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GEOTECHNICAL INVESTIGATION & HYDROGEOLOGICAL ASSESSMENT

2004 HAMILTON ROAD, LONDON

PROJECT NO. SC-02055

APRIL 15, 2026

Submitted to:

KREATIVE DEVELOPMENTS INC.

Distribution (via email):

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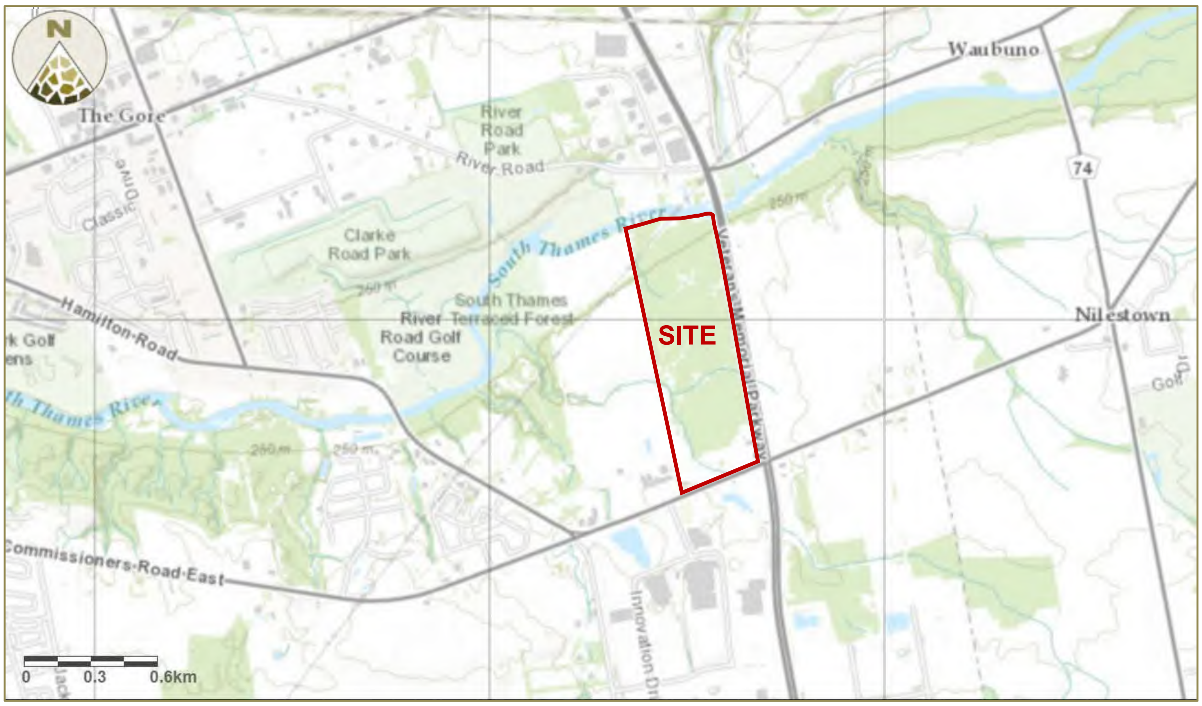
1. INTRODUCTION

Stonecairn Consulting Inc. (Stonecairn) has been retained by Kreative Developments Inc. to conduct a Geotechnical Assessment for a multi-block subdivision which will include commercial blocks, office space, along with research and development blocks, which will be accessed from an internal roadway system. The subject lands are located west of Veterans Memorial Parkway and north of Hamilton Road, on the east end of the City of London, Municipal Number (MN) 2004 Hamilton Road. A Key Plan showing the site location is provided on Figure 1, below.

Figure 1: Key Plan



It is understood that the proposed development will have local roads and full municipal services. The site is expected to be accessed from Hamilton Road at the southern end of the site. It is understood that only the southern portion of the property (approximately 16.3 ha) of the total 50.4 ha parcel are currently being considered for development, since the remainder of the property is occupied by woodlands.

1.1 Terms of Reference

This document has been prepared for the purposes of providing geotechnical comments and recommendations for the design and construction of a proposed multi-block commercial development located west of Veterans Memorial Parkway and north of Hamilton Road, on the east end of the city of London.

Authorization to complete this Investigation was received from Bilal Rahhal, on behalf of Kreative Developments Inc.

Preparation of this report relies on information collected by LDS Consultants Inc., which is now closed. This report was prepared by the supervising engineer who oversaw the original geotechnical site assessment work.

This report provides a summary of the borehole findings (documenting soil and groundwater conditions at the site). The report provides geotechnical comments and recommendations for the propose development, including:

- Site preparation, including guidance for cut and fill operations, the re-use of excavated materials as engineered fill / structural fill and guidance for engineered fill placement;
- Temporary excavations, including maximum slope inclinations to provide stable excavation side slopes in accordance with OHSA requirements, excavation support (shoring methods, if required), and lateral earth pressures;
- Groundwater Control, including the need for a Permit to Take Water (PTTW) or Environmental Activity Sector Registry (EASR) submission for construction dewatering, if required;
- Foundation design, including soil bearing capacity, subgrade preparation and allowable settlements, foundation drainage and backfilling;
- Concrete slab and basement construction (including lateral earth pressures and provisions for shallow groundwater conditions);
- Seismic design considerations based on borehole data and published information for soil conditions below the depth of exploration;
- Site servicing, including recommendations for pipe bedding and trench backfill;
- Pavement design, including pavement component thicknesses for access roads and recommendations for concrete curbs and sidewalks within the site; and
- Excess soil management discussion to assist contractors in understanding the characteristics of excess soils which may be generated from onsite excavations, and which may require disposal offsite, in addition to discussing possible regulatory exemptions, under O.Reg. 406/19.

The report also provides information about the characterization of the hydrogeological setting for the site, including:

- A summary of the baseline groundwater quality data from the water quality samples;
- A summary of MECP well records in vicinity of the site. The information collected from the Well Record review will be used in supplementing the hydrogeological setting in the vicinity of the site. It is noted that a well survey has not been incorporated into the scope of work;
- Construction dewatering discussion, including estimated construction dewatering volumes, potential zones of influence, and confirming the requirements for permitting required to carry

out site servicing which may encounter shallow groundwater conditions. In the event that construction dewatering is expected to require a PTTW or EASR, discussion will be incorporated into the report to identify preliminary water taking calculations and expected zone of influence distances.

- A preliminary feature-based water balance assessment for the wooded areas which are located on the west side of the property (adjacent to the northwest corner of the site) and the wooded area on the east side of the property (adjacent to the southeast corner of the site.)
- Stormwater management considerations, and factored soil infiltration rates for at-source infiltration features, including a discussion on limitations which result from soil and/or shallow groundwater conditions; and providing recommendations for best management practices during construction and the inclusion of at-source infiltration and/or LID measures (where site conditions permit) to increase post-development infiltration volumes; and
- Mitigation measures will also be discussed to address concerns with contamination which could result from typical construction activities and the installation of site services to conventional depths for this type of development.

This report is provided on the basis of the terms noted above, and on the assumption that the design will follow applicable codes and standards. The site investigation and recommendations provided in this report follow generally accepted practice for geotechnical consultants in Ontario. The format and content of this report has been guided to address specific client needs. Stonecairn has provided engineering guidelines for the geotechnical design and construction at the site.

A copy of the City of London Table 4 Hydrogeological Checklist is provided in Appendix G, to demonstrate how the report has addressed the hydrogeological reporting requirements established in consultation with the City of London scoping discussions.

Laboratory testing, where applicable, follows ASTM or CSA Standards.

1.2 Coordination with Other Consultants

In preparing this report, Stonecairn has coordinated efforts with other members of the consulting team working in support of the proposed development of the site. Coordination between consultants has occurred for data sharing, and to help ensure that comments and recommendations for the development align with the various elements which contribute to the overall design. Information from the following documents has been incorporated into the report, where appropriate:

- Draft Plan of Subdivision, 2004 Hamilton Road, Sheet DP, April 2025
- Preliminary Stormwater Management Report, 2004 Hamilton Road, City of London, prepared by Development Engineering (London) Ltd., dated April 2025
- Flood Line Delineation Study, 2004 Hamilton Road, City of London, prepared by Development Engineering (London) Ltd., dated April 2025

- Geomorphic Assessment - Fekete Drain, South Thames River Subwatershed, 2004 Hamilton Road, City of London, prepared by Momentum Earth Sciences Ltd., April 2025
- 2004 Hamilton Road Environmental Impact Study, prepared by Natural Resource Solutions Inc., April 2025)

1.3 Qualifications of Assessor

The program which was undertaken for this project was conducted under the supervision of Rebecca Walker, P. Eng., QPESA. She has been thoroughly trained in conducting geotechnical and hydrogeological assessments. Mrs. Walker is a licensed professional engineer in the Province of Ontario. She obtained a Bachelor of Applied Science in Geological Engineering from Queen's University in 1998 and is a Qualified Person (QPESA) registered with MECP. She has been practicing geoscience services under the Guideline of Professional Engineers Providing Geotechnical Engineering Services under the Professional Engineers Act in Ontario.

Mrs. Walker has 25 years of direct experience in the geotechnical and hydrogeological consulting industry. Over 5,000 projects have been completed under her supervision. Mrs. Walker is also a recognized expert in the industry and has testified as an expert witness in Local Planning Appeal Tribunal (formerly Ontario Municipal Board) hearings and Municipal Councils related to groundwater hydrogeology and geotechnical matters for land development and construction. She has been retained for many projects, both directly and indirectly (as a subconsultant) by local municipalities as a hydrogeological and geotechnical consultant.

2. SITE CHARACTERIZATION

2.1 Site Description, Topography and Surface Drainage

A review of aerial photographs dating from 1998 to current indicates that the northerly 2/3 of the site has contained woodlot, and the southerly 1/3 located closest to Hamilton Road has transitioned (in part) from a wooded plantation to open space. The South Branch of the Thames River runs along the northerly limit of the site, and the lands immediately adjacent to the river consist of floodplain, and a well vegetated valley slope. Former buildings in the southeast corner of the site appear to have been removed in 2020. The site is rectangular in shape, and comprises an area of approximately 50.4 hectares.

The site is bound by Hamilton Road to the South, Cerro Horse Stables to the west, Veteran's Memorial Parkway to the east, and a woodlot (associated with the aforementioned branch of the Thames River) to the north. From a topographical perspective, the ground surface exhibits a gradual relief of 4 meters from southwest to the north, towards the Thames River. Any minor surface flows which occur at the site under existing conditions, are generally expected to follow the topography of the site.

The grade of Hamilton Road and Veteran's Memorial Parkway are set slightly above the ground surface at the site. A roadside drainage ditch is present between the roadways and the southern and eastern property limits. No significant surface water accumulation was observed within the drainage ditch during the site visits conducted by Stonecairn.

Historical aerial photographs indicate that a former drainage swale and/or drainage feature crossed through the central part of the site (proximal to Borehole BH5) connecting to the wooded area to the north. A tributary of the South Branch of the Thames River transects the southwestern portion of the site, conveying flow from south to north, towards the Thames River.

The location of the Thames River, as well as the other aforementioned site features, are highlighted on Drawing 1, in Appendix A.

2.2 UTRCA Generic Regulation

In April 2024, Ontario Regulation 41/24 came into effect as part of the significant amendments which were introduced to the Conservation Authorities Act, which included amendments to the jurisdiction of conservation authorities in Ontario, and replaced the thirty-six various separate regulation which governed each of the conservation authorities. This regulation is intended to ensure public safety, prevent property damage and social disruption, due to natural hazards such as flooding and erosion.

The Thames River, valley slopes and tributary that transects the southwestern portion of the site are all included within the UTRCA Regulated Lands, as shown on Drawing 3, appended. Property owners must obtain permission from UTRCA before beginning any development, site alteration, construction, or placement of fill within the regulated area. Proposed development within the study area will be subject to the above referenced Regulation. Consultation with the local Conservation Authority for review of site-specific development plans is recommended in this regard.

2.3 Source Water Protection Mapping

Where proposed developments are being planned, it is important to determine the presence of Significant Groundwater Recharge Areas and High Vulnerability Aquifers in the area. These areas are protected under the Clean Water Act (2006). In general, Significant Groundwater Recharge Areas are defined as areas where water seeps into an aquifer from rain and melting snow, supplying water to the underlying aquifer. A highly vulnerable aquifer occurs where the subsurface material offers limited protection from contamination resulting from surface activities.

The MECP Source Water Protection Information has been reviewed to determine whether the site is located in any identified areas of source water concern, as they relate to local groundwater quality (current to December 2024). The property is located within the Upper Thames River Source Protection Area, and the following observations are noted for the site:

The Property is not located in any of the following designated areas listed in the MECP Source Protection mapping:

- Wellhead Protection Area, Wellhead Protection Area E (GUDI), Wellhead Protection Area Q1 or Wellhead Protection Area Q2;
- Intake Protection Zone or Intake Protection Zone Q;
- Issue Contributing Area; and,
- Event Based Area.

The Property is located within a Significant Groundwater Recharge Area with a rating/score of 6, indicative of a high vulnerability rating. An area is a significant groundwater recharge area when the area annually recharges water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more; or, the area annually recharges a volume of water to the underlying aquifer that is 55% or more of the volume determined by subtracting the annual evapotranspiration for the whole of the related groundwater recharge area from the annual precipitation for the whole of the related groundwater recharge area.

The Property is located within a Highly Vulnerable Aquifer with a rating/score of 6, indicative of a high vulnerability rating. In general terms, a highly vulnerable aquifer occurs where the subsurface material offers limited protection from contamination resulting from surface activities. The susceptibility of an aquifer to contamination is a function of the susceptibility of its recharge area to the infiltration of contaminants.

Overlays are included on Drawing 4 (Appendix A) showing the limits of the Significant Groundwater Recharge Area and Highly Vulnerable Aquifer zone.

2.4 Review of Geological Mapping

Select geological mapping and publications were reviewed for the purposes of reviewing regional characteristics for soil conditions in the area of London, Ontario. Findings are summarized below, for reference.

<u>Physiography & Quaternary Geology</u>

Physiographic mapping for Southwestern Ontario (Chapman, L.J. and Putnam, D.F. 2007. Physiography of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 228), identifies that the property is located in the north western extent of the physiographic region known as the Mount Elgin Ridges. and is set within a transition zone between till moraines and glacial spillways. Subgrade soils are generally expected to be comprised of silt till, with intermittent sand seams, transitioning to sand and gravel soils to the north, near the Thames River.

Pleistocene geology mapping for the St. Thomas area (Pleistocene Geology of St. Thomas Area, East Half, Southern Ontario; Ontario Department of Mines, Map P606, Scale 1:50,000, 1970) indicates that the southern portion of the study area consists of undifferentiated glacial till deposits, comprised of layered sand and silt till deposits, transitioning to the north to glaciolacustrine and glaciofluvial beach deposits, comprised of gravel and gravelly sand, from the Late Wisconsin glaciation period. An excerpt from the aforementioned mapping is provided on Drawing 5, in Appendix A.

Bedrock Geology

Bedrock geology mapping for Southwestern Ontario (Ontario Geological Survey. 1:250 000 scale, Bedrock Geology of Ontario. Ontario Geological Survey, Miscellaneous Release Data 126, Revised 2006) indicates that bedrock in the general area consists of limestone, dolostone and shale from the Dundee Formation, from the Middle Devonian Period.

Geological publications and well records in the area indicate that the bedrock surface is below 31-40 m of overburden soils in the vicinity of the site. Bedrock was not encountered during the fieldwork for this investigation.

2.5 MECP Well Record Review

A review of local well records available through the Ministry of Environment, Conservation, and Parks (MECP) for this area was carried out to review the water levels recorded in the nearby wells. Drawing 6 in Appendix A shows the location of the wells (with corresponding Well Registration No.) which are in close proximity (within 500 m) of the site. The water supply wells and observation wells are summarized in the following table (refer to Table 1 on the following page).

Two water supply wells noted in the records (located just outside the southern limits of the site, south of Hamilton Road) are set in the shallow (<15 m depth) overburden aquifers, with reported static water levels of 2.4 m and 3.7 m. One water supply well (located southwest of the southwestern limits of the site) was set in the intermediate (15 – 30 m depth) overburden aquifer, with a reported static water level of 10.7 m. The majority of the remaining water supply wells are set into the deep (>30 m depth) overburden aquifers, with reported static water levels ranging from 1.2 to 8.2 m. Some water supply wells in the vicinity of the site have been abandoned, following access to municipal water supply/serving which is now available in the area.

The remaining well records are recorded as observation wells, test holes and abandoned wells, as shown above. Observation wells and test holes are recorded at variable depths within the well records.

Table 1 - MECP Well Record Summary

4103304	1958-09-20	Water Supply	28.3	27.4	10.7	NR	4756948	489114	58.7
4103305	1962-07-26	Water Supply	42.1	39.6	1.2	30.3	4757213	489234	On Site
4103306	1964-06-01	Water Supply	6.1	2.4	2.4	7.6	4756888	489184	140.2
4103307	1964-09-23	Water Supply	46.0	46.0	6.1	22.7	4756893	489114	109.8
4103308	1952-11-28	Water Supply	33.5	24.4	6.7	NR	4757003	488974	90.7
4106018	1972-08-21	Water Supply	7.9	3.7	3.7	11.4	4757063	489334	33.0
4112160	1990-08-23	Water Supply	41.5	41.5	3.0	94.6	4757048	488889	163.0
4116096	2005-05-11	Test Hole	25	NR	NR	NR	4757025	489388	88.5
7390671	2021-06-10	Observation Well	4.6	2.1	2.1	NR	4757503	489196	71.2
7390709	2021-05-21	Observation Well	4.6	3.0	3.0	NR	4757134	489086	On Site
7390716	2021-05-21	Observation Well	4.6	2.4	2.4	NR	4757025	489105	On Site
4116324	2005-11-09	Abandoned-Other		NR	NR	NR	4756910	489011	101.9
7171318	2011-10-07	Abandoned-Other		NR	NR	NR	4756879	488958	159.7
7189493	2012-08-15	Abandoned-Other	NR	NR	NR	NR	4756907	489254	148.4
7189495	2012-08-15	Abandoned-Other		NR	NR	NR	4756910	489252	144.9

NR – denotes data which was not recorded

3. SUMMARIZED CONDITIONS

3.1 Field Program and Laboratory Testing

Geotechnical field staff and the drilling contractor carried out a Safety Meeting prior to drilling at the site, which included a review of the underground utility locates were completed through Ontario-One-Call in preparation for the drilling program.

The field program consisted of a series of boreholes, drilled on May 21 and June 10, 2021. The boreholes were advanced at the site by a local drilling-contractor, using a track-mounted drill-rig. Nine boreholes (denoted as BH1 through BH9) were advanced to depths ranging from 5.0 m (16.5 feet) to 8.1 m (26.5 feet) below existing grade. Ground surface elevations at the borehole locations were surveyed using a Trimble R10 GPS rover. The location of the boreholes is summarized below, and illustrated on Drawing 7, in Appendix A.

Table 2 – Borehole Locations

Location	Northing, m N	Easting, m E	Ground Surface Elevation (m asl)
BH1/MW	4757130.40	489088.88	256.64
BH2	4757297.47	489009.68	256.41
BH3/MW	4757022.00	489112.64	260.17
BH4	4757132.46	489370.22	258.29
BH5	4757256.89	489348.28	258.53
BH6	4757094.59	489279.14	256.60
BH7	4757238.40	489206.60	257.58
BH8	4757440.40	489296.86	258.23
BH9/MW	4757411.60	489192.74	256.09
PZ201	4757098.50	489171.75	255.27
PZ202	4757079.13	489241.84	255.22

Monitoring wells were installed in three of the boreholes (BH1, BH3, and BH9) to allow for monitoring the stabilized groundwater level at the site. Wells are comprised of a 50 mm diameter CPVC pipe, with a slotted and filtered screen. Details of monitoring well construction are provided on the attached borehole logs. The screens on each well are mill-slotted, with a slot spacing of 0.5 mm, and were backfilled with Type 2 Silica Sand. Above the screened depth, the annular space was backfilled with a bentonite slurry, up to ground surface. The wells have been equipped with lockable caps. The monitoring wells have been registered with the Ministry of Environment, Conservation, and Parks (MECP), in accordance with Ontario Regulation (O.Reg.) 903.

Table 3 (below) summarizes the well construction details.

Table 3 – Well Construction Details

BH1/MW	256.64	4.57	3.05	Medium grained sand and silt till
BH3/MW	260.17	4.57	1.52	Medium grained sand and silt till
BH9/MW	256.09	4.57	3.05	silty sand and silt till

In addition, in March 2025, two piezometers were installed within the tributary drain in the southwest part of the site, to confirm shallow groundwater and surface water levels in this part of the site. The piezometers are denoted as PZ201 and PZ202, and were set 0.5 m into the base of the watercourse. Refer to photographs (right). Installation details are noted below. Surveyed coordinates are in included in Table 2.

Piezometer PZ 201

Piezometer PZ 202

PZ201 – Ground level 255.27 m asl
Top of Pipe – 256.81 m asl
Water Level at install – 255.73 m asl

PZ202 – Ground level 255.22 m asl
Top of Pipe – 256.71 m asl
Water Level at install – 255.68 m asl

The depth to groundwater seepage and short-term water level measurements were obtained prior to backfilling the remaining boreholes. Boreholes were backfilled with a mixture of bentonite chips and cuttings, to restore holes back to level conditions with the ground surface.

Single Well Response Tests (rising head test) was conducted in each of the monitoring wells on July 9, 2021 to estimate the hydraulic conductivity of the subgrade soils at the site. The test method and results are discussed in Section 3.1.2.

All samples recovered from the site were returned to a CCIL-certified lab for detailed examination and selective testing. Three grain size analyses were carried out on select samples of the predominant subgrade soils, where perched groundwater conditions were identified. Routine moisture content determinations were carried out on select samples and results are presented on the borehole logs provided in Appendix B.

Collected soil samples will be disposed of, following the issuance of the Geotechnical Report, unless prior arrangements have been made for longer term storage.

3.1.1 Soil Conditions

A series of nine boreholes were advanced at the site to examine soil and shallow groundwater conditions. The borehole locations are shown on Drawing 7, appended. In general, soils observed in the boreholes consisted of topsoil overlying interlayered sand and silt till deposits. General descriptions of subsurface conditions are summarized in the following sections. Borehole logs are provided in Appendix B, for reference.

It should be noted that boundaries of soil indicated in the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries reflect transition zones for the purposes of geotechnical design and should not be interpreted as exact planes of geological change.

<u>Topsoil and Organics</u>

Each borehole was surfaced with a layer of topsoil. The topsoil consisted of brown sandy loam, and the thickness generally ranging from 200 to 450 mm across the site. The topsoil was in a damp to moist state at the time of the fieldwork, based on visual and tactile examination. It should be noted that topsoil quantities noted above are based on information provided at the borehole locations only, and may vary in areas with existing vegetation and tree cover, and where tilling has occurred and mixed the topsoil with the underlying soil strata. If required, a more detailed analysis (involving additional shallow test pits) is recommended to accurately quantify the amount of topsoil to be removed for construction purposes.

A layer of organic material (approx. 200 mm thick) was observed in the samples collected from BH2, at a depth of 2.3 m. This appears to be an isolated condition. The other borehole logs do not identify any other areas where buried peat or organics are present. It is noted that the samples collected from the boreholes are collected from discontinuous sampling, and other minor seams may be present between sampled intervals.

<u>Silty Sand/Sandy Silt</u>

A near surface layer of silty sand/sandy silt was encountered underlying the topsoil in borehole BH5, and interlayered with the silt till in boreholes BH7 and BH9. The silty sand/sandy silt was generally described as brown to grey with depth, with a fine to medium grained texture and in a weathered condition.

A sample of the silty sand/sandy silt was submitted for gradation analyses, and the following table shows the grain size distribution. The results are also shown graphically in Appendix B.

Table 4 - Gradation Summary, Silty Sand/Sandy Silt

Sample ID	% Clay	% Silt	% Sand	% Gravel
BH9, Sample 1 – 1.6 m depth	16.7%	41.9%	35.5%	5.9%

The silty sand is in a variable very loose to compact state, based on SPT N-values in the range of 3 to 16 blows per 0.3 m of split-spoon sampler penetration. Moisture content determinations conducted on recovered samples of the silty sand generally range between 14.1 to 20.4 percent, generally indicative of very moist to saturated soil conditions.

Silt Till

The predominant subgrade soil encountered across the site was a silt till. The till was encountered underlying the topsoil in Boreholes BH2, BH3, BH6, BH8 and BH9, and encountered underlying the near surface sand layer in Boreholes BH1, BH4, BH5 and BH7 at depths ranging from 0.6 m to 1.7 m below ground surface. Each borehole terminated within the till layer. The till encountered near surface was described as mottled brown/grey and weathered, becoming grey with depth. The silt till is described as containing some sand and trace fine gravel, with a noted decrease is the sand content with depth. A buried layer of topsoil/organics was encountered within the silt till layer in Borehole BH2 proximal to the existing woodlot at a depth of 2.3 m. Furthermore, several damp to saturated sand and gravel and sand seams (~50 to 150 mm thickness) were encountered at variable depths within the till layer across the entire site.

The till is in a variable compact to very dense state below the weathered zone, based on Standard Penetration Test (SPT) N-values in the range of 10 to 73 blows per 0.3 m of split-spoon sampler penetration. A loose zone (SPT N < 10 blows) was encountered within the till layer in Borehole BH2 at a depth of 1.4 m, which extended to a depth of 2.9 m below ground surface. Auger refusal was noted within the very dense silt till in Boreholes BH2, BH7 and BH8 at depths ranging from 6.7 m to 7.5 m. This may be the result of the presence of cobbles or boulders within the till, and/or the very dense condition of the silt till at these depths.

Moisture content determinations conducted on recovered samples of the till generally range between 14.7 to 17.8 percent within the near surface weathered zone, and on the order of 7.4 to 14.0 percent below the weathered soils.

Sand and Gravel

An interbedded layer of sand and gravel was encountered within the silt till layer in Borehole BH7. The sand and gravel was encountered at a depth of 4.0 m, and extended to a depth of 5.6 m below ground surface. The sand and gravel was described as brown in colour, with a medium to coarse grained texture, and containing trace to some silt.

A sample of the sample and gravel was submitted for gradation analyses, and the following table shows the grain size distribution. The results are also shown graphically in Appendix B.

Table 5 - Gradation Summary, Sand and Gravel

Sample ID	% Silt & Clay	% Sand	% Gravel
BH7, Sample 5 – 4.6 m depth	10.2%	65.4%	24.4%

The sand and gravel soils are in a dense state based on a SPT N-value of 40 blows per 0.3 m of split-spoon sampler penetration. A moisture content determination conducted on a recovered sample of the sand and gravel yielded a value of 11.0 percent, generally indicative of very moist soil conditions.

Sand

An additional sand layer was encountered underlying the topsoil in boreholes BH1 and BH4, and interlayered with the silt till in borehole BH3, which is distinguished from the near surface sand layer by its coarser grain size distribution and lower silt content. The sand layer was generally described as being brown in colour and stratified, with a medium grained texture, and containing trace silt and trace fine gravel. A saturated seam of sand and gravel was encountered within the sand layer in Borehole BH3 at a depth of 2.3 m below ground surface.

A sample of the sand layer was submitted for gradation analyses, and the following table shows the grain size distribution. The results are also shown graphically in Appendix B.

Table 6 - Gradation Summary, Sand

Sample ID	% Silt & Clay	% Sand	% Gravel
BH3, Sample 4 – 3.0 m depth	5.6	92.8%	1.6%

The sand is in a loose to compact state, based on SPT N-values in the range of 7 to 11 blows per 0.3 m of split-spoon sampler penetration. Moisture content determinations conducted on recovered samples of the sand generally range between 9.7 to 23.9 percent, generally indicative of moist to saturated soil conditions.

3.1.2 Soil Permeability

The hydraulic conductivity of a soil depends on a number of factors, including particle size distribution, degree of saturation, compactness, adsorbed water (which depends on clay content). The heterogeneous nature of glacial deposits can also contribute to variations in soil permeability where the soil composition may include localized areas with increased fine material or sandy material which can influence soil permeability at different points within the soil strata.

The soil permeability of select sand samples was assessed by two methods. The first method is correlation of hydraulic conductivity and factored infiltration rates based on the results of gradation analyses on collected samples. The second method is with field measurements during single well response testing.

Grain Size Analyses

Based on the gradation results of the predominantly sandy soils presented in Section 3.1.1, the following values for saturated hydraulic conductivity have been determined for the sandy soils encountered across the site. Hazen's method was used to correlate the grain size analysis to the hydraulic conductivity of the sand soils. This correlation is based on the following relationship:

$k\ (cm/s) = C(d_{10})^2$

where, d_{10} is the diameter (size measured in mm) at which 10% of the sample passes; and,

C is an empirical coefficient (average value of 1.0).

Table 7 - Hydraulic Conductivity and Factored Infiltration Rates from Hazen's Method

Sample ID	% Silt	% Sand	% Gravel	D_{10} (mm)	Saturated Hydraulic Conductivity (m/sec)	Factored Infiltration Rate (mm/hr)
BH3, Sample 4 – 3.0 m depth	5.6	92.8	1.6	0.14	1.96×10^{-4}	75
BH7, Sample 5 – 4.6 m depth	10.2	65.4	24.4	0.20	4.00×10^{-4}	90

The natural water-bearing sand soils and sand seams have a saturated hydraulic conductivity in the range of 10^{-4} m/s, based on the above results.

Based on the gradation results of the silty subgrade soils presented in Section 3.1.1, the following values for saturated hydraulic conductivity have been determined using the Puckett method.

Table 8 - Hydraulic Conductivity and Factored Infiltration Rates from Puckett Method

Sample ID	% Clay	% Silt	% Sand	% Gravel	Saturated Hydraulic Conductivity (m/sec)	Factored Infiltration Rate mm/hr
BH9, Sample 1 – 1.6 m depth	16.7	41.9	35.5	5.9	1.61×10^{-6}	21

The glacial till soils encountered in the boreholes are expected to have a saturated hydraulic conductivity in the range of 10^{-6} m/s, based on the above results. This is consistent with published values for silt till and clayey silt till soils.

The infiltration rates displayed in Tables 7 and 8 have been calculated using correlation from TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide protocol which references Supplementary Guidelines to the Ontario Building Code 2024. SG-6 Percolation Time and Soil Descriptions. A Factor of Safety of 2.5 has been applied, in accordance with TRCA/CVC Low Impact Development Stormwater Management Planning and Design Guide protocol.

Single Well Response Test (SWRT)

A Single Well Response Test (rising head test) was conducted in the monitoring wells at Boreholes BH1/MW, BH3/MW and BH9/MW on July 9, 2021 to estimate the hydraulic conductivity of the sand layering which was encountered with the glacial till which is prevalent across the site. The SWRT provides an estimate of the hydraulic conductivity value of the geological formation within the immediate area around the well screens, which are generally set within the near surface sand and intermittent water-bearing sand and gravel seams/layers.

Groundwater level measurements were taken prior to the start of the test. A submersible pressure transducer with a water level logger was inserted into the monitoring well to measure the change in water level for the duration of the test. Use of the data logger allows for high frequency data collection and increased accuracy, compared to manual measurements during the testing.

The Hydraulic conductivity values were estimated from field SWRT data as per the Hvorslev's method (refer to worksheets provided in Appendix C). A summary of the hydraulic conductivity values estimated from the field SWRT is provided in the table below.

Table 9 - Hydraulic Conductivity and Factored Infiltration Rates from Single Well Response Tests

Well ID	Well Depth, m bgs	Screen Length, m	Formation Screened	Estimated Hydraulic Conductivity, m/s	Factored Infiltration Rate mm/hr
BH1/MW	4.57	3.05	Silt Till with sand / sand and gravel seams	7.72×10^{-5}	58
BH3/MW	4.57	1.52	Poorly graded, fine grained sand	2.23×10^{-7}	12
BH9/MW	4.57	3.05	Silty sand and silt till	3.75×10^{-6}	24

The test data results yield hydraulic conductivity values which are in the range of 10-5 to 10-7 m/s for the water-bearing sand layers within the silt till soils.

Onsite Verification During Construction

Both approaches which are presented above yield results which are within a similar range. However, a number of factors can influence the actual soil permeability and infiltration rate onsite during the site grading activities, including cut-fill activities, and the use of onsite or imported materials to achieve design grades. It is recommended that geotechnical inspection of materials which are used onsite and field testing during the construction phase of the project be carried out to confirm that infiltration rates which have been used for design purposes are appropriate to the actual site conditions.

3.1.3 Shallow Groundwater Conditions

Short term water level observations were recorded from the open boreholes at the time of installation. Groundwater observations in the open boreholes and a review of soil moisture contents are indicative of the shallow groundwater generally being contained within the sandy soils near surface, or within intermittent and discontinuous wet sand/sand and gravel seams. Short term water levels were measured between 4.0 and 5.9 m depth, with some boreholes being open and dry at completion.

Manual groundwater level measurements were recorded in the monitoring wells installed across the site on an intermittent basis from 2021 through to 2025, and are summarized in the following table (refer to Table 10 on the following page).

Shallow groundwater generally is present within the near-surface sandy soils, or upper weathered silt till soils. The shallow groundwater is heavily influenced by the surface topography, and the presence of the tributary drain which is present in the south end of the. Localized overland flows and perched shallow groundwater flows are towards the drain, which conveys surface flows towards the Thames River, to the north. In the north part of the proposed development area, the groundwater flow direction is towards the drain to the west, and towards the north woodlot area, as shown on Drawing 8. Where monitoring wells are not present, consideration has been given to short term groundwater observations in open boreholes, and soil moisture content to determine inferred groundwater contour data. In our experience in this part of the City, it is typical for local creeks and drains to have a localized drawdown effect, influencing the regional groundwater flow towards the Thames River. The groundwater contours shown on Drawing 8 are consistent with this interpretation, and with the recorded water levels in the wells and piezometers onsite.

It is further noted that although the water levels measured in BH/MW3 are above the other monitoring points at the site, that no significant seeps or other shallow groundwater daylighting on the face of the slopes of the existing creek banks in proximity to the well, has been observed by Stonecairn field staff.

Shallow groundwater will vary in response to climatic or seasonal conditions, and, as such, may differ at the time of construction, with higher levels possible during mild weather conditions which create melting conditions, and during wet periods. The monitoring wells have remained in place to allow for additional groundwater level monitoring under seasonal conditions.

Table 10 - Stabilized Groundwater Observations (2021-2022)

BH1	256.64	1.22 *255.42*	1.12 *255.52*	1.20 *255.44*	1.21 *255.43*	0.78 *255.86*	0.83 *255.81*	0.78 *255.86*	0.41 *256.23*	1.20 *255.44*	1.43 *255.21*	1.28 *255.36*
BH3	260.17	3.13 *257.04*	3.17 *257.00*	3.20 *256.97*	3.29 *256.88*	3.05 *257.12*	3.06 *257.11*	2.66 *257.51*	2.65 *257.52*	2.95 *257.22*	3.35 *256.82*	3.46 *256.71*
BH9	256.09	0.75 *255.34*	0.47 *255.62*	0.40 *255.69*	0.82 *255.27*	0.20 *255.89*	0.23 *255.86*	0.14 *255.95*	0.00 *256.09*	0.40 *255.69*	2.11 *253.98*	2.90 *253.19*

Note: Groundwater measurements are recorded as depths below ground surface (m bgs) *and as groundwater elevations (m asl)*

Table 10 continued - Stabilized Groundwater Observations (2023-2025)

BH1	256.64	1.38 *255.26*	0.65 *255.99*	1.29 *255.35*	1.43 *255.21*	1.38 *255.26*	0.38 *256.26*	0.66 *255.98*	0.84 *255.80*	0.9 *255.74*
BH3	260.17	3.3 *256.87*	2.97 *257.20*	2.87 *257.30*	3.08 *257.09*	3.23 *256.94*	2.72 *257.45*	2.70 *257.47*	2.67 *257.50*	2.57 *257.60*
BH9	256.09	0.98 *255.11*	0.20 *255.89*	1.07 *255.02*	1.07 *255.02*	1.65 *254.44*	0.08 *256.01*	0.06 *256.03*	0.00 *256.09*	0.25 *255.84*
PZ201	*Water surface*	--	--	--	--	--	--	*255.68*	*255.64*	*255.66*
PZ202	*Water surface*	--	--	--	--	--	--	*255.73*	*damaged*	*damaged*

Note: Groundwater measurements are recorded as depths below ground surface (m bgs) *and as groundwater elevations (m asl).*

3.1.4 Groundwater Quality

The monitoring wells at BH1/MW and BH9/MW were developed on July 14, 2021, including the removal of the equivalent of three water-columns of water. Samples were collected by a technician wearing disposable nitrile gloves, and were collected using designated bailer tubes. Water samples were placed in laboratory-supplied sample bottles, labelled with a unique sample number, dated, and recorded on the laboratory chain of custody form. Groundwater samples for metals analyses were field-filtered prior to preservation using dedicated 0.45 micron in-line filters. Samples were immediately placed in a cooler with ice for delivery to an accredited laboratory (Paracel Laboratories Inc. depot in London Ontario) under a Chain of Custody.

The analytical testing included the following sampling parameters.

- Dissolved Metals: Standard Metals Package for General Chemistry;
- Cation and Anion Parameters;
- Nutrients: Nitrate, Nitrite
- General Inorganic Parameters: pH, Total Suspended Solids, Electrical Conductivity, Hardness.

A full comparison of the groundwater results to the Ontario Drinking Water Standards is provided in Appendix D, for reference. The following observations are considered noteworthy from a review of the general chemistry results of the groundwater samples:

- Dissolved chloride levels were recorded at 4 and 28 mg/L. Corresponding concentrations of 17,400 to 34,700 μg/L for dissolved sodium, and 1630 to 6150 μg/L for dissolved potassium were also recorded in the sample. Chloride is widely distributed in nature, generally as the sodium (NaCl) and potassium (KCl) salts. Sodium chloride and, to a lesser extent, calcium chloride (CaCl2) are used for snow and ice control in Canada. In addition, the historical agricultural use of the property, would also contribute to the range of concentrations noted.
- The water sample is considered 'very hard', with a hardness level in the range of 305 to 468 mg/L. The cations that are the major contributors to hardness, are calcium and magnesium. The testing indicates concentrations of calcium (78,800 to 181,000 μg/L) and magnesium (19,800 to 53,500 μg/L), which contribute to the overall water hardness.
- Concentrations of Manganese (55 and 306 μg/L) were recorded in both water samples. Both of these results do not fall within the Ontario Drinking Water Quality aesthetic objectives which specify the maximum acceptable concentration of nitrates as 50 mg/L. Concerns regarding the presence of manganese in drinking water are often related to consumer complaints regarding discoloured water. The aesthetic objective is intended to minimize the occurrence of discoloured water complaints based on the presence of manganese oxides

Due to the surface water conditions being regularly influenced by stormwater runoff being conveyed through the municipal drainage system, baseline water quality testing within the watercourse has not been conducted. It is recommended that through the detailed design process and prior to construction, and/or prior to the watercourse receiving any construction dewatering or directed stormwater flows from the site, that baseline water quality testing be carried out. In this regard, dedicated sampling locations should be established within the watercourse, to facilitate comparison of water quality conditions with regard to perspective inputs, and can continue to be used for monitoring purposes through construction and post-construction.

4. SLOPE STABILITY

A slope stability assessment was carried out to assess the valley slopes along the Fekete Drain (a Thames River tributary drain). During various site visits, the slopes along the Fekete Drain are generally described as being well vegetated with a mixture of young and mature trees. No water seepage or signs of significant overland erosion were observed in the face of the slopes; however, it is anticipated that minor localized seepage where surface water which has infiltrated through the weathered near-surface soils may daylight at the slope under wet weather conditions. Similar site conditions have been observed by Stonecairn field staff.

The slope condition has been documented using the Ministry of Natural Resources and Forestry (MNRF) Slope Stability Rating Chart. The Rating Chart summarizes site observations and empirically scores various elements which contribute to slope stability, to assess the potential for slope instabilities at the site. A copy of the typical slope rating charts are provided in Appendix E for reference, and indicate a low potential for instability.

4.1 Stable Slope Geometry

Ten cross sections were surveyed along the Fekete Drain, at the locations identified on Drawing E1, in Appendix E. Data gaps in the survey data relied upon topographic mapping obtained from the City of London OBM mapping. The overall slope height was ranges some 2.0 to 4.0 m along the drain alignment. The boreholes generally revealed a layer of surficial topsoil which is underlain by a layer of silt till. Intermittent sandy soils are also expected to be present along the drain. Groundwater seepage was observed in the nearby boreholes, and surface water was observed along the drain. As such, the analysis considers minor groundwater seepage at the slope face under seasonally wet conditions. A computational slope stability analysis (using Slope/W) was conducted using the following soil parameters based on the results of the field program:

Table 11: Soil Parameters for Slope Stability Analysis

Soil Type	Unit Weight	Angle of Internal Friction	Cohesion
Sand	19.5 kN/m^3	33°	0 kPa
Silt Till, compact	18.5 kN/m^3	28°	0 kPa

A number of potential failure types were assessed, including shallow slumping/sliding failures, medium depth rotation failures near the crest of the slope, and deep rotational failures through the entire height of the slope. A minimum factor of safety of 1.4 is recommended as the threshold for an acceptable slope stability, as indicated in the report "Geotechnical Principles for Stable Slopes" prepared for the Ministry of Natural Resources.

Slope stability calculations using Slope/W software indicate the following range of factors of safety.

Table 12: Slope Stability Factors of Safety

Cross Section	Shallow Sliding Failure	Medium Depth Failure	Deep Rotational Failure
Slope Profile A	>1.42	> 2.2	> 4.2
Slope Profile B	>1.92	> 2.6	> 4.4
Slope Profile C	>2.16	> 3.3	> 4.8
Slope Profile D	>1.40	> 2.2	> 2.8
Slope Profile E	>1.88	> 3.0	> 4.3
Slope Profile F	>1.77	> 2.6	> 3.8
Slope Profile G	>1.59	> 2.5	> 4.2
Slope Profile H	> 1.63	> 2.3	> 4.0
Slope Profile I	>1.75	> 2.6	> 3.9
Slope Profile J	>1.71	> 2.5	> 3.8

The lowest factors of safety occur for shallow sliding failures in the most steeply inclined part of the slope in each case. The slip planes generally intersect the less steep portions of the slope, and would result in localized slumping. The factors of safety for medium and deep rotational failures are greater than 2.2 and 2.8 respectively for all profiles, indicative of an overall stable slope condition along both sides of the drain.

4.2 Toe Erosion Allowance

The toe erosion allowance allows for potential erosion or recession of the slope toe resulting from flows along the existing watercourse. A toe erosion allowance for the Fekete Drain has been applied at the toe of the existing slopes for each side of the drain, as shown on the cross sections on drawings E2, E3, E4 and E5 in Appendix E.

Given the anticipated flow through the drain, and a nominal depth in the range of 0.5 m and the soil conditions documented in the boreholes located closest to the slopes, a toe erosion allowance of 5.0 has been applied to Fekete Drain.

4.3 Emergency Access Allowance

The emergency access allowance is required to ensure that there is a large enough safety zone for people and vehicles to enter and exit an area during an emergency, such as flooding and/or slope failure. Since the subsurface conditions within the study area are generally considered to be geologically stable, a 6 m setback is considered to be appropriate for the site, and should be applied to the tableland area, immediately adjacent to the defined top of existing (stable) slope.

4.4 Erosion Hazard Limit

The Erosion Hazard Limit includes the following 3 elements in determining the setback limits from a geotechnical standpoint:

- Toe Erosion Allowance (5.0 m from edge of watercourse)
- Stable Slope Setback based on the stable slope geometry of (top of existing slope_)
- Emergency Access Allowance (measured at 6 m from the limit of the toe erosion allowance or the top of slope, whichever is greater)

Ultimately the erosion hazard limit also defines the development limit for the site. Based on the analyses, the erosion hazard limit is located some 8.2 to 9.5 m back from the top of existing slope, as summarized in the following table. It is noted that the EHL setback is presented for the west side / east side of the drain.

Table 13: Slope Stability Factors of Safety

Cross Section	Toe Erosion Allowance (m)	Top of Stable Slope (m)	Emergency Access Allowance (m)	EHL – Setback from top of existing slope (m)
Slope Profile A	5.0	No additional setback	6.0	9.1 / 9.2
Slope Profile B	5.0	No additional setback	> 4.4	7.7 / 8.7
Slope Profile C	5.0	No additional setback	> 4.8	8.6 / 9.8
Slope Profile D	5.0	No additional setback	> 2.8	10.6 / 8.6
Slope Profile E	5.0	No additional setback	> 4.3	9.1 / 8.2
Slope Profile F	5.0	No additional setback	> 3.8	8.6 / 8.2
Slope Profile G	5.0	No additional setback	> 4.2	6.0 / 9.6
Slope Profile H	5.0	No additional setback	> 4.0	6.4 / 9.6
Slope Profile I	5.0	No additional setback	> 3.9	8.1 / 7.5
Slope Profile J	5.0	No additional setback	> 3.8	8.1 / 10.3

Drawing E1 shows the defined EHL along the Fekete Drain, and demonstrates the relevant findings of the slope analysis. It is noted that the geomorphological setbacks determined by others may provide additional setbacks which need to be considered in establishing the development setback. Similarly, ecological setbacks (by others) should also be reviewed. The most conservative of the three setbacks are expected to define the development limits along the drain.

4.5 Slope Stability Recommendations

The overall slope stability is considered to be in a stable condition, as indicated by the slope stability analyses presented previously. From a geotechnical standpoint, development outside of the erosion hazard limit can be carried out without detrimental impact to the long-term slope stability, provided that some care is taken by the contractors doing the work, and by adhering to the following recommendations.

- Where possible, uncontrolled surface water flows over the face of the slope should be minimized, to reduce the risk of surface erosion. Erosion control measures may be required during construction, to reduce the risk of concentrated surface water flows from causing surface erosion.
- Excavated soils should not be placed over the tableland near the crest of the slope. Any fill placement or changes to existing grades in proximity to the site slope may be subject to review and approval by the UTRCA.
- Care must be taken when excavating for building footings and foundations in proximity to the top of the slope, to ensure that excavations are provided with adequate sidewall support. The design of any excavation support system should be prepared by a certified engineer, and should consider the loading associated with the sloped surface.
- In the event that existing drains are exposed during the excavation and site work for the proposed residence, the drains should be restored and re-routed to ensure continued controlled flows into an appropriate discharge location away from the slope face.
- Vegetation on the slope should be maintained. A program of plantation where appropriate, including deciduous trees and deep-rooted vegetation is recommended.
- Final design drawings including final building locations should be reviewed by this office to ensure that the comments and recommendations provided in this report have been properly interpreted.

It is also noted that portions of the drain alignment may be subject to larger setback values based on the geomorphological review work for the site, as well as the ecological setbacks which are identified through the EIS. Where greater setbacks are identified, they should take precedent in determining the final development setback limits.

5. GEOTECHNICAL DISCUSSION

The proposed development will include the construction of a multi-block subdivision which will include commercial blocks, office space, along with research and development blocks, which will be accessed from an internal roadway system, connected to Hamilton Road at the southern end of the site. It is understood that current lotting is only proposed for a portion of the lands (approximately 16.3 ha).

The boreholes generally revealed a layer of surficial topsoil which is underlain by interlayered deposits of sand and silt till. Shallow groundwater is present in the near-surface sandy soils, perched above the less permeable silt till, with stabilized water levels measured some 0.4 to 3.2 m below existing ground surface (generally below Elevation 257.0 m). Depending on the timing of construction, it is anticipated that seasonal conditions may cause variations in the stabilized groundwater level.

The following sections of this report provide geotechnical comments and recommendations to assist with design and construction of the proposed development, including: site preparation (including the re-use of excavated materials as engineered fill, structural fill, and guidance for engineered fill placement), temporary excavations (including maximum slope inclinations to provide stable excavation side slopes in accordance with OHSA requirements), excavation support (shoring methods and lateral earth pressures), groundwater control (including the need for a Permit to Take Water (PTTW) or Environmental Activity and Sector Registry (EASR) submission for construction dewatering, foundation design (including soil bearing capacity, subgrade preparation, and allowable settlements), slab-on-grade and basement construction (including provisions for shallow groundwater conditions, if encountered), site servicing (including the re-use of onsite soils in service trenches, pipe bedding, trench backfill, and trenchless technology options), stormwater management considerations (including an evaluation of possible LID measures,) and pavement design (including pavement component thicknesses for local roads and pavement connections which extend into the municipal right-of-way).

5.1 Site Preparation

5.1.1 Site Grading Activities

Based on existing site conditions, it is expected that some site grading activities will be required. Vegetation removal and topsoil stripping is anticipated throughout the area to be developed. In general, this is expected to require the removal of 200 to 450 mm of surficial topsoil. Thicker topsoil areas may be present in proximity to existing wooded areas, and where local depressions are present at the site.

Surficial topsoil may be stockpiled on site for possible re-use as landscaping fill. Stockpiling locations should be kept at least 30 m away from the woodlot located along the northern limits of the area to be developed. In the event that material is disposed of offsite, testing of the material for transport should conform to MECP Guidelines and requirements.

There were a set of buildings and structures formerly located in the southeastern part of the site. In the event that old and/or abandoned septic tanks or septic distribution systems are encountered, they should be removed in their entirety. Septic tanks should be pumped out by licensed contractors, prior to being removed from the site. In the event that any old or abandoned wells are revealed, they should be properly decommissioned under the supervision of a licensed well technician, in accordance with O.Reg. 903.

Fill material containing building debris is generally not expected to be suitable for re-use onsite, except where landscaping (non-structural) fill may be needed. Offsite disposal of these soils will require analytical testing, in accordance with MECP Guidelines and classification requirements for transport and disposal. The testing requirements for disposal will depend on the requirements outlined by the receiver.

Prior to placement of engineered fill or new building foundations, existing fill and topsoil, vegetation and otherwise deleterious materials should be removed. Once complete, the exposed subgrade should be thoroughly proof-rolled and inspected by a geotechnical inspector. Any loose or soft zones noted during the inspection should be over excavated and replaced with approved fill.

In areas which engineered fill is to be placed to raise grades, the exposed subgrade soils should be reviewed approved by the geotechnical consultant following topsoil stripping. In accordance with the Ontario Building Code (Section 4.2.4.15), foundations may be set on fill material provided that it can be demonstrated that the fill is capable of safely supporting the building and that detrimental movement of the building will not occur. In this regard, it is recommended that any fill material placed in future building footprints be engineered and verified through an inspection and testing program. Engineered fill should consist of suitable, compactable, inorganic soils, which are free of topsoil, organics and miscellaneous debris. For best compaction results, the fill material should have a moisture content within about 3 percent of optimum, as determined by Standard Proctor testing.

The placement of the engineered fill should be monitored by the geotechnical consultant to verify that suitable materials are used, and to confirm that suitable levels of compaction are achieved. The engineered fill material should be placed in maximum 300 mm (12 inch) thick lifts and uniformly compacted to 100 percent Standard Proctor Maximum Dry Density (SPMDD). Additional notes regarding engineered fill placement are provided in Appendix A.

The existing natural subgrade soils, comprised of sand, silt till and sand and gravel that are not mixed with obviously unsuitable material may be suitable for re-use as engineered fill. The possible re-use of onsite soils should be subject to review and approval by the geotechnical consultants.

Fill material containing building debris and / or topsoil and organic inclusions is generally not expected to be suitable for re-use onsite, except where landscaping (non-structural) fill may be needed. Offsite disposal of these soils will require analytical testing, in accordance with MECP Guidelines and classification requirements for transport and disposal. The testing requirements for disposal will depend on the requirements outlined by the receiver.

In the event that a water supply well is encountered, it should be decommissioned in accordance with the Regulations outlined in O.Reg. 903. This same regulation applies to the decommissioning of monitoring wells, when they are no longer required.

5.1.2 Excess Soils Management Considerations

In December of 2019, the Ministry of Environment, Conservation, and Parks (MECP) released a regulation under the Environmental Protection Act, titled *On-Site and Excess Soil Management* to support improved management of excess construction soil. The current version of Regulation 406/19 includes amendments which were introduced in December 2024.

Excess soil is defined as material that was generated during construction activities at a Site but will not be needed for grading, fill, or other purposes and therefore needs to be transported off-Site. The regulation requires a project leader to comply with specific requirements before removing excess soil from a project area.

Generally, these requirements include:

- Preparation of an Assessment of Past Uses Report which is similar to a Phase One Environmental Site Assessment for the source site, to evaluate the presence of potentially contaminating activities which may have resulted in the potential for impacted soil or groundwater conditions to be present at the source site;
- Preparation and implementation of a Sampling and Analysis Plan which outlines the suggested sample locations and sampling intervals, analytical sample testing parameters, and sampling frequency;
- Preparation of a Soil Characterization Report, following the soil sampling and analytical testing;
- Preparation of an Excess Soil Destination Assessment Report which identifies where excess soils can be disposed offsite, including a review of Beneficial Reuse Sites, if the developer and/or their contractor have a potential re-use site being considered; and,
- Development and implementation of a tracking system.

The site is within a predominantly agricultural area. Stonecairn is not currently aware of the site being considered as an “enhanced investigation project area” as defined in O.Reg. 406/19 and O.Reg. 153/04, as amended. Provided that no significant environmental concerns were identified with respect to current and/or former activities at the subject properties, the proposed development may be considered to qualify for an exemption from the regulatory requirements (preparation of planning documents, soil characterization, and tracking requirements), as noted in Section 8 of the Regulation.

Offsite disposal of excess soils may still require soil characterization and analytical testing to satisfy the receivers of excess soil. Coordination with their QP will be required to ensure that their testing requirements are satisfied prior to transporting soils offsite for beneficial reuse or disposal off-site.

It is noted that under the Regulation, the onus is on the Excess Soil Source Site to carry out environmental soil quality testing for the removal and transport of their excess soils. The property owner is expected to retain a Qualified Person (QP) to assist in the preparation of the aforementioned documents and in the soil characterization work (environmental testing on select soil samples), prior to any excess soils being removed from the Site. Stonecairn has staff that can provide this service, if required.

In the event that the site requires imported fill material to achieve design grades, the site would be characterized as a Beneficial Re-Use Site. As such, a Qualified Person (QP) will need to be retained to prepare an Excess Soil Destination Assessment Report (ESDAR), which outlines the geotechnical requirements for beneficial reuse of imported materials onsite along with the environmental soil quality criteria (including the applicable O.Reg. 153/04 Site Condition Standards) for material which is appropriate to be accepted at the Site.

For the purpose of importing and stockpiling materials at the site, consideration should be given to accepting material which has concentrations consistent with, or less than the standard concentrations identified in O. Reg. 153 (last amended April 15, 2011) meeting Table 2 Site Condition Standards (for commercial land-use) criteria is considered appropriate.

5.2 Methane Abatement

As presented in MECP Guideline D-4-1, the LEL (lower explosive level) of methane is generally considered to be 5% methane by volume. That means the mixture is too lean to burn if there is less than 5% methane present. But at 5%, it can burn or explode if there is an ignition source. The total combustible vapours are presented as an equivalent % LEL value in the above table.

A threshold limit of 500 ppm is used for monitoring purposes, to identify if a potential hazard exists (equivalent to 0.05% methane). For additional reference, the National Institute for Occupational Safety and Health's (NIOSH) maximum recommended safe methane concentration during an 8-hour period is 1,000 ppm.

No discernable methane concentrations were recorded in the open boreholes. As noted in Section 9.13.4.2 (b) of the Ontario Building Code, where detected soil gas levels remain below the threshold limit identified above, no special methane abatement measures are required.

5.3 Excavations and Groundwater Control

Excavations for the proposed buildings and site services are generally expected to extend into the natural sand and silt till soils, or possible engineered fill material, depending on final site grades. Site servicing depths are generally expected to be in the range of 4 m maximum depth.

All work associated with design and construction relative to excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). The following soil classifications are provided in accordance with Section 226 of Ontario Regulation 213/91:

- The compact silt till encountered in each borehole is generally classified as Type 2 soil. For excavations which extend through or terminate in Type 2 soil, temporary excavation side slopes must be cut near vertical in the bottom 1.2 m, and sloped back at an inclination of 1H:1V above that level.
- The natural sand, and gravel and sand soils encountered in each borehole are generally classified as Type 3 soils above the stabilized water table, or where soils have been suitably dewatered. For excavations which extend through or terminate in Type 3 soil, temporary excavation side slopes must be cut back at a maximum inclination of 1H:1V from the base of the excavation.

It should be noted that, if wet seams or zones are encountered, some sloughing to flatter slopes may be expected. If the construction excavation side slopes recommended above cannot be maintained due to lack of space or close proximity of other structures, an engineered excavation support system must be used. Minimum support system requirements for steeper excavations are stipulated in Sections 234 through 242 of the Occupational Health and Safety Act. The engineered shoring system, if required, must be in place prior to commencement of the installation operations.

5.3.1 Excavation Support

If space restrictions at the site do not allow for conventional open cut without risk of undermining, or where excavation sizes are to be limited, the use of adequate bracing or shoring may be required. In the natural subgrade soils, bracing will not normally be required if the structures are behind a 45-degree line drawn up from the near edge of the excavation.

If the construction excavation side slopes recommended above cannot be maintained due to lack of space or close proximity of other structures, an engineered excavation support system must be used. Minimum support system requirements for steeper excavations are stipulated in Sections 234 through 242 of the Act and Regulations. The shoring system must be designed to be internally (overturning, and sliding) and externally stable (slope stability/base heave).

A prefabricated trench box may be used provided that it is designed (by a professional engineer) to withstand the soil and hydrostatic loading (if applicable). Based on the field and laboratory testing during the present geotechnical investigation and our experience with similar soils, the following soil parameters are recommended for the design of the engineered shoring system.

Table 14 - Soil Parameters for Excavation Support

Soil	φ	γ (kN/m³)	K_a	K_o	K_p
Compact Silt/Silt Till	28	19.5	0.36	0.53	2.78
Compact Sand and Silty Sand	30	19.5	0.33	0.50	3.15
Compact Sand and Gravel	30	21.5	0.32	0.47	3.20
Compact Granular 'B' (OPSS 1010)	32	22.0	0.31	0.47	3.25

In the event that imported fill material is present near the excavation which vary materially from the above soils, the geotechnical consultant should review the soil conditions to confirm the design parameters.

5.3.2 Groundwater Control

Shallow groundwater conditions were encountered at the site, contained within sandy soils which are perched above and within the predominant silt till soils. The depth to shallow groundwater was typically measured some 0.4 to 3.2 m below existing ground surface, with seasonal high conditions near ground surface at BH9.

Conventional groundwater control methods are expected to be suitable for shallow excavations which remain above the stabilized groundwater table at the site, to address surface water infiltration and minor shallow groundwater seepage from thin sand seams for excavations which do not extend below the stabilized groundwater table.

Where excavations extend below the stabilized groundwater table, or where groundwater levels are elevated, positive groundwater control methods will need to be utilized for construction dewatering. Soil permeability values in the natural sandy subgrade soils are expected to be in the range of 10^{-4} to 10^{-6} m/s, based on laboratory and field testing (presented in Section 3.1.2). Groundwater control measures at the site should be sufficient to maintain stable excavated slopes; and provide a dry and stable base for excavations and construction operations. The contractor should use a reasonable effort to direct surface run-off away from open excavations.

It is anticipated that installation of site services to conventional depths may require groundwater control measures which can accommodate over 50,000 L/day. As such, a submission to the Environmental Activity and Sector Registry (EASR) will be required. The EASR should be supported by a Construction Dewatering and Discharge Plan, prepared by a qualified person. Stonecairn can assist in this regard. Water taking volumes are not expected to be in excess of 400,000 litres per day; therefore, a Permit to Take Water (PTTW) is not anticipated for this development. However, the water taking volumes should be reviewed when detailed design information is available, to confirm the permitting requirements.

The existing wells at the site may be used for ongoing/future groundwater monitoring. Seasonal variations in the groundwater level are anticipated at the site. In this regard, consideration should be given to establishing a program of manual groundwater measurements or installation of dataloggers in select wells to provide a continuous record of seasonal groundwater levels that can be used to assist in the detailed design of the proposed subdivision development. Stonecairn would be pleased to assist in providing a scope and budget for this work.

5.4 Building Design and Construction

The following geotechnical comments and recommendations are provided for typical single-family construction, which may be considered on the subject lands.

5.4.1 Foundation Design

For design of footings on the natural subgrade soils below 1.2 m below existing grades or supported on engineered fill, the following allowable bearing pressures (net stress increase) can be used for design of footings:

- Serviceability Limit States (SLS) 145 kPa (~3000 psf)
- Ultimate Limit States (ULS) 225 kPa (~4700 psf)

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m (4 ft.) of soil cover or equivalent insulation.

The natural sandy subgrade soils may be susceptible to disturbance by construction activities, especially during adverse weather conditions or when water seepage from excavation sidewalls are present. Consequently, after the founding surfaces have been exposed, the soils should be thoroughly recompacted to provide a uniform base, suitable to provide the bearing capacity noted above. Consideration should be given to placing concrete foundations as soon as possible following excavation and subgrade inspection.

Excessive differential settlements can occur where the subgrade support material types differ below the underside of continuous strip footings, (i.e., natural sand soils to engineered fill). As such, where strip footings transition from one material to another the transition between the materials should be suitably sloped or benched to mitigate differential settlements. It is recommended that the following transition precautions to mitigate/accommodate potential differential settlements be considered, and incorporated into the design, subject to review by the structural engineer:

- For strip footings, the transition zones should be adequately reinforced with additional reinforced steel lap lengths or widened footings;
- Steel reinforced poured concrete foundation walls; and
- Control joints throughout the transition zone(s).

Individual spread footings should generally be spaced a minimum distance of 1.5 times the largest footing width apart from each other to avoid stress bulb interaction between footings. This assumes the footings are at the same elevation.

Footings at different elevations should be located such that the higher footings are set below a line drawn up at 10 horizontal to 7 vertical from the closest edge of the lower footing. It is important that servicing excavations which encroach on the building foundations are checked to ensure that they do not undermine the building foundations.

Verification of the footing base conditions should be undertaken by the geotechnical engineer at the time of excavation. Provided that the stability of the soils exposed at the founding level is not compromised as a result of construction activity, precipitation, cold weather conditions, etc., and the design bearing pressures are not exceeded, the total and differential settlements of footings are expected to be less than 25 mm and 19 mm, respectively.

It should be noted that the recommended bearing capacities have been calculated by based on the observations of the soil and groundwater conditions within the borehole program at the site. Where variations occur between the borehole locations, and during construction of the new buildings, site verification by the geotechnical engineer is recommended to confirm soil conditions and verify soil bearing capacity.

Site specific Geotechnical Investigations are advised within the proposed blocks to confirm soil bearing capacity and to provide geotechnical comments and recommendations specific to the proposed building plans.

5.4.2 Concrete Slab Construction

Concrete floors may be constructed using conventional concrete poured slab techniques, following the review and approval of the subgrade soils.

In preparation for the construction of the floor slab, any unstable (loose) fill material should be removed and recompacted (as noted previously) where founding soils will support the floor slab. In the event that the exposed subgrade soils are wet they will exhibit a greater sensitivity to disturbance. Structural fill placed below the concrete floor slab should be comprised of inorganic soils, placed and compacted in uniform lifts, to a minimum of 98 percent SPMDD.

Care should be taken to protect the subgrade below the floor slab during construction, by limiting construction traffic on the prepared subgrade soils. In addition, if the exposed subgrade soils are exposed to inclement weather conditions (i.e. rain, snow, freezing conditions), some remedial works may be required to remove wet, soft, or disturbed soils prior to stone and concrete placement.

A moisture barrier, consisting of a minimum 200 mm thick of uniformly compacted 19 mm clear stone should be placed over the approved subgrade. For design purposes, the modulus of subgrade reaction (k) can be taken as 45 MPa/m, for the compacted stone over approved subgrade soils. An alternate configuration of compacted granular material such as OPSS 1010 Granular A may also be considered for the moisture barrier. If alternative materials are proposed for use onsite, the minimum level of compaction and overall design thickness of the moisture barrier layer should be reviewed by the geotechnical consultant.

The water-to-cement ratio of the concrete utilized in the floor slab should be strictly controlled to minimize shrinkage of the slab. Adequate joints and / or the use of fibre reinforcement may be considered by the designer to help control cracking. The sawcut depth for control joints should be ¼ of the slab thickness. The use of super plasticizers should be considered to reduce shrinkage and increase workability of the concrete.

Exterior concrete slabs and concrete aprons may also be constructed using conventional slab-on-grade techniques. For external concrete slabs, or where slab-on-grade concrete is placed in unheated areas, and where settlements cannot be tolerated, consideration may be given to provide insulation below the slabs to minimize the potential for movements as a result of frost action. In general, the use of high-density rigid board extruded polystyrene, such as DOWTM HI-40 or equivalent is considered appropriate. Stonecairn can provide additional recommendations regarding design thickness, depending on specific structural requirements. In general, the insulation should extend a minimum of 1.2 m beyond the edges of the slab. The portion of the rigid board insulation which extends beyond the edges of the slab should be sloped in a manner that promotes drainage of surface water away from the slab area.

In the event that exterior concrete slabs abut the building, it is recommended that a suitable expansion joint be used between the exterior slab and the building foundations.

During construction, concrete sampling and testing is recommended to ensure that concrete mix design requirements are satisfied.

5.4.3 Loading Docks & Loading Bays

It is anticipated that some industrial and commercial buildings may incorporate loading docks and loading bays into their building design. The retaining walls associated with the proposed loading docks will be subjected to lateral earth pressures. If small lateral movements in the structure can be tolerated, earth pressures behind the walls will reduce the active condition as the shear strength of the soil is mobilized. If no movement in the structure can be tolerated, the wall must be designed employing an at rest condition.

Assuming that the retained soil (backfill) is adequately drained to the base of the wall, the earth pressure generated at any depth (h) may be computed using the following expression:

$P = K(\gamma h + q)$

Where: p = pressure at any depth, in kPa;
K = coefficient of earth pressure (use 0.5 for at rest conditions; and 0.35 for active conditions);
γ = unit weight of the retained soil (backfill);
h = depth, in metres; and
q = surcharge allowance on the ground surface, if any, in kPa.

The above expression assumes that the build-up of hydrostatic pressure behind the wall has been prevented through appropriate drainage measures.

Material types and preliminary un-factored strength properties to assist in the lateral earth pressure calculations are provided in the following table for design purposes. The design calculations can be verified when actual retained soil materials are verified.

5.4.4 Foundation Drainage and Backfilling

As noted previously, shallow perched groundwater conditions are present at the site, and engineered fill placement is expected throughout much of the site to raise grades. Building foundations are generally expected to be set in the engineered fill, above the shallow groundwater level. Foundations (which are set above the high groundwater table) should be provided with damp-proofing and foundation drainage tiles, in accordance with standard Ontario Building Code (OBC) requirements. Consideration may be given to enhanced damp-proofing measures (such as subfloor drains), where there is reasonable concern that the basement level may encounter the high groundwater level on an intermittent basis.

In general, the existing soils excavated from the building footprints (from above the stabilized water level) are generally expected to be suitable for re-use as foundation wall backfill. The materials to be re-used as foundation wall backfill should be within three percent of optimum moisture content for best compaction results. It is recommended that heavy compaction equipment be restricted within 0.5 m of the wall. In the event that excavated materials contain topsoil, organics or otherwise unsuitable material, such materials should be stockpiled separately, and limited to re-use where settlements can be tolerated.

A review of the Site Grading Plans should be conducted to confirm that building foundations will be set above the stabilized groundwater level. If this can be confirmed, no special water-proofing measures are required. Foundations should be provided with damp-proofing and foundation drainage tiles, in accordance with standard Ontario Building Code (OBC) requirements. Perimeter drains should be wrapped with filter fabric, and set in stone to limit the movement of fines into the drain tiles.

5.4.5 Seismic Design Considerations

Subsoil and groundwater information at the Site have been examined in relation to Section 4.1.8.4 of the Ontario Building Code (OBC) 2024. The subsoils expected below the buildings will generally consist of compact silt and silt till soils with interbedded sand layers.

Table 4.1.8.4 -B, Site Classes, S for Site Designation Xs, OBC 2024 indicated that to determine the site classification, the average properties in the top 30 m are to be used. The Site Classification recommendation is based on the available information as well as our interpretation of conditions at and below the boreholes, and based on a review of geological mapping, and our knowledge of the soil conditions in the area.

Based on the above assumptions, interpretations in combination with the known local geological conditions, the Site Class for the proposed development is classified as “C” as per Table 4.1.8.4 -B. In the event that a higher Site Classification is being sought by the structural design engineer, additional deep boreholes and / or multichannel analysis of surface waves (MASW) testing would be required to determine if the soil conditions below the current depth of exploration can support a higher Site Classification.

5.5 Site Services

Subgrade soils beneath new services are generally expected to consist of sand and silt till soils. Although no bearing problems are anticipated for flexible or rigid pipes founded on natural deposits, localized base improvement along the trench bottom may be required for excavations which terminate in wet subgrade soils. The extent of base improvement or stabilization is best determined in the field during construction, with consultation from a geotechnical engineer.

For services supported on native deposits, the bedding should conform to Municipal and OPS Standards. Bedding aggregate should be compacted to a minimum 95 percent SPMDD. Water and sewer lines installed outside of heated areas should be provided with a minimum 1.2 m of soil cover for frost protection.

A well graded stone layer may be used in service trenches as bedding below the spring line of the pipe if necessary, to provide stabilization to the excavation base in wet subgrade soils, where encountered. Geotextile may be considered for wrapping the pipe and to limit movement of fines from surrounding soils into the bedding material. Potential locations for use of stone bedding can be identified through site inspection during construction and will vary across the site due to seasonal conditions and variations in perched groundwater conditions.

Requirements for backfill in service trenches, etc. should also conform to Municipal and OPS Standards. A program of in situ density testing should be set up to ensure that satisfactory levels of compaction are achieved. Based on the results of this investigation, excavated material for trenches will generally consist of sand and silt till. Select portions of this inorganic material may be used for construction backfill provided that reasonable care is exercised in handling the material. In this regard, material should be within 3 percent of the optimum moisture as determined by the Standard Proctor density test. Stockpiling of material for prolonged periods of time should be avoided. This is particularly important if construction is carried out in wet, adverse weather.

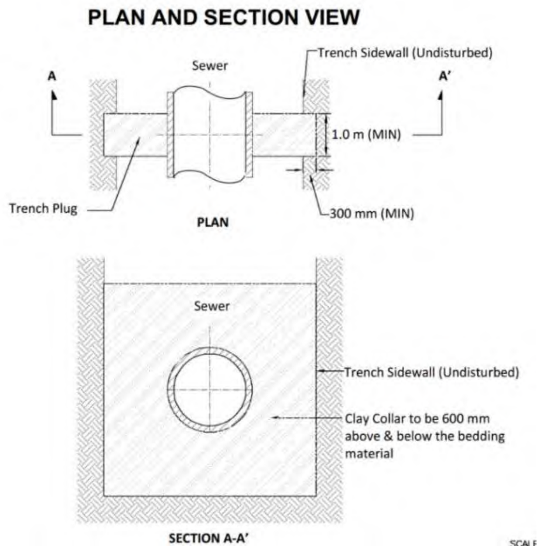
Soils excavated from below the stabilized groundwater table may be too wet for re-use as backfill, unless adequate time is allowed for drying, or if material is blended with approved dry fill; otherwise, it may be stockpiled onsite for re-use as landscape fill, or disposed of off-site, testing of the material for transport should conform to MECP Guidelines and requirements.

Backfill above bedding aggregate can consist of excavated (inorganic) soils, compacted in maximum 300 mm thick lifts to a minimum of 95 percent SPMDD. A program of in situ density testing should be set up to ensure that satisfactory levels of compaction are achieved.

5.5.1 Pipe Collars

In the event that seepage is encountered in open cut excavations, consideration should be given for the strategic use of trench collars along any deep sewers to minimize flow along the pipe bedding material. The location and frequency of collars use can be best assessed during the early stage of construction, by a geotechnical engineer. A typical detail is provided on the figure below. The figure also includes notes regarding the selection of soils to be used for the construction of anti-seepage collars. It is noted that design dimensions are provided on the schematic detail; however, additional depth and/or width of compacted soil may be required, if soils selected for use do not meet the recommended design parameters. The location of installed collars and any field adjustments to the provided detail will be documented through inspection and testing reports.

Figure 2: Trench Plug / Anti-Seepage Collar Schematic



Installation Notes

1. Trench plug shall be constructed of with 25 MPa concrete or plastic silty clay with moisture content about 3 percent above optimum moisture (as determined by the Standard Proctor density test).
2. Excavation shall be carried out to the minimum dimensions indicated on the sketches. Excavation below 600 mm depth below the groundwater table through the granular soils may require dewatering to maintain the stability.
3. When using clay to construct the trench plug, the excavation shall be backfilled with compacted silty clay or approved native materials to at least 98 percent SPMDD with the material specified in Item ii) to minimize settlement.
4. Required height of the clay collar should be at least 600 mm above and below the pipe. The geotechnical engineer may recommend additional height or depth, depending on soil and groundwater conditions.

5.5.2 Pipe Infiltration/Exfiltration Testing

In general terms, OPSS 410 and OPSS 407 specify that infiltration tests shall be conducted where the groundwater level at the time of testing is 600 mm or more above the crown of the pipe for the entire length of the test section, and exfiltration testing is appropriate where the groundwater level is 600 mm or more above crown of the pipe or the highest point of the highest service connection included in the test section.

Stabilized water levels have been measured at variable depths across the site. It is anticipated that sections of the storm and sanitary sewers will extend below the stabilized groundwater levels measured at the site. In this regard, suitable water-tight gaskets to prevent infiltration and exfiltration of groundwater and pipe effluent are required at joints and at manhole connections.

When testing is required (in accordance with OPSS 407 and OPSS 410), the test sections are expected to be defined between maintenance access / manhole locations. Infiltration tests shall be conducted where the groundwater level at the time of testing is 600 mm or more above the crown of the pipe for the entire length of the test section. Exfiltration testing is appropriate where the groundwater level is 600 mm or more above crown of the pipe or the highest point of the highest service connection included in the test section.

5.5.3 Considerations for Directional Drilling

It is understood that consideration may be given to install servicing using directional drilling techniques. The natural silt till soils encountered in the boreholes are well suited to accommodate directional drilling. Where the pipe is set within the undisturbed silt till, these soils are considered to be relatively self-supporting and an open bore can be achieved. Where sandy soils and wet sand seams are encountered, the conditions are more challenging; however, the use of drilling mud can assist.

The typical technique for installing pipe by directional drilling uses a surface mounted drill rig that launches drill rods creating a string of rods below the ground guided by a drill head that is directionally controlled by the drill operator. The direction of the drill is along a pre-determined path. A locating device is used during the drill to track the location of the drill head so that the operator may make adjustments as necessary.

A small diameter pilot hole is drilled from the entrance point (typically in a sending pit) to the desired exit point (receiving pit). It is necessary to use a drilling fluid during drilling to lubricate and protect the pipe, and to maintain the size of the hole being opened. Following the exit of the pilot drill bit, the hole is then enlarged by the use of a back-reamer attached to the end of the drill string which is pulled back through the pilot hole. As the back-reaming takes place, the pipe being installed is also pulled into the hole.

It should be noted that larger stone, such as cobbles and boulders, even if not encountered in the glacial deposits during the field investigation, may exist within the silt till, and thus could influence the progress of construction.

Sending and Receiving Pits

The work area for the sending and receiving pits must provide suitable access to the drilling equipment, and will require stable ground conditions to support the equipment. Site review by the geotechnical consultant is recommended to confirm the suitability of the site prior to drilling.

Excavations which extend through the silty soils are generally classified as Type 2 soils. Temporary excavation sidewalls should be cut back near vertical in the bottom 1.2 m, and sloped back at an inclination of 1H:1V above that level. Where excavation sidewalls extend through wet zones, side slopes may slough to flatter angles.

In the event that the base of the sending and receiving pits encounter the shallow perched groundwater, the base stability may be improved by placing a mud-mat or granular base layer over the exposed subgrade soils. This is best determined by a geotechnical engineer following a site examination of the excavations. Construction dewatering recommendations should be also reviewed in this regard once final design elevations are confirmed.

Construction Monitoring

Trenchless work should be carried out by a specialist contractor experienced in the area, and should be continually monitored for alignment and grade. If the work is carried out properly, and no significant obstructions are encountered, only nominal settlement would be expected in the overlying soils.

Monitoring drilling fluid returns is an important QA/QC procedure during directional drill installations. Full-time monitoring by a geotechnical engineer is recommended. Generally, drilling fluid, which carries soils from down-hole, should exit the hole at the entry or exit end of the installation. Drilling fluid flow provides visual verification that the hole is open and that the fluids are not inadvertently escaping.

5.6 Pavement Design

The development will be accessed with an internal road network, accessing Hamilton Road on the south end of the site. The exposed subgrade soils within the roadways are expected to be comprised of re-compacted soils comprised of sand and silt till. The road subgrade should be thoroughly proof-rolled and reviewed by the geotechnical consultant. In the event that loose or soft areas are noted, additional work may be required to sub excavate and replace unstable soils with suitable compactable material. In general terms, subgrade soils supporting site pavements should be compacted to a minimum level of 98 percent SPMDD.

The recommended pavement structure provided in this report is based on the natural subgrade soils encountered in the boreholes or suitably re-compacted soils, as described previously.

Provided that the preceding recommendations are followed, the pavement thickness design requirements given in the following table are recommended for the anticipated subgrade conditions and traffic loading on the internal network of local roads.

Table 15 – Pavement Design Recommendations

Pavement Component	Local Roads	Light Duty Pavements (Car Parking)	Heavy Duty Pavements (Truck Routes)	Restoration of Hamilton Road	Specified Compaction Levels
Asphaltic Concrete	40 mm HL 3 50 mm HL 8	35 mm HL 3 40 mm HL 8	40 mm HL3 60 mm HL8	60 mm HL 3 120 mm HL 8 (2 lifts)	Min. 97% BRD
Granular A Base	150 mm	150 mm	150 mm	150 mm	100% SPMDD
Granular B Subbase	400 mm	300 mm	400 mm	450 mm	100% SPMDD

Other granular configurations may be possible provided the granular base equivalency (GBE) thickness is maintained. These recommendations on thickness design are not intended to support heavy and concentrated construction traffic, particularly where only a portion of the pavement section is installed. If frequent construction traffic is anticipated while only a portion of the site pavements are in place, or if construction is undertaken in poor weather conditions, thickening of the granular subbase may be appropriate and/or the subgrade improved with a geotextile separator or geogrid stabilizing layer. This is best determined in the field during the site servicing stage of construction, prior to road construction.

In the event that a biaxial geogrid stabilizing layer is recommended at the time of construction, the source of the granular material should be reviewed to verify its compatibility with the geogrid. For example, where Tensar BX1200 (or equivalent) is utilized, the Granular B material should have a nominal size of 26.5 mm, with a maximum of 25 percent (by mass) passing the 4.75 mm sieve size.

In the event that Hamilton Road may be widened to accommodate turning lanes, the existing topsoil and/or fill material which may be present in the boulevard area should be removed, to expose suitable subgrade soils. Existing granular materials in the shoulder may be suitable for re-use to raise grades in the area of the existing drainage ditches. Fill placed adjacent to the existing roadway should be placed in maximum 300 mm thick lifts, and uniformly compacted to a minimum of 98 percent SPMDD. In this area, and where the roadway from the subdivision intersects the existing roads, subgrade levels and pavement components should be tapered to match / tie-into existing pavement structures to minimize differential settlements at the transition from existing to new pavement.

It is recommended that a program of inspection and materials testing (including laboratory analyses and compaction testing) be carried out during construction to confirm that geotechnical requirements are satisfied.

- Samples of both the Granular 'A' and Granular 'B' aggregates should be checked for conformance to OPSS 1010 prior to use on site, and during construction.
- The asphaltic concrete paving materials should conform to the requirements of OPSS 1150. The asphalt should be placed in accordance with OPSS 310.
- Specified compaction levels are identified in the table, above. Alternatively, to the specified compaction range noted in the above table for asphalt compaction, a compaction level of 92.0 to 96.5 percent of the Marshall relative density (MRD) is also an appropriate measure for asphalt compaction.

Good drainage provisions will optimize pavement performance. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum grade of two percent) to provide effective surface drainage. Short (3.0 m long) subdrains are recommended at each catchbasin location to intercept excess subsurface moisture and prevent subgrade softening. The subdrains should be comprised of 150 mm perforated pipe set in stone and wrapped in geotextile (Terrafix 270 R or equivalent).

5.7 Curbs and Sidewalks

Concrete for any new exterior curbs and sidewalks should be proportioned, mixed placed and cured in accordance with the requirements of OPSS 353, and OPSS 1350. Field sampling and testing of concrete should be in accordance with OPSS 904.

During cold weather (when the air temperature is at or is likely to fall below 5°C within 96 hours of concrete placement) the freshly placed concrete must be covered with insulating blankets to protect against freezing, as per OPSS 904. Ice and snow must be removed from the area where concrete is to be placed and the concrete must not be placed against frozen ground. All cold weather protection material shall be on site prior to each concrete placement.

Subgrade for sidewalks should consist of undisturbed natural soil or well compacted fill. A minimum 100 mm thick layer of compacted (minimum 100 percent SPMDD) Granular 'A' should be placed below sidewalk slabs. It is recommended that Granular 'A' material extend at least 150 mm beyond the edges of the proposed sidewalk. The subgrade and granular base should be prepared in accordance with the requirements of OPSS 315.

5.8 Fekete Drain Crossing

It is anticipated that there will be a road crossing at the Fekete Drain. A constructed box culvert crossing is expected to be utilized in this location. Excavations for the bridge foundations / abutments are generally expected to extend into the natural silt till. All work associated with design and construction relative to excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA), as discussed in Section 5.3.

Shallow groundwater conditions may be encountered in the foundation excavations. Minor groundwater seepage into the excavations can be handled with strategically located sump pits and pumps. Groundwater discharge should be directed to suitable locations, to ensure that sediment-laden water isn't being discharged into the watercourse, without suitable filtration measures.

Diversion measures are expected to include cofferdams to restrict flows, and a pump system to reroute water around the work area. The pumped water should be equipped with suitable filtration measures at the discharge point. Filter bags should be maintained (cleaned and/or replaced) to ensure that they function as intended for the duration of the dewatering works. Controlled outlets should be inspected to confirm that they are not going to result in scour, erosion or other adverse impacts to the drain.

For design of bridge foundations on the natural subgrade soils below 1.2 m below existing grades, the following allowable bearing pressures (net stress increase) can be used for design:

- Serviceability Limit States (SLS) 190 kPa (~4000 psf)
- Ultimate Limit States (ULS) 250 kPa (~5250 psf)

All footings exposed to seasonal freezing conditions should be protected from frost action by at least 1.2 m (4 ft.) of soil cover or equivalent insulation.

The natural subgrade soils may be susceptible to disturbance by construction activities, especially during adverse weather conditions or when water seepage from excavation sidewalls are present.

Consequently, after the founding surfaces have been exposed, the soils should be thoroughly recompacted to provide a uniform base, suitable to provide the bearing capacity noted above. Consideration should be given to placing concrete foundations as soon as possible following excavation and subgrade inspection.

5.9 Geotechnical Inspection and Testing

An effective inspection and testing program is an essential part of construction monitoring. The Inspection and Testing Program may include the following items:

- Subgrade examination prior to engineered fill placement and footing base confirmations for any foundations constructed on engineered fill;
- Inspection and materials testing during engineered fill placement (full-time monitoring is recommended) and site servicing works, including soil sampling, laboratory testing, and compaction testing;
- Inspection and testing during road construction, including compaction testing and laboratory testing for pavement components and concrete sampling and testing for curbs; and,
- Inspection and materials testing for base and surface asphalt, including laboratory testing for conformance to the asphalt mix design; and,
- Benkelman Beam deflection testing to confirm conformance to City of London specifications and standards.

The municipality will require a geotechnical (Schedule H) certification prior to assumption. The certification is prepared by the geotechnical consultant, based on their inspection and testing records which verify that project specifications have been satisfied for site servicing and road construction.

6. WATER BALANCE ANALYSIS

6.1 Overview and Methodology

For the purposes of documenting existing conditions at the site, the following table is provided which summarizes the elements of the water balance assessment.

Table 16: Water Balance Overview

Obtain precipitation values from a reliable source such as Environment Canada Meteorological Services for the area (utilize the closest station with adequate data)	Environment Canada Climate Normals 1991 – 2020 London Ontario Weather Station. Climate ID 6144475
Estimation of local values for water balance components (evapotranspiration, precipitation surplus, runoff, and infiltration) for pre-development, post-development and post-development with mitigation conditions	Estimated pre- and post-development values of evapotranspiration, precipitation surplus, runoff, and infiltration as summarized in the following paragraphs. Calculation sheets are provided in Appendix F, whose reference values are based on Table 3.1 of the MOE (now MECP) Stormwater Management Planning and Design Manual.
Calculations of impervious areas that reflect actual conditions based on the proposed site plan or a reasonable range of impervious areas.	Imperious area is based on existing conditions (farmland) and the anticipated property use and proposed densities). A summary of the total areas and percent impervious lands is provided in Appendix F.
The water balance is required to take into account the changes to grading/topography and land cover	Variables such as elevation, surficial soils, hydrologic soil group, vegetation, root zone, impervious areas, grading and topography are taken into account when estimating the pre- and post-development water balance components and are presented on the Water Balance Calculation Worksheets in Appendix F.
Grain size analysis for both the fill material and on-site soils to confirm that fill material is similar to existing soil conditions (maybe recommended)	Soil permeability values are based on correlation with collected sample gradation results presented in this report.
Appropriate catchments should be used within the analysis (i.e., delineate catchments based on drainage, grades, vegetation, and soils and show how infiltration and runoff will change within these zones for both pre-and post-development)	Under pre-existing conditions, the site was identified as two catchment areas for the calculations provided. Post-development subcatchment areas were delineated based on proposed lotting/blocks, property use, and existing site grades and typical vegetative cover expected.

Feature-Based Water Balance Assessment Parameters	**Reference**
The figure of catchments used within the pre- and post-development water balance	Pre-construction and conceptual post-development site plans (based on the Draft Plan of Subdivision) are included in Appendix F, fore reference.
All calculations should be provided in a table format which demonstrates that inputs (precipitation, additional runoff, water from municipal well, etc.) are equal to outputs (i.e., infiltration, runoff, evapotranspiration)	Calculations are summarized in table format in the following sections of this report while the design sheets are attached in Appendix F.

The Thornthwaite water balance (Thornthwaite and Mather 1957) method is used to analyze the allocation of water among various components of the hydrologic cycle. Inputs to the model are; monthly temperature, site latitude, precipitation and unadjusted daily potential evaporation. Outputs include the monthly potential and actual evapotranspiration, evaporation, and water surplus (total infiltration and runoff).

The basic water budget for a region can be expressed as: $P = RO + ET + I + \Delta S$

Where, P = Precipitation (rain and snow)
RO = Runoff
ET = Evapotranspiration
I = Infiltration (Groundwater Recharge)
ΔS = Change in Storage (assumed = 0 under steady-state conditions)

Precipitation is a measured value, with the average between (1991 to 2020) used in this assessment obtained from Environment Canada, operating in London Climate Station (ID No. 6144475). It was assumed that precipitation during freezing months (December to February) would accumulate as snow and melt, providing additional surplus water in the first month thereafter, when average temperatures are greater than -1^{o}C.

Monthly Potential Evapotranspiration (PET) is estimated using monthly temperature data and is defined as a water loss from a homogeneous vegetation-covered area that never lacks water (Thornthwaite and Mather, 1957). Evapotranspiration is calculated based on measured air temperatures. The water holding capacity and infiltration factors for topography, soil types and cover as described in Table 3.1 of the SWM Planning & Design Manual, quantify the ratio of infiltration in existing and proposed site conditions. The runoff component calculated is the remaining volume of precipitation surplus following infiltration.

Groundwater storage of native soils for the existing site was estimated using values of water holding capacity (mm). For pervious areas, precipitation surplus has two components in the Thornthwaite model; a runoff component (overland flow that occurs when soil moisture capacity is exceeded) and an infiltration component. The infiltration factor soil values were determined based on the grain size analysis (estimated using Unified Classification) from soil samples collected at the site, vegetation values were determined based on a review of aerial imagery/field observation during site visits and the topographic range was calculated from existing contour information.

6.2 Catchment / Sub-Catchment Areas

The total pre-development catchment area, is defined by the entirety of the subject site, with outlets defined by existing site topography. A summary of the outlets and catchment areas are summarized in the table below.

Table 17: Pre-Development Water Balance Catchment Areas

E3 - Undeveloped Lands - Woodlot	14.62	0%	0.70	400 mm
E1 - Grassed Field - W of the Drain	4.63	0%	0.65	250 mm
E2 - Grassed Field - E of the Drain	26.30	0%	0.65	300 mm
Ext 1 - Adjacent Property to the W	0.74	27%	0.55	125 mm

Post-development catchment areas are based on post-development SWM modelling prepared by Development Engineering. A summary of the post-development outlets and catchment areas are summarized in the table below.

Table 18: Post-Development Water Balance Catchment Areas

P8 - Undeveloped Lands - Woodlot	14.62	0%	0.70	400 mm
P8 - Grassed Field - E of the Drain	19.51	0%	0.65	250 mm
P9 - Grassed Field - W of the Drain	2.34	0%	0.65	250 mm
P7 - Blocks 7, 8+11 (Open Space)	0.92	0%	0.65	250 mm
P12, P13, P14 & P15 - Hamilton Road widening easement & Veterans/Hamilton widening easement	0.49	0%	0.65	125 mm
P1 & P2 - Blocks 1 and 2	1.32	80%	0.55	125 mm
P3 - Block 3	0.08	10%	0.55	125 mm
P4, P5 - Blocks 4 and 5	5.44	85%	0.55	125 mm
P6 - Future Road Allowance	0.82	60%	0.55	125 mm
P10 - Adjacent Property to the W	0.47	32%	0.55	125 mm
P11 - Adjacent Property to the W	0.27	17%	0.55	125 mm

6.3 Water Balance Analysis

Based on the areas noted above, water balance calculations for pre-development and post-development conditions were carried out and are detailed in Appendix F. Tables 19A and 19B (below) summarizes the findings of the calculations and analysis.

Table 19A: Summary of Water Balance Parameters for North Woodlot

Catchment Area	14.62 ha	14.62 ha	-
Total Evapotranspiration	84,990 m^3	84,990 m^3	--
Total Infiltration	38,917 m^3	38,917 m^3	--
Total Run-off	16,679 m^3	16,679 m^3	--

Table 19B: Summary of Water Balance Parameters for Fekete Drain (Without LIDs)

Catchment Area	30.93 ha	31.66 ha	-
Total Evapotranspiration	167,492 m^3	154,378 m^3	92%
Total Infiltration	88,285 m^3	71,307 m^3	80%
Total Run-off	48,855 m^3	80,913 m^3	166%

Table 19C: Summary of Water Balance Parameters for Fekete Drain
(With LIDs capturing 20% of clean run-off and directing it to secondary infiltration features)

Catchment Area	30.93 ha	31.66 ha	-
Total Evapotranspiration	167,492 m^3	154,378 m^3	92%
Total Infiltration	88,285 m^3	79,075 m^3	89%
Total Run-off	48,855 m^3	73,143 m^3	150%

The proposed development at the site does not alter the water balance assessment for the north woodlot. Based on the results of the assessment, the proposed development will result in a decrease in annual infiltration Fekete Drain. Run-off volumes increase as a result of the urbanization of the site, and as a result of the stormwater management strategy, the stormwater run-off will change by 166%.

There is a total reduction in the total infiltration which contributes to base flows to the Fekete Drain. As shown in Table 19C, in the event that 20% of the runoff from Blocks 1, 2, 3, 4, and 5 was intercepted and directed to LID features which would direct clean stormwater runoff to secondary infiltration features which contribute to the Fekete Drain base flows, the total infiltration deficit would decrease by almost 10%, making the post-development contributions 89% of the predevelopment values.

Consideration may be given to incorporating low-impact development (LID) measures during the detailed design stage to attenuate or provide temporary storage of stormwater, and/or promote infiltration, as noted by the above discussion. Any design of LID features must have regard for soil and groundwater conditions at the site.

It is noted that the water balance assessment acknowledges the presence of shallow groundwater across the site and its potential role in sustaining baseflow to the Fekete Drain. However, given the scale of the proposed development and the limited availability of site-specific details of the stormwater management plans for each of the proposed blocks, explicit quantification of pre- and post-development baseflow contributions was not undertaken in this initial analysis. When site specific stormwater management design strategies are confirmed through detailed design, the water balance analysis, and potential hydrologic impacts can be more accurately assessed. Should the subsequent and more detailed assessment identify potential reductions in baseflow, additional mitigation measures—such as enhanced infiltration or controlled discharge—will be explored.

6.4 Low Impact Development Considerations

At this time, the development within the Blocks are conceptual in nature. As part of the site plan preparation, the designers should have regard for the use of possible LIDs within their respective blocks.

Consideration has been given to identify stormwater management options which allow secondary infiltration or reduced run-off under post-development conditions, to be incorporated into the stormwater management design. LID (Low Impact Development) strategies help to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible, by incorporating site features which enhance post-development infiltration, evapotranspiration, filtration and detention of stormwater. These practices can help to reduce contaminants in runoff, and can reduce the volume and intensity of stormwater flows.

The infiltration capacity of a soil depends on a number of factors, including particle size distribution, degree of saturation, compactness, adsorbed water (which depends on clay content). The heterogeneous nature of glacial deposits can also contribute to variations in soil permeability where the soil composition may include localized areas with increased fine material or sandy material which can influence soil permeability at different points within the soil strata.

Based on the permeability results presented in Section 3.3, the predominant silt till soils have a saturated hydraulic conductivity in the range of 10^{-6} m/s, with factored infiltration rates in the range of 21 mm/hr, and the localized water-bearing sands and gravel seams have a saturated hydraulic conductivity in the range of 10^{-4} to 10^{-7} m/s, with factored infiltration rates in the range of 12 to 90 mm/hr. In addition, consideration must be given to the depth of shallow groundwater, and the potential drawdown effects of site servicing on perched groundwater levels.

It is also important to note that the presence and effective depth of sandy soils may be altered by site grading activities at the site. The stormwater management strategy at the site will need to consider site grading activities at the site, which may alter the near-surface soil conditions, as a result of cut-fill activities to accommodate design grades.

Where low permeability soils are present (such as the silt till), the use of infiltration-based features may not be effective. Alternative measures such as grassed swales, thickened topsoil, reduced lot grading and discharging water collected from roof leaders into landscaped areas are generally considered better suited to the soil conditions at the site. These alternative measures extend the retention time for surface water run-off, to help moderate and potentially reduce run-off volumes, and provide opportunities for evapotranspiration and limited infiltration.

Field confirmation of soil permeability and effective infiltration rates in the natural or reconstructed subgrade soils will need to be undertaken to confirm soil suitability for any infiltration-based LID measures which are considered at the site.

6.5 Monitoring Considerations

It is expected that an Environmental Monitoring Plan will be prepared, incorporating monitoring and mitigation measures from both a hydrogeological and ecological standpoint, and will be provided through the detailed design process. Based on input received from UTRCA, it is expected that monitoring should be anticipated throughout the construction period, and for at least 5 years post-development. The monitoring program should also set out protocols for frequency of testing (monthly/seasonally), with clear reporting requirements, and set alert level thresholds which would trigger mitigation measures.

7. HYDROGEOLOGICAL DISCUSSION

7.1 Hydrogeologic Setting

As discussed in Section 3.1.3, stabilized water levels were recorded during two visits to the site, prior to issuance of this report. The results indicate that the shallow groundwater contained within the near surface sandy soils, as well as within intermittent sand and sand and gravel seams encountered at variable depths within the silt till soils.

The groundwater measurements (as reported in Section 3.1.3) indicate that the shallow flow generally follows a north-westerly direction, towards the Thames River.

It is important to note that shallow groundwater will vary in response to climatic or seasonal conditions, and, as such, may differ depending on the seasonal conditions. Shallow groundwater in unconfined aquifers can be significantly influenced by exceptional and/or sustained rainfall events.

7.2 Water Level and Groundwater Quantity Considerations

7.2.1 Construction Dewatering

Conventional groundwater control methods are generally expected to be suitable for shallow excavations at the site, to address surface water infiltration and minor shallow groundwater seepage for excavations which do not extend below the stabilized groundwater table.

Where excavations extend below the stabilized groundwater table, or where groundwater levels are elevated, positive groundwater control methods may need to be utilized for construction dewatering. Groundwater control measures at the site should be sufficient to maintain stable excavated slopes; and provide a dry and stable base for excavations and construction operations. The contractor should use a reasonable effort to direct surface run-off away from open excavations.

As noted in Section 4.3.2, it is anticipated that construction dewatering will require water takings in excess of 50,000 litres per day (and less than 400,000 litres per day), and than an EASR submission will be required. The extent of dewatering, estimates for water-taking volumes and zone of influence calculations can be carried out when servicing depths and design grades are available. Under the EASR approval process, a dewatering and discharge plan would need to be prepared.

7.2.2 Local Water Supply Wells

The proposed development is expected to be provided with full municipal services, including water supply, sanitary and storm sewer services. The development will not be reliant on potable aquifers in the area, as the municipal water supply is sourced from Lake Huron.

Typical site servicing depths and excavations for building foundations are expected to be well above the intermediate and deep overburden aquifers. From a quantitative standpoint, temporary construction dewatering will not result in the alterations in the water level within those aquifers.

However, it has been recognized that two water supply wells noted in the MECP well records in the vicinity of the site are set in the shallow overburden aquifer. A well survey of the nearby and neighbouring properties is recommended to confirm the presence of any additional shallow wells which may be present in the area.

In the unlikely event that long-term or permanent water supply interference occurs to a shallow well located in the area, which can be attributed to the development activities at the site, the developer should have a contingency plan which includes providing an alternate water source, which may include a suitable replacement well, either by deepening the existing well, or installation of a new well. Alternatively, coordination of a connection to the municipal water service may also be considered.

Any wells which are deemed to no longer be suitable for use, should be decommissioned in accordance with the requirements of Ontario Regulation 903.

7.3 Hydrogeological Impact Assessment

Baseline groundwater quality conditions (including general chemistry parameters) have been established through sampling conducted in July 2021. The results have been discussed previously (Section 3.1.4).

Given the naturally low permeability of the predominant silt till soils which underlie the site, the intermediate and deep overburden aquifers are not expected to be exposed to contamination from surface sources. However, shallow groundwater contained within the near surface sandy soils may be susceptible to water quality impacts as a result of surface activities during construction, since it does not have the benefit of a low-permeability protective soil layer above it.

7.3.1 Impacts to Existing Surface Water Features

A tributary of the south branch of the Thames River (identieid as the Fekete Drain) transects the southwestern section of the site. The shallow groundwater which exists near surface is expected to be influenced by the restrictions which will exist for surface water to infiltrate directly into the near surface soils.

Where possible, clean stormwater runoff (from roof-tops and landscaped areas) may be able to be directed towards the channel and naturalized areas along the drain). Filtration and treatment of any stormwater runoff from the site pavements is recommended, to prevent the introduction of contaminants into the subsurface. Providing this surface water contribution is recommended to sustain base flows to the watercourse, and to support the wildlife and vegetation within the feature.

7.3.2 Potential Impact from Construction Equipment

Construction activities at the site are not expected to impact the general chemistry or bacteriological properties of the unconfined intermediate and deep overburden aquifers. However, the possibility exists that a spill or uncontrolled release of fuel or associated material could occur during construction, which could have a direct impact to surface water and shallow groundwater conditions.

A Best Management Practice (BMP) and spill contingency plan (including a spill action response plan) should be in place for fuel handling, storage and onsite equipment maintenance activities. It is recommended that there be a designated equipment fuelling areas located away from the wetland, and implementing a spill contingency plan (including a spill action response plan) for fuel handling, storage and onsite equipment maintenance activities to minimize the risk of contaminant releases as a result of the proposed construction activities.

It is important to note that if a spill (possible incident) is related to the contractor's activities, the contractor is responsible to report the incident to the Spills Action Centre, and/or notify the local MECP office. Depending on the type of incident, water sampling and quality testing may be warranted to document the extent of the impact. Scoping for the required testing will depend on the incident report.

7.3.3 Potential Impact from Uncontrolled Erosion / Sediment Discharge

Surface water quality can be detrimentally impacted by uncontrolled erosion and sediment discharge from the site. As such, it is imperative that an adequate Sediment and Erosion Control Strategy be established for the site. In addition to implementing sediment and erosion controls during construction, regular inspection and maintenance will also be necessary to ensure that sensitive receptors are not negatively impacted during construction.

Sediment and erosion control measures will be required to limit sediment discharge towards the natural features. It is important to ensure that the sediment control measures are installed properly, and in accordance with the design drawings. If deficiencies are identified in its performance through regular inspection, enhancements beyond the recommended design may be required.

The following table summarizes general mitigation measures are suggested as best management practices to limit foreseeable events where contamination or negative impacts to hydrologic features at the site may be possible.

- Delineate work areas to limit construction activities encroaching into the natural heritage features and setback areas, to prevent unnecessary vegetation removal.
- Monitoring of discharge water (for water quality – turbidity) from stormwater run-off and construction dewatering activities.
- Installing perimeter ESC measures such as silt fence and/or silt sock around temporary soil stockpiles, with dedicated points of access clearly marked onsite.

- Use of mud-mats at construction entrance/exit points to help control the amount of loose soil being carried offsite from construction vehicles.
- Dedicated fuel storage and equipment fuelling areas located away from natural or otherwise sensitive features. Contractors should have an emergency spills management plan.
- Incorporate trench plugs/clay collars in servicing trenches to minimize groundwater migration through granular pipe bedding and disturbed backfill material.
- Re-establishing vegetative cover in disturbed areas. In areas which are susceptible to erosion, additional measures may include the use of sod, hydroseeding, or mulch to protect the exposed subgrade soils.
- Maintain perimeter silt fence (and other perimeter ESC measures) in place until disturbed areas and lots are sodded/seeded, and vegetative cover has become established.
- Build-up boulevard areas to help limit sediment-laden stormwater run-off (from open or partially constructed lots) from discharging into catchbasins and stormwater infrastructure, and regular inspection and maintenance of silt bags/geotextile filters installed in catchbasins.

As construction work progresses at the site, regular maintenance and additional sedimentation measures may be required to limit the effect of siltation of run-off water in localized areas.

While active construction dewatering occurs at the site, a program which includes turbidity monitoring is recommended, to confirm that the quality of discharge water will not have adverse impacts to sensitive receptors. In the event that water discharged from the site is considered to have an elevated turbidity level, associated construction activities should be halted until remedial measures can be implemented. Such measures may include enhanced or more robust sediment and erosion control measures, incorporating pooling areas and measures that will reduce suspended solids, temporary storage measures to prevent off-site discharge.

7.3.4 Snow Removal and Salt Management

Contractors used to carry out salting activities should be familiar with best practices to ensure that salt is used only during conditions when it will be effective, and should able to produce equipment inspection or calibration records to ensure that spreader controls are not over-applying salt.

Snow can be impacted by salts and other ice control chemicals; oil, grease and heavy metals from vehicles; litter and debris; and, dirt, dust and airborne pollutants. If snow is pushed into areas which contain LID features, snowmelt may result in a release of contaminants, debris and litter into such areas, which can directly impact their effectiveness and have a negative impact to local water quality.

7.3.5 Well Decommissioning

Monitoring wells associated with the preparation of this report have been installed at the site, to document stabilized groundwater conditions. These wells have been registered with MECP, and may be utilized for ongoing monitoring to document seasonal variations in the stabilized groundwater levels at the site.

A site plan showing all wells to be maintained and protected at the site will be provided to the contractors working at the site, to ensure that monitoring wells are not inadvertently damaged during the construction activities onsite. When the monitoring wells are determined to be no longer required, the wells should be properly decommissioned in accordance with Ontario Regulation 903. This regulation identifies that only certified and qualified well drilling technicians are permitted to direct the decommissioning work for existing wells.

Decommissioning a well which is no longer in use helps to ensure the safety of those in the vicinity of the well, prevents surface water infiltration into an aquifer via the well, prevents the vertical movement of water within a well, conserves aquifer yield and hydraulic head and can potentially remove a physical hazard.

7.4 Monitoring and Mitigation

With the importance of maintaining the natural features along the drain and the northern woodlot, it is recommended that an environmental monitoring program be prepared, to help ensure that site activities during construction, and in post-development conditions do not have a detrimental impact. The main objectives of the Environmental Monitoring Plan are expected to include:

- Providing an early indication should any environmental control measures (such as sediment and erosion control measures) or practices fail to achieve prescribed standards;
- Monitoring the performance and effectiveness of mitigation measures;
- Determining project compliance with regulatory requirements and standards and outlining reporting requirements, including timing and distribution;
- Identifying an emergency contact list and response protocol to respond to any issues or concerns identified during construction; and,
- Taking remedial actions if unexpected problems or unacceptable interference or negative impacts arise.

From a preliminary standpoint, the following comments are provided regarding monitoring efforts which are expected to be confirmed and refined as detailed design information becomes available. The Monitoring Plan should be prepared by a Qualified Person (QP) and periodically reassessed and updated by the QP, as appropriate, to ensure that the objectives stated above are effectively and efficiently achieved.

The Contractor and Contract Administrator should endeavour to preserve all monitoring points, where reasonable.

The contractor is responsible for managing precipitation to maintain positive drainage across all earthwork areas, including during non-working hours. To ensure site stability, the contractor must actively monitor weather forecasts and implement necessary drainage measures before storm events.

During construction dewatering, weekly water level monitoring of the existing monitoring wells should be implemented prior to the start of construction, and continue for at least two months following construction, or until water levels return to 90 percent of the pre-construction water level, or return to typical groundwater levels recorded under similar seasonal conditions.

Inspection of sediment and erosion control measures at the site during construction will be incorporated into the environmental monitoring program for the site. The frequency of inspections will depend on weather conditions (such as periods with rainfall or snowmelt). At a minimum, inspections are expected to include checks on siltation barrier installations to confirm that it is properly installed and secured, including inspection for evidence of damage or tears, and overtopping or undermining; checking condition of surface water ponding areas and storm drain inlets, and documenting areas where seeding / sodding / mulching is implemented to re-establish vegetative cover.

While active construction dewatering occurs at the site, a program which includes turbidity monitoring is may be appropriate to confirm that the quality of discharge water will not have adverse impacts to sensitive receptors. In the event that water discharged from the site is considered to have an elevated turbidity level, (typically 8 NTU above background levels for discharges near surface water bodies and over 50 NTU for water discharging to municipal stormwater system) associated construction activities should be halted until remedial measures can be implemented. Such measures may include enhanced or more robust sediment and erosion control measures, incorporating pooling areas and measures that will reduce suspended solids, temporary storage measures to prevent off-site discharge.

In the event that there is an incident or perceived impact to groundwater quality identified through monitoring at the site, interim water quality testing should be carried out within 24 hours of the reported incident, to document conditions which may have been impacted. Scoping for the required testing will depend on the incident reported.

For general guidance, the following parameters are suggested, however it is important to note that some parameters may be added or removed depending on the site activities and incident reporting.

- General inorganic parameters, such as pH, electrical conductivity, total dissolved and suspended solids, turbidity;
- Major anions and cations;
- Nutrients (including ammonia and nitrogen species);
- A limited selection of dissolved and total metals; and,

- Petroleum hydrocarbons.

Groundwater field parameters, including pH, temperature and EC should also be measured. All monitoring activities and groundwater/surface water sample collection should be conducted by qualified environmental field staff.

8. CLOSING

The geotechnical and hydrogeological recommendations provided in this report are applicable to the project described in the text. Stonecairn would be pleased to provide a review of design drawings and specifications to ensure that the geotechnical comments and recommendations provided in this report have been accurately and appropriately interpreted.

It is important to note that the investigation involves a limited sampling of the subsurface conditions at specific borehole locations. The conclusions and recommendations presented in this report reflect site conditions existing at the time of the investigation and a review of available information which has been presented in the report. Should subsurface conditions be encountered which vary materially from those observed in the boreholes, we recommend that Stonecairn be consulted to review the additional information and verify if there are any changes to the geotechnical recommendations.

The comments given in this report are intended to provide guidance for design engineers. Contractors making use of this report are responsible for their construction methods and practices, and should seek confirmation or additional information if required, to ensure that they understand how subsurface soil and groundwater conditions may affect their work.

No portion of this report may be used as a separate entity. It is intended to be read in its entirety.

We trust this satisfies your present requirements. If you have any questions or require anything further, please feel free to contact our office.

Respectfully Submitted,

STONECAIRN CONSULTING INC.

LICENSED PROFESSIONAL ENGINEER
April 15, 2026
R.A. WALKER
PROVINCE OF ONTARIO

Rebecca A. Walker, P. Eng., QPESA
President, Geotechnical Director
Rebecca.walker@stonecairn.ca

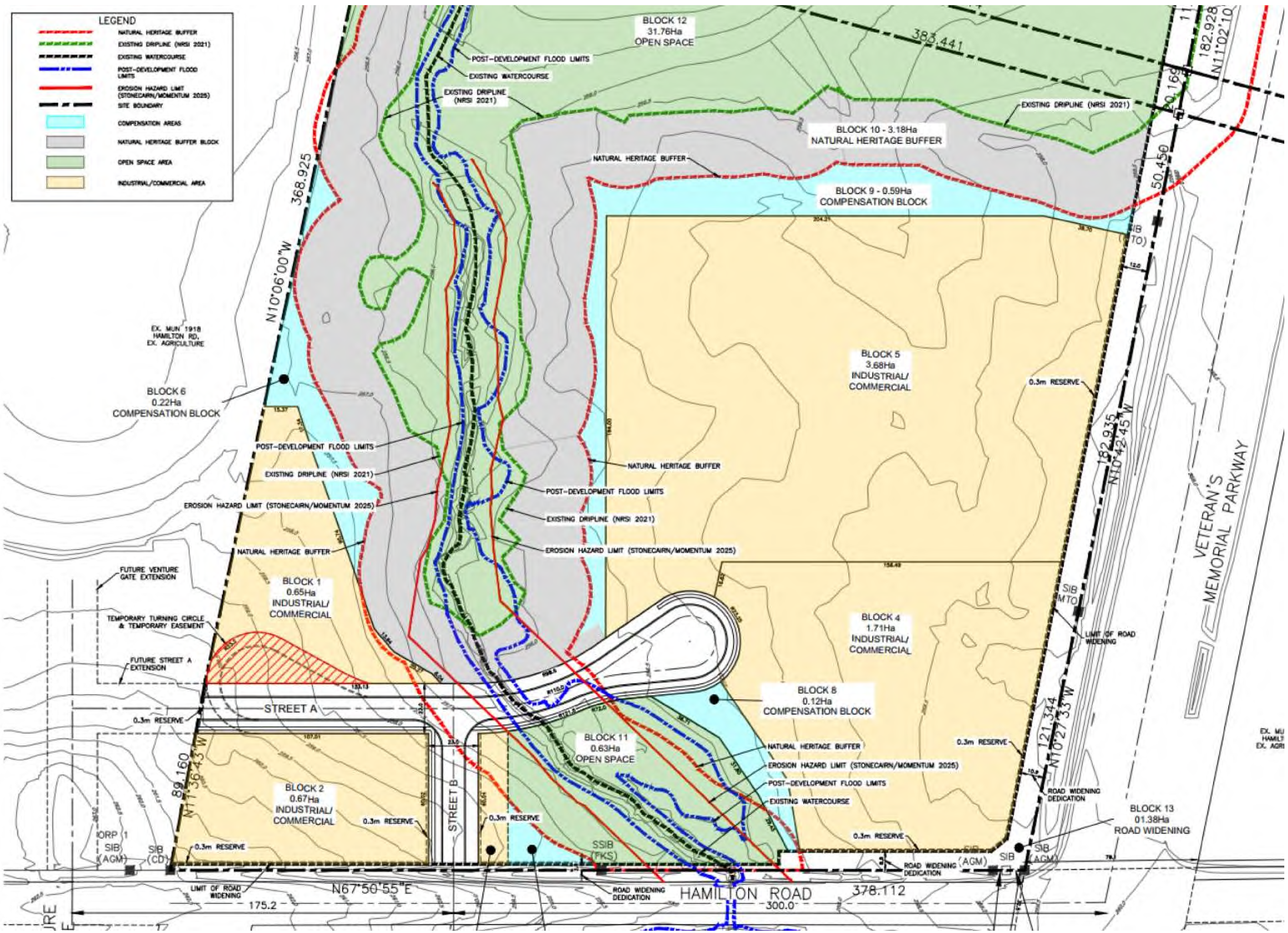
APPENDIX A

DRAWINGS AND NOTES

SOURCE:
Google Earth Pro, Version 7.3.2.5776,
Coordinates 17T, 489215 m E, 4757254 m N,
Imagery date 7/2/2018

STONECAIRN CONSULTING

PROJECT NAME	PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT
PROJECT LOCATION	2004 HAMILTON ROAD, LONDON
DRAWING NAME	SITE FEATURES
SCALE AS SHOWN	**PROJECT NO.** SC-02055
DATE APRIL 2025	**DRAWING NO.** 1



SOURCE:
Produced from Draft Plan prepared by Development Engineering – DP, Project No. DEL21-035

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

DRAWING NAME

DRAFT PLAN

SCALE	PROJECT NO.
NTS	SC-02055
DATE	**DRAWING NO.**
APRIL 2025	2

LEGEND

UTRCA Regulated Land

Site Boundary

SOURCE

URTCA Regulatory Mapping, May 2021

STONECAIRN CONSULTING

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

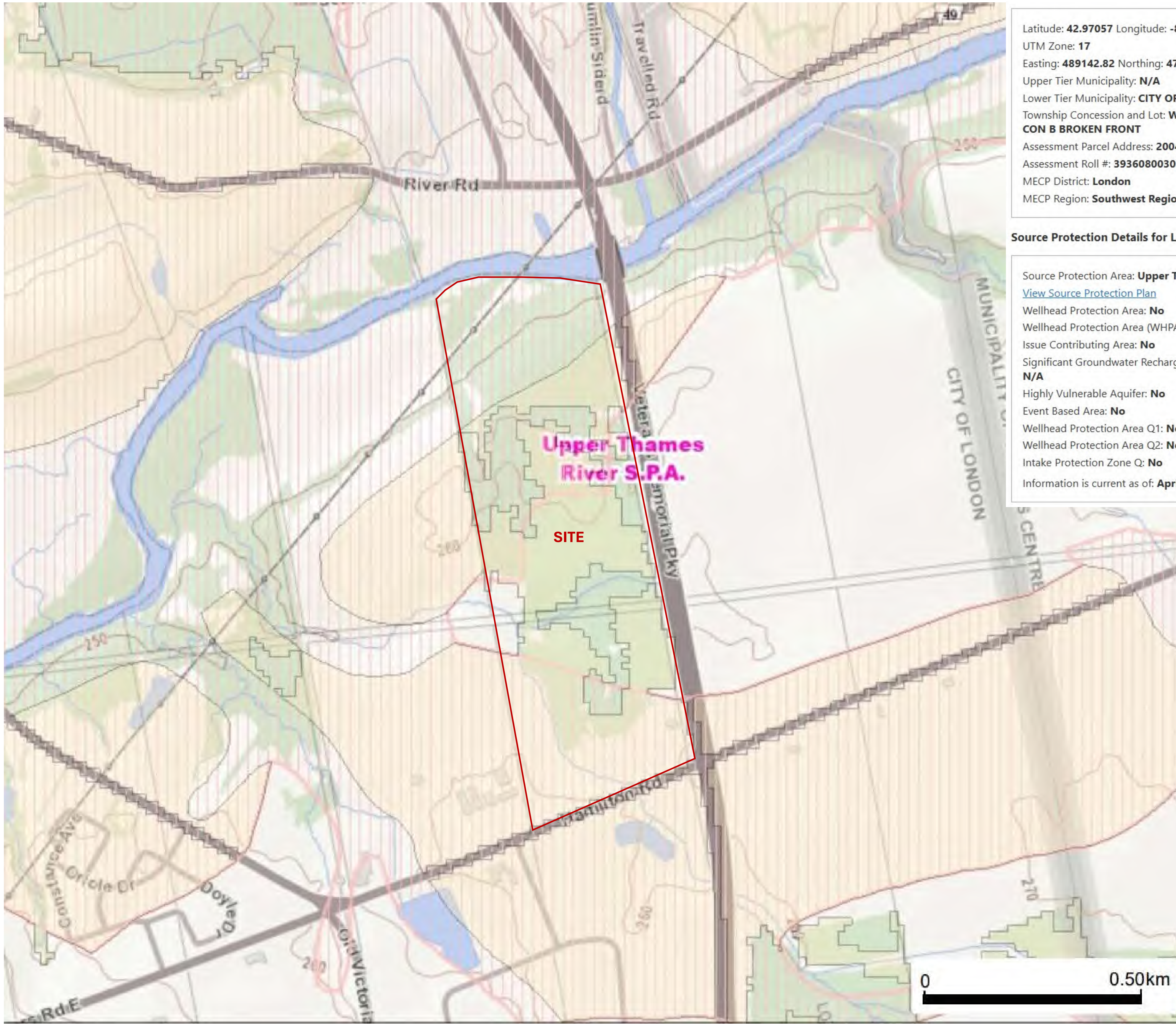
PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

DRAWING NAME

UTRCA REGULATED LANDS

SCALE	PROJECT NO.
AS SHOWN	SC-02055
DATE	**DRAWING NO.**
APRIL 2025	3



Latitude: **42.97057** Longitude: **-81.13314**
UTM Zone: **17**
Easting: **489142.82** Northing: **4757555.68**
Upper Tier Municipality: **N/A**
Lower Tier Municipality: **CITY OF LONDON**
Township Concession and Lot: **WESTMINSTER LOT 5 CON B BROKEN FRONT**
Assessment Parcel Address: **2004 Hamilton Road**
Assessment Roll #: **393608003016600000000**
MECP District: **London**
MECP Region: **Southwest Region**

Source Protection Details for Location

Source Protection Area: **Upper Thames River**
View Source Protection Plan
Wellhead Protection Area: **No**
Wellhead Protection Area (WHPA-E): **No**
Issue Contributing Area: **No**
Significant Groundwater Recharge Area: **Yes** ; score is **N/A**
Highly Vulnerable Aquifer: **No**
Event Based Area: **No**
Wellhead Protection Area Q1: **No**
Wellhead Protection Area Q2: **No**
Intake Protection Zone Q: **No**
Information is current as of: **April 23, 2025**

Legend

Significant Groundwater Recharge Area

- N/A
- 0
- 2
- 4
- 6

Issue Contributing Areas

Highly Vulnerable Aquifers

SOURCE:
Source Protection Information Atlas, Ministry of Environment, Conservation and Parks www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/ Current to April 23, 2025

STONECAIRN CONSULTING

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

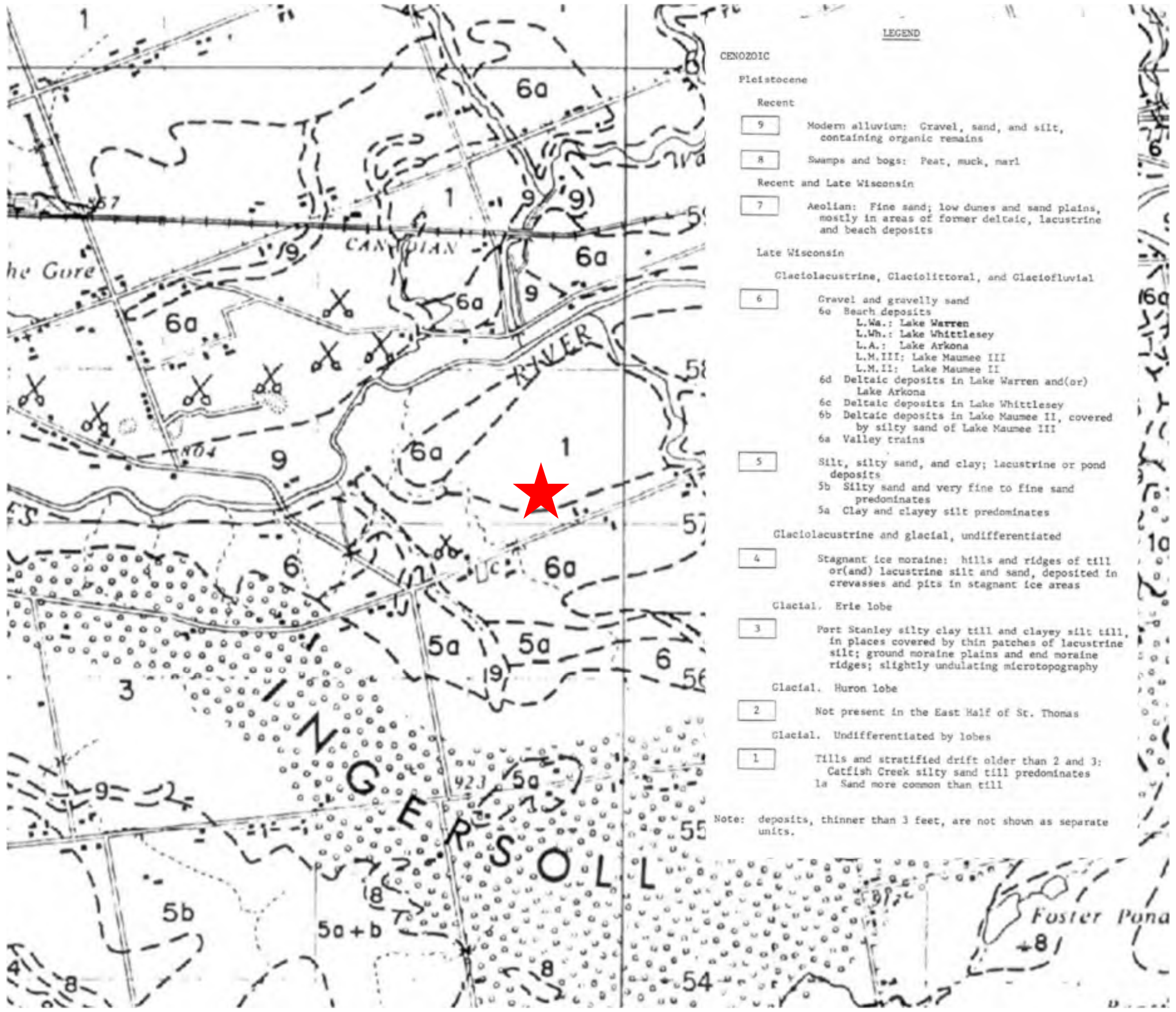
PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

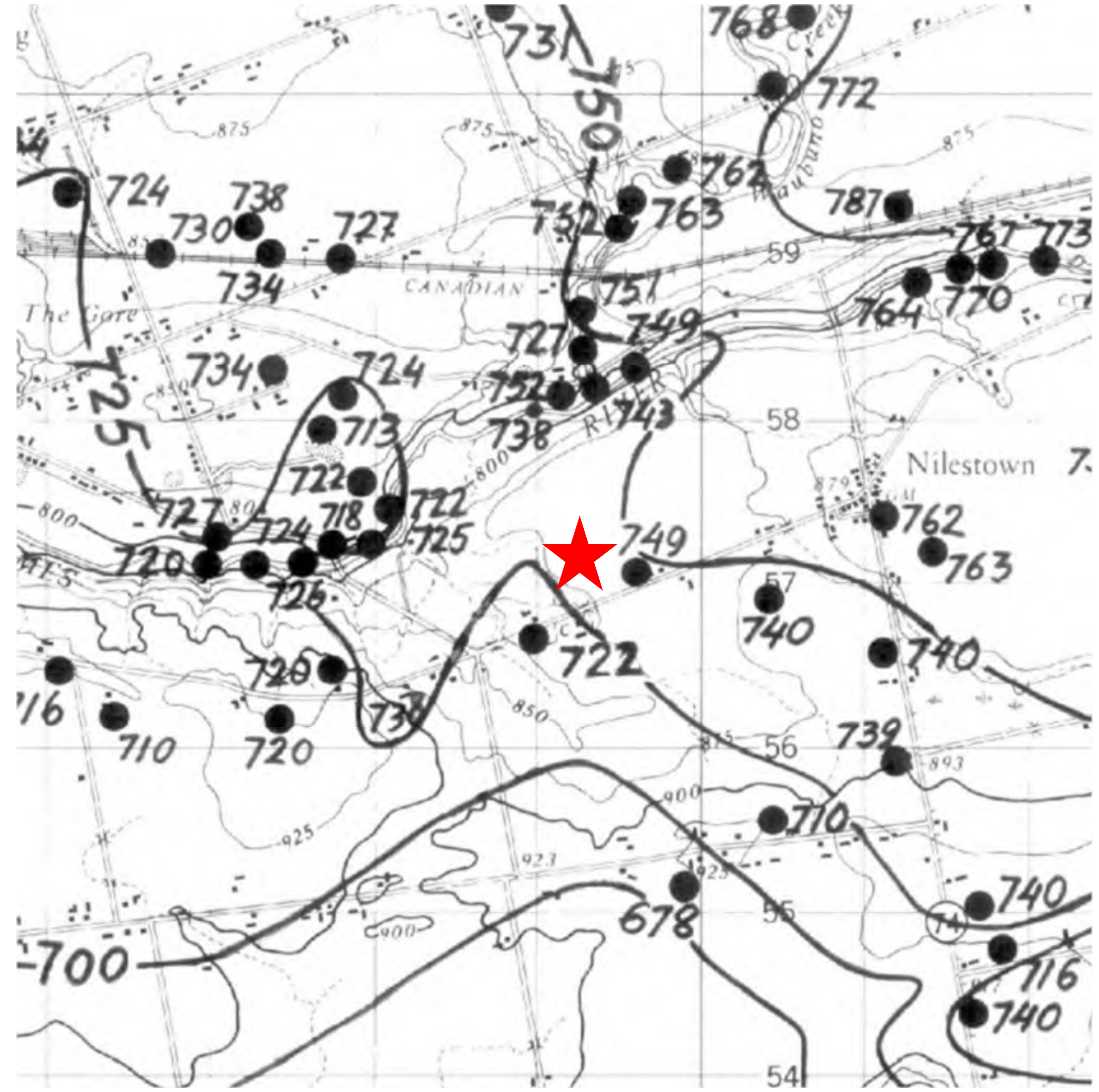
DRAWING NAME

UPPER THAMES RIVER SOURCE WATER PROTECTION MAPPING- MECP INFORMATION ATLAS

SCALE	PROJECT NO.
AS SHOWN	SC-02055
DATE	**DRAWING NO.**
APRIL 2028	4



SOURCE
Pleistocene Geology of St. Thomas Area, East Half, Southern Ontario;
Ontario Department of Mines, Map P606,
Scale 1:50,000, ©1970



SOURCE
Bedrock Topography, St. Thomas Sheet, Ontario Geological Survey Map P0482,
Scale 1:50,000, © 1968

STONECAIRN CONSULTING

PROJECT NAME	
PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT	
PROJECT LOCATION	
2004 HAMILTON ROAD, LONDON	
DRAWING NAME	
GEOLOGICAL MAPPING	
SCALE	**PROJECT NO.**
1:50,000	SC-02055
DATE	**DRAWING NO.**
APRIL 2025	5

SOURCE:
MECP Well Records: www.ontario.ca/environment-and-energy/map-well-records, updated January 10, 2024

STONECAIRN CONSULTING

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

DRAWING NAME

MECP WELL LOCATIONS – ALL WELLS

SCALE	**PROJECT NO.**
AS SHOWN	SC-02055
DATE	**DRAWING NO.**
APRIL 2025	6

Location	Northing, m N	Easting, m E	Elevation (m asl)
BH1/MW	4757130.40	489088.88	256.64
BH2	4757297.47	489009.68	256.41
BH3/MW	4757022.00	489112.64	260.17
BH4	4757132.46	489370.22	258.29
BH5	4757256.89	489348.28	258.53
BH6	4757094.59	489279.14	256.60
BH7	4757238.40	489206.60	257.58
BH8	4757440.40	489296.86	258.23
BH9/MW	4757411.60	489192.74	256.09
PZ201	4757098.50	489171.75	255.27
PZ202	4757079.13	489241.84	255.22

SOURCE:
Google Earth Pro, Version 7.3.2.5776,
Coordinates 17T, 489215 m E, 4757254 m N,
Imagery date 7/2/2018

STONECAIRN CONSULTING

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

DRAWING NAME

BOREHOLE LOCATION PLAN

SCALE	**PROJECT NO.**
AS SHOWN	SC-02255
DATE	**DRAWING NO.**
APRIL 2025	7

LEGEND

WL - 256.03 *Groundwater Elevation, March 17, 2025*

Groundwater Contour (inferred)

Groundwater Flow Direction (inferred)

SOURCE:
Google Earth Pro, Version 7.3.2.5776,
Coordinates 17T, 489215 m E, 4757254 m N,
Imagery date 7/2/2018

STONECAIRN CONSULTING

PROJECT NAME

PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT

PROJECT LOCATION

2004 HAMILTON ROAD, LONDON

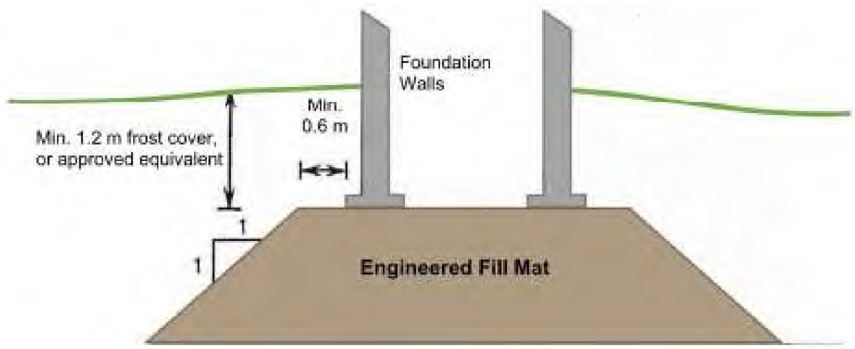
DRAWING NAME

GROUNDWATER CONTOUR PLAN

SCALE	**PROJECT NO.**
AS SHOWN	SC-02055
DATE	**DRAWING NO.**
APRIL 2025	8

ENGINEERED FILL PLACEMENT

SCHEMATIC DIAGRAM



NOTES:

1. The area must be stripped of all topsoil contaminated fill material, and other unsuitable soils, and proof rolled. Soft spots must be dug out. The stripped natural subgrade must be examined and approved by the geotechnical consultant.
2. In areas where engineered fill is placed on a slope, the fill should be benched into the approved subgrade soils.
3. Material used for engineered fill must be free of topsoil, organics, frost and frozen material, and otherwise unsuitable or compressible soils, as determined by a Geotechnical Engineer. Any material proposed for use as engineered fill must be examined and approved prior to use onsite.
4. Engineered fill should be placed in maximum 300 mm thick lifts, and uniformly compacted to 100% Standard Proctor dry density. For best compaction results, engineered fill should be within 3 percent of its optimum moisture content, as determined by the Standard Proctor density test.
5. Full time geotechnical monitoring, inspection and in-situ density (compaction) is required during placement of the engineered fill.
6. Site grades should be maintained during area grading activities to promote drainage, and to minimize ponding of surface water on the engineered fill mat. Rutting by construction equipment should be kept to a minimum, where possible. Additional work to ensure suitability of engineered fill may be required if fill is placed in inclement weather conditions.
7. The fill must be placed such that the specified geometry is achieved. Refer to schematic diagram for minimum requirements. Environmental protection may be required, such as frost protection during construction, and after the completion of the engineered fill mat.
8. An allowable bearing pressure of 145 kPa (3000 psf) may be used provided that all conditions outlined above, and in the Geotechnical Report are adhered to.
9. These guidelines are to be read in conjunction with the accompanying Geotechnical Report.
10. For foundations set on engineered fill, footing enhancement and/or concrete reinforcing steel placement may be recommended. The footing geometry and extent of concrete reinforcing steel will depend on site specific conditions. In general, consideration may be given to having a minimum strip footing width of 500 mm (20 inches), containing nominal steel reinforcement.

STONECAIRN CONSULTING	PROJECT NAME	SCALE	PROJECT NO.
	PROPOSED INDUSTRIAL/COMMERCIAL SUBDIVISION DEVELOPMENT	NTS	SC-02055
	PROJECT LOCATION	DATE	DRAWING NO.
	2004 HAMILTON ROAD, LONDON	APRIL 2025	9

APPENDIX B

BOREHOLE LOGS & LABORATORY TEST RESULTS

NOTES ON SAMPLE DESCRIPTIONS

1. All descriptions included in this report follow the Canadian Foundation Engineering Manual soil classification system, based on visual and tactile examination which are consistent with the field identification procedures. Soil descriptions and classifications are based on the Unified Soil Classification System (USCS), based on visual and tactile observations. Where grain size analyses have been specified, mechanical grain size distribution has been used to confirm the soil classification.

Clay: < 0.002 mm
Silt: 0.002 – 0.075 mm
Sand: 0.075 – 4.75 mm
Gravel: 4.75 mm – 75 mm
Cobbles: 75 – 200 mm
Boulders: > 200 mm

Trace: < 10%
Some: 10-20%
Adjective, sandy, gravelly, etc.: 20-35%
And, and gravel, and silt, etc.: > 35%
Noun, Sand, Gravel, Silt, etc.: > 35% and main fraction

2. The compactness condition of cohesionless soils is based on excavator / drilling resistance, and Standard Penetration Test (SPT) N-values where available. The Canadian Foundation Engineering Manual provides the following summary for reference.

Very Loose	0 – 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	50+

3. Topsoil Thickness - It should be noted that topsoil quantities should not be established from information provided at the test hole locations only. If required, a more detailed analysis with additional test holes may be recommended to accurately quantify the amount of topsoil to be removed for construction purposes.

4. Fill material is heterogeneous in nature, and may vary significantly in composition, density and overall condition. Where uncontrolled fill is contacted, it is possible that large obstructions or pockets of otherwise unsuitable or unstable soils may be present beyond the test hole locations.

5. Where glacial till is referenced, this is indicative of material which originates from a geological process associated with glaciation. Because of this geological process, till must be considered heterogeneous in composition and as such, may contain pockets and / or seams of material such as sand, gravel, silt or clay. Till often contains cobbles or boulders and therefore, contractors may encounter them during excavation, even if they are not indicated on the test hole logs. Where soil samples have been collected using borehole sampling equipment, it should be understood that normal sampling equipment can not differentiate the size or type of obstruction. Because of horizontal and vertical variability of till, the sample description may be applicable to a very limited area; therefore, caution is essential when dealing with excavations in till material.

6. Consistency of cohesive soils is based on tactile examination and undrained shear strength where available. The Canadian Foundation Engineering Manual provides the following summary for field identification methods and classification by corresponding undrained shear strength.

Very Soft	Easily penetrated several cm by the fist	0 – 12
Soft	Easily penetrated several cm by the thumb	12 – 25
Firm	Can be penetrated several cm by the thumb with moderate effort	25 – 50
Stiff	Readily indented by the thumb, but penetrated only with great effort	50 – 100
Very Stiff	Readily indented by the thumb nail	100 – 200
Hard	Indented with difficulty by the thumbnail	200+

LDS	Project	Proposed Residential Subdivision	Borehole ID
	Project Location	2004 Hamilton Road, London, ON	**1/MW**
	Project Number	GE-00519	*Sheet 1 of 1*

Date Drilled	**May 21, 2021**	Ground Surface Elevation	**256.64 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
						TOPSOIL - dark brown, sandy loam, moist, 254 mm	
0.5						**SAND** - brown, medium grained, trace silt, trace gravel, damp, loose	
1.0	SPT	1	70	9	Jun 7/21		*MC - 9.7%*
1.5					1.68 m		
2.0	SPT	2	90	3		**SILT TILL** - brown/grey, mottled, weathered, trace gravel, moist, very loose	
2.5	SPT	3	90	21		- becoming compact below 2.1 m depth	*MC - 10.8%*
3.0						- becoming grey below 2.1 m depth	
3.5	SPT	4	90	53			
4.0						- saturated sand and gravel seam encountered at 4.0 m depth	
4.5							
5.0	SPT	5	80	71	5.03 m		*MC - 9.4%*
5.5						BH Terminated at 5.03 m MW Installed at 4.57 m - refer to details below	
6.0							
6.5							
7.0							
7.5							
8.0							

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	50 mm CPVC Pipe
Installation Depth	4.57 m
Screen Length	3.05 m w/ No. 2 filter sand
Depth of Bentonite Seal	0.91 m

Well equipped with locking J-Plug cap.

Additional Notes

MC - denotes moisture content

June 7, 2021 - WL, 1.22 m bgs

July 14, 2021 - WL, 1.20 m bgs

LDS	Project	**Proposed Residential Subdivision**	Borehole ID
	Project Location	**2004 Hamilton Road, London, ON**	**2**
	Project Number	**GE-00519**	*Sheet 1 of 1*

Date Drilled	**May 21, 2021**	Ground Surface Elevation	**256.41 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**4.57 m bgs**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
						TOPSOIL - dark brown, sandy loam, moist, 203 mm	
0.5						**SILT TILL** - brown/grey, mottled, weathered, trace sand, damp, compact	
1.0	SPT	1	60	10			*MC - 16.0%*
1.5						- becoming moist and loose below 1.4 m depth	
2.0	SPT	2	30	9			
2.5	SPT	3	40	6		- intermittent organics/peat layers encountered at 2.3 m depth	*MC - 21.7%*
3.0	SPT	4	60	14		- becoming brown, compact and less weathered below 2.9 m depth	
3.5							
4.0						- becoming damp and dense below 4.0 m depth	
4.5					Inferred Groundwater		
5.0	SPT	5	10	73*			*MC - 14.0%*
5.5						- becoming grey below 5.6 m depth	
6.0							
6.5	SPT	6	90	44	*6.71 m*		
7.0						Auger refusal at 6.71 m Borehole observed open to 6.40 m depth at completion Water measured at 4.57 m depth at completion	
7.5							
8.0							

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content
* - Stone in tip

LDS			Borehole ID
	Project	**Proposed Residential Subdivision**	**3/MW**
	Project Location	**2004 Hamilton Road, London, ON**	
	Project Number	**GE-00519**	*Sheet 1 of 1*

Date Drilled	**May 21, 2021**	Ground Surface Elevation	**260.17 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
						TOPSOIL - dark brown, sandy loam, moist, 254 mm	
0.5						**SILT TILL** - brown/grey, mottled, weathered, trace sand, damp, compact	
1.0	SPT	1	10	17*			*MC - 15.7%*
1.5					1.68 m		
	SPT	2	60	7		**SAND** - brown, medium grained, moist, compact	
2.0							
2.5	SPT	3	70	11		- saturated sand and gravel seam encountered at 2.3 m depth	*MC - 22.1%*
					Jun 7/21	- becoming stratified and saturated below 2.6 m depth	
3.0						Gradation: 2% Gravel, 93% Sand, 5% Fines (Silt/Clay)	
	SPT	4	80	11			*MC - 21.1%*
3.5						- becoming loose below 3.7 m depth	
4.0	SPT	5	90	7			*MC - 23.9%*
4.5							
	SPT	6	95	4	4.88 m	**SILT TILL**- grey, trace gravel, damp	
5.0					5.03 m	BH Terminated at 5.03 m MW Installed at 4.57 m - refer to details below	
5.5							
6.0							
6.5							
7.0							
7.5							
8.0							

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	50 mm CPVC Pipe
Installation Depth	4.57 m
Screen Length	1.52 m w/ No. 2 filter sand
Depth of Bentonite Seal	2.44 m

Well equipped with locking J-Plug cap.

Additional Notes

MC - denotes moisture content
* - Stone in tip

June 7, 2021 - WL, 3.13 m bgs
July 14, 2021 - WL, 3.20 m bgs

LDS	Project	Proposed Residential Subdivision	Borehole ID
	Project Location	2004 Hamilton Road, London, ON	4
	Project Number	GE-00519	Sheet 1 of 1

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**258.29 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**5.94 m bgs**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
						TOPSOIL - dark brown, sandy loam, moist, 203 mm	
0.5					0.61 m	**SAND** - brown, coarse grained, trace silt, moist	
1.0	SPT	1	40	6		**SILT TILL** - brown/grey, mottled, weathered, moist sand seams throughout, very moist, loose	MC - 17.8%
1.5						- becoming compact with iron staining observed below 1.4 m depth	
2.0	SPT	2	70	13			MC - 16.2%
						- becoming grey and damp below 2.1 m depth	
2.5	SPT	3	70	25			MC - 10.8%
3.0						- becoming dense below 2.9 m depth	
3.5	SPT	4	80	44			MC - 8.8%
4.0						- becoming compact below 4.0 m depth	
4.5							
5.0	SPT	5	90	25			MC - 9.8%
5.5						- becoming dense below 5.6 m depth	
6.0							
6.5	SPT	6	10	43*			
7.0							
7.5							
8.0	SPT	7	90	45	8.08 m	- saturated sand and gravel seam encountered at 7.8 m depth	MC - 9.2%
						Borehole terminated at 8.08 m Borehole observed open to 7.31 m depth at completion Water measured at 5.94 m depth at completion	

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content

* - Stone in tip

LDS	Project: **Proposed Residential Subdivision** Project Location: **2004 Hamilton Road, London, ON** Project Number: **GE-00519**	Borehole ID **5** *Sheet 1 of 1*

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**258.53 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**3.96 m bgs**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
0.0–0.2						**TOPSOIL** - dark brown, sandy loam, moist, 203 mm	
0.2–1.37	SPT	1	50	3	1.37 m	**SILTY SAND** - brown/grey weathered, medium grained, very moist, very loose - becoming saturated below 0.6 m depth	*MC - 20.4%*
1.37–1.83	SPT	2	60	18	1.83 m	**SILT TILL** - brown, trace gravel, damp, compact	*MC - 12.9%*
1.83–2.13					2.13 m	**SAND** - medium to coarse grained, trace silt, compact	
2.13–5.03	SPT	3	60	24		**SILT TILL** - grey, moist seams throughout, damp, compact	*MC - 11.3%*
	SPT	4	80	57		- becoming very dense below 2.9 m depth	*MC - 8.2%*
	SPT	5	50	92	5.03 m		*MC - 7.4%*

Depth scale (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0

BH terminated at 5.03 m
Borehole observed open at completion
Water measured at 3.96 m depth at completion

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content

LDS	Project	**Proposed Residential Subdivision**	Borehole ID
	Project Location	**2004 Hamilton Road, London, ON**	**6**
	Project Number	**GE-00519**	*Sheet 1 of 1*

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**256.60 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**Dry**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	**Sample Type**	**Sample Number**	**Recovery (%)**	**SPT N-value (blows/0.3 m)**	**Graphic Log**	**Material Description**	**Remarks and Other Tests**
						TOPSOIL - dark brown, sandy loam, moist, 203 mm	
0.5						**SILT TILL** - brown/grey mottled, weathered, moist sand seams throughout, iron staining, moist, loose	
1.0	SPT	1	60	6			*MC - 14.7%*
1.5	SPT	2	90	22		- becoming brown, compact and less weathered below 1.4 m depth	*MC - 12.1%*
2.0						- becoming grey, damp and dense below 2.1 m depth	
2.5	SPT	3	90	35			*MC - 9.0%*
3.0	SPT	4	80	45			*MC - 8.3%*
3.5							
4.0							
4.5	SPT	5	90	48	*5.03 m*		*MC - 7.4%*
5.0						BH terminated at 5.03 m Borehole observed open and dry at completion	
5.5							
6.0							
6.5							
7.0							
7.5							
8.0							

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content

LDS	Project	Proposed Residential Subdivision	Borehole ID
	Project Location	2004 Hamilton Road, London, ON	7
	Project Number	GE-00519	Sheet 1 of 1

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**257.58 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**5.18 m bgs**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
					0.46 m	**TOPSOIL** - dark brown, sandy loam, moist	
0.5					0.91 m	**SILTY SAND** - brown, medium grained, moist	
1.0	SPT	1	60	19	1.68 m	**SILT TILL** - brown/grey, mottled, weathered, moist, compact	*MC - 14.1%*
1.5–2.0	SPT	2	60	25	2.13 m	**SILTY SAND** - brown, fine grained, moist, compact	*MC - 15.6%*
2.5	SPT	3	80	30		**SILT TILL** - brown, trace gravel, damp, dense	*MC - 11.0%*
3.0	SPT	4	80	66	4.04 m	- becoming grey below 2.9 m depth	*MC - 8.4%*
4.5–5.0	SPT	5	60	40	5.56 m	**SAND AND GRAVEL** - grey, coarse grained, trace silt, saturated, dense Gradation: 25% Gravel, 65% Sand, 10% Fines (Silt/Clay)	*MC - 11.0%*
6.0–6.5	SPT	6	50	50*	7.01 m	**SILT TILL** - grey, trace gravel, damp, very dense	*MC - 8.0%*
7.0–8.0						Auger refusal at 7.01 m Borehole observed open at completion Water measured at 5.18 m depth at completion	

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content

* - 50 blows for 140 mm

	Project	Proposed Residential Subdivision	Borehole ID
LDS	Project Location	2004 Hamilton Road, London, ON	8
	Project Number	GE-00519	Sheet 1 of 1

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**258.23 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	**Dry**
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
						TOPSOIL - dark brown, sandy loam, 254 mm	
0.5						**SILT TILL** - brown/grey, mottled, weathered, some sand, trace fine gravel, damp, compact	
1.0	SPT	1	60	17		- damp sand seam encountered at 1.0 m depth	MC - 14.9%
1.5						- becoming dense below 1.4 m depth	
2.0	SPT	2	80	36			MC - 14.8%
						- becoming brown and less weathered below 2.1 m depth	
2.5	SPT	3	80	42			MC - 9.1%
3.0						- becoming very dense below 2.9 m depth	
	SPT	4	90	92			MC - 8.5%
3.5						- becoming grey below 3.4 m depth	
4.0							
4.5							
5.0	SPT	5	90	51			MC - 9.2%
5.5							
6.0							
6.5	SPT	6	90	37		- damp sand seam encountered at 6.4 m depth	MC - 13.9%
7.0							
7.5					7.47 m	Auger refusal at 7.47 m Borehole observed open and dry at completion	
8.0							

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	**no well installed**
Installation Depth	
Screen Length	
Depth of Bentonite Seal	

Additional Notes

MC - denotes moisture content

LDS	Project	**Proposed Residential Subdivision**	Borehole ID
	Project Location	**2004 Hamilton Road, London, ON**	**9/MW**
	Project Number	**GE-00519**	*Sheet 1 of 1*

Date Drilled	**June 10, 2021**	Ground Surface Elevation	**256.09 m asl**
Drill Rig	**D50 Turbo**	Groundwater Level at Completion	
Drilling Method	**Hollow Stem Auger**	Technician	**J. May**
Drilling Contractor	**London Soil Test**	Checked By	**S. Hadden, EIT**

Depth (m)	Sample Type	Sample Number	Recovery (%)	SPT N-value (blows/0.3 m)	Graphic Log	Material Description	Remarks and Other Tests
0.0–0.25						**TOPSOIL** - dark brown, sandy loam, 254 mm	
0.25–1.68					Jun 7/21	**SILT TILL** - brown/grey, mottled, weathered, some sand, trace fine gravel, damp, compact	
					1.68 m		
1.68–3.35	SPT	1	60	37		**SILTY SAND** - grey, fine grained, damp, dense	*MC - 14.7%*
	SPT	2	70	16	3.35 m		*MC -11.5%*
3.35–5.03						**SILT TILL** - grey, trace gravel, damp, very dense	
						- saturated sand seam encountered at 3.7 m depth	
	SPT	3	80	34	5.03 m		*MC - 9.4%*
						Borehole terminated at 5.03 m MW Installed at 4.57 m - refer to details below	

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0

Legend

- SPT Sample
- Bulk Sample
- Shelby Tube
- Stabilized Groundwater
- Inferred Groundwater

Well Construction Details

Pipe Diameter	50 mm CPVC Pipe
Installation Depth	4.57 m
Screen Length	3.05 m w/ No. 2 filter sand
Depth of Bentonite Seal	0.91 m

Well equipped with locking J-Plug cap.

Additional Notes

MC - denotes moisture content

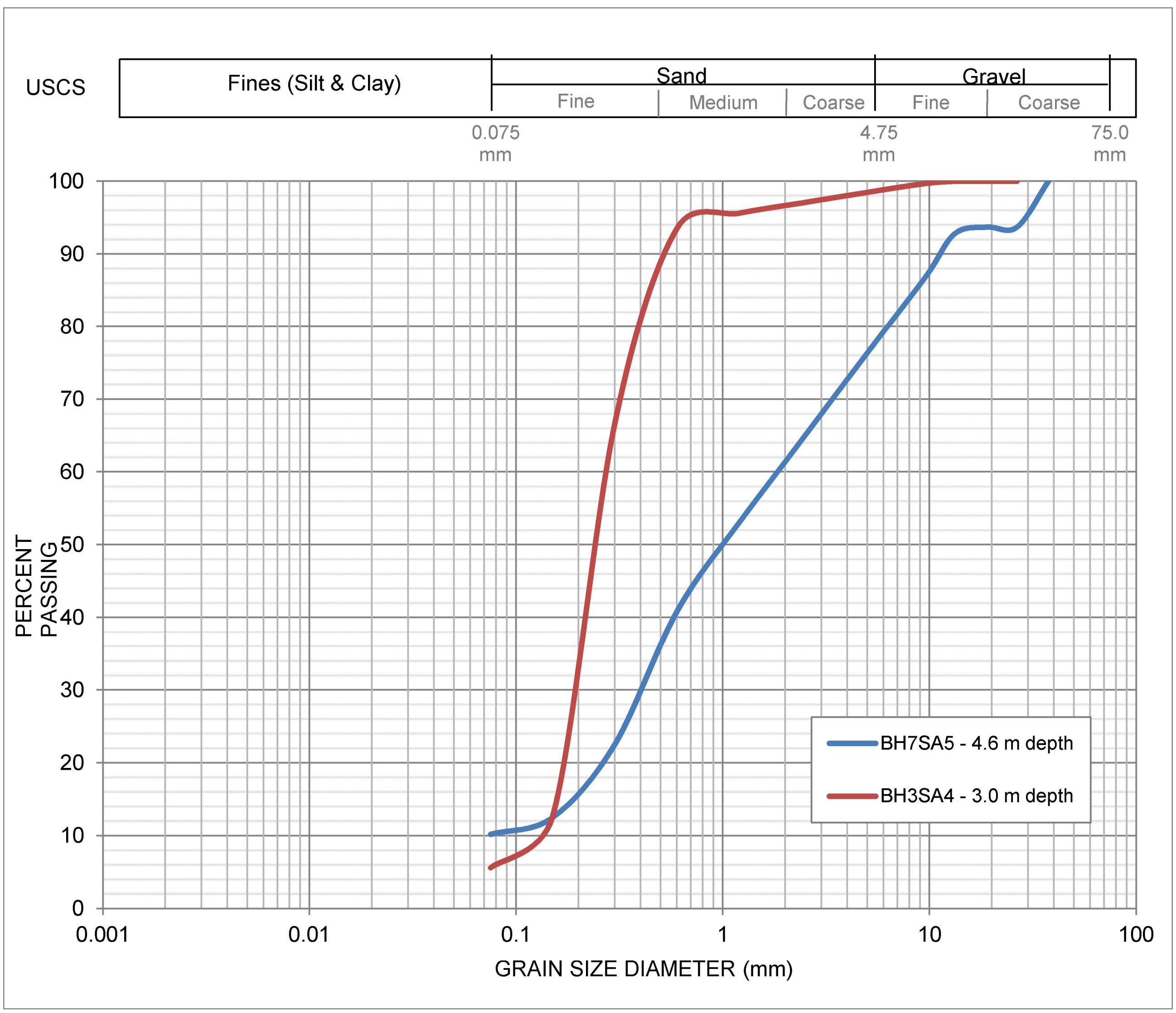
June 7, 2021 - WL, 0.75 m bgs
July 14, 2021 - WL, 0.40 m bgs

Particle Size Distribution
Results of Sieve Analysis

Project Name: Draft Plan of Subdivision **Date:** 30-Jun-21

Project Location: 2004 Hamilton Road **Project No.:** GE-00519

Sample ID	Unified Soil Classification				Moisture Content (%)
	Fines (Silt & Clay)	% Sand	% Gravel	% Cobbles	
BH7SA5 - 4.6 m depth	10.2%	65.4%	24.4%	0.0%	11.0
BH3SA4 - 3.0 m depth	5.6%	92.8%	1.6%	0.0%	21.1

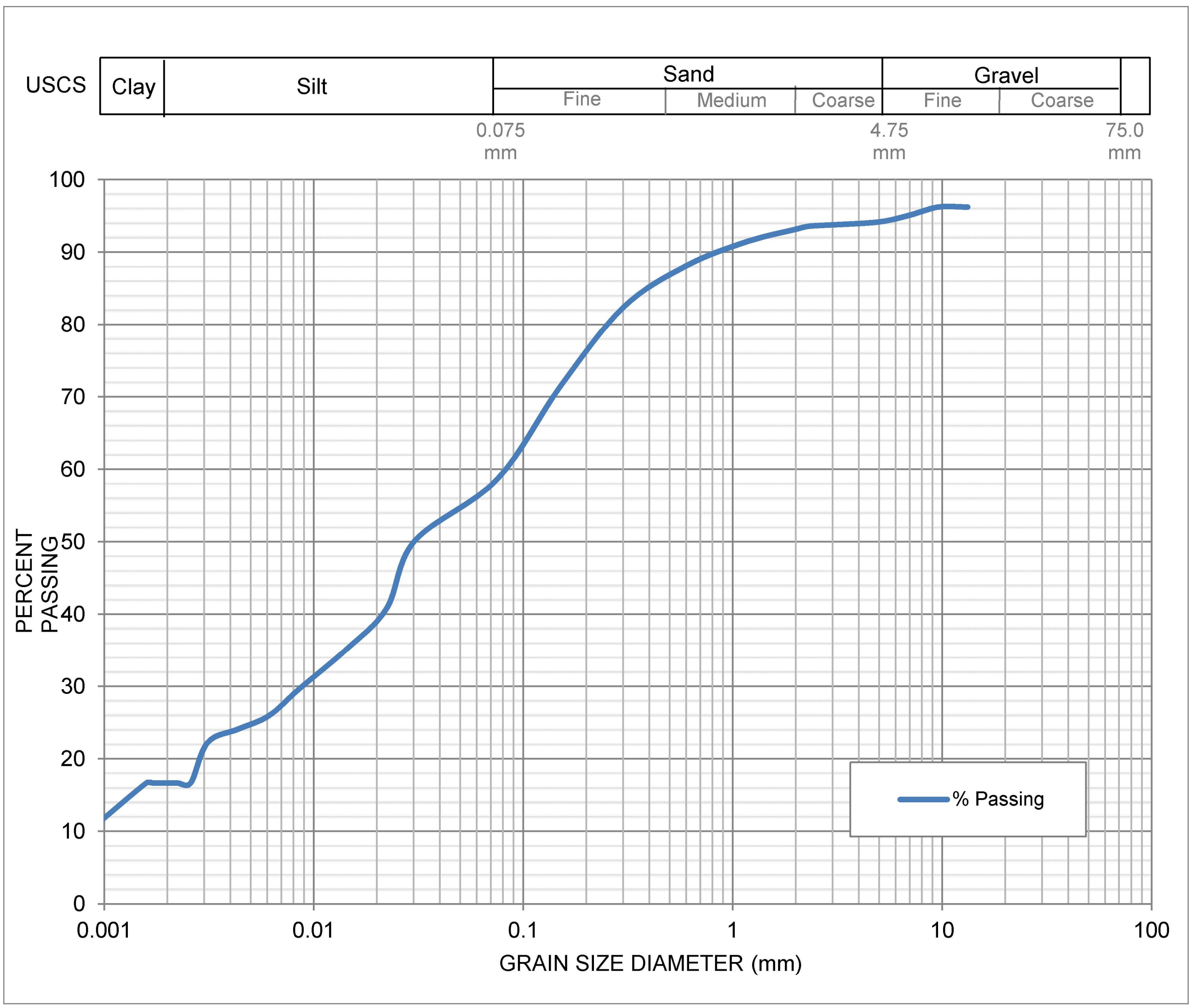


Particle Size Distribution
Results of Sieve Analysis

Project Name: Draft Plan of Subdivision **Date:** 20-Jul-21

Project Location: 2004 Hamilton Road **Project No.:** GE-00519

Sample ID	Unified Soil Classification				Moisture Content (%)
	% Clay	% Silt	% Sand	% Gravel	
BH9SA1 - 1.6 m depth	16.7	41.9	35.5	5.9	6.2



APPENDIX C

SINGLE WELL RESPONSE TESTS

SINGLE WELL RESPONSE TEST
Estimation of Saturated Hydraulic Conductivity from Well Recovery Data

Project No.	**GE-00519**	**Monitoring Well ID**	**BH1/MW**
Project Name	**2004 Hamilton Road**	**Date of Testing**	**9-Jul-21**

Well Data:

Radius of well casing, r,(m) =	0.025	Data Logger S/N:	20246303	
Radius of filter pack/borehole, R, (m) =	0.101	Reading Interval:	1 - 10 seconds	
Length of well screen, L, (m) =	1.52			
Submerged well screen length, Ls, (m) =	1.32	Gravel Pack Correction $R_{equiv} = [(1-n)r^2 + nR^2]^{½}$		0.070
Static water level, h, (m) =	3.17			
Porosity of Gravel Pack, n (%) =	0.45			

Figure 1: Single Well Response Test

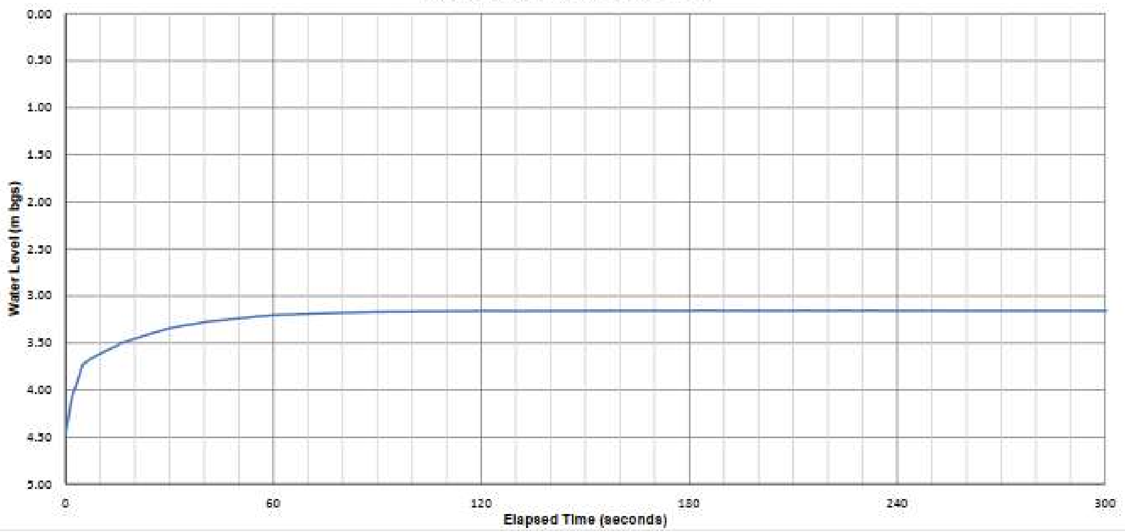
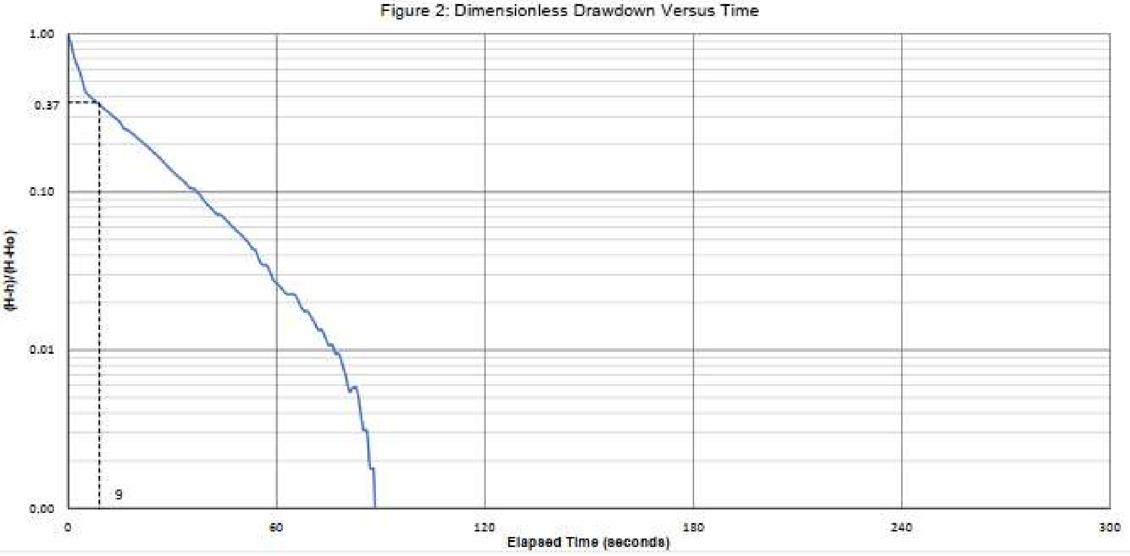


Figure 2: Dimensionless Drawdown Versus Time



Estimation of Saturated Hydraulic Conductivity From Hvorslev's Equation

Hvorslev's Equation: $K = \frac{r^2(\ln(L/R))}{2(To)(L)}$ for L/R > 8

where

K = Hydraulic Conductivity (m/s)
r = Radius of the well casing (m)
R = Radius of the well screen (m)
L = Length of the submerged portion of the well screen under static conditions (m)
To = Basic time lag; time for water level to rise or fall to 37% of the initial change (Sec)

Check if L/R > 8	L/R =	15.0	
Evaluation of basic time lag	To=	9.0	sec
Estimated Saturated Hydraulic Conductivity	**K=**	**7.72E-05**	**m/sec**

SINGLE WELL RESPONSE TEST
Estimation of Saturated Hydraulic Conductivity from Well Recovery Data

BH3/MW

Project No.	**GE-00519**	**Monitoring Well ID**	**BH3/MW**
Project Name	**2004 Hamilton Road**	**Date of Testing**	**9-Jul-21**

Well Data:

Radius of well casing, r,(m) =	0.025
Radius of filter pack/borehole, R, (m) =	0.101
Length of well screen, L, (m) =	1.52
Submerged well screen length, Ls, (m) =	1.32
Static water level, h, (m) =	1.12
Porosity of Gravel Pack, n (%) =	0.45

Data Logger S/N: 20246303
Reading Interval: 1 - 10 seconds

Gravel Pack Correctior $R_{equiv} = [(1-n)r^2 + nR^2]^{½}$ 0.070

Figure 1: Single Well Response Test

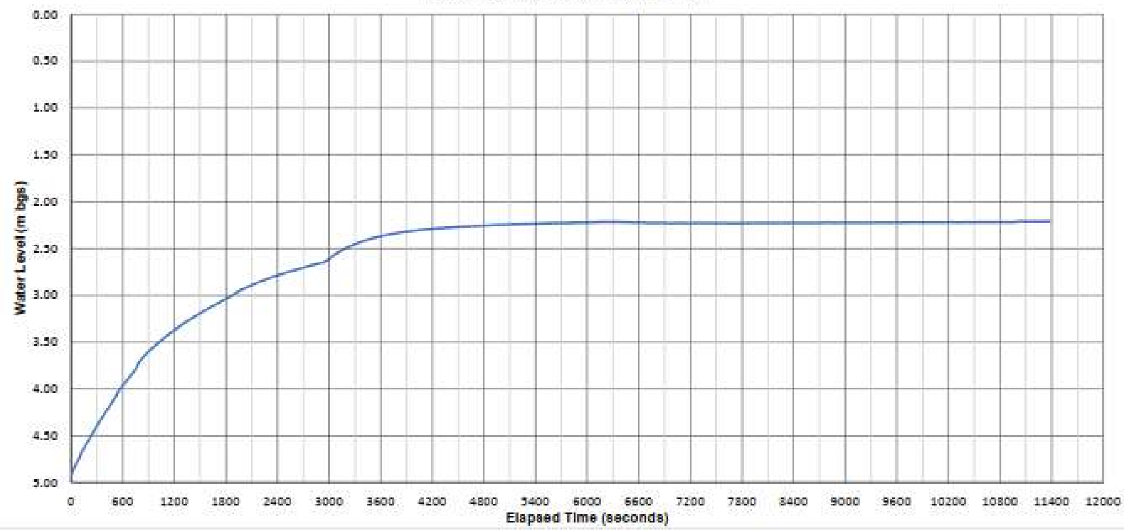
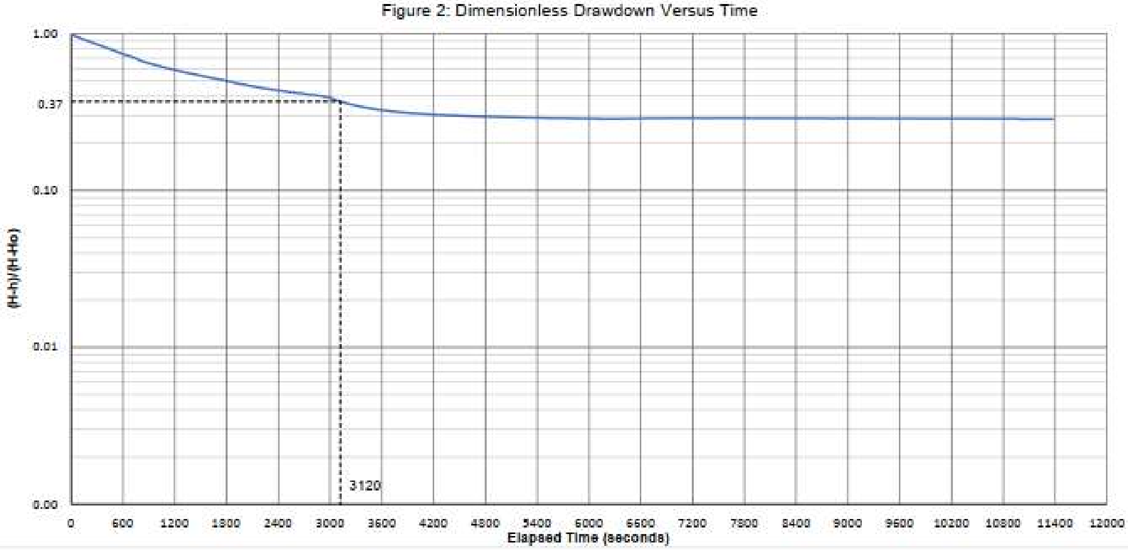


Figure 2: Dimensionless Drawdown Versus Time



Estimation of Saturated Hydraulic Conductivity From Hvorslev's Equation

Hvorslev's Equation: $K = \dfrac{r^2(\ln(L/R))}{2(To)(L)}$ for L/R > 8

where

K = Hydraulic Conductivity (m/s)
r = Radius of the well casing (m)
R = Radius of the well screen (m)
L = Length of the submerged portion of the well screen under static conditions (m)
To = Basic time lag; time for water level to rise or fall to 37% of the initial change (Sec)

Check if L/R > 8	L/R =	15.0	
Evaluation of basic time lag	To=	3120.0	sec
Estimated Saturated Hydraulic Conductivity	**K=**	**2.23E-07**	**m/sec**

SINGLE WELL RESPONSE TEST
Estimation of Saturated Hydraulic Conductivity from Well Recovery Data

BH9/MW

Project No.	**GE-00519**	**Monitoring Well ID**	**BH9/MW**
Project Name	**2004 Hamilton Road**	**Date of Testing**	**9-Jul-21**

Well Data:

Radius of well casing, r,(m) =	0.025	Data Logger S/N:	20246303
Radius of filter pack/borehole, R, (m) =	0.101	Reading Interval:	1 - 10 seconds
Length of well screen, L, (m) =	1.52		
Submerged well screen length, Ls, (m) =	1.32	Gravel Pack Correction $R_{equiv} = [(1-n)r^2 + nR^2]^{1/2}$	0.070
Static water level, h, (m) =	0.47		
Porosity of Gravel Pack, n (%) =	0.45		

Figure 1: Single Well Response Test

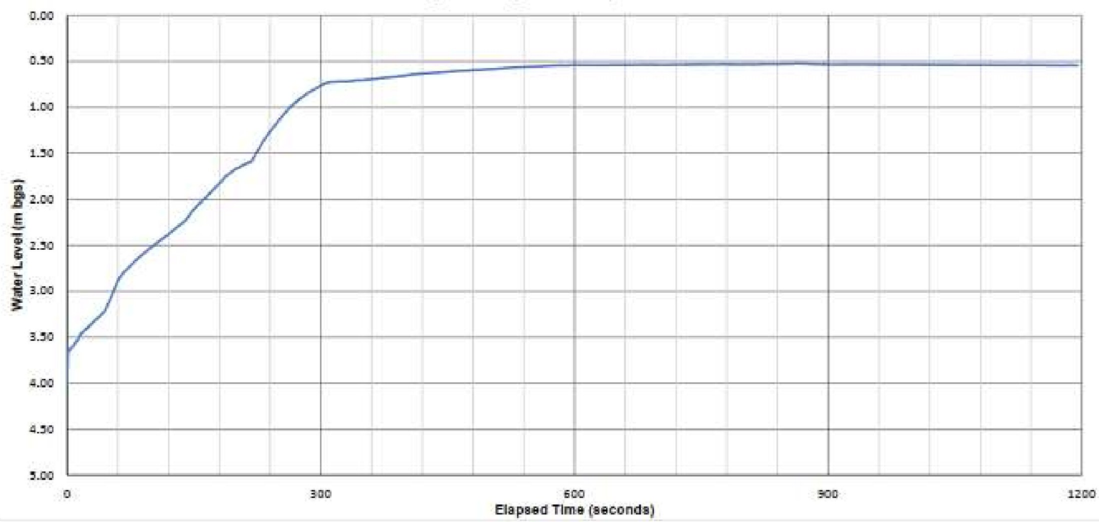
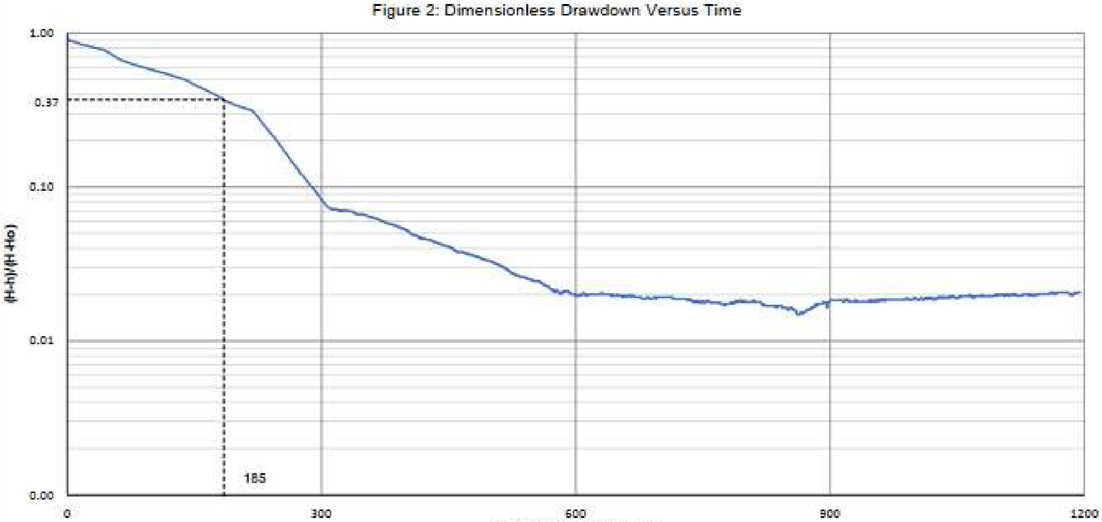


Figure 2: Dimensionless Drawdown Versus Time



Estimation of Saturated Hydraulic Conductivity From Hvorslev's Equation

Hvorslev's Equation: $K = \frac{r^2(\ln(L/R))}{2(To)(L)}$ for L/R > 8

where

K = Hydraulic Conductivity (m/s)
r = Radius of the well casing (m)
R = Radius of the well screen (m)
L = Length of the submerged portion of the well screen under static conditions (m)
To = Basic time lag; time for water level to rise or fall to 37% of the initial change (Sec)

Check if L/R > 8	L/R =	15.0	
Evaluation of basic time lag	To=	185.0	sec
Estimated Saturated Hydraulic Conductivity	**K=**	**3.75E-06**	**m/sec**

APPENDIX D

ANALYTICAL TEST RESULTS

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Certificate of Analysis

LDS Consultants Inc. (London)

15875 Robins Hill Road, Unit 1
London, ON N5V 0A5
Attn: Natascha Ungerer

Client PO:
Project: GE-00519
Custody: 51351

Report Date: 16-Jul-2021
Order Date: 14-Jul-2021

Order #: 2129434

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

Paracel ID	Client ID	Paracel ID	Client ID
2129434-01	BH1/MW		
2129434-02	BH9/MW		

Approved By: Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

Certificate of Analysis

Client: **LDS Consultants Inc. (London)**

Client PO:

Report Date: 16-Jul-2021

Order Date: 14-Jul-2021

Project Description: GE-00519

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	15-Jul-21	15-Jul-21
Anions	EPA 300.1 - IC	15-Jul-21	15-Jul-21
Conductivity	EPA 9050A- probe @25 °C	15-Jul-21	15-Jul-21
Hardness	Hardness as CaCO3	15-Jul-21	15-Jul-21
Metals, ICP-MS	EPA 200.8 - ICP-MS	15-Jul-21	15-Jul-21
pH	EPA 150.1 - pH probe @25 °C	15-Jul-21	15-Jul-21
Total Suspended Solids	SM 2540D - Gravimetric	16-Jul-21	16-Jul-21

Summary of Exceedances

(If this page is blank then there are no exceedances)

Only those criteria that a sample exceeds will be highlighted in red

Regulatory Comparison:

Paracel Laboratories has provided regulatory guidelines on this report for informational purposes only and makes no representations or warranties that the data is accurate or reflects the current regulatory values. The user is advised to consult with the appropriate official regulations to evaluate compliance. Sample results that are highlighted have exceeded the selected regulatory limit. Calculated uncertainty estimations have not been applied for determining regulatory exceedances. Regulatory limts displayed in brackets, (), applies to medium and fine textured soils.

Criteria:

Client ID	Analyte	MDL / Units	Result	Reg 153/04 (2011)-Table 1 Groundwater

Certificate of Analysis

Client: LDS Consultants Inc. (London)

Client PO:

Report Date: 16-Jul-2021

Order Date: 14-Jul-2021

Project Description: GE-00519

						Criteria:	
	Client ID:	BH1/MW	BH9/MW	-	-	**Reg 153/04 (2011)-Table 1 Groundwater**	
	Sample Date:	14-Jul-2021	14-Jul-2021	-	-		
	Sample ID:	2129434-01	2129434-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
General Inorganics							
Alkalinity, total	5 mg/L	568	305	-	-		
Hardness	mg/L	673	278	-	-		
Conductivity	5 uS/cm	1390	655	-	-		
pH	0.1 pH Units	7.2	7.4	-	-	5 - 9	pH units
Total Suspended Solids	2 mg/L	3	<2	-	-		
Anions							
Bromide	0.1 mg/L	0.3	<0.1	-	-		
Chloride	1 mg/L	28	4	-	-	790,000	ug/L
Fluoride	0.1 mg/L	<0.1	0.4	-	-		
Nitrate as N	0.1 mg/L	<0.1	<0.1	-	-		
Nitrite as N	0.05 mg/L	0.05	<0.05	-	-		
Phosphate as P	0.2 mg/L	<0.2	<0.2	-	-		
Sulphate	1 mg/L	187	30	-	-		
Metals							
Aluminum	1 ug/L	<1	2	-	-		
Antimony	0.5 ug/L	<0.5	<0.5	-	-	1.5	ug/L
Arsenic	1 ug/L	<1	2	-	-	13	ug/L
Barium	1 ug/L	192	91	-	-	610	ug/L
Beryllium	0.5 ug/L	<0.5	<0.5	-	-	0.5	ug/L
Boron	10 ug/L	72	67	-	-	1,700	ug/L
Cadmium	0.1 ug/L	<0.1	<0.1	-	-	0.5	ug/L
Calcium	100 ug/L	181000	78800	-	-		
Chromium	1 ug/L	<1	<1	-	-	11	ug/L

Certificate of Analysis

Client: **LDS Consultants Inc. (London)**

Client PO:

Report Date: 16-Jul-2021

Order Date: 14-Jul-2021

Project Description: GE-00519

	Client ID:	BH1/MW	BH9/MW	-	-	**Criteria:**	
	Sample Date:	14-Jul-2021	14-Jul-2021	-	-	**Reg 153/04 (2011)-Table 1 Groundwater**	
	Sample ID:	2129434-01	2129434-02	-	-		
	Matrix:	Ground Water	Ground Water	-	-		
	MDL/Units						
Cobalt	0.5 ug/L	0.6	<0.5	-	-	3.8	ug/L
Copper	0.5 ug/L	2.5	2.8	-	-	5	ug/L
Iron	100 ug/L	<100	<100	-	-		
Lead	0.1 ug/L	<0.1	<0.1	-	-	1.9	ug/L
Magnesium	200 ug/L	53500	19800	-	-		
Manganese	5 ug/L	306	55	-	-		
Molybdenum	0.5 ug/L	1.5	3.7	-	-	23	ug/L
Nickel	1 ug/L	7	2	-	-	14	ug/L
Potassium	100 ug/L	6150	1630	-	-		
Selenium	1 ug/L	<1	<1	-	-	5	ug/L
Silver	0.1 ug/L	<0.1	<0.1	-	-	0.3	ug/L
Sodium	200 ug/L	34700	17400	-	-	490,000	ug/L
Strontium	10 ug/L	1090	575	-	-		
Thallium	0.1 ug/L	<0.1	<0.1	-	-	0.5	ug/L
Tin	5 ug/L	<5	<5	-	-		
Titanium	5 ug/L	<5	<5	-	-		
Tungsten	10 ug/L	<10	<10	-	-		
Uranium	0.1 ug/L	2.6	1.0	-	-	8.9	ug/L
Vanadium	0.5 ug/L	1.1	0.7	-	-	3.9	ug/L
Zinc	5 ug/L	<5	5	-	-	160	ug/L

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Bromide	ND	0.1	mg/L						
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						
Phosphate as P	ND	0.2	mg/L						
Sulphate	ND	1	mg/L						
General Inorganics									
Alkalinity, total	ND	5	mg/L						
Conductivity	ND	5	uS/cm						
Total Suspended Solids	ND	2	mg/L						
Metals									
Aluminum	ND	1	ug/L						
Antimony	ND	0.5	ug/L						
Arsenic	ND	1	ug/L						
Barium	ND	1	ug/L						
Beryllium	ND	0.5	ug/L						
Boron	ND	10	ug/L						
Cadmium	ND	0.1	ug/L						
Calcium	ND	100	ug/L						
Chromium	ND	1	ug/L						
Cobalt	ND	0.5	ug/L						
Copper	ND	0.5	ug/L						
Iron	ND	100	ug/L						
Lead	ND	0.1	ug/L						
Magnesium	ND	200	ug/L						
Manganese	ND	5	ug/L						
Molybdenum	ND	0.5	ug/L						
Nickel	ND	1	ug/L						
Potassium	ND	100	ug/L						
Selenium	ND	1	ug/L						
Silver	ND	0.1	ug/L						
Sodium	ND	200	ug/L						
Strontium	ND	10	ug/L						
Thallium	ND	0.1	ug/L						
Tin	ND	5	ug/L						
Titanium	ND	5	ug/L						
Tungsten	ND	10	ug/L						
Uranium	ND	0.1	ug/L						
Vanadium	ND	0.5	ug/L						

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Zinc	ND	5	ug/L						

Certificate of Analysis

Report Date: 16-Jul-2021

Client: LDS Consultants Inc. (London)

Order Date: 14-Jul-2021

Client PO:

Project Description: GE-00519

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Bromide	ND	0.1	mg/L	ND			NC	10	
Chloride	58.0	1	mg/L	58.0			0.1	10	
Fluoride	ND	0.1	mg/L	ND			NC	10	
Nitrate as N	ND	0.1	mg/L	ND			NC	10	
Nitrite as N	ND	0.05	mg/L	ND			NC	10	
Phosphate as P	ND	0.2	mg/L	ND			NC	10	
Sulphate	44.7	1	mg/L	44.6			0.2	10	
General Inorganics									
Alkalinity, total	43.2	5	mg/L	43.7			1.2	14	
Conductivity	217	5	uS/cm	218			0.7	5	
pH	7.6	0.1	pH Units	7.6			0.1	3.3	
Total Suspended Solids	ND	2	mg/L	ND			NC	10	
Metals									
Aluminum	ND	1	ug/L	ND			NC	20	
Antimony	ND	0.5	ug/L	ND			NC	20	
Arsenic	ND	1	ug/L	ND			NC	20	
Barium	ND	1	ug/L	ND			NC	20	
Beryllium	ND	0.5	ug/L	ND			NC	20	
Boron	ND	10	ug/L	ND			NC	20	
Cadmium	ND	0.1	ug/L	ND			NC	20	
Calcium	ND	100	ug/L	ND			NC	20	
Chromium	ND	1	ug/L	ND			NC	20	
Cobalt	ND	0.5	ug/L	ND			NC	20	
Copper	ND	0.5	ug/L	ND			NC	20	
Iron	ND	100	ug/L	ND			NC	20	
Lead	ND	0.1	ug/L	ND			NC	20	
Magnesium	ND	200	ug/L	ND			NC	20	
Manganese	ND	5	ug/L	ND			NC	20	
Molybdenum	ND	0.5	ug/L	ND			NC	20	
Nickel	ND	1	ug/L	ND			NC	20	
Potassium	ND	100	ug/L	ND			NC	20	
Selenium	ND	1	ug/L	ND			NC	20	
Silver	ND	0.1	ug/L	ND			NC	20	
Sodium	267	200	ug/L	255			4.6	20	
Strontium	ND	10	ug/L	ND			NC	20	
Thallium	ND	0.1	ug/L	ND			NC	20	
Tin	ND	5	ug/L	ND			NC	20	
Titanium	ND	5	ug/L	ND			NC	20	
Tungsten	ND	10	ug/L	ND			NC	20	

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Uranium	ND	0.1	ug/L	ND			NC	20	
Vanadium	ND	0.5	ug/L	ND			NC	20	
Zinc	ND	5	ug/L	ND			NC	20	

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Bromide	0.95	0.1	mg/L	ND	94.5	84-116			
Chloride	67.6	1	mg/L	58.0	96.0	77-123			
Fluoride	1.09	0.1	mg/L	ND	109	79-121			
Nitrate as N	1.05	0.1	mg/L	ND	105	79-120			
Nitrite as N	1.01	0.05	mg/L	ND	101	84-117			
Phosphate as P	5.67	0.2	mg/L	ND	113	59-141			
Sulphate	53.4	1	mg/L	44.6	87.4	74-126			
General Inorganics									
Total Suspended Solids	23.0	2	mg/L	ND	115	75-125			
Metals									
Aluminum	46.0	1	ug/L	ND	91.9	80-120			
Antimony	47.2	0.5	ug/L	ND	94.4	80-120			
Arsenic	49.5	1	ug/L	ND	99.0	80-120			
Barium	50.8	1	ug/L	ND	101	80-120			
Beryllium	47.6	0.5	ug/L	ND	95.2	80-120			
Boron	46	10	ug/L	ND	89.2	80-120			
Cadmium	51.0	0.1	ug/L	ND	102	80-120			
Calcium	9300	100	ug/L	ND	92.8	80-120			
Chromium	50.6	1	ug/L	ND	101	80-120			
Cobalt	50.2	0.5	ug/L	ND	100	80-120			
Copper	50.0	0.5	ug/L	ND	99.9	80-120			
Iron	2380	100	ug/L	ND	95.0	80-120			
Lead	48.5	0.1	ug/L	ND	97.0	80-120			
Magnesium	9520	200	ug/L	ND	95.2	80-120			
Manganese	50.4	5	ug/L	ND	101	80-120			
Molybdenum	37.4	0.5	ug/L	ND	74.6	80-120			QM-07
Nickel	49.3	1	ug/L	ND	98.5	80-120			
Potassium	9130	100	ug/L	ND	91.1	80-120			
Selenium	48.9	1	ug/L	ND	97.8	80-120			
Silver	50.5	0.1	ug/L	ND	101	80-120			
Sodium	9640	200	ug/L	255	93.8	80-120			
Strontium	50	10	ug/L	ND	98.9	80-120			
Thallium	47.5	0.1	ug/L	ND	95.0	80-120			

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Tin	42.5	5	ug/L	ND	84.9	80-120			
Titanium	52.3	5	ug/L	ND	105	80-120			
Tungsten	33.1	10	ug/L	ND	65.4	80-120			QM-07
Uranium	46.9	0.1	ug/L	ND	93.8	80-120			
Vanadium	50.0	0.5	ug/L	ND	100	80-120			
Zinc	51	5	ug/L	ND	102	80-120			

Qualifier Notes:

QC Qualifiers :

QM-07 : The spike recovery was outside acceptance limits for the MS and/or MSD. The batch was accepted based on other acceptable QC.

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.

NC: Not Calculated

PARACEL LABORATORIES

Paracel ID: 2129434

...e
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...49-1947
...@paracellabs.com
...paracellabs.com

Paracel Order Number (Lab Use Only)

Chain Of Custody (Lab Use Only)

№ 51351

Client Name: LDS Consultants	Project Ref: GE-00519
Contact Name: Natascha Unger	Quote #:
Address: 15875 Robins Hill Rd, Unit London	PO #:
Telephone: 226-973-2312	E-mail: rebecca.walker@ldsconsultants.ca shaun.hadden@ldsconsultants.ca

Page 1 of 1

Turnaround Time

- ☐ 1 day
- ☐ 3 day
- ☐ 2 day
- ☒ Regular

Date Required:

Regulation 153/04: ☒ Table 1 ☐ Res/Park ☐ Med/Fine ☐ Table 2 ☐ Ind/Comm ☐ Coarse ☐ Table 3 ☐ Agri/Other ☐ Table N/A

For RSC: ☐ Yes ☐ No

Other Regulation: ☐ REG 558 ☐ PWQO ☐ CCME ☐ MISA ☐ SU - Sani ☐ SU - Storm

Mun:

☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Time	Metals (standard package)	cations + Anions	Nitrite, Nitrate	pH	TSS	EC	Hardness					
1	BH1/MW	GW		5	July 14, 2021	12:30	X	X	X	X	X	X	X					
2	BH9/MW	GW		5	↓	12:00	X	X	X	X	X	X	X					
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

Comments:

Method of Delivery: walk-in

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab: Sumeepavm Dohmai	Verified By:
Relinquished By (Print): Natascha Unger	Date/Time: 14 July, 2021 1259	Date/Time: Jul 15, 2021 11.20	Date/Time: Jul 15 2021 1040
Date/Time: July 14, 2021 (13:00)	Temperature: 17.2 °C	Temperature: 6.3 °C	pH Verified: ☐ By:

Site Location	2004 Hamilton Rd, London, ON
LDS Project Reference	GE-00519
Water Sample Collection Date	July 14, 2021
Sample Location	BH1/MW
Technician	Natascha Ungerer
Analytical Laboratory	Paracel Laboratories Ltd.
Paracel Workorder	2129434

Paracel (Lab ID)			**2129434-01**
Parameter	**UNITS**	**ODWS**	**BH1/MW**
General Inorganics			
Hardness	mg/L		468
Conductivity	uS/cm		1390
pH	pH Units		7.2
Total Suspended Solids	mg/L		3

Paracel (Lab ID)			**2129434-01**
Parameter	**UNITS**	**ODWS**	**BH1/MW**
Anions			
Bromide	mg/L		0.3
Chloride	mg/L	*250*	28
Fluoride	mg/L	1.5	ND (0.1)
Nitrate as N	mg/L	10	ND (0.1)
Nitrite as N	mg/L	1	0.05
Phosphate as P	mg/L		ND (0.2)
Sulphate	mg/L	*500*	187

Paracel (Lab ID)			**2129434-01**
Parameter	**UNITS**	**ODWS**	**BH1/MW**
Metals			
Aluminum	ug/L		ND (1)
Antimony	ug/L	6	ND (0.5)
Arsenic	ug/L	10	ND (1)
Barium	ug/L	1000	192
Beryllium	ug/L		ND (0.5)
Boron	ug/L	5000	72
Cadmium	ug/L	5	ND (0.1)
Calcium	ug/L		181000
Chromium	ug/L	50	ND (1)
Cobalt	ug/L		0.6
Copper	ug/L	*1000*	2.5
Iron	ug/L	*300*	ND (100)
Lead	ug/L	10	ND (0.1)
Magnesium	ug/L		53500
Manganese	ug/L	*50*	306
Molybdenum	mg/L		1.5
Nickel	ug/L		7
Potassium	ug/L		6150
Selenium	ug/L	50	ND (1)
Silver	ug/L		ND (0.1)
Sodium	ug/L	20000	34700
Strontium	ug/L		1090
Thallium	ug/L		ND (0.1)
Tin	ug/L		ND (5)
Titanium	ug/L		ND (5)
Tungsten	ug/L		ND (10)
Uranium	ug/L	20	2.6
Vanadium	ug/L		1.1
Zinc	ug/L	*5000*	ND (5)

Notes:

ODWS - denotes Ontario Drinking Water Standards

black font - maximum allowable concentrations

blue italics - aesthetic objectives

ND - denotes not detected (laboratory reported detection limit)

Results denote ODWS exceedance

Results Reviewed By:

Rebecca Walker, P.Eng.
LDS Consultants Inc.

Site Location	2004 Hamilton Rd, London, ON
LDS Project Reference	GE-00519
Water Sample Collection Date	July 14, 2021
Sample Location	BH9/MW
Technician	Natascha Ungerer
Analytical Laboratory	Paracel Laboratories Ltd.
Paracel Workorder	2129434

Paracel (Lab ID)			**2129434-02**
Parameter	**UNITS**	**ODWS**	**BH9/MW**
General Inorganics			
Hardness	mg/L		305
Conductivity	uS/cm		655
pH	pH Units		7.4
Total Suspended Solids	mg/L		ND (2)

Paracel (Lab ID)			**2129434-02**
Parameter	**UNITS**	**ODWS**	**BH9/MW**
Anions			
Bromide	mg/L		ND (0.1)
Chloride	mg/L	*250*	4
Fluoride	mg/L	1.5	0.4
Nitrate as N	mg/L	10	ND (0.1)
Nitrite as N	mg/L	1	ND (0.05)
Phosphate as P	mg/L		ND (0.2)
Sulphate	mg/L	*500*	30

Paracel (Lab ID)			**2129434-02**
Parameter	**UNITS**	**ODWS**	**BH9/MW**
Metals			
Aluminum	ug/L		2
Antimony	ug/L	6	ND (0.5)
Arsenic	ug/L	10	2
Barium	ug/L	1000	91
Beryllium	ug/L		ND (0.5)
Boron	ug/L	5000	67
Cadmium	ug/L	5	ND (0.1)
Calcium	ug/L		78800
Chromium	ug/L	50	ND (1)
Cobalt	ug/L		ND (0.5)
Copper	ug/L	*1000*	2.8
Iron	ug/L	*300*	ND (100)
Lead	ug/L	10	ND (0.1)
Magnesium	ug/L		19800
Manganese	ug/L	*50*	55
Molybdenum	mg/L		3.7
Nickel	ug/L		2
Potassium	ug/L		1630
Selenium	ug/L	50	ND (1)
Silver	ug/L		ND (0.1)
Sodium	ug/L	20000	17400
Strontium	ug/L		575
Thallium	ug/L		ND (0.1)
Tin	ug/L		ND (5)
Titanium	ug/L		ND (5)
Tungsten	ug/L		ND (10)
Uranium	ug/L	20	1.0
Vanadium	ug/L		0.7
Zinc	ug/L	*5000*	5

Notes:

ODWS - denotes Ontario Drinking Water Standards

black font - maximum allowable concentrations

blue italics - aesthetic objectives

ND - denotes not detected (laboratory reported detection limit)

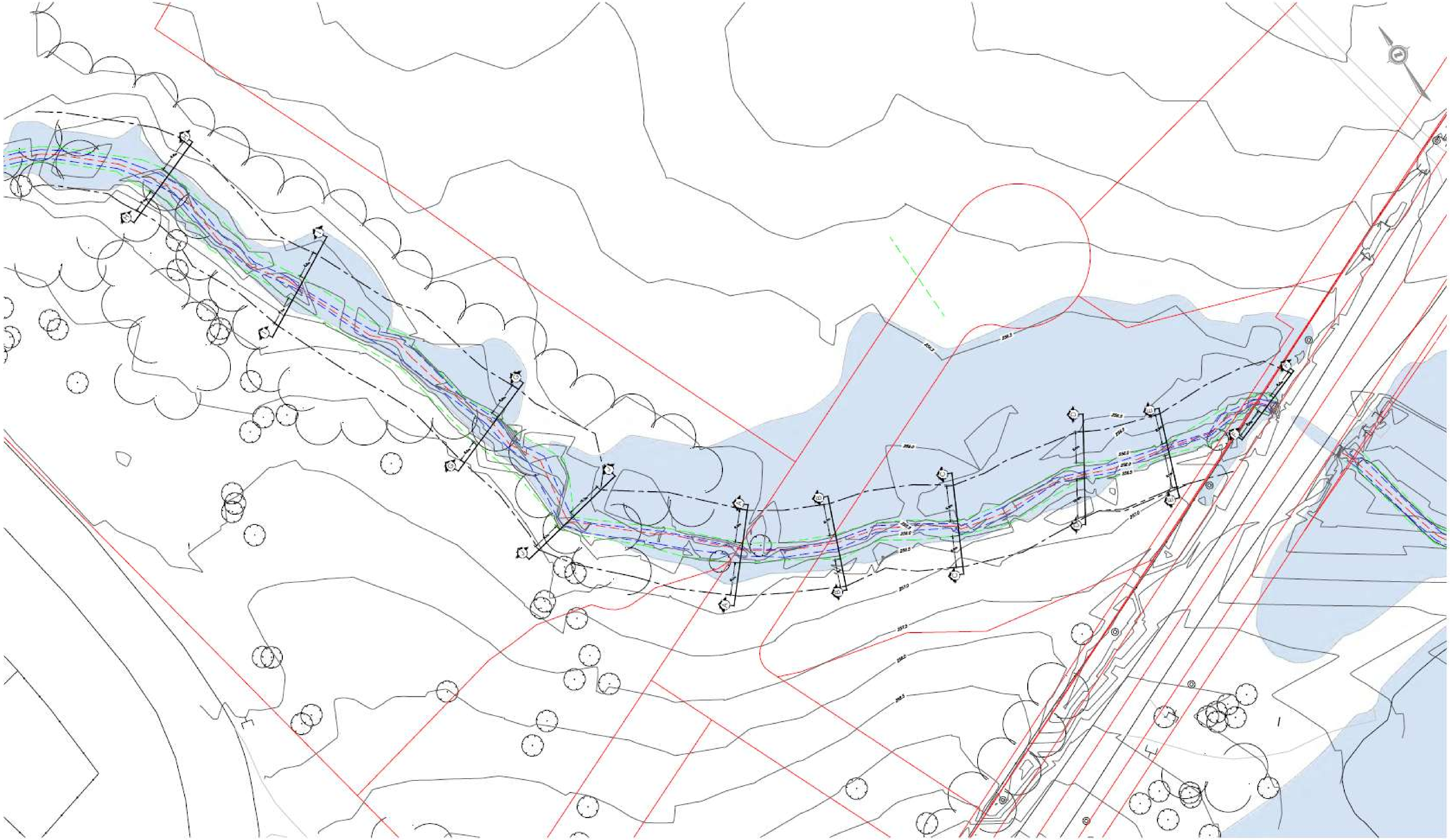
Results denote ODWS exceedance

Results Reviewed By:

Rebecca Walker, P.Eng.
LDS Consultants Inc.

APPENDIX E

SLOPE STABILITY



LEGEND

- TOP OF SLOPE
- EDGE OF WATER
- CENTERLINE OF STREAM
- EROSION HAZARD LIMIT

NOTES

Slope assessment figures based on topographic survey data provided by Development Engineering.

ENGINEER'S STAMP

LICENSED PROFESSIONAL ENGINEER
R.A. WALKER
MAY 20, 2024
PROVINCE OF ONTARIO

CONSULTANT

STONECAIRN CONSULTING

SCALE

HORZ – 1 : 500
5 0 10m

TITLE

SLOPE ASSESSMENT PLAN

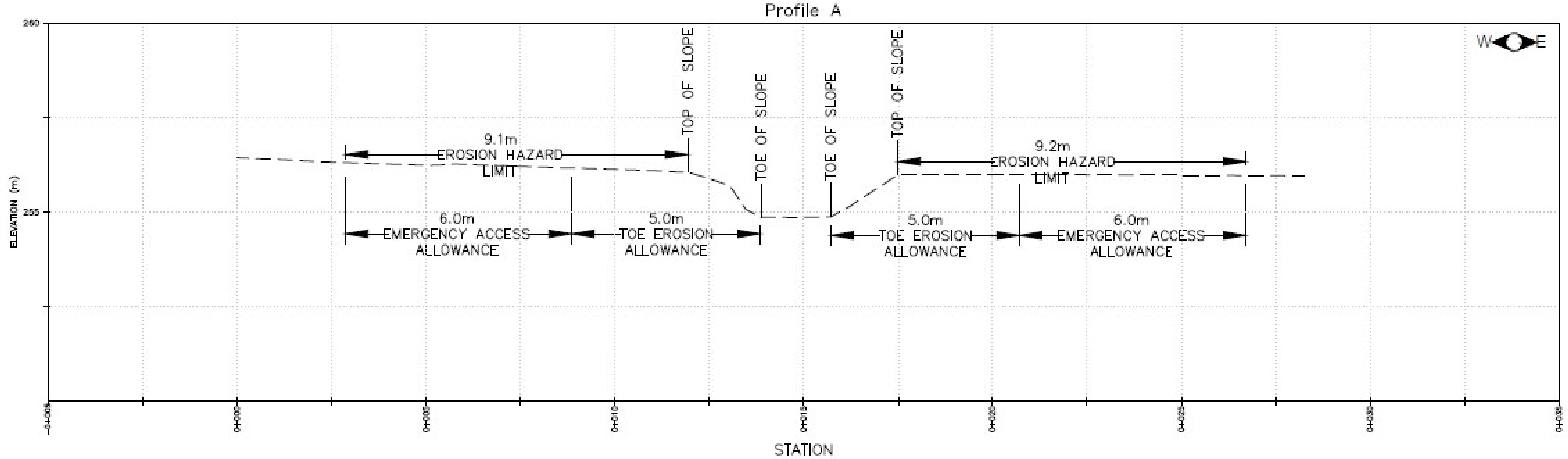
2004 HAMILTON ROAD, LONDON

PROJECT No. SC-02055

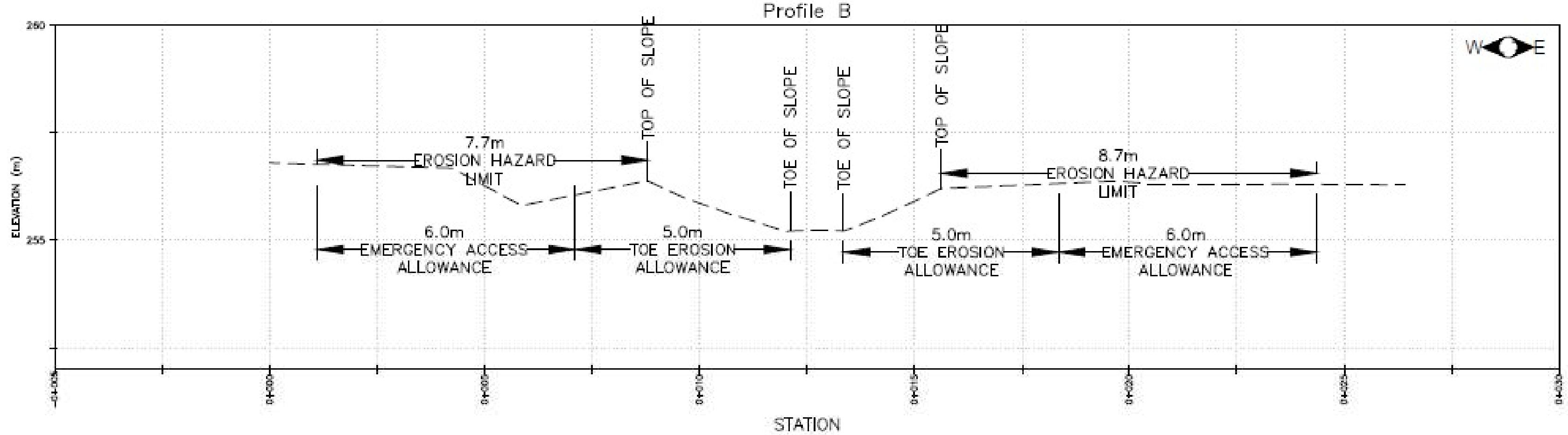
SHEET No. E1

DATE MAR 31, 2025

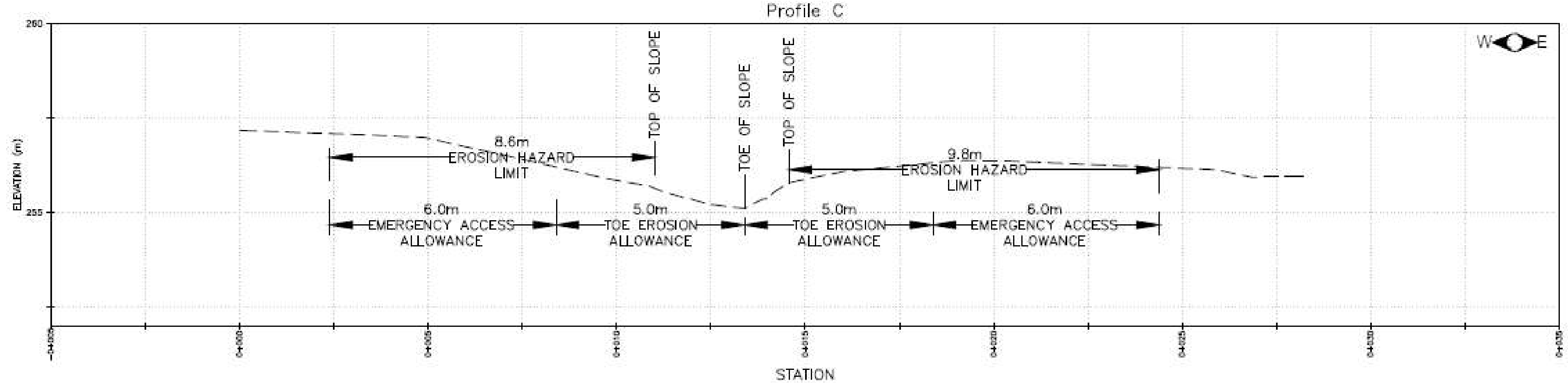
Profile A



Profile B



Profile C



LEGEND

ENGINEER'S STAMP

LICENSED PROFESSIONAL ENGINEER
R.A. WALKER
PROVINCE OF ONTARIO

CONSULTANT

STONECAIRN CONSULTING

SCALE

TITLE

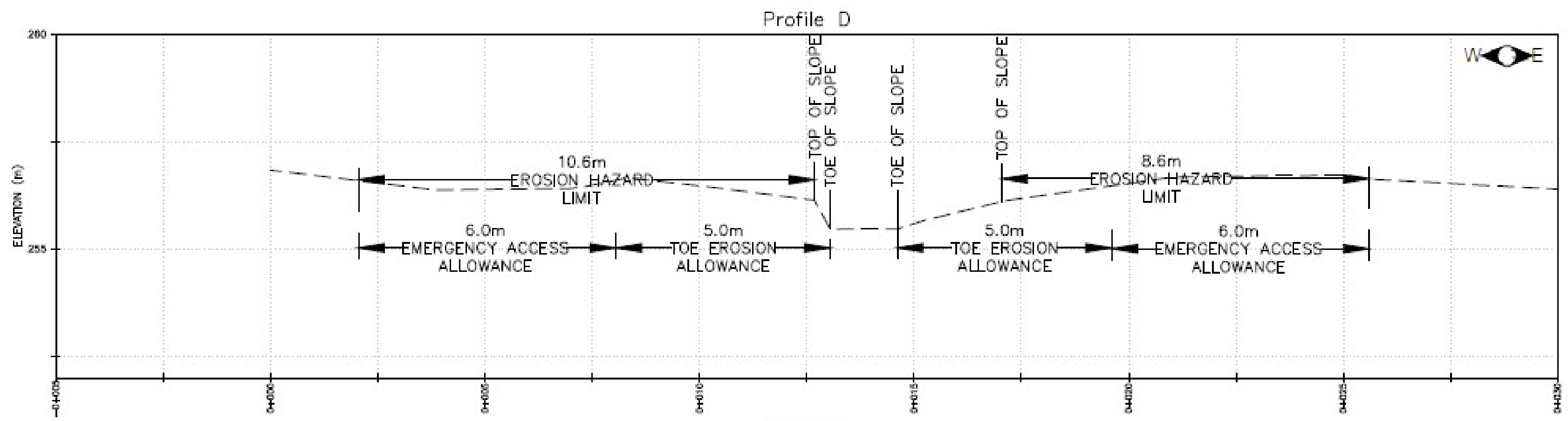
PROFILES A – C

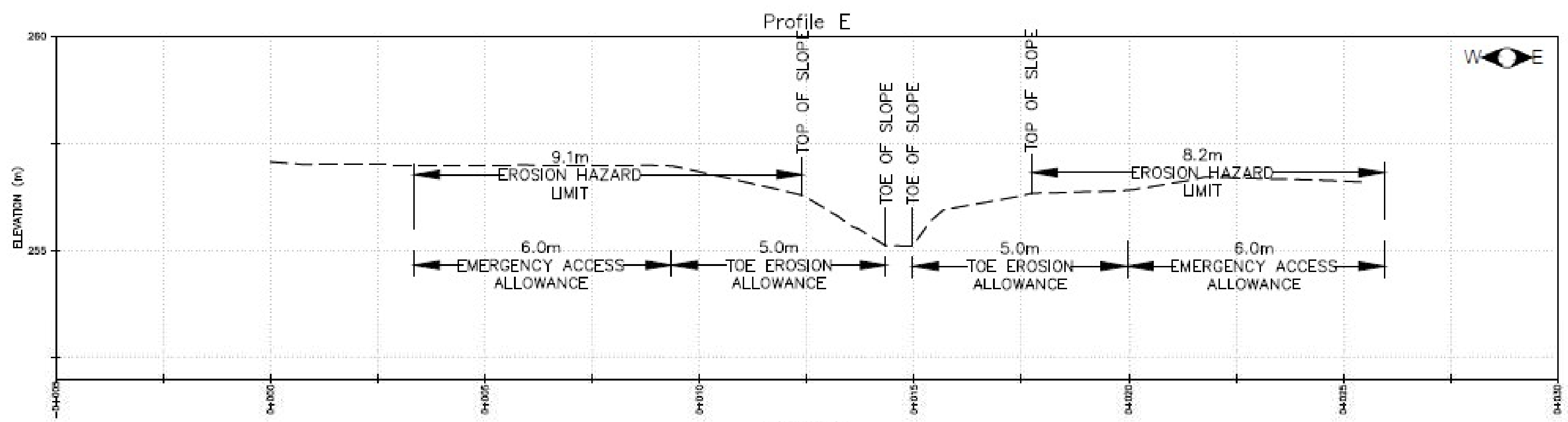
2004 HAMILTON ROAD,
LONDON

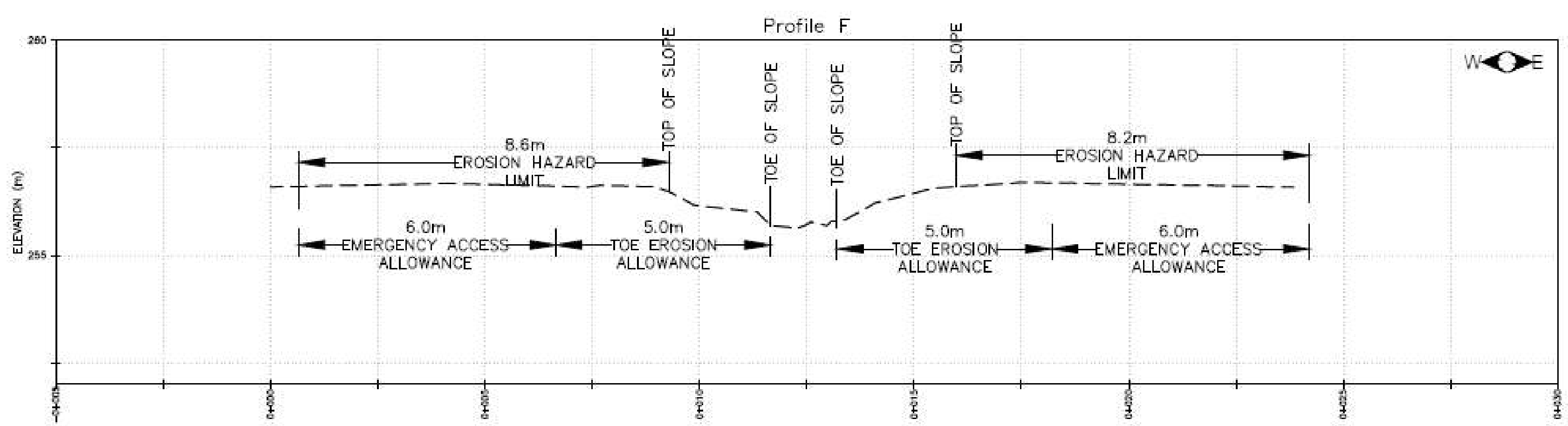
PROJECT No.
SC-02055

SHEET No.
E

DATE
MAR 31, 2025







LEGEND	ENGINEER'S STAMP	CONSULTANT	SCALE	TITLE	PROJECT No.
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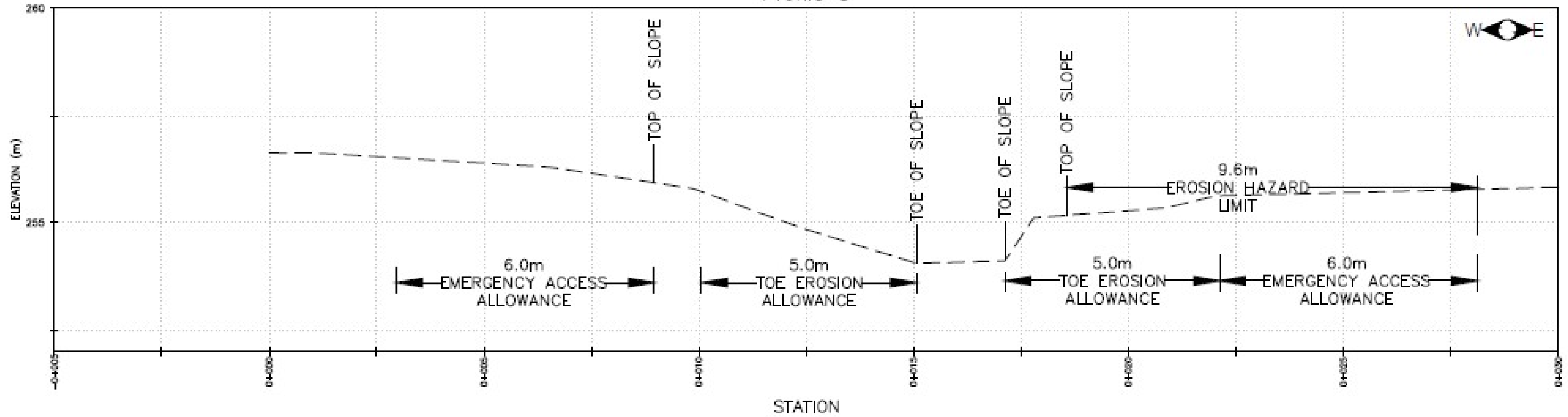
				2004 HAMILTON ROAD, LONDON	SHEET No. E
					DATE MAR 31, 2025

Profile G



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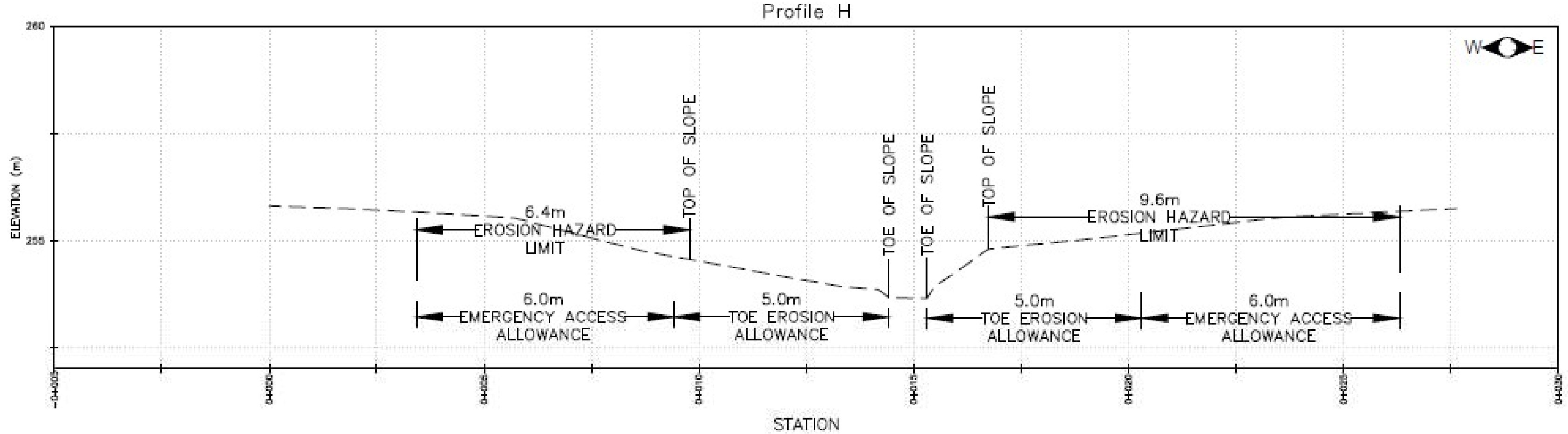
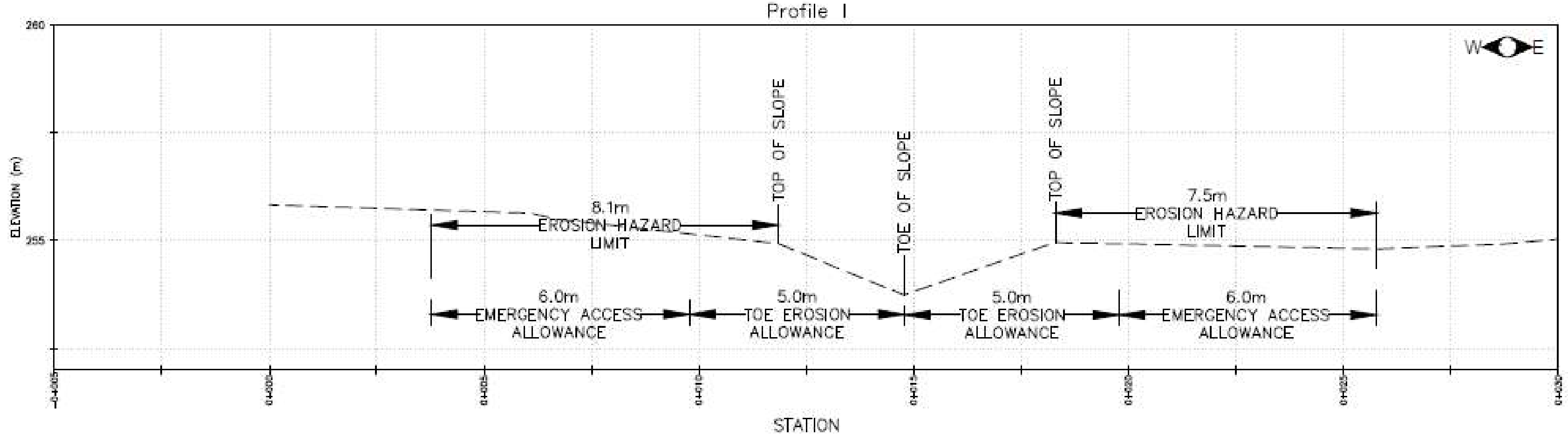
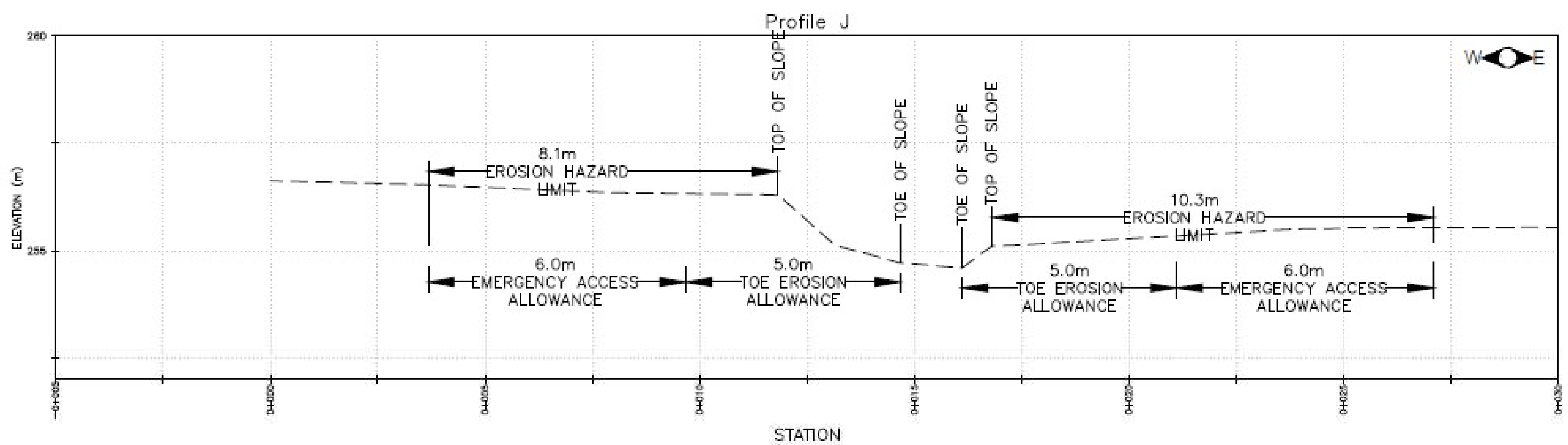


Profile I



LEGEND	ENGINEER'S STAMP	CONSULTANT	SCALE	TITLE	
	LICENSED PROFESSIONAL ENGINEER R.A. WALKER PROVINCE OF ONTARIO	STONECAIRN CONSULTING		PROFILES G – I 2004 HAMILTON ROAD, LONDON	PROJECT No. SC-02055 SHEET No. E4 DATE MAR 31, 2025



LEGEND	ENGINEER'S STAMP	CONSULTANT	SCALE	TITLE	PROJECT No.
	LICENSED PROFESSIONAL ENGINEER R.A. WALKER PROVINCE OF ONTARIO	STONECAIRN CONSULTING		PROFILE J	SC-02055
				2004 HAMILTON ROAD, LONDON	SHEET No. E
					DATE MAR 31, 2025

APPENDIX F

WATER BALANCE CALCULATIONS

Table 1A **Climatic Water Budget: Climate Normal 1991-2020 (LONDON, ON)**
Data Retrieved from Environment Canada - Atmospheric Environment Services

January	-5.4	78.6	0	0.0	24.3	0.0
February	-4.8	62.8	0	0.0	24.6	0.0
March	0.1	67.4	0	0.0	30.6	0.0
April	6.8	88.5	1.59	1.0	33.6	33.6
May	13.5	88.8	4.50	2.1	37.8	79.4
June	18.8	85.9	7.43	3.0	38.4	115.2
July	21.0	80.5	8.78	3.5	38.7	135.5
August	20.1	66.9	8.22	3.3	36.0	118.8
September	16.3	92.7	5.98	2.5	31.2	78.0
October	9.9	82.6	2.81	1.4	28.5	39.9
November	3.6	87.7	0.61	0.5	24.3	12.2
December	-2.0	79.2	0	0.0	23.1	0.0
Total:		**961.6**	**39.9**	**17.3**		**612.5**

Notes:

1) Water Budget adjusted for latitude and daylight
2) ‡ (^{0}C) Represents calculated mean of daily temperatures for the month
3) ‡ Climate Precipitation data from Environment Canada, as provided under the Climate Normals data (1991-2020), London, Ontario, Climate ID 6144475
4) Daylight Correction value extracted from Table 6 (Thornthwaithe and Mather); Mean Possible Monthly duration of sunlight in the Northern Hemisphere
5) Monthly Heat Index values extracted from Table 2 (Thornthwaite and Mather)
6) Values of Unadjusted Daily Potential Evapotranspiration for different mean Temperatures extracted from Table 4 (Thornthwaite and Mather)

Table 1B **Pre-development Site Areas**

E3	Undeveloped Lands - Woodlot	14.62	0%	100%	0.00	14.62
	Subtotal	***14.6***			***0.00***	***14.62***
E1	Grassed Field - W of the Drain	4.63	0%	100%	0.00	4.63
E2	Grassed Field - E of the Drain	26.30	0%	100%	0.00	26.30
Ext 1	Adjacent Property to the W	0.74	27%	73%	0.20	0.54
	Subtotal	***31.7***			***0.20***	***31.47***
	Total	**46.29**			**0.20**	**46.09**

Table 1C **Post-development Site Areas**

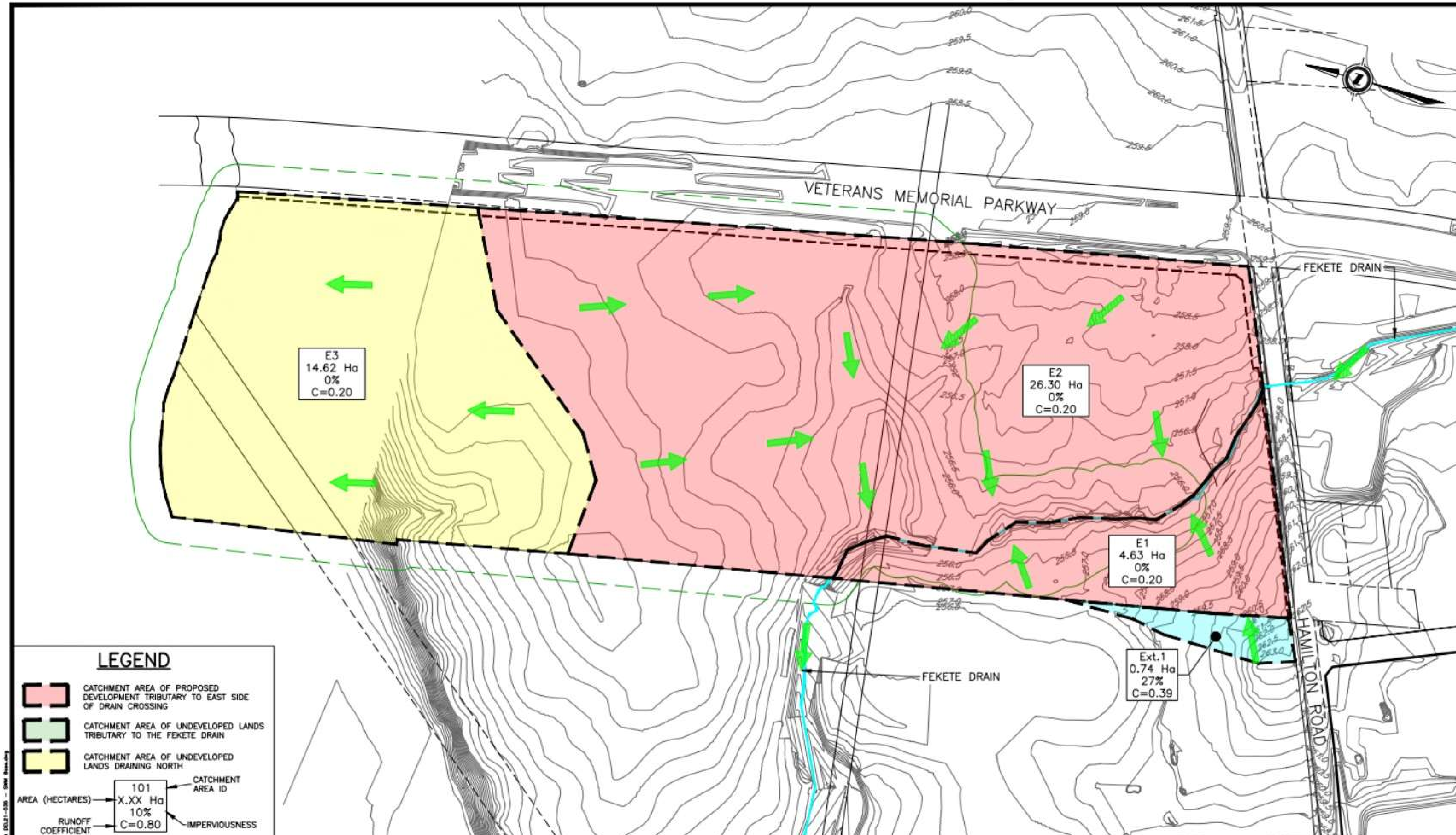
P8	Undeveloped Lands - Woodlot	14.62	0%	100%	0.00	14.62
	Subtotal	***14.62***			***0.00***	***14.62***
P8	Grassed Field - E of the Drain	19.51	0%	100%	0.00	19.51
P9	Grassed Field - W of the Drain	2.34	0%	100%	0.00	2.34
P7	Blocks 7, 8+11 (Open Space)	0.92	0%	100%	0.00	0.92
P12 & P13	Hamilton Road widening easement	0.07	0%	100%	0.00	0.07
P14 & P15	Veterans/Hamilton widening easement	0.42	0%	100%	0.00	0.42
P1 & P2	Blocks 1 and 2	1.32	80%	20%	1.06	0.26
P3	Block 3	0.08	10%	90%	0.01	0.07
P4, P5	Blocks 4 and 5	5.44	85%	15%	4.62	0.82
P6	Future Road Allowance	0.82	60%	40%	0.49	0.33
P10	Adjacent Property to the W	0.47	32%	68%	0.15	0.32
P11	Adjacent Property to the W	0.27	17%	83%	0.05	0.22
	Subtotal	***31.66***			***6.38***	***25.28***
	Total	**46.28**			**6.38**	**39.90**

MECP SWMPD Manual, Table 3.1

Soils	Water Holding Capacity (mm)	Hydrologic Soil Group	Precipitation (mm)	Evapo-transpiration (mm)	Run-Off (mm)	Infiltration* (mm)
Urban Lawns / Shallow Rooted Crops						
Fine Sand	50	A	940	515	149	276
Fine Sandy Loam	75	B	940	525	187	228
Silt Loam	125	C	940	536	222	182
Clay Loam	100	CD	940	531	245	164
Clay Loam	75	C	940	525	270	145
Moderately Rooted Crops						
Fine Sand	75	A	940	525	125	291
Fine Sandy Loam	150	B	940	539	160	241
Silt Loam	200	C	940	543	199	199
Clay Loam	200	CD	940	543	218	179
Clay Loam	150	C	940	539	241	160
Pasture and Shrubs						
Fine Sand	100	A	940	531	102	307
Fine Sandy Loam	150	B	940	539	140	261
Silt Loam	250	C	940	546	177	217
Clay Loam	250	CD	940	546	197	197
Clay Loam	200	C	940	543	218	179
Mature Forests						
Fine Sand	250	A	940	546	79	315
Fine Sandy Loam	300	B	940	548	118	274
Silt Loam	400	C	940	550	156	234
Clay Loam	400	CD	940	550	176	215
Clay Loam	350	C	940	549	196	196

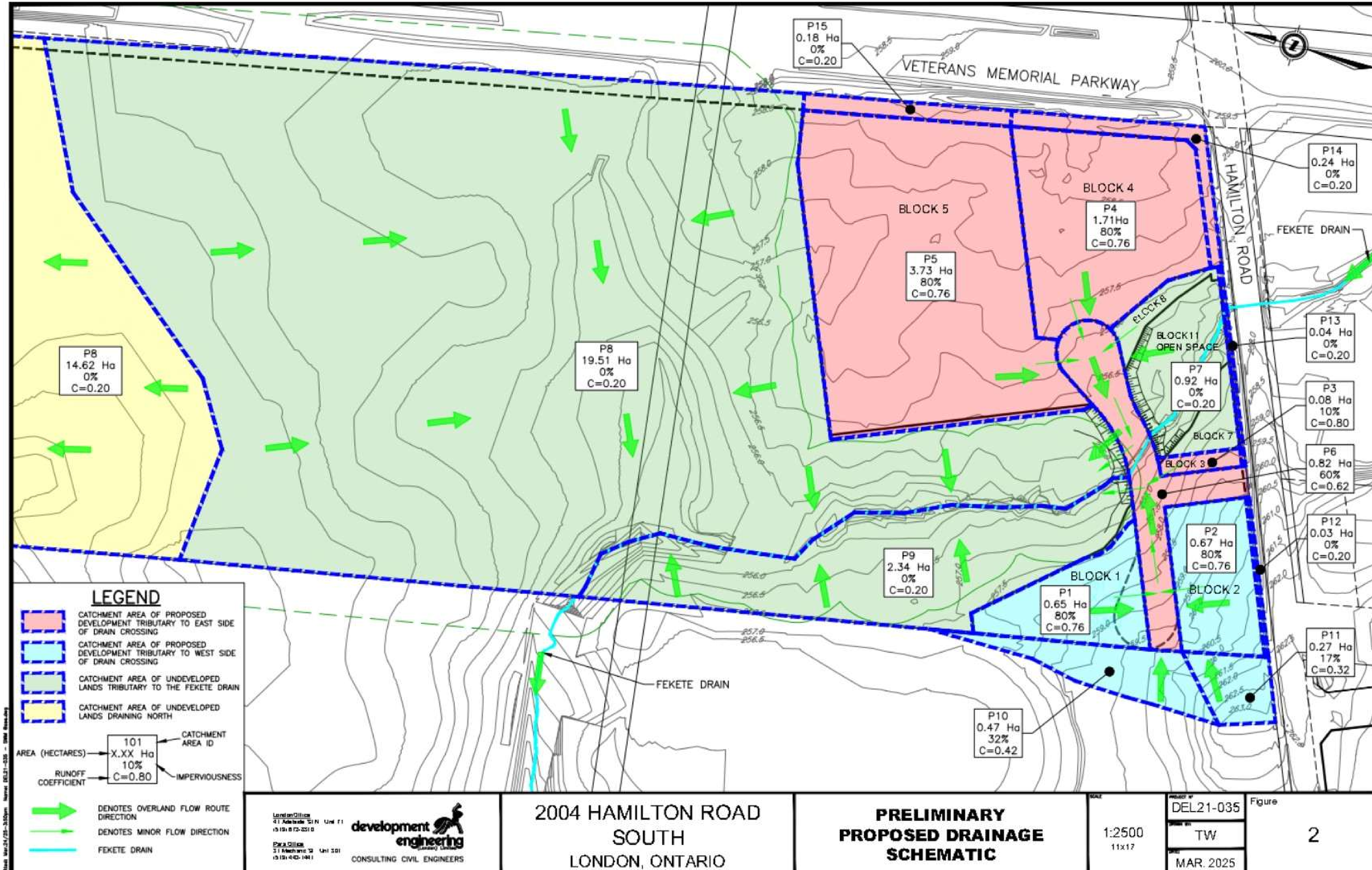
Notes:
Hydrogeologic Soil Group A represents soil with low run-off potential and Soil Group D represents soils with high runoff potenial. The evapotranspiration values are for mature vegetation. Streamflow is composted of baseflow and run-off.

Infiltration Factors		
Topography	Flat Land, average slope <0.6 m/km	0.30
	Rolling Land, average slope 2.8 - 3.8 m/km	0.20
	Hilly Land, average slope 28-47 m/km	0.10
Soils	Fine Sand	0.40
	Fine Sandy Loam	0.30
	Silt Loam	0.20
	Clay Loam	0.15
	Clay Loam	0.10
Cover	Urban Lawns/Shallow rooted crops	0.05
	Moderately Rooted Crops	0.10
	Pasture and Shrubs	0.15
	Mature Forest	0.20



London Office Paris Office development engineering (London) Limited CONSULTING CIVIL ENGINEERS	2004 HAMILTON ROAD SOUTH LONDON, ONTARIO	**PRELIMINARY EXISTING DRAINAGE SCHEMATIC**	1:4000 11x17	DEL21-035 TW MAR. 2025

Figure 1


VETERANS MEMORIAL PARKWAY
HAMILTON ROAD
FEKETE DRAIN
BLOCK 5
BLOCK 4
BLOCK 8
BLOCK 11 OPEN SPACE
BLOCK 7
BLOCK 3
BLOCK 1
BLOCK 2
P15 0.18 Ha 0% C=0.20
P14 0.24 Ha 0% C=0.20
P4 1.71Ha 80% C=0.76
P5 3.73 Ha 80% C=0.76
P8 14.62 Ha 0% C=0.20
P8 19.51 Ha 0% C=0.20
P13 0.04 Ha 0% C=0.20
P7 0.92 Ha 0% C=0.20
P3 0.08 Ha 10% C=0.80
P6 0.82 Ha 60% C=0.62
P12 0.03 Ha 0% C=0.20
P2 0.67 Ha 80% C=0.76
P9 2.34 Ha 0% C=0.20
P1 0.65 Ha 80% C=0.76
P11 0.27 Ha 17% C=0.32
P10 0.47 Ha 32% C=0.42
LEGEND
CATCHMENT AREA OF PROPOSED DEVELOPMENT TRIBUTARY TO EAST SIDE OF DRAIN CROSSING
CATCHMENT AREA OF PROPOSED DEVELOPMENT TRIBUTARY TO WEST SIDE OF DRAIN CROSSING
CATCHMENT AREA OF UNDEVELOPED LANDS TRIBUTARY TO THE FEKETE DRAIN
CATCHMENT AREA OF UNDEVELOPED LANDS DRAINING NORTH
101 X.XX Ha 10% C=0.80
AREA (HECTARES)
CATCHMENT AREA ID
RUNOFF COEFFICIENT
IMPERVIOUSNESS
DENOTES OVERLAND FLOW ROUTE DIRECTION
DENOTES MINOR FLOW DIRECTION
FEKETE DRAIN
development engineering
CONSULTING CIVIL ENGINEERS
2004 HAMILTON ROAD SOUTH
LONDON, ONTARIO
PRELIMINARY PROPOSED DRAINAGE SCHEMATIC
1:2500
11x17
DEL21-035
TW
MAR. 2025
Figure
2

STONECAIRN CONSULTING

TABLE 2A **Pre-Development Water Balance**

Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**349.1**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	400.0	400.0	400.0	400.0	400.0				365.7	400.0	400.0	400.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	129.5	94.9	78.0	39.9	12.2	0.0	**581.3**
0.2 Mature Forest	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-49.0	-28.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-49.0	-28.0	14.7	34.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	8.4	75.6	79.2	**436.3**
Water Holding Capcity:	**MECP Infiltration Factor**	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	-
400 mm	**Run-off Coefficient**	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	-
	Infiltration (mm)	55.0	44.0	47.2	38.4	6.6	0.0	0.0	0.0	0.0	5.9	52.9	55.4	**305.4**
	Run-Off (mm)	23.6	18.8	20.2	16.5	2.8	0.0	0.0	0.0	0.0	2.5	22.7	23.8	**130.9**
	Catchment Area (ha) = 14.62	**Subcatchment Monthly Volumes**												

Notes:

1) Water Budget adjusted for latitude and daylight

2) (^{0}C) Represents calculated mean of daily temperatures for the month

3) ‡ Climate Precipitation data from Environment Canada, as provided under the Climate Normals data (1991-2020), London, Ontario

4) Daylight Correction value extracted from Table 6 (Thornthwaithe andMather); Mean Possible Monthly duration of sunlight in the Northern Hemisphere

5) Monthly Heat Index values extracted from Table 2 (Thornthwaite and Mather)

6) Values of Unadjusted Daily Potential Evapotranspiration for different mean Temperatures extracted from Table 4 (Thornthwaite and Mather)

7) Precipitation during freezing months(i.e. December to March) is assumed to accumulate as snow and result in additional precipitation in the first month there after where the average temperature is greater than 0^{0}C (i.e. March).

8) Infiltration is governed by groundwater contours not surface runoff catchment area.

TABLE 2B **Post-Development Water Balance**

Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**349.1**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	400.0	400.0	400.0	400.0	400.0				365.7	400.0	400.0	400.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	129.5	94.9	78.0	39.9	12.2	0.0	**581.3**
0.2 Mature Forest	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-49.0	-28.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-49.0	-28.0	14.7	34.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	8.4	75.6	79.2	**436.3**
Water Holding Capcity:	**MECP Infiltration Factor**	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	-
400 mm	**Run-off Coefficient**	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	-
	Infiltration (mm)	55.0	44.0	47.2	38.4	6.6	0.0	0.0	0.0	0.0	5.9	52.9	55.4	**305.4**
	Run-Off (mm)	23.6	18.8	20.2	16.5	2.8	0.0	0.0	0.0	0.0	2.5	22.7	23.8	**130.9**
	Catchment Area (ha) = 14.62	**Subcatchment Monthly Volumes**												

Notes:

1) Water Budget adjusted for latitude and daylight

2) (°C) Represents calculated mean of daily temperatures for the month

3) ‡ Climate Precipitation data from Environment Canada, as provided under the Climate Normals data (1991-2020), London, Ontario

4) Daylight Correction value extracted from Table 6 (Thornthwaithe andMather); Mean Possible Monthly duration of sunlight in the Northern Hemisphere

5) Monthly Heat Index values extracted from Table 2 (Thornthwaite and Mather)

6) Values of Unadjusted Daily Potential Evapotranspiration for different mean Temperatures extracted from Table 4 (Thornthwaite and Mather)

7) Precipitation during freezing months(i.e. December to March) is assumed to accumulate as snow and result in additional precipitation in the first month there after where the average temperature is greater than 0°C (i.e. March).

8) Infiltration is governed by groundwater contours not surface runoff catchment area.

TABLE 3A **Pre-Development Water Balance**

Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**349.1**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	300.0	300.0	300.0	300.0	300.0				266.7	300.0	300.0	300.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	103.5	69.9	78.0	39.9	12.2	0.0	**530.3**
0.15 Pasture & Shrubs	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-23.0	-3.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-23.0	-3.0	14.7	33.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	9.4	75.6	79.2	**437.3**
	MECP Infiltration Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
Water Holding Capacity:	**Run-off Coefficient**	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
300 mm	**Infiltration (mm)**	51.1	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	6.1	49.1	51.5	**284.2**
(partial woodlot - 400 mm; and,	**Run-Off (mm)**	27.5	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	3.3	26.4	27.7	**153.0**
partial pasture - 250 mm)	**Catchment Area (ha) = 26.30**	**Subcatchment Monthly Volumes**												
Pervious Area	**Soil Moisture Storage (mm)**	250.0	250.0	250.0	250.0	250.0	222.0	200.0	204.0	218.7	250.0	250.0	250.0	-
Infiltration Factors	**Actual Potenital Evapotranspiration** (mm)	0.0	0.0	0.0	33.6	79.4	113.9	103.5	69.9	78.0	39.9	12.2	0.0	**530.3**
0.15 Pasture & Shrubs	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-23.0	-3.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-22.0	4.0	14.7	31.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	11.4	75.6	79.2	**439.3**
	MECP Infiltration Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
Water Holding Capacity:	**Run-off Coefficient**	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
250 mm	**Infiltration (mm)**	51.1	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	7.4	49.1	51.5	**285.5**
	Run-Off (mm)	27.5	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	4.0	26.4	27.7	**153.7**
	Catchment Area (ha) = 4.63	**Subcatchment Monthly Volumes**												

TABLE 3A **Pre-Development Water Balance (Continued)**
Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**349.1**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Lawn	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	-
125 mm	**Run-off Coefficient**	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	-
	Infiltration (mm)	43.2	34.5	37.1	30.2	5.2	0.0	0.0	0.0	0.0	7.9	41.6	43.6	**243.2**
	Run-Off (mm)	35.4	28.3	30.3	24.7	4.2	0.0	0.0	0.0	0.0	6.5	34.0	35.6	**199.0**
	Catchment Area (ha) = 0.54	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	**-**
Driveway/Road/paved surface	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	**-**
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
0.33	**Catchment Area (ha) =** 0.20													

Notes:

1) Water Budget adjusted for latitude and daylight

2) (^{0}C) Represents calculated mean of daily temperatures for the month

3) ‡ Climate Precipitation data from Environment Canada, as provided under the Climate Normals data (1991-2020), London, Ontario

4) Daylight Correction value extracted from Table 6 (Thornthwaithe andMather); Mean Possible Monthly duration of sunlight in the Northern Hemisphere

5) Monthly Heat Index values extracted from Table 2 (Thornthwaite and Mather)

6) Values of Unadjusted Daily Potential Evapotranspiration for different mean Temperatures extracted from Table 4 (Thornthwaite and Mather)

7) Precipitation during freezing months(i.e. December to March) is assumed to accumulate as snow and result in additional precipitation in the first month there after where the average temperature is greater than 0^{0}C (i.e. March).

8) Infiltration is governed by groundwater contours not surface runoff catchment area.

TABLE 3B **Post-Development Water Balance**

Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	-
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	250.0	250.0	250.0	250.0	250.0	222.0	200.0	204.0	218.7	250.0	250.0	250.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	102.5	70.9	78.0	39.9	12.2	0.0	**530.3**
0.15 Pasture & Shrubs	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-22.0	-4.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-22.0	-4.0	14.7	31.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	11.4	75.6	79.2	**439.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
250 mm	**Run-off Coefficient**	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
(partial woodlot - 300 mm; and,	**Infiltration (mm)**	51.1	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	7.4	49.1	51.5	**285.5**
partial pasture - 150 mm)	**Run-Off (mm)**	27.5	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	4.0	26.4	27.7	**153.7**
	Catchment Area (ha) = 19.51	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	961.6
None	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
	Run-Off Coefficient (mm)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
Evaporation Factor	**Evaporation (mm)**	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
0.33	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
	Catchment Area (ha) = 0.00	**Subcatchment Monthly Volumes**												
Pervious Area	**Soil Moisture Storage (mm)**	250.0	250.0	250.0	250.0	250.0	222.0	200.0	204.0	218.7	250.0	250.0	250.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	102.5	70.9	78.0	39.9	12.2	0.0	**530.3**
0.15 Pasture & Shrubs	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-22.0	-4.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-22.0	-4.0	14.7	31.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	11.4	75.6	79.2	**439.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
250 mm	**Run-off Coefficient**	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
	Infiltration (mm)	51.1	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	7.4	49.1	51.5	**285.5**
	Run-Off (mm)	27.5	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	4.0	26.4	27.7	**153.7**
	Catchment Area (ha) = 2.34	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
None	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	**-**
	Run-Off Coefficient (mm)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	**-**
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
0.33	**Catchment Area (ha) = 0.00**													

TABLE 3B **Post-Development Water Balance (continued)**
Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	-
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	250.0	250.0	250.0	250.0	250.0	222.0	200.0	204.0	218.7	250.0	250.0	250.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	113.9	102.5	70.9	78.0	39.9	12.2	0.0	**530.3**
0.15 Pasture & Shrubs	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-28.0	-22.0	-4.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-28.0	-22.0	-4.0	14.7	31.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	11.4	75.6	79.2	**439.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.65	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	-
250 mm	**Run-off Coefficient**	0.35	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	-
	Infiltration (mm)	51.1	34.5	37.1	30.2	5.2	0.0	0.0	0.0	0.0	6.3	41.6	43.6	**249.5**
	Run-Off (mm)	27.5	28.3	30.3	24.7	4.2	0.0	0.0	0.0	0.0	5.1	34.0	35.6	**189.8**
	Catchment Area (ha) = 0.92	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	961.6
None	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
	Run-Off Coefficient (mm)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	317.3
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	644.3
	Catchment Area (ha) = 0.00	**Subcatchment Monthly Volumes**												
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
125 mm	**Run-off Coefficient**	0.45	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
	Infiltration (mm)	43.2	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	9.4	49.1	51.5	**279.6**
	Run-Off (mm)	35.4	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	5.0	26.4	27.7	**162.7**
	Catchment Area (ha) = 0.49	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
None	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
	Run-Off Coefficient (mm)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
	Catchment Area (ha) = 0.00													

TABLE 3B **Post-Development Water Balance (continued)**
Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	-
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	-
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	-
125 mm	**Run-off Coefficient**	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	-
	Infiltration (mm)	43.2	34.5	37.1	30.2	5.2	0.0	0.0	0.0	0.0	7.9	41.6	43.6	**243.2**
	Run-Off (mm)	35.4	28.3	30.3	24.7	4.2	0.0	0.0	0.0	0.0	6.5	34.0	35.6	**199.0**
	Catchment Area (ha) = **0.82**	**Subcatchment Monthly Volumes**												
									0.0					
									0.0					
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	961.6
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
Driveway/Road/parking lots	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	317.3
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	644.3
	Catchment Area (ha) = **4.62**	**Subcatchment Monthly Volumes**												
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	139.9	78.0	39.9	12.2	0.0	**594.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-73.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-73.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
125 mm	**Run-off Coefficient**	0.45	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
	Infiltration (mm)	43.2	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	9.4	49.1	51.5	**279.6**
	Run-Off (mm)	35.4	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	5.0	26.4	27.7	**162.7**
	Catchment Area (ha) = **0.33**	**Subcatchment Monthly Volumes**												
									0.0					
									0.0					
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
Paved Surfaces / Sidewalks	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
	Run-Off Coefficient (mm)	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
	Catchment Area (ha) = **0.49**													

-

TABLE 3B **Post-Development Water Balance (continued)**
Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**-**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	**-**
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	**-**
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	**-**
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	**-**
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	**-**
125 mm	**Run-off Coefficient**	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	**-**
	Infiltration (mm)	43.2	34.5	37.1	30.2	5.2	0.0	0.0	0.0	0.0	7.9	41.6	43.6	**243.2**
	Run-Off (mm)	35.4	28.3	30.3	24.7	4.2	0.0	0.0	0.0	0.0	6.5	34.0	35.6	**199.0**
	Catchment Area (ha) = 0.07	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	961.6
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
Driveway/Road/parking lots	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	317.3
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	644.3
	Catchment Area (ha) = 0.01	**Subcatchment Monthly Volumes**												
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
125 mm	**Run-off Coefficient**	0.45	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
	Infiltration (mm)	43.2	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	9.4	49.1	51.5	**279.6**
	Run-Off (mm)	35.4	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	5.0	26.4	27.7	**162.7**
	Catchment Area (ha) = 0.26	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	**-**
Driveway/Road/parking lots	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	**-**
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
	Catchment Area (ha) = 1.06													

TABLE 3B **Post-Development Water Balance (continued)**
Water Balance Analysis Assessment

		0.0	0.0	0.0	33.6	79.4	115.2	135.5	118.8	78.0	39.9	12.2	0.0	**612.5**
		78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
		78.6	62.8	67.4	54.9	9.4	-29.3	-55.0	-51.9	14.7	42.7	75.6	79.2	**-**
		0.0	0.0	0.0	0.0	0.0	-29.3	-84.3	-136.2	0.0	0.0	0.0	0.0	**-**
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	-
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	-
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	-
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	-
125 mm	**Run-off Coefficient**	0.45	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	-
	Infiltration (mm)	43.2	40.8	43.8	35.7	6.1	0.0	0.0	0.0	0.0	9.4	49.1	51.5	**279.6**
	Run-Off (mm)	35.4	22.0	23.6	19.2	3.3	0.0	0.0	0.0	0.0	5.0	26.4	27.7	**162.7**
	Catchment Area (ha) = 0.32	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	**961.6**
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	**-**
Driveway/Road/parking lots	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	**-**
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	**317.3**
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	**644.3**
	Catchment Area (ha) = 0.15													
Pervious Area	**Soil Moisture Storage (mm)**	125.0	125.0	125.0	125.0	125.0	99.0	80.0	82.0	96.7	125.0	125.0	125.0	**-**
Infiltration Factors	**Actual Potential Evapotranspiration (mm)**	0.0	0.0	0.0	33.6	79.4	111.9	99.5	68.9	78.0	39.9	12.2	0.0	**523.3**
0.05 Urban Lawns	**P-AET (mm)**	78.6	62.8	67.4	54.9	9.4	-26.0	-19.0	-2.0	14.7	42.7	75.6	79.2	**-**
0.2 Silt Loam	**Change in soil Moisture Deficit**	0.0	0.0	0.0	0.0	0.0	-26.0	-19.0	-2.0	14.7	28.3	0.0	0.0	**-**
0.3 Flat Topography	**Precipitation Surplus**	78.6	62.8	67.4	54.9	9.4	0.0	0.0	0.0	0.0	14.4	75.6	79.2	**442.3**
Water Holding Capacity:	**MECP Infiltration Factor**	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	**-**
125 mm	**Run-off Coefficient**	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	**-**
	Infiltration (mm)	43.2	34.5	37.1	30.2	5.2	0.0	0.0	0.0	0.0	7.9	41.6	43.6	**243.2**
	Run-Off (mm)	35.4	28.3	30.3	24.7	4.2	0.0	0.0	0.0	0.0	6.5	34.0	35.6	**199.0**
	Catchment Area (ha) = 0.22	**Subcatchment Monthly Volumes**												
Impervious Area	**Precipitation Surplus (mm)**	78.6	62.8	67.4	88.5	88.8	85.9	80.5	66.9	92.7	82.6	87.7	79.2	961.6
Building Roof Tops	**Evaporation factor (mm)**	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	-
Driveway/Road/parking lots	**Run-Off Coefficient (mm)**	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	-
	Evaporation (mm)	25.9	20.7	22.2	29.2	29.3	28.3	26.6	22.1	30.6	27.3	28.9	26.1	317.3
0.33 Evaporation Factor	**Run-Off (mm)**	52.7	42.1	45.2	59.3	59.5	57.6	53.9	44.8	62.1	55.3	58.8	53.1	644.3
	Catchment Area (ha) = 0.05	**Subcatchment Monthly Volumes**												

Notes:

1) Water Budget adjusted for latitude and daylight
2) (^{o}C) Represents calculated mean of daily temperatures for the month
3) ‡ Climate Precipitation data from Environment Canada, as provided under the Climate Normals data (1991-2020), London, Ontario
4) Daylight Correction value extracted from Table 6 (Thornthwaithe andMather); Mean Possible Monthly duration of sunlight in the Northern Hemisphere
5) Monthly Heat Index values extracted from Table 2 (Thornthwaite and Mather)
6) Values of Unadjusted Daily Potential Evapotranspiration for different mean Temperatures extracted from Table 4 (Thornthwaite and Mather)
7) Precipitation during freezing months(i.e. December to March) is assumed to accumulate as snow and result in additional precipitation in the first month there after where the average temperature is greater than 0^{o}C (i.e. March).
8) Infiltration is governed by groundwater contours not surface runoff catchment area.

WATER BALANCE SUMMARY

Total Evapotranspiration	84,990	m3	84,990	m3	--
Total Infiltration	44,648	m3	44,648	m3	--
Total Run-off	19,135	m3	19,135	m3	--

WITHOUT LIDS

Total Evapotranspiration	167,492	m3	154,378	m3	92%
Total Infiltration	89,285	m3	71,307	m3	80%
Total Run-off	48,855	m3	80,913	m3	166%

WITH LIDS intercepting 20% of clean run-off from Blocks 1 - 5 and utilizing secondary infiltration

Total Evapotranspiration	167,492	m3	154,378	m3	92%
Total Infiltration	89,285	m3	79,075	m3	89%
Total Run-off	48,855	m3	73,145	m3	150%

APPENDIX G

HYDROGEOLOGICAL CHECKLIST

CHECKLIST 4 HYDROGEOLOGY ASSESSMENT CHECKLIST

TASK	Complete? (Y, N, N/A)
Acknowledge that prior to undertaking this assessment, the City's Hydrogeologist Engineer was contacted regarding scope and requirements of the report.	Yes – Consultation with Jeff Hachey, most recently though Stonecairn Consulting, June 2025 and February 2026
Meeting notes from the scoping meeting are appended to the submitted Hydrogeology Assessment.	Yes – see attached.
Site location and description of development, including planned servicing for the site.	Refer to Section 1 - Introduction
Description and mapping of relevant site features, including topography and surface water drainage, physiography, regional overburden and bedrock geology, regional hydrogeology, and proximity to nearby natural heritage features (e.g., stream, ponds, wetlands, woodlots, etc.). Consideration should be given if the site falls within Highly Vulnerable Aquifers (HVAs) and/or Significant Groundwater Recharge Areas (SGRAs), as defined in the Thames - Sydenham & Region Source Water Protection Plan.	Refer to the various sections in Section 2 – Site Characterization
Description and mapping of field activities completed as part of the assessment (e.g., advancement of boreholes, installation of monitoring wells, advancement of test pits, installation of piezometers, etc.).	Refer to Section 3, which presents information obtained through borehole program and site investigation work.
Description of the relevant site hydrogeological information, including aquifer properties (e.g., hydraulic conductivity), static groundwater levels, groundwater flow direction, groundwater gradients, etc. Note that if Low Impact Development (LID) measures are being considered for the site, seasonal fluctuations in water levels must be considered.	Review to Section 3.1.3, describing shallow groundwater conditions
Description of water quality characteristics (groundwater and surface water).	Refer to Section 3.1.4. Groundwater Quality information is summarized. Surface Water Quality sampling and testing is recommended through detailed design stages.
Evaluation of potential domestic wells, in the area if the proposed development. In some cases, a door-to-door domestic well survey may be required.	Refer to Section 2.5 and Section 7.2.2
Evaluation of potential water takings required to support construction activities. This should include a summary of anticipated servicing depths, anticipated pumping rates, discharge locations, and erosion and sediment control (ESC) measures to be implemented during construction.	Refer to Section 5.3.2 and Section 7.2.1
Evaluation of the potential impact from the development to the natural environment including impacts on groundwater levels, water quality (groundwater and surface water), groundwater baseflow, etc. Both short-term (e.g., construction) and long-term impacts should be considered. If LID measures are being considered, an evaluation of the anticipated performance of the system(s) as it relates to the hydrogeological environment will be required.	Refer to Section 6.4 which discusses LIDs as they relate to post-construciton water balance enhancements. Refer to Section 7.3 which includes subsections on potential hydrogeological impacts.
Evaluation of the potential interaction between below grade structures (e.g., basement foundations, underground parking structures, etc.) within the development and seasonal groundwater table fluctuations. Recommendations for mitigation measures (e.g., final basement elevations, foundation drain elevations, etc.) within the development should be provided to reduce basement flooding potential or frequent sump pump operation.	Refer to Section 5.4.4 which includes discussion on foundation drainage.
Completion of a water balance for the site, as per Section 6.3.2 of the design standards. For sites located adjacent to sensitive natural features, the water balance should consider baseflow requirements of downstream receptors, and ensure they are maintained in the post development scenario.	Refer to Water Balance Analysis presented in Section 6. It is noted that this is an iterative process and is subject to updates as detailed design occurs.
Evaluation of mitigation measures to be implemented at the site. Mitigation measures should be used to minimize potential impacts groundwater and surface water resources, and potential receptors. Consideration should be given to maintaining infiltration and groundwater recharge (as practical), and maintaining overall water quality.	Refer to Sections 6.5 and 7.4 which discusses monitoring and mitigation measures.
Evaluation of monitoring and contingency plans, as necessary.	These will be established in more detail through detailed design, as discussed in Section 6.5 and 7.4.
Other Site-Specific Considerations as Identified by the Consultant:	
Identify any abandoned wells in this plan.	Monitoring wells are still maintained onsite. Section 7.3.5 discusses future decommissioning of the monitoring wells.
Any fill required in the plan.	Section 5.1.1 discusses site grading operations
Provide recommendations regarding soil conditions and fill needs in the location of any existing watercourses or bodies of water on the site.	Section 5.1.2 discusses Excess Soils Management, as well as soil quality for imported soils brought to site.

I confirm that I reviewed and completed the above checklist in relation to the application being submitted.

Rebecca Walker, P.Eng., QPESA
President, Geotechnical Director
Stonecairn Consulting Inc.

From: Gina MacVeigh <gmacveigh@nrsi.on.ca>
Sent: Friday, June 17, 2022 9:25 AM
To: Butnari, Shane <sbutnari@london.ca>; Stefanie Pratt <pratts@thamesriver.on.ca>; Jason Fleury <JFleury@deveng.net>; Trevor Hawkins <thawkins@mhbcplan.com>; rebecca.walker@LDSConsultants.ca; Hachey, Jeff <jhachey@london.ca>; Lysynski, Heather <hlysynsk@London.ca>
Subject: [EXTERNAL] 2004 Hamilton Road Scoping Checklist - June 7, 2022 Meeting

Good morning and my apologies for the delay in getting this to you. Please find attached the updated Scoping Checklist based on the meeting held virtually on June 7, 2022. Please note that the First Nations consultation requirement is now checked off based on email correspondence provided by Shane.
Meeting Key Points are as follows:
- SLSR/EIS can be combined.
- Concept Plan was previously done without thought of the natural environment features and will likely be updated. If the Drain is to be moved, discussions on how it would still connect to the south side of Hamilton Road will need to occur. Stephanie (UTRCA) to discuss internally any additional requirements should the feature need to be moved.
- City would be interested in acquiring the lands to the north in the ESA. NRSI will provide this info to the client.
- Clearing in 2015/2106 of the pine plantation, UTRCA cannot find any supporting documentation on this. Dev. Eng to discuss with client and provide information to agencies.
- Water balance to be completed in the subdivision plan, not the site plan.
- Review of LDS reports to be by UTRCA as they hired a new hydro-g staff but also have staff on retainer for review.
- A TOR from LDS should be prepared and provided to the UTRCA and City of London for review, to ensure any new staff is aware of the scope.

Thanks again for attending the meeting and let me know if you need any clarification.
Gina

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@nrsinews Natural Resource Solutions Inc.
Over 20 years of environmental consulting excellence

Gina MacVeigh has invited you to 2004 Hamilton Road Scoping Meeting

Title:	2004 Hamilton Road Scoping Meeting
Location:	Virtual
When:	Tuesday, June 7, 2022 9:00 AM – 10:00 AM
Organizer:	Gina MacVeigh <gmacveigh@nrsi.on.ca>
Description:	Scoping meeting for 2004 Hamilton Road, London. Documents provided through email. Gina MacVeigh is inviting you to a scheduled Zoom meeting. Topic: 2004 Hamilton Road Scoping Meeting Time: Jun 7, 2022 09:00 AM Eastern Time (US and Canada) Join Zoom Meeting https://us06web.zoom.us/j/85284510976?pwd=S3dUUEtzczZ3YU52Q0JROGR0QWx2QT09 Meeting ID: 852 8451 0976 Passcode: 385689 One tap mobile +13126266799,,85284510976#,,,,*385689# US (Chicago) +13462487799,,85284510976#,,,,*385689# US (Houston) Dial by your location +1 312 626 6799 US (Chicago) +1 346 248 7799 US (Houston) +1 669 900 6833 US (San Jose) +1 929 205 6099 US (New York) +1 253 215 8782 US (Tacoma) +1 301 715 8592 US (Washington DC) Meeting ID: 852 8451 0976 Passcode: 385689 Find your local number: https://us06web.zoom.us/u/kcrKuO8hB2
Attachments:	
Comment:	
Attendees:	sbutnari@london.ca Stefanie Pratt <pratts@thamesriver.on.ca> Jason Fleury <JFleury@deveng.net> Trevor Hawkins <thawkins@mhbcplan.com> Rebecca Walker (rebecca.walker@LDSConsultants.ca) <rebecca.walker@LDSConsultants.ca> Hachey, Jeff <jhachey@london.ca> hlysynsk@london.ca
Related Link:	

APPENDIX B - Environmental Study Scoping Checklist

Application/Project Name: 2004 Hamilton Road Industrial Lands
Proponent: Kreative Developments Inc. **Date:** June 7, 2022
Proposed Project Works: Industrial development
Study Type: EIS
Lead Consultant: Natural Resource Solutions Inc.
Key Contact: Gina MacVeigh, Senior Aquatic Biologist (gmacveigh@nrsi.on.ca)
Subconsultants: LDS Consultants, MHBC, Development Engineering Ltd.

Technical Review Team:

- ☑ Ecologist Planner: Shane Butnari
- ■ Province – Species at Risk: MECP
- ☐ Planner for the File:
- ■ Province - Other: NDMNRF
- ☑ Conservation Authority: UTRCA, Stef P
- Contact:
- ☐ EEPAC:
- ☐ Other:
- ☐ Project Manager, Environmental Assessment:
- ☑ First Nation(s):

Subject Lands and Study Area:

Location/Address and Size (ha) of Subject Lands:
2004 Hamilton Road, London (only 13 ha part of the overall parcel)

Study Area Size (approximate ha): 45 ■ Map (attached):

Position of Site in Subwatershed: South of Thames River

Tributary Fact Sheet: South Thames Subwatershed

Is the proposed location within the vicinity of the Thames River (<120 m)? ☑ Yes ☐ No

If Yes, initiate engagement with local First Nation communities. Consultation activity to be provided at Application Review stage.

Policy:

- ☑ Study must demonstrate how it conforms to the Provincial Policy Statement
- ☑ Study must demonstrate how it conforms to *The London Plan*

Map 1 Place Types:

☑ Green Space ☑ Environmental Review

Other Place Types: Light Industrial

Map 4 Active Mobility Network:

☑ Pathway placement and future trail accesses shall be considered as part of this study.

Map 5 Natural Heritage System:

(Subject Lands and Study Area delineated on current aerial photographs)

- ☐ Provincially Significant Wetland Name:
- ☑ Wetlands ☑ Unevaluated Wetlands*
- ☐ Area of Natural & Scientific Interest Name:
- ☑ Environmentally Significant Area Name:
- ☐ Potential ESAs ☐ Upland Corridors
- ☑ Significant Woodlands ☐ Woodlands
- ☑ Significant Valleylands ☐ Valleylands
- ☐ Unevaluated Vegetation Patches ☐ Potential Naturalization Areas

Patch No.

** ELC (air photo interpretation and / or previous studies) may identify potential wetlands or other potential features not captured on Map 5.*

Map 6 Hazards and Natural Resources:

☑ Maximum Hazard Line ☑ Conservation Authority Regulation Limit (and text based regulatory limit) – Project falls under *Conservation Authority Act* Section 28

Required Field Investigations:

Aquatic:

- ☑ Aquatic Habitat Assessment: two aquatic habitat assessments
- ☑ Fish Community (Collection): electrofishing survey
- ☐ Spawning Surveys:
- ☑ Benthic Invertebrate Survey: 3 stations following OBBN protocol
- ☑ Mussels: visual assessment for mussels in drain
- ☐ Other:

Wetlands:

- ☑ Wetland Delineation: May 10 with agency staff, second needed in late June
- ☑ Wetland Evaluation (OWES):
- ☐ Other:

Terrestrial (Wetland, Upland and Lowland):

- [x] Vegetation Communities (ELC):
- [x] Botanical Inventories ☐ Winter ☑ Spring ☑ Summer ☑ Fall
- [x] Breeding Bird Surveys (type & frequency): migratory, 2 BB 10-min point counts
- [ ] Raptor Surveys: ☐ Shoreline Birds:
- [ ] Crepuscular Surveys: ☐ Grassland Surveys:
- [x] Amphibian Surveys (type & frequency): Anurna call surveys, 3 surveys following protoc
- [x] Reptile Surveys:
  - [ ] Turtle (type & frequency):
  - [x] Snake (type & frequency): Snake cover boards (5)
  - [ ] Other (type & frequency):
- [x] Bat Habitat, Cavity & Acoustic Surveys: Habitat and Cavity
- [x] Mammal Surveys: Incidental, SAR/SWH Screening
  - [ ] Winter Wildlife Surveys:
- [x] Butterflies (Lepidoptera): Area searches 2 dates
- [x] Dragonflies / Damselflies (Odonata): Area searchs 2 dates
- [x] Species at Risk Specific Surveys: Bat habitat, general assessment of habitats for SAR
- [x] Species of Conservation Concern Surveys: General assessments - background review
- [x] Significant Wildlife Habitat Surveys: General assessment of habitats within 120m
- [x] Other field investigations: Wetland delineation, Woodland delineation with staff

Supporting Concurrent Studies/Investigations:

- [x] Hydrogeological/Groundwater:
- [x] Surface Water/Hydrology:
- [x] Water Balance:
- [ ] Fluvial Geomorphological:
- [x] Geotechnical:
- [x] Tree Inventory: May be required pending concept plan
- [ ] Other:

Evaluation of Significance:

Federal:

- [x] Fish Habitat ☐ Other Federal:
- [x] Species at Risk (*SARA*)

Provincial:

- [x] Provincially Significant Wetlands ☑ Significant Woodlands
- [x] Significant Valleylands ☑ Significant Wildlife Habitat Ecoregion 7E
- [ ] Areas of Natural & Scientific Interest ☑ Fish Habitat
- [ ] Water Resource Systems
- [x] Species at Risk (*ESA*):

Municipal/London:

- [x] Environmentally Significant Areas (ESAs), Potential ESAs
- [x] Significant Woodlands, Woodlands
- [x] Significant Valleylands, Valleylands
- [x] Wetlands, Unevaluated Wetlands
- [x] Significant Wildlife Habitat
- [ ] Unevaluated Vegetation Patches
- [ ] Other Vegetation Patches >0.5 ha
- [ ] Potential Naturalization Area
- [ ] Other:

Impact Assessment:

- [x] Impact Assessment Required
- [x] Net Effects Table Required

Environmental Management Recommendations:

- [x] Environmental Management Plan:
- [ ] Specifications & Conditions of Approval:
- [ ] Other:

Environmental Monitoring:

- [x] Baseline Monitoring: EIS surveys
- [x] Construction Monitoring: to be made within the EMP
- [x] Post-Construction Monitoring: to be made within the EMP

Additional Requirements and Notes:

Previous email from Emily Williamson regarding project. Discussed with her via phone as well prior to scoping meeting.

UTRCA and City staff have been on site.

Send any documentation on clearing to Stefanie and team (clearing in 2015/2016).

Hydro-g work - 9 boreholes, 3 of which had monitoring wells, all of which in the developable lands. Both sides of the drains. Staff gauges within the drain suggested.
- mini piezometers within wetland areas
- surface water within drains and wetlands, comparision.
- water table wells (base flows to drain or wetlands) to document
- potential need to add in a couple additional monitoring well locations

Rebecca Walker

From: Hachey, Jeff <jhachey@london.ca>
Sent: June 27, 2025 1:34 PM
To: Rebecca Walker
Subject: RE: [EXTERNAL] 2004 Hamilton Road Scoping Checklist - June 7, 2022 Meeting

Thanks Rebecca.

A few things I am noting is the absence of relevant ecological information from the EIS incorporated into the report, as well as a section on groundwater/surface water interactions supported by chemical analysis from both sources, transposed on a piper diagram or durov plot. There also doesn't appear to be any hydrographs from the various monitoring well locations. Most of those are standards elements discussed during a scoping meeting for a hydrogeological assessment when there are natural heritage implications.

I think the best way to handle this would be to accept the report as "complete" for the time being, and then once I am able to complete a more fulsome review we can provide those comments to you to address. If you like, I am happy to meet after you receive the comments if there are any questions or you need clarification.

Sound like a reasonable approach?

Jeff

Jeff Hachey, M.Sc.E., P.Eng., QP$_{ESA}$
Hydrogeologist/Environmental Engineer
Stormwater Engineering Division
City of London

300 Dufferin Avenue, London, ON, N6A 4L9
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jhachey@london.ca | www.london.ca

From: Rebecca Walker <rebecca.walker@stonecairn.ca>
Sent: Friday, June 27, 2025 1:05 PM
To: Hachey, Jeff <jhachey@london.ca>
Subject: RE: [EXTERNAL] 2004 Hamilton Road Scoping Checklist - June 7, 2022 Meeting

The scoping for the HG and the ecology was handled in the same meeting. A separate Terms of Reference was not prepared.

According to my notes, the specific requirements which came out of that meeting for hydrogeological was to include the piezometers in the wetland to confirm surface water conditions within the drain, and to provide a feature-based water balance as the development limits were being refined to confirm base flow contributions to the Fekete Drain. We also needed to review the distribution of the wells to determine if any additional monitoring wells were required. This is consistent with the 'additional notes' in the attached document. I don't recall the discussion in that meeting concluding that a separate TOR document was required. I don't have access to the former LDS emails / phone logs, so I can't check to see if there was any internal follow-up with the consulting team or with others discussed.

We added the piezometers in the drain, but had to reinstall them on 2 occasions, since they were disturbed/damaged. We also installed staff gauges 2x, and they were stolen from the site before we could get meaningful readings from them. We determined that additional monitoring wells were not required since we didn't expect them to yield any additional information which would change our conclusions about the shallow groundwater conditions at the site. The updated report included the updated feature-based water balance analysis based on the concept plans provided by Development Engineering.

If there is something specific that you are looking for, can you let me know and then we can figure out how best to get you what you need.

Rebecca

REBECCA WALKER
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85 Midpark Road – Unit 3
London, Ontario N6N 1B2

From: Hachey, Jeff <jhachey@london.ca>
Sent: June 27, 2025 12:49 PM
To: Rebecca Walker <rebecca.walker@stonecairn.ca>
Subject: FW: [EXTERNAL] 2004 Hamilton Road Scoping Checklist - June 7, 2022 Meeting

Hi Rebecca – See below and attached. As per the email from Gina, LDS (now Stonecairn) was supposed to prepare a hydrogeological TOR for this site, after the scoping meeting was held. I have gone through my own files and emails and can't find that one was ever prepared and/or submitted. I have also skimmed through the hydro-g report submitted, and the TOR is not included as an appendix. Are you able to send me the TOR, assuming it exists?

We are in the process to assessing completeness of this application, and I am hoping that the report complies with the outcome of the scoping meeting, since I am seeing a few things which we would always ask for that don't seem to be included.

Thanks,

Jeff

Jeff Hachey, M.Sc.E., P.Eng., QPESA
Hydrogeologist/Environmental Engineer
Stormwater Engineering Division
City of London
London CANADA

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jhachey@london.ca | www.london.ca

From: Gina MacVeigh <gmacveigh@nrsi.on.ca>
Sent: Friday, June 17, 2022 9:25 AM
To: Butnari, Shane <sbutnari@london.ca>; Stefanie Pratt <pratts@thamesriver.on.ca>; Jason Fleury <JFleury@deveng.net>; Trevor Hawkins <thawkins@mhbcplan.com>; rebecca.walker@LDSConsultants.ca; Hachey, Jeff <jhachey@london.ca>; Lysynski, Heather <hlysynsk@London.ca>
Subject: [EXTERNAL] 2004 Hamilton Road Scoping Checklist - June 7, 2022 Meeting

Good morning and my apologies for the delay in getting this to you. Please find attached the updated Scoping Checklist based on the meeting held virtually on June 7, 2022.

Please note that the First Nations consultation requirement is now checked off based on email correspondence provided by Shane.

Meeting Key Points are as follows:

- SLSR/EIS can be combined.

- Concept Plan was previously done without thought of the natural environment features and will likely be updated. If the Drain is to be moved, discussions on how it would still connect to the south side of Hamilton Road will need to occur. Stephanie (UTRCA) to discuss internally any additional requirements should the feature need to be moved.

- City would be interested in acquiring the lands to the north in the ESA. NRSI will provide this info to the client.

- Clearing in 2015/2106 of the pine plantation, UTRCA cannot find any supporting documentation on this. Dev. Eng to discuss with client and provide information to agencies.

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Thanks again for attending the meeting and let me know if you need any clarification.

Gina

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Over 20 years of environmental consulting excellence

On 6/7/2022 9:03 AM, Gina MacVeigh wrote:

Here is the link if people are having difficulty finding it:

https://us06web.zoom.us/j/85284510976?pwd=S3dUUEtzczZ3YU52Q0JROGR0QWx2QT09

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On 5/26/2022 10:09 AM, Gina MacVeigh wrote:

Gina MacVeigh has invited you to 2004 Hamilton Road Scoping Meeting

Title:	2004 Hamilton Road Scoping Meeting
Location:	Virtual
When:	Tuesday, June 7, 2022 9:00 AM – 10:00 AM
Organizer:	Gina MacVeigh <gmacveigh@nrsi.on.ca>
Description:	Scoping meeting for 2004 Hamilton Road, London. Documents provided through en Gina MacVeigh is inviting you to a scheduled Zoom meeting. Topic: 2004 Hamilton F Scoping Meeting Time: Jun 7, 2022 09:00 AM Eastern Time (US and Canada) Join Zoc Meeting https://us06web.zoom.us/j/85284510976?pwd=S3dUUEtzczZ3YU52Q0JROGR0QW Meeting ID: 852 8451 0976 Passcode: 385689 One tap mobile +13126266799,,85284510976#,,,,*385689# US (Chicago)

	+13462487799,,85284510976#,,,,*385689# US (Houston) Dial by your location +1 3 6799 US (Chicago) +1 346 248 7799 US (Houston) +1 669 900 6833 US (San Jose) +1 205 6099 US (New York) +1 253 215 8782 US (Tacoma) +1 301 715 8592 US (Washin DC) Meeting ID: 852 8451 0976 Passcode: 385689 Find your local number: https://us06web.zoom.us/u/kcrKuO8hB2
Attachments:	
Comment:	
Attendees:	sbutnari@london.ca Stefanie Pratt <pratts@thamesriver.on.ca> Jason Fleury <JFleury@deveng.net> Trevor Hawkins <thawkins@mhbcplan.com> Rebecca Walker (rebecca.walker@LDSConsultants.ca) <rebecca.walker@LDSConsultants.ca> Hachey, Jeff <jhachey@london.ca> hlysynsk@london.ca
Related Link:	

Rebecca Walker

From: Rebecca Walker
Sent: February 4, 2026 11:21 AM
To: 'Hachey, Jeff'
Subject: Hydrogeological Scoping Discussions with Stonecairn

Jeff,

Thanks for your time today to chat about the various projects. For the sake of having better record keeping at our end, I have prepared the following notes to supplement the City of London Checklist for Hydrogeological scoping for each of the sites, based on our discussion. I have also included my notes for 2496 Dundas Street discussion we had back on January 21, 2026. Let me know if I've missed anything.

Project Site	Notes
2496 Dundas Street Townhouse Development Discussion: Jan 21, 2026, 10:00 am Attendees: J Hachey, R Walker	Overview: Drilling and MWs installed. Site is adjacent to Loveless Drain. Soils are predominantly silt & silt till. Shallow groundwater is intermittent (some open dry holes), but flow is towards the drain. Hydrogeological Requirements: - Any applicable City of London HG checklist items - Confirm flow direction of shallow GW - Feature based water balance for base flow contributions to the drain - Assess opportunities to direct clean water towards drain and use LIDs where soil and groundwater conditions are conducive. Note: field verification of LIDs will be requirement of the City - Establish background water quality in Loveless Drain - Construction dewatering discussion, and note that City will require a copy of the Dewatering and Discharge Plan which is required to support the construction dewatering EASR - Include monitoring recommendations & discussion
2004 Hamilton Road Industrial Subdivision Discussion: Feb 4, 2026, 10:00 am Attendees: J Hachey, R Walker	Overview: First submission reports already received by the City. Previous pre-consultation was carried out under LDS (pre Sep 2024). Updated scoping discussion for complete records and for 2nd submission report updates. Hydrogeological Requirements - Feature based water balance for post-development conditions to include discussion on the compensation areas contributing to base flows supporting the drain corridor - Surface water diversion for drain crossing – expected to be covered under construction dewatering EASR. Make note that City will require a copy of the Dewatering and Discharge Plan which is required to support the EASR
3180 Wonderland Rd S Possible Apartment Building Discussion: Feb 4, 2026, 10:00 am Attendees: J Hachey, R Walker	Overview: Drilling to be completed on this parcel. Site is adjacent to SWM pond and Pincombe Drain. Based on lands S of Bradley Avenue, shallow perched groundwater is expected. EIS at the site has not identified any sensitive features. Hydrogeological Requirements: - Any applicable City of London HG checklist items - Establish flow direction of shallow GW - If flow towards Pincombe drain, then assess opportunities to direct clean roof water towards drain, and assess if bioretention feature along E side is possible - Include discussion on foundations and shallow GW (waterproofing vs foundation drainage) - Establish background water quality in Pincombe Drain - Construction dewatering discussion, and note that City will require a copy of the Dewatering and Discharge Plan which is required to support the construction dewatering EASR - Include monitoring recommendations & discussion
3274 Wonderland Rd S Possible Apartment Building Discussion: Feb 4, 2026, 10:00 am Attendees: J Hachey, R Walker	Overview: Drilling and MWs installed in east half of this parcel. Site is adjacent to Pincombe Drain. Boreholes confirm presence of shallow perched groundwater. EIS input required for surface water / wet area in SE corner of the site and surrounding treed area. Need to confirm intent to maintain or remove / compensate for loss of this feature. Hydrogeological Requirements: - Any applicable City of London HG checklist items - Establish flow direction of shallow GW - If flow towards Pincombe drain, then assess opportunities to direct clean roof water towards drain, and assess if bioretention feature along E side is possible - If wet area in SE corner is being maintained – will need feature based water balance for this feature, and confirm opportunities to direct clean water towards it for maintaining base flow contributions - Include discussion on foundations and shallow GW (waterproofing vs foundation drainage) - Establish background water quality in Pincombe Drain - Construction dewatering discussion, and note that City will require a copy of the Dewatering and Discharge Plan which is required to support the construction dewatering EASR - Include monitoring recommendations & discussion

Shorthand references: HG = hydrogeological, GW = groundwater, MW = monitoring wells, N S E W cardinal directions

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