Scoped Hydrogeological Assessment

31 Church Street
Alma (Mapleton), Ontario

Project 10056

1. INTRODUCTION 1
1.1 Concurrent Study of the Property 1
1.2 Scope of Work 1
1.2.1 Borehole Drilling and Monitoring Well Installation 2
2. STUDY AREA PHYSIOGRAPHY AND GEOLOGY 2
2.1 Site Description 2
2.2 Physiography 3
2.3 Geology 3
2.4 Local Hydrogeology and Groundwater 3
2.5 Surface Water Features 4
2.6 Soil Hydraulic Conductivity 5
2.6.1 Slug Test Results 5
2.6.2 Grain Size Analysis Results 6
2.7 Groundwater Chemistry 6
3. WATER USERS 7
3.1 Municipal Wellhead Protection Areas and Vulnerability Mapping 8
3.2 Sensitive Features 9
4. PREDICTIVE NITRATE IMPACT ASSESSMENT 9
4.1 Sewage Effluent Impact Assessment 12
5. PATHOGEN MIGRATION ASSESSMENT 12
6. WATER SUPPLY POTENTIAL ASSESSMENT 13
7. CLOSURE 14
8. LIMITATIONS AND USE 17
9. REFERENCES 18

APPENDIX A: DRAWINGS
APPENDIX B: TABLES
APPENDIX C: BOREHOLE LOGS
APPENDIX D: MECP WATER WELL RECORDS
APPENDIX E: SLUG TEST ANALYSIS GRAPHS
APPENDIX F: GRAIN SIZE ANALYSIS GRAPHS
APPENDIX G: LABORATORY CERTIFICATE OF ANALYSIS

1. INTRODUCTION

Hydrogeology Consulting Services (HCS) was retained by Exact Construction Ltd. to conduct a scoped hydrogeological assessment for 31 Church Street in Alma, a community in the Township of Mapleton, Ontario. The location of the subject property is shown on Drawings 1 and 2 in Appendix A. Proposed development of the property includes a multiple residential lot subdivision with individual private water supplies and sewage effluent disposal systems.

The scope of work for this assessment was developed to respond to comments and guidelines provided by the Township of Mapleton, and to satisfy the Ontario Ministry of the Environment, Conservation, and Parks (MECP) Procedure D-5-4.

1.1 Concurrent Study of the Property

Concurrent study of the property includes a geotechnical investigation by CMT Engineering Inc. (December, 2020) comprising drilling and installation of boreholes and monitoring wells on the property, and the preparation of a geotechnical report. The geotechnical investigation report includes discussion of subsurface conditions, identification of major stratigraphic units encountered during drilling, borehole stratigraphic logs, and other pertinent information. The CMT Engineering Inc. geotechnical report should be reviewed in conjunction with this report.

1.2 Scope of Work

The three monitoring wells were installed on the property by CMT Engineering Inc. on December 11, 2020 and observed by HCS. These three wells were developed (purged) using Waterra inertial valves and tubing on December 14, 2020 to remove fine-grained material from the well screen sand pack and mitigate smearing on the borehole walls during drilling. Water chemistry samples were obtained from two wells for analysis of general chemistry parameters, and the three wells were assessed via slug tests to estimate saturated soil hydraulic conductivity. Stabilized groundwater elevations were measured using an electronic water level tape before and after testing, and the monitoring wells were instrumented with electronic pressure transducers (dataloggers) to allow continuous measurement of groundwater levels throughout the slug testing. Water level measurements are summarized in Table 1 in Appendix C.

Existing data for the subject property and surrounding area were compiled from multiple sources to gain an understanding of the subsurface stratigraphy, shallow groundwater flow regime, and downgradient receptors for on-site in-ground sewage effluent disposal systems. Local water users were identified through a review of Ministry of the Environment, Conservation and Parks (MECP) water well records surrounding the subject property.

1.2.1 Borehole Drilling and Monitoring Well Installation

On December 11, 2020, CMT Engineering Inc. conducted a geotechnical and environmental drilling program including the advancement of three boreholes to a maximum depth of 9.14 metres below ground surface (mBGS) using a direct push drillrig.

Continuous cores were advanced and soil samples were obtained. Selected soil samples were analyzed by CMT Engineering Inc. for particle size distribution (grain size) analysis.

The three boreholes were completed as 38-mm diameter monitoring wells using 1.52 m slotted Schedule 40 PVC well screen and PVC riser pipe, with well sand installed around the well screens and the borehole annular spaces sealed with bentonite. The wells were constructed with 10 cm square steel protective casings, and lockable vented protective caps were installed. Monitoring well construction followed Ontario Regulation 903 (as amended). Borehole logs are included in Appendix C for reference. The borehole ground surface elevations were surveyed by CMT Engineering Inc. to a local datum.

A manual electronic water level tape was used by HCS to measure the groundwater elevations on December 14, 2020. Water level comments are included on the borehole logs in Appendix C.

2. STUDY AREA PHYSIOGRAPHY AND GEOLOGY

2.1 Site Description

The subject property is a 6.8-hectare rural agricultural lot bordering the hamlet of Alma, within the Township of Mapleton. Currently an undeveloped agricultural lot, the proposed development of the subject property includes a residential subdivision with associated driveways, access road(s), and individual private on-site wells and septic systems. The subject property consists of an open field with a treeline bordering the southern property boundary, associated with a former rail line. Bordering the property to the west is a commercial development and agricultural field, with the hamlet of Alma to the north and northeast. East of the property is a small wooded/wetland area along with agricultural fields to the east and south.

This proposed usage of the subject property is in general accordance with the current zoning designation by the Township of Mapleton as “Future Development” (Township of Mapleton, 2020).

The ground surface topography of the subject property varies from a high point of approximately 446 metres above sea level (mASL) at the westernmost most portion of the lot (fronting on Peel Street West), gradually sloping downwards to a low point of approximately 437.5 mASL at the easternmost corner of the lot, as indicated by Grand River Conservation Authority (GRCA) mapping.

2.2 Physiography

The subject property is located within the undrumlinized Till Plains physiographic unit (Chapman and Putnam, 2007) which consists of glacially deposited fine-grained silty clay till soils, found more commonly to be in plain (or valley) formation rather than a drumlinized (hilly) formation. Neighbouring the property to the south and east is the Spillways physiographic unit, indicating an area of larger-grained soils from glacial river deposits. The property lies within the Stratford Till Plain physiographic region, consisting of a broad plain of relatively uniform silty clay (till) soils.

2.3 Geology

Quaternary Geology mapping of the Guelph area (Karrow, 1967) indicates the subject property is generally underlain by clayey sand till deposits.

As shown on the borehole logs included in Appendix C, near-surface soils on the subject property consist generally of topsoil underlain by clayey silt and silt deposits, with borehole BH 02-20 encountering an underlying sand deposit. The locations of the boreholes are indicated on Drawing 2 of the CMT Engineering Inc. geotechnical report (CMT Engineering Inc., 2020), included in Appendix A.

Geology from MECP Water Well Records (WWR) in Appendix D indicates overburden stratigraphy in the area typically consists of deposits of clay, sand, gravel, hardpan, and stones with clay being the most common near-surface deposit.

Paleozoic Geology mapping (Armstrong and Dodge, 2007) indicates underlying the overburden deposits is the Guelph Formation dolostone bedrock. MECP Well Records suggest overburden deposits in the area surrounding the subject property are approximately 75 m thick.

2.4 Local Hydrogeology and Groundwater

As shown on the appended Table 1, measured overburden groundwater elevations at the subject property range from 437.98 to 445.76 mASL, at depths between 0.05 to 2.48 mBGS, between December 14, 2020 and April 20, 2022. It is noted the groundwater measurement from BH 01-20 taken on December 14, 2020 is considered erroneous (and likely due to slow recovery of the well after drilling) as all subsequent measurements are significantly higher.

Groundwater encountered in the clayey silt and silt layers (as well as BH 02-20, which has a screened interval in a sand horizon) is interpreted to represent perched groundwater rather than a regional water-bearing aquifer deposit. Groundwater contour mapping shown on the appended Drawing 3 indicates the perched overburden groundwater beneath the subject property flows eastwards towards the origin of the surface drainage feature/headwaters of the tributary of Carroll Creek.

Locally, shallow overburden groundwater would be expected to flow generally eastwards as a subtle reflection of surface topography alongside and parallel to the drainage swale at the southwestern property boundary. Subsurface agricultural drainage tile may be installed at this property to manage and drain the perched groundwater, as ponded water was observed at ground surface near to both BH 01-20 and BH 02-20 on December 14, 2020. GRCA mapping indicates the property lies within the Upper Grand River subcatchment and tertiary watershed. This Upper Grand River subwatershed is a component of the larger more regional Northern Lake Erie watershed, ultimately draining into Lake Erie after passing through the Lower Grand River subcatchment.

The community of Alma is not municipally serviced for water supply, and drinking water is obtained by private water supply wells screened in the upper bedrock aquifer as well as the shallow overburden.

GRCA regional mapping indicates the subject property lies within a low average annual recharge area, with the majority of the property estimated at less than 50 mm of recharge per year, and portions of the property estimated at 50 – 100 mm of recharge per year. It is important to consider this regional mapping does not consider site-level soil stratigraphy. Based on the subsurface stratigraphy encountered in the on-site boreholes, it is expected that low volumes of precipitation infiltrate into the near-surface clayey silt material, and a larger proportion of this precipitation would be expected to join the evapotranspiration or stormwater runoff regimes. Relatively small and minor volumes of water are inferred to percolate vertically downwards over time, or flow laterally to areas with more vertically extensive granular deposits, to contribute small recharge volumes to the deeper overburden groundwater regime.

2.5 Surface Water Features

Surface water features on the property include a man-made stormwater drainage channel or swale running alongside the southwestern property boundary. Topographic contours of the subject property indicate that overall surface water drainage would be expected to flow to the southeast in the general direction of the constructed drainage swale. There are no wetland areas delineated on the subject property.

Surface water features surrounding the property consist of a GRCA regulated watercourse just beyond the southeastern property boundary, indicated by natural heritage mapping from the Ministry of Natural Resources and Forestry (MNRF) to be a non-evaluated wetland, approximately 70 m southeast of the subject property. The wetlands are associated with a drainage swale/tributary creek of Carroll Creek originating just beyond the northeastern property boundary, which generally flows south-westwards/southwards towards its eventual confluence with the Grand River.

Several small ponds and other GRCA-delineated wetland areas are located to the west and south within 1km of the subject property.

Due to the low hydraulic conductivity of the soils generally encountered on-site during drilling, water perched within the near-surface silty soils would not be expect to contribute significant baseflow to nearby creeks or wetland areas. Stormwater runoff as overland flow is inferred to generate a more significant contribution to the local surface water regime.

2.6 Soil Hydraulic Conductivity

Hydraulic conductivity estimates for the site soils were determined using single response hydraulic (slug) tests of the soil deposits screened by the monitoring wells. Estimates of hydraulic conductivity were also made using soil sample grain size analyses and the Kaubisch, Breyer, Kozeny-Carman, and Hazen formulae where appropriate.

2.6.1 Slug Test Results

Prior to conducting slug testing of the monitoring wells, each well was developed (purged) to remove fine-grained material from the sand pack around the well screen and the screened interval.

The slug test methodology followed the procedures developed by Hvorslev (1951), as described in Freeze and Cherry (1979). Three slug tests were conducted, two as a falling head tests by adding a known volume of water to the well, and one as a rising head test by purging the well dry and measuring the groundwater level recovery. The displacement and gradual re-equilibration of the water level in the well was recorded using an electronic pressure transducer (datalogger). Hvorslev's method is expressed by the following equation:

$$K = \frac{r^2 \ln (L/R)}{2LT_{0.37}}$$

where:

- K = hydraulic conductivity of the tested material (m/sec)
- r = inner radius of the well riser pipe (m)
- R = outer radius of the well riser pipe (m)
- L = length of screen and sand pack (m)
- $T_{0.37}$ = time lag (sec), where $(H-h)/(H-H_0) = 0.37$
- h = water level at each time of measurement (m)
- H_0 = initial water level (m, start of test)
- H = stabilized water level prior to slug testing (m)

The time lag, $T_{0.37}$, represents the time required for the water level to recover to the stabilized level if the initial flow rate from the surrounding aquifer into the well is maintained. This time lag is determined graphically as the time where $(H-h)$ divided by $(H-H_0)$ is equal to 0.37.

Graphical analysis of the slug tests are included in Appendix E, and the hydraulic conductivity estimate is listed in Table 2 in Appendix B.

The hydraulic conductivity estimate of <1 x 10^{-8} m/sec for borehole BH 01-20 is due to the very slow recovery time of the slug test (i.e. not achieving $T_{0.37}$), and indicates a very low permeability for the deeper silt and clay soils. The hydraulic conductivity estimate for BH 03-20 was also low, at 6.6 x 10^{-7} m/sec, providing further evidence for low permeability of the clayey silt stratigraphy. BH 02-20 is installed in sandier soils with a relatively higher estimated hydraulic conductivity of 4.7 x 10^{-6} m/sec. Further discussion related to the permeability of the subsurface environment is included in Section 2.6.2, below.

2.6.2 Grain Size Analysis Results

Soil samples collected from boreholes BH01-20, BH02-20 and BH03-20 during drilling were submitted to the CMT Engineering Inc. laboratory facility in St. Clements, Ontario for analysis of particle size distribution (grain size). As shown on the grain size analysis graphs included in Appendix F, the analyzed soils consist primarily of silts and clays, with the sample from BH 02-20 consisting of predominantly sand. The grain size analysis results were used to estimate soil hydraulic conductivity (K) values by applying the Kaubisch, Breyer, Hazen, and Kozeny-Carman formulae were appropriate based on the limitations of each formula. For BH 01-20, the D_{10} value was estimated resulting in an estimated hydraulic conductivity value using the Kaubisch formula. The calculated hydraulic conductivity values as summarized in the appended Table 2 range from 3.3 x 10^{-9} to 1.3 x 10^{-8} m/sec for the silty soil from BH 01-20 and 03-20, to 1.9 x 10^{-4} m/sec for the sandy soil from BH 02-20. The calculated values indicate very low permeability for the silt and clay soils, and a more moderate to high permeability for the sandy soil.

The hydraulic conductivity estimates from both the slug tests and the grain size analyses correlate reasonably well with published ranges for the major soil types (Freeze and Cherry, 1979).

2.7 Groundwater Chemistry

On December 14, 2020 water chemistry samples were obtained from the monitoring wells at BH 03-20 and BH 01-20. Samples were collected in the appropriate containers, stored in a cooler, and delivered to ALS Environmental Laboratories in Waterloo, Ontario for analysis of general chemistry parameters. The laboratory Certificate of Analysis is included in Appendix G for reference, and the appended Table 3 summarizes parameters of interest.

Please Note: It is important to consider that while the sample results are compared to the Ontario Drinking Water Quality Standards (ODWQS) for reference purposes, the ODWQS are only applicable to potable water. Perched groundwater extracted from a monitoring well is not considered potable water.

Additionally, it is important to consider the water chemistry samples were obtained using inertial valve pumps (Waterra tubing and foot valves). The method of water collection inherently results in the inclusion of sediments into the water sample, thereby increasing concentrations of

parameters such as colour, turbidity, total suspended solids, total dissolved solids, and total metals where metals are adsorbed onto soil particles.

As shown on the appended Table 3 the samples exhibited low and non-detectable concentrations of Nitrate and Nitrite (all less than 1 mg/L) and a Total Ammonia (as N) concentration of 0.164 mg/L in BH 01-20 and 0.048 in BH 03-20.

One or both samples exhibited exceedances of the ODWQS for aesthetic/operational parameters including Total Dissolved Solids, Turbidity, Colour, Hardness, and a variety of metals. Additionally, one or both samples exceeded the ODWQS Maximum Acceptable Criteria (MAC) for Aluminum, Arsenic, Barium, Chromium, Manganese, and Lead. These elevated concentrations are expected to be a result of the sampling methodology.

The near surface silt and clay soils are expected to function as an aquitard, inhibiting the vertical migration of contaminants (e.g. agricultural fertilizers, sewage effluent, etc.) from the ground surface to deeper overburden and/or bedrock aquifers beneath the subject property and adjacent areas. Although the subject property is bordered by properties serviced by on-site sewage (septic) systems, the Nitrate, Nitrite and Total Ammonia concentrations observed in the shallow perched groundwater were less than 1 mg/L.

3. WATER USERS

Well Records from the MECP Water Well Record (WWR) Database were reviewed to determine the number of private water supply wells present. As shown on the well records in Appendix D, one hundred and thirty-one wells are located within an approximate radius of 500 m from the subject property according to the MECP WWR Database. Of these wells, three are identified as monitoring wells not used for water supply, two are identified as not in use, eight are abandonment records, seven wells have no completion details, and nine wells have a diameter of 50 mm and are concluded to be geotechnical investigative wells not used for water supply. These twenty-nine wells have been excluded from further consideration.

Of the remaining one hundred and two wells, one hundred and one wells are completed in overburden at depths ranging from 7.6 mBGS to 78.3 mBGS, and one well is completed in bedrock at a total depth of 78.3 mBGS (bedrock encountered at 75.6 mBGS).

The overburden wells consist of seventeen dug wells (with diameters of 0.4 to 0.8 m) completed at depths of less than 15 m; four drilled wells completed at depths of 24 to 31 m; and eighty wells completed at depths of more than 47 m.

Three of the one hundred and two wells are identified as commercial wells, two wells are identified as institutional use, one is identified as a public supply well, one identified as livestock supply, and the remainder are domestic wells. These wells are plotted on Drawing 3 in

Appendix A. As indicated on Drawing 3, there are only five wells with depths of less than 31 m plotted within 100 m of the subject property. These wells are as follows:

Table I: Shallow Water Supply Wells Within 100 m of the Subject Property

Well Name	Completed Depth (mBGS)
6702085	27.4
6709097	10.7
6710987	31.1
6705957	9.1
6706635	8.2

Of the five wells identified as shallow wells within 100 m of the subject property, only three are completed at depths of less than 25 m.

It is noted that some wells plotted on the appended Drawing 3 are located in areas where the actual existence of a well is unlikely (they may be associated with nearby properties), and that some properties shown on the aerial imagery do not have a well associated with them; however, the MECP WWR coordinate data has been used in the absence of more reliable information. As the community of Alma is not serviced municipally for water supply, residences within town limits would are expected to have private water supply wells. The locations and completion depths of private water supply wells adjacent to/downgradient of the subject property could be investigated further by HCS through a door-to-door well survey.

3.1 Municipal Wellhead Protection Areas and Vulnerability Mapping

Grand River Conservation Authority Mapping (2019) shown on the appended Drawing 1 indicates the closest nearby Wellhead Protection Area (WHPA) to the subject property is located approximately 3.77 km from the southeast property boundary. This WHPA–B represents a 5 to 25-year time of travel to municipal wells supplying water to the Towns of Salem and Elora within the Township of Centre-Wellington. The property is not located within a surface water Intake Protection Zone (IPZ).

WHPA vulnerability mapping indicates the property is not located in an area of vulnerability, that the intrinsic vulnerability for the area is low, and that the property is not located within a Significant Groundwater Recharge Area (SGRA). The subject property is located within a Wellhead Water Quantity Protection Area (WHPA-Q). As described in the Centre Wellington Tier 3 Water Budget Study, the WHPA-Q suggests future groundwater takings that consume water, and land use changes which limit the ability of water to soak into the ground (groundwater recharge), could potentially affect the availability of water for municipal supply

wells within the Township of Centre Wellington. While groundwater takings located within the WHPA-Q would not necessarily be expected to impact groundwater levels at the municipal wells, additional study may be necessary for new water takers within the WHPA-Q.

Additionally, the study concluded that cumulative effects of unserviced domestic water well pumping on bedrock water supply aquifers utilized by municipal wells is minimal.

3.2 Sensitive Features

Ontario Source Protection Information Atlas (OSPIA) mapping (2020) indicates that the subject property does not fall within a highly vulnerable aquifer zone, or a significant groundwater recharge area.

4. PREDICTIVE NITRATE IMPACT ASSESSMENT

The subject property is proposed to be developed with individual lots and associated residential dwellings, including private servicing for water supply and sewage disposal. These single-family residential sewage systems will discharge effluent to the local subsurface via individual leaching beds. The leaching beds will load residential waste nutrients to the subsurface, and eventually the shallow perched groundwater system(s). The principal components of the sewage effluent will be nitrate (as nitrogen), ammonia, and phosphorus (total). As ammonia is normally aerobically converted to nitrate in the unsaturated zone, and phosphorus typically reacts with and attaches to soil particles, nitrate is the primary nutrient parameter that percolates downwards to the water table and can impact groundwater. Nitrate can persist in groundwater; however, under anaerobic conditions it is typically converted to nitrogen gas by bacteria in the process of denitrification.

Assessment of the potential impact of a subsurface sewage disposal systems is performed based on nitrate loading of the shallow groundwater aquifer, as excessive amounts of nitrate can impact both drinking water (particularly for infants) and surface water (due to eutrophication and plant growth).

The Ontario Drinking Water Quality Standard (ODWQS) for nitrate-N is 10 mg/L, and this is the criteria applied to the predictive nitrate impact assessment.

For the purposes of this assessment, the Ontario Ministry of the Environment and Climate Change (MOECC, now MECP) Technical Guideline for Individual On-Site Sewage Systems Procedure D-5-4 (1996) is applied as follows:

$$C_{PB} = \frac{(SEF \times C_{SEF}) + (GR \times C_{GR}) + (GUF \times C_{GUF})}{(SEF + GR + GUF)}$$

Variables:

C_{PB} = Nitrate concentration in groundwater at the down-gradient property boundary (mg/L as nitrate-N)

SEF = Sewage effluent flow (m^3/yr)

For the purposes of this assessment, the daily design sewage flow for a 3-bedroom home as provided by Table 8.1.2.3. from the Ontario Building Code (2012, as amended) is applied assuming the smallest proposed lot size for all lots.

= 1,600 L/day x 19 lots x 365 days
= 11,096,000 L/yr

C_{SEF} = Nitrate concentration of sewage effluent (mg/L)

Sewage effluent nitrate concentration of 40 mg/L for a conventional treatment system, 20 mg/L for a tertiary treatment system, and 12 mg/L for an enhanced tertiary treatment system.

GR = Groundwater recharge from infiltrating precipitation (m^3/yr)

Groundwater Recharge = Infiltration Rate[1] x Site Area[2]

= 0.125 m/yr x 55,100 m^2
= 6,887.5 m^3/yr
= 6,887,500 L/yr

C_{GR} = Nitrate concentration of groundwater recharge (mg/L)

0.1 mg/L Nitrate concentration assumed for infiltrating precipitation.

It is noted that the groundwater recharge calculations above have assumed a minimum lot area of 0.29 hectares for each of the 19 proposed lots. Lot sizes are expected to vary from 0.29-0.55 hectares; therefore, the calculations provided are considered conservative and provide an additional factor of safety.

Based on the variables described above, predictive nitrate impact calculation results are summarized in Table II below.

[1] Infiltration rate from MOEE Hydrogeological Technical Information Requirements for Land Development Applications (1995).

[2] Site Area is taken as the total property area assigned to residential building lots, based on methodology outlined in MOECC (now MECP) Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment.

Table II: Nitrate Impact Assessment Calculated Results

	Sewage Effluent Concentration (mg/L)	Total Annual Sewage volume (L/yr)	Nitrate-N Concentration at Downgradient Property Boundary (mg/L)
31 Church Street – 19 Lots with minimum size of 0.29 hectares	40	11,096,000	**24.72**
	20	11,096,000	**12.38**
	12	11,096,000	**7.44**

The nitrate impact assessment calculations show using a conventional or tertiary treatment system for each lot would result in nitrate-N concentrations at the downgradient lot boundaries exceeding the ODWQS criteria limit of 10 mg/L. Using an enhanced tertiary treatment sewage system for each lot would result in groundwater nitrate-N concentrations at the downgradient lot boundaries below the 10 mg/L ODWQS criteria limit.

To minimize the potential for impacts to the shallow overburden soils and overburden aquifers, enhanced tertiary treatment of sewage effluent with a design effluent concentration of 12 mg/L or less for nitrate-N should be considered for the sewage effluent disposal systems for the proposed lots.

As an example, empirical test results provided by Waterloo Biofilter for CAN-BNQ 3680-600 testing of their Water NOx system demonstrated a six month average total nitrogen effluent concentration of 11.9 mg/L, an average nitrate + nitrite concentration of 3.4 mg/L, and an average total nitrogen reduction rate of 80.3%. It is reasonable to conclude enhanced tertiary treatment systems can achieve the required nitrate reduction.

It is important to note that these calculations have conservatively assumed no dilution effects from groundwater underflow, and a conservatively small lot size for each of the 19 proposed lots.

4.1 Sewage Effluent Impact Assessment

The theoretical calculations presented in Section 4.0 show enhanced tertiary treatment will meet the MECP's Procedure D-5-4 Nitrate Impact Assessment criteria. As discussed previously in Section 3 within a 500 m radius of the proposed lot the MECP WWR database suggests one hundred and two overburden wells may exist, including shallow wells completed at depths of less than 10 mBGS. As discussed previously in Section 3, of the five wells identified as shallow wells within 100 m of the subject property, only three are completed at depths of less than 25 m. As shown on the appended Drawing 3 shallow perched groundwater is flowing eastwards, generally cross-gradient of the residential properties to the north of the subject property. If necessary, a door-to-door well survey could determine whether any shallow water supply wells are in fact located in proximity to and downgradient of the proposed development.

5. PATHOGEN MIGRATION ASSESSMENT

The possibility exists for pathogens entering the effluent leaching bed to be transported by the infiltrating precipitation to the groundwater table, and then flow towards downgradient receptors (e.g. private water supply wells, surface water features, etc.).

While MECP Procedure D-5-4 for residential lots does not contemplate pathogen assessment, Chapter 22 (Large Subsurface Sewage Disposal Systems) of the Design Guidelines for Sewage Works (MECP, 2008) does discuss pathogen movement and its potential impact on groundwater and surface water. An evaluation of the potential for pathogen migration is provided below.

Pathogens can travel relatively quickly through granular material; however, appropriate vertical separation between an effluent leaching bed and the shallow groundwater table can remove most effluent-borne pathogens.

Based on the perched groundwater contour mapping provided on the appended Drawing 3 it is reasonable to consider the drainage swale/tributary headwaters along the eastern/northeastern property boundary as the shallow groundwater outflow boundary (or closest downgradient receptor) for the purposes of a pathogen migration assessment.

Subsurface stratigraphy observed in the on-site monitoring wells generally consists of topsoil underlain by varying deposits of clayey silt and silt, and isolated deposits of sand, with perched groundwater encountered at depths of ranging from 0.06 mBGS to 7.40 mBGS. As the typical required vertical separation from a leaching bed to the water table is 0.9 m, it is concluded the opportunity exists within portions of the subject property for extended unsaturated percolation of effluent to allow for filtration of pathogens from the effluent and pathogen decay. A geotechnical test-pitting program could confirm shallow perched groundwater and near-surface soil conditions to evaluate on-site sewage system design constraints based on the site-specific soils and groundwater presence.

As a conservative measure and a factor of safety, it is recommended that raised leaching beds (i.e. raised filter beds) be constructed with fine sands to achieve a longer travel time for percolating sewage effluent and increase the opportunity for pathogen filtration and decay. A septic design engineer should be retained to design appropriate leaching beds, incorporating raised filter beds constructed from fine sand to maximize the potential for pathogen attenuation.

It is reasonable to conclude there is a sufficient separation between the leaching beds and surface water to minimize the possibility of pathogen migration to surface water features. Adherence to required setback distances from surface water features should be incorporated during the detailed design of the on-site sewage systems.

6. WATER SUPPLY POTENTIAL ASSESSMENT

The proposed residential lots will be serviced by private water supply wells. The attached Drawing 2 shows a GRCA delineated wetland area just beyond the southeast property border; however, as discussed in Section 2.4 the low permeability near-surface soils and perched groundwater conditions are not expected to contribute significant baseflow to the surface water feature.

According to the GRCA, the closest municipal wellhead protection area (WHPA) is approximately 3.7 km from the subject property.

Well Records from the Ministry of the Environment, Conservation, and Parks (MECP) Water Well Record (WWR) Database indicate one hundred and two wells within 500 m of the subject property, with one hundred and one wells completed in overburden at depths ranging from 7.6 mBGS to 78.3 mBGS, and one well completed in bedrock at a total depth of 78.3 mBGS (bedrock encountered at 75.6 mBGS).

The overburden wells consist of seventeen dug wells (with diameters of 0.4 to 0.8 m) completed at depths of less than 15 m; four drilled wells completed at depths of 24 to 31 m; and eighty wells completed at depths of more than 47 m.

Pumping test results were recorded for one well completed in overburden at a depth of less than 15 m, with a pumping test rates of 113 litres per minute (L/min) during a pump test that lasted 1 hour. Shallow dug wells are not considered suitable for the proposed subdivision due to increased risk of impacts from surficial contaminants.

Pumping test results were recorded for four wells completed in overburden at depths of 24-31 m, with pumping test rates ranging from 19 to 113 litres per minute, averaging 54 L/min during pump tests that lasted 1 to 4 hours.

Pumping test results were recorded for seventy-seven wells completed in overburden at depths of more than 47 m, with pumping test rates ranging from 11 to 302 litres per minute, averaging 83 L/min during pump tests that lasted 1 to 72 hours.

The on-site supply well (MECP Well Tag #A299778) is completed in overburden gravel and sand deposits at a depth of 54.3 m. The logged soil stratigraphy of this well indicates a clay till aquitard from 21.6 to 51.5 m overlying the granular aquifer deposit from 51.5 to 54.3 m. This deep overburden granular aquifer was pumped at 68 L/min for one hour with zero drawdown observed.

Quaternary geology mapping indicates the subject property is underlain by silty clay till deposits. MECP Well Records from the area indicate overburden thickness of 33-88 m. Beneath overburden soils is the Salina Formation dolostone, shale, and gypsum bedrock.

Within the scope of this desktop study, the information available indicates that a sufficient supply of groundwater should be available to provide for the needs of 19 single-family residential dwellings from the deep overburden aquifer beneath the property. While a high yield of good quality groundwater would be expected to be available from the Guelph Formation bedrock aquifer, the Salina Formation bedrock contact is mapped in close proximity to the subject property. The Salina Formation is known to produce water of a lesser quality with aesthetic issues such as Sulphur, Manganese, and Iron; therefore, while bedrock wells may yield high quantities of water the aesthetic quality of the water could be impaired and require treatment to make it acceptable for potability. It is suggested that private water supply wells for the proposed severances be completed in the deep overburden aquifer at depths below 47 m to minimize the potential for water quality issues unless a test well can be drilled to the bedrock aquifer for water chemistry assessment.

If bedrock water of acceptable quality can be identified beneath the property, a mix of overburden and bedrock wells would serve to minimize cumulative impacts to a single aquifer resource.

Please be advised that this assessment is based on a desktop review of publicly available information. Verification of available water supply and/or water quality, and/or empirical investigation of the potential cumulative impact of groundwater extraction, would require a pumping test to be conducted.

7. CLOSURE

This scoped hydrogeological assessment compiled data for the subject property from existing sources and on-site investigation to gain an understanding of the subsurface statigraphy and shallow groundwater flow regime.

The subject property is underlain by predominantly clayey silt and silt soils, with some sand deposits, as determined through a shallow hydrogeological investigation to a depth of at least 9.14 m. These generally fine-grained soils provide aquitard-type conditions that inhibits the infiltration and vertical percolation of precipitation downwards, creating shallow perched groundwater conditions and limiting recharge of underlying overburden/bedrock aquifers.

Subsurface stratigraphy beneath the subject property consists of silt, clayey silt, and sand deposits to a depth of at least 9.14 m, underlain at depths of more than 78 m by the Guelph Formation dolostone bedrock. Groundwater was observed in the near-surface soils, exhibiting perched and in some cases confined conditions. Shallow perched groundwater is flowing eastwards across the subject property towards the tributary headwater of Carrol Creek.

Soil hydraulic conductivity estimates from grain size analyses indicate the overburden silt and clay deposits have a low hydraulic conductivity of 3.3×10^{-9} m/sec to 6.6×10^{-7} m/sec, with sandy conditions observed at BH 02-20 having a higher hydraulic conductivity.

A drainage swale/tributary headwater of Carroll Creek originates beyond the northeast property boundary, flowing to a GRCA-delineated wetland area approximately 67 m southeast of the southeastern property boundary. The subject property is not identified as an area of significant groundwater recharge, and it is anticipated only small volumes of precipitation infiltrate on site and percolate vertically downwards through the low permeability aquitard-type conditions, contributing little if any recharge to deeper overburden/bedrock aquifers. Surface water runoff follows ground surface topography through drainage swales.

The subject property is approximately 3.7 km from the closest WHPA boundary surrounding the Salem and Elora municipal wells.

Water chemistry analysis of perched groundwater beneath the subject property encountered very low concentrations of nitrate, nitrite, and ammonia, suggesting that the perched groundwater is not locally impacted by nitrogen pollution from agricultural or residential activities.

According to the MECP WWR database one hundred and two private water supply wells in the area are screened in the overburden aquifer at depths between 7.6 and 78.3 mBGS. Groundwater contouring for the overburden aquifer shows that perched groundwater is flowing north-eastwards.

Nitrate impact assessment calculations using conservatively assessed lot sizes demonstrate that the use of enhanced tertiary treatment for the sewage effluent disposal systems will result in a nitrate-N concentration at the downgradient property boundary below the ODWQS criteria limit of 10 mg/L. The use of enhanced tertiary treatment systems with a maximum effluent nitrate-N concentration of 12 mg/L will be required to support the proposed 19 lot development.

To minimize the potential for pathogen mitigation from effluent discharge, raised filter beds should be constructed of fine sands to increase the percolation time for leachate.

Should the lot severance proposal or sewage system design parameters change, an updated nitrate impact assessment would be required.

We trust that this report satisfies your present requirements, and we thank you for this opportunity to be of service. If you have any questions, or require further hydrogeological consulting services, please feel free to contact the undersigned.

Respectfully submitted,

Chris Helmer, B.Sc., P.Geo.
Senior Hydrogeologist
MECP Licensed Well Contractor and Class 5 Well Technician
www.hydrog.ca

8. LIMITATIONS AND USE

This report has been prepared for the exclusive use of the Client indicated in Section 1. Chris F Helmer hereby disclaims any liability or responsibility to any person or party, other than the Client, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by anyone other than the Client.

The conclusions and recommendations provided in this report are not intended as specifications or instructions to contractors. Any use contractors may make of this report, or decisions made based on it, are the responsibility of the contractors. Contractors must accept responsibility for means and methods of construction they select, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect them.

In preparing this report Chris F Helmer has relied in good faith on information provided by individuals and companies noted in this report, and assumes that the information provided is factual and accurate. No responsibility is accepted for any deficiencies, misstatements, or inaccuracies contained in this report as a result of errors, omissions, misinterpretations, or fraudulent acts in the resources referenced, or of persons interviewed or consulted during the preparation of this report.

The report and its complete contents are based on data and information collected during investigations conducted by Chris F Helmer, and pertains solely to the conditions of the site at the time of the investigation, supplemented by historical information and data as described in this report. It is important to note that the investigation involves sampling of the site at specific locations, and the conclusions in this report are based on the information gathered. Limitations of the data and information include the fact that conditions between and beyond the sampling locations may vary; that the assessment is dependent upon the accuracy of the analytical data generated through sample analysis; and that conditions or contaminants may exist for which no analyses have been conducted. Furthermore, no assurance is made regarding potential changes in site conditions and/or the regulatory regime (standards, guidelines, etc.), subsequent to the time of investigation.

The professional services provided for this project include only the hydrogeological aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. No other warranty or representation is either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

9. REFERENCES

Armstrong, D.K. and Dodge, J.E.P. 2007. *Paleozoic Geology Map of Southern Ontario*. Ontario Geological Survey.

Chapman, L.J. and Putnam, D.F. 2007. *Physiography of Southern Ontario*. Ontario Geological Survey.

CMT Engineering Inc. 2020. *Geotechnical Investigation, Proposed Residential Subdivision. 31 Church Street, Alma Ontario.*
County of Wellington Planning and Development Department. 2020. *Township of Mapleton Schedule A-4 Alma Detail.* Ministry of Natural Resources.

Freeze, R.A. and J.A. Cherry. 1979. *Groundwater.* Englewood Cliffs, New Jersey: Prentice-Hall. 614pp.

Karrow, P.F. 1967. *Pleistocene Geology of the Guelph Area, Southern Ontario*. Geological Survey of Canada.

Ontario Ministry of the Environment. 2003. *Stormwater Management Planning and Design Manual.*

Ontario Ministry of the Environment. 1995. *Hydrogeological Technical Information Requirements for Land Development Applications.*

APPENDIX A: DRAWINGS

Drawing 1 – Location Plan
Drawing 2 – Site Plan (CMT Engineering Inc., 2020)
Drawing 3 – Groundwater Contours
Drawing 3 – MECP Water Well Records

LEGEND

Subject Property

GRCAWetland Area

imagery from Grand River Conservation Authority © 2021

Drawing 1 - Location Plan
31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	02-Jan-21

NOTES:

Base map provided by Bing.

Legend

CMT Borehole with Monitoring Well

Temporary Benchmark (TBM)
Top of Existing Water Well (A299778)
Assumed Elevation: 100.00 m

N

NO.	DESCRIPTION	DATE

REVISIONS

CMT ENGINEERING INC.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Tel.: 519-699-5775
Fax: 519-699-4664
www.cmtinc.net

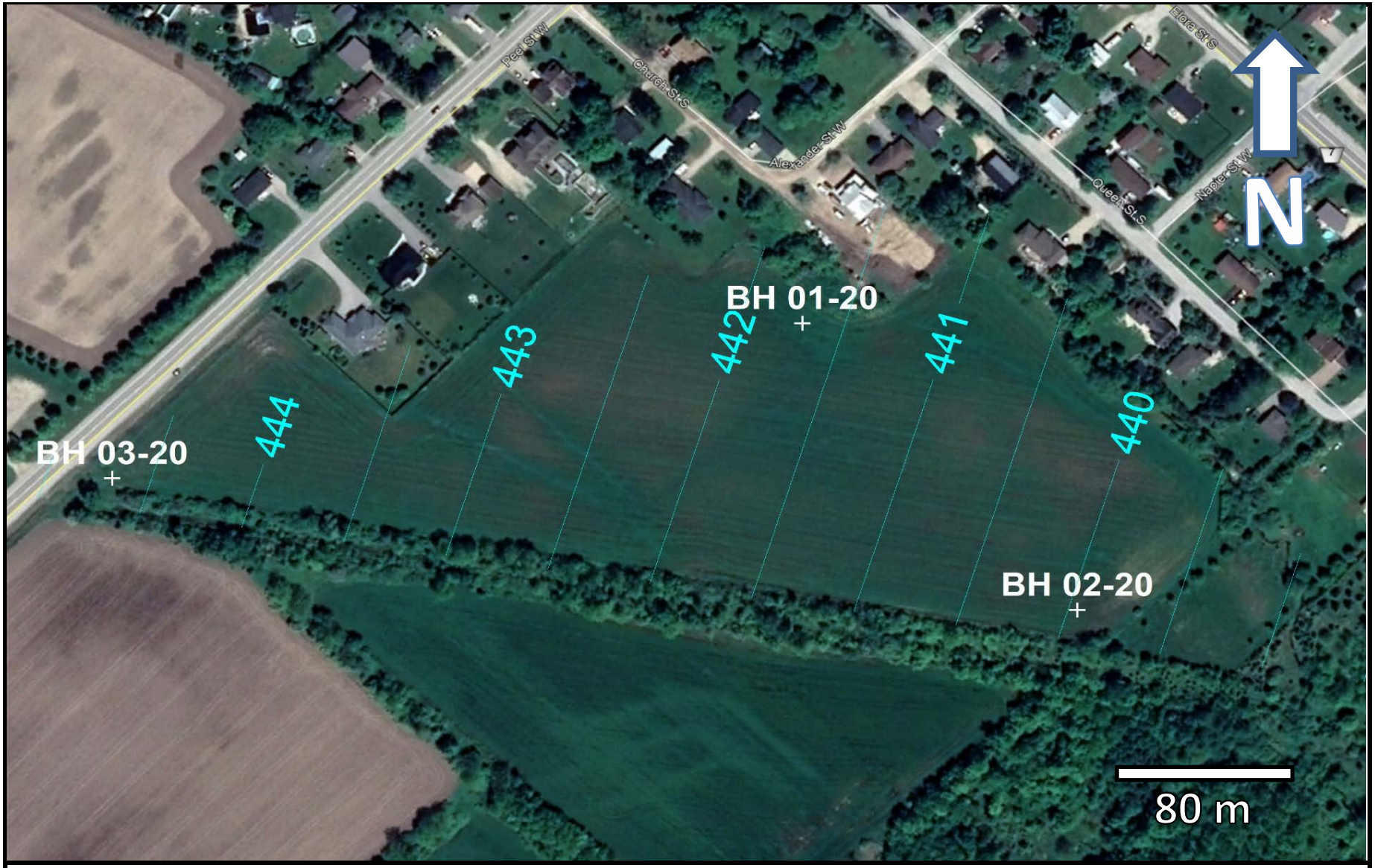
PROJECT:

Proposed Subdivision
31 Church Street
Alma, Ontario

DRAWING TITLE:

AERIAL VIEW SHOWING
BOREHOLE LOCATIONS

PROJECT NO.:	DATE:
20-732	December 18, 2020
SCALE:	DRAWING NO.
N.T.S.	2



imagery from Google Earth © 2022

LEGEND

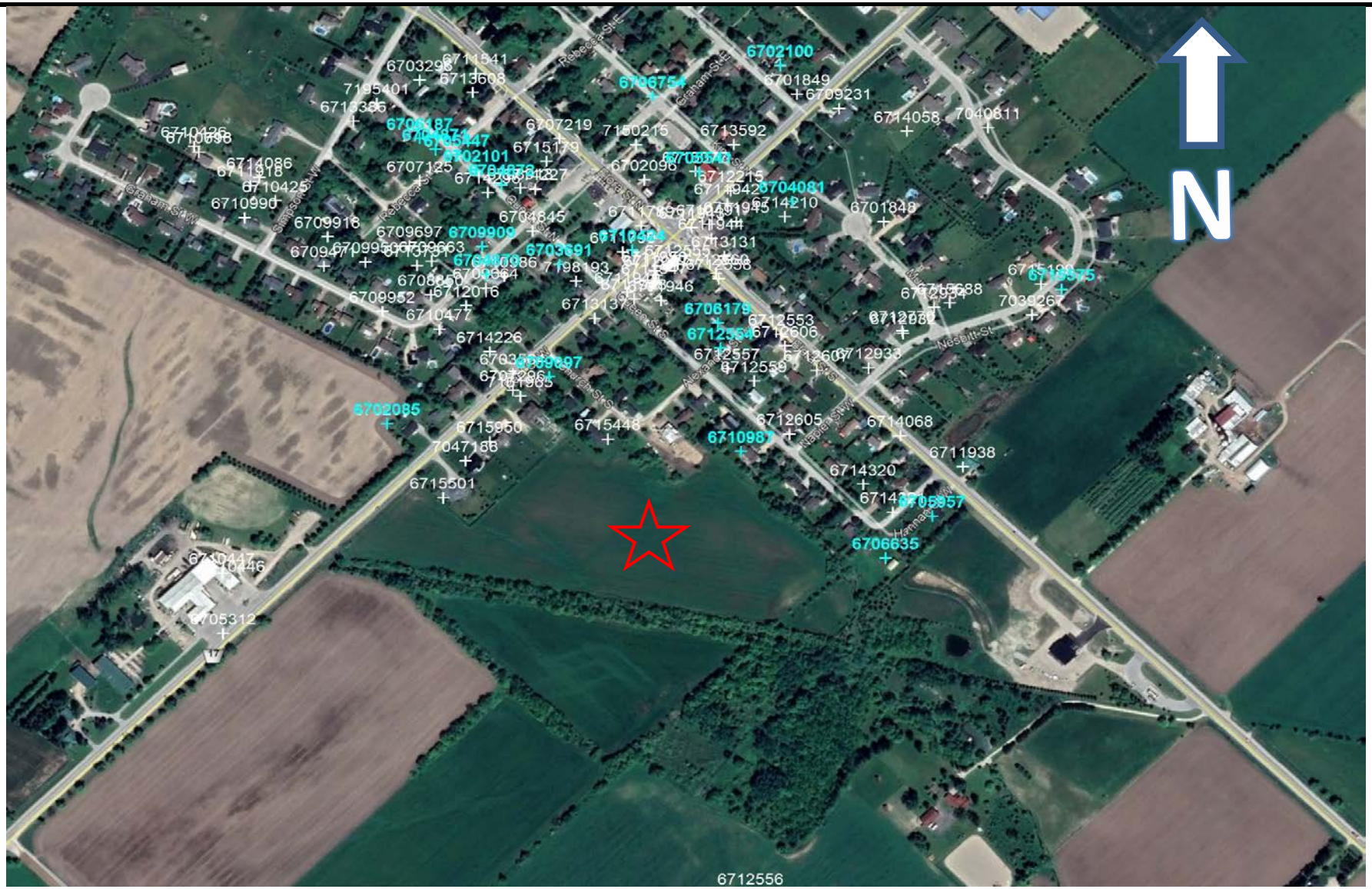
- Monitoring Well
- 219.91 Groundwater Contour (mASL)

Drawing 3 - Groundwater Contour Mapping (20-Apr-2022)

31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	01-May-22



LEGEND

- Subject Property
- Supply Well (<31 m deep)
- Supply Well (>47 m deep)

imagery from Google Earth © 2021

Drawing 4 - MECP WWRs
31 Church Street, Alma

HCS HYDROGEOLOGY CONSULTING SERVICES

Drawn:	CFH
Date:	02-Jan-21

APPENDIX B: TABLES

Table 1 – Groundwater Level Measurements

Table 2 – Hydraulic Conductivity Estimates

Table 3 – Water Chemistry Analysis Results

31 Church Street, Alma, Ontario
Table 1 - Groundwater Level Measurements

Name	Ground Surface Elevation (mASL)	Stickup (m)	14-Dec-20			22-Apr-21			2021-15-Jul			29-Oct-21		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	8.41	7.40	435.23	1.95	0.94	441.69	3.49	2.48	440.15	2.32	1.31	441.32
BH 02-20	438.21	0.97	1.03	0.06	438.15	1.02	0.05	438.16	1.35	0.38	437.83	1.15	0.18	438.03
BH 03-20	447.02	0.98	2.24	1.26	445.76	2.39	1.41	445.61	3.01	2.03	444.99	2.39	1.41	445.61

Name	Ground Surface Elevation (mASL)	Stickup (m)	10-Jan-22			20-Apr-22		
			WL (mBTOP)	WL (mBGS)	WL (mASL)	WL (mBTOP)	WL (mBGS)	WL (mASL)
BH 01-20	442.63	1.01	2.46	1.45	441.18	2.47	1.46	441.17
BH 02-20	438.21	0.97	1.20	0.23	437.98	1.06	0.09	438.12
BH 03-20	447.02	0.98	2.54	1.56	445.46	2.44	1.46	445.56

Measurement is considered erroneous
mASL - metres Above Sea Level
mBGS - metres Below Ground Surface

31 Church Street, Alma, Ontario
Table 2 - Hydraulic Conductivity Estimates

Name	Soil Sample Depth or Screened Interval (mBGS)	Soil Type	Analysis Method	Hydraulic Conductivity (m/sec)
BH 01-20	1.52 - 2.13	Clayey, sandy silt, trace gravel	Kaubisch	5.2×10^{-7}
BH 01-20	7.62 - 9.14	Silt, trace clay and sand	Hvorslev	#VALUE!
BH 02-20	7.62 - 9.14	Sand, trace silt and clay	Breyer	2.5×10^{-4}
BH 02-20	7.62 - 9.14	Sand, trace silt and clay	Hvorslev	4.7×10^{-6}
BH 03-20	6.10 - 7.62	Silt, trace clay and sand	Kozeny Carman	1.1×10^{-7}
BH 03-20	6.10 - 7.62	Silt, trace clay and sand	Hvorslev	$<1 \times 10^{-8}$

mBGS - metres Below Ground Surface
m/sec - metres per second

Measurement is considered erroneous

31 Church Street, Alma, ON
Table 3 - December Water Chemistry Analysis Results
14-Dec-20

Parameter	Units[i]	ODWQS [ii]	ODWQS Operational & Aesthetic [iii]	BH 01-20	BH 03-20
				0	
Physical Tests					
Colour, Apparent	CU		**5**	**24.7**	**9.7**
Conductivity	umhos/cm			906	1480
pH	pH units		**6.5-8.5**	8.12	7.74
Total Dissolved Solids	mg/L		**500**	**646**	**1150**
Turbidity	NTU		**5**	**>4000**	**>4000**
Anions and Nutrients					
Alkalinity, Total (as $CaCO_3$)	mg/L		**30-500**	253	324
Ammonia, Total (as N)	mg/L			0.164	0.048
Chloride (Cl)	mg/L		**250**	156	**278**
Fluoride	Measurement	*1.5*		0.267	0.15
Nitrite (as N)	mg/L		**80-100**	**22000**	**17500**
Orthophosphate, Dissolved (as P)	mg/L	*10*		0.471	<0.10
	mg/L	*1*		<0.010	<0.050
	mg/L			<0.0030	<0.0030
Sulfate (SO_4)	mg/L		**500**	23.0	86.8
Total Metals					
Aluminum (Al)-Total	mg/L		**0.1**	**38.4**	**62.4**
Antimony (Sb)-Total	mg/L	*0.006*		<0.010	<0.010
Arsenic (As)-Total	mg/L	*0.0100*		*0.022*	*0.050*
Barium (Ba)-Total	mg/L	*1*		*1.33*	*1.26*
Boron (B)-Total	mg/L	*5*		<1.0	<1.0
Cadmium (Cd)-Total	mg/L	*0.005*		0.00458	0.00305
Calcium (Ca)-Total	mg/L			6040	5000
Chromium (Cr)-Total	mg/L	*0.05*		*0.125*	*0.192*
Copper (Cu)-Total	mg/L		**1**	0.338	0.318
Iron (Fe)-Total	mg/L		**0.3**	**16.8**	153
Lead (Pb)-Total	mg/L	*0.01*		*0.290*	*0.267*
Magnesium (Mg)-Total	mg/L			1670	1230
Manganese (Mn)-Total	mg/L		**0.05**	**16.4**	**14.9**
Nickel (Ni)-Total	mg/L			0.140	0.165
Phosphorus (P)-Total	mg/L			<5.0	14.6
Selenium (Se)-Total	mg/L	*0.05*		<0.0050	<0.0050
Silicon (Si)-Total	mg/L			56	83
Silver (Ag)-Total	mg/L			<0.0050	<0.0050
Sodium (Na)-Total	mg/L	*20*	**200**	*59.0*	*62.3*
Sulfur (S)-Total	mg/L			<50	58
Uranium (U)-Total	mg/L	*0.02*		0.0174	0.0235
Zinc (Zn)-Total	mg/L		**5**	0.91	0.91

i - All measured concentrations are in units indicated. CU = Colour Unit. NTU = Napthalene Turbidity Unit

ii - Concentrations in *underlined and italicized text* exceed the Ontario Drinking Water Quality Standards (ODWQS) - Tables 1 & 2; Safety Standards.

iii - Concentrations in **bold text** exceed the ODWQS - Aesthetic and Operational parameters.

iv - Parameters that are not listed in this table were reported to be below the detection limit and are included on the Certificate of Analysis in Appendix D.

APPENDIX C: BOREHOLE LOGS

BH 01-20 through BH 03-20 (CMT Engineering Inc., 2020)

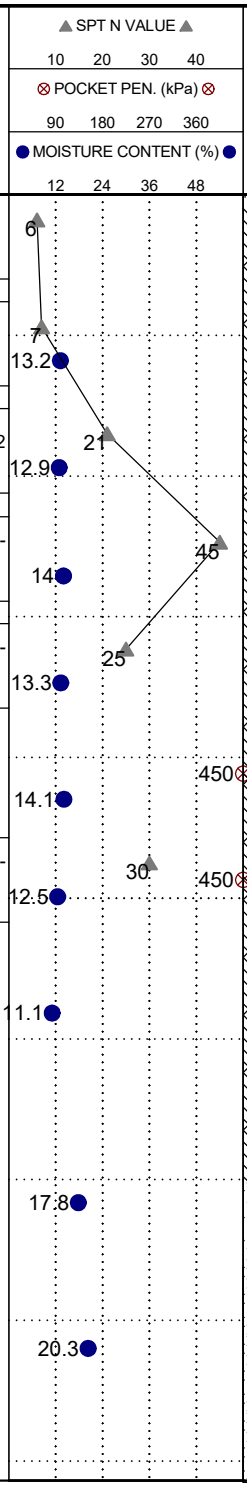
CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

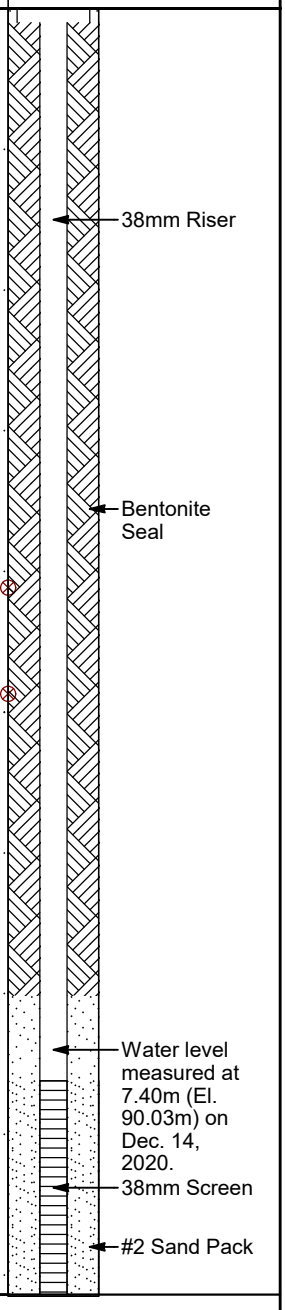
BOREHOLE NUMBER 1

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 97.43 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
	TOPSOIL: Loose, dark brown silty topsoil, moist (410 mm)	0.00, 97.43	SS 1	67	2-3-3-3 (6)
	CLAYEY SILT: Firm, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.41, 97.02	SS 2	100	2-3-4-4 (7)
1			SS 3	100	4-6-15-12 (21)
2	becoming stiff to very stiff, some sand	1.83, 95.60	SS 4	33	13-20-25-38 (45)
			SS 5	100	12-11-14-13 (25)
3			MC5 6	100	
4	becoming grey	4.65, 92.78	SS 7	100	12-14-16-21 (30)
	occasional wet seams encountered	5.49, 91.94	MC5 8	100	
5			MC5 9	100	
6	**SILT:** Compact, grey silt, trace clay and sand, moist	7.37, 90.06			
7	becoming loose, wet	7.92, 89.51	MC5 10	100	
8	becoming compact, moist	8.69, 88.74			
9					

Bottom of borehole at 9.14 m, Elevation 88.29 m.
Groundwater measured at approximately 7.40 m below ground surface (elevation 90.03 m) on December 14, 2020.





CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 2

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 92.78 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	SPT N VALUE / POCKET PEN. (kPa) / MOISTURE CONTENT (%)	WELL DIAGRAM
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (360 mm)	0.00, 92.78	SS 1	50	1-1-2-2 (3)	3	Water level measured at 0.06m (El. 92.72m) on Dec. 14, 2020.
	CLAYEY SILT: Soft, brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 92.42					
1	becoming stiff to very stiff	1.07, 91.71	SS 2	100	1-2-7-7 (9)	9 14.7	
			SS 3	100	6-8-11-12 (19)	19 13.8	38mm Riser
2			SS 4	100	9-10-12-15 (22)	22 14.1	
3	becoming sandy, some gravel	2.67, 90.11	SS 5	100	8-7-6-8 (13)	13 13.3	
	becoming stiff, more plastic (about the plastic limit)	3.30, 89.48	MC5 6	100		175 13	Bentonite Seal
4			SS 7	67	7-6-7-9 (13)	13 13.1	
5			MC5 8	100		14.6	
6			MC5 9	100		14.1	
7							
8	**SAND:** Compact, brown sand, trace silt and clay, wet	7.82, 84.96	MC5 10	100		12.2	#2 Sand Pack 38mm Screen
9							

Bottom of borehole at 9.14 m, Elevation 83.64 m.
Groundwater measured at approximately 0.06 m below ground surface (elevation 92.72 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-4

CMT Engineering Inc.
1011 Industrial Crescent, Unit 1
St. Clements, Ontario N0B 2M0
Telephone: 519-699-5775
Fax: 519-699-4664

BOREHOLE NUMBER 3

PROJECT: Geotechnical Investigation for Proposed Subdivsion
PROJECT ADDRESS: 31 Church Street
PROJECT NUMBER: 20-732
PROJECT LOCATION: Alma, Ontario
DRILLING DATE: 20-12-11
GROUND ELEVATION: 101.75 m
DRILLING CONTRACTOR: CMT Drilling Inc.
LOGGED BY: BB
DRILLING EQUIPMENT: Geoprobe 7822DT
SAMPLING METHOD: SPT/MC5

DEPTH (m)	MATERIAL DESCRIPTION	Depth, Elevation (m)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)
0	**TOPSOIL:** Loose, dark brown silty topsoil, moist (360 mm)	0.00, 101.75	SS 1	67	1-2-2-4 (4)
	CLAYEY SILT: Soft, mottled grey-brown clayey silt, some sand, trace gravel, drier than the plastic limit	0.36, 101.39			
1	becoming stiff	0.76, 100.99	SS 2	100	6-6-6-7 (12)
	becoming very stiff, brown	1.52, 100.23	SS 3	100	5-9-12-12 (21)
2			SS 4	100	13-15-16-20 (31)
3			SS 5	100	9-12-18-20 (30)
4			MC5 6	100	
	becoming grey, more plastic (about the plastic limit)	4.22, 97.53	SS 7	100	8-29-16-18 (45)
5	(-5.03 m) wet silty sand seam encountered		MC5 8	100	
	(-5.49 m) saturated silty sand seam encountered				
6	**SILT:** Loose, grey silt, trace clay and sand, wet	5.89, 95.86	MC5 9	100	
7	becoming compact, moist	7.01, 94.74			

SPT N VALUE: 10 20 30 40
POCKET PEN. (kPa): 90 180 270 360
MOISTURE CONTENT (%): 12 24 36 48

SPT N values: 4, 12, 21, 31, 30, 45, 17, 22
Pocket pen. (kPa): 450, 450, 250
Moisture content (%): 12.5, 12.2, 12.9, 13.1, 12.8, 11.5, 14.8

WELL DIAGRAM
- Water level measured at 1.26m (El. 100.49m) on Dec. 14, 2020.
- Bentonite Seal
- 38mm Riser
- #2 Sand Pack
- 38mm Screen

Bottom of borehole at 7.62 m, Elevation 94.13 m.

Groundwater measured at approximately 1.26 m below ground surface (elevation 100.49 m) on December 14, 2020.

BOREHOLE LOG WITH WELL2 20-732.GPJ CMT_TEMPLATE_2020-05-15.GDT 21-1-4

APPENDIX D: MECP WATER WELL RECORDS

Water Well Records

December 29, 2020

2:15:56 PM

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
KINCARDINE TOWNSHIP 03 035	17 539806 4842197 W	2006-08 7146						7034387 (Z49494) A	
NICHOL TOWNSHIP 003	17 540383 4841927 W	2006-01 2663	6.21	FR 0157	26/26/25/1:	DO		6715688 (Z41577) A039863	BRWN CLAY STNS 0155 GRVL 0157
NICHOL TOWNSHIP 003	17 540503 4841943 W	2005-10 2663	15.7	FR 0049	9/10/30/1:0	DO		6715575 (Z29024) A017819	BRWN CLAY STNS 0024 BRWN CLAY GRVL 0037 BRWN CLAY STNS 0047 GRVL 0049
NICHOL TOWNSHIP 11 001	17 540471 4841913 W	2006-10 6865	5.11	FR 0164	10/11/12/1:0	DO	0162 3	7039267 (Z56267) A039863	BRWN SILT SAND 0162 GRVL SAND 0169
NICHOL TOWNSHIP CON 11 001	17 540312 4842024 W	1954-04 1723	4 4	FR 0257	0///:	ST DO		6701848 ()	BRWN CLAY BLDR 0182 GRVL 0235 MSND 0248 LMSN 0257
NICHOL TOWNSHIP CON 11 001	17 540481 4841950 W	2004-09 2663	6.25	FR 0155 FR 0160	16/20/30/1:0	DO		6715199 (Z17931) A007148	BRWN CLAY STNS 0155 GRVL 0160
NICHOL TOWNSHIP CON 11 001	17 540214 4842048 W	1971-11 2519	30	FR 0027	25///:	DO		6704081 ()	GREY CLAY 0027 GREY SAND 0028 GREY CLAY MUCK 0035
NICHOL TOWNSHIP CON 11 001	17 540148 4842061 W	1997-03 6865	6	FR 0194	5/7/15/1:0	DO		6712215 (176918)	LOAM 0001 BRWN CLAY SNDY 0003 GREY CLAY GRVL 0040 GREY CLAY 0048 GREY CLAY GRVL 0101 GREY HPAN 0124 GREY CLAY GRVL 0142 GREY HPAN 0168 GREY CLAY GRVL 0183 BRWN SAND GRVL 0194
NICHOL TOWNSHIP CON 11 001	17 540332 4841894 W	1998-12 2663	6	FR 0160	8/20/30/1:0	DO		6712770 (198833)	BRWN CLAY STNS GRVL 0035 BRWN CLAY GRVL 0075 BRWN GRVL SAND 0115 BRWN CLAY GRVL 0135 BRWN CLAY SAND GRVL 0154 GRVL 0160
NICHOL TOWNSHIP CON 11 001	17 540141 4841983 W	1999-09 6865	6	UK 0167	9/12/10/1:0	DO		6713131 (203987)	LOAM 0001 BRWN CLAY STNS 0012 GREY CLAY 0021 GREY SAND CLAY 0025 GREY HPAN CLAY 0042 GREY CLAY GRVL 0116 GREY HPAN CLAY 0143 GREY CLAY STNS 0162 BRWN GRVL SAND 0167
NICHOL TOWNSHIP CON 11 001	17 540264 4842159 W	1988-03 4643	5	FR 0175	15/80/40/1:0	DO		6709231 (02496)	BLCK LOAM 0001 RED CLAY 0168 BRWN GRVL 0179
NICHOL TOWNSHIP CON 11 001	17 540154 4842024 W	1996-04 2336	2		4///:	CO	0001 5	6711945 (168003)	BRWN GRVL SAND 0003 GREY GRVL SAND CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540127 4842004 W	1996-04 2336	2		4///:	CO	0001 5	6711944 (168002)	BRWN GRVL SAND 0003 GREY GRVL SAND CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540106 4842017 W	1996-04 2336	2		4///:	CO	0001 5	6711943 (168001)	BRWN GRVL CLAY 0002 GREY GRVL SAND CLAY 0006

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
NICHOL TOWNSHIP CON 11 001	17 540219 4842176 W	1965-12 3316	4 4	FR 0172	///:	DO		6701849 ()	GREY CLAY STNS GRVL 0170 GRVL 0172
NICHOL TOWNSHIP CON 11 001	17 540144 4842046 W	1996-04 2336	2		4///:	CO	0001 5	6711942 (167000)	BRWN GRVL CLAY FILL 0003 GREY GRVL CLAY 0006
NICHOL TOWNSHIP CON 11 001	17 540125 4842021 W	1990-10 4552	6	FR 0170	0/40/10/18:0	CO		6710491 (70360)	BRWN LOAM 0002 BRWN SAND CLAY 0011 GREY CLAY STNS 0118 BRWN CLAY 0166 BRWN GRVL 0170
NICHOL TOWNSHIP CON 11 002	17 540397 4841732 W	1996-02 6865	6	FR 0165	/15/30/1:30	DO		6711938 (168201)	BRWN LOAM 0002 BRWN CLAY SNDY STNS 0011 BRWN SAND GRVL 0017 GREY CLAY GRVL 0123 BRWN HPAN 0152 BRWN GRVL SAND 0165
NICHOL TOWNSHIP CON 11 002	17 540296 4841850 W	1999-04 2663	6	FR 0167	5/8/30/1:	DO		6712933 (198858)	BRWN CLAY STNS 0025 BRWN CLAY SAND GRVL 0085 BRWN SAND GRVL 0105 BRWN CLAY SAND GRVL 0162 GRVL 0167
NICHOL TOWNSHIP CON 11 003	17 540366 4841922 W	1999-04 2663	6	FR 0166	8/10/30/1:	DO		6712934 (198855)	BRWN CLAY STNS 0025 BRWN CLAY SAND GRVL 0075 BRWN SAND GRVL 0085 BRWN CLAY SAND GRVL 0120 BRWN SAND GRVL 0125 BRWN CLAY SAND GRVL 0160 GRVL 0166
NICHOL TOWNSHIP CON 11 012	17 540333 4841891 W	1999-04 2663	6	FR 0167	11/13/30/1:	DO		6712932 (198854)	BRWN CLAY STNS GRVL 0025 BRWN CLAY GRVL 0095 BRWN CLAY SAND GRVL 0165 GRVL 0167
NICHOL TOWNSHIP CON 11 019	17 540337 4842132 W	2002-05 2663	6	FR 0163	11/11/25/1:0	DO		6714058 (235155)	BRWN CLAY STNS GRVL 0102 BRWN CLAY HARD 0143 BRWN CLAY HARD 0160 GRVL 0163
NORTH DUMFRIES TOWNS 12 003	17 539792 4842186 W	2006-11 7146						7044591 (Z58071)	
PEEL TOWNSHIP	17 539687 4842189 W	2013-09 7146	6.11	0180	20/23/10/1:0	DO		7210467 (Z170184) A146919	
PEEL TOWNSHIP	17 539736 4841932 W	2015-08 7557			21/35/10/1:	DO		7248261 (Z218781) A193144	
PEEL TOWNSHIP	17 539768 4842165 W	2012-08 7146	6.11	FR 0205	20/30/20/1:0	PS		7195401 (Z140617) A136885	BRWN LOAM 0001 BRWN CLAY SAND 0060 BRWN CLAY STNS 0170 BRWN CLAY GRVL 0190 BRWN GRVL SAND 0205
PEEL TOWNSHIP	17 540063 4841984 W	2009-10 7238	1.78			MO	0005 10	7133280 (Z104442) A091557	BRWN SILT CLAY SAND 0008 BRWN TILL 0015
PEEL TOWNSHIP 006	17 539811 4841972 W	2001-07 2663	6	FR 0184	21/25/30/1:	DO		6713731 (225435)	BRWN CLAY 0080 BRWN CLAY GRVL 0085 BRWN CLAY 0120 BRWN GRVL CLAY 0126 BRWN CLAY 0131 GRVL 0144 BRWN CLAY 0178 GRVL 0184
PEEL TOWNSHIP 008	17 540145 4842210 W	2002-10 2663				NU		6714295 (247511) A	
PEEL TOWNSHIP 061	17 539873 4842064 W	2002-10 2663				NU		6714297 (247505) A	
PEEL TOWNSHIP 061	17 539887 4842059 W	2002-10 2663	6	FR 0160	/1/25/1:0	DO		6714296 (247504)	BRWN CLAY STNS GRVL 0155 BRWN SAND CLAY 0160 GRVL 0166

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 11 001	17 540206 4842030 W	2002-08 2663	6 5	FR 0165	7/20/25/1:0	DO		6714210 (247563)	BRWN CLAY STNS BLDR 0113 BLDR 0115 BRWN CLAY STNS BLDR 0162 GRVL 0165
PEEL TOWNSHIP CON 13 021	17 539642 4842077 W	2002-05 6865	6	UK 0188	20/21/10/1:0	DO		6714086 (242335)	BRWN CLAY 0013 GREY CLAY 0032 GREY GRVL CLAY 0049 GREY CLAY STNS ROCK 0083 GREY CLAY HARD 0152 GREY CLAY GRVL 0186 BRWN GRVL SAND 0188
PEEL TOWNSHIP CON 13 021	17 539603 4841533 W	1974-09 1804	5	FR 0218	10/10/40/2:0	ST		6705312 ()	BLCK LOAM 0003 RED CLAY GRVL STNS 0214 GRVL 0218
PEEL TOWNSHIP CON 13 021	17 539964 4841973 W	1970-06 2519	30	FR 0022	14/25//:	DO		6703691 ()	BRWN CLAY 0009 GREY CLAY STNS 0022 GREY MSND GRVL 0025
PEEL TOWNSHIP CON 13 021	17 539626 4842029 W	1991-08 1660	6	FR 0232	27/35/10/2:0	DO		6710990 (43769)	BRWN CLAY 0004 BRWN CLAY SAND 0039 GREY CLAY FGVL 0098 GREY CLAY BLDR 0101 GREY CLAY SILT 0147 GREY CLAY 0189 GREY SAND MGVL 0226 GREY CGVL 0232
PEEL TOWNSHIP CON 13 022	17 539841 4841850 W	2017-09 6231						7298013 (Z250077) A	
PEEL TOWNSHIP CON 13 022	17 539914 4841843 W	1969-11 1657	5 5	FR 0185	5/25/20/1:0	DO		6703564 ()	BRWN CLAY 0005 BRWN MSND GRVL 0070 GREY CLAY BLDR 0185 GRVL 0193
PEEL TOWNSHIP CON 13 022	17 539756 4841976 W	1989-06 4643	6	FR 0210	15/60//1:0	DO		6709950 (15746)	BRWN FILL 0004 YLLW CLAY 0171 BLUE CLAY STNS 0209 BRWN GRVL 0214
PEEL TOWNSHIP CON 13 022	17 539715 4842006 W	1989-09 2665	5	FR 0192	20/20/15/72:0	DO		6709918 (69751)	BRWN CLAY STNS 0097 GRVL SAND 0101 BRWN CLAY STNS 0187 CGVL 0192
PEEL TOWNSHIP CON 13 022	17 539779 4841783 W	1966-05 1906	5	FR 0090	8/50/10/3:0	DO		6702085 ()	LOAM 0001 CLAY STNS 0028 STNS 0032 CLAY GRVL 0088 GRVL 0090
PEEL TOWNSHIP CON 13 022	17 539711 4841971 W	1988-11 1906	5	FR 0215	24/45/20/2:0	DO		6709471 (19524)	BRWN CLAY STNS 0210 CGVL 0215
PEEL TOWNSHIP CON 13 022	17 539743 4842144 W	2000-05 6865	6	UK 0168	50/75/8/1:	DO		6713386 (211312)	LOAM 0002 BRWN CLAY SNDY GRVL 0013 GREY CLAY GRVL 0101 GREY CLAY STNS 0114 GREY HPAN CLAY 0140 BRWN SAND CLAY 0158 BRWN GRVL SAND 0168
PEEL TOWNSHIP CON 13 022	17 539889 4841869 W	2002-09 6865	6	UK 0193	22/22/12/1:0	DO		6714226 (242365)	BRWN CLAY SNDY 0013 GREY CLAY STNS 0080 GREY CLAY GRVL 0093 GREY CLAY HARD 0119 GREY CLAY STNS 0132 GREY CLAY HARD 0166 GREY CLAY GRVL 0189 BRWN GRVL SAND 0193
PEEL TOWNSHIP CON 13 022	17 539853 4841839 W	1987-11 4854	30	FR 0012 FR 0019	10///:	DO		6709097 (24404)	BRWN CLAY 0014 GREY CLAY 0024 GREY CLAY BLDR 0035
PEEL TOWNSHIP CON 13 022	17 539602 4841605 W	1990-10 4552	6	FR 0212	20/80/30/1:20	IN		6710447 (61228)	BRWN FILL SOFT 0006 BRWN CLAY STNS SOFT 0080 GREY CLAY SOFT 0105 GREY GRVL SOFT 0112 GREY CLAY STNS HARD 0190 GREY CLAY GRVL PCKD 0200 GREY CLAY DNSE 0208 BRWN GRVL PCKD 0212
PEEL TOWNSHIP CON 13 022	17 539613 4841596 W	1990-09 4552	6	FR 0230	20/80/30/1:30	IN		6710446 (61227)	BRWN FILL SOFT 0007 BRWN CLAY PCKD 0020 BRWN CLAY DNSE 0030 BRWN CLAY HARD 0080 GREY CLAY DNSE 0105 GREY GRVL SOFT 0112 GREY CLAY DNSE 0220 BRWN GRVL PCKD 0230

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 13 022	17 540042 4841990 W	1990-06 2663	6	FR 0085	15//5/1:0	DO		6710424 (83518)	LOAM 0002 CLAY 0025 CLAY GRVL 0045 SAND CGVL 0075 SAND 0085
PEEL TOWNSHIP CON 13 022	17 539914 4841823 W	1980-07 4716	5	FR 0179	17/18/8/10:0	DO		6707296 ()	BLCK LOAM 0002 BRWN CLAY STNS 0018 GREY CLAY STNS 0032 GREY CLAY GRVL STNS 0078 BRWN CLAY SILT GRVL 0100 BRWN CLAY SAND GRVL 0148 GREY SAND SILT 0154 BRWN CLAY 0179 GREY GRVL CSND 0181
PEEL TOWNSHIP CON 14 021	17 539632 4842067 W	1996-01 2663	6	FR 0190 FR 0202	25//15/1:0	DO		6711918 (169058)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 GRVL CLAY 0140 HPAN CLAY GRVL 0170 CLAY SLTY GRVL 0202
PEEL TOWNSHIP CON 14 021	17 539577 4842107 W	1991-08 2663	6	FR 0190 FR 0200	32//15/1:0	DO		6710718 (109364)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 CLAY GRVL 0140 CLAY GRVL HPAN 0170 CLAY GRVL SLTY 0200
PEEL TOWNSHIP CON 14 021	17 539659 4842049 W	1990-06 2663	6 6	FR 0190 FR 0195	50//20/1:0	DO		6710425 (83519)	CLAY 0015 CLAY GRVL 0040 SAND GRVL 0060 CLAY GRVL 0100 CLAY HPAN 0140 CLAY GRVL 0146 CLAY HPAN 0190 GRVL 0195
PEEL TOWNSHIP CON 14 021	17 539577 4842107 W	1991-07 2663	6	FR 0190 FR 0200	32//15/1:0	DO		6710696 (83487)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 CLAY GRVL 0140 CLAY GRVL HPAN 0170 CLAY GRVL SLTY 0200
PEEL TOWNSHIP CON 14 021	17 539572 4842114 W	1990-07 2663	6 6	FR 0190 FR 0200	25//15/1:0	DO		6710426 (83516)	BRWN CLAY 0040 SAND 0050 CLAY SLTY GRVL 0100 GRVL CLAY 0140 HPAN CLAY GRVL 0170 CLAY SLTY GRVL 0200
PEEL TOWNSHIP CON 14 022	17 539827 4841977 W	1988-11 3518	6	FR 0219	18/50/20/1:0	DO		6709663 (55180)	BRWN FILL STNS 0002 GREY CLAY STNS BLDR 0208 BRWN GRVL SAND LOOS 0219
PEEL TOWNSHIP CON 14 022	17 539881 4841994 W	1989-07 4854	30	FR 0022 FR 0038	18///:	DO		6709909 (39128)	BRWN CLAY 0004 GREY CLAY 0021 GREY CLAY BLDR 0023 BLUE CLAY 0038 GREY SAND 0039 GREY CLAY 0042
PEEL TOWNSHIP CON 14 022	17 540005 4841950 W	2013-02 7221						7198194 (Z159296) A	
PEEL TOWNSHIP CON 14 022	17 540032 4841988 W	1995-05 6865	6 6	FR 0201	10//15/1:0	DO		6711790 (146657)	BRWN LOAM 0001 BRWN CLAY SNDY 0007 GREY CLAY STNS 0020 GREY GRVL 0023 BRWN CLAY GRVL 0029 GREY CLAY GRVL 0075 GREY GRVL CLAY 0133 BRWN HPAN 0161 GREY GRVL CLAY 0197 GREY FGVL MSND 0201
PEEL TOWNSHIP CON 14 022	17 540052 4842019 W	1995-05 6865	6 6	FR 0201	3/3/15/1:0	DO		6711789 (146655)	BRWN LOAM 0003 BRWN FILL WDFR LOOS 0007 BRWN CLAY GRVL 0012 GREY GRVL CLAY 0021 GREY CLAY 0033 GREY GRVL CLAY STNS 0130 BRWN HPAN 0166 GREY GRVL CLAY 0199 GREY CGVL 0204
PEEL TOWNSHIP CON 14 022	17 539874 4842201 W	1994-09 2336	6	FR 0180	13/20/30/1:0	DO		6711541 (139394)	BRWN CLAY GRVL 0015 GREY CLAY STNS 0070 GREY CLAY GRVL 0140 GREY HPAN 0180
PEEL TOWNSHIP CON 14 022	17 539905 4841959 W	1992-09 2576	6	FR 0191	7//200/1:0	DO		6710986 (114454)	PRDR 0167 BRWN GRVL CLAY 0170 BRWN CLAY STNS GRVL 0191 GRVL 0201
PEEL TOWNSHIP CON 14 022	17 539922 4842064 W	1987-08 4643	5	FR 0200	/50/30/1:0	DO		6708913 (01294)	RED CLAY BLDR 0198 BRWN GRVL 0203
PEEL TOWNSHIP CON 14 022	17 539774 4841917 W	1989-04 4643	6	FR 0215	27/60/40/2:15	DO		6709952 (15748)	BRWN CLAY 0040 YLLW CLAY 0186 BLUE CLAY 0213 BRWN GRVL 0218
PEEL TOWNSHIP CON 14 022	17 539814 4842123 W	1976-07 2519	30	FR 0027	20///:	DO		6706187 ()	BLCK LOAM 0001 GREY CLAY 0027 BRWN GRVL BLDR 0028

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 14 022	17 539805 4842059 W	2018-08 7557			15/40/15/1:0	DO		7325734 (Z284215) A256238	
PEEL TOWNSHIP CON 14 022	17 539835 4841896 W	1990-09 1737	6	FR 0229	30/55/10/2:0	DO	0234 3	6710477 (85493)	BRWN FILL SOFT 0014 BRWN CLAY STNS GRVL 0085 GREY CLAY STNS HARD 0135 GREY CLAY HARD 0229 GREY GRVL SOFT 0237
PEEL TOWNSHIP CON 14 022	17 539885 4841945 W	1988-11 3518	6	FR 0190	15/56/20/1:0	DO		6709664 (55158)	RED CLAY SOFT 0004 BRWN SAND CLAY STNS 0021 GREY CLAY STNS BLDR 0176 BRWN GRVL LOOS 0201
PEEL TOWNSHIP CON 14 022	17 540046 4842116 W	2010-06 7154	6.25	FR 0185	10/31/10/2:0	DO		7150215 (Z107344) A084724	BRWN CLAY STNS 0067 GREY CLAY 0174 GREY GRVL HARD 0185
PEEL TOWNSHIP CON 14 022	17 539823 4842193 W	2009-05 7146	6.25		22/50/40/1:0	DO		7123133 (Z93328) A078583	
PEEL TOWNSHIP CON 14 022	17 539814 4842193 W	1968-07 3518	5	FR 0196	14/20/20/5:0	DO		6703296 ()	LOAM 0002 CLAY BLDR 0024 CLAY HPAN 0160 HPAN 0165 CLAY HPAN 0196 GRVL 0197
PEEL TOWNSHIP CON 14 022	17 539875 4842085 W	1967-07 2519	30	FR 0015		DO		6702101 ()	BRWN CLAY 0012 BLUE CLAY MSND 0022 CLAY STNS 0025 HPAN 0030
PEEL TOWNSHIP CON 14 022	17 539950 4842096 W	2004-09 2663	6.25	FR 0179	39/43/30/1:0	DO		6715179 (Z17934) A007203	BLCK LOAM 0002 BRWN CLAY GRVL 0175 GRVL 0180
PEEL TOWNSHIP CON 14 022	17 540110 4842084 W	2004-08 6865	6.30	0166	8/10/7/1:0	DO		6715077 (Z05738) A005678	BRWN CLAY STNS 0018 GREY CLAY STNS 0089 GREY CLAY 0094 GREY CLAY GRVL 0105 GREY CLAY STNS STNS 0148 BRWN GRVL SAND SILT 0159 BRWN SAND GRVL 0165 BRWN GRVL SAND 0166
PEEL TOWNSHIP CON 14 022	17 540201 4842210 W	1964-12 2519	30	FR 0007 FR 0026	7/29//:	DO		6702100 ()	LOAM 0002 BRWN CLAY 0008 BRWN MSND 0009 BRWN CLAY 0026 MSND STNS 0030
PEEL TOWNSHIP CON 14 022	17 539938 4842063 W	2002-09 6865	6	UK 0182	8/12/12/1:0	DO		6714227 (242367)	LOAM 0001 BRWN CLAY 0010 GREY CLAY STNS 0081 GREY CLAY STNS HARD 0139 GREY CLAY STNS 0173 GREY CLAY GRVL 0180 BRWN GRVL SAND 0182
PEEL TOWNSHIP CON 14 022	17 539935 4842013 W	1973-08 3518	5	FR 0180	-2/15/15/2:0	DO		6704845 ()	BLCK LOAM 0002 GREY CLAY GRVL 0048 GREY STNS 0050 BRWN SAND GRVL 0060 GREY GRVL 0075 BRWN CLAY GRVL 0175 GREY GRVL 0183
PEEL TOWNSHIP CON 14 022	17 539886 4841961 W	1973-11 2519	30	FR 0023	20/35/0/:	DO		6704870 ()	BRWN CLAY 0012 GREY CLAY 0023 GREY GRVL SAND 0025 GREY CLAY STNS 0035
PEEL TOWNSHIP CON 14 022	17 539814 4842073 W	1979-08 2564	4	FR 0195	20/40/20/4:0	DO		6707125 ()	CLAY SNDY 0005 SILT SAND 0060 GRVL CMTD 0100 CLAY 0195 GRVL 0198
PEEL TOWNSHIP CON 14 022	17 540061 4842120 W	2010-06 7154						7150214 (Z107345) A	
PEEL TOWNSHIP CON 14 022	17 539864 4841924 W	1996-06 2576	6	FR 0190 UK 0196	5//80/1:30	DO		6712016 (157438)	BRWN CLAY GRVL 0009 GREY CLAY SLTY GRVL 0075 BRWN CLAY SLTY GRVL 0190 BRWN GRVL 0196

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PEEL TOWNSHIP CON 14 022	17 539803 4841995 W	1988-12 3518	6	FR 0201	48/130/20/1:0	DO		6709697 (55159)	GREY CLAY STNS BLDR 0170 BRWN STNS SAND CLAY 0198 BRWN CGVL LOOS 0201
PEEL TOWNSHIP CON 14 022	17 539964 4842123 W	1979-10 4544	5	FR 0180	3//25/1:0	CO		6707219 ()	BLCK LOAM 0001 RED CLAY 0047 BRWN GRVL 0052 RED CLAY 0180 BRWN GRVL 0185
PEEL TOWNSHIP CON 14 022	17 539902 4842068 W	1973-11 2519	30	FR 0017	4/30/0/:	DO		6704872 ()	BRWN CLAY 0010 GREY CLAY 0017 GREY SAND GRVL 0020 GREY CLAY ROCK 0030
PEEL TOWNSHIP CON 14 022	17 539854 4842103 W	1975-02 2519	30	FR 0020	8//5/:	DO		6705447 ()	FILL 0003 LOAM 0004 BRWN CLAY 0012 BRWN CLAY SNDY 0020 SAND GRVL 0026 GREY CLAY STNS 0028
PEEL TOWNSHIP CON 14 022	17 540114 4842083 W	1975-06 2519	30	FR 0020	19//3/:	DO		6705541 ()	BRWN CLAY 0012 GREY CLAY 0020 BRWN SAND 0021 GREY CLAY 0032
PEEL TOWNSHIP CON 14 022	17 540064 4842173 W	1978-08 5469	30	FR 0021	20/30/3/:	DO		6706754 ()	BRWN CLAY 0016 GREY CLAY 0020 GRVL 0021 GREY SAND GRVL 0030
PEEL TOWNSHIP CON 14 022	17 539831 4842110 W	1973-11 2519	30	FR 0015	10/30/0/:	DO		6704871 ()	BRWN CLAY 0010 GREY GRVL 0015 GREY SAND 0017 GREY CLAY STNS 0030
PEEL TOWNSHIP CON 14 022	17 540055 4842074 W	1958-07 3524	6	FR 0164	/164//:	CO DO		6702096 ()	PRDG 0012 CLAY FSND 0032 BLUE CLAY 0068 HPAN 0078 GRVL CLAY 0086 HPAN 0140 GRVL HPAN 0160 0164
PEEL TOWNSHIP CON 14 022	17 539982 4841953 W	2013-02 7221	6.26	UT 0201	10/13/3/1:0	DO		7198193 (Z159297) A118971	BRWN CLAY 0012 GREY CLAY 0043 GREY FSND 0052 GREY CLAY 0109 GREY CLAY 0194 GREY SAND 0204
PEEL TOWNSHIP CON 14 022	17 540151 4842116 W	2000-09 1737	6	FR 0205	25/45/10/3:30	DO	0202 3	6713592 (217912)	LOAM 0001 BRWN CLAY SAND SOFT 0025 GREY CLAY STNS HARD 0097 GREY CLAY HARD 0193 BRWN CGVL 0205
PEEL TOWNSHIP CON 14 022	17 539826 4841937 W	1987-06 5469	5	FR 0182	1//30/2:	DO		6708850 (09408)	BRWN CLAY LOOS 0050 BRWN GRVL CLAY PORS 0054 BLUE CLAY BLDR DNSE 0182
PEEL TOWNSHIP CON 61 012	17 540424 4842136 W	2007-01 2663	6.25	FR 0166	33/39/8/1:0	DO		7040811 (Z41615) A039545	BRWN CLAY STNS 0162 GRVL 0166
PILKINGTON TOWNSHIP	17 540012 4841854 W	2018-11 7556				PS		7323683 (Z291454) A	
PILKINGTON TOWNSHIP	17 540501 4841536 W	2019-02 7221	6 6		///:	CO		7331187 (Z306172) A090010 A	
PILKINGTON TOWNSHIP 01 001	17 539889 4841762 W	2006-08 2644	6.25	FR 0198	23/50/75/1:	DO		6715950 (Z41928) A037661	BRWN CLAY FILL 0004 GREY CLAY STNS 0018 GREY HPAN STNS 0096 GREY GRVL SLTY 0109 GREY HPAN STNS 0198 BRWN CGVL 0201
PILKINGTON TOWNSHIP 01 001	17 539839 4841695 W	2005-09 7154	6.25	FR 0204 FR 0204	22/72/10/2:0	DO	0201 3	6715501 (Z35593) A030082	BRWN CLAY SLTY STNS 0027 GREY CLAY STNS 0118 GREY CLAY 0197 GREY GRVL SAND SOFT 0204
PILKINGTON TOWNSHIP 01 001	17 540016 4841765 W	2005-08 7154	6.25	FR 0184 0187	12/21/12/1:0	DO	0184 3	6715448 (Z32403) A020155	BRWN CLAY SLTY 0011 BRWN CLAY STNS 0052 BRWN CLAY 0074 GREY GRVL 0084 GREY CLAY STNS 0124 GREY CLAY 0177 GREY GRVL SAND SOFT 0187

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP 01 001	17 539863 4841739 W	2007-06 6865	6.30	0198	24/25/13/1:	DO		7047188 (Z56280) A034702	BRWN CLAY 0016 GREY CLAY STNS 0089 GREY CLAY SAND SILT 0118 BRWN CLAY STNS HARD 0159 GREY CLAY STNS STNS 0183 BRWN SAND GRVL CLAY 0195 BRWN GRVL SAND 0198
PILKINGTON TOWNSHIP P 099	17 540137 4841873 W	1998-06 2663	6	FR 0080	34/60/30/1:0	DO		6712554 (192804)	LOAM 0001 BRWN CLAY SAND 0040 BRWN CLAY SAND GRVL 0065 BRWN SAND GRVL 0075 GRVL 0080
PILKINGTON TOWNSHIP P 131	17 540202 4841890 W	1998-06 2663	6	FR 0161	6/6/30/1:0	DO		6712553 (192805)	LOAM 0001 BRWN CLAY SAND STNS 0020 BRWN CLAY GRVL 0040 GRVL 0045 BRWN CLAY SAND GRVL 0080 BRWN SAND GRVL 0104 BRWN CLAY GRVL HARD 0157 GRVL 0161
PILKINGTON TOWNSHIP P 132	17 540091 4841973 W	1998-06 2663	6	FR 0160	7/78/30/1:0	DO		6712555 (192803)	LOAM 0002 BRWN CLAY STNS 0030 BRWN CLAY SAND GRVL 0045 BRWN SAND GRVL 0055 BRWN CLAY GRVL HPAN 0158 GRVL CGRD 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540068 4841960 W	1996-08 6865	6	FR 0194	0/6/15/1:0	DO		6712097 (169678)	LOAM 0002 BRWN CLAY 0009 GREY CLAY GRVL STNS 0095 BRWN HPAN 0156 GREY CLAY GRVL 0186 GRVL 0194
PILKINGTON TOWNSHIP GR W 01 001	17 540002 4841909 W	1999-10 6865	6	FR 0171	6/9/10/1:0	DO		6713137 (203999)	LOAM 0002 BRWN CLAY 0017 BRWN GRVL SAND 0021 GREY CLAY STNS 0083 GREY HPAN 0115 GREY CLAY STNS 0167 BRWN GRVL SAND 0171
PILKINGTON TOWNSHIP GR W 01 001	17 540330 4841769 W	2002-03 6865	6	UK 0158	-4/2/6/:	DO		6714068 (225340)	BRWN CLAY SAND GRVL 0010 GREY CLAY STNS 0089 GREY CLAY HARD 0110 GREY CLAY GRVL 0151 GREY CLAY HARD 0157 BRWN GRVL SAND 0158
PILKINGTON TOWNSHIP GR W 01 001	17 540290 4841711 W	2002-09 6865	6	UK 0156	-4/-2//:	DO		6714320 (242376)	BRWN GRVL CLAY SNDY 0014 GREY CLAY HARD 0026 GREY CLAY STNS 0096 GREY CLAY HARD 0146 GREY CLAY STNS 0155 BRWN SAND GRVL 0156
PILKINGTON TOWNSHIP GR W 01 001	17 540322 4841678 W	2002-09 6865	6	UK 0155	-5/-2/10/1:0	DO		6714321 (242375)	BRWN CLAY GRVL SNDY 0013 GREY CLAY HARD 0028 GREY CLAY STNS STNS 0083 GREY CLAY GRVL 0110 GREY CLAY STNS 0149 GREY CLAY HARD 0153 BRWN GRVL SAND 0155
PILKINGTON TOWNSHIP GR W 01 001	17 540211 4841771 W	1998-06 2663	6	FR 0159	/2/30/1:0	DO		6712605 (192829)	LOAM 0001 BRWN CLAY 0010 BRWN SAND GRVL 0025 BRWN CLAY SAND GRVL 0080 BRWN BLDR LTCL 0082 BRWN SAND GRVL 0095 BRWN CLAY SAND GRVL 0120 BRWN CLAY GRVL 0130 GRVL 0154 UNKN 0159
PILKINGTON TOWNSHIP GR W 01 001	17 540123 4841887 W	2009-07 7221						7129535 (Z102430) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540132 4841962 W	1998-06 2663	6	FR 0160	5/14/30/1:0	DO		6712560 (192811)	LOAM 0001 FILL 0015 BRWN CLAY SAND STNS 0025 BRWN CLAY SAND GRVL 0085 BRWN SAND GRVL 0095 BRWN CLAY GRVL HPAN 0157 GRVL 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540063 4841984 W	2009-10 7238	1.76			MO	0005 10	7133279 (Z104444) A090730	BRWN CLAY SILT SAND 0008 BRWN TILL 0015
PILKINGTON TOWNSHIP GR W 01 001	17 540083 4841996 W	2009-10 7238	1.76			MO	0005 10	7133281 (Z104443) A091556	BRWN SILT CLAY SAND 0008 BRWN TILL 0015

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP GR W 01 001	17 539922 4841816 W	2010-07 7221	6.26	UT 0189	23/25/12/1:0	DO		7161965 (Z118761) A090016	BRWN CLAY HARD 0010 GREY CLAY STNS 0100 GREY CLAY HARD 0172 GREY CLAY STNS 0184 BRWN GRVL SAND 0189
PILKINGTON TOWNSHIP GR W 01 001	17 540094 4841959 W	2014-05 7154						7221972 (Z181427) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540231 4841698 W	2016-03 7556				DO		7262913 (Z226395) A199518	
PILKINGTON TOWNSHIP GR W 01 001	17 540045 4841816 W	2009-07 7146						7127595 (Z099228) A	
PILKINGTON TOWNSHIP GR W 01 001	17 540135 4841956 W	1998-06 2663	6	FR 0163	6/12/30/1:0	DO		6712558 (192810)	LOAM 0001 BRWN CLAY SAND STNS 0025 BRWN CLAY SAND GRVL 0090 BRWN CLAY GRVL HARD 0158 GRVL 0163
PILKINGTON TOWNSHIP GR W 01 001	17 540073 4841930 W	1996-04 2336	2		4///:	CO	0016 5	6711946 (168004)	BRWN GRVL FILL 0002 GREY CLAY 0017 BRWN SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540066 4841951 W	1996-04 2336	2		5///:	CO	0016 5	6711947 (168005)	BRWN GRVL FILL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540044 4841932 W	1996-04 2336	2		4///:	CO	0016 5	6711948 (168006)	BRWN GRVL FILL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540037 4841940 W	1996-04 2336	2		4///:	CO	0016 5	6711949 (168007)	GRVL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540066 4841965 W	1996-04 2336	2		4///:	CO	0016 5	6711950 (168008)	GRVL 0001 GREY CLAY 0017 GREY SAND 0018 GREY CLAY 0021
PILKINGTON TOWNSHIP GR W 01 001	17 540206 4841876 W	1998-07 2663	6	FR 0161	0/2/30/1:0	DO		6712606 (192828)	LOAM 0001 BRWN CLAY STNS 0035 BRWN CLAY SAND GRVL 0080 BRWN SAND GRVL 0090 BRWN CLAY GRVL 0157 GRVL 0161
PILKINGTON TOWNSHIP GR W 01 001	17 540144 4841849 W	1998-06 2663	6	FR 0160	/6/30/1:0	DO		6712557 (192812)	LOAM 0001 BRWN CLAY SAND STNS 0040 BRWN CLAY SAND GRVL 0065 BRWN SAND GRVL 0070 BRWN CLAY SAND GRVL 0090 BRWN SAND GRVL 0100 BRWN CLAY GRVL HARD 0155 GRVL 0160
PILKINGTON TOWNSHIP GR W 01 001	17 540159 4841750 W	1992-09 6624	5	FR 0100	17/40/12/4:0	DO		6710987 (093827)	BRWN LOAM 0001 BRWN CLAY GRVL SAND 0019 BRWN CLAY HPAN GRVL 0022 BRWN CLAY FGVL 0062 GREY CLAY GRVL STNS 0095 GRVL SAND 0102
PILKINGTON TOWNSHIP GR W 01 001	17 540314 4841623 W	1977-12 5469	30	FR 0013	12//4/1:0	DO		6706635 ()	BLCK LOAM 0003 BRWN CLAY 0011 GREY CLAY 0013 SAND GRVL 0014 GREY CLAY 0026 GRVL SAND 0027
PILKINGTON TOWNSHIP GR W 01 001	17 540173 4841834 W	1998-06 2663	6	FR 0164	/1/30/1:0	DO		6712559 (192813)	LOAM 0001 BRWN CLAY SAND STNS 0035 BRWN CLAY SAND GRVL 0075 BRWN SAND GRVL 0090 BRWN CLAY GRVL 0155 GRVL 0164
PILKINGTON TOWNSHIP GR W 01 001	17 540134 4841903 W	1976-08 2519	30	FR 0028	20///:	DO		6706179 ()	BRWN LOAM 0001 BRWN CLAY 0008 GREY CLAY 0028 BRWN GRVL 0028
PILKINGTON TOWNSHIP GR W 01 002	17 540364 4841673 W	1976-03 2519	30	FR 0020	9//4/1:0	DO		6705957 ()	BRWN FILL 0004 BRWN CLAY 0009 BRWN SAND GRVL 0021 GREY CLAY 0030

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	WELL	FORMATION
PILKINGTON TOWNSHIP GR W 01 002	17 540169 4841223 L	1998-06 2663	6 5	FR 0155	45/45/30/1:0	DO		6712556 (192802)	LOAM 0002 BRWN CLAY STNS 0020 BRWN SAND GRVL 0030 GREY CLAY GRVL 0085 BRWN CLAY SAND GRVL 0100 BRWN CLAY GRVL HPAN 0140 BRWN CLAY BLDR HPAN 0153 GRVL CGRD 0155
PILKINGTON TOWNSHIP GR W 07 001	17 540240 4841847 W	1998-06 2663	6	FR 0161	6/2/30/1:0	DO		6712607 (192827)	LOAM 0001 BRWN CLAY STNS 0020 BRWN SAND GRVL 0025 BRWN CLAY GRVL 0130 BRWN CLAY SAND GRVL 0140 BRWN CLAY GRVL 0157 GRVL CGRD 0161
PUSLINCH TOWNSHIP CON 12 028	17 539871 4842178 W	2001-01 2663	6	FR 0205	30/30/25/1:	DO		6713608 (225372)	BRWN CLAY 0075 BRWN CLAY SAND STNS 0100 BRWN CLAY HPAN 0203 CGVL 0205

Notes:
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 Completedand Well Contractor Licence Number
CASING DIA: .Casing diameter in inches
WATER: Unit of Depth in Fee. See Table 4 for Meaning of Code
PUMP TEST: Static Water Level in Feet / Water Level After Pumping in Feet / Pump Test Rate in GPM / Pump Test Duration in Hour : Minutes
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

1. Core Material and Descriptive terms

Code	Description	Code	Description	Code	Description	Code	Description	Code	Description
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		

2. Core Color

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

3. Well Use

Code	Description	Code	Description
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		

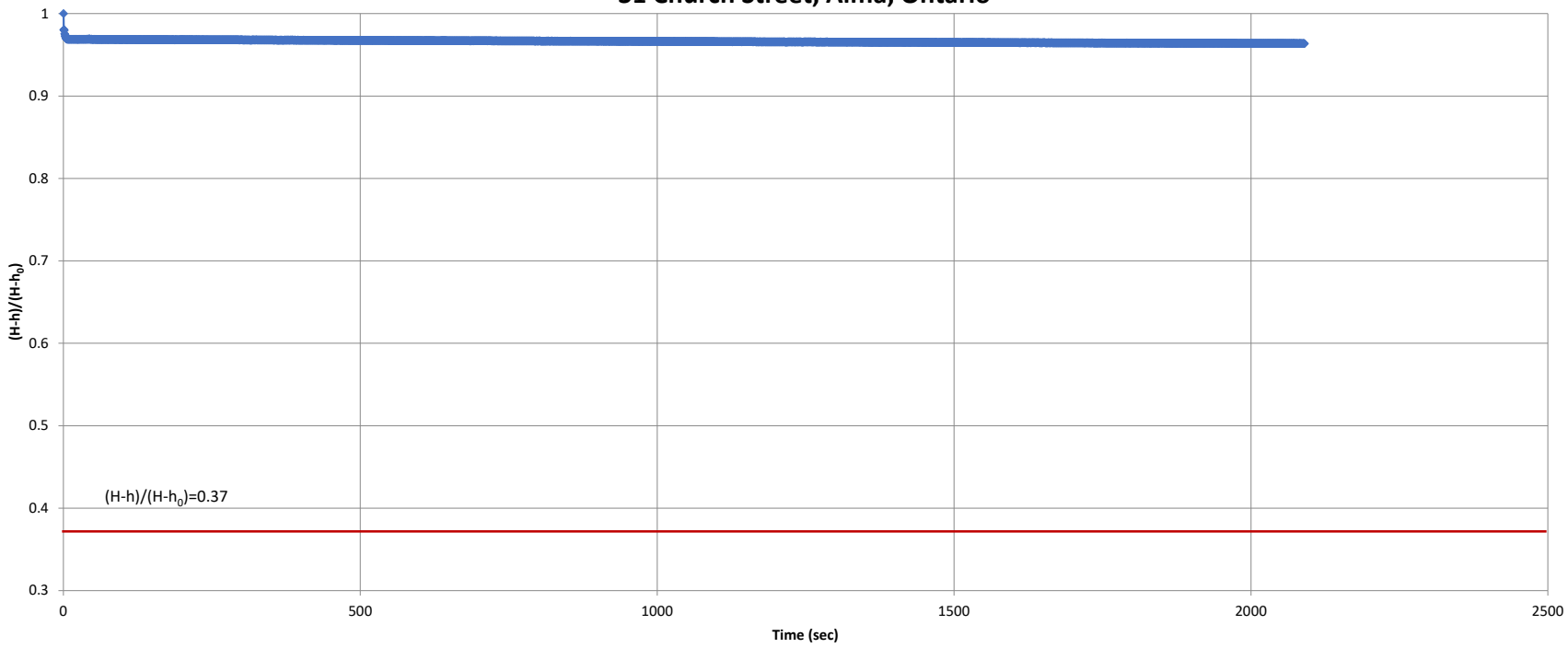
4. Water Detail

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

APPENDIX E: SLUG TEST ANALYSIS GRAPHS

Figure 1-3: BH 01-20 to BH 03-20

Figure 1
BH01-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

stickup=	1.01	m	casing stickup from ground surface
SWL=	8.41	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.524	m	screen length
R =	0.10	m	borehole radius
$H-h_o$ =	9.80	m	Water level change at T=0
$T_{0.37}$ =	n/a	sec	T at $(H-h)/(H-h_0)=0.37$

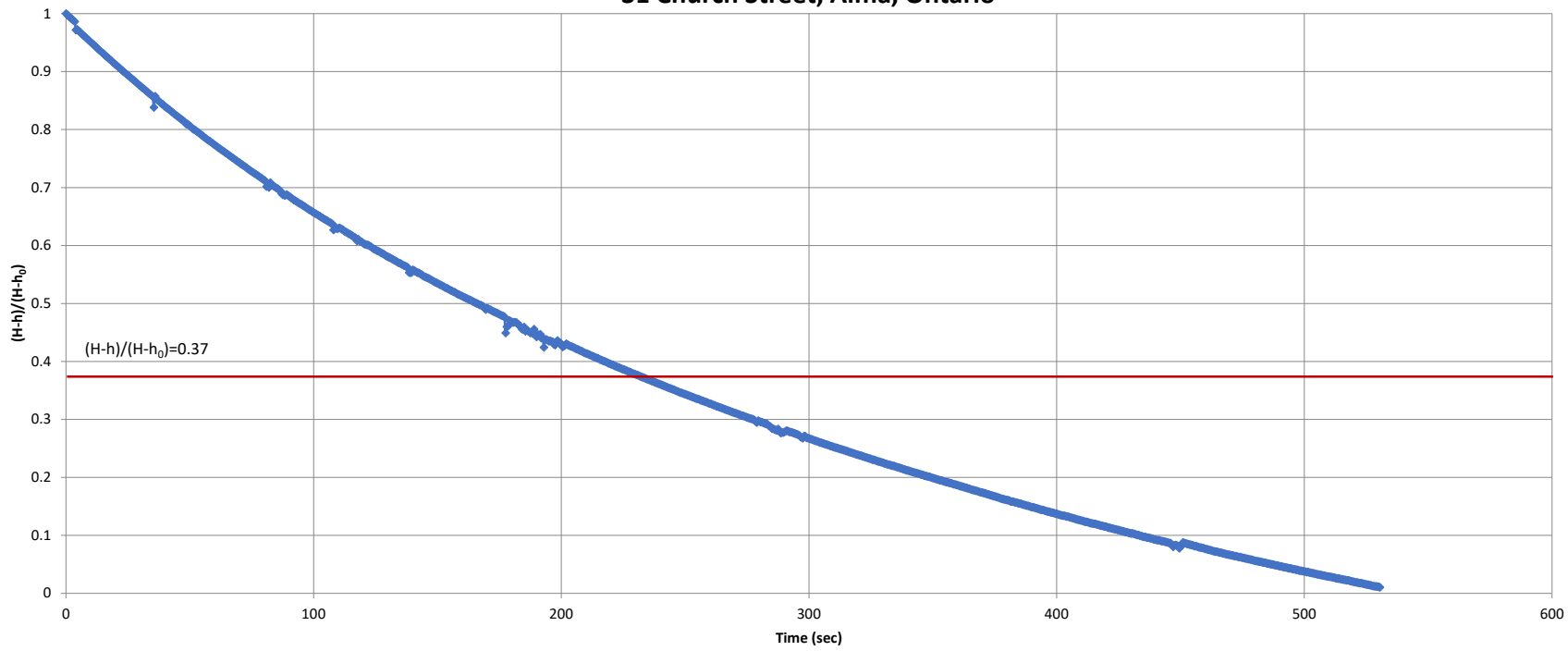
$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= <1 x 10^{-8} m/sec

HCS HYDROGEOLOGY CONSULTING SERVICES

12/14/2020

Figure 2
BH02-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

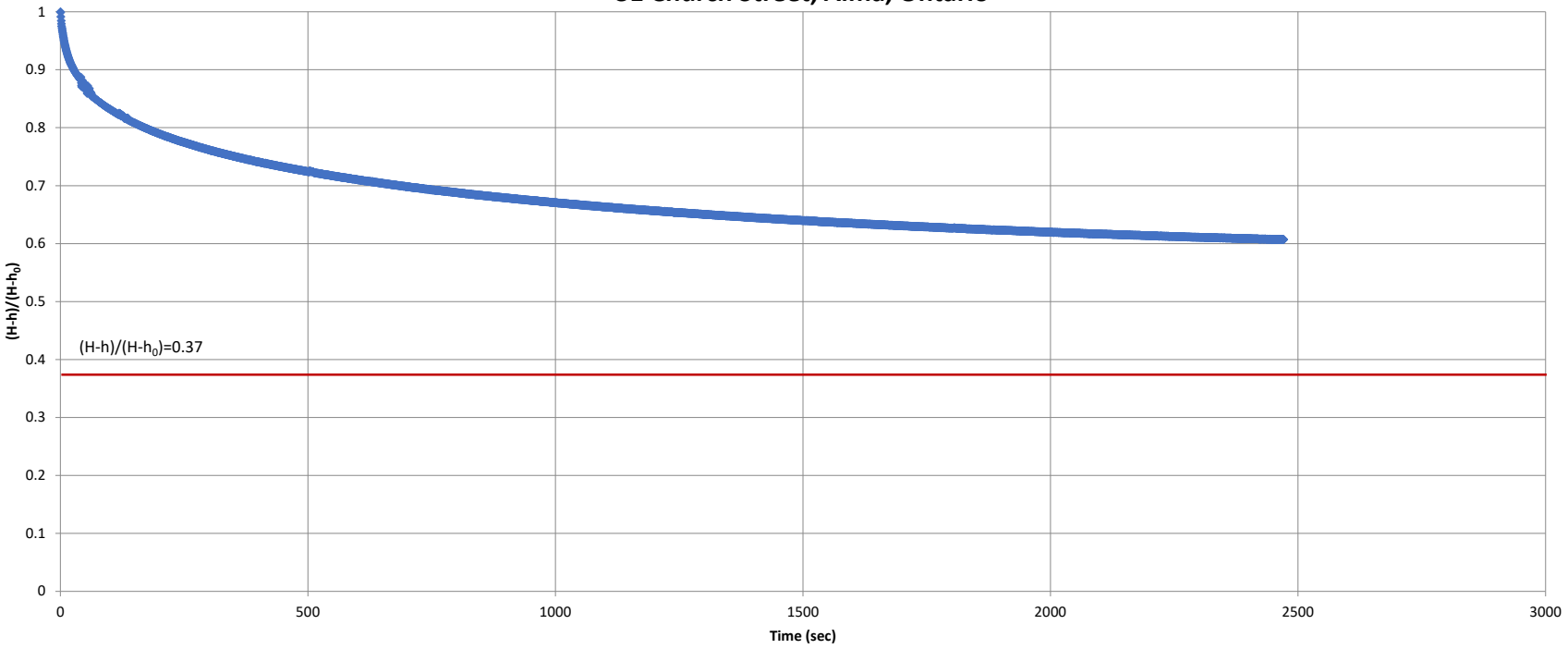
stickup=	0.97	m	casing stickup from ground surface
SWL=	1.03	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.52	m	screen length
R =	0.15	m	borehole radius
$H-h_o$ =	-3.00	m	Water level change at T=0
$T_{0.37}$ =	232	sec	T at $(H-h)/(H-h_0)=0.37$

$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= 4.7E-06 m/sec

12/14/2020

Figure 3
BH03-20 Slug Test Analysis
31 Church Street, Alma, Ontario



Hvorslev Method for Slug Test Analysis

stickup=	0.98	m	casing stickup from ground surface
SWL=	5.31	m	Static Water Level (mBTOP)
r =	0.038	m	casing radius
L =	1.52	m	screen length
R =	0.15	m	borehole radius
$H-h_o$ =	5.19	m	Water level change at T=0
$T_{0.37}$ =	n/a	sec	T at $(H-h)/(H-h_0)=0.37$

$$k = \frac{r^2 \ln(L/R)}{2LT_{0.37}}$$

k= <1 x 10^{-8} m/sec

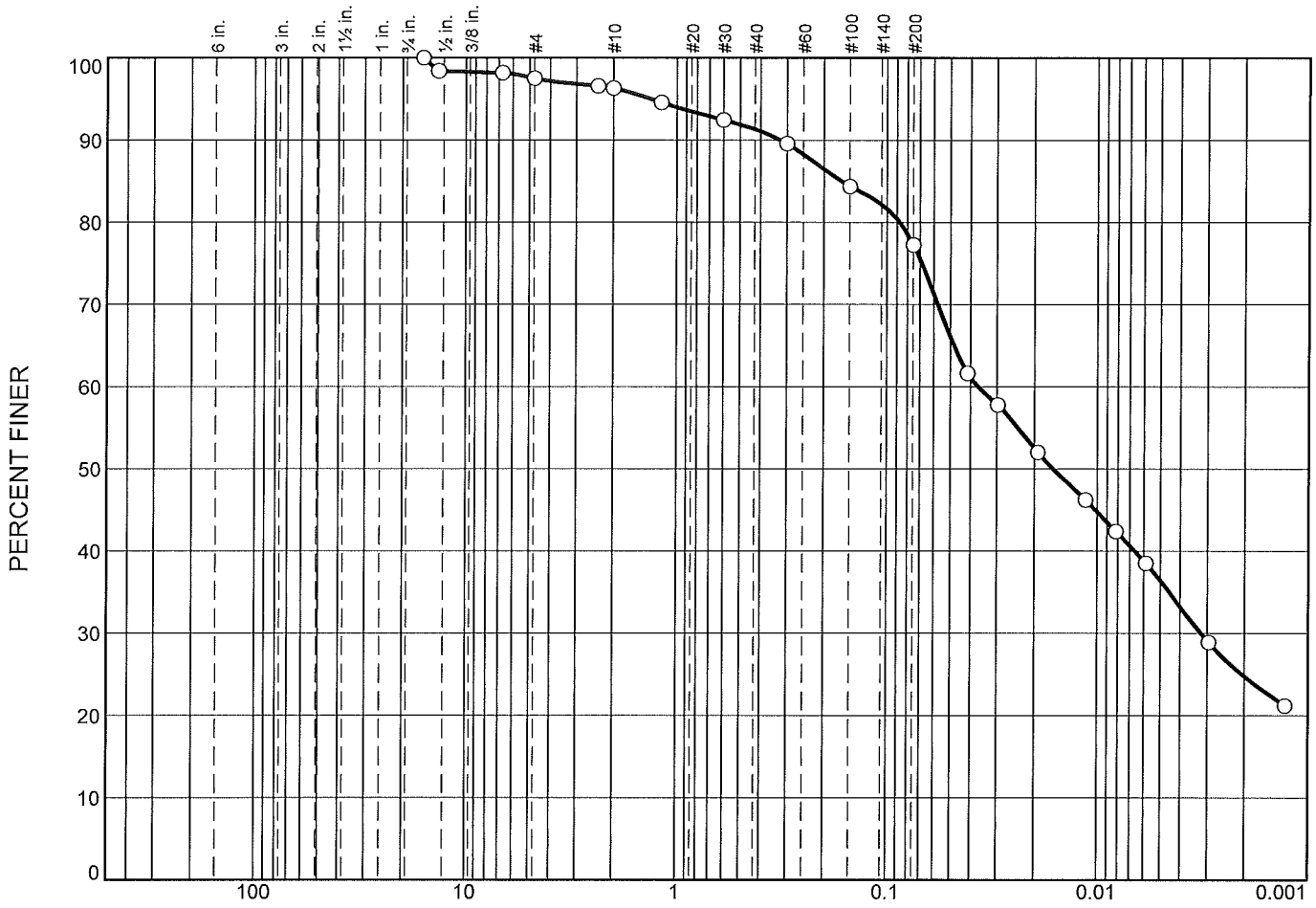
HCS HYDROGEOLOGY CONSULTING SERVICES

12/14/2021

APPENDIX F: GRAIN SIZE ANALYSIS GRAPHS

Figures 1-3

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.5	1.2	5.0	14.1	52.4	24.8

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH1	3	1.52-2.13m	clayey, sandy silt, trace gravel	ML
				Estimated Percolation Rate; T = 50 min/cm	
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

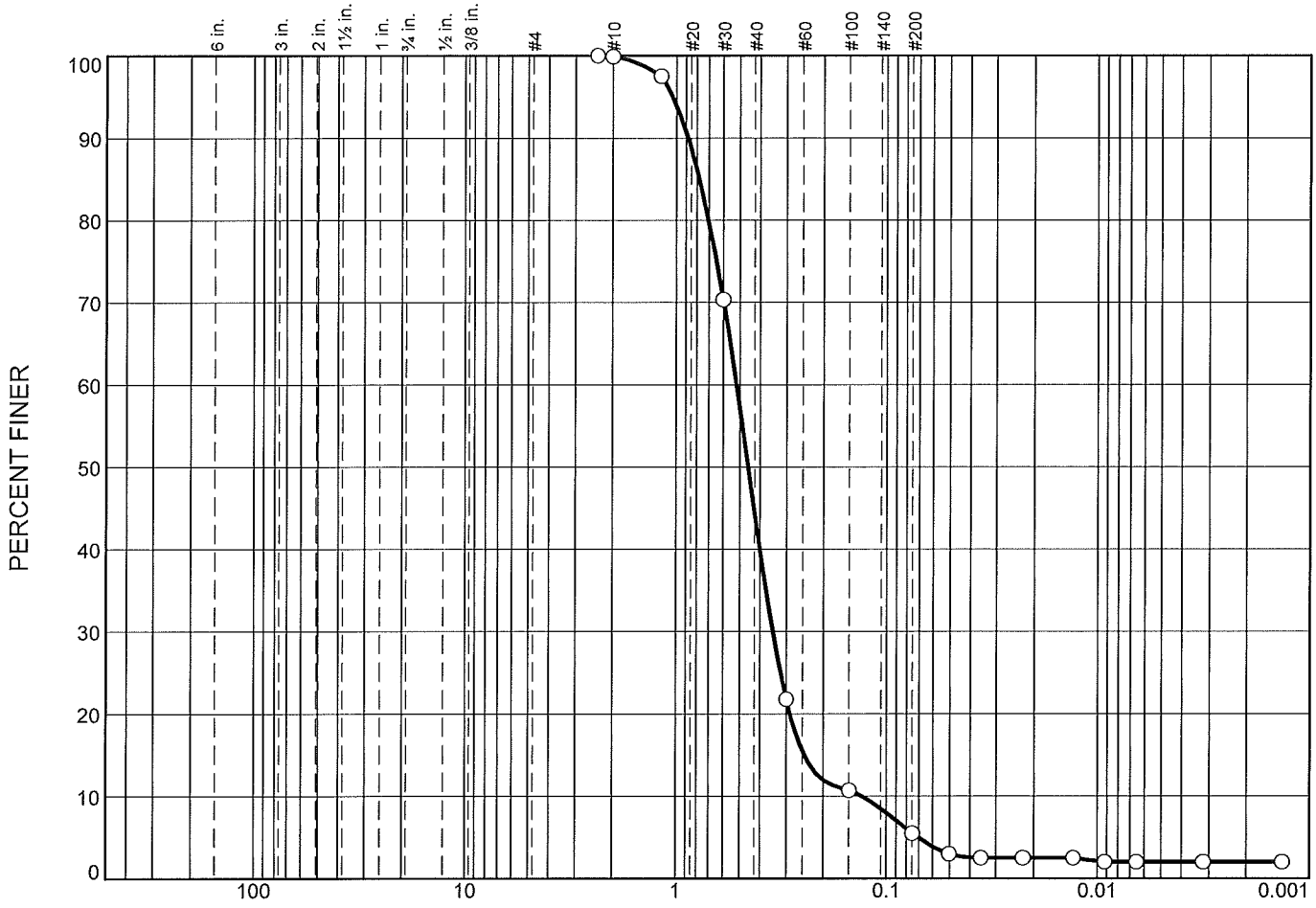
Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 1

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	55.4	39.0	3.5	2.0

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH2	10	7.62-9.14m	sand, trace silt and clay	SP-SM
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

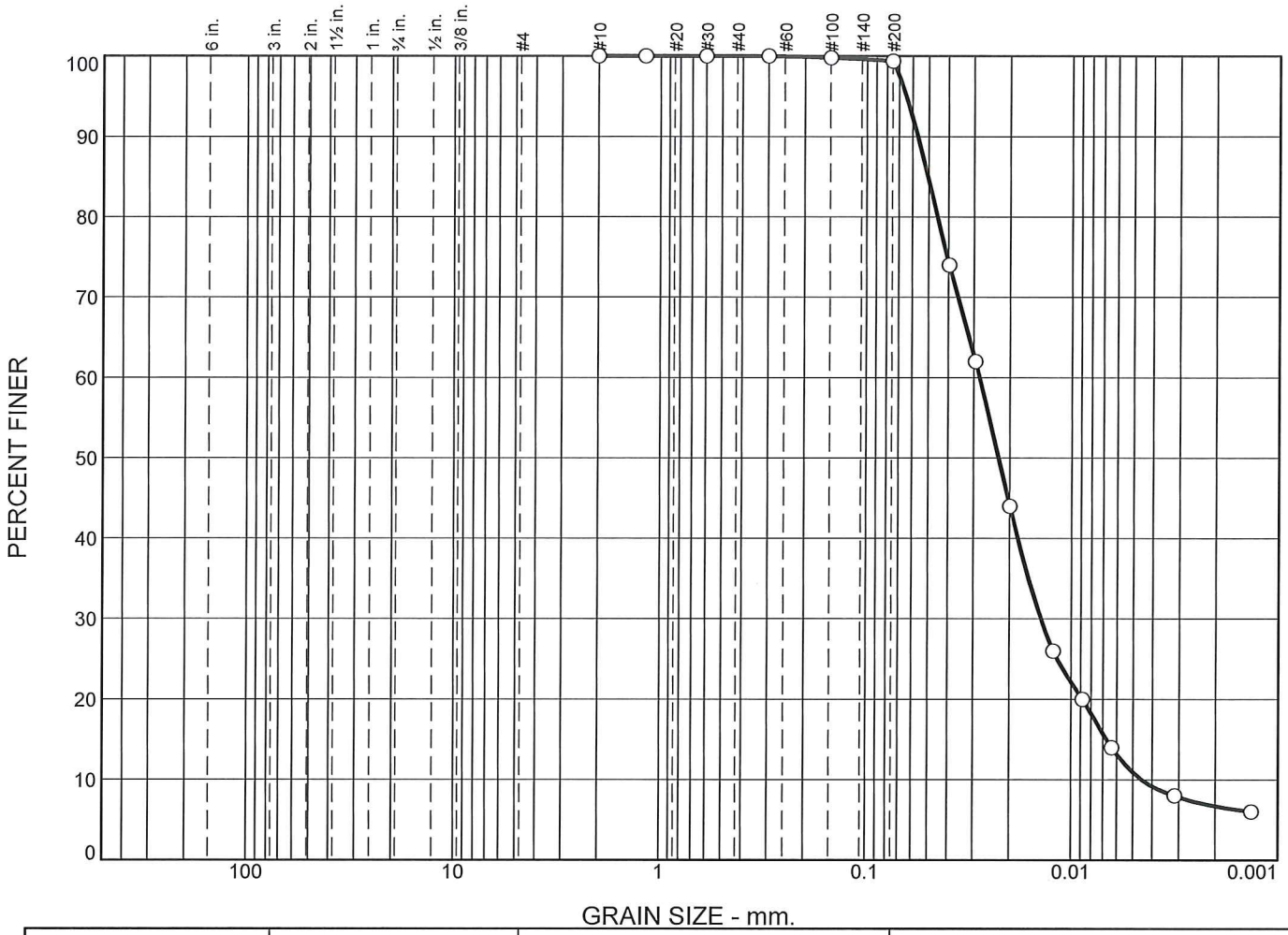
Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 2

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	0.6	92.7	6.7

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	BH3	9	6.10-7.62m	silt, trace clay and sand	ML
				Sampled by BB of CMT Engineering Inc., December 11, 2020	
				Tested by MS of CMT Engineering Inc., December 15, 2020	

CMT Engineering Inc.

St. Clements, ON

Client: Exact Construction

Project: Proposed Subdivision
31 Church Street, Alma, Ontario

Project No.: 20-732

Figure 3

APPENDIX G: LABORATORY CERTIFICATE OF ANALYSIS

L2540181

Hydrogeology Consulting Services
(Kitchener)
ATTN: Chris F Helmer
6 Lynn Court
Kitchener ON N2A 4H6

Date Received: 14-DEC-20
Report Date: 21-DEC-20 07:11 (MT)
Version: FINAL

Client Phone: 905-550-0969

Certificate of Analysis

Lab Work Order #: L2540181

Project P.O. #: NOT SUBMITTED
Job Reference: CHURCH ST-ALMA
C of C Numbers:
Legal Site Desc:

Emily Smith
Account Manager

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	Guideline Limits #2
L2540181-1 BH03-20							
Sampled By: CLIENT on 14-DEC-20 @ 11:53							
Matrix: WATER							
Physical Tests							
Colour, Apparent	9.7		2.0	CU	15-DEC-20		*5
Conductivity	1480		3.0	umhos/cm	17-DEC-20		
Hardness (as CaCO3)	17500	HTC	13	mg/L	16-DEC-20		*80-100
pH	7.74		0.10	pH units	17-DEC-20		6.5-8.5
Total Dissolved Solids	1150	DLM	80	mg/L	16-DEC-20		*500
Turbidity	>4000		0.10	NTU	15-DEC-20		*5
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	324		10	mg/L	17-DEC-20		30-500
Ammonia, Total (as N)	0.048		0.010	mg/L	16-DEC-20		
Chloride (Cl)	278	DLDS	2.5	mg/L	16-DEC-20		*250
Fluoride (F)	0.15	DLDS	0.10	mg/L	16-DEC-20	1.5	
Nitrate (as N)	<0.10	DLDS	0.10	mg/L	16-DEC-20	10	
Nitrite (as N)	<0.050	DLDS	0.050	mg/L	16-DEC-20	1	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L	18-DEC-20		
Sulfate (SO4)	86.8	DLDS	1.5	mg/L	16-DEC-20		500
Total Metals							
Aluminum (Al)-Total	62.4	DLHC	0.50	mg/L	15-DEC-20		*0.1
Antimony (Sb)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20	**0.006	
Arsenic (As)-Total	0.050	DLHC	0.010	mg/L	15-DEC-20	*0.0100	
Barium (Ba)-Total	1.26	DLHC	0.010	mg/L	15-DEC-20	*1	
Beryllium (Be)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20		
Bismuth (Bi)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20		
Boron (B)-Total	<1.0	DLHC	1.0	mg/L	15-DEC-20	5	
Cadmium (Cd)-Total	0.00305	DLHC	0.00050	mg/L	15-DEC-20	0.005	
Calcium (Ca)-Total	5000	DLHC	5.0	mg/L	15-DEC-20		
Cesium (Cs)-Total	0.0049	DLHC	0.0010	mg/L	15-DEC-20		
Chromium (Cr)-Total	0.192	DLHC	0.050	mg/L	16-DEC-20	*0.05	
Cobalt (Co)-Total	0.080	DLHC	0.010	mg/L	15-DEC-20		
Copper (Cu)-Total	0.318	DLHC	0.050	mg/L	15-DEC-20		1
Iron (Fe)-Total	153	DLHC	1.0	mg/L	15-DEC-20		*0.3
Lead (Pb)-Total	0.267	DLHC	0.0050	mg/L	16-DEC-20	*0.01	
Magnesium (Mg)-Total	1230	DLHC	0.50	mg/L	15-DEC-20		
Manganese (Mn)-Total	14.9	DLHC	0.050	mg/L	15-DEC-20		*0.05
Molybdenum (Mo)-Total	0.0090	DLHC	0.0050	mg/L	15-DEC-20		
Nickel (Ni)-Total	0.165	DLHC	0.050	mg/L	15-DEC-20		
Phosphorus (P)-Total	14.6	DLHC	5.0	mg/L	15-DEC-20		
Potassium (K)-Total	19.4	DLHC	5.0	mg/L	15-DEC-20		
Rubidium (Rb)-Total	0.103	DLHC	0.020	mg/L	15-DEC-20		
Selenium (Se)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20	0.05	
Silicon (Si)-Total	83	DLHC	10	mg/L	15-DEC-20		
Silver (Ag)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20		
Sodium (Na)-Total	62.3	DLHC	5.0	mg/L	15-DEC-20	*20	200
Strontium (Sr)-Total	6.09	DLHC	0.10	mg/L	15-DEC-20		
Sulfur (S)-Total	58	DLHC	50	mg/L	15-DEC-20		
Tellurium (Te)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20		
Thallium (Tl)-Total	0.0014	DLHC	0.0010	mg/L	15-DEC-20		

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Sample Details Grouping / Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	Guideline Limits #2
L2540181-1 BH03-20							
Sampled By: CLIENT on 14-DEC-20 @ 11:53							
Matrix: WATER							
Total Metals							
Thorium (Th)-Total	0.042	DLHC	0.010	mg/L	15-DEC-20		
Tin (Sn)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20		
Titanium (Ti)-Total	0.791	DLHC	0.030	mg/L	15-DEC-20		
Tungsten (W)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20		
Uranium (U)-Total	0.0235	DLHC	0.0010	mg/L	15-DEC-20	*0.02	
Vanadium (V)-Total	0.139	DLHC	0.050	mg/L	15-DEC-20		
Zinc (Zn)-Total	0.91	DLHC	0.30	mg/L	15-DEC-20		5
Zirconium (Zr)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20		
L2540181-2 BH01-20							
Sampled By: CLIENT on 14-DEC-20 @ 16:04							
Matrix: WATER						#1	#2
Physical Tests							
Colour, Apparent	24.7		2.0	CU	15-DEC-20		*5
Conductivity	906		3.0	umhos/cm	17-DEC-20		
Hardness (as CaCO3)	22000	HTC	13	mg/L	16-DEC-20		*80-100
pH	8.12		0.10	pH units	17-DEC-20		6.5-8.5
Total Dissolved Solids	646	DLM	80	mg/L	16-DEC-20		*500
Turbidity	>4000		0.10	NTU	15-DEC-20		*5
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	253		10	mg/L	17-DEC-20		30-500
Ammonia, Total (as N)	0.164		0.010	mg/L	16-DEC-20		
Chloride (Cl)	156		0.50	mg/L	16-DEC-20		250
Fluoride (F)	0.267		0.020	mg/L	16-DEC-20	1.5	
Nitrate (as N)	0.471		0.020	mg/L	16-DEC-20	10	
Nitrite (as N)	<0.010		0.010	mg/L	16-DEC-20	1	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L	18-DEC-20		
Sulfate (SO4)	23.0		0.30	mg/L	16-DEC-20		500
Total Metals							
Aluminum (Al)-Total	38.4	DLHC	0.50	mg/L	15-DEC-20		*0.1
Antimony (Sb)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20	**0.006	
Arsenic (As)-Total	0.022	DLHC	0.010	mg/L	15-DEC-20	*0.0100	
Barium (Ba)-Total	1.33	DLHC	0.010	mg/L	15-DEC-20	*1	
Beryllium (Be)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20		
Bismuth (Bi)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20		
Boron (B)-Total	<1.0	DLHC	1.0	mg/L	15-DEC-20	5	
Cadmium (Cd)-Total	0.00458	DLHC	0.00050	mg/L	15-DEC-20	0.005	
Calcium (Ca)-Total	6040	DLHC	5.0	mg/L	15-DEC-20		
Cesium (Cs)-Total	0.0029	DLHC	0.0010	mg/L	15-DEC-20		
Chromium (Cr)-Total	0.125	DLHC	0.050	mg/L	16-DEC-20	*0.05	
Cobalt (Co)-Total	0.067	DLHC	0.010	mg/L	15-DEC-20		
Copper (Cu)-Total	0.338	DLHC	0.050	mg/L	15-DEC-20		1
Iron (Fe)-Total	16.8	DLHC	1.0	mg/L	15-DEC-20		*0.3
Lead (Pb)-Total	0.290	DLHC	0.0050	mg/L	16-DEC-20	*0.01	
Magnesium (Mg)-Total	1670	DLHC	0.50	mg/L	15-DEC-20		
Manganese (Mn)-Total	16.4	DLHC	0.050	mg/L	15-DEC-20		*0.05

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Sample Details Grouping	Analyte	Result	Qualifier	D.L.	Units	Analyzed	Guideline Limits #1	#2		
L2540181-2	BH01-20									
Sampled By:	CLIENT on 14-DEC-20 @ 16:04									
Matrix:	WATER									
Total Metals										
	Molybdenum (Mo)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20				
	Nickel (Ni)-Total	0.140	DLHC	0.050	mg/L	15-DEC-20				
	Phosphorus (P)-Total	<5.0	DLHC	5.0	mg/L	15-DEC-20				
	Potassium (K)-Total	30.1	DLHC	5.0	mg/L	15-DEC-20				
	Rubidium (Rb)-Total	0.076	DLHC	0.020	mg/L	15-DEC-20				
	Selenium (Se)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20	0.05			
	Silicon (Si)-Total	56	DLHC	10	mg/L	15-DEC-20				
	Silver (Ag)-Total	<0.0050	DLHC	0.0050	mg/L	15-DEC-20				
	Sodium (Na)-Total	59.0	DLHC	5.0	mg/L	15-DEC-20	*20	200		
	Strontium (Sr)-Total	6.81	DLHC	0.10	mg/L	15-DEC-20				
	Sulfur (S)-Total	<50	DLHC	50	mg/L	15-DEC-20				
	Tellurium (Te)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20				
	Thallium (Tl)-Total	0.0011	DLHC	0.0010	mg/L	15-DEC-20				
	Thorium (Th)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Tin (Sn)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Titanium (Ti)-Total	<0.050	DLUI	0.050	mg/L	15-DEC-20				
	Tungsten (W)-Total	<0.010	DLHC	0.010	mg/L	15-DEC-20				
	Uranium (U)-Total	0.0174	DLHC	0.0010	mg/L	15-DEC-20	0.02			
	Vanadium (V)-Total	<0.050	DLHC	0.050	mg/L	15-DEC-20				
	Zinc (Zn)-Total	0.91	DLHC	0.30	mg/L	15-DEC-20		5		
	Zirconium (Zr)-Total	<0.020	DLHC	0.020	mg/L	15-DEC-20				

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

Ontario Drinking Water Regulation (ODWQS) JAN.1,2020 = [Suite] - ON-DW-STANDARD+GUIDELINES

#1: Schedule 1 (Microbiological) and 2 (Chemical) Standards (JAN,2020) **#2: Ontario DW Aesthetic and Operational Guidelines (June, 2006)**

Reference Information

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLUI	Detection Limit Raised: Unknown Interference generated an apparent false positive test result.
HTC	Hardness was calculated from Total Ca and/or Mg concentrations and may be biased high (dissolved Ca/Mg results unavailable).
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Method Reference***
ALK-WT	Water	Alkalinity, Total (as CaCO3)	APHA 2320B

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint.

CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

EC-SCREEN-WT	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-WT	Water	Hardness	APHA 2340 B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

MET-T-CCMS-WT	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-F-WT	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PH-WT	Water	pH	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011). Holdtime for samples under this regulation is 28 days

Reference Information

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-WT	Water	Turbidity	APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA		

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guideline limits are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Quality Control Report

Workorder: L2540181 Report Date: 21-DEC-20

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
Alkalinity, Total (as CaCO3)		<10	<10	RPD-NA	mg/L	N/A	20	17-DEC-20
WG3463635-2 LCS								
Alkalinity, Total (as CaCO3)			99.9		%		85-115	17-DEC-20
WG3463635-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	17-DEC-20
CL-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Chloride (Cl)		156	154		mg/L	0.7	20	16-DEC-20
WG3462929-7 LCS								
Chloride (Cl)			100.7		%		90-110	16-DEC-20
WG3462929-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Chloride (Cl)			N/A	MS-B	%		-	16-DEC-20
COLOUR-APPARENT-WT	**Water**							
Batch R5317729								
WG3462461-3 DUP		**WG3462461-4**						
Colour, Apparent		54.9	56.5		CU	2.9	20	15-DEC-20
WG3462461-2 LCS								
Colour, Apparent			103.3		%		85-115	15-DEC-20
WG3462461-1 MB								
Colour, Apparent			<2.0		CU		2	15-DEC-20
EC-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
Conductivity		<3.0	<3.0	RPD-NA	umhos/cm	N/A	10	17-DEC-20
WG3463635-2 LCS								
Conductivity			98.4		%		90-110	17-DEC-20
WG3463635-1 MB								
Conductivity			<3.0		umhos/cm		3	17-DEC-20
F-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Fluoride (F)		0.267	0.261		mg/L	2.2	20	16-DEC-20
WG3462929-7 LCS								

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
F-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-7 LCS								
Fluoride (F)			104.4		%		90-110	16-DEC-20
WG3462929-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Fluoride (F)			91.9		%		75-125	16-DEC-20
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-4 DUP		**WG3461819-3**						
Aluminum (Al)-Total		0.0173	0.0168		mg/L	3.2	20	15-DEC-20
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Arsenic (As)-Total		0.00483	0.00483		mg/L	0.1	20	15-DEC-20
Barium (Ba)-Total		0.300	0.291		mg/L	2.8	20	15-DEC-20
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Boron (B)-Total		0.026	0.027		mg/L	2.9	20	15-DEC-20
Cadmium (Cd)-Total		<0.0000050	<0.000005C	RPD-NA	mg/L	N/A	20	15-DEC-20
Calcium (Ca)-Total		130	134		mg/L	3.1	20	15-DEC-20
Chromium (Cr)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Cesium (Cs)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	15-DEC-20
Cobalt (Co)-Total		0.00028	0.00027		mg/L	1.3	20	15-DEC-20
Copper (Cu)-Total		0.00068	0.00064		mg/L	5.5	20	15-DEC-20
Iron (Fe)-Total		0.633	0.643		mg/L	1.5	20	15-DEC-20
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Magnesium (Mg)-Total		43.0	44.0		mg/L	2.3	20	15-DEC-20
Manganese (Mn)-Total		0.0669	0.0684		mg/L	2.2	20	15-DEC-20
Molybdenum (Mo)-Total		0.00105	0.00107		mg/L	1.5	20	15-DEC-20
Nickel (Ni)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	15-DEC-20
Potassium (K)-Total		2.90	3.00		mg/L	3.2	20	15-DEC-20
Rubidium (Rb)-Total		0.00096	0.00095		mg/L	0.5	20	15-DEC-20
Selenium (Se)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20
Silicon (Si)-Total		10.4	10.4		mg/L	0.9	20	15-DEC-20
Silver (Ag)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-4 DUP		**WG3461819-3**						
Sodium (Na)-Total		200	197		mg/L	1.8	20	15-DEC-20
Strontium (Sr)-Total		0.420	0.423		mg/L	0.7	20	15-DEC-20
Sulfur (S)-Total		24.3	24.6		mg/L	1.3	25	15-DEC-20
Thallium (Tl)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	15-DEC-20
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	15-DEC-20
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	25	15-DEC-20
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Titanium (Ti)-Total		0.00036	0.00050	J	mg/L	0.00014	0.0006	15-DEC-20
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	15-DEC-20
Uranium (U)-Total		0.00159	0.00161		mg/L	1.7	20	15-DEC-20
Vanadium (V)-Total		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	15-DEC-20
Zinc (Zn)-Total		0.0148	0.0145		mg/L	2.1	20	15-DEC-20
Zirconium (Zr)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	15-DEC-20
WG3461819-2 LCS								
Aluminum (Al)-Total			101.6		%		80-120	15-DEC-20
Antimony (Sb)-Total			103.8		%		80-120	15-DEC-20
Arsenic (As)-Total			102.1		%		80-120	15-DEC-20
Barium (Ba)-Total			101.3		%		80-120	15-DEC-20
Beryllium (Be)-Total			98.0		%		80-120	15-DEC-20
Bismuth (Bi)-Total			101.6		%		80-120	15-DEC-20
Boron (B)-Total			94.6		%		80-120	15-DEC-20
Cadmium (Cd)-Total			103.6		%		80-120	15-DEC-20
Calcium (Ca)-Total			98.5		%		80-120	15-DEC-20
Chromium (Cr)-Total			102.2		%		80-120	15-DEC-20
Cesium (Cs)-Total			102.8		%		80-120	15-DEC-20
Cobalt (Co)-Total			101.3		%		80-120	15-DEC-20
Copper (Cu)-Total			101.7		%		80-120	15-DEC-20
Iron (Fe)-Total			101.6		%		80-120	15-DEC-20
Lead (Pb)-Total			102.1		%		80-120	15-DEC-20
Magnesium (Mg)-Total			105.0		%		80-120	15-DEC-20
Manganese (Mn)-Total			101.5		%		80-120	15-DEC-20
Molybdenum (Mo)-Total			99.9		%		80-120	15-DEC-20
Nickel (Ni)-Total			101.1		%		80-120	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-2 LCS								
Phosphorus (P)-Total			109.9		%		70-130	15-DEC-20
Potassium (K)-Total			102.7		%		80-120	15-DEC-20
Rubidium (Rb)-Total			103.0		%		80-120	15-DEC-20
Selenium (Se)-Total			98.9		%		80-120	15-DEC-20
Silicon (Si)-Total			96.7		%		60-140	15-DEC-20
Silver (Ag)-Total			103.0		%		80-120	15-DEC-20
Sodium (Na)-Total			105.3		%		80-120	15-DEC-20
Strontium (Sr)-Total			104.9		%		80-120	15-DEC-20
Sulfur (S)-Total			96.7		%		80-120	15-DEC-20
Thallium (Tl)-Total			102.3		%		80-120	15-DEC-20
Tellurium (Te)-Total			95.0		%		80-120	15-DEC-20
Thorium (Th)-Total			104.6		%		70-130	15-DEC-20
Tin (Sn)-Total			97.2		%		80-120	15-DEC-20
Titanium (Ti)-Total			97.8		%		80-120	15-DEC-20
Tungsten (W)-Total			98.4		%		80-120	15-DEC-20
Uranium (U)-Total			103.8		%		80-120	15-DEC-20
Vanadium (V)-Total			102.9		%		80-120	15-DEC-20
Zinc (Zn)-Total			99.1		%		80-120	15-DEC-20
Zirconium (Zr)-Total			97.1		%		80-120	15-DEC-20
WG3461819-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	15-DEC-20
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Arsenic (As)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Barium (Ba)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Boron (B)-Total			<0.010		mg/L		0.01	15-DEC-20
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	15-DEC-20
Calcium (Ca)-Total			<0.050		mg/L		0.05	15-DEC-20
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	16-DEC-20
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Copper (Cu)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Iron (Fe)-Total			<0.010		mg/L		0.01	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-1 MB								
Lead (Pb)-Total			<0.000050		mg/L		0.00005	16-DEC-20
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	15-DEC-20
Manganese (Mn)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Phosphorus (P)-Total			<0.050		mg/L		0.05	15-DEC-20
Potassium (K)-Total			<0.050		mg/L		0.05	15-DEC-20
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	15-DEC-20
Selenium (Se)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Silicon (Si)-Total			<0.10		mg/L		0.1	15-DEC-20
Silver (Ag)-Total			<0.000050		mg/L		0.00005	15-DEC-20
Sodium (Na)-Total			<0.050		mg/L		0.05	15-DEC-20
Strontium (Sr)-Total			<0.0010		mg/L		0.001	15-DEC-20
Sulfur (S)-Total			<0.50		mg/L		0.5	15-DEC-20
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	15-DEC-20
Thorium (Th)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Tin (Sn)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	15-DEC-20
Tungsten (W)-Total			<0.00010		mg/L		0.0001	15-DEC-20
Uranium (U)-Total			<0.000010		mg/L		0.00001	15-DEC-20
Vanadium (V)-Total			<0.00050		mg/L		0.0005	15-DEC-20
Zinc (Zn)-Total			<0.0030		mg/L		0.003	15-DEC-20
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	15-DEC-20
WG3461819-5 MS		**WG3461819-3**						
Aluminum (Al)-Total			102.9		%		70-130	15-DEC-20
Antimony (Sb)-Total			101.3		%		70-130	15-DEC-20
Arsenic (As)-Total			101.1		%		70-130	15-DEC-20
Barium (Ba)-Total			N/A	MS-B	%		-	15-DEC-20
Beryllium (Be)-Total			106.7		%		70-130	15-DEC-20
Bismuth (Bi)-Total			89.5		%		70-130	15-DEC-20
Boron (B)-Total			103.3		%		70-130	15-DEC-20
Cadmium (Cd)-Total			92.9		%		70-130	15-DEC-20
Calcium (Ca)-Total			N/A	MS-B	%		-	15-DEC-20

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-WT	**Water**							
Batch R5316920								
WG3461819-5 MS		**WG3461819-3**						
Chromium (Cr)-Total			99.5		%		70-130	15-DEC-20
Cesium (Cs)-Total			102.4		%		70-130	15-DEC-20
Cobalt (Co)-Total			96.7		%		70-130	15-DEC-20
Copper (Cu)-Total			91.9		%		70-130	15-DEC-20
Iron (Fe)-Total			N/A	MS-B	%		-	15-DEC-20
Lead (Pb)-Total			90.5		%		70-130	15-DEC-20
Magnesium (Mg)-Total			N/A	MS-B	%		-	15-DEC-20
Manganese (Mn)-Total			N/A	MS-B	%		-	15-DEC-20
Molybdenum (Mo)-Total			103.6		%		70-130	15-DEC-20
Nickel (Ni)-Total			93.7		%		70-130	15-DEC-20
Phosphorus (P)-Total			108.4		%		70-130	15-DEC-20
Potassium (K)-Total			N/A	MS-B	%		-	15-DEC-20
Rubidium (Rb)-Total			101.6		%		70-130	15-DEC-20
Selenium (Se)-Total			96.0		%		70-130	15-DEC-20
Silicon (Si)-Total			N/A	MS-B	%		-	15-DEC-20
Silver (Ag)-Total			93.1		%		70-130	15-DEC-20
Sodium (Na)-Total			N/A	MS-B	%		-	15-DEC-20
Strontium (Sr)-Total			N/A	MS-B	%		-	15-DEC-20
Sulfur (S)-Total			N/A	MS-B	%		-	15-DEC-20
Thallium (Tl)-Total			91.6		%		70-130	15-DEC-20
Tellurium (Te)-Total			87.1		%		70-130	15-DEC-20
Thorium (Th)-Total			100.2		%		70-130	15-DEC-20
Tin (Sn)-Total			96.1		%		70-130	15-DEC-20
Titanium (Ti)-Total			106.5		%		70-130	15-DEC-20
Tungsten (W)-Total			96.3		%		70-130	15-DEC-20
Uranium (U)-Total			N/A	MS-B	%		-	15-DEC-20
Vanadium (V)-Total			107.5		%		70-130	15-DEC-20
Zinc (Zn)-Total			82.2		%		70-130	15-DEC-20
Zirconium (Zr)-Total			100.3		%		70-130	15-DEC-20
NH3-F-WT	**Water**							
Batch R5318437								
WG3462467-3 DUP		**WG3462467-5**						
Ammonia, Total (as N)		0.240	0.236		mg/L	1.6	20	16-DEC-20
WG3462467-2 LCS								

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-WT	**Water**							
Batch R5318437								
WG3462467-2 LCS								
Ammonia, Total (as N)			108.0		%		85-115	16-DEC-20
WG3462467-1 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	16-DEC-20
WG3462467-4 MS		**WG3462467-5**						
Ammonia, Total (as N)			N/A	MS-B	%		-	16-DEC-20
NO2-IC-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	16-DEC-20
WG3462929-7 LCS								
Nitrite (as N)			101.0		%		90-110	16-DEC-20
WG3462929-6 MB								
Nitrite (as N)			<0.010		mg/L		0.01	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Nitrite (as N)			97.8		%		75-125	16-DEC-20
NO3-IC-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Nitrate (as N)		0.471	0.470		mg/L	0.2	20	16-DEC-20
WG3462929-7 LCS								
Nitrate (as N)			100.6		%		90-110	16-DEC-20
WG3462929-6 MB								
Nitrate (as N)			<0.020		mg/L		0.02	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Nitrate (as N)			96.1		%		75-125	16-DEC-20
PH-WT	**Water**							
Batch R5319109								
WG3463635-4 DUP		**WG3463635-3**						
pH		5.95	5.92	J	pH units	0.03	0.2	17-DEC-20
WG3463635-2 LCS								
pH			7.00		pH units		6.9-7.1	17-DEC-20
PO4-DO-COL-WT	**Water**							
Batch R5319344								
WG3463951-3 DUP		**L2540047-1**						
Orthophosphate-Dissolved (as P)		0.0100	0.0092		mg/L	8.7	20	18-DEC-20
WG3463951-2 LCS								

Quality Control Report

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R5319344								
WG3463951-2 LCS								
Orthophosphate-Dissolved (as P)			106.1		%		80-120	18-DEC-20
WG3463951-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	18-DEC-20
WG3463951-4 MS		**L2540047-1**						
Orthophosphate-Dissolved (as P)			106.0		%		70-130	18-DEC-20
SO4-IC-N-WT	**Water**							
Batch R5318533								
WG3462929-10 DUP		**L2540181-2**						
Sulfate (SO4)		23.0	23.0		mg/L	0.0	20	16-DEC-20
WG3462929-7 LCS								
Sulfate (SO4)			102.4		%		90-110	16-DEC-20
WG3462929-6 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	16-DEC-20
WG3462929-9 MS		**L2540181-2**						
Sulfate (SO4)			98.5		%		75-125	16-DEC-20
SOLIDS-TDS-WT	**Water**							
Batch R5318732								
WG3462905-6 DUP		**L2540878-1**						
Total Dissolved Solids		1310	1330		mg/L	1.4	20	16-DEC-20
WG3462905-5 LCS								
Total Dissolved Solids			98.4		%		85-115	16-DEC-20
WG3462905-4 MB								
Total Dissolved Solids			<10		mg/L		10	16-DEC-20
TURBIDITY-WT	**Water**							
Batch R5316660								
WG3461927-3 DUP		**WG3461927-4**						
Turbidity		18.2	17.9		NTU	1.7	15	15-DEC-20
WG3461927-2 LCS								
Turbidity			103.0		%		85-115	15-DEC-20
WG3461927-1 MB								
Turbidity			<0.10		NTU		0.1	15-DEC-20

Quality Control Report

Workorder: L2540181 Report Date: 21-DEC-20

Client: Hydrogeology Consulting Services (Kitchener)
6 Lynn Court
Kitchener ON N2A 4H6
Contact: Chris F Helmer

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

www.alsglobal.com

Canada Toll Free: 1 800 668 987[illegible]

L2540181-COFC

COC Number: 17 - [illegible]e

Page 1 of 1

Report To	Contact and company name below will appear on the final report
Company:	Hydrogeology Consulting
Contact:	Chris Helmer
Phone:	905-550-0969
	Company address below will appear on the final report
Street:	28 Upper Mercer Street
City/Province:	Kitchener, ON
Postal Code:	N2A 4M9
Invoice To	Same as Report To ☑ YES ☐ NO
	Copy of Invoice with Report ☐ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ YES ☐ NO
☐ Compare Results to Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: chrishelmer@hydrog.ca
Email 2:
Email 3:

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax: chrishelmer@hydrog.ca
Email 2:

Project Information

ALS Account # / Quote #: Q73754
Job #: Church St-Alma
PO / AFE:
LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#:
Major/Minor Code: Routing Code:
Requisitioner:
Location:

ALS Lab Work Order # (lab use only): L2540181 COFC

ALS Contact: Emily Smith **Sampler:**

Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☑ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ | 3 day [P3-25%] ☐ | 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ | Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	GENCHEM1-P-WT	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
	BH03-20	14-Dec-20	11:53	GW	3	X		
	BH01-20	14-Dec-20	4:04	GW	3	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☑ NO
Are samples for human consumption/ use? ☐ YES ☑ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

please compare to ODWQS sched 1, 2 operational/aesthetic.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☐
Ice Packs	☑ Ice Cubes ☐	Custody seal intact	Yes ☐	No	☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				4.4			

SHIPMENT RELEASE (client use)

Released by: [signature] Date: Dec 14, 2020 Time: 5:35 pm

INITIAL SHIPMENT RECEPTION (lab use only)

Received by: Date: Time:

FINAL SHIPMENT RECEPTION (lab use only)

Received by: [signature] Date: 12/14/20 Time: 1800

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NOV 2018 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.