

APPENDIX

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STORMWATER DRAINAGE ASSESSMENT



Environmental Assessment Study of Arterial Roads within the Highway 427 Industrial Secondary Plan Area (Area 47)

Part B: Stormwater Drainage Assessment

City of Brampton and Region of Peel
TP115086

Prepared for:

City of Brampton & Region of Peel

1/20/2023

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City of Brampton & Region of Peel

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Preface

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited (Wood), has been retained by the City of Brampton and Region of Peel to conduct a Schedule C Municipal Class EA for a future arterial road network within Secondary Plan Area 47.

The City of Brampton, to accommodate future growth in north-east Brampton, has approved a secondary plan for Area 47. The area is bound by Mayfield Road to the north, Castlemore Road to the south, Regional Road 50 (RR50) to the east and The Gore Road to the west.

The City of Brampton has identified through its Transportation and Transit Master Plan (TTMP, 2009), and supporting studies the need for additional road network capacity up to 2031. As part of these studies, road network improvements within Secondary Plan Area 47 were recommended. The recommended road improvements are being addressed by the current Class EA in two parts:

Part A (Region owned R.O.W.s¹):

1. A new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
2. Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50; and,

Part B (City owned R.O.W.s):

1. A new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial);
2. Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and
3. Widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

In order to service this growth, new infrastructure must be provided that recognizes the capacity needs of planned growth and the objectives of protecting established communities and businesses from threats created by surface water drainage. As per Section 4.2.1.1 and Figure 4.4 of the MESP (ref. Aquafor Beech, 2016) the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the required water quantity, water quality, and erosion control SWM requirements. This approach has been adopted as the overall premise for design of the stormwater quantity, quality and erosion features required for all the roadways within the Study Area. Notwithstanding, the following negotiations are still ongoing:

- The Region and City are in discussion to formalize acceptance of stormwater discharge of the Region's roadway drainage systems to City owned drainage systems and SWM facilities; and,
- The Region, City and land owner's are in discussion regarding the overall premise for stormwater management for the Study Area, particularly along Coleraine Drive. This has driven the evaluation of alternatives focused on a stormwater management facility located near the intersection of Coleraine Drive and Arterial A2.

Decisions regarding these ongoing negotiations are a prerequisite to developing a preferred alternative for stormwater management for the Study Area. As such, alternative solutions will be developed and assessed in detailed design leading to a preferred approach and the road drainage as per the catchments divide provided in this report will be the responsibility of the R.O.W. adjacent land owners to accommodate.

1 R.O.W. = road right-of-way

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1.0 INTRODUCTION

Wood Environment & Infrastructure Solutions, a division of Wood Canada Limited (Wood), has been retained by the City of Brampton and Region of Peel to conduct a Schedule C Municipal Class EA (Class EA) for a future arterial road network within Secondary Plan Area 47.

The City of Brampton continues to grow and urbanize, and to accommodate future growth in north-east Brampton, Council has approved a secondary plan for Area 47. Area 47 is bound by Mayfield Road to the north, Castlemore Road to the south, Regional Road 50 (RR50) to the east and The Gore Road to the west (ref. Figure 1-1). To service this growth, new infrastructure must be provided that recognizes the capacity needs of planned growth and the objectives of protecting established communities and businesses from threats created by surface water drainage.

The City of Brampton has identified through its Transportation and Transit Master Plan (TTMP, 2009), and supporting studies (including the Highway 427 Extension Area Transportation Master Plan and the Highway 427 Industrial Secondary Plan (Area 47) Transportation Master Plan) the need for additional capacity in the road network up to the planning horizon year of 2031. As part of these studies, road network improvements within Secondary Plan Area 47 were recommended. The recommended road improvements are being addressed by the current Class EA in two parts:

Part A (Region owned R.O.W.s²):

3. A new six-lane north-south major arterial road (Arterial A2) from Mayfield Road east of Clarkway Drive to Major Mackenzie Drive/RR50; and,
4. Widening of Coleraine Drive from Arterial A2 to Mayfield Road including realignment at Arterial A2 west of RR50; and,

Part B (City owned R.O.W.s):

4. A new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial);
5. Widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and
6. Widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

The Part A and Part B features, as described above, are illustrated in Figure 1-1, as well as Plans 1 and 12 (ref. Appendix C).

The Highway 427 Industrial Secondary Plan (Area 47) Transportation Master Plan has satisfactorily completed Phases 1 and 2 of the Municipal Class EA process for the recommended arterial road network improvements and recommended commencement of Phases 3 and 4 of the EA process. The current study will satisfy Phases 3 and 4 of the Class EA requirements for the identified arterial road improvements.

This report has been prepared to document the stormwater drainage conditions for Part B of the Study Area. The following sections describe the background review, the assessment of existing and proposed hydraulic structures within Part B of the Study Area including hydraulic analyses, establish the proposed arterial road R.O.W. drainage conditions, and summarize stormwater management criteria for the proposed arterial road improvements, and new arterial roads. Part B of the Study Area includes drainage to the Clarkway and Gore Road Tributaries.

Stormwater drainage conditions for Part A of the Study Area are documented under separate cover.

2 R.O.W. = road right-of-way

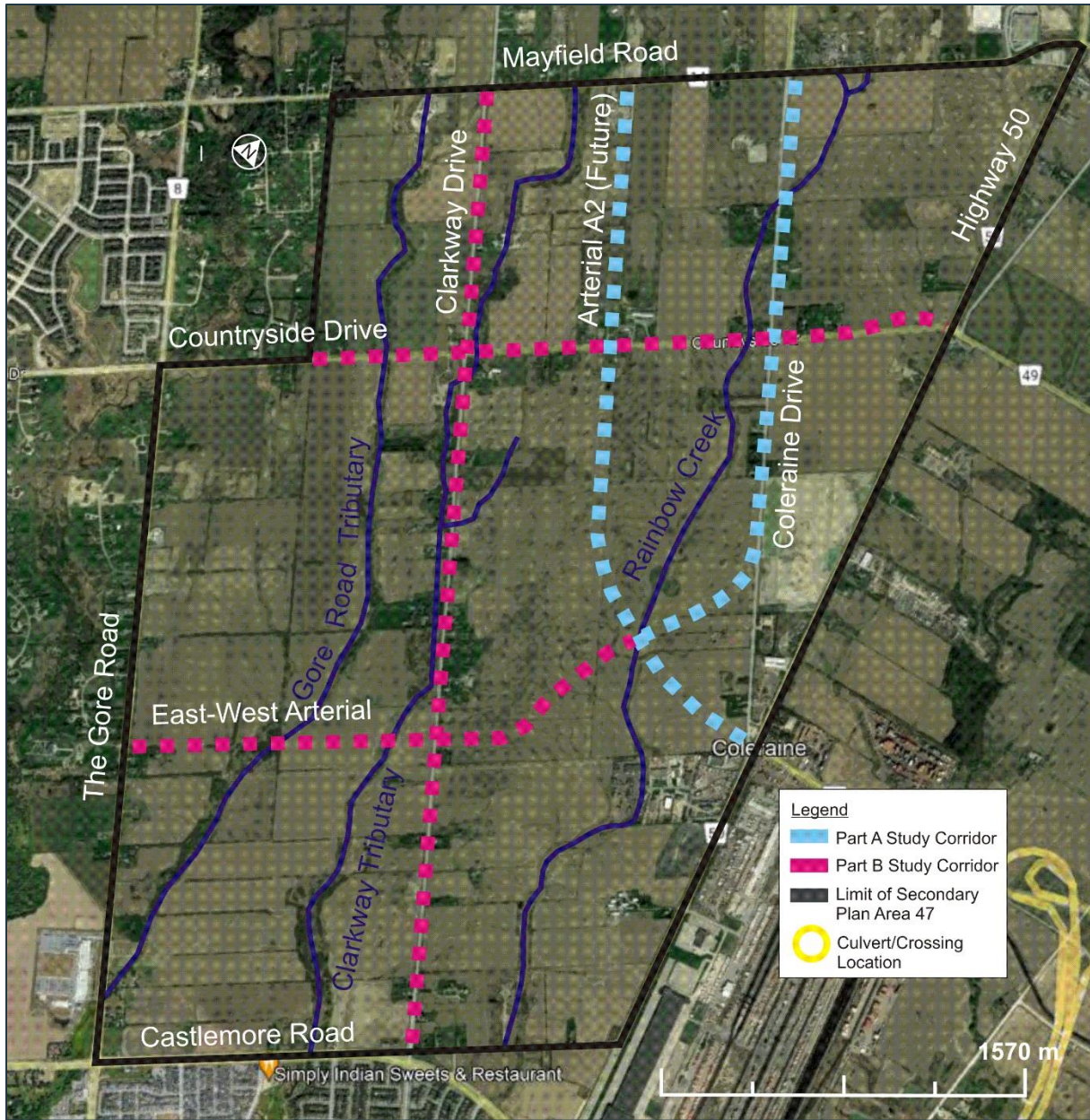


Figure 1-1 Study Corridors
(background image source Google Earth Pro™)

2.0 BACKGROUND REVIEW

2.1 Previous Studies

Several previous studies have been completed which are relevant to the current project as summarized below.

Humber River Hydrology Update, Civica Infrastructure Inc., June 2015

This study, prepared as a joint effort between the Toronto and Region Conservation Authority (TRCA) and Civica Infrastructure Inc. (Civica), was an update to the hydrologic model of the Humber River Watershed. The update was completed to reflect the increase in urban development, including stormwater management facilities constructed within the last 15 years, and included significantly refined subcatchment discretization. The hydrologic model was developed in Visual OTTHYMO 4 (VO4) for existing land uses and future land uses based on approved Regional and local municipality Official Plans. The model for the Humber River Watershed was a new model which superseded the previous SWMHYMO model developed by Aquafor Beech Limited (ref. Humber River Watershed Hydrology Update, November 2002). Peak flows were reported for the 2 to 500-year return periods and the Regional Storm event (Hurricane Hazel). The model was calibrated using rainfall-runoff data from recent storm events. Of the 6-hour, 12-hour, and 24-hour AES distribution design storms simulated, the 6-hour and 12-hour storms were found to be the critical storms (i.e. these storms generated the highest peak flows). The study found that the 2 to 100-year unit flow relationship equations provided in the TRCA Stormwater Management Criteria (2012) are sufficient to maintain existing conditions peak flows under the proposed future land use condition.

Master Environmental Servicing Plan: Highway 427 Industrial Secondary Plan Area ("Area 47"), Aquafor Beech Limited, May 9, 2016

This Master Environmental Servicing Plan (MESP) was prepared for the "Area 47" study area to address the constraints and opportunities associated with the proposed land use changes. The MESP provides a comprehensive management plan including stormwater and natural heritage strategies to protect the natural environment resources within the Study Area. Part of the MESP involved extending and updating TRCA generated HEC-RAS models of The Gore Road Tributary, the Clarkway Tributary, and Rainbow Creek.

2.2 Data, Mapping & Models

In addition to the reporting described in Section 2.1, additional background data, mapping and models have been provided by the City of Brampton, TRCA, Aquafor Beech, and Wood's Geotechnical Team. The following summarizes the data relevant to this assessment:

City of Brampton

- Various digital GIS base mapping layers including roads, property, watercourses, subwatershed boundaries, Official Plan land use, etc.
- Aerial photography
- Digital terrain mapping

TRCA

- Various digital GIS mapping layers including watercourses, TRCA regulation limit, meander belt, floodplain limits, etc.
- Visual OTTHYMO 4.0 hydrologic model of the Humber River Watershed (2015)

- Existing Conditions 6-hour AES 2 year – 100-year Design Storm Peak Flows (March 2018) from revised Humber River Hydrology Update
- Existing & Future Conditions Regional Storm Peak Flows (March 2018) from revised Humber River Hydrology Update
- HEC-RAS hydraulic models of the Gore Road Tributary, the Clarkway Tributary, and Rainbow Creek (March 2018)

Aquafor Beech

- HEC-RAS hydraulic models of The Gore Road Tributary, the Clarkway Tributary, and Rainbow Creek (2016 - Superseded by CDC. TMIG, dated July 2018).
- Various digital GIS base mapping layers including contours, watercourses, HEC-RAS section lines, and floodlines.

Wood's Geotechnical Team

- Borehole logs - 47 borehole logs were advanced by Wood's Geotechnical Team in the period January 2020 to April 2020 along the Coleraine Drive and Arterial A2 R.O.W.s. Relevant borehole logs are provided in Appendix A.

3.0 STORMWATER MANAGEMENT

3.1 Existing Conditions Storm Drainage

The Part B Study Area is located within the Humber River Watershed and contributes drainage to both the West Humber and the Main Humber subwatersheds. In the context of the West Humber subwatershed, the Study Area is located within the headwaters. There are two (2) tributaries that drain through the Part B Study Area, namely the Gore Road Tributary and the Clarkway Tributary (ref. Figure 3-1).

The existing land uses are predominantly agricultural, with a dispersion of pasture land and low-density residential. The soil type encountered throughout the Study Area is dominated by imperfectly drained stone-free clays, underlain by silty sand.

Under existing conditions, approximately 27.6 ha of existing R.O.W. (imperviousness = 16.3%) (i.e. Countryside Drive and Clarkway Drive) contributes stormwater runoff to the subject watercourses.

The existing R.O.W.s consist of rural cross-sections with ditches. Overland drainage from external lands enters the existing R.O.W.s at various points and is conveyed by the existing ditches to the watercourse receivers (i.e. Gore Road Tributary and the Clarkway Tributary).

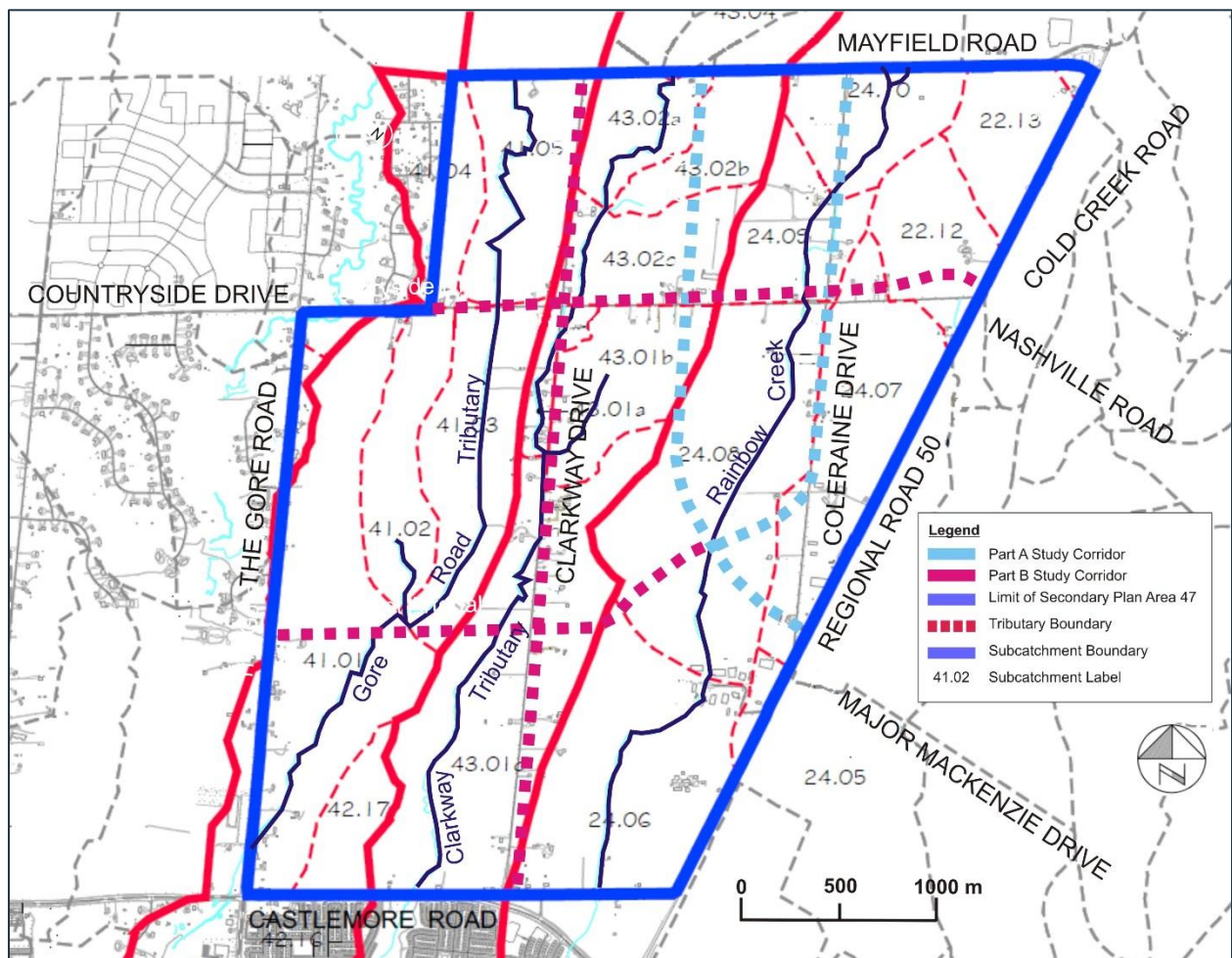


Figure 3-1 Existing Condition Drainage

3.1.1 Hydrologic Assessment

The hydrologic assessment completed for the Part B Study Area has estimated 2-year through 100-year return period peak flows for study relevant watercourses for existing land use conditions with stormwater management at key locations, including existing road crossings and the Study Area boundary. Application of existing land use conditions is considered conservative for the return period events as the future conditions peak flows are generally lower than existing conditions due to the application of unitary release rates. For the purposes of sizing future hydraulic crossings, as a component of the next phase of the study, the most conservative of the existing and future land use peak flows will be applied.

Peak flows have been simulated in the hydraulic model (Section 4.0) to assess the performance of the existing hydraulic structures (i.e. bridges & culverts).

3.1.1.1 Methodology

The Rational Method has been used to calculate the peak flows for 2 to 100-year storm events according to the Region of Peel IDF data (which is marginally higher than the City's design IDF rainfall). As well, a VO6 model has been developed to simulate the Regional (Hazel Storm), 6-hour and 12-hour AES design storm events peak flows for comparison with the Rational Method results. The subcatchments have been discretized to obtain peak flows suited to each reach within the Clarkway Tributary HEC-RAS model. Figure 3-1 provides the existing conditions catchment layout for the Study Area. The naming for the discretized subcatchments retains the parent catchment number, with a subscript of either "a", "b", or "c".

The estimated peak flows have been input to the HEC-RAS hydraulic model to estimate flood levels throughout the Part B Study Area. The updates to the HEC-RAS model are discussed in Section 4.0 of this report.

3.1.1.2 Results

The 6-hour and 12-hour duration, 2-year to 100-year return period AES distribution and Regional Storm events have been simulated using the VO6 hydrologic model. Peak flow estimates from the Rational Method and the VO6 model have been compared and it has been determined that the Rational Method produced the highest peak flows.

Using Region of Peel IDF data, peak flow estimates for the 2-year to 100-year storm events have been calculated for the existing and proposed conditions. Overall, the size of the discretized subcatchments is the same, however, the subcatchment imperviousness has increased significantly reflecting proposed development. A summary of the peak flows at key locations is included in Appendix B.

3.2 Future Conditions Storm Drainage

As outlined in Section 1.0, the future condition for Part B of the Study Area proposes a new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial); widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with a possible continuous center turn lane, and widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50. Urbanized cross-sections are proposed for all R.O.W.s.

A proposed road profile was developed by the City, Region, and Wood. The future condition storm drainage boundaries were developed based on the proposed road profile and are illustrated in Plans 5 to 12 (ref. Appendix C).

Under future conditions: Approximately 33.24 ha of future R.O.W. (imperviousness = 63.7%) (i.e. Clarkway Drive, Countryside Drive, and E-W Arterial) is proposed to contribute to stormwater runoff to the Clarkway Tributary. This proposes an increase of the impervious area of 15.73 ha relative to existing conditions. The increase is made up of the new and widened R.O.W.s. Table 3-1 summarizes the changes in imperviousness of each roadway between the existing and proposed conditions.

Table 3-1 Existing and Proposed Subcatchments Imperviousness

Road	ROW (ha)	Existing Imp (%)	Proposed Imp (%)	Net Imp Increase (%)
Countryside Dr.	8.48	19.0	73.6	54.6
Clarkway Dr.	16.93	21.4	57.1	35.7
E-W Arterial	7.83	2.4	67.0	64.6

Under future ultimate development conditions, external drainage will not enter the R.O.W.s. Notwithstanding, the proposed roadways may be constructed prior to the development of adjacent blocks. As such, and until development of adjacent blocks commences, temporary conveyance (e.g. ditches and culverts) to the downstream receiving systems under the interim conditions will be required.

3.3 Soils and Groundwater

Wood has advanced and prepared 94 borehole logs along the Part B road alignments. The soil types encountered within the Study Area are dominated by imperfectly drained stone-free clays, underlain by silty sand. These soil types have a typical saturated hydraulic conductivity value ranging between 7×10^{-5} and 2×10^{-4} (ref. User's Guide to SWMM5, 13th Edition).

Borehole logs indicate that groundwater was encountered within 21 boreholes, ranging in depths of 0.6 m to 4.6 m below existing ground surface for Clarkway Drive and depths of 1.5 m to 8.2 m for Countryside Drive. The remaining boreholes indicate that groundwater was not encountered to the depth of the individual borehole.

In general, the future conditions road profile proposes to raise grades within the R.O.W. limits. Therefore, depths from surface to groundwater levels will increase under future conditions, ranging in depths of 3.1 m to 8.7 m below the proposed ground surface for Coleraine Drive and depths of 1.2 m to 9.7 m for Arterial A2. A summary of the borehole logs, groundwater levels and separation from existing and proposed grades is provided in Appendix B.

3.4 Stormwater Management Design Criteria

The stormwater management analyses of the Study Area has considered design criteria from several agencies including, the City of Brampton, the Toronto and Region Conservation Authority (TRCA), the Ministry of Transportation (MTO). In addition to agency design criteria, the stormwater management analyses of the Study Area will also consider design criteria outlined in the MESP (ref. Aquafor Beech, 2016). The stormwater management criteria relevant to the Study Area are outlined below.

3.4.1 City of Brampton (2008)

All design shall comply with the City of Brampton's Subdivision Design Manual (Brampton, 2008)³. As previously noted, the future roadways are planned as Arterial Roads. The following excerpts from the

³ Available via URL https://www.brampton.ca/en/Business/planning-development/Documents/Eng/2008_subdivision_design_manual.pdf

Subdivision Design Manual are relevant:

- Part III (1) Stormwater Management
 - Where required, stormwater management techniques shall be implemented to the satisfaction of the City of Brampton, the local Conservation Authority and all concerned departments and agencies.
- Part III (3) The Minor System (Storm Sewers)
 - The storm sewer design must meet the following City of Brampton criteria for storm sewer design, based on City of Brampton Rainfall Intensity Curves (Standard Drawing No: 343) and a time of concentration of ten (10) minutes.
 - Item (a) Minimum Standard No. 1: A ten-year return storm design plus adequate provision for continuous overland drainage of roads.
- Part III (18) Overland Flow
 - Item (a): The major stormwater system must be designed to accommodate runoff exceeding the capacity of the minor system for the flows up to the 100-year return frequency. Major overland flow must be contained within the road allowance and walkways only.
 - Item: (f) The Major Storm Overland Flow (100-year and greater): In the event that the major storm overland flow from a subdivision exceeds the capacity of the maximum number of catchbasins as specified above, major storm overland flow shall be allowed to flow onto the arterial or major collector roads with the condition that the additional flow from the subdivisions would not cause the ponding depth to exceed 0.15 m above the gutter along the arterial or major collector roads. A minimum of 2 lanes of roadway pavement must be flood-free at all times for emergency vehicles during the major storm event. However, the major overland flow shall not be permitted to flow across any arterial or major collector roads under any circumstances.
- Part VI (3) Culverts and Bridges: Culverts and bridges under arterial roads must be designed to prevent overtopping during all storm conditions including the Regional storm.

3.4.2 Region of Peel (2019)

- *Minor System:* Storm sewers are to convey the 10-year storm event, and are to be designed using Region of Peel IDF information;
 - *Major System:* Regional road R.O.W.s, including both urban and rural, are to convey flows generated by the R.O.W. itself, up to the 100-year storm event;
 - External lands should not drain to the Region's storm sewer system;
 - *Water Balance:* For Low Volume Groundwater Recharge Areas (LGRA), provided the site does not impact a sensitive ecological feature, or require a subwatershed study, or Environmental Impact Study (EIS), the proponent has the option to:
 - provide a minimum post development recharge of the first 5 mm for any precipitation event, or;
 - complete a site-specific water balance to identify pre-development groundwater recharge rates
- As per Figure C.10 from the TRCA Stormwater Management Guidelines (ref. TRCA, August 2012) the Study Area is located within a LGRA. Refer to Appendix A for Figure C.10 of (TRCA, August 2012).
- *Road Reconstruction:* New linear projects without restrictions and subject to the approved Source Protection Plan, that results in the creation of impervious surface(s) and/or fully reconstructs the

existing impervious surfaces, shall control per the mandatory control hierarchy the larger of the following:

- The runoff generated from the geographically specific 90th percentile rainfall event (27 mm) from the new and/or fully reconstructed impervious surfaces on the site. The site shall be required to maintain the pre-development water balance, or;
- The runoff generated from the geographically specific 90th percentile rainfall event (27 mm) from the net increase in impervious area(s) on the site. The site shall be required to maintain the pre-development water balance.

As per Map 3.4 of the “Approved Source Protection Plan: CTC Source Protection Region”, prepared by the CTC Source Protection Committee, dated March 25, 2019 (ref. Appendix A), the Study Area is located outside of the nearest Wellhead Protection Area (WHPA-Q1/Q2), and is therefore not subject to the approved Source Protection Plan. As such, the road reconstruction criteria as stated above would not apply to the Part B Study Area⁴.

- *Climate Change*: Per Section 7.2.2 of the Region’s SWM Criteria (2019), the Region has a four (4) step process for considering climate change resiliency in the design of SWM infrastructure.

3.4.3 Toronto and Region Conservation Authority (2012)

- *Quantity Control*: Control post-development peak flows to target rates established using the unit flow relationships for Sub Basin 36 (Equation F) for all storms up to and including the 100-year storm (i.e., 2, 5, 10, 25, 50, and 100-year storms);
- *Quality Control*: MOE Enhanced Level (Level 1) Water Quality Control (80% Average Annual Removal of Total Suspended Solids [TSS]). A treatment train solution is to be implemented;
- *Water Balance*: For sites located within a LGRA best efforts to maintain recharge are expected, provided the site does not impact an ecological feature; and
- *Erosion Control*: Minimum infiltration of 5 mm is required. For sites with a SWM pond, extended detention of the 25 mm event for a period of 48 hours may also be required.

As per Figure C.10 from the TRCA Stormwater Management Guidelines (ref. TRCA, August 2012) the Study Area is located within a LGRA. Refer to Appendix A for Figure C.10.

3.4.4 Master Environmental Servicing Plan (2016)

- *Quantity Control*: TRCA Criteria – Control post-development peak flows to target rates established using the unit flow relationships for Sub Basin 36 (Equation F) for all storms up to and including the 100-year storm (i.e., 2, 5, 10, 25, 50, and 100-year storms);
- *Quality Control*: MOE Enhanced Level (Level 1) Water Quality Control;
- *Water Balance*: Infiltration of runoff from a 5 mm storm event using Low-Impact Development (LID) Best Management Practices (BMPs); and
- *Erosion Control*: For drainage to Rainbow Creek, Clarkway Tributary, and Gore Road Tributary, extended detention of the 25 mm storm event for a period of 48 hours is required. For drainage to Headwater

⁴ Please note that despite this, the Region has noted to Wood that the road reconstruction criteria should still be applied to the Regional owned R.O.W.s within the Study Area (ref. Email correspondence Bubas-Khan, dated October 28, 2020). As such, this criterion is to be applied to the Part A R.O.W.s (i.e. Coleraine Drive and Arterial A2).

Drainage Features (HDFs), extended detention of the 25 mm storm event for a period of 120 hours is required.

As per Section 4.2.1.1 and Figure 4.4 of the MESP (ref. Aquafor Beech, 2016) the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements noted above. As such, Wood has not addressed these SWM criteria in this report as it is assumed to be addressed by the reporting prepared for the Area 47 development blocks.

Based on the foregoing, the water balance criteria (ref. Section 3.5), and road reconstruction criteria (ref. Section 3.6) are addressed with this report.

It should be noted that if any of the development blocks that are intended to provide the water quantity, water quality, and erosion control SWM requirements for a portion of the City and Region R.O.W.s be developed with privately-owned SWM infrastructure, the City and Region R.O.W. drainage cannot drain into the development block without a formal agreement. If a formal agreement is not established, then the requisite water quantity, water quality, and erosion control SWM requirements for the R.O.W. drainage must be implemented within the R.O.W. These details are to be determined as each development block advances to the detailed design stage.

Notwithstanding, it should be noted that conveyance of R.O.W. drainage to the SWM facilities within the development blocks may not be feasible (e.g., grading constraints). In addition, the proposed roadways may be constructed prior to the development of adjacent blocks. Therefore, consideration of management of stormwater runoff within the R.O.W. is required.

In this context, discussions between the City and Region are ongoing on the issue of possible management of roadway stormwater runoff from each other's R.O.W.'s. Further discussions are required in this regard and any agreement may influence the design of SWM systems for this development area.

3.5 Water Balance

As outlined in Section 3.4, the Region, TRCA, and MESP have water balance criteria that require the on-site retention of the larger of the runoff volume from a 5 mm storm event and the pre-development water balance/groundwater recharge volume. Table 3-6 below outlines the volumes for each subcatchment, with an identification of the larger volume requirement.

Pre-development water balance volumes were calculated using Table 3-2 (Urban Lawns/Shallow Rooted Crops) of the Ministry of the Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual (SWMPDM, 2003), and historical rainfall data obtained from the Environment Canada rainfall gauge located at the Toronto Lester B. Pearson International Airport (Gauge A). Monthly and daily precipitation data were obtained for the years 1995 to 2019 and converted into an annual average rainfall depth. The pre-development water balance volumes were calculated using the proposed R.O.W. subcatchments and existing impervious conditions (ref. Plans 1 to 4, Appendix C). Supporting calculations are provided in Appendix B.

Post-Development runoff volumes from the 5 mm storm event were calculated using the proposed R.O.W.s and proposed imperviousness (ref. Plans 5 to 12, Appendix C).

Table 3-2 Water Balance Retention Volume Requirements

Subcatchment	Pre-Development Water Balance/Groundwater Recharge Volume (Average Daily Volume in m ³)	Post-Development Runoff Volume from 5 mm Storm Event (m ³)
CS1	5.0	56.6
CS2	0.8	11.3
CS3	2.6	38.8
CS5	5.9	57.0
CS6	1.4	13.2
CS7	4.2	38.4
CS9	2.3	31.4
CS10	1.3	18.0
CS11	0.4	6.5
CS12	2.0	16.4
CS13	2.3	18.0
CS14	0.8	6.6
CL1	4.5	24.3
CL2	13.3	102.0
CL3	11.6	93.2
CL4	7.6	57.5
CL5	7.7	61.0
CL6	5.4	71.5
CL7	6.2	74.4
EW1	9.9	82.6
EW2	6.1	46.5
EW3	6.1	49.8
EW4	5.0	40.9
EW5	1.2	9.1
EW6	4.1	33.5

Note(s):

1. Bolded values indicate governing water balance volume

As outlined in Table 3-2, the runoff volumes from the 5 mm storm event govern the water balance retention volume requirements, compared to the pre-development groundwater recharge volume. Water Balance retention volume requirements are discussed further in Section 3.7, and a long list of stormwater management practices suitable to achieving the water balance criteria are outlined in Section 3.7.2.

As outlined in Section 3.7.2, the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements. Information pertaining to the way the major and minor systems of the City and Region R.O.W.s would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the subcatchments represented on Plans 1 to 12 (ref. Appendix C), and the corresponding water balance volume requirements, should be reviewed and refined when this information becomes available. This is expected to occur at the detailed design stage.

3.6 Road Reconstruction

As outlined in Section 3.4, the Region’s road reconstruction criterion is to be applied to Part B R.O.W.s. The road reconstruction criterion requires new linear projects that result in the creation of impervious surface(s) and/or fully reconstructs the existing impervious surface, to provide storage for the greater volume associated with the following scenarios:

1. The runoff generated from the geographically specific 90th percentile rainfall event (27 mm) from the new and/or fully reconstructed impervious surfaces on the site. The site shall be required to maintain the pre-development water balance, or;
2. The runoff generated from the geographically specific 90th percentile rainfall event (27 mm) from the net increase in impervious area(s) on the site. The site shall be required to maintain the pre-development water balance.

Based on a review of the proposed R.O.W.s, scenario #1, as described above, would generate larger runoff volume as the new and/or fully reconstructed impervious surface area is larger than the net increase in impervious surface area. Therefore, calculations of the runoff from the 90th percentile rainfall event were completed for this scenario. The impervious coverages and resulting runoff volumes are summarized in Table 3-3 below. Supporting calculations for both scenarios are provided in Appendix B.

Table 3-3 Region’s Volume Control Requirements for Linear Developments (m³)

Subcatchment	Total Proposed Impervious Area (ha)	Runoff Volume from 27 mm Storm Event (m ³)
CS1	1.1	304.3
CS2	0.2	60.9
CS3	0.8	209.2
CS5	1.1	307.7
CS6	0.3	71.5
CS7	0.8	207.1
CS9	0.6	169.7
CS10	0.4	97.2
CS11	0.1	35.3
CS12	0.3	88.6
CS13	0.4	97.2
CS14	0.1	35.8
CL1	0.5	131.2
CL2	2.0	550.5
CL3	1.9	503.1
CL4	1.2	310.6
CL5	1.2	329.4
CL6	1.4	386.3
CL7	1.5	401.6
EW1	1.7	445.9
EW2	0.9	251.2
EW3	1.0	268.7
EW4	0.8	220.8
EW5	0.2	49.0
EW6	0.7	180.8

It is concluded from a comparison of the water balance retention requirements, presented in Table 3-2 to the road reconstruction runoff volume control requirements, presented in Table 3-3, that the latter criterion governs. Retention volume requirements are discussed further in Section 3.7, along with a long list of stormwater management practices suitable for the study area.

3.7 Stormwater Management Opportunities

3.7.1 General Stormwater Management Opportunities

Stormwater Management practices (SWMPs) for the management of roadway runoff generally fall into two categories: those that address stormwater quantity (including erosion) and those that manage stormwater quality of surface runoff. In addition, Low Impact Development (LID) best management practices are designed to provide water quality treatment and quantity control for smaller, more frequent storm events, and water retention.

As outlined in Section 3.4.1, stormwater quantity, quality and erosion criteria for the Study Area are to be provided by the internal development blocks within Area 47. As such, proposed works for the current study are limited to water balance and road reconstruction criteria.

In terms of water balance and road reconstruction criteria, the SWMPs relate to the retention (i.e. infiltration) of runoff from the new pavement, and where possible, runoff from the existing pavement; however, current legislation solely relates to the former. Typically, the required retention volumes are dictated by agency standards, and are also often defined in a watershed or subwatershed planning study. Water balance and road reconstruction retention volume requirements for the Study Area are outlined in Table 3-1 and Table 3-2 respectively, and it has been determined that the City's road reconstruction criteria govern the retention volume requirements.

Various Best Management Practices or Stormwater Management practices are available to address the water balance retention volume requirements of runoff from roadways. Due to the linear nature of roadway corridors however, not all stormwater management practices are considered to be appropriate. Typically, suitable BMPs for linear roadway corridor come in the form of Low-Impact Development (LID) BMPs. Various LID BMPs are reviewed in the following section. The review was completed to determine suitability of each LID BMP in managing the water balance retention volume requirements, taking into consideration the Study Area topography, soils, groundwater level, and future conditions land use.

It is directed that detailed evaluation of stormwater management alternatives be evaluated as a component of detailed design.

3.7.2 Low Impact Development Best Management Practices

Low Impact Development represents the application of a suite of BMPs normally related to source and conveyance storm water management controls to promote infiltration and pollutant removal on a local site by site basis. These measures rely on eliminating the direct connection between impervious surfaces such as roads and the storm drainage system, as well as the promotion of infiltration of road drainage. General design guidelines and considerations for source and conveyance controls have been advanced since the early 1990's as part of the Ministry of Municipal Affairs and Housing (MMAH) "Making Choices" and in 1994 as part of the Ministry of the Environment's original Best Management Practices Guidelines.

Subsequent to the 1994 MOE Guidelines, technologies and standards have been developed further for the application of source and conveyance controls. These have evolved into a class of BMPs referred to as Low Impact Development (LID) practices, which have advanced as an integrated form of site planning and storm servicing to maintain water balance and providing storm water quality control for urban developments. Initial results from studies in other settings have demonstrated that LID practices provide benefits by way

of reducing the erosion potential within receiving watercourses and thereby reducing the total volume of end-of-pipe storm water erosion control requirements. In addition, due to volumetric controls afforded by LID BMP's, water quality is also improved through a reduction in mass loading. The benefits from LID storm water management practices are generally focused on the more frequent storm events (e.g. 2-year storm) of lower volumes as opposed to the less frequent storm events (e.g. 100-year storm) with higher volumes. It is also recognized that the forms of LID practices which promote infiltration or filtration through a granular medium provide thermal mitigation for storm runoff.

Guidelines regarding the application of LID practices and techniques have been developed within various jurisdictions in the United States and Canada. The Toronto and Region Conservation Authority (TRCA) and Credit Valley Conservation (CVC) have produced the 2010 Low Impact Development Stormwater Management Manual, for the design and application of LID measures, various LID techniques, as well as their function that are applicable to road projects. While most of these are typically implemented to provide water quality and/or water quantity control, they can also be utilized to provide water balance retention given their ability to capture and retain runoff volume. Descriptions of various LID BMPs with infiltration capabilities are provided below.

3.7.2.1 Infiltration Trenches

Infiltration trenches can be positioned at surface level or below ground (i.e. subsurface). At-surface infiltration trenches are designed to receive surface runoff, while subsurface infiltration trenches receive runoff that has been captured by catch basins and/or storm sewers. Infiltration trenches are preferred in areas that have reasonable infiltration properties (15 mm/ hr, 1×10^{-6} cm/s), but can be implemented in all soil types as long as they are large enough to store the design volume.

For R.O.W.s, at-surface infiltration trenches are restricted to the pervious areas within the boulevards or island areas (if proposed). Subsurface infiltration trenches can be positioned beneath impervious areas such as sidewalks and multi-use pathways. For subsurface infiltration trenches receiving drainage from catch basins, all catch basins should be fitted with goss traps to filter floatable debris.

Infiltration trenches are restricted in depth by local groundwater levels. As per the Low Impact Development Stormwater Management Planning and Design Guide (ref. CVC, TRCA, 2010), the minimum separation between the underside of an infiltration trench and the seasonally high groundwater level is 1.0 m. As outlined in Section 3.4, depths from surface to groundwater levels will increase under future conditions, ranging in depths of 1.2 m – 9.7 m below proposed ground surface. Infiltration trenches will likely require a depth of at least 500 mm. Therefore, to implement an infiltration trench, the minimum depth from surface to groundwater level would have to be at least 1.5 m. Many boreholes did not encounter groundwater during drilling, indicating that there are no restrictions to the depth of infiltration trenches in those areas, up to the termination of the borehole. Infiltration trench feasibility would need to be considered on a location-by-location basis based on the preceding identified depths.

3.7.2.2 Permeable Pavers/ Pavement

Permeable pavement could be implemented for the entirety, or for sections, of the proposed sidewalks and multi-use trails. Permeable paved sidewalks and multi-use trails would reduce the runoff volume from paved surfaces within the urban road R.O.W. As a standalone LID BMP, however, it would not be able to meet the water balance criteria, as it would treat a limited area and would not treat the roadway itself (which would be expected to generate the largest portion of runoff). It is understood that the Region does not prefer to implement permeable pavement on their projects due to operations/maintenance issues and performance concerns. As such, permeable pavement is not recommended for implementation.

3.7.2.3 Pervious Pipes

Pervious pipes could be used in combination with either bioretention systems or infiltration trenches. As a standalone SWM measure, pervious pipes can be a cost-effective and relatively simple method to achieve water balance requirements, while eliminating the need for surface space within the right-of-way.

3.7.2.4 Conventional Underground Storage (Cellular Systems)

Modular style plastic chambers (e.g. Brentwood™, StormTech™, Triton™ or other equivalent and approved systems), could be considered to achieve water balance requirements. Conventional underground storage can be implemented in a similar manner to subsurface infiltration trenches, receiving runoff that has been captured by catch basins and/or storm sewers. Conventional underground storage is typically implemented to achieve water quantity requirements; however, these systems often serve also to achieve water balance requirements by making the bottom of the storage tank infiltrative.

3.7.2.5 Bioretention Systems

Bioretention systems can be implemented in the pervious areas within the boulevards or island areas (if proposed), similar to at-surface infiltration trenches. Bioretention systems should be approximately 10% to 20% in size of the contributing drainage area, with typical drainage areas of 0.50 ha and a maximum drainage area of 0.80 ha. Slopes within bioretention systems are typically 1% to 5%. Bioretention systems are also preferred in areas that have reasonable infiltration properties (15 mm/ hr, 1×10^{-6} cm/s), but can be implemented in all soil types if the water quality event can be temporarily stored (typical depths 0.15 m to 0.25 m) before infiltrating and an underdrain is provided. Bioretention systems should have forebays for a form of surface water pre-treatment. Catch basins fitted with goss traps can be used to filter out floatable debris before directing runoff to the infiltrative component of the bioretention system.

3.7.2.6 Enhanced Grassed Swales

Grassed swales designed with a trapezoidal geometry and flat longitudinal profiles with largely unmaintained turf can provide infiltration, similar to bioretention cells. Their application in linear corridors is particularly appropriate and can be further enhanced through the introduction of check dams to provide additional on-line storage. Their application in urbanized roadway cross-sections (i.e. curb and gutter) often requires alternative grading and roadway configurations which can compromise the function of the roadway itself and are therefore typically not preferred in those cases. Notwithstanding, gutter outlets along outside lanes have been demonstrated to function effectively where the right-of-way can accommodate the design. Based on the proposed ultimate urbanized road ROW, enhanced grassed swales are likely not a practical water balance measure.

3.7.2.7 Filter Strips

Filter strips are typically designed for small drainage areas (less than 2 ha ±) and are applied as part of a treatment train. Filter strips require flat areas with slopes ranging from 1 to 5% and are usually in the range of 10 to 20 m in length in the direction of flow. Flow leaving filter strips should be a maximum of 0.10 m depth, based on a 10 mm storm event. Based on the limited space within the proposed R.O.W.s, filter strips are likely not a practical water balance measure.

Based on the foregoing review, the following LID BMPs have been short-listed:

- Infiltration Trenches;
- Pervious Pavers/Pavement;
- Pervious Pipes;

- Conventional Underground Storage; and
- Bioretention Systems

As outlined in Section 3.4.1, the SWM facilities proposed within the Area 47 development blocks are to be designed to service the City and Region R.O.W.s for the water quantity, water quality, and erosion control SWM requirements. Information pertaining to the way the major and minor systems of the City and Region R.O.W.s would be connected to the systems servicing the development blocks has not been made available for the current study. As such, the advantages, and disadvantages of the short-listed LID BMPs should be further reviewed and refined when this information becomes available. This is expected to occur at the detailed design stage.

4.0 HYDRAULICS

4.1 Purpose

Hydraulics relates to the calculation of water surface elevations and velocities for the design storm peak flows generated by the hydrologic models and supports assessment of hydraulic structure performance (i.e. capacity, overtopping conditions, etc.) and delineation of floodplains. Structures included in this evaluation are outlined in Table 4-1 and illustrated in Figure 4-1.

This report section documents the evaluation of the Part B crossing.

Table 4-1 Structures included for Assessment for Parts A and B

Project Component	Crossing Reference	HEC-RAS Reference			Watercourse	Crossing Location
		River	Reach	Section		
Part A	I	River-4	Reach-1	24.4425	Rainbow Creek	Coleraine Drive
	G	River-4	Reach-1	24.343		proposed intersection of Coleraine Drive and E-W Arterial A2
Part B	H	River-4	Reach-1	24.424		Gore Road Tributary
	B	Gore Road Trib	Reach1	1412.42	Countryside Drive	
	A	Gore Road Trib	Reach1	1410.052	E-W Arterial A2	
	E	Clarkway Trib	Reach3	1512.505	Clarkway Tributary	Countryside Drive
	D	Clarkway Trib	Reach2	1512.372		Clarkway Drive
	F	River11	Reach 11	356.6		Clarkway Drive
	C	Clarkway Trib	Reach31	1510.123		E-W Arterial A2

4.2 Methodology

TRCA prepared the original HEC-RAS hydraulic models for The Gore Road and Clarkway Tributaries of the West Humber River. The two (2) HEC-RAS models were extended upstream to the northern limit of Area 47 (where required) and updated as part of the Master Environmental Servicing Report (Aquafor Beech Ltd., May 2016).

The Gore Road Tributary model extends from north of Humber Station Road downstream to the confluence of the Gore Road Tributary and the West Humber Main Branch.

The Clarkway Tributary model extends from just north of Healey Road downstream to the confluence of the Clarkway Tributary and the West Humber Main Branch. The same confluence is shared by The Gore Road Tributary.

All models contain several bridges/culverts and branches along their entire lengths. The models, as originally received by Wood, contained 2-year to 100-year return period and Regional Storm peak flows, as well as a set of peak flows entitled "TRCA 2014". The TRCA 2014 peak flows are of similar magnitude to the Regional Storm peak flows. The original models contained a downstream boundary condition of Known Water Surface Elevations.

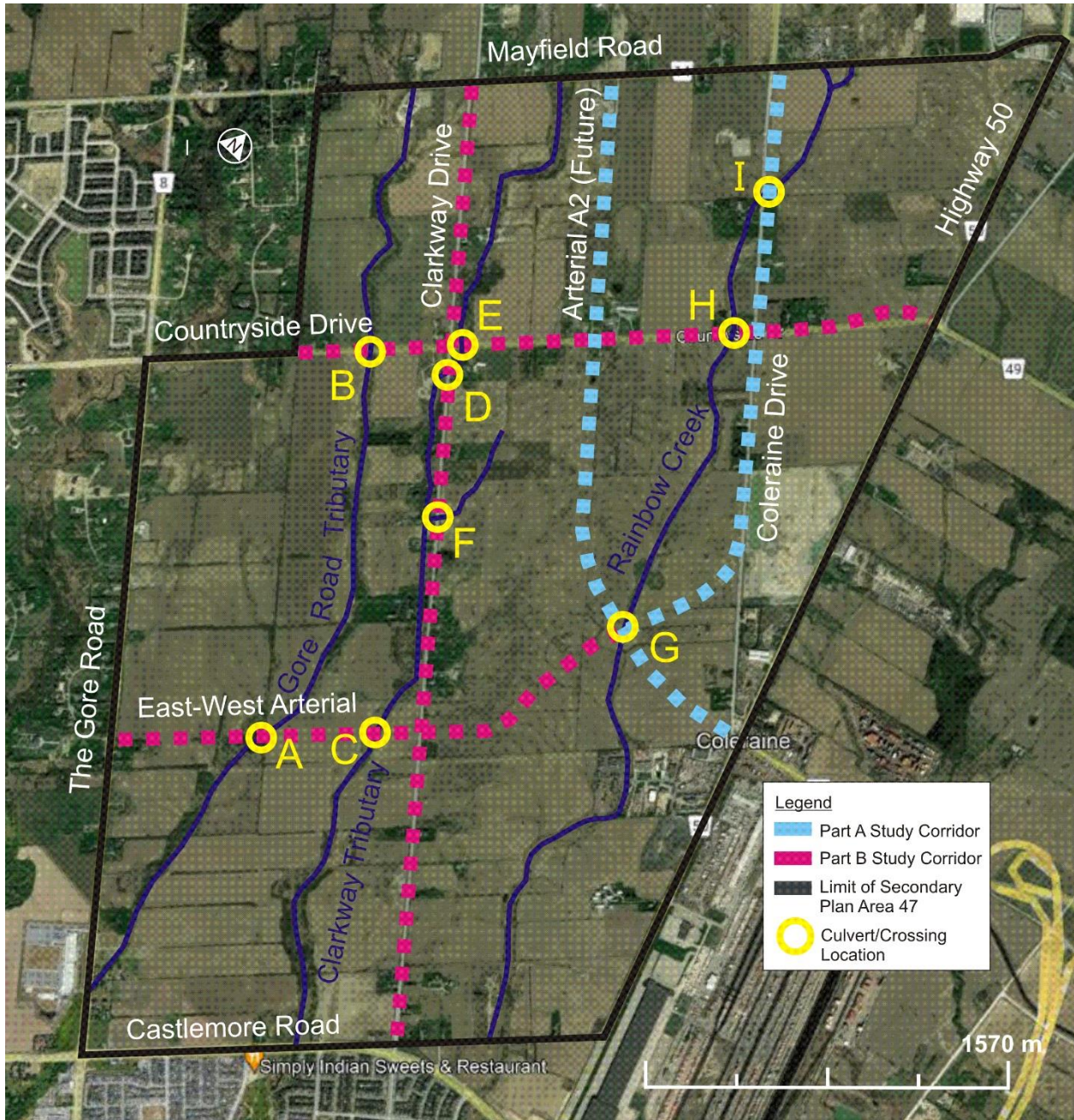


Figure 4-1 Structures included for Assessment for Parts A and B

(background image source Google Earth Pro™)

The HEC-RAS models have been reviewed and refined for the current study. Revisions include updates to hydraulic crossings within the Study Area, as well as updates to flow change locations and peak flows based on the rational method. The following crossings have been updated with respect to crossing span, crossing length, ineffective flow areas, high chord, reach lengths, deck/roadway data, and road widths:

The Gore Road Tributary	Countryside Drive box culvert (Culvert B)
Clarkway Tributary	Countryside Drive bridge (Culvert E) Clarkway Drive bridge (Culvert D)

Updates were based on a combination of topographic survey of the rights-of-way and hydraulic structures, and DTM provided by the City, as well as structural condition assessments completed by Wood.

One (1) culvert crossing (Culvert F as illustrated on Figure 4-1) was added to the Clarkway Tributary HEC-RAS model. The culvert is a 1.5 m diameter Corrugated Steel Pipe (CSP) located on Clarkway Drive, south of Countryside Drive, and conveys drainage from a headwater feature of the Clarkway Tributary. The DTM provided by the City has been utilized to establish two (2) cross-sections upstream and one (1) cross-section downstream of the culvert. The culvert size was measured by Matrix Solutions Inc. as part of the Geomorphologic Assessment for the current study.

Relevant crossing characteristics are provided in Table 4-2.

In addition to the crossing information, peak flows have been updated utilizing the rational method for The Gore Road and Clarkway Tributary models within the Study Area. Flow change locations were also added and removed where required.

Boundary conditions have been maintained consistent with the Aquafor Beech 2016 models. One exception is noted for the Clarkway Tributary model wherein the boundary conditions for this model were set the same as the Gore Road Tributary model as they share the same downstream section.

It is noted that, to Wood’s knowledge, the flow values contained in the steady flow files are not reflective of climate change projections. Per Section 7.2.2 of the Region’s SWM Criteria (2019), the Region has a four (4) step process for considering climate change resiliency in the design of SWM infrastructure. As such, Wood recommends that climate change influences be assessed at the detailed design stage as necessary.

Table 4-2 Part B Existing Culverts

Crossing Reference	Watercourse	Road	Structure		Future Road Classification
			Type	Size (m)	
B	Gore Trib	Countryside Drive	Concrete Box Culvert - Open Bottom	5.52 x 1.52	Urban Arterial
D	Clarkway Trib	Clarkway Drive	Concrete Box Culvert - Open Bottom	6.82 x 1.94	Urban Arterial
E	Clarkway Trib	Countryside Drive	Steel Girder Bridge	6.88 x 1.34	Urban Arterial
F	Clarkway Trib	Clarkway Drive	CSP	1.50 dia.	Urban Arterial
H	Rainbow Creek	Countryside Drive	Concrete Box Culvert - Open Bottom	3.05 x 1.22	Urban Arterial

4.3 Hydraulic Structure Performance Assessment

4.3.1 Hydraulic Structure Sizing Criteria

The hydraulic assessment of the Study Area has considered design criteria from several agencies including, the Region, City, the MTO, and the Ministry of Natural Resources and Forestry (MNRF) as follows.

4.3.1.1 The Region of Peel

No overtopping of the roadway during the Regional Storm Event is to occur at culverts and bridges.

4.3.1.2 City of Brampton

Culverts and bridges under arterial roads must be designed to prevent overtopping during all storm conditions including the Regional Storm.

4.3.1.3 MTO

MTO guidelines for culvert and bridge hydraulic design are based on providing a set freeboard and clearance. Freeboard is measured from the design event water surface elevation to the edge of travelled way. Clearance is measured from the design event water surface elevation to the obvert of the crossing. The design event, freeboard and clearance required consider the road classification and the total structure span. MTO guidelines are summarized in Table 4-3. The existing crossings have been assessed based on the future road classifications which are proposed to be classified as Urban Arterial.

Table 4-3 Standard Road Classification Design Flows for Bridges and Culverts

Functional Road Classification	MTO ¹ Design Flow Return Period (years)		Freeboard Criteria (m) ¹	Clearance Criteria for Bridges (m) ¹	Clearance Criteria for Open-Footing Culverts (m) ^{1,2}
	Total Span less than or equal to 6.0 m	Total Span greater than 6.0 m			
Freeway, Urban Arterial	50	100	1.0	1.0	0.3
Rural Arterial, Collector	25	50	1.0	1.0	0.3
Local	10	25	0.3	0.3	0.3

Note(s)

1. Highway Drainage Design Standard (MTO, January 2008)
2. It is noted that there are no clearance criteria for closed-footing culverts

4.3.1.4 MNRF

The MNRF's guidelines relate to the safe passage of pedestrians and passenger and emergency vehicles across the length of road over which the Regulatory storm event may overtop. Safe passage is determined by overtopping depths, overtopping velocities and consideration for the combined impact (i.e. product of depth and velocity) and represents 'low risk' to the method of transportation (i.e. pedestrian or vehicle). Table 4-4 summarizes the maximum allowable depths and velocities.

Table 4-4 Design Criteria for Pedestrian and Vehicular Access

Access	Maximum Overtopping Depth (m)	Maximum Overtopping Velocity (m/s)	Maximum Product (m ² /s)
Pedestrian	0.3	1.7	0.4
Passenger Vehicle	0.3	3.0	N/A ¹
Emergency Vehicle	0.9	4.5	N/A ¹

Note(s): ¹ Highway Drainage Design Standard (MTO, January 2008)

4.3.2 Existing Conditions

4.3.2.1 Hydraulic Performance Evaluation

All existing roads within the Study Area are proposed to be classified as Urban Arterial in the future and have been assessed on this basis. It is noted that the MNRF criteria are not relevant for the proposed conditions since the travelled way is required to be flood-free for the Regional Storm (ref. Section 4.3.1) as directed by Region of Peel requirements. However, the existing conditions assessment has considered these criteria for information purposes. The criteria for safe passage have been applied assuming ingress/egress for pedestrians.

The results of the hydraulic structure performance assessment are summarized in Tables 4-5 and 4-6. The results indicate that none of the existing Study Area Part B culverts meet both applicable MTO and/or MNRF design criteria and will therefore be considered for upgrade as part of the Preferred Alternative. The HEC-RAS model is provided in Appendix B.

It is also noted that Culvert F, under existing conditions, is a private driveway structure and is not within control of the City or Region; however, it has been included in the current assessment as backwater from the structure contributes to flooding of Clarkway Drive (ref. Section 4.4). As such, upgrade of this structure may be required to meet 'flood-free' criteria for the future arterial roads.

Table 4-5 Existing Culvert Performance - MTO Criteria

Crossing Reference	Capacity Criteria (Frequency in Years)		Required Freeboard (m)	Provided Freeboard (m) ¹	Required Clearance (m)	Provided Clearance (m) ¹	Criteria Achieved?
	Design	Actual					
B	50 Year	100 Year	1.00	0.62	0.30	<0.00	No
C ²	N/A	50 Year	N/A	0.63	N/A	0.53	N/A ²
D	100 Year	5 Year	1.00	<0.00	1.00	<0.00	No
E	100 Year	5 Year	1.00	<0.00	1.00	<0.00	No
F	50 Year	<2 Year	1.00	<0.00	N/A	N/A	No
H	100 Year	5 Year	1.00	<0.00	1.00	<0.00	No

Notes: ¹ Values shown are at the design storm conveyance requirement

² Private structure (existing conditions), backwater influences Clarkway Drive

³ Structure capacity assessed using MTO Nomograph (Design Chart 2.32), ref. Appendix A

Table 4-6 Existing Culvert Performance - MNRF Criteria

Crossing Reference	Ingress/Egress Mode	Overtopping				Maximum Allowable Product (D x V)	Actual Product (D x V)	Criteria Achieved?
		Maximum Allowable Depth (m)	Actual Depth (m)	Maximum Allowable Velocity (m/s)	Actual Velocity (m/s)			
B	Pedestrian	0.30	0.44	1.70	0.91	0.40	0.40	No
C	N/A	N/A	0.61	N/A	1.37	N/A	0.84	N/A
D	Pedestrian	0.30	0.52	1.70	2.14	0.40	1.11	No
E	Pedestrian	0.30	1.43	1.70	2.20	0.40	0.10	No
F	Pedestrian	0.30	0.24	1.70	0.25	0.40	0.06	Yes
H	Pedestrian	0.30	0.23	1.70	2.02	0.40	0.46	No

Notes: ¹ Provided values are for Regulatory event (Regional Storm)

² Culvert performance not assessed against MNRF criteria

4.3.2.2 Existing Conditions Flooding Evaluation

There are existing sections of Clarkway Drive, unassociated with hydraulic crossings, that are predicted to be inundated during various design storm events due to the roadway’s proximity to the Clarkway Tributary. The vertical profile of these sections of Clarkway Drive will need to be raised to elevate the travelled way above the Regional Storm floodplain for ‘flood-free’ access. Table 4-7 summarizes the sections of roadway predicted to be inundated and identifies the frequency of flooding (ref. Figure 4-2).

It is noted that raising the road profile will have impacts on floodplain storage that will need to be mitigated by way of compensatory cut to achieve a net-zero impact, as required by TRCA.

Table 4-7 Existing Roadway Flooding Areas

Roadway Flooding ID	Chainage measured south from the Countryside Drive & Clarkway Drive intersection	Flood Frequency (Storm Event)
F1	490 m to 600 m south	Regional
F2	900 m south	25 Year
F3	1040 m south	Regional
F4	1200 m south	10 Year
F5	1400 m to 1580 m south	Regional

4.3.3 Proposed Conditions

Proposed culvert configurations crossing the Gore Road Tributary and the Clarkway Tributary are summarized in Table 4-8. Additionally, four scenarios incorporating alternate crossing configurations have been evaluated for crossings A and C along the proposed new road, Arterial A2 (E-W arterial), namely:

- **Scenario 1** – Spans are based on an openness ratio of 0.6
- **Scenario 2** – 40 m spans (i.e. the largest single span structures that can be designed as a rigid frame)
- **Scenario 3** – Full span of floodplains
- **Scenario 4** – Spans are based on an openness ratio of 1.0
- **Scenario 5** – 35 m spans (proposed by Candevcon)

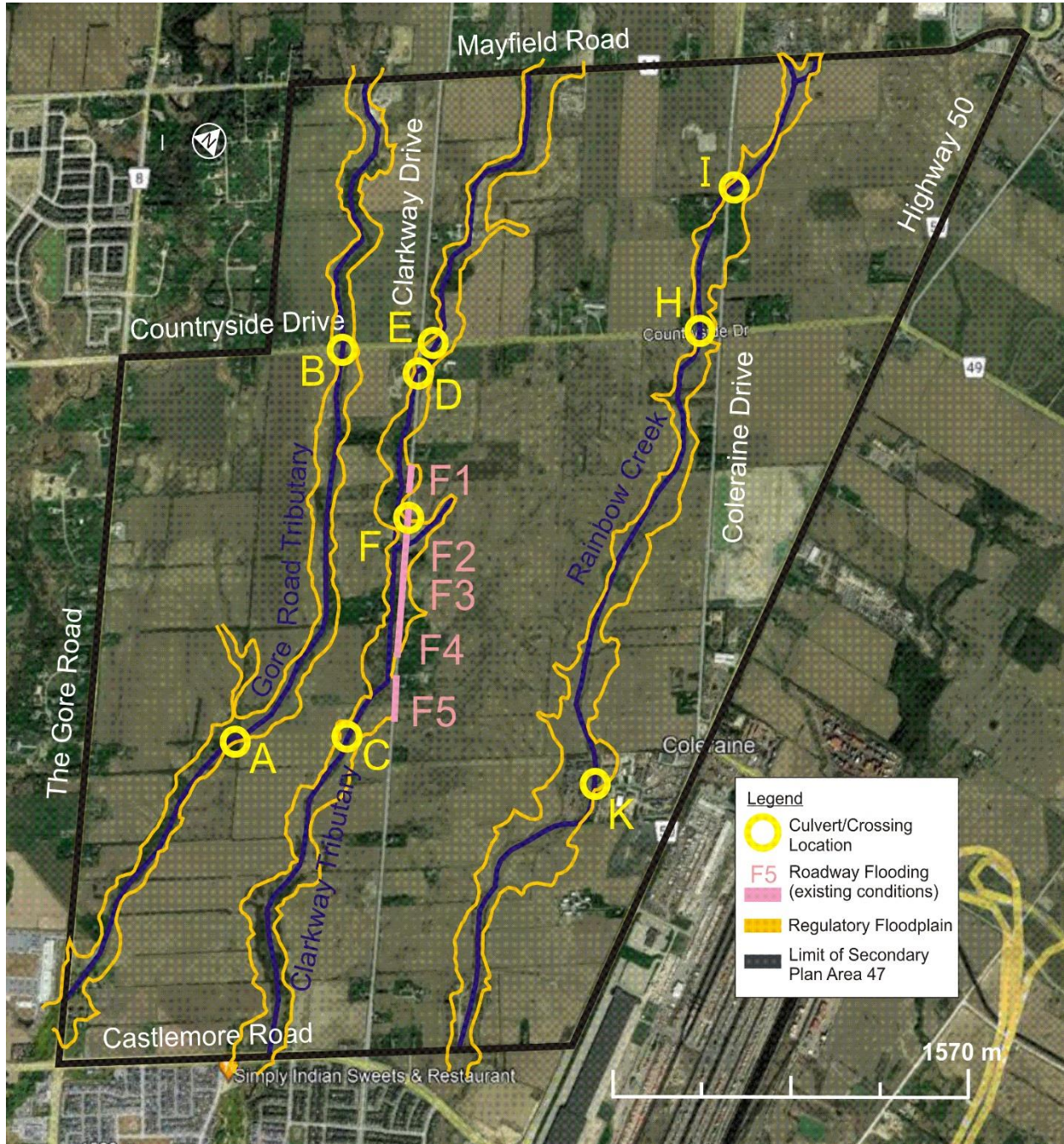


Figure 4-2 Existing Conditions Flooding Evaluation

(background image source Google Earth Pro™)

In the rest of this report, the “Proposed Condition” refers to scenario 5. The evaluations considered a variety of factors related to potential impacts/issues resulting from the implementation of each scenario, as follows:

- **Existing Creek Re-Alignment** – Impacts that the alternative may have on existing creek system, requiring adjustment to the creek alignment. Smaller re-alignment lengths are preferable.
- **Floodplain Encroachment** – Impacts that the alternative may have on the existing floodplain limits, requiring supplementation of lost floodplain storage, recognizing that smaller floodplain encroachment area is preferable.
- **Hydraulic Criteria** – as outlined in Section 4.3.1.

Table 4-8 Proposed Culvert Configurations

Crossing Reference	Watercourse	Road	Span (m)	Rise (m)	Length (m)	Type/Configuration
A	Gore Trib	EW Arterial	35	3	69.41	Bridge
B	Gore Trib	Countryside Drive	6.4	2.13	36	Culvert
C	Clarkway Trib	EW Arterial	35	4	120	Bridge
D	Clarkway Trib	Clarkway Drive	36	4.11	30	Bridge
E	Clarkway Trib	Countryside Drive	40	4.23	36	Bridge
F	Clarkway Trib	Clarkway Drive	1.5	1.5	12	Culvert
H	Rainbow Creek	Countryside Drive	17	2	53	Bridge

4.3.3.1 Hydraulic Performance Evaluation

As outlined in Section 1.0, the future conditions for Part B of the Study Area proposes a new four-lane east-west minor arterial road from The Gore Road to Arterial A2 (E-W arterial); widening of Clarkway Drive from Castlemore Road to E-W Arterial to four lanes and urbanizing Clarkway Drive between E-W arterial and Mayfield Road with possible continuous centre turn lane; and widening of Countryside Drive to four lanes from Clarkway Drive to RR50 including realignment at RR50.

The proposed crossings (ref. Figure 4-1) have been sized using the HEC-RAS models provided by TRCA. The geometry files representing the proposed conditions of the realigned Clarkway Tributary and Gore Road Tributary have been revised, including adjustments to structure coding, as well as the addition, removal, and adjustment to bounding cross sections. Geometries for the added cross sections have been estimated by interpolating between two (2) original cross sections contained in the received model (ref. Appendix B for HEC-RAS model details). The Part B crossings have been sized to meet the criteria outlined under Section 4.3.1 with the proposed configurations outlined in Tables 4-8 and 4-9.

The hydraulic performance of the proposed culverts is summarized in Tables 4-10 and 4-11. The results indicate that the proposed sizes for the crossings within the Study Area satisfy both the MTO and Region design criteria. As previously noted, the MNRF criteria are not relevant for the proposed conditions as the travelled way is required to be flood-free for the Regional Storm (ref. Section 4.3.1). As such, the results for the MNRF criteria have not been presented.

Table 4-9 Proposed Culvert Configurations

Crossing Reference	Watercourse	Road	Span (m)	Rise (m)	Length (m)	Type/Configuration
Scenario 1 - Spans are based on an openness ratio of 0.6						
A	Gore Trib	EW Arterial	13.88	3	69.41	Bridge
C	Clarkway Trib	EW Arterial	26.88	3	120	Bridge
Scenario 2 - 40 m spans						
A	Gore Trib	EW Arterial	40	3	69.41	Bridge
C	Clarkway Trib	EW Arterial	40	3	120	Bridge
Scenario 3 - Full span of floodplains						
A	Gore Trib	EW Arterial	85	3	69.41	Bridge
C	Clarkway Trib	EW Arterial	85	3	120	Bridge
Scenario 4 - Spans are based on an openness ratio of 1.0						
A	Gore Trib	EW Arterial	24	3	69.41	Bridge
C	Clarkway Trib	EW Arterial	45	3	120	Bridge
Scenario 5 - 35 m Spans						
A	Gore Trib	EW Arterial	35	3	69.41	Bridge
C	Clarkway Trib	EW Arterial	35	4	120	Bridge

Table 4-10 Part B Crossings - Proposed Configuration Hydraulic Performance

Crossing Reference	MTO Design Criteria			Hydraulic Performance		
	Design Event (Return Period)	Freeboard (m)	Clearance (m)	Design Event (Return Period)	Freeboard (m)	Clearance (m)
Scenario 1 - Spans are based on an openness ratio of 0.6						
A	100 Year	1.00	0.30	100 Year	2.54 m	1.31 m
C	100 Year	1.00	0.30	100 Year	5.90 m	1.01 m
Scenario 2 - 40 m spans						
A	100 Year	1.00	0.30	100 Year	2.80 m	1.70 m
C	100 Year	1.00	0.30	100 Year	6.60 m	1.20 m
Scenario 3 - Full span of floodplains						
A	100 Year	1.00	0.30	100 Year	2.64 m	1.75 m
C	100 Year	1.00	0.30	100 Year	6.25 m	1.33 m
Scenario 4 - Spans are based on an openness ratio of 1.0						
A	100 Year	1.00	0.30	100 Year	2.71 m	1.49 m
C	100 Year	1.00	0.30	100 Year	6.19 m	1.22 m
Scenario 5 - 35 m Spans						
A	100 Year	1.00	0.30	100 Year	2.53 m	1.64 m
C	100 Year	1.00	0.30	100 Year	5.87 m	2.15 m

Table 4-11 Part B Crossings - Proposed Configuration Hydraulic Performance

Crossing Reference	MTO Design Criteria			Hydraulic Performance		
	Design Event (Return Period)	Freeboard (m)	Clearance (m)	Design Event (Return Period)	Freeboard (m)	Clearance (m)
B	50 Year	1.00	0.30	50 Year	1.38	0.81
D	100 Year	1.00	0.30	100 Year	1.88	1.60
E	100 Year	1.00	0.30	100 Year	2.07	1.31
F	50 Year	1.00	0.30	50 Year	1.29	0
H	100 Year	1.00	0.30	100 Year	1.85	0.39

Tables 4-12 to 4-16 summarize the comparison of existing and proposed conditions along the Gore Road Tributary and the Clarkway Tributary from Castlemore Road to Mayfield Road. It is noted that there are no changes in computed water surface elevations or computed channel velocities between proposed and existing conditions downstream of Old Castlemore Road, where no changes are contemplated as part of the Area 47 development plans.

Between Old Castlemore Road and Mayfield, channel alterations are contemplated, as are new and replaced watercourse crossings at roadways (specifically crossings A, C and D). In the reaches of Gore Road Tributary and Clarkway Tributary, the reconfiguration of the HEC-RAS model to model proposed conditions does not allow direct comparison, section for section, with the existing conditions model, however, the following observations are noted:

- Between Old Castlemore Road and the new structures proposed at Arterial A2, computed water surface elevations for proposed conditions are slightly higher than those computed under existing conditions, for both Regional and 100-year flood conditions. But for both crossings, the rise remains less than 0.2 m.
- Between the new structures proposed at the intersection of Arterial A2 and the new Countryside Drive culvert, computed water surface elevations for proposed conditions are generally higher than those computed under existing conditions, for both Regional and 100-year flood conditions.

4.3.3.2 Proposed Conditions Flooding Evaluation

The potential impacts of changed water surface elevations on the existing flooding risk of adjacent private properties and the land use plans approved as part of Block Plan Areas 47-1 and 47-2 planning process has been assessed. The Block Plans, in part, define the valley corridor within which the floodplain should reside. TRCA has noted that the Block Plans were developed in the 2014 time frame and are based, in part, on floodplain mapping current at that time. TRCA acknowledges that the floodplain mapping for the relevant watercourses has since been updated and has advised this EA that the Block Plans will be updated as development proceeds. As such, any comparison to the current Block Plans is considered qualitative only.

This flood risk assessment is founded on floodplain inundation limits generated using the HEC-RAS RAS-Mapper software. The flood limits are based on existing conditions flood data and the existing Digital Elevation Model (DEM) previously provided to Wood by the City. It should be noted that water surface elevations were plotted without any alterations/modifications in the DEM (therefore representing existing conditions).

Wood is not aware of the exact DEM used by TRCA to delineate their floodplain inundation limits, therefore, the comparisons illustrated on Figures 4-3 through 4-7 are considered qualitative only.

**Table 4-12 The Gore Road Tributary (Reach-1) –
 Comparison of Existing and Proposed Hydraulic Conditions – Regional Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1413.956	Regional	220.29	0.87	220.29	0.87	0	0
1413.794	Regional	219.71	0.57	219.71	0.57	0	0
1413.674	Regional	219.22	0.86	219.22	0.85	0	-0.01
1413.411	Regional	218.4	0.84	218.4	0.85	0	0.01
1413.199	Regional	217.52	1.56	217.55	1.5	0.03	-0.06
1413.003	Regional	216.31	0.95	216.27	1	-0.04	0.05
1412.814	Regional	215.55	1.78	215.65	1.55	0.1	-0.23
1412.603	Regional	215.12	1.57	215.45	1.16	0.33	-0.41
1412.431	Regional	214.63	1.59	215.38	0.84	0.75	-0.75
1412.428	Regional	214.62	1.48	215.2	1.9	0.58	0.42
1412.42	Countryside Drive						
1412.412	Regional	214.28	1.63	214.23	3.53	-0.05	1.9
1412.405	Regional	213.87	1.66	213.79	1.78	-0.08	0.12
1412.236	Regional	213.23	0.96	213.23	0.96	0	0
1411.983	Regional	212.32	0.84	212.32	0.84	0	0
1411.783	Regional	211.6	2.14	211.6	2.14	0	0
1411.583	Regional	210.59	2.35	210.59	2.35	0	0
1411.383	Regional	209.67	1.99	209.67	1.99	0	0
1411.183	Regional	208.72	2.32	208.72	2.32	0	0
1410.983	Regional	207.79	2.27	207.79	2.27	0	0
1410.783	Regional	207.03	1.13	207.03	1.14	0	0.01
1410.583	Regional	205.93	2.54	205.93	2.53	0	-0.01
1410.482	Regional	205.67	0.94	205.67	0.94	0	0
1410.383	Regional	205.15	2.55	205.12	2.66	-0.03	0.11
1410.183	Regional	204.51	2	204.79	1.48	0.28	-0.52
1410.11*	Regional	204.3	1.54	204.59	1.75	0.29	0.21
1410.052	EW Arterial A2						
1410.00*	Regional	203.91	2.15	204	2.63	0.09	0.48
1409.889	Regional	203.21	1.53	203.21	1.53	0	0

**Table 4-13 The Gore Road Tributary (Reach-1) –
 Comparison of Existing and Proposed Hydraulic Conditions – 100-Year Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1413.956	Regional	219.96	0.61	219.96	0.61	0	0
1413.794	Regional	219.44	0.4	219.44	0.4	0	0
1413.674	Regional	218.94	0.71	218.94	0.7	0	-0.01
1413.411	Regional	218.05	0.63	218.05	0.64	0	0.01
1413.199	Regional	217.15	1.33	217.15	1.31	0	-0.02
1413.003	Regional	216.01	0.71	216	0.72	-0.01	0.01
1412.814	Regional	215.09	1.63	215.1	1.6	0.01	-0.03
1412.603	Regional	214.58	1.18	214.54	1.24	-0.04	0.06
1412.431	Regional	214.06	1.33	214.16	1.38	0.1	0.05
1412.428	Regional	214.01	1.51	214.1	1.55	0.09	0.04
1412.42	Countryside Drive						
1412.412	Regional	213.7	2.84	213.67	2.57	-0.03	-0.27
1412.405	Regional	213.65	1.86	213.4	1.45	-0.25	-0.41
1412.236	Regional	212.79	0.77	212.79	0.77	0	0
1411.983	Regional	211.86	0.61	211.86	0.61	0	0
1411.783	Regional	211.17	1.63	211.17	1.63	0	0
1411.583	Regional	210.19	1.76	210.19	1.76	0	0
1411.383	Regional	209.22	1.52	209.22	1.52	0	0
1411.183	Regional	208.32	1.58	208.32	1.57	0	-0.01
1410.983	Regional	207.26	1.98	207.26	1.99	0	0.01
1410.783	Regional	206.62	0.73	206.62	0.73	0	0
1410.583	Regional	205.47	2.45	205.47	2.45	0	0
1410.482	Regional	205.1	0.72	205.11	0.71	0.01	-0.01
1410.383	Regional	204.68	1.73	204.62	1.95	-0.06	0.22
1410.183	Regional	203.91	1.71	203.99	1.44	0.08	-0.27
1410.11*	Regional	203.7	1.08	203.8	1.14	0.1	0.06
1410.052	EW Arterial A2						
1410.00*	Regional	203.42	1.36	203.47	1.47	0.05	0.11
1409.889	Regional	202.57	1.74	202.57	1.74	0	0

**Table 4-14 Clarkway Tributary (Reach-31) –
 Comparison of Existing and Proposed Hydraulic Conditions – Regional Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1511.588	Regional	211.8	2.16	211.74	0.8	-0.06	-1.36
1511.584	Regional	211.81	1.8	211.75	0.92	-0.06	-0.88
1511.577	Private Driveway 4						
1511.572	Regional	211.74	2.05	211.56	1.46	-0.18	-0.59
1511.568	Regional	211.74	2	211.54	0.85	-0.2	-1.15
1511.473	Regional	211.66	0.85	211.45	1	-0.21	0.15
1511.47	Regional	211.64	1.02	211.45	0.77	-0.19	-0.25
1511.465	Private Driveway 3						
1511.459	Regional	211.32	2.64	210.86	1.58	-0.46	-1.06
1511.456	Regional	211.07	3.47	210.51	3.15	-0.56	-0.32
1511.385	Regional	210.58	2.5	210.38	1.3	-0.2	-1.2
1511.185	Regional	210.33	1.56	210.29	0.76	-0.04	-0.8
1511.156	Regional	210.31	0.85	210.25	0.8	-0.06	-0.05
1511.151	Regional	210.23	2.06	210.24	0.99	0.01	-1.07
1511.145	Private Driveway 2						
1511.138	Regional	209.97	1.47	209.44	2.01	-0.53	0.54
1511.13	Regional	209.61	3.57	209.37	2.18	-0.24	-1.39
1510.981	Regional	208.51	2.76	208.28	1.61	-0.23	-1.15
1510.788	Regional	208.19	0.96	207.94	1.59	-0.25	0.63
1510.693	Regional	207.77	3.01	207.55	3.2	-0.22	0.19
1510.589	Regional	207.47	2.68	207.47	0.69	0	-1.99
1510.56	Regional	207.4	2.34	207.44	0.87	0.04	-1.47
1510.556	Regional	207.4	1.79	207.41	1.63	0.01	-0.16
1510.546	Private Driveway 1						
1510.54	Regional	206.98	2.07	207.06	1.91	0.08	-0.16
1510.534	Regional	206.97	1.32	207.05	1.2	0.08	-0.12
1510.386	Regional	206.28	2.55	206.69	1.85	0.41	-0.7
1510.186	Regional	205.48	3.08	206.26	2.58	0.78	-0.5
1510.123	EW Arterial A2						
1510.06*	Regional	205.12	2.32	205.1	4.43	-0.02	2.11
1509.93*	Regional	204.74	2.52	204.73	2.53	-0.01	0.01
1509.863	Regional	204.5	2.76	204.5	2.76	0	0

**Table 4-15 Clarkway Tributary (Reach-31) –
 Comparison of Existing and Proposed Hydraulic Conditions – 100-Year Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1511.588	Regional	211.17	1.15	210.75	0.46	-0.42	-0.69
1511.584	Regional	211.17	1	210.72	1.04	-0.45	0.04
1511.577	Private Driveway 4						
1511.572	Regional	211.15	1.05	210.59	1.32	-0.56	0.27
1511.568	Regional	211.15	1.03	210.61	0.45	-0.54	-0.58
1511.473	Regional	211.12	0.43	210.58	0.46	-0.54	0.03
1511.47	Regional	211.12	0.53	210.58	0.36	-0.54	-0.17
1511.465	Private Driveway 3						
1511.459	Regional	210.17	2.18	209.84	2.55	-0.33	0.37
1511.456	Regional	209.85	3.1	209.77	2.53	-0.08	-0.57
1511.385	Regional	209.87	1.55	209.61	0.67	-0.26	-0.88
1511.185	Regional	209.78	0.78	209.57	0.36	-0.21	-0.42
1511.156	Regional	209.77	0.45	209.57	0.38	-0.2	-0.07
1511.151	Regional	209.75	1.06	209.56	0.47	-0.19	-0.59
1511.145	Private Driveway 2						
1511.138	Regional	209.02	1.94	208.79	3.77	-0.23	1.83
1511.13	Regional	208.64	3.02	208.74	1.16	0.1	-1.86
1510.981	Regional	207.86	2.36	207.63	2.21	-0.23	-0.15
1510.788	Regional	207.42	0.82	207.23	1	-0.19	0.18
1510.693	Regional	207.14	1.83	207.1	1.49	-0.04	-0.34
1510.589	Regional	206.85	2.14	207.05	0.4	0.2	-1.74
1510.56	Regional	206.83	1.61	207.04	0.45	0.21	-1.16
1510.556	Regional	206.83	1.2	206.61	2.68	-0.22	1.48
1510.546	Private Driveway 1						
1510.54	Regional	206.23	3.42	206.2	3.86	-0.03	0.44
1510.534	Regional	206.32	1.26	206.3	1.29	-0.02	0.03
1510.386	Regional	205.54	1.88	205.59	1.76	0.05	-0.12
1510.186	Regional	204.87	2.02	205.06	1.83	0.19	-0.19
1510.123	EW Arterial A2						
1510.06*	Regional	204.36	2.27	204.38	2.89	0.02	0.62
1509.93*	Regional	204.01	1.78	204.01	1.78	0	0
1509.863	Regional	203.84	1.84	203.84	1.84	0	0

**Table 4-16 Clarkway Tributary (Reach-2) –
 Comparison of Existing and Proposed Hydraulic Conditions – Regional Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1513.456	100-year	218.68	3.35	218.68	3.35	0	0
1513.385	100-year	218.65	1.17	218.66	1.17	0.01	0
1513.185	100-year	217.38	3.07	217.36	3.13	-0.02	0.06
1512.981	100-year	216.74	1.25	216.9	1.09	0.16	-0.16
1512.786	100-year	215.84	3.3	216.57	2.03	0.73	-1.27
1512.589	100-year	215.5	1	216.52	1.03	1.02	0.03
1512.515	100-year	215.47	1.05	216.51	0.97	1.04	-0.08
1512.512	100-year	215.43	1.69	216.49	1.19	1.06	-0.5
1512.505	Countryside Drive						
1512.494	100-year	214.65	4.12	216.32	2.14	1.67	-1.98
1512.488	100-year	214.45	3.41	215.47	4.67	1.02	1.26
1512.371	100-year	214.22	0.76	215.26	1.59	1.04	0.83
1512.364	100-year	214.2	0.91	214.96	2.89	0.76	1.98
1512.356	Clarkway Drive						
1512.345	100-year	214.14	1.55	214.04	4.12	-0.1	2.57
1512.34	100-year	214.14	1.33	214.08	1.99	-0.06	0.66
1512.182	100-year	213.9	1.32	213.79	1.25	-0.11	-0.07
1511.983	100-year	213.08	1.63	212.89	1.92	-0.19	0.29
1511.898	100-year	212.74	1.31	212.61	1.03	-0.13	-0.28
1511.787	100-year	212.08	1.92	212.12	1.85	0.04	-0.07
1511.723	100-year	211.91	0.94	211.97	0.89	0.06	-0.05

**Table 4-17 Clarkway Tributary (Reach-2) –
 Comparison of Existing and Proposed Hydraulic Conditions – 100-Year Flood Event**

HEC-RAS Section	Profile	Existing Conditions		Proposed Conditions		Change in	
		W. S. Elev (m) A	Vel Chnl (m/s) B	W. S. Elev (m) C	Vel Chnl (m/s) D	W. S. Elev (m) =C-A	Vel Chnl (m/s) =D-B
1513.456	100-year	218.17	2.58	218.17	2.58	0	0
1513.385	100-year	217.97	1.13	217.98	1.12	0.01	-0.01
1513.185	100-year	216.88	2.06	216.87	2.08	-0.01	0.02
1512.981	100-year	216.14	1.12	216.17	1.07	0.03	-0.05
1512.786	100-year	215.25	2.62	215.17	2.89	-0.08	0.27
1512.589	100-year	215.04	0.66	215.12	1	0.08	0.34
1512.515	100-year	215.03	0.6	215.11	0.88	0.08	0.28
1512.512	100-year	215.01	1.08	215.1	0.91	0.09	-0.17
1512.505	Countryside Drive						
1512.494	100-year	214.15	3.33	214.88	1.55	0.73	-1.78
1512.488	100-year	213.94	2.46	214.48	2.92	0.54	0.46
1512.371	100-year	213.73	0.47	213.89	2.52	0.16	2.05
1512.364	100-year	213.64	1.35	213.92	2.03	0.28	0.68
1512.356	Clarkway Drive						
1512.345	100-year	213.45	1.88	213.04	3.44	-0.41	1.56
1512.34	100-year	213.45	1.34	213.26	1.7	-0.19	0.36
1512.182	100-year	213.16	1.08	212.98	0.86	-0.18	-0.22
1511.983	100-year	212.28	1.3	212.12	1.62	-0.16	0.32
1511.898	100-year	211.96	0.94	211.85	0.76	-0.11	-0.18
1511.787	100-year	211.31	1.61	211.2	1.9	-0.11	0.29
1511.723	100-year	211.21	0.57	210.91	0.83	-0.3	0.26

Table 4-18 describes the four scenarios which have been evaluated with reference to floodplain comparison illustration figures and assessment outcomes. Based on ESRI Areal Imagery in ArcGIS Pro, none of the scenarios that are presented here represent a significant increased flood risk to private properties meaning, no structure/building that was located outside of the current TRCA floodplain would be located within the floodplain under any of the scenarios, however, a detailed comparison with approved Block Plans will be warranted when they are available. Notwithstanding, Scenario 3 (i.e., full span of floodplains) was found to have the least impact to the upstream computed water surface elevations and spatial extent of the floodplain. Detailed tables with water surface elevations comparisons are provided in Tables 4-14 and 4-15 in the preceding section.

Table 4-18 Proposed Conditions Flood Evaluation Summary

Scenario	Reference Figure	Outcome
1	4-3	The resultant computed water surface elevations are approximately 1 to 2 m higher than existing TRCA floodplain conditions. As a result, the Regional Storm floodplain is significantly larger in comparison to the existing TRCA floodplain just upstream of crossings.
2	4-4	The resultant computed water surface elevations are higher by less than 1 m at Crossing A and less than 1.12 m at Crossing B. As a result, the Regional Storm floodplain is somewhat larger in comparison to the existing TRCA floodplain just upstream of crossings.
3	4-5	The resultant computed water surface elevations are essentially unchanged (less than 0.01 m) at Crossing A and less than 0.17 m higher at Crossing B. As a result, the Regional Storm floodplain is only marginally changed in comparison to the existing TRCA floodplain just upstream of crossings.
4	4-6	The resultant computed water surface elevations are higher by less than 0.70 m at Crossing A and less than 0.56 m at Crossing B. As a result, the Regional Storm floodplain is somewhat larger in comparison to the existing TRCA floodplain just upstream of crossings.
5	4-7	The resultant computed water surface elevations are higher by less than 0.29 m at Crossing A and less than 0.57 m at Crossing B. As a result, the Regional Storm floodplain is somewhat larger in comparison to the existing TRCA floodplain just upstream of crossings.

4.3.3.3 Preferred Crossing Sizing Scenario

As noted previously, the determination of a preferred crossings (A and C) scenario has been based on consideration of several factors related to potential impacts and/or issues resulting from the implementation of each scenario, namely requirements for watercourse re-alignment, floodplain impacts and hydraulic performance criteria (ref. Table 4-19).

In consideration of the evaluation criteria and information available to this assessment, Scenario 5 has been deemed to best meet the hydraulic criteria. Optimization of the design and associated cost may result in loss of developable lands to accommodate a larger floodplain.

4.3.3.4 Cut/Fill Evaluation

A cut/fill evaluation was performed for Clarkway Tributary-Reach 31 for creek alignment. This creek re-alignment is required to accommodate the proposed 30m right-of-way for Clarkway Drive. Cut/fill totals for HEC-RAS sections are listed in Table 4-20. Figure 4-7 illustrates an example of cut/fill for a HEC-RAS section. The results along the reach are near balanced with 41,533 m³ of fill and 43,425 m³ of cut resulting in an excess cut of 1,892 m³.

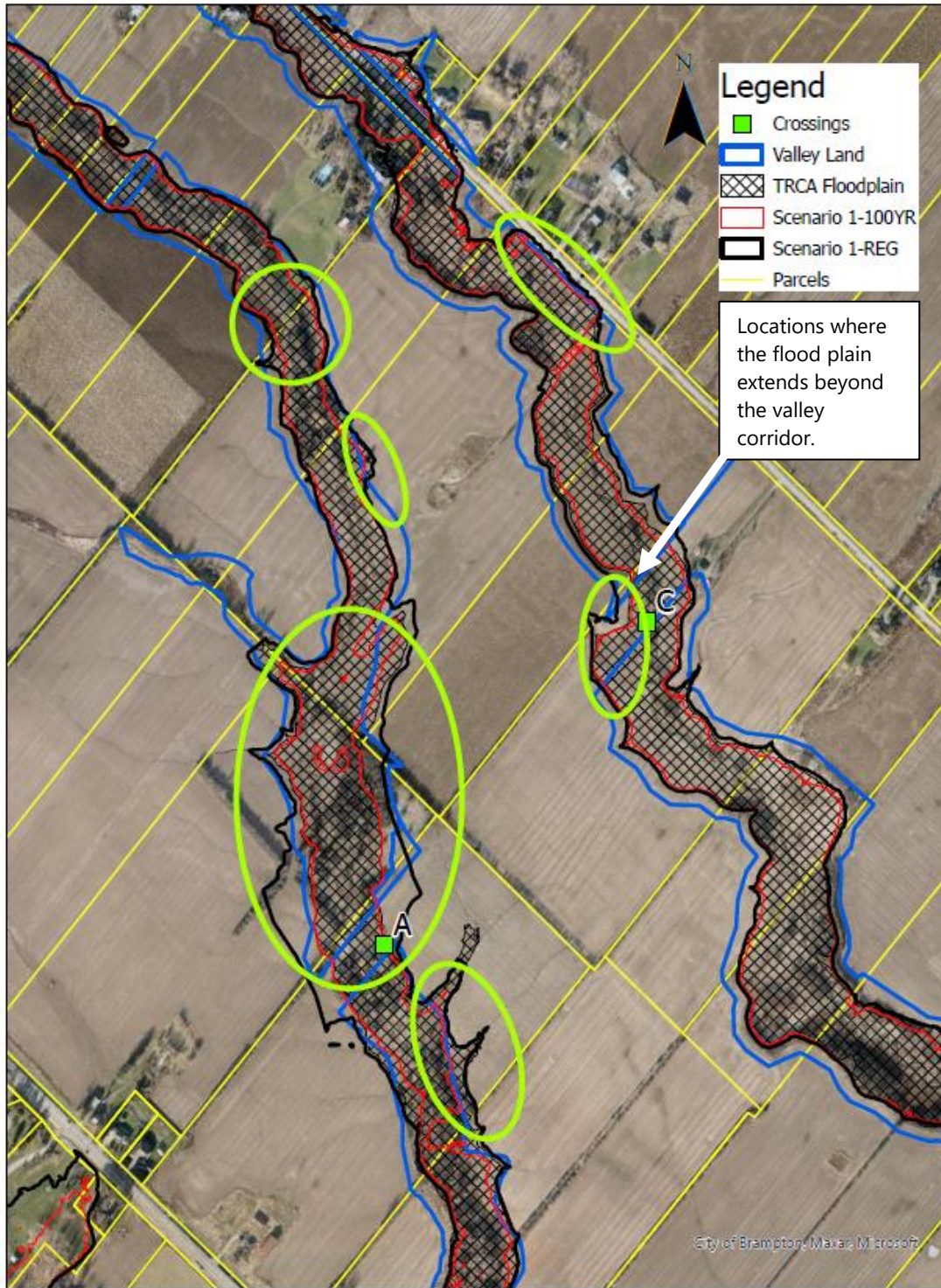


Figure 4-3 Scenario 1 and Existing Valley Land Comparison

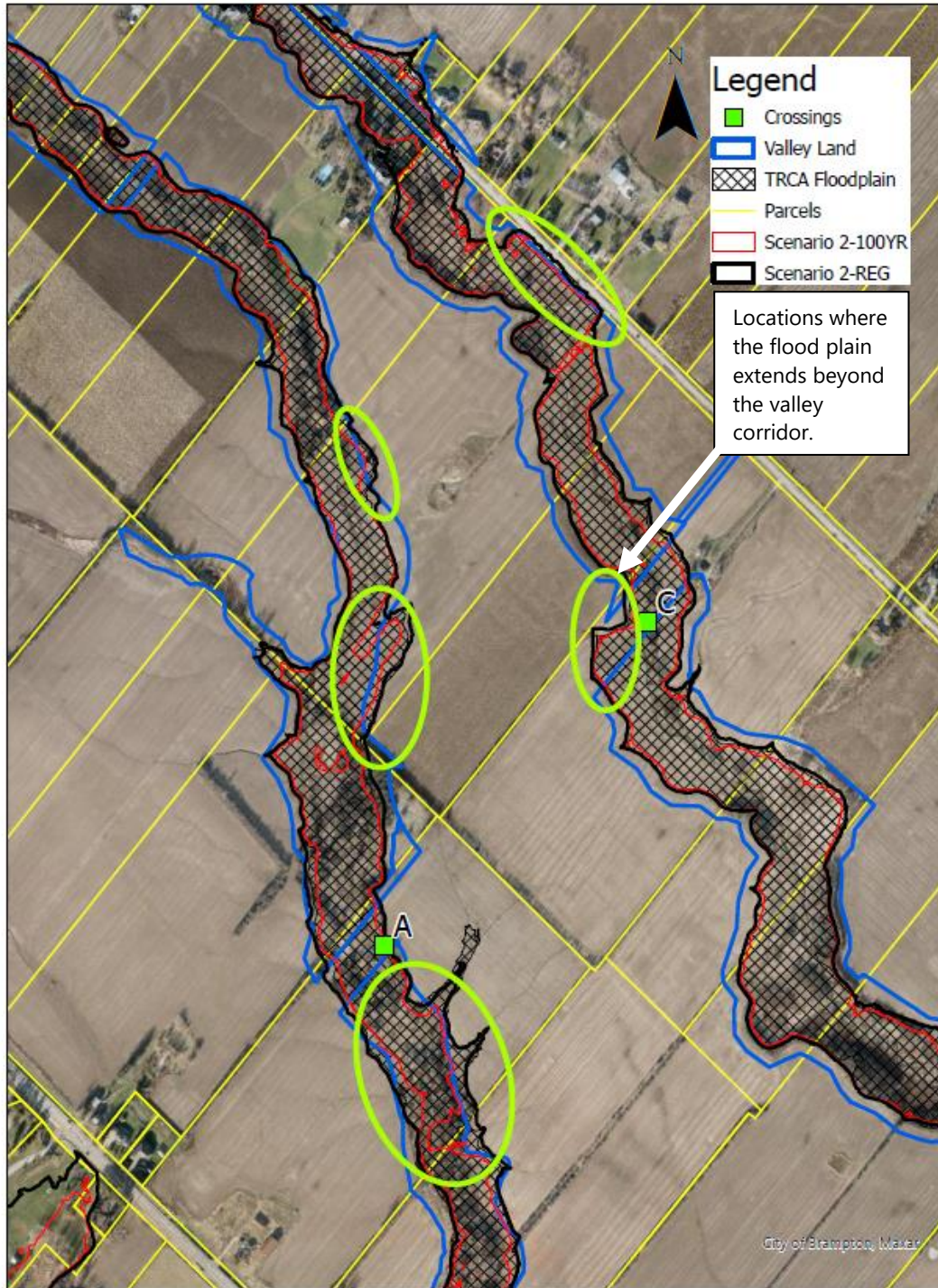


Figure 4-4 Scenario 2 and Existing Valley Land Comparison

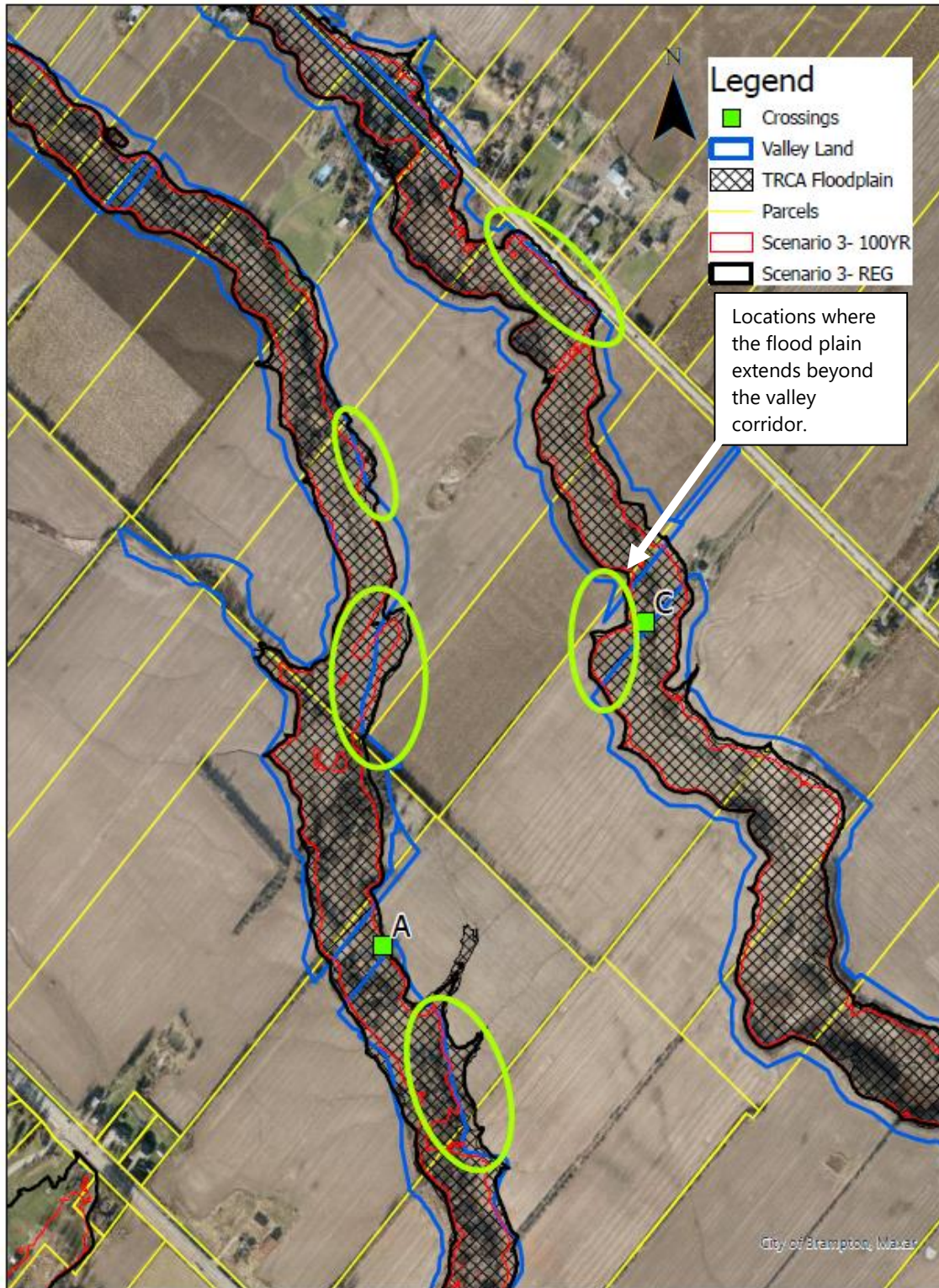


Figure 4-5 Scenario 3 and Existing Valley Land Comparison

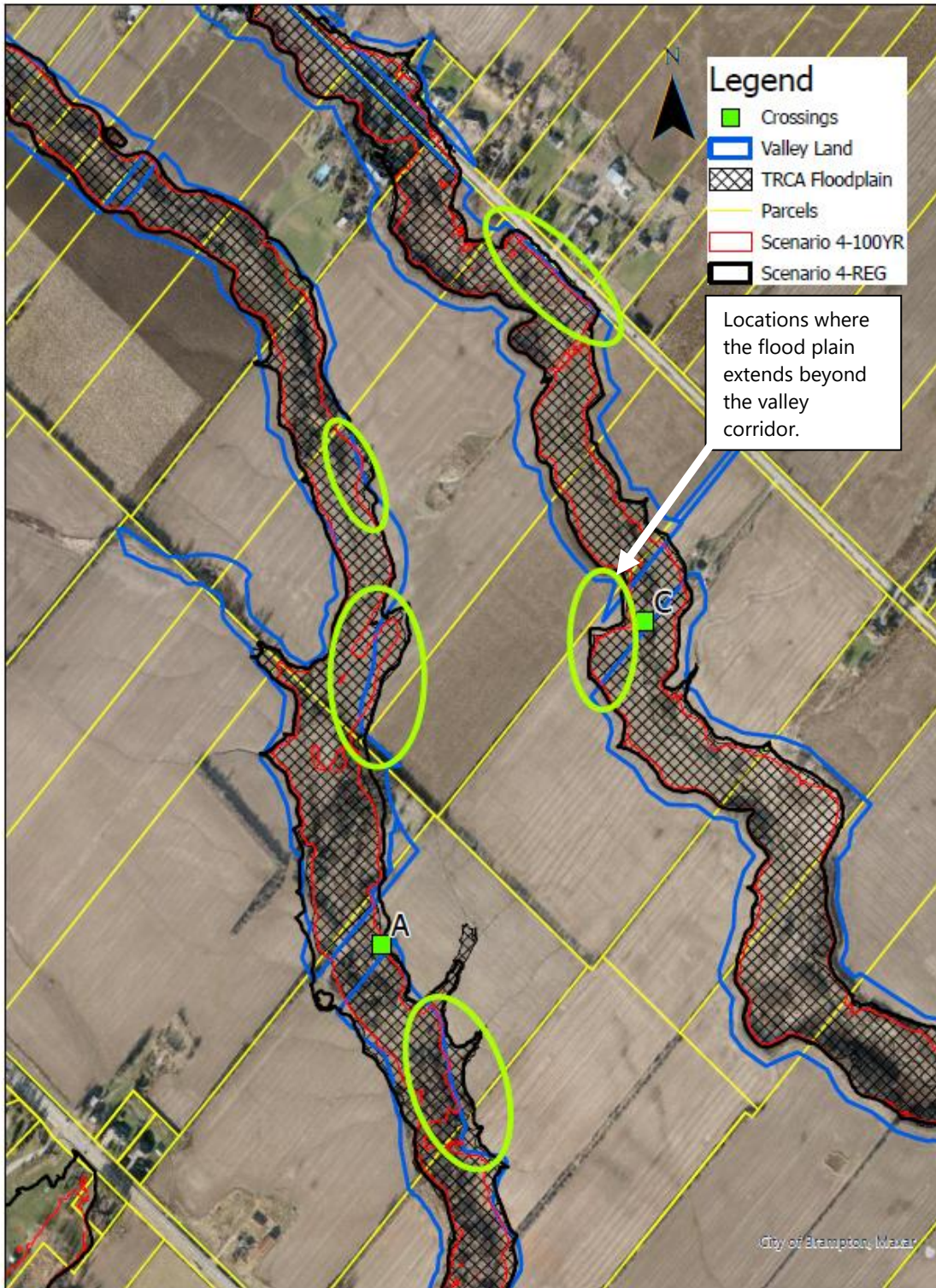


Figure 4-6 Scenario 4 and Existing Valley Land Comparison

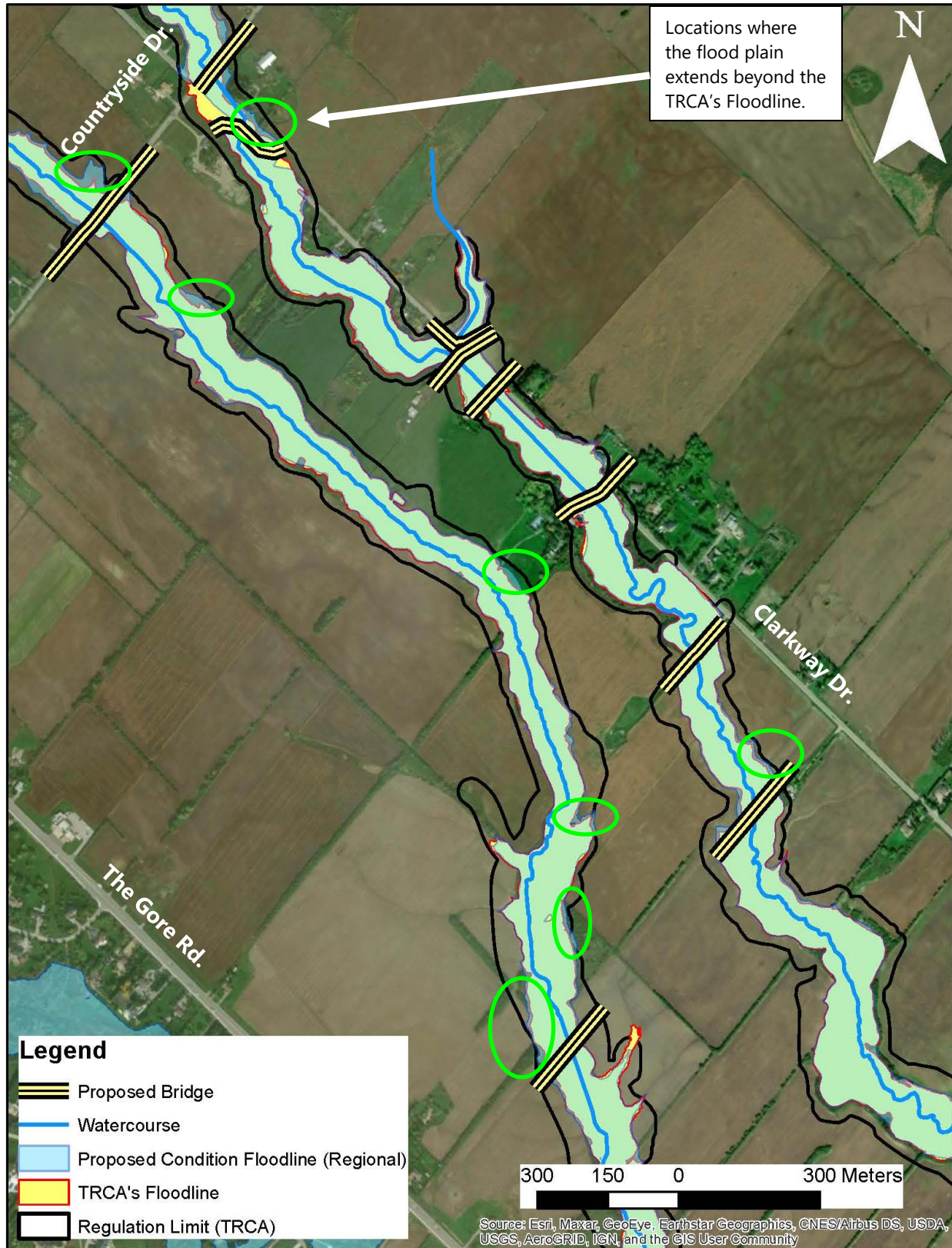


Figure 4-7 Final Proposed Condition Floodline Map (Scenario 5)

Table 4-19 Crossing Configurations Evaluations

Scenario	Basis	Need for Creek Re-Alignment	Floodplain Impacts	Hydraulic Performance (MTO Criteria)
1	Spans are based on an openness ratio of 0.6	Yes	High	Met
2	40 m spans (i.e. the largest single span structures that can be designed as a rigid frame)	Yes	Medium	Met
3	Full span of floodplains	Yes	Low	Met
4	Spans are based on an openness ratio of 1.0	Yes	Medium	Met
5	35 m spans	Yes	Medium	Met

Table 4-20 Cut/Fill Totals

HEC-RAS Section	Volume (m ³)		
	Fill A	Cut B	Change in Cut/Fill = A-B
1510.556	127	147	-20
1510.56	64	66	-2
1510.589	529	573	-44
1510.693	2,549	2,423	126
1510.788	2,582	2,648	-66
1511.13	15,339	16,520	-1,181
1511.138	408	471	-63
1511.151	886	940	-54
1511.156	1,287	1,065	221
1511.185	1,433	1,801	-368
1511.385	5,583	4,790	793
1511.456	2,528	2,567	-39
1511.459	147	186	-39
1511.47	1,160	1,514	-354
1511.473	221	160	61
1511.568	5,962	6,725	-763
1511.572	195	212	-17
1511.584	469	547	-78
1511.588	66	72	-6
Totals	41,533	43,425	-1,892

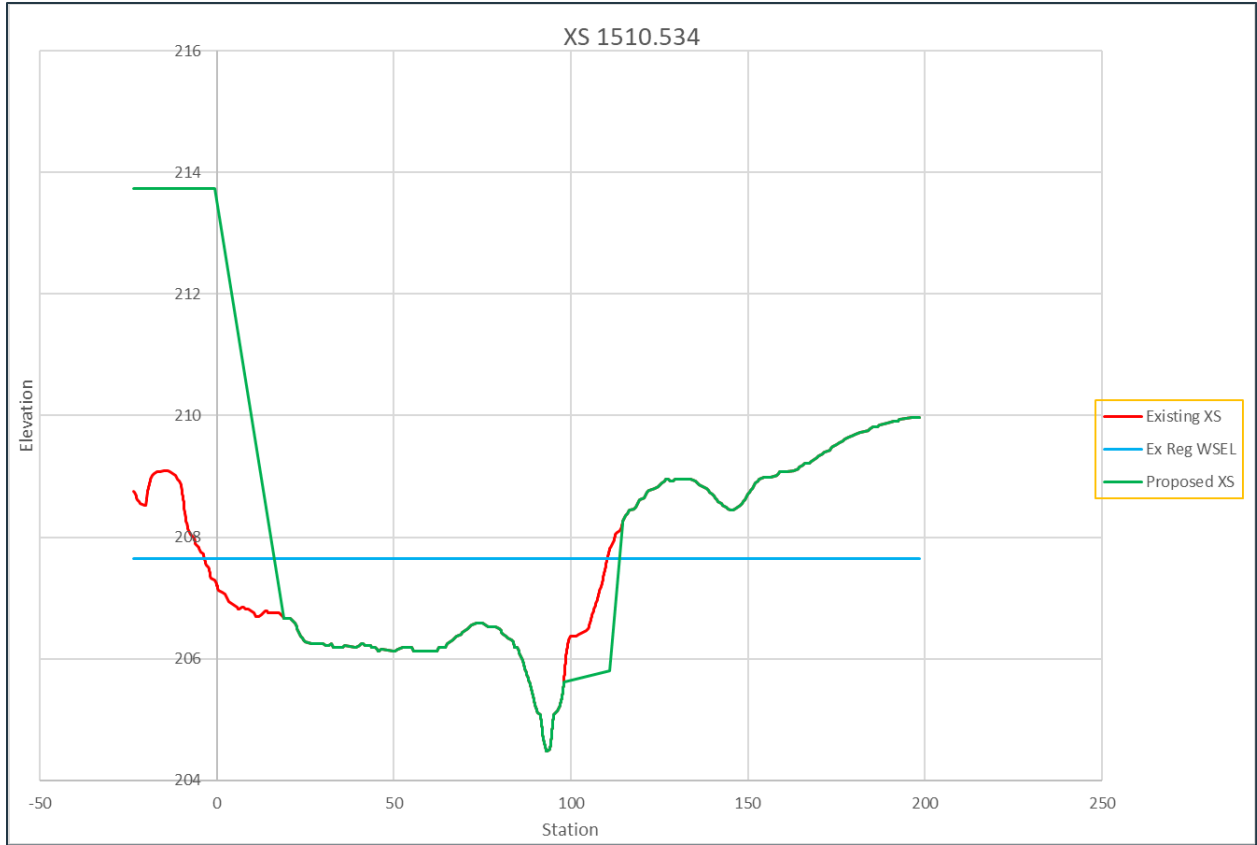


Figure 4-8 HEC-RAS section showing a cut/fill example

5.0 SUMMARY AND RECOMMENDATIONS

The following conclusions and recommendations stem from the foregoing hydrologic and hydraulic assessments for the Part B right-of-ways.

5.1 Summary

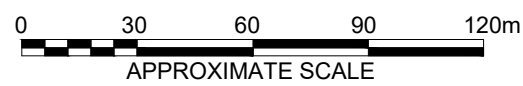
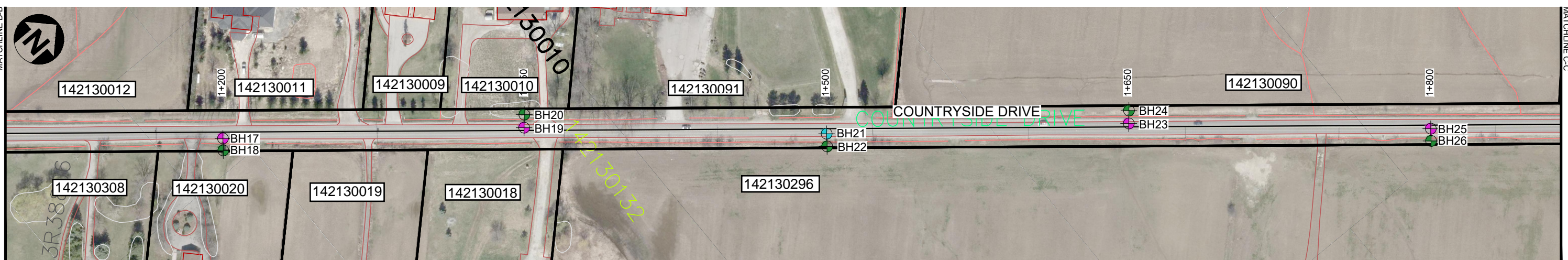
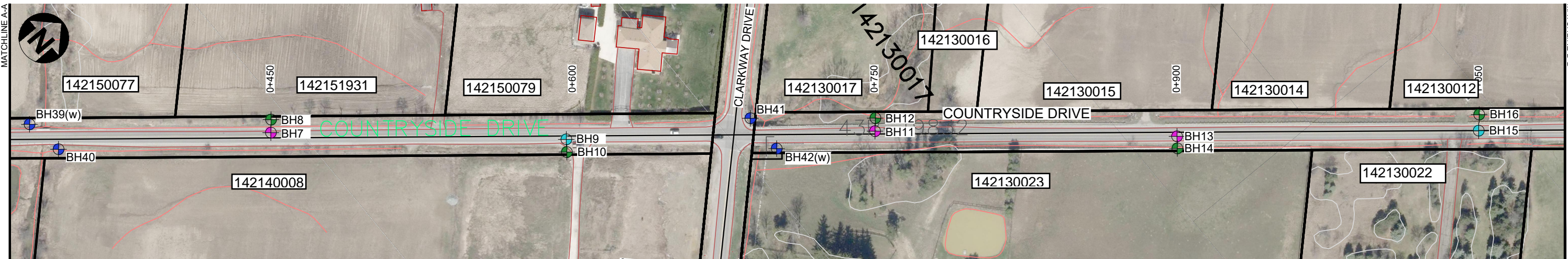
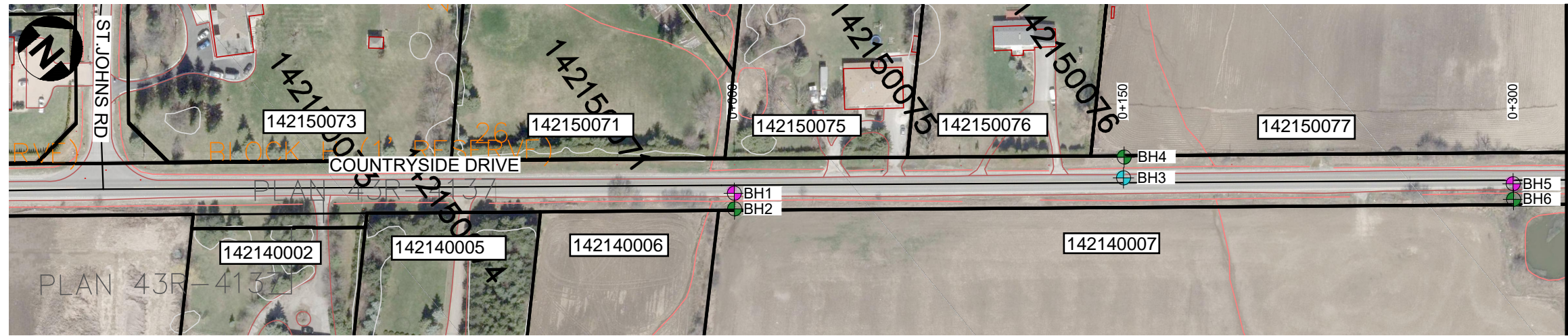
1. The right-of-ways are required to control the runoff from the 90th percentile storm event, as per the Region of Peel road reconstruction criteria.
2. Based on available borehole logs and groundwater information, the runoff from the 90th percentile storm event can be controlled via on-site retention by implementing Low-Impact Development Best Management Practices within the right-of-way.
3. The existing crossing of Clarkway Drive (F) does not meet the applicable Ministry of Transportation criteria for conveyance, and the applicable Regional Peel criteria for conveyance.
4. The proposed crossings of Countryside Drive (B and E) and Clarkway Drive (D) have been sized to meet the applicable Ministry of Transportation criteria for freeboard and conveyance, and the applicable Region of Peel criteria for conveyance.
5. The new proposed crossings of EW Arterial have been sized to meet the applicable Ministry of Transportation criteria for freeboard, clearance, and conveyance, and the applicable Region of Peel criteria for conveyance.
6. A comparison of computed water surface elevations and computed channel velocities under existing and proposed conditions, indicates that changes are expected, within Area 47.
7. A flood risk assessment of alternate crossing configurations has been completed. It has been noted that the underlying Block Plans defining the valley corridor are out of date regarding flood, but will be revised through the land development process. The assessment noted locations where the proposed floodplain extended outside of the valley corridor. However, the comparisons documented for this assessment are consider qualitative only.
8. A cut/fill assessment was completed for Clarkway Tributary-Reach 31 for creek alignment.

5.2 Recommendations

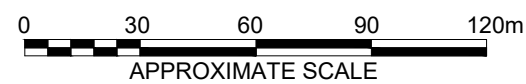
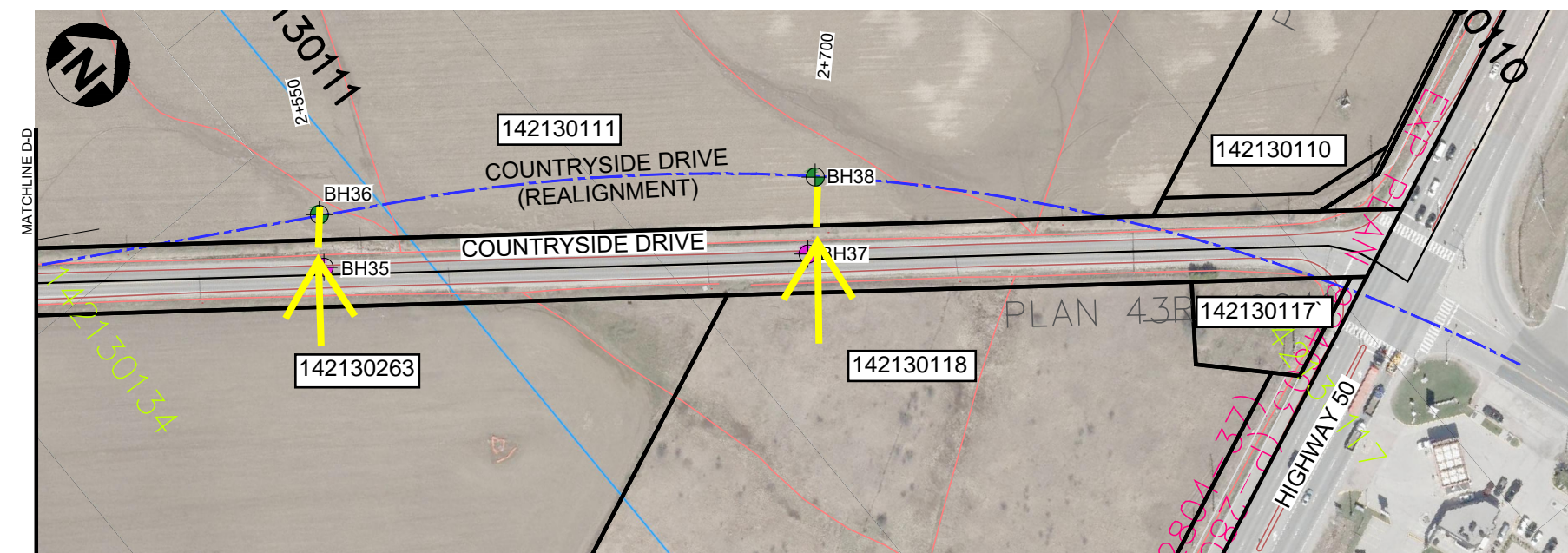
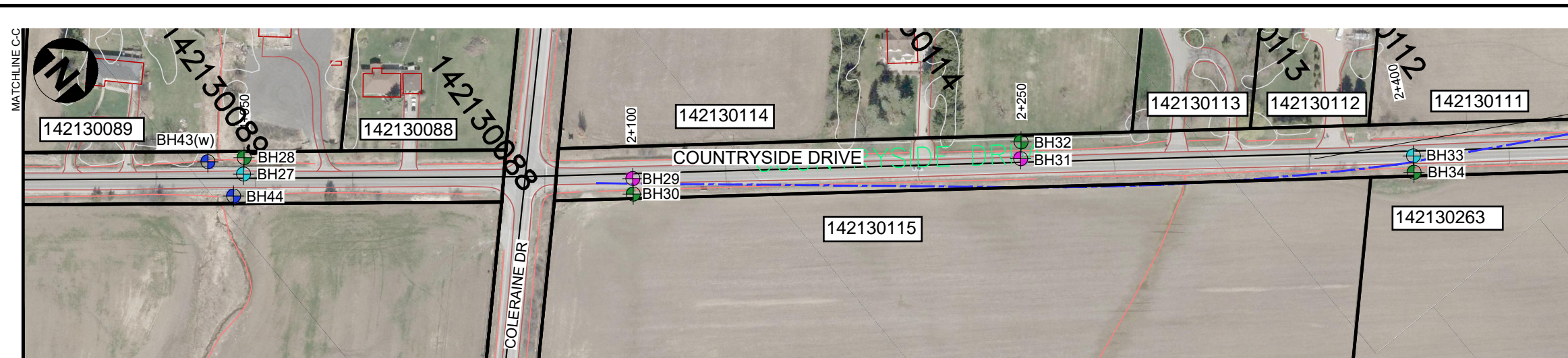
1. Wood understands that multi-lateral discussions are underway but have yet not reached conclusion at the time of writing of this report. As a result, if there are any changes in the road profiles those will need to be updated to reflect correctly in the hydrologic-hydraulic modeling components and resultant calculations.
2. Considering the impacts on the floodplain and water surface elevations, Wood recommends that the bridge spans for the crossings A and C across EW Arterial be set to 35 m.
3. It is recommended that Gore Road Tributary and Clarkway Tributary Creek alterations for the reach from EW Arterial to Mayfield Road be designed to achieve a near zero change in computed results between existing and proposed conditions.

Appendix A: Background Information

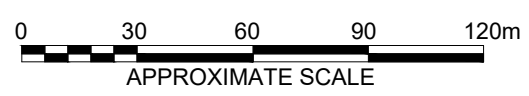
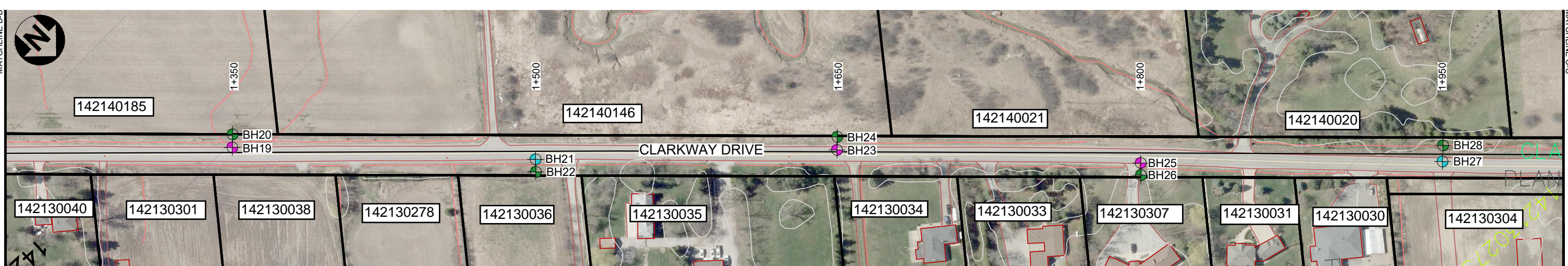
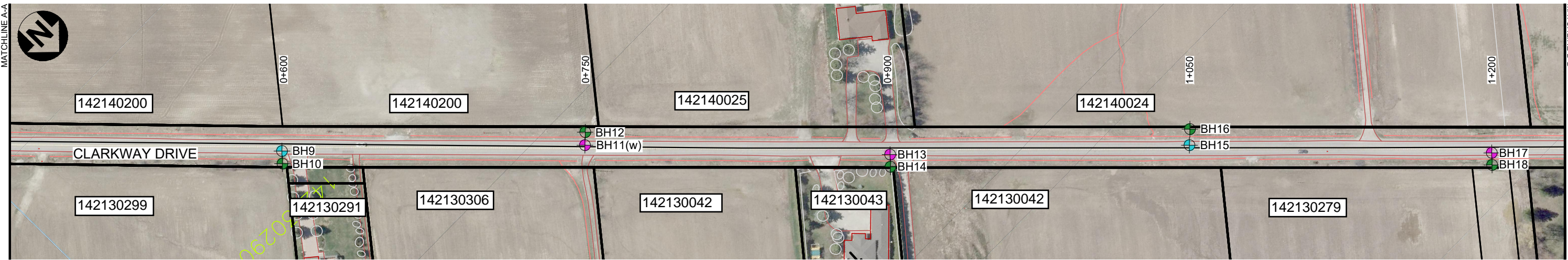
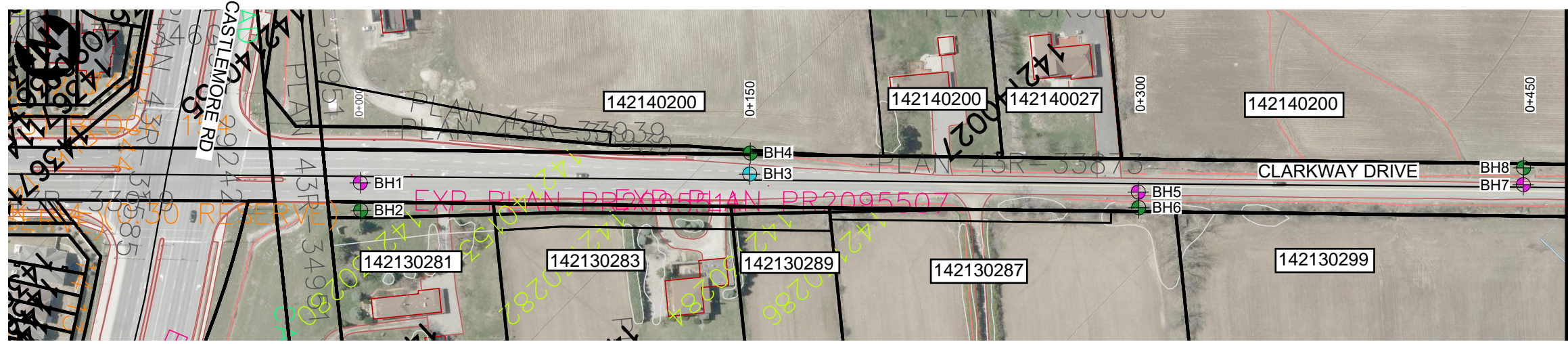
Appendix A: Background Information



LEGEND 	CLIENT LOGO 	CLIENT: THE CORPORATION OF THE CITY OF BRAMPTON Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited 50 Vogell Road, Units 3 & 4, Richmond Hill, Ontario, L4B 3K6	KW	TITLE SITE AND BOREHOLE LOCATION PLAN (COUNTRYSIDE DRIVE)	DATE: JUNE 2019
			CHK'D BY: SM		PROJECT GEOTECHNICAL INVESTIGATIONS ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 17) CITY OF BRAMPTON, ONTARIO
			DATUM: NAD83		RFQ NO: 2015-016
			PROJECTION: UTM Zone 17T		FIGURE No. 1A
			SCALE: AS SHOWN		



LEGEND BOREHOLE LOCATION (MDL/EP - depth 1.5m) BOREHOLE LOCATION (SHR/TOS - depth 1.5m) BOREHOLE LOCATION (MDL/EP - depth 3m to 5m) BOREHOLE LOCATION (depth 10m) MONITORING WELL LOCATIONS	CLIENT LOGO 	CLIENT: THE CORPORATION OF THE CITY OF BRAMPTON		KW	TITLE SITE AND BOREHOLE LOCATION PLAN (COUNTRYSIDE DRIVE)	DATE: JUNE 2019
		 Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited 50 Vogell Road, Units 3 & 4, Richmond Hill, Ontario, L4B 3K6		CHK'D BY: SM		PROJECT GEOTECHNICAL INVESTIGATIONS ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 17) CITY OF BRAMPTON, ONTARIO
				DATUM: NAD83		RFQ NO: 2015-016
				PROJECTION: UTM Zone 17T		FIGURE No. 1B
				SCALE: AS SHOWN		



LEGEND	
	BOREHOLE LOCATION (MDL/EP - depth 1.5m)
	BOREHOLE LOCATION (SHR/TOS - depth 1.5m)
	BOREHOLE LOCATION (MDL/EP - depth 3m to 5m)
	BOREHOLE LOCATION (depth 10m)
	MONITORING WELL LOCATIONS



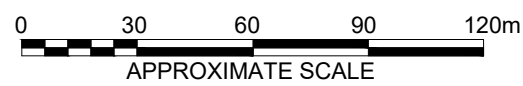
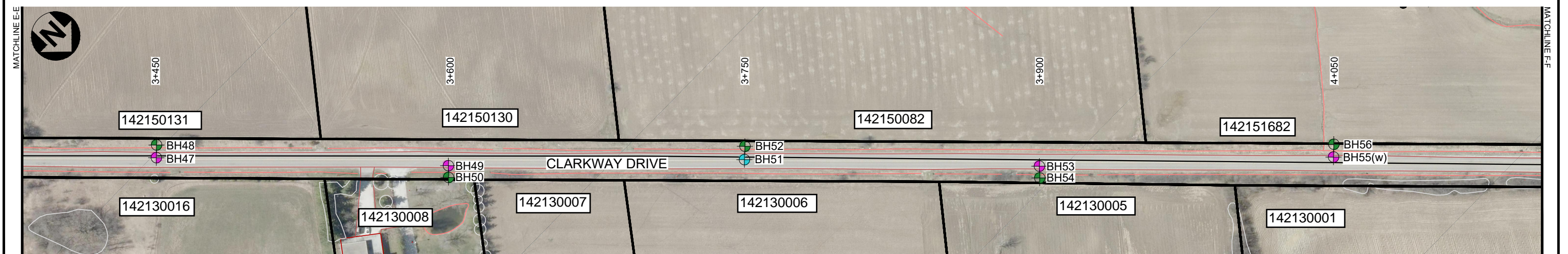
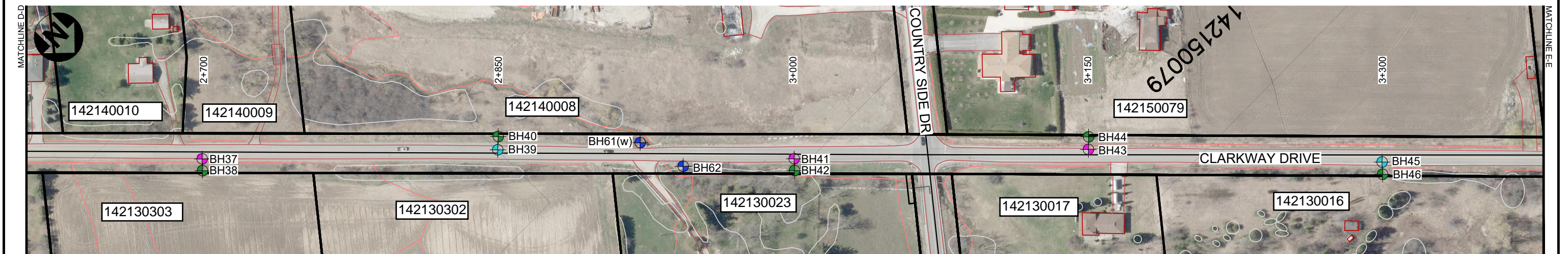
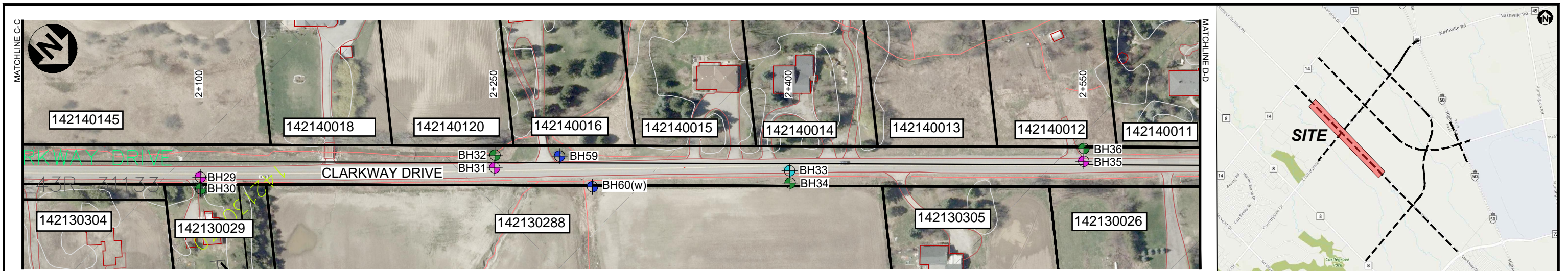
CLIENT:
THE CORPORATION OF THE CITY OF BRAMPTON
 Wood Environment & Infrastructure Solutions,
 a Division of Wood Canada Limited
 50 Vogell Road, Units 3 & 4, Richmond Hill, Ontario, L4B 3K6



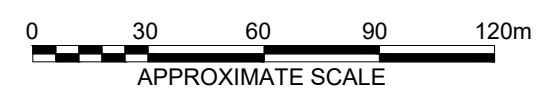
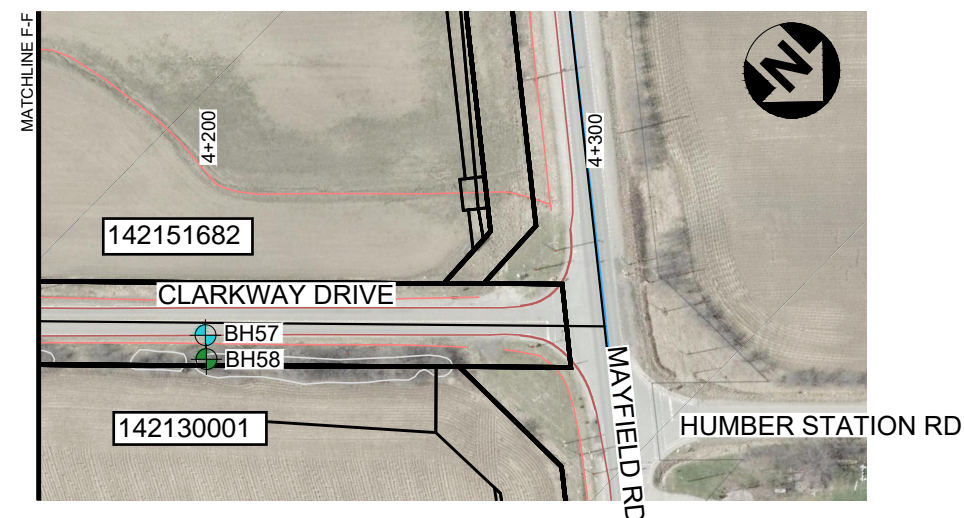
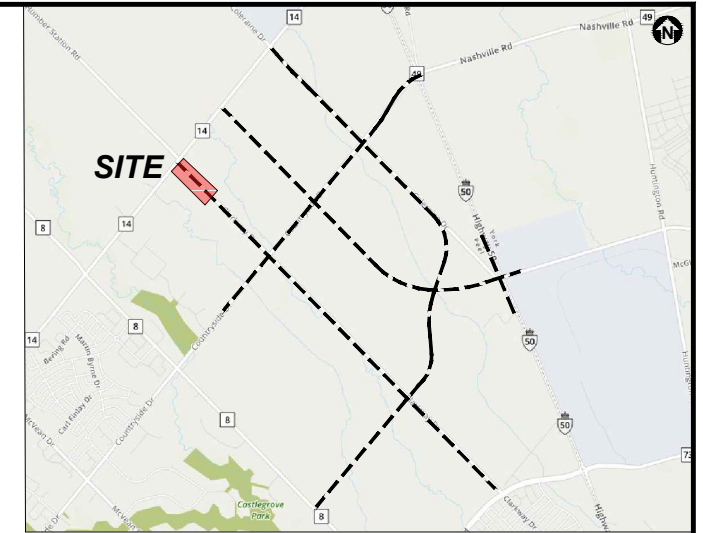
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 CHK'D BY: SM
 DATUM: NAD83
 PROJECTION: UTM Zone 17T
 SCALE: AS SHOWN

TITLE
**SITE AND BOREHOLE LOCATION PLAN
 (CLARKWAY DRIVE)**
 PROJECT
**GEOTECHNICAL INVESTIGATIONS
 ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN
 AREA (AREA 17)
 CITY OF BRAMPTON, ONTARIO**

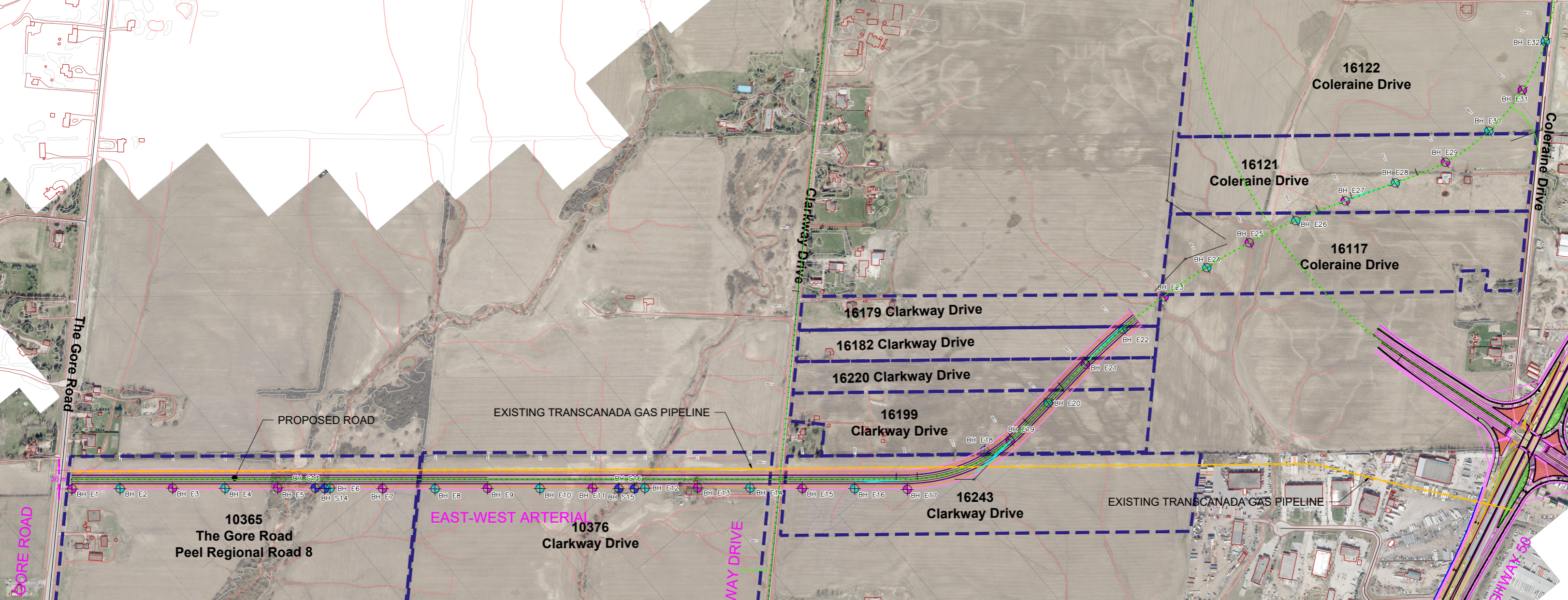
DATE: JUNE 2019
 PROJECT NO: TP115068
 RFQ NO: 2015-016
 FIGURE No. 1A



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			CHK'D BY: SM		PROJECT GEOTECHNICAL INVESTIGATIONS ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 17) CITY OF BRAMPTON, ONTARIO
			DATUM: NAD83	RFQ NO: 2015-016	FIGURE No. 1B
			PROJECTION: UTM Zone 17T		
			SCALE: AS SHOWN		



LEGEND BOREHOLE LOCATION (MDL/EP - depth 1.5m) BOREHOLE LOCATION (SHR/TOS - depth 1.5m) BOREHOLE LOCATION (MDL/EP - depth 3m to 5m) BOREHOLE LOCATION (depth 10m) MONITORING WELL LOCATIONS	CLIENT LOGO 	CLIENT: THE CORPORATION OF THE CITY OF BRAMPTON		KW CHK'D BY: SM	TITLE SITE AND BOREHOLE LOCATION PLAN (CLARKWAY DRIVE)	DATE: JUNE 2019
			Wood Environment & Infrastructure Solutions, a Division of Wood Canada Limited 50 Vogell Road, Units 3 & 4, Richmond Hill, Ontario, L4B 3K6	DATUM: NAD83 PROJECTION: UTM Zone 17T SCALE: AS SHOWN		PROJECT GEOTECHNICAL INVESTIGATIONS ARTERIAL ROADS WITHIN HIGHWAY 427 INDUSTRIAL SECONDARY PLAN AREA (AREA 17) CITY OF BRAMPTON, ONTARIO



16122 Coleraine Drive

16121 Coleraine Drive

16117 Coleraine Drive

16179 Clarkway Drive

16182 Clarkway Drive

16220 Clarkway Drive

16199 Clarkway Drive

16243 Clarkway Drive

10365 The Gore Road
Peel Regional Road 8

10376 Clarkway Drive

PROPOSED ROAD

EXISTING TRANSCANADA GAS PIPELINE

EXISTING TRANSCANADA GAS PIPELINE

EAST-WEST ARTERIAL

WAY DRIVE

The Gore Road

Clarkway Drive

Coleraine Drive

GORE ROAD

WAY DRIVE

BH E1

BH E2

BH E3

BH E4

BH E5

BH E6

BH E7

BH E8

BH E9

BH E10

BH E11

BH E12

BH E13

BH E14

BH E15

BH E16

BH E17

BH E18

BH E19

BH E20

BH E21

BH E22

BH E23

BH E24

BH E25

BH E26

BH E27

BH E28

BH E29

BH E30

BH E31

BH E32

BH S13

BH S14

BH S15

BH S16

RECORD OF BOREHOLE No. BH C1



Project Number: TP115086 Drilling Location: Countryside Drive E:603645 N:4852294 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 25, 2020 Date Completed: Mar 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 215.8 m about 100 mm ASPHALT brown Sand and Gravel FILL moist					215.7 0.1					
	SS	1	83	12						
214.9 0.9 grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics					214					
	SS	2	92	8						
	SS	3	100	8						
213.6 2.2 brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders hard					214					
	SS	4	100	40						
212.8 3.0 END OF BOREHOLE					213					

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 Richmond Hill, Ontario, L4B 3K6
 Canada
 Tel. No.: (905) 415-2632
 www.woodplc.com

∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH C2**



Project Number: **TP115086** Drilling Location: **Countryside Drive E:603646 N:4852295** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 25, 2020** Date Completed: **Mar 25, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)					
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading								
								○ SPT □ PPT ● DCPT	○ MTO Vane* △ Intact ▲ Remould	○ Nilcon Vane* ◇ Intact ◆ Remould	▲ COV (LEL) ■ TOV (LEL)	△ COV (ppm) □ TOV (ppm)	100 200 300 400	2 4 6 8	W _p W W _L	Plastic Liquid	20 40 60 80	GR SA SI CL
	Geodetic Ground Surface Elevation: 215.1 m																	
	brown Sand and Gravel FILL moist	SS	1	75	6													
	214.5																	
	0.6 dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	100	7	1	214											
	213.2																	
	213.2																	
	END OF BOREHOLE																	
	1.8																	

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 Richmond Hill, Ontario, L4B 3K6
 Canada
 Tel. No.: (905) 415-2632
 www.woodplc.com

∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 53
 Page: 1 of 1

RECORD OF BOREHOLE No. **BH C3**



Project Number: **TP115086** Drilling Location: **Countryside Drive E:603738 N:4852420** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 25, 2020** Date Completed: **Mar 25, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Soil Vapour Reading						
								Penetration Testing		COV (LEL)		TOV (LEL)		COV (ppm)
Geodetic Ground Surface Elevation: 216.5 m about 90 mm ASPHALT 216.4 brown Sand and Gravel FILL 216.2 moist 0.3 dark brown / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics 215.6 brown 0.9 SILTY CLAY / CLAYEY SILT TILL trace sand, trace gravel stiff 215.0 END OF BOREHOLE 1.5														
		SS	1	83	5		216							
		SS	2	100	9		1							
							215							

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 Richmond Hill, Ontario, L4B 3K6
 Canada
 Tel. No.: (905) 415-2632
 www.woodplc.com

∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 53
 Page: 1 of 1

RECORD OF BOREHOLE No. BH C5



Project Number: TP115086 Drilling Location: Countryside Drive E:603831 N:4852531 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 25, 2020 Date Completed: Mar 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 214.6 m										
	about 100 mm ASPHALT					214.5				
	brown Sand and Gravel FILL moist	SS	1	83	30	214.0	○	■		
	dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	100	38	213.8	○	■		
	brown SILTY CLAY / CLAYEY SILT TILL trace to sandy, trace gravel hard	SS	3	83	46	213.1	○	■		
	grey	SS	4	100	82	212.0	○	■		
		SS	5	100	69	211.0	○	■		
		SS	6	79	52	210.0	○	■		
		SS	7	100	55 / 150mm	209.7	○	■		
	END OF BOREHOLE					209.7				

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▽ Groundwater encountered on completion of drilling on 3/25/2020 at a depth of: 3.0 m. ■ Cave in depth after removal of augers: 4.0 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH C6



Project Number: TP115086 Drilling Location: Countryside Drive E:603832 N:4852529 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 25, 2020 Date Completed: Mar 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Lithology Plot Geodetic Ground Surface Elevation: 214.6 m	brown Sand and Gravel FILL moist 214.0	SS	1	83	11	214	○	■		
	brown Silty Clay / Clayey Silt FILL trace sand, trace to some gravel 213.4	SS	2	88	34	213.4	○	■		
	brown SILTY CLAY / CLAYEY SILT TILL trace to sandy, trace gravel hard 213.0	SS	3	100	75	75	○	■		
END OF BOREHOLE 1.7										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH C7**



Project Number: **TP115086** Drilling Location: **Countryside Drive E:603917 N:4852640** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 25, 2020** Date Completed: **Mar 25, 2020** Revision No.: **0, 8/14/20**

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)	
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	MTO Vane*	Nilcon Vane*	Soil Vapour Reading	COV (LEL)	TOV (LEL)	COV (ppm)			TOV (ppm)
	Geodetic Ground Surface Elevation: 216.5 m																	
	about 100 mm ASPHALT	216.4																
	brown Sand and Gravel FILL moist	215.9	SS	1	50	15		216	○									
	dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel	215.5						1										
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard	213.5	SS	2	100	16		215	○									
			SS	3	100	28		2	○									
	grey							214	○									
	END OF BOREHOLE	213.5	SS	4	100	32		3	○									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH C8**



Project Number: **TP115086** Drilling Location: **Countryside Drive E:603915 N:4852650** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 25, 2020** Date Completed: **Mar 25, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading						
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)	W _p	W
Geodetic Ground Surface Elevation: 216.6 m														GR SA SI CL		
	brown Sand and Gravel FILL moist	SS	1	42	9		216.0	○								
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard	SS	2	100	22	1	216.0	○								
		SS	3	58	49		214.8	○								
	END OF BOREHOLE						214.8									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.





Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH C9



Project Number: TP115086 Drilling Location: Countryside Drive E:604016 N:4852761 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 25, 2020 Date Completed: Mar 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 218.3 m										
	about 110 mm ASPHALT					218.2				
	brown Sand and Gravel FILL					217.9				
	moist dark grey / brown Silty Clay / Clayey Silt FILL	SS	1	83	10	217.4				
	trace sand, trace gravel, trace organics brown SILTY CLAY / CLAYEY SILT TILL	SS	2	100	20	216.8				
	trace to some sand, trace gravel very stiff					216.8				
	END OF BOREHOLE					215.3				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C11



Project Number: TP115086 Drilling Location: Countryside Drive E:604113 N:4852893 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 215.2 m										
	about 120 mm ASPHALT					215.0				
	brown Sand and Gravel FILL	SS	1	83	21	214.4	○	■		
	moist									
	dark grey / grey Silty Clay / Clayey Silt FILL	SS	2	100	18	214.4	○	■		
	trace sand, trace to some gravel, trace organics									
	SS	3	92	7		213.6	○	■		
	212.9									
brown / brownish grey SILTY CLAY / CLAYEY SILT TILL	SS	4	100	17	212.9	○	■			
trace to some sand, trace gravel very stiff to hard										
SS	5	100	29		212.1	○	■			
grey										
SS	6	83	22		211.3	○	■			
SS	7	83	34		210.5	○	■			
210.0										
END OF BOREHOLE						210.0				

▽ Groundwater encountered on completion of drilling on 3/27/2020 at a depth of: 4.9 m.

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RECORD OF BOREHOLE No. BH C12



Project Number: TP115086 Drilling Location: Countryside Drive E:604113 N:4852900 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 25, 2020 Date Completed: Mar 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 213.6 m about 100 mm TOPSOIL brown Sand and Gravel FILL moist	SS	1	75	6		213				
dark brown / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	100	6		1				
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C13



Project Number: TP115086 Drilling Location: Countryside Drive E:604197 N:4852992 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Geodetic Ground Surface Elevation: 219.0 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	Nilcon Vane* ◇ Intact ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL)	△ COV (ppm) □ TOV (ppm)	W _p	W _L		
	about 140 mm ASPHALT	218.9															
	brown	0.1															
	Sand and Gravel FILL	218.5															
	moist	0.6															
	dark brown / brown		SS	1	83	11											
	Silty Clay / Clayey Silt FILL	218.1															
	trace sand, trace gravel, trace organics																
	brown/grey	0.9					1	218									
	SILTY CLAY / CLAYEY SILT TILL		SS	2	100	17											
	trace to some sand, trace gravel																
	very stiff to hard		SS	3	100	23	2	217									
			SS	4	100	30											
	END OF BOREHOLE	215.9					3	216									
		3.0															

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH C15



Project Number: TP115086 Drilling Location: Countryside Drive E:604285 N:4853111 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)	COV (ppm)	TOV (ppm)		
	Geodetic Ground Surface Elevation: 219.7 m															
	about 130 mm ASPHALT	219.6														
	brown Sand and Gravel FILL	0.1 219.2														
	moist dark grey / brown Silty Clay / Clayey Silt FILL	0.5 218.8	SS	1	100	16	219									
	trace sand, trace to some gravel, trace organic brown SILTY CLAY / CLAYEY SILT TILL	0.9 218.2	SS	2	100	8	1									
	trace to some sand, trace gravel firm END OF BOREHOLE	1.5														

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∇ No freestanding groundwater measured in open borehole on completion of drilling.









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RECORD OF BOREHOLE No. BH C17



Project Number: TP115086 Drilling Location: Countryside Drive E:604386 N:4853230 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) △ COV (ppm) □ TOV (ppm)		
Geodetic Ground Surface Elevation: 219.9 m												
	about 130 mm ASPHALT					219.8						
	brown					0.1						
	Sand and Gravel FILL					219.5						
	moist					0.7						
	dark brown / brown Silty Clay / Clayey Silt FILL	SS	1	100	11	219.0	○	■				
	trace sand, trace gravel, trace organics					0.9						
	brown / brownish grey SILTY CLAY / CLAYEY SILT TILL	SS	2	88	14	218.0	○	■				
	trace to some sand, trace gravel very stiff to hard					1						
		SS	3	100	24	217.0	○	■				
						2						
		SS	4	100	41	216.0	○	■				
						3						
		SS	5	100	30	215.0	○	■				
						4						
	grey	SS	6	50	14	214.0	○	■				
						5						
	END OF BOREHOLE					214.9						
						5.0						

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH C18



Project Number: TP115086 Drilling Location: Countryside Drive E:604388 N:4853229 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Apr 1, 2020 Date Completed: Apr 1, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Soil Vapour Reading						
								Penetration Testing		COV (LEL)		TOV (LEL)		COV (ppm)
								O SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	2 4 6 8 100 200 300 400 W _p W W _L Plastic Liquid 20 40 60 80					
	Geodetic Ground Surface Elevation: 219.9 m brown Sand and Gravel FILL moist	SS	1	88	5		219.3							
	0.6 brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel stiff to very stiff	SS	2	100	12		219							
	218.1	SS	3	100	19									
	END OF BOREHOLE						1.8							

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C20



Project Number: TP115086 Drilling Location: Countryside Drive E:604492 N:4853362 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Apr 1, 2020 Date Completed: Apr 1, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Lithology Plot Geodetic Ground Surface Elevation: 220.2 m brown Sand and Gravel FILL moist 219.8	SS	1	100	16	220	○				
dark grey / brown Silty Clay / Clayey Silt FILL trace sand, trace to some gravel, trace organics 0.5 219.0	SS	2	67	11	1	○				
END OF BOREHOLE 1.2 Borehole was terminated due to the close proximity of existing watermain										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C21



Project Number: TP115086 Drilling Location: Countryside Drive E:604570 N:4853458 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	W _p	W _L		
	Geodetic Ground Surface Elevation: 221.3 m													
	about 200 mm ASPHALT	221.1					221							
	brown	0.2												
	Sand and Gravel FILL	220.8												
	moist	0.5												
	dark grey / brown		SS	1	100	9								
	Silty Clay / Clayey Silt FILL	220.4												
	trace sand, trace gravel, trace organics	0.9												
	brown		SS	2	100	14	1							
	SILTY CLAY / CLAYEY SILT TILL	219.7												
	trace to some sand, trace gravel													
	stiff	1.5												
	END OF BOREHOLE													

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C23



Project Number: TP115086 Drilling Location: Countryside Drive E:604645 N:4853563 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 27, 2020 Date Completed: Mar 27, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 221.3 m										
about 150 mm ASPHALT						221.2				
brown						0.1				
Sand and Gravel FILL						220.7				
moist						0.6				
dark grey	SS	1	100		16	220.4	○	■		
Silty Clay / Clayey Silt FILL						0.9				
trace sand, trace gravel, trace organics						220.4				
brown / brownish grey	SS	2	100		8	220.1	○	■		
SILTY CLAY / CLAYEY SILT TILL						0.9				
trace to some sand, trace gravel, cobbles/boulders						220.1				
very stiff to hard	SS	3	100		23	219.8	○	■		
						219.4				
	SS	4	100		41	219.1	○	■		
						218.7				
	SS	5	100		44	218.4	○	■		
						218.0				
	SS	6	100		30	217.7	○	■		
						217.3				
grey	SS	7	100		18	217.0	○	■		
						216.6				
END OF BOREHOLE						216.1				
						5.2				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C24



Project Number: TP115086 Drilling Location: Countryside Drive E:604647 N:4853568 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Apr 1, 2020 Date Completed: Apr 1, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)						
Geodetic Ground Surface Elevation: 220.9 m										
	brown Sand and Gravel FILL moist	SS	1	67	5					
	220.3									
	dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	100	15	1				
	219.7									
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders stiff to very stiff	SS	3	58	22					
	219.1									
	END OF BOREHOLE									
	1.8									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH C25**



Project Number: **TP115086** Drilling Location: **Countryside Drive E:604747 N:4853682** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 27, 2020** Date Completed: **Mar 27, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 220.9 m										
about 150 mm ASPHALT brown Sand and Gravel FILL moist										
220.7 0.1 220.3										
dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	1	100	11		220	○	■		
0.6 219.9 0.4 brown / brownish grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel stiff to hard	SS	2	100	14	1		○	■		
	SS	3	100	25	2	219	○	■		
	SS	4	100	46	3	218	○	■		
217.8 3.0 END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH C27 / BH S7**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:604850** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4853816 150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 26, 2020** Date Completed: **Mar 26, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing	Soil Vapour Reading	COV (ppm)		
Geodetic Ground Surface Elevation: 217.8 m												
about 130 mm ASPHALT brown					217.6	0.1						
Sand and Gravel FILL trace to some silt moist	SS	1	83	17	217							
dark brown / dark grey Silty Clay / Clayey Silt FILL some sand, trace to some gravel, trace organics	SS	2	100	11	216.9	0.9						
	SS	3	100	13	216							
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders hard	SS	4	21	40	215.6	2.2						
	SS	5	100	59	215							
	SS	6	50	62 / 150mm	214							
	SS	7	100	55 / 150mm	213							
					212							
grey	SS	8	25	67	211							
					210							
	SS	9	100	44	209							
					208.0							
END OF BOREHOLE					9.8							

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∇ Groundwater encountered on completion of drilling on 3/26/2020 at a depth of: 2.7 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH C27 / BH S7**



Project Number: **TP115086**

Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)**

Project Location: **Countryside Drive, Brampton, Ontario**

Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)		
	50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 5.5 m Sand Filter: 5.5 - 6.1 m Screen: 6.1							Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) 2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400 W _p W W _L Plastic Liquid 20 40 60 80				GR SA SI CL

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C29



Project Number: TP115086 Drilling Location: Countryside Drive E:604945 N:4853935 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 221.4 m										
about 150 mm ASPHALT 221.2										
brown 220.1										
Sand and Gravel FILL 0.3										
dark grey / grey Silty Clay / Clayey Silt FILL 18										
trace sand, trace gravel, trace organics										
220										
brown 219.9										
SILTY CLAY / CLAYEY SILT TILL 11										
trace to some sand, trace gravel hard										
1.5										
219										
SS 4 100 55 / 150mm										
218										
SS 5 100 50 / 100mm										
217										
grey										
SS 6 100 50 / 100mm										
216.5										
SS 7 100 74 / 150mm										
4.9										
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH C30



Project Number: TP115086 Drilling Location: Countryside Drive E:604944 N:4853931 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 221.0 m										
Lithology Plot	brown Sand and Gravel FILL moist	SS	1	83	10					
	220.7 0.3 dark grey / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	100	19	1	220			
	219.8 1.2 brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff	SS	3	25	17					
	219.2 1.8 END OF BOREHOLE									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH C31



Project Number: TP115086 Drilling Location: Countryside Drive E:605023 N:4854046 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL)		COV (ppm) □ TOV (ppm)			
	Geodetic Ground Surface Elevation: 221.7 m																
	about 150 mm ASPHALT	221.6															
	brown Sand and Gravel FILL moist	221.1															
	dark grey / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	220.2	SS	1	83	11	1	221	○			○	○				
	brown SILTY CLAY / CLAYEY SILT TILL trace to sandy, trace gravel hard	220.2	SS	2	100	9	1	221	○			○	○				
		220.2					2	220	○			○	○				
		218.7	SS	3	100	38	2	220	○			○	○				
		218.7					3	219	○			○	○				
	END OF BOREHOLE	3.0															

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▽ Groundwater encountered on completion of drilling on 3/19/2020 at a depth of: 1.5 m. ■ Cave in depth after removal of augers: 2.7 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C32



Project Number: TP115086 Drilling Location: Countryside Drive E:605023 N:4854047 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)	
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading				
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)
Geodetic Ground Surface Elevation: 221.7 m														
	brown Sand and Gravel FILL moist 221.1	SS	1	50	8		221	○						
	dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics 220.5	SS	2	100	13		221	○						
	brown SILTY CLAY / CLAYEY SILT TILL trace to sandy, trace gravel hard 219.8	SS	3	100	33		220	○						
	END OF BOREHOLE 1.8													

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C33



Project Number: TP115086 Drilling Location: Countryside Drive E:605131 N:4854170 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 221.8 m										
 about 100 mm ASPHALT					221.7					
 Sand and Gravel FILL					221.3					
 Silty Clay / Clayey Silt FILL	SS	1	83	12	220.9					
 SILTY CLAY / CLAYEY SILT TILL	SS	2	100	22	220.2					
END OF BOREHOLE					1.5					

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C35



Project Number: TP115086 Drilling Location: Countryside Drive E:605211 N:4854296 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 220.6 m										
	about 100 mm ASPHALT					220.5				
	brown					0.1				
	Sand and Gravel FILL					220.2				
	moist					0.5				
	dark grey / brown Silty Clay / Clayey Silt FILL	SS	1	100	10	220	○			
	trace sand, trace gravel									
	brownish grey SILTY CLAY / CLAYEY SILT TILL	SS	2	100	45	1	○			
	trace to some sand, trace gravel hard									
	END OF BOREHOLE					1.5				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH C37



Project Number: TP115086 Drilling Location: Countryside Drive E:605295 N:4854406 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Countryside Drive, Brampton, Ontario Date Started: Mar 19, 2020 Date Completed: Mar 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)						
Geodetic Ground Surface Elevation: 220.0 m										
	about 90 mm ASPHALT									
	brown Sand and Gravel FILL									
	moist brown Silty Clay / Clayey Silt FILL	SS	1	100	16					
	trace sand, trace gravel brown SILTY CLAY / CLAYEY SILT TILL	SS	2	83	47	1	219			
	hard									
	END OF BOREHOLE									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH S8**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:604854** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4853824 150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 26, 2020** Date Completed: **Mar 26, 2020** Revision No.: **0, 8/14/20**

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Geodetic Ground Surface Elevation: 219.5 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	Soil Vapour Reading	Soil Vapour Reading	Soil Vapour Reading	Soil Vapour Reading	Soil Vapour Reading		
	about 140 mm ASPHALT	219.4															
	brown Sand and Gravel FILL trace to some silt moist	218.6	SS	1	42	15	219										
	dark brown Silty Clay / Clayey Silt FILL some sand, trace to some gravel, trace organics	217.3	SS	2	92	6	218										
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders hard	217.3	SS	3	83	6	218										
	trace to some shale fragments	217.3	SS	4	100	56	217										
		217.3	SS	5	33	45	216										
		217.3	SS	6	100	72 / 150mm	215										
		217.3	SS	7	100	50 / 80mm	215										
	grey	217.3	SS	8	100	60	213										
		217.3	SS	9	100	31	211										
		217.3	SS	10	100	50	210										
	END OF BOREHOLE	209.9					210										

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Groundwater encountered on completion of drilling on 3/26/2020 at a depth of: 2.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH S8



Project Number: TP115086

Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)

Project Location: Countryside Drive, Brampton, Ontario

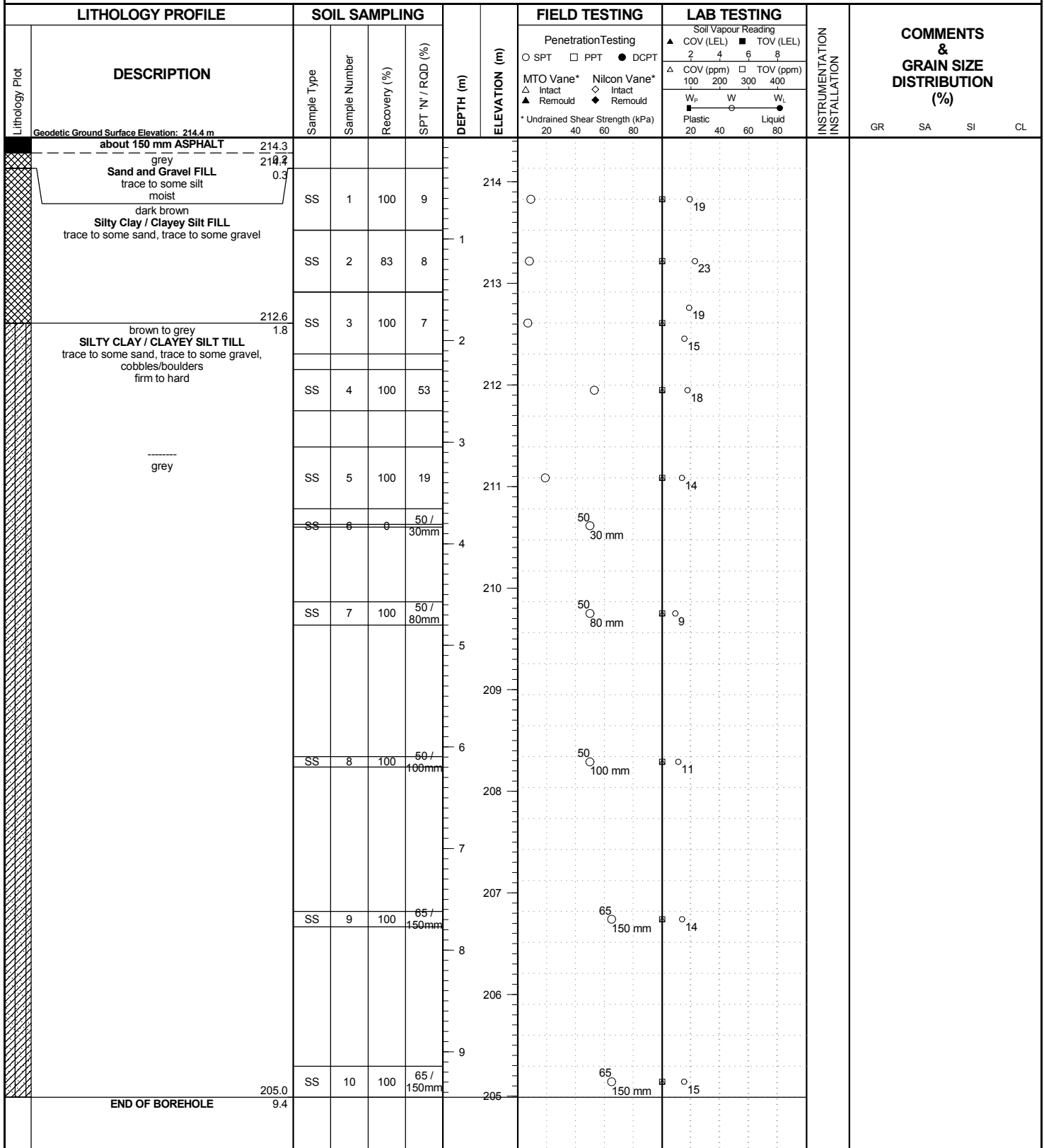
Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)		
	50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 5.8 m Sand Filter: 5.8 - 6.1 m Screen: 6.1							Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) 2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400 W _p W W _L Plastic Liquid 20 40 60 80				GR SA SI CL

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S9**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:604080** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4852848**
150 mm Solid Stem Augers Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 18, 2020** Date Completed: **Mar 18, 2020** Revision No.: **0, 8/14/20**



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∇ No freestanding groundwater measured in open borehole on completion of drilling.

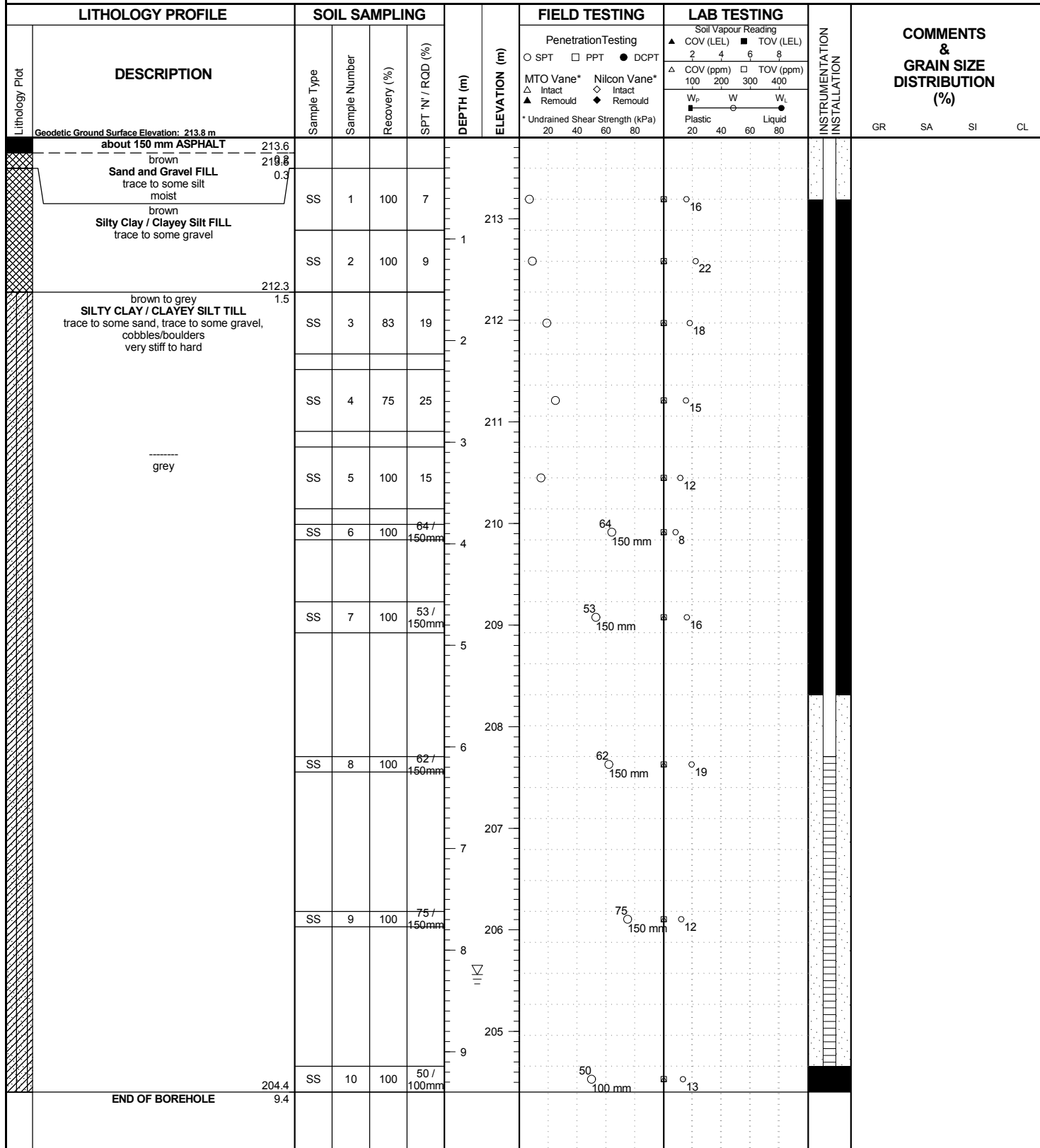
Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH S10**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:604082** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4852848**
150 mm Solid Stem Augers Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 18, 2020** Date Completed: **Mar 18, 2020** Revision No.: **0, 8/14/20**



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▽ Groundwater encountered on completion of drilling on 3/18/2020 at a depth of: 8.2 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. BH S10



Project Number: TP115086

Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)

Project Location: Countryside Drive, Brampton, Ontario

Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)		
	50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 5.5 m Sand Filter: 5.5 - 9.1 m Screen: 6.1							Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) 2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400 W _p W W _L Plastic Liquid				GR SA SI CL

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S11**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:603849** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4852560**
150 mm Solid Stem Augers Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 24, 2020** Date Completed: **Mar 24, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing	Soil Vapour Reading	COV (LEL)		
Geodetic Ground Surface Elevation: 213.2 m												
about 200 mm ASPHALT						213.0						
brown Sand and Gravel FILL						212.6						
trace to some silt moist	SS	1	100	9								
dark grey/brown Silty Clay / Clayey Silt FILL						212.0						
trace to some gravel, trace organics	SS	2	83	7								
						211.0						
brown to grey SILTY SAND / SANDY SILT						211.0						
trace gravel dense moist to wet	SS	4	100	46								
						210.0						
	SS	5	83	39								
						209.0						
grey	SS	6	83	44								
						208.0						
	SS	7	333	35								
						207.0						
	SS	8	88	35								
						206.0						
trace shale fragments						205.0						
	SS	9	100	55 / 150mm								
						204.7						
brown to grey SILTY CLAY / CLAYEY SILT TILL						204.0						
trace sand to sandy, trace to some gravel, cobbles/boulders hard	SS	10	100	50 / 80mm								
END OF BOREHOLE						204.0						

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Groundwater encountered on completion of drilling on 3/24/2020 at a depth of: 2.1 m. Cave in depth after removal of augers: 7.6 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S12**



Project Number: **TP115086** Drilling Location: **Culvert at Countryside Drive E:603857** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **N:4852567**
150 mm Solid Stem Augers Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Countryside Drive, Brampton, Ontario** Date Started: **Mar 24, 2020** Date Completed: **Mar 24, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing	Soil Vapour Reading	COV (LEL)		
Geodetic Ground Surface Elevation: 213.5 m												
about 140 mm ASPHALT brown						213						
Sand and Gravel FILL trace to some silt moist	SS	1	100	12		212.9						
darkgrey/ brown Silty Clay / Clayey Silt FILL trace to some gravel, trace organics	SS	2	67	6	1	212						
	SS	3	83	7	2	211.3						
brown to grey SILTY SAND / SANDY SILT trace gravel compact to very dense moist to wet	SS	4	75	20	3	211						
grey	SS	5	83	36	4	210						
	SS	6	100	91	5	209						
	SS	7	100	104	6	208						
	SS	8	100	50/30mm	7	207.7						
END OF BOREHOLE Auger refusal at 5.8 m depth. 50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 2.1 m Sand Filter: 2.1 - 5.8 m Screen: 2.7						207.7						

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D1



Project Number: TP115086 Drilling Location: Clarkway Drive E:606251 N:4850676 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 18, 2020 Date Completed: Feb 18, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing			Soil Vapour Reading				
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)	W _p
Geodetic Ground Surface Elevation: 205.6 m															
	about 150 mm ASPHALT						205.5								
	brown Sand and Gravel FILL moist	SS	1	100	94		205.1								
	204.9						204.9								
	brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	100	29		204.2								
	204.1						204.1								
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard	SS	3	100	27		203.6								
	202.6						202.6								
	END OF BOREHOLE						202.6								

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D2**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:606254 N:4850680** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 18, 2020** Date Completed: **Feb 18, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 206.0 m										
about 50 mm TOPSOIL 206.8										
brown Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	1	100	6						
204.8										
204.8					1	205				
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders hard	SS	2	100	15						
1.2										
204.1										
204.1										
END OF BOREHOLE 1.8										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D3**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:606138 N:4850776** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 18, 2020** Date Completed: **Feb 18, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 206.0 m										
 about 130 mm ASPHALT					205.8					
brown Sand and Gravel FILL moist					0.1					
205.4										
 Silty Clay / Clayey Silt FILL brown trace sand, trace gravel	SS	1	79	12	0.6					
204.6										
 SILTY CLAY / CLAYEY SILT TILL brown trace to some sand, trace gravel very stiff	SS	2	100	16	1.5					
204.4										
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D5**



Project Number: **TP115086** Drilling Location: **Clarkway Drive** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 18, 2020** Date Completed: **Feb 18, 2020** Revision No.: **0, 8/14/20**

Lithology Profile	DESCRIPTION	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading		Grain Size Distribution					
	Geodetic Ground Surface Elevation: 205.7 m															
	about 110 mm ASPHALT brown Sand and Gravel FILL moist					205.6 0.1										
	205.1 0.6 brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	1	100	20	205										
	204.5 1.2 brown/grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders stiff	SS	2	100	9	204										
		SS	3	58	11	204										
		SS	4	0	9	203										
		SS	5	17	14	202										
		SS	6	75	10	201										
		SS	7		NA	200.7										
	END OF BOREHOLE					200.7 5.0										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D6**



Project Number: **TP115086** Drilling Location: **Clarkway Drive** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 18, 2020** Date Completed: **Feb 18, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 206.1 m										
brown Sand and Gravel FILL some fines moist 205.5	SS	1	100	17		206	○	● 8		36 49 (15)
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel firm to stiff 205 204.3	SS	2	33	8	1	205	○	● 14		
	SS	3	25	8			○	● 13		
END OF BOREHOLE 1.8										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D7**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605935 N:4850986** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 18, 2020** Date Completed: **Feb 18, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 205.9 m about 100 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	100	36		205.8 0.1	○	▲ 11		
dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	100	10	1	205.3 0.6	○	▲ 23		
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff	SS	3	100	6	2	203.7 2.2	○	▲ 28		
END OF BOREHOLE	SS	4	100	20	3	202.9 3.0	○	▲ 15		

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D8



Project Number: TP115086 Drilling Location: Clarkway Drive E:605935 N: Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 18, 2020 Date Completed: Feb 18, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Lithology Plot Geodetic Ground Surface Elevation: 205.6 m brown Sand and Gravel FILL moist 204.7 END OF BOREHOLE 0.9 Borehole was terminated due to the existing Bell cable.	SS	1	83	22		205	○			Borehole was terminated due to the existing utility cables.
	SS	2	0	NA						

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D9**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605832 N:4851092** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Soil Vapour Reading					
								Penetration Testing		COV (LEL)		TOV (LEL)	
Geodetic Ground Surface Elevation: 207.0 m about 100 mm ASPHALT brown Sand and Gravel FILL moist													
		SS	1	75	27								
	grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, cobbles	SS	2	83	12	1	206						
	END OF BOREHOLE												

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D11



Project Number: TP115086 Drilling Location: Clarkway Drive E:605720 N:4851194 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 19, 2020 Date Completed: Feb 19, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould		
Geodetic Ground Surface Elevation: 207.9 m												
about 90 mm ASPHALT						207.9						
brown Sand and Gravel FILL						207.6						
moist Silty Clay / Clayey Silt FILL	SS	1	75			207.3						
brown trace sand, trace gravel												
	SS	2	100	14		207.0						
	SS	3	83	11		206.4						
brown SILTY CLAY / CLAYEY SILT TILL						206.1						
trace to some sand, trace gravel												
stiff to very stiff												
	SS	4	100	11		205.8						
	SS	5	100	22		205.4						
	SS	6	92	19		204.8						
grey												
	SS	7	100	16		203.8						
END OF BOREHOLE						202.9						
						5.0						

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D13**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605607 N:4851398** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
	DESCRIPTION	Geodetic Ground Surface Elevation: 209.3 m	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL)	△ COV (ppm) □ TOV (ppm)	W _p	W _L		Plastic	Liquid	GR	SA
	about 100 mm ASPHALT	209.2					209													
	brown Sand and Gravel FILL moist	208.7	SS	1	100	50 / 150mm			50											
	brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, cobbles/boulders	208.0					1													
	brown / grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders very stiff	208.0	SS	2	83	NA	208													
		1.2																		
			SS	3	54	NA	2													
			SS	4	100	NA	3													
	END OF BOREHOLE	206.2					3													
		3.0																		

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D15**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605513 N:4851403** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 209.5 m										
					209.4	209				
	SS	1	100	44	208.6	209				
	SS	2	67	15	208.0	208				
					208.0	208				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D17**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605385 N:4851532** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Apr 1, 2020** Date Completed: **Apr 1, 2020** Revision No.: **0, 8/14/20**

Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
		DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	Nilcon Vane* ◇ Intact ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL)	△ COV (ppm) □ TOV (ppm)	W _p W W _L		
	Geodetic Ground Surface Elevation: 210.5 m															
	about 100 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	83	37	210										
	209.3 1.2 brown / dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	92	9	209										
		SS	3	100	10	208										
		SS	4	100	11	207										
	206.7 3.7 grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel stiff	SS	6	100	10	206										
		SS	7	83	11	205.3										
	205.3 5.2 END OF BOREHOLE															

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D18



Project Number: TP115086 Drilling Location: Clarkway Drive E:605387 N:4851534 Logged by: MS
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Apr 1, 2020 Date Completed: Apr 1, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 210.1 m										
brown Sand and Gravel FILL moist	SS	1	83	12			○			
209.0					1	209	○			
1.1 dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	75	13			○			
208.2							○			
END OF BOREHOLE										
1.8										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D19**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605297 N:4851614** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 210.6 m about 90 mm ASPHALT brown Sand and Gravel FILL moist										
210.5 0.1 brown / dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	1	100	47	210		5			
210.0 0.6 209.7 0.9 grey SILTY CLAY / CLAYEY SILT TILL trace sand to sandy, trace gravel very stiff	SS	2	58	13	209		19			
	SS	3	79	23	209		16			2 22 49 27
	SS	4	83	29	208		16			
207.6 3.0 END OF BOREHOLE					208					

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D21**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605194 N:4851719** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Lithology Plot Geodetic Ground Surface Elevation: 209.0 m about 90 mm ASPHALT brown Sand and Gravel FILL cobbles/boulders moist										
	SS	1	79	48						
	SS	2	42	29	1	208				
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D23**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:605071 N:4851839** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 19, 2020** Date Completed: **Feb 19, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 209.2 m										
Lithology Plot	about 90 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	58	35	209	○	4		
	grey Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	75	11	208	○	16		
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel hard to very stiff	SS	3	100	30	207	○	19		
	grey	SS	4	100	36	207	○	20		
		SS	5	100	22	206	○	20		
		SS	6	0	18	205	○	19		
		SS	7	22	19	204	○	21		
	END OF BOREHOLE					204.2				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D25**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:604975 N:4851935** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 24, 2020** Date Completed: **Feb 24, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 209.1 m about 90 mm ASPHALT brown Sand and Gravel FILL moist					0.1	209.0				
	SS	1	100	28			○	5		
208.1 grey Silty Clay / Clayey Silt FILL trace sand, trace gravel					0.9	208				
	SS	2	100	12			○	14		
207.5 grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel stiff to firm					1.5	207				
	SS	3	83	10			○	13		
	SS	4	83	7			○	18		
END OF BOREHOLE					3.0	206.0				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D27**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:604867 N:4852040** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 24, 2020** Date Completed: **Feb 24, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 208.6 m about 90 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	100	26	208	○	■			
207.7 dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics	SS	2	100	7	1	○	■			
207.1										
207.1										
END OF BOREHOLE										
1.5										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D29



Project Number: TP115086 Drilling Location: Clarkway Drive E:604765 N:4852155 Logged by: MM
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 25, 2020 Date Completed: Feb 25, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading			
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)
	Geodetic Ground Surface Elevation: 211.7 m												
	about 150 mm TOPSOIL 211.6												
	0.2 brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	1	83	7		211	○					
		SS	2	100	17		211	○					
		SS	3	92	20		210	○					
	209.9 END OF BOREHOLE 1.8												

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D31



Project Number: TP115086 Drilling Location: Clarkway Drive E:604668 N:4852236 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 210.0 m										
	about 130 mm ASPHALT					209.9				
	brown Sand and Gravel FILL moist	SS	1	94	68	0.1				
	209.3					0.7				
	dark brown Sandy Silt FILL trace to some clay, trace gravel	SS	2	100	9	1	209	○	■	○
										14
		SS	3	100	9	2	208	○	■	○
										23
	207.8					2.2				
	grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel firm to stiff	SS	4	100	8			○	■	○
										15
		SS	5	100	9	3	207	○	■	○
										13
	206.5					3.5				
	END OF BOREHOLE									

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D32



Project Number: TP115086 Drilling Location: Clarkway Drive E:604666 N:4852234 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing			Soil Vapour Reading				
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)	W _p
Geodetic Ground Surface Elevation: 208.3 m															
	about 110 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	100	41		208								
	dark brown Silty Clay / Clayey Silt FILL trace to some sand, trace gravel	SS	2	92	10	1	207.6								
		SS	3	83	13		206.4								
	END OF BOREHOLE						1.8								

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D33



Project Number: TP115086 Drilling Location: Clarkway Drive E:604548 N:4852361 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 13, 2020 Date Completed: Feb 13, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 214.0 m about 110 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	89	41			○			
213.9 0.1 dark brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	100	14	1	213	○			
213.3 0.7 212.2 1.8 END OF BOREHOLE	SS	3	100	20			○			

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D35**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:604458 N:4852462** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 12, 2020** Date Completed: **Feb 12, 2020** Revision No.: **0, 8/14/20**

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING			LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	MTO Vane*	Nilcon Vane*	Soil Vapour Reading	COV (LEL)	TOV (LEL)	COV (ppm)		TOV (ppm)	W _p	W _L	GR
	Geodetic Ground Surface Elevation: 212.9 m																			
	about 130 mm ASPHALT	212.8																		
	brown Sand and Gravel FILL moist	0.1	SS	1	89	46														
	grey Silty Clay / Clayey Silt FILL trace to some sand, trace gravel, trace wood fragments in SS2	212.2																		
		0.7	SS	2	100	11	1	212												
			SS	3	67	5	2	211												
			SS	4	89	9														
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to stiff	210.0																		
		2.9	SS	5	89	16	3	210												
	grey						4	209												
			SS	6	89	14	5	208												
	END OF BOREHOLE	207.9																		
		5.0																		

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D36



Project Number: TP115086 Drilling Location: Clarkway Drive E:604437 N:4852462 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing			Soil Vapour Reading				
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)	W _p
Geodetic Ground Surface Elevation: 211.9 m													GR SA SI CL		
	brown Sand and Gravel FILL moist	SS	1	75	34		211.3								
	grey Silty Clay / Clayey Silt FILL trace to some sand, trace gravel	SS	2	83	13	1	211.0								
		SS	3	79	13		210.1								
	END OF BOREHOLE						210.1								

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D37**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:604335 N:4852470** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 13, 2020** Date Completed: **Feb 13, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 214.5 m										
 about 110 mm ASPHALT					214.3					
 brown Sand and Gravel FILL moist	SS	1		17	214					
 grey / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	100	9	213.8	1				
 brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	3	0	0	213	2				
 brown Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	4	100	16	212	3				
 brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff	SS	5	22	27	211.6	3				
 END OF BOREHOLE					210.9					

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D38



Project Number: TP115086 Drilling Location: Clarkway Drive E:604336 N:4852567 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 13, 2020 Date Completed: Feb 13, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 215.3 m										
brown Sand and Gravel FILL moist	SS	1	75	18	215					
214.7										
0.6 grey / brown Silty Clay / Clayey Silt FILL trace to some sand, trace gravel	SS	2	83	12	214					
213.4										
END OF BOREHOLE										
1.8										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D39



Project Number: TP115086 Drilling Location: Clarkway Drive E:604234 N:4852659 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing			Soil Vapour Reading				
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)	□ TOV (ppm)	W _p
Geodetic Ground Surface Elevation: 213.0 m															
	about 150 mm ASPHALT						212.9								
	brown Sand and Gravel FILL moist	SS	1	89	34										
	212.3														
	dark grey Sandy Silt FILL trace to some clay, trace gravel	SS	2	100	9	1	212								
	0.7														
		SS	3	72	9										
	211.0														
	END OF BOREHOLE						2.0								

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D40



Project Number: TP115086 Drilling Location: Clarkway Drive E:604138 N:4852764 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 13, 2020 Date Completed: Feb 13, 2020 Revision No.: 0, 8/14/20

Lithology Plot	LITHOLOGY PROFILE		SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
	DESCRIPTION		Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)			COV (ppm)	TOV (ppm)
	Geodetic Ground Surface Elevation: 212.9 m															
	about 150 mm ASPHALT brown Sand and Gravel FILL moist	212.8 0.1	SS	1	100	50/150mm										
			SS	2	89	20	1	212								
	grey Silty Clay / Clayey Silt FILL trace to some sand, trace gravel	211.5 1.4	SS	3	83	10	2	211								
			SS	4	56	7										
			SS	5	50	16	3	210								
	grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel firm to stiff	209.1 3.8					4	209								
			SS	6	94	8										
	END OF BOREHOLE	207.9 5.0					5	208								

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D41



Project Number: TP115086 Drilling Location: Clarkway Drive E:604141 N:4852766 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 13, 2020 Date Completed: Feb 13, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)					
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading				GR	SA	SI	CL	
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)					□ TOV (ppm)
	Geodetic Ground Surface Elevation: 213.9 m																	
	about 110 mm ASPHALT brown Sand and Gravel FILL some silt, trace clay moist	SS	1	100	50 / 150mm	0.1	213.8	○										
	grey Silty Clay / Clayey Silt FILL trace to some sand, trace gravel	SS	2	67		1.4	212.5	○										
	END OF BOREHOLE	SS	3	75	12	2.1	211.7	○										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D43



Project Number: TP115086 Drilling Location: Clarkway Drive E:604009 N:4852887 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 11, 2020 Date Completed: Feb 11, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 217.5 m about 130 mm ASPHALT brown Sand and Gravel FILL moist dark grey / brown Silty Clay / Clayey Silt FILL trace sand, trace gravel brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard grey END OF BOREHOLE	SS	1	83	12	217.3 217.2 0.3	217	○	▲		
	SS	2	100	12	216.1 1.4	216	○	▲		
	SS	3	100	27	215	215	○	▲		
	SS	4	100	44	214.0 3.5	214	○	▲		
	SS	5	89	44			○	▲		

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D44



Project Number: TP115086 Drilling Location: Clarkway Drive E:604007 N:4852886 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 11, 2020 Date Completed: Feb 11, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 216.8 m										
brown Sand and Gravel FILL moist brown / dark grey Silty Clay / Clayey Silt FILL trace to some sand, trace gravel, trace organics 216.7 0.1	SS	1	83	8						
215.6 1.2 SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff	SS	2	75	16	1					
215.0 1.8 END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D45**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603917 N:4852984** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 11, 2020** Date Completed: **Feb 11, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 218.8 m about 130 mm ASPHALT 218.7 brown 218.5 Sand and Gravel FILL 0.3 moist brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel 217.6 brown / grey 1.2 SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel hard 217.0 END OF BOREHOLE 1.8	SS	1	75	9		218				
	SS	2	83	14		218				
	SS	3	100	36		217				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. **BH D47**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603816 N:4853079** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 11, 2020** Date Completed: **Feb 11, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 219.9 m										
about 160 mm ASPHALT brown Sand and Gravel FILL moist	SS	1	83	8		219.8	○	▲ 21		
0.3 dark brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel	SS	2	89	12	1	219	○	▲ 17		
218.5 brown / grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard	SS	3	100	18	2	218	○	▲ 14		
1.4	SS	4	100	41	3	217	○	▲ 14		
	SS	5	100	37	4	216	○	▲ 14		
grey										
214.9 END OF BOREHOLE	SS	6	94	17	5	215	○	▲ 17		
5.0										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

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RECORD OF BOREHOLE No. BH D48



Project Number: TP115086 Drilling Location: Clarkway Drive E:603814 N:4853078 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 11, 2020 Date Completed: Feb 11, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 219.9 m										
brown Sand and Gravel FILL moist 219.7 0.1	SS	1	75	4						
dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel 218.6 1.2	SS	2	100	12	219					
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff 218.0 1.8	SS	3	100	24						
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D49



Project Number: TP115086 Drilling Location: Clarkway Drive E:603698 N:4853200 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 220.8 m about 120 mm ASPHALT 220.6 brown 220.4 Sand and Gravel FILL 0.3 moist brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel 218.5 brown 2.2 SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff ----- grey 217.3 END OF BOREHOLE 3.5	SS	1	83	6						
	SS	2	89	10	1	220	○	○ 14		
	SS	3	100	8	2	219	○	○ 16		
	SS	4	100	23	3	218	○	○ 14		
	SS	5	100	28			○	○ 13		2 19 48 31

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D50



Project Number: TP115086 Drilling Location: Clarkway Drive E:603700 N:4853201 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 12, 2020 Date Completed: Feb 12, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 220.8 m										
brown Sand and Gravel FILL moist 220.7 0.1	SS	1	79	7						
brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics 219.6 1.2	SS	2	83	13	220					
brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff 219.0 1.8	SS	3		24	219					
END OF BOREHOLE										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D51**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603599 N:4853290** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 11, 2020** Date Completed: **Feb 11, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 221.5 m										
						221.4				
	SS	1	89	9		221.2				
						221.0				
	SS	2	100	7	1	220.1				
						220.1				
	SS	3	100	27		219.5				
						219.5				
END OF BOREHOLE						2.0				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D53**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603497 N:4853398** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 12, 2020** Date Completed: **Feb 12, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 222.0 m about 130 mm ASPHALT brown Sand and Gravel FILL moist brown / dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel, trace organics 221.9 0.1 221.7 0.3 219.8 2.2 brown / grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff to hard ----- grey 217.0 5.0 END OF BOREHOLE	SS	1	94	13			○	6		
	SS	2	100	10	1	221	○	13		
	SS	3	100	16	2	220	○	15		
	SS	4	100	29	3	219	○	15		
	SS	5	100	22	4	218	○	16		
	SS	6	100	36	5	217	○	13		

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH D54**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603499 N:4853399** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 12, 2020** Date Completed: **Feb 12, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE		SOIL SAMPLING				FIELD TESTING		LAB TESTING				INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)		
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)	DEPTH (m)	ELEVATION (m)	Penetration Testing		Soil Vapour Reading				GR	SA
								○ SPT	□ PPT	● DCPT	▲ COV (LEL)	■ TOV (LEL)	△ COV (ppm)		
Geodetic Ground Surface Elevation: 221.7 m															
	brown Sand and Gravel FILL moist 221.6 0.1	SS	1	100	6		221								
	brown / dark brown Silty Clay / Clayey Silt FILL trace sand, trace gravel 221.1 0.6	SS	2	83	7		221								
	brown SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel firm to very stiff 219.9	SS	3	33	23		220								
END OF BOREHOLE															

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D55**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603388 N:4853502** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 11, 2020** Date Completed: **Feb 11, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 222.5 m about 150 mm ASPHALT 222.4 brown Sand and Gravel FILL 222.2 moist 0.3 brown / grey Silty Clay / Clayey Silt FILL trace sand, trace gravel 221.1 brown SILTY CLAY / CLAYEY SILT TILL 221.4 trace to some sand, trace gravel hard 219.0 END OF BOREHOLE 3.5	SS	1	89	12						
	SS	2	94	24	1					
	SS	3	100	30	2					
	SS	4	100	59	3					
	SS	5	100	38						

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. BH D56



Project Number: TP115086 Drilling Location: Clarkway Drive E:603380 N:4853532 Logged by: MD
 Project Client: City of Brampton Drilling Method: 150 mm Solid Stem Augers Compiled by: SN
 Project Name: Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47) Drilling Machine: Track Mounted Drill Reviewed by: SM
 Project Location: Clarkway Drive, Brampton, Ontario Date Started: Feb 11, 2020 Date Completed: Feb 11, 2020 Revision No.: 0, 8/14/20

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 222.0 m										
Sand and Gravel FILL brown moist 221.9 0.2	SS	1	75	8						
Silty Clay / Clayey Silt FILL brown / dark brown trace sand, trace gravel, trace organics 221.4 0.6	SS	2	92	15	1	221				
SILTY CLAY / CLAYEY SILT TILL brown trace to some sand, trace gravel stiff to very stiff 220.2	SS	3	46	26						
END OF BOREHOLE 1.8										

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH D57**



Project Number: **TP115086** Drilling Location: **Clarkway Drive E:603286 N:4853614** Logged by: **MD**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 12, 2020** Date Completed: **Feb 12, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80		
Geodetic Ground Surface Elevation: 223.6 m										
	about 85 mm ASPHALT	SS	1	94	6	223.5	○			
	about 180 mm CONCRETE					223.4				
	dark grey Silty Clay / Clayey Silt FILL trace sand, trace gravel					222.9				
	brown / grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel stiff to very stiff	SS	2	100	13	222.7	○			
						222.6				
	END OF BOREHOLE					2.0				

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∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S13**



Project Number: **TP115086** Drilling Location: **Culvert at Clarkway Drive E:604621 N:4852286** Logged by: **MM**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 25, 2020** Date Completed: **Feb 25, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing ○ SPT □ PPT ● DCPT	MTO Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL)		
Geodetic Ground Surface Elevation: 210.2 m												
about 80 mm ASPHALT brown Sand and Gravel FILL trace to some silt moist	SS	1	100	62	210	210.1						
greyish brown Silty Clay / Clayey Silt FILL trace to some sand, trace to some gravel, trace organics	SS	2	63	8	1	209.2						
	SS	3	100	15	2	208.1						
	SS	4	100	9	3	207.1						
	SS	5	100	7	4	206.1						
grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel very stiff	SS	6	100	27	5	206.1						3 16 50 31
grey SILTY SAND / SANDY SILT trace gravel, cobbles/boulders loose to very dense moist to wet	SS	7	133	22	6	204.6						
	SS	8	100	9	7	203.6						
	SS	9	100	55 / 130mm	8	200.9						
END OF BOREHOLE					9	200.9						

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▽ Groundwater encountered on completion of drilling on 2/25/2020 at a depth of: 4.3 m. ■ Cave in depth after removal of augers: 1.5 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

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RECORD OF BOREHOLE No. **BH S13**



Project Number: **TP115086**

Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)**

Project Location: **Clarkway Drive, Brampton, Ontario**

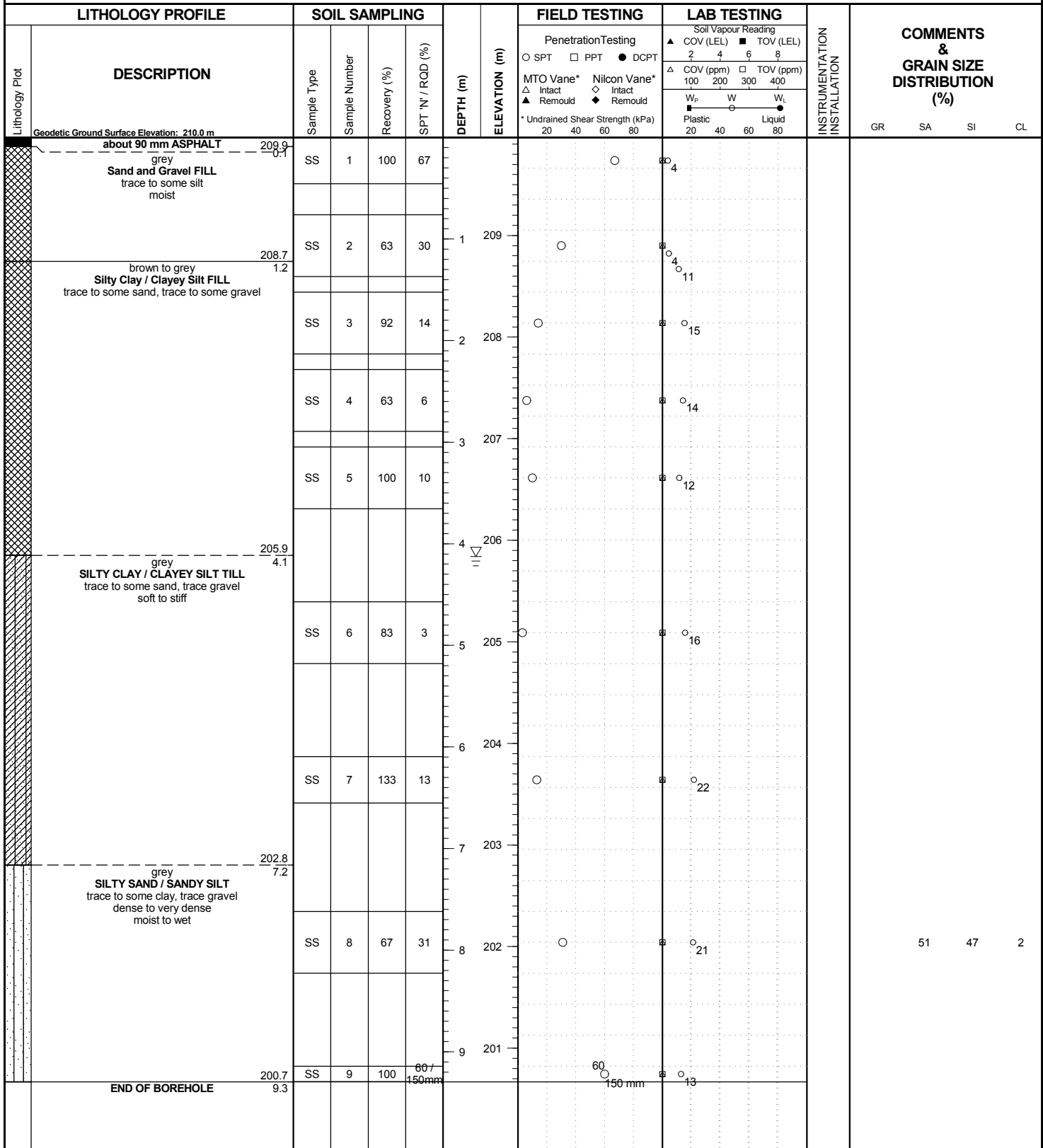
Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			Penetration Testing	Soil Vapour Reading	COV (LEL)	TOV (LEL)		
	50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 4.0 m Sand Filter: 4.0 - 7.6 m Screen: 4.6							Penetration Testing ○ SPT □ PPT ● DCPT MTO Vane* Nilcon Vane* △ Intact ◇ Intact ▲ Remould ◆ Remould * Undrained Shear Strength (kPa) 20 40 60 80	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) 2 4 6 8 △ COV (ppm) □ TOV (ppm) 100 200 300 400 W _p W W _L Plastic Liquid				GR SA SI CL

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S14**



Project Number: **TP115086** Drilling Location: **Culvert at Clarkway Drive E:604618 N:4852293** Logged by: **MM**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 25, 2020** Date Completed: **Feb 25, 2020** Revision No.: **0, 8/14/20**



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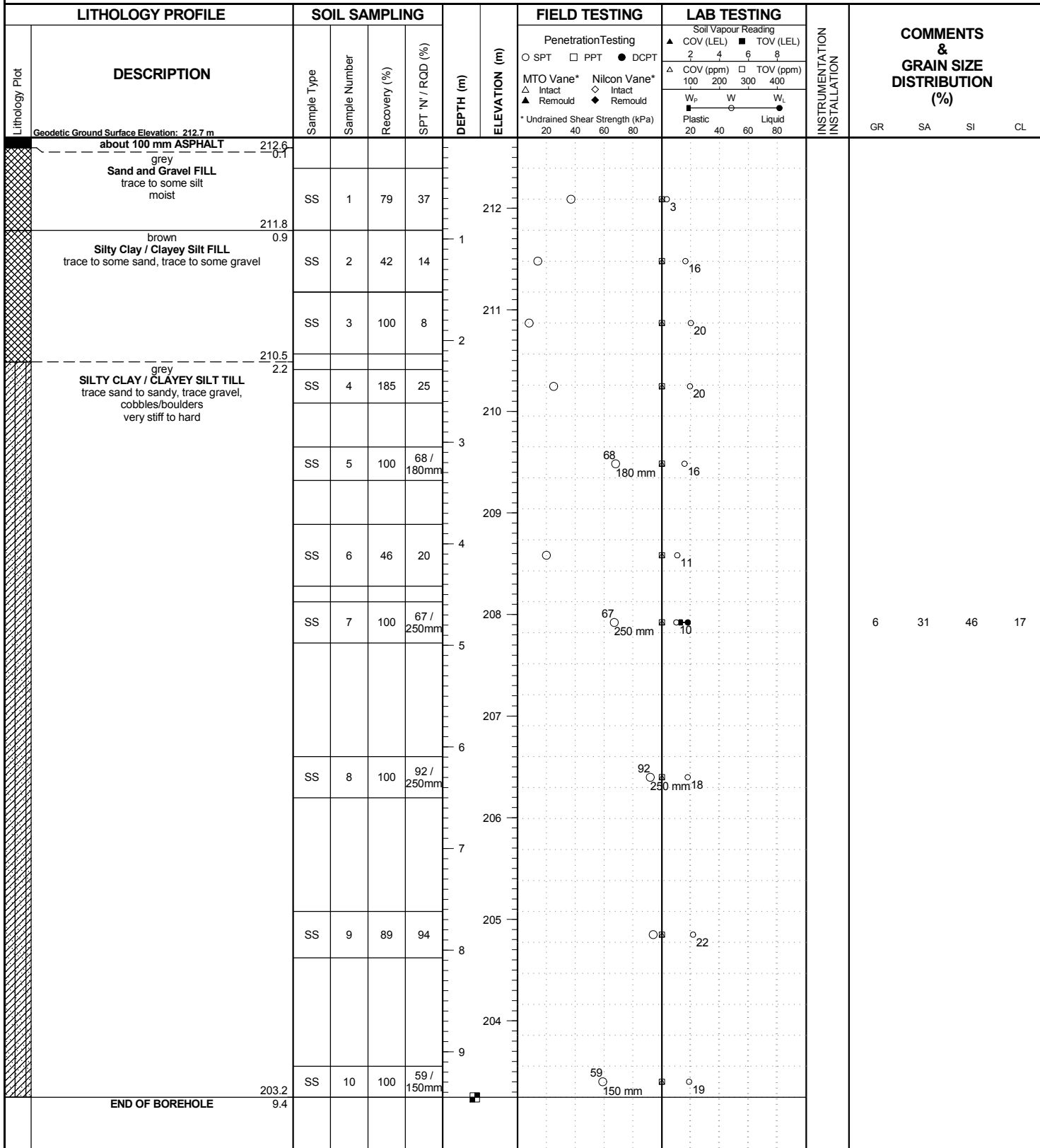
Groundwater encountered on completion of drilling on 2/25/2020 at a depth of: 4.1 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

RECORD OF BOREHOLE No. **BH S15**



Project Number: **TP115086** Drilling Location: **Culvert at Clarkway Drive E:604169 N:4852729** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 24, 2020** Date Completed: **Feb 24, 2020** Revision No.: **0, 8/14/20**



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∇ No freestanding groundwater measured in open borehole on completion of drilling. ■ Cave in depth after removal of augers: 9.4 m.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.
 Scale: 1 : 53
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RECORD OF BOREHOLE No. **BH S16**



Project Number: **TP115086** Drilling Location: **Culvert at Clarkway Drive E:604158 N:4852745** Logged by: **MS**
 Project Client: **City of Brampton** Drilling Method: **150 mm Solid Stem Augers** Compiled by: **SN**
 Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)** Drilling Machine: **Track Mounted Drill** Reviewed by: **SM**
 Project Location: **Clarkway Drive, Brampton, Ontario** Date Started: **Feb 24, 2020** Date Completed: **Feb 24, 2020** Revision No.: **0, 8/14/20**

LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)			SPT 'N' / RQD (%)	Penetration Testing	Soil Vapour Reading	COV (LEL)		
Geodetic Ground Surface Elevation: 213.0 m												
about 90 mm ASPHALT					0.1	213.0						
grey Sand and Gravel FILL trace to some silt moist	SS	1	100	32								
212.1												
dark grey Silty Clay / Clayey Silt FILL trace to some sand, trace to some gravel	SS	2	83	14	1	212						
0.9												
SS 3	3	100	8		2	211						
210.8												
brown to grey SILTY CLAY / CLAYEY SILT TILL trace to some sand, trace gravel, cobbles/boulders very stiff to hard	SS	4	100	22								
2.2												
SS 5	5	100	37		3	210						
SS 6	6	100	29		4	209						
grey	SS	7	100	62								
	SS	8	100	50 / 100mm								
	SS	9	100	70 / 150mm								
	SS	10	100	71								
203.3												
END OF BOREHOLE						9.8						

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 Canada
 Tel. No.: (905) 415-2632
 www.woodplc.com

∇ No freestanding groundwater measured in open borehole on completion of drilling.

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Scale: 1 : 53
 Page: 1 of 2

RECORD OF BOREHOLE No. **BH S16**



Project Number: **TP115086**

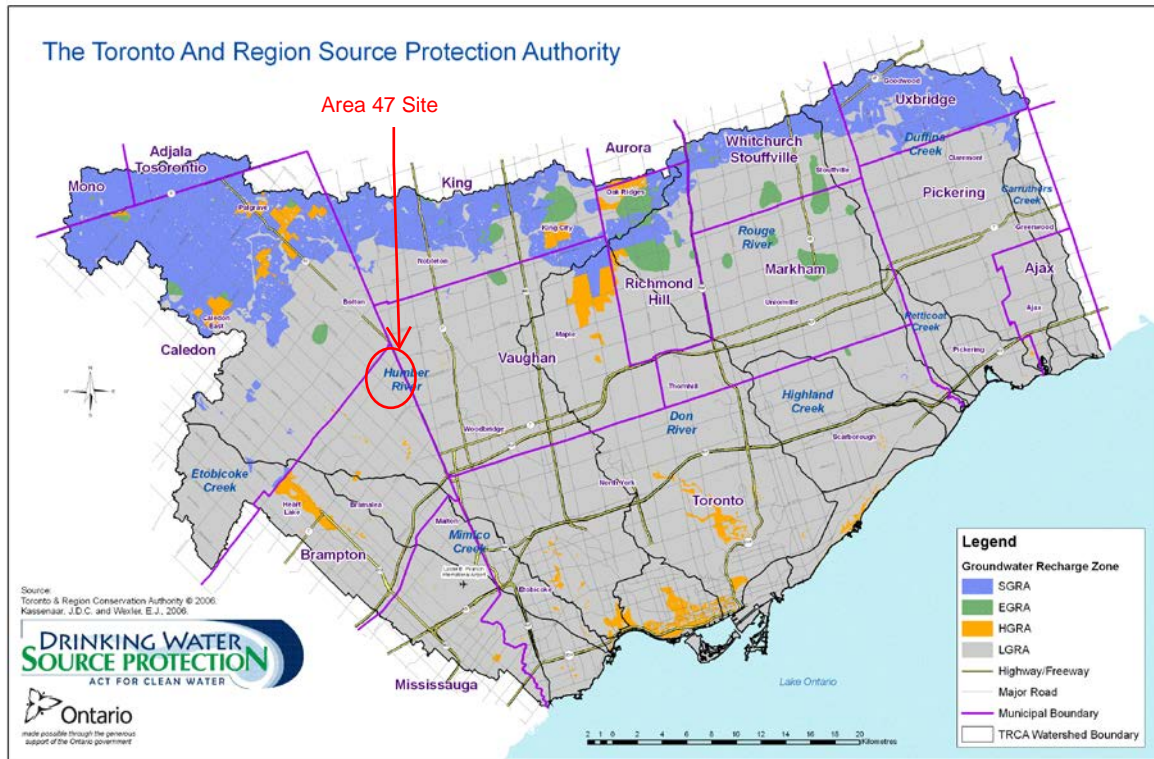
Project Name: **Arterial Roads within Highway 427 Industrial Secondary Plan Area (Area 47)**

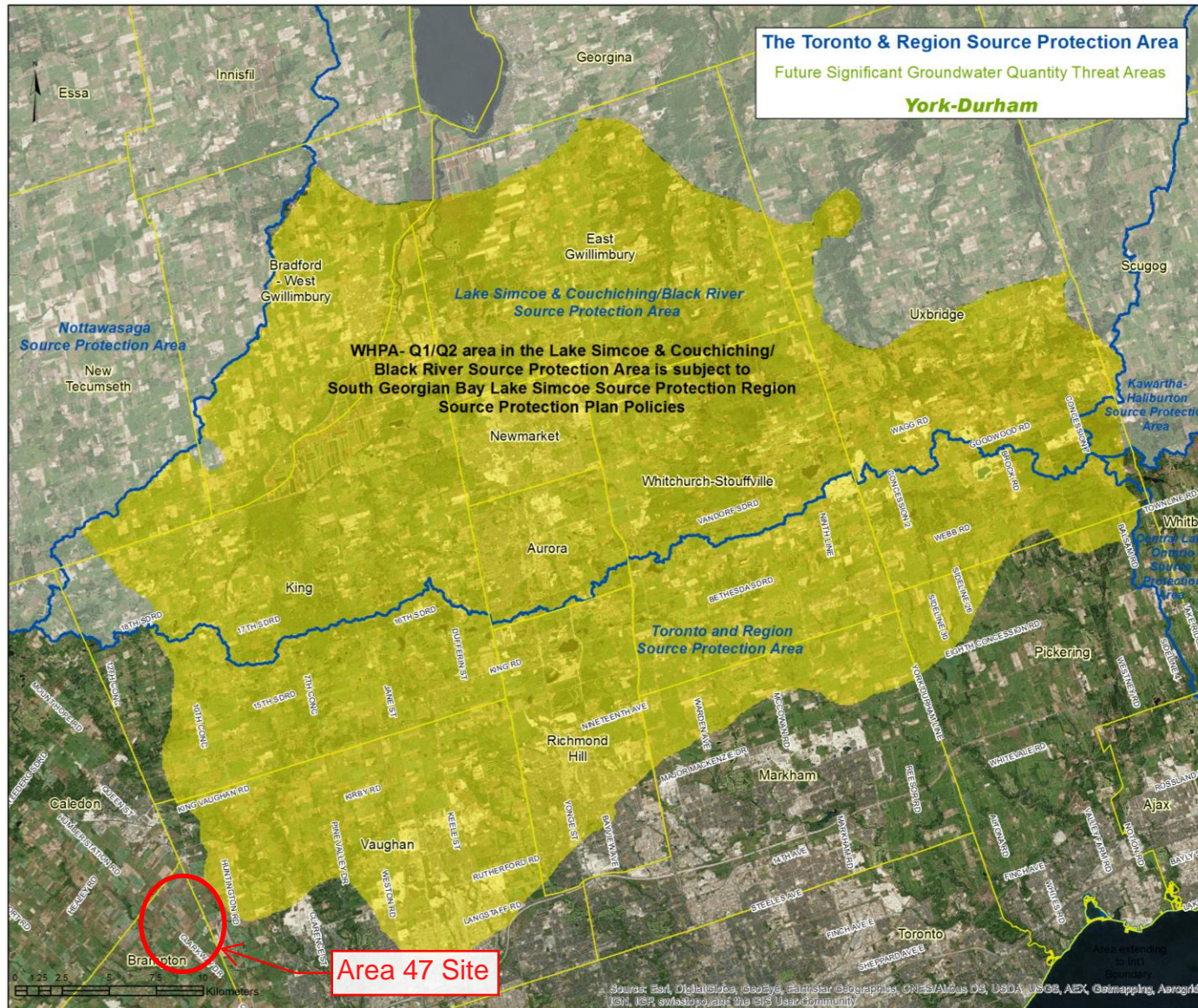
Project Location: **Clarkway Drive, Brampton, Ontario**

Lithology Plot	LITHOLOGY PROFILE	SOIL SAMPLING				DEPTH (m)	ELEVATION (m)	FIELD TESTING		LAB TESTING		INSTRUMENTATION INSTALLATION	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT 'N' / RQD (%)			MTO Vane* △ Intact ▲ Remould	Nilcon Vane* ◇ Intact ◆ Remould	Soil Vapour Reading ▲ COV (LEL) ■ TOV (LEL) 2 4 6 8	△ COV (ppm) □ TOV (ppm) 100 200 300 400		
	50 mm dia. monitoring well with flushmount protective casing installed (depth below ground surface): Sand: 0.0 - 0.6 m Bentonite: 0.6 - 5.5 m Sand Filter: 5.5 - 9.1 m Screen: 6.1												

Borehole details as presented, do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified Geotechnical Engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Borehole Log'.

Figure C 10: Recharge Area Classification








Legend

- WHPA- Q1/Q2 - Moderate Risk Level
- DEM** - Demand: Water Taking
- REC** - Recharge: Recharge Reduction
- Source Protection Area (SPA) Boundary

Reference: Prescribed threat circumstances as listed in the Ministry of the Environment Table of Drinking Water Threats (2009)

(c) Copyright. Toronto & Region Source Protection Area, 2014.
Source: TRCA, 2014; ESRI (ArcGIS Online), 2014.

This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

Map 3.4: York-Durham – Future Significant Groundwater Quantity Threat Areas

Appendix B: Supporting Calculations

Catchment	Subcatchments	NHYD	Area (ha)	TIMP (ha)	XIMP (ha)	TIMP (%)	XIMP (%)	100-Year 6-Hour AES (Bloor, TRCA) PKFW (m3/s)	100-Year 12-Hour AES (Bloor, TRCA) PKFW (m3/s)	Regional - Hazel PKFW (m3/s)	100-Year Rational Method (City's IDF) PKFW (m3/s)
C6	CL1	201	1.07	0.49	0.30	0.46	0.28	0.179	0.102	0.151	0.417
G8	CL2	202	4.20	2.04	1.36	0.49	0.32	0.712	0.405	0.594	1.695
C4	CL3	203	3.35	1.86	1.26	0.56	0.38	0.586	0.332	0.477	1.449
C3	CL4	204	2.46	1.15	0.66	0.47	0.27	0.413	0.235	0.348	0.976
R1	CL5	205	1.98	1.22	0.88	0.62	0.45	0.356	0.200	0.284	0.905
R1	CL6	206	1.95	1.43	1.17	0.74	0.60	0.367	0.205	0.282	0.984
C2	CL7	207	1.93	1.49	1.22	0.77	0.63	0.367	0.205	0.280	1.003
G7	CS10 & CS11	208	0.73	0.49	0.37	0.67	0.50	0.134	0.075	0.105	0.351
G6	CS12	209	0.49	0.33	0.25	0.67	0.51	0.090	0.050	0.070	0.235
G4	CS13 & CS14	210	0.74	0.49	0.37	0.67	0.50	0.136	0.076	0.106	0.352
C5a	CS9	211	0.88	0.63	0.49	0.71	0.55	0.164	0.092	0.127	0.438
R3	EW1	212	2.33	1.65	1.29	0.71	0.55	0.434	0.242	0.336	1.154
G5a	EW2	213	1.55	0.93	0.66	0.60	0.42	0.276	0.156	0.222	0.699
G3	EW3	214	1.47	1.00	0.76	0.68	0.52	0.270	0.151	0.212	0.708
C1	EW4	215	1.22	0.82	0.62	0.67	0.51	0.224	0.125	0.175	0.584
G1	EW5	216	0.27	0.18	0.14	0.67	0.50	0.049	0.028	0.039	0.130
G2	EW6	217	0.98	0.67	0.51	0.68	0.52	0.180	0.101	0.141	0.475
R8	CS1 & CS2	218	1.77	1.35	1.06	0.76	0.60	0.336	0.187	0.257	0.916
R6	CS3	219	0.98	0.78	0.61	0.79	0.62	0.188	0.105	0.142	0.518
R7a	CS5	220	1.54	1.14	0.89	0.74	0.58	0.290	0.162	0.223	0.782
R4b	CS6	221	0.34	0.26	0.22	0.78	0.64	0.065	0.036	0.049	0.178
R5	CS7	222	1.01	0.77	0.60	0.76	0.59	0.192	0.107	0.146	0.521

Runoff Generated from the 90th Percentile Rainfall Event (27mm)

Subcatchment	Total Area (ha)	Pervious Area (ha)		Impervious Area (ha)			27 mm Runoff Volume (m ³)	
		Proposed	Existing	Proposed	Existing	Net	Total Imp Area	Net Increase
<i>Countryside Drive</i>								
CS1	1.46	0.34	1.19	1.13	0.27	0.85	304.3	230.3
CS2	0.30	0.08	0.18	0.23	0.12	0.10	60.9	28.0
CS3	0.98	0.21	0.60	0.77	0.38	0.40	209.2	107.1
CS5	1.54	0.40	1.40	1.14	0.15	0.99	307.7	268.4
CS6	0.34	0.08	0.34	0.26	0.00	0.26	71.5	71.0
CS7	1.01	0.24	1.00	0.77	0.01	0.76	207.1	204.6
CS9	0.88	0.26	0.53	0.63	0.35	0.28	169.7	74.3
CS10	0.54	0.18	0.31	0.36	0.23	0.13	97.2	36.2
CS11	0.19	0.06	0.10	0.13	0.09	0.04	35.3	10.4
CS12	0.49	0.16	0.48	0.33	0.01	0.32	88.6	86.2
CS13	0.54	0.18	0.54	0.36	0.00	0.36	97.2	97.2
CS14	0.20	0.07	0.20	0.13	0.00	0.13	35.8	35.8
<i>Clarkway Drive</i>								
CL1	1.07	0.58	1.06	0.49	0.00	0.48	131.2	130.1
CL2	4.20	2.16	3.13	2.04	1.07	0.97	550.5	261.6
CL3	3.35	1.49	2.75	1.86	0.60	1.26	503.1	340.9
CL4	2.46	1.31	1.79	1.15	0.67	0.48	310.6	129.4
CL5	1.98	0.76	1.81	1.22	0.17	1.05	329.4	284.1
CL6	1.95	0.51	1.28	1.43	0.67	0.76	386.3	206.5
CL7	1.93	0.44	1.48	1.49	0.45	1.04	401.6	279.7
<i>E-W Arterial A2</i>								
EW1	2.33	0.68	2.33	1.65	0.00	1.65	445.9	445.9
EW2	1.55	0.62	1.43	0.93	0.12	0.81	251.2	218.0
EW3	1.47	0.47	1.45	1.00	0.02	0.98	268.7	263.7
EW4	1.22	0.40	1.18	0.82	0.03	0.79	220.8	212.3
EW5	0.27	0.09	0.27	0.18	0.00	0.18	49.0	49.0
EW6	0.98	0.31	0.96	0.67	0.02	0.65	180.8	175.7

Runoff Generated from a 5mm Rainfall Event

Subcatchment	Impervious Area (ha)	5 mm Runoff Volume (m ³)
<i>Countryside Drive</i>		
CS1	1.13	56.35
CS2	0.23	11.27
CS3	0.77	38.75
CS5	1.14	56.98
CS6	0.26	13.24
CS7	0.77	38.35
CS9	0.63	31.44
CS10	0.36	18.00
CS11	0.13	6.53
CS12	0.33	16.41
CS13	0.36	18.00
CS14	0.13	6.64
<i>Clarkway Drive</i>		
CL1	0.49	24.30
CL2	2.04	101.95
CL3	1.86	93.17
CL4	1.15	57.51
CL5	1.22	61.00
CL6	1.43	71.53
CL7	1.49	74.37
<i>E-W Arterial A2</i>		
EW1	1.65	82.58
EW2	0.93	46.52
EW3	1.00	49.77
EW4	0.82	40.88
EW5	0.18	9.07
EW6	0.67	33.48

Pre-Development Water Balance Volume Calculations - Countryside Drive

Notes: Ratios of runoff, evapotranspiration, and infiltration as per Table 3.1 of MOE SWMPDM 2003

Drainage Area Table (ha)													
Land Cover	Soil Group	Subcatchment CS1	Subcatchment CS2	Subcatchment CS3	Subcatchment CS5	Subcatchment CS6	Subcatchment CS7	Subcatchment CS9	Subcatchment CS10	Subcatchment CS11	Subcatchment CS12	Subcatchment CS13	Subcatchment CS14
		Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)
Pervious Area	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	1.19	0.18	0.60	1.40	0.34	1.00	0.53	0.31	0.10	0.48	0.54	0.20
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Area	N/A	0.27	0.12	0.38	0.15	0.00	0.01	0.35	0.23	0.09	0.01	0.00	0.00
Totals		1.47	0.30	0.98	1.54	0.34	1.01	0.88	0.54	0.20	0.49	0.54	0.20

Soil Group Weighting (per Table 3.1 of SWMPDM 2003)				
Soil Group	Runoff	Infiltration	Evapotranspiration	Precipitation
A	149	276	515	940
B	187	228	525	940
C	222	182	536	940
D	270	145	525	940
A	16%	29%	55%	100%
B	20%	24%	56%	100%
C	24%	19%	57%	100%
D	29%	15%	56%	100%

Annual Soil Infiltration (mm)					
Year Range	Average Annual Precipitation (mm)	Soil A Infiltration (mm)	Soil B Infiltration (mm)	Soil C Infiltration (mm)	Soil D Infiltration (mm)
1995 - 2019	797.6	234.19	193.46	154.43	123.03

Annual Subcatchment Infiltration (m³)													
Subcatchment #:	Subcatchment CS1	Subcatchment CS2	Subcatchment CS3	Subcatchment CS5	Subcatchment CS6	Subcatchment CS7	Subcatchment CS9	Subcatchment CS10	Subcatchment CS11	Subcatchment CS12	Subcatchment CS13	Subcatchment CS14	
Volume:	1839.23	281.06	929.65	2154.26	523.51	1544.27	820.01	481.81	159.06	742.80	830.82	305.77	

Daily Subcatchment Infiltration (m³)													
Subcatchment #:	Subcatchment CS1	Subcatchment CS2	Subcatchment CS3	Subcatchment CS5	Subcatchment CS6	Subcatchment CS7	Subcatchment CS9	Subcatchment CS10	Subcatchment CS11	Subcatchment CS12	Subcatchment CS13	Subcatchment CS14	
Volume:	5.04	0.77	2.55	5.90	1.43	4.23	2.25	1.32	0.44	2.04	2.28	0.84	

Pre-Development Water Balance Volume Calculations - Clarkway Drive

Notes: Ratios of runoff, evapotranspiration, and infiltration as per Table 3.1 of MOE SWMPDM 2003

Drainage Area Table (ha)								
Land Cover	Soil Group	Subcatchment CL1	Subcatchment CL2	Subcatchment CL3	Subcatchment CL4	Subcatchment CL5	Subcatchment CL6	Subcatchment CL7
		Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)
Pervious Area	A	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	C	1.06	3.13	2.75	1.79	1.81	1.28	1.48
	D	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Area	N/A	0.00	1.07	0.60	0.67	0.17	0.67	0.45
Totals		1.07	4.20	3.35	2.47	1.98	1.95	1.93

Soil Group Weighting (per Table 3.1 of SWMPDM 2003)				
Soil Group	Runoff	Infiltration	Evapotranspiration	Precipitation
A	149	276	515	940
B	187	228	525	940
C	222	182	536	940
D	270	145	525	940
A	16%	29%	55%	100%
B	20%	24%	56%	100%
C	24%	19%	57%	100%
D	29%	15%	56%	100%

Annual Soil Infiltration (mm)					
Year Range	Average Annual Precipitation (mm)	Soil A Infiltration (mm)	Soil B Infiltration (mm)	Soil C Infiltration (mm)	Soil D Infiltration (mm)
1995 - 2019	797.6	234.19	193.46	154.43	123.03

Annual Subcatchment Infiltration (m³)							
Subcatchment #:	Subcatchment CL1	Subcatchment CL2	Subcatchment CL3	Subcatchment CL4	Subcatchment CL5	Subcatchment CL6	Subcatchment CL7
Volume:	1641.56	4836.67	4245.21	2770.43	2798.22	1976.67	2277.80

Daily Subcatchment Infiltration (m³)							
Subcatchment #:	Subcatchment CL1	Subcatchment CL2	Subcatchment CL3	Subcatchment CL4	Subcatchment CL5	Subcatchment CL6	Subcatchment CL7
Volume:	4.50	13.25	11.63	7.59	7.67	5.42	6.24

Pre-Development Water Balance Volume Calculations - E-W Arterial A2

Notes: Ratios of runoff, evapotranspiration, and infiltration as per Table 3.1 of MOE SWMPDM 2003

Drainage Area Table (ha)							
Land Cover	Soil Group	Subcatchment EW1	Subcatchment EW2	Subcatchment EW3	Subcatchment EW4	Subcatchment EW5	Subcatchment EW6
		Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)	Contributing Area (ha)
Pervious Area	A	0.00	0.00	0.00	0.00	0.00	0.00
	B	0.00	0.00	0.00	0.00	0.00	0.00
	C	2.33	1.43	1.45	1.19	0.27	0.96
	D	0.00	0.00	0.00	0.00	0.00	0.00
Impervious Area	N/A	0.00	0.12	0.02	0.03	0.00	0.02
Totals		2.33	1.56	1.47	1.22	0.27	0.98

Soil Group Weighting (per Table 3.1 of SWMPDM 2003)				
Soil Group	Runoff	Infiltration	Evapotranspiration	Precipitation
A	149	276	515	940
B	187	228	525	940
C	222	182	536	940
D	270	145	525	940
A	16%	29%	55%	100%
B	20%	24%	56%	100%
C	24%	19%	57%	100%
D	29%	15%	56%	100%

Annual Soil Infiltration (mm)					
Year Range	Average Annual Precipitation (mm)	Soil A Infiltration (mm)	Soil B Infiltration (mm)	Soil C Infiltration (mm)	Soil D Infiltration (mm)
1995 - 2019	797.6	234.19	193.46	154.43	123.03

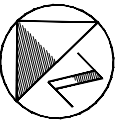
Annual Subcatchment Infiltration (m³)						
Subcatchment #:	Subcatchment EW1	Subcatchment EW2	Subcatchment EW3	Subcatchment EW4	Subcatchment EW5	Subcatchment EW6
Volume:	3604.34	2211.40	2239.20	1829.96	418.50	1487.14

Daily Subcatchment Infiltration (m³)						
Subcatchment #:	Subcatchment EW1	Subcatchment EW2	Subcatchment EW3	Subcatchment EW4	Subcatchment EW5	Subcatchment EW6
Volume:	9.87	6.06	6.13	5.01	1.15	4.07

Borehole Log ID	BH Plan Station	Road Profile Station	Ground Surface Elevation (m)	End of Borehole Elevation (m)	GW Depth (m)	GW Level Elev. (m)	Proposed Road Surface Elevation (m)	GW Depth from Proposed Road Surface (m)
<i>Countryside Drive</i>								
C1	0+000	10+20	215.8	212.8	(Dry)	-	215.7	>2.9
C2	0+000	10+20	215.1	213.2	(Dry)	-	215.7	>2.5
C3	0+150	10+170	216.5	215.0	(Dry)	-	216.4	>1.4
C5	0+300	10+320	214.6	209.7	3	211.6	215.5	3.9
C6	0+300	10+320	214.6	213.0	(Dry)	-	215.5	>2.5
S11	0+330	10+350	213.2	204.0	2.1	211.1	215.6	4.5
S12	0+344	10+364	213.5	207.7	(Dry)	-	215.7	>8
C7	0+450	10+470	216.5	213.5	(Dry)	-	216.2	>2.7
C8	0+450	10+470	216.6	214.8	(Dry)	-	216.2	>1.4
C9	0+600	10+620	218.3	216.8	(Dry)	-	217.0	>0.2
S9	0+693	10+713	214.4	205.0	(Dry)	-	217.5	>12.5
S10	0+705	10+725	213.8	204.4	8.2	205.6	217.5	11.9
C11	0+750	10+770	215.2	210.0	4.9	210.3	217.8	7.5
C12	0+750	10+770	213.6	212.4	(Dry)	-	217.8	>5.4
C13	0+900	10+920	219.0	215.9	(Dry)	-	218.5	>2.6
C15	1+050	11+70	219.7	218.2	(Dry)	-	219.3	>1.1
C17	1+200	11+220	219.9	214.9	(Dry)	-	220.1	>5.2
C18	1+200	11+220	219.9	218.1	(Dry)	-	220.1	>2
C20	1+350	11+370	220.2	219.0	(Dry)	-	220.8	>1.8
C21	1+500	11+520	221.3	219.7	(Dry)	-	221.6	>1.9
C23	1+650	11+670	221.3	220.4	(Dry)	-	222.2	>1.8
C24	1+650	11+670	220.9	219.1	(Dry)	-	222.2	>3.1
C25	1+800	11+820	220.9	217.8	(Dry)	-	222.5	>4.7
S8	1+945	11+965	219.5	209.9	2.4	217.1	222.3	5.2
C27	1+950	11+970	217.8	208.0	2.7	215.1	222.3	7.2
C29	2+100	12+120	221.4	216.5	(Dry)	-	221.6	>5.1
C30	2+100	12+120	221.0	219.2	(Dry)	-	221.6	>2.4
C31	2+250	12+270	221.7	218.7	1.5	220.2	220.9	0.7
C32	2+250	12+270	221.7	219.8	(Dry)	-	220.9	>1.1
C33	2+400	12+420	221.8	220.2	(Dry)	-	220.1	-
C35	2+550	12+570	220.6	219.1	(Dry)	-	219.4	>0.3
C37	2+700	12+720	220.0	218.5	(Dry)	-	218.6	>0.1

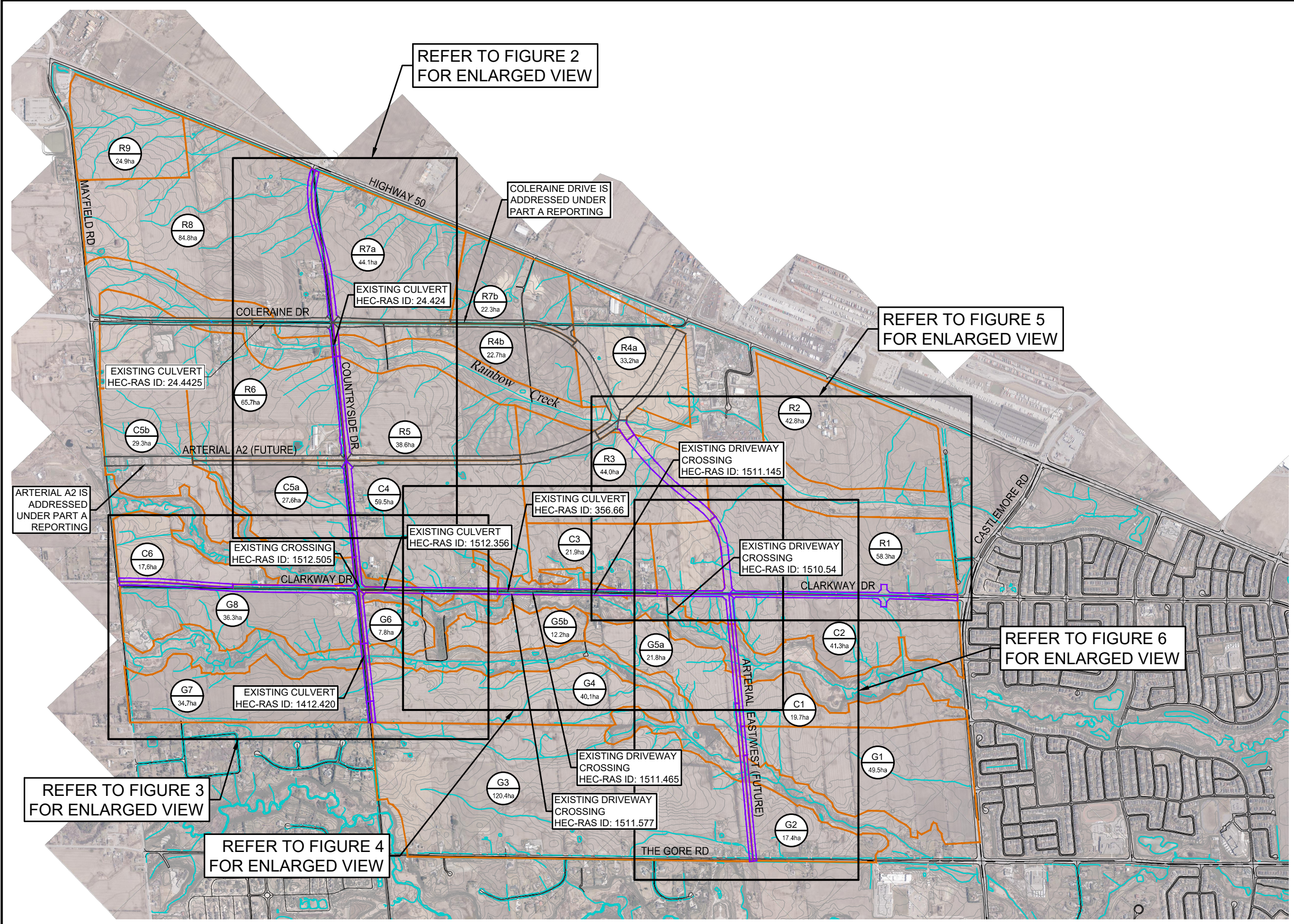
Borehole Log ID	BH Plan Station	Road Profile Station	Ground Surface Elevation (m)	End of Borehole Elevation (m)	GW Depth (m)	GW Level Elev. (m)	Proposed Road Surface Elevation (m)	GW Depth from Proposed Road Surface (m)
<i>Clarkway Drive</i>								
D1	0+000	14+310	205.6	202.6	(Dry)	-	205.6	>3
D2	0+000	14+310	206.0	204.1	(Dry)	-	206.0	>1.9
D3	0+150	14+160	206.0	204.4	(Dry)	-	206.3	>1.9
D5	0+300	14+10	205.7	200.7	(Dry)	-	206.3	>5.6
D6	0+300	14+10	206.1	204.3	(Dry)	-	206.3	>2
D7	0+450	13+860	205.9	202.9	(Dry)	-	206.0	>3.1
D8	0+450	13+860	205.6	204.7	(Dry)	-	206.0	>1.3
D9	0+600	13+710	207.0	205.5	(Dry)	-	206.9	>1.4
D11	0+750	13+560	207.9	202.9	(Dry)	-	207.8	>4.9
D13	0+900	13+410	209.3	206.2	(Dry)	-	208.8	>2.6
D15	1+050	13+260	209.5	208.0	(Dry)	-	209.8	>1.8
D17	1+200	13+110	210.5	205.3	(Dry)	-	210.7	>5.4
D18	1+200	13+110	210.1	208.2	(Dry)	-	210.7	>2.5
D19	1+350	12+960	210.6	207.6	(Dry)	-	211.4	>3.8
D21	1+500	12+810	209.0	207.5	(Dry)	-	210.9	>3.4
D23	1+650	12+660	209.2	204.2	(Dry)	-	210.0	>5.8
D25	1+800	12+510	209.1	206.0	(Dry)	-	209.2	>3.2
D27	1+950	12+360	208.6	207.1	(Dry)	-	208.9	>1.8
D29	2+100	12+210	211.7	209.9	(Dry)	-	210.1	>0.2
D31	2+250	12+60	210.0	206.5	(Dry)	-	211.5	>4.9
D32	2+250	12+60	208.3	206.4	(Dry)	-	211.5	>5
D33	2+400	11+910	214.0	212.2	(Dry)	-	212.6	>0.4
D35	2+550	11+760	212.9	207.9	(Dry)	-	213.7	>5.8
D36	2+550	11+760	211.9	210.1	(Dry)	-	213.7	>3.6
D37	2+700	11+610	214.5	210.9	(Dry)	-	214.8	>3.9
D38	2+700	11+610	215.3	213.4	(Dry)	-	214.8	>1.4
D39	2+850	11+460	213	211	(Dry)	-	215.8	>4.8
D40	2+850	11+460	212.9	207.9	(Dry)	-	215.8	>7.9
D41	3+000	11+310	213.9	211.7	(Dry)	-	216.9	>5.2
D43	3+150	11+160	217.5	214	(Dry)	-	217.9	>3.9
D44	3+150	11+160	216.8	215	(Dry)	-	217.9	>2.9
D45	3+300	11+10	218.8	217	(Dry)	-	219.0	>2
D47	3+450	10+860	219.9	214.9	(Dry)	-	220.1	>5.2
D48	3+450	10+860	219.9	218	(Dry)	-	220.1	>2.1
D49	3+600	10+710	220.8	217.3	(Dry)	-	221.1	>3.8
D50	3+600	10+710	220.8	219	(Dry)	-	221.1	>2.1
D51	3+750	10+560	221.5	219.5	(Dry)	-	222.2	>2.7
D53	3+900	10+410	222	217	(Dry)	-	223.2	>6.2
D54	3+900	10+410	221.7	219.9	(Dry)	-	223.2	>3.3
D55	4+050	10+260	222.5	219	(Dry)	-	224.3	>5.3
D56	4+050	10+260	222	220.2	(Dry)	-	224.3	>4.1
D57	4+200	10+110	223.6	221.6	(Dry)	-	225.4	>3.8

Appendix C: Plans



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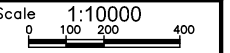
Plotted By: richard.bartolo
Last Saved By: richard.bartolo
2021-11-05
2021-11-05



LEGEND

- EXISTING ROADWAY
- WATERCOURSE
- CONTOUR (0.5m)
- ROAD DRAINAGE 'PART A'**
- SUBCATCHMENT BOUNDARY
- ROAD DRAINAGE 'PART B'**
- SUBCATCHMENT BOUNDARY
- MESP DEVELOPMENT DRAINAGE**
- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID#
- SUBCATCHMENT AREA

SCALE VALID ONLY FOR 24"x36" VERSION



ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
CITY OF BRAMPTON
REGION OF PEEL

SUBCATCHMENT
BOUNDARY PLAN
(EXISTING CONDITION)

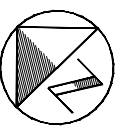
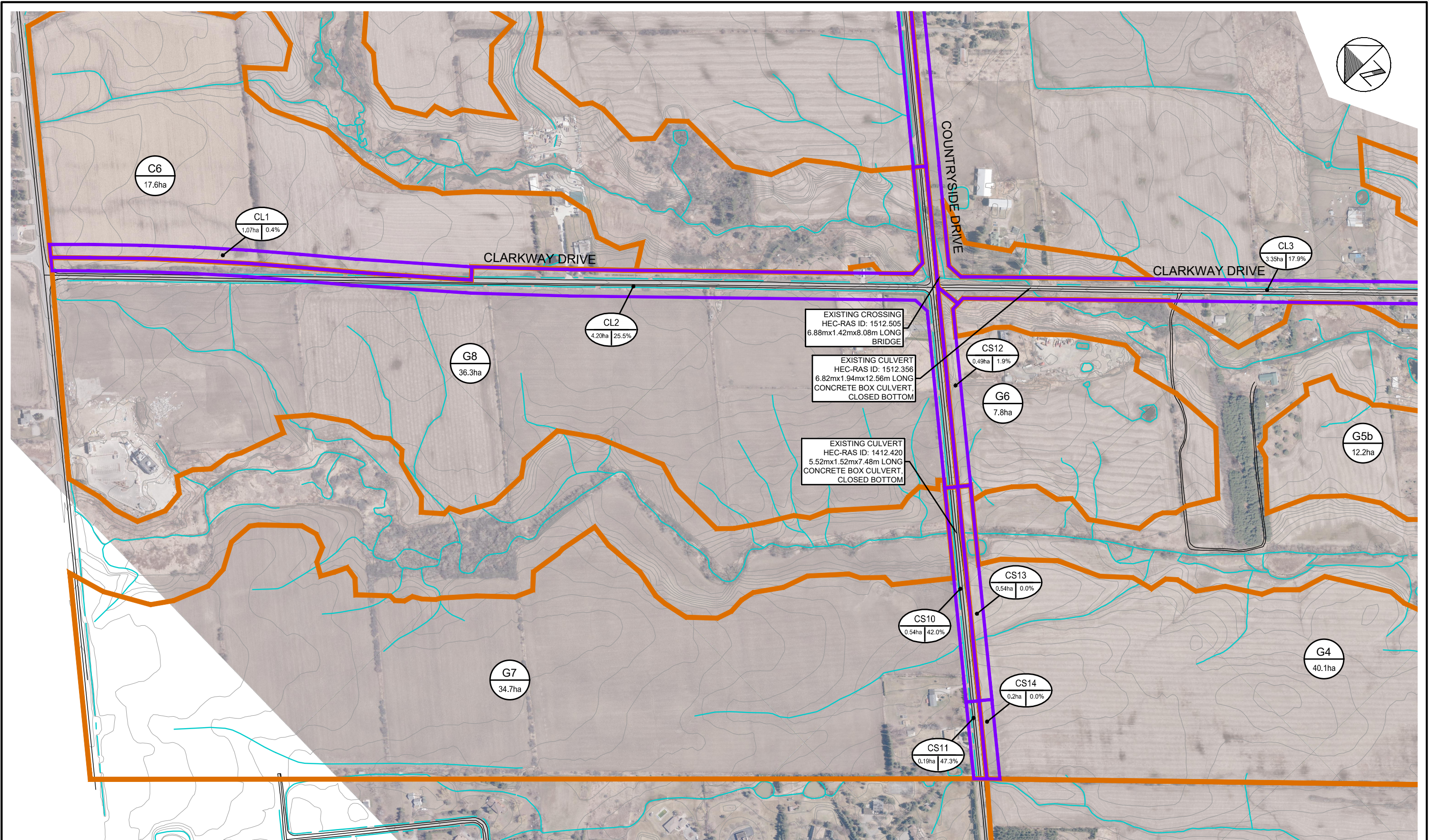


Consultant File No.
TP115086

Plan No.
1

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Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
 2021-11-05

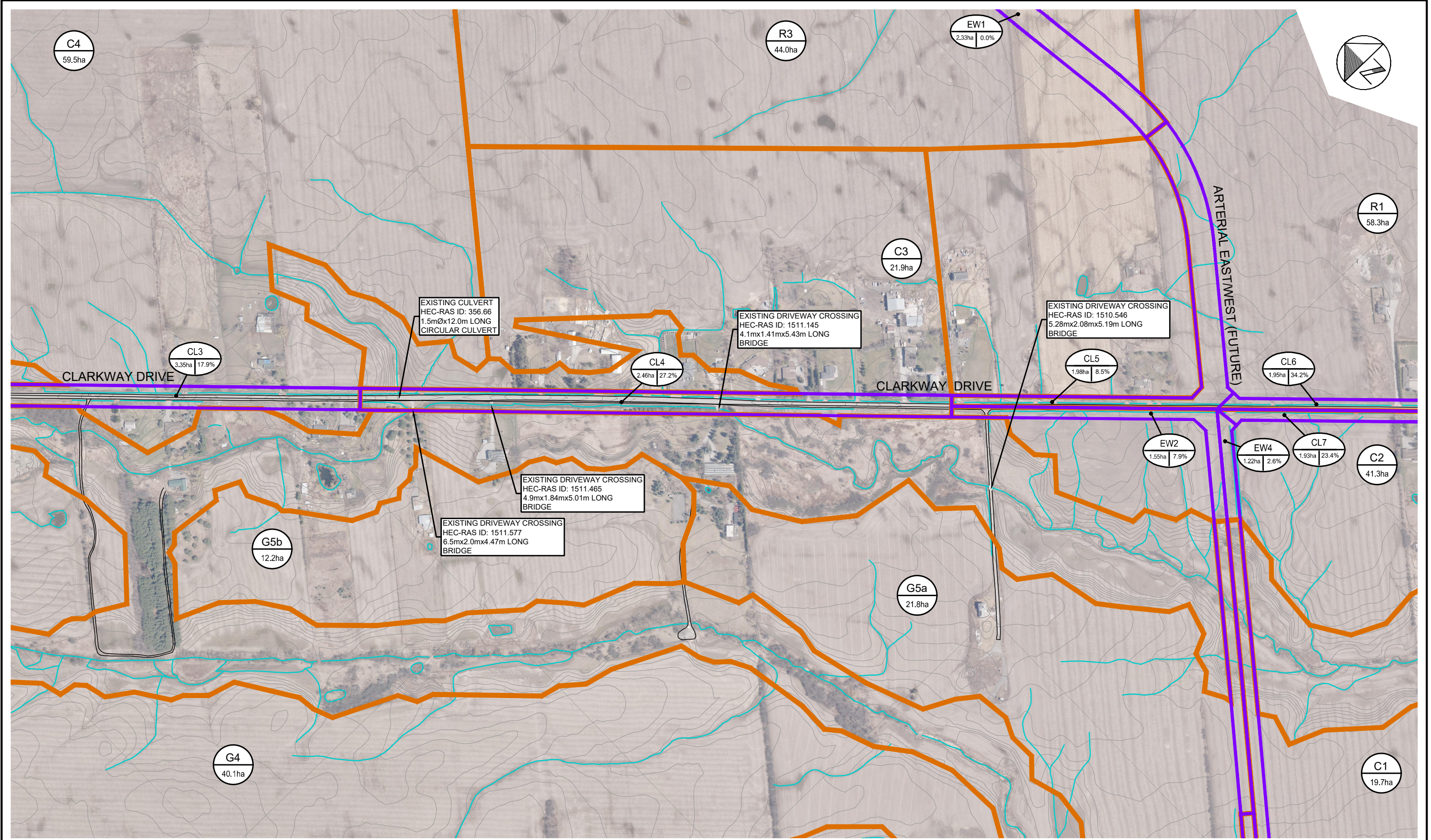


LEGEND

- | | | | |
|--|--|--|--|
| <ul style="list-style-type: none"> EXISTING ROADWAY WATERCOURSE CONTOUR (0.5m) | <p>ROAD DRAINAGE 'PART A'</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA | <p>ROAD DRAINAGE 'PART B'</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA | <p>MESP DEVELOPMENT DRAINAGE</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# SUBCATCHMENT AREA |
|--|--|--|--|

<p>ENVIRONMENTAL ASSESSMENT ARTERIAL ROADS - AREA 47 CITY OF BRAMPTON REGION OF PEEL</p>	<p>SUBCATCHMENT BOUNDARY PLAN (EXISTING CONDITION)</p>		<p>SCALE VALID ONLY FOR 24"x36" VERSION</p> <p>Scale 1:2500 </p> <p>Consultant File No. TP115086</p> <p>Plan No. 3</p>
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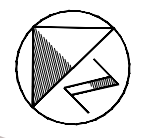
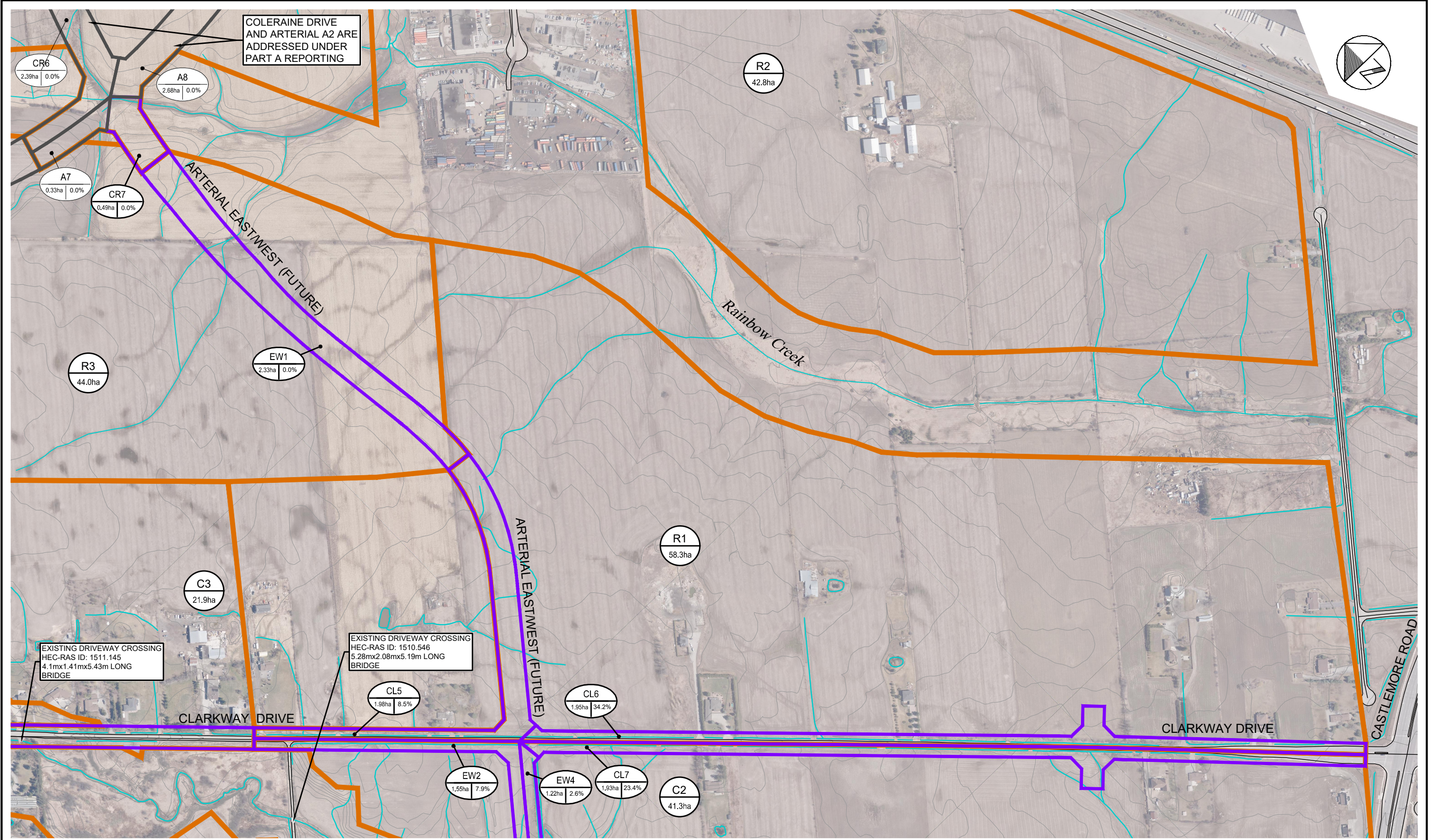
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LEGEND	ROAD DRAINAGE 'PART A'	ROAD DRAINAGE 'PART B'	MESP DEVELOPMENT DRAINAGE
EXISTING ROADWAY	SUBCATCHMENT BOUNDARY	SUBCATCHMENT BOUNDARY	SUBCATCHMENT BOUNDARY
WATERCOURSE	SUBCATCHMENT ID#	SUBCATCHMENT ID#	SUBCATCHMENT ID#
CONTOUR (0.5m)	PERCENTAGE OF IMPERVIOUS AREA	PERCENTAGE OF IMPERVIOUS AREA	SUBCATCHMENT AREA
	SUBCATCHMENT AREA	SUBCATCHMENT AREA	

ENVIRONMENTAL ASSESSMENT ARTERIAL ROADS - AREA 47 CITY OF BRAMPTON REGION OF PEEL	SUBCATCHMENT BOUNDARY PLAN (EXISTING CONDITION)		SCALE VALID ONLY FOR 24"x36" VERSION
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			Consultant File No. TP115086
			Plan No. 4

Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
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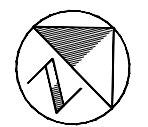
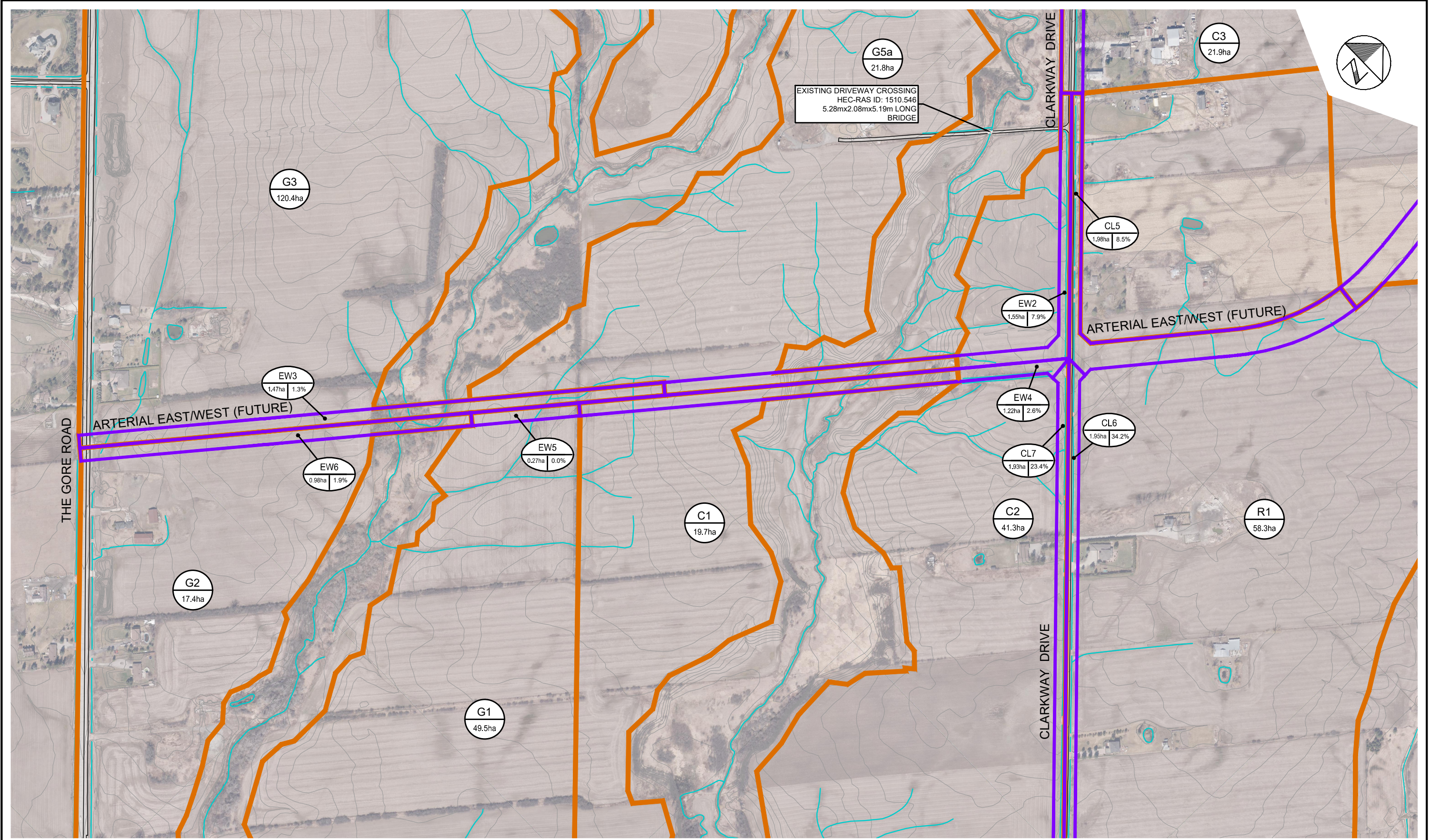
LEGEND

	EXISTING ROADWAY		ROAD DRAINAGE 'PART A'		ROAD DRAINAGE 'PART B'		MESP DEVELOPMENT DRAINAGE
	WATERCOURSE		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY
	CONTOUR (0.5m)		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
			PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			SUBCATCHMENT AREA		SUBCATCHMENT AREA		

ENVIRONMENTAL ASSESSMENT ARTERIAL ROADS - AREA 47 CITY OF BRAMPTON REGION OF PEEL	SUBCATCHMENT BOUNDARY PLAN (EXISTING CONDITION)		SCALE VALID ONLY FOR 24"x36" VERSION Scale 1:2500 Consultant File No. TP115086 Plan No. 5
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Plotted: 2021-11-05
 Last Saved: 2021-11-05



LEGEND

- EXISTING ROADWAY
- WATERCOURSE
- CONTOUR (0.5m)

ROAD DRAINAGE 'PART A'

- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID#
- PERCENTAGE OF IMPERVIOUS AREA
- SUBCATCHMENT AREA

ROAD DRAINAGE 'PART B'

- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID#
- PERCENTAGE OF IMPERVIOUS AREA
- SUBCATCHMENT AREA

MESP DEVELOPMENT DRAINAGE

- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID#
- SUBCATCHMENT AREA

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (EXISTING CONDITION)



SCALE VALID ONLY FOR 24"x36" VERSION

Scale 1:2500
 0 25 50 100

Consultant File No. TP115086

Plan No. 6



REFER TO FIGURE 6 FOR ENLARGED VIEW

REFER TO FIGURE 8 FOR ENLARGED VIEW

RAINBOW CREEK PROPOSED TO BE REALIGNED (BY OTHERS) IN THIS LOCATION

COUNTRYSIDE DRIVE WILL BE ADDRESSED UNDER PART B REPORTING

PROPOSED CROSSING REPLACEMENT (PART 'B' ROADS) 17.0mx2.0mx53.4m

CULVERT ID: 24.4425 PROPOSED CROSSING REPLACEMENT 17.0mx2.2mx47.3m LONG BRIDGE

RAINBOW CREEK PROPOSED TO BE MODIFIED (BY OTHERS) IN THIS LOCATION

CULVERT ID: 24.343 PROPOSED NEW CROSSING 25.0mx2.5mx75.0m LONG BRIDGE

RAINBOW CREEK PROPOSED TO BE REALIGNED (BY OTHERS) IN THIS LOCATION

EAST/WEST ARTERIAL WILL BE ADDRESSED UNDER PART B REPORTING

CLARKWAY DRIVE WILL BE ADDRESSED UNDER PART B REPORTING

REFER TO FIGURE 7 FOR ENLARGED VIEW

- LEGEND**
- EXISTING ROADWAY
 - WATERCOURSE
 - CONTOUR (0.5m)
 - ROAD DRAINAGE 'PART A'**
 - SUBCATCHMENT BOUNDARY
 - MAJOR/MINOR SYSTEM FLOW DIRECTION
 - ROAD DRAINAGE 'PART B'**
 - SUBCATCHMENT BOUNDARY
 - MAJOR/MINOR SYSTEM FLOW DIRECTION
 - MESP DEVELOPMENT DRAINAGE**
 - SUBCATCHMENT BOUNDARY
 - SUBCATCHMENT ID#
 - SUBCATCHMENT AREA
 - STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#

SCALE VALID ONLY FOR 24"x36" VERSION

Scale 1:6000

0 50 100 200

Consultant File No. TP115086

Plan No. 5

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
CITY OF BRAMPTON
REGION OF PEEL

SUBCATCHMENT
BOUNDARY PLAN
(FUTURE CONDITION)

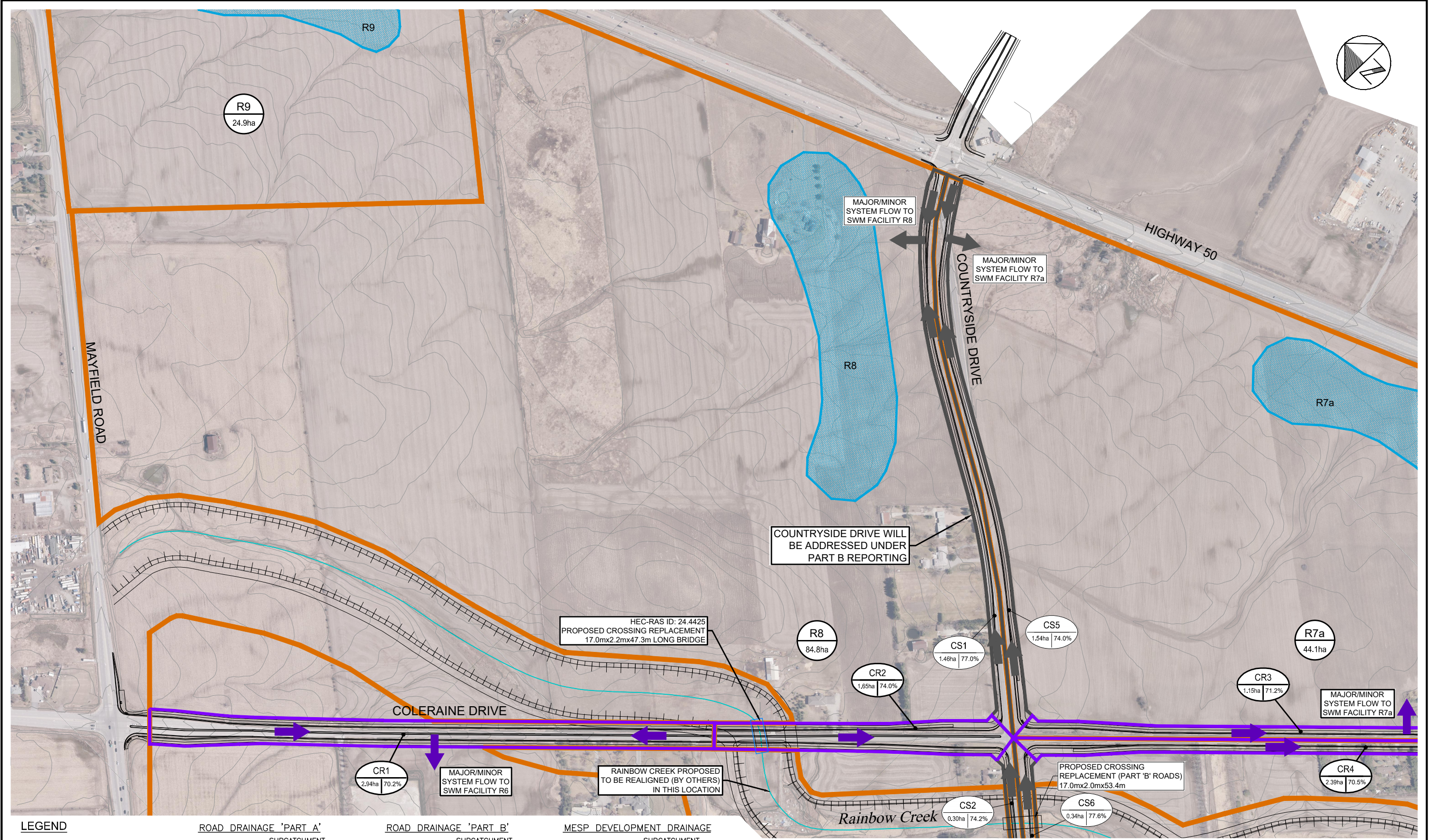


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Last Saved By: richard.bartolo
2021-11-05
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Path: I:\TP115086\06_DES-ENG\01_CAD\02_DWGS\05_WR\01_PRCU\2021-08(PIA-Rev)\Fig6-8 Catchment-Fut.dwg

Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
 Last Saved: 2021-11-05



LEGEND		ROAD DRAINAGE 'PART A'	ROAD DRAINAGE 'PART B'	MESP DEVELOPMENT DRAINAGE
	EXISTING ROADWAY			
	WATERCOURSE			
	CONTOUR (0.5m)			
		SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA MAJOR/MINOR SYSTEM FLOW DIRECTION	SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA MAJOR/MINOR SYSTEM FLOW DIRECTION	SUBCATCHMENT ID# SUBCATCHMENT AREA STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)

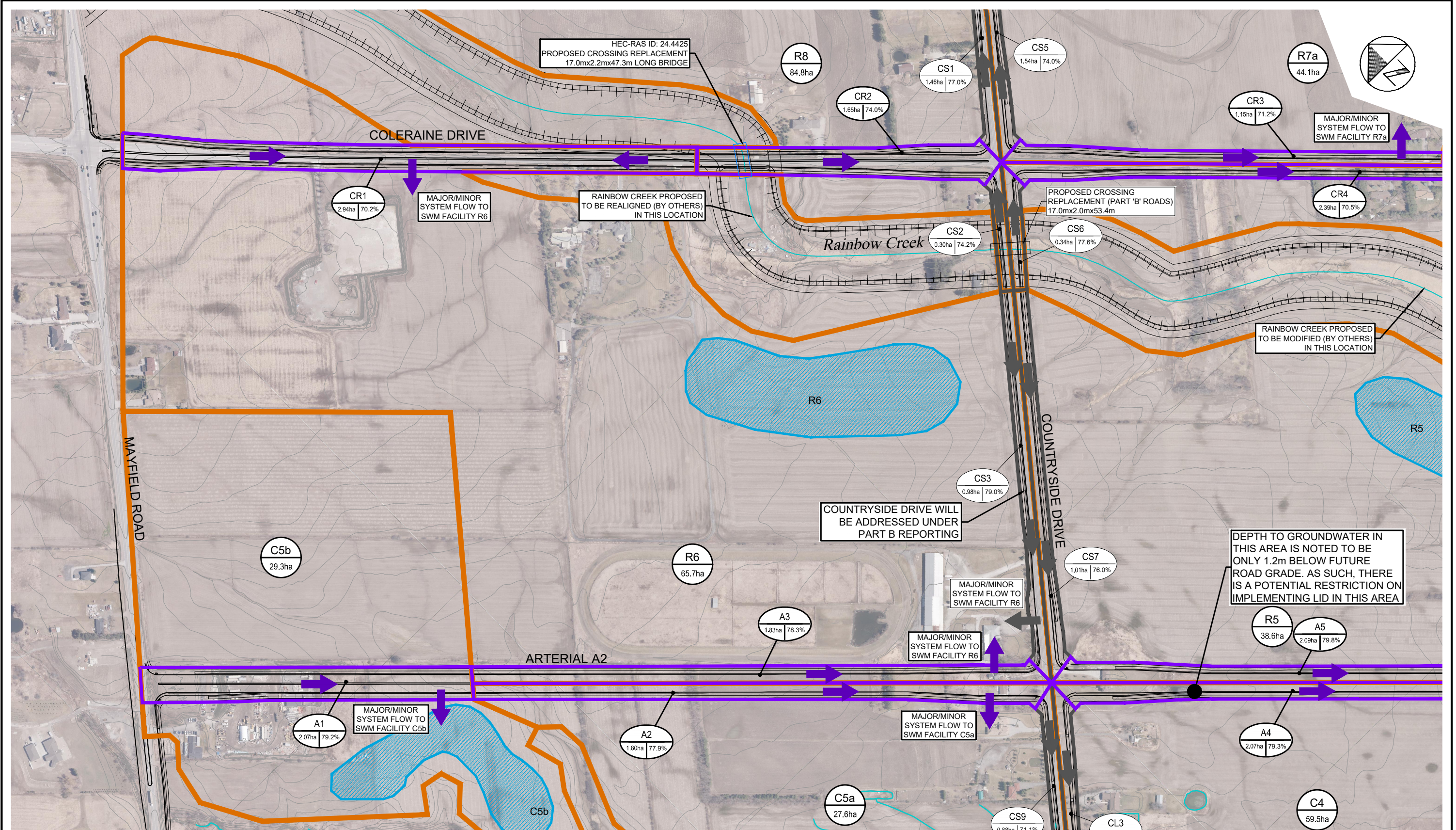


SCALE VALID ONLY FOR 24"x36" VERSION

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Consultant File No. TP115086
 Plan No. 6

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 Last Saved By: richard.bartolo
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LEGEND		ROAD DRAINAGE 'PART A'		ROAD DRAINAGE 'PART B'		MESP DEVELOPMENT DRAINAGE	
	EXISTING ROADWAY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY
	WATERCOURSE		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
	CONTOUR (0.5m)		PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			SUBCATCHMENT AREA		SUBCATCHMENT AREA		STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#
			MAJOR/MINOR SYSTEM FLOW DIRECTION		MAJOR/MINOR SYSTEM FLOW DIRECTION		

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

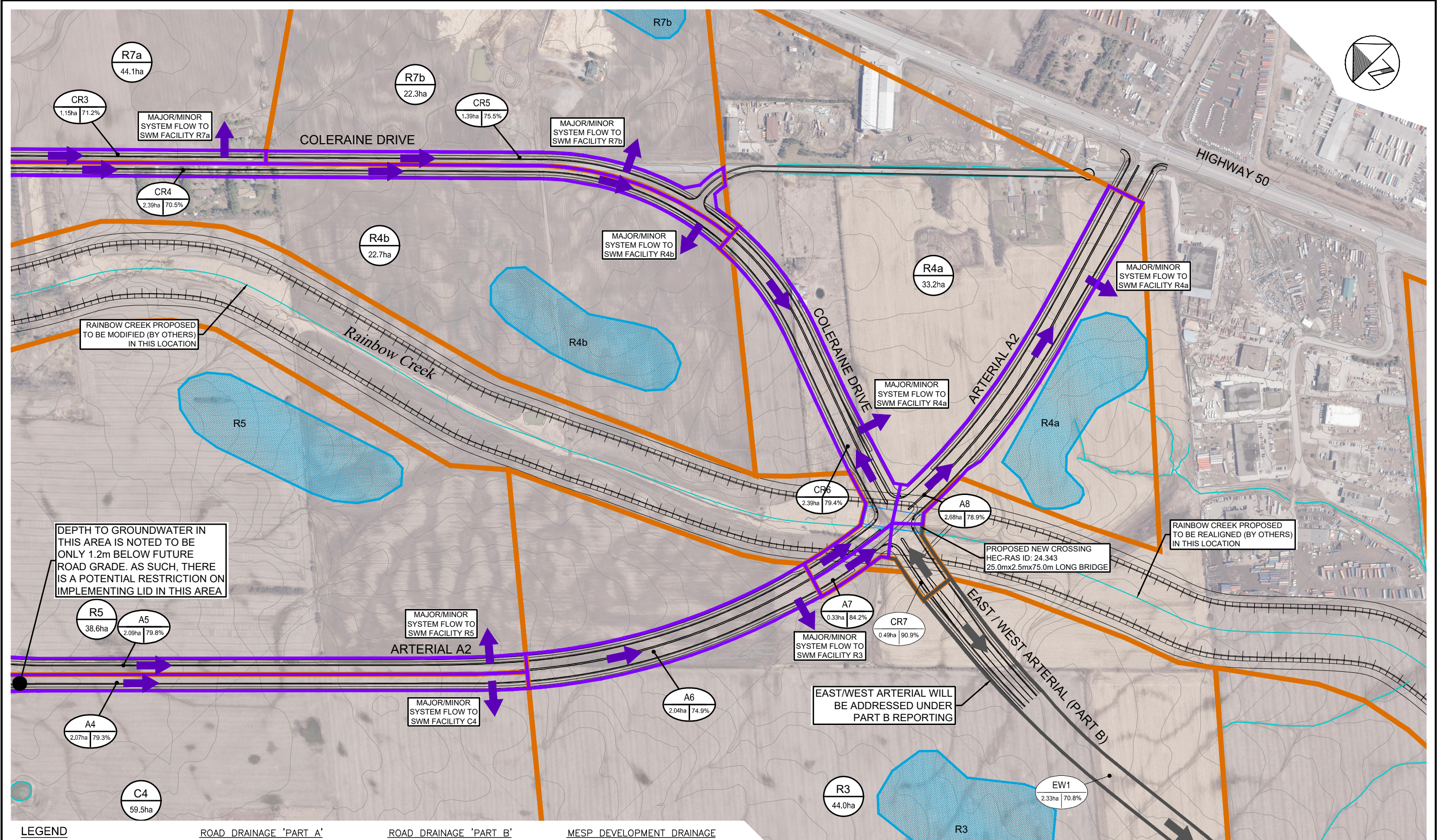
SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



SCALE VALID ONLY FOR 24"x36" VERSION
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 Consultant File No. TP115086
 Plan No. 7

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Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
 Last Saved: 2021-11-05



DEPTH TO GROUNDWATER IN THIS AREA IS NOTED TO BE ONLY 1.2m BELOW FUTURE ROAD GRADE. AS SUCH, THERE IS A POTENTIAL RESTRICTION ON IMPLEMENTING LID IN THIS AREA

RAINBOW CREEK PROPOSED TO BE MODIFIED (BY OTHERS) IN THIS LOCATION

RAINBOW CREEK PROPOSED TO BE REALIGNED (BY OTHERS) IN THIS LOCATION

PROPOSED NEW CROSSING
 HEC-RAS ID: 24.343
 25.0m x 2.5m x 75.0m LONG BRIDGE

EAST/WEST ARTERIAL WILL BE ADDRESSED UNDER PART B REPORTING

LEGEND		ROAD DRAINAGE 'PART A'		ROAD DRAINAGE 'PART B'		MESP DEVELOPMENT DRAINAGE	
	EXISTING ROADWAY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY
	WATERCOURSE		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
	CONTOUR (0.5m)		PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			MAJOR/MINOR SYSTEM FLOW DIRECTION		MAJOR/MINOR SYSTEM FLOW DIRECTION		STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

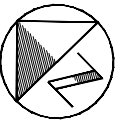
SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



SCALE VALID ONLY FOR 24"x36" VERSION

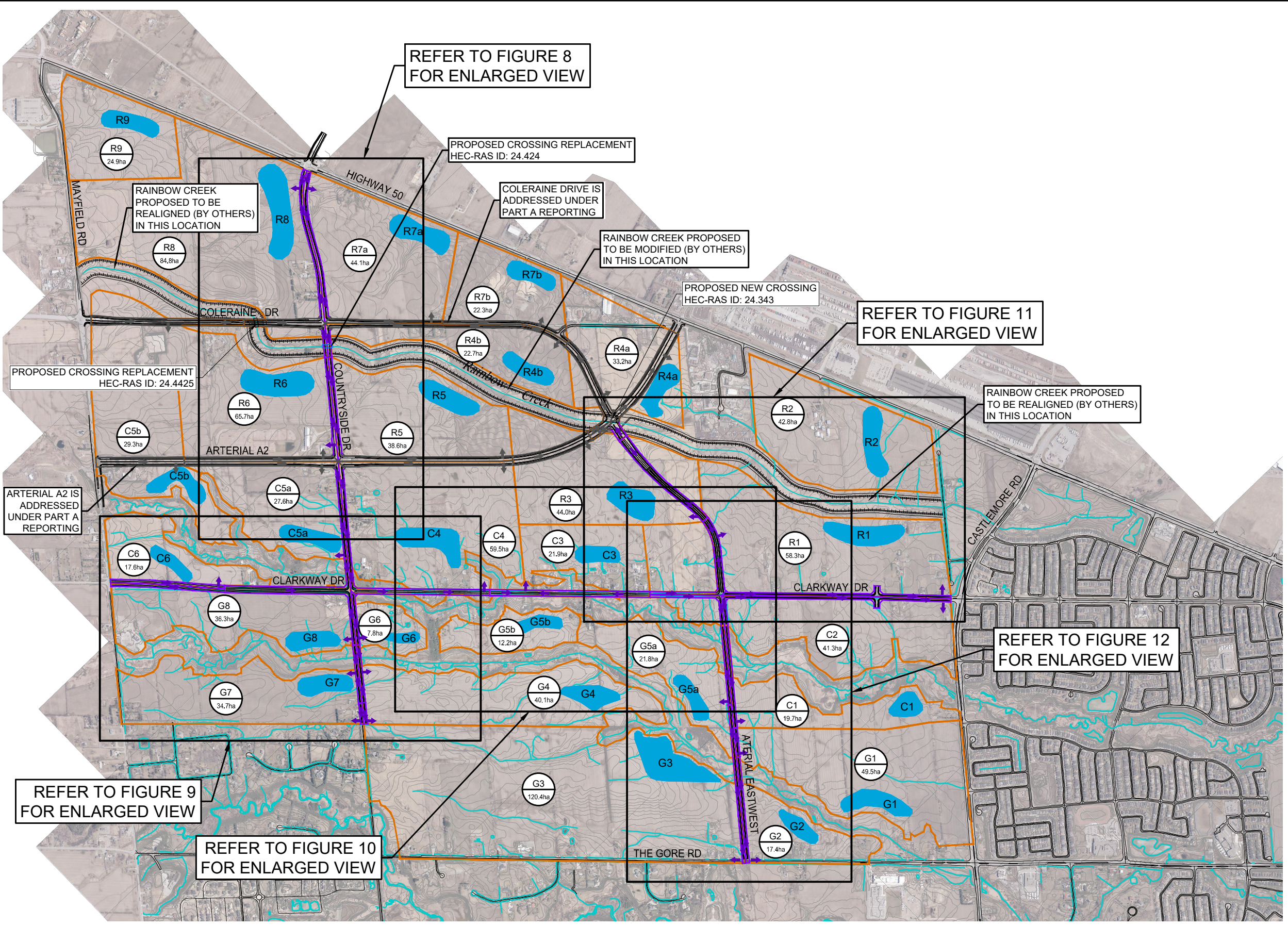
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Consultant File No. TP115086
 Plan No. 8



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Plotted By: richard.bartolo
Last Saved By: richard.bartolo
2021-11-05
Last Saved: 2021-11-05



REFER TO FIGURE 8 FOR ENLARGED VIEW

PROPOSED CROSSING REPLACEMENT
HEC-RAS ID: 24.424

RAINBOW CREEK PROPOSED TO BE REALIGNED (BY OTHERS) IN THIS LOCATION

COLERAINE DRIVE IS ADDRESSED UNDER PART A REPORTING

RAINBOW CREEK PROPOSED TO BE MODIFIED (BY OTHERS) IN THIS LOCATION

PROPOSED NEW CROSSING
HEC-RAS ID: 24.343

REFER TO FIGURE 11 FOR ENLARGED VIEW

PROPOSED CROSSING REPLACEMENT
HEC-RAS ID: 24.4425

RAINBOW CREEK PROPOSED TO BE REALIGNED (BY OTHERS) IN THIS LOCATION

ARTERIAL A2 IS ADDRESSED UNDER PART A REPORTING

REFER TO FIGURE 12 FOR ENLARGED VIEW

REFER TO FIGURE 9 FOR ENLARGED VIEW

REFER TO FIGURE 10 FOR ENLARGED VIEW

LEGEND

- EXISTING ROADWAY
- WATERCOURSE
- CONTOUR (0.5m)
- ROAD DRAINAGE 'PART A'**
- SUBCATCHMENT BOUNDARY
- MAJOR/MINOR SYSTEM FLOW DIRECTION
- ROAD DRAINAGE 'PART B'**
- SUBCATCHMENT BOUNDARY
- MAJOR/MINOR SYSTEM FLOW DIRECTION
- MESP DEVELOPMENT DRAINAGE**
- SUBCATCHMENT BOUNDARY
- SUBCATCHMENT ID#
- SUBCATCHMENT AREA
- STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#

SCALE VALID ONLY FOR 24"x36" VERSION

Scale 1:6000
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Consultant File No. TP115086

Plan No. 7

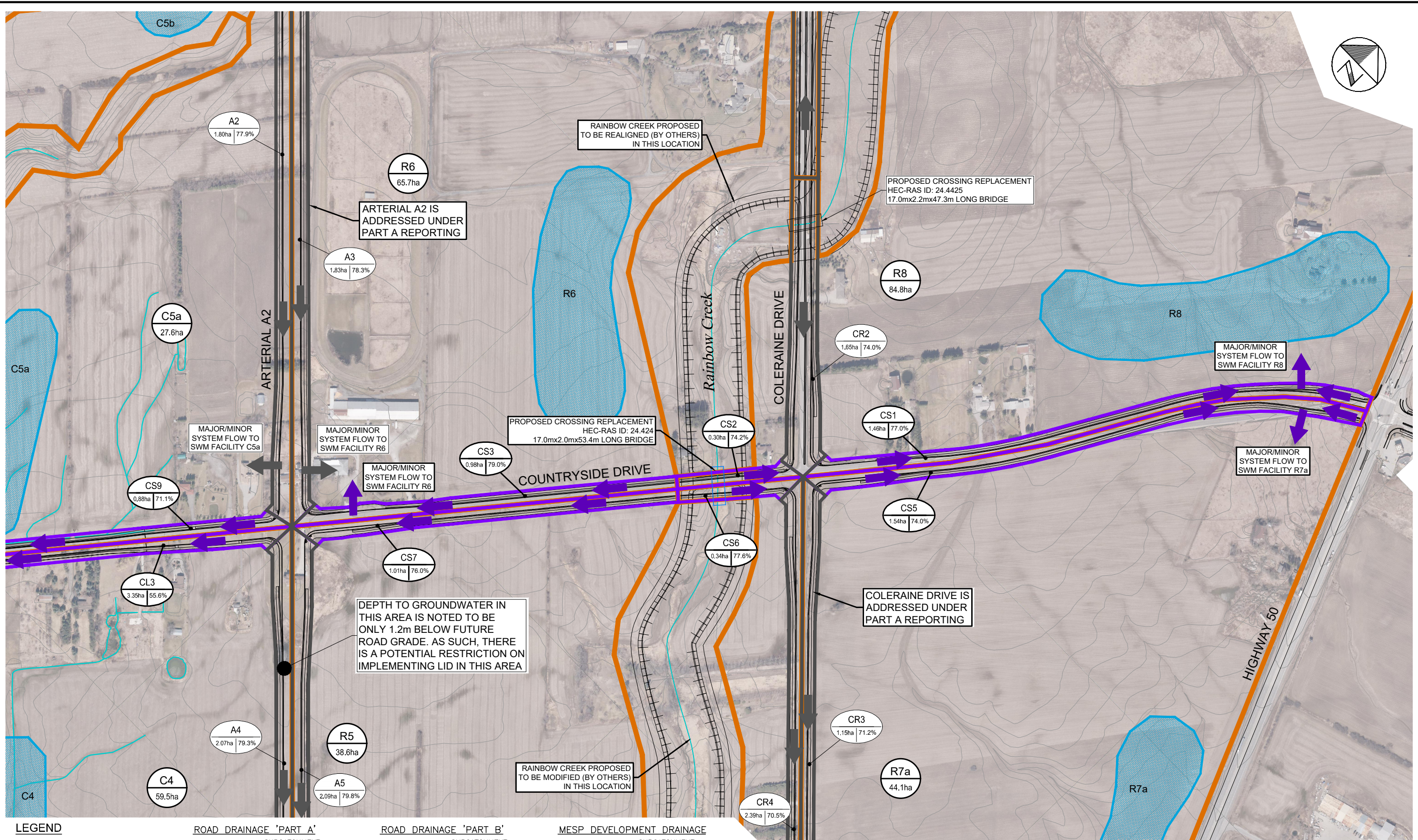
ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
CITY OF BRAMPTON
REGION OF PEEL

SUBCATCHMENT
BOUNDARY PLAN
(FUTURE CONDITION)



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Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
 Last Saved: 2021-11-05



LEGEND		ROAD DRAINAGE 'PART A'		ROAD DRAINAGE 'PART B'		MESP DEVELOPMENT DRAINAGE	
	EXISTING ROADWAY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY
	WATERCOURSE		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
	CONTOUR (0.5m)		PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			SUBCATCHMENT AREA		SUBCATCHMENT AREA		STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#
			MAJOR/MINOR SYSTEM FLOW DIRECTION		MAJOR/MINOR SYSTEM FLOW DIRECTION		

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



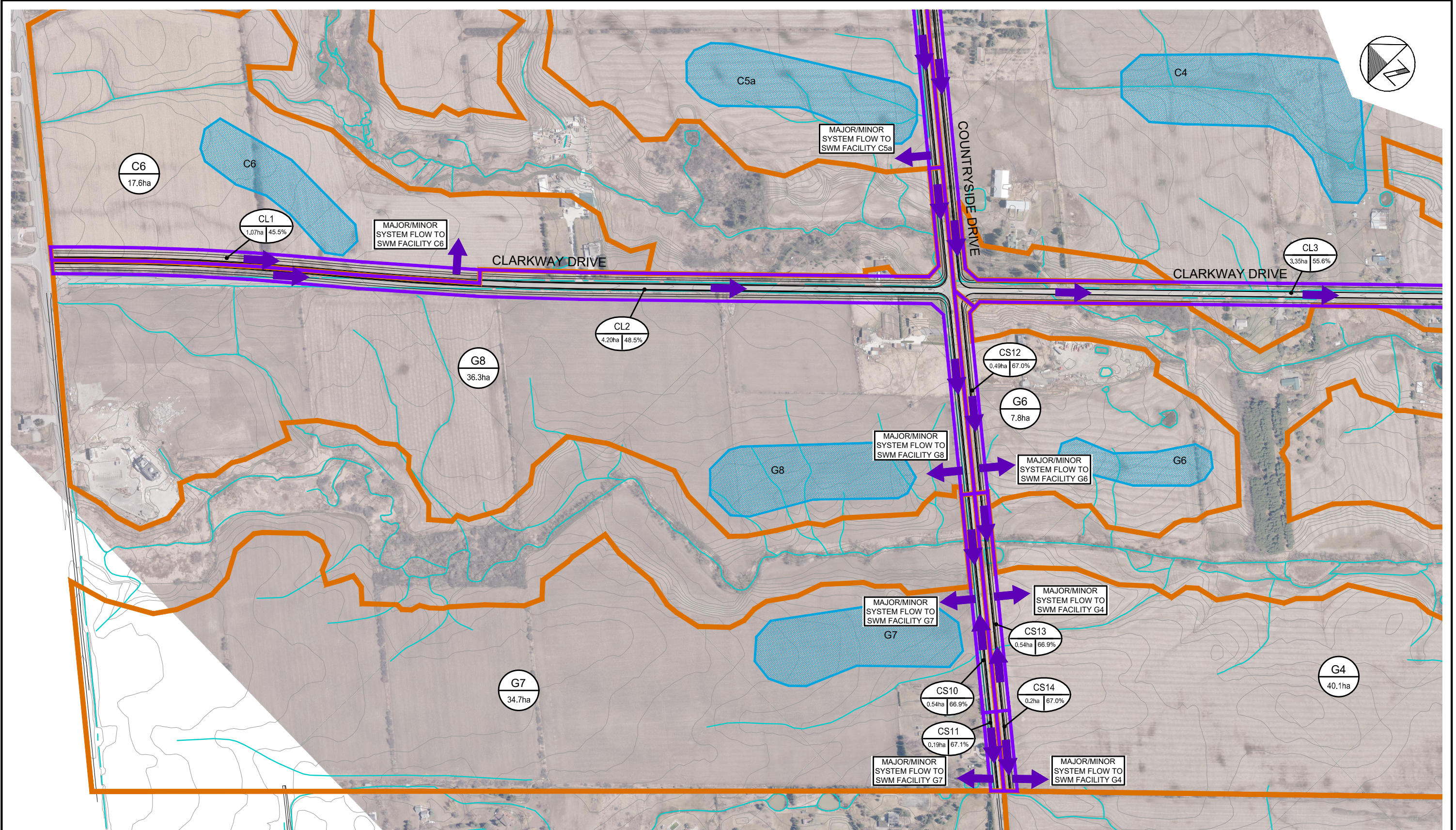
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Consultant File No. TP115086
 Plan No. 8

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Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 2021-11-05
 Last Saved: 2021-11-05



LEGEND

- | | | | |
|--|--|--|---|
| <p>EXISTING ROADWAY</p> <p>WATERCOURSE</p> <p>CONTOUR (0.5m)</p> | <p>ROAD DRAINAGE 'PART A'</p> <p>SUBCATCHMENT BOUNDARY</p> <p>SUBCATCHMENT ID#</p> <p>PERCENTAGE OF IMPERVIOUS AREA</p> <p>SUBCATCHMENT AREA</p> <p>MAJOR/MINOR SYSTEM FLOW DIRECTION</p> | <p>ROAD DRAINAGE 'PART B'</p> <p>SUBCATCHMENT BOUNDARY</p> <p>SUBCATCHMENT ID#</p> <p>PERCENTAGE OF IMPERVIOUS AREA</p> <p>SUBCATCHMENT AREA</p> <p>MAJOR/MINOR SYSTEM FLOW DIRECTION</p> | <p>MESP DEVELOPMENT DRAINAGE</p> <p>SUBCATCHMENT BOUNDARY</p> <p>SUBCATCHMENT ID#</p> <p>SUBCATCHMENT AREA</p> <p>STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#</p> |
|--|--|--|---|

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



SCALE VALID ONLY FOR 24"x36" VERSION

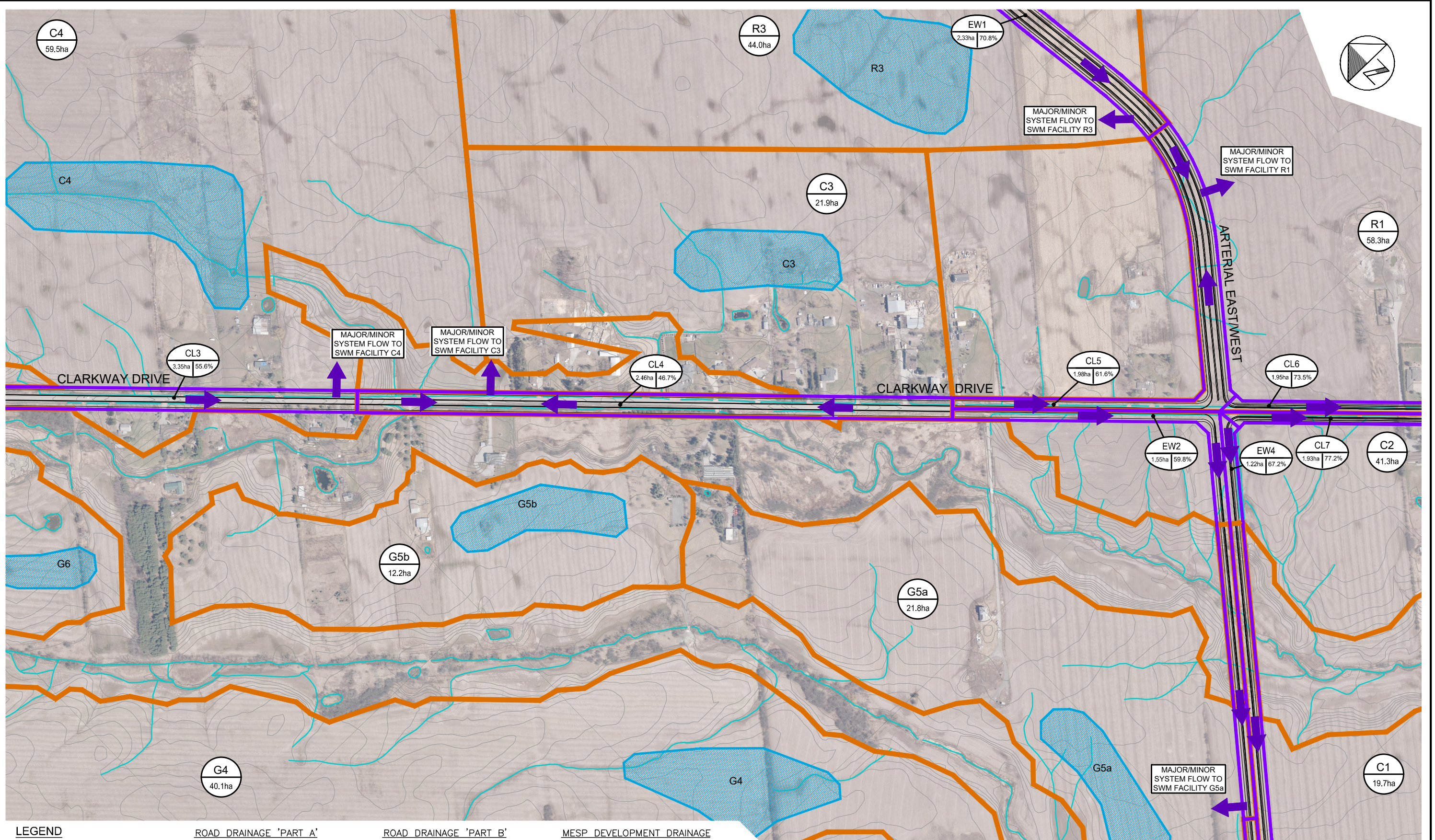
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Consultant File No. TP115086

Plan No. 9

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 2021-11-05
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LEGEND

- | | | | |
|--|--|--|--|
| <ul style="list-style-type: none"> EXISTING ROADWAY WATERCOURSE CONTOUR (0.5m) | <p>ROAD DRAINAGE 'PART A'</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA MAJOR/MINOR SYSTEM FLOW DIRECTION | <p>ROAD DRAINAGE 'PART B'</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# PERCENTAGE OF IMPERVIOUS AREA SUBCATCHMENT AREA MAJOR/MINOR SYSTEM FLOW DIRECTION | <p>MESP DEVELOPMENT DRAINAGE</p> <ul style="list-style-type: none"> SUBCATCHMENT BOUNDARY SUBCATCHMENT ID# SUBCATCHMENT AREA STORMWATER MANAGEMENT FACILITY AND REFERENCE ID# |
|--|--|--|--|

SCALE VALID ONLY FOR 24"x36" VERSION

Scale 1:2500

Consultant File No. TP115086

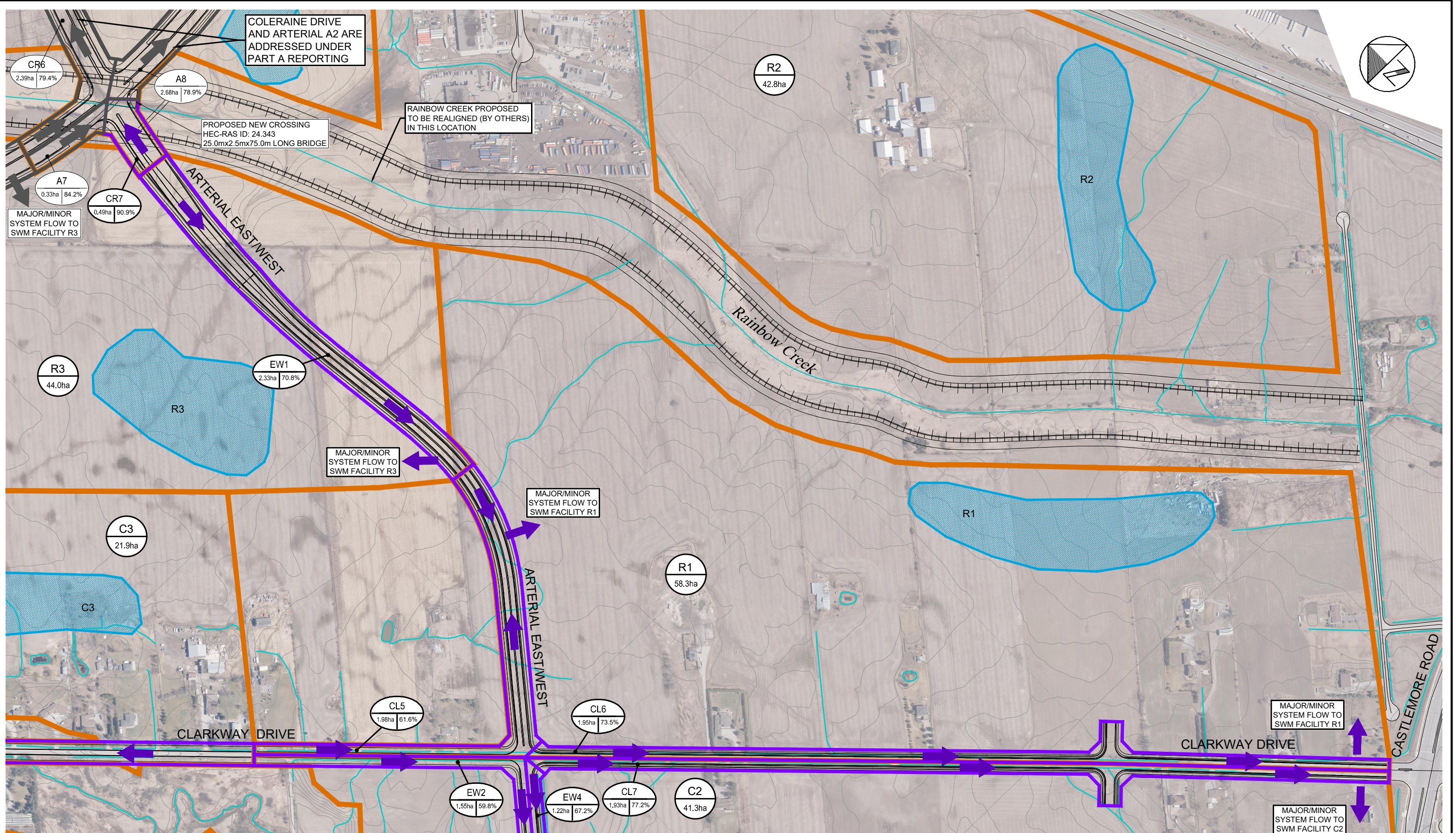
Plan No. 10

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



Plotted: 2021-11-05
 Last Saved: 2021-11-05
 Plotted By: richard.bartolo
 Last Saved By: richard.bartolo
 Path: I:\P115086\06_DES-ENG\01_CAD\02_DWGS\05_WR\01_PROJ\2021-06(P1B)\Fig8-12_Catchment-Fut(P1B).dwg



LEGEND		ROAD DRAINAGE 'PART A'		ROAD DRAINAGE 'PART B'		MESP DEVELOPMENT DRAINAGE	
	EXISTING ROADWAY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY		SUBCATCHMENT BOUNDARY
	WATERCOURSE		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
	CONTOUR (0.5m)		PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			SUBCATCHMENT AREA		SUBCATCHMENT AREA		STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#
			MAJOR/MINOR SYSTEM FLOW DIRECTION		MAJOR/MINOR SYSTEM FLOW DIRECTION		

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

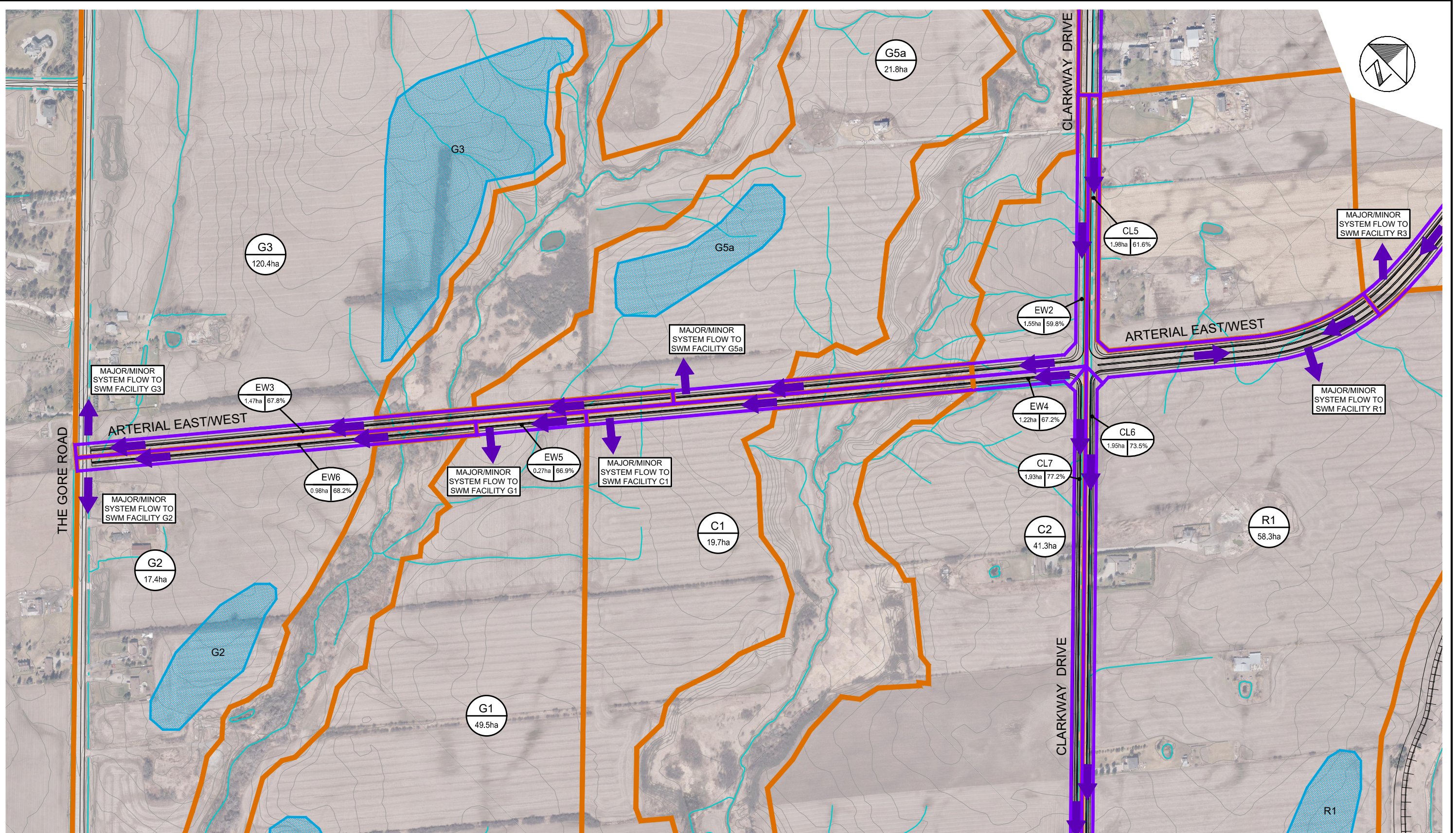
SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



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 Scale 1:2500
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 Consultant File No. TP115086
 Plan No. 11

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 Last Saved By: richard.bartolo
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Plotted: 2021-11-05
 Last Saved: 2021-11-05



LEGEND

	EXISTING ROADWAY		ROAD DRAINAGE 'PART A' SUBCATCHMENT BOUNDARY		ROAD DRAINAGE 'PART B' SUBCATCHMENT BOUNDARY		MESP DEVELOPMENT DRAINAGE SUBCATCHMENT BOUNDARY
	WATERCOURSE		SUBCATCHMENT ID#		SUBCATCHMENT ID#		SUBCATCHMENT ID#
	CONTOUR (0.5m)		PERCENTAGE OF IMPERVIOUS AREA		PERCENTAGE OF IMPERVIOUS AREA		SUBCATCHMENT AREA
			SUBCATCHMENT AREA		SUBCATCHMENT AREA		STORMWATER MANAGEMENT FACILITY AND REFERENCE ID#
			MAJOR/MINOR SYSTEM FLOW DIRECTION		MAJOR/MINOR SYSTEM FLOW DIRECTION		

ENVIRONMENTAL ASSESSMENT
ARTERIAL ROADS - AREA 47
 CITY OF BRAMPTON
 REGION OF PEEL

SUBCATCHMENT BOUNDARY PLAN
 (FUTURE CONDITION)



SCALE VALID ONLY FOR 24"x36" VERSION

Scale 1:2500
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Consultant File No. TP115086
 Plan No. 12