advanced on July 3 to confirm the bedrock surface elevation and bedrock composition. The location of the boreholes was obtained from a handheld GPS unit while the elevation of the boreholes was surveyed relative to BM (porch at the front door of the existing house). The elevation of the top of porch at the northeast corner has a geodetic elevation of 89.671 masl according to the survey plan provided by the client. A Site Plan, including borehole locations and benchmark is appended as Figure 1 of this report.

Drilling and sampling was completed using a track-mounted drill rig operating under the supervision of a Cambium technician. The boreholes were advanced to the sampling depths by means of continuous flight solid or hollow stem augers with 50 mm O.D. split spoon samplers. Soil samples were collected at approximately 0.75 m intervals in the upper 3.0 m depth and in 1.5 m intervals below 3.0 m depth. Bedrock coring involved one 1.5 m long rock core obtained from borehole BH104-19 using a 63.5 mm diameter HQ diamond core rock sampler to assess the quality of the bedrock on-site. The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage.

Open boreholes were checked for groundwater and general stability prior to backfilling. Borehole BH101-19, BH102-19 and BH103-19 were outfitted as monitoring wells in order to understand the groundwater conditions at the site. All other boreholes were backfilled and sealed in accordance with Ontario Regulation (O.Reg.) 903, as amended, and the property was reinstated to pre-existing conditions.

Borehole logs are provided in Appendix A.



2.2 Physical Laboratory Testing

Physical laboratory testing, including five particle size distribution analyses (LS-702,705) and testing results are presented in Appendix B and are discussed in Section 3.0.

3.0 Geological and Hydrogeological Setting

The Site is located in the physiographic region known as the Iroquois Plain. The Iroquois Plain extends around the western part of Lake Ontario from the Niagara River to the Trent River. Specifically, in the area of the Site, the Iroquois Plain is identified by a mosaic of sandy off-shore deposits, till plans, drumlins and areas of silty lacustrine deposits (Chapman, L.J. and D.F. Putnam, 1984).

According to Map 2556 of the Ontario Geological Survey (Barnett, P.J., Cowan, W.R. and Henry, A.P., 1991), the following soils are located in the in the area of the Site:

- Lacustrine deposits, silt and clay, minor sand; basin and quiet water deposits.
- Glaciolactustrine deposits, sand, gravelly sand gravel; nearshore and beach deposits.

According to the *Bedrock Geology of Ontario, southern sheet*, Ontario Geological Survey, Map 2544, scale 1:1 000 000 (Ontario Geological Survey, 1991), the bedrock in the area of the Site consists of shale, limestone, dolostone and silt stone of the Georgian Bay Formation, Blue Mountain Formation, Billings Formation, Collingwood Member and Eastview Member.

3.1 Subsurface Investigation

The results of the geotechnical investigation indicate that the subsurface conditions generally range from clayey silt to silty sand deposits, underlain by sandy silt till. Borehole logs are included in Appendix A and locations are indicated on Figure 1.

Bedrock was encountered at a depth of 16.1 mBGS in BH104-19 and consisted of shale and interbedded shale and limestone. Borehole BH104-19 was augered to bedrock refusal at a depth of 22.3 mbgs and was cored 1.5 m into competent bedrock. The upper 0.3 m of core recovered has a grey, soft, crumbly appearance, with some soil obtained from within fractures and fissures in the rock.

3.2 Grain Size Analyses and Hydraulic Conductivity Estimation

Laboratory grain size distribution analyses were completed on samples collected from boreholes MW101-1, MW102-19 and MW103-19. A summary of the grain size analyses results is outlined below in Table 1.

Table 1 Grain Size Analysis Results

Borehole	Depth (mbgs)	Material	%Gravel	%Sand	%Silt	%Clay	Puckett Method K (m/s)
MW101-19	1.4 – 2.0	Silty clay, trace sand	0	1	56	43	8.94×10^{-9}
MW101-19	9.2 – 9.8	Sand and silt, trace clay & gravel	4	54	37	5	1.62×10^{-5}
MW102-19	13.6 – 14.2	Silty sand, some gravel & clay	16	41	33	10	6.05×10^{-6}
MW103-19	0.8 – 1.4	Silty clay	0	1	62	37	2.92×10^{-8}
MW103-19	4.6 – 5.2	Gravelly sand, some silt, trace clay	26	50	15	9	7.37×10^{-6}

3.3 Regulated Areas

The Ministry of Environment, Conservation and Parks' (MECP) Source Protection Information Atlas (SPIA) indicates that the Site is not within a regulated area for source water protection.

3.4 Water Well Records

The area that the Site is located is municipally serviced. The MECP's Water Well Information System (WWIS) was accessed to review water well records located within 250 m of the Site. All of the well records in the vicinity of the Site are generally for decommissioned wells (6 wells) or historical well records (2 wells). The two historical well records were both dated in the 1960's for shallow, large diameter water wells 7.3 to 8.2 mBGS. Both wells encountered a water bearing coarse sand unit, which was between various clay layers. Static water levels were 3 to 6 mBGS, with a rated well yield of 1 gpm.

3.5 Hydrogeological Conditions

Three groundwater monitoring wells were installed on the Site, into saturated overburden deposits which would be defined as the shallow aquifer system or the water table. During



drilling, water levels were measured at depths of 3.3 m to 6.1 m below ground surface as listed on Table 2 below. The stabilized groundwater levels observed in the monitoring wells on June 13, 2019 were at depths ranging from 2.3 mbgs to 3.3 mbgs, corresponding to elevations from 86.6 masl to 87.6 masl, as shown on Figure 1.

Table 2 Groundwater Levels Observed in Boreholes

Borehole	Date of Drilling	Date of Observation	Depth of Groundwater (mbgs)	Notes
MW101-19	June 06, 2019	June 06, 2019	6.1	During drilling Monitoring Well
		June 13, 2019	3.3	
MW102-19	June 06, 2019	June 06, 2019	3.3	During drilling Monitoring Well
		June 13, 2019	3.0	
MW103-19	June 07, 2019	June 07, 2019	3.6	During drilling Monitoring Well
		June 13, 2019	2.3	
BH104-19	July 03, 2019	July 03, 2019	3.6	During drilling

Groundwater flow in the shallow overburden aquifer is towards the south, and ultimately towards Lake Ontario.



4.0 Hydrogeological Assessment

4.1 Dewatering

As discussed in the previous section, groundwater was observed in all three monitoring wells at depths ranging between 2.3 mbgs and 3.3 mbgs. Excavations below this depth will likely require dewatering as the water bearing units encountered consist of sand and silt to silty sand deposits, with an estimated hydraulic conductivity of 1.62×10^{-5} to 6.05×10^{-6} m/s.

It is understood that the proposed development will include two subsurface based levels to a depth of 10.4 mBGS (34 feet). As such, a dewatering system will be required to depress the groundwater level below the excavation bases during construction and for the permanent dewatering of the subsurface levels in the building design.

Groundwater inflow was estimated by using the methods outlined in the text titled Construction Dewatering and Groundwater Control (J.P.Powers, 2007). Calculations are included in Appendix C. The lowest hydraulic conductivity estimate and the highest hydraulic conductivity estimate (both derived from the Puckett Method and grain size analysis) were included as part of the calculations to establish a range of results.

Groundwater inflow into the excavation was estimated to range between 5 m³/day and 57 m³/day.

Groundwater inflow into the excavation for the proposed building is estimated to range between 72 m³/day and 159 m³/day.

Based on the depth of excavation, significant volumes of water will have to be dewatered, requiring registration on the Environmental Activity and Sector Registry (EASR) for the construction of the building and the application for a Category 3 Permit to Take Water (PTTW) from the Ministry of the Environment Conservation and Parks (MOECP) for the permanent dewatering of the subsurface levels.



4.2 Zone of Influence

The dewatering calculations include estimates of the horizontal distance away from the walls of the excavation where the influence of water withdrawal will be negligible (i.e., the length to zero drawdown (Kyrieleis, W., Sichardt, W, 1930)).

The length to zero drawdown from the excavation for the foundation is estimated to be, at a maximum, 368 m. The area included within the length of zero drawdown from the excavation is known as the zone of influence (ZOI).

The area of the Site is highly developed with various residential and commercial structures and is municipally serviced for water and wastewater. There are no water supply wells in the zone of influence of the excavation. As such, there will be no impacts to surrounding water supply wells as a result of the proposed development.

There is a natural watercourse located approximately 400 m to the west from the excavation. It is unknown if the watercourse is sustained by groundwater baseflow, however considering the extent of existing urbanization adjacent to the watercourse, it is assumed that it is not likely sustained by baseflow in this area. Considering the distance of the watercourse from the Site is outside the calculated maximum zone of influence, and the amount of existing urban development in between the watercourse and the Site, it is anticipated that there will be no changes in water flow nor impacts to the watercourse as a result of the proposed development.



5.0 CLOSING

Please note that this report is governed by the attached qualifications and limitations. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at 705-742-7900.

Cambium Inc.



Kevin Warner, M.Sc., P.Geo (Ltd)
Senior Hydrogeologist

KDW/kdw

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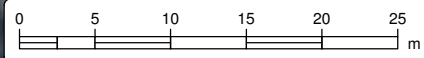
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Appended Figures

O:\GIS\project_LMC\8800 to 8999\8960-001 Grant Morris Associates Ltd. - Geo-Environmental Studies - 1854 Liverpool Road\2019\07-31 FIG 1 Site Plan.mxd



HYDROGEOLOGIC ASSESSMENT
GRANT MORRIS ASSOCIATES LTD
 1854 Liverpool Road,
 Pickering, Ontario

- LEGEND**
- Benchmark
 - Borehole
 - Monitoring Well (June 13, 2019)
 - Subject Property

Notes:

- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

Benchmark:
 BM - Top nut of a fire hydrant located on the west side of Liverpool Road, to the south-west of the subject property.



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SITE PLAN

Project No.:	8960-001	Date:	July 2019
Scale:	1:500	Rev.:	
Created by:	MAT	Projection:	NAD 1983 UTM Zone 17N
Checked by:	ZL	Figure:	1



Appendix A

Borehole Logs

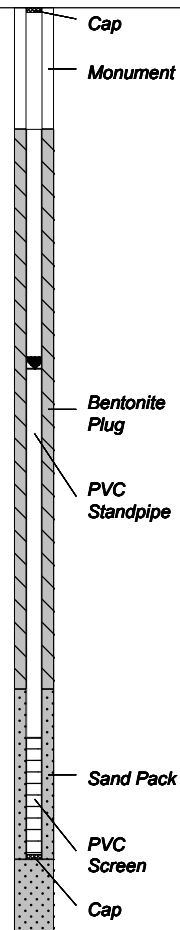


Client: Grant Morris Associates Ltd.
Contractor: Drilltech
Location: 1854 Liverpool Road

Project Name: Geotechnical Drilling
Method: Solid Stem Auger
UTM: 17 T 653446 m E 4855555 m N

Project No.: 8960-001
Date Completed: June 6, 2019
Elevation: 89.32 masl

SUBSURFACE PROFILE			SAMPLE												
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture			SPT (N) / DCPT			Well Installation	Remarks
								25	50	75	10	20	30		
89.32	0	TOPSOIL: 330 mm thickness		1A	SS	83	3								
89.0	0.33			1B	SS	83	3								
88.5	0.83	SILT AND CLAY: Light brown, silt and clay, trace sand, trace organics, about plastic limit, firm		2	SS	87	9								
88.0	1.33	-no organics, stiff		3	SS	100	10								
87.5	1.83	SILTY CLAY: Light brown, silty clay, about plastic limit, firm		4	SS	63	6								
87.0	2.33	-some sand, trace gravel, about plastic limit, stiff		5	SS	83	12								
86.5	2.83	SILT AND CLAY: Grey, silt and clay, trace sand, trace gravel, about plastic limit, very stiff		6	SS	58	17								
86.0	3.33	SILTY CLAY: Light brown, silty clay, some sand, wetter than plastic limit, very soft to soft		7	SS	0	2								
85.5	3.83	SAND AND SILT: Grey, sand and silt, trace clay, trace gravel, saturated, very loose		8	SS	17	1								
85.0	4.33														
84.5	4.83														
84.0	5.33														
83.5	5.83														
83.0	6.33														
82.5	6.83														
82.0	7.33														
81.5	7.83														
81.0	8.33														
80.5	8.83														
80.0	9.33														
79.5	9.83														
79.0	10.33														
78.5	10.83														
78.0	11.33														
77.5	11.83														
77.0	12.33														
76.5	12.83														
76.0	13.33														
75.5	13.83														
75.0	14.33														
75.0	14.33		Borehole terminated at 14.2 mbgs in silty sand												



GSA SS3: 1% Sand, 56% Silt, 43% Clay
 Water level measured at 3.3 mbgs on June 13, 2019
 Water level at 4.0 mbgs upon completion
 Borehole cave to 4.2 mbgs upon completion
 First groundwater encounter at 6.1 mbgs
 GSA SS9: 4% Gravel, 54% Sand, 37% Silt, 5% Clay

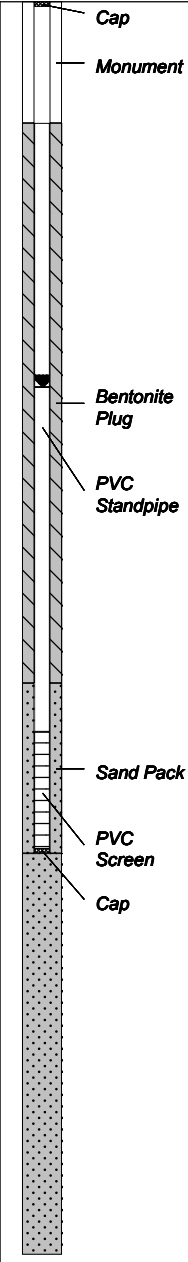


Client: Grant Morris Associates Ltd.
Contractor: Drilltech
Location: 1854 Liverpool Road

Project Name: Geotechnical Drilling
Method: Solid Stem Auger
UTM: 17T 653389 m E 4855567 m N

Project No.: 8960-001
Date Completed: June 6, 2019
Elevation: 89.10 masl

SUBSURFACE PROFILE			SAMPLE												
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture			SPT (N) / DCPT			Well Installation	Remarks
								25	50	75	10	20	30		
90	-1														
89	0		TOPSOIL: 250 mm thickness	1	SS	83	5								
88	1		SILT AND CLAY: Light brown, silt and clay, trace sand, trace gravel, trace organics, about plastic limit, firm	2	SS	71	6								
87	2		SILTY CLAY: Light brown, silty clay, about plastic limit, firm	3	SS	96	13								
86	3		-becomes stiff	4	SS	63	14								
85	4		SANDY SILT: Light brown, sandy silt, trace clay, trace gravel, moist, compact	5	SS	50	11								
84	5		SILT AND CLAY: Grey, silt and clay, some sand, trace gravel, about plastic limit, stiff	6	SS	46	9								
83	6		SILTY SAND: Grey, silty sand, some gravel, some clay, wet, very loose	7	SS	0	3								
82	7														
81	8														
80	9														
79	10														
78	11														
77	12		-becomes dense	9	SS	54	45								
76	13		-more clay and gravel												
75	14			10	SS	33	31								
74	15		Borehole terminated at 14.2 mbgs in silty sand												



Water level at 2.7 mbgs upon completion
 Water level measured at 3.0 mbgs on June 13, 2019

Borehole caved to 3.0 mbgs upon completion
 First groundwater encounter at 3.4 mbgs

GSA SS10: 16% Gravel, 41% Sand, 33% Silt, 10% Clay

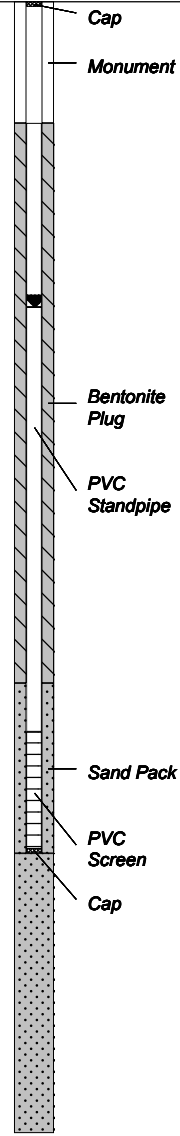


Client: Grant Morris Associates Ltd.
Contractor: Drilltech
Location: 1854 Liverpool Road

Project Name: Geotechnical Drilling
Method: Solid Stem Auger
UTM: 17T 653389 m E 4855582 m N

Project No.: 8960-001
Date Completed: June 7, 2019
Elevation: 88.43 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture				SPT (N) / DCPT		
								25	50	75	10	20	30	40
89	-1													
88	0		TOPSOIL: 150 mm thickness	1	SS	38	4							
87	1		SILT AND CLAY: Light brown, silt and clay, trace gravel, trace organics, about plastic limit, soft to firm	2	SS	92	5							
86	2		SILTY CLAY: Light brown, silty clay, about plastic limit, firm	3	SS	83	10							
85	3		-becomes light brown to grey, stiff	4	SS	63	5							
84	4		CLAYEY SILT: Light brown, clayey silt, some sand, trace gravel, about plastic limit, firm	5	SS	54	11							
83	5		GRAVELLY SAND: Grey, gravelly sand, some silt, trace clay, wet, compact	6	SS	54	28							
82	6		-some gravel											
81	7		CLAYEY SILT: Grey, clayey silt, some sand, trace gravel, wetter than plastic limit, soft	7	SS	0	5							
80	8		SANDY SILT: Grey, sandy silt, some clay, trace gravel, moist, dense											
79	9			8	SS	63	46							
78	10													
77	11		-becomes compact	9	SS	38	20							
76	12		SILTY SAND: Grey, silty sand, some gravel, some clay, moist, very dense	10	SS	50	>50							
75	13		Borehole terminated at 12.6 mbgs in silty sand											
74	14													
	15													



GSA SS2: 1% Sand, 62% Silt, 37% Clay

Water level measured at 2.3 mbgs on June 13, 2019

Borehole caving and water level at 3.7 mbgs completion

GSA SS6: 26% Gravel, 50% Sand, 15% Silt, 9% Clay



Client: Grant Morris Associates Ltd.

Project Name: Geotechnical Investigation

Project No.: 8960-001

Contractor: Drilltech Drilling Ltd.

Method: Solid Stem Auger

Date Completed: July 3, 2019

Location: 1854 Liverpool Road, Pickering

UTM: 17 T 653432 m E 4855567 m N

Elevation: 89.50 masl

SUBSURFACE PROFILE			SAMPLE							Well Installation	Remarks			
Elevation (m)	Depth (m)	Lithology	Description	Number	Type	% Recovery / TCR (%)	SPT (N) / RQD (%)	% Moisture				SPT (N)		
								25	50	75	10	20	30	40
77	13	TILL: Dark grey, sandy silt, trace to some gravel and clay, compact, wet		1	SS	58	19							
76	14													
75	15	TILL: Dark grey, sandy gravelly silt, dense, saturated		2	SS	100	50/75							
74	16													
73	17	SHALE: Shale, highly weathered, interbeds of sand and silt, wet		3	SS	100	50/75							
72	18													
71	19	-Interbedded with silt		4	SS	100	50/50							
70	20													
69	21	Shale and Limestone Interbeds: Dark grey to black, shale interbedded with limestone bedrock, very fine grained with thin beds of fine grained, thin to medium bedding, narrowly separated fractures are smooth to slightly rough		5	RC	74	57							
68	22													
67	23	Borehole terminated at 23.5 mbgs on limestone bedrock												
66	24													
65	25													
64	26													
63	27													
62	28													
61														

Refusal at 21.9 mbgs
 RQD: 57%



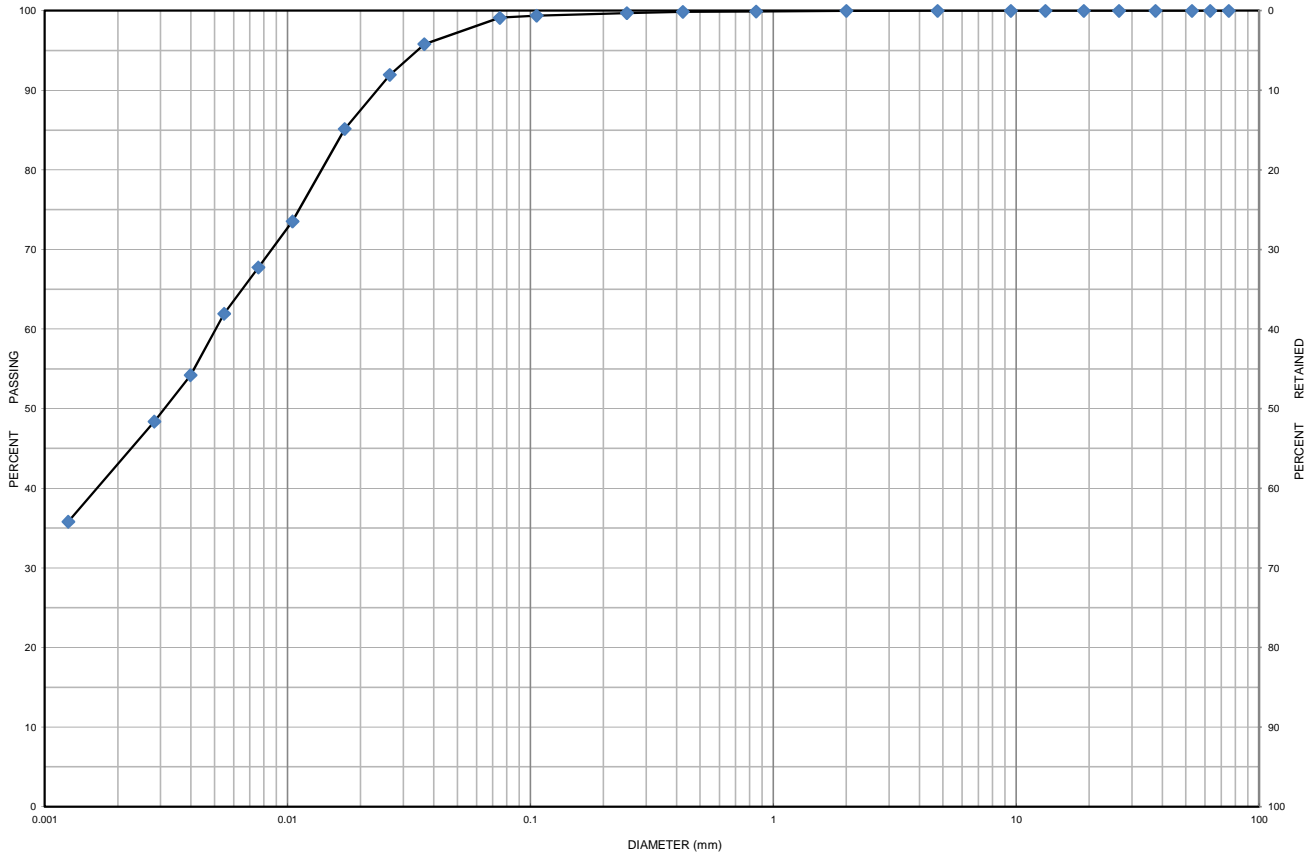
Appendix B
Physical Laboratory Testing Results



Grain Size Distribution Chart

Project Number: 8960-001 **Client:** Alireza Adejani
Project Name: 1854 Liverpool Road
Sample Date: June 7, 2019 **Sampled By:** Sean Neumann - Cambium Inc.
Location: BH 101-19 SS 3 **Depth:** 1.5 m to 2 m **Lab Sample No:** S-19-0490

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-19	SS 3	1.5 m to 2 m	0	1	99		23.2
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silt and Clay trace Sand		ML-CL	0.005	-	-	-	-

Issued By: *John Baird*
 (Senior Project Manager)

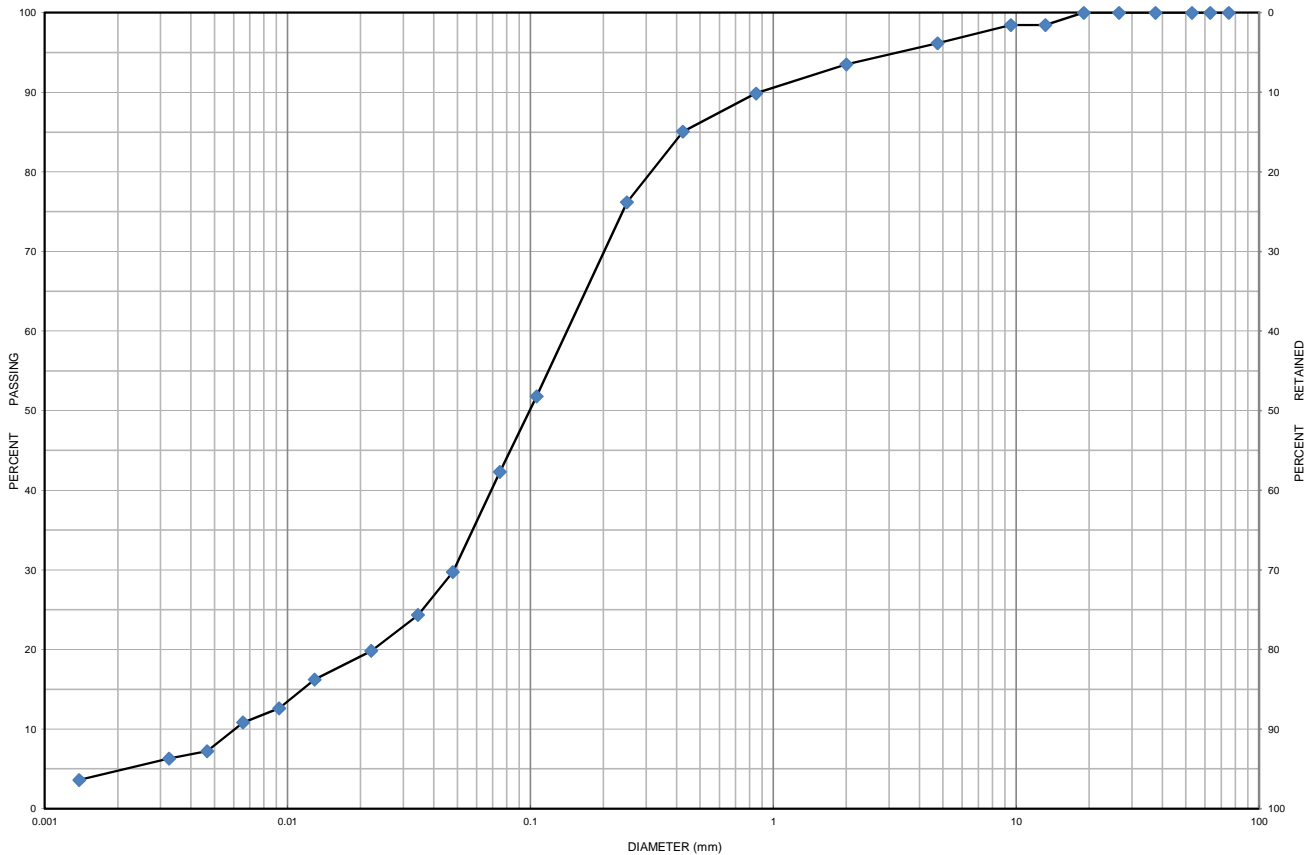
Date Issued: July 16, 2019



Grain Size Distribution Chart

Project Number: 8960-001 **Client:** Alireza Adejani
Project Name: 1854 Liverpool Road
Sample Date: June 7, 2019 **Sampled By:** Sean Neumann - Cambium Inc.
Location: BH 101-19 SS 9 **Depth:** 9.1 m to 9.6 m **Lab Sample No:** S-19-0491

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-19	SS 9	9.1 m to 9.6 m	4	54	42		12.0
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Sand and Silt trace Clay trace Gravel		SW-ML	0.150	0.048	0.0061	24.59	2.52

Issued By: *Shane Baird*
 (Senior Project Manager)

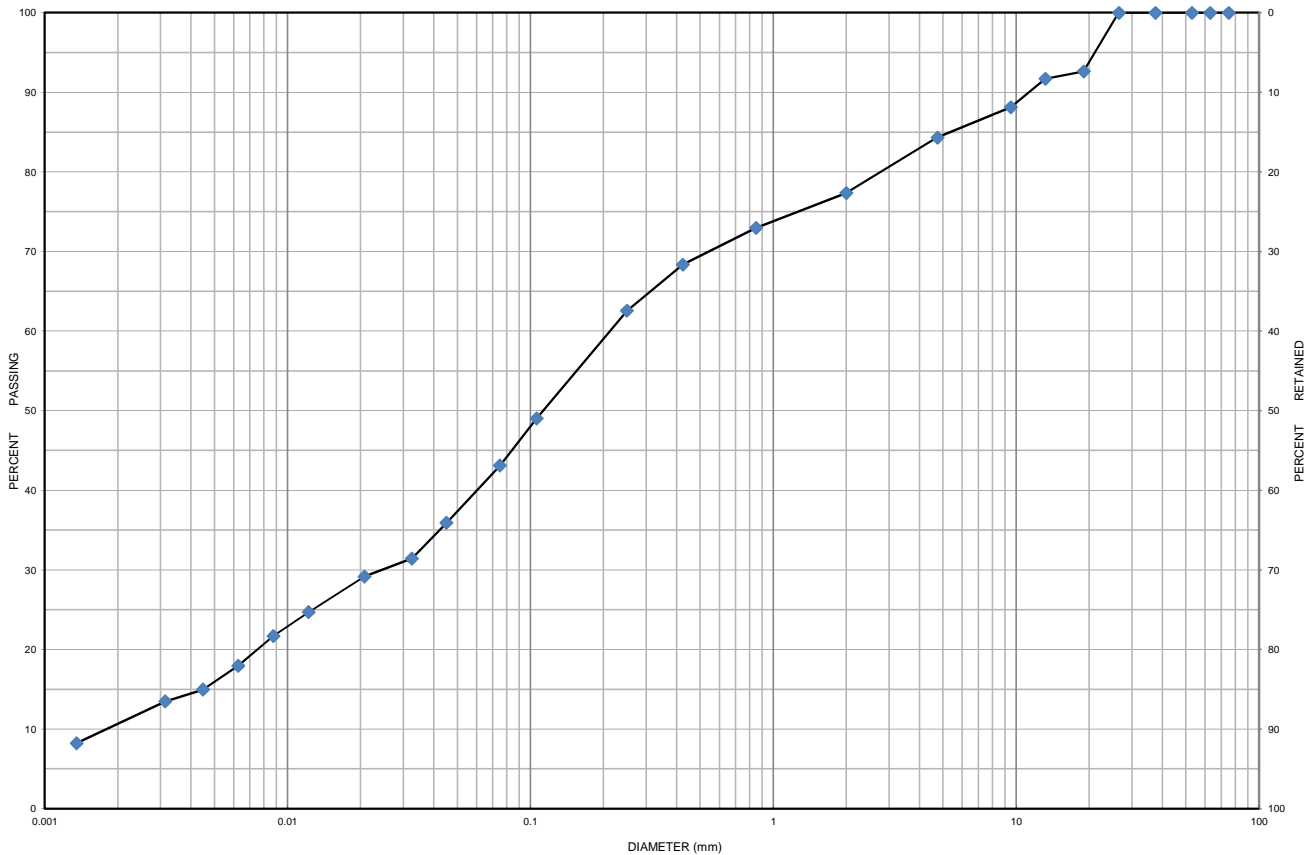
Date Issued: July 16, 2019



Grain Size Distribution Chart

Project Number: 8960-001 **Client:** Alireza Adejani
Project Name: 1854 Liverpool Road
Sample Date: June 7, 2019 **Sampled By:** Sean Neumann - Cambium Inc.
Location: BH102-19 SS10 **Depth:** 13.7 m to 14.2 m **Lab Sample No:** S-19-0492

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH102-19	SS10	13.7 m to 14.2 m	16	41	43		8.0
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silty Sand some Gravel some Clay		SM	0.220	0.024	0.0018	122.22	1.45

Issued By: *Shane Baird*
 (Senior Project Manager)

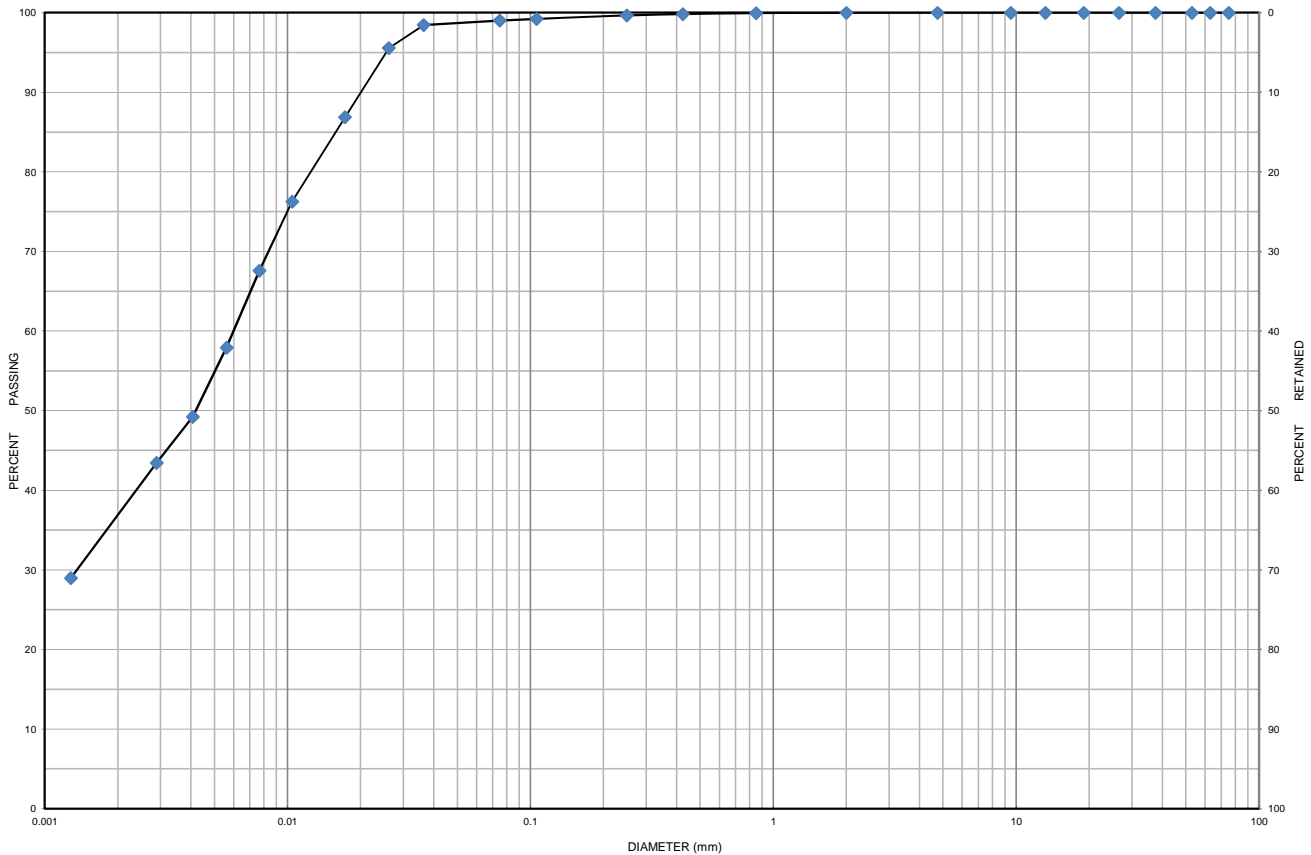
Date Issued: July 16, 2019



Grain Size Distribution Chart

Project Number: 8960-001 **Client:** Alireza Adejani
Project Name: 1854 Liverpool Road
Sample Date: June 7, 2019 **Sampled By:** Sean Neumann - Cambium Inc.
Location: BH 103-19 SS 2 **Depth:** 0.8 m to 1.2 m **Lab Sample No:** S-19-0493

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-19	SS 2	0.8 m to 1.2 m	0	1	99		23.2
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Silt and Clay trace Sand		ML-CL	0.006	0.0014	-	-	-

Issued By: *John Baird*
 (Senior Project Manager)

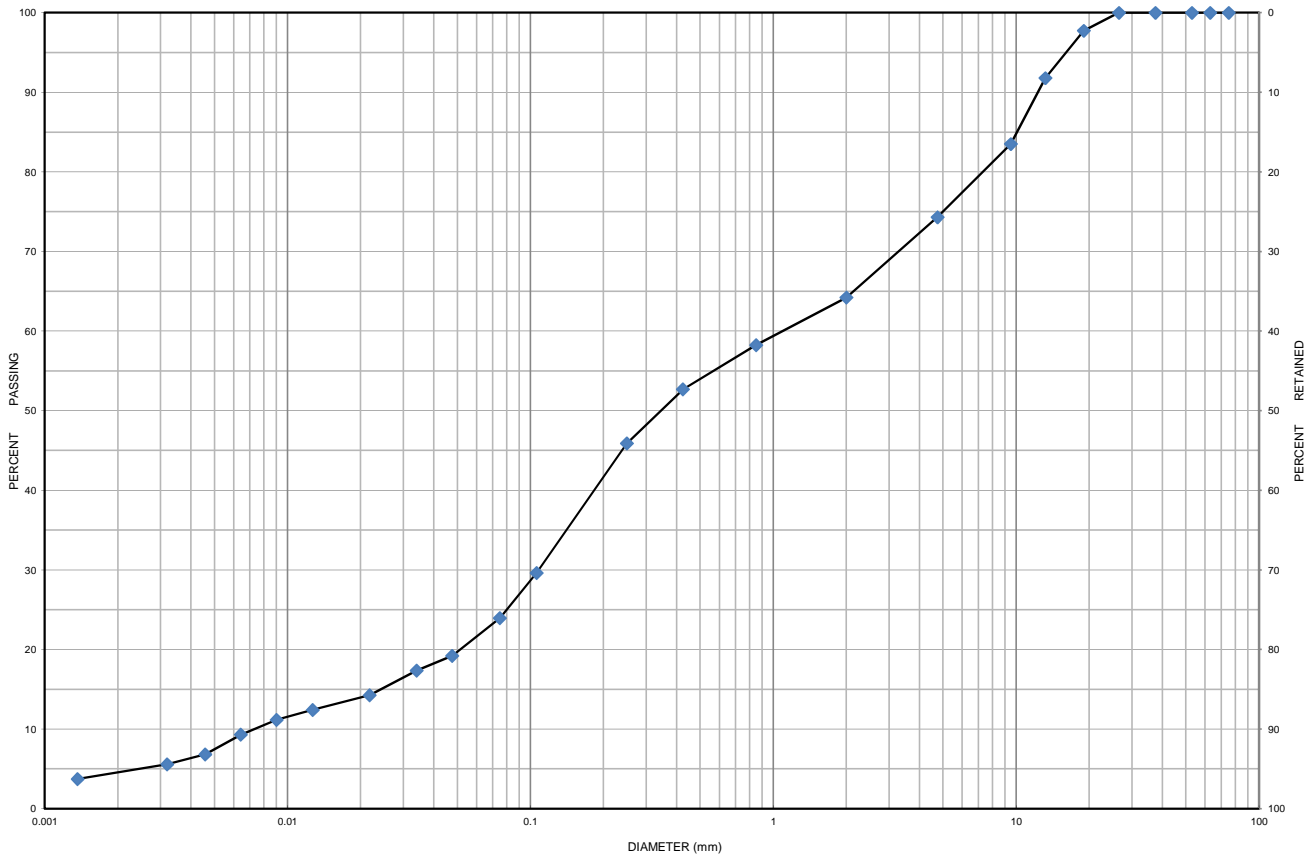
Date Issued: July 16, 2019



Grain Size Distribution Chart

Project Number: 8960-001 **Client:** Alireza Adejani
Project Name: 1854 Liverpool Road
Sample Date: June 7, 2019 **Sampled By:** Sean Neumann - Cambium Inc.
Location: BH 103-19 SS 6 **Depth:** 4.6 m to 5 m **Lab Sample No:** S-19-0494

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-19	SS 6	4.6 m to 5 m	26	50	24		9.7
Description		Classification	D ₆₀	D ₃₀	D ₁₀	C _u	C _c
Gravelly Sand some Silt trace Clay		SW	1.200	0.120	0.0073	164.38	1.64

Issued By: *John Baird*
 (Senior Project Manager)

Date Issued: July 16, 2019



Appendix C

Dewatering Calculations



Dewatering Calculations

Scenario	Depth (mbgs)	Equivalent Radius (m)	Static Level (m)	Dewatered level (m)	Aquifer Thickness (m)	Drawdown (m)	Conductivity (K) (m/s)	Length to Zero Drawdown (R ₀) (m)	(H ² -h ²) (m)	Inflow (L/sec)	Inflow (m ³ /day)
High Hydraulic Conductivity	10.5	31	3	11.5	12.5	8.5	1.62E-05	368	89.25	1.84	159
Low Hydraulic Conductivity	10.5	31	3	11.5	12.5	8.5	6.05E-06	237	89.25	0.83	72

ln(R₀/r_w) (high) 2.47
 ln(R₀/r_w) (low) 2.03
 Hydraulic Conductivity (m/s) (high) 1.62E-05
 Hydraulic Conductivity (m/s) (low) 6.05E-06

Length to Zero Drawdown	$3000 * ((\text{DRAWDOWN}) / 0.3048) * (\text{HYDRAULIC CONDUCTIVITY}^{0.5})$
(H²-h²)	$((\text{AQUIFER THICKNESS-STATIC LEVEL})^2) - ((\text{AQUIFER THICKNESS-DEWATERED LEVEL})^2)$
Estimated Inflow	$((\pi K (H^2 - h^2)) / (\ln(R_0 / \text{Equivalent Radius})))$