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796060 Grey Road 19, Town of the Blue Mountains

HYDROGEOLOGICAL ASSESSMENT

2483302 Ontario Inc.

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Issue	Date	Description
1	May 3, 2024	Hydrogeological Assessment Report

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1 Introduction

Tatham Engineering Limited (Tatham) has been retained by 2483302 Ontario Incorporated (the client) to complete a Hydrogeological Assessment for the proposed new housing development located at 796060 Grey Road 19 in the Town of The Blue Mountains.

The site is approximately 9.9 hectares (24.3 acres) in plan area, primarily comprised of wooded/undeveloped lands, with one rural residential dwelling and various storage areas and equipment located within the northern limits of the site. A watercourse, a tributary of silver creek, originating from the central portion of the site appears to be flowing in a northeastern direction. Another watercourse, a tributary of silver creek, flowing towards the east, is located approximately 200 m south of the site boundary. Based on the review of records, wooded areas are scattered around the site. Moreover, a wetland feature is located within the western and southwestern limits of the site, which extends further south and west of the site boundary. The site is bounded by Grey Road 19 and Crosswinds Boulevard followed by a residential development and undeveloped lands to the north, rural residential properties and undeveloped land to the east, undeveloped land followed by rural residential properties to the west, and undeveloped lands to the south. A site location plan is enclosed as Figure 1.

Based on the review of the conceptual site plan prepared by CMV Group Architects, dated October 25, 2023, the proposed mixed-use development will include 13 blocks (Block A-M) comprising residential and retail units along with associated roads and walkways. As per the conceptual plan, the site will be split into northwestern (Block A-H) and southeastern (Block I-M) quadrants divided by the existing watercourse on-site. The northwestern quadrant will comprise 624 residential units and 21,288 ft^2. of retail space along with 556 parking spaces. The southeastern quadrant will comprise of 600 residential units along with 458 parking spaces. It should be noted the current geotechnical and hydrogeological assessment is limited to northwestern quadrant only, it is assumed the assessment for southeastern quadrant will be completed at later stage. The concept plan is enclosed as Figure 2.

A geotechnical investigation was carried out concurrently by Fisher Engineering (Fisher). and was reported separately.

As part of the development planning process a hydrogeological assessment in accordance with the Town of The Blue Mountains, Nottawasaga Valley Conservation Authority (NVCA), and the Ministry of the Environment, Conservation and Parks (MECP) typical hydrogeological requirements was requested.

1.1 PURPOSE AND SCOPE OF WORK

The main objectives of the Hydrogeological Investigation were to:

- Establish local and regional geology and hydrogeology;
- Determine potential construction dewatering requirements and provide an assessment of anticipated construction dewatering flow rates for a generic construction scenario;
- Assess groundwater quality and compare the results to the Provincial Water Quality Objectives (PWQO), and Ontario Regulation 153/04, as amended (O.Reg. 153/04).
- Qualitatively assess the potential impacts to the nearby structures, water bodies and water uses, if any, and comment on future regulatory agency involvement; and,
- Prepare a Hydrogeological Assessment report.

To achieve the above objectives, Tatham proposed the following scope of work:

- Complete a desktop review of pertinent geological and hydrogeological resources, Ministry of the Environment, Conservation and Parks (MECP) water well records, previous geotechnical reports completed by others, and proposed site plan drawings.
- Visit the site to note existing site conditions, topography, drainage, water features, neighboring land uses, and/or existing water supply or monitoring wells.
- Complete groundwater level monitoring of all accessible and functional wells installed on-site from the 2023 geotechnical investigation completed by Fisher.
- Perform borehole permeability testing at up to four monitoring wells to determine hydraulic conductivity of the screened soil deposits.
- Install data loggers in three of the monitoring wells on-site and visit the site a total of five times between now and next year's spring freshet to establish the seasonally high groundwater levels (to be reported separately).
- Evaluate the background information, field, and laboratory data to evaluate the construction dewatering requirements.
- Assess the feasibility of implementing Low Impact Development Features on-site.
- Prepare a Hydrogeological Assessment report.

1.2 WATER TAKING – TEMPORARY

Temporary construction dewatering is governed by the Environmental Protection Act, and the following water taking limits and requirements are outlined in O.Reg. 63/16:

- Construction dewatering less than 50,000 L/day: the taking of both groundwater and stormwater does not require a hydrogeological report nor a water taking permit.
- Construction dewatering greater than 50,000 L/day but less than 400,000 L/day: the taking of both groundwater and stormwater does require a hydrogeological report and registration on the Environmental Activity and Sector Registry (EASR).
- Construction dewatering greater than 400,000 L/day: the taking of groundwater and stormwater requires a hydrogeological report and an approved MECP Category 3 Permit-To-Take-Water (PTTW).

This hydrogeological assessment was carried out to assess the potential construction dewatering volumes in order to proceed in accordance with the applicable water taking regulatory requirements and to obtain the applicable water taking permit.

2 Site Setting

The site is approximately 9.9 hectares (24.3 acres) in plan area, primarily comprised of wooded/undeveloped lands, with one rural residential dwelling and various storage areas and equipment located within the northern limits of the site. A watercourse, a tributary of silver creek, originating from the central portion of the site appears to be flowing in a northeastern direction. Another watercourse, a tributary of silver creek, flowing towards the east, is located approximately 200 m south of the site boundary. Based on the review of records, wooded areas are scattered around the site. Moreover, a wetland feature is located within the western and southwestern limits of the site, which extends further south and west of the site boundary. The site is bounded by Grey Road 19 and Crosswinds Boulevard followed by a residential development and undeveloped lands to the north, rural residential properties and undeveloped land to the east, undeveloped land followed by rural residential properties to the west, and undeveloped lands to the south. A site location plan is enclosed as Figure 1.

2.1 PHYSIOGRAPHY, SURFICIAL AND BEDROCK GEOLOGY

The site lies within the physiographic region known as the Simcoe Lowlands comprising Clay Plains and Beaches (Chapman and Putnam, 1984). Ontario Geological Survey (OGS) surficial geology mapping indicates the site is comprised of sandy silt to silty sand-textured till. Review of the Ontario Geological Survey indicate the majority of the site is mapped as Newmarket Till deposits consisting of sandy silt to silt, and a small portion within the western limits of the site is mapped as Paleozoic bedrock.

The regional mapping is consistent with the geotechnical findings which noted topsoil over fill, over primarily sandy clayey silt till over silty sand with interbedded layers of clayey silt/silty clay till across the majority of the site.

The bedrock in the area is primarily Paleozoic Bedrock consisting of shale and/or limestone of the Blue Mountain Formation.

2.2 TOPOGRAPHY AND DRAINAGE

Based on the review of ground surface elevation contour from Grey County GIS interactive mapping on April 30, 2024, the site and the surrounding area elevation is generally dropping towards east with some minor undulations. During the site visit, the northcentral portion of the site was noted to be at slightly higher elevation than the rest of the site. Based on the recorded ground surface elevation at monitoring well location, the ground surface elevation varies between 224.31 masl and 220.72 masl.

Under current conditions it is anticipated drainage on-site will follow the local topography on-site to the existing tributary and/or wetland on-site, and ultimately to the east/northeast beyond the site.

A watercourse, a tributary of silver creek, originating from the central portion of the site flows in northeastern direction. Another watercourse, a tributary of silver creek, appears to be flowing towards the east, and is located approximately 200 m south of the site boundary. Both the tributaries ultimately drain to Georgian Bay located approximately 3.7 km to the northeast of the site.

2.3 MECP WATER WELL RECORDS

To assess the nature of the groundwater resources as well as the history of the current well usage in the area, MECP water well records were reviewed for a 500 m radius surrounding the site. The approximate MECP water well locations are shown in Figure 3, and a summary of the MECP water well records are provided in Appendix A.

A total of 29 water well records were reviewed within a 500 m boundary of the site. 22 of the records indicate domestic water well usage, five records indicate monitoring/test hole usage, and two of the records did not indicate monitoring well usage.

In general, stratigraphy noted from the well records indicated fill and/or topsoil over clay and sand units with variable silt and gravel overlying weathered shale and limestone bedrock. Bedrock was encountered at depths of roughly 1.5 to 28.7 m below existing grades.

2.4 SOURCE WATER PROTECTION MAPPING

The site lies within the Nottawasaga Valley Source Protection Area (SPA). The site does not lie within a municipal Well Head Protection Area (WHPA) nor an Intake Protection Zone (IPZ) as shown on Figures 4 and 5, respectively. The site does not lie within a Significant Groundwater Recharge Area (SGRA); however, the site does lie within a Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6 as shown on Figures 6 and 7, respectively.

2.5 SITE INPSECTION

A visual site inspection was completed on April 5, 2024, to assess the site drainage, topography, and surface water features.

The site is located south of Grey County Road 19 and Crosswinds Boulevard in the Town of The Blue Mountains and was comprised of a mixture of cultivated and wooded/grassland areas, with one singular dwelling used as a garage and for miscellaneous storage. The surrounding properties are primarily rural residential followed by wooded lands to the north and east, and wooded land to the west and south.

In general, the topography of the site consisted of flat land with a slight slope from the central northern portion of the site towards the western, southern, and eastern limits of the site. A watercourse, a tributary of silver creek, originating from the central portion of the site flows in northeastern direction.

During the site visit, standing water was observed at the northwestern property boundary and the central portion of the site near the existing garage.

3 Procedures and Methodology

A total of eight boreholes (BH1 through BH8) were advanced during the geotechnical investigation documented in the preliminary geotechnical report, dated December 08, 2023 by Fisher, to approximate depths of 5.0 to 6.7 m below existing grades. All boreholes were instrumented as monitoring wells (MW1 through MW8) upon completion of drilling to be used for groundwater monitoring and sampling. The borehole/monitoring well locations are presented on Figure 8.

The geotechnical borehole logs are discussed further in Section 4 and are provided in Appendix B. The geotechnical laboratory data for the boreholes are provided in Appendix C.

3.1 BOREHOLE PERMEABILITY TESTING

Rising head tests were conducted in the selected four monitoring wells on April 9, 2024, following well development. Water was purged from the wells using low density polyethylene (LDPE) tubing and a foot valve. Following the removal of three well volumes worth of groundwater or the well going dry, and after at least 95% recovery, the test was initiated. The static water level was measured prior to the start of the test and the change in water level was manually recorded following purging. The change in water level was also recorded on regular intervals for a total of 30 minutes or until 95% recovery. The test was completed to estimate the hydraulic conductivity (K) of the soils at the well screen depth. The plot for drawdown versus time is presented in Appendix D.

3.2 GROUNDWATER SAMPLING

To establish baseline conditions and assess the suitability for discharge of pumped groundwater to the surface during potential construction dewatering, a representative groundwater sample was collected from MW3 on April 9, 2024.

The samples were collected using low-flow sampling methods to reduce the sediment content within the samples. Each sample was directly placed into pre-cleaned laboratory-supplied vials and/or bottles with analytical test group specific preservatives. Dedicated nitrile gloves were used during sampling and non-dedicated equipment was sanitized between monitoring wells.

A representative sample was submitted for chemical analysis of PWQO metals, and O.Reg.153/04, as amended, Petroleum Hydrocarbons (PHCs) and Volatile Organic Compounds (VOCs).

Samples were analyzed by Caduceon Environmental Laboratories, a CALA accredited lab, in Barrie, Ontario. Groundwater chemistry results are included in the laboratory Certificates of Analysis, provided in Appendix E.

3.3 LONG-TERM GROUNDWATER LEVEL MONITORING

Following the completion of the geotechnical borehole drilling and monitoring well installation program, data loggers were installed to MW2, MW3, and MW7 on-site to facilitate long-term groundwater monitoring. Groundwater levels will be manually measured a total of five times between April 2024 and April 2025 to establish the seasonal high groundwater levels.

A supplemental groundwater level letter will be prepared at the end of the long-term groundwater monitoring program, highlighting the seasonal high groundwater levels measured.

4 Subsurface Conditions

4.1 STRATIGRAPHY

The geotechnical investigation (Fisher, December 08, 2023) was reviewed for the preparation of this hydrogeological investigation report. The borehole and monitoring well locations are presented in Figure 8, detailed subsurface borehole logs are presented in Appendix B, and the geotechnical laboratory data for the boreholes are provided in Appendix C.

In general, the boreholes encountered topsoil over fill, over sandy clayey silt till/clayey silt till over silty sand deposits. Locally at MW3 topsoil over fill over silty sand over silty sand till deposits were encountered.

4.2 GROUNDWATER

Unstabilized groundwater level measurements and cave-in measurements were taken upon borehole drilling completion of each borehole by Fisher. These measurements provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations arising. Upon completion of the boreholes, all the boreholes were open and dry with the exception of MW4, 5 and 8 where groundwater was noted at a depth of 6.1 m (Elevation 214.62 to 217.41 m asl).

Monitoring wells were installed in all eight of the boreholes to facilitate the measurement of stabilized groundwater levels beneath the site. The monitoring wells were installed with 50 mm diameter PVC riser pipe and slotted 3.0-meter-long screens. A summary of the monitoring well installations is presented in Table 1. Stabilized groundwater measurements are presented in Table 2.

Table 1: Monitoring Well Installation Details

MONITORING WELL ID	GROUND SURFACE (M ASL)	LOCATION OF SCREEN		STRATA SCREENED
		DEPTH (M)	ELEVATION (M ASL)	
MW1	223.72	3.1 – 6.1	217.62 – 220.62	Clayey Silt Till and Silty Sand
MW2[1]	224.31	3.1 – 6.1	218.21 – 221.21	Silty Clay Till
MW3[1]	223.22	1.6 – 4.6	218.62 – 221.62	Silty Sand and Sandy Silt Till
MW4	220.77	3.1 – 6.1	214.67 – 217.67	Clayey Silt Till and Silty Sand
MW5	220.72	3.1 – 6.1	214.62 – 217.62	Clayey Silt Till and Silty Sand

MONITORING WELL ID	GROUND SURFACE (M ASL)	LOCATION OF SCREEN		STRATA SCREENED
		DEPTH (M)	ELEVATION (M ASL)	
MW6	223.48	3.1 – 6.1	217.38 – 220.38	Clayey Silt Till
MW7[1]	223.58	3.1 – 6.1	217.48 – 220.48	Clayey Silt Till
MW8	223.51	3.1 – 6.1	217.41 – 220.41	Sandy Clayey Silt Till and Silty Sand

Note:
1. Long-term groundwater monitoring data logger installed to well on April 9, 2024.

Table 2: Groundwater Levels

WELL ID	GROUND SURFACE ELEVATION (m asl)	GROUNDWATER ELEVATION (m bgs) / ELEVATION (m asl)	
		November 27, 2023[1]	April 5, 2024
MW1	223.72	4.94 / 218.78	4.21 / 219.51
MW2	224.31	5.83 / 218.48	5.36 / 218.95
MW3	223.22	0.40 / 222.82	0.16 / 223.06
MW4	220.77	3.14 / 217.63	2.81 / 217.96
MW5	220.72	2.98 / 217.74	2.61 / 218.11
MW6	223.48	0.95 / 222.53	0.47 / 223.01
MW7	223.58	4.86 / 218.72	4.26 / 219.32
MW8	223.51	Dry	6.13 / 217.38

Note:
1. Water levels were taken prior to well development.

Stabilized groundwater levels were measured on April 5, 2024, and ranged between 0.16 to 6.13 m below existing grade (elevations 217.38 to 223.06 m asl).

The shallow groundwater flows radially from the northcentral high portion of the site in the vicinity of MW3 and MW6 as shown on Figure 9.

4.3 IN-SITU PERMEABILITY

In-situ borehole permeability testing was carried out on the selected four monitoring wells out of the eight installed monitoring wells on-site. Rising head tests were conducted and the hydraulic conductivities (K) were calculated using the Dagan (1978) solution for the monitoring wells on-site with screens straddling the water table and the Hvorslev (1951) solution for the monitoring wells on-site with screens completely submerged by the water table.

The semi-log plot for drawdown versus time is provided in Appendix D and summarized in Table 3, below.

Table 3: Hydraulic Conductivity

MONITORING WELL ID	WELL DEPTH (m bgs)	STRATA SCREENED	HYDRAULIC CONDUCTIVITY (m/s)
MW2	6.1	Silty Clay Till	5.64×10^{-8}
MW3	4.6	Silty Sand and Sandy Silt Till	4.73×10^{-7}
MW5	6.1	Clayey Silt Till and Silty Sand	3.21×10^{-7}
MW7	6.1	Clayey Silt Till	3.47×10^{-8}

According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated area:

- Silty Sand: 10^{-3} m/s to 10^{-7} m/s
- Silt: 10^{-5} m/s to 10^{-9} m/s
- Glacial Till: 10^{-6} m/s to 10^{-12} m/s

The measured hydraulic conductivities of the screened soils were generally within the expected ranges.

4.4 BASELINE GROUNDWATER CHEMISTRY

To establish baseline conditions and assess the suitability for discharge of pumped groundwater to the surface during potential construction dewatering, one groundwater sample was collected and analyzed for selected parameters including: PWQO Metals and O.Reg. 153/04, as amended, PHCs and VOCs. The groundwater samples were obtained from MW3.

The samples were placed into pre-cleaned laboratory supplied vials and/or bottles provided with analytical test group specific preservatives, as required. Dedicated nitrile gloves were used during sample collection and handling.

The results of the groundwater chemistry analysis are presented in the laboratory Certificates of Analysis provided in Appendix E and are summarized Table 4, below.

Table 4: Groundwater Chemistry Results

SAMPLE LOCATION	PARAMETERS TESTED	EXCEEDANCES OF PWQO AND INTERIM PWQO			EXCEEDANCES OF O.REG. 153/04, AS AMENDED, TBL.1 - GW
		Parameter	Concentration (µg/L)	Limit (µg/L)	
MW3	PWQO Metals, O.Reg. 153/04, as amended PHCs and VOCs	Iron	2440	300	No Exceedances
		Cobalt	1.6	0.9 (interim)	
		Copper	5.9	5 (interim)	
		Lead	2.17	1 (interim)	

The above chemical testing results suggest the groundwater quality for the above listed parameter exceeds the established PWQO and Interim PWQO limits. Hence, some pre-treatment to lower the concentration of above-noted parameters is required before discharging the dewatering effluents into any natural feature or surface.

Treatment of dewatering discharge by filtration or sedimentation to reduce the concentration of TSS may reduce the concentration of non-dissolved metals to achieve compliance with PWQO and Interim PWQO guidelines; however, other treatment methods may still be required to reduce the concentration of dissolved analytes during construction.

It is expected during construction dewatering, the pumped water will first be discharged to a silt bag or sedimentation tank, at minimum, before being discharged to the surface and/or nearby natural feature. However, dewatering contractor should be responsible for the final design of the pre-treatment dewatering system.

5 Discussion and Analysis

Based on the review of the conceptual site plan prepared by CMV Group Architects, dated October 25, 2023, the proposed mixed-use development will include 13 blocks (Block A-M) comprising residential and retail units along with associated roads and walkways. As per the conceptual plan, the site will be split into northwestern (Block A-H) and southeastern (Block I-M) quadrants divided by the existing watercourse on-site. The northwestern quadrant will comprise 624 residential units and 21,288 ft^2. of retail space along with 556 parking spaces. The southeastern quadrant will comprise of 600 residential units along with 458 parking spaces. It should be noted the current geotechnical and hydrogeological assessment is limited to northwestern quadrant only, it is assumed the assessment for southeastern quadrant will be completed at later stage.

During the preparation of this report, detailed design drawings showing the finished floor elevation (FFE) for the ground floor slab or basement structure were not available for our review.

5.1 TEMPORARY CONSTRUCTION DEWATERING

To estimate the construction dewatering flow rate for the proposed development, the following assumptions have been made:

- Groundwater is to be drawn down 1.0 m below the proposed bulk excavations.
- The water bearing soils exposed during construction primarily consist of sandy clayey silt till/silty sand with interbedded layers of clayey silt/silty clay till. For the purposes of this assessment, a value of 5.0 x 10^{-7} m/s will be used as a conservative approach.
- Groundwater levels are anticipated to range from 0.16 to 6.13 m below existing grade (elevations 217.38 to 223.06 masl).
- Given the final grading plan for the site is not available for review, the ground surface elevation recorded at the MW locations are considered as final grade for the proposed development. Construction dewatering flow rates are estimated based on the following considerations:
    - Building Construction*:* the proposed development has been assumed to comprise slab-on-grade structures for the residential and retail buildings. It has been assumed fill will need to be removed and excavations will extend to depths of up to 2.0 m depth. For the purposes of this construction dewatering assessment, it has been assumed an entire block will be excavated at one time. As such, the following dimensions have been assumed:

i) Block A to Block E: to be completed in sections, 60 m length and 50 m width.

ii) Block F and Block H: to be completed in sections, 80 m length and 50 m width.

iii) Block G: to be completed in sections, 100 m length and 50 m width.

- Site Servicing: it is assumed 4.0 m deep trenches will be excavated for the installation of underground servicing.

- It is assumed surface water will be managed so it will not enter the excavation.
- It is assumed all measures will be implemented to ensure the allowable/permitted water taking volumes are not to be exceeded. This includes completing the work in smaller sections.

For the purposes of this Hydrogeological Assessment, the site has been separated into two quadrants, with calculations completed for only the northwest quadrant as shown on Figure 10.

5.1.1 Radius of Influence (ROI)

The Radius of Influence (ROI) for construction dewatering refers to the distance at which the drawdown resulting from pumping becomes negligible. The ROI is calculated using the empirical Sichardt Equation. The equation is empirical and provides representative flow rates using the steady state flow dewatering equations. The Sichardt Equation is used to provide representative flow calculations; however, it is not precise in determining the actual radius of influence by pumping since during steady state conditions, the ROI of pumping will extend until boundary flow conditions are reached and provide sufficient water inputs to the aquifer, such as recharge and surface water bodies.

The Sichardt Equation is expressed as the following equation:

$$R_0 = 3000(H - h)\sqrt{k}$$

Where:

K = Hydraulic Conductivity (m/s)

H = Static Saturated Head (m)

h = Dynamic Saturated Head (m)

R_0 = Radius of Influence (m)

Based on the Sichardt equation and the design K value, the ROI from the centre of the excavation for radial flow for each zone is tabulated below in Table 5. Calculation details are provided in Appendix F.

Table 5: Radius of Influence

ZONE	CLOSEST MW	PROPOSED DEVELOPMENT	ROI (m)
1	MW 1	Housing Development (Block A)	--
2	MW 1	Housing Development (Block B)	--
3	MW 6	Housing Development (Block C)	36
4	MW 3	Housing Development (Block D)	37
5	MW 5	Housing Development (Block E)	32
6	MW 7	Housing Development (Block F)	--
7	MW 8	Housing Development (Block G)	--
8	MW 8	Housing Development (Block H)	--
9	MW3	Site Servicing (per 100 m trench)	10

5.1.2 Temporary Dewatering Flow Rate

The Dupuit-Forcheimer method for radial flow in an unconfined aquifer for a fully penetrating excavation was used for the housing and retail development construction, and is expressed as:

$$Q = \frac{\pi K(H^2 - h^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - h^2)}{L}$$

Where:

Q = rate of pumping (m^3/s)

K = hydraulic conductivity (m/s)

H = head beyond the influence of pumping (static groundwater elevation) (m)

h = head above base of aquifer at the excavation (m)

R_0 = Radius of Influence (m)

r_e = Equivalent Radius (m)

x = length of excavation (m)

L = length of excavation (m)

It is anticipated the initial dewatering rate will be higher to remove groundwater from within the overburden formation. As the water level reaches its target elevation, dewatering rates are expected to decrease as the local groundwater storage will have been removed and lessen seepage rates into the excavation.

Using the assumptions and equations outlined above, the estimated dewatering rates were determined and summarized below, in Table 6. Calculation details are provided in Appendix F.

Table 6: Construction Dewatering Estimated Daily Flow Rate

ZONE	PROPOSED DEVELOPMENT	CONSTRUCTION DEWATERING FLOW RATE (L/day)	CONSTRUCTION DEWATERING FLOW RATE INCLUDING SAFETY FACTOR OF 2 (L/day)	CONSTRUCTION DEWATERING FLOW RATE INCLUDING SAFETY FACTOR OF 2 INCLUDING 10mm PRECIPITATIONEVENT (L/day)
1	Housing Development (Block A)	No significant dewatering anticipated. Localized sump pumping may be required.		
2	Housing Development (Block B)	No significant dewatering anticipated. Localized sump pumping may be required.		
3	Housing Development (Block C)	7,300	14,600	44,600
4	Housing Development (Block D)	8,400	16,800	46,800
5	Housing Development (Block E)	700	1,400	31,400
6	Housing Development (Block F)	No significant dewatering anticipated. Localized sump pumping may be required.		
7	Housing Development (Block G)	No significant dewatering anticipated. Localized sump pumping may be required.		
8	Housing Development (Block H)	No significant dewatering anticipated. Localized sump pumping may be required.		
9	Site Servicing (100 m trench)	19,200	38,400	41,400

To account for seasonal fluctuations of the groundwater table and variation in the hydrogeological properties beyond those encountered during this study, a safety factor of 2 was applied. Further to account for surface water infiltration within the excavation footprint, a 10 mm precipitation event was applied. This rate can be considered a contingency volume subject to the timing and season of construction.

The estimates provided in this report are based on information available at the time of the investigation. If design changes are implemented, additional dewatering estimates will be required to reflect the design changes.

The estimated dewatering volume for the anticipated housing development construction was calculated to range from 31,400 to 46,800 L/day. Although the construction dewatering estimates remain below 50,000 L/day it is still recommended registration for a dewatering construction EASR be completed. It is assumed all measures will be implemented to ensure 400,000 L/day threshold will not be exceeded. This includes completing the work in smaller sections.

In accordance with O.Reg. 63/19 a water taking and discharge plan have been prepared for the site and are provided in Appendix G and H, respectively.

It is the responsibility of the contractor to ensure dry conditions are always maintained within excavations. If dewatering does exceed the 400,000 L/day volume during construction, a PTTW with the MECP will be required. Dewatering volumes should be closely monitored during construction in order to stay below the threshold of 400,000 L/day which may require construction being carried out in smaller sections.

5.2 WATER BUDGET

An evaluation of the anticipated changes in the water budget between pre-development and post-development conditions for the proposed new housing development has been included to quantify the expected changes to water budget within the northwest and southeast quadrants on-site without mitigation.

Using historical Environment Canada precipitation data from the Thornbury Salma weather station (1984-2003) located approximately 17.6 kilometers northwest of the site, the pre-development water budget model for the new housing development shows a total of 21,027 m^3 of annual infiltration volume is provided over the entire site area (9.9 ha).

The proposed land-use for the new housing development is residential comprising 13 separate housing development blocks with 624 total proposed units and associated retail area, with internal roadways and 556 parking spaces in the northwestern quadrant of the site and 600 total proposed units, with internal roadways and 458 parking spaces in the southeastern quadrant of

the site. Based on the preliminary site plans to date it is anticipated approximately 53% of the 9.9 ha developable area will be impervious. With no mitigative measures implemented, the post-development water budget assessment shows a reduction in annual infiltration volume of 11,094 m^3 post development.

Climate data and water budget calculations are included in Appendix I for reference.

5.3 LOW IMPACT DEVELOPMENT FEASIBILITY ASSESSMENT

As discussed in previous sections, the soil consists of topsoil over fill, over primarily sandy clayey silt till over silty sand with interbedded layers of clayey silt/silty clay till throughout majority of the site.

Groundwater level measurements to date have been noted at depths of 0.16 to 6.13 m below existing grade (elevations 217.38 to 223.06 masl); however, the typically high groundwater period between March and June has not been fully captured with the groundwater levels measured to date.

The native sandy clayey silt deposits encountered throughout the site are not considered feasible for Low Impact Development (LID) features given the anticipated low permeability of the soils and resulting low infiltration rates.

6 References

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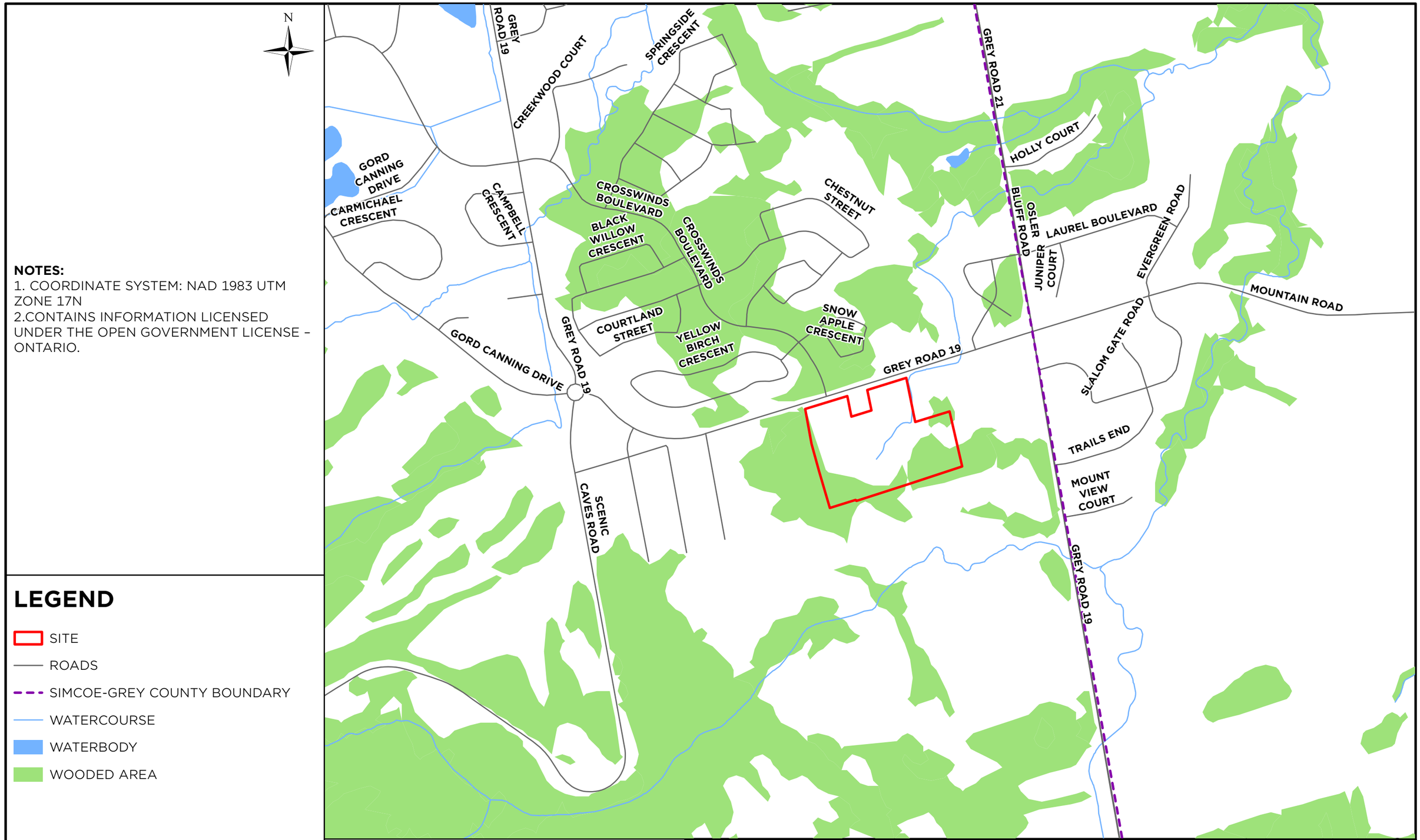


NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- ROADS
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WATERBODY
- WOODED AREA

0 200 400 800 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
SITE LOCATION PLAN

DWG. No. **FIG-1**

SCALE: 1:10,000 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

NOTES:

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
CONCEPT PLAN

DWG. No. **FIG-2**

SCALE: NTS	DRAWN: AO	DATE: MAY. 2024	JOB NO. 123143

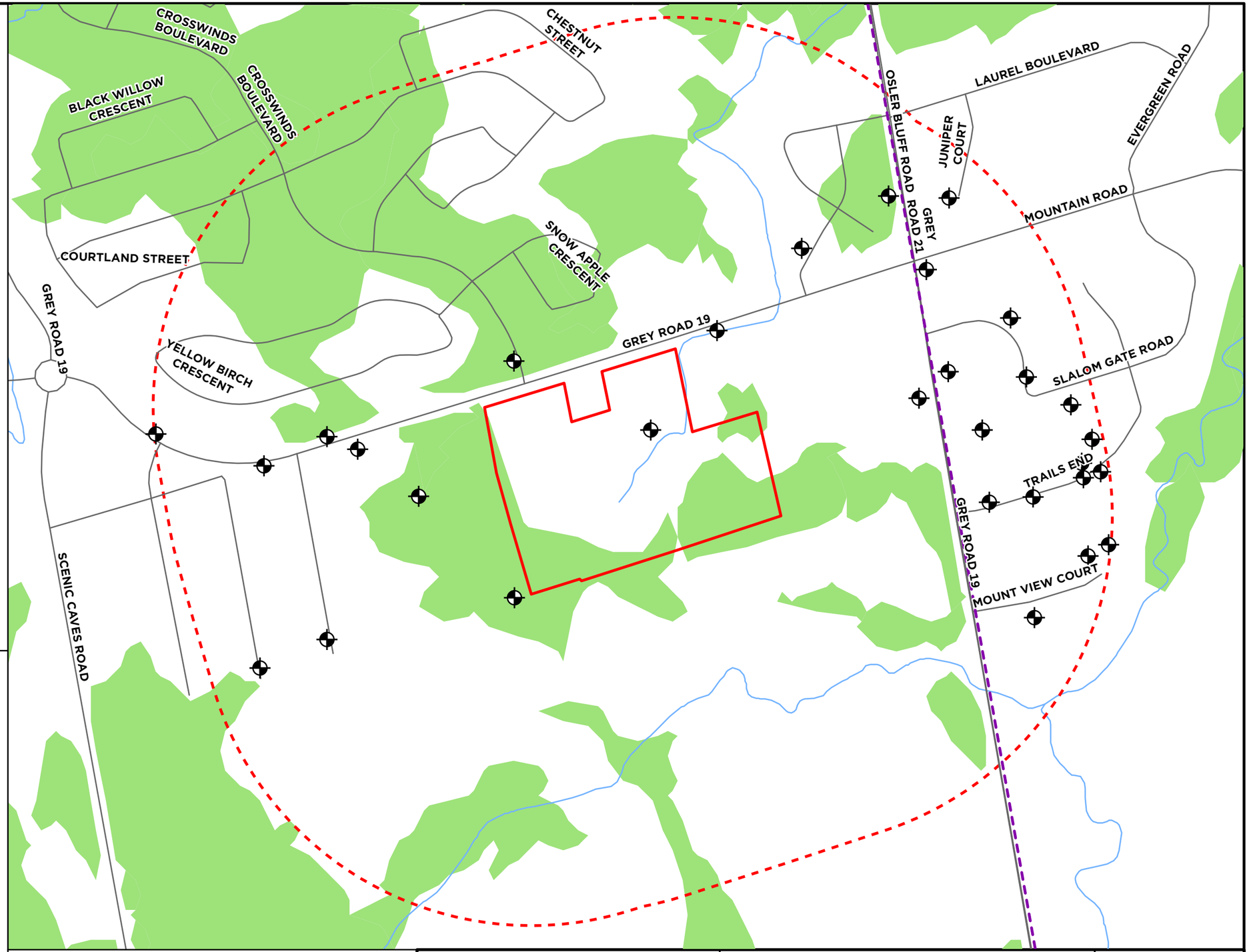
\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- STUDY AREA (500 M)
- MECP WATER WELLS
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WOODED AREA



0 120 240 480 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
MECP WATER WELL RECORDS

DWG. No. **FIG-3**

SCALE: 1:6,000	DRAWN: AO	DATE: MAY. 2024	JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

BLACK WILLOW CRESCENT
CROSSWINDS BOULEVARD
CHESTNUT STREET
LAUREL BOULEVARD
OSLER BLUFF ROAD
JUNIPER COURT
GREY ROAD 21
MOUNTAIN ROAD
COURTLAND STREET
SNOW APPLE CRESCENT
TRAILS END
YELLOW BIRCH CRESCENT
GREY ROAD 19
SLALOM GATE ROAD
TRAILS END
GREY ROAD 19
MOUNT VIEW COURT
SCENIC CAVES ROAD

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- WELLHEAD PROTECTION AREA
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WOODED AREA

0 100 200 400 METERS

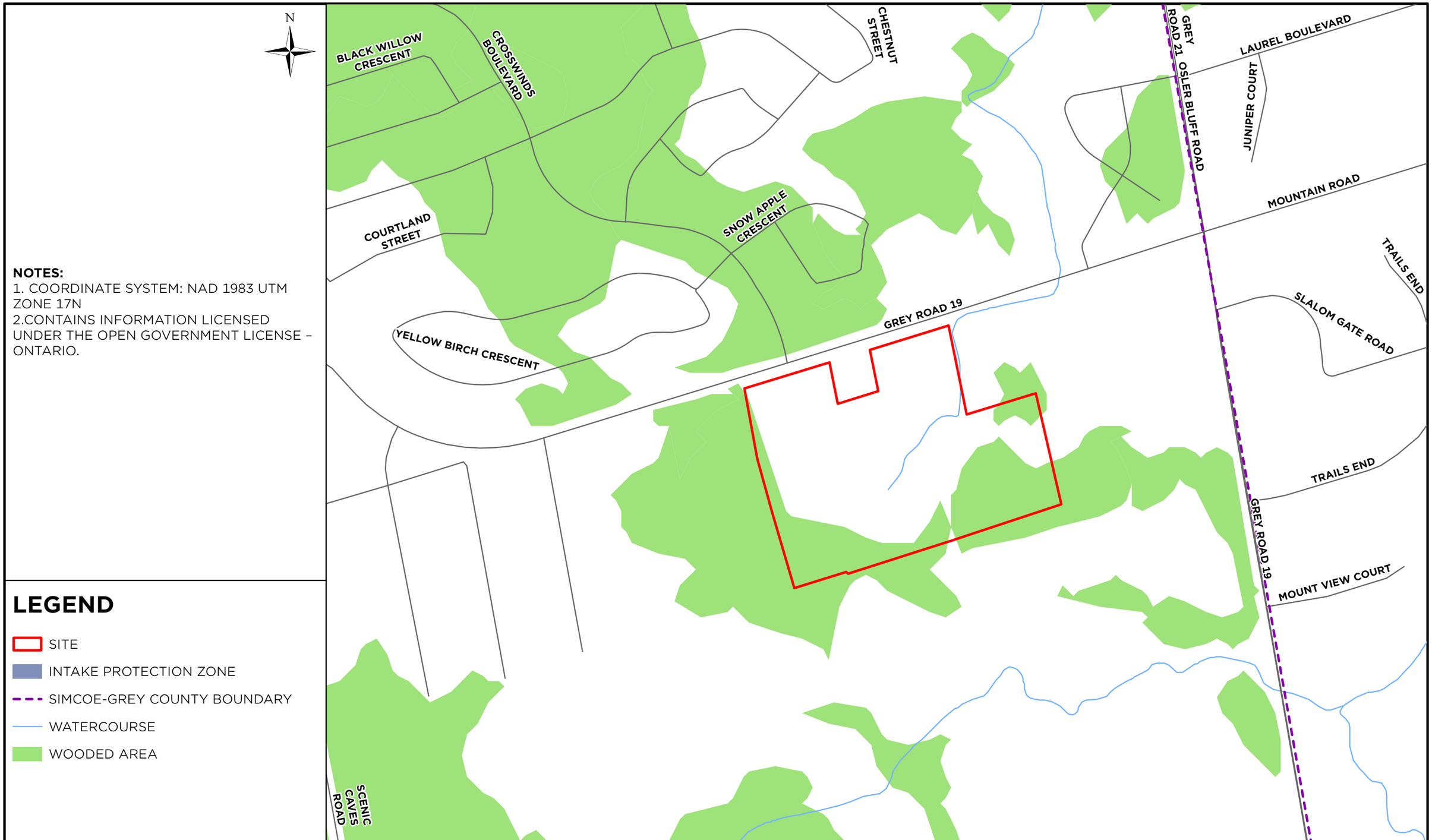
TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
WELL HEAD PROTECTION AREA

DWG. No. **FIG-4**

SCALE: 1:5,000	DRAWN: AO	DATE: MAY. 2024	JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx



NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- INTAKE PROTECTION ZONE
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WOODED AREA

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
INTAKE PROTECTION ZONE

DWG. No. **FIG-5**

SCALE: 1:5,000	DRAWN: AO	DATE: MAY. 2024	JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

BLACK WILLOW CRESCENT
CROSSWINDS BOULEVARD
CHESTNUT STREET
LAUREL BOULEVARD
OSLER BLUFF ROAD
JUNIPER COURT
GREY ROAD 21
MOUNTAIN ROAD
COURTLAND STREET
SNOW APPLE CRESCENT
TRAILS END
GREY ROAD 19
SLALOM GATE ROAD
YELLOW BIRCH CRESCENT
TRAILS END
GREY ROAD 19
MOUNT VIEW COURT
SCENIC CAVES ROAD

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- SIGNIFICANT GROUNDWATER RECHARGE AREA
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WOODED AREA

0 100 200 400 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
SIGNIFICANT GROUNDWATER RECHARGE AREA

DWG. No. **FIG-6**

SCALE: 1:5,000 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

BLACK WILLOW CRESCENT
CROSSWINDS BOULEVARD
CHESTNUT STREET
LAUREL BOULEVARD
OSLER BLUFF ROAD
ROAD 21
GREY
JUNIPER COURT
MOUNTAIN ROAD
COURTLAND STREET
SNOW APPLE CRESCENT
GREY ROAD 19
SLALOM GATE ROAD
YELLOW BIRCH CRESCENT
TRAILS END
GREY ROAD 19
MOUNT VIEW COURT
SCENIC CAVES ROAD

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- HIGHLY VULNERABLE AQUIFER
- SIMCOE-GREY COUNTY BOUNDARY
- WATERCOURSE
- WOODED AREA

0 100 200 400 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
HIGHLY VULNERABLE AQUIFER

DWG. No. **FIG-7**

SCALE: 1:5,000 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- MONITORING WELLS

0 40 80 160 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
BOREHOLE/MONITORING WELL LOCATION PLAN

DWG. No. **FIG-8**

SCALE: 1:2,000 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

N

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

- SITE
- MONITORING WELLS
- GROUNDWATER CONTOUR
- GROUNDWATER ELEVATION (MEASURED APRIL 5, 2024)
- GROUNDWATER FLOW DIRECTION

0 40 80 160 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
GROUNDWATER CONTOUR

DWG. No. **FIG-9**

SCALE: 1:2,000 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

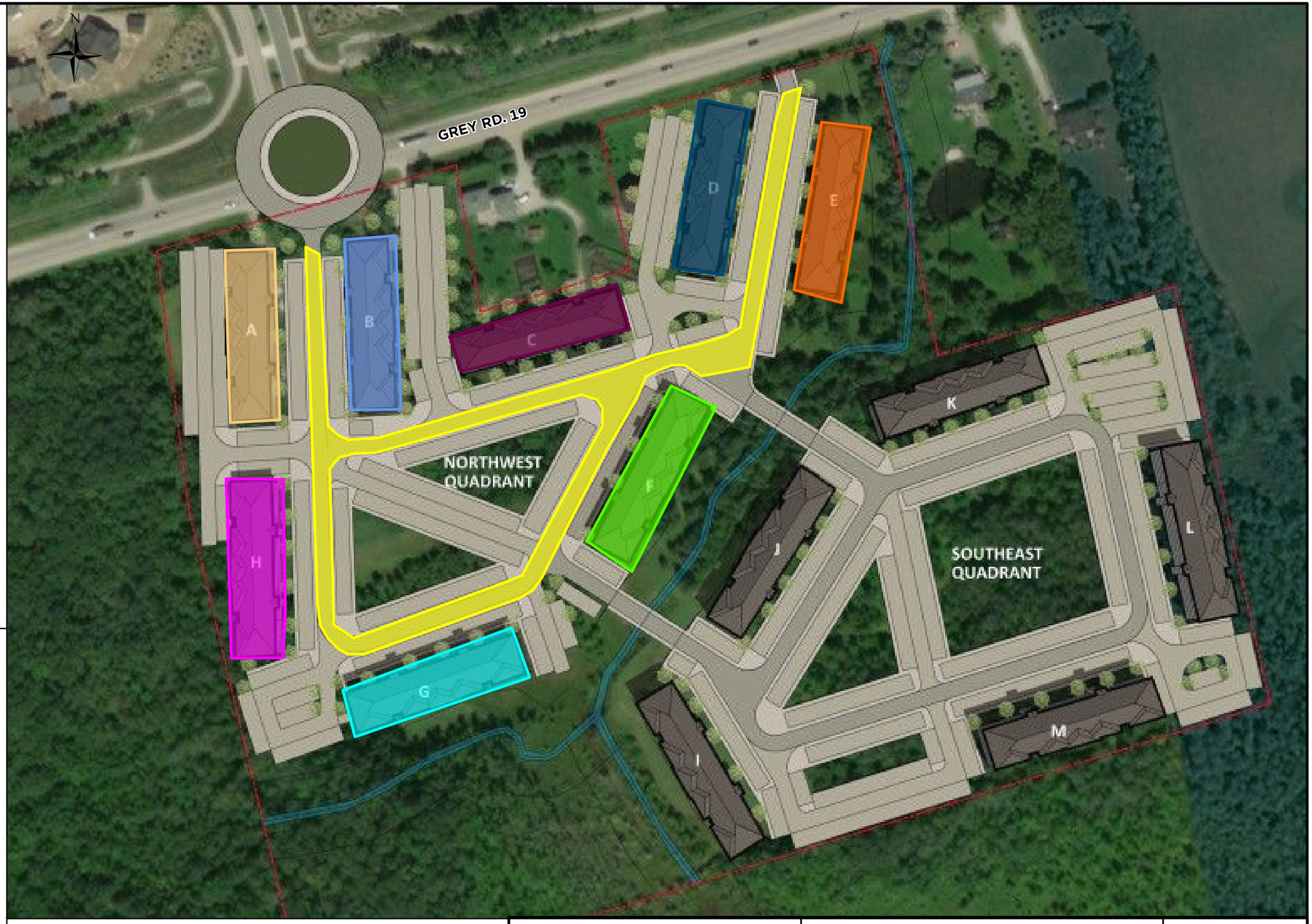
\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

NOTES:
1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2.CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE – ONTARIO.

LEGEND

DEWATERING ZONE

- ZONE 1
- ZONE 2
- ZONE 3
- ZONE 4
- ZONE 5
- ZONE 6
- ZONE 7
- ZONE 8
- ZONE 9



0 30 60 120 METERS

TATHAM ENGINEERING

796060 GREY ROAD 19, BLUE MOUNTAIN
HYDROGEOLOGICAL SITE ASSESSMENT
CONSTRUCTION DEWATERING ZONES

DWG. No. **FIG-10**

SCALE: 1:1,520 | DRAWN: AO | DATE: MAY. 2024 | JOB NO. 123143

\\col-fs-01\ENGFS\Data\2023 Projects\123143 - 796060 Grey Road 19, Blue Mountains\GIS\GIS Models\123143 - 796060 Grey Road 19, Blue Mountains\123143 - 796060 Grey Road 19, Blue Mountains.aprx

Appendix A:
MECP Water Well Records

TATHAM ENGINEERING

Ministry of the Environment, Conservation and Parks
Water Well Records

Township Con Lot	UTM	Date Centre	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
45 012	17 556863 4927262 W	2006/08 1565	6.25	FR 0046	8/17/5/48:0	DO	0047 4	7037415 (Z41000) A021751	FILL 0002 BRWN CLAY SNDY STNS 0011 GREY CLAY SNDY 0025 GREY CLAY SAND GRVL 0046 SAND GRVL 0051
COLLINGWOOD TOWN 12 064	17 556957 4927343 W	2007/11 6433	7	FR 0100	18/106/2/1:0	DO		7101979 (Z61662) A054200	CLAY SNDY 0000 SAND SILT 0057 CLAY SAND 0059 SAND CLAY 0079 BLCK SHLE 0091 BRWN SHLE 0118 BRWN LMSN 0123 WHIT LMSN 0126
COLLINGWOOD TOWN CON 12 045	17 556925 4927065 W	2011/09 2576	6 5	FR 0032	25//10/1:	DO	0032 4	7174871 (Z139665) A107877	LOAM 0001 BRWN CLAY STNS 0008 GREY CLAY GRVL HARD 0025 GREY SAND 0036 GREY CLAY
COLLINGWOOD TOWN CON 12 045	17 557048 4927212 W	2014/12 1565	6.25 6.25	FR 0093 FR 0117	14/60/8/15:	DO		7233943 (Z197419) A141704	FILL 0003 CLAY SAND GRVL 0020 CLAY SAND GRVL 0090 SHLE ROCK 0117
NOTTAWASAGA TOWNSHIP CON 12 017	17 556991 4927073 W	2002/02 3602	6	FR 0064	6/30/10/2:30	DO	0005 7	5736656 (236377)	BRWN SAND GRVL STNS 0008 GREY CLAY STNS STNS 0023 GREY CLAY HARD 0039 GREY CLAY SAND CMTD 0058 BRWN SAND CLN 0064
NOTTAWASAGA TOWNSHIP CON 12 045	17 556981 4927254 W	1993/11 2652	6	FR 0062	38/72/20/2:0	DO	0066 3	5730414 (141056)	BRWN SAND GRVL 0039 GREY HPAN 0062 GREY CSND LMSN BLDR 0072
NOTTAWASAGA TOWNSHIP CON 12 045	17 556993 4926891 W	1991/08 1565	6	FR 0044	7/4/5/18:0	DO		5728324 (099972)	BRWN CLAY BLDR 0010 GREY CLAY SILT 0034 MSND 0044
NOTTAWASAGA TOWNSHIP CON 12 045	17 557093 4927111 W	1998/06 1565	6	FR 0038 FR 0043	14/24/6/17:0	DO	0037 4	5733716 (177425)	BRWN CLAY STNS 0020 BRWN CLAY SAND LYRD 0035 SAND MGRD 0043

Township Con Lot	UTM	Date Centre	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
NOTTAWASAGA TOWNSHIP CON 12 045	17 557080 4927160 W	1998/06 1565	6	FR 0041 FR 0050	16/25/5/48:0	DO	0043 4	5733718 (194149)	GREY CLAY STNS 0041 SAND 0050
NOTTAWASAGA TOWNSHIP CON 12 045	17 557067 4927102 W	1998/06 1565	6	FR 0047	/36/5/0:0	DO	0047 4	5733717 (194145)	GREY CLAY STNS 0020 GREY CLAY SAND LYRD 0040 SAND MGRD 0053
NOTTAWASAGA TOWNSHIP CON 12 045	17 557074 4926984 W	1998/09 1565	6	FR 0062 FR 0068	9/42/8/14:	DO	0062 4	5733861 (194101)	BRWN CLAY STNS 0052 CLAY SAND GRVL 0060 MSND 0068
NOTTAWASAGA TOWNSHIP CON 12 045	17 557105 4927001 W	1998/10 1565	6 6	FR 0110	22/60/8/14:	DO		5733888 (194144)	BRWN CLAY STNS 0035 BRWN CLAY LYRD SAND 0061 CLAY SAND 0069 CLAY 0074 CLAY SAND GRVL 0094 SHLE ROCK 0120
NOTTAWASAGA TOWNSHIP CON 12 045	17 556914 4927174 W	1981/05 4816	6	FR 0021	6/21/5/2:45	DO	0017 5	5717685 ()	CLAY GRVL BLDR 0021 CSND 0027 FSND GRVL 0035
NOTTAWASAGA TOWNSHIP CON 12 045	17 556864 4927524 W	1983/09 4716	6	FR 0035	8/14/15/2:0	DO	0035 3	5718691 ()	BLCK LOAM 0001 GREY CLAY SAND STNS 0012 BRWN CLAY STNS 0035 BLCK GRVL STNS SAND 0041 GREY CLAY 0042
NOTTAWASAGA TOWNSHIP CON 12 045	17 556830 4927416 W	1986/10 3602	6	FR 0039	6/35/8/5:0	DO	0040 5	5721081 (03530)	BRWN LOAM 0001 GREY CLAY STNS STNY 0039 BRWN SAND CLN WBRG 0044

Township Con Lot	UTM	Date Centre	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
NOTTAWASAGA TOWNSHIP CON 12 045	17 557064 4927124 W	1984/08 3429	6 6	FR 0094 FR 0105	/100/4/1:20	DO		5719366 ()	BLCK LOAM 0001 BRWN CLAY BLDR 0019 BRWN CLAY GRVL STNS 0040 BRWN GRVL CSND SILT 0043 BRWN SAND SILT 0056 GREY CLAY SILT 0062 GREY CLAY GRVL SILT 0088 BLCK SHLE 0110
COLLINGWOOD TOWNSHIP	17 556642 4927448 W	2015/03 7190	0.75	UT 0003		MT	0015 5	7240103 (Z202369) A177438	BRWN LOAM 0001 BRWN SILT SAND GRVL 0008 GREY SILT SAND GRVL 0020
COLLINGWOOD TOWNSHIP	17 555825 4926815 W	2017/06 7190	6 1.25	0	0///:	TH MO	0015 5	7290225 (Z262980) A223981	BRWN GRVL SAND ---- 0002 BRWN SILT CLAY ---- 0005 GREY LMSN WTHD 0020
COLLINGWOOD TOWNSHIP	17 555926 4926858 W	2017/06 7190	6 1.25	0	0///:	TH MO	0012 5	7290223 (Z262981) A222398	BRWN GRVL SAND ---- 0002 BRWN CLAY SILT ---- 0005 GREY LMSN WTHD 0017
COLLINGWOOD TOWNSHIP CON 01 015	17 556514 4927324 W	1976/06 4716	6	FR 0063	5/48/2/3:0	DO	0062 3	2505653 ()	BRWN LOAM 0001 GREY CLAY STNS 0027 BLCK SILT SAND 0035 GREY CLAY 0053 GREY CLAY SILT 0063 BRWN SAND 0068
COLLINGWOOD TOWNSHIP CON 01 015	17 556819 4927222 W	1973/12 1565	7	FR 0030	2/15/8/3:30	DO	0035 6	2504523 ()	LOAM 0001 GREY CLAY 0018 FSND 0030 CSND 0040
COLLINGWOOD TOWNSHIP CON 01 015	17 556414 4927174 W	1986/09 3741	6	FR 0062	23/33/10/4:0	DO	0058 4	2508647 (NA)	GREY CLAY GRVL 0038 CSND 0062 CLAY 0063
COLLINGWOOD TOWNSHIP CON 01 015	17 556064 4927074 W	1987/05 1565	6	FR 0058	3/13/5/5:0	DO	0056 4	2508879 (NA)	LOAM 0001 BRWN CLAY STNS 0032 CLAY SNDY 0044 FSND 0055 SAND MGRD 0062

Township Con Lot	UTM	Date Centre	Casing Dia	Water	Pump Test	Well Use	Screen Depth	Well	Formation
COLLINGWOOD TOWNSHIP CON 01 015	17 556209 4926921 L	2001/10 1565	6 6	FR 0051	8/11/8/13:0	DO		2514805 (226945)	CLAY SNDY GRVL 0008 CLAY GRVL 0012 ROCK SHLE 0052
COLLINGWOOD TOWNSHIP CON 01 015	17 555831 4927120 W	2019/11 7190	6 1.25			MO	0020 5	7354560 (XYP38V8B) A281488	BRWN SAND GRVL 0007 GREY SILT CLAY 0011 GREY SHLE 0025
COLLINGWOOD TOWNSHIP CON 01 016	17 556208 4927278 W	2020/02 7190	4 2			MT	0005 5	7357517 (78REUDNJ) A281413	BRWN LOAM 0001 GREY SILT GRVL 0010
COLLINGWOOD TOWNSHIP CON 01 016	17 556773 4927527 W	2020/02 7190	6 2			MT	0005 5	7357488 (6ENUYWDR) A157503	BRWN LOAM 0001 GREY SILT GRVL 0010
COLLINGWOOD TOWNSHIP CON 01 016	17 555668 4927168 W	2019/11 7190	6 1.25			MO	0020 5	7354561 (K7WH75G8) A281489	BRWN SAND GRVL 0005 BRWN PEAT 0008 GREY CLAY SLTY 0012 GREY SHLE 0025
COLLINGWOOD TOWNSHIP CON 01 017	17 555972 4927145 W	1990/10 6433	8 8	FR 0032	8/62/3/1:0	DO		2511085 (75978)	LOAM 0002 GREY CLAY STNS 0015 BLUE SHLE LYRD 0062

UTM: UTM in Zone, Easting, Northing and Datum is NAD83; L: UTM estimated from Centroid of Lot; W: UTM not from Lot Centroid
DATE CNTR: Date Work Completed and Well Contractor Licence Number
CASING DIA: Casing diameter in inches
WATER: Unit of Depth in Feet. See Table 4 for meanign of code.
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hr : Min
WELL USE: See Table 3 for Meaning of Code
SCREEN: Screen Depth and Length in feet
WELL: WEL (AUDIT #) Well Tag. A: Abandonment; P: Partial Data Entry Only
FORMATION: See Table 1 and 2 for Meaning of Code

Table 1: Core Material and Descriptive Terms

BLDR BOULDERS	FCRD FRACTURED	IRFM IRON FORMATION	PORS POROUS	SOFT SOFT
BSLT BASALT	FGRD FINE-GRAINED	LIMY LIMY	PRDG PREVIOUSLY DUG	SPST SOAPSTONE
CGRD COARSE-GRAINED	FGVL FINE GRAVEL	LMSN LIMESTONE	PRDR PREV. DRILLED	STKY STICKY
CGVL COARSE GRAVEL	FILL FILL	LOAM TOPSOIL	QRTZ QUARTZITE	STNS STONES
CHRT CHERT	FLDS FELDSPAR	LOOS LOOSE	QSND QUICKSAND	STNY STONEY
CLAY CLAY	FLNT FLINT	LTCL LIGHT-COLOURED	QTZ QUARTZ	THIK THICK
CLN CLEAN	FOSS FOSILIFEROUS	LYRD LAYERED	ROCK ROCK	THIN THIN
CLYY CLAYEY	FSND FINE SAND	MARL MARL	SAND SAND	TILL TILL
CMTD CEMENTED	GNIS GNEISS	MGRD MEDIUM-GRAINED	SHLE SHALE	UNKN UNKNOWN TYPE
CONG CONGLOMERATE	GRNT GRANITE	MGVL MEDIUM GRAVEL	SHLY SHALY	VERY VERY
CRYS CRYSTALLINE	GRSN GREENSTONE	MRBL MARBLE	SHRP SHARP	WBRG WATER-BEARING
CSND COARSE SAND	GRVL GRAVEL	MSND MEDIUM SAND	SHST SCHIST	WDFR WOOD FRAGMENTS
DKCL DARK-COLOURED	GRWK GREYWACKE	MUCK MUCK	SILT SILT	WTHD WEATHERED
DLMT DOLOMITE	GVLY GRAVELLY	OBDN OVERBURDEN	SLTE SLATE	
DNSE DENSE	GYPS GYPSUM	PCKD PACKED	SLTY SILTY	
DRTY DIRTY	HARD HARD	PEAT PEAT	SNDS SANDSTONE	
DRY DRY	HPAN HARDPAN	PGVL PEA GRAVEL	SNDY SANDYOAPSTONE	

Table 2: Core Color

WHIT WHITE
GREY GREY
BLUE BLUE
GREN GREEN
YLLW YELLOW
BRWN BROWN
RED RED
BLCK BLACK
BLGY BLUE-GREY

Table 3: Well Use

DO Domestic	OT Other
ST Livestock	TH Test Hole
IR Irrigation	DE Dewatering
IN Industrial	MO Monitoring
CO Commercial	MT Monitoring TestHole
MN Municipal	
PS Public	
AC Cooling And A/C	
NU Not Used	

Table 4:Water Detail

FR Fresh	GS Gas
SA Salty	IR Iron
SU Sulphur	
MN Mineral	
UK Unknown	

Appendix B:
Borehole Logs

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW1 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 14 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				223.72			
0	0	TOPSOIL: Dark brown clayey silt, trace rootlets, moist		0.30 / 223.42	23-2117-1	SS-1	9
2	1	FILL/Disturbed soil: Grey and light brown clayey silt, some fine sand, wet			23-2117-2	SS-2	25
4				1.52 / 222.20			
6	2	SANDY CLAYEY SILT TILL: Brown to greyish brown, trace gravel, moist, hard				SS-3	36
8						SS-4	47
10	3	CLAYEY SILT TILL: Grey, trace gravel, trace fine sand, moist, hard		3.05 / 220.67		SS-5	48
12	4						
14							
16	5					SS-6	35
18		SILTY SAND: Grey, trace gravel, trace clay, wet, very dense		5.49 / 218.23			
20	6					SS-7	100+
22		End of borehole at 6.55m		6.55 / 217.17			
24	7						
26	8						
28							
30	9						
32							
34	10						

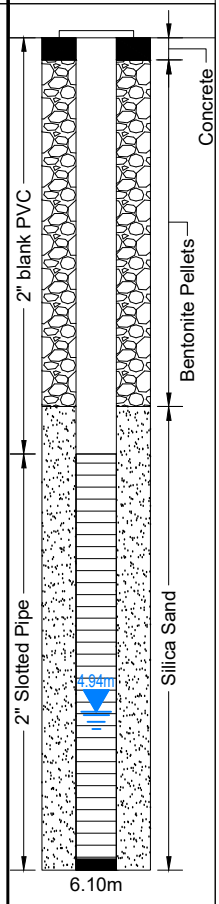
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: Dry/ On November 27, 2023: 4.94m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW2 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

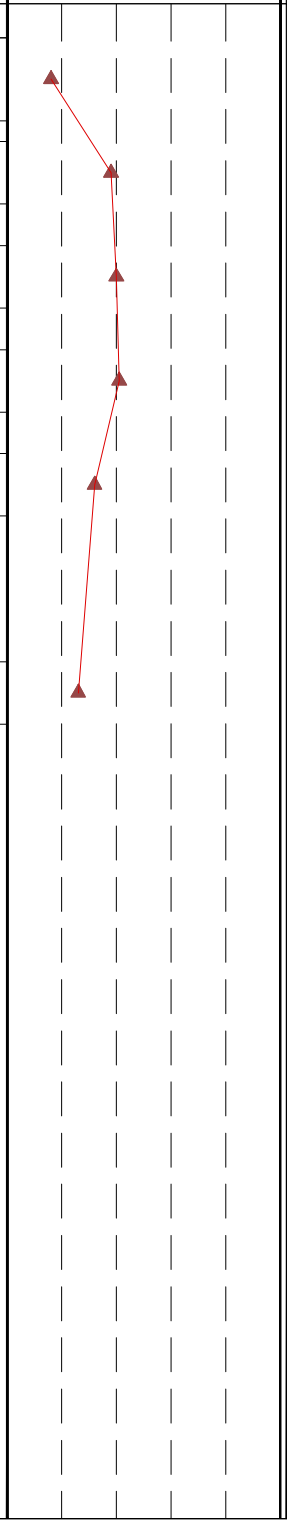
PROJECT NAME: GEOTECHNICAL & PHASE II ESA

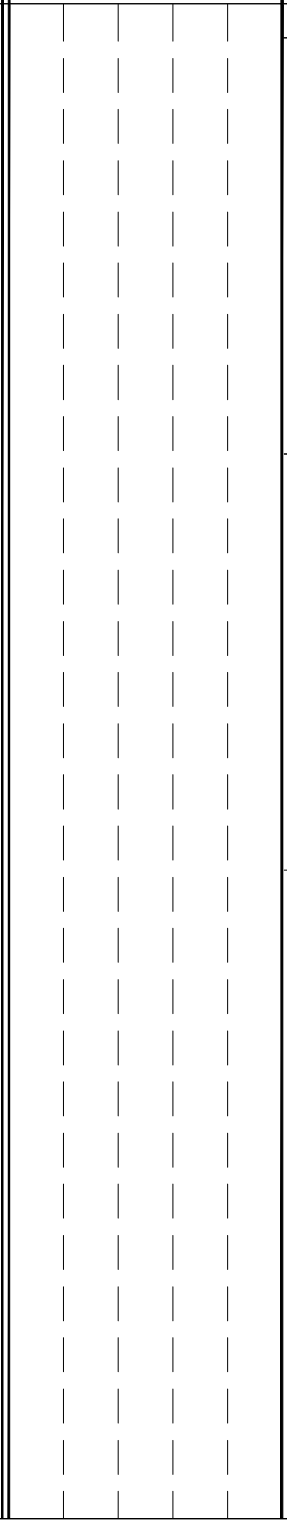
LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

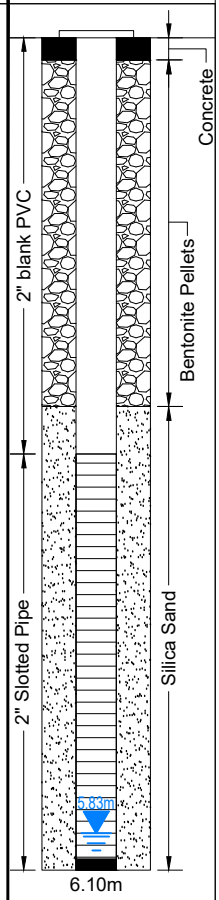
DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 14 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				224.31			
0	0	TOPSOIL: Dark brown clayey silt, trace rootlets		0.15 / 224.16	23-2117-3	SS-1	16
2		FILL: Brown sandy silt, some clay, trace gravel, moist		0.76 / 223.55			
4	1	CLAYEY SILT TILL: Grey to brown, trace gravel, trace fine sand, moist, hard				SS-2	38
6	2					SS-3	40
8						SS-4	41
10	3	SILTY CLAY TILL: Grey, trace gravel, moist, very stiff to hard		3.05 / 221.26		SS-5	32
12	4						
14							
16	5					SS-6	26
18					23-2117-4	AG-7	
20	6	End of borehole at 6.14m		6.14 / 218.17			
22	7						
24							
26	8						
28							
30	9						
32	10						
34							







Groundwater Depth (m): on completion: Dry/ On November 27, 2023: 5.83m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW3 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 14 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				223.22			
0	0	~76mm CONCRETE					
		FILL/Disturbed soil: Brown silt to sandy silt, trace gravel, wet			23-2117-5	SS-1	0
2	1				23-2117-6	SS-2	17
4				1.52 / 221.70			
6	2	SILTY SAND: Brown, very fine sand, trace clay, trace gravel, moist, dense to very dense				SS-3	34
8						SS-4	89
10	3					SS-5	49
12				3.81 / 219.41			
	4	SANDY SILT TILL: Grey, trace clay, trace gravel, moist, very dense					
14							
16	5			5.03 / 218.19		SS-6	68
		End of borehole at 5.03m					
18							
20	6						
22	7						
24							
26	8						
28							
30	9						
32							
34	10						

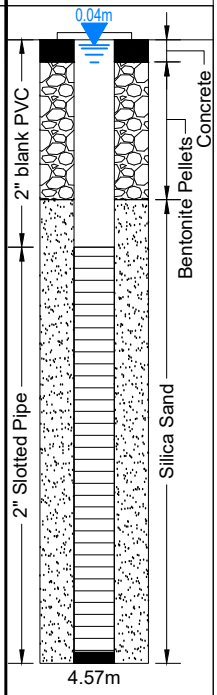
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: Dry/ On November 27, 2023: 0.40m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW4 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 14 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				220.77			
0	0	TOPSOIL		0.15 / 220.62			
2	1	FILL: Grey and brown silty sand, trace gravel, moist		0.76 / 220.01	23-2117-7	SS-1	16
4	1	SANDY CLAYEY SILT TILL: Brown, trace gravel, moist, very stiff to hard				SS-2	20
6	2					SS-3	39
8	2					SS-4	67
10	3	CLAYEY SILT TILL: Grey, trace gravel, trace fine sand, moist, hard		3.05 / 217.72		SS-5	45
12	4						
14	4						
16	5					SS-6	45
18	5			5.49 / 215.28			
20	6	SILTY SAND: Grey, trace clay, wet, dense			23-2117-8	SS-7	33
22	7	End of borehole at 6.55m		6.55 / 214.22			
24	7						
26	8						
28	8						
30	9						
32	10						
34	10						

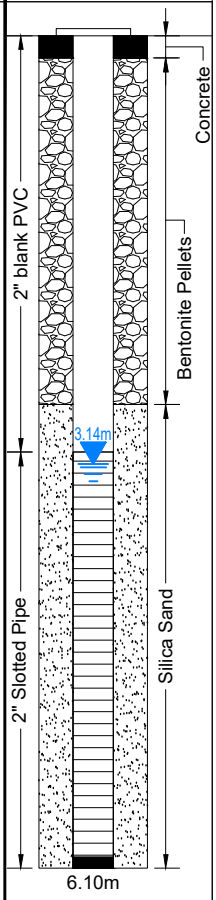
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: 6.10m/ On November 27, 2023: 3.14m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW5 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 14 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				220.72			
0	0	TOPSOIL: Dark brown clayey silt, trace rootlets		0.15 / 220.57	23-2117-9	SS-1	6
2	1	FILL/Disturbed soil: Grey and brown clayey silt, some fine sand, trace gravel, moist			23-2117-10 23-2117-11 (DUP)	SS-2	27
4				1.52 / 219.20			
6	2	SANDY CLAYEY SILT TILL: Brown, trace gravel, moist, very dense				SS-3	55
8		CLAYEY SILT TILL: Grey, trace gravel, trace fine sand, moist, hard		2.29 / 218.43		SS-4	47
10	3					SS-5	51
12	4						
14							
16	5					SS-6	43
18		SILTY SAND: Grey, trace clay, wet, dense		5.49 / 215.23			
20	6					SS-7	37
22		End of borehole at 6.55m		6.55 / 214.17			
24	7						
26	8						
28							
30	9						
32							
34	10						

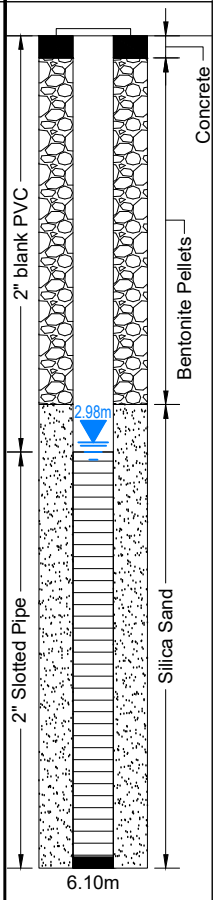
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: 6.10m/ On November 27, 2023: 2.98m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW6 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 13 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				223.48			
0	0	TOPSOIL: Dark brown clayey silt, trace sand, rootlets		0.15 / 223.33	23-2117-12	SS-1	8
2		FILL: Brown clayey silt, some sand, trace gravel		0.76 / 222.72			
4	1	SANDY CLAYEY SILT TILL: Greyish brown, trace gravel, moist, hard				SS-2	43
6	2					SS-3	44
8				2.44 / 221.04		SS-4	50
10	3	CLAYEY SILT TILL: Grey, trace gravel, trace fine sand, moist, hard				SS-5	36
12	4						
14							
16	5				23-2117-13	SS-6	42
18							
20	6					SS-7	59
22	7	End of borehole at 6.55m		6.55 / 216.93			
24							
26	8						
28							
30	9						
32	10						
34							

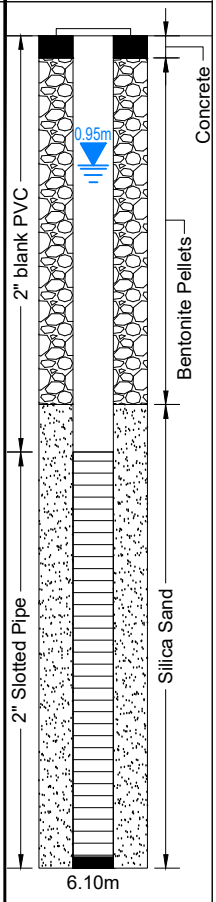
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: Dry/ On November 27, 2023: 0.95m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW7 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

PROJECT NAME: GEOTECHNICAL & PHASE II ESA

LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 13 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				223.58			
0	0	TOPSOIL: Dark brown clayey silt, rootlets		0.15 / 223.43			
		FILL: Grey and brown clayey silt, some sand, trace bricks, trace gravel, moist			23-2117-14	SS-1	3
2				0.76 / 222.82			
	1	SANDY CLAYEY SILT TILL: Greyish brown, trace gravel, moist, hard			23-2117-15	SS-2	42
4							
6	2					SS-3	47
8						SS-4	36
10	3			3.05 / 220.53			
		CLAYEY SILT TILL: Grey, trace gravel, trace fine sand, moist, hard				SS-5	32
12							
14	4						
16						SS-6	45
	5						
18							
20	6	Sand seam @6.40m to 6.55m				SS-7	32
				6.55 / 217.03			
22		End of borehole at 6.55m					
	7						
24							
26	8						
28							
30	9						
32							
	10						
34							

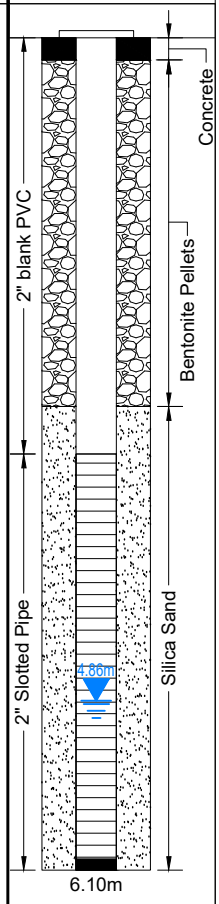
PENETRATION TESTING (SPT) ▲ 20 40 60 80

SHEAR STRENGTH (Kpa) ✚ 40 80 120 160

VAPOUR READING (ppm) □ 20 40 60 80

MOISTURE CONTENT (%) ● 10 20 30 40

PIEZOMETER OR WELL CONSTRUCTION



Groundwater Depth (m): on completion: Dry/ On November 27, 2023: 4.86m

DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

FISHER ENGINEERING

LOG OF BOREHOLE

NO. MW8 SHEET. 1 of 1

PROJECT NO.: FE# 23-13472/73

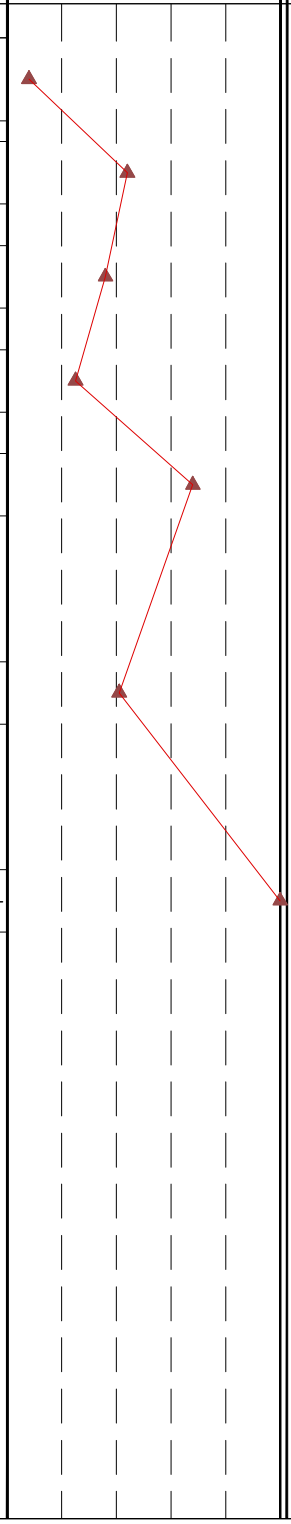
PROJECT NAME: GEOTECHNICAL & PHASE II ESA

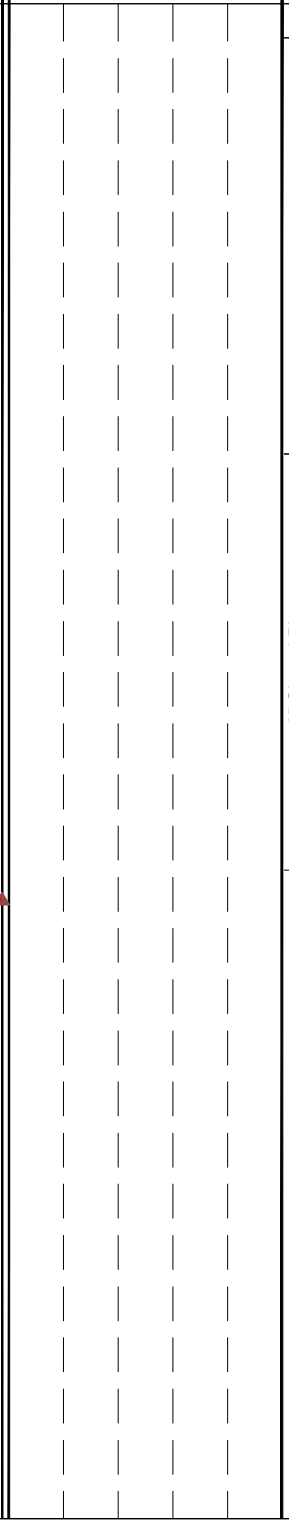
LOCATION: South of Grey Rd. 19 & Crosswinds Blvd., Town of Blue Mountains, ON

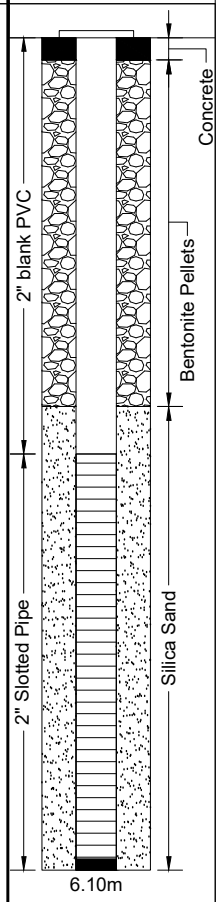
DRILLING METHOD: Morooka, Solid Stem

DRILLING DATE: 13 November, 2023

DEPTH (feet)	DEPTH (meters)	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	LAB ID	Type NO.	"N" VALUE
				223.51			
0	0	TOPSOIL: Dark brown clayey silt, trace rootlets, moist		0.30 / 223.21	23-2117-16	SS-1	8
2		FILL: Grey and brown sandy clayey silt, trace gravel, moist		0.76 / 222.75			
4	1	SANDY CLAYEY SILT TILL: Grey, trace gravel, trace rock pieces, moist, very stiff to hard				SS-2	44
6						SS-3	36
8	2	Sand seam @2.29m to 2.59m				SS-4	25
10	3					SS-5	68
12							
14	4			4.57 / 218.94			
16	5	SILTY SAND: Brown to grey, trace gravel, wet, dense to very dense				SS-6	41
18							
20	6	Grey @6.10m			23-2117-17	SS-7	100+
22	7	End of borehole at 6.71m		6.71 / 216.80			
24							
26	8						
28							
30	9						
32							
34	10						







Groundwater Depth (m): on completion: 6.10m/ On November 27, 2023: Dry

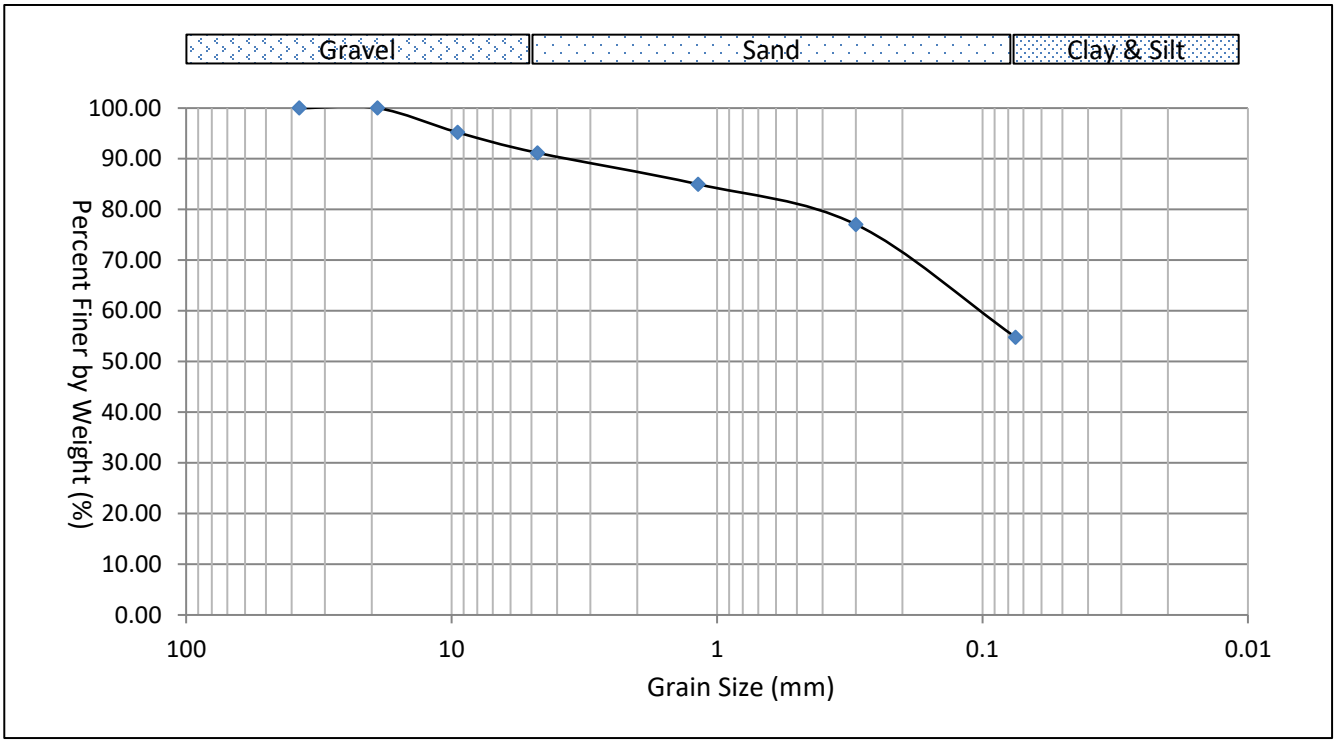
DRAWN: T.L. LOGGED: M.M. CHECKED: C.W.

Appendix C:
Grain Size Distribution

Grain Size Distribution

Sample ID: 23-1029 BH1 SS3 (1.53-1.98m)

Gravel: 8.8% Sand: 36.4% Clay and Silt 54.8%

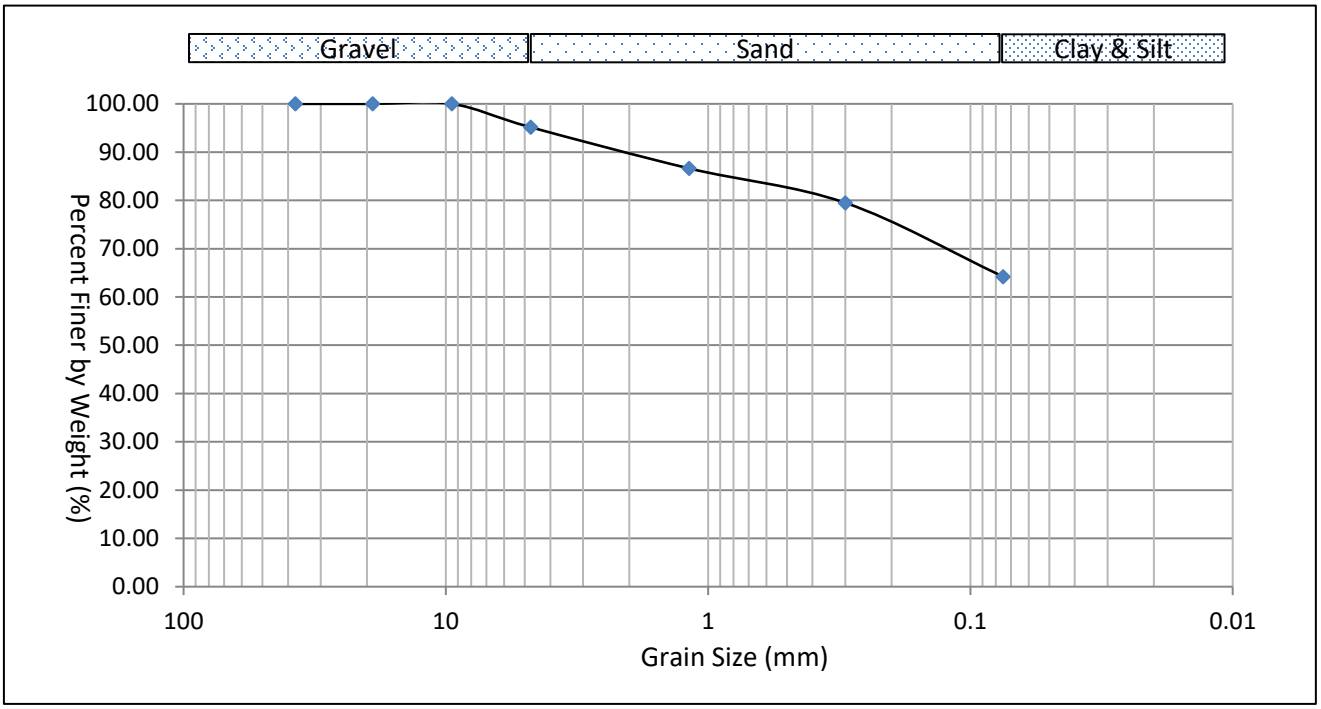


Results related only to the items tested

Grain Size Distribution

Sample ID: 23-1030 BH1 SS5 (3.05-3.51m)

Gravel: 4.8% Sand: 30.9% Clay and Silt 64.2%

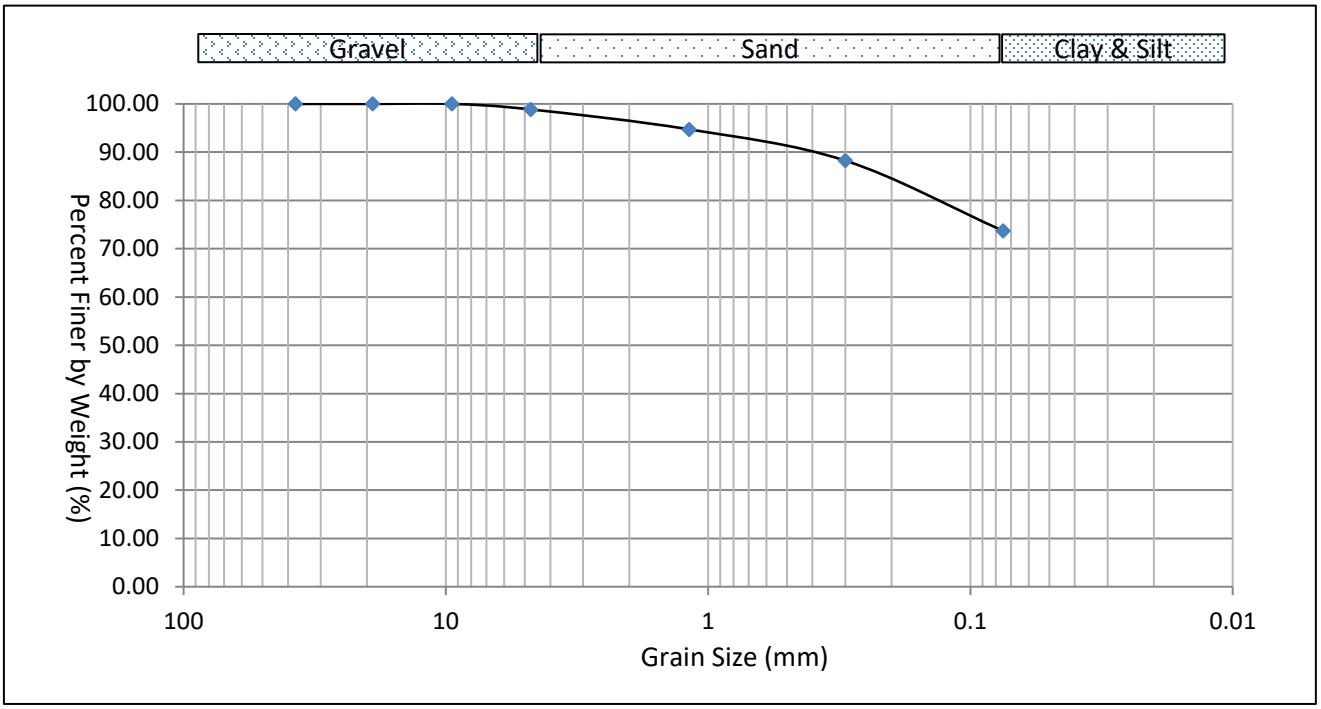


Results related only to the items tested

Grain Size Distribution

Sample ID: 23-1031 BH5 SS3 (1.53-1.98m)

Gravel: 1.1% Sand: 25.2% Clay and Silt 73.7%

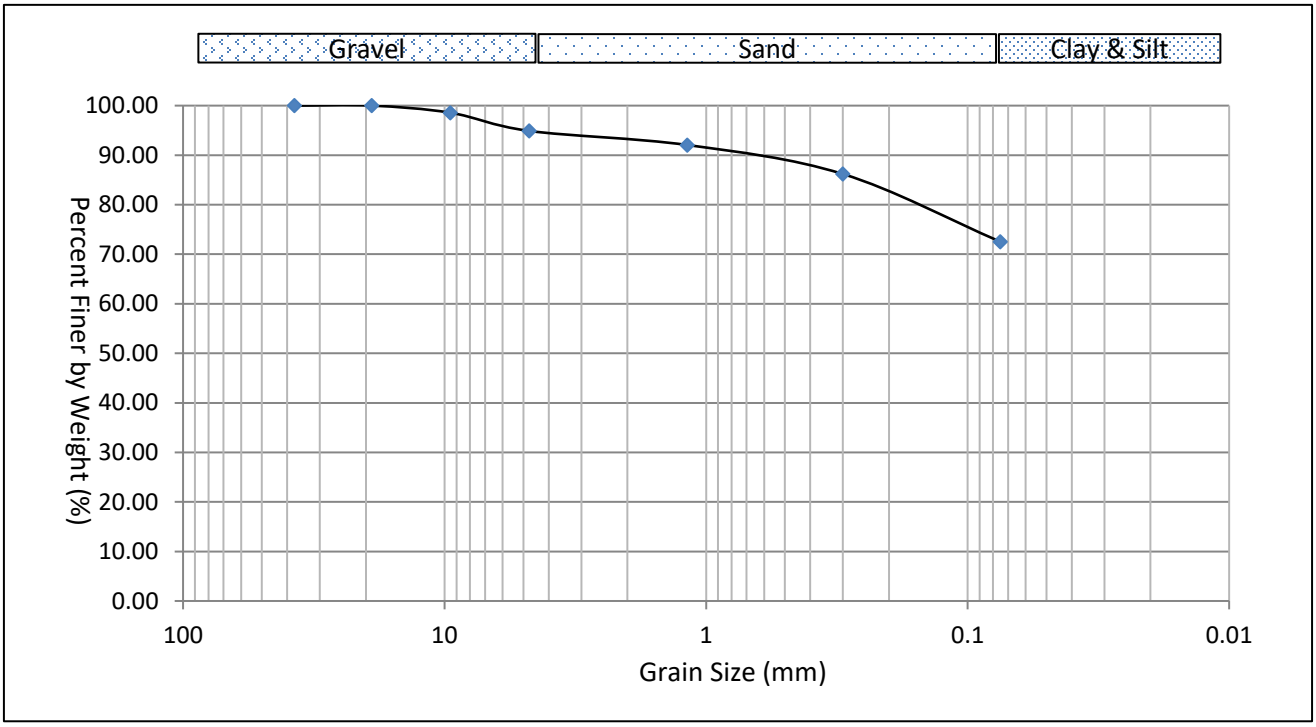


Results related only to the items tested

Grain Size Distribution

Sample ID: 23-1032 BH5 SS5 (3.05-3.51m)

Gravel: 5.1% Sand: 22.4% Clay and Silt 72.5%



Results related only to the items tested

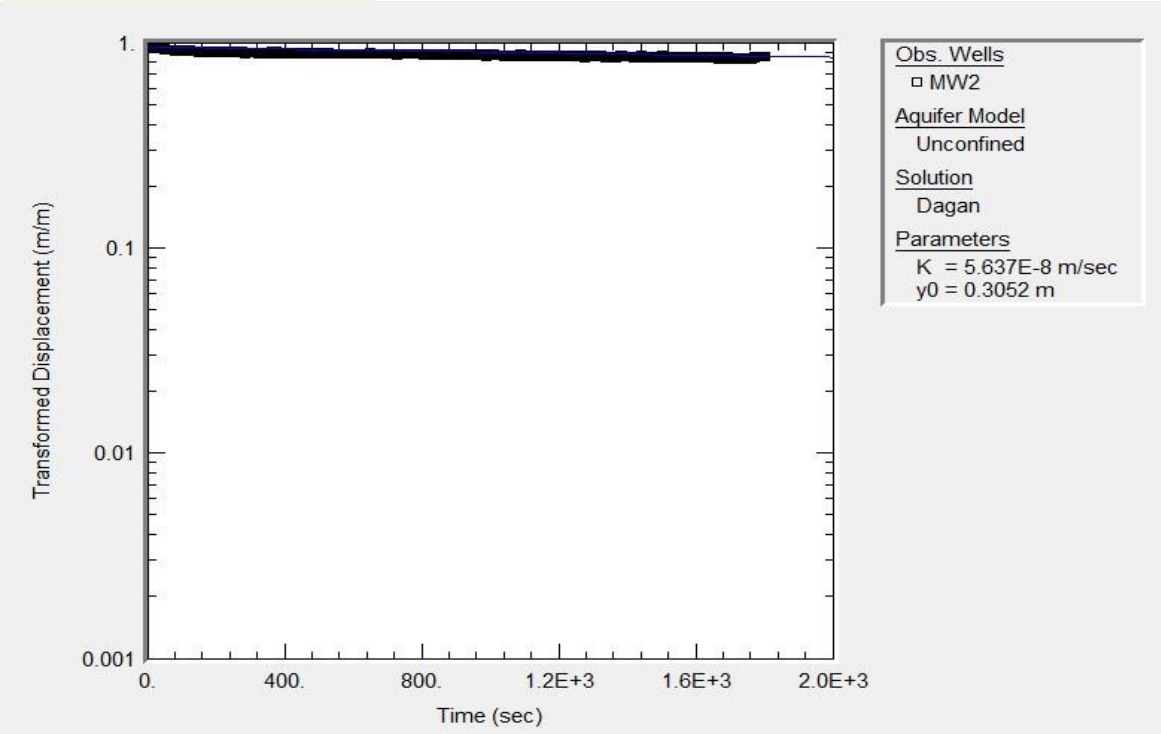
Appendix D:
Rising Head Test Results

TATHAM ENGINEERING

Estimated Hydraulic Conductivity - Slug Test
Dagan Equation

Date Completed:	4/15/2024
Conducted by:	NT

Well Number:	MW2	
Well Screen Bottom:	6.1	mbgs
Top of Pipe:	0.99	mags
Well Casing Diameter:	5	cm
Well Elevation:	224.31	masl
Static Water Level:	5.36	mbgs
K:	5.64E-08	m/s



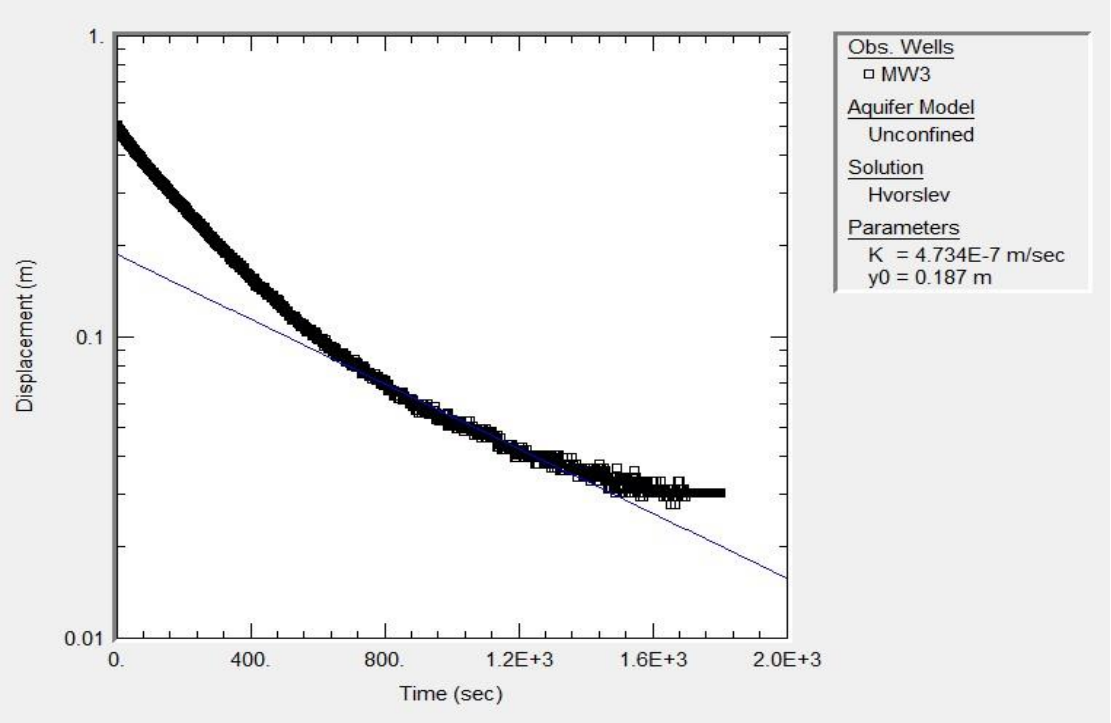
Reference: Dagan, M.J., 1978. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, US Army, Vicksburg, Mississippi, pp 1-50.

TATHAM ENGINEERING

Estimated Hydraulic Conductivity - Slug Test
Hvorslev Equation

Date Completed:	4/15/2024
Conducted by:	NT

Well Number:	MW3	
Well Screen Bottom:	4.6	mbgs
Top of Pipe:	N/A - flushmount	mags
Well Casing Diameter:	5	cm
Well Elevation:	223.22	masl
Static Water Level:	0.16	mbgs
K:	4.73E-07	m/s



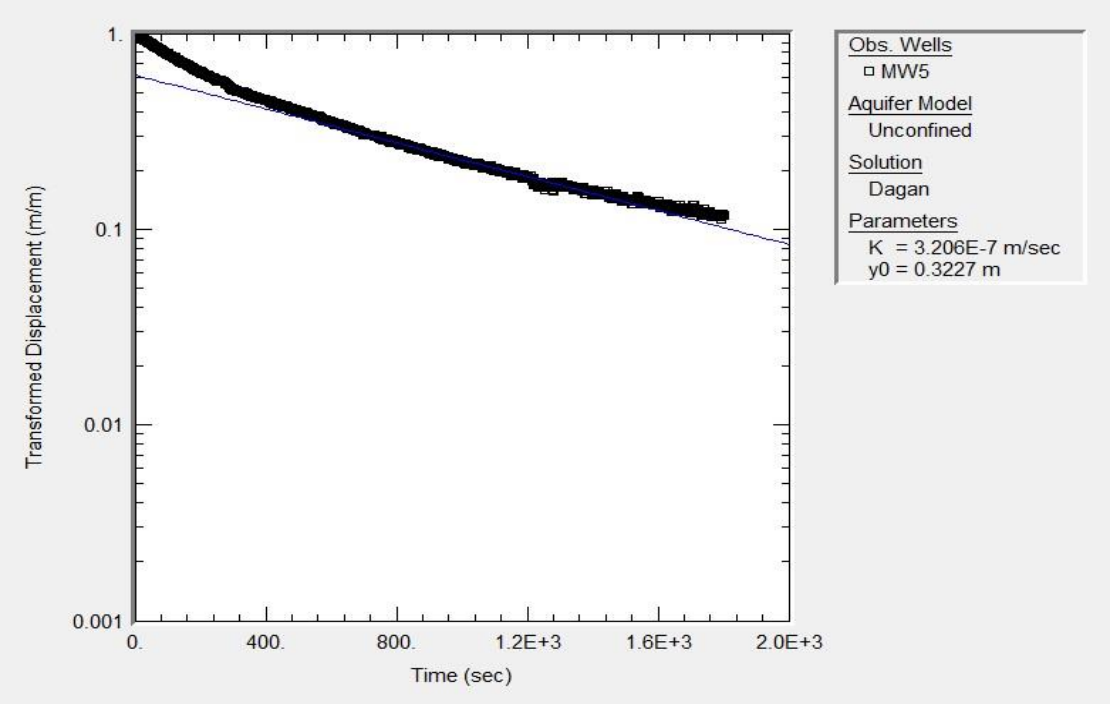
Reference: Hvorslev, 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, US Army, Vicksburg, Mississippi, pp 1-50.

TATHAM ENGINEERING

Estimated Hydraulic Conductivity - Slug Test
Dagan Equation

Date Completed:	4/15/2024
Conducted by:	NT

Well Number:	MW5	
Well Screen Bottom:	6.1	mbgs
Top of Pipe:	0.98	mags
Well Casing Diameter:	5	cm
Well Elevation:	220.72	masl
Static Water Level:	2.61	mbgs
K:	3.21E-07	m/s



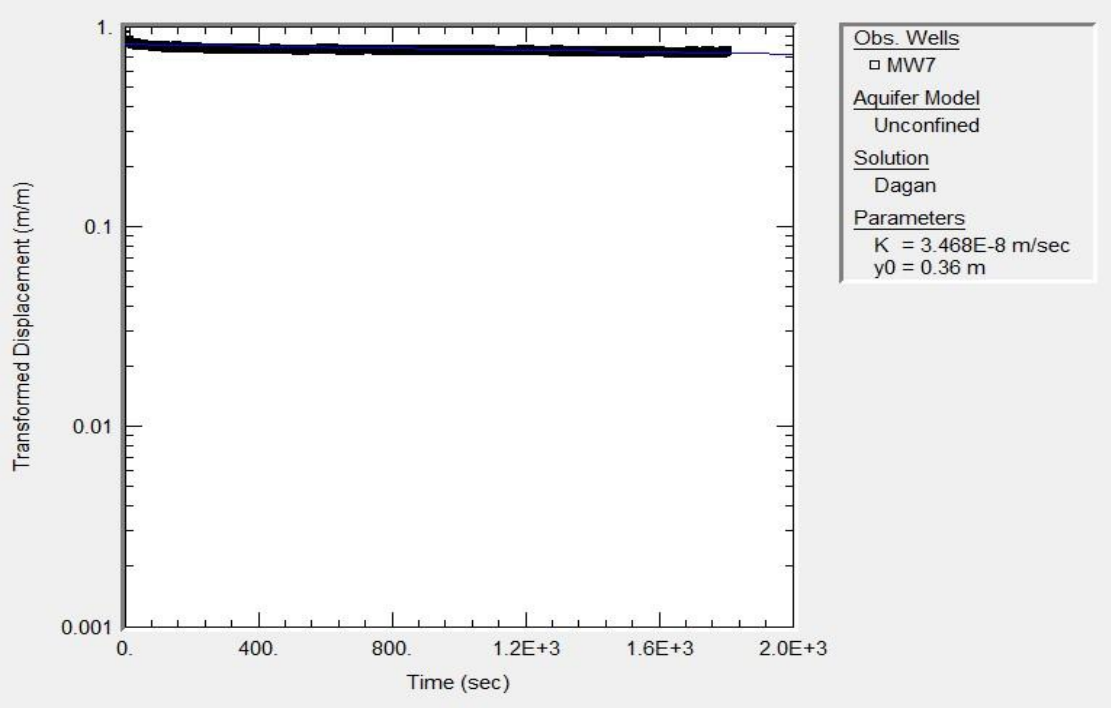
Reference: Dagan, M.J., 1978. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, US Army, Vicksburg, Mississippi, pp 1-50.

TATHAM ENGINEERING

Estimated Hydraulic Conductivity - Slug Test
Dagan Equation

Date Completed:	4/15/2024
Conducted by:	NT

Well Number:	MW7	
Well Screen Bottom:	6.1	mbgs
Top of Pipe:	1.02	mags
Well Casing Diameter:	5	cm
Well Elevation:	223.58	masl
Static Water Level:	4.26	mbgs
K:	3.47E-08	m/s



Reference: Dagan, M.J., 1978. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, US Army, Vicksburg, Mississippi, pp 1-50.

Appendix E:
Groundwater Chemistry COA

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G114896 **REPORT No: 24-009572 - Rev. 0**

Report To:
Tatham Engineering
115 Sandford Fleming Drive
Suite 200
Collingwood, ON L9Y 5A6

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Noah Trembley

DATE RECEIVED: 2024-Apr-09
DATE REPORTED: 2024-Apr-16
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 123143
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Chromium VI (Liquid)	1	OTTAWA	STAILLON	2024-Apr-12	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-12	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-12	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-12	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2024-Apr-12	D-HG-02	SM 3112B
PHC F1 (Liquid)	1	RICHMOND_HILL	FLENA	2024-Apr-12	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	1	KINGSTON	STHOMPSON	2024-Apr-12	PHC-W-001	MECP E3421
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-12	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Michelle Dubien
Data Specialist

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CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G114896 **REPORT No: 24-009572 - Rev. 1**

Report To:
Tatham Engineering
115 Sandford Fleming Drive
Suite 200
Collingwood, ON L9Y 5A6

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Noah Trembley

DATE RECEIVED: 2024-Apr-09
DATE REPORTED: 2024-Apr-16
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 123143
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Chromium VI (Liquid)	1	OTTAWA	STAILLON	2024-Apr-12	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-12	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-12	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	NHOGAN	2024-Apr-12	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2024-Apr-12	D-HG-02	SM 3112B
PHC F1 (Liquid)	1	RICHMOND_HILL	FLENA	2024-Apr-12	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	1	KINGSTON	STHOMPSON	2024-Apr-12	PHC-W-001	MECP E3421
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-12	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-
Aluminum	µg/L	10.0			31.0
Hardness (as CaCO3)	mg/L	-			389
Aluminum (Total)	mg/L	0.01			1.56
Boron (Total)	mg/L	0.005			0.040
Calcium (Total)	mg/L	0.02			134
Iron (Total)	mg/L	0.005			2.44
Magnesium (Total)	mg/L	0.02			13.2
Tungsten (Total)	mg/L	0.01			<0.01
Zinc (Total)	mg/L	0.005			0.015
Zirconium (Total)	mg/L	0.003			<0.003
Antimony (Total)	mg/L	0.0001			0.0004
Arsenic (Total)	mg/L	0.0001			0.0008
Beryllium (Total)	mg/L	0.0001			<0.0001
Cadmium (Total)	mg/L	0.000015			0.000021
Chromium (Total)	mg/L	0.001			0.002
Cobalt (Total)	mg/L	0.0001			0.0016
Copper (Total)	mg/L	0.0001			0.0059
Lead (Total)	mg/L	0.00002			0.00217
Molybdenum (Total)	mg/L	0.0001			0.0002
Nickel (Total)	mg/L	0.0002			0.0051
Selenium (Total)	mg/L	0.001			<0.001

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-
Silver (Total)	mg/L	0.0001			<0.0001
Thallium (Total)	mg/L	0.00005			<0.00005
Uranium (Total)	mg/L	0.00005			0.00049
Vanadium (Total)	mg/L	0.0001			0.0023
Chromium (VI)	µg/L	1	25	T1GW	<1
Mercury	µg/L	0.02	0.1	T1GW	<0.02

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-
Acetone	µg/L	30	2700	T1GW	<30
Benzene	µg/L	0.5	0.5	T1GW	<0.5
Bromodichloromethane	µg/L	2	2	T1GW	<2
Bromoform	µg/L	5	5	T1GW	<5
Bromomethane	µg/L	0.5	0.89	T1GW	<0.5
Carbon Tetrachloride	µg/L	0.2	0.2	T1GW	<0.2
Chlorobenzene	µg/L	0.5	0.5	T1GW	<0.5
Chloroform	µg/L	1	2	T1GW	<1
Dibromochloromethane	µg/L	2	2	T1GW	<2
Ethylene Dibromide	µg/L	0.2	0.2	T1GW	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	0.5	T1GW	<0.5
Dichlorodifluoromethane (Freon 12)	µg/L	2	590	T1GW	<2
Dichloroethane,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethane,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethylene,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	1.6	T1GW	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	1.6	T1GW	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5			<0.5

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-
Dichloropropene,1,3-cis+trans-(Calculated)	µg/L	0.5	0.5	T1GW	<0.5
Dichloropropene,1,3-trans-	µg/L	0.5			<0.5
Ethylbenzene	µg/L	0.5	0.5	T1GW	<0.5
Hexane	µg/L	5	5	T1GW	<5
Dichloromethane (Methylene Chloride)	µg/L	5	5	T1GW	<5
Methyl Ethyl Ketone	µg/L	2	400	T1GW	<2
Methyl Isobutyl Ketone	µg/L	20	640	T1GW	<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2	15	T1GW	<2
Styrene	µg/L	0.5	0.5	T1GW	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	1.1	T1GW	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	0.5	T1GW	<0.5
Tetrachloroethylene	µg/L	0.5	0.5	T1GW	<0.5
Toluene	µg/L	0.5	0.8	T1GW	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	0.5	T1GW	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	0.5	T1GW	<0.5
Trichloroethylene	µg/L	0.5	0.5	T1GW	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5	150	T1GW	<5
Vinyl Chloride	µg/L	0.2	0.5	T1GW	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1	72	T1GW	<1.1
Xylene, o-	µg/L	0.5			<0.5

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-
PHC F1 (C6-C10)	µg/L	25	420	T1GW	<25
PHC F2 (>C10-C16)	µg/L	50	150	T1GW	<50
PHC F3 (>C16-C34)	µg/L	400	500	T1GW	<400
PHC F4 (>C34-C50)	µg/L	400	500	T1GW	<400

Reg 153 - Liquid: Reg 153 - Liquid
T1GW: R153 Tbl. 1 - GW

Christine Burke
Laboratory Manager

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits		-
Aluminum	µg/L	10	75	INTERIM	31
Hardness (as CaCO3)	mg/L as CaCO3	-			389
Aluminum (Total)	µg/L	10			1560
Boron (Total)	µg/L	5	200	INTERIM	40
Calcium (Total)	µg/L	20			134000
Iron (Total)	µg/L	5	300	PWQO	**2440**
Magnesium (Total)	µg/L	20			13200
Tungsten (Total)	µg/L	10	30	INTERIM	<10
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO	15
Zirconium (Total)	µg/L	3	4	INTERIM	<3
Antimony (Total)	µg/L	0.1	20	INTERIM	0.4
Arsenic (Total)	µg/L	0.1	5, 5	INTERIM, PWQO	0.8
Beryllium (Total)	µg/L	0.1	11	PWQO	<0.1
Cadmium (Total)	µg/L	0.015	0.1, 0.2	INTERIM, PWQO	0.021
Chromium (Total)	µg/L	1			2
Cobalt (Total)	µg/L	0.1	0.9	INTERIM	**1.6**
Copper (Total)	µg/L	0.1	5	INTERIM	**5.9**
Lead (Total)	µg/L	0.02	1, 5	INTERIM, PWQO	**2.17**
Molybdenum (Total)	µg/L	0.1	40	INTERIM	0.2
Nickel (Total)	µg/L	0.2	25	PWQO	5.1
Selenium (Total)	µg/L	1	100	PWQO	<1

Michelle Dubien
Data Specialist

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Parameter	Units	R.L.	Limits		Client I.D.: MW3 Sample I.D.: 24-009572-1 Date Collected: 2024-Apr-09
					-
Silver (Total)	µg/L	0.1	0.1	PWQO	<0.1
Thallium (Total)	µg/L	0.05	0.3, 0.3	INTERIM, PWQO	<0.05
Uranium (Total)	µg/L	0.05	5	INTERIM	0.49
Vanadium (Total)	µg/L	0.1	6	INTERIM	2.3
Chromium (VI)	µg/L	1	1	PWQO	<1
Mercury	µg/L	0.02	0.2	PWQO	<0.02

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Data Specialist

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Parameter	Units	R.L.	Limits		Client I.D.: MW3 Sample I.D.: 24-009572-1 Date Collected: 2024-Apr-09 -
Acetone	µg/L	30			<30
Benzene	µg/L	0.5	100	INTERIM	<0.5
Bromodichloromethane	µg/L	2	200	INTERIM	<2
Bromoform	µg/L	5	60	INTERIM	<5
Bromomethane	µg/L	0.5	0.9	INTERIM	<0.5
Carbon Tetrachloride	µg/L	0.2			<0.2
Chlorobenzene	µg/L	0.5	15	PWQO	<0.5
Chloroform	µg/L	1			<1
Dibromochloromethane	µg/L	2	40	INTERIM	<2
Ethylene Dibromide	µg/L	0.2	5, 5	INTERIM, PWQO	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	4	PWQO	<0.5
Dichlorodifluoromethane (Freon 12)	µg/L	2			<2
Dichloroethane,1,1-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethane,1,2-	µg/L	0.5	100	INTERIM	<0.5
Dichloroethylene,1,1-	µg/L	0.5	40	INTERIM	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	200	INTERIM	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.7	INTERIM	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5			<0.5

Michelle Dubien
Data Specialist

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits		-
Dichloropropene,1,3-cis+trans-(Calculated)	µg/L	0.5			<0.5
Dichloropropene,1,3-trans-	µg/L	0.5	7	INTERIM	<0.5
Ethylbenzene	µg/L	0.5	8	INTERIM	<0.5
Hexane	µg/L	5			<5
Dichloromethane (Methylene Chloride)	µg/L	5	100	INTERIM	<5
Methyl Ethyl Ketone	µg/L	2	400	INTERIM	<2
Methyl Isobutyl Ketone	µg/L	20			<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2	200	INTERIM	<2
Styrene	µg/L	0.5	4	INTERIM	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	20	INTERIM	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	70	INTERIM	<0.5
Tetrachloroethylene	µg/L	0.5	50	INTERIM	<0.5
Toluene	µg/L	0.5	0.8, 0.8	INTERIM, PWQO	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	10	INTERIM	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	800	INTERIM	<0.5
Trichloroethylene	µg/L	0.5	20	INTERIM	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5			<5
Vinyl Chloride	µg/L	0.2	600	INTERIM	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1			<1.1
Xylene, o-	µg/L	0.5	40	INTERIM	<0.5

Michelle Dubien
Data Specialist

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				Client I.D.	MW3
				Sample I.D.	24-009572-1
				Date Collected	2024-Apr-09
Parameter	Units	R.L.	Limits		-
PHC F1 (C6-C10)	µg/L	25			<25
PHC F2 (>C10-C16)	µg/L	50			<50
PHC F3 (>C16-C34)	µg/L	400			<400
PHC F4 (>C34-C50)	µg/L	400			<400

: PWQO Limits
INTERIM: Interim PWQO
PWQO: PWQO

Summary of Exceedances

Interim PWQO

MW3	Found Value	Limit
Cobalt (Total)	1.6	0.9
Copper (Total)	5.9	5
Lead (Total)	2.17	1

PWQO

MW3	Found Value	Limit
Iron (Total)	2440	300

Michelle Dubien
Data Specialist

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GENERAL SAMPLE SUBMISSION FORM

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Proudly Canadian.

SAMPLES SUBMITTED TO: Kingston [ ] Ottawa [ ] Richmond Hill [ ] Barrie [X] Windsor [ ]

TESTING REQUIREMENTS

[X] O'Reg 153/04 Table (1 - 9) ____ Record of Site ____
[ ] O'Reg 406/19 Table (1 - 9.1) ____ SPLP Table (1-9.1) ____
[ ] RPI [ ] ICC [ ] Agricultural
[ ] Coarse [ ] Medium/Fine [ ] O'Reg 558 TCLP
[ ] MISA [X] PWQO [ ] Landfill Monitoring
[ ] Other: ____

REPORT NUMBER (Lab Use): 24-009572

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? [ ] Yes [X] No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Organization: Tatham Engineering Ltd.	Address: 41 King St, Barrie ON	Invoicing Address (if different): 123143
Contact: Noah Trembley		
Tel: (705) 791-7858 Fax:	Quote #: (Tatham) Tatham 3764	Project Name or #: ~~4258~~
Email: ntrembley@tathameng.com	P.O. #:	Additional Info: * as per client email CS
Additional Info (email, cell, etc):		

ANALYSES REQUESTED

PWQO Metals + inorganics * / O.Reg 153/04 PAHs + Vocs

Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page)

*Must be arranged in advance

[ ]	Platinum*	200% Surcharge
[ ]	Gold*	100% Surcharge
[ ]	Silver	50% Surcharge
[ ]	Bronze	25% Surcharge
[X]	Standard	5-7 days
[ ]	Specific Date:	____

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No.	Sample Source and/or Sample Identification	S.P.L. (Watertrax)	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	X	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered Y/N
	MW3	~~Glot~~	GW	24-04-09	10AM	X X					Y
	* inorganics not req'd as per client email CS 240410										
	genchem → K										
	Hg + CrVI + metals(UF) + metals(F) → O										
	Vials → RH										

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:	Noah Trembley	Noah Trembley
Sign:	N Trembley	N Trembley
	24-04-09	24-04-09
	Date (yy-mm-dd)/Time:	Date (yy-mm-dd)/Time:

SHIPPING INFORMATION

Courier (Client account) [ ]
Courier (Caduceon account) [ ]
Drop Off [X]
Caduceon (Pick-up) [ ]

Invoice: ____
# of Pieces: 1

REPORTING / INVOICING

Report by Fax [ ]
Report by Email [X]
Invoice by Email [X]
Invoice by Mail [ ]

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print): Brady Signature: B Qa
Date Received (yy-mm-dd): 24 04 09 Time Received: 14:00
Laboratory Prepared Bottles: [V] Yes [ ] No
Sample Temperature °C: 19.4 Labeled by: BW

Comments:

Page 1 of 1

G 114896

Appendix F:
Water Taking Estimates

TATHAM ENGINEERING

Construction Dewatering Rate Estimate
Dupuit - Radial Flow

Zone 1 - Housing Development (Block A)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		224.31	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		219.51	m asl	MW1
Lowest Proposed Excavation		222.31	m asl	Assume 2 m
Target Water Level		221.31	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		221.31	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	60	m	Block A approx. total area = 3000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	-1.8	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	27	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	31	m	
Length of Influence ($L_0=R_0/2$)	L_0	14	m	
10 mm Precipitation Event		30,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	No significant dewatering anticipated. Localized sump pumping may be required.		
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q			
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q			

Zone 2 - Housing Development (Block B)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		224.31	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		219.51	m asl	MW1
Lowest Proposed Excavation		222.31	m asl	Assume 2 m
Target Water Level		221.31	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		221.31	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	60	m	Block B approx. total area = 3000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	-1.8	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	27	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	31	m	
Length of Influence ($L_0=R_0/2$)	L_0	14	m	
10 mm Precipitation Event		30,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	No significant dewatering anticipated. Localized sump pumping may be required.		
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q			
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q			

Zone 3 - Housing Development (Block C)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		223.48	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		223.01	m asl	MW6
Lowest Proposed Excavation		221.48	m asl	Assume 2 m
Target Water Level		220.48	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		220.48	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	60	m	Block C approx. total area = 3000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	2.53	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	36	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	31	m	
Length of Influence ($L_0=R_0/2$)	L_0	18	m	
10 mm Precipitation Event		30,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	**7,300**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q	**14,600**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q	**44,600**	L/day	

Zone 4 - Housing Development (Block D)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		223.22	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		223.06	m asl	MW3
Lowest Proposed Excavation		221.22	m asl	Assume 2 m
Target Water Level		220.22	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		220.22	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	60	m	Block D approx. total area = 3000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	2.84	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	37	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	31	m	
Length of Influence ($L_0=R_0/2$)	L_0	18	m	
10 mm Precipitation Event		30,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	**8,400**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q	**16,800**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q	**46,800**	L/day	

Zone 5 - Housing Development (Block E)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		220.77	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		218.11	m asl	MW5
Lowest Proposed Excavation		218.77	m asl	Assume 2 m
Target Water Level		217.77	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		217.77	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	60	m	Block E approx. total area = 3000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	0.34	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	32	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	31	m	
Length of Influence ($L_0=R_0/2$)	L_0	16	m	
10 mm Precipitation Event		30,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	**700**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q	**1,400**	L/day	
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q	**31,400**	L/day	

Zone 6 - Housing Development (Block F)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		223.58	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		219.32	m asl	MW7
Lowest Proposed Excavation		221.58	m asl	Assume 2 m
Target Water Level		220.58	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		220.58	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	80	m	Block F approx. total area = 4000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	-1.26	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	33	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	36	m	
Length of Influence ($L_0=R_0/2$)	L_0	17	m	
10 mm Precipitation Event		40,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	No significiant dewatering anticipated. Localized sump pumping may be required.		
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q			
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q			

Zone 7 - Housing Development (Block G)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		223.51	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		217.38	m asl	MW8
Lowest Proposed Excavation		221.51	m asl	Assume 2 m
Target Water Level		220.51	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		220.51	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	100	m	Block G approx. total area = 5000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	-3.13	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	33	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	40	m	
Length of Influence ($L_0=R_0/2$)	L_0	17	m	
10 mm Precipitation Event		50,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	No significiant dewatering anticipated. Localized sump pumping may be required.		
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q			
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q			

Zone 8 - Housing Development (Block H)

$$Q = \frac{\pi K(H^2 - {h_w}^2)}{In\frac{R_0}{r_e}} + 2\frac{xK(H^2 - {h_w}^2)}{L}$$

Ground Elevation		223.51	m asl	Highest ground elevation in zone
Highest Groundwater Elevation		217.38	m asl	MW8
Lowest Proposed Excavation		221.51	m asl	Assume 2 m
Target Water Level		220.51	m asl	Assume 1 m of drawdown below excavation
Aquifer Bottom		220.51	m asl	
Hydraulic Conductivity	K	5.00E-07	m/s	
Length of Excavation	x	80	m	Block H approx. total area = 4000 m^2
Width of Excavation	a	50	m	
Calculated Parameters				
Water level above aquifer bottom	H	-3.13	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	29	m	$R_0<r_e$, $R_0=r_e+3000(H-h_w)K^{0.5}$
Equivalent Radius (re=(a*x)/π)^0.5)	r_e	36	m	
Length of Influence ($L_0=R_0/2$)	L_0	15	m	
10 mm Precipitation Event		40,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	No significiant dewatering anticipated. Localized sump pumping may be required.		
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q			
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event per 100 m	2Q			

Zone 9: Site Servicing (per 100 m of trench)

$$Q = Kx\frac{H^2 - h^2}{L_0}$$

Ground Elevation		223.22	m asl	MW3
Highest Groundwater Elevation		223.06	m asl	MW3 on April 5, 2024
Lowest Proposed Excavation		219.22	m asl	Assume 4m below ground surface
Target Water Level		218.22	m asl	Assume 1 m of drawdown
Aquifer Bottom		218.22	m asl	
Hydraulic Conductivity	K	4.73E-07	m/s	Assumed K value
Length of Excavation	x	100	m	Per 100 m section
Width of Excavation	a	3	m	
Calculated Parameters				
Water level above aquifer bottom	H	4.84	m	
Target water level above aquifer bottom	h	0	m	
Radius of Influence	R_0	10	m	
Length of Influence (L_0=R_0/2)	L_0	5	m	
Precipitation		3,000	L/day	
Construction Dewatering Flow Rate - Steady State	Q	**19,200**	L/day	Per 100 m section
Maximum Construction Dewatering Flow Rate (safety factor of 2)	2Q	**38,400**	L/day	Per 100 m section
Maximum Construction Dewatering Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q	**41,400**	L/day	Per 100 m section

Appendix G:
Water Taking Plan

Water Taking Plan

CONSTRUCTION DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

The Radius of Influence (ROI) and temporary dewatering discharge rates were calculated in Section 5.1 and the details are summarized below:

ZONE	DESCRIPTION	ROI (m)	CONSTRUCTION DEWATERING FLOW RATE (L/day)	CONSTRUCTION DEWATERING FLOW RATE INLCUDING SAFETY FACTOR OF 2 AND A 10 mm RAIN EVENT (L/day)	CONSTRUCTION DEWATERING FLOW RATE INCLUDING SAFETY FACTOR OF 2 AND A 10 mm RAIN EVENT (L/day)
1	Housing Development (Block A)	No significant dewatering anticipated. Localized sump pumping may be required.			
2	Housing Development (Block B)	No significant dewatering anticipated. Localized sump pumping may be required.			
3	Housing Development (Block C)	36	7,300	7,300	7,300
4	Housing Development (Block D)	37	8,400	8,400	8,400
5	Housing Development (Block E)	32	700	700	700
6	Housing Development (Block F)	No significant dewatering anticipated. Localized sump pumping may be required.			
7	Housing Development (Block G)	No significant dewatering anticipated. Localized sump pumping may be required.			
8	Housing Development (Block H)	No significant dewatering anticipated. Localized sump pumping may be required.			

9	Site Servicing (100 m trench)	10	19,200	19,200	19,200

POTENTIAL SETTLEMENT AND MONITORING

The site is located on the south side of Grey Road 19 approximately 380 m west of the intersection of Grey Road 19 and Osler Bluff Road/Grey Road 19 in the Town of The Blue Mountains. The surrounding land uses include primarily residential and undeveloped lands to the north, rural residential properties to the east, undeveloped land followed by rural residential properties and mountains to the west, and undeveloped lands and mountains to the south. One small structure may lie within the dewatering ROI; therefore, there is the potential for settlement related impacts. Prior to construction dewatering, a settlement analysis is to be completed by the geotechnical engineer, to provide input on the recommended monitoring and/or mitigative actions (if any). Site servicing will be installed before the proposed new houses are constructed, and therefore the proposed new housing development will not be impacted by the small settlements resulting from dewatering activities.

Another cause of significant dewatering related settlement is due to pumping of fines through the system. It is imperative any dewatering systems shall be designed and installed adequately to ensure no soil is conveyed through the system. Sufficient filtering techniques should be incorporated at the entry point to avoid migration of fines in the pumping and/or dewatering system. The turbidity of pumped water should be monitored daily to ensure the minimal fines are being conveyed.

POTENTIAL IMPACT ON OTHER WATER USERS

Temporary dewatering activities are not anticipated to impact any water well users as municipal water from a treatment plant is available to the nearest neighboring properties, and the proposed development consists of relatively shallow works.

REDUCTION OF GROUNDWATER FLOW TO WATERBODIES

A watercourse traversing through the site and an existing unevaluated wetland feature may also be located within ROI. Hence, water levels within these features may be impacted during the construction dewatering activities on-site.

Given the short duration of the proposed construction dewatering and that the water removed will be returned back to the watershed, dewatering activities are not anticipated to have negative impacts to natural features on-site.

WATER QUANTITY, QUALITY AND GROUNDWATER LEVEL MONITORING PROGRAM

Based on baseline groundwater quality analysis, potential dewatering discharge may not meet the PWQO and Interim PWQO requirements during construction dewatering. Water Quality parameters shall be confirmed during the trail dewatering.

Based on the preliminary background quality, it is recommended discharge be treated by a sediment control facility such as sediment/ filtration bags or a decantation tank. Treatment of dewatering discharge water by filtration or sedimentation to reduce the concentration of suspended solids will likely reduce the concentration of non-dissolved metals to achieve compliance with the PWQO.

If water quality parameters exceed the PWQO during construction dewatering, standard treatment options should be evaluated and/or the system should be shut down.

WATER QUALITY MONITORING AND POTENTIAL TREATMENT PLAN

The discharge and monitoring plan are detailed in Table G-1, below.

GROUNDWATER LEVEL MONITORING PROGRAM

The ground water level monitoring program is detailed in Appendix G-1, below.

DISCHARGE RATE MONITORING

Daily groundwater takings are to be measured and recorded using a flow measuring device during construction dewatering by the contractor, in accordance with O.Reg. 63/16. The total daily takings shall be recorded for the duration of the EASR and be submitted through the MECP online reporting system.

SUMMARY OF QUALIFICATIONS

Alicia Kimberley is a licensed professional geoscientist with a Bachelors and Masters degree in Earth Sciences from McMaster University and the University of Waterloo, respectively. She has twelve years of professional experience with geoenvironmental and hydrogeological assessments.

Her experiences include the design and execution of aquifer testing, in-situ groundwater sampling, groundwater modelling, and preparation of hydrogeological reports to support EASR registry.

Noah Trembley obtained a bachelor's degree in Environmental Engineering from the University of Guelph and is a registered Engineering Intern with PEO. He has over a year of experience with geotechnical and environmental engineering and consulting, focusing mostly on excess soil

programs, field investigations (soil and groundwater sampling and monitoring), and preparation of a variety of environmental/hydrogeological reports.

DATE OF PLAN PREPARATION

This plan was prepared on May 3, 2024.

Table G-1: Water Quality Monitoring Plan for Dewatering Discharge to Surface

PERIOD	MONITORING LOCATION	PARAMETERS	MONITORING FREQUENCY	TRIGGIER FOR MITIGATION	MITIGATION MEASURES/COMMENTS
Trial Dewatering	Dewatering Discharge	PWQO Metals	Once during trial dewatering	Exceeds the PWQO	Modify treatment method and/or shut down.
During Construction	Dewatering Discharge	PWQO Metals	Weekly, then every four weeks after three consecutive weekly compliant samples	Exceeds the PWQO	Modify/change treatment method and/or shut down.
		Turbidity	Daily until stable, then weekly. Minimum of five samples	Exceeds 15 NTU	
	Discharge Point	Impact Assessment	At each sampling event	Sedimentation, erosion	Reduce pumping and/or improve sediment/erosion control measures
	On-site monitoring wells	Water level meter	Every two weeks	Water level to be no more than 1 m lower than proposed depth of excavation	Reduce pumping
Post Construction	On-site monitoring wells	Water level meter	Every two weeks for four weeks, then every four weeks until 90% recovery	Water level recovery less than 90% of baseline level	Continue monitoring

Appendix H:
Discharge Plan

Discharge Plan

CONSTRUCTION DEWATERING DISCHARGE RATE AND ZONE OF INFLUENCE

The Radius of Influence (ROI) and temporary dewatering discharge rates were calculated in Section 5.1 and the details are summarized below:

ZONE	DESCRIPTION	ROI (m)	CONSTRUCTION DEWATERING FLOW RATE (L/day)	CONSTRUCTION DEWATERING FLOW RATE INLCUDING SAFETY FACTOR OF 2 AND A 10 mm RAIN EVENT (L/day)	CONSTRUCTION DEWATERING FLOW RATE INCLUDING SAFETY FACTOR OF 2 AND A 10 mm RAIN EVENT (L/day)
1	Housing Development (Block A)	No significant dewatering anticipated. Localized sump pumping may be required.			
2	Housing Development (Block B)	No significant dewatering anticipated. Localized sump pumping may be required.			
3	Housing Development (Block C)	36	7,300	7,300	7,300
4	Housing Development (Block D)	37	8,400	8,400	8,400
5	Housing Development (Block E)	32	700	700	700
6	Housing Development (Block F)	No significant dewatering anticipated. Localized sump pumping may be required.			
7	Housing Development (Block G)	No significant dewatering anticipated. Localized sump pumping may be required.			
8	Housing Development (Block H)	No significant dewatering anticipated. Localized sump pumping may be required.			
9	Site Servicing (100 m trench)	10	19,200	19,200	19,200

PROPOSED DISCHARGE METHOD AND LOCATION

The preferred discharge location is at the ground surface. The dewatering discharge will be transported by a hose and/or pipe to the treatment system. Following treatment at a sediment tank, filtration/silt bag or similar, the dewatering discharge will be transported by a hose/pipe to the preferred discharge location. However, finally responsibility of the discharged location should be decided by others.

If significant rainfall events occur (including a 100-year storm event), the on-site excavation shall shut down until storm water infiltration is reduced and the dewatering system can operate efficiently and accurately.

EROSION AND SEDIMENT CONTROL MEASURES

Sediment and erosion control measures will be set up on-site according to typical best management practices.

STATEMENTS

The Water Taking Plan included in Appendix G, including the water quantity and quality monitoring program shall be implemented at the site. No adverse effects on the environment are expected if the plan is adhered to.

SUMMARY OF QUALIFICATIONS

Alicia Kimberley is a licensed professional geoscientist with a Bachelors and Masters degree in Earth Sciences from McMaster University and the University of Waterloo, respectively. She has twelve years of professional experience with geoenvironmental and hydrogeological assessments.

Her experiences include the design and execution of aquifer testing, in-situ groundwater sampling, groundwater modelling, and preparation of hydrogeological reports to support EASR registry.

Noah Trembley obtained a bachelor's degree in Environmental Engineering from the University of Guelph and is a registered Engineering Intern with PEO. He has over a year of experience with geotechnical and environmental engineering and consulting, focusing mostly on excess soil programs, field investigations (soil and groundwater sampling and monitoring), and preparation of a variety of environmental/hydrogeological reports.

DATE OF PLAN PREPARATION

This plan was prepared on May 3, 2024.

Appendix I:
Water Budget

TATHAM ENGINEERING

Water Budget
Climate Normal Data

Project Details

796060 Grey Road 19	123143

Prepared By

Noah Trembley	April 15, 2024

Water Budget Details

Methodology	Thornthwaite Method
Climate Data & Source	Thornbury SLAMA
	Climate Normal Data for 1984 to 2003 (Environment Canada)
Thornthwaite Coefficient	1.056

Month	Temp (°C)	Precip (mm)	Heat Index	PET (mm)	Daylight Factor	Adjusted PET (mm)	AET (mm)	Surplus (mm)	Deficit (mm)
Jan.	-6.3	100	0.0	0.0	0.77	0.0	0.0	100.0	0.0
Feb.	-5.4	68.4	0.0	0.0	0.87	0.0	0.0	68.4	0.0
Mar.	-1.5	64	0.0	0.0	1.00	0.0	0.0	64.0	0.0
Apr.	5.5	65.3	1.2	28.9	1.12	32.5	32.5	32.8	0.0
May	11.5	82.7	3.5	71.4	1.23	88.0	82.7	0.0	5.3
Jun.	16.7	79.1	6.2	107.1	1.29	138.1	79.1	0.0	59.0
Jul.	19.8	72.1	8.0	129.6	1.26	163.5	72.1	0.0	91.4
Aug.	19.2	78.2	7.7	115.9	1.17	135.1	78.2	0.0	56.9
Sep.	15.5	95.9	5.5	80.0	1.04	83.4	83.4	12.5	0.0
Oct.	9.1	87.3	2.5	41.4	0.92	37.9	37.9	49.4	0.0
Nov.	3.1	99.6	0.5	11.3	0.80	9.0	9.0	90.6	0.0
Dec.	-2.7	99.4	0.0	0.0	0.74	0.0	0.0	99.4	0.0
Total	**-**	**992**	**35.1**	**585.4**	**-**	**687.5**	**474.9**	**517.1**	**212.6**

Additional Notes

PET = Potential Evapotranspiration; AET = Actual Evapotranspiration

Equations

$PET = 16\left(\frac{L}{12}\right)\left(\frac{N}{30}\right)\left(\frac{10T_d}{I}\right)^{\alpha}$ Where

PET is the estimated potential evapotranspiration (mm/month)

T_d is the average daily temperature (degrees Celsius; if this is negative, use 0) of the month being calculated

N is the number of days in the month being calculated

L is the average day length (hours) of the month being calculated

$\alpha = (6.75 \times 10^{-7})I^3 - (7.71 \times 10^{-5})I^2 + (1.792 \times 10^{-2})I + 0.49239$

$I = \sum_{i=1}^{12}\left(\frac{T_{m_i}}{5}\right)^{1.514}$ is a heat index which depends on the 12 monthly mean temperatures T_{m_i}.[1]

TATHAM ENGINEERING

Water Budget

Pre and Post Development Comparison

Project Details

796060 Grey Road 19	123143

Prepared By

Noah Trembley	Apr-24

Pre-Development Catchment Details

Area (ha)	9.9
Pervious Area (ha)	9.865
Impervious Area (ha)	0.035

Post Development Catchment Details

Area (ha)	9.9
Pervious Area (ha)	4.66
Impervious Area (ha)	5.24

Infiltration Factor

Infiltration Factor	Pre-Development		Post Development	
	Pervious	Impervious	Pervious	Impervious
Topography	0.300	0.0	0.300	0.0
Soil	0.200	0.0	0.200	0.0
Land Cover	0.200	0.0	0.200	0.0
Infiltration Factor	0.700	0.0	0.700	0.0

Water Budget

Water Budget	Pervious	Impervious	Total	Pervious	Impervious	Total
Water Surplus (m^3)	30,038	107	30,145	14,189	15,956	30,145
Infiltration (m^3)	21,027	0	21,027	9,933	0	9,933
Runoff (m^3)	9,012	107	9,118	4,257	15,956	20,212
Reduction in Infiltration Volume (m^3)						**11,094**

Additional Notes

Infiltration Factors

Topography	Flat Land, average slope < 0.6 m/km	0.3
	Rolling Land, average slope 2.8 m to 3.8 m/km	0.2
	Hilly Land, average slope 28 m to 47 m/km	0.1
Soils	Tight impervious clay	0.1
	Medium combinations of clay and loam	0.2
	Open Sandy loam	0.4
Cover	Cultivated Land	0.1
	Woodland	0.2

(Stormwater Planning and Design Manual. MOE, 2003.)