Prepared By:

Thomasfield Homes

Hydrogeological Study for Mayberry Hill Subdivision Phase 3B

GMBP File: 115049

March 2020

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HYDROGEOLOGICAL STUDY FOR MAYBERRY HILL SUBDIVISION PHASE 3B

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1. INTRODUCTION

Thomasfield Homes Limited (the Client) has retained GM BluePlan Engineering Limited to perform a hydrogeological study to support the development of a proposed subdivision in the vicinity of the settlement known as Grand Valley. The proposed subdivision will occupy Parts of Lots 29 and 30, Concession 2 of the Geographic Township of East Luther, Ontario (see Figure 1).

The following report presents the findings of the hydrogeological study and hydrogeological impact assessment pertaining to the proposed development.

1.1 Purpose and Scope

The purpose of this study is to support the development process by providing hydrogeological information and assessments to satisfy the needs of the project within the regulatory context of the applicable municipalities and Conservation Authority. The guidance document that forms the basis for this study is entitled *Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications* (June 2013).

Objectives of this study are as follows:

- Review existing information and undertake field investigation to gather information about the hydrogeological aspects of the site.
- Characterize the site through the development of a conceptual hydrogeological model
- Assess the proposed development project in its physical and regulatory context for potential hydrogeological impacts and for the applicability of the stormwater management design or functional servicing.

The following is a brief outline of the scope of work that was undertaken to meet the objectives:

- Complete a desktop study including review of existing geological, topographic, and physiographic maps, source protection documentation, water well records, and geotechnical investigation reports for the site.
- Field investigation, including
    - Installation of piezometers and water level monitoring
    - Collection and analysis of groundwater samples
- Hydrogeological Assessment including,
    - Potential hydrogeological impacts concerning sourcewater protection, stormwater management, and ecological receptors, as may be caused by the construction or operation of the development.

2. BACKGROUND

For the purposes of this report, the term “north” shall be taken to mean the direction along Taylor Drive toward Amaranth Street. The directions “west”, “east” and “south” are to be understood relative to “north” as defined above.

2.1 Site Location and Setting

The Site is situated to the west of the presently-settled area of the community of Grand Valley. The Site covers Parts of Lots 29 and 30 of Concession 2 of the Geographic Township of East Luther. The Site is bounded to the north and east sides by existing residential developments, to the west by agricultural land uses and to the south by the Upper Grand Trailway.

See Figure 2 for an aerial photo showing the Site and neighbouring lands.

2.2 Proposed Development

The Client proposes to develop the Site for residential land use as part of the greater Mayberry Hill development. Previous Phases 1 and 2 have been approved and largely constructed. Phase 3A has been approved and is, at the time of writing, under construction. This Study concerns Phases 3B and 4. Appendix A provides a conceptual site plan of the proposed development.

According to preliminary planning layouts, Phase 3B (i.e. the portion of the lands within Lot 30) will comprise approximately 153 residential lots and a stormwater management block.

A future Phase 4 (i.e. the portion of the lands within Lot 29) will comprise a piece of land approximately 127 m wide by 1,000 m long and will include residential lots, townhouses, and a park.

The development is proposed to utilize municipal water and sewage services.

2.3 Local Relief and Drainage

The topographic relief of the Site is that of a gently sloped hillside, and elevations on-site range from about 480 masl down to 470 masl. The high part of the Site is in the northeastern part of Phase 3B and from there the land falls generally southwestward at a slope of about 5%. The northern portion of Phase 4 mainly falls westward to northwestward at a slope of about 2 to 5%. It appears that most of the Site drains toward a low-lying, flat area with small ponds, dugouts, and hummocks in the southern part of the Site. This low-lying area appears not to be cropped, and is bounded on the north by the cropped, upper areas of the Site and on the south by the Upper Grand Trailway. A portion of this low-lying area has been mapped by ecological consultant NRSI to be a wetland area (see Appendix A). The wetland boundary was subsequently confirmed by the Grand River Conservation Authority.

The nearest surface waterbody to the Site is a stream known as “No. 1 Drain” which is a tributary of Boyne Creek (OMAFRA 2015, see Figure 2). No. 1 Drain flows southeastward, crossing the Upper Grand Trailway at a point approximately 115 m west-by-southwest from the southwestern part of the Site.

GRCA (2016) hydrological mapping shows that most of the Site area accepts a small rate of recharge (<30 mm/yr) but produces a large rate of runoff (<300 mm/yr). The low-lying wetland area just to the north of the Upper Grand Trailway is just the opposite, with a large rate of recharge (<290 mm/yr) and a low rate of runoff (<20 mm/yr).

2.4 Geology and Physiography

The Site lies within the physiographic region known as the Stratford Till Plain (Chapman and Putnam 1984). In terms of physiographic landforms, the Site occupies an undrumlinized till plain (Chapman and Putnam 2007,

see Figure 3). Surficial geological maps indicate that the site is predominantly covered by a silty till known as the Tavistock Till, though the low-lying wetland area in the southern part of the Site is understood to be covered by glaciofluvial sands (Ministry of Northern Development and Mines 2006, see Figure 4).

Bedrock in the vicinity of the Site is reported to be of the Guelph Formation, a Silurian sedimentary deposit chiefly composed of dolostone (Ministry of Northern Development and Mines 2018).

A review of water well records near the Site corroborates the surficial soils, with driller observations of "sandy clay" and "clay" describing near surface soils (Well IDs 1701208 and 1701002) near the Site. Bedrock is described as blue or grey "limestone", with subcrop lying 95 or 120 feet below ground surface (29.0 to 36.6 mbgs): the dolostone of the Guelph Formation is commonly referred to as limestone in driller's logs.

2.5 Local Use of Groundwater and Sourcewater Protection

The local municipal water supply system is a groundwater-based system. The nearest well belonging to the municipal system is located on Melody Lane (between Leeson Street and Water Street) approximately 330 m east of the eastern side of the Site.

With respect to Sourcewater Protection designated areas (such as Wellhead Protection Areas and Intake Protection Zones), most of the site does not bear any designation, though a small portion of the northern area of Phase 4 intersects a Wellhead Protection Area "D" (WHPA-D) with vulnerability score of 2 (GRCA 2019a and 2019b, see Figure 5). This Wellhead Protection Area actually belongs to a pair of wells (Well IDs 1900112 and 1900119) that are located outside the Study Area on the opposite side of the Grand River from the Site.

Due to the Site being located adjacent to agricultural areas, there is potential for some rural residences to be supplied by private water wells. Water well records from the MECP water well database are plotted in Figure 6. A summary of details from the water well records found within the study area has been tabulated (Table 1).

A review of water well records in the vicinity of the Site indicates:

- 111 total records
    - 70 domestic
    - 15 abandonment records
    - 6 use unlisted (no details in well record)
    - 6 monitoring or observation wells
    - 5 "not used"
    - 2 public use
    - 2 livestock
    - 2 municipal wells
    - 2 commercial wells
    - 1 alteration (casing extension)
- Of the domestic wells
    - All 70 of the records indicate that they are bedrock wells
        - Average depth to bedrock 20.0 m
        - Minimum depth to bedrock 6.4 m

Only one of the well records is attributed to the Site (Well ID 7239534). Though there are no construction details given on the well record, the coordinates of the well record correspond to BH-01-15 in the LVM geotechnical Report (2015).

The two municipal wells identified in the well search are:

- Well ID 1701325, apparently no longer in use as it does not appear in the Approved Assessment Report (Lake Erie Region Source Protection Committee 2015)

- Well ID 1703757, which is the well noted previously to be located on Melody Lane approximately 330 m east of the Site.

Prior study for earlier stages of the Mayberry Hill development revealed the possibility that an unlisted overburden well may be in use at 133181 28-29th Side Road East, approximately 180 m west of the southwestern-most point of the Site. This property is understood to be owned by Thomasfield Homes.

2.6 Relevant Local and Site-Specific Reports

2.6.1 2015 Geotechnical Investigation by LVM

The geotechnical investigation conducted by LVM included the drilling of eight (8) boreholes to depths ranging from 6.2 mbgs to 8.1 mbgs, with four of the boreholes being completed as monitoring wells. Borehole logs and grain-size test results from the LVM study are included in Appendix B.

The soil conditions encountered in drilling are described as follows:

- Topsoil (up to 0.84 m thick) overlying
- Silt Till (extending to full depth of investigation except at BH-04-15 and BH-06-15)
- Sand or Sand and Gravel (encountered in BH-06-15, 2.3 m thick, and BH-04-15, extending to full depth)
- Silt Till (extending to full depth of investigation at BH-06-15)

The Silt Till material was described as non-cohesive with loose to very dense consistency. Two particle size analyses on the Silt Till indicated a minimum of 62% fines content (i.e. proportion of silt plus clay by mass).

The Sand and Gravel was described as containing trace to some silt and occasional cobbles. One particle size analysis of this material indicated a fines content of about 35% (predominantly silt). The Sand and Gravel material extended beyond the depth of investigation at BH-04-15, but in BH-06-15 was found to be a layer 2.3 m thick overlain and underlain by silt till materials.

The report indicates that the grey colour of the soil at depths of about 3.1 to 6.1 mbgs is indicative of permanent saturation: though the water table may fluctuate in elevation throughout the year, it generally does not drop to greater depths than this level.

The report also discusses expected requirements for dewatering, indicating that “moderate groundwater inflow” can be expected where excavations extend below the groundwater table by less than 1.0 m in saturated granular deposits. LVM indicates that this “moderate groundwater inflow” is expected to be manageable by a “gravity dewatering system with perimeter interceptor ditches and high capacity pumps”. Where deeper excavations occur, LVM note that a positive dewatering system (i.e. wellpoints) will likely be required. In most other locations on-site, LVM indicates that conventional sump pumping would likely be sufficient to control groundwater but that flatter excavation slopes may be required to ensure stability.

2.6.2 2020 Geotechnical Investigation by V.A. Wood (Guelph) Inc.

A geotechnical investigation was completed by V.A. Wood (Guelph) Inc. and consisted of the completion of four (4) test pits in the southern portion of the Site within what is proposed to be the stormwater management block. Each test pit was advanced to a depth of 3.0 m and the soils that were encountered were mainly sandy silty clay and clayey sand materials.

Based on the grain-size analyses conducted as part of this investigation, hydraulic conductivity rates of these materials were estimated to be in the range of 10^{-8} m/s up to 10^{-5} m/s.

3. FIELD INVESTIGATION

3.1 Methodology

The field activities of the hydrogeological study involved three main components: groundwater level monitoring, groundwater sampling and analyses, and a scoped door-to-door well survey.

Groundwater levels have been measured on-Site through the monitoring of the existing monitoring wells (i.e. the "BH" series of wells installed by LVM) as well as through the installation and monitoring of an additional three piezometers. The monitoring wells are located generally within the area that will be developed with housing and roadways, while the piezometers were installed within the wetland area in the southern portion of the property.

In May 2019, the Site was attended by GMBP staff with the intent of collecting a groundwater sample from each of the monitoring wells and piezometers on-Site. One of the piezometers (PZ-02-19) did not recharge sufficiently during the time on-site, so only a total of six samples were collected.

Groundwater quality samples were collected using industry-accepted practices. Each well was first purged of at least three well-volumes of water or until the well ran dry, whichever occurred first. For purging and sampling, water was withdrawn from the wells using dedicated Waterra tube inertial pumps. Samples were collected into laboratory supplied bottles appropriate to the planned analyses. Due to the muddiness of the water withdrawn from the piezometers, it was deemed impractical to field-filter the samples for metals analyses: these samples were instead collected into unpreserved bottles for laboratory filtering. Sample bottles were kept cool (between 0 and 10°C) and submitted under chain-of-custody protocols to an SCC/CALA accredited laboratory for analysis of a general suite of chemical parameters including metals, inorganics, and major anions. The laboratory Certificates of Analysis are provided in the Appendix C.

A door-to-door water well survey was conducted in an attempt to gain information about the water well and usage patterns at the residence located at 133181 28-29th Side Road East.

3.2 Subsurface Investigation

Apart from the geotechnical work done by LVM, GMBP staff used hand-tools to manually advance three testholes, one for each piezometer that was installed in the wetland floodplain area. The soil profiles were logged during the installation of the piezometers and borehole logs prepared (see Appendix D).

3.3 Groundwater Levels

Groundwater levels have been monitored in the "BH"-series monitoring wells using datalogging pressure transducers since spring 2015 and readings were confirmed using manual measurements. Hydrograph plots provided in Appendix E show the record of groundwater level data that has been collected to-date from these monitoring wells. Groundwater levels in the piezometers ("PZ"-series instruments) were monitored using manual methods only. On May 13, 2019 the water level in each well and piezometer was measured and is reported in Table 2 along with other relevant well details as well as historical maximum readings reported at the "BH"-series wells.

As can be seen from the plots in Appendix E, the groundwater level in each of the monitoring wells tends to fluctuate from season to season, with a span of 1 to 2 m separating seasonal highs (occurring in late winter and spring) from seasonal lows (occurring in late autumn). 2016 appears to have been a particularly dry year as the water levels dropped to about 1 m lower than in other years on record. With respect to depth to groundwater, there is significant variation across the Site: BH-07-15 indicates a maximum groundwater level within 0.2 m of ground surface, while BH-04-15 indicates a maximum groundwater level of more than 4.0 m below ground surface.

Groundwater levels in the piezometers coincided roughly with ground surface at each of the three locations (PZ-01-19 through PZ-03-19).

3.4 Groundwater Quality

Generally, the results indicate moderately mineralized water typical of southern Ontario groundwater. Magnesium and calcium concentrations are elevated due to the prevalence of dolomite and limestone-derived materials in the surficial materials. Sodium concentrations are variable, with values over 20 mg/L being reported in BH-01-15, BH-05-15 and BH-07-15, and values less than 7 mg/L being reported in BH-04-15 and the piezometers. Chloride concentrations are less than 20 mg/L for all samples. Nitrate concentration is highest in BH-04-15 (5.62 mg/L).

The results of the analyses of groundwater quality samples are provided in Table 3. The results are compared against three sets of standards:

- *Ontario Drinking Water Standards* Maximum Acceptable Concentration (MAC),
- *Ontario Drinking Water Standards* Aesthetic Objectives (A/O), and
- *Provincial Water Quality Objectives.*

Because the samples are groundwater and are taken from monitoring wells (i.e. as opposed to a potable water well or from surface water sources), none of the above standards are strictly applicable, but they do provide a reference for general comparison.

It is noted, however, that in the event that construction dewatering is required, the discharge of the dewatering system will likely be released to land and may ultimately enter a surface water body or storm sewer. In such an event, the *Provincial Water Quality Objectives* should be met as an initial step in ensuring against potential environmental/ecological impacts.

Concerning the *Provincial Water Quality Objectives*, there were two samples that reported exceedances:

- BH-01-15:
    - Aluminum, 110 µg/L result vs 75 µg/L standard)
    - Uranium, 6.2 µg/L result vs 5 µg/L standard
- PZ-03:
    - Cobalt, 1.8 µg/L result vs 0.9 µg/L standard

It appears that these exceedances are due to naturally-occurring concentrations of these elements within the soil materials. Some metals will occasionally be elevated in concentration in till groundwater simply due to the composition of the local geological materials: this is commonly the case with aluminum and cobalt. Furthermore, it does not appear that any activities have been conducted at the Site which would lead to the existence of heavy metals impacts such as those reported.

3.5 Site Reconnaissance

The Site is presently under agricultural use. When wet, the surficial soils are generally quite sticky, indicative of high silt and clay content. The wetland area to the south of the Site and just north of the trailway appears to be the recipient of runoff from the higher ground to the north (i.e. the Site): surface water found in this wetland area appears to generally be stagnant. Though groundwater levels in the wetland area were identified to be roughly coincident with ground surface, no evidence of visibly-flowing springs was observed in this area at the time of reconnaissance.

3.6 Door to Door Well Survey

A limited door-to-door well survey was completed in an attempt to obtain information about the water well and water usage patterns at the residence located at 133181 28-29th Side Road East, which is located approximately 180 m west of the southwesternmost part of the Site. Information from other sources had indicated that there may be an unlisted dug well at this property.

An information request package was hand-delivered to the residence on June 13, 2019. The information request package included a cover letter explaining the purpose for the data collection as well as a questionnaire for the resident to complete. A self-addressed postage-paid envelope was provided for the resident to return their response to GM BluePlan. Copies of the cover letter and questionnaire form are included in Appendix F. No response was received.

4. HYDROGEOLOGICAL CONCEPTUAL MODEL

A “conceptual model” of a site describes its physical setting and provides an interpreted overview of the hydrogeological behavior of the Site. It provides a basis for general understanding of groundwater flows and other hydrogeological phenomena as well as a basis for the assessment of potential impacts. The plan drawing in Figure 7 and the cross sections in Figures 7a and 7b are provided to aid in the visualization of the hydrogeological system of the Site.

The hydrostratigraphy of the Site is generally described as a thick till aquitard overlying a bedrock aquifer. The till does contain some pockets or lenses of sandy/coarse material which, if intersected by an excavation, could result in a requirement for increased groundwater control during construction.

Groundwater levels tend to mimic the ground surface and the pattern of groundwater levels appears to indicate that the horizontal component of groundwater flow is generally away from the high point on-site (near BH-07-15): for most of Phase 3B, this means that groundwater is flowing generally south in the southern parts of the Site and west in the western parts of the Site. Due to the upland location of the Site, the aquitard qualities of the surficial tills, and the elevation of the Site above the Grand River and other smaller streams (e.g. the municipal drains and Boyne Creek), it is interpreted that there is an appreciable vertical gradient favouring downward groundwater flow. This is formally termed a “recharge” condition, though the actual rate of groundwater recharge is likely limited due to the low hydraulic conductivity of the till soils.

Seasonal high groundwater levels approach the surface in some parts of the Site, but remain quite deep in other parts. It is interpreted that the areas where groundwater levels remain deep are influenced by drainage through the sand and gravel lenses within the till deposit (e.g. BH-04-15). Areas where groundwater levels reach nearer to the ground surface indicate that the soils there are poorly drained due to the prevalence of soils of low hydraulic conductivity (e.g. uninterrupted till strata as at BH-01-15, BH-05-15, and BH-07-15).

The portion of the Site proposed to be developed with houses exhibits significant seasonal fluctuations in groundwater level. This is interpreted to be a product of the fine-grained soils (which limit the rate of infiltration) and the effects of evapotranspiration, which is greatest during the summertime and lowest during the winter.

The high ratio of runoff to recharge that prevails across much of the Site area is due in large part to the topography of the Site, which is generally consistently sloped to encourage surface runoff, and the fine-textured soils, which tend to inhibit recharge. The wetland area in the southern part of the Site, however, due its flat slope and hummocky relief leads to increased recharge due to the abundance of closed depressions where runoff can be pooled and infiltrate. Groundwater quality on-Site is typical of that which is naturally found in till soils in the Wellington-Dufferin area.

5. IMPACT AND RISK ASSESSMENT

Hydrogeological impacts may result when a project disrupts either the quality or quantity of water resources, whether with respect to an environmental receptor (e.g. sensitive ecological features) or with respect to a water user (e.g. a well owner). Furthermore, hydrogeological conditions may result in impacts to the project itself which may require management to ensure serviceability of the civil engineering design (e.g. seasonal high groundwater levels) or to facilitate construction (e.g. construction dewatering).

The following section will identify and address potential risks and impacts associated with the Mayberry Hill Phase 3B development project.

5.1 Ecological Effects

In the southern portion of the Site is a piece of low-lying land which was recently confirmed by the GRCA to be a wetland area. The extents of the wetland area are shown on the conceptual site plan which is provided in Appendix A.

A portion of this area that lies within about 60 m of the trailway and within about 360 m of No. 1 Drain is identified by the GRCA to be part of the floodplain of the Boyne Creek catchment area.

The stormwater management design and development plan should be composed in such a way as to minimize disruption to the wetland area and floodplain area. This includes managing peak stormwater runoff flows from the Site and providing suitable energy dissipation to mitigate against erosion by flowing water. It is expected that stormwater released to this area will need to have been adequately treated to address suspended solids and other common constituents of residential and roadway runoff. The stormwater management facility design should thus include consideration for both quality and quantity.

5.2 Stormwater Management and Water Balance Effects

To date, stormwater management design has not been completed for Phase 3B of the Mayberry Hill development. As such, general hydrogeological considerations will be listed herein to provide guidance to the stormwater management design.

Comparing the relative annual rate of recharge in the northern upland area (i.e. the area to be developed with houses) and the wetland area in the southern part of the Site, it seems that it will be important to ensure that the stormwater management design preserves the recharge function of the wetland area. This is especially important now that the ecological study has found the low-lying area to be designated as a wetland.

Because erosion and channelization can cause increased runoff and reduced recharge, to preserve the recharge functionality of the wetland area it is recommended that the stormwater management facility outlet be designed to minimize erosion. This may involve the provision of a dispersed discharge (e.g. flow spreader) in the design of the stormwater management facility outlet. The stormwater management design should also seek to maintain peak runoff flows at pre-development levels.

5.3 Source Protection

A small portion of the northern part of the Site is understood to be designated a WHPA-D of vulnerability score 2. The Table of Drinking Water Threats (2017) indicates that there are no identified activities that constitute a “Significant” drinking water threat in areas designated WHPA-D (2).

The Grand River Source Protection Plan for the Township of Grand Valley (LESPC 2019) does not list particular policies with respect to WHPA-D (2) areas. As such the Source Protection policies do not mandate specific considerations or requirements to be incorporated into the design of Phase 3B. No Risk Management Plans are expected to be required.

5.4 Private Water Wells

The proposed development will be serviced with municipal water and sewer. As such, the potential for impacts to nearby private water wells is minimal with respect to those items.

The greatest risk for impact to private water wells is likely to arise from the effects that stormwater management may have on groundwater resources. A reduction in overall recharge (i.e. due to paving, grading) may result in reduced water quantity available to wells. Infiltration of stormwater, whether intentionally at Low-Impact Development structures or inadvertently at stormwater management detention ponds, may result in the introduction of contaminants into the groundwater supply which may affect the groundwater quality at private wells.

Due to the prevalence of till soils at the Site, it is expected that groundwater quality and quantity effects will be minimal due to the hydraulic separation provided by the thick deposit of soils of low hydraulic conductivity. However, overburden wells (e.g. which draw from sand and gravel seams in the till) may be more susceptible to such effects. Though the risk may still be considered relatively low, it is still of interest to monitor the groundwater quality and quantity at overburden wells that may exist near the Site. It is therefore recommended that the resident at 133181 28-29th Side Road East be invited for inclusion in a groundwater monitoring program.

5.5 Construction Site Dewatering

Depending on the quantity and quality of water encountered, construction site dewatering may require provincial approvals and concomitant monitoring and mitigation measures.

The geotechnical report (LVM 2015) notes that “moderate groundwater inflow” may be expected where excavations intersect saturated granular deposits less than 1.0 m below the groundwater table. To provide more detailed guidance regarding approvals requirements GM BluePlan has completed estimates for construction dewatering (see Appendix G).

Based on the design grades for the adjacent development of Phase 3A, it is anticipated that servicing excavations in Phase 3B may be as deep as 7 m below original ground (e.g. Donaghy Drive south of Lang Lane).

To determine the construction dewatering requirements in greater detail, groundwater flow estimates were completed based on analytical models for groundwater flow as described in Powers et al (2007). The models were set to correspond to a trench 45 m long and 3 m wide.

Two different dewatering cases were estimated to account for the different geological conditions which may be encountered: Case 1 accounted for flow to a deep excavation in till soils; Case 2 accounted for flow to an excavation via a seam of sand and gravel within the till. Because flows may be contributed by the till and by the sand and gravel, the superposition (i.e. sum) of both of these flow cases will also be calculated. Details on calculation assumptions and example calculations are provided in Appendix G.

The results of the construction dewatering estimates indicate expected groundwater flows of about 200,000 L/d (i.e. superposition of Case 1 and Case 2). Therefore, dewatering is likely to exceed 50,000 L/d but is likely to be less than 400,000 L/d. As such, a water-taking approval in the form of a registration with the Environmental Activity and Sector Registry (EASR) will be required. Ontario Regulation 63/16 governs the use and requirements of EASR approvals for construction dewatering.

The requirements include, but are not limited to:

- The need to have a water-taking plan and discharge plan prepared by a Qualified Person and provided to the contractor to be followed for the duration of dewatering activities.
- Notification of the municipality (or municipalities if upper and lower exist) before the start of dewatering.
- Recording of daily water taking volumes which are to be reported by March 31 of the following year.

It is expected that construction dewatering can largely be managed using in-excavation sump pumps. However, where the silty sand and gravel materials are encountered (or expected to be encountered) it may be advantageous to dewater these in advance of excavation by using wellpoints or ejector wells and/or by providing flatter excavation slopes (per the recommendations of LVM 2015).

5.6 Occupiable Subsurface Structures

Occupiable subsurface structures (e.g. basements) are those structures which may be used for habitual human occupancy or for the storage of property and therefore should be protected from risks due to groundwater.

The record of groundwater measurements has shown that groundwater levels have at times risen to be within 1 m of the surface in some parts of the Site (e.g. BH-01-15 and BH-07-15). As such, it is reasonable to expect that some form of protection against moisture intrusion into basements would be required.

Due to the predominance of till on-Site, basements are likely to be seated within material of low hydraulic conductivity. This, along with the provision of positive drainage (i.e. through grading) will greatly reduce the rate of groundwater seepage that occurs near basements and thus limit the amount of water that needs to be handled by the foundation drains and/or sump pump system. Due to these constraints on groundwater seepage, the provision of typical foundation drainage (i.e. per *Ontario Building Code*) is expected to provide adequate protection to basements that are seated within the till. Foundation drains should be discharged according to the municipal design requirements.

In the event that a basement excavation is found to intersect a coarse deposit (e.g. the Sand/Sand and Gravel layer found at BH-06-15), waterproofing may be advantageous to protect against moisture ingress and reduce or eliminate reliance on sump pumping.

6. SUMMARY OF CONCLUSIONS

A hydrogeological study has been undertaken to support the proposed development of a residential subdivision on a Site forming Parts of Lots 29 and 30, Concession 2 of the Geographic Township of East Luther, Ontario. The hydrogeological system and regulatory setting have been characterized and a hydrogeological impact assessment has been completed. A summary of findings is as follows:

- The Site lies in the western portion of the settlement area of Grand Valley and varies in elevation from about 480 masl (central part) to 470 masl (southern part).
- Groundwater flow in the horizontal plane has been interpreted to be generally westward in the western part of the Site and southward in the southern part of the Site.
- Most of the Site area proposed to be developed with houses is identified as having a high runoff to recharge ratio, mainly due to the topography and the fine-textured surficial soils. This is in contrast to the southernmost part of the Site (just north of the trailway) which has a low runoff to recharge ratio by virtue of its flat overall slope and hummocky topography.
- A small portion of the northern part of the Site is designated Wellhead Protection Area “D”, Vulnerability 2.

- The geology of the Site consists of a thick deposit of fine-textured (i.e. silt) till overlying bedrock of the Guelph Formation. The till unit features occasional coarse (i.e. silty sand and gravel) seams and/or pockets.
- Groundwater levels on-Site were observed to rise as high as 0.2 m below ground surface (mbgs) at BH-07-15, but at BH-04-15 it remained deeper than 4.0 mbgs.
- Laboratory testing for groundwater quality indicated that groundwater on-Site is typical of the natural geological conditions encountered at the Site.
- A scoped door-to-door well survey was conducted but no response was received from the residence in question.
- A review of Source Protection Policies was conducted, and no “Significant” drinking water threats were identified relevant to the land use in the context of the policy areas in place at the Site. No Risk Management Plans are expected to be required.
- The stormwater management design should include provisions that will mitigate water quality and water quantity impacts to the wetland and floodplain areas downgradient (i.e. in the southernmost portion of the Site). The stormwater management block should be designed and constructed in such a way as to preserve the recharge functionality of the wetland area in the southern part of the Site
- To detect potential groundwater quality or quantity impacts, it is recommended that a well monitoring program be undertaken at 133181 28-29th Side Road East on the condition that the resident/well-owner consents to join the program and that the property is using an overburden well.
- Construction dewatering is expected to exceed 50,000 L/d and an EASR water-taking approval will be required from the MECP.
- Foundation drainage is expected to provide effective protection against groundwater seepage or moisture ingress to basements where till soils predominate. However, where sand and gravel seams are encountered, waterproofing may be advantageous to reduce risk and reduce reliance on sump pumps.

7. RECOMMENDATIONS

A hydrogeological study has been completed for the site forming Parts of Lots 29 and 30, Concession 2 of the Geographic Township of East Luther. Based on the information collected to date, the hydrogeological impact assessment of the Site indicates that there are no major obstacles to the development of the Site.

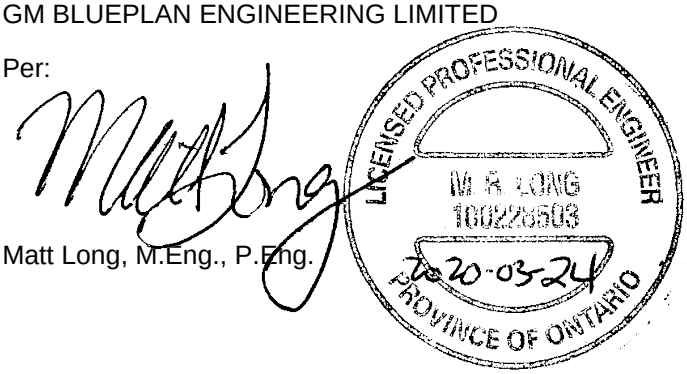
Regarding the hydrogeological conditions and impact assessment of the Site, GMBP make the following recommendations for consideration in design and construction of the development:

- To support construction dewatering, a water-taking approval is recommended to be obtained in the form of a registration via the Environmental Activity and Sector Registry (EASR).
- All monitoring wells and piezometers on-Site are recommended to be decommissioned prior to construction unless they are identified to be of use in future work related to an Environmental Impact Study or ecological monitoring.
- Stormwater management facilities should be designed and constructed in such a way as to preserve the recharge functionality of the wetland area in the southern part of the Site. Stormwater quality and quantity controls should be incorporated into the stormwater management design to mitigate against potential impacts to the wetland area.
  This may include, but is not limited to, providing erosion control features and flow dispersion structures to minimize channelization and drainage by runoff and thus encourage recharge in the area.
- Waterproofing (per *Ontario Building Code*) may be required where excavations for basements intersect sand and gravel layers (or seams within the till) below the seasonal high groundwater level.
- To detect potential groundwater quality or quantity impacts, it is recommended that a well monitoring program be undertaken at 133181 28-29th Side Road East on the condition that the resident/well-owner consents to join the program and that the property is using an overburden well.

All of which is respectfully submitted.

GM BLUEPLAN ENGINEERING LIMITED

Per:



Matt Long, M.Eng., P.Eng.

8. STATEMENT OF LIMITATIONS

The information in this report is intended for the sole use of Thomasfield Homes. GM BluePlan Engineering Limited accepts no liability for use of this information by third parties. Any decisions made by third parties on the basis of information provided in this report are made at the sole risk of the third parties.

GM BluePlan Engineering Limited cannot guarantee the accuracy or reliability of information provided by others. GM BluePlan Engineering Limited does not accept liability for unknown, unidentified, undisclosed, or unforeseen surface or sub-surface conditions that may be later identified.

The conclusions pertaining to the condition of soils and/or groundwater identified at the site are based on the visual observations at the locations of the investigative boreholes/monitoring wells and on the reported laboratory results for the selected soil and/or groundwater samples. GM BluePlan Engineering Limited cannot guarantee the condition of soil and/or groundwater that may be encountered at the site in locations that were not specifically investigated as part of this investigation.

9. REFERENCES

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GRCA. 2019b. Sourcewater Protection Wellhead Protection Area Vulnerability Scoring Layer *In* GRCA Web Map. Accessible at https://maps.grandriver.ca/web-gis/public/

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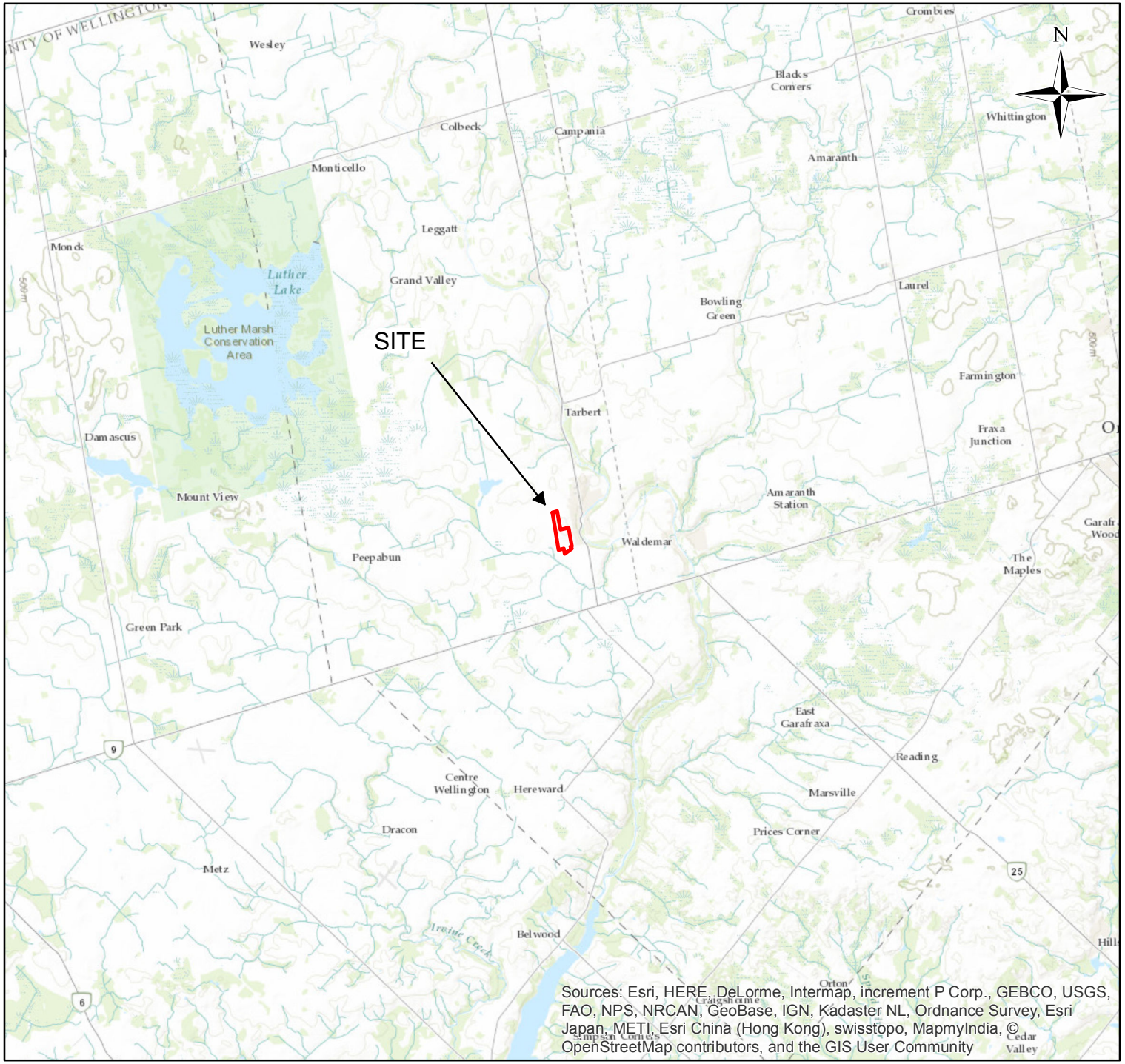
FIGURES



Project: 115049
Hydrogeological Study
Mayberry Hill
Subdivision
Phase 3B

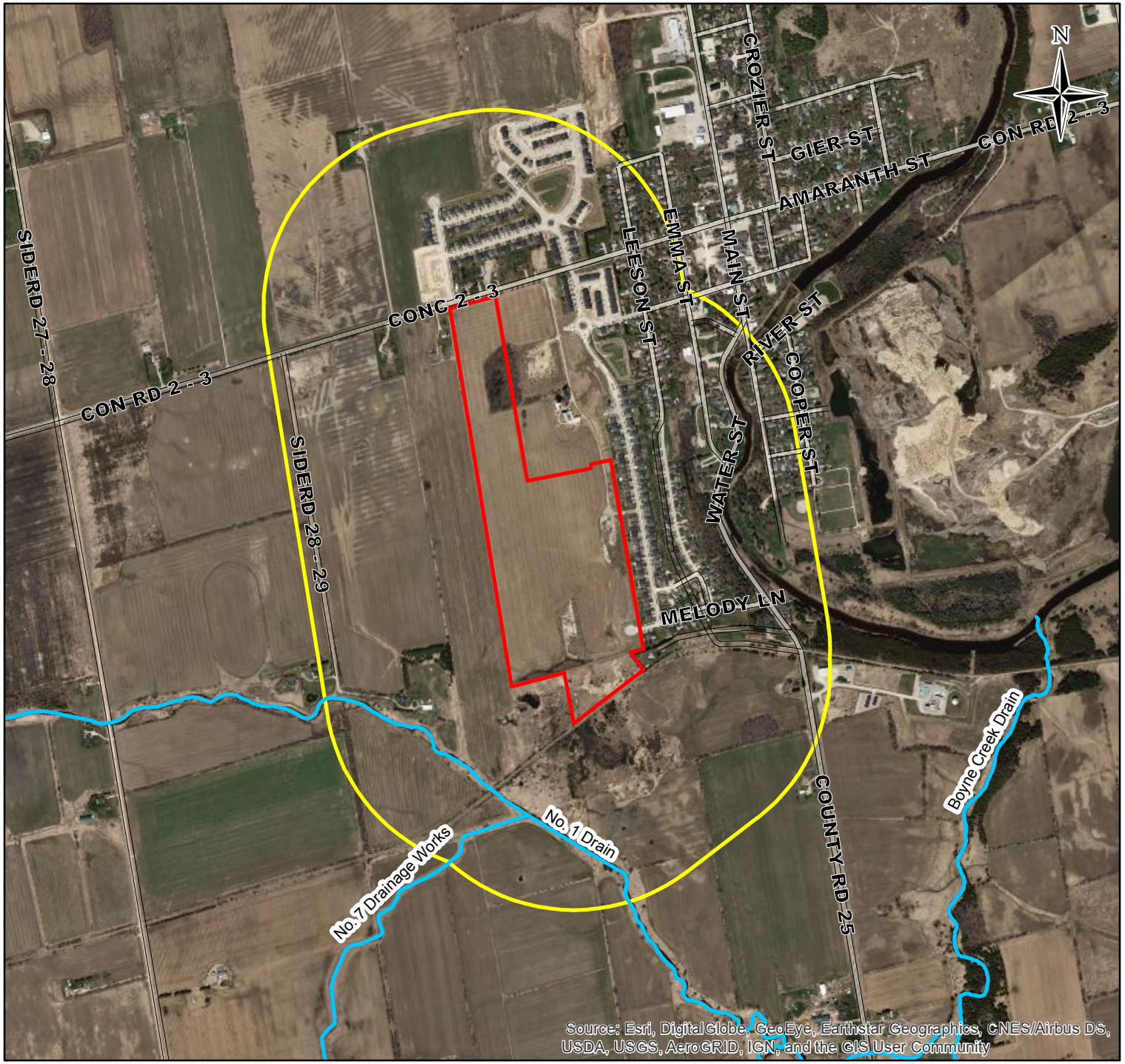
Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East
Luther

Site Boundary

Scale: 1: 150,000
May, 2019

Figure 1 : Site Location

BluePlan ENGINEERING



Project: 115049
Hydrogeological Study
Mayberry Hill Subdivision
Phase 3B

Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East Luther

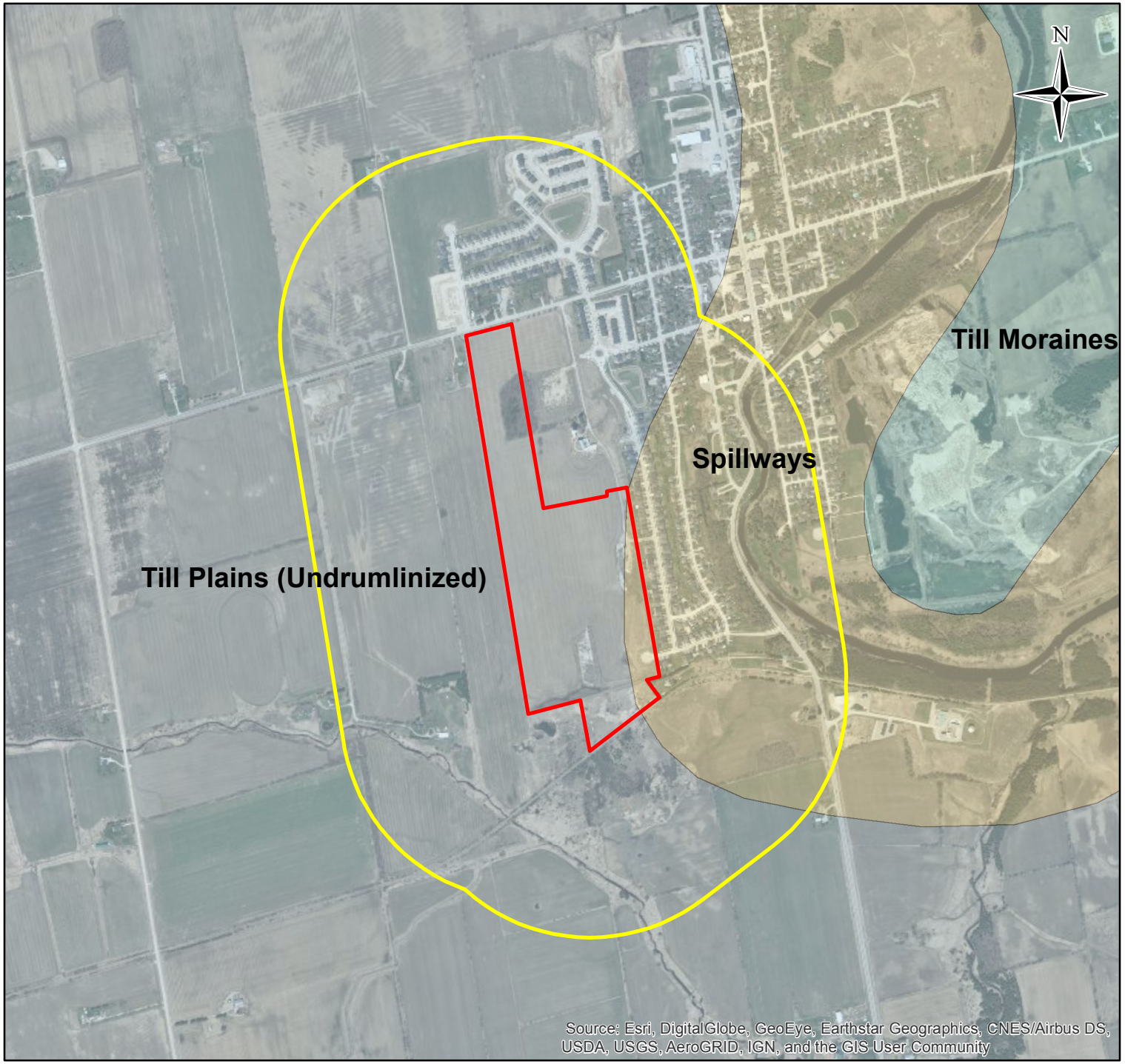
Constructed Drain

Roads
Study Area
Site Boundary

Scale: 1: 15,000
August, 2019

Figure 2: Study Area

BluePlan ENGINEERING



Project: 115049
Hydrogeological Study
Mayberry Hill
Subdivision
Phase 3B

Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East
Luther

Study Area
Site Boundary

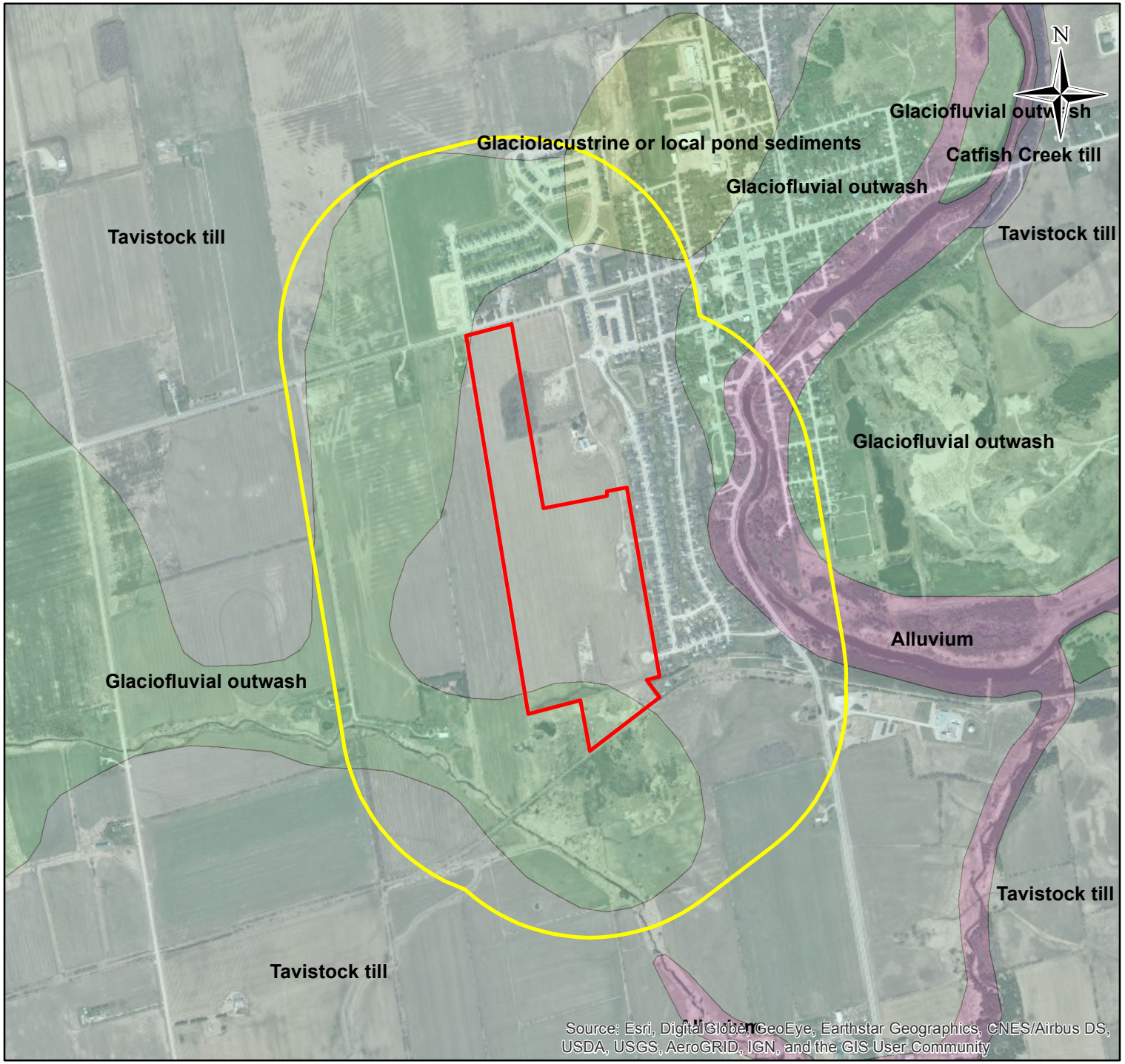
Physiography of Southern Ontario

Spillways
Till Moraines
Till Plains (Undrumlinize...

Scale: 1: 15,000
May, 2019

Figure 3: Site Physiography

BluePlan ENGINEERING



Project: 115049
Hydrogeological Study
Mayberry Hill Subdivision
Phase 3B

Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East Luther

Study Area
Site Boundary

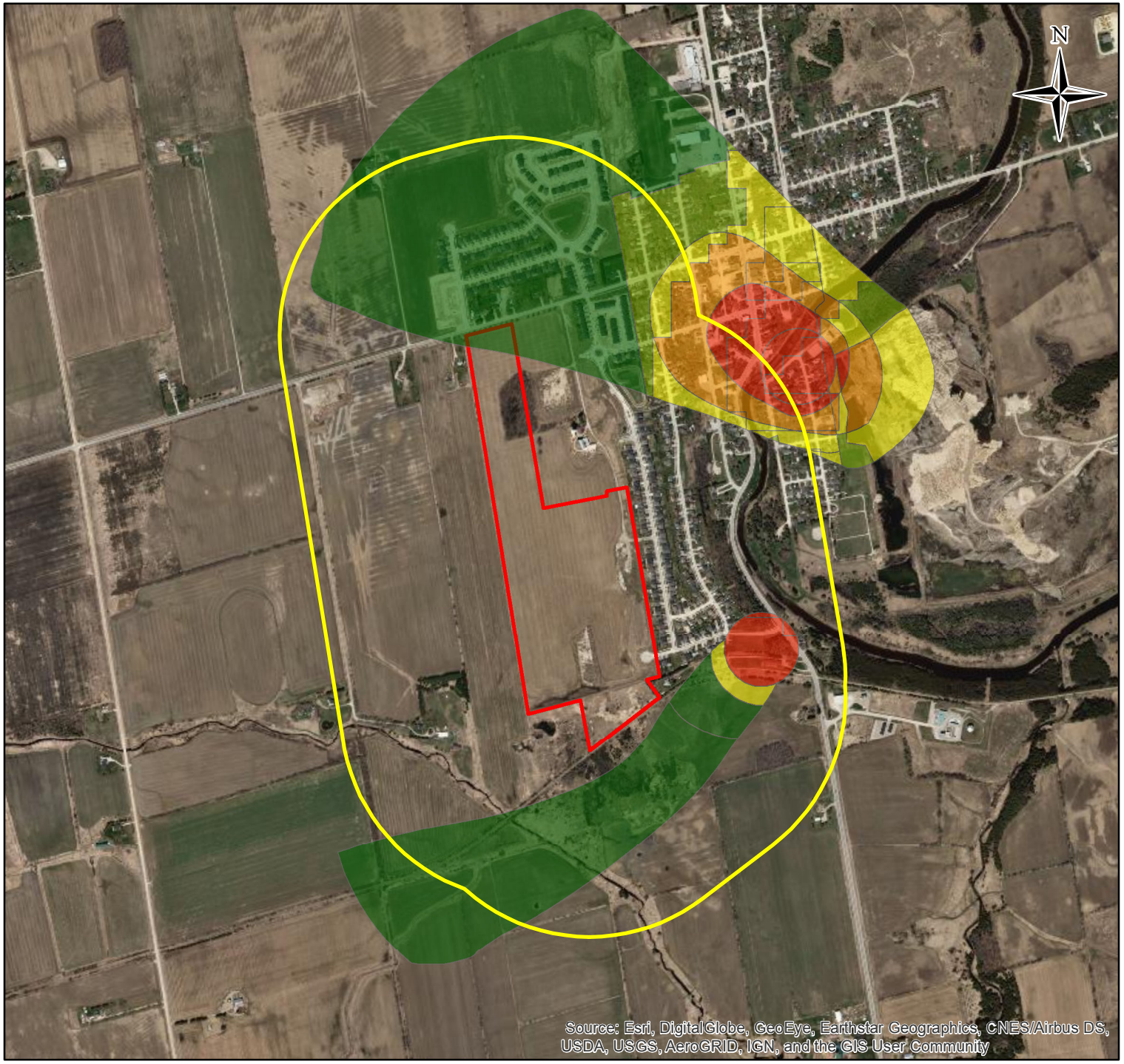
Surficial Geology of Ontario

Alluvium
Catfish Creek till
Glaciofluvial outwash
Glaciolacustri... or local pond sediments
Tavistock till

Scale: 1: 15,000
May, 2019

Figure 4: Surficial Geology

BluePlan ENGINEERING



Project: 115049
Hydrogeological Study
Mayberry Hill Subdivision
Phase 3B

Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East Luther

Study Area

Vulnerability Score

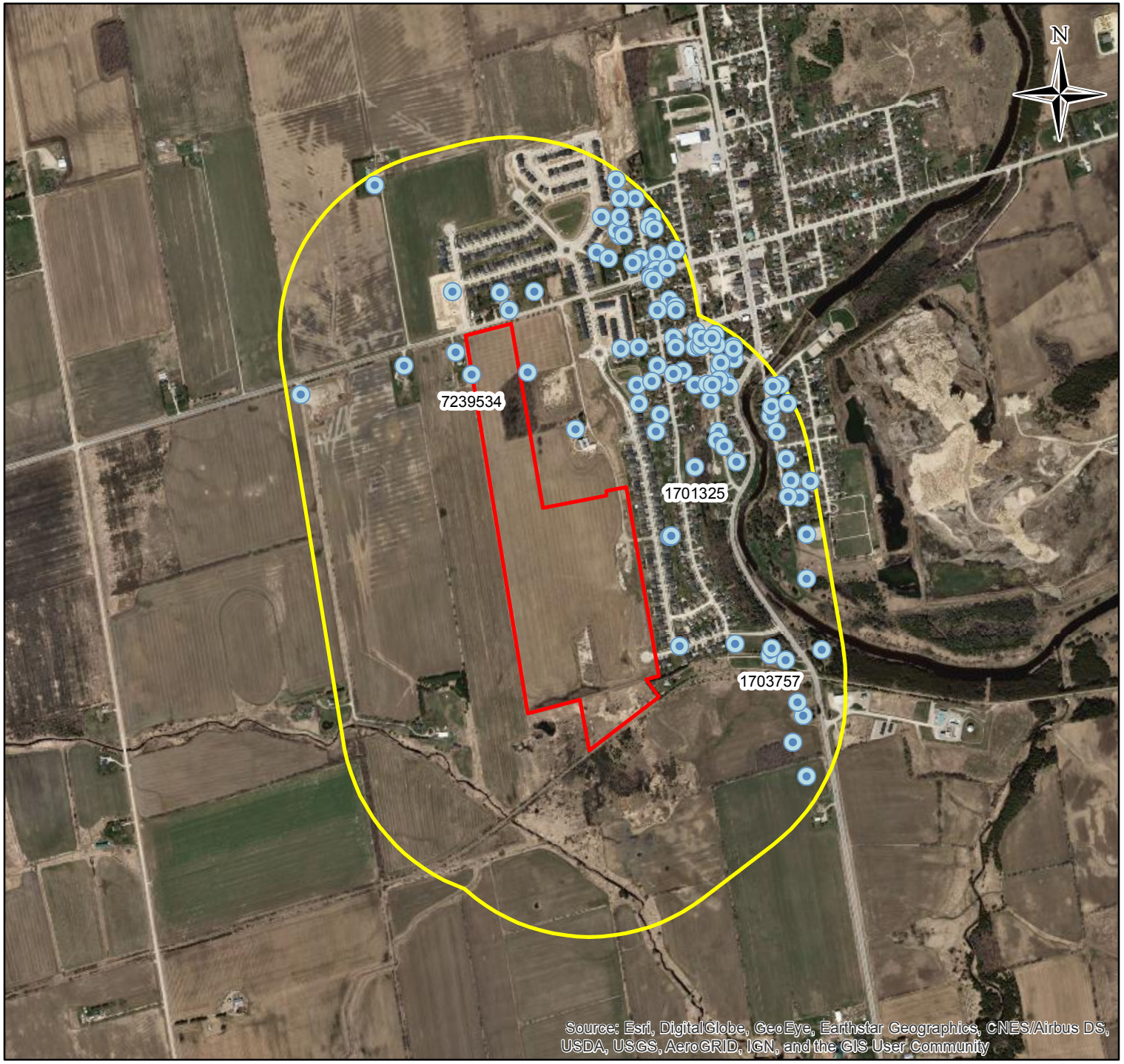
- 2
- 4
- 6
- 8
- 10

Site Boundary

Scale: 1: 15,000
June, 2019

Figure 5: Well Head Protection Area Vulnerability Scores

BluePlan ENGINEERING



Project: 115049
Hydrogeological Study
Mayberry Hill
Subdivision
Phase 3B

Part of Lot 29 & 30
Concession 2,
Geo. Twp. of East
Luther

MECP Well Records

Study Area

Site Boundary

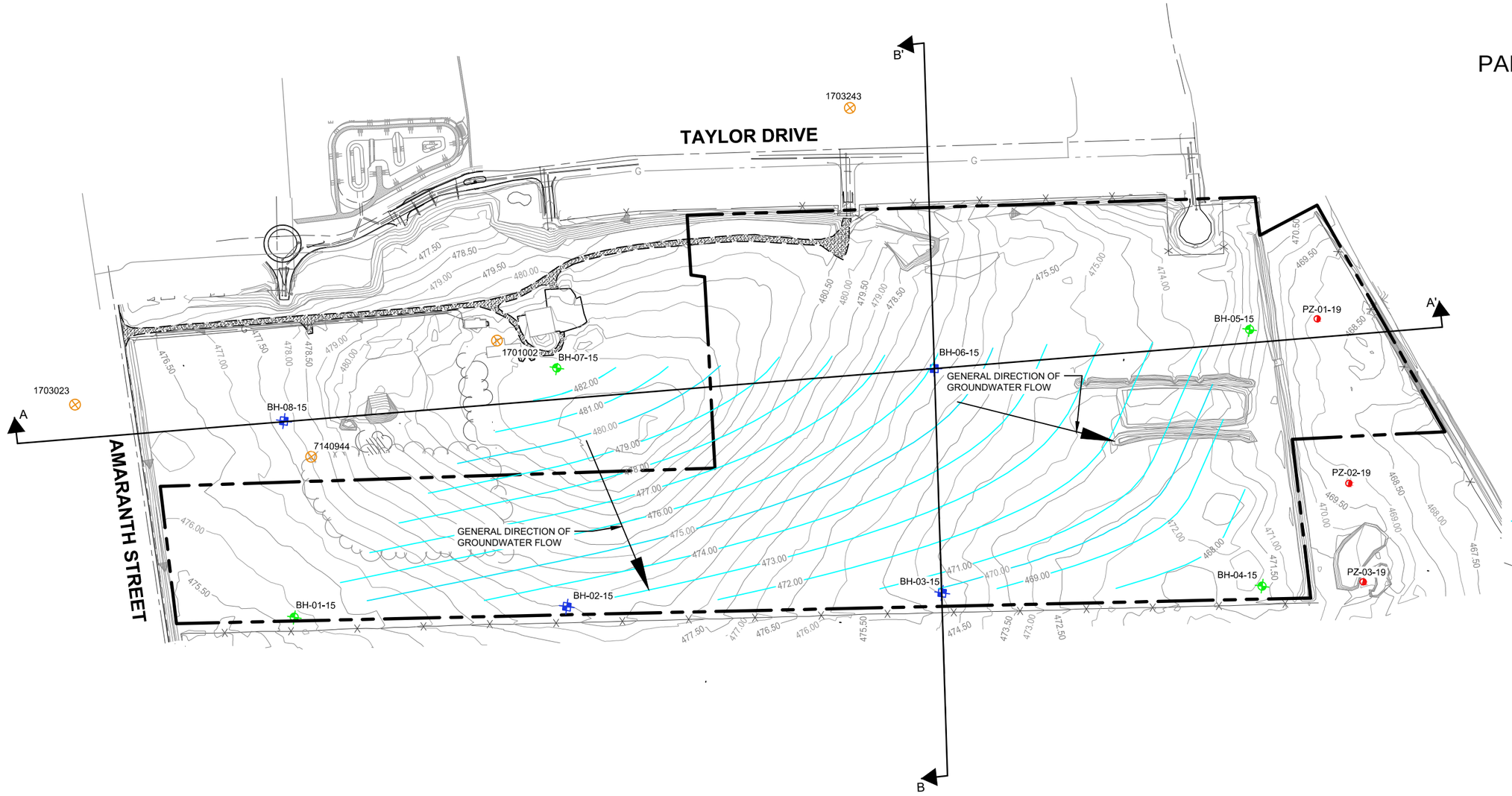
Scale: 1: 15,000
June, 2019

Figure 6: MECP Well Records

BluePlan ENGINEERING

PROJECT: 115049
HYDROGEOLOGICAL STUDY
MAYBERRY HILL
SUBDIVISION
PHASE 3B
GRAND VALLEY, ON

PART OF LOT 29 & 30,
CONCESSION 2
GEO. TWP. OF
EAST LUTHER



N

LEGEND

- PROPERTY LINE
- MONITORING WELL (LVM)
- BOREHOLE (LVM)
- MECP WELL RECORDS
- PIEZOMETER
- GROUNDWATER CONTOUR
- EXISTING SURFACE CONTOUR

50 20 0 50 100 150

1:4000 (m)

Figure No. 7

BluePlan ENGINEERING

118073-2
AUGUST 2019
Scale: 1:4000 | NAD 1983 UTM Zone 17N

FILE:W:\Guelph\118-2018\118073-2 Mayberry Hill Ph. III Well Monitoring\5 Work In Progress\Drafting\118073 - Hydro Geo Figures.dwg LAYOUT:Figure 7
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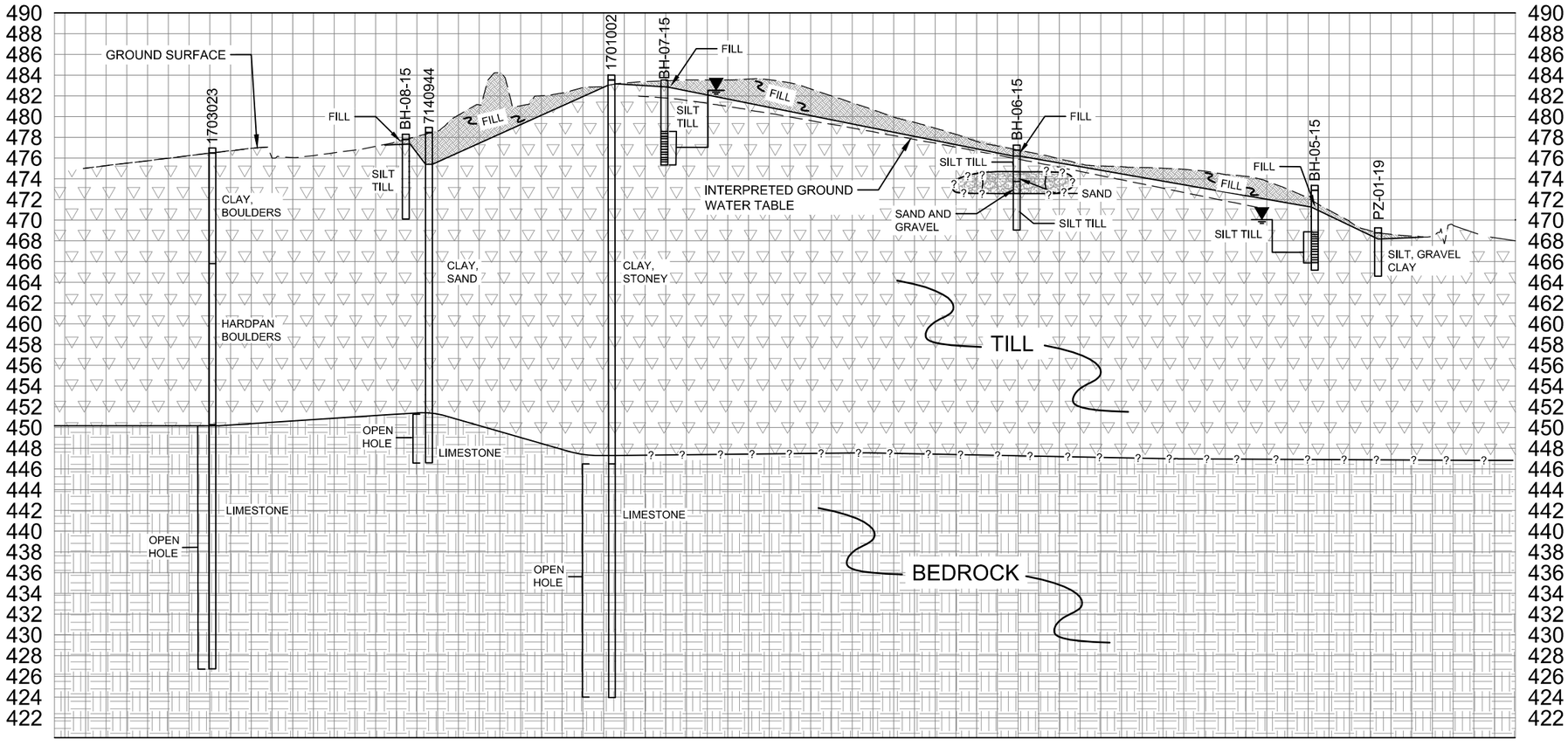
PROJECT: 115049
HYDROGEOLOGICAL STUDY
MAYBERRY HILL
SUBDIVISION
PHASE 3B
GRAND VALLEY, ON

PART OF LOT 29 & 30,
CONCESSION 2
GEO. TWP. OF
EAST LUTHER

SECTION A - A'



HORIZONTAL

75 0 50 100 200
1:5000 (m)

VERTICAL

5 0 5 10 20
1:500 (m)

Figure No. 7a

BluePlan ENGINEERING

118073-2
AUGUST 2019
NAD 1983 UTM Zone 17N

FILE:W:\Guelph\118-2018\118073-2 Mayberry Hill Ph. III Well Monitoring\5 Work In Progress\Drafting\118073 - Hydro Geo Figures.dwg LAYOUT:Figure 7a
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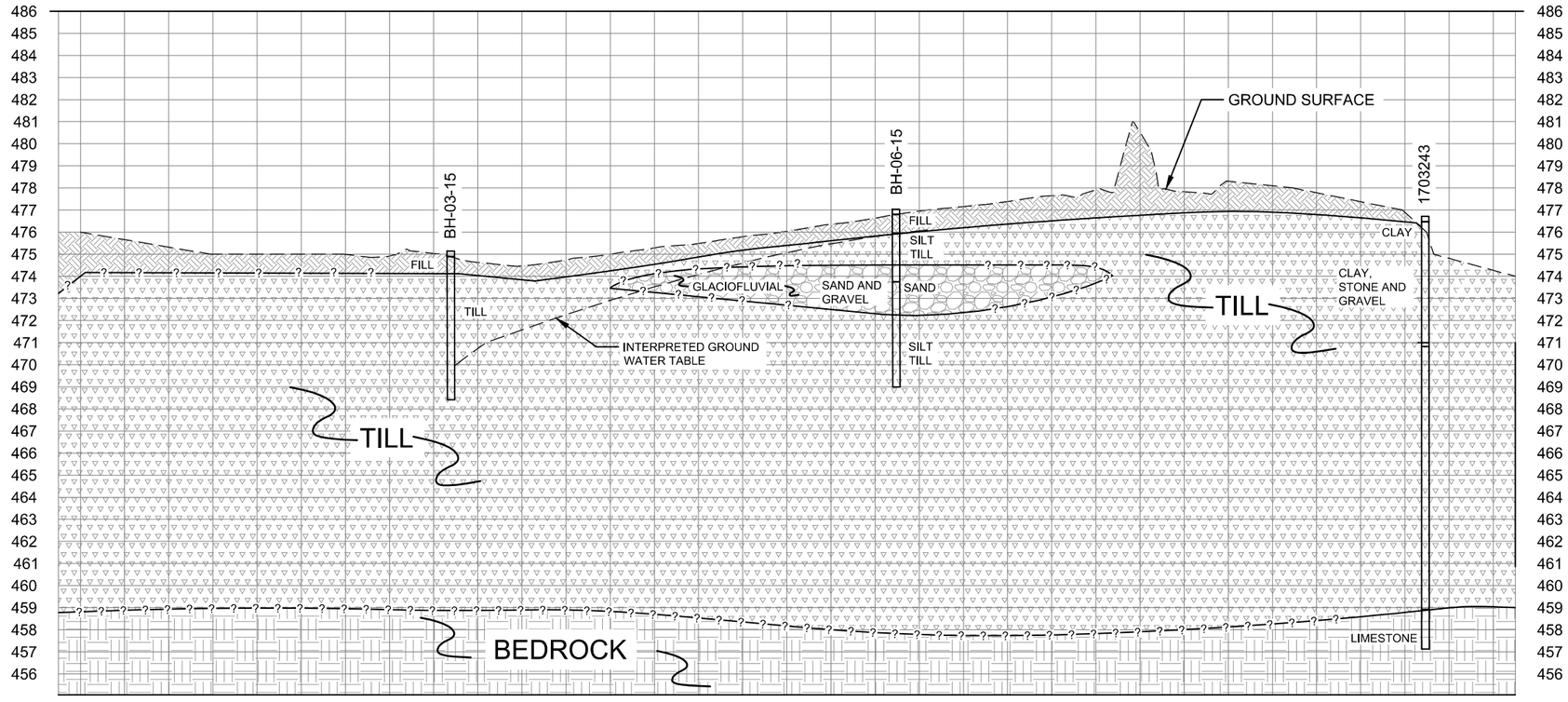
PROJECT: 115049
HYDROGEOLOGICAL STUDY
MAYBERRY HILL
SUBDIVISION
PHASE 3B
GRAND VALLEY, ON

PART OF LOT 29 & 30,
CONCESSION 2
GEO. TWP. OF
EAST LUTHER

SECTION B - B'

B

B'



HORIZONTAL
30 15 0 25 50 100
1:2500 (m)

VERTICAL
3 0 5 10
1:250 (m)

Figure No. 7b

BluePlan ENGINEERING

118073-2
AUGUST 2019
NAD 1983 UTM Zone 17N

FILE:W:\Guelph\118-2018\118073-2 Mayberry Hill Ph. III Well Monitoring\5 Work In Progress\Drafting\118073 - Hydro Geo Figures.dwg LAYOUT:Figure 7b
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TABLES

Table 1: Summary of Water Well Records

MOECC Well ID	Address	Lot	Conc.	Easting	Northing	Township	County/ Municipality	Well Use	Bedrock/ Overburden	Depth to Bedrock (m)	Total Depth of Well (m)	Static Water Level (m)	Year Drilled	Notes
Wells on Site														
7239534				554267	4860549	EAST LUTHER TOWNSHIP	DUFFERIN						2015	No construction details given in record, but presumed to correspond to the four geotechnical monitoring wells drilled by LVM
Wells on Neighbouring Properties														
1700206		29	3	554343	4860770	EAST LUTHER TOWNSHIP	DUFFERIN	Livestock	Bedrock	29.6	40.5	8.8	1952	
1700207				554814	4860883	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	21.0	32.3	8.2	1949	
1700245				554791	4860836	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	18.3	19.8		1951	
1700250		30	2	555140	4859670	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	29.6	62.2	15.2	1952	
1700257				555084	4860398	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	10.1	36.6	1.8	1955	
1700259				554750	4860972	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	17.1	30.5	7.3	1955	
1700263				554655	4860936	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.2	38.1	10.1	1957	
1700265				554796	4860751	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	18.9	32.0	6.7	1958	
1700266				554761	4860831	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	21.0	41.1	10.1	1958	
1700267				554720	4860861	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	16.8	41.1	6.1	1959	
1700268				554897	4860524	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	6.7	22.6		1960	
1700275				554967	4860625	GRAND VALLEY VILLAGE	DUFFERIN	Public	Bedrock	5.5	18.0	1.8	1963	
1700276				554746	4860816	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	32.9	51.2	14.6	1963	
1700279				555068	4860439	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	15.2	39.6	8.2	1963	
1700280				555070	4859816	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.2	44.2	7.3	1964	
1700281				554666	4860619	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.5	42.7	12.8	1965	
1700282				554666	4860619	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	22.6	47.9	10.7	1965	
1700291				554700	4860846	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	12.2	26.8	5.5	1966	
1700294				554746	4860811	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	15.2	29.6	7.9	1966	
1700869				555094	4860523	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	13.1	33.5	3.7	1968	
1700870				554814	4860723	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	18.0	30.5	4.6	1968	
1700929				554654	4861073	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	18.3	27.4	5.5	1968	
1701002		30	2	554544	4860403	EAST LUTHER TOWNSHIP	DUFFERIN	Livestock	Bedrock	36.6	59.1	17.4	1969	
1701027				555114	4860223	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	13.7	70.1	0.6	1969	
1701170				555164	4860003	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	11.6	41.1		1970	
1701171				554864	4860523	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	7.6	16.8		1970	
1701175				554814	4860733	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	16.2	22.9	9.8	1970	
1701208				554824	4859823	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	29.0	54.9	4.0	1971	

Table 1: Summary of Water Well Records

MOECC Well ID	Address	Lot	Conc.	Easting	Northing	Township	County/ Municipality	Well Use	Bedrock/ Overburden	Depth to Bedrock (m)	Total Depth of Well (m)	Static Water Level (m)	Year Drilled	Notes
Wells on Neighbouring Properties														
1701216				554704	4861023	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	19.8	43.3	9.1	1971	
1701237				555174	4860263	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	13.1	42.7	0.6	1971	
1701246				554714	4860623	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	22.6	44.2	12.2	1971	
1701271				554924	4860373	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	7.0	38.1		1971	
1701272				554749	4860533	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	22.9	51.8	10.7	1971	
1701307				554674	4860923	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	22.3	51.8	14.3	1971	
1701325				554864	4860303	GRAND VALLEY VILLAGE	DUFFERIN	Municipal	Bedrock	6.7	32.3		1972	
1701385				554764	4860873	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	17.7	23.2	9.8	1972	
1701490				555164	4860123	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	12.5	45.7		1973	
1701494				555114	4860473	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	9.8	42.7	0.3	1973	
1701571				555147	4860222	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	13.1	42.7	1.5	1973	
1701610				554807	4860553	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	18.9	45.4	9.1	1973	
1701745		30	3	554601	4860877	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	28.3	30.5	15.2	1974	
1701756				554814	4860623	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	42.1	45.7	5.5	1974	
1701930				554743	4860948	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	21.6	24.1	12.2	1975	
1701998				554664	4860923	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.2	32.3	13.1	1975	
1701999				554664	4860973	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.2	31.7	12.5	1975	
1702046				554764	4860723	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	23.2	42.4	12.2	1975	
1702129		29	3	554214	4860773	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	28.0	36.6	8.2	1976	
1702195				554664	4861023	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	24.7	53.0	13.7	1976	
1702196				554614	4860973	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	24.4	55.2	13.7	1976	
1702197				554664	4860953	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	25.6	54.6	13.7	1976	
1702198				554664	4860923	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	25.0	54.9	13.7	1974	
1702239				554864	4860623	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	8.2	79.2	1.5	1976	
1702261		30	1	555164	4859473	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	29.3	31.7	9.1	1976	
1702334		30	2	554714	4860473	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	22.6	54.9	14.6	1977	
1702378		30	2	554764	4860573	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	19.8	56.4	7.0	1977	
1702501				554764	4860823	GRAND VALLEY VILLAGE	DUFFERIN	Domestic	Bedrock	13.4	64.0	9.4	1978	
1703023		30	3	554434	4860773	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	26.2	49.7	13.7	1984	
1703112		31	2	555074	4860518	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	6.4	31.4	0.9	1984	
1703113		30	2	554770	4860869	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	18.0	25.0	11.3	1984	
1703188		30	3	554698	4860850	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	21.9	85.3	14.6	1985	
1703243		30	2	554801	4860117	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	17.7	27.4	9.4	1986	

Table 1: Summary of Water Well Records

MOECC Well ID	Address	Lot	Conc.	Easting	Northing	Township	County/ Municipality	Well Use	Bedrock/ Overburden	Depth to Bedrock (m)	Total Depth of Well (m)	Static Water Level (m)	Year Drilled	Notes
Wells on Neighbouring Properties														
1703297		30	2	554808	4860649	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	19.2	29.6	8.5	1986	
1703416		30	2	554772	4860442	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	24.4	53.0	11.9	1987	
1703417		29	3	554367	4860723	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	29.9	46.9	11.0	1987	
1703418				554760	4860398	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	24.7	33.5	13.7	1987	
1703541		29	2	554085	4860573	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	28.7	75.3	1.5	1987	
1703542		29	2	554223	4860609	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	30.2	56.4	13.1	1987	
1703661		30	2	554923	4860629	EAST LUTHER TOWNSHIP	DUFFERIN	Commerical	Bedrock	9.8	32.0	3.7	1988	
1703662		30	2	554882	4860627	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	14.3	33.5	5.2	1988	
1703743		30	2	554833	4860560	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	18.9	53.3	12.2	1988	
1703745		30	2	554928	4860398	EAST LUTHER TOWNSHIP	DUFFERIN	Commerical	Bedrock	9.8	39.6		1988	
1703756		30	2	554972	4859828	EAST LUTHER TOWNSHIP	DUFFERIN	Public	Bedrock	28.7	56.4	11.9	1988	
1703757		30	2	555066	4859799	EAST LUTHER TOWNSHIP	DUFFERIN	Municipal	Bedrock	26.5	116.4	9.8	1988	
1703817		31	2	555205	4859812	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	11.3	20.4	5.8	1988	
1703819		30	3	554761	4860869	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	18.9	29.0	9.4	1988	
1703968		30	3	554756	4860942	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	18.6	61.9	10.1	1989	
1704827		30	2	554970	4860593	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned		5.5	77.7		1994	
1705628		29	2	553808	4860497	EAST LUTHER TOWNSHIP	DUFFERIN	Not Used	Overburden		14.3		2000	
1705632		29	2	553808	4860497	EAST LUTHER TOWNSHIP	DUFFERIN	Observation	Bedrock	26.4	28.7	4.6	2000	
1706116		30	2	554797	4860116	EAST LUTHER TOWNSHIP	DUFFERIN	Not Used					2003	
1706236		30	2	554919	4860657	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2003	
7039134				554976	4860317	EAST LUTHER TOWNSHIP	DUFFERIN	Not Used	Overburden		8.0		2006	
7039991		2	30	554934	4860582	EAST LUTHER TOWNSHIP	DUFFERIN	Not Used	Overburden		5.2		2006	
7040138		2	30	554934	4860582	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2006	
7052194		29	3	554006	4861059	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	30.2	73.2	15.8	2007	
7122086		30	2	554931	4860567	EAST LUTHER TOWNSHIP	DUFFERIN	Monitoring			3.7		2008	
7122087		30	2	554912	4860522	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2008	
7122088		30	2	554939	4860535	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2008	
7122089		30	2	554907	4860482	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2008	
7134264	115 Main St			555070	4860466	GRAND VALLEY VILLAGE	DUFFERIN	Abandoned					2009	
7139106	173146 C.R. 25	30	2	555156	4859636	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned				3.0	2009	
7140944		30	2	554417	4860555	EAST LUTHER TOWNSHIP	DUFFERIN	Domestic	Bedrock	27.1	32.0		2009	
7142416				554976	4860317	GRAND VALLEY VILLAGE	DUFFERIN	Abandoned			8.0		2010	
7143021		30	2	554710	4860523	EAST LUTHER TOWNSHIP	DUFFERIN	Monitoring	Overburden		7.6		2010	

Table 1: Summary of Water Well Records

MOECC Well ID	Address	Lot	Conc.	Easting	Northing	Township	County/ Municipality	Well Use	Bedrock/ Overburden	Depth to Bedrock (m)	Total Depth of Well (m)	Static Water Level (m)	Year Drilled	Notes
Wells on Neighbouring Properties														
7150499				555110	4860323	GRAND VALLEY VILLAGE	DUFFERIN	Not Used					2010	
7154974				554969	4860621	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2010	
7154975	4 Parkview Dr.			555122	4860266	GRAND VALLEY VILLAGE	DUFFERIN	Abandoned					2010	
7161608		30	2	555108	4859783	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2010	
7183895				554929	4860537	EAST LUTHER TOWNSHIP	DUFFERIN	Monitoring	Overburden		4.3		2012	
7183896	Water and William			554957	4860519	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2012	
7186072		30	2	554754	4860805	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned				12.2	2012	
7188516				554946	4860532	EAST LUTHER TOWNSHIP	DUFFERIN	Monitoring	Overburden		6.5		2012	
7188594				554884	4860648	EAST LUTHER TOWNSHIP	DUFFERIN						2012	No construction details
7203991				554910	4860648	EAST LUTHER TOWNSHIP	DUFFERIN						2013	No construction details
7205374				554918	4860654	EAST LUTHER TOWNSHIP	DUFFERIN						2012	No construction details
7225112				554878	4860625	EAST LUTHER TOWNSHIP	DUFFERIN						2013	No construction details
7227475				554869	4860666	EAST LUTHER TOWNSHIP	DUFFERIN						2014	No construction details
7239534				554267	4860549	EAST LUTHER TOWNSHIP	DUFFERIN						2015	No construction details
7248376				554943	4860358	EAST LUTHER TOWNSHIP	DUFFERIN	Alteration					2015	Casing extension
7258497	173146 Water St.	30	2	555127	4859565	EAST LUTHER TOWNSHIP	DUFFERIN	Monitoring			13.7		2016	
7262305				554634	4860862	EAST LUTHER TOWNSHIP	DUFFERIN	Abandoned					2015	

Table 2: Groundwater Levels

			Screen		Piezometer Water Level		Max Recorded WL	
Piezo. ID	TOC Elev.	Ground Elev.	Bottom Elev.	Length	Depth	Elev.	Depth	Elev.
(--)	(masl)	(masl)	(masl)	(m)	(mbgs)	(masl)	(mbgs)	(masl)
BH-01-15	477.018	475.996	470.0	3.3	1.328	474.668	1.057	474.939
BH-04-15	472.989	472.023	466.0	3.3	4.359	467.664	4.163	467.860
BH-05-15	472.853	472.029	466.0	3.3	1.986	470.043	1.778	470.251
BH-07-15	484.206	483.314	475.7	3.3	0.798	482.516	0.14	483.174
PZ-01-19	468.828	467.885	466.685	0.6	0.077	467.808		
PZ-02-19	469.068	467.948	466.748	0.9	-0.01	467.958		
PZ-03-19	468.994	468.164	467.214	0.9	0.03	468.134		

Water levels measured on May 13, 2019
mbgs - metres below ground surface
masl - metres above Sea Level
Elev. - Elevation
WL - Water Level

Table 3a: Results of Groundwater Quality Analyses - General Chemistry and Organic Parameters

	Sample ID	BH-01-15	BH-04-15	BH-05-15	BH-07-15	PZ-01-19	PZ-03-19
	Sample Description	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
	Screened Interval (m asl)	469.77 - 472.82	465.71 - 468.76	465.88 - 468.93	475.62 - 478.67	466.69 - 467.29	467.21 - 468.11
	Sampling Date	2019-05-13	2019-05-13	2019-05-13	2019-05-13	2019-05-13	2019-05-13
Parameters	**Criteria 1** **ODWS MAC**	**Criteria 2** **PWQO**	**Concentration**					
Bicarb. Alkalinity (calc. as CaCO3) (mg/L)			240	270	250	230	240	350
Calculated TDS (mg/L)			450	360	350	310	260	360
Carb. Alkalinity (calc. as CaCO3) (mg/L)			2.4	2.5	2.3	3.3	2.2	2.5
Hardness (CaCO3) (mg/L)			370	340	290	250	260	370
Total Ammonia-N (mg/L)			<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Conductivity (umho/cm)			720	630	610	570	480	640
Dissolved Organic Carbon (mg/L)			1.8	0.84	1.6	0.85	3.2	3.3
Orthophosphate (P) (mg/L)			<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
pH (pH)		***6.5:8.5***	8.03	7.99	7.98	8.18	7.99	7.88
Dissolved Sulphate (SO4) (mg/L)			140	27	35	38	4	<1.0
Alkalinity (Total as CaCO3) (mg/L)			240	270	250	230	240	350
Dissolved Chloride (Cl-) (mg/L)			5.6	14	16	20	9.9	1.9
Nitrite (N) (mg/L)	1		<0.010	<0.010	<0.010	<0.010	0.016	<0.010
Nitrate (N) (mg/L)	10		<0.10	5.62	2.97	0.39	0.1	<0.10
Nitrate + Nitrite (N) (mg/L)	10		<0.10	5.62	2.97	0.39	0.12	<0.10

Notes:

1. Criteria are from the *Ontario Drinking Water Standards* Maximum Acceptable Concentration (Criteria 1) and the *Provincial Water Quality Objectives* (Criteria 2). Criteria are indicated by:

   White Text for Criteria 1, *Italics* for Criteria 2
2. Criteria and concentrations are given in units consistent with the units listed for the associated parameter.
3. Concentrations with bold, italic, or underlined text in shaded cells exceed the corresponding criteria.
4. Screened well intervals presented are approximate.
5. ---- represents sample parameters that were not analyzed; ~ = No value specified.
6. Maxxam Laboratory job number: B9C8765

Table 3b: Results of Groundwater Quality Analyses - Metals Parameters

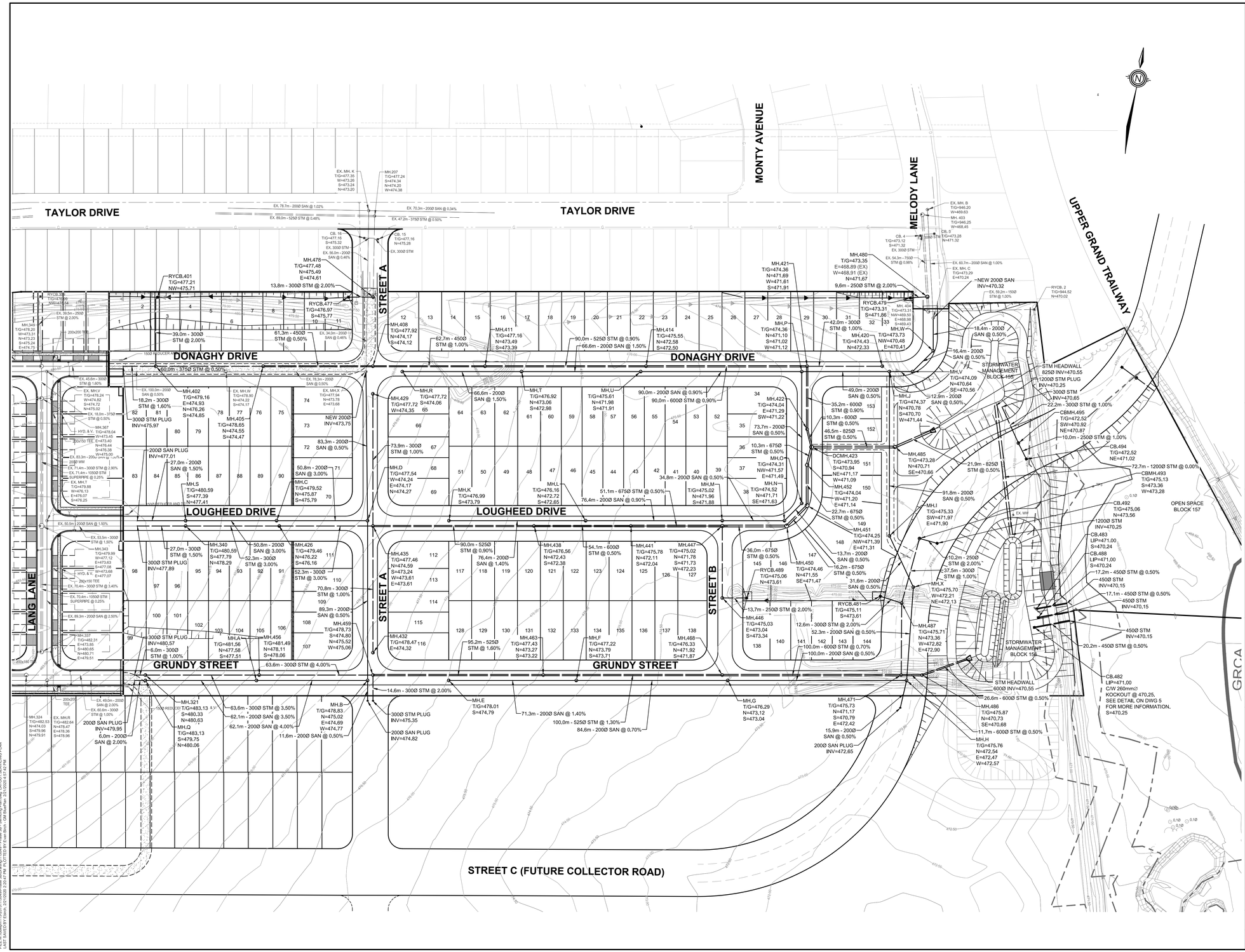
	Sample ID	BH-01-15	BH-04-15	BH-05-15	BH-07-15	PZ-01-19	PZ-03-19
	Sample Description	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
	Screened Interval (m asl)	469.77 - 472.82	465.71 - 468.76	465.88 - 468.93	475.62 - 478.67	466.69 - 467.29	467.21 - 468.11
	Sampling Date	2019-05-13	2019-05-13	2019-05-13	2019-05-13	2019-05-13	2019-05-13
Parameters	**Criteria 1** **ODWS MAC**	**Criteria 2** **PWQO**	**Concentration**					
Dissolved Aluminum (Al) (ug/L)*		***75***	***110***	<5.0	5.5	5.5	22	15
Dissolved Antimony (Sb) (ug/L)		***20***	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Arsenic (As) (ug/L)		***100***	<1.0	<1.0	<1.0	<1.0	<1.0	1.4
Dissolved Barium (Ba) (ug/L)	1000		77	61	79	79	15	18
Dissolved Beryllium (Be) (ug/L)*		***1100***	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Boron (B) (ug/L)		***200***	56	12	43	43	<10	<10
Dissolved Cadmium (Cd) (ug/L)	5	***0.2***	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Calcium (Ca) (ug/L)			74000	80000	64000	64000	74000	110000
Dissolved Chromium (Cr) (ug/L)	50	***8.9***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Cobalt (Co) (ug/L)		***0.9***	<0.50	<0.50	<0.50	<0.50	<0.50	***1.8***
Dissolved Copper (Cu) (ug/L)		***5***	1.7	<1.0	1.1	1.1	<1.0	1
Dissolved Iron (Fe) (ug/L)		***300***	120	<100	<100	<100	<100	<100
Dissolved Lead (Pb) (ug/L)*	10	***25***	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg) (ug/L)			44000	34000	31000	31000	19000	21000
Dissolved Manganese (Mn) (ug/L)			89	<2.0	5.8	5.8	<2.0	2000
Dissolved Molybdenum (Mo) (ug/L)		***40***	5.8	0.58	3	3	<0.50	<0.50
Dissolved Nickel (Ni) (ug/L)		***25***	<1.0	<1.0	<1.0	<1.0	<1.0	2.3
Dissolved Phosphorus (P) (ug/L)		***10***	<100	<100	<100	<100	<100	<100
Dissolved Potassium (K) (ug/L)			3700	1400	3100	3100	220	1300
Dissolved Selenium (Se) (ug/L)	10	***100***	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Silicon (Si) (ug/L)			4200	5000	4400	4400	1900	2700
Dissolved Silver (Ag) (ug/L)		***0.1***	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dissolved Sodium (Na) (ug/L)	20000		21000	6400	22000	22000	3000	910
Dissolved Strontium (Sr) (ug/L)			510	160	400	400	84	130
Dissolved Thallium (Tl) (ug/L)		***0.3***	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Dissolved Titanium (Ti) (ug/L)			5.1	<5.0	<5.0	<5.0	<5.0	<5.0
Dissolved Uranium (U) (ug/L)	20	***5***	***6.2***	1	3.8	3.8	0.61	0.31
Dissolved Vanadium (V) (ug/L)		***6***	0.57	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Zinc (Zn) (ug/L)		***30***	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

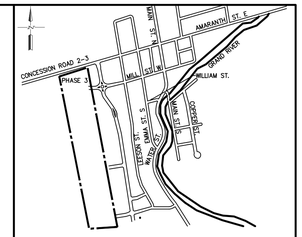
Notes:

1. Criteria are from the *Ontario Drinking Water Standards* Maximum Acceptable Concentration (Criteria 1) and the *Provincial Water Quality Objectives* (Criteria 2). Criteria are indicated by:
   White Text for Criteria 1, *Italics* for Criteria 2
2. Criteria and concentrations are given in units consistent with the units listed for the associated parameter.
3. Concentrations with bold, italic, or underlined text in shaded cells exceed the corresponding criteria.
4. Screened well intervals presented are approximate.
5. ---- represents sample parameters that were not analyzed; ~ = No value specified.
6. Maxxam Laboratory job number: B9C8765

* - Criterion selected based on pH, Hardness, Alkalinity or some other parameter, as per *Water Management: Policies, Guidelines, Provincial Water Quality Objectives. July 1994*.

APPENDIX A:
CONCEPTUAL SITE PLAN





TOWN OF GRAND VALLEY
KEY PLAN
NOT TO SCALE

NOTES :

1. TOPOGRAPHIC AND EXISTING FEATURES SURVEY COMPLETED BY GM BLUEPLAN ENGINEERING ON APRIL 30, 2018. ADDITIONAL TOPOGRAPHIC SURVEY OF BOYNE CREEK AND THE UPPER GRAND TRAILWAY COMPLETED BY GM BLUEPLAN ENGINEERING ON NOVEMBER 25, 2019.
2. DRAFT PLAN PREPARED BY ASTRID J CLOS PLANNING CONSULTANTS, DATED OCTOBER 31, 2019.
3. EXISTING INFRASTRUCTURE INVERT INFORMATION PROVED BY GM BLUEPLAN ENGINEERING AS RECORDED DRAWINGS, 10, 11, 14, 15, 16, AND 17 DATED APRIL, 28, 2014.

BENCH MARKS :

STATION: 00019798443 - ELEV: 479.359m
TWO STOREY BRICK AND ALUMINUM SIDING HOUSE ON EAST SIDE OF HWY 25 AND NORTH SIDE OF FIFE RD. 0.9 KM NORTH OF THE ROYAL BANK AT GRAND VALLEY, 19.0m NORTH OF CENTERLINE OF FIFE RD, 30.3m EAST OF CENTERLINE OF HWY 25. TAB LEFT IS SET HORIZONTALLY IN WEST FACE OF CONCRETE FOUNDATION, 3.08m SOUTH OF N.W. CORNER 18cm BELOW BRICKWORK AND 18cm ABOVE GROUND LEVEL.

STATION: 00019798442 - ELEV: 472.479m
TWO STORY RED BRICK HOUSE ON WEST SIDE OF HWY 25, 1.2KM SOUTH OF ROYAL BANK AT GRAND VALLEY, 1.5km NORTH OF WEST JCT HWYS 25 AND 9 AND 21.5m WEST OF CENTERLINE OF HWY 25. TABLET IS SET HORIZONTALLY IN SOUTH FACE OF STONE FOUNDATION, 51cm EAT OF S.W. CORNER, 16cm BELOW BRICKWORK AND 11cm ABOVE GROUND LEVEL.

THE POSITION OF POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND, WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED.

BEFORE STARTING WORK, THE CONTRACTOR SHALL INFORM HIMSELF OF THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES, AND SHALL ASSUME ALL LIABILITY FOR ANY DAMAGE TO THEM.

NO.	DATE	REVISION DESCRIPTION	CHKD
1	--/--/----	ISSUED FOR DRAFT PLAN APPROVAL	A.E.K.

GM BluePlan ENGINEERING
GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | LONDON | HAMILTON | GTA
330 TRILLIUM DRIVE, UNIT D, KITCHENER, ON N2E 3J2
TEL. 519-748-1440
www.gmblueplan.ca

MAYBERRY HILL SUBDIVISION PHASE 3B

THOMASFIELD HOMES LTD

TOWN OF GRAND VALLEY

CONCEPTUAL SERVICING PLAN

DRAWN BY :	APPROVED BY :	PROJECT NO. :	DRAWING NO. :
E.B.	A.E.K.	115049	3
DESIGNED BY :	DATE :	SCALE :	
A.E.K.	NOVEMBER 2019	1:1000	

APPENDIX B:
BOREHOLE LOGS AND GRAIN SIZE DATA FROM LVM STUDY

Ground Elevation: *475.87 m*

Borehole Number: **BH-01-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-01-29*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		475.87			
	FILL: brown silt (topsoil), some sand, trace organics, moist		0.00 / 475.26			
	SILT TILL: hard brown sandy clayey silt, trace gravel, wet sand seams, APL		0.61	SS-1	3-6 8	14
				SS-2	5-9 12	21
				SS-3	4-7 8	15
	very stiff, grey		472.82 / 3.05	SS-4	3-5 7	12
	hard		471.30 / 4.57	SS-5	3-6 8	14
	compact grey sandy silt, some clay, trace gravel, moist		469.77 / 6.10	SS-6	8-8 12	20
	Borehole terminated at 6.55 m		469.32 / 6.55			

Dynamic Cone: 20 40 60 80 — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200 — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

WP WL — Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

- protective cover and concrete
- el. 473.60 m 2015-02-09
- bentonite seal
- sand pack
- 50 mm pipe
- 3.05 m slotted screen
- native cave

Reviewed by: *K. Rundle Drake*

Drafted by: *E.Ciochon*

Sheet: *1 of 1*

Notes:

Ground Elevation: *478.22 m*

Borehole Number: **BH-02-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-02-03*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		478.22			
	FILL: dark brown silt (topsoil), some sand and clay, trace gravel, moist		0.00 / 477.46			
1	***SILT TILL:*** loose brown sandy silt, some clay, trace gravel, wet		0.76 / 476.70	SS-1	2-3 4	7
	very stiff brown clayey silt, some sand, trace gravel, occasional cobbles/boulders, wet sand seams, APL		1.52	SS-2	3-3 7	10
2				SS-3	7-10 14	24
3	very dense brown sandy silt, some clay, trace gravel, moist		3.05 / 475.17	SS-4	18-24 30	54
4						
	grey		4.57 / 473.65	SS-5	16-31 42	73
5						
6				SS-6	50 /100 mm	
	Borehole terminated at 6.20 m		6.20 / 472.02			
7						
8						

Dynamic Cone — 20 40 60 80
Std Penetration — 20 40 60 80
Shear Strength (PP) kPa — 50 100 150 200
Initial / Remold
Shear Strength (FV) kPa — 50 100 150 200
WP WL
Water Content (%) — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave
At drilling completion, borehole open and dry.

Vertical Scale = 1 : 50.0

Reviewed by: ***K. Rundle Drake*** **Drafted by:** ***E.Ciochon*** **Sheet:** ***1 of 1***

Notes: *Bulk Sample GS-5 taken from 3.05 - 3.66 m.*

Z:\Style_LVM_Ontario\LogBorehole_Log_LVM_Ontario.sty- Printed : 2015-02-27 14h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Ground Elevation: *475.55 m*

Borehole Number: **BH-03-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-02-03*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Elevation (m)	Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation	475.55				
	FILL: dark brown silt (topsoil), some sand and clay, trace organics, moist		0.00			
		474.79	0.76			
	compact brown, trace topsoil pockets, moist	474.71	0.84	SS-1	4-5 7	12
	SILT TILL: compact brown sandy silt, some clay, trace gravel, very moist					
	occasional cobbles/boulders	474.03	1.52	SS-2	5-8 16	24
	hard brown clayey silt, some sand, trace gravel, wet sand seams, APL	473.26	2.29	SS-3	6-6 8	14
	very stiff, grey	472.50	3.05	SS-4	3-6 6	12
				SS-5	5-8 13	21
	hard	469.45	6.10	SS-6	7-9 20	29
	Borehole terminated at 6.55 m	469.00	6.55			

Dynamic Cone / Std Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200 — Initial / Remold

Water Content (%): WP WL — 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, borehole open and dry.

Reviewed by: *K. Rundle Drake*

Drafted by: *E.Ciochon*

Sheet: *1 of 1*

Notes:

Ground Elevation: *471.81 m*

Borehole Number: **BH-04-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-01-29*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

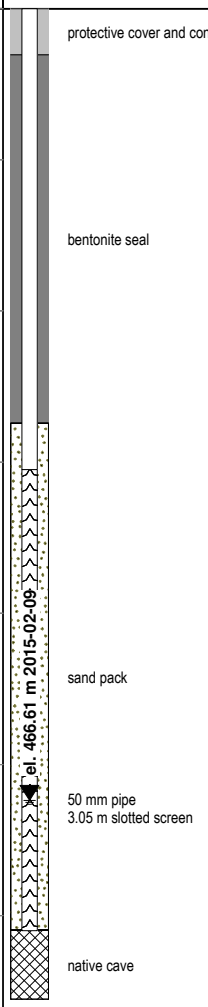
Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		471.81			
	FILL: dark brown silt (topsoil), some sand, moist		0.00 / 471.20			
	SILT TILL: very stiff brown clayey silt, some sand, trace gravel, APL		0.61	SS-1	6-4 6	10
	compact brown sandy silt, some clay, trace gravel, very moist		470.29 / 1.52	SS-2	3-4 6	10
	very stiff clayey silt, some sand, trace gravel, wet sand seams, APL		469.52 / 2.29	SS-3	7-4 8	12
	hard		468.76 / 3.05	SS-4	7-9 11	20
	grey, occasional cobbles/boulders		468.46 / 3.35			
	DTPL		467.24 / 4.57	SS-5	8-12 15	27
	SAND AND GRAVEL: dense brown sand and gravel, trace silt and clay, saturated		465.71 / 6.10	SS-6	11-16 20	36
	Borehole terminated at 6.55 m		465.26 / 6.55			

Dynamic Cone — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200 — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

Water Content (%): WP WL — 10 20 30



Groundwater Observations and Standpipe Details

Vertical Scale = 1 : 50.0

Reviewed by: *K. Rundle Drake* **Drafted by:** *E.Ciochon* **Sheet:** *1 of 1*

Notes: *Bulk sample GS-3 taken from 1.52 to 2.29 m.*

Ground Elevation: *471.98 m*

Borehole Number: **BH-05-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-01-30*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		471.98			
	FILL: dark brown silt, some sand and clay, trace gravel and organics, moist		0.00 / 471.52			
	SILT TILL: hard brown clayey silt, some sand, trace gravel, occasional cobbles/boulders, APL		0.46	SS-1	15-33 13	46
	compact brown sandy silt, some clay and gravel		470.46 1.52	SS-2	8-5 10	15
				SS-3	9-7 9	16
	very stiff brown clayey silt, some sand, trace gravel, wet sand seams, APL		468.93 3.05	SS-4	4-6 7	13
	grey		467.41 4.57	SS-5	4-5 6	11
				SS-6	5-6 10	16
	compact grey sandy silt, some clay, trace gravel, wet		465.48 6.50			
	Borehole terminated at 6.55 m		465.43 6.55			

Dynamic Cone: 20 40 60 80
Std Penetration: 20 40 60 80
Shear Strength (PP) kPa: 50 100 150 200
Initial
Remold
Shear Strength (FV) kPa: 50 100 150 200
WP WL
Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

- protective cover and concrete
- bentonite seal
- el. 469.31 m 2015-02-09
- sand pack
- 50 mm pipe
- 3.05 m slotted screen
- native cave

Vertical Scale = 1 : 50.0

Reviewed by: *K. Rundle Drake*

Drafted by: *E.Ciochon*

Sheet: *1 of 1*

Notes:

Ground Elevation: *477.69 m*

Borehole Number: **BH-06-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-01-30*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		477.69			
	FILL: dark brown silt, some sand and clay, trace gravel and organics, moist		0.00 / 477.08			
1	***SILT TILL:*** very stiff brown clayey silt, some sand, trace gravel, wet sand seams, APL		0.61 / 476.17	SS-1	7-7 7	14
	occasional cobbles/boulders		1.52 / 475.40	SS-2	23-18 14	32
2	***SAND:*** compact brown silty sand, some gravel, occasional cobbles/boulders, moist		2.29 / 474.64	SS-3	16-10 11	21
3	***SAND AND GRAVEL:*** dense silty, sandy gravel, trace clay, occasional cobbles/boulders, moist		3.05 / 473.12	SS-4	17-15 16	31
4	***SILT TILL:*** very dense brown sandy silt, some clay, trace gravel, occasional cobbles/boulders, moist		4.57 / 471.59	SS-5	18-44 40	84
5	grey		6.10 / 469.94	SS-6	20-31 34	65
6				SS-7	50 /125 mm	
7	Borehole terminated at 7.75 m		7.75			
8						

Dynamic Cone: 20 40 60 80 — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200 — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

WP WL — Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave

At drilling completion, dry cave at 6.10 m.

Vertical Scale = 1 : 50.0

Reviewed by: ***K. Rundle Drake*** **Drafted by:** ***E.Ciochon*** **Sheet:** ***1 of 1***

Notes: *Bulk sample GS-4 taken from 2.29 to 3.05 m.*

Z:\Style_LVM_Ontario\LogBorehole_Log_LVM_Ontario.sty- Printed : 2015-02-27 14h

Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Ground Elevation: *483.24 m*

Borehole Number: **BH-07-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-01-30*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation		483.24			
	FILL: dark brown silt (topsoil), some sand and clay, trace gravel, moist		0.00 / 482.63			
	SILT TILL: hard brown clayey silt, some sand, trace gravel, occasional cobbles/boulders, wet sand seams, APL		0.61	SS-1	5-5 7	12
	very stiff		1.52 / 481.72	SS-2	5-6 9	15
	sandy silt, some clay, trace gravel, occasional cobbles/boulders, moist		2.29 / 480.95	SS-3	6-10 14	24
	dense		3.05 / 480.19	SS-4	16-17 22	39
	grey		4.57 / 478.67	SS-5	13-20 23	43
	hard grey clayey silt, some sand, trace gravel, occasional cobbles/boulders, wet sand seams, APL		6.10 / 477.14	SS-6	12-26 23	49
	DTPL		7.62 / 475.62	SS-7	11-22 31	53
	Borehole terminated at 8.08 m		8.08 / 475.16			

Dynamic Cone: 20 40 60 80

Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200

Initial / Remold

Shear Strength (FV) kPa: 50 100 150 200

WP WL

Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

el. 480.63 m 2015-02-09

protective cover and concrete

bentonite seal

sand pack

50 mm pipe
3.05 m slotted screen

native cave

Reviewed by: *K. Rundle Drake*

Drafted by: *E.Ciochon*

Sheet: *1 of 1*

Notes:

Ground Elevation: *477.94 m*

Borehole Number: **BH-08-15**

Job N°: *P-0007970-0-01-100*

Drill Date: *2015-02-03*

Project: *Mayberry Hills Subdivision, Phases 3 and 4*

Field Tech: *K.Rundle Drake*

Location: *Amaranth Street, Town of Grand Valley, Ontario*

Drill Method: *Hollow Stem Auger*

Depth (m)	Description	Elevation (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value
	Ground Elevation	477.94			
	FILL: dark brown silt (topsoil), some sand and clay, trace gravel, moist	0.00 / 477.48			
	SILT TILL: hard brown clayey silt, some sand, trace gravel, wet sand seams, APL	0.46	SS-1	3-5 6	11
	very stiff, occasional cobbles/boulders	476.42 1.52	SS-2	7-10 10	20
	very dense brown sandy silt, some clay, trace gravel, occasional cobbles/boulders, moist	475.65 2.29	SS-3	10-21 50 /50 mm	
	numerous cobbles	474.89 3.05	SS-4	35-50 /150 mm	
			SS-5	50 /150 mm	
	dense, grey	471.84 6.10	SS-6	10-20 25	45
	very dense	470.32 7.62			
	Borehole terminated at 7.70 m	470.24 7.70	SS-7	12-50 /75 mm	

Dynamic Cone: 20 40 60 80 — Std Penetration: 20 40 60 80

Shear Strength (PP) kPa: 50 100 150 200 — Initial / Remold — Shear Strength (FV) kPa: 50 100 150 200

WP WL — Water Content (%): 10 20 30

Groundwater Observations and Standpipe Details

native backfill

bentonite seal

native cave
At drilling completion, borehole open and dry.

Vertical Scale = 1 : 50.0

Reviewed by: ***K. Rundle Drake*** **Drafted by:** ***E.Ciochon*** **Sheet:** ***1 of 1***

Notes: *Bulk sample GS-6 taken from 4.57 - 5.18 m.*

PARTICLE SIZE ANALYSIS

Project: **Mayberry Hills Subdivision, Phases 3 and 4**

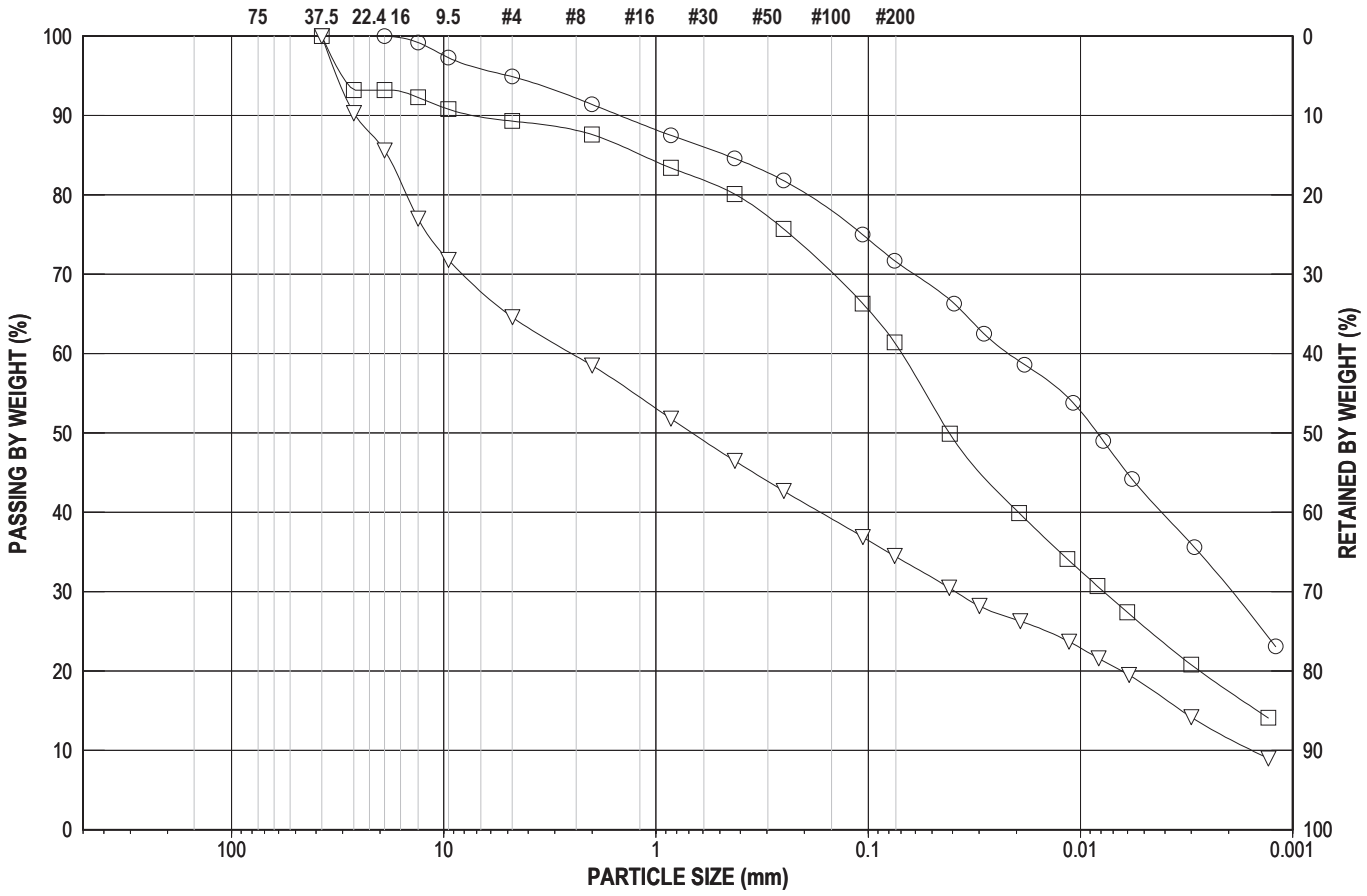
Location: **Amaranth Street, Town of Grand Valley, Ontario**

Figure No : 3

File No : **P-0007970-0-01-100**

UNIFIED SOIL CLASSIFICATION

COBBLES	*GRAVEL*		*SAND*			*SILT OR CLAY*
	COARSE	FINE	COARSE	MEDIUM	FINE	
U.S. SIEVE SIZE IN MILLIMETRES			*U.S. STANDARD SIEVE No.*			*HYDROMETER*



Symbol	Borehole n°	Sample n°	Depth (m)	Description
○	BH-01-15	SS-5	4.57 - 5.03	Sandy Clayey SILT, trace Gravel
□	BH-05-15	SS-2	1.52 - 1.98	Sandy SILT, some Clay and Gravel
▽	BH-06-15	SS-4	3.05 - 3.51	Silty Sandy GRAVEL, trace Clay

APPENDIX C:
CERTIFICATES OF ANALYSIS

Maxxam
A Bureau Veritas Group Company

Your Project #: 118073-2 Grand Valley
Your C.O.C. #: 717303-01-01

Attention: Reporting Contacts

GM BluePlan Engineering Limited
1260 - 2nd Ave E
Unit 1
Owen Sound, ON
CANADA N4K 2J3

Report Date: 2019/05/21
Report #: R5719136
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B9C8765
Received: 2019/05/14, 09:27

Sample Matrix: Water
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Alkalinity	6	N/A	2019/05/16	CAM SOP-00448	SM 23 2320 B m
Carbonate, Bicarbonate and Hydroxide	1	N/A	2019/05/16	CAM SOP-00102	APHA 4500-CO2 D
Carbonate, Bicarbonate and Hydroxide	5	N/A	2019/05/17	CAM SOP-00102	APHA 4500-CO2 D
Chloride by Automated Colourimetry	6	N/A	2019/05/16	CAM SOP-00463	SM 4500-Cl E m
Conductivity	6	N/A	2019/05/16	CAM SOP-00414	SM 23 2510 m
Dissolved Organic Carbon (DOC) (1)	6	N/A	2019/05/16	CAM SOP-00446	SM 23 5310 B m
Hardness (calculated as CaCO3)	6	N/A	2019/05/16	CAM SOP 00102/00408/00447	SM 2340 B
Lab Filtered Metals by ICPMS	2	2019/05/15	2019/05/16	CAM SOP-00447	EPA 6020B m
Dissolved Metals by ICPMS	4	N/A	2019/05/16	CAM SOP-00447	EPA 6020B m
Ion Balance (% Difference)	6	N/A	2019/05/17		
Anion and Cation Sum	1	N/A	2019/05/16		
Anion and Cation Sum	5	N/A	2019/05/17		
Total Ammonia-N	6	N/A	2019/05/19	CAM SOP-00441	EPA GS I-2522-90 m
Nitrate (NO3) and Nitrite (NO2) in Water (2)	6	N/A	2019/05/16	CAM SOP-00440	SM 23 4500-NO3I/NO2B
pH	6	2019/05/15	2019/05/16	CAM SOP-00413	SM 4500H+ B m
Orthophosphate	6	N/A	2019/05/16	CAM SOP-00461	EPA 365.1 m
Sat. pH and Langelier Index (@ 20C)	6	N/A	2019/05/17		
Sat. pH and Langelier Index (@ 4C)	6	N/A	2019/05/17		
Sulphate by Automated Colourimetry	6	N/A	2019/05/16	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (TDS calc)	6	N/A	2019/05/17		

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Your Project #: 118073-2 Grand Valley
Your C.O.C. #: 717303-01-01

Attention: Reporting Contacts

GM BluePlan Engineering Limited
1260 - 2nd Ave E
Unit 1
Owen Sound, ON
CANADA N4K 2J3

Report Date: 2019/05/21
Report #: R5719136
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B9C8765

Received: 2019/05/14, 09:27

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing. Maxxam is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Maxxam, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(2) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ashton Gibson, Project Manager
Email: AGibson@maxxam.ca
Phone# (905)817-5765

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
A Bureau Veritas Group Company

Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		JSD170	JSD171		JSD172			JSD172		
Sampling Date		2019/05/13 11:10	2019/05/13 09:20		2019/05/13 08:05			2019/05/13 08:05		
COC Number		717303-01-01	717303-01-01		717303-01-01			717303-01-01		
	UNITS	BH-01-15	BH-04-15	QC Batch	BH-05-15	RDL	QC Batch	BH-05-15 Lab-Dup	RDL	QC Batch
Calculated Parameters										
Anion Sum	me/L	7.96	6.78	6122967	6.46	N/A	6122967			
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	240	270	6122965	250	1.0	6122965			
Calculated TDS	mg/L	450	360	6122970	350	1.0	6122970			
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.4	2.5	6122965	2.3	1.0	6122965			
Cation Sum	me/L	8.34	7.11	6122967	6.76	N/A	6122967			
Hardness (CaCO3)	mg/L	370	340	6122670	290	1.0	6122670			
Ion Balance (% Difference)	%	2.37	2.40	6122966	2.26	N/A	6122966			
Langelier Index (@ 20C)	N/A	0.831	0.896	6122968	0.757		6122968			
Langelier Index (@ 4C)	N/A	0.583	0.647	6122969	0.508		6122969			
Saturation pH (@ 20C)	N/A	7.20	7.10	6122968	7.22		6122968			
Saturation pH (@ 4C)	N/A	7.45	7.35	6122969	7.47		6122969			
Inorganics										
Total Ammonia-N	mg/L	<0.050	<0.050	6125061	<0.050	0.050	6125061			
Conductivity	umho/cm	720	630	6123904	610	1.0	6124289	610	1.0	6124289
Dissolved Organic Carbon	mg/L	1.8	0.84	6123147	1.6	0.50	6123147			
Orthophosphate (P)	mg/L	<0.010	<0.010	6123703	<0.010	0.010	6123703			
pH	pH	8.03	7.99	6123905	7.98		6124293	7.99		6124293
Dissolved Sulphate (SO4)	mg/L	140	27	6123699	35	1.0	6123699			
Alkalinity (Total as CaCO3)	mg/L	240	270	6123899	250	1.0	6124287	260	1.0	6124287
Dissolved Chloride (Cl-)	mg/L	5.6	14	6123693	16	1.0	6123693			
Nitrite (N)	mg/L	<0.010	<0.010	6123730	<0.010	0.010	6123730			
Nitrate (N)	mg/L	<0.10	5.62	6123730	2.97	0.10	6123730			
Nitrate + Nitrite (N)	mg/L	<0.10	5.62	6123730	2.97	0.10	6123730			
Metals										
Dissolved Aluminum (Al)	ug/L	110	<5.0	6123636	5.5	5.0	6123636			
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	6123636	<0.50	0.50	6123636			
Dissolved Arsenic (As)	ug/L	<1.0	<1.0	6123636	<1.0	1.0	6123636			
Dissolved Barium (Ba)	ug/L	77	61	6123636	79	2.0	6123636			
Dissolved Beryllium (Be)	ug/L	<0.50	<0.50	6123636	<0.50	0.50	6123636			
Dissolved Boron (B)	ug/L	56	12	6123636	43	10	6123636			
Dissolved Cadmium (Cd)	ug/L	<0.10	<0.10	6123636	<0.10	0.10	6123636			
Dissolved Calcium (Ca)	ug/L	74000	80000	6123636	64000	200	6123636			
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	6123636	<5.0	5.0	6123636			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		JSD170	JSD171		JSD172			JSD172		
Sampling Date		2019/05/13 11:10	2019/05/13 09:20		2019/05/13 08:05			2019/05/13 08:05		
COC Number		717303-01-01	717303-01-01		717303-01-01			717303-01-01		
	UNITS	BH-01-15	BH-04-15	QC Batch	BH-05-15	RDL	QC Batch	BH-05-15 Lab-Dup	RDL	QC Batch
Dissolved Cobalt (Co)	ug/L	<0.50	<0.50	6123636	<0.50	0.50	6123636			
Dissolved Copper (Cu)	ug/L	1.7	<1.0	6123636	1.1	1.0	6123636			
Dissolved Iron (Fe)	ug/L	120	<100	6123636	<100	100	6123636			
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	6123636	<0.50	0.50	6123636			
Dissolved Magnesium (Mg)	ug/L	44000	34000	6123636	31000	50	6123636			
Dissolved Manganese (Mn)	ug/L	89	<2.0	6123636	5.8	2.0	6123636			
Dissolved Molybdenum (Mo)	ug/L	5.8	0.58	6123636	3.0	0.50	6123636			
Dissolved Nickel (Ni)	ug/L	<1.0	<1.0	6123636	<1.0	1.0	6123636			
Dissolved Phosphorus (P)	ug/L	<100	<100	6123636	<100	100	6123636			
Dissolved Potassium (K)	ug/L	3700	1400	6123636	3100	200	6123636			
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	6123636	<2.0	2.0	6123636			
Dissolved Silicon (Si)	ug/L	4200	5000	6123636	4400	50	6123636			
Dissolved Silver (Ag)	ug/L	<0.10	<0.10	6123636	<0.10	0.10	6123636			
Dissolved Sodium (Na)	ug/L	21000	6400	6123636	22000	100	6123636			
Dissolved Strontium (Sr)	ug/L	510	160	6123636	400	1.0	6123636			
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	6123636	<0.050	0.050	6123636			
Dissolved Titanium (Ti)	ug/L	5.1	<5.0	6123636	<5.0	5.0	6123636			
Dissolved Uranium (U)	ug/L	6.2	1.0	6123636	3.8	0.10	6123636			
Dissolved Vanadium (V)	ug/L	0.57	<0.50	6123636	<0.50	0.50	6123636			
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	6123636	<5.0	5.0	6123636			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Maxxam Analytics International Corporation o/a Maxxam Analytics 6740 Campobello Road, Mississauga, Ontario, L5N 2L8 Tel: (905) 817-5700 Toll-Free: 800-563-6266 Fax: (905) 817-5777 www.maxxam.ca

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		JSD173		
Sampling Date		2019/05/13 10:30		
COC Number		717303-01-01		
	UNITS	**BH-07-15**	**RDL**	**QC Batch**
Calculated Parameters				
Anion Sum	me/L	6.01	N/A	6122967
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	230	1.0	6122965
Calculated TDS	mg/L	310	1.0	6122970
Carb. Alkalinity (calc. as CaCO3)	mg/L	3.3	1.0	6122965
Cation Sum	me/L	6.20	N/A	6122967
Hardness (CaCO3)	mg/L	250	1.0	6122670
Ion Balance (% Difference)	%	1.54	N/A	6122966
Langelier Index (@ 20C)	N/A	0.751		6122968
Langelier Index (@ 4C)	N/A	0.502		6122969
Saturation pH (@ 20C)	N/A	7.43		6122968
Saturation pH (@ 4C)	N/A	7.68		6122969
Inorganics				
Total Ammonia-N	mg/L	<0.050	0.050	6125061
Conductivity	umho/cm	570	1.0	6123904
Dissolved Organic Carbon	mg/L	0.85	0.50	6123147
Orthophosphate (P)	mg/L	<0.010	0.010	6123703
pH	pH	8.18		6123905
Dissolved Sulphate (SO4)	mg/L	38	1.0	6123699
Alkalinity (Total as CaCO3)	mg/L	230	1.0	6123899
Dissolved Chloride (Cl-)	mg/L	20	1.0	6123693
Nitrite (N)	mg/L	<0.010	0.010	6123136
Nitrate (N)	mg/L	0.39	0.10	6123136
Nitrate + Nitrite (N)	mg/L	0.39	0.10	6123136
Metals				
Dissolved Aluminum (Al)	ug/L	<5.0	5.0	6123636
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	6123636
Dissolved Arsenic (As)	ug/L	<1.0	1.0	6123636
Dissolved Barium (Ba)	ug/L	42	2.0	6123636
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	6123636
Dissolved Boron (B)	ug/L	59	10	6123636
Dissolved Cadmium (Cd)	ug/L	<0.10	0.10	6123636
Dissolved Calcium (Ca)	ug/L	42000	200	6123636
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	6123636
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	6123636

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

RCAP - COMPREHENSIVE (WATER)

Maxxam ID		JSD173		
Sampling Date		2019/05/13 10:30		
COC Number		717303-01-01		
	UNITS	BH-07-15	RDL	QC Batch
Dissolved Copper (Cu)	ug/L	<1.0	1.0	6123636
Dissolved Iron (Fe)	ug/L	<100	100	6123636
Dissolved Lead (Pb)	ug/L	<0.50	0.50	6123636
Dissolved Magnesium (Mg)	ug/L	34000	50	6123636
Dissolved Manganese (Mn)	ug/L	7.1	2.0	6123636
Dissolved Molybdenum (Mo)	ug/L	7.8	0.50	6123636
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	6123636
Dissolved Phosphorus (P)	ug/L	<100	100	6123636
Dissolved Potassium (K)	ug/L	3300	200	6123636
Dissolved Selenium (Se)	ug/L	<2.0	2.0	6123636
Dissolved Silicon (Si)	ug/L	4100	50	6123636
Dissolved Silver (Ag)	ug/L	<0.10	0.10	6123636
Dissolved Sodium (Na)	ug/L	27000	100	6123636
Dissolved Strontium (Sr)	ug/L	290	1.0	6123636
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	6123636
Dissolved Titanium (Ti)	ug/L	<5.0	5.0	6123636
Dissolved Uranium (U)	ug/L	2.5	0.10	6123636
Dissolved Vanadium (V)	ug/L	0.71	0.50	6123636
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	6123636

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

RCAP - COMPREHENSIVE (LAB FILTERED)

Maxxam ID		JSD174	JSD175		
Sampling Date		2019/05/13 08:25	2019/05/13 09:10		
COC Number		717303-01-01	717303-01-01		
	UNITS	PZ-01-19	PZ-03-19	RDL	QC Batch
Calculated Parameters					
Anion Sum	me/L	5.14	7.10	N/A	6122967
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	240	350	1.0	6122965
Calculated TDS	mg/L	260	360	1.0	6122970
Carb. Alkalinity (calc. as CaCO3)	mg/L	2.2	2.5	1.0	6122965
Cation Sum	me/L	5.40	7.46	N/A	6122967
Hardness (CaCO3)	mg/L	260	370	1.0	6122670
Ion Balance (% Difference)	%	2.52	2.43	N/A	6122966
Langelier Index (@ 20C)	N/A	0.834	1.05		6122968
Langelier Index (@ 4C)	N/A	0.584	0.799		6122969
Saturation pH (@ 20C)	N/A	7.16	6.84		6122968
Saturation pH (@ 4C)	N/A	7.41	7.09		6122969
Inorganics					
Total Ammonia-N	mg/L	<0.050	<0.050	0.050	6125061
Conductivity	umho/cm	480	640	1.0	6123904
Dissolved Organic Carbon	mg/L	3.2	3.3	0.50	6123147
Orthophosphate (P)	mg/L	<0.010	<0.010	0.010	6123703
pH	pH	7.99	7.88		6123905
Dissolved Sulphate (SO4)	mg/L	4.0	<1.0	1.0	6123699
Alkalinity (Total as CaCO3)	mg/L	240	350	1.0	6123899
Dissolved Chloride (Cl-)	mg/L	9.9	1.9	1.0	6123693
Nitrite (N)	mg/L	0.016	<0.010	0.010	6123730
Nitrate (N)	mg/L	0.10	<0.10	0.10	6123730
Nitrate + Nitrite (N)	mg/L	0.12	<0.10	0.10	6123730
Metals					
Dissolved Aluminum (Al)	ug/L	22	15	5.0	6122632
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	0.50	6122632
Dissolved Arsenic (As)	ug/L	<1.0	1.4	1.0	6122632
Dissolved Barium (Ba)	ug/L	15	18	2.0	6122632
Dissolved Beryllium (Be)	ug/L	<0.50	<0.50	0.50	6122632
Dissolved Boron (B)	ug/L	<10	<10	10	6122632
Dissolved Cadmium (Cd)	ug/L	<0.10	<0.10	0.10	6122632
Dissolved Calcium (Ca)	ug/L	74000	110000	200	6122632
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	5.0	6122632
Dissolved Cobalt (Co)	ug/L	<0.50	1.8	0.50	6122632

RDL = Reportable Detection Limit
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N/A = Not Applicable

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

RCAP - COMPREHENSIVE (LAB FILTERED)

Maxxam ID		JSD174	JSD175		
Sampling Date		2019/05/13 08:25	2019/05/13 09:10		
COC Number		717303-01-01	717303-01-01		
	UNITS	PZ-01-19	PZ-03-19	RDL	QC Batch
Dissolved Copper (Cu)	ug/L	<1.0	1.0	1.0	6122632
Dissolved Iron (Fe)	ug/L	<100	<100	100	6122632
Dissolved Lead (Pb)	ug/L	<0.50	<0.50	0.50	6122632
Dissolved Magnesium (Mg)	ug/L	19000	21000	50	6122632
Dissolved Manganese (Mn)	ug/L	<2.0	2000	2.0	6122632
Dissolved Molybdenum (Mo)	ug/L	<0.50	<0.50	0.50	6122632
Dissolved Nickel (Ni)	ug/L	<1.0	2.3	1.0	6122632
Dissolved Phosphorus (P)	ug/L	<100	<100	100	6122632
Dissolved Potassium (K)	ug/L	220	1300	200	6122632
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	2.0	6122632
Dissolved Silicon (Si)	ug/L	1900	2700	50	6122632
Dissolved Silver (Ag)	ug/L	<0.10	<0.10	0.10	6122632
Dissolved Sodium (Na)	ug/L	3000	910	100	6122632
Dissolved Strontium (Sr)	ug/L	84	130	1.0	6122632
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	0.050	6122632
Dissolved Titanium (Ti)	ug/L	<5.0	<5.0	5.0	6122632
Dissolved Uranium (U)	ug/L	0.61	0.31	0.10	6122632
Dissolved Vanadium (V)	ug/L	<0.50	<0.50	0.50	6122632
Dissolved Zinc (Zn)	ug/L	<5.0	<5.0	5.0	6122632

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

TEST SUMMARY

Maxxam ID: JSD170
Sample ID: BH-01-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6123899	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/17	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6123904	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	6123636	N/A	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/17	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123730	N/A	2019/05/16	Chandra Nandlal
pH	AT	6123905	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

Maxxam ID: JSD171
Sample ID: BH-04-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6123899	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/17	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6123904	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	6123636	N/A	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/17	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123730	N/A	2019/05/16	Chandra Nandlal
pH	AT	6123905	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

TEST SUMMARY

Maxxam ID: JSD172
Sample ID: BH-05-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6124287	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/16	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6124289	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	6123636	N/A	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/16	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123730	N/A	2019/05/16	Chandra Nandlal
pH	AT	6124293	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

Maxxam ID: JSD172 Dup
Sample ID: BH-05-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6124287	N/A	2019/05/16	Surinder Rai
Conductivity	AT	6124289	N/A	2019/05/16	Surinder Rai
pH	AT	6124293	2019/05/15	2019/05/16	Surinder Rai

Maxxam ID: JSD173
Sample ID: BH-07-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6123899	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/17	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6123904	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Dissolved Metals by ICPMS	ICP/MS	6123636	N/A	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/17	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123136	N/A	2019/05/16	Chandra Nandlal
pH	AT	6123905	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

TEST SUMMARY

Maxxam ID: JSD173
Sample ID: BH-07-15
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

Maxxam ID: JSD174
Sample ID: PZ-01-19
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6123899	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/17	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6123904	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	6122632	2019/05/15	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/17	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123730	N/A	2019/05/16	Chandra Nandlal
pH	AT	6123905	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

Maxxam ID: JSD175
Sample ID: PZ-03-19
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Alkalinity	AT	6123899	N/A	2019/05/16	Surinder Rai
Carbonate, Bicarbonate and Hydroxide	CALC	6122965	N/A	2019/05/17	Automated Statchk
Chloride by Automated Colourimetry	KONE	6123693	N/A	2019/05/16	Deonarine Ramnarine
Conductivity	AT	6123904	N/A	2019/05/16	Surinder Rai
Dissolved Organic Carbon (DOC)	TOCV/NDIR	6123147	N/A	2019/05/16	Mandeep Kaur
Hardness (calculated as CaCO3)		6122670	N/A	2019/05/16	Automated Statchk
Lab Filtered Metals by ICPMS	ICP/MS	6122632	2019/05/15	2019/05/16	Arefa Dabhad
Ion Balance (% Difference)	CALC	6122966	N/A	2019/05/17	Automated Statchk
Anion and Cation Sum	CALC	6122967	N/A	2019/05/17	Automated Statchk
Total Ammonia-N	LACH/NH4	6125061	N/A	2019/05/19	Amanpreet Sappal
Nitrate (NO3) and Nitrite (NO2) in Water	LACH	6123730	N/A	2019/05/16	Chandra Nandlal
pH	AT	6123905	2019/05/15	2019/05/16	Surinder Rai
Orthophosphate	KONE	6123703	N/A	2019/05/16	Alina Dobreanu
Sat. pH and Langelier Index (@ 20C)	CALC	6122968	N/A	2019/05/17	Automated Statchk

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

TEST SUMMARY

Maxxam ID: JSD175
Sample ID: PZ-03-19
Matrix: Water

Collected: 2019/05/13
Shipped:
Received: 2019/05/14

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Sat. pH and Langelier Index (@ 4C)	CALC	6122969	N/A	2019/05/17	Automated Statchk
Sulphate by Automated Colourimetry	KONE	6123699	N/A	2019/05/16	Alina Dobreanu
Total Dissolved Solids (TDS calc)	CALC	6122970	N/A	2019/05/17	Automated Statchk

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

GENERAL COMMENTS

All 250mL plastic General bottles contained visible sediment
The 120mL plastic bottle for DOC analysis contained visible sediment
All of the 250mL plastic bottles for NH4LOW analysis contained visible sediment.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6122632	Dissolved Aluminum (Al)	2019/05/16	108	80 - 120	102	80 - 120	<5.0	ug/L		
6122632	Dissolved Antimony (Sb)	2019/05/16	107	80 - 120	104	80 - 120	<0.50	ug/L		
6122632	Dissolved Arsenic (As)	2019/05/16	109	80 - 120	102	80 - 120	<1.0	ug/L		
6122632	Dissolved Barium (Ba)	2019/05/16	104	80 - 120	101	80 - 120	<2.0	ug/L	1.6	20
6122632	Dissolved Beryllium (Be)	2019/05/16	108	80 - 120	108	80 - 120	<0.50	ug/L		
6122632	Dissolved Boron (B)	2019/05/16	NC	80 - 120	103	80 - 120	<10	ug/L	0.87	20
6122632	Dissolved Cadmium (Cd)	2019/05/16	103	80 - 120	102	80 - 120	<0.10	ug/L		
6122632	Dissolved Calcium (Ca)	2019/05/16	NC	80 - 120	102	80 - 120	<200	ug/L	7.9	20
6122632	Dissolved Chromium (Cr)	2019/05/16	100	80 - 120	98	80 - 120	<5.0	ug/L		
6122632	Dissolved Cobalt (Co)	2019/05/16	100	80 - 120	101	80 - 120	<0.50	ug/L		
6122632	Dissolved Copper (Cu)	2019/05/16	101	80 - 120	102	80 - 120	<1.0	ug/L		
6122632	Dissolved Iron (Fe)	2019/05/16	102	80 - 120	101	80 - 120	<100	ug/L	NC	20
6122632	Dissolved Lead (Pb)	2019/05/16	96	80 - 120	95	80 - 120	<0.50	ug/L		
6122632	Dissolved Magnesium (Mg)	2019/05/16	NC	80 - 120	105	80 - 120	<50	ug/L	4.3	20
6122632	Dissolved Manganese (Mn)	2019/05/16	103	80 - 120	102	80 - 120	<2.0	ug/L		
6122632	Dissolved Molybdenum (Mo)	2019/05/16	106	80 - 120	100	80 - 120	<0.50	ug/L		
6122632	Dissolved Nickel (Ni)	2019/05/16	97	80 - 120	98	80 - 120	<1.0	ug/L		
6122632	Dissolved Phosphorus (P)	2019/05/16	NC	80 - 120	110	80 - 120	<100	ug/L		
6122632	Dissolved Potassium (K)	2019/05/16	NC	80 - 120	102	80 - 120	<200	ug/L		
6122632	Dissolved Selenium (Se)	2019/05/16	107	80 - 120	101	80 - 120	<2.0	ug/L		
6122632	Dissolved Silicon (Si)	2019/05/16	112	80 - 120	104	80 - 120	<50	ug/L		
6122632	Dissolved Silver (Ag)	2019/05/16	89	80 - 120	101	80 - 120	<0.10	ug/L		
6122632	Dissolved Sodium (Na)	2019/05/16	NC	80 - 120	100	80 - 120	<100	ug/L	2.3	20
6122632	Dissolved Strontium (Sr)	2019/05/16	NC	80 - 120	100	80 - 120	<1.0	ug/L		
6122632	Dissolved Thallium (Tl)	2019/05/16	99	80 - 120	99	80 - 120	<0.050	ug/L		
6122632	Dissolved Titanium (Ti)	2019/05/16	109	80 - 120	99	80 - 120	<5.0	ug/L		
6122632	Dissolved Uranium (U)	2019/05/16	99	80 - 120	96	80 - 120	<0.10	ug/L		
6122632	Dissolved Vanadium (V)	2019/05/16	106	80 - 120	101	80 - 120	<0.50	ug/L		
6122632	Dissolved Zinc (Zn)	2019/05/16	100	80 - 120	102	80 - 120	<5.0	ug/L		
6123136	Nitrate (N)	2019/05/16	89	80 - 120	91	80 - 120	<0.10	mg/L	0.48	20
6123136	Nitrite (N)	2019/05/16	107	80 - 120	102	80 - 120	<0.010	mg/L	NC	20
6123147	Dissolved Organic Carbon	2019/05/16	94	80 - 120	98	80 - 120	<0.50	mg/L	0.63	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6123636	Dissolved Aluminum (Al)	2019/05/16	114	80 - 120	101	80 - 120	<5.0	ug/L		
6123636	Dissolved Antimony (Sb)	2019/05/16	112	80 - 120	102	80 - 120	<0.50	ug/L	1.2	20
6123636	Dissolved Arsenic (As)	2019/05/16	108	80 - 120	102	80 - 120	<1.0	ug/L	0.95	20
6123636	Dissolved Barium (Ba)	2019/05/16	105	80 - 120	96	80 - 120	<2.0	ug/L	2.9	20
6123636	Dissolved Beryllium (Be)	2019/05/16	115	80 - 120	104	80 - 120	<0.50	ug/L	NC	20
6123636	Dissolved Boron (B)	2019/05/16	110	80 - 120	104	80 - 120	<10	ug/L	0.95	20
6123636	Dissolved Cadmium (Cd)	2019/05/16	106	80 - 120	101	80 - 120	<0.10	ug/L	NC	20
6123636	Dissolved Calcium (Ca)	2019/05/16	NC	80 - 120	101	80 - 120	<200	ug/L		
6123636	Dissolved Chromium (Cr)	2019/05/16	104	80 - 120	99	80 - 120	<5.0	ug/L	NC	20
6123636	Dissolved Cobalt (Co)	2019/05/16	104	80 - 120	104	80 - 120	<0.50	ug/L	0.93	20
6123636	Dissolved Copper (Cu)	2019/05/16	104	80 - 120	98	80 - 120	<1.0	ug/L	3.0	20
6123636	Dissolved Iron (Fe)	2019/05/16	103	80 - 120	101	80 - 120	<100	ug/L		
6123636	Dissolved Lead (Pb)	2019/05/16	95	80 - 120	96	80 - 120	<0.50	ug/L	NC	20
6123636	Dissolved Magnesium (Mg)	2019/05/16	NC	80 - 120	102	80 - 120	<50	ug/L		
6123636	Dissolved Manganese (Mn)	2019/05/16	106	80 - 120	101	80 - 120	<2.0	ug/L		
6123636	Dissolved Molybdenum (Mo)	2019/05/16	109	80 - 120	100	80 - 120	<0.50	ug/L	0.70	20
6123636	Dissolved Nickel (Ni)	2019/05/16	102	80 - 120	100	80 - 120	<1.0	ug/L	8.8	20
6123636	Dissolved Phosphorus (P)	2019/05/16	116	80 - 120	109	80 - 120	<100	ug/L		
6123636	Dissolved Potassium (K)	2019/05/16	113	80 - 120	99	80 - 120	<200	ug/L		
6123636	Dissolved Selenium (Se)	2019/05/16	105	80 - 120	101	80 - 120	<2.0	ug/L	NC	20
6123636	Dissolved Silicon (Si)	2019/05/16	116	80 - 120	102	80 - 120	<50	ug/L		
6123636	Dissolved Silver (Ag)	2019/05/16	87	80 - 120	100	80 - 120	<0.10	ug/L	NC	20
6123636	Dissolved Sodium (Na)	2019/05/16	NC	80 - 120	101	80 - 120	<100	ug/L	3.4	20
6123636	Dissolved Strontium (Sr)	2019/05/16	NC	80 - 120	100	80 - 120	<1.0	ug/L		
6123636	Dissolved Thallium (Tl)	2019/05/16	99	80 - 120	98	80 - 120	<0.050	ug/L	NC	20
6123636	Dissolved Titanium (Ti)	2019/05/16	112	80 - 120	99	80 - 120	<5.0	ug/L		
6123636	Dissolved Uranium (U)	2019/05/16	98	80 - 120	96	80 - 120	<0.10	ug/L	1.1	20
6123636	Dissolved Vanadium (V)	2019/05/16	109	80 - 120	101	80 - 120	<0.50	ug/L	3.0	20
6123636	Dissolved Zinc (Zn)	2019/05/16	105	80 - 120	101	80 - 120	<5.0	ug/L	NC	20
6123693	Dissolved Chloride (Cl-)	2019/05/16	88	80 - 120	103	80 - 120	<1.0	mg/L	0.14	20
6123699	Dissolved Sulphate (SO4)	2019/05/16	NC	75 - 125	105	80 - 120	<1.0	mg/L	0.42	20
6123703	Orthophosphate (P)	2019/05/16	109	75 - 125	100	80 - 120	<0.010	mg/L	NC	25

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
6123730	Nitrate (N)	2019/05/16	98	80 - 120	101	80 - 120	<0.10	mg/L	0.27	20
6123730	Nitrite (N)	2019/05/16	103	80 - 120	100	80 - 120	<0.010	mg/L	2.2	20
6123899	Alkalinity (Total as CaCO3)	2019/05/16			95	85 - 115	<1.0	mg/L	0.23	20
6123904	Conductivity	2019/05/16			103	85 - 115	1.1, RDL=1.0	umho/cm	0.26	25
6123905	pH	2019/05/16			102	98 - 103			0.60	N/A
6124287	Alkalinity (Total as CaCO3)	2019/05/16			96	85 - 115	<1.0	mg/L	0.84	20
6124289	Conductivity	2019/05/16			99	85 - 115	<1.0	umho/cm	0.33	25
6124293	pH	2019/05/16			102	98 - 103			0.079	N/A
6125061	Total Ammonia-N	2019/05/19	100	75 - 125	97	80 - 120	<0.050	mg/L	NC	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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Maxxam Job #: B9C8765
Report Date: 2019/05/21

GM BluePlan Engineering Limited
Client Project #: 118073-2 Grand Valley
Sampler Initials: AHN

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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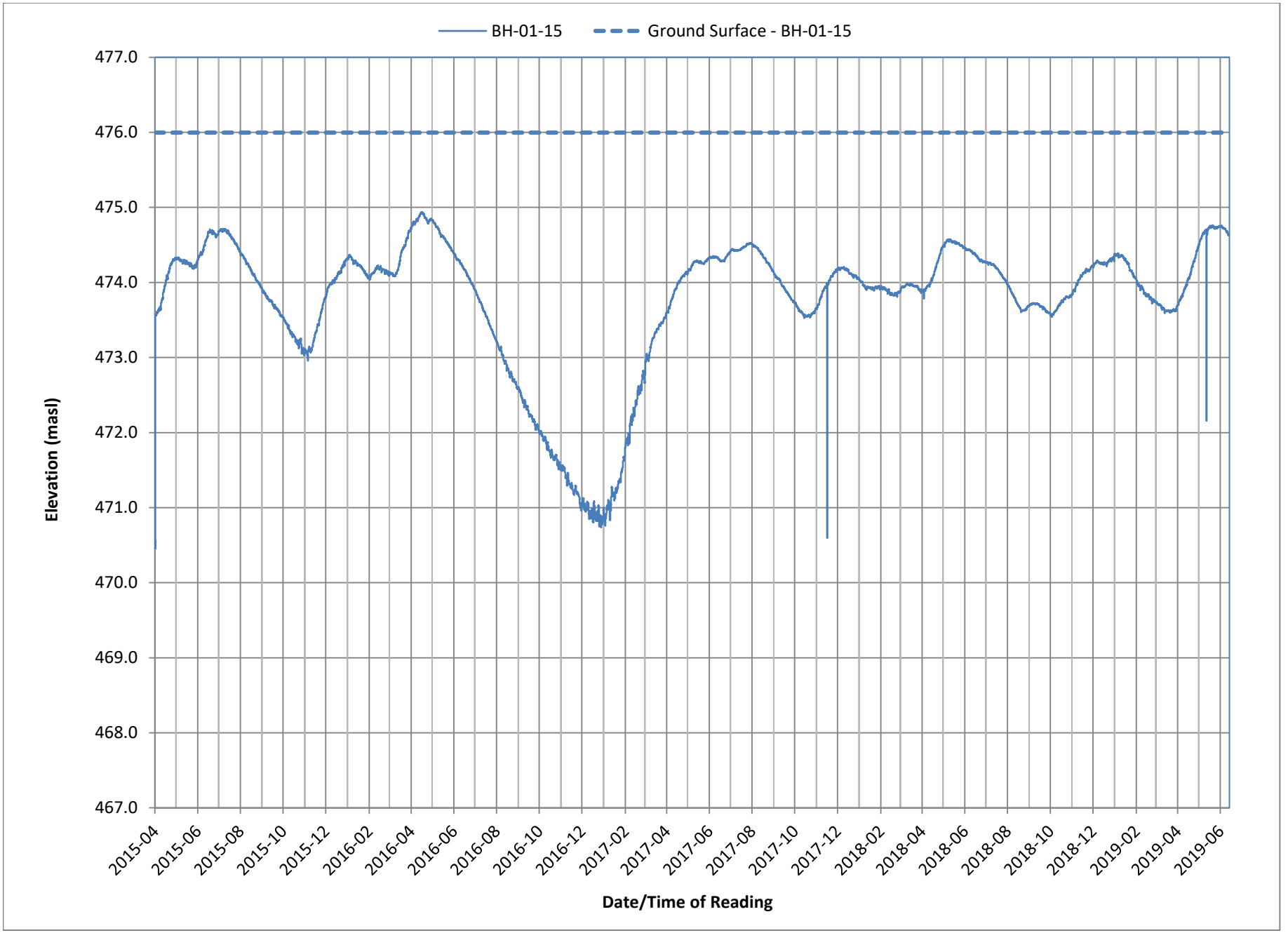
APPENDIX D:
PIEZOMETER LOGS


BH-01-15
Ground Surface - BH-01-15
Elevation (masl)
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476.0
475.0
474.0
473.0
472.0
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470.0
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2015-04
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2019-06
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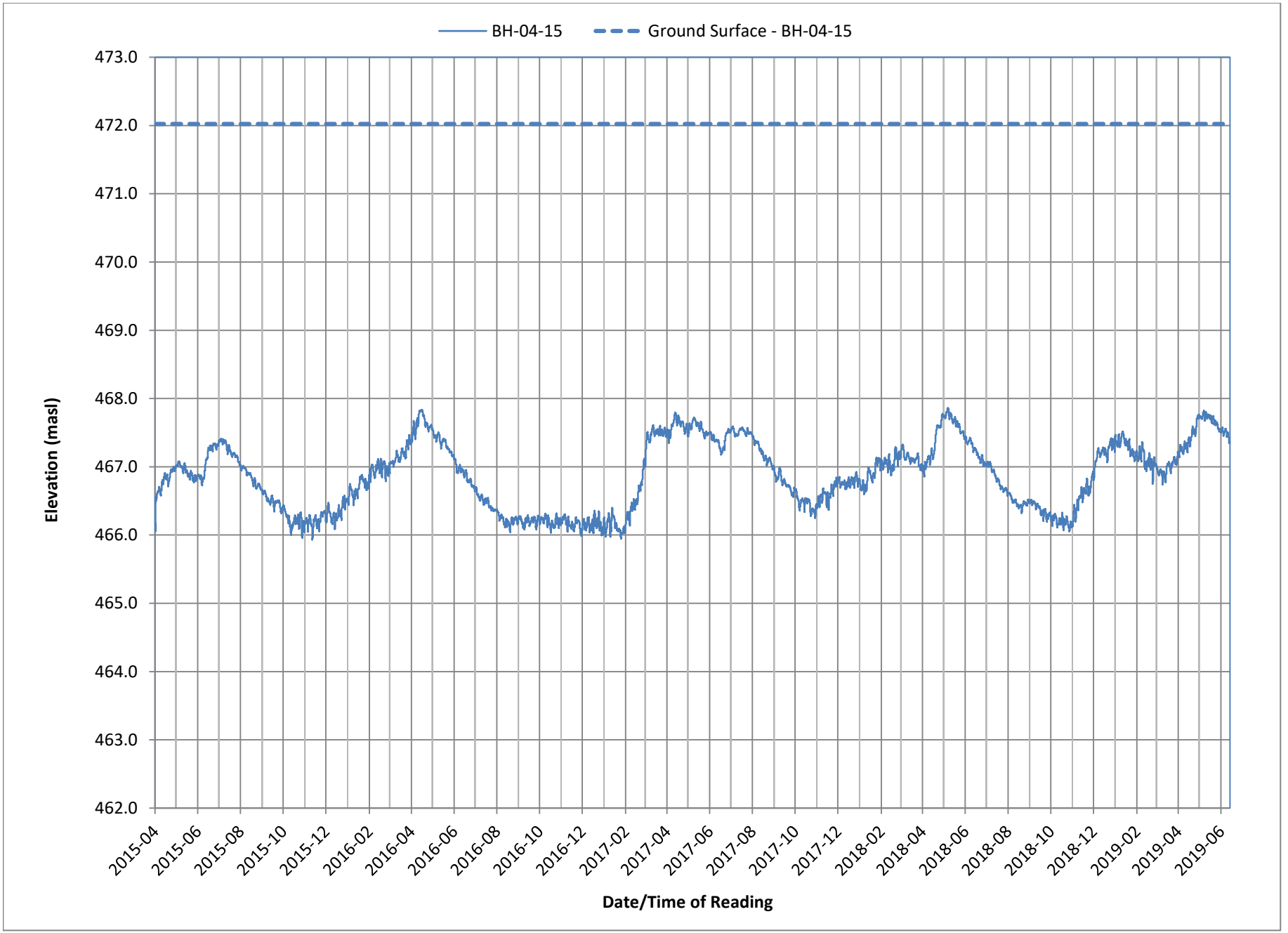
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Ground Surface - BH-04-15
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465.0
464.0
463.0
462.0
Elevation (masl)
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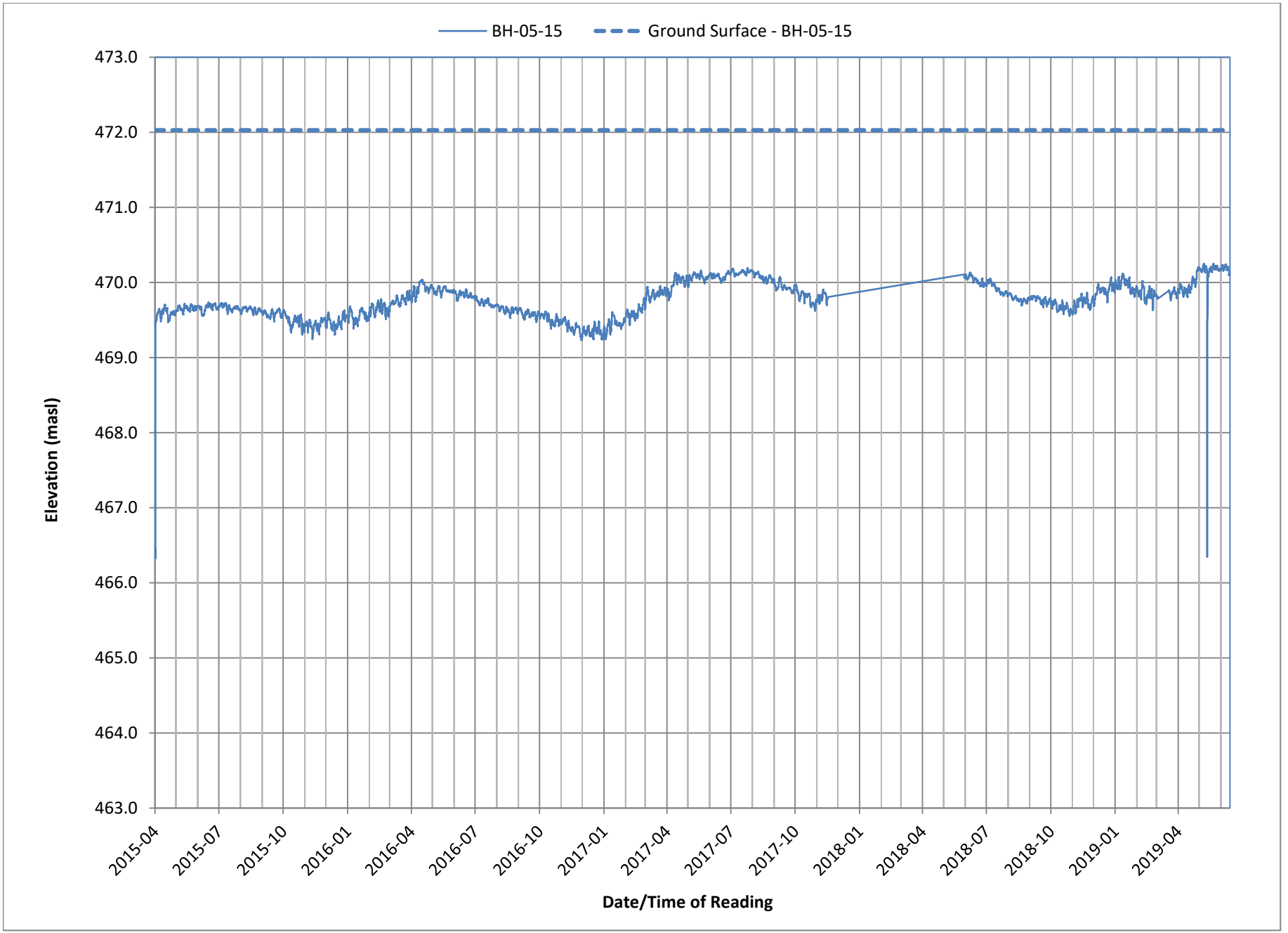
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Ground Surface - BH-05-15
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465.0
464.0
463.0
Elevation (masl)
2015-04
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2016-07
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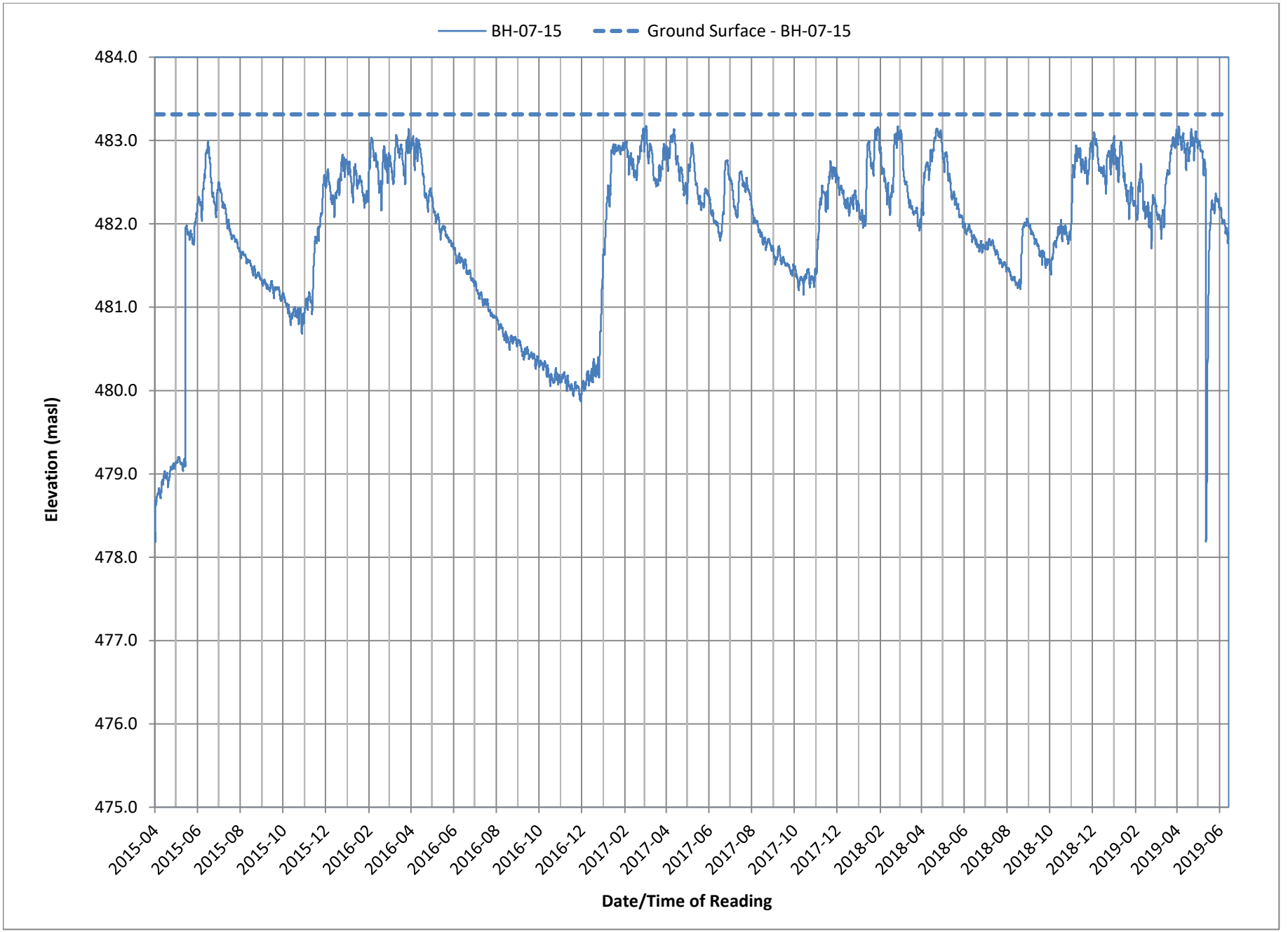
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Ground Surface - BH-07-15
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Elevation (masl)
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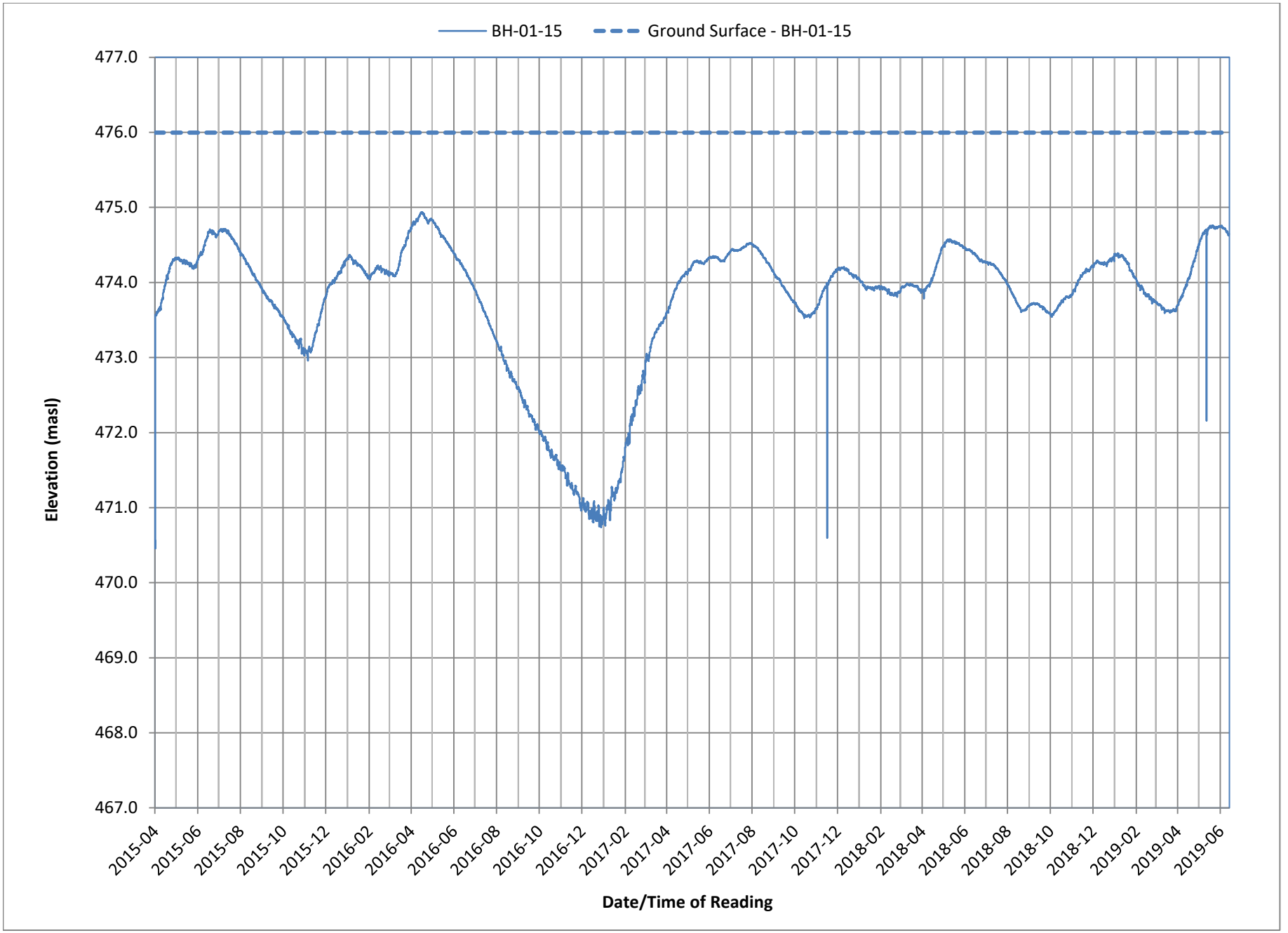
Date/Time of Reading

APPENDIX E:
GROUNDWATER HYDROGRAPHS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Ground Surface - BH-01-15
Elevation (masl)
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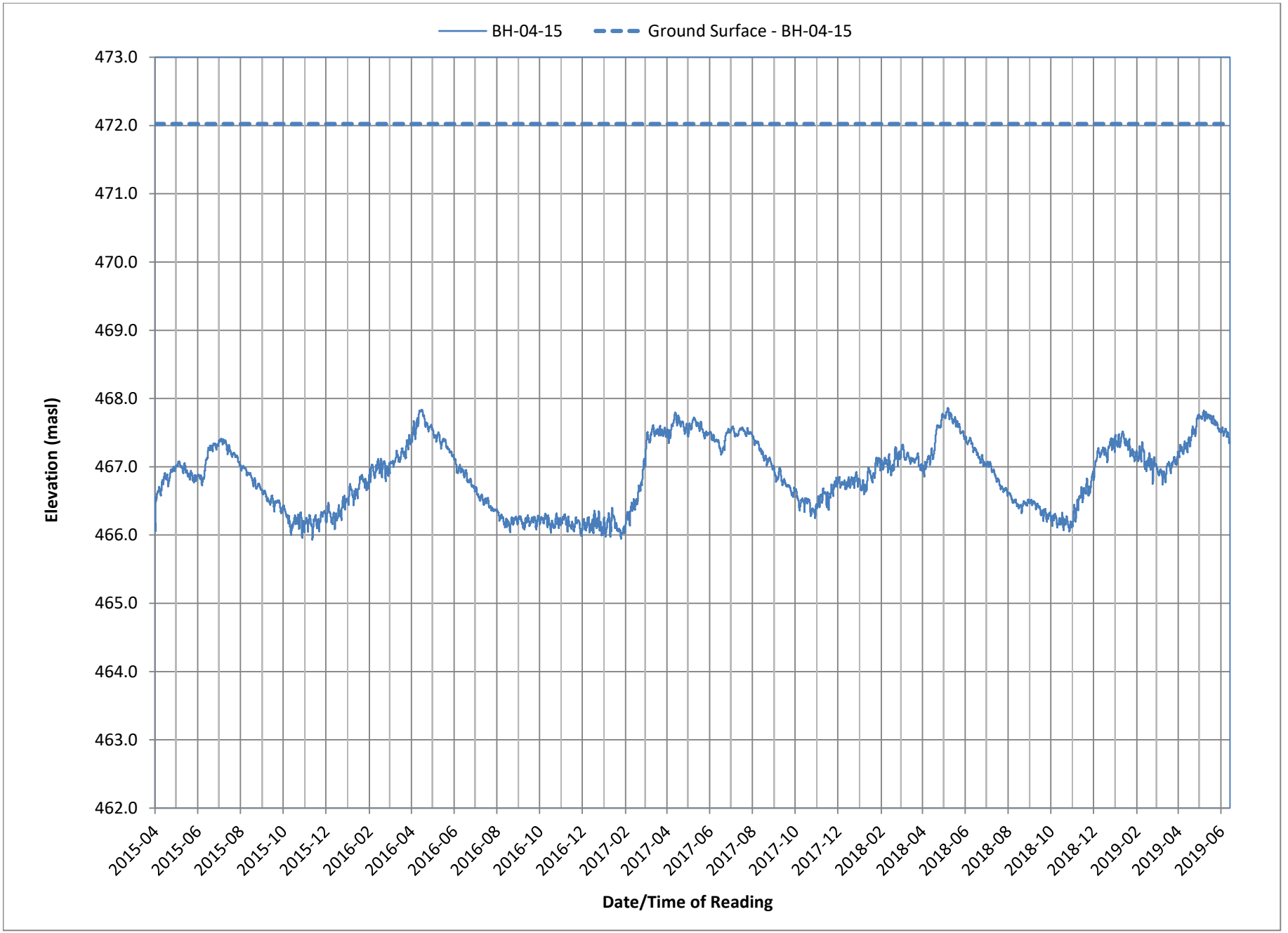
BH-04-15
Ground Surface - BH-04-15
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Elevation (masl)
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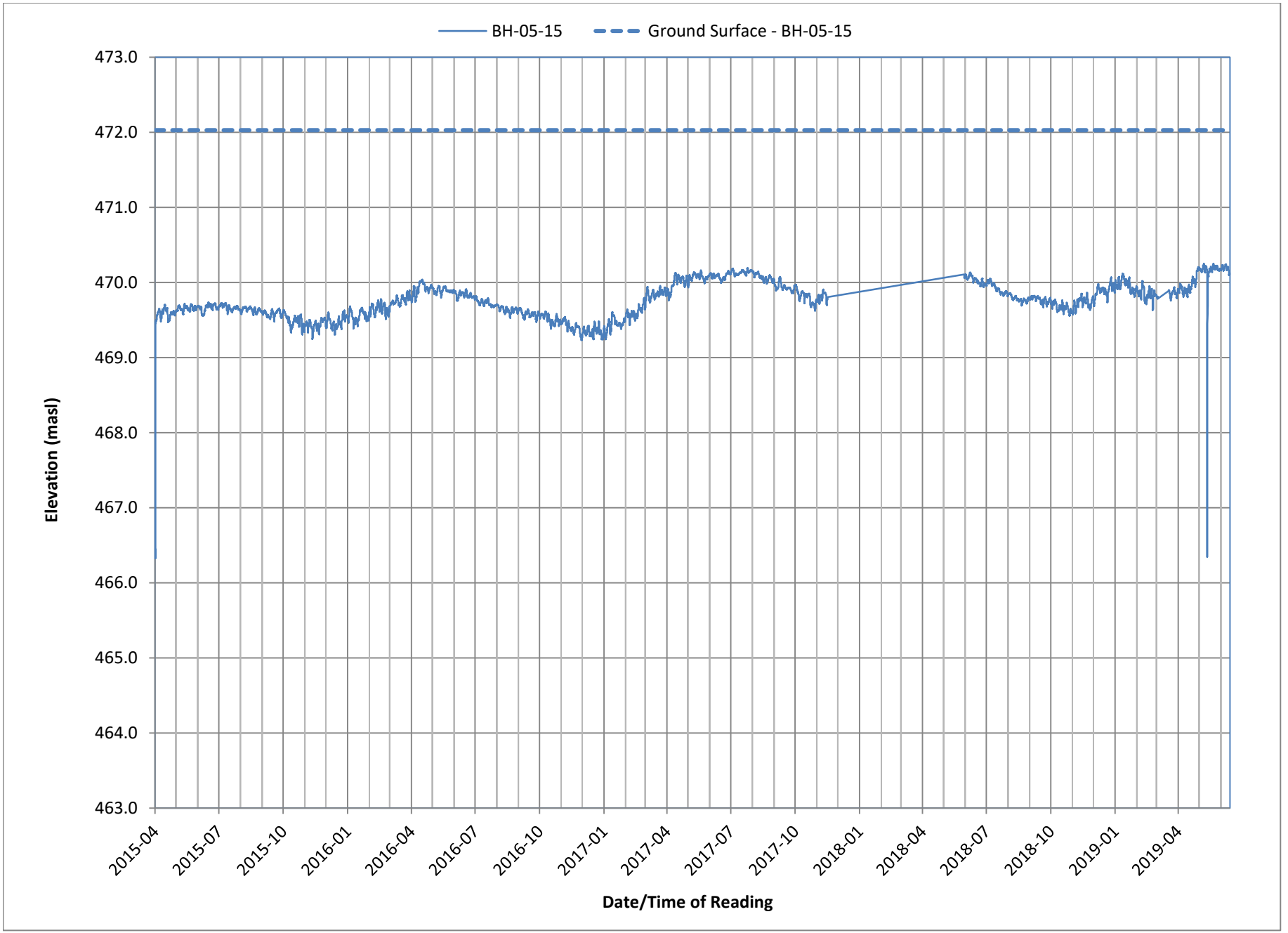
Date/Time of Reading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Ground Surface - BH-05-15
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Elevation (masl)
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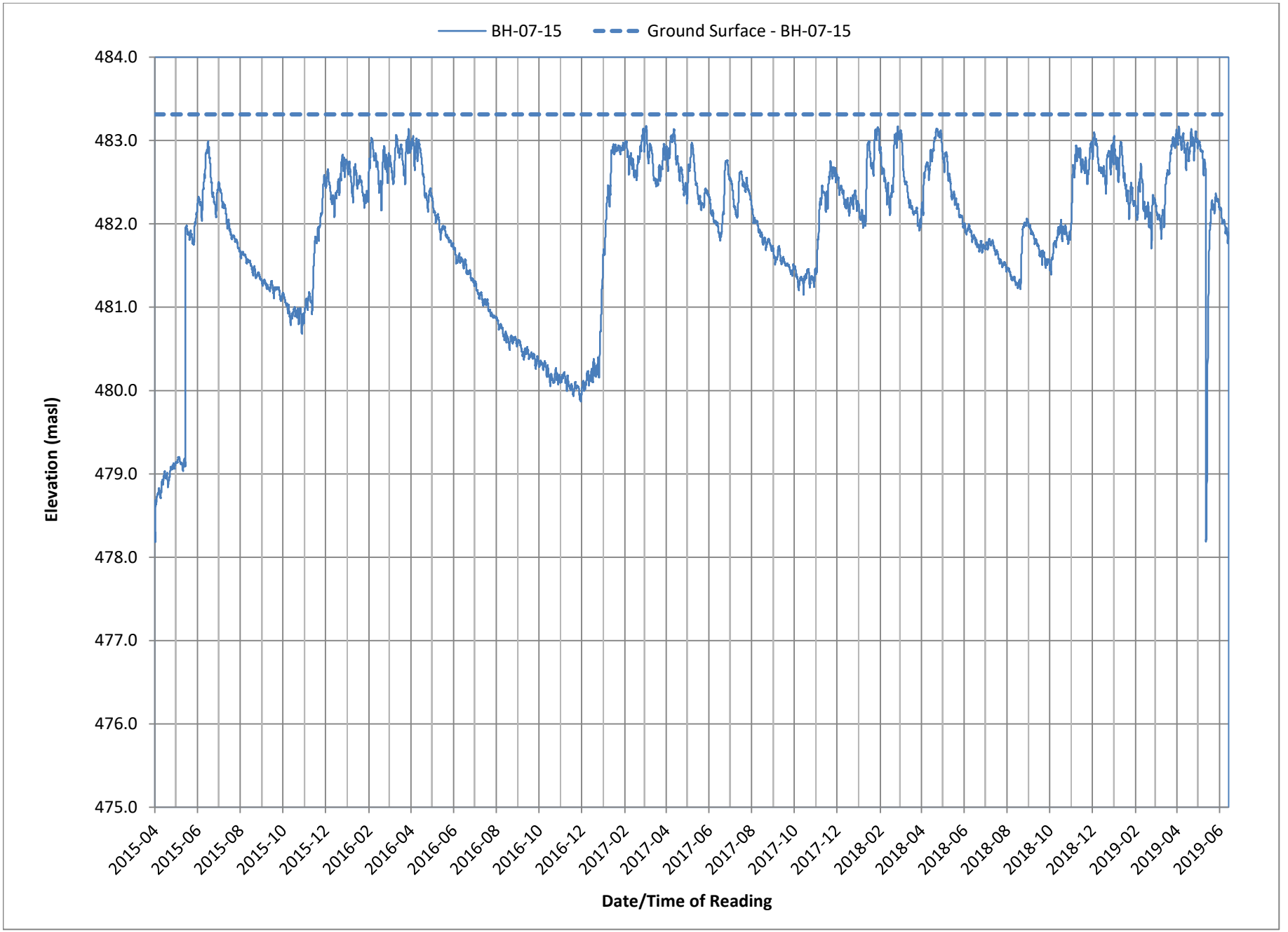
BH-07-15
Ground Surface - BH-07-15
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Elevation (masl)
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2019-06
Date/Time of Reading

APPENDIX F:
DOOR-TO-DOOR WELL SURVEY DOCUMENTS

June 10, 2019
Our File: 118073-2

Re: Proposed Residential Subdivision
Mayberry Hill Phase 3b and 4, Grand Valley, ON
Private Water Well Supply Survey

Dear Well Owner or Resident,

On behalf of Thomasfield Homes Ltd., GM BluePlan Engineering (GM BluePlan) are requesting you complete the attached survey regarding your private water supply. This information is being requested in order to support the municipal approvals process for a proposed residential subdivision that is proposed in the western portion of the settlement of Grand Valley (Parts of Lots 29 and 30, Concession 2 of the Geographic Township of Luther). The proposed subdivision will be municipally serviced for water and sewage and will include a stormwater management facility.

Information obtained from this local survey is requested to assess the potential for the proposed subdivision to influence the water quality in nearby water supply wells. We ask that you please complete the enclosed form, to the best of your ability, and return it to GM BluePlan using the self-addressed and postage-paid envelope enclosed.

We would appreciate if the enclosed questionnaire form is completed and returned by June 28, 2019. If you have any questions regarding the water supply survey, please contact Matthew Long at GM BluePlan, 519-824-8150 (extension 1274) or by e-mail at matt.long@gmblueplan.ca.

Personal information collected through this process will only be used by GM BluePlan for the assessment purposes stated above and may involve submission to municipalities (e.g. the County of Dufferin, Town of Grand Valley) or regulators (e.g. Ministry of the Environment, Conservation and Parks) for their review. By providing us with your personal information for the purposes listed above, you consent to our collection, use, and disclosure of the information or the above-mentioned purposes only. We will not collect, use, or disclose your personal information for any other purpose without your consent. You may refuse or withdraw your consent at any time by contacting the undersigned.

On behalf of Thomasfield Homes Ltd., we thank you for your consideration. Your co-operation and time are greatly appreciated.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED
Per:

Matthew Long, M.Eng., P.Eng.
Enclosed.

WELL USE QUESTIONNAIRE
for
WATER WELL INVENTORY

Project: Mayberry Hill Phase 3b and 4 **Project #:** 118073-2

Please complete these sections to the best of your ability.

Name of Well Owner: _____
Phone Number of Well Owner: _____
Lot/Concession: _____
Fire Number (if applicable): _____
Lived at this location since (YYYY/MM/DD): _____/____/____.

Well Usage

Do you use your well? Yes ☐ No ☐
Do you use your well for drinking water? Yes ☐ No ☐
Do you use your well for other purposes? _____

Has your well ever run dry? Yes ☐ No ☐
Has it run dry… Intermittently? ☐ Seasonally? ☐ Permanently? ☐
If so, please describe when and under what circumstances (i.e. time of day/year, uses/activities): _____

Water Quality

Has your well water ever been tested for quality? Yes ☐ No ☐
If yes, how often and when was the last time? _____
Were any water quality problems identified? Yes ☐ No ☐
If yes, please describe them: _____

Please describe the following aspects of your well water:
Appearance (colour, clarity) _____
Odour _____
Taste _____
Staining on Fixtures (colour, texture) _____

(CONTINUED ON REVERSE)

Well Construction Details

MOE Well ID _____ Well Tag No. _____

Type of Well: Dug ☐ or Drilled ☐

Bedrock ☐ or Overburden ☐

Depth to Water: _____ Depth to Bottom: _____

Well Diameter: _____ Casing Material: _____

Screen Depth: _____ Screen Length: _____

Elevation (m): _____ Casing Stickup (m) _____

UTM Coordinate (N): _____ UTM Coordinate (E): _____

Company Name/Date Drilled: _____

Visible Condition of Well:

Please provide a sketch of general well location here:

Well and Water Equipment

No pump ☐ Depth of Pump Intake: _____

Submersible pump ☐ Pumping Rate (gpm): _____

Jet (shallow) pump ☐ Storage Tank ☐ Size (gal): _____

Jet (deep) pump ☐ Pressure Tank ☐ Size (gal): _____

Piston pump ☐ Disinfection Unit ☐ Type: _____

Other type of pump: _____ Filter Unit ☐ Type: _____

Other Treatment: _____

Do you have a tap/faucet that is located before any/all treatment units? (i.e. produces raw water) ☐

Is that tap/faucet accessible? ☐

Other Comments _____

APPENDIX G:
CONSTRUCTION DEWATERING ESTIMATES

Hydrogeological Calculations for Dewatering Estimates

Project:	Mayberry Subdivision Phase 3b and 4		
Project Number:	118073-2	**Engineer/Technician:**	MRL

Description of Project: Residential subdivision featuring municipal servicing for storm, water and sanitary.

Greatest dewatering requirements expected from trenches for sewers.

Description of Conceptual Model for Dewatering Estimation:

Finite Trench Model
- Length of Trench (L) = 45 m
- Half-Width of Trench (r_w) = 1.5 m

Case 1: Unconfined Flow through Till Deposit
Assume:
- Hydraulic Conductivity (k) = 10^{-6} m/s (Dense Sandy Silt)
- Drawdown (H-h) = 6 m (maximum recorded groundwater level to 0.5 m below deepest service)
- Depth to "Base" (H) = 12 m (no "impermeable base" identified; select twice the drawdown)
- Sichart Equation to determine how far radius of influence extends beyond trench.

Case 2: Confined Flow through Intertill Sand and Gravel
Assume:
- Hydraulic Conductivity (k) = 10^{-5} m/s (Sand and Gravel with ~35% fines)
- Drawdown (H-h) = 3 m (maximum recorded groundwater level to base of sand and gravel e.g. BH-06-15)
- Aquifer Thickness = 2.3 m (e.g. BH-06-15)
- Jacob-Cooper to determine how far radius of influence extends beyond trench.

Hydrogeological Calculations for Dewatering Estimates

Project: Mayberry Subdivision Phase 3b and 4

Project Number: 118073-2 **Engineer/Technician:** MRL

Case 1: Unconfined Flow to Trench through Till Deposit

Radius of Influence

Sichart (Unconfined)

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

R_0 =	18	m (Radius of Influence)
H=	6	m (Initial Head)
h=	0	m (Head at Drawdown)
k=	1.00E-06	m/s (Hydraulic Conductivity)

Flow Calculation

Aquifer Type: Unconfined (Water Table)

Calculation Approach: Flow to Finite Trench

Governing Equation:

$$Q = \pi k \frac{(H^2 - h^2)}{ln\frac{R_o}{r_w}} + xk\frac{(H^2 - h^2)}{L}$$

Q=	5.95E-04	m^3/s (Dewatering Flow)
x=	45	m (Length of Trench)
k=	1.00E-06	m/s (Hydraulic Conductivity)
H=	12	m (Initial Head)
h=	6	m (Head at Drawdown)
L=	10.5	m (Distance to "Source")
R_0 =	19.5	m (Radius of Influence)
r_w=	1.5	m (Radius of Well or System)

Hydrogeological Calculations for Dewatering Estimates

Project: Mayberry Subdivision Phase 3b and 4

Project Number: 118073-2 **Engineer/Technician:** MRL

Case 2: Confined Flow to Trench through Intertill Sand and Gravel

Radius of Influence

Cooper-Jacob (Confined)

$$R_o = \sqrt{\frac{2.25kBt}{C_s}}$$

R_0 =	5.4	m (Radius of Influence)
k=	1.00E-05	m/s (Hydraulic Conductivity)
C_s =	0.1	(Storage Coefficient)
B=	1.5	m (Thickness of Aquifer)
t=	86400	s (Time, Duration of Pumping)

Flow Calculation

Aquifer Type: Confined

Calculation Approach: Flow to Finite Trench

Governing Equation:

$$Q = 2\pi k \frac{(\Delta H)}{ln\frac{R_o}{r_w}} + 2xkB\frac{(\Delta H)}{L}$$

Q=	1.60E-03	m^3/s (Dewatering Flow)
x=	45	m (Length of Trench)
k=	1.00E-05	m/s (Hydraulic Conductivity)
ΔH=	3	m (Drawdown)
B=	2.3	m (Thickness of Aquifer)
L=	4.2	m (Distance to "Source")
R_0 =	6.9	m (Radius of Influence)
r_w=	1.5	m (Radius of Well or System)

Daily Discharge Estimates

Case 1:	**52,000 L**
Case 2:	**139,000 L**
Superposition (Case 1 + Case 2):	**191,000 L**

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