City of Markham

Stormwater Management Report

Markham 404 North Collector Roads MCEA Study

March 5, 2020

Project Number: B000801

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City of Markham

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Markham 404 North Collector Roads MCEA Study

Project Number: B000801

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March 5, 2020
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March 5, 2020

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1. Introduction

The City of Markham retained CIMA+ to complete a Municipal Class Environmental Assessment (MCEA) on the Markham 404 North Employments Lands. Since the approval of the Highway 404 North Secondary Plan (OPA 149), development within the area has proceeded including the Honda Campus, Mobis Parts Canada and Enbridge, and the OPA 149 proposed roadway network is no longer feasible. The MCEA is required to confirm the final alignment of a new north-south and east-west internal collector roads within the Highway 404 North Employment Lands. The purpose of the drainage and stormwater management report is to document existing stormwater conditions and identify any impacts resulting from the proposed changes to the roadway network.

1.1 Study Area

The study area extends from approximately 400 meters north of 19th Ave and south to approximately 600 meters north of Elgin Mills Rd. Highway 404 defines the western limit while the eastern limit is primarily defined by Woodbine Ave with a small area at the south end located east of Woodbine Ave, between Woodbine Ave and a Hydro One transmission corridor.

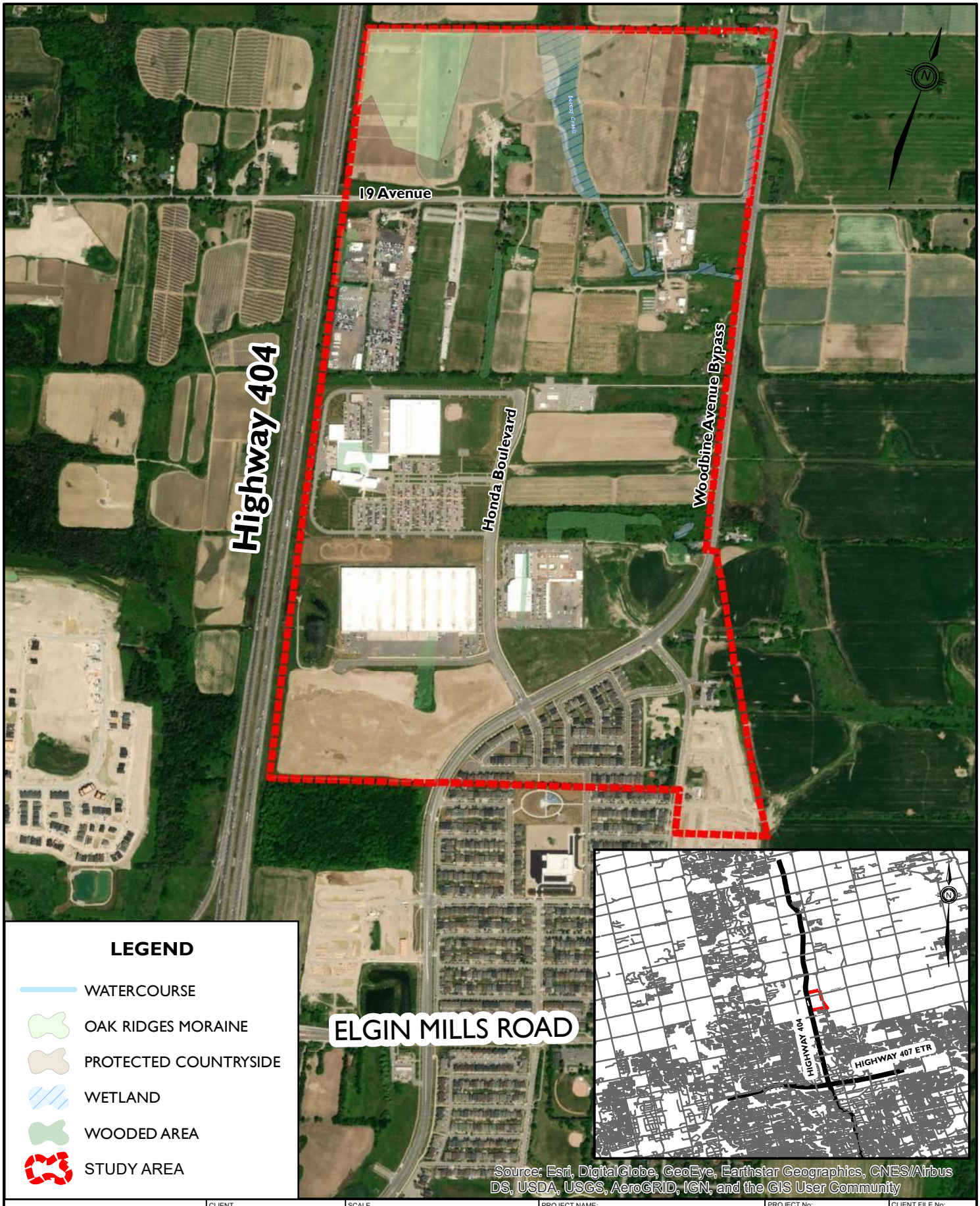
Most of the study area drains into Berczy Creek, which runs through the north eastern portion of the study area. The western portion of the study area drains into a tributary of the Rouge River across Highway 404. Drainage from a small area (approximately 1.35 ha) located in the south west portion of the study area drains to the south to the existing woodlot in the West Cathedral Community and is ultimately tributary to the East Branch of Carlton Creek. The study area is within the jurisdiction of the Toronto and Region Conservation Authority (TRCA).

A map of the study area can be seen on the next page.

1.2 Background Documents

The following background drawings, studies and guidance documents were obtained as part of the SWM Study:

- 404 North Secondary Plan Area (OPA 149) Stormwater Management Master Plan, SCS Consulting Group, 2010;
- OPA 149 Official Plan, City of Markham, 2008;
- City of Markham Engineering Design Criteria, Section E, Storm Drainage and Stormwater Management;
- Highway 404 Crossing Between Elgin Mills Road and 19th Avenue, Class Environmental Assessment Study, Drainage and Stormwater Management Report, MMM Group, 2015;
- Stormwater Management Planning and Design Manual, MOE, 2003;
- Stormwater Management Criteria, TRCA, 2012.



CIMA+

CLIENT: MARKHAM

SCALE: 100 50 0 100 200 300 meters
1:12,000

PROJECT NAME:
MUNICPAL CLASS
ENVIRONMENTAL ASSESSMENT STUDY
HIGHWAY 404 NORTH COLLECTOR ROADS

SHEET TITLE:
STUDY AREA MAP

PROJECT No: B000801		CLIENT FILE No: ---
DRAFTER: B. LEMIEUX	DESIGNER ---	DRAWING No: 1
APPROVER --	APPROVER ---	
DATE: 10/2/2019		SHEET No: 1 of 1

1.2.1 404 North Employment Lands – Stormwater Master Plan

In 2010, SCS Consulting Group Ltd prepared a Stormwater Management Master Plan (SWMMP) for the 404 North Employment Lands. The plan summarizes the 2010 property ownership, existing drainage conditions as well as interim and proposed drainage conditions. The plan also provides preliminary sizing and requirements for all stormwater management facilities.

Interim conditions were required as the various land owners have different development timing objectives, and therefore it is possible that the implementation of the overall storm drainage system may require alternate solutions to reflect the requirements of the various landowners.

The plan also requires on-site quantity controls within the proposed business park developments to control the release rates during a 100-year storm event to a maximum of 180 l/ha/s.

See Appendix A for details on the SCS SWMMP.

1.3 Design Criteria

The western portion of the study area drains west to a tributary of the Rouge River, while the majority of the study area drains east to Berczy Creek. These combine downstream and drain to the Rouge River, within the jurisdiction of the Toronto and Region Conservation Authority (TRCA).

1.3.1 TRCA Criteria

The TRCA developed the SWM Criteria in 2012, outlining storm water management guidelines that must be followed while within their watersheds. The main criteria that must be followed cover water quantity and water quality control.

Water Quantity

The TRCA requires that for developments draining into the Rouge River and its tributaries upstream of Major Mackenzie Dr and Berczy Creek upstream of Warden Ave, that post development peak flows must be controlled to pre-development levels for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50 and 100-year storms).

Water Quality

For all watercourses and water bodies within the TRCA’s jurisdiction, enhanced level of protection (80% TSS removal) is required.

Excerpts from the TRCA Stormwater Management Criteria 2012 document can be found in Appendix B.

Rouge River Watershed Hydrology Study, 2018, Wood

The Rouge River Watershed Hydrology Report, 2018, created by Wood Engineering provides unitary peak flow rates and retention volumes for quantity and quality calculations for proposed

designs. As these reports were publish on the TRCA website after calculations on current designs had been performed, existing calculations will be used. Excerpts of the report can be found in Appendix G.

Erosion Control

The TRCA requires on site retention of 5 mm of rainfall on all newly impervious areas. The implementation of LID within the study area to infiltrate 5 mm storm event for all newly impervious areas should be performed during detailed design.

1.3.2 City of Markham

The City of Markham SWM criteria was reviewed, which set requirements for stormwater quantity and quality within the City of Markham and specifically for the Rouge River and its tributaries.

Water Quantity

The City of Markham requires that for development draining into the Rouge River and its tributaries upstream of Major Mackenzie Drive, that post development peak flows must be controlled to pre-development levels for all storms up to and including the 100-year storm (i.e. 2, 5, 10, 25, 50 and 100-year storms).

Water Quality

For all watercourses within the City of Markham, enhanced level of protection (80% TSS removal) is required.

Wellhead Protection Area – Quantity (WHPA-Q)

The City of Markham has designated a WHPA-Q in which any future development is required to maintain existing groundwater recharge rates. The study area is completely within this WHPA-Q and will therefore require the implementation of LID in order to ensure that existing groundwater recharge rates are met.

Excerpts from the City of Markham Design Criteria, 2016 can be found in Appendix B.

2. Existing Conditions

This section describes the existing conditions drainage and SWM within the study area that will be impacted by the proposed expansion. The drainage characteristics of the site depend on many things, including the topography, local land use and the type of native soil.

2.1 Land use

There are currently three major industrial buildings within the study area. These include Honda Canada, Mobis Parts Canada Corp. and Enbridge Inc. There are two commercial areas located

on 19th Ave, Monument Depot Inc and the 19th Ave Farmers Market. Along the south east of the study area, there is a residential area. The remaining land includes a grouping of sports fields (Fletchers Fields) and a random distribution of farm fields and forested lands.

2.2 Soils

Soil groups in the area were taken from the Ontario Soil Survey Complex. The hydraulic soil groups found in the study area range from B to D. Hydraulic soil groups B, C and D are predominantly silty loam, loam, sandy clay loam and clay. They have moderate to low infiltration rates.

The soils map for the area can be seen in Appendix G.

2.3 Regulation Limits

The TRCA does not have engineered floodplain mapping for the study area. An estimated hydraulic model was used to create regulatory limits for Berzcy Creek within the study area. In 2018, the hydrology model and flows for the creek were updated, but the hydraulic model was not updated and the regulatory limits remain the same. During detailed design, it is recommended to request updated floodplain maps or regulatory limits from the TRCA. If none are available, it may be necessary to update the existing hydraulic model with the updated hydrology.

2.4 Existing Culverts

There are seven existing culverts within the study area. Two culverts are along Berczy Creek running under 19th Avenue and Woodbine Avenue. There are four more culverts along Woodbine Avenue, one of which conveys the flows from SWM Pond B3. The final culvert is located at the outlet of SWM Pond L1 and crosses Highway 404. An analysis of existing conditions was performed by SCS Consulting Group in November 2010 as part of the the Stormwater Management Master Plan, which can be found in Appendix A.

2.5 Existing Storm Water Management Ponds

Currently two of the SWM ponds that were planned in the OPA 149 have been implemented. These ponds are the Interim SWM Pond B3 and Ultimate SWM Pond L1.

Interim Pond B3 provides quantity and quality controls for the central portion of the study area, approximately 70 ha and drains to Berczy Creek. The land use tributary to the pond is industrial parkland, unimproved area and some residential and community amenity uses south of Woodbine Ave.

SWM Pond L1 provides quantity and quality controls for the western portion of the study area, approximately 27 ha, draining into the Tributary of the Rouge River. The proposed land use tributary to Pond L1 is primarily industrial park land.

The remaining land in the study area drains through overland flow and storm ditches into Berczy Creek or the Tributary of the Rouge River. The existing conditions drainage mosaics can be seen in Appendix F.

2.6 Existing Roadway Conditions

Currently a small section of Honda Blvd on the western side of the study area drains to SWM Pond L1, along with an access road along Mobis Parts Canada Corp. The remaining majority of Honda Blvd, as well as Woodbine Ave within the study area drains to SWM Pond B3.

19th Ave drains uncontrolled in multiple directions. The western portion of the roadway drains to the Rouge River, while the central portion drains directly to Berczy Creek and the eastern portion drains through a series of storm ditches into Berczy Creek.

Existing drainage area maps can be seen in Appendix F.

3. Proposed Conditions

The MCEA provides a new proposed roadway network from the OPA 149. Both the OPA 149 proposed roadway network and MCEA proposed roadway network can be seen in Appendix D. The proposed roadway network establishes 5 major parcels for development south of 19th Ave with access onto Honda Blvd, the new east-west collector road or the Victoria Square Blvd Extension. This provides four new internal access roadways serving the planning district which connect directly into the larger road network (19 Ave and Woodbine Ave). The proposed network also provides access to development parcels north of 19th Ave.

Based on the MCEA proposed roadway network, there will be an incremental decrease in the amount of roadway within the study area, and an incremental increase in the amount of commercial/industrial available land from the OPA 149 plan.

3.1 Future Land Use

Future land use is detailed in the official plan created by the City of Markham. The entire area, other than a 9-ha area designated for Berczy Creek and associated valley land, will be urbanized. The total impervious based on this land use will be approximately 60%.

An excerpt of the table from the City of Markham official plan can be seen in Appendix C.

3.2 Regulation Limits

Portions of Roadway A, Roadway D, SWM Pond B1 and SWM Pond B2 are within TRCA's regulation limits. Therefore, a TRCA regulation permit will be required for works within the regulated areas. There are no proposed roadways crossing Berczy Creek that will require hydraulic analysis within the study area.

During detailed design, the floodplain mapping and associated hydraulic modeling within the study area should be updated to reflect the most current hydrologic studies.

3.3 Proposed Roadway Conditions

Multiple roadways have been proposed for the study area. For the purposes of this report, road names have been based on the assessment of the Markham 404 Collectors EA performed by CIMA+. The preferred MCEA collector roadway network can be seen in Appendix D.

- Proposed roadway E1 has a Right of Way (ROW) of approximately 1.56 ha. Storm drainage will be conveyed via storm sewers south into the proposed SWM Pond B3.
- Proposed roadways D, C1 and B have a ROW of approximately 3.43 ha. Storm drainage will be conveyed via storm sewers south east into the proposed SWM Pond B2.
- Proposed roadway A drains in two directions. The western portion of the roadway ROW, 0.81 ha, drains south via storm sewers to proposed SWM Pond B1. The eastern portion of the roadway ROW, 0.32 ha, drains uncontrolled to Berczy Creek via storm sewers. It may be necessary to include an Oil and Grit Separator (OGS) at the outlet of the uncontrolled flow to ensure that the runoff meets necessary quality control standards.

Table 1: Drainage Area Outlet

Roadway	Area (ha)	Draining To
A (Controlled)	0.81	SWMP B1
A (Uncontrolled)	0.32	Berczy Creek
B	0.13	SWMP B2
C1 & D	3.30	SWMP B2
E1	1.56	SWMP B3

When SCS Consulting Group created the Stormwater Management Master Plan (SWMMP) and did preliminary design and sizing of the SWM ponds, they accounted for a certain area of internal roadway at a specified % impervious draining to the ponds. These values can be seen in Appendix A. Proposed internal roadways were updated based on the preferred cross-sections presented below. Table 2 below shows the difference in area between the internal roadways proposed by the SCS SWMMP and the MCEA.

Table 2: Change in Internal Roadway Area Between SCS SWMMP and the MCEA

Pond	SCS SWMMP	MCEA Plan	
	Internal Roadway Area (ha)	Internal Roadway Area (ha)	Difference (ha)
B1	0.65	0.81	+ 0.16
B2	5.92	3.43	- 2.49
B3	5.49	3.79*	- 1.70
Total	12.06	8.03	- 4.03

*Includes proposed roadway E1 and existing portion of Honda Blvd that drains to SWM pond B3
Note: There are no changes to ponds L1 or B4

Assuming that the excess land that will no longer be used for internal roadways will be used for commercial or industrial area and based on the % impervious values used in the SCS SWMMP, there will be an overall increase to the amount of impervious land draining to the SWM ponds. The changes in impervious areas can be seen in table 3 below.

Between previously designed and proposed roadway's, overall there are only minor variances to the amount of roadway runoff that needs to be treated, which can be considered during detailed design of the SWM ponds.

Refer to Appendix A for SCS Pond Design Calculations.

Typical Cross-Section

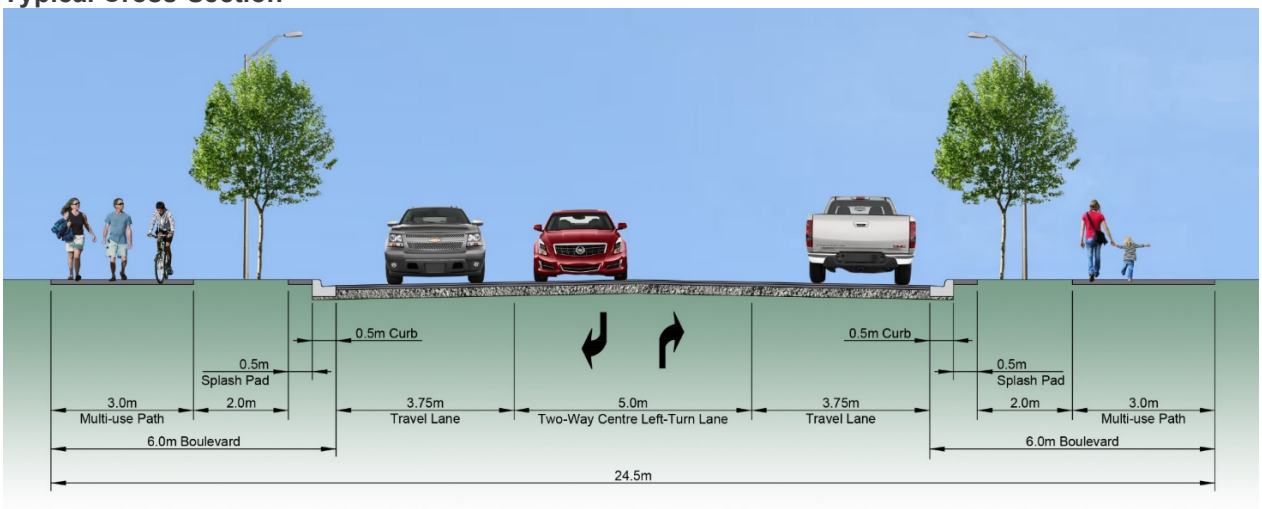


Table 3: Change in Impervious Area Between SCS SWMMP and the MCEA

B1 - Ultimate					
	SCS SWMMP		MCEA Study		
Catchment Area	Area (ha)	Impervious (%)	Area (ha)	Impervious (%)	
Business Park (222-7)	14.71	85	14.55	85	
Internal Road (222-8)	0.65	67	0.81	82	
Business Park (222-9)	1.72	85	1.72	85	
19th Avenue	0.45	75	0.45	75	
Total	17.53		17.53		Change in % Impervious
Average Impervious =		84.1%		84.6%	0.50%

B2 - Ultimate					
	SCS SWMMP		MCEA Study		
Catchment Area	Area (ha)	Impervious (%)	Area (ha)	Impervious (%)	
Business Park (222-3)	11.42	85	11.42	85	
Business Park (222-4)	17.25	85	19.74	85	
Internal Roads (222-5)	5.92	70	3.43	82	
Business Park (222-14)	2.44	85	2.44	85	
Undeveloped (222-2)	4.55	0	4.55	0	
Total	41.58		41.58		Change in % Impervious
Average Impervious =		73.6%		75.5%	1.90%

B3 - Ultimate					
	SCS SWMMP		MCEA Study		
Catchment Area	Area (ha)	Impervious (%)	Area (ha)	Impervious (%)	
Business Park (222-15)	42.71	85	44.41	85	
Internal Roads (222-16)	5.49	72	3.79	82	
Woodbine Bypass (222-17)	3.00	88	3.00	88	
Residential (222-18)	9.36	60	9.36	60	
Community Ammenity (222-19)	2.10	85	2.10	85	
Internal Roads (222-20)	0.50	75	0.50	82	
Total	63.16		63.16		Change in % Impervious
Average Impervious =		80.2%		81.2%	1.00%

3.4 Interim and Ultimate Storm Water Management Ponds

Depending on the phase of development and present land owner development objectives, it is possible for final proposed ponds to be built without the implementation of interim ponds. If interim ponds are implemented, it is possible that they will be moved and upgraded to their final design, or that they will remain, and any downstream development will need to provide their own quantity and quality controls.

The location of stormwater management ponds within this report and on the attached figures is based on preliminary planning studies. During detailed design of any stormwater management ponds, care should be taken to ensure that their footprint avoid sensitive features and their associated buffers.

3.4.1 Interim Storm Water Management Ponds

It is possible that land owners of the locations of the final proposed ponds may not be prepared for development prior to those upstream of their site. If it is not possible to go directly to final SWM ponds, the interim design includes the implementation of two more interim ponds, both to the north of 19th Ave within the study area.

Interim Pond B1 is located at the north west of the intersection of Woodbine Ave and 19th Ave. The SWM pond receives the stormwater runoff from an approximate 17.5 ha area to the east of Berczy creek and west of Woodbine Ave.

Interim Pond B2 is located to the north of 19th Ave and to the west of Berczy Creek. The SWM pond receives the stormwater runoff from an approximate 15 ha area to the east of Highway 404 and west of Berczy Creek.

The two existing ponds, B3 and L1, remain the same as in existing conditions. The drainage mosaics for the interim conditions can be seen in Appendix F.

3.4.2 Proposed Storm Water Management Ponds

With the implementation of the proposed collector road network, the drainage areas for the proposed conditions vary from the existing and interim design. The following describes the proposed final designs assuming the interim SWM ponds had been implemented and will be upgraded to ultimate conditions.

The implementation of a fourth SWM pond, B4, to the south east of the study area will capture and treat the runoff from the residential area to the south of the study area. There will be no impacts to SWM pond B4 or L1 from the proposed work, therefore no analysis was done on these ponds.

Interim SWM Pond B1 will be moved from the north west corner of 19th Ave and Woodbine Ave to the south west corner. Its drainage area will increase to approximately 20 ha.

Interim SWM Pond B2 will be moved from north of 19th Ave to the north west corner of Woodbine Ave and Proposed Road D (reference Appendix D & F). Its drainage area will increase to approximately 43 ha.

Interim SWM Pond B3 will generally remain in the same location. Its shape will change, and its drainage area will decrease to approximately 66 ha, with the lost drainage area now directed to SWM Pond B2.

The drainage mosaics for the proposed conditions can be seen in Appendix F.

3.5 Preliminary OGS Sizing

For the portion of proposed Road A that drains uncontrolled into Berczy Creek, an OGS unit be used to provide Level 1 (80% TSS removal) water quality treatment for the runoff. Preliminary sizing using the ETV sediment particle distribution details the requirement of a Hydroworks Hydroguard Model # HG 4 or equivalent to provide the necessary water quality treatment for the runoff.

It is the TRCA's position that a standalone OGS unit cannot provide more that 50% TSS removal. As ETV particle distribution was used to calculate OGS unit sizing, it was anticipated that the TRCA would credit the full 80% TSS removal. If not, a treatment train approach utilizing low impact development such as a bioswale can be implemented at detailed design to increase the water quality of the roadway runoff.

Refer to Appendix E for calculation parameters.

3.6 Climate Change Considerations

A review of intensity-duration-frequency (IDF) parameters based on MTO's Lookup Curves was completed to assess the impact of climate change on drainage and SWM infrastructure. Future IDF parameters based on MTO Lookup Curve Year 2085 compared to 2010 predicts a maximum increase of 17% and 8%, respectively for the 2-year and 100-year design intensity. To mitigate the potential impacts from climate change, during detailed design the computed capacity of storm sewers should be designed such that the peak flow is less than 80% of the pipe flowing full. This will provide resilience for the drainage infrastructure under predicted future conditions.

3.7 Low Impact Development

Low Impact Development (LID) can be used in order to increase the amount of runoff that will be retained on site and infiltrated into the ground. This will increase the quality of runoff as well as decreasing the total runoff quantity, reducing downstream erosion and the required volume of the SWM Ponds.

The incorporation of LID within the study area depends on many factors, including the hydrologic soil group of the soil and the groundwater elevations.

Soils within the study area were found to have a spread of BC, C and D hydrologic soil groups. These soils do not have great hydraulic conductivity and are not great for the incorporation of LID's. More explanation on soils can be found in section 2.2 and a Figure can be found in Appendix G.

A geotechnical assessment of the study area was completed by Thurber Engineering Ltd. in July and August of 2019. On these dates, five boreholes designated BH-01 to BH-05 were drilled into the ground. The locations of these boreholes can be seen in Appendix G. The analysis of groundwater elevations at these boreholes can be seen in Table 4 below:

Table 4: Summary of Borehole Analysis

Borehole No.	Date	Water Level		Comment
		Depth Below Surface (m)	Elevation (m)	
BH-01	Aug. 9, 2019	1.2	237.7	In piezometer
BH-02	Aug. 9, 2019	0.5	238.3	In piezometer
BH-03	Aug. 9, 2019	2.1	238.8	In piezometer
BH-04	Aug. 9, 2019	1.4	235.0	In piezometer
BH-05	Aug. 9, 2019	3.1	232.0	In piezometer

The recorded levels are short-term observation and seasonal fluctuations are to be expected. The groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. The overall depth below ground surface is relatively shallow and may pose a barrier to the implementation of LID.

Based on both the hydrologic soils grouping and groundwater depths, it is found that the majority of development area will not be suitable for LID's.

The two best areas within the study area that should be assessed during detailed design for the implementation of LID's are:

- The area draining to ultimate SWM Pond B1 in the north east section of the study area. This area has soils with hydrologic group BC, with moderate to low infiltration rates and based on the single borehole analysis, the area has a groundwater table 1.2 m below the surface. The small area of uncontrolled drainage in this area which is proposed to have its water quality provided by an OGS unit can also use the LID to provide another level of water quality treatment in a treatment train approach.

- The area draining to ultimate SWM Pond B2 in the north central section of the study area. Just west of the SWM Pond and before the inlet, the area has soils with hydrologic group BC, with moderate to low infiltration rates and based on the single borehole analysis, the area has a groundwater table 2.1 m below the surface.

The implementation of LID within the study area should be further investigated during detailed design and implemented where feasible.

4. Conclusions

The City of Markham retained CIMA+ to complete a Municipal Class Environmental Assessment (MCEA) on the Markham 404 North Employments Lands. The purpose of the drainage and stormwater management report was to document existing stormwater conditions and identify any impacts resulting from the proposed changes to the roadway network. Based on the assessment the following can be concluded:

- The 2010 Stormwater Management Plan completed by SCS Consulting Ltd. for the 404 North Secondary Plan Area (OPA 149) outlines the strategy for addressing water quality and quantity in the study area. The plan summarizes the existing drainage conditions as well as interim and proposed drainage conditions. The plan also provides preliminary sizing and requirements for all stormwater management facilities.
- The SWM strategy for the majority of the study area is to incorporate end of pipe SWM facilities in order to provide quantity and quality control for the urbanization of the area. The ultimate stormwater management plan includes five (5) ponds L1, B1, B2, B3 and B4, and one (1) oil and grit separator. The stormwater management plan also included potential development phasing including implementation of two (2) interim SWM ponds B1 and B2.
- The MCEA provides an updated proposed layout for the internal roadway network within the Markham 404 North Employment Lands compared to the original OPA 149. Based on the recommended roadway network, there will be an incremental decrease in the amount of roadway within the study area, and an increase in the amount of commercial/industrial available land from the OPA 149 plan. Any consequential changes to SWM can be assessed during detailed design.

5. Recommendations

The following recommendations should be furthered considered at detailed design:

- The location of stormwater management ponds within this report and on the attached figures is based on the stormwater management plan completed by SCS in 2010. During detailed design of the stormwater management ponds, care should be taken to ensure that their footprint avoid sensitive features and their associated buffers.

- The TRCA recommends on site retention of 5 mm of rainfall on all newly impervious area. The implementation of LID within the study area should be further investigated during detailed design and implemented where feasible. Specifically, a treatment train approach should be considered as part of the OGS installation.
- During detailed design, the floodplain mapping and associated hydraulic modeling within the study area should be updated to reflect the most current hydrologic studies.

A

Appendix A

Excerpts; Stormwater Management Master Plan, SCS Consulting Group Ltd, 2010

404 North Secondary Plan Area (OPA 149)

Stormwater Management Master Plan

November 2010

Submitted by:

SCS Consulting Group Ltd
30 Centurian Drive, Suite 100
Markham, ON, L3R 8B8
Phone 905 475 1900
Fax 905 475 8335

Project No. 1120

Table 1.1: Property Ownership

Property No.	Property Name/Owner	Participating	Non-Participating
1	The Romanovich Family Trust		X
2	Fletchers Fields Ltd.		X
3	404/19th Avenue Developments Inc.	X	
4	Roccoa Antonio & Carmela Colangelo		X
5	Bruno Galati		X
6	Saverio F. Bavaro		X
7	Domenic & Anna Defilippis		X
8	Yefim & Eva Sadetsky		X
9	John Cuthbert		X
10	Raymond & Rebecca Miu		X
11	462048 Ontario Ltd.		X
12	Phillip & Joyce Rumney		X
13	John Anderson Young		X
14	Michael Emanual Kushner		X
15	Vetmar Limited	X	
16	Speros & Besie Zaharopoulos		X
17	Chi Sun Tao The Temple		X
18	Finlay W. McLachlan Properties Inc.		X
19	11160 Woodbine Ave. Ltd.	X	
20	11258 Woodbine Avenue Ltd.	X	
21	Advance Construction Industries		X
22	1099490 Ontario Inc.		X
23	Gallo & Gallo Investments Ltd.		X
24	11258 Woodbine Avenue Ltd.	X	
25	559975 Ontario Inc.		X
26	Enbridge Gas Services		X
27	Annunziata Defilippis		X
28	TransCanada Pipeline		X
29	Anthony Man-Lung Lui		X
30	1570128 Ontario Inc,; 480944 Ontario Ltd		X
31	The Hydro-Electric Power Commission of Ontario		X
32	Town of Markham (Original Woodbine)		X
33	Ontario Realty Corporation		X

Legend

- Business Park Area
- Business Corridor Area
- Community Amenity Area
- Residential - Low Density
- SWMP
- Environmental Protection
- Transportation & Utilities

DEVELOPMENT PLAN FOR OPA 149

HIGHWAY 404 NORTH SECONDARY PLAN AREA TOWN OF MARKHAM

Gatzios Planning + Development Consultants Inc.

NOTE:
This *Development Plan* and *Local Road Network* are conceptual only.
It is not to be considered a legal document. It is for demostration purposes only.

Legend

- OPA 149 Boundary
- Trans Canada Pipeline
- **Participating Landowners**
- Phasing Boundaries

Roads

- Region of York Roads
- Town of Markham Roads

PREPARED BY: 404 North Landowners Group
DATE: November 30, 2010

4.0 PHASING CONSIDERATIONS

The 404 North study area consists of a number of landowners with different development timing objectives (refer to Development Plan in **Appendix A** for landowner map). Implementation of the overall storm drainage system may require alternate solutions to reflect the requirements of the various landowners. To facilitate the requirements of a multiple ownership Secondary Plan area, the proponent should be required to demonstrate to the satisfaction of the Town and TRCA, that the proposed alternate storm servicing solutions:

- meet the required runoff controls of the EMS;
- can be incorporated into the ultimate servicing scheme; and
- do not adversely impact upstream or downstream lands.

Methods to achieve the required level of flexibility include:

Temporary Pond Locations: It is appropriate to allow temporary or interim pond locations upstream of the ultimate location, subject to phasing requirements. The pond shall provide the required level of treatment but avoid extensive downstream works. Note that temporary or interim pond design shall meet Town, TRCA and MOE design criteria.

On-site BMP's and Controls: On-site BMP's and controls can provide the required treatment and avoid the need for ponds. Methods such as outletting roof leaders directly to watercourses, water quality inlets in parking areas, grassed swales and filter strips, and underground storage may be appropriate on an area specific basis.

Flexibility in the implementation of the ultimate servicing scheme is vital to the practical and cost effective development of the study area.

Potential stormwater management alternatives based on landowner independence are difficult to predict. Based on the existing land ownership and current status of participating landowners, three (3) alternatives have been identified and are described below.

4.1 Stormwater Alternative for Catchments 222-7 to 222-9

Figure 4.1 shows the alternative storm drainage boundaries for the lands north of 19th Avenue and east of the West Tributary of Berczy Creek (approximately 15.03 ha – Catchments 222-7 to 222-9), which will be serviced by a SWM pond located at the north west corner of Woodbine Avenue and 19th Avenue. This SWM pond (Pond B1 – Interim) will outlet to the existing ditch along the west side of Woodbine Avenue. The preliminary grading for this facility is illustrated on **Figure 4.2.**

6.0 SUMMARY

The study area can be efficiently serviced using the existing and proposed infrastructure.

- Post-development site release rates to the Leslie Street Tributary watershed to be controlled to pre-development levels for the 2 through 100 year storm events, with the exception of the 5 year storm being over-controlled to 50% of the pre-development rate.
- Post-development site release rates to the Berczy Creek watershed to be controlled to pre-development levels for the 2 through 100 year storm events.
- On-site quantity controls to reduce release rates to a maximum of 180 l/s/ha during the 100 year storm event are proposed for all business park developments.
- Storm drainage will be conveyed via storm sewers and the road network to the various proposed SWM ponds.
- A minimum of five (5) stormwater management facilities are proposed for the study area.
- Enhanced Level quality control will be provided.
- Erosion control to be provided via detention of the 25 mm rainfall runoff for a minimum of 48 hours for areas draining to the Leslie Street Tributary watershed.
- Erosion control to be provided via detention of the 25 mm rainfall runoff for a minimum of 48 hours and/or a simplified Distributed Runoff Control (DRC) approach to over-control SWM facility outlet flows by 10% during a portion of the 2 year storm event shall be applied, if applicable for areas draining to the Berczy Creek watershed.

This report is intended to provide an overview of the proposed storm servicing and stormwater management requirements. The final development concepts for the lands within the study area have not been finalized at this time. As such, a more detailed level of design will be required for each site to confirm exact pipe sizing, infrastructure routing and stormwater quality/erosion/quantity requirements. Some minor modifications to the proposed servicing scheme may be required based on the final road network.

Respectfully Submitted:

SCS Consulting Group Ltd.

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223–1
117.85ha

222–1
35.64ha

104–1
1.75ha

222–2
2.81ha

222–3
9.07ha

104–2
2.35ha

222–5
15.82ha

104–3
0.56ha

222–8
10.19ha

222–7
0.93ha

104–4
1.75ha

EXISTING 3100mm x1300mm CONC. BOX CULVERT

EXISTING 900mm CSP

19TH AVENUE

WEST TRIBUTARY OF BERCZY CREEK

222–6
2.65ha

222–9
0.45ha

104–5
3.04ha

222–4
9.77ha

EXISTING 104'-72"x44" PIPE ARCHES (32m-1833mm x 1120mm)

INV. 234.06

NODE A

INV. 233.75

INV. 233.63

INV. 233.93

EXISTING 104'-72"x44" PIPE ARCHES (32m-1833mm x 1120mm)

NODE F

EXISTING 1200mm CSP

104–6
3.54ha

INV. 233.02

NODE B

INV. 232.90

TRANS CANADA PIPELINE

222–10
12.40ha

EXISTING 68'-18" CIP (20.7m-450mm)

222–11
2.52ha

WOODBINE AVENUE

EXISTING 76'-58"x36" CIA PIPE (23m-1500mm x 900mm)

222–12
51.96ha

NODE C

INV. 231.95

INV. 232.26

NODE D

INV.233.32

INV. 237.48

EXISTING 72'-29"x18" CIP (21.9m-740mm x 450mm)

WEST TRIBUTARY OF BERCZY CREEK

EXISTING 3000mm x 1520mm CONC. BOX CULVERT

NODE G

101–1
21.83ha

222–13
14.42ha

HWY 404

101–2
0.98ha

205–1
1.35ha

222–14
6.26ha

222–17
8.94ha

NODE H

NODE I

NODE E

222–15
10.0ha

INV. 236.83

INV. 238.14

EXISTING 76'-29"x18" CIP (23.2m-740mm x 450mm)

222–16
0.45ha

EXISTING 1830mm x 1220mm CONC. BOX CULVERT

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FAX: (905) 475-8335

LEGEND:

STUDY BOUNDARY

EXISTING DRAINAGE BOUNDARY

EXISTING FLOW DIRECTION

15 — PROPERTY OWNERSHIP NUMBER

222–2 / 10.28ha — CATCHMENT ID / EXISTING DRAINAGE AREA (ha)

222–1 / 4.54ha — EXTERNAL CATCHMENT ID / EXTERNAL DRAINAGE AREA (ha)

404 NORTH (OPA 149) STORMWATER MANAGEMENT MASTER PLAN

PRE-DEVELOPMENT DRAINAGE PLAN

DATE: NOVEMBER 2010	PROJECT No: 1120	FIGURE No: 2.1
SCALE: 1:3000		

223–1
EXTERNAL
117.85ha

222–1
EXTERNAL
35.64ha

222–2
4.55ha

222–10
4.54ha

222–3
10.77ha

222–4
0.65ha

INTERIM SWM POND B2

19TH AVENUE

WEST TRIBUTARY OF BERCZY CREEK

INTERIM NODE AT 19TH AVE CULVERT

222–8
0.32ha

222–7
13.91ha

STREET G

222–32
0.45ha

222–31
0.33ha

INTERIM SWM POND B1

222–9
0.80ha

STREET F

222–12
7.25ha

STREET A

STREET E

TRANS CANADA PIPELINE

STREET B

HYDRO CORRIDOR

WOODBINE AVENUE

HIGHWAY 404

101–1
10.29ha

222–14
10.49ha

NODE C

222–13
1.72ha

222–16
4.61ha

222–15
27.45ha

222–21
2.46ha

STREET C

INTERIM SWM POND B3

1014
1.44ha

NODE G

SWM POND L1

STREET D

222–20
0.50ha

WOODBINE AVENUE BY-PASS

222–22
1.20ha

101–3
0.84ha

222–19
2.10ha

222–25
1.46ha

101–2
14.09ha

222–17
3.00ha

222–18
9.36ha

222–23
1.59ha

222–27
5.76ha

SWM POND B4

222–28
0.64ha

222–30
0.27ha

222–24
10.0ha

EXISTING-RESIDENTIAL DEVELOPMENT

PRINCE OF WALES DRIVE

222–26
0.45ha

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LEGEND:

STUDY BOUNDARY

PROPOSED DRAINAGE BOUNDARY

DRAINAGE DIRECTION

222–2 — CATCHMENT ID
10.28ha — PROPOSED DRAINAGE AREA (ha)

222–1 — EXTERNAL CATCHMENT ID
4.54ha — EXTERNAL DRAINAGE AREA (ha)

404 NORTH (OPA 149) STORMWATER MANAGEMENT MASTER PLAN

INTERIM POST-DEVELOPMENT DRAINAGE PLAN

DATE: NOVEMBER 2010
SCALE: 1:3000
PROJECT No: 1120
FIGURE No: 4.1

223-1
EXTERNAL
117.85ha

222-1
EXTERNAL
35.64ha

222-2
POND B2
4.55ha

222-3*
POND B2
11.42ha

222-4*
POND B2
17.25ha

222-5
POND B2
5.92ha

222-6
POND B2
1.39ha

222-7*
POND B1
14.71ha

222-8
POND B1
0.65ha

222-9*
POND B1
1.72ha

222-10
POND B1
0.94ha

222-11
UNCONTROLLED
0.93ha

222-12
UNCONTROLLED
10.19ha

222-13
POND B1
0.45ha

222-29
UNCONTROLLED
0.45ha

222-14
POND B2
2.44ha

222-15*
POND B3
42.71ha

222-16
POND B3
5.49ha

222-17
POND B3
3.00ha

222-18
POND B3
9.36ha

222-19
POND B3
2.10ha

222-20
POND B3
0.50ha

222-21
POND B3
3.41ha

222-22
POND B4
1.20ha

222-23
POND B4
1.59ha

222-24
POND B4
10.0ha

222-25
POND B4
1.46ha

222-26
POND B4
0.45ha

222-27
POND B4
5.76ha

222-28
POND B4
0.64ha

222-30
UNCONTROLLED
0.27ha

104-1
UNCONTROLLED
0.56ha

104-2
UNCONTROLLED
1.78ha

104-3
UNCONTROLLED
3.04ha

104-4
UNCONTROLLED
3.91ha

101-1*
POND L1
10.29ha

101-2*
POND L1
14.09ha

101-3
POND L1
0.84ha

101-4
POND L1
1.44ha

WEST TRIBUTARY OF BERCZY CREEK

19TH AVENUE

TRANS CANADA PIPELINE

HIGHWAY 404

WOODBINE AVENUE

WOODBINE AVENUE BY-PASS

HYDRO CORRIDOR

STREET A

STREET B

STREET C

STREET D

STREET E

STREET F

STREET G

NODE A

NODE C

NODE E

NODE F

NODE G

SWM POND B1

SWM POND B2

SWM POND B3

SWM POND B4

SWM POND L1

EXISTING-RESIDENTIAL DEVELOPMENT

PRINCE OF WALES DRIVE

POND B4

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LEGEND:

- TRIBUTARY TO BOUNDARY
- STUDY BOUNDARY
- PROPOSED DRAINAGE BOUNDARY
- DRAINAGE DIRECTION

101-2 / POND L1 / 14.09ha — CATCHMENT ID; TRIBUTARY TO; PROPOSED DRAINAGE AREA (ha)

222-26 / POND B4 / 0.45ha — EXTERNAL CATCHMENT ID; TRIBUTARY TO; EXTERNAL DRAINAGE AREA (ha)

* ON-SITE CONTROL REQUIRED

404 NORTH (OPA 149)
STORMWATER MANAGEMENT MASTER PLAN
ULTIMATE POST-DEVELOPMENT DRAINAGE PLAN

DATE:	NOVEMBER 2010	PROJECT No:	FIGURE No:
SCALE:	1:3000	1120	3.1

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Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B1 - Ultimate

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-7)	14.71	85	12.50
Internal Road (222-8)	0.65	67	0.44
Business Park (222-9)	1.72	85	1.46
19th Avenue (222-13)	0.45	75	0.34
Total	**17.53**		**14.74**
Average Impervious =	**84.1**	%	

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Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B2 - Ultimate

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-3)	11.42	85	9.71
Business Park (222-4)	17.25	85	14.66
Internal Roads (222-5)	5.92	70	4.14
Business Park (222-14)	2.44	85	2.07
Undeveloped (222-2)	4.55	0	0.00
Total	**41.58**		**30.59**
Average Impervious =	**73.6**	%	

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Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B3 - Ultimate

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-15)	42.71	85	36.30
Internal Roads (222-16)	5.49	72	3.95
Woodbine Bypass (222-17)	3.00	88	2.64
Residential (222-18)	9.36	60	5.62
Community Ammenity (222-19)	2.10	85	1.79
Internal Roads (222-20)	0.50	75	0.38
Total	**63.16**		**50.67**
Average Impervious =	**80.2**	%	

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Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B4

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Community Ammenity (222-22)	1.20	85	1.02
Residential (222-23)	1.59	60	0.95
Woodbine (222-25)	1.46	75	1.10
Woodbine (222-26)	0.45	75	0.34
Residential (222-27)	5.76	60	3.46
Total	**10.46**		**6.86**
Average Impervious =	**65.6**	%	

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Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond L1

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (101-1)	10.29	85	8.75
Business Park (101-2)	14.09	85	11.98
Internal Roads (101-3)	0.84	67	0.56
Total	**25.22**		**21.29**
Average Impervious =	**84.4**	%	

scs consulting group ltd

Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B1 - Interim

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-7)	13.91	85	11.82
Internal Road (222-8)	0.32	67	0.21
Total	**14.23**		**12.04**
Average Impervious =	**84.6**	%	

scs consulting group ltd

Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B2 - Interim

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-3)	10.77	85	9.15
Undeveloped (222-2)	4.55	0	0.00
Total	**15.32**		**9.15**
Average Impervious =	**59.8**	%	

scs consulting group ltd

Impervious Calculation

Project Name: 404 North
Project Number: 1120
Date: 11-Nov-10

Pond B3 - Interim

Catchment Area	Area (ha)	Imperviousness (%)	Impervious Hectares
Business Park (222-15)	27.45	85	23.33
Internal Roads (222-16)	4.61	72	3.32
Woodbine Bypass (222-17)	3.00	88	2.64
Residential (222-18)	9.36	60	5.62
Community Ammenity (222-19)	2.10	85	1.79
Internal Roads (222-20)	0.50	75	0.38
Undeveloped (222-13)	1.72	0	0.00
Undeveloped (222-12)	7.25	0	0.00
Total	**55.99**		**37.07**
Average Impervious =	**66.2**	%	

APPENDIX G

CULVERT CAPACITY ANALYSIS

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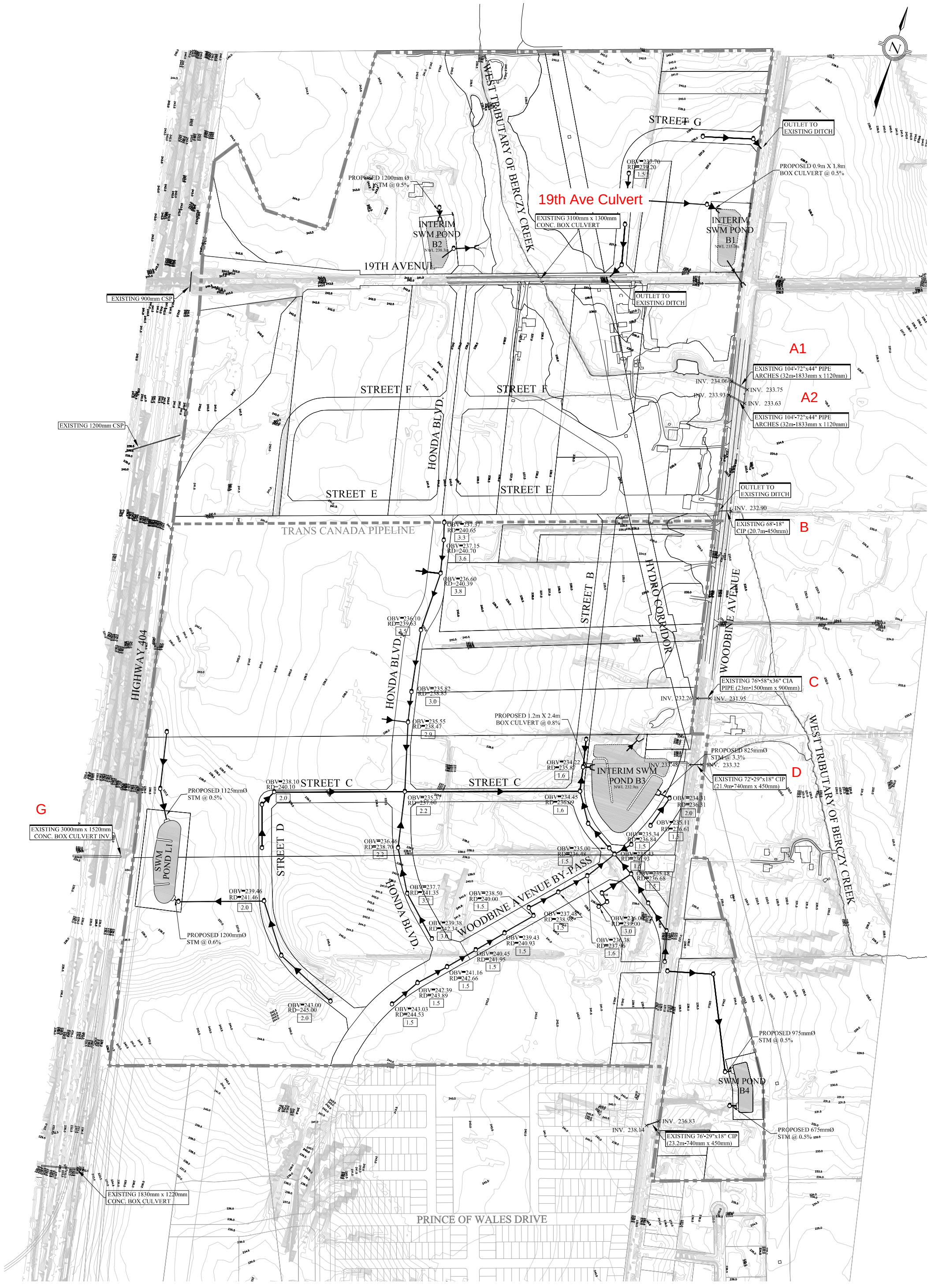

WEST TRIBUTARY OF BERCZY CREEK
STREET G
OUTLET TO EXISTING DITCH
OBV=237.70
RD=239.20
1.5
PROPOSED 0.9m X 1.8m BOX CULVERT @ 0.5%
PROPOSED 1200mm Ø STM @ 0.5%
19th Ave Culvert
EXISTING 3100mm x 1300mm CONC. BOX CULVERT
INTERIM SWM POND B2
NWL 238.3m
INTERIM SWM POND B1
NWL 235.0m
19TH AVENUE
EXISTING 900mm CSP
OUTLET TO EXISTING DITCH
A1
EXISTING 104'-72"x44" PIPE ARCHES (32m-1833mm x 1120mm)
INV. 234.06
INV. 233.75
INV. 233.93
INV. 233.63
A2
EXISTING 104'-72"x44" PIPE ARCHES (32m-1833mm x 1120mm)
EXISTING 1200mm CSP
STREET F
STREET F
HONDA BLVD.
STREET E
STREET E
OUTLET TO EXISTING DITCH
INV. 232.90
EXISTING 68'-18" CIP (20.7m-450mm)
B
TRANS CANADA PIPELINE
OBV=237.37
RD=240.65
3.3
OBV=237.15
RD=240.70
3.6
OBV=236.60
RD=240.39
3.8
STREET B
HYDRO CORRIDOR
WOODBINE AVENUE
HIGHWAY 404
OBV=236.10
RD=239.63
4.5
HONDA BLVD.
OBV=235.82
RD=238.83
3.0
EXISTING 76'-58"x36" CIA PIPE (23m-1500mm x 900mm)
C
INV. 232.26
INV. 231.95
OBV=235.55
RD=238.47
2.9
PROPOSED 1.2m X 2.4m BOX CULVERT @ 0.8%
WEST TRIBUTARY OF BERCZY CREEK
PROPOSED 825mmØ STM @ 3.3%
INV. 233.32
OBV=234.22
RD=235.87
1.6
INV 233.48
INTERIM SWM POND B3
NWL 232.9m
D
EXISTING 72'-29"x18" CIP (21.9m-740mm x 450mm)
OBV=238.10
RD=240.10
2.0
STREET C
STREET C
PROPOSED 1125mmØ STM @ 0.5%
G
OBV=235.37
RD=237.60
2.2
OBV=234.45
RD=236.09
1.6
OBV=234.31
RD=236.31
2.0
EXISTING 3000mm x 1520mm CONC. BOX CULVERT INV.
SWM POND L1
OBV=235.11
RD=236.61
1.5
OBV=235.34
RD=236.84
1.5
OBV=236.46
RD=238.70
2.2
OBV=235.00
RD=236.48
1.5
OBV=235.43
RD=236.93
1.5
OBV=235.18
RD=236.68
1.5
STREET D
HONDA BLVD.
OBV=237.7
RD=241.35
3.7
OBV=238.50
RD=240.00
1.5
WOODBINE AVENUE BY-PASS
OBV=237.48
RD=238.98
1.5
OBV=236.08
RD=239.00
3.0
OBV=239.38
RD=242.34
3.0
OBV=239.43
RD=240.93
1.5
OBV=236.38
RD=237.96
1.6
OBV=239.46
RD=241.46
2.0
OBV=240.45
RD=241.95
1.5
OBV=241.16
RD=242.66
1.5
OBV=242.39
RD=243.89
1.5
OBV=243.00
RD=245.00
2.0
OBV=243.03
RD=244.53
1.5
PROPOSED 1200mmØ STM @ 0.6%
PROPOSED 975mmØ STM @ 0.5%
SWM POND B4
INV. 236.83
INV. 238.14
EXISTING 76'-29"x18" CIP (23.2m-740mm x 450mm)
PROPOSED 675mmØ STM @ 0.5%
EXISTING 1830mm x 1220mm CONC. BOX CULVERT
PRINCE OF WALES DRIVE

SCS consulting group ltd

Culvert Capacity Analysis

Project Name: OPA 149 Group Engineering
Project Number: 1120
Date: 5-Mar-10

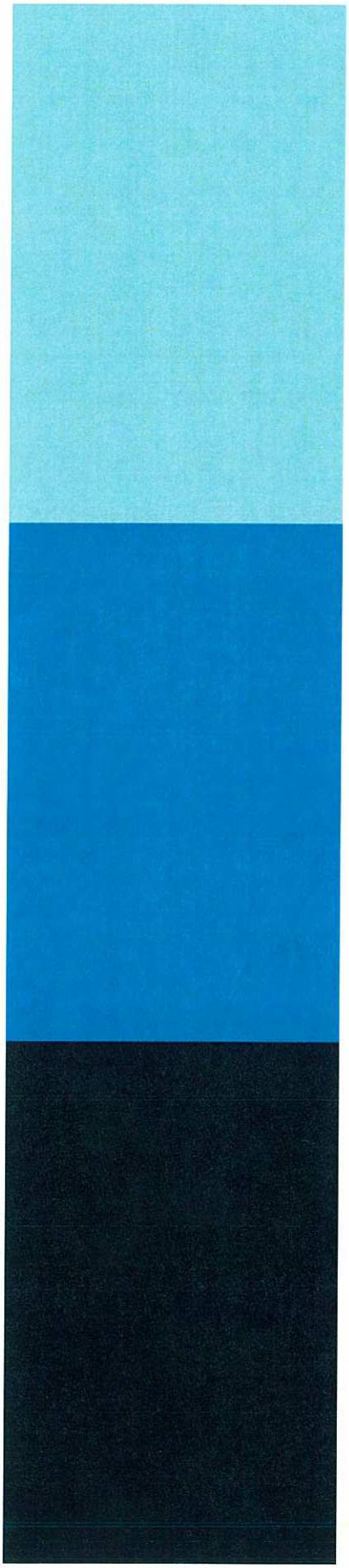
Node	Location	HW (m)	U/S Invert Elev (m)	D/S Invert Elev (m)	Length (m)	Culvert Type	Culvert Size (mm)	Entrance Condition	Culvert Capacity before Spill over Road (m^3/s)	100 year Pre-Dev Flows* (m^3/s)	100 year Proposed Post Dev Flows* (m^3/s)
A1	Woodbine	234.39	234.06	233.75	32.00	CMP - Arch	1830 x 1120	Thin Wall Projecting	0.29	11.93	11.93
A2	Woodbine	234.39	233.93	233.63	32.00	CMP - Arch	1830 x 1120	Thin Wall Projecting	0.53		
B	Woodbine	234.39	233.02	232.90	20.70	CMP - Circular	450	Projecting	0.30	1.62	N/A
C	Woodbine	234.10	232.26	231.95	23.00	CMP - Arch	1490 x 910	Thin Wall Projecting	2.95	3.03	3.03
D	Woodbine	234.10	233.48	233.32	21.90	CMP - Arch	720 x 460	Thin Wall Projecting	0.33	1.69	N/A
G	Hwy 404	235.50	233.55	233.37	86.50	Conc - Box	3050 x 1520	0° wingwall flares	9.53	2.38	2.38
19th Ave Culvert	19th Ave	237.59	236.34	236.21	9.24	Conc - Box	3051 x 1220	0° wingwall flares	5.30	8.49	8.49

* Does not include drainage from Woodbine Avenue or Highway 404 R.O.W.s

CMP - Arch	
Entrance Type:	Ke
Thin wall projecting	0.9
90° Headwall	0.5
Mitered to Slope (arch)	0.7

CMP - Circular	
Entrance Type:	Ke
Beveled Ring, 33.7° (1.5:1) bevels	0.2
Beveled Ring, 45° (1:1) bevels	0.2
Headwall	0.5
Mitered to Slope	0.7
Projecting	0.9

Concrete - Box	
Entrance Type:	Ke
0° Wingwall flares	0.7
18.4° Offset and non-offset wingwall flares	0.5
3/4 inch chamfers; 15° - 45° skewed headwall	0.5
30° to 75° Wingwall flares with or without offset	0.5
45° Bevels; 10° to 45° skewed headwall	0.5
45° Offset and non-offset wingwall flares	0.5
90° and 15° wingwall flares	0.5
90° Headwall	0.2



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B

Appendix B: SWM Criteria

Excerpts; TRCA Stormwater Management Criteria, 2012

Excerpts; City of Markham Design Criteria: Section E – Storm Drainage & Stormwater Management, 2016

Watershed	Water Quantity Control Criteria	References and Notes
Rouge River	▪ Control post-development peak flows to pre-development levels for all storms up to and including the 100 year storm (i.e. 2, 5, 10, 25, 50, and 100 year storms), for the following: › Rouge River (main channel) and tributaries upstream of Major Mackenzie Dr. › Leslie Street Tributary upstream of Major Mackenzie Drive › Beaver Creek (upstream of 16th Ave.) › Carlton Creek › Burndenett Creek, Robinson Creek and Exhibition Creek (all upstream of 16th Ave.) › Box Grove Tributary, Morningside Tributary › Katabokokonk Creek › Kennedy Rd Tributary, McCowan Rd. Tributary of the Little Rouge River › Bruce Creek upstream of 16th Ave › Berczy Creek upstream of Warden Ave › Hwy 48 Tributary › Carlton Creek › Ninth Line Tributary ▪ No flood flow requirements for: › Main Rouge - downstream of Major Mackenzie Dr. › Little Rouge River (downstream of the confluence of Kennedy Rd McCowan Rd and HWY 48 Tributaries) near Elgin Mills Rd. › Beaver Creek (downstream 16th Ave) › Berczy Creek (downstream of Warden Ave) › Bruce Creek downstream of 16th Ave › Burndenett Creek, Robinson Creek and Exhibition Creek (all downstream of 16th Ave)	▪ Hydrologic Model: VISUAL OTTHYMO (V2.0) ▪ Return period peak flows based upon 12 AES distribution ▪ Hydrology Study: "Rouge River Watershed Hydrology Update" (Marshall Macklin Monaghan, October 2001)

SWM Criteria TRCA 2012, 3.2 Stormwater Quantity (Flood) Control Criteria

The stormwater management criterion stipulates that all watercourses and water bodies (e.g. Lake Ontario) within TRCA's jurisdiction are classified as requiring an Enhanced level of protection (80% TSS removal).

SWM Criteria TRCA 2012, 5.2 Quality Control Criteria

E1 INTRODUCTION

Storm drainage system design includes the design of a minor system (storm sewers) and a major system (overland flow routes, stormwater management ponds, etc.).

The design of the storm drainage system shall be based on an accepted Stormwater Management Report, in accordance with the City of Markham's "Stormwater Management Guidelines" and the "Stormwater Management Pond Safety and Maintenance Criteria".

Site plan (Industrial, Commercial, Condo, etc.) developments shall be designed in accordance with the on-site detention (OSD) requirements of the City of Markham "Design of On-Site Detention (OSD)' manual.

Quantity control criteria for river flood protection are according to TRCA requirements (TRCA Criteria as of 2009 are summarised in Section E10), while criteria to protect downstream drainage systems will be determined on a site specific basis and may require over control to prevent impacts.

Water balance criteria shall be in accordance with TRCA and MNR requirements. The proposed water balance measures shall be discussed with the City staff and must be to the satisfaction of the Director of Engineering.

Design of the minor system shall be in accordance with the criteria in the following sections.

E2 STORM SEWER DESIGN

E2.1 Storm Sewer Flows

Storm sewers (minor system) shall be designed to accommodate a 5-Year design flow and shall operate without surcharge. Minor and major systems drainage analyses shall be provided in a report and this shall preferably be carried out using established computer models (e.g. PCSWM, OTTSWMM, etc.) accepted by the Director of Engineering.

A 100-Year Hydraulic Grade Line (HGL) analysis shall be performed and provided in a tabular format.

For Greenfield developments, the basement slab elevations shall be set minimum 0.5 m above the 100-Year (HGL) and shall be indicated on the Plan and Profile drawings.

For Infill developments, where HGL information is not readily available or determined, then the HGL shall be estimated to be minimum 1.8 m below the road centreline elevation, provided the municipal sewer is located at the standard 2.5 m depth. Therefore, the minimum basement slab elevation shall be set at maximum 1.3 m depth from the road centreline elevation. Sump pump shall be installed if the basement elevation is lower than 1.3 m from the centreline elevation of the road.

The minimum basement slab elevations shall be shown on all lots where HGL is above obvert of the pipe.

Inlet control devices (ICDs) shall only be used to control flow into the sewer to reduce 100-Year HGL.

Storm sewer calculations shall be completed on the design sheets as per the City's Standard Format (attached) and the final design sheets shall be included in the Engineering Drawings.

E2.2 Runoff Calculations

Storm sewers shall be designed based on the Rational Method. The Stormwater Management Guidelines shall be referred to for further details and principles.

Rational Method

$$Q = KRCIA$$

Where:

Q = Design flow (m^3 / sec)
K = Conversion factor (0.00278)
R = Return period factor
C = Runoff coefficient
I = Rainfall intensity (mm / hour)
A = Contributing drainage area (ha)

Runoff Coefficient (C)

The following runoff coefficient shall be used for the design purposes:

Area Types	Run-of-Coefficient (C)
Asphalt, Concrete, Roof Areas, Gravel Areas and Parking Lots	0.90
Grassed Areas, Parkland	0.25
Commercial	0.90
Industrial	0.90
Institutional (Schools and Churches)	0.75
Residential	
Single Family	0.65
Semi-detached, Duplex	0.70
Row Housing, Townhouse	0.75
Apartments / Mix Used	0.85

To calculate the corresponding Runoff Coefficient for existing development or where coefficients may be lower than standard values, the following formula may be used:

$C = 0.25 (1 - i) + 0.9 i$

Where,

C = Runoff Coefficient

i = Imperviousness Ratio

Supporting calculations demonstrating the calculated Imperviousness Ratio (i) must be provided. Lower Runoff Coefficients (C) values may be considered where lot-level best management practices detain 50% or more of the runoff from the City's 5-Year design event. Values must be accepted by the Director of Engineering.

Return Period Factor (R)

The following return period factor shall be used for design purposes:

Return Period	Return Period Factor (R)
Up to 10-Year	1.00
25-Year	1.10

50-Year	1.20
100-Year	1.25

When applying the above factors, the inlet capture and by-pass rates may be considered in determining the effective peak flow rate in the minor system.

Rainfall Intensity (I)

The intensity of rainfall shall be determined using the following equation:

I (mm / hr) = A / (T+B)^C , where T is Time of Concentration in minutes.

The values of A, B and C for the various storms are as follows:

Return Period	A	B	C
2-Year Storm	651.63	3.75	0.80
5-Year Storm	1045.41	4.90	0.83
10-Year Storm	1331.42	5.26	0.84
25-Year Storm	1817.88	6.22	0.87
50-Year Storm	1918.97	6.00	0.86
100-Year Storm	2167.43	6.03	0.86

The minimum initial time of concentration shall be 10 minutes.

Contributing Drainage Area: Drainage systems shall be designed to accommodate all upstream drainage areas for interim and ultimate conditions, as determined by contour mapping and drainage plans.

Pre-Development: To calculate the initial time of concentration (T) for upstream, undeveloped lands, the following formulae may be used: Bransby Williams, HYMO / OTTHYMO, SCS Upland Method, Airport Formula, etc. The most appropriate method shall be determined at the discretion of the Director of Engineering.

Post-Development: To calculate the initial external time of concentration (T) for external lands that are scheduled for future development, a straight line shall be drawn from the furthest point within the watershed to the proposed inlet. The top 50.0 m shall have an initial T of 10 minutes and the remainder shall have a T as if the velocity in the sewer is 2.0 m / s. The summation of the two T's will give the future external time of concentration.

E2.3 Storm Sewer Requirements

Minimum Size

The minimum size for a storm sewer, excluding FDC sewer, shall be 300 mm.

Sewer Capacity

Manning's formula (see Section D) shall be used in determining the capacity of all storm sewers. The capacity of the sewer shall be determined on the basis of the pipe flowing full. Design flow calculations shall be completed on the City's Standard Format for Storm Sewer Design Sheets.

E7 SERVICE CONNECTIONS

See Section M - Service Connections for information regarding storm service connections.

E8 OVERLAND FLOW

Overland flow routes shall be designed to convey flows in excess of the capacity of the minor storm sewer system. Overland flow routes shall be continuous either within the road right-of-way or by walkways to the nearest outlet, such as river, stormwater management pond, etc.

Maximum depth of flow shall be 250 mm in accordance with the City of Markham Stormwater Management Guidelines.

Where super catchbasins are to be installed to capture the major overland flow, the catchbasin inlet capacity shall be designed considering 50% blockage.

Where major flow (100-Year) is required to be captured in storm sewer through catchbasins, an unobstructed emergency flow route must be provided at this location to cater for events beyond 100-Year. The emergency flow route shall be designed with proper erosion protection works to safely convey 100-Year flow considering no attenuation. The Director of Engineering, at his discretion, may require an easement / block to be dedicated to the City for emergency flow route.

E8.1 Inlet Control Device (ICD)

Should the Consulting Engineer requires to use ICDs to control the ingress of runoff into the minor system, the ICDs shall be sized and spaced to limit runoff in excess of 5-Year.

Catchbasins shall be equipped with IPEX Inlet Control or approved equivalent where shown on plan / profile drawings.

ICD ratings shall be as follows (assumes 950 mm depth to orifice centerline, plus 250 mm maximum ponding at curb; total 1,200 mm head):

- Type ‘A’ 19.8 l / s
- Type ‘B’ 28.3 l / s
- Type ‘C’ 36.8 l / s

E9 STORMWATER MANAGEMENT

E9.1 Stormwater Management Guidelines

In general, the document “**Stormwater Management Guidelines**”, **by Paul Wisner & Associates - January 1995** for the Town of Markham and the MOE’s “**Stormwater Management Planning and Design Manual” - March 2003** shall be followed in the design and treatment of runoff quality (enhanced protection) and quantity control measures. The City guidelines may be obtained from the Engineering Department. The 1995 Stormwater Management Guidelines are currently being updated.

E9.2 SWM Pond Design Policy

Included in this section are the City policies specific to the design of SWM pond facilities, which are in addition to the Guidelines referenced in E9.1.

Stormwater runoff from new development shall be managed to achieve appropriate levels of quantity, quality, and erosion controls in order to minimize any adverse effects to downstream watercourses. Stormwater management ponds are frequently used to provide the necessary controls.

On-site control shall not be assumed for school site block when sizing a SWM pond facility.

The location of a SWM pond shall be based on site specific conditions and an appropriate analysis of environmental, technical (safety, maintenance, and operations), economic and social considerations and be subject to relevant the City and other approval authorities policies.

Stormwater management ponds shall be designed to provide a reasonable level of safety, both in terms of stormwater management function and in relation to potential use of the pond area by members of the public. Additional safety provisions may be required in areas where an increased level of public access may be anticipated, such as ponds that are integrated with adjacent to parks and pathways.

Stormwater management ponds shall be designed to facilitate ease of maintenance.

Stormwater management ponds shall also emulate a passive natural feature and provide a visual amenity for surrounding development. This can be achieved through a basic level of landscaping which is required to support stormwater management functions, ground stability, and safety.

In addition to safety and maintenance requirements, the Consulting Engineer shall also consider the latest MOE guidelines regarding storage requirements, maximum or minimum water depths, configuration, temperature mitigation, etc. and consult with the Director of Engineering on their applicability.

SAFETY CRITERIA

DESIGN FEATURE	OBJECTIVE	CRITERIA
Pond Depth (Difference between top of bank elevation and permanent pool elevation)	Provide barriers to prevent access to the permanent pool	Provide enhanced vegetative barriers and 3.0 m wide flat terraces at approximately mid-depth for ponds with total depths of 6.0 – 9.0 m. Terraces may be integrated with maintenance access roads.
Slope Grades	Reduce risk of uncontrolled fall	Slopes to be varied between 3:1 to 7:1, however 3:1 slopes shall be avoided in areas expected to have greater exposure to the public, otherwise consideration of enhanced vegetative barriers and / or terracing shall be required.
Tableland Buffer	Provide barrier to uncontrolled falls	Minimum 2.0 m wide buffer between top of the slope and the edge of the ROW or the edge of the pathway
Water Edge Treatment	Provide ease of egress from water	6:1 terrace at permanent pool edge, 3.0 m wide either side of permanent pool
Vegetative Barriers	Prevent falls	Ponds within residential areas shall be provided with enhanced vegetative barriers
Signage	Warn the public of potential hazards	All wet ponds must have the information / warning signage shown in the Standard Drawings
Safety Equipment	Facilitate rescues	Provide, in areas with greater exposure to public and, as required by the Director of Engineering

Clay Liner	Prevent interaction between the stormwater and the groundwater and to maintain the permanent pool level	Provide a minimum of 1.0 m thick compacted clay liner extended to the permanent pool or the seasonal high groundwater lever (whichever is higher) + 0.5 m
Chain Link Fence	Provides public safety	Provide a 1.5 m high black vinyl chain link perimeter fencing along the property lines of residential, commercial, industrial or institutional lands where they abut a stormwater management facility block Gates along fences shall not be allowed

MAINTENANCE CRITERIA

DESIGN FEATURES	OBJECTIVE	CRITERIA
Maintenance Roads	Facilitate access for maintenance vehicles to critical pond features	Roads shall be constructed on a granular base, covered with grass and minimum topsoil, 4.0 m wide within a 5.0 m "no shrub / tree" zone, 2% cross-fall, 10% gradient with maximum 15% gradient. Refer to Standard Drawing MP4.
Access To Pond Inlet / Outlet	Facilitate maintenance of pond inlets / outlets	Create routes, accessible by personnel and maintenance vehicles, to top and bottom of inlet and outlet structures.
Access To Sediment Forebay	Facilitate removal of sediments	Grade of ramp shall be 10% with maximum 15% gradient maintenance access above permanent pool.
Sediment Forebay Bottom Treatment	Provide adequate bearing capacity for maintenance vehicles removing sediment	4.0 m wide ramp of adequate bearing capacity shall continue to the bottom of the permanent pool.
Vegetation	Stabilize ground surface, enhance stormwater control effectiveness, safety, and aesthetics	Vegetation shall be native species requiring minimal maintenance and suited to variations in water levels experienced in ponds (ie see MOE guidelines). For pond depths < 6.0 m, basic slope landscaping shall contain grasses and shrubs of adequate density to discourage public access and geese.
Sediment Dewatering Area	Dewater sediment	Temporary dewatering areas for sediment shall be provided within the SWM block if there is no adjacent park.

E10 WATERSHED FLOOD CONTROL CRITERIA

This section details the watershed flood control criteria related to the Rouge River, Don River, Highland Creek, Duffins Creek, and Petticoat Creek Watersheds in the City of Markham (Figure 1). The following criteria are intended to manage riverine-based flood risks related to design flows that affect flood hazards along watercourses and at watercourse crossings. The following generalized watershed criteria are suitable for greenfield development within the City of Markham and have been derived from the TRCA 2009 Criteria Document.

Figure 1

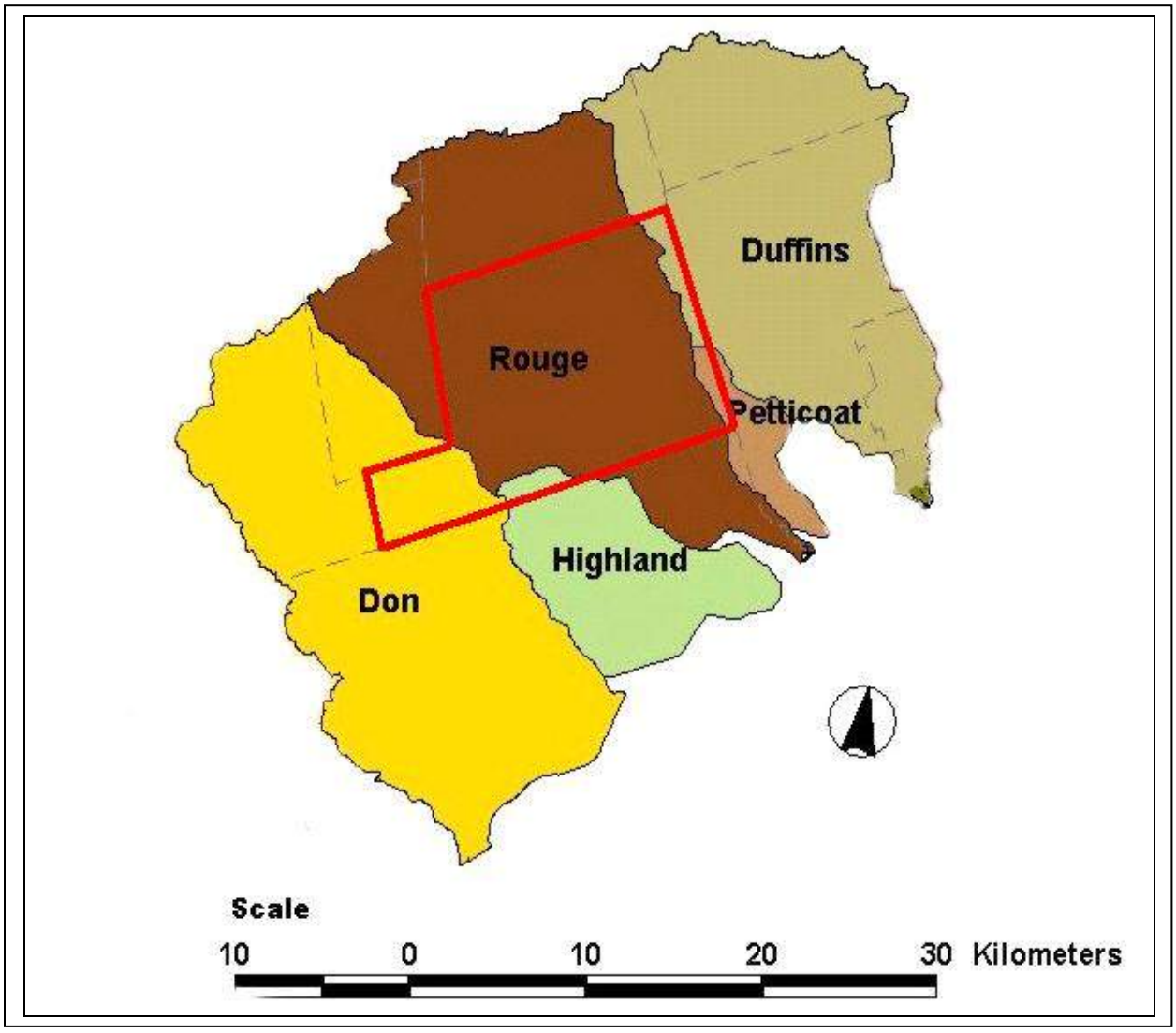


Table: Flood (Quantity) Control Criteria

Watershed	Flood (Quantity) Control Criteria	References & Notes
Rouge River	• Control post-development peak flows to pre-development levels for all storms up to and including the 100-Year storm (i.e. 2, 5, 10, 25, 50 and 100-Year storms), for the following: ➢ Rouge River (main channel) and tributaries upstream of Major Mackenzie Drive ➢ Leslie Street Tributary upstream of Major Mackenzie Drive ➢ Beaver Creek (upstream of 16th Avenue) ➢ Carlton Creek (upstream of Warden Avenue) ➢ Burndenett Creek, Robinson Creek, and Exhibition Creek (all upstream of 16th Avenue) ➢ Box Grove Tributary, Morningside Tributary ➢ Katabokokonk Creek ➢ Kennedy Road Tributary, McCowan Road Tributary of the Little Rouge River ➢ Bruce Creek upstream of 16th Avenue ➢ Berczy Creek upstream of Warden Avenue ➢ Hwy 48 Tributary ➢ Carlton Creek • No flood flow Control requirements for: ➢ Main Rouge - downstream of Major Mackenzie Drive ➢ Little Rouge River (downstream of the confluence of Kennedy Road, McCowan, and HWY 48 Tributaries) near Elgin Mills Road ➢ Beaver Creek (downstream 16th Avenue) ➢ Berczy Creek (downstream of Warden Avenue) ➢ Bruce Creek downstream of 16th Avenue ➢ Burndenett Creek, Robinson Creek, and Exhibition Creek (all downstream of 16th Avenue) ***Note:*** *Further study is required to determine the appropriate level of control for lands draining to contributing tributaries of the above noted watercourses*	• Hydrologic Model: Visual OTTHYMO (V2.0)-Return period peak flows based upon 12 hour AES distribution • Hydrology Study: "Rouge River Watershed Hydrology Update" (Marshall Macklin Monaghan, October 2001)
Don River	• Control post-development peak flows to pre-development levels for all storms up to and including the 100-Year storm (i.e. 2, 5, 10, 25, 50 and 100-Year storms). • Unit flow relationships representing pre-development levels (ie flow targets on a per area basis) have been established and should be used for all sites located north of Steeles Avenue that are greater than 2 ha. See Figure 2.	• Hydrologic Model: Visual OTTHYMO-Return period peak flows based on 12 hour SCS event • Hydrology Study: *Don River Hydrology Update* (Marshall Macklin Monaghan Ltd., Dec. 2004)

<table>
<tr>
<td>Highland Creek</td>
<td>

Control post-development peak flows to pre-development levels for all storms up to and including the 100-Year storm (i.e. 2, 5, 10, 25, 50 and 100-Year storms)

</td>
<td>

Hydrologic Model: Visual OTTHYMO
Return period peak flows based on 6hour AES event
Hydrology Study: Highland Creek Hydrology Update (Aquafor Beech Ltd., December 2004)

</td>
</tr>
<tr>
<td>Petticoat Creek</td>
<td>

Control post-development peak flows to pre-development levels for all storms up to and including the 100-Year storm (i.e. 2, 5, 10, 25, 50 and 100-Year storms)

</td>
<td>

Hydrologic Model: Visual OTTHYMO (Version 2.0)
Return period peak flows based upon 12hour AES event
Hydrology Study: "Petticoat Creek Watershed Hydrology Update" (Greenland Consulting Engineers, 2005)

</td>
</tr>
<tr>
<td>Duffins Creek</td>
<td>

Control post-development peak flows to pre-development levels for all storms up to and including the 100-Year storm (i.e. 2, 5, 10, 25, 50 and 100-Year storms) except for the main branches of the East and West Duffins where no quantity control is required
Unit flow relationships have been established representing pre-development levels (ie, flow targets on a per area basis) have been established and should be used for all sites located in the Duffins Creek Watershed. For the portion of Duffins Creek within the boundaries of the City of Markham, unit flow rates can be calculated based on the following equations. Should future development be proposed beyond those assumed for the official plan scenario in the 2002 Duffins Creek Hydrology Update, “post-to-pre” runoff controls may be required regardless of the location within the watershed and an assessment will also be required to determine whether Regional Storm quantity controls will be necessary for such developments.

Unit flow Relationships for Duffins Creek in the City of Markham
<table>
<tr><th>Return Period</th><th>Equation – [note: Q (l / s); Drainage Area (ha)]</th></tr>
<tr><td>2- Year</td><td>Q_2 = 6.125 – 0.675 * LN (Drainage Area)</td></tr>
<tr><td>5-Year</td><td>Q_5 = 8.601 – 0.890 * LN (Drainage Area)</td></tr>
<tr><td>10-Year</td><td>Q_{10} = 11.032 – 1.168 * LN (Drainage Area)</td></tr>
<tr><td>25-Year</td><td>Q_{25}= 14.199 – 1.530 * LN (Drainage Area)</td></tr>
<tr><td>50-Year</td><td>Q_{50} = 15.580 – 1.612 * LN (Drainage Area)</td></tr>
<tr><td>100-Year</td><td>Q_{100} = 17.972 – 1.870 * LN (Drainage Area)</td></tr>
</table>
</td>
<td>

Return period peak flows based on the AES - 6 hour design storm
hydrology study: “Duffins Creek Hydrology Update" (Aquafor Beech Ltd., May 2002)
Example: 100-Year pre-development flow for a 40 hectare development:

Q_{100} = 17.972 – 1.870 * LN (40), where LN is the natural logarithm function
Q_{100} = 17.972 – (1.870 * 3.69) = 11.1 l / s

</td>
</tr>
</table>

(*Source: 2009 TRCA Criteria Document)*
Refer to the latest TRCA requirements

C

Appendix C

Excerpts; City of Markham Official Plan OPA 149, Future Land Use

Attachment 2

Table 1
Land Use Summary

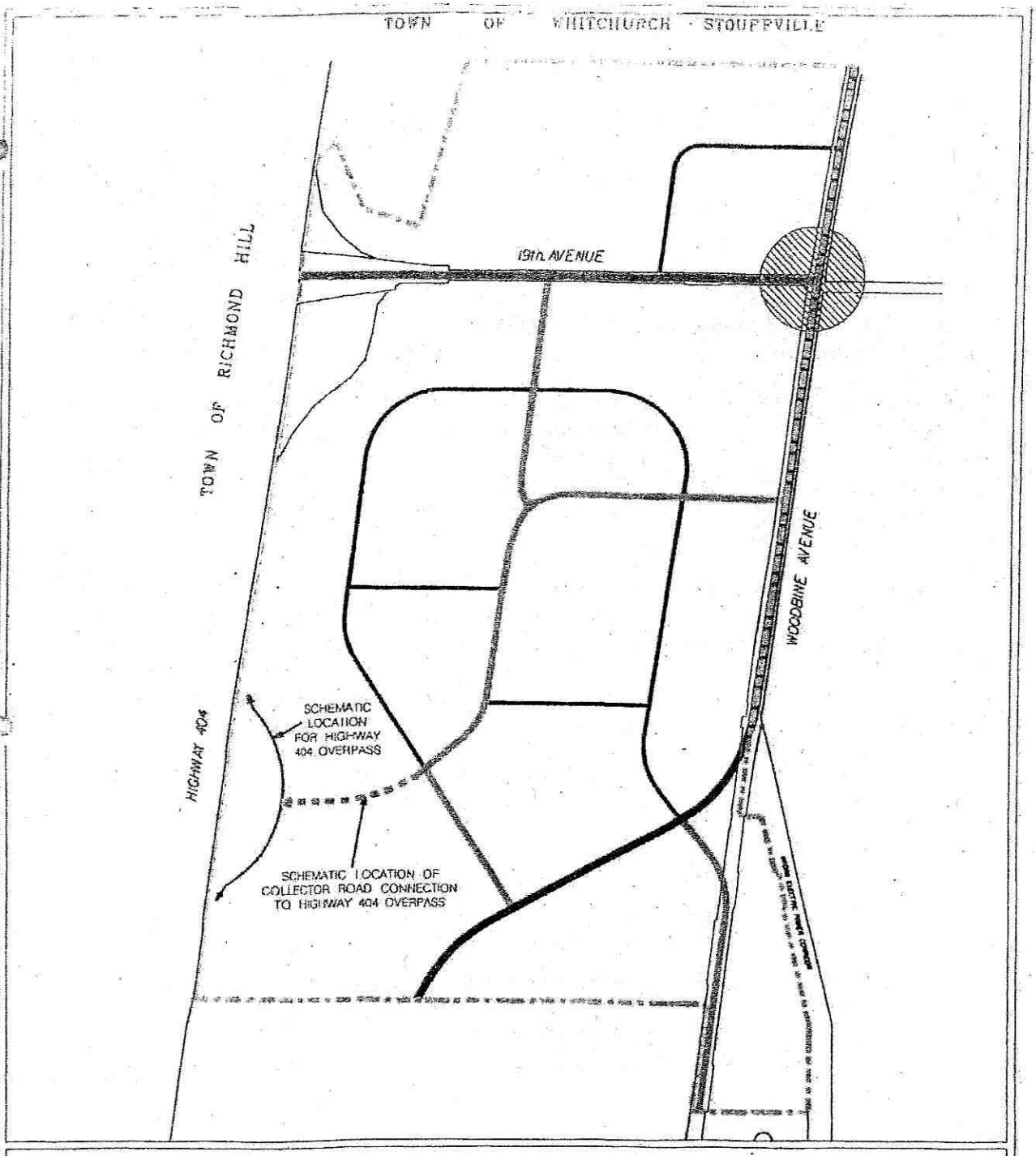
Primary Land Use Designation	Land Use Designation Proposed by OPA 149	Area Ha (acres)	Uses
Industrial	Business Park Area	112 (277)	Office/industrial business parks characterized by development displaying high design standards including corporate head offices and research facilities. Retail and service commercial uses are strictly controlled.
	Business Corridor Area	9 (22)	A mix of high quality business activities primarily in corridors along major road frontages, adjacent to industrial areas. Industrial and office uses requiring exposure to travelling public.
Commercial	Community Amenity Area	3 (8)	Multi-use, multi-purpose centre offering a diverse range of retail, service, community, institutional and recreational uses serving several nearby residential and/or business areas. Office development and medium and high density housing at appropriate locations.
Residential	Urban Residential – Low Density	13 (31)	Single detached, semi-detached, linked, duplex, street townhouses and limited block townhouses at 17.0 to 37.0 units per net hectare (6.88 to 14.97 units per net acre).
Transportation & Utility	Transportation & Utility	10 (24)	The Hydro One electrical transmission corridor, the future Highway 404/19th Avenue full interchange, and the future mid-block Highway 404 flyover.
Hazard Lands/Open Space	"Environmental Protection Area – Hazard Lands" & Environmental Protection Area – Valley Lands	9 (22)	Berczy Creek and associated valley land

D

Appendix D

OPA 149 Roadway Network

Proposed Roadway Network



OFFICIAL PLAN AMENDMENT No. 149

TOWN OF MARKHAM OFFICIAL PLAN (REVISED 1987) AS AMENDED
SCHEDULE BB – TRANSPORTATION

BOUNDARY OF AREA COVERED BY THIS AMENDMENT

REGION OF YORK ARTERIAL ROAD

MAJOR ARTERIAL ROAD (TOWN OF MARKHAM)

MAJOR COLLECTOR ROAD

INDUSTRIAL COLLECTOR ROAD 23 metre right-of-way

INTERSECTION IMPROVEMENT

SCHEMATIC LOCATION (See section 6.1.5)

MARKHAM DEVELOPMENT SERVICES COMMISSION

SECONDARY PLAN PD 42-1

DRAWN BY: DD
CHECKED BY: TL

SCALE: 1:10 000
DATE: 05/1/24

MARKHAM

CIMA+

T: 289-288-0287
400-3027 Harvester Rd, Burlington ON L7N 3G7 CANADA

SCALE

0 15 30 90m

1:3000

ROAD A, C1, D AND E1

THE REGIONAL MUNICIPALITY OF YORK
MARKHAM 404 COLLECTORS EA

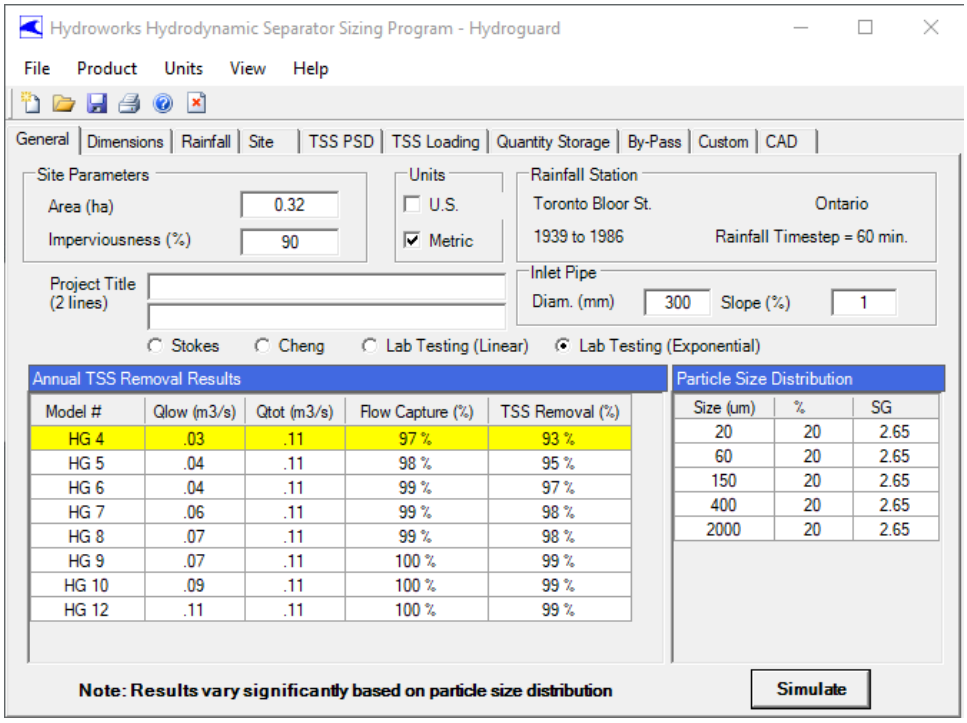
LEGEND

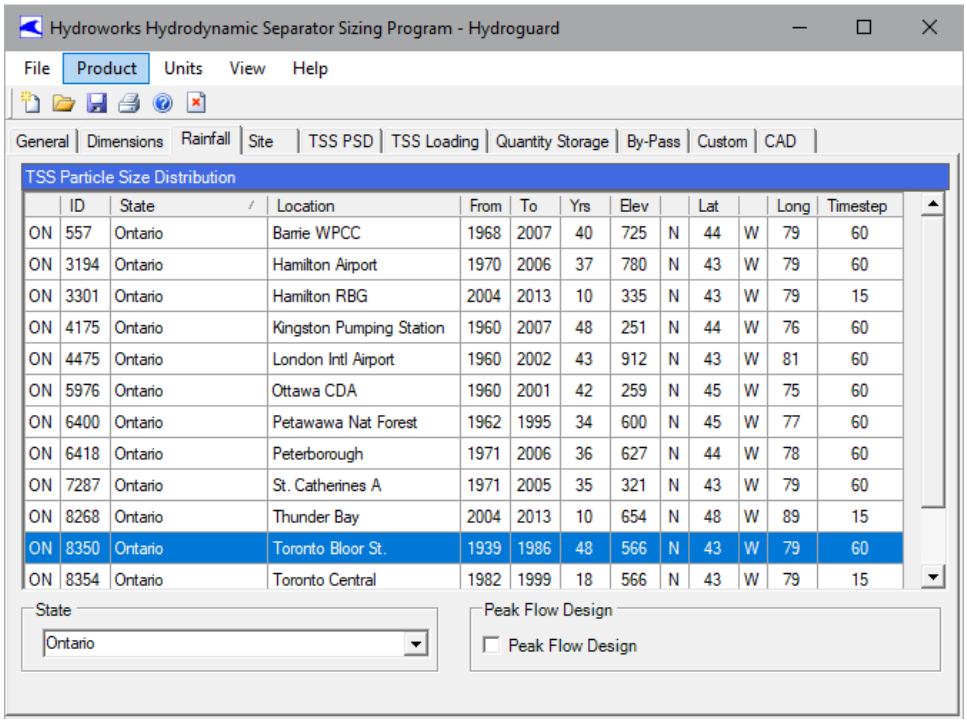
- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- 3.0m ACTIVE TRANSPORTATION (AT) BUFFER
- BOULEVARD WITH URBAN DESIGN FEATURES
- VALLEYLANDS
- WATERCOURSE
- UNEVALUATED WETLANDS
- WETLANDS

E

Appendix E

OGS Sizing


Hydroworks Hydrodynamic Separator Sizing Program - Hydroguard
File Product Units View Help
General Dimensions Rainfall Site TSS PSD TSS Loading Quantity Storage By-Pass Custom CAD
Site Parameters
Area (ha) 0.32
Imperviousness (%) 90
Units
U.S.
Metric
Rainfall Station
Toronto Bloor St. Ontario
1939 to 1986 Rainfall Timestep = 60 min.
Project Title (2 lines)
Inlet Pipe
Diam. (mm) 300 Slope (%) 1
Stokes Cheng Lab Testing (Linear) Lab Testing (Exponential)
Annual TSS Removal Results
Model # Qlow (m3/s) Qtot (m3/s) Flow Capture (%) TSS Removal (%)
HG 4 .03 .11 97 % 93 %
HG 5 .04 .11 98 % 95 %
HG 6 .04 .11 99 % 97 %
HG 7 .06 .11 99 % 98 %
HG 8 .07 .11 99 % 98 %
HG 9 .07 .11 100 % 99 %
HG 10 .09 .11 100 % 99 %
HG 12 .11 .11 100 % 99 %
Particle Size Distribution
Size (um) % SG
20 20 2.65
60 20 2.65
150 20 2.65
400 20 2.65
2000 20 2.65
Note: Results vary significantly based on particle size distribution
Simulate


Hydroworks Hydrodynamic Separator Sizing Program - Hydroguard
File Product Units View Help
General Dimensions Rainfall Site TSS PSD TSS Loading Quantity Storage By-Pass Custom CAD
TSS Particle Size Distribution
ID State Location From To Yrs Elev Lat Long Timestep
ON 557 Ontario Barrie WPCC 1968 2007 40 725 N 44 W 79 60
ON 3194 Ontario Hamilton Airport 1970 2006 37 780 N 43 W 79 60
ON 3301 Ontario Hamilton RBG 2004 2013 10 335 N 43 W 79 15
ON 4175 Ontario Kingston Pumping Station 1960 2007 48 251 N 44 W 76 60
ON 4475 Ontario London Intl Airport 1960 2002 43 912 N 43 W 81 60
ON 5976 Ontario Ottawa CDA 1960 2001 42 259 N 45 W 75 60
ON 6400 Ontario Petawawa Nat Forest 1962 1995 34 600 N 45 W 77 60
ON 6418 Ontario Peterborough 1971 2006 36 627 N 44 W 78 60
ON 7287 Ontario St. Catherines A 1971 2005 35 321 N 43 W 79 60
ON 8268 Ontario Thunder Bay 2004 2013 10 654 N 48 W 89 15
ON 8350 Ontario Toronto Bloor St. 1939 1986 48 566 N 43 W 79 60
ON 8354 Ontario Toronto Central 1982 1999 18 566 N 43 W 79 15
State
Ontario
Peak Flow Design
Peak Flow Design

Hydroworks Hydrodynamic Separator Sizing Program - Hydroguard

File Product Units View Help

General | Dimensions | Rainfall | Site | TSS PSD | TSS Loading | Quantity Storage | By-Pass | Custom | CAD

TSS Particle Size Distribution

	Size (um)	%	SG
▶	20	20	2.65
	60	20	2.65
	150	20	2.65
	400	20	2.65
	2000	20	2.65
*			

Notes:

1. To change data just click a cell and type in the new value(s)
2. To add a row just go to the bottom of the table and start typing.
3. To delete a row, select the row by clicking on the first pointer column, then press delete
4. To sort the table click on one of the column headings

TSS Distributions

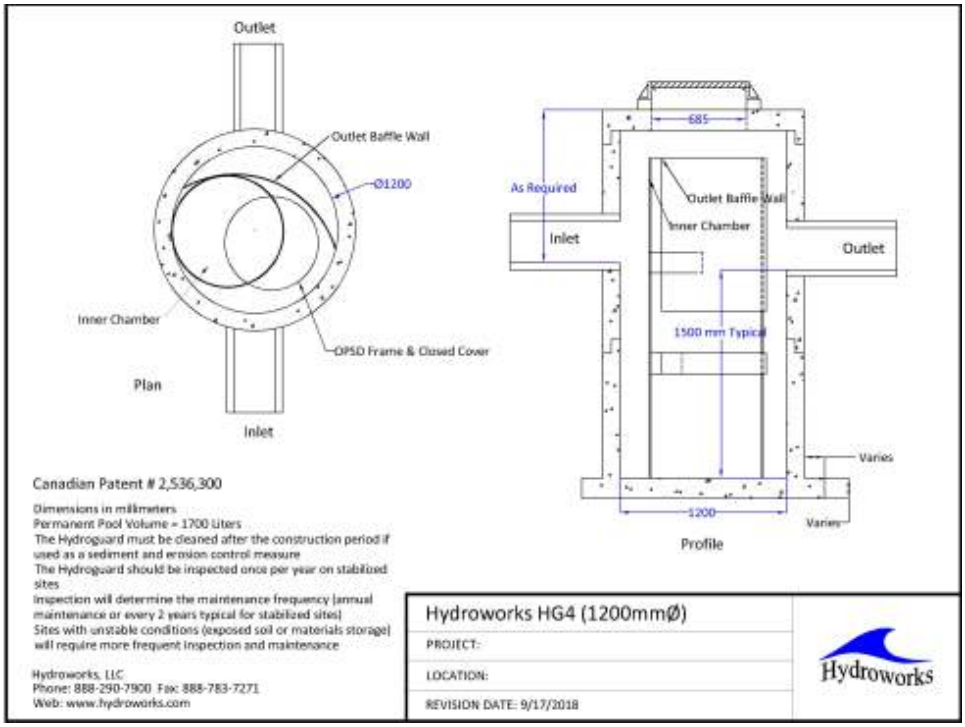
- ○ NJDEP / ETV
- ○ OK110
- ○ Toronto
- ◉ Ontario (1994)
- ○ Calgary Forebay
- ○ F95 Sand
- ○ NURP (1983)

Clear

TSS Removal Required (%) 80

Water Temp (C) 20

You must select a particle size distribution for TSS to simulate TSS removal



F

Appendix F

Drainage Mosaics

HIGHWAY 404

19TH AVENUE

WOODBINE AVENUE

Berczy Creek
66.1

Rouge River
9.6

SWMP B3
72.2

SWMP L1
26.6

Honda Boulevard

GILLINGS STREET

PRINCE OF WALES DRIVE

EARNSHAW DRIVE

THOMAS REID ROAD

Legend

- EXISTING OUTLETS
- EXISTING STORM SEWERS
- EXISTING STORM DITCHES
- WATERSHED DIVIDE
- WATERCOURSES
- CONTOURS 1m
- TRCA REGULATORY LIMIT
- STUDY AREA
- EXISTING PONDS
- PROPERTY PARCEL

Existing Drainge

Drain to:

- Berczy Creek
- Rouge River
- SWMP B3
- SWMP L1

CIMA+

CLIENT: MARKHAM

SCALE:
0 30 60 120 180 240
Meters
1:3,000
(1:1,500 11x17 Paper)

PROJECT NAME: MUNICIPAL CLASS ENVIROMENTAL ASSESSMENT STUDY - HIGHWAY 404 NORTH COLLECTOR ROADS

SHEET TITLE: EXISTING CONDITIONS DRAINAGE MOSAIC

PROJECT No: B000801		CLIENT FILE No: –
DRAFTER: K. Lukawiecki	DESIGNER: —	DRAWING No: –
APPROVER: R. Cressman	APPROVER: —	
DATE: 8/28/2019		SHEET No: 1 of 1

HIGHWAY 404

HIGHWAY 404

19TH AVENUE

19TH AVENUE

WOODBINE AVENUE

Berczy Creek

Honda Boulevard

GILLINGS STREET

PRINCE OF WALES DRIVE

THOMAS REID ROAD

SWMP B2
14.9

SWMP B1
17.7

SWMP B3
72.2

Rouge River
9.5

Berczy Creek
33.8

Interim SWM Pond B2

Interim SWM Pond B1

Interim SWM Pond B3

SWM Pond L1

Legend

- EXISTING STORM SEWERS
- EXISTING STORM DITCHES
- WATERSHED DIVIDE
- WATERCOURSES
- CONTOURS 1m
- TRCA REGULATORY LIMIT
- STUDY AREA
- PROPERTY PARCEL
- INTERIM PONDS

INTERIM DRAINAGE AREAS DRAIN TO:

- BERCZY CREEK
- ROUGE RIVER
- SWMP B1
- SWMP B2
- SWMP B3
- SWMP L1

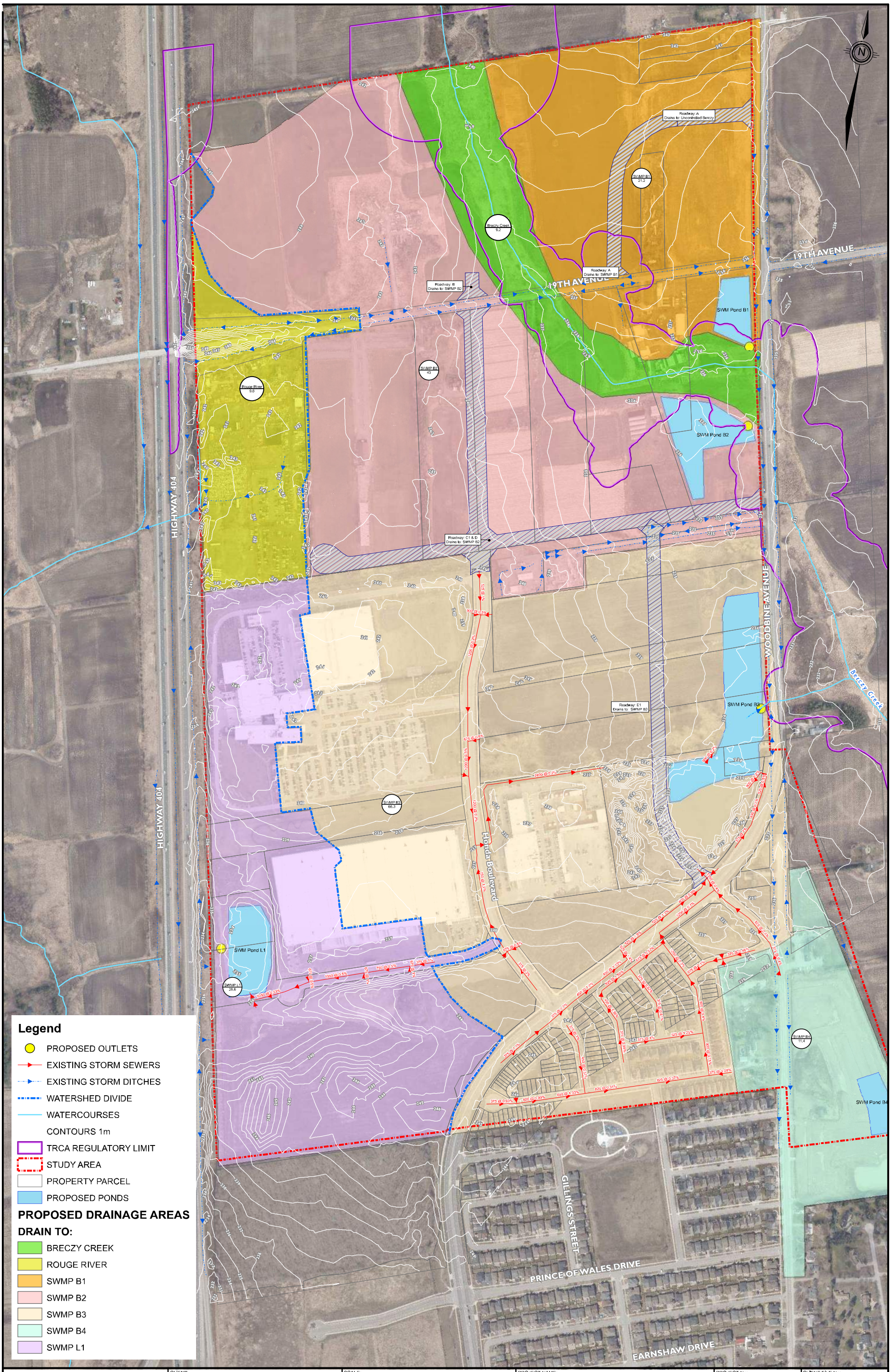
CLIENT: MARKHAM

SCALE: 0 30 60 120 180 240 Meters
1:3,000
(1:6000 11x17 Paper)

PROJECT NAME: MUNICIPAL CLASS ENVIROMENTAL ASSESSMENT STUDY - HIGHWAY 404 NORTH COLLECTOR ROADS

SHEET TITLE: INTERIM CONDITIONS DRAINAGE MOSAIC

PROJECT No: B000801		CLIENT FILE No: –
DRAFTER: K. Lukawiecki	DESIGNER: –	DRAWING No: –
APPROVER: R. Cressman	APPROVER: –	
DATE: 10/2/2019		SHEET No: 1 of 1



CLIENT: MARKHAM

SCALE: 0 30 60 120 180 240 Meters
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(1:6,000 11x17 Paper)

PROJECT NAME: MUNICIPAL CLASS ENVIROMENTAL ASSESSMENT STUDY - HIGHWAY 404 NORTH COLLECTOR ROADS

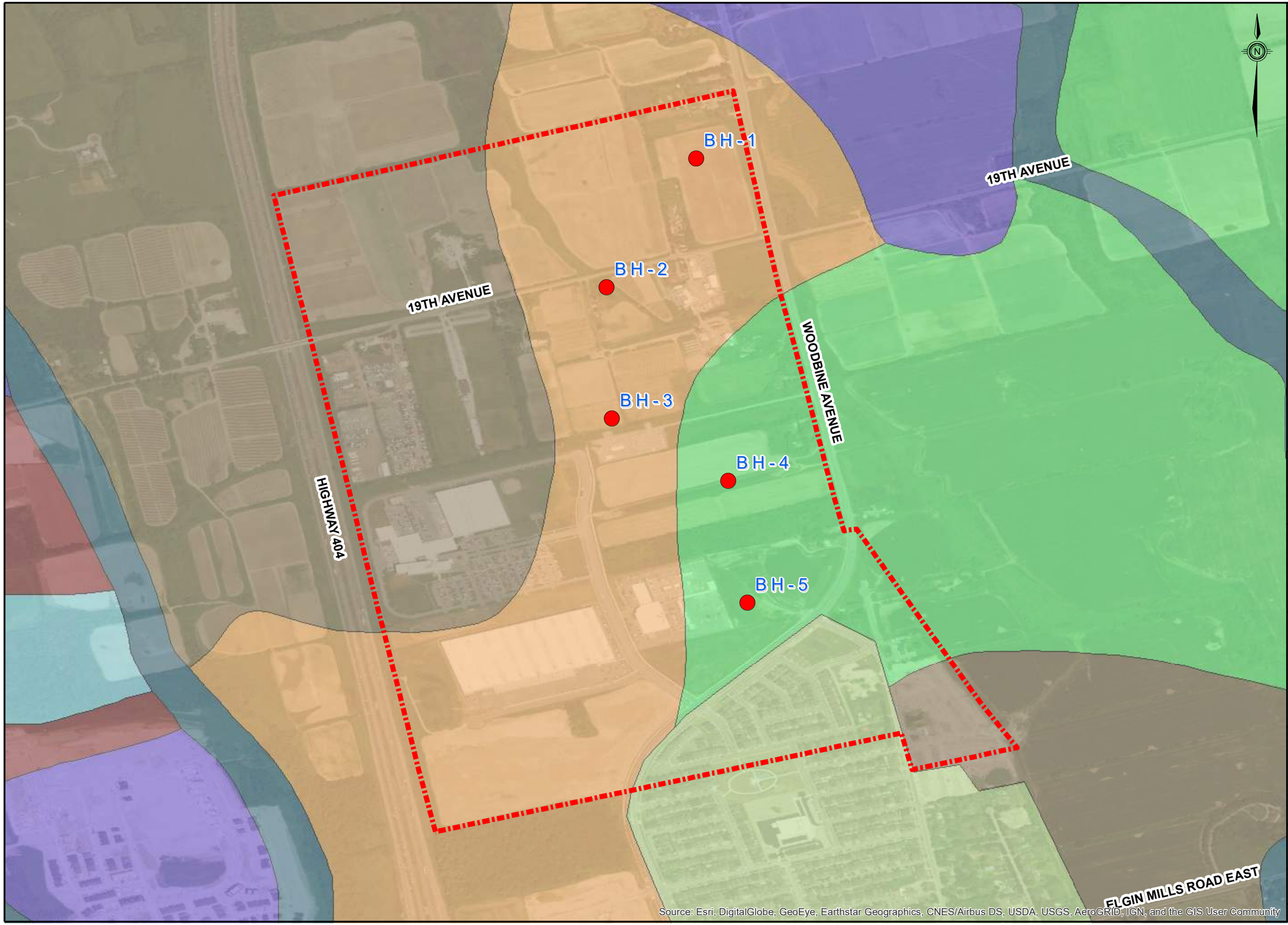
SHEET TITLE: PROPOSED CONDITIONS DRAINAGE MOSAIC

PROJECT No: B000801		CLIENT FILE No: –	
DRAFTER: K. Lukawiecki	DESIGNER: –	DRAWING No: –	
APPROVER: R. Cressman	APPROVER: –		
DATE: 8/28/2019		SHEET No: 1 of 1	

G

Appendix G

Soil Map



LEGEND

STUDY AREA

SOIL TYPE

- BOTTOM LAND
- BUILT UP AREA
- CHINGUACOUSY CLAY LOAM - C
- GRANBY SANDY LOAM - B
- LYONS LOAM - B
- MILLIKEN LOAM - BC
- PEEL CLAY - D
- TECUMSETH SANDY LOAM - AB
- WOBURN LOAM - B
- Boreholes

Soil Type Information Taken From Land Information Ontario

CLIENT

PROJECT NAME:

MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT STUDY - HIGHWAY 404 NORTH COLLECTOR ROADS

SHEET TITLE:

SOIL MAP

SCALE:

0 0.0325 0.065 0.13 0.195 0.26

kilometres

1:10,000

FIGURE No:

PROJECT No: B000801

DATE: 2/5/2020

H

Appendix H

Geotechnical Report
Existing Groundwater Levels

PRELIMINARY GEOTECHNICAL INVESTIGATION
HIGHWAY 404 NORTH COLLECTOR ROADS
ENVIRONMENTAL ASSESSMENT STUDY
MARKHAM, REGION OF YORK

Report Submitted

To

CIMA+

Geoff Lay, P.Eng.
Geotechnical Engineer

September 11, 2019
File: 18189

Murray R. Anderson, M.Eng., P.Eng
Senior Geotechnical Engineer, Associate

Till soils frequently contain cobbles and boulders, and these should be anticipated when excavating during construction.

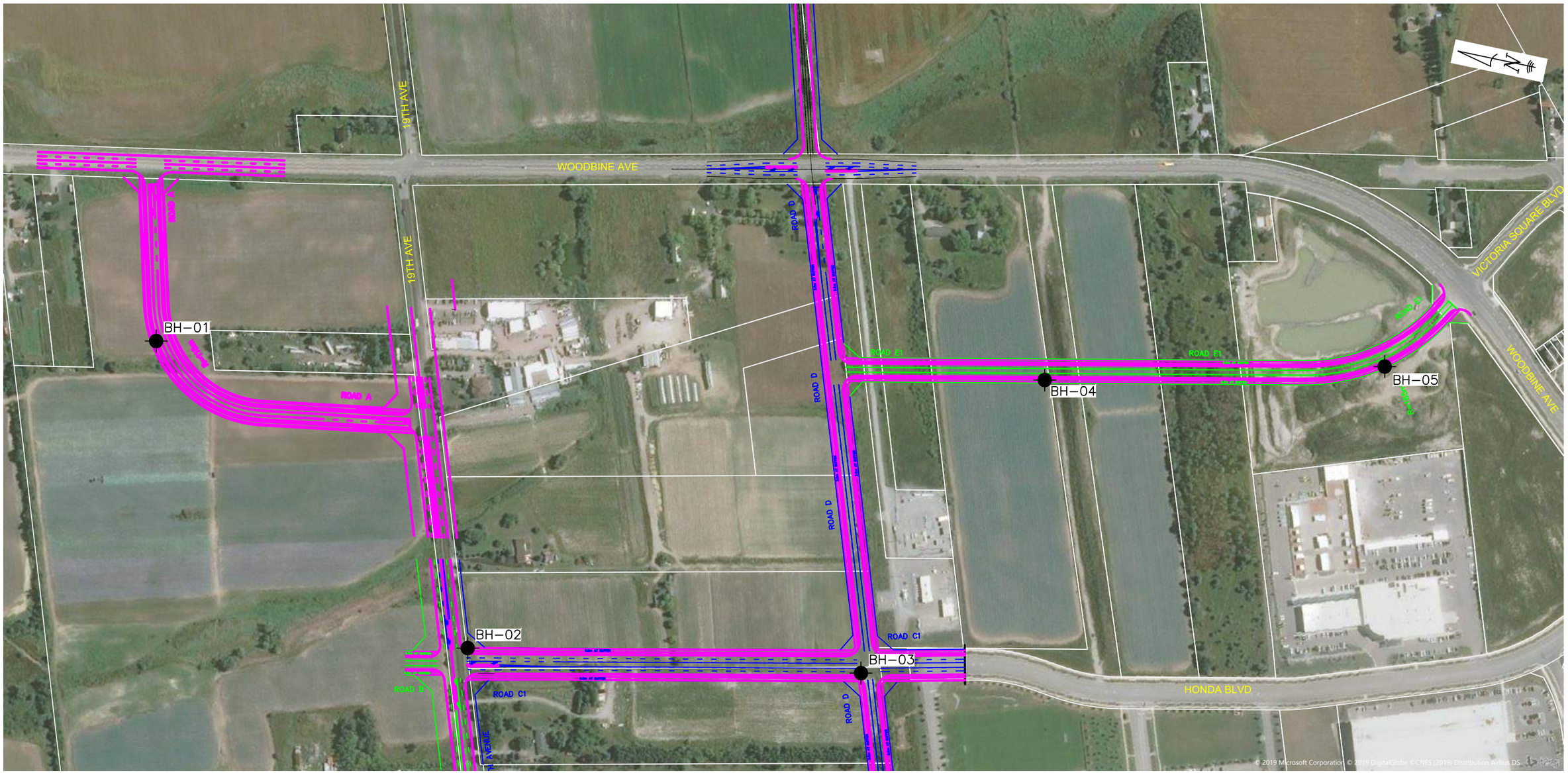
4.3 Groundwater

Groundwater was measured at 3.9 m depth (Elev. 237.0) in Borehole BH-03 upon completion of drilling. Groundwater was not observed in the remaining boreholes during drilling. The groundwater depths and elevations measured in the piezometers after drilling are summarized in the following table.

Table 4.1 – Ground Water Level Measurements

Borehole No.	Date	Water Level		Comment
		Depth (m)	Elevation (m)	
BH-01	Aug. 9, 2019	1.2	237.7	In piezometer
BH-02	Aug. 9, 2019	0.5	238.3	In piezometer
BH-03	Aug. 9, 2019	2.1	238.8	In piezometer
BH-04	Aug. 9, 2019	1.4	235.0	In piezometer
BH-05	Aug. 9, 2019	3.1	232.0	In piezometer

The recorded levels are short-term observations and seasonal fluctuations are to be expected. The groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.



PLAN

80 0 80 160m

SCALE 1:4000

LEGEND

BOREHOLE LOCATION

BASE PLAN PROVIDED BY

CIMA Canada Inc.

HIGHWAY 404 NORTH COLLECTOR ROADS
CITY OF MARKHAM

BOREHOLE LOCATION PLAN

JOB# 18189

THURBER ENGINEERING LTD.

ENGINEER :	DRAWN :	APPROVED :
GRL	BH	MRA
DATE :	SCALE :	DRAWING No.
SEPTEMBER	1:4000	1

FILENAME: H:\Drafting\18000\18189\TED-18189-BHPL.dwg
PLOTDATE: Sep 9, 2019 - 8:53 AM

SUBMITTED BY CIMA CANADA INC.
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