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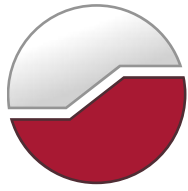
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**Hydrogeological Investigation,
Terrain Analysis & Impact
Assessment
Proposed Truck Repair Facility,
Badger Daylighting
3025 Carp Road
Ottawa, Ontario**

experience • knowledge • integrity



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GEMTEC

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Submitted to:

Argue Construction Ltd.
2900 Carp Road
Ottawa, Ontario
K0A 1L0

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Terrain Analysis & Impact
Assessment
Proposed Truck Repair Facility,
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July 23, 2020 – Rev 1
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1.0 INTRODUCTION

GEMTEC Consulting Engineers and Scientists Limited (GEMTEC) was retained by Argue Construction Ltd. (herein referred to as Argue) to carry out a hydrogeological investigation, terrain analysis and groundwater impact assessment in support of a proposed truck repair facility to be located at 3025 Carp Road in Ottawa, Ontario. The site location is provided on Figure 1, which is located following the text of this report.

The objectives of the investigation are the following:

- Confirm that the construction of any new well is in accordance with the Ministry of Environment, Conservation and Parks (MECP) requirements;
- Confirm that the quality of the well water meets the Ontario Drinking Water Standards and maximum treatable limits prescribed in MECP Procedure D-5-5;
- Confirm that the quantity of water meets the MECP requirements;
- Confirm that the septic impact assessment meets the MECP requirements; and,
- Complete a groundwater water balance.

2.0 SITE BACKGROUND

2.1 Project Description

Plans are being prepared to construct a truck repair facility for Badger Daylighting at 3025 Carp Road in Ottawa, Ontario. The proposed development includes a warehouse building with office space, access roadway, truck and office parking areas and a new water well and septic system. The building will consist of a slab on grade warehouse building with a footprint of about 875 square metres. Based on the plans provided, an area for a future building expansion is located on the northwest side of the proposed warehouse building. A copy of the most current site development plan is provided in the Appendix A.

The site is currently undeveloped with gravel access road and parking on the site and a pond on the west side of the site. The pond is associated with previous sand/gravel resource extraction; the depth of the pond is unknown. The total site area is 1.828 hectares.

2.2 Site Geology

Surficial geology maps (Ontario Geologic Survey, 2010) indicate that the site is underlain by nearshore marine sediments (sand, gravel, minor silt and clay) and stone-poor, sandy silt to silty sand-textured till overlying relatively shallow bedrock. Bedrock geology maps (Armstrong and Dodge, 2007) indicate that bedrock is comprised of interbedded limestone and shale of the Verulam formation at depths ranging between about 1 and 5 metres. Available karst mapping (Brunton and Dodge, 2008) does not indicate the presence of any inferred or potential karstic features.

2.3 Background Studies

A number of available background reports were reviewed as part of this investigation, including:

- “Carp Road Corridor, Community Design Plan” prepared by the City of Ottawa and dated June 2004 (Publication No. 3-08). This report is referred to herein as the “CDP Report”.
- “Carp Road Corridor, Groundwater Study” prepared by Dillon Consulting Limited and dated November 30, 2004 (ref: 04-3219). This report will herein be referred to as the “Groundwater Study Report”

Based on the background reports, Schedule 2 of the CDP Report indicates that a small portion of the site is located within an area of moderate recharge and the Groundwater Study Report prepared by Dillon (2004) indicates the majority of the site is located in moderate recharge areas and a small portion of the site is within the high groundwater recharge area.

2.4 Stormwater Management

A stormwater management report was prepared by D.B. Gray Engineering Inc., titled “Servicing Brief & Stormwater Management Report, 3025 Carp Road, Ottawa, Ontario, Report No. 19048” and dated November 18, 2019. Stormwater measures at the subject site will consist of grass swales leading to a retention pond (refer grading plan in Appendix A). All stormwater will be managed on-site and will be released into the existing pond located immediately to the west. The existing pond does not outlet to any ditches or watercourses. The report assessed stormwater quantity control for 5-year and 100-year storm events. The proposed stormwater management design is capable of capturing the 5-year (97.13 L/s) and 100-year (220.70 L/s) pre and post-development storm events.

2.5 Additional Studies Completed by GEMTEC

The studies completed by GEMTEC for the subject site include:

- “Geotechnical Investigation, Proposed Truck Repair Facility, Badger Daylighting, 3025 Carp Road, Ottawa, Ontario” dated November 11, 2019 (herein referred to as GEMTEC geotechnical investigation).
- “Phase One Environmental Site Assessment, Proposed Truck Repair Facility, Badger Daylighting, 3025 Carp Road, Ottawa, Ontario” dated November 5, 2019 (herein referred to as GEMTEC Phase One ESA).
- “Phase Two Environmental Site Assessment, Proposed Truck Repair Facility, Badger Daylighting, 3025 Carp Road, Ottawa, Ontario” dated November 8, 2019 (herein referred to as GEMTEC Phase Two ESA).

The relevant subsurface information from the geotechnical investigation is discussed in the terrain analysis section below. The GEMTEC Phase One and Phase Two ESAs identified one area of potential environmental concern associated with soil stockpiles of unknown origin on the site. The results of the GEMTEC Phase Two ESA identified one soil stockpile which exceeded the application site condition standards for benzo[a]pyrene and recommended that soil in the vicinity of the soil stockpile be disposed of at an approved landfill. No other areas of potential environmental concern were identified.

3.0 TERRAIN ANALYSIS

3.1 Subsurface Conditions

The subsurface conditions at the subject site are described in the geotechnical investigation completed by GEMTEC. The field work for the geotechnical investigation was carried out on September 6 and 12, 2019. Seven boreholes, numbered 19-1, 19-2, 19-3a, 19-3b, 19-4, 19-5, and 19-6 were advanced across the subject site; practical auger refusal was encountered at depths between about 0.3 and 3.3 metres below ground surface level. In addition, five test pits, numbered 19-1a, 19-1b, 19-2 to 19-5, inclusive, were advanced to practical excavation refusal at depths between about 1.0 and 2.4 metres below ground surface level. The results of the boreholes and test pits are provided on the Record of Borehole and Test Pit sheets in Appendix B. The locations of the test holes are shown on the Detailed Site Plan, Figure 2. The overburden thickness map is shown on Figure 3.

One well screen was sealed in the overburden at borehole 19-3b to measure the groundwater level. The groundwater conditions in the other test holes were observed on completion of drilling or excavating.

A summary of the soil conditions, based on the geotechnical investigation, are summarized below.

Fill Material

Fill material, having a thickness of between 0.4 and 1.8 metres, was encountered below the temporary road base at borehole 19-6 and at the ground surface at boreholes 19-1, 19-2, 19-3a, 19-3b, and 19-4 and test pits 19-1a, 19-1b, 19-2, 19-3, and 19-4. The composition of the fill material generally ranges from silty sand some gravel to sand and gravel some silt. The fill material also contains cobbles, boulders, organics, and wood, plastic, metal, and concrete pieces.

Silty Sand

At borehole 19-3b and test pits 19-1a, 19-1b, and 19-2, the fill material is underlain by a deposit of reddish brown to brown silty sand to sand with some silt. The silty sand to sand deposit has a thickness ranging from about 0.2 to 0.6 metres and extends to depths ranging from about 1.2 to 2.3 metres below ground surface (elevations of about 117.7 to 119.6 metres).

Glacial Till

A deposit of glacial till was encountered in boreholes 19-3b and 19-5. The glacial till deposit has a thickness of about 0.2 and 0.1 metres and extends to depths of about 2.4 and 0.3 metres below ground surface (elevation 117.8 and 120.0 metres) in boreholes 19-3b and 19-5, respectively. The glacial till can generally be described as grey brown silty sand with some gravel and probable cobbles and boulders.

Inferred Bedrock

Practical auger or excavator refusal occurred in all of the test holes between 0.3 and 3.3 metres below ground surface (elevation 116.2 to 118.4 metres). In borehole 19-3b, the upper 0.9 metres of the bedrock was weathered and was penetrated by the augers.

It should be noted that practical auger refusal can sometimes occur within cobbles and boulders and may not necessarily be representative of the upper surface of the bedrock.

3.2 Groundwater Levels

All of the test holes were dry upon completion of drilling or excavating. One well screen was installed in borehole 19-3b. The monitoring well was dry, at a depth of 2.44 metres below ground surface, as measured on September 24, 2019. The groundwater levels may be higher during wet periods of the year such as the early spring or following periods of precipitation.

Groundwater was not encountered within the overburden at the time of the investigation; however, groundwater levels may vary seasonally and/or following periods of significant precipitation. Based on the Carp Road Corridor Groundwater Study (Dillon, 2004), the general shallow groundwater flow direction along the Carp Road corridor is north to northeast, towards the Carp River. Shallow groundwater on-site may also be influenced by surface topography and bedrock topography. Based on the proximity of the pond located immediately adjacent to the developable area of the Site, shallow groundwater within the overburden may also flow southwest, towards the pond (Figure 1).

4.0 GROUNDWATER SUPPLY INVESTIGATION

4.1 Background Water Well Records

A search of the Ministry of Environment, Conservation and Parks (MECP) water well records (<https://www.ontario.ca/environment-and-energy/map-well-records>) returned 41 water well records within 500 metres of the subject site. The results of the well record search are provided in Appendix C. The well depths range from 10.4 to 152.4 metres below ground surface, with an average well depth of 46.6 metres. The recommended pumping rates provided by the well drillers range from 11.3 to 75.7 litres per minute, with an average of 28.9 litres per minute.

Of the 41 well records located within 500 metres of the site, 13 are located in the adjacent West Lake Estates residential subdivision. A review of the well construction details indicates that the majority of wells within the subdivision are completed into the limestone bedrock, with casings extended approximately 3 metres into bedrock.

4.2 On-Site Test Well Construction

A water supply well (TW19-1) was constructed at 3025 Carp Road on November 4, 2019, by a licensed MECP well contractor (Saunders Well Drilling; License No. 4879). The approximate location of the water well is provided on the Site Plan, Figure 1. A copy of the MECP Water Well Record and Certificate of Well Compliance is provided in Appendix C.

The construction details from the MECP Water Well Record are summarized in Table 1:

Table 1: On-Site Water Well Construction Details

Well Construction Details – Well ID A276750 (TW19-1)	
Depth to Bedrock	0 ⁽¹⁾ metres
Length of Well Casing	20.4 metres
Length of Well Casing Above Ground Surface	2.0 ⁽²⁾ metres
Length of Well Casing Below Ground Surface	18.4 metres
Length of Well Casing Set Into Bedrock	18.4 metres
Depth Water Found	Between 24.4 to 54.9 metres (hydrofracked)
Total Well Depth	54.9 metres
Overburden Description	-
Bedrock Description	Grey limestone

Note: 1. Access road to the test well was stripped to bedrock surface.

2. Well casing extended to 2.0 metres above ground surface to account for site re-grading.

The water well construction recommendations were provided to Saunders Well Drilling by GEMTEC. Due to the shallow bedrock conditions encountered on-site, ranging from 0 to 3.3 metres below ground surface, combined with the pond on-site, the well casing was extended from the minimum MECP requirements of 6 metres to at least 18.0 metres below ground surface. The

extended well casing recommendation is provided to reduce potential impacts from surface. The well was hydrofracked at the time of drilling due to insufficient water quantity.

4.3 Groundwater Quantity

A pumping test was carried out on the water well by a GEMTEC technologist on November 4, 2019. The well was pumped at a constant rate of 26.5 litres per minute for a period of six hours. The water from the pumping test was discharged to the ground surface approximately 10 metres away from the test well such that the discharge flow was away from the well head.

Water level and flow rate measurements were taken at regular intervals throughout the pumping test. Water levels were also taken during the recovery phase of the pumping test (after the pump was turned off). The pumping test drawdown and recovery graph is provided in Appendix D.

During the pumping test the water level decreased approximately 7.3 metres from a static water level of 4.40 metres below ground surface, following approximately 60 minutes of pumping. After 60 minutes, the water level gradually decreased an additional 0.5 metres throughout the remaining 5 hours of pumping. Frequent flow rate measurements confirmed that the pumping was maintained at a constant rate of 26.5 litres per minute. The pumping test withdrew approximately 9,540 litres.

The transmissivity of the water supply aquifer was estimated from the pumping test drawdown data using Aqtesolv (Version 4.5), a commercially available software program from HydroSOLVE Inc. An analysis of the pumping test and recovery data was carried out using the Cooper-Jacob and Theis recovery method of analyses. The results of the Aqtesolv analyses are provided in Appendix D.

The Cooper-Jacob and Theis recovery analyses indicate that the transmissivity of the water supply aquifer is calculated to be 1.6 m²/day and 1.1 m²/day respectively. The maximum drawdown in the water level of the well was approximately 7.6 metres following 6 hours of pumping at a flow rate of 26.5 litres per minute. Based on a static water level of 4.4 metres below ground surface, the total well depth of 54.9 metres and the water level after 6 hours of pumping, the remaining available drawdown in the well is approximately 42.9 metres.

4.4 Groundwater Quality

Water samples were collected by a GEMTEC technologist after three and six hours of pumping and were submitted to Paracel Laboratories, a CALA-certified laboratory, located in Ottawa for analysis of 'subdivision package' parameters. Copies of the laboratory certificates of analysis for the water samples are provided in Appendix E.

Field measurements were taken at regular intervals throughout the pumping test and are summarized in Appendix E.

The results of the laboratory analysis on the water samples are also summarized in Attachment D, along with the applicable standards, guidelines and objectives provided in the Ontario Drinking Water Quality Standards (ODWQS).

The following comments are provided regarding the drinking water quality and exceedances of the ODWQS:

Bacteriological Results

Total chlorine measurements at the time of bacteriological sampling confirmed that total chlorine concentrations in the groundwater were non-detectable.

The results of the bacteriological analysis of the November 4, 2019, water samples indicate that the water samples met all the standards of the ODWQS for bacteriological parameters. In addition, the concentration of other bacteria indicator species such as fecal coliform, were determined to be non-detectable in all of the water samples.

Based on the bacteriological testing, the water is suitable for consumption.

Chemical Results

The results of the chemical testing on the water samples indicate the operational guideline for hardness, the aesthetic objectives for colour, total dissolved solids (3-hour sample only) and the warning levels for sodium were exceeded in the water samples.

The above noted exceedances are discussed in the follow sections:

Hardness

The hardness of the water samples was reported to be 378 and 390 mg/L as CaCO_3 , which exceeds the ODWQS operational guideline for hardness. Water having a hardness above 100 milligrams per litre as CaCO_3 is often softened for domestic use. Water softeners are widely used throughout rural areas to treat hardness and there is no upper treatable limit for hardness. The ODQWS indicates that hardness levels exceeding 200 mg/L as CaCO_3 is considered poor but tolerable and hardness levels exceeding 500 mg/L as CaCO_3 is considered to be unacceptable for most domestic purposes.

Water softening by conventional sodium ion exchange water softeners that use sodium chloride may introduce relatively high concentrations of sodium into the drinking water, which may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium) could be considered as a means of keeping sodium concentrations in softened water at the background level. Alternatively, consideration could be given to providing a cold-water bypass water line for drinking water purposes that is not treated by a water softener.

Total Dissolved Solids

The total dissolved solids (TDS) concentrations decreased from 526 and 492 mg/L in the 3hr and 6hr samples respectively. The initial TDS concentration of 526 mg/L slightly exceeds the ODWQS aesthetic objective of 500 mg/L. Total dissolved solids refer to inorganic substances such as chloride, sulphates, calcium, magnesium, and bicarbonates that are dissolved in water.

Elevated levels of TDS can lead to problems associated with encrustation and corrosion. To determine the corrosive nature of the groundwater, the Langelier Saturation Index (LSI) was calculated for the samples obtained from the well. These values are based on the TDS, field measured temperature, pH, alkalinity, and calcium observed in the sample. A copy of the calculation to determine the LSI value is provided in Appendix E. The LSI was calculated to be 0.18 using field measured groundwater temperature of 9.13°C. This indicates that the water is slightly scale forming and corrosive.

Sodium

The sodium concentrations were reported to be 64.0 and 65.8 mg/L, which exceeds the ODWQS warning level of 20 mg/L for persons on sodium restricted diets. The sodium levels remain below the ODWQS aesthetic objective of 200 mg/L.

Colour

The colour level was reported to be 11 and 10 TCU, which exceeds the aesthetic objective of 5 TCU listed by the ODWQS. Elevated levels of colour can be associated with certain metals and organic substances in the water. The colour level is not within the maximum concentration considered reasonably treatable (7 TCU) provided in Table 3 of the MECP Guideline D-5-5.

However, it should be noted that colour may be affected by various factors to which the water sample would have been subjected from the time of sampling to the time of analysis. For example, iron concentrations, measured at 0.2 mg/L, can increase the laboratory turbidity measurements.

As such, field measurements of colour are considered to be more representative of the water being sampled. At the time of sampling, the field measured colour was 0 True Colour Units (TCU). The unfiltered colour (Actual Colour Unit; ACU) was measured to be 13 and 0 ACU in the 3-hour and 6-hour samples respectively.

Furthermore, given the absence of any elevated organic substances (e.g. dissolved organic carbon, nitrate, nitrite, tannins and lignins and organic nitrogen) exceeding the ODWQS, the elevated colour may be the result of iron and can be treated through removal of iron (e.g. manganese greensand treatment systems). As stated in Table 3 of the Appendix in the MECP Guideline D-5-5, higher iron-related colour (exceeding the maximum concentration considered reasonably treatable limit of 7 TCU) may be removed by manganese greensand treatment.

5.0 IMPACT ASSESSMENT

The impact on groundwater and surface water resources due to wastewater treatment and disposal by the onsite sewage disposal system on the subject site is assessed in the following sections.

It should be noted that the following information is provided for general guidance purposes only and that the septic system installed on the subject site should be designed using specific subsurface conditions at the location of the proposed septic system. In all cases, the septic system design must conform to the Ontario Building Code (OBC) requirements.

5.1 Hydrogeological Sensitivity

Areas of thin soils cover, fractured bedrock exposed at ground surface and karst environments contribute to hydrogeological sensitivity of the site, which may not allow for sufficient attenuative processes for on-site septic systems and negatively impact the receiving aquifer. Areas of thin soil cover, generally taken to be less than two metres, were encountered at the subject site and the overburden thickness is expected to range from 0 to 3.3 metres across the site (Figure 3). Karst mapping (Brunton and Dodge, 2008) does not indicate the presence of any inferred or potential karstic features and no karstic features were observed on-site.

Based on the MECP water well records in the vicinity of the subject site and the overburden thickness, the receiving aquifer for the septic effluent is the limestone bedrock aquifer. The groundwater samples from TW19-1 reported low background nitrate concentrations of 0.5 mg/L. Protective measures such as a clay liner beneath the septic system, increased well casing and increased separation distance between well and septic is anticipated to reduce potential impacts from septic effluent.

5.2 Groundwater Impacts

5.2.1 On-Site Septic

The potential risk to groundwater resources on and off the subject site was assessed in accordance with Ministry of Environment Procedure D-5-4: Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment. To evaluate the groundwater impacts, lot size considerations as well as nitrate dilution calculations for commercial properties outlined in MECP D-5-4 were followed.

The proposed development area of 1.828 hectares is greater than 1.0 hectares, which is assumed to be sufficient to reduce nitrate concentrations to an acceptable level through attenuative processes, according to MECP Procedure D-5-4. However, the hydrogeologically sensitive terrain identified on-site may reduce nitrate attenuation. As such, the risks of individual on-site septic systems will be assessed using nitrate-nitrogen contaminant loading.

The maximum allowable concentration of nitrate in the groundwater at the boundaries of the subject property is 10 milligrams per litre as per the Ministry of the Environment, Conservation and Parks' guideline D-5-4, dated August 1996.

The nitrate concentration at the site boundaries was calculated using the following information:

- Subject site area of 1.828 hectares (refer to Lot Development Plan, Appendix A);
- Water holding capacity of soils (WHC) based on information obtained from Table 3.1 of the Ministry of Environment Stormwater Management Planning and Design Manual, dated March 2003;
- Post-Development water holding capacity;
 - 75 mm: Urban lawns, fine sandy-loam.
- An annual water surplus of 0.379 metres/year (post-development) for soils with a water holding capacity of 75 mm (average of Ottawa Airport and Carleton Place data, Environment Canada Water Surplus Datasets, attached in Appendix F);
 - Ottawa International Airport (1939-2013), 75 mm WHC - surplus of 0.378 metres/yr.
 - Carleton Place (1984-2006), 75 mm WHC - surplus of 0.381 metres/yr.
- It is noted that the overburden soils are approximately equal to or greater than 1.0 metres in thickness in the location of urban lawns (Figure 3) and the Thornthwaite and Mather water surplus calculations are considered to be applicable. Areas of thin overburden (less than 1 metre) are generally within the building footprint and gravel parking area.
- Post-Development hard surface area of approximately 51%; and,
 - Building footprint (6.5%) and gravel parking lot (44.5%).
- The use of advanced treatment systems in the construction of the septic systems at the commercial lot, capable of reducing the concentration of nitrate in the effluent exiting the treatment unit to a maximum of 20 mg/L (this concentration value was utilized when re-simplifying the formula provided in D-5-4 for the purpose of determining the factor used to determine the maximum allowable flow for each lot from the determined available infiltration volume. The factor becomes 1 versus 3 as is the case without advanced treatment).

The septic flow for the commercial lot is based on information provided in Section 5.6.3 of Guideline D-5-4, the Carp Road Corridor Nitrate Impact Assessment Recommendations memo dated September 27, 2016 and the MOE SWM Planning and Design Manual, dated March 2003. Based on the nitrate impact assessment for commercial properties, the allowable daily design sanitary sewage flow (DDSSF) for the proposed commercial lot is 5,315 litres per day. The calculations and assumptions of this are provided in Appendix F. For comparison purposes, the calculated maximum septic flow, assuming all runoff is captured and infiltrated, is 13,287 litres per day.

Based on information provided to us (maximum number of employees, site use, building size, etc.) and the DDSSF provided in Table 8.2.1.3.B of the Ontario Building Code (2012), the average DDSSF is calculated to be 3,700 litres per day. This calculation assumes that the maximum number of full-time employees in the office and working within the truck repair facility is 12 and the warehouse/truck repair facility has 2 washrooms and 6 loading bay doors. The DDSSF based on the building code of 3,700 litres per day is within the allowable flow of 5,315 litres per day based on the D-5-4 nitrate impact assessment.

5.2.2 Septic Impacts to Neighbouring Properties

The proposed on-site septic system is located in the northwest portion of the subject site, adjacent to two residential properties along Carp Road - 3037 and 3047 Carp Road (Figure 1). The well construction details for the properties are unknown; however, based on the thin overburden thickness, it is anticipated that the bedrock aquifer is being utilized as the water supply aquifer. The proposed on-site septic system is located approximately 15 metres from the property boundary (Site and Landscaping Plan, Appendix A) and the two residential dwellings are located approximately 22 and 37 metres from the property line. The locations of the private water wells have not been confirmed; however, they are assumed to be located in close proximity to the dwellings. The separation distance between the on-site septic and neighbouring water wells (3037 and 3047 Carp Road) are expected to be at least 30 metres.

The Carp Road Corridor Groundwater Study (Dillon, 2004) indicates shallow groundwater flow direction is north to northeast, towards the Carp River. Given the two residential properties along Carp Road are located immediately downgradient of the proposed on-site septic, additional protective measures are recommended to promote on-site attenuation and reduce the risks to neighbouring well users. The additional recommended protective measures include the use of a clay liner beneath the septic system, to be sloped towards the southwest such that septic effluent is directed towards the pond and away from residential properties along Carp Road (Figure 1).

Based on the nitrate impact assessment for commercial properties in combination with additional protective measures, nitrate impacts to neighbouring water well users are not anticipated.

5.3 Background Nitrate Conditions

To further evaluate the potential risk of septic effluent on the water supply aquifer, the background water quality in the receiving bedrock aquifer was assessed. Water samples were collected on November 4, 2019 from TW19-1 reported a nitrate concentration of 0.5 mg/L. The background nitrate concentrations are attributed to previous agricultural practices which occurred on the subject site and neighbouring on-site septic systems.

6.0 WATER BALANCE

The subject site is located within an area of low to moderate groundwater recharge area based on available Carp Road Corridor studies (City of Ottawa, 2004 and Dillon, 2004). Pre and post-

development water budgets were calculated for the subject site in order to assess the groundwater impact of the proposed development.

6.1 Water Balance Method

The water balance of the site was assessed, based on the following equation:

$$\text{Mean Annual Precipitation} - \text{Change in Groundwater Storage} - \text{Evapotranspiration} = \text{Runoff} + \text{Infiltration}$$

where:

- Mean annual precipitation is based on data provided by Environment Canada, from the Ottawa Int A weather station for the period of 1939-2013 and Carleton Place – Appleton weather stations for the period of 1984-2006. The Ottawa Intl A and Carleton-Place – Appleton weather station are located approximately 26 and 38 kilometres from the subject site respectively.
- Long term changes to groundwater storage are assumed to be negligible. Short term or seasonal changes are anticipated to balance out (e.g. increased groundwater recharge following spring freshet, followed by dry conditions in the summer months).
- Evapotranspiration is calculated based on the Thornthwaite and Mather (1955) model, run by Environment Canada. The technical documentation provided by Environment Canada is titled “Water Balance Tabulations for Canadian Climate Stations”, written by K. Johnstone and P.Y.T. Louie, Hydrometeorology Division, Canadian Climate Centre, Atmospheric Environmental Services (undated).

The hydrologic factors used to estimate infiltration, such as topography, soil, cover and water holding capacities are based on the Ministry of Environment (MOE) Stormwater Management Planning and Design Manual Section 3.0 (MOE, 2003) and the Ministry of the Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (MOEE, 1995).

6.2 Pre-Development

The subject site is currently vacant, with no structures and soil conditions consist of silty sand to sand and gravel fill material from the previous sand and gravel extraction. The site is vegetated with grasses and shrubs, along with trees lining the northern portion of the site. The subject site is generally flat, with a steep slope in the immediate vicinity of the pond located immediately west of the site. Based on the site characteristics, the infiltration factor is estimated to be 0.70, based on the following:

- Topography factor of 0.2 – rolling land with an average slope between 2.8 m to 3.8m /km;

- The site is generally flat, with steep topography in the immediate vicinity of the pond.
- Soil factor of 0.4 – open sandy loam; and,
 - On-site soils characterized as silty sand to sand and gravel fill (high permeability).
- Cover factor of 0.1 – Cultivated land.
 - The site consists of fill material and short grasses.

An estimated water holding capacity of 150 mm was selected from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003). The site vegetation is classified as pasture and shrubs underlain by fine sandy loam.

6.3 Post-Development

The post-development conditions at the subject site will consist of 599.76 and 279.48 m² buildings, an approximate gravel parking area of 8,437 m² and the remaining vegetated areas are anticipated to be landscaped (refer to Site and Landscaping Plan, Appendix A). Based on the anticipated post-development site characteristics, there are no changes to the estimated infiltration factor for vegetated areas, which remains to be 0.70. The infiltration for the proposed building and gravel parking area (51% coverage) is considered to be impervious and the infiltration factor is 0. Landscaping of the existing soils may change the water holding capacity and the post-development water holding capacity is expected to be 75 mm, selected from Table 3.1 of the MOE Stormwater Management Planning and Design Manual (MOE, 2003). The post-development site vegetation will be classified as urban lawn underlain by fine sand.

6.4 Water Balance Summary

Based on the water balance calculations, the annual infiltration volumes will decrease from 4,261 m³ to 2,263 m³ and the runoff will increase from 1,826 m³ to 7,766 m³ post-development. The hydrologic factors and the water balance calculations are provided in Appendix G. The pre and post-development infiltration and runoff factors are summarized in Table 2.

Table 2: Water Balance Summary

	Infiltration (mm/year)	Runoff (mm/year)	Infiltration (m3/year)	Runoff (m3/year)
Pre-Development	233	100	4,261	1,826
Post-Development ¹	124	425	2,263	7,766

	Infiltration (mm/year)	Runoff (mm/year)	Infiltration (m3/year)	Runoff (m3/year)
Change	-109	-325	1,998	-5,940

Notes: 1. Weighted averages based on area (refer to Appendix F).

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Based on the results of this investigation, the following conclusions are provided:

- The surficial soils encountered at the subject site consist of silty sand and sand and gravel fill material, ranging in thickness from 0.3 to 3.3 metres below ground surface. The site is considered to be hydrogeologically sensitive and protective measures are recommended to minimize potential impacts to the water supply aquifer.
- The test well is capable of providing at least 9,540 litres per day, which is greater than the anticipated maximum water demand of 5,315 litres (equivalent to the maximum daily design septic flows). The maximum drawdown in the water level of the well was approximately 7.6 metres following 6 hours of pumping at a flow rate of 26.5 litres per minute. Based on a static water level of 4.4 metres below ground surface, the total well depth of 54.9 metres and the water level after 6 hours of pumping, the remaining available drawdown in the well is approximately 42.9 metres.
- The groundwater quality exceeds the ODWQS for the operational guideline for hardness, the aesthetic objectives for total dissolved solids (3-hour sample only), colour and the warning levels for sodium.
- The subject site is considered to be hydrogeologically sensitive due to thin soils encountered on-site. The on-site test well (TW19-1) casing extends 18.3 metres into bedrock as a protective measure. Background nitrates in the water supply aquifer was measured to be 0.5 mg/L.
- The maximum allowable daily design sanitary sewage flows (DDSSF) is calculated to be 5,315 litres per day, assuming the use of an advanced treatment septic system. The maximum DDSSF is greater than the anticipated average DDSSF of 3,700 litres per day, based on:
 - 12 employees utilizing the office space (75 litres/employee x 12 employees = 900 litres).

- Warehouse with two washrooms (950 litres per washroom x 2 washrooms and 150 litres per loading bay door x 6 loading bay doors = 2,800 litres).
- Based on the water budget calculations, the annual infiltration volumes will decrease from 4,261 m³ to 2,263 m³ and the runoff will increase from 1,826 m³ to 7,766 m³ post-development. The subject site is located within a low to moderate groundwater recharge zone based on Carp Road Corridor studies (City of Ottawa, 2004 and Dillon, 2004) and post-development infiltration should be maintained in order to maintain recharge to the bedrock aquifer.
- Low impact development (LID) and stormwater management measures will be required in order to maintain pre-development infiltration rates.

7.2 Recommendations

Based on the results of this investigation, the following water supply, septic system and groundwater impact mitigation measures recommendations are provided:

Water Supply Recommendations

- It is recommended that the property owners construct, maintain and test their drinking water well in accordance with the Ministry of the Environment and Climate Change document “Water Supply Wells - Requirements and Best Management Practices, Revised April 2015”.
- The use of earth energy systems shall not be permitted.
- Groundwater quality treatment may be utilized to treat the following ODWQS exceedances:
 - Hardness – Hardness levels in TW19-1 were greater than the operational guideline for hardness and can be treated using a water softening by conventional sodium ion exchange water softeners that use sodium chloride may introduce relatively high concentrations of sodium into the drinking water, which may be of concern to persons on a sodium restricted diet. The use of potassium chloride in the water softener (which adds potassium to the water instead of sodium) could be considered as a means of keeping sodium concentrations in softened water at the background level. Alternatively, consideration could be given to providing a cold-water bypass water line for drinking water purposes that is not treated by a water softener
 - Colour – Colour exceeded the maximum reasonably treatable concentration of 7 TCU; however, it is anticipated that through iron treatment, iron-related colour will decrease to within the ODWQS.
 - Sodium - Sodium concentrations in the raw water supply exceed the ODWQS warning level for persons on sodium restricted diets and the local Medical Officer of Health should be notified.

Septic System Recommendations

- The proposed development will be serviced by advanced treatment septic sewage disposal system that achieve a minimum of 50% reduction in nitrogen, approved under the Ontario Building Code, prior to the effluent being disposed to a Class IV leaching bed (Type A or Type B). The advanced treatment septic system is recommended to be BNQ certified. A site-specific investigation should be conducted on each lot for the design of the septic system;
- It is required that the property owners enter a maintenance agreement with authorized agents of the advanced treatment septic system manufacturer for the service life of the system;
- The maximum daily design sewage flows are calculated to be 5,315 litres per day;
- Septic system separation distance from the on-site test well (TW19-1) should be at least 30 metres in order to provide additional protective measures due to hydrogeologically sensitive terrain.
 - Based on current Site and Landscaping Plan provided in Appendix A, the separation distance between on-site septic and water well is 76.50 metres.
 - Septic system separation distances from neighbouring water well users should also be maximized, with a minimum separation distance of 30 metres.
- It is recommended that a minimum 150-millimetre-thick clay seal be placed between the bedrock and the imported septic sand;
 - The clay seal should further be utilized to direct septic effluent towards the on-site stormwater retention pond (Site and Landscaping Plan, Appendix A) and away from residential properties along Carp Road.
- It is recommended that the property owners construct, maintain and check their onsite septic system in accordance with the Ontario Building Code.

Groundwater Impact Mitigation Recommendations

- Low Impact Development (LID) and stormwater management measures are recommended to maintain pre-development infiltration rates of 253 mm/year. The post-development infiltration rates are calculated to be 124 mm/year.
- The post-development water balance indicates significant increase in runoff, which may be diverted to the grass swales and the stormwater retention pond. The stormwater management report indicates that the grass swales and retention pond will remove 80% TSS. Potential impacts from contaminant sources include winter maintenance (road salting) and fuel spills from the repair shop. It is recommended that BMP for road salting and fuel storage/spills be followed.

- It is recommended that the best management practices for the application of road salts should follow the City of Ottawa's "Material Application Policy, Revision 3.2, October 31, 2011" Salt Management Plan.
- It is recommended that the best management practices for fuel storage follow the Liquid Fuels Handling Code and the Ontario Water Resources Act.
- It is recommended that best management practices be implemented for waste treatment.
- It is recommended that a spills prevention and management plan be prepared to protect the vulnerable aquifer which is used as a drinking water source for adjacent developments.

8.0 LIMITATIONS OF REPORT

This report was prepared for Argue Construction Ltd. and is intended for the exclusive use of Argue Construction Ltd.. This report may not be relied upon by any other person or entity without the express written consent of GEMTEC and Argue Construction Ltd.. Nothing in this report is intended to provide a legal opinion.

The investigation undertaken by GEMTEC with respect to this report and any conclusions or recommendations made in this report reflect the best judgments of GEMTEC based on the site conditions observed during the investigations undertaken at the date(s) identified in the report and on the information available at the time the report was prepared. This report has been prepared for the application noted and it is based, in part, on visual observations made at the site, subsurface investigations at discrete locations and depths and laboratory analyses of specific chemical parameters and material during a specific time interval, all as described in the report. Unless otherwise stated, the findings contained in this report cannot be extrapolated or extended to previous or future site conditions, portions of the site that were unavailable for direct investigation, subsurface locations on the site that were not investigated directly, or chemical parameters, materials or analysis which were not addressed.

Should new information become available during future work, including excavations, borings or other studies, GEMTEC should be requested to review the information and, if necessary, re-assess the conclusions presented herein.

We trust that this report is sufficient for your purposes. If you have any questions or require additional information, please call.



Andrius Paznekas, M.Sc., P.Geo.
Hydrogeologist

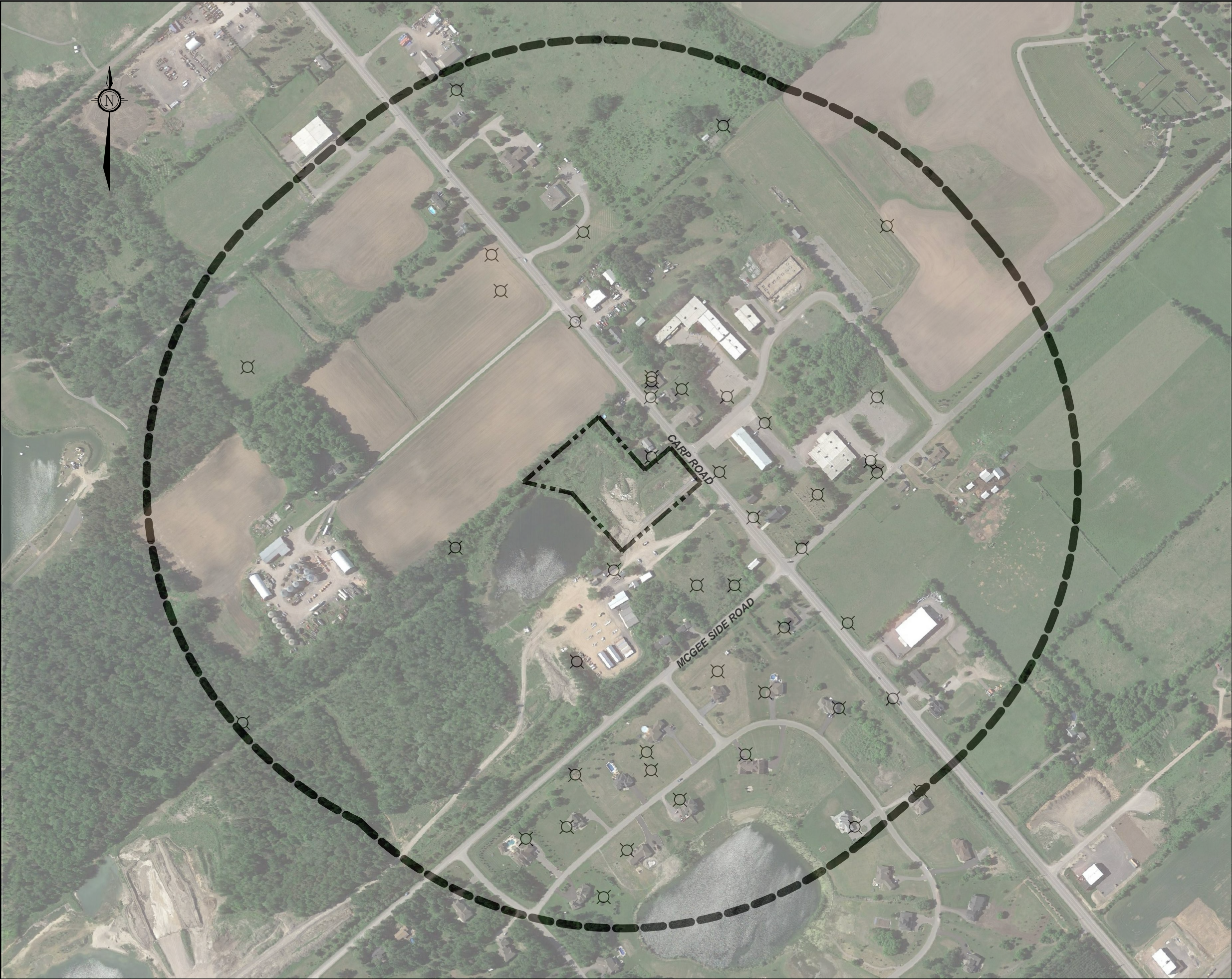


Shaun Pelkey, M.Sc.E., P.Eng.
Principal, Environmental Engineer



9.0 REFERENCES

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LEGEND

----- PROPERTY BOUNDARY

----- STUDY AREA, 500m BUFFER AROUND PROPERTY BOUNDARY

⊗ MECP WELL LOCATION

Scale 1:5000

0 100 200 300m



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Drawing

SITE PLAN

Client

ARGUE CONSTRUCTION LTD.

Project	61730.61	HYDROGEOLOGICAL INVESTIGATION 3025 CARP ROAD OTTAWA, ONTARIO
Drwn by	P.C.	
Chkd by	A.P.	

Date	JULY 2020	Rev.	1	FIGURE 1
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LEGEND

PROPERTY BOUNDARY

PROPOSED GRAVEL PARKING AREA

BOREHOLE LOCATION IN PLAN
(current investigation by GEMTEC)

TEST PIT LOCATION IN PLAN
(current investigation by GEMTEC)

BH/TP #

TEST HOLE ID

XX.XX

GROUND SURFACE ELEVATION, IN METRES
GEODETIC DATUM

TEST WELL LOCATION IN PLAN
(current investigation by GEMTEC)

Scale 1:750

0

15

30

45m

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DETAILED SITE PLAN

Client
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Project
61730.61

Drwn by
P.C.

Chkd by
A.P.

Date
JULY 2020

HYDROGEOLOGICAL
INVESTIGATION
3025 CARP ROAD
OTTAWA, ONTARIO

Rev.
1


FIGURE 2



LEGEND
- - - - - PROPERTY BOUNDARY

1.5 OVERBURDEN THICKNESS CONTOURS
(0.5 METRE INTERVALS)

Scale 1:750
0 15 30 45m

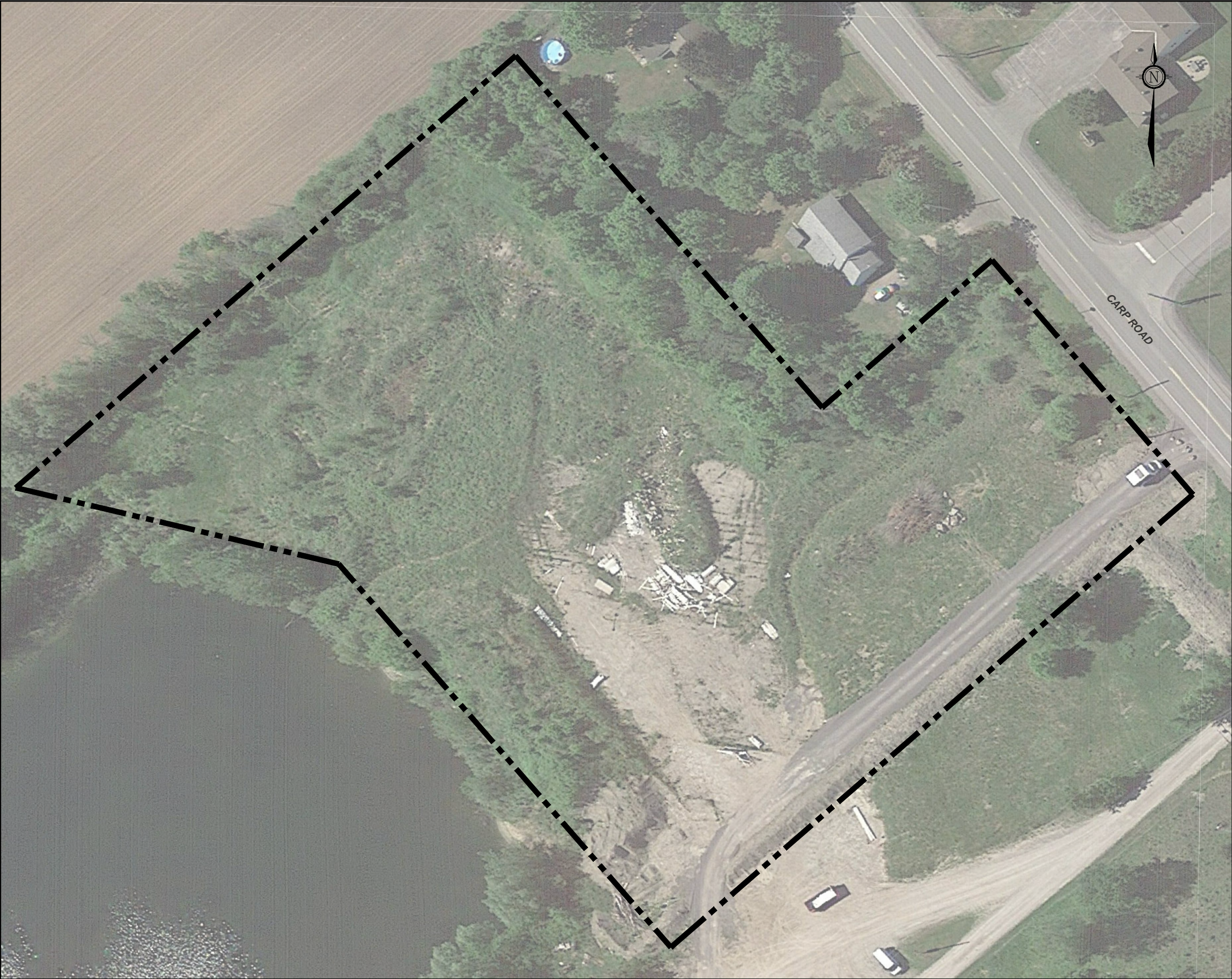
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Drawing
OVERBURDEN THICKNESS MAP

Client
ARGUE CONSTRUCTION LTD.

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Drwn by P.C.		
Chkd by A.P.	Date JULY 2020	Rev. 1

FIGURE 3



LEGEND

----- PROPERTY BOUNDARY

1.5 OVERBURDEN THICKNESS CONTOURS
(0.5 METRE INTERVALS)

Scale 1:750

0 15 30 45m



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Drawing
PRE-DEVELOPMENT CONDITIONS

Client
ARGUE CONSTRUCTION LTD.


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Drwn by P.C.	
Chkd by A.P.	

Date JULY 2020	Rev. 1	FIGURE 4
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LEGEND
- - - - - PROPERTY BOUNDARY
- - - - - PROPOSED GRAVEL PARKING AREA

Scale 1:750
0 15 30 45m

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Drawing
POST-DEVELOPMENT CONDITIONS

Client
ARGUE CONSTRUCTION LTD.

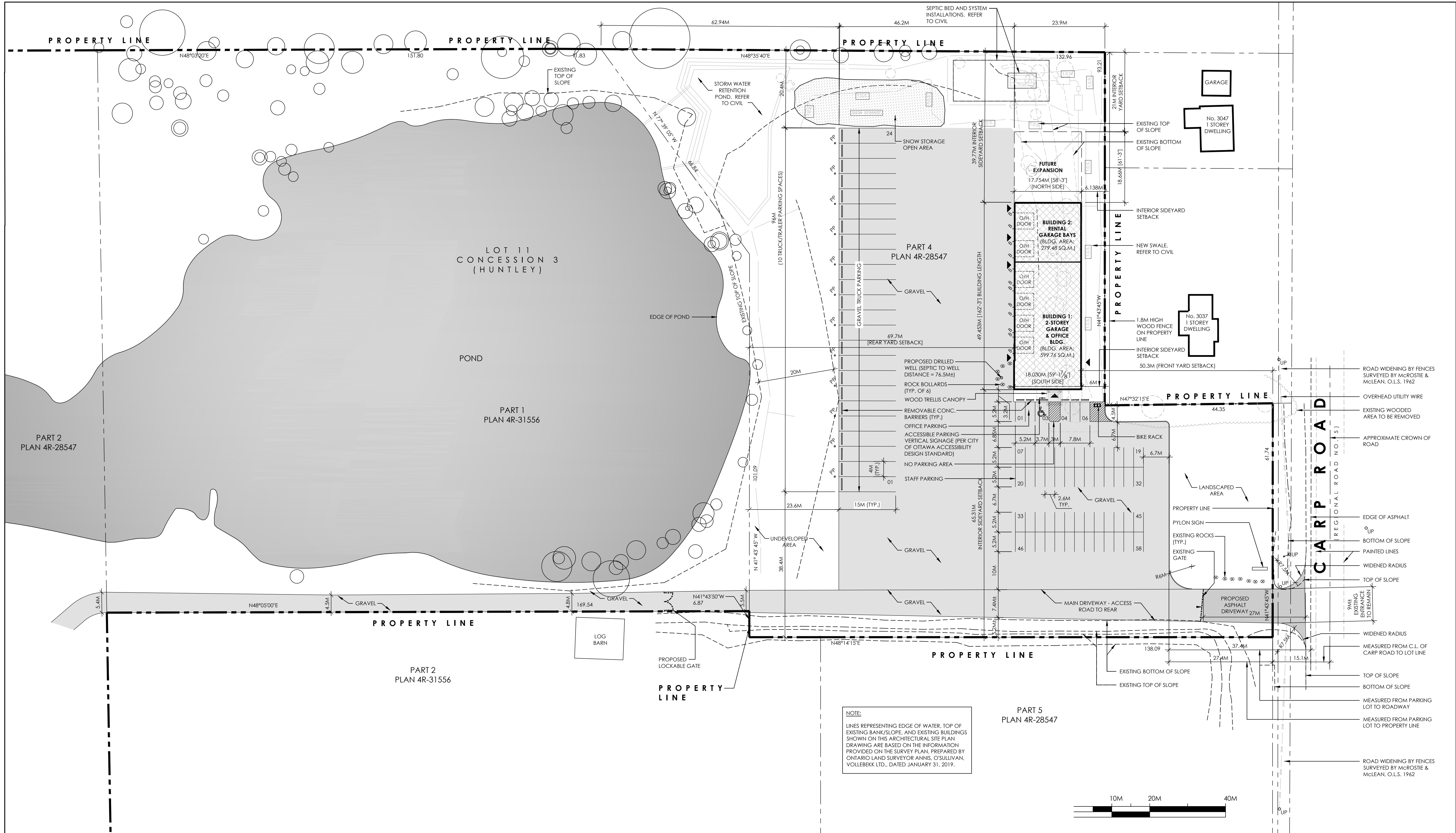
Project 61730.61		HYDROGEOLOGICAL INVESTIGATION 3025 CARP ROAD OTTAWA, ONTARIO
Drwn by P.C.	Chkd by A.P.	
Date JULY 2020	Rev. 1	

FIGURE 5

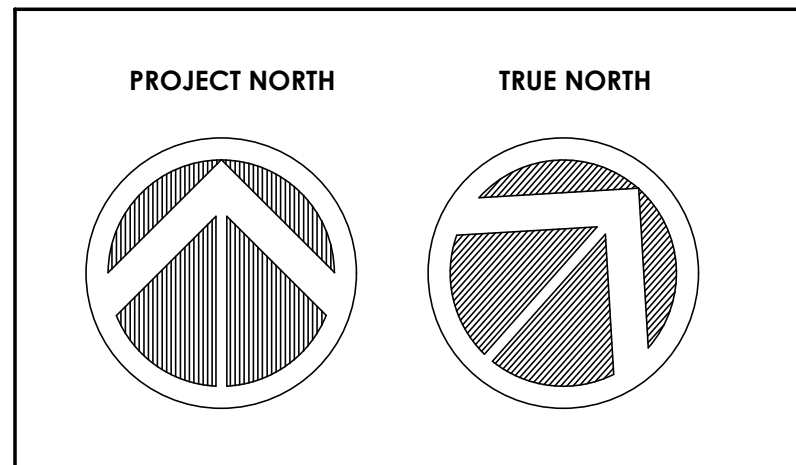


APPENDIX A

Lot Development Plan



1 SITE & LANDSPACE PLAN
A1.0 SCALE 1:500



ZONING DATA (BASED ON ZONING BY-LAW 2008-250)						
<div><div>Municipal Address:</div><div>3025 Carp Road, Ottawa, Ontario</div><div>Legal Description:</div><div>Part of Lot 11, Concession 3, Geographic Township of Huntley, City of Ottawa</div><div>Zoning Designation:</div><div>Rural Commercial Zone; Carp Road Corridor (RC9); Area D - Rural</div><div>Site Area: 1,828 Ha [18,281.3 Sq.M.]</div><div>Building Area:</div><div><div>• Building 1: 599.76 Sq.M.</div><div>• Building 2: 279.48 Sq.M.</div><div>• Total Buildings Gross Area: 879.24 Sq.M.</div></div><div>Lot Coverage: [879.24/18281.3] x 100 = 4.81%</div><div>Gross Floor Area (Principal Use Bldg.):</div><div><div>• First Floor Area: 879.24 Sq.M.</div><div>• Second Floor Area: 138.31 Sq.M.</div><div>• Total GFA: 1,017.55 Sq.M.</div></div></div>	RC9 ZONING PROVISIONS			LOADING SPACES REQUIREMENTS		
	ZONING MECHANISM	REQUIRED	PROVIDED	USE	REQUIRED	PROVIDED
	FRONT YARD SET BACK	10M (min.)	50.3M	REPAIR GARAGE	1	24 SPACES
	REAR YARD SET BACK	10M (min.)	70.1M	(739.59 Sq.M.)		
	INTERIOR SIDE YARD SET BACK	6M ABUTTING RESIDENTIAL/3M OTHERS (min.)	6M	OFFICE (277.96 Sq.M.)	0	0
	PRINCIPAL BUILDING HEIGHT	11M (max.)	8.5M±	ACCESSIBLE PARKING STALL PROVISIONS		
	LOT COVERAGE	25% (max.)	4.81%	REQUIRED	PROVIDED	
	PARKING REQUIREMENTS	Repair Garage: (Table 101 - Row N41) 0.75/100 Sq.M. GFA (739.59 Sq.M./100) X 0.75 = 5.6 parking spaces		2.4M WIDE + 1.5M WIDE ACCESS AISLE (min.)	3.7M (W) + 3M (W) ACCESS AISLE	
		Office: (Table 101 - Row N59) 2.4/100 Sq.M. GFA (277.96 Sq.M./100) X 2.4 = 6.7 parking spaces		AISLE AND DRIVEWAY PROVISIONS		
		Total: 5.6 + 6.4 = (12.3) 13 spaces		REQUIRED	PROVIDED	
				6.7M (min.) FOR DOUBLE TRAFFIC LANE	VARIES	
				SETBACK FROM WATERCOURSES PROVISIONS		
				REQUIRED	PROVIDED	
	DISABLED PARKING SPACES	1 Parking Space	58 Spaces	30M FROM HIGH WATER MARK/15M FROM T.O. BANK	30M SETBACK FROM T.O. BANK	
	BICYCLE PARKING SPACES	2 Parking Spaces	1 Space			
			2 Spaces			

LEGEND			
---	PROPERTY LINE	±	EXISTING LIGHT STANDARD
	OUTLINE OF NEW BUILDING	±	PROPOSED TRUCK POWER PLUG/BOLLARD
	OUTLINE OF ASPHALT AREA	±	PROPOSED PAINTED GALVANIZED STEEL BOLLARD
	OUTLINE OF GRAVEL AREA	° UP	EXISTING UTILITY POLE
	OUTLINE OF LANDSCAPED AREA		
	OUTLINE OF STORAGE YARD DESIGNATED FOR SNOW STORAGE		



- GENERAL NOTES**
- CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE AND SHALL REPORT ANY DISCREPANCIES TO THE ARCHITECT PRIOR TO COMMENCEMENT OF WORK.
 - CONTRACTOR MUST COMPLY WITH ALL CODES AND BYLAWS AND OTHER REGULATIONS BY AUTHORITIES HAVING JURISDICTION OVER THE WORK.
 - DO NOT SCALE THIS DRAWING.
 - THIS DRAWING MAY NOT BE USED FOR CONSTRUCTION UNLESS SEALED/SIGNED BY THE ARCHITECT.
 - COPYRIGHT OF THIS DRAWINGS IS RESERVED.

SURVEY PLAN DISCLAIMER

THIS ARCHITECTURAL SITE PLAN DRAWING IS PREPARED BASED ON A SURVEY PLAN PROVIDED TO A+ ARCHITECTURE INC. OF EXISTING LAND FEATURES, INCLUDING BUT NOT LIMITED TO, EXISTING LEGAL BOUNDARIES, LOT LINES, GRADES, TOPOGRAPHY, VEGETATION ETC., SHOWN ON THIS DRAWING FOR COORDINATION PURPOSES ONLY AND ARE BASED ON THE SURVEY PLAN PREPARED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD., ONTARIO LAND SURVEYOR, DATED JANUARY 31, 2019.

THE AFOREMENTIONED SURVEY PLAN WAS INCORPORATED INTO THE ARCHITECTURAL SITE PLAN DRAWING, AS PROVIDED TO A+ ARCHITECTURE INC., WITH NO ALTERATIONS WHATSOEVER. A+ ARCHITECTURE INC. SHALL NOT BE HELD LIABLE AS TO THE ACCURACY OF THE INFORMATION PROVIDED ON THE SURVEY PLAN.

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THE ARCHITECT SHALL ASSUME NO LIABILITY, WHATSOEVER, FOR THE SUITABILITY OF THE SELECTED TREES, PLANTING SPECIFICATIONS, NOR FOR THE RECOMMENDED WATERING AND MAINTENANCE PROCEDURES. THE CONSTRUCTION MANAGER SHALL RETAIN THE SERVICES OF A PROFESSIONAL AND EXPERIENCED LANDSCAPER FOR THE INSPECTION AND APPROVAL OF THE PLANTING PROCESS AND TO PROVIDE A FOLLOW UP INSPECTION IN THE FOLLOWING CALENDAR YEAR UPON COMPLETION OF CONSTRUCTION.

00	ISSUED FOR SITE PLAN APPROVAL	2019/11/13
NO.	ISSUE	DATE (YY/MM/DD)
REVISIONS		

ORIENTATION	SEAL
-------------	------

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BADGER DAYLIGHTING
EQUIPMENT STORAGE AND
OFFICE BUILDING
3025 CARP ROAD, OTTAWA, ON

DRAWING TITLE		
SITE & LANDSCAPE PLAN		
DRAWN BY	A.A.	DRAWING NO.
REVIEWED BY	A.A.	A1.0
START DATE	2019/08/06	
PROJECT NO.	19011	REVISION NO.
		00



APPENDIX B

Record of Borehole and Test Pit Sheets

RECORD OF BOREHOLE 19-1

CLIENT: Argue Construction Ltd
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 6 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				● PENETRATION RESISTANCE (N), BLOWS/0.3m ▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH (Cu), kPa + NATURAL ⊕ REMOULDED WATER CONTENT, % W_p — W — W_L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m				
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		120.27								
		Compact, dark to grey brown silt, sand, gravel, organics (FILL MATERIAL)										
		Compact, grey brown silty sand some gravel (Possible Fill)		119.94 0.33	1	SS	406	11	●			
		Very dense, grey brown silty sand to sandy silt (Possible Fill)		119.46 0.81	2	SS	76	50 for 127 mm				
1		Auger refusal. End of borehole.		119.33 0.94								
2												
3												

No groundwater inflow observed at the time of drilling.

RECORD OF BOREHOLE 19-2

CLIENT: Argue Construction Ltd
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 6 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				PENETRATION RESISTANCE (N), BLOWS/0.3m												ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	SHEAR STRENGTH (Cu), kPa													
				DEPTH (m)					WATER CONTENT, %													
									10 20 30 40 50 60 70 80 90													
0	Power Auger	Ground Surface		120.74																		
	Hollow Stem Auger (210mm OD)	Very dense, dark to grey brown silt, sand, gravel, organics (FILL MATERIAL)		120.59	1	SS	229	63 for 76 mm														
		Very dense, grey brown silty sand, some gravel (Possible Fill).		0.15																		
		Auger refusal. End of borehole.		120.31																		
				0.43																		
1																						
2																						
3																						

No groundwater inflow observed at the time of drilling.

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Sep 6 2019

GEO - BOREHOLE LOG 6173061.GPJ GEMTEC 2018.GDT 10-24-19

SHEET: 1 OF 1
DATUM: CGVD28
BORING DATE: Sep 6 2019

GEO - BOREHOLE LOG 6173061.GPJ GEMTEC 2018.GDT 10-24-19

RECORD OF BOREHOLE 19-4

CLIENT: Argue Construction Ltd
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 6 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				PENETRATION RESISTANCE (N), BLOWS/0.3m		SHEAR STRENGTH (Cu), kPa		ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV.	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m	▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	WATER CONTENT, %				
				DEPTH (m)						W _p	W	W _L		
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		120.41										
		Dark to grey brown silt, sand, gravel, organics (FILL MATERIAL)		120.33 0.08										
		Compact to very dense, brown silty sand, some gravel (Possible Fill)			1	SS	200	13						
					2	SS	100	50 for 100 mm						
1		Auger refusal. End of borehole.		119.44 0.97										

No groundwater inflow observed at the time of drilling.

RECORD OF BOREHOLE 19-5

CLIENT: Argue Construction Ltd
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 6 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				● PENETRATION RESISTANCE (N), BLOWS/0.3m ▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH (Cu), kPa + NATURAL ⊕ REMOULDED WATER CONTENT, % W _p — W — W _L										ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m													
0	Power Auger	Ground Surface		120.30																	
		Grey crushed sand and gravel, trace silt. (BASE/SUBBASE MATERIAL)			1	SS	200	57 for	229 mm												
	Hollow Stem Auger (210mm OD)	Grey brown silty sand, some gravel (GLACIAL TILL).		120.02																	
		Auger refusal. End of borehole.		0.28																	
				0.33																	
1																					
2																					
3																					

No groundwater
inflow observed
at the time of
drilling.

RECORD OF BOREHOLE 19-6

CLIENT: Argue Construction Ltd
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 6 2019

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE			SAMPLES				● PENETRATION RESISTANCE (N), BLOWS/0.3m ▲ DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m	SHEAR STRENGTH (Cu), kPa + NATURAL ⊕ REMOULDED		WATER CONTENT, % W _p — W — W _L	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	RECOVERY, mm	BLOWS/0.3m						
0	Power Auger Hollow Stem Auger (210mm OD)	Ground Surface		120.60										
		Grey crushed sand and gravel, trace silt (temporary road base)			1	SS	355	60						
		Grey brown silty sand to sandy silt (FILL MATERIAL)		120.07 0.53 120.00 0.60										
1		Compact, grey brown silty sand, some gravel and organics (FILL MATERIAL)			2	SS	508	21						
		Auger refusal. End of borehole.		119.20 1.40										
2														
3														

No groundwater inflow observed at the time of drilling.

RECORD OF TEST PIT 19-1a

CLIENT: Argue Construction Ltd.
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 12 2019

DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED	WATER CONTENT, %		ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)				W _p	W _L		
0	Ground Surface		120.1							
1	Dark brown to brown sand and gravel, some silt, cobbles, boulders, wood pieces and concrete (FILL MATERIAL)		118.3							
2	Red brown to brown SILTY SAND		117.7							
3	Refusal on inferred bedrock		2.4							
4										
5										
6										
7										
8										
9										
10										

No groundwater inflow observed at time of excavation.

RECORD OF TEST PIT 19-1b

CLIENT: Argue Construction Ltd.
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 12 2019

DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA										WATER CONTENT, %				ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)			+ NATURAL					⊕ REMOULDED					Wp — W — Wl					
						10	20	30	40	50	60	70	80	90							
0	Ground Surface		120.1																		
	Dark brown to brown sand and gravel, some silt, cobbles, boulders, wood pieces and concrete (FILL MATERIAL)																				
1																					

No groundwater inflow observed at time of excavation.

RECORD OF TEST PIT 19-2

CLIENT: Argue Construction Ltd.
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 12 2019

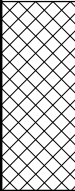
DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED										WATER CONTENT, % w _p — w — w _L			ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)			10	20	30	40	50	60	70	80	90						
0	Ground Surface		120.8																	
	Dark brown to brown silty sand, some gravel, cobbles, boulders, wood pieces, and concrete (FILL MATERIAL)																			
1			119.8																	
	Red brown SILTY SAND		1.0																	
	Refusal on inferred bedrock		119.6																	
			1.2																	
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				

No groundwater inflow observed at time of excavation.

RECORD OF TEST PIT 19-3

CLIENT: Argue Construction Ltd.
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 12 2019


DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPA + NATURAL ⊕ REMOULDED WATER CONTENT, % w_p — w — w_L	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
0	Ground Surface		120.7					
	Dark brown to brown sand and gravel, some silt, cobbles, boulders, wood pieces, and concrete (FILL MATERIAL)							
1			119.5					
	Refusal on inferred bedrock		1.3					
2								
3								
4								
5								
6								
7								
8								
9								
10								

No groundwater inflow observed at time of excavation.

RECORD OF TEST PIT 19-4

CLIENT: Argue Construction Ltd.
 PROJECT: Geotechnical Investigation, 3025 Carp Road, Ottawa, ON
 JOB#: 61730.61
 LOCATION: See Figure 1, Site Plan

SHEET: 1 OF 1
 DATUM: CGVD28
 BORING DATE: Sep 12 2019

DEPTH SCALE METRES	SOIL PROFILE			SAMPLE NUMBER	SAMPLE TYPE	SHEAR STRENGTH (Cu), kPa + NATURAL ⊕ REMOULDED WATER CONTENT, % w_p — w — w_L	ADDITIONAL LAB. TESTING	WATER LEVEL IN OPEN TEST PIT OR STANDPIPE INSTALLATION
	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)					
0	Ground Surface		120.6					
	Dark brown to brown sand and gravel, some silt, cobbles, boulders, concrete, plastic, and steel (FILL MATERIAL)							
1	Refusal on inferred bedrock		119.6 1.0					
2								
3								
4								
5								
6								
7								
8								
9								
10								

No groundwater inflow observed at time of excavation.



APPENDIX C

TW19-1 Water Well Record and Certificate of Well Compliance

&

Well Record Summary

Measurements recorded in: ☐ Metric ☒ Imperial

A276750

Page of

Well Owner's Information

First Name	Last Name / Organization		E-mail Address		<input type="checkbox"/> Well Constructed by Well Owner	
	1614791 ONT. INC					
Mailing Address (Street Number/Name)		Municipality	Province	Postal Code	Telephone No. (inc. area code)	
2650 CARP RD.		OTTAWA		K0A1L0		

Well Location

Address of Well Location (Street Number/Name) 3025 CARP RD			Township HUNTLEY/OTTAWA		Lot	Concession	
County/District/Municipality OTTAWA			City/Town/Village CARP		Province Ontario		Postal Code
UTM Coordinates NAD 8 3 18421596 5018418			Municipal Plan and Sublot Number		Other		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

[illegible]

Annular Space

Depth Set at (m/ft)		Type of Sealant Used	Volume Placed
From	To	(Material and Type)	(m ³ /yd ³)
0	60 1/2	BENTONITE GROUT.	0.896

Method of Construction

<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input checked="" type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input checked="" type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning	
<input checked="" type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial		
<input type="checkbox"/> Other, <i>specify</i> _____		<input type="checkbox"/> Other, <i>specify</i> _____		

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		<input checked="" type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Quantity
			From	To	
6 1/4 6	STEEL OPEN HOLE	0.188	0+6 1/2 60 1/2	60 1/2 180	

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		<input type="checkbox"/> Abandoned; Poor Water Quality <input type="checkbox"/> Abandoned, other, <i>specify</i> _____ <input type="checkbox"/> Other, <i>specify</i> _____
			From	To	

Water Details

Water found at Depth <u>80 - 180</u> (m) <input checked="" type="checkbox"/> Gas	Kind of Water: <input type="checkbox"/> Fresh <input checked="" type="checkbox"/> Untested <u>HYDRO FRACK</u> <input type="checkbox"/> Other, specify _____	Depth (m/ft) From To	Diameter (cm/in)
Water found at Depth (m/ft) <input type="checkbox"/> Gas	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Other, specify _____	0 60 $\frac{1}{2}$	9 $\frac{3}{4}$ "
Water found at Depth (m/ft) <input type="checkbox"/> Gas	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Other, specify _____	60 $\frac{1}{2}$ 180	6"

Well Contractor and Well Technician Information

Business Name of Well Contractor SAUNDERS WELL DRILLING LTD		Well Contractor's Licence No. 4879	
Business Address (Street Number/Name) 1680 SCHEEL DR		Municipality BRAESIDE	
Province ONT	Postal Code K0A1G0	Business E-mail Address	
Bus. Telephone No. (inc. area code) 613 623 5648		Name of Well Technician (Last Name, First Name) SAUNDERS TROY	
Well Technician's Licence No. T517	Signature of Technician and/or Contractor Troy Saunders	Date Submitted 2019/12/04	

Results of Well Yield Testing

After test of well yield, water was:		Draw Down		Recovery	
<input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify <u>CLEAR</u>		Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:		Static Level	15.21		
		1	21.91	1	40.12
Pump intake set at (m/ft)		2	23.84	2	32.34
Pumping rate (l/min / GPM)		3	25.25	3	26.99
Duration of pumping		4	27.03	4	23.91
6 hrs + 0 min		5	28.40	5	22.17
Final water level end of pumping (m/ft)		10	32.73	10	17.61
If flowing give rate (l/min / GPM)		15	35.13	15	16.56
Recommended pump depth (m/ft)		20	36.54	20	16.33
Recommended pump rate (l/min / GPM)		25	37.36	25	16.20
Well production (l/min / GPM)		30	37.92	30	15.90
Disinfected?		40	38.57	40	
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		50	38.84	50	
		60	38.97	60	

Map of Well Location

Please provide a map below following instructions on the back.

A hand-drawn diagram showing a rectangular area. Inside the rectangle is an 'x' mark. To the right of the rectangle is a vertical line, and to the right of that is the text 'CARD RD.' and an arrow pointing upwards labeled 'N'.

Comments:

Well owner's information package delivered	Date Package Delivered	Ministry Use Only Audit No. 318973 Received
	2019/1/18 Date Work Completed 2019/1/04	

CERTIFICATE OF WELL COMPLIANCE

I, TROY SAUNDERS DO HEREBY CERTIFY that I am licensed to drill water wells in the Province of Ontario, and that I have supervised the drilling of a well on the property of 1614791 (Name of Landowner), located at 3025 CARP RD (Legal Description, Lot / Plan No.) in the City of Ottawa.

I CERTIFY FURTHER that, I am aware of well drilling requirements, the guidelines, recommendations and regulations of the Ministry of the Environment governing well installations in the Province of Ontario, and the standards specified in any subdivision agreement and hydrogeological report applicable to this site and Township Standards:

AND DO HEREBY CERTIFY THAT the said well has been drilled, cased, grouted (cement or bentonite) and constructed in strict conformity with the standards required.

SIGNED this 13th day of NOVEMBER, 2019.

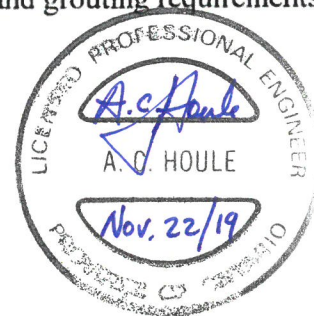
Troy Saunders / SAUNDERS WELL DRILLING LTD
Well Driller / Company

The Engineer on behalf of the landowner set out above CERTIFIES that he/she has inspected the well and it was constructed in accordance with the specifications in O.Reg.903, ^{and} this report ~~and the Hydrogeological Report~~ with regards to casing length and grouting requirements.

SIGNED this 22 day of November, 2019.

Engineer

A.C. Houle, P.Eng.
Gemtec



Well Tag # A 276750

MECP Water Well Record Summary
500 metre radius 3025 Carp Road, Ottawa, Ontario

Well ID	Well Tag # (since 2003)	Audit #	Contractor Lic#	Well Depth (m)	Well Yield (Litres per minute)	Date of Completion (MM/DD/YYYY)
1503064	N/A	N/A	4832	54.9	18.9	03/18/1960
1503065	N/A	N/A	4825	36.6	18.9	04/30/1962
1503068	N/A	N/A	4833	30.5	18.9	05/03/1961
1503069	N/A	N/A	4825	39.6	18.9	05/23/1962
1503070	N/A	N/A	4806	32	18.9	06/05/1964
1503123	N/A	N/A	4833	37.8	26.5	12/05/1959
1503124	N/A	N/A	4833	30.8	18.9	09/28/1961
1503125	N/A	N/A	4825	38.7	18.9	05/05/1962
1503126	N/A	N/A	4806	32.9	18.9	09/03/1964
1503127	N/A	N/A	4824	24.7	11.3	03/15/1966
1510221	N/A	N/A	4847	33.8	18.9	05/10/1969
1510511	N/A	N/A	4806	36.9	37.8	07/24/1969
1511759	N/A	N/A	3644	42.4	18.9	05/03/1972
1511921	N/A	N/A	1558	43	18.9	05/06/1972
1512118	N/A	N/A	1558	38.1	18.9	10/06/1972
1512382	N/A	N/A	4806	39.3	22.7	09/18/1968
1514608	N/A	N/A	3503	24.4	-	10/18/1972
1516282	N/A	N/A	1365	15.2	37.8	08/16/1977
1516579	N/A	N/A	3644	19.5	18.9	06/27/1978
1517377	N/A	N/A	3644	25.6	15.1	10/30/1980
1517526	N/A	N/A	1558	45.7	18.9	10/22/1980
1517781	N/A	N/A	1558	90.8	18.9	09/30/1981
1517897	N/A	N/A	3504	39	37.8	06/24/1982
1519074	N/A	N/A	1558	79.2	18.9	06/05/1984
1519233	N/A	N/A	3142	21.3	26.5	09/14/1984
1524587	N/A	84307	5222	11.3	22.7	N/A
1536296	A035418	Z39257	1558	37.5	-	02/14/2006
7050820	A049703	Z60149	1119	152.4	26.5	08/31/2007
7123248	A076799	Z095326	1558	42.7	45.5	03/25/2009
7132598	A089342	Z102713	1119	73.2	56.8	10/06/2009
7139851	A076883	Z101735	1558	49.4	45.5	10/02/2009
7151500	A102298	Z115581	1558	70.4	45.5	07/26/2010
7156095	A102342	Z115626	1558	29.9	45.5	10/05/2010
7162182	A105577	Z119816	1119	99.1	30.2	03/14/2011
7165287	A113197	Z119868	1119	91.4	30.2	05/16/2011
7170957	A102437	Z135444	1558	83.2	45.5	08/02/2011
7173853	A105339	Z137113	1119	36.6	75.7	11/10/2011
7187451	A119626	Z139757	1558	75.6	36.4	04/19/2012
7193278	A130166	Z153945	1844	10.4	-	10/24/2012
7257727	A192653	Z218222	6574	70.4	37.8	10/14/2015
7266948	A204317	Z232615	1517	22.9	37.8	06/20/2016
min				10.4	11.3	
max				152.4	75.7	
average				46.6	28.9	



APPENDIX D

Pumping Test Data



GEMTEC

CONSULTING ENGINEERS
AND SCIENTISTS

Pumping Test Analysis Report

Project: Hydrogeological Investigation

Project Number: 61730.61

Client: Argue Construction Ltd.

Location: 3025 Carp Road, Ottawa, Ontario

Test Conducted by: CS

Pumping Well: TW19-1

P-Test Date: Nov 4, 2019

Analysis Performed by: AP

Method: Manual Measurements

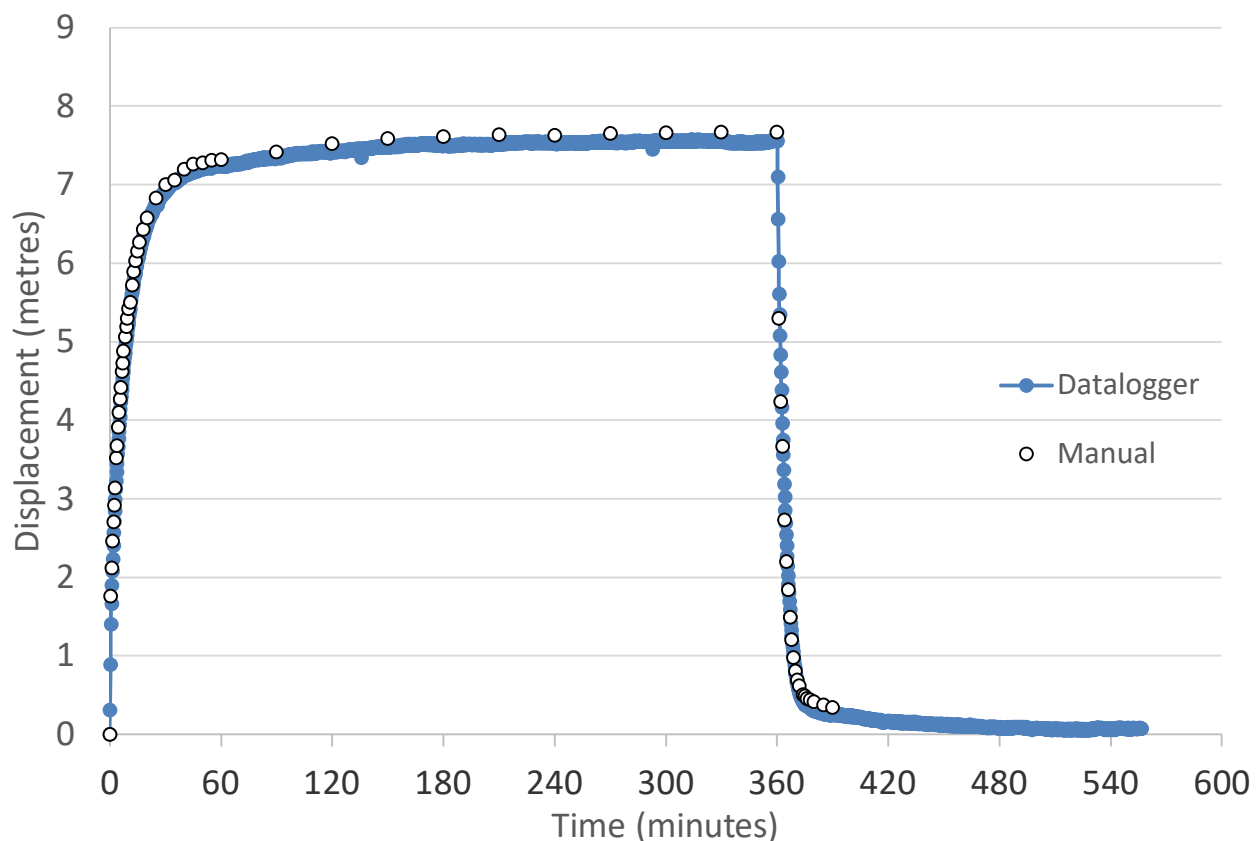
Analysis Date: Nov 13, 2019

Aquifer Thickness: 48 m

Discharge: Constant 26.5 L/min

Duration: 6 hours

Pumping Test Data (TW19-1): Drawdown and Recovery



Water Levels TW19-1

Static : 4.41 m bgs

End of pump test (6-hours): 12.08 m

Following recovery (2-hours): 4.41 m



GEMTEC

CONSULTING ENGINEERS
AND SCIENTISTS

Pumping Test Analysis Report

Project: Hydrogeological Investigation

Project Number: 61730.61

Client: Argue Construction Ltd.

Location: 3025 Carp Road, Ottawa, Ontario

Test Conducted by: CS

Pumping Well: TW19-1

P-Test Date: Nov 4, 2019

Analysis Performed by: AP

Method: Cooper-Jacob

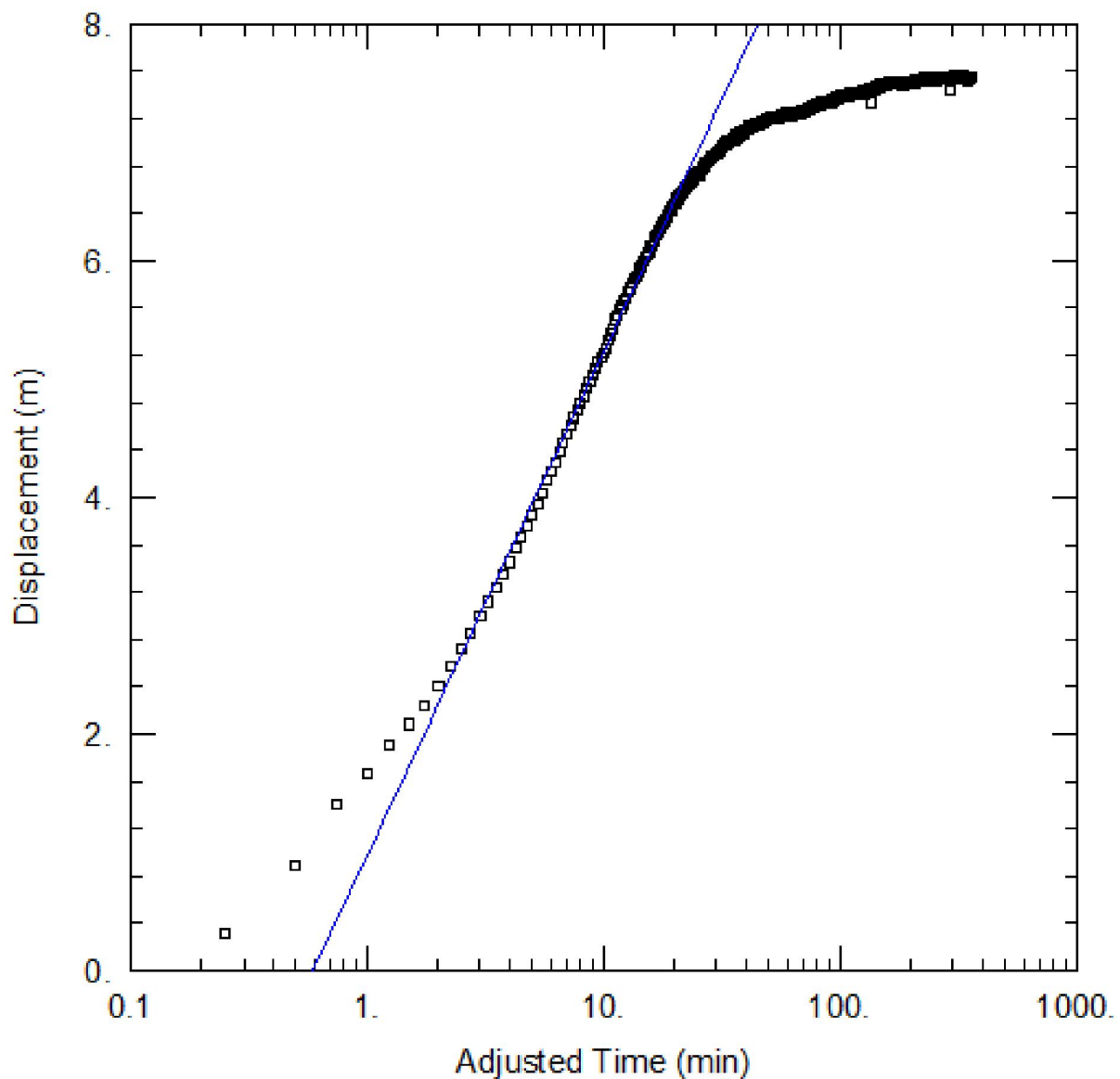
Analysis Date: Nov 13, 2019

Aquifer Thickness: 48 m

Discharge: Constant 26.5 L/min

Duration: 6 hours

Pumping Test Analysis (TW19-1): Cooper-Jacob (Confined Aquifer)



Estimated Transmissivity: $1.6 \text{ m}^2/\text{day}$ or $2 \times 10^{-5} \text{ m}^2/\text{s}$



GEMTEC

CONSULTING ENGINEERS
AND SCIENTISTS

Pumping Test Analysis Report

Project: Hydrogeological Investigation

Project Number: 61730.61

Client: Argue Construction Ltd.

Location: 3025 Carp Road, Ottawa, Ontario

Test Conducted by: CS

Pumping Well: TW19-1

P-Test Date: Nov 4, 2019

Analysis Performed by: AP

Method: Theis Recovery

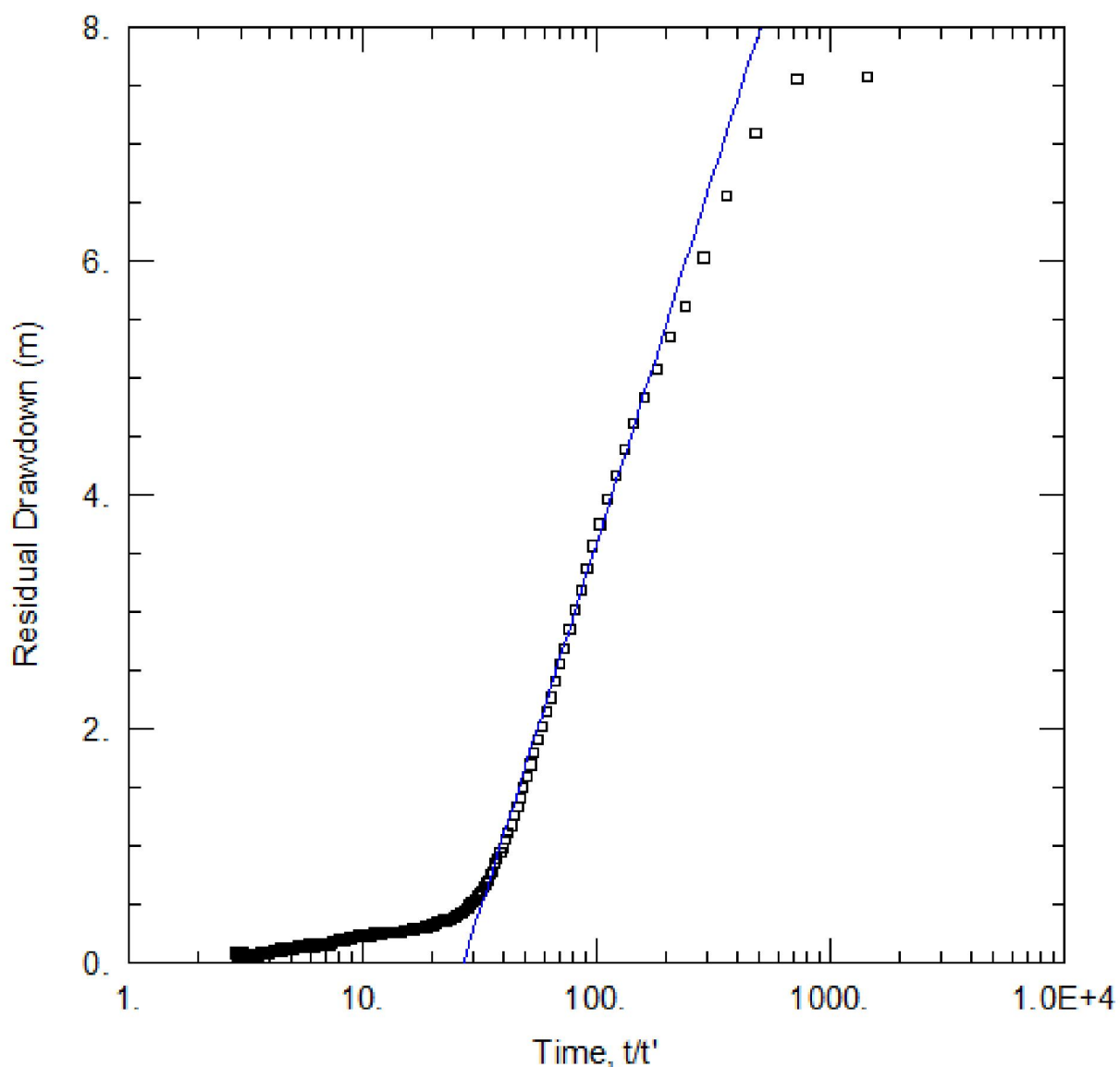
Analysis Date: Nov 13, 2019

Aquifer Thickness: 48 m

Discharge: Constant 26.5 L/min

Duration: 6 hours

Pumping Test Analysis (TW19-1): Theis Recovery (Confined Aquifer)



Estimated Transmissivity: $1.1 \text{ m}^2/\text{day}$ or $1 \times 10^{-5} \text{ m}^2/\text{s}$



APPENDIX E

Laboratory Certificates of Analysis & Summary Tables

Certificate of Analysis

GEMTEC Consulting Engineers and Scientists Limited

32 Steacie Drive
Kanata, ON K2K 2A9
Attn: Andrius Paznekas

Client PO:
Project: 61730.61
Custody: 12118

Report Date: 8-Nov-2019
Order Date: 4-Nov-2019

Order #: 1945140

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
1945140-01	TW19-1 3hr
1945140-02	TW19-1 6hr

Approved By:



Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis

Report Date: 08-Nov-2019

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 4-Nov-2019

Client PO:

Project Description: 61730.61

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Alkalinity, total to pH 4.5	EPA 310.1 - Titration to pH 4.5	4-Nov-19	5-Nov-19
Ammonia, as N	EPA 351.2 - Auto Colour	6-Nov-19	6-Nov-19
Anions	EPA 300.1 - IC	4-Nov-19	5-Nov-19
Colour	SM2120 - Spectrophotometric	5-Nov-19	5-Nov-19
Conductivity	EPA 9050A- probe @25 °C	4-Nov-19	5-Nov-19
Dissolved Organic Carbon	MOE E3247B - Combustion IR, filtration	5-Nov-19	5-Nov-19
E. coli	MOE E3407	5-Nov-19	5-Nov-19
Fecal Coliform	SM 9222D	5-Nov-19	5-Nov-19
Heterotrophic Plate Count	SM 9215C	5-Nov-19	5-Nov-19
Mercury by CVAA	EPA 245.2 - Cold Vapour AA	6-Nov-19	6-Nov-19
Metals, ICP-MS	EPA 200.8 - ICP-MS	5-Nov-19	5-Nov-19
pH	EPA 150.1 - pH probe @25 °C	4-Nov-19	5-Nov-19
Phenolics	EPA 420.2 - Auto Colour, 4AAP	5-Nov-19	5-Nov-19
Subdivision Package	Hardness as CaCO ₃	5-Nov-19	5-Nov-19
Sulphide	SM 4500SE - Colourimetric	7-Nov-19	7-Nov-19
Tannin/Lignin	SM 5550B - Colourimetric	8-Nov-19	8-Nov-19
Total Coliform	MOE E3407	5-Nov-19	5-Nov-19
Total Dissolved Solids	SM 2540C - gravimetric, filtration	5-Nov-19	6-Nov-19
Total Kjeldahl Nitrogen	EPA 351.2 - Auto Colour, digestion	7-Nov-19	7-Nov-19
Turbidity	SM 2130B - Turbidity meter	5-Nov-19	5-Nov-19

Certificate of Analysis

Report Date: 08-Nov-2019

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 4-Nov-2019

Client PO:

Project Description: 61730.61

Client ID:	TW19-1 3hr	TW19-1 6hr	-	-
Sample Date:	04-Nov-19 09:00	04-Nov-19 09:00	-	-
Sample ID:	1945140-01	1945140-02	-	-
MDL/Units	Drinking Water	Drinking Water	-	-

Microbiological Parameters

E. coli	1 CFU/100 mL	ND	ND	-	-
Fecal Coliforms	1 CFU/100 mL	ND	ND	-	-
Total Coliforms	1 CFU/100 mL	ND	ND	-	-
Heterotrophic Plate Count	10 CFU/mL	10	90	-	-

General Inorganics

Alkalinity, total	5 mg/L	296	292	-	-
Ammonia as N	0.01 mg/L	0.11	0.19	-	-
Dissolved Organic Carbon	0.5 mg/L	1.4	1.7	-	-
Colour	2 TCU	11	10	-	-
Conductivity	5 uS/cm	847	837	-	-
Hardness	mg/L	378	390	-	-
pH	0.1 pH Units	7.4	7.4	-	-
Phenolics	0.001 mg/L	<0.001	<0.001	-	-
Total Dissolved Solids	10 mg/L	526	492	-	-
Sulphide	0.02 mg/L	<0.02	<0.02	-	-
Tannin & Lignin	0.1 mg/L	<0.1	<0.1	-	-
Total Kjeldahl Nitrogen	0.1 mg/L	0.1	0.2	-	-
Turbidity	0.1 NTU	2.4	2.0	-	-

Anions

Chloride	1 mg/L	68	69	-	-
Fluoride	0.1 mg/L	<0.1	<0.1	-	-
Nitrate as N	0.1 mg/L	0.5	0.5	-	-
Nitrite as N	0.05 mg/L	<0.05	<0.05	-	-
Sulphate	1 mg/L	72	73	-	-

Metals

Mercury	0.0001 mg/L	-	<0.0001	-	-
Arsenic	0.001 mg/L	-	<0.001	-	-
Cadmium	0.0001 mg/L	-	<0.0001	-	-
Calcium	0.1 mg/L	127	130	-	-
Chromium	0.001 mg/L	-	<0.001	-	-
Cobalt	0.0005 mg/L	-	<0.0005	-	-
Copper	0.0005 mg/L	-	0.0012	-	-
Iron	0.1 mg/L	0.2	0.2	-	-
Lead	0.0001 mg/L	-	<0.0001	-	-
Magnesium	0.2 mg/L	14.9	15.7	-	-

Certificate of Analysis

Client: **GEMTEC Consulting Engineers and Scientists Limited**

Client PO:

Report Date: 08-Nov-2019

Order Date: 4-Nov-2019

Project Description: 61730.61

	Client ID:	TW19-1 3hr	TW19-1 6hr	-	-
	Sample Date:	04-Nov-19 09:00	04-Nov-19 09:00	-	-
	Sample ID:	1945140-01	1945140-02	-	-
	MDL/Units	Drinking Water	Drinking Water	-	-
Manganese	0.005 mg/L	0.009	0.009	-	-
Molybdenum	0.0005 mg/L	-	0.0007	-	-
Nickel	0.001 mg/L	-	<0.001	-	-
Potassium	0.1 mg/L	4.8	4.9	-	-
Selenium	0.001 mg/L	-	<0.001	-	-
Sodium	0.2 mg/L	64.0	65.8	-	-
Zinc	0.005 mg/L	-	<0.005	-	-

Certificate of Analysis

Report Date: 08-Nov-2019

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 4-Nov-2019

Client PO:

Project Description: 61730.61

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	ND	1	mg/L						
Fluoride	ND	0.1	mg/L						
Nitrate as N	ND	0.1	mg/L						
Nitrite as N	ND	0.05	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Ammonia as N	ND	0.01	mg/L						
Dissolved Organic Carbon	ND	0.5	mg/L						
Colour	ND	2	TCU						
Conductivity	ND	5	uS/cm						
Phenolics	ND	0.001	mg/L						
Total Dissolved Solids	ND	10	mg/L						
Sulphide	ND	0.02	mg/L						
Tannin & Lignin	ND	0.1	mg/L						
Total Kjeldahl Nitrogen	ND	0.1	mg/L						
Turbidity	ND	0.1	NTU						
Metals									
Mercury	ND	0.0001	mg/L						
Arsenic	ND	0.001	mg/L						
Cadmium	ND	0.0001	mg/L						
Calcium	ND	0.1	mg/L						
Chromium	ND	0.001	mg/L						
Cobalt	ND	0.0005	mg/L						
Copper	ND	0.0005	mg/L						
Iron	ND	0.1	mg/L						
Lead	ND	0.0001	mg/L						
Magnesium	ND	0.2	mg/L						
Manganese	ND	0.005	mg/L						
Molybdenum	ND	0.0005	mg/L						
Nickel	ND	0.001	mg/L						
Potassium	ND	0.1	mg/L						
Selenium	ND	0.001	mg/L						
Sodium	ND	0.2	mg/L						
Zinc	ND	0.005	mg/L						
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL						
Fecal Coliforms	ND	1	CFU/100 mL						
Total Coliforms	ND	1	CFU/100 mL						
Heterotrophic Plate Count	ND	10	CFU/mL						

Certificate of Analysis

Report Date: 08-Nov-2019

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 4-Nov-2019

Client PO:

Project Description: 61730.61

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	6.49	1	mg/L	6.48			0.1	10	
Fluoride	0.13	0.1	mg/L	0.14			2.7	10	
Nitrate as N	ND	0.1	mg/L	ND			0.0	10	
Nitrite as N	ND	0.05	mg/L	ND				10	
Sulphate	15.5	1	mg/L	15.7			0.7	10	
General Inorganics									
Alkalinity, total	161	5	mg/L	163			1.3	14	
Ammonia as N	0.074	0.01	mg/L	0.068			8.5	17.7	
Dissolved Organic Carbon	0.9	0.5	mg/L	1.1			18.2	37	
Colour	12	2	TCU	11			8.7	12	
Conductivity	302	5	uS/cm	309			2.4	5	
pH	8.1	0.1	pH Units	8.1			0.4	3.3	
Phenolics	ND	0.001	mg/L	ND				10	
Total Dissolved Solids	492	10	mg/L	526			6.7	10	
Sulphide	ND	0.02	mg/L	ND				10	
Tannin & Lignin	ND	0.1	mg/L	ND			0.0	11	
Total Kjeldahl Nitrogen	0.12	0.1	mg/L	0.12			2.2	16	
Turbidity	2.4	0.1	NTU	2.4			0.4	10	
Metals									
Mercury	ND	0.0001	mg/L	ND				20	
Arsenic	ND	0.001	mg/L	ND			0.0	20	
Cadmium	ND	0.0001	mg/L	ND			0.0	20	
Calcium	9.1	0.1	mg/L	9.3			2.0	20	
Chromium	ND	0.001	mg/L	ND			0.0	20	
Cobalt	ND	0.0005	mg/L	ND			0.0	20	
Copper	0.0271	0.0005	mg/L	0.0279			2.8	20	
Iron	ND	0.1	mg/L	ND			0.0	20	
Lead	0.0011	0.0001	mg/L	0.0010			8.8	20	
Magnesium	2.5	0.2	mg/L	2.6			2.6	20	
Manganese	ND	0.005	mg/L	ND			0.0	20	
Molybdenum	ND	0.0005	mg/L	ND			0.0	20	
Nickel	ND	0.001	mg/L	ND			0.0	20	
Potassium	0.8	0.1	mg/L	0.9			1.1	20	
Selenium	ND	0.001	mg/L	ND			0.0	20	
Sodium	16.5	0.2	mg/L	17.0			2.5	20	
Zinc	0.008	0.005	mg/L	0.008			0.3	20	
Microbiological Parameters									
E. coli	ND	1	CFU/100 mL	ND				30	
Total Coliforms	ND	1	CFU/100 mL	ND				30	
Heterotrophic Plate Count	10	10	CFU/mL	10			0.0	30	

Certificate of Analysis

Report Date: 08-Nov-2019

Client: GEMTEC Consulting Engineers and Scientists Limited

Order Date: 4-Nov-2019

Client PO:

Project Description: 61730.61

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	16.0	1	mg/L	6.48	95.6	77-123			
Fluoride	1.09	0.1	mg/L	0.14	95.1	79-121			
Nitrate as N	1.11	0.1	mg/L	ND	111	79-120			
Nitrite as N	0.913	0.05	mg/L	ND	91.3	84-117			
Sulphate	24.9	1	mg/L	15.7	92.6	74-126			
General Inorganics									
Ammonia as N	0.352	0.01	mg/L	0.068	114	81-124			
Dissolved Organic Carbon	11.6	0.5	mg/L	1.1	105	60-133			
Phenolics	0.027	0.001	mg/L	ND	109	69-132			
Total Dissolved Solids	96.0	10	mg/L		96.0	75-125			
Sulphide	0.50	0.02	mg/L	ND	99.0	79-115			
Tannin & Lignin	1.0	0.1	mg/L	ND	95.7	71-113			
Total Kjeldahl Nitrogen	2.07	0.1	mg/L	0.16	95.3	81-126			
Metals									
Mercury	0.0032	0.0001	mg/L	ND	105	70-130			
Arsenic	48.9		ug/L	0.269	97.2	80-120			
Cadmium	52.0		ug/L	0.0374	104	80-120			
Calcium	19100		ug/L	9330	97.5	80-120			
Chromium	54.8		ug/L	0.545	109	80-120			
Cobalt	50.0		ug/L	0.0453	100	80-120			
Copper	77.1		ug/L	27.9	98.3	80-120			
Iron	2350		ug/L	7.9	93.7	80-120			
Lead	46.3		ug/L	0.996	90.7	80-120			
Magnesium	12000		ug/L	2590	94.5	80-120			
Manganese	53.3		ug/L	0.581	105	80-120			
Molybdenum	49.1		ug/L	0.417	97.3	80-120			
Nickel	50.6		ug/L	0.367	100	80-120			
Potassium	10700		ug/L	858	98.4	80-120			
Selenium	47.5		ug/L	0.105	94.9	80-120			
Sodium	26800		ug/L	17000	98.5	80-120			
Zinc	58.6		ug/L	7.95	101	80-120			

Certificate of Analysis

Client: GEMTEC Consulting Engineers and Scientists Limited

Client PO:

Report Date: 08-Nov-2019

Order Date: 4-Nov-2019

Project Description: 61730.61

Qualifier Notes:

Sample Qualifiers :

QC Qualifiers :

Sample Data Revisions

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

Summary of Laboratory Parameters Analyzed
Project # 61730.61

		Parameter	Units	TW 19-1 Nov 4/19 P-Test “TW19-1 3hr”	TW 19-1 Nov 4/19 P-Test “TW19-1 6hr”	ODWS	Standard
Microbiological Parameters		Escherichia coli	CFU/100mL	ND	ND	0	MAC ²
		Fecal Coliform	CFU/100mL	ND	ND	0	MAC
		Total coliforms	CFU/100mL	ND	ND	0	MAC
		Heterotrophic Plate Count	CFU/1mL	<10	90	-	-
General Inorganics		Alkalinity (as CaCO ₃)	mg/L	296	292	30-500	OG
		Ammonia as N (NH ₃)	mg/L	0.11	0.19	-	-
		Dissolved Organic Carbon (DOC)	mg/L	1.4	1.7	5	AO
		Colour	TCU	11	10	5	AO
		Electrical Conductivity	uS/cm	847	837	-	-
		Total Hardness (as CaCO ₃)	mg/L	378	390	80-100	OG
		pH	pH units	7.4	7.4	6.5-8.5	OG
		Phenols	mg/L	ND (0.001)	ND (0.001)	-	-
		Total Dissolved Solids (TDS)	mg/L	526	492	500	AO
		Sulphide (S ₂)	mg/L	ND (0.02)	ND (0.02)	0.05	AO
		Tannin and Lignin	mg/L	ND (0.1)	ND (0.1)	-	-
		Total Kjeldahl Nitrogen	mg/L	0.1	0.2	0.15	OG
		Turbidity	NTU	2.4	2.0	5	AO
		Organic Nitrogen	mg/L	-	<0.1	0.15	OG
Anions		Chloride (Cl)	mg/L	68	69	250	AO
		Fluoride (F)	mg/L	ND (0.1)	ND (0.1)	1.5	MAC
		Nitrate as N (NO ₃)	mg/L	0.5	0.5	10	MAC
		Nitrite as N (NO ₂)	mg/L	ND (0.05)	ND (0.05)	0.1	MAC
		Sulphate (SO ₄)	mg/L	72	73	500	AO
Metals		Calcium (Ca)	mg/L	127	130	-	-
		Iron (Fe)	mg/L	0.2	0.2	0.3	AO
		Magnesium (Mg)	mg/L	14.9	15.7	-	-
		Manganese (Mn)	mg/L	0.009	0.009	0.05	AO
		Potassium (K)	mg/L	4.8	4.9	-	-
		Sodium (Na)	mg/L	64.0	65.8	200 (20)	AO (WL)

NOTES: ODWS = Ontario Drinking Water Standard, MAC = Maximum Acceptable Concentration, OG = Operational Guideline, AO = Aesthetic Objective, ND = Not Detectable, WL = Warning Level for persons on sodium restricted diets.

Summary of Field Measurements

Project # 61730.61

TW19-1 6-Hour Pumping Test		1 Hour	2 Hours	3 Hours	4 Hours	5 Hours	6 Hours
Parameters	Units						
Temperature	°C	9.39	9.13	9.13	9.13	9.13	9.13
pH	-	7.00	7.11	7.11	7.11	7.11	7.11
Electrical Conductivity (EC)	uS/cm	908	929	929	929	929	929
Total Dissolved Solids (TDS)	mg/L	454	414	414	414	414	414
Turbidity	NTU	49.8	9.0	9.0	9.0	9.0	09.0
Colour	ACU	-	-	13	-	-	0
Colour	TCU	-	-	0	-	-	0
Chlorine	mg/L	-	-	0	-	-	0
Measured Flow Rate	Litres per minute	26.5	26.5	26.5	26.5	26.5	26.5
Sample Collected	-	-	-	"TW19-1 3hr"	-	-	"TW19-1 6hr"
Comments	-	-	-	Clear, no odour	-	-	-

NOTES: NTU = Nephelometric Turbidity Units, ACU = Actual Colour Units, TCU = True Colour Units (field filtered using 0.45 micron filter),



APPENDIX F

Nitrate Dilution Calculations

TABLE 1: Allowable Flows - Commercial Septic Systems

Site	Area m ²	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Factor	Annual Water Surplus (m ³ /year)	Infiltration Volume (m ³ /year)	Scenario 1: 60% hard surface and use of tertiary treatment			Scenario 2: Tertiary treatment (100% infiltration, runoff captured)	
								Hard Surface Area	Available Infiltration (litres per day)	Maximum Septic Flow (litres per day)	Available Infiltration (litres per day)	Maximum Septic Flow (litres per day)
3025 Carp Road	18280	0.20	0.40	0.10	0.70	0.379	6928	0.60	5315	5315	13287	13287

Notes:

1. Scenario No. 1 values are calculated under the following:
 - a) Carried out in accordance with Section 5.6.3 of the MECF Procedure D-5-4
 - b) Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system
 - c) The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit
 - d) A total of 60% hard surface from which runoff is not available for infiltration
2. Scenario No. 2 values are calculated under the following:
 - a) Carried out in accordance with Section 5.6.3 of the MECF Procedure D-5-4
 - b) Incorporates a value of 20 mg/L nitrate in the discharged effluent from the tertiary treatment system
 - c) The calculated maximum allowable flow is based on a simplification of the formula provided in Section 5.6.3, utilizing a concentration of 20 mg/L of Nitrate in the effluent discharging from the tertiary treatment unit
 - d) Assumes all runoff is captured and infiltrated



APPENDIX G

Water Balance Calculations

Water Budget - 3025 Carp Road

Pre-Development Conditions

Geology	Land Use ¹	Water Holding Capacity (mm) ¹	Area (m2)	Surplus ² (mm/yr)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m3/yr)	Runoff Volume (m3/yr)
Silty Sand to sand and gravel	Pasture and Shrubs	100	18280	361	0.2	0.4	0.1	0.7	0.3	253	108	46194	19797
Total Site Area			18280										

1. Table 3.1 MOE SWMP Planning and Design Manual (2003)
2. Surplus data taken to be average of Environment Canada Water Budget Means for Ottawa Intl A 1939-2013 and Carleton-Appleton 1984-2006.

Post-Development Conditions

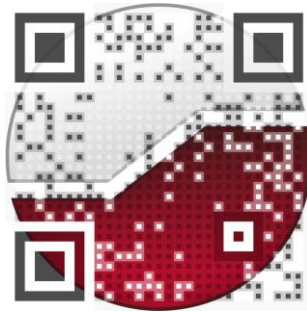
Geology	Land Use ¹	Water Holding Capacity (mm) ¹	Area (m2)	Surplus ² (mm/yr)	Topography Factor	Soil Factor	Vegetation Factor	Infiltration Coefficient	Runoff Coefficient	Infiltration (mm/yr)	Runoff (mm/yr)	Infiltration Volume (m3/yr)	Runoff Volume (m3/yr)
Silty Sand to sand and gravel	Urban Lawn	75	7312	361	0.2	0.4	0.1	0.7	0.3	253	108	18477	7919
Hard Surface (building and parking)	Impermeable ³	0	10968	729	-	-	-	0	1	0	729	0	79957
Total			18280									18477	87876
Weighted Average ⁴										101	481		

1. Table 3.1 MOE SWMP Planning and Design Manual (2003)
2. Surplus data taken to be average of Environment Canada Water Budget Means for Ottawa Intl A 1939-2013 and Carleton-Appleton 1984-2006.
3. Hard Surface surplus calculated to be average precipitation - 20% evaporation (conservative estimate as per Cuddy et al., 2013)
4. Weight average

Water Budget Summary

Summary	Infil mm/yr	Runoff mm/yr	Infil m ³ /yr	Runoff m ³ /yr
Pre-Development	253	108	46194	19797
Post-Development	101	481	18477	87876
% Change	-60	344	-60	344

experience • knowledge • integrity



civil
geotechnical
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