Chinguacousy Road Improvements Schedule C Class EA

Stormwater Management Design
Technical Design Brief

Prepared For:

Town of Caledon

MARCH 2023

CREATING QUALITY SOLUTIONS TOGETHER

Ainley GROUP

CHINGUACOUSY ROAD IMPROVEMENTS SCHEDULE C CLASS EA
STORMWATER MANGEMENT DESIGN TECHNICAL BRIEF

PROJECT NO. 120065

Prepared For:

Town of Caledon

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1 Introduction

The Town of Caledon has retained Ainley Group to undertake a Municipal Class Environmental Assessment (Class EA) for improvements to Chinguacousy Road from Mayfield Road to Old School Road. The study area (**Figure 1**) is focused on this corridor of Chinguacousy Road.

- Project Limits - Chinguacousy Road from Mayfield Road to Old School Road
- Approximate Length – 3.0 Km

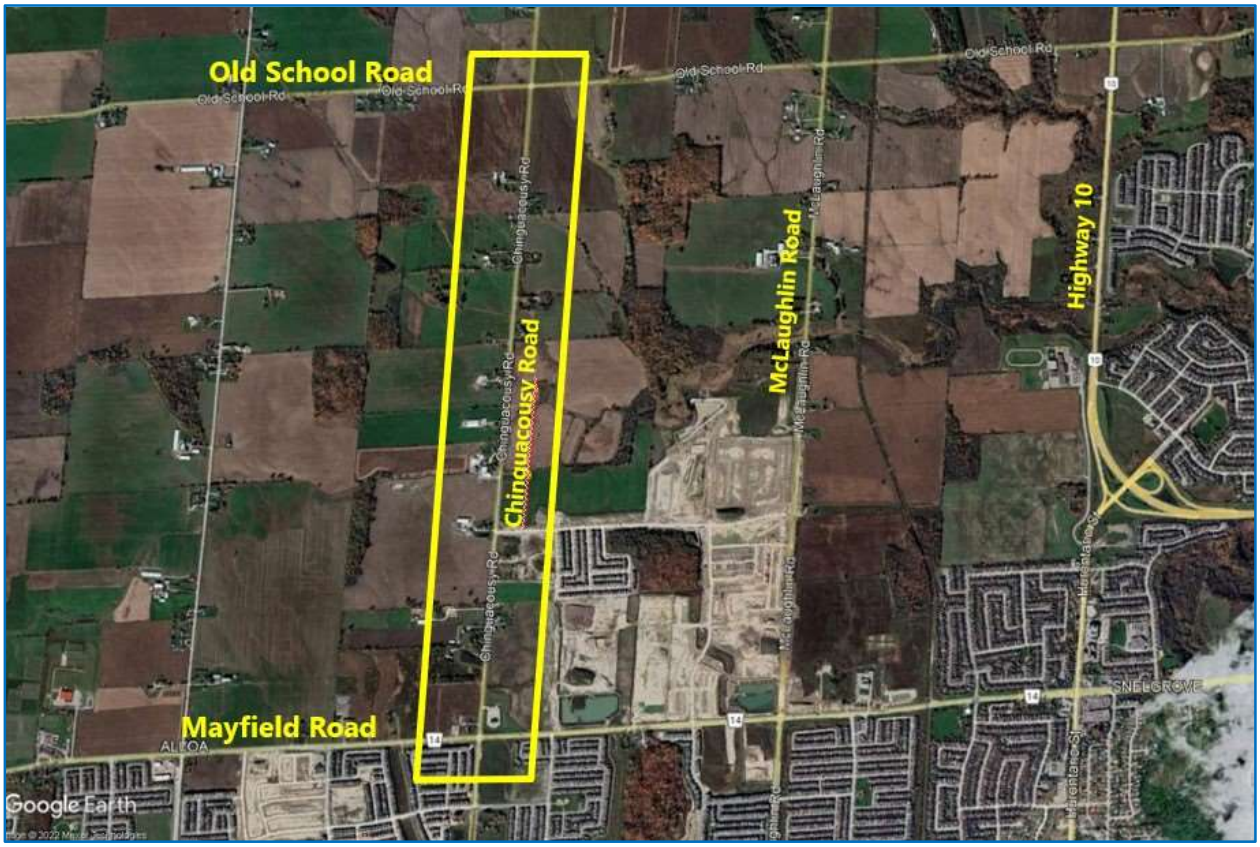


Figure 1: Project Study Location

The Chinguacousy Road segment, from Mayfield Road to Old School Road, is a two-lane rural collector road with a posted speed of 80 km/hr. The roadside drainage is mainly conveyed through existing ditches. There are five major water crossings, three of which are concrete box culverts. Based on our site visit, we understand that three of the box culverts (B20028314, B20028314a and B20028315) are being replaced by the Town of Caledon as part of RFT Project No#2020-03. The table below summarizes the inventory of features along the project corridor.

Table 1: Major Water Crossings

Culvert ID	Type	STA	W/C No.	Dimensions (mm)			Material	Length
				Height	Width	Dia.		
B20028314	Box	12+700	CH1	TBD	6.3	NA	Concrete	13.0
B20028314a	Box	12+400	CH2	TBD	4	NA	Concrete	12.9
B20028315	Box	12+060	CH3	TBD	4	NA	Concrete	12.6
NA	Box	11+520	CH4	2500	6000	NA	Concrete	22.0
NA	Circular	10+330	CHHDF1	NA	NA	600	CSP	14.7

Through the 2051 panning horizon, Caledon is forecasted to grow from a population of approximately 80,000 residents to approximately 300,000. The Caledon Transportation Master Plan (TMP) furthers defines the transportation vision for the Town, to focus on addressing the Town's mobility needs in an effective, responsible, and sustainable manner. The TMP has identified the corridor of Chinguacousy Road from Mayfield Road to the northern limits as an area needing road network improvements. This corridor is part of the new extended Region of Peel settlement boundary.

The existing transportation corridor does not support active transportation or provide multimodal transportation, limiting the ability of residence to connect to adjacent neighborhoods or hubs. Additionally, the current road design does not align with the Town of Caledon's Official Plan for Arterial roads, resulting in an inability to accommodate future traffic demands. The improvements will provide opportunity to increase road capacity and to provide an efficient travel corridor to correspond with forecasted growth and traffic demands. Creating multimodal transportation options as well as transit-oriented opportunities will support active transportation and the creation of complete communities.

Through completion of Phases 1 and 2 of the Municipal Class EA process 6 Design Alternatives were considered and evaluated based on consideration of how effectively each alternative addressed the effectiveness of the transportation corridor with consideration for the impacts each alternative might have had on all aspects of the environment, as described in the Environmental Study Report. On this basis, the selected Preferred Alternative was to

- Modify existing roadway and intersections locally to improve operations. Modifications may include works such as adding traffic signals and timing optimization, through and turn lanes, resurfacing and paving roadway shoulders;
- Increase capacity on Chinguacousy Road with the addition of vehicle lanes. This alternative would require widening of the current road right of way; and
- Improve facilities for other modes of travel such as walking, cycling, and transit, without adding traffic lanes.

The purpose of this report is to provide a stormwater management strategy that will mitigate the increased impervious area required to implement the Preferred Alternative Design Option. The

stormwater management strategy will provide recommended measures to achieve the relevant stormwater runoff water quantity, water quality, and water balance for each of the proposed options, as well as an assessment of the suitability of implementing these measures within the project area.

1.1 Background Documents

The following documents were referenced in the preparation of this report:

- Development Standards Manual – Version 5; Town of Caledon. 2019.
- Functional Servicing Report Mayfield West Phase 2 – Stage 2; prepared for Town of Caledon and Region of Peel by Urbantech Consulting, 2nd Submission August 2021.
- Stormwater Management Criteria, Toronto and Region Conservation, Version 1.0 August 2012.
- Crossings Guideline for Valley and Stream Corridors, Toronto and Region Conservation, September 2015.
- Stormwater Management Guideline, Credit Valley Conservation, July 2022.
- Fletchers Creek Subwatershed Plan Study Report, City of Brampton by Paragon Engineering Ltd., August 1995.
- Draft Fletchers Creek Restoration Study, Credit Valley Conservation, February 2012.
- Runoff Volume Control Targets for Ontario, Final Report, Ministry of the Environment & Climate Change, October 27, 2016.
- Design Criteria for Sanitary Sewers, Storm Sewers and Forcemains for Alterations Authorized under Environmental Compliance Approval, Ministry of Environment, Conservation, and Parks, v.1 April 22, 2022.
- Stormwater planters: LID SWM Planning and Design Guide. (2022, October 5). Sustainable Technologies Evaluation Program. Retrieved 13:20, November 3, 2022 from https://wiki.sustainabletechnologies.ca/index.php?title=Stormwater_planters&oldid=14392.

2 Stormwater Management Design Criteria

Based on our review of the background documents, the relevant stormwater management targets have been determined based on an evaluation of the required criteria established by the Town of Caledon, Toronto and Region Conservation Authority, Ministry of the Environment, Conservation, and Parks, and relevant Watershed Planning documents or Subwatershed Impact Studies. Each of the relevant criteria and targets are described below.

2.1 Water Quantity and Flood Control

The Town of Caledon requires that stormwater management measures are implemented to control increases in storm runoff due to development. In areas where no Watershed, Subwatershed Planning, or Subwatershed studies have been completed, the Town requires that runoff peak flows are controlled to pre-development levels, unless it can be demonstrated that uncontrolled flow will not cause detrimental impacts on flood conditions on downstream properties and watercourse systems. Before the Town will accept any increase in runoff rates, it must also receive endorsement from the agencies having jurisdiction.

Where Subwatershed Plans or Subwatershed Impact Studies have been completed, stormwater measurement requirements will be based on the recommendations of the specific plan. Any variations are required to be supported by detailed analysis and be approved by agencies having jurisdiction.

The water quantity and flood control targets are established to ensure that any newly developed areas incorporate design measures to ensure that any potential impacts to local or regional flooding are mitigated accordingly.

The Toronto and Region Conservation Authority provides stormwater quantity control criteria for the purpose of protecting downstream properties from flood increases due to upstream development. To accomplish this objective, the TRCA has completed Hydrologic Studies and Subwatershed-level Stormwater Management Studies to characterize flood flow rates, define the location and extent of Flood Damage Centres, assess the potential impacts of further urbanization, and to establish flood control targets for future SWM planning

For the Fletcher's Creek watershed, these same criteria are established by the Credit Valley Conservation Authority. To protect life and property from the hazards of flooding and erosion, it was determined that post-development peak flows should not exceed pre-development peak flows in the upper reaches of the Fletcher Creek subwatershed (Paragon, 1995).

An updated Subwatershed study was completed by AMEC as part of the Mayfield West Development in 2013. The volumetric control unit release rates to control post development flows to pre-development levels for this watershed were identified in the Functional Servicing Report (Urbantech, 2021), and are summarised in Table 2.

Table 2: Fletcher's Creek Catchment Unit Release Flow Rates (m^3/s/ha)

Storm Return Period Years	Storage Requirement m^3/impervious ha	Unit Release Flow Rate m^3/s/ha
25	575	0.008
100	1,215	0.080
Regional	1,225	0.090

For the Etobicoke Creek watershed unit flow relationships have been established by TRCA to define pre-development flow targets for specific areas within the watershed for 2 through 100-year return period events. Based on the analysis completed by TRCA the subject area is located within Catchments 232, 233, and 234 of the model for Etobicoke Creek. Unit flow rates for these catchments are provided in the TRCA document (Appendix A, Table I1; TRCA, 2012). These rates are summarized in Table 3 below. However, TRCA's notes indicate that the criteria may be superseded by the results of further studies or based upon local constraints. It is recommended that proponents consult with TRCA staff to determine the criteria for regional flood control or the need for additional assessments given the risk that upstream urbanization can increase flood risk in downstream areas for the regional storm. Since the subject area is located outside of the urban boundary based on when the TRCA's Etobicoke Creek study was finalized it is recommended that TRCA be consulted to determine the need for regional storm protection for this area, since they are currently updating their watershed model for Etobicoke Creek.

Table 3: Etobicoke Creek Catchment Unit Peak Flow Rates (L/s/ha)

TRCA Catchment ID No.	Storm Return Period Years					
	2	5	10	25	50	100
232	3.7	6.7	9	12.2	14.8	17.4
233	4.7	8.4	11.3	15.3	18.4	21.7
234	3.6	6.4	8.6	11.7	14.1	16.7

Per the description provided in the Functional Servicing Report prepared for Phase 2, Stage 2 of the Mayfield West subdivision (Urbantech, Aug. 2021), wet ponds have been designed within the subdivision to meet quantity control requirements for the development and surrounding area to ensure that existing flow rates downstream of the subject lands are not exceeded under post-development conditions, thereby providing flood protection for downstream properties. For the design of the subdivision ponds, Visual OTTHYMO 5.0 models were prepared to establish the storage requirements to control post development runoff to pre-development targets based on the pre-development tributary area and the required unit flow rates per the relevant watershed criteria. The 12-hour AES storms were considered to be the most conservative storm distributions to establish storage requirements for these facilities.

Stormwater management facilities 1 and 5 service portions of Chinguacousy Road within the current study area (Drawing 501, Urbantech, 2021). The design of SWM Facility 1 includes an allowance for runoff from 1.56 ha of the study area extending from Tim Manley Avenue southward to Collector Road 'B', and another 0.85 ha extending from Collector Road 'B' to north of the Commercial Block. The design of SWM Facility 5 captures runoff from approximately 1.25 ha of the study area extending from approximately 150 south of the Etobicoke Creek crossing southward to Tim Manley Avenue. ROW areas were assumed to have a C-value of 0.9 for Rational Method calculations, and an assumed impervious area of 100% (Table 6.3, Urbantech, 2021). A portion of the study area has been included in the external catchment area for the clean water collection box culvert. During the subdivision design process, it was determined that Regional controls are typically not required for facilities discharging directly to Etobicoke Creek (Section 6.2, Urbantech, 2021). However, TRCA noted that, for lands along Chinguacousy Road and north of Etobicoke Creek, 214 m^3/ha of Regional storage was required to be implemented into the design of SWM Facility 5. In addition, all facilities were designed to meet the criteria in Section 4.2.1 of the TRCA's *Approaches to Manage Regulatory Event Flow Increases resulting from Urban Development*, where applicable (Section 6.2, Urbantech, 2021). Flow targets for Fletcher's Creek were established as part of the background studies for the FSR at 575 m^3/ha, released at 0.008 m^3/s/ha for the 25-year storm, 1,215 m^3/ha, released at 0.080 m^3/s/ha for the 100-year event, and , 1,225 m^3/ha, released at 0.090 m^3/s/ha for the Regional event which are consistent with post to pre-development control requirements (Section 6.2, Urbantech, 2021). Based on results from the VO5 model, using a 24-hour distribution at the request of CVC, it was determined in the FSR that the stated rates and volumes are conservative, but used as the basis for the design. Targets at Facility 5 were established with the acknowledgement that the outlet included consolidated areas, which were not tributary to that outlet under pre-development conditions. As a result, the target release rate was determined based on the application of the unit rates, stated above, to the smaller pre-development tributary area (Section 6.2, Urbantech, 2021).

Following the recommended improvements to accommodate the Town's Master Transportation Plan and the updated Official Plan Chinguacousy Road will be classified as an arterial road. As

a result, in accordance with Town of Caledon requirements all culvert or bridge crossings must be designed for a Design Flood Frequency of the greater runoff generate from either the 1:100-year return period event or the Regional storm (Section 1.4.2.2.7, Town of Caledon, 2019).

TRCA objectives for watercourse crossing are that all proposed crossing structures must not result in an increased flood risk for design storm events up to and including the Regulatory event. However, it is recognized by TRCA that in some instances this may not be practical for modifications to existing crossings (Section 2, TRCA, 2015).

2.2 Water Quality Control

Under the requirements of the April 2022 development criteria, the Town of Caledon prefers control of the 90th percentile storm event for suspended solids for new development or enhanced, normal or basic levels of protection where conventional methods are necessary and dependent on the receiver. Phosphorous loadings to Lake Erie and its tributaries, must be minimized as compared to 2018 or conditions prior to the proposed development. For retrofit scenarios, if this development criteria cannot be met, the level of water quality control provided must be improved on site and works designed for a multi-year retrofit project, in accordance with a rehabilitation study or similar area-wide Stormwater study, such that the completed treatment train will achieve the development criteria.

The Toronto Region Conservation and Credit Valley Conservation Authorities have established their requirements for water quality control based on Provincial acts concerned with the protection, and conservation of water, and the quality of drinking water supplied to the public, with associated requirements pertaining to stormwater management, along with the requirements of the federal Fisheries Act which prohibits the deposit of deleterious substances into waters that may degrade or alter the quality of water causing impact to fish or fish habitat. On this basis, both suspended solids and thermal warming are considered as pollutants to the aquatic ecosystem. In accordance with the recommendation from the MOE Stormwater Management Planning and Design Manual (SMPDM), TRCA requires an Enhanced Level of protection throughout these jurisdictions, as a minimum. For areas with coldwater species and other target species, TRCA and CVC recommend that discharge temperatures are equal to, or within an acceptable ecological range of ambient stream temperatures.

Based on the descriptions provided in the Mayfield West FSR all SWM facilities within the Etobicoke Creek and Fletcher Creek Watersheds have been designed to meet the Enhanced criteria per the SMPDM (Section 6.2, Urbantech, 2021). Each facility includes a deep outlet pool, an extended detention reverse-slope pipe extending from 0.5m above the bottom of the permanent pool to an orifice plate on the control structure at normal water level, and a sub-surface outlet pipe (Section 6.3 & 6.5, Urbantech, 2021). These are typical measures recommended by the TRCA and CVC to protect downstream cool to coldwater fisheries (Appendix E1, TRCA, 2012). In addition, planting and landscaping will be further refined during the detailed design of the subdivision as part of the thermal mitigation strategy (Section 6.5, Urbantech, 2021).

2.3 Erosion Control

The Town of Caledon requires that appropriate protection is provided, depending on erosion assessments or as per the Detailed Design Approach of Simplified Design Approach methods described in the Stormwater Management Planning and Design Manual (MOECC, 2003). In the

absence of a guiding study, detention of, at minimum, the runoff volume generated from a 25mm storm event over 24 to 48 hours is required.

TRCA and CVC support the principle for a target flow, usually defined as an erosion threshold, which is the flow that can theoretically entrain bed or bank sediments within the most sensitive reach of a receiving watercourse. Target flows can be established through an established methodology (Section 4.3, TRCA, 2012), and appropriate controls provided, or, where conditions do not merit a detailed analysis 5mm of on-site retention is required. For sites with a SWM pond, extended detention of the 25mm for a period of 48 hours may also be required.

A key element of the SWM strategy for the development of the Mayfield West property was the determination of erosion thresholds. Appropriate release rates for all facilities were determined based on threshold analysis completed by AMEC, resulting in the following target volumes and release rates (Section 6.2, Urbantech, 2021):

- Fletcher's Creek 250 m^3/impervious ha, released at 0.00041m^3/s/ha; and
- Etobicoke Creek 325 m^3/impervious ha, released at 0.00031m^3/s/ha.

2.4 Water Balance

This section of Chinguacousy Road is located in a Low Ground Water Recharge Area (Figure C 9, TRCA, 2012). As a result, based on TRCA and CVC requirements infiltration rates in these areas are relatively low and maintenance of pre-development infiltration rates is judged based on a best effort made approach, and assessment studies are not required for these areas (Section 1.2 Appendix C, TRCA 2012).

The Town of Caledon requires control in accordance with water balance assessments completed in previous approved studies, or in the absence of these studies, control of recharge to meet pre-development conditions on the property or control the runoff from the 90th percentile storm event.

2.5 Climate Change Considerations

CVC have developed considerations for climate change based on an impending need to reduce further erosion potential and flood hazard risk within the Credit River watershed, pending more specific guidance to be introduced by the Province or local municipalities. Additional design criteria to account for future increases have been suggested by CVC to improve transparency, consistency, and predictability without the need for additional modelling or assessments. These considerations include:

- Using updated IDF curves that have been prepared by the affected local municipality, in consideration of potential impacts of climate change;
- Where updated curves are not available consideration for an increase of 15% for all design rainfall intensities is recommended to be applied for all SWM design. A minimum recommendation is to utilize future IDF curves for SWM design.

3 Proposed Conditions

The project is divided into 2 phases the widening of Chinguacousy Road from a 2-lane rural cross-section to a 4-lane urban section from just north of the intersection of Mayfield Road to north of Tim Manley Avenue, and the rehabilitation of the rural road from north of Tim Manley Avenue to Old School Road. The design options for each segment are included in Appendix A.

For the urbanized section, 26m of impervious surfaces are considered for road surface and multi-use pathways within the typical 36m cross-section, including non-continuous turn lanes. Effectively, the percentage impervious area for this option can be conservatively considered at 75%, which does not account for the transition segments or landscaped median, which provide additional pervious areas within the road allowance. The rural sections will have a maximum of 7m of paved driving surface with 3m of bicycle accessible shoulder within the 36m road allowance, which is an approximate impervious coverage of 30%. Both of these are in comparison to 7m of paved surface within the future 36m road allowance representing existing conditions, for a calculated impervious coverage of approximately 19.4%.

4 Stormwater Management Design

The following section provides the rationale for the stormwater management design for each segment based on the relevant criteria and existing or proposed infrastructure occurring as part of other projects in the vicinity of the subject area.

4.1 Water Quantity Control

As described in Section 2.1, all segments require a minimum of post to pre development controls. Within the Etobicoke Creek subwatershed post development flows controls must also be verified to ensure they are sufficient to achieve the target flow rates as shown in Table 2 of Section 2.1. Stormwater management facilities within the Mayfield West development have been designed to satisfy the most stringent control requirements for the Etobicoke Creek and Fletchers Creek subwatersheds.

The southern portion of the area, up to 220m north of the intersection with Mayfield Road (Approx STA 10 +340), which is located in the segment slated for urbanization, will be conveyed southward to Mayfield Road and easterly to Fletcher Creek. Post to pre-development flow rate controls will be required for this area for all design events ranging from the 2-year return period event up to and including the Regional storm, based on the volumetric control rates as outlined in Table 2 in Section 2.1. The Region of Peel has completed the Detailed Design and is undertaking the reconstruction of Mayfield Road from Chinguacousy Road to Heart Lake Road which includes the north leg of the intersection of Mayfield Road and Chinguacousy Road. The Region's design team has confirmed that with respect to Chinguacousy Road quantity controls have only been provided to account for the road in the interim condition for the intersection works and taper required to accommodate the improvements along Mayfield Road. Quantity controls for the widening of Chinguacousy Road must be accommodated as part of the detailed design of the current improvements and discharge to the clean water pipe constructed as part of the Mayfield Road improvements. As shown on the Functional Design Drawings included in Appendix L of the ESR report, the proposed works tie-in to the limits of the works completed by the Region at STA 10+160. Controls are required to capture all drainage originating from the proposed high point at STA 10+337.19. As a result, a total of 0.46ha of impervious area will drain to this location from within the total post construction road allowance of 0.64ha. The required storage volumes and target release rates for this area are summarized in Table 3 based on the unit requirements for Fletcher's Creek, as discussed in Section 5.1 of this report.

Table 4: Storage Volumes and Release Rates to Mayfield Road

Storm Return Period Years	Storage Requirement m^3	Allowable Release Rate m^3/s
25	265	0.005
100	560	0.051
Regional	565	0.057

Arched stormwater infiltration chambers with stone embedment would be one of the most efficient means of obtaining these targets. Based on a storage volume per chamber for a standard installation of 0.88 m^3, approximately 645 chambers will be required to achieve the required storage volumes. Assuming that a width of 12 chambers can be installed on either side of the road, on the north side of the outlet to the clean water pipe, a total width of approximately 24.8m will be required (12.4m either side). A maximum of 7m of width can be provided under the boulevard and multi-use path, which will require additional storage must be considered for the entire width of the 6m setback on the private lots. Based on standard chamber measurements this would be required for a length of 60m (approximately 27 chambers long) along the road allowance for each of the 2 outlet locations on either side of the road. However, utilities and entrance will reduce the available area within the road allowance for storage so additional coordination with private owners may be required to achieve the storage objectives for this area. The option considered for this analysis was a typical semi-cylindrical chamber with stone bedding. Several other products are available on the market and could be considered during detailed design to suit property availability and utility configurations while providing sufficient storage to achieve the drainage control requirements. It should be noted that given that the obvert of the clean water pipe at the outlet is approximately 255.55m, based on information provided by Peel Region, depth of cover could be an issue under this configuration, due to the low existing grades on the adjacent lots along the estimated length required under this scenario. As a result, alternative configurations or products which do not require stone embedment may need to be considered as part of the detailed design.

Quantity control requirements for the segment extending from STA 10+337.19 to the high point near the intersection of Tim Manley Avenue at STA 11+013.94 designated for urbanization will be treated within SWM Pond 1 within the Mayfield West Development. Drainage Plans for this development, as well as a summary of runoff coefficients and associated impervious assumptions (Urbantech, 2021) have been included in Appendix B of this report for reference purposes. The design for SWM Pond 1, discharging to Fletcher Creek, includes an allowance for 2.41 ha from the Chinguacousy Road municipal road allowance at 100% impervious coverage (Drawing 503 and Table 6.3) via 2 separate major overland flow capture points connected to the Mayfield West storm sewer system. Based on the preliminary profile design of the Chinguacousy Road Improvements, the tributary area contributing to this facility, delineated as Areas 2 and 3 on Drawing A, included in Appendix B, is expected to be 2.44 ha at 72.3% impervious coverage, equivalent to 1.76 ha of impervious surface area. Therefore, there is sufficient capacity within the proposed SWM Pond 1 to accommodate the required post to pre-development flow rate quantity controls for this segment, ultimately discharging to Fletchers Creek. Design of this segment will be coordinated with the Owner of the Mayfield West Development to ensure that the ultimate area is consistent with the proposed design for SWM Pond 1, previously approved by the Town, Region of Peel, CVC, and MECP. In addition, a portion of the proposed road section will be graded to drain towards the planter boxes provided within the median and roadside bioswales wherever possible, providing a further reduction in the impervious area contribution to SWM Pond 1.

From this point northward to the high point at approximately STA 11+385, a portion of the urbanized segment will have quantity control requirements addressed within SWM Pond 5, to be constructed as part of the Mayfield West Development. The design for SWM Pond 5, discharging to Etobicoke Creek, includes an allowance for approximately 1.15 ha from the Chinguacousy Road municipal road allowance at 100% impervious coverage (Drawing 503 and Table 6.3 Urbantech, 2021) via a single major overland flow capture point connected to the Mayfield West storm sewer system. Based on the preliminary profile design of the Chinguacousy Road Improvements, the tributary area contributing to this facility, delineated as Area 4 on Drawing A, included in Appendix B, is expected to be 1.32 ha at 72.3% impervious coverage, equivalent to 0.95 ha of impervious surface area. Therefore, there is sufficient capacity within the proposed SWM Pond 5 to accommodate the required post to pre-development flow rate quantity controls for this segment, ultimately discharging to Etobicoke Creek. Design of this segment will be coordinated with the Owner of the Mayfield West Development to ensure that the ultimate area is consistent with the proposed design for SWM Pond 5, previously approved by the Town, Region of Peel, TRCA, and MECP

Most of the remaining segment to be urbanized, extending from approximately 11+385 to 11+905, will drain directly to Etobicoke Creek. Quantity controls for the widening of Chinguacousy Road along this segment must be accommodated as part of the detailed design of the current improvements prior to discharging into Etobicoke Creek Based on the preliminary road profile, as shown on the Functional Design Drawings included in Appendix L of the ESR report, controls are required to capture all drainage originating from this area. As a result, a total of 1.35ha of impervious area will drain to this location from within the total post construction road allowance of 1.87ha. It is expected that the maximum required control volume for post to pre-development flow rate control will be consistent with the volume ratio established for the design of Pond 5 within the Mayfield West development, given the similar impervious coverage and the outlet to the same creek. Pond 5 required an approximate treatment volume of 546 m^3/ha for control of the 12-hour SCS event. On this basis, the expected control volume for this segment of Chinguacousy Road will be approximately 1,022 m^3.

Arched stormwater infiltration chambers with stone embedment would be one of the most efficient means of obtaining these targets. Based on a storage volume per chamber for a standard installation of 0.88 m^3, approximately 1,162 chambers will be required to achieve the required storage volumes. Assuming that a width of 12 chambers can be installed on either side of the road, and both sides of the outlet, a total width of approximately 24.8m will be required. A maximum of 7m of width can be provided under the boulevard and multi-use path, which will require additional storage to be considered for the entire width of the 6m setback on the private lots. Based on standard chamber measurements this would be required for a length of 26m (approximately 12 chambers long) along the road allowance for each of the 4 outlet locations. However, utilities and entrance will reduce the available area within the road allowance for storage so additional coordination with private owners may be required to achieve the storage objectives for this area. The option considered for this analysis was a typical semi-cylindrical chamber with stone bedding. Several other products are available on the market and could be considered during detailed design to suit property availability and utility configurations while providing sufficient storage to achieve the drainage control requirements. It should be noted that given the expected 100-year water level expected at this crossing, as discussed in Section 4.2, depth of cover could be an issue at the outside limits of these proposed chambers as a result of low existing grades at the north and south limits under this configuration. As a

result, alternative configurations or products which do not require stone embedment may need to be considered as part of the detailed design.

One segment of the road slated for rehabilitation (STA 11+905 to 11+970) will drain to the main branch of Etobicoke Creek within TRCA Catchment 234. The most restrictive criteria will be applied to establish the required quantity control target based either on controlling post development peak flow rates from all return period storms from the 2 through 100-year events, as well as the Regional event to pre-development peak flow rates or to the allowable unit rates established for Catchment 234 with the TRCA study (TRCA, 2012). Further, it is understood that TRCA is currently in the process of developing a new watershed plan for the Etobicoke Creek in collaboration with the City of Toronto, Region of Peel, City of Mississauga, City of Brampton, Town of Caledon, Mississaugas of the Credit First Nation, and the Greater Toronto Airport Authority. As a result, target flows can be reviewed during detailed design to ensure they achieve the desired targets based on the latest available information. Given the size of the external areas and the relatively low increase in impervious area associated with rehabilitation of the rural segment, it is expected that all necessary quantity controls can be provided within proposed bioswales incorporated into the base of flat-bottomed ditches proposed within the road allowance. Similarly,

- From STA 11+970 to 12+320 the road will drain towards a tributary of Etobicoke Creek (CH3 Palmer, TRCA Catchment 233)
- From STA 12+320 to 12+700 the road will drain towards a tributary of Etobicoke Creek (CH2 Palmer, TRCA Catchment 233)
- From STA 12+700 to the intersection with Old School Road the road will drain towards a tributary of Etobicoke Creek (CH1 Palmer, TRCA catchment 232).

Target flows from each of these catchments will be based on the unit rates established by TRCA for Catchment 234 (TRCA, 2012) or to pre-development flow rates based on the most stringent criteria. Coordination with TRCA will be required through the detailed design to ensure proposed controls are consistent with the recommendations from the current update of the Etobicoke Creek Subwatershed Study update.

4.2 Flood Control

As described in Section 1, and summarized in Table 1 there are 5 watercourses crossing Chinguacousy Road within the project limits. All watercourse crossings will be analyzed to determine required sizing to achieve the hydraulic criteria in accordance with the requirements from the Ministry of Transportation Drainage Design Standards for watercourse culvert crossings (WC-1 and WC-7). All crossings will be designed such that the required design storms can be conveyed with water levels at least 1 metre below the edge of the travelled lane. Within the Town of Caledon, the design event for all crossings on arterial roads is the 1:100-year return period event. If open-footing culverts are specified for any of the crossings, a minimum 0.3 metres clearance will be provided from the design water level to the underside of the hydraulic opening. In addition, the most recent hydraulic models will be obtained from TRCA and CVC to ensure that the most current flow rates are utilized for the design of the proposed crossings, and to ensure that they have adequate hydraulic capacity to prevent any negative impact on expected flood elevations up to and including the Regional event.

A preliminary review of the HEC-RAS models provided in support of the Mayfield West Development indicates that the existing structure will be sufficient to convey the 100-year storm

within the culvert and to maintain safe access during the Regional event once the raised road profile is accounted for in an updated model. Once the final flows have been established for Etobicoke Creek at the conclusion of the current update by TRCA, this crossing should be reviewed to determine if additional capacity is required through additional culverts or whether a bridge will be required at this location.

4.3 Water Quality Control

As identified in Section 2.2, to ensure that adequate surface water quality is achieved for runoff from the project area, Enhanced level quality controls, as described in the MECP manual, are required. In discussion with the Region of Peel it has been confirmed that quality control will be required upstream of the connection to the clean water pipe. Assuming 150mm of aggregate are required underneath the proposed infiltration chambers required for quantity control retention, as described in Section 4.1, approximately 88m^3 of retention volume can be provided. Based on MECP requirements (Table 3.2 MOECC, 2003), the configuration of these proposed chambers will be sufficient to achieve the volumetric criteria of 36.7 m^3/ha required for enhanced level treatment for runoff from this 0.64ha area with 75% impervious coverage.

For the portion of Chinguacousy Road slated for urbanization, extending from approximately 200 m north of Mayfield Road to Tim Manley Avenue, and up to approximately STA 11+385 under the current project, allowances have been provided in Ponds 1 and 5 of the Mayfield West Development (Urbantech, 2021). The assumptions made for the water quality design within these facilities, as described in detail in Section 4.1 of this report, are based on smaller areas contributing to the facilities with 100% impervious coverage while calculations under the proposed cross-sections indicate that the impervious coverage for the urban cross-section will be approximately 75%, not accounting for segments which include median planter boxes ensures that the quality targets for Enhanced level treatment will be achieved for these segments.

Most of the remaining segment to be urbanized, extending from approximately 11+385 to 11+905, will drain directly to Etobicoke Creek. Quality controls for the widening of Chinguacousy Road along this segment must be accommodated as part of the detailed design of the current improvements prior to discharge into Etobicoke Creek Assuming 150mm of aggregate are required underneath the proposed infiltration chambers required for quantity control retention, as described in Section 4.1, approximately 156m^3 can be provided. Based on MECP requirements (Table 3.2 MOECC, 2003), the configuration of these proposed chambers will be sufficient to achieve the volumetric criteria of 36.7 m^3/ha required for enhanced level treatment for runoff from this 1.87ha area with 75% impervious coverage.

For the rural segment Enhanced level treatment will be achieved via filtration and infiltration with bioswales located within portions of the 1m flat-bottomed ditches to be located on either side of the road along the length of the entire segment. Based on MECP requirements (Table 3.2 MOECC, 2003), the design of the bioswales will be sufficient to achieve the volumetric criteria of 24 m^3/ha required for enhanced level treatment for runoff from an area with 30% impervious coverage. It is expected that the storage requirements for water balance, within the rural segment, will exceed those for quality control, as discussed further in Section 4.5.

4.4 Erosion Control

In addition, as described in Section 2.3 of this report, erosion control targets have been established previously by AMEC resulting in the following target release rates (Section 6.2, Urbantech, 2021):

- Fletcher's Creek 250 m^3/impervious ha, released at 0.00041m^3/s/ha; and
- Etobicoke Creek 325 m^3/impervious ha, released at 0.00031m^3/s/ha.

Based on the assumptions made the water quantity and quality controls described in the previous sections, allowances have been provided in the design of Ponds 1 and 5 within the Mayfield West development, or will be accommodated through the use of infiltration chambers for the proposed works along Chinguacousy Road associated with the current project. For the remaining rural sections, bioswales will be proposed at strategic locations near the watercourse outlet to provide the required storage volumes to satisfy the erosion control requirements.

It is expected that the storage requirements for water balance, within the rural segment, will exceed those for erosion control, as discussed further in Section 4.5.

4.5 Water Balance

The most conservative criterion for water balance is the 27 mm retention requirement preferred by the Town. There is approximately 1.75 km of urbanized road proposed for the current project. It is expected that tree cells or stormwater planters can be incorporated within the 3.5m boulevards on either side of the road. Accounting for intersections and entrances, there is approximately 1.4 km of boulevard along each side of the road. Assuming that 60% of this length is available for planters or tree cells, accounting for potential utilities, and utilizing 1m of filter media, enough to support tree growth (STEP, 2022), and 1 wide cells within the 3.5 m boulevard, sufficient storage can be provided to retain the 27 mm event. Additional storage can be provided if 150 mm of ponding can occur within the planters. Calculations for the bioretention can be found in Appendix C. As noted in previous sections, this amount of storage is sufficient to achieve water quality and erosion control retention volumes as well.

For the remaining 1.25 km segment of the project slated for rehabilitation with a rural cross section, bioswales can be incorporated within the 1m flat-bottomed ditch. Assuming the filtration layers will consist of 600 mm of filter media above 400 mm of clear stone, with subdrains connected to catchbasins, and allowing for up to 300 mm of surface ponding, sufficient storage can be provided to retain the 26 mm event. Calculations for the bioretention can be found in Appendix C. As noted in previous sections, this amount of storage is sufficient to achieve water quality and erosion control retention volumes as well.

4.6 Climate Change Considerations

It is our understanding that TRCA and the Town of Caledon are updating their standards with regards to climate change. CVC recommends, in the absence of updated IDF curves which include climate change considerations, consideration that expected rainfall intensities can be expected to increase by approximately 15%, and that future flows, based on future climate change conditions, be evaluated based on target flows established under existing conditions with unadjusted IDF curves. As a minimum it is recommended that this CVC policy should be followed through detailed design while consulting the latest available regulations and IDF information available at that time.

5 Summary and Recommendations

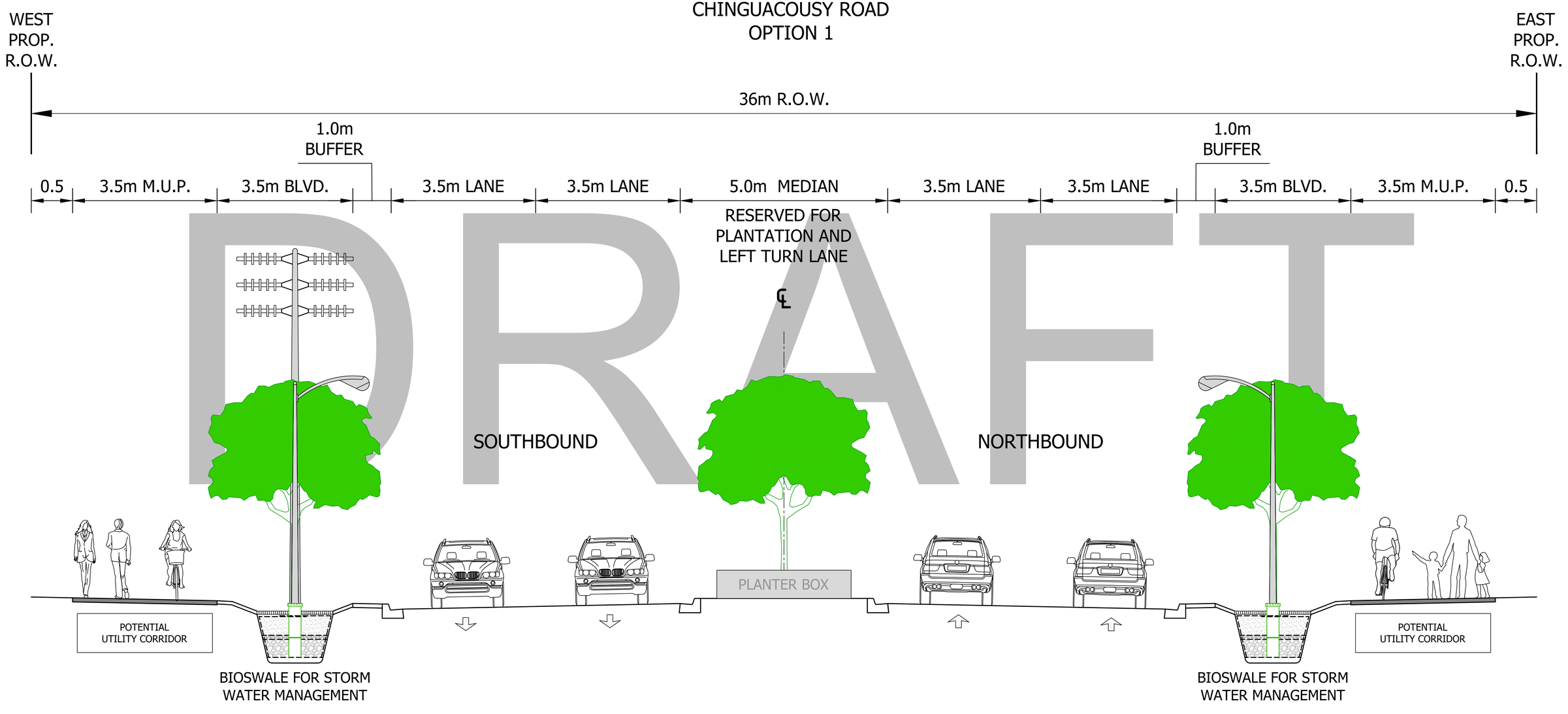
Implementation of the proposed stormwater management strategy will mitigate the increased impervious area associated with the Preferred Alternative Design Option. The recommended measures to be implemented during detail design phase to achieve the relevant stormwater runoff water quantity, water quality, and water balance for each of the proposed options, are as follows:

1. Stormwater quantity controls shall be provided through a combination of the existing facilities within the Mayfield West Development, underground storage for the urbanized segments draining towards Mayfield Road, or directly to Etobicoke Creek, and bioswale retention within the flat-bottomed ditches throughout the rural segment of the proposed works.
2. Stormwater quantity control targets will be based on the most restrictive requirements and shall be either based on control of post development peak flow rates to pre-development levels, or on a unit discharge basis established as part of subwatershed studies for Etobicoke and Fletcher's Creeks. Controls are required for the 2 through 100-year storms for all segments and up to the Regional event for segments tributary to Fletcher's Creek.
3. Stormwater quality controls shall be provided through a combination of the existing facilities within the Mayfield West Development, underground storage for the urbanized segments draining towards Mayfield Road, or directly to Etobicoke Creek, and bioswale retention within the flat-bottomed ditches throughout the rural segment of the proposed works to achieve Enhanced level controls.
4. Erosion control retention shall be implemented through a combination of the existing facilities within the Mayfield West Development, and bioswale retention within the flat-bottomed ditches throughout the rural segment of the proposed works with underground retention for other urban segments. The design retention volumes and associated release rates shall be based on rates established in previous subwatershed studies as follows:
   - Fletcher's Creek, 250 m^3/impervious ha, released at 0.00041m^3/s/ha
   - Etobicoke Creek, 325 m^3/impervious ha, released at 0.00031m^3/s/ha.
5. Water balance requirements shall be provided through bioretention via stormwater planters in the boulevards through the urban section of the proposed works, and bioswale retention within the flat-bottomed ditches throughout the rural segment of the proposed works. Calculations for the required bioretention measures are provided in Appendix C.
6. Once the TRCA has completed the Etobicoke Creek Hydrology update, the road profile and proposed crossing sizes should be reviewed to ensure they are capable of conveying the required flows in accordance with the Town of Caledon Development Standards. A preliminary analysis of the available model for Branch 2 of Etobicoke Creek indicate that the existing structure is sufficient to pass 100-year flows with the proposed road profile, based on the current expected flows. However, Regional flow is expected to overtop the road while maintain safe access.
7. Throughout detailed design coordination will be required with the Owner of the Mayfield West design to ensure that contributions from the subject areas are consistent with the design of the infrastructure within the development, such that all performance criteria are achieved with safe conveyance through the proposed subdivision development.

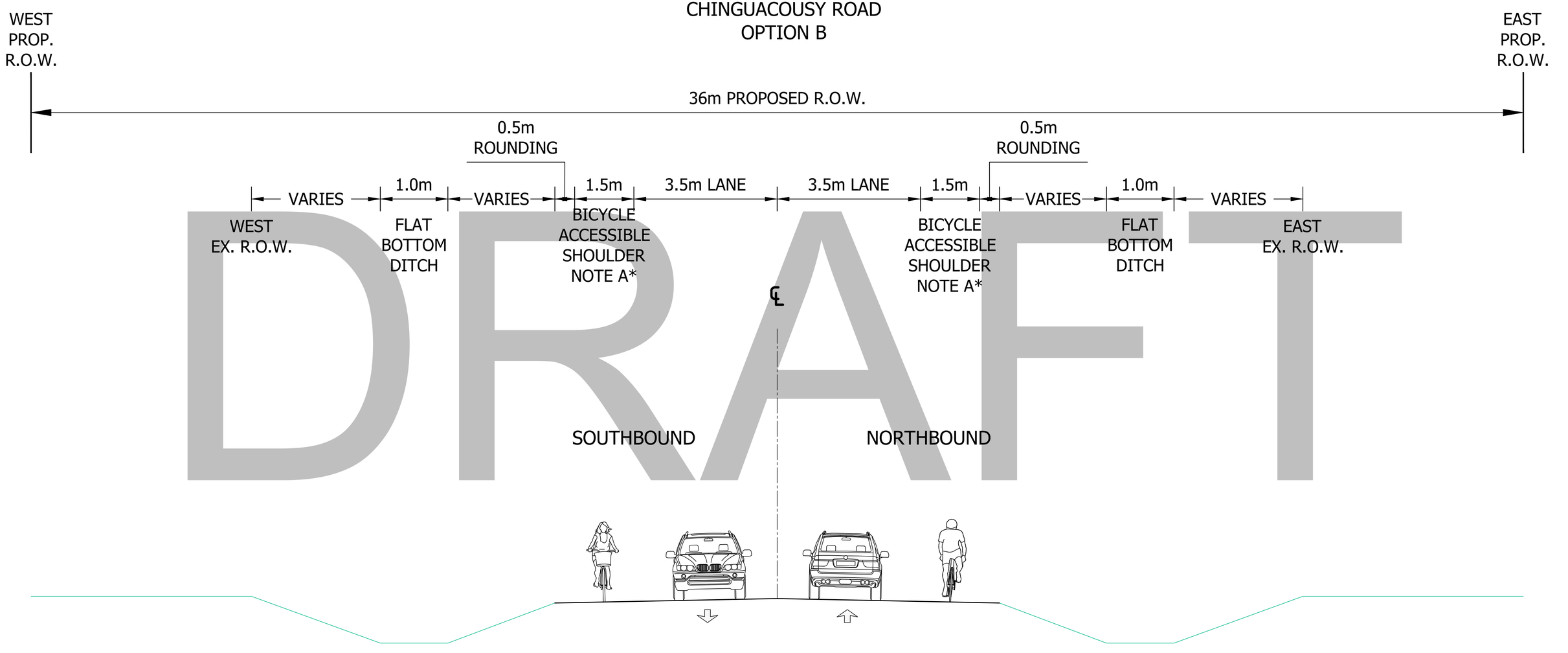
8. Coordination with TRCA will be required through the detailed design process to ensure that the recommendations from the ongoing update of the Etobicoke Creek update are considered in the ultimate design for any of the required stormwater management controls.

Appendix A
Design Options for Road Cross-Sections

CHINGUACOUSY ROAD
OPTION 1

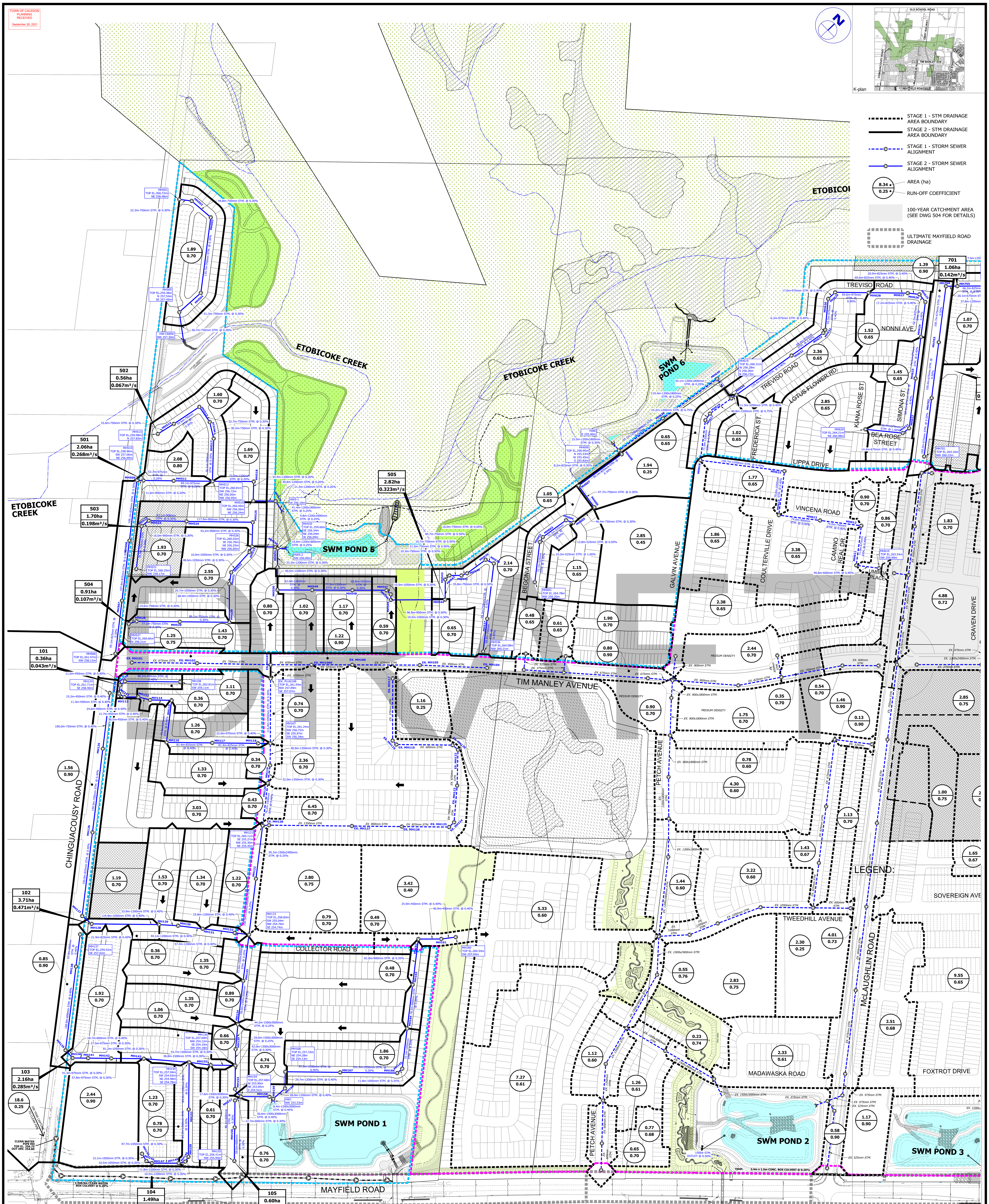


CHINGUACOUSY ROAD
OPTION B



NOTE A: THIS OPTION WILL REQUIRE SOME WIDENING ALONG THE CORRIDOR TO INCLUDE BIKE ACCESSIBLE SHOULDER ON BOTH SIDES.

Appendix B
Excerpts from Mayfield West Development FSR


TOWN OF CALEDON PLANNING RECEIVED September 28, 2021
K-plan
OLD SCHOOL ROAD
CHINGUACOUSY ROAD
McLAUGHLIN ROAD
TIM MANLEY AVE
HURONTARIO STREET
MAYFIELD ROAD
STAGE 1 - STM DRAINAGE AREA BOUNDARY
STAGE 2 - STM DRAINAGE AREA BOUNDARY
STAGE 1 - STORM SEWER ALIGNMENT
STAGE 2 - STORM SEWER ALIGNMENT
8.34 AREA (ha)
0.25 RUN-OFF COEFFICIENT
100-YEAR CATCHMENT AREA (SEE DWG 504 FOR DETAILS)
ULTIMATE MAYFIELD ROAD DRAINAGE
ETOBICOKE CREEK
SWM POND 1
SWM POND 2
SWM POND 3
SWM POND 5
SWM POND 6
TREVISO ROAD
NONNI AVE.
LOTUS FLOWER RD.
FREDERICA ST.
KIANA ROSE ST
SIMONA ST.
BEA ROSE STREET
LIPPA DRIVE
VINCENA ROAD
COULTERVILLE DRIVE
CAMINO REAL DR.
UMBRIA PLACE
BEGONIA STREET
GALVIN AVENUE
CRAVEN DRIVE
TIM MANLEY AVENUE
PETCH AVENUE
TWEEDHILL AVENUE
SOVEREIGN AVE
MADAWASKA ROAD
FOXTROT DRIVE
COLLECTOR ROAD 'B'
MAYFIELD ROAD
EDENBROOK HILL DRIVE
501 2.06ha 0.268m³/s
502 0.56ha 0.067m³/s
503 1.70ha 0.198m³/s
504 0.91ha 0.107m³/s
505 2.82ha 0.323m³/s
701 1.06ha 0.142m³/s
101 0.36ha 0.043m³/s
102 3.71ha 0.471m³/s
103 2.16ha 0.285m³/s
104 1.49ha 0.176m³/s
105 0.60ha 0.071m³/s
PROPOSED OPEN BOTTOM CULVERT (B.O.) 7300mm x 1750mm INV. 253.30 OUT INV. 253.00 (CLEAN PIPE INV. 253.30)
PROPOSED EAST CHANNEL (BY BLOCK 51-2)
PROPOSED OPEN BOTOM CULVERT (B.O.) 3600mm x 1750mm INV. 253.30 OUT INV. 253.00
PROPOSED NE CHANNEL (BY BLOCK 51-2)
PROPOSED CHANNEL AND SWM POND 2 TO TEMPORARILY OUTLET TO THE EXISTING CHANNEL EAST OF McLAUGHLIN ROAD PRIOR TO DOWNSTREAM CREEK REALIGNMENT AND LOWERING WITHIN BLOCK 51-2

MAYFIELD ROAD DRAINAGE NOTE:

*** AS CONFIRMED BY PEEL REGION, ULTIMATE MAYFIELD ROAD DRAINAGE SHALL NOT RELY ON DISCHARGE TO PROPOSED MW2 SWM PONDS. ROW DRAINAGE TO BE CONVEYED TO EXISTING AND PROPOSED CHANNELS SOUTH OF MAYFIELD ROAD.**

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TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL
MAYFIELD WEST PHASE 2-STAGE 2

STORM DRAINAGE PLAN 2 (WEST SIDE)

SURVEYED BY:	RPE	DATE:	2015	JOB NO.	15-483
DRAWN BY:	M.L.	CHECKED BY:	S.R.	DRAWING NO.	SHEET NO.
DESIGNED BY:	S.R.	CHECKED BY:	D.Z.	503	
SCALE:	1:2000	DATE:	AUGUST 2021		

File: P:\Projects\15-483\STAGE 2 MW2 FSR\05 - STORM SERVICING - STAGE 2\S02_503-Storm Drainage Plan.dwg - Revised by <MLYSYK> : Wed, Aug 25 2021 - 11:39am

TOWN OF CALEDON
PLANNING
RECEIVED
September 28, 2021

K-plan

LEGEND:

- MW2 STAGE 1 LIMIT
- MW2 STAGE 2 LIMIT
- 100-YEAR CATCHMENT AREA
- EXISTING GREENBELT
- AREA ID / MAJOR SYSTEM CAPTURE AREA / CONSTANT FLOW CAPTURED IN PIPE AT LOW POINT
- STORM SEWER ALIGNMENT
- OVERLAND FLOW DIRECTION

502	0.56ha	0.067m³/s
501	2.06ha	0.268m³/s
503	1.70ha	0.198m³/s
505	2.82ha	0.323m³/s
504	0.91ha	0.107m³/s
EX. 109	0.76ha	0.089m³/s
101	0.36ha	0.043m³/s
102	3.71ha	0.471m³/s
103	2.16ha	0.285m³/s
104	1.49ha	0.176m³/s
105	0.60ha	0.071m³/s
EX. 202	0.58ha	0.069m³/s
701	1.06ha	0.142m³/s
702	1.30ha	0.173m³/s
EX. 301	17.81ha	2.008m³/s
EX. 201	1.59ha	0.177m³/s
EX. 303	3.05ha	0.381m³/s
EX. OLF-1	4.14ha	0.497m³/s
EX. OLF-2	0.47ha	0.061m³/s
EX. 901	0.56ha	0.076m³/s
EX. 302	0.77ha	0.104m³/s
EX. 902	0.60ha	0.091m³/s

CHINGUACOUSY ROAD · ETOBICOKE CREEK · McLAUGHLIN ROAD · GREENBELT PLAN AREA · FUTURE GREENBELT AREA (CHANGE) · SWM POND 6 · SWM POND 7 · SWM POND 8 · FUTURE SWM POND 10 (BY OTHERS) · EMPLOYMENT · PICKFORD ST. · FUTURE EMPLOYMENT · EXISTING BRAMPTON CHRISTIAN SCHOOL · NEIGHBOURHOOD PARK NO. 1 · SWM POND 5 · COMMUNITY PARK NO. 2 · PUBLIC ELEMENTARY SCHOOL · GALVIN AVENUE · LIPPA DRIVE · SHOOTING STAR DRIVE · DERBYSHIRE DRIVE · OBRY RAILWAY · Neigh. Park No. 2 · NEIGH. PARK NO. 4 · NORTH EAST WETLAND · COMMERCIAL · HIGH DENSITY RESIDENTIAL · VILLAGE SQUARE NO. 1 · VILLAGE SQUARE NO. 2 · MEDIUM DENSITY · LIVE / WORKS · TIM MANLEY AVE · TIM MANLEY AVENUE · VARNER DRIVE · COLLECTOR ROAD 'F' · TRANSIT HUB · SOUTH WEST WETLAND · WEIL PROMENADE · PETCH AVE · COMMUNITY PARK / RECREATION CENTRE · PUBLIC SECONDARY SCHOOL · SOUTH EAST WETLAND (TRCA) · SOUTH EAST WETLAND (CVC) · COLLECTOR ROAD 'F' (SOUTH LEG) · SWM POND 9 · PEEL REGIONAL POLICE FACILITY · COLLINGWOOD AVENUE · VIRGINIA DRIVE · ROBERTSON DAVIES DRIVE · HUMBERSIDE AVENUE · HURONTARIO STREET · SEPARATE ELEMENTARY SCHOOL · COMMUNITY PARK NO. 1 · TWEED HILL AVENUE · SOVEREIGN AVENUE · PUBLIC ELEMENTARY SCHOOL · COMMUNITY PARK NO. 3 · NEIGH.PARK NO. 3 · PETCH AVENUE · MADAWASKA ROAD · FOXTROT DRIVE · BUSHBERRY ROAD · SWM POND 1 · SWM POND 2 · SWM POND 3 · SWM POND 4 · EXISTING CHURCH · MAYFIELD ROAD · EDENBROOK DRIVE · VAN KIRK DRIVE

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TOWN OF CALEDON
REGIONAL MUNICIPALITY OF PEEL
MAYFIELD WEST PHASE 2

MAJOR SYSTEM FLOW CAPTURE

SURVEYED BY:	R.P.E.	DATE:	2015	JOB NO.	15-483
DRAWN BY:	T.L.	CHECKED BY:	D.Z.	DRAWING NO.	SHEET NO. 504
DESIGNED BY:	D.Z.	CHECKED BY:	D.Z.		
SCALE:	1:4000	DATE:	AUGUST 2020		

Table 6.3: Runoff Coefficients & Imperviousness for various land uses

Land Use	Town Runoff Coefficient	Town Percent Impervious*	AMEC %IMP Values	TRCA %IMP Values	Selected Value
Commercial	0.90	100%	96%	95%	**100%**
Industrial – Downtown	0.90	100%	80%	95%	**100%**
Industrial – Suburban	0.75	79%	80%		**95%**
Apartments	0.75	79%	65%	80%	**80%**
ROW dwellings / Townhouses	0.70	71%	65%	75%	**75%**
Duplex	0.70	71%	50%	75%	**75%**
Semi-detached (downtown)	0.60	57%	50%	60%	**60%**
Single family (downtown)	0.40	29%	30%	60%	**60%**
Semi-detached (suburban)	0.50	43%	50%	55%	**55%**
Single family (suburban)	0.40	29%	30%	40%	**40%**
Schools / Institutional	0.75	79%	32%	80%	**80%****
SWM Facilities	-	50%	100%	80-100%	**100%**
Parks / Open space over 4 hectares	0.20	7%	10%	10%	**10%**
Parks / Open space under 4 hectares	0.25		10%		**10%**

*Note – values include ROW areas; converted from Town runoff coefficients using C=0.7I+0.2

**It is recommended that the imperviousness for school blocks be reviewed on a site-by-site basis. Typical values of school block imperviousness, based on aerial imagery, range from 50% to 60%.

Appendix C
Bioretention Requirement Calculations

NO.	REVISIONS	DATE	INITIAL
1	EXHIBIT 1	MAR. 29, 2023	NM

SCALE: H: 1:1000 V: 1:100
DESIGN: KE
DRAWN: KE
CHECKED: NM
DATE: MAR. 29, 2023

TOWN OF CALEDON
CHINGUACOUSY RD
FROM MAYFIELD RD TO OLD SCHOOL RD

STORMWATER DRAINAGE SECTIONS

Ainley GROUP CONSULTING ENGINEERS PLANNERS

CONTRACT No. | DWG. No. | EXHIBIT 1

Ainley GROUP CONSULTING ENGINEERS PLANNERS	Client	Town of Caledon	Date	27-Mar-23
	Project	Chinguacousy Road EA	By	RDS
	File #	120065	Checked	
	Subject	Bioswale Design	Sheet no.	1

Urban Boulevards

Length of Swale	1848	m
Width of Swale	2	m
Void Ratio of Filter Media	0.4	
Void Ratio of Mulch	0.7	

Orifice - 1			Weir - 1		
Diameter	TBD	mm	Width	TBD	m
Invert	TBD	m	Invert	TBD	m
Area	NA	m^2	Side slope	3	:1
Coeff.	0.6		Coeff.	1.67	

Orifice Equation - $Q = C \times A \times (2gH)^{0.5}$

Stage Storage Discharge Table

Description	Elevation (m)	Depth (m)	Surface Area (m^2)	Segment Storage (m^3)	Total Storage (m^3)	Controlled Flow (m^3/s)			Storage (ha.m)
						Orifice 1	Weir 1	Total	
Bottom of Filter Media	100.00	0.00	3696	0	0	0.000	0.000	0.000	0.000
Top of Filter Media	101.00	1.00	3696	1478	1478	0.000	0.000	0.000	0.148
Top of Mulch	101.07	0.07	3696	181	1659.5	NA	0.000	NA	0.166
0.15m ponding	101.22	0.15	3696	554	2213.9	NA	NA	NA	0.221

Catchment ID	Catchment Area (m^2)	Proposed Impervious Area (m^2)	Runoff Volume for 27mm storage (m^3)	Ratio Imperv to Facility Area
Urban	63000	47250	1275.8	13

Bioswales will receive sufficient runoff volume to be fully utilized for 27 mm retention.

Ainley GROUP CONSULTING ENGINEERS PLANNERS	Client	Town of Caledon	Date	27-Mar-23
	Project	Chinguacousy Road EA	By	RDS
	File #	120065	Checked	
	Subject	Bioswale Design	Sheet no.	1

Section 5 Bioswale

Length of Swale	210	m
Width of Swale	1	m
Void Ratio of Clear Stone	0.4	
Void Ratio of Filter Media	0.25	

Orifice - 1			Weir - 1		
Diameter	TBD	mm	Width	TBD	m
Invert	TBD	m	Invert	TBD	m
Area	NA	m^2	Side slope	3	:1
Coeff.	0.6		Coeff.	1.67	

Orifice Equation - $Q = C \times A \times (2gH)^{0.5}$

Stage Storage Discharge Table

Description	Elevation (m)	Depth (m)	Surface Area (m^2)	Segment Storage (m^3)	Total Storage (m^3)	Controlled Flow (m^3/s)			
						Orifice 1	Weir 1	Total	Storage (ha.m)
Bottom of Stone	100.00	0.00	210	0	0	0.000	0.000	0.000	0.000
Top of Subdrain	100.15	0.00	210	0	0	0.000	0.000	0.000	0.000
Top of Clear Stone	100.55	0.40	210	35.8	35.8	NA	0.000	NA	0.004
Top of Filter Media	101.15	1.00	210	31.5	67.3	NA	0.000	NA	0.007
Top of Topsoil	101.30	1.15	210	7.9	75.2	NA	0.000	NA	0.008
0.30 m above bottom	101.60	1.45	210	135.0	210.2	NA	NA	NA	0.021

Catchment ID	Catchment Area (m^2)	Proposed Impervious Area (m^2)	Runoff Volume for 27mm storage (m^3)	Ratio Imperv to Facility Area
SEC5	2340	702	19.0	3

Bioswales will receive sufficient runoff volume to be fully utilized for 27 mm retention.

Ainley GROUP CONSULTING ENGINEERS PLANNERS	Client	Town of Caledon	Date	27-Mar-23
	Project	Chinguacousy Road EA	By	RDS
	File #	120065	Checked	
	Subject	Bioswale Design	Sheet no.	1

Section 6 Bioswale

Length of Swale	185	m
Width of Swale	1	m
Void Ratio of Clear Stone	0.4	
Void Ratio of Filter Media	0.25	

Orifice - 1			Weir - 1		
Diameter	TBD	mm	Width	TBD	m
Invert	TBD	m	Invert	TBD	m
Area	NA	m^2	Side slope	3	:1
Coeff.	0.6		Coeff.	1.67	

Orifice Equation - $Q = C \times A \times (2gH)^{0.5}$

Stage Storage Discharge Table

Description	Elevation (m)	Depth (m)	Surface Area (m^2)	Segment Storage (m^3)	Total Storage (m^3)	Controlled Flow (m^3/s)			
						Orifice 1	Weir 1	Total	Storage (ha.m)
Bottom of Stone	100.00	0.00	185	0	0	0.000	0.000	0.000	0.000
Top of Subdrain	100.15	0.00	185	0	0	0.000	0.000	0.000	0.000
Top of Clear Stone	100.55	0.40	185	31.6	31.6	NA	0.000	NA	0.003
Top of Filter Media	101.15	1.00	185	27.7	59.3	NA	0.000	NA	0.006
Top of Topsoil	101.30	1.15	185	6.9	66.2	NA	0.000	NA	0.007
0.30 m above bottom	101.60	1.45	185	135.0	201.2	NA	NA	NA	0.020

Catchment ID	Catchment Area (m^2)	Proposed Impervious Area (m^2)	Runoff Volume for 27mm storage (m^3)	Ratio Imperv to Facility Area
SEC6	12600	3780	102.1	20

Bioswales will receive sufficient runoff volume to be fully utilized for 27 mm retention.

Ainley GROUP CONSULTING ENGINEERS PLANNERS	Client	Town of Caledon	Date	27-Mar-23
	Project	Chinguacousy Road EA	By	RDS
	File #	120065	Checked	
	Subject	Bioswale Design	Sheet no.	1

Section 7 Bioswale

Length of Swale	210	m
Width of Swale	1	m
Void Ratio of Clear Stone	0.4	
Void Ratio of Filter Media	0.25	

Orifice - 1			Weir - 1		
Diameter	TBD	mm	Width	TBD	m
Invert	TBD	m	Invert	TBD	m
Area	NA	m^2	Side slope	3	:1
Coeff.	0.6		Coeff.	1.67	

Orifice Equation - $Q = C \times A \times (2gH)^{0.5}$

Stage Storage Discharge Table

Description	Elevation (m)	Depth (m)	Surface Area (m^2)	Segment Storage (m^3)	Total Storage (m^3)	Controlled Flow (m^3/s)			
						Orifice 1	Weir 1	Total	Storage (ha.m)
Bottom of Stone	100.00	0.00	210	0	0	0.000	0.000	0.000	0.000
Top of Subdrain	100.15	0.00	210	0	0	0.000	0.000	0.000	0.000
Top of Clear Stone	100.55	0.40	210	35.8	35.8	NA	0.000	NA	0.004
Top of Filter Media	101.15	1.00	210	31.5	67.3	NA	0.000	NA	0.007
Top of Topsoil	101.30	1.15	210	7.9	75.2	NA	0.000	NA	0.008
0.30 m above bottom	101.60	1.45	210	135.0	210.2	NA	NA	NA	0.021

Catchment ID	Catchment Area (m^2)	Proposed Impervious Area (m^2)	Runoff Volume for 27mm storage (m^3)	Ratio Imperv to Facility Area
SEC7	13680	4104	110.8	20

Bioswales will receive sufficient runoff volume to be fully utilized for 27 mm retention.

Ainley GROUP CONSULTING ENGINEERS PLANNERS	Client	Town of Caledon	Date	27-Mar-23
	Project	Chinguacousy Road EA	By	RDS
	File #	120065	Checked	
	Subject	Bioswale Design	Sheet no.	1

Section 8 Bioswale

Length of Swale	260	m
Width of Swale	1	m
Void Ratio of Clear Stone	0.4	
Void Ratio of Filter Media	0.25	

Orifice - 1			Weir - 1		
Diameter	TBD	mm	Width	TBD	m
Invert	TBD	m	Invert	TBD	m
Area	NA	m^2	Side slope	3	:1
Coeff.	0.6		Coeff.	1.67	

Orifice Equation - $Q = C \times A \times (2gH)^{0.5}$

Stage Storage Discharge Table

Description	Elevation (m)	Depth (m)	Surface Area (m^2)	Segment Storage (m^3)	Total Storage (m^3)	Controlled Flow (m^3/s)			Storage (ha.m)
						Orifice 1	Weir 1	Total	
Bottom of Stone	100.00	0.00	260	0	0	0.000	0.000	0.000	0.000
Top of Subdrain	100.15	0.00	260	0	0	0.000	0.000	0.000	0.000
Top of Clear Stone	100.55	0.40	260	44.4	44.4	NA	0.000	NA	0.004
Top of Filter Media	101.15	1.00	260	39.0	83.4	NA	0.000	NA	0.008
Top of Topsoil	101.30	1.15	260	9.8	93.1	NA	0.000	NA	0.009
0.30 m above bottom	101.60	1.45	260	135.0	228.1	NA	NA	NA	0.023

Catchment ID	Catchment Area (m^2)	Proposed Impervious Area (m^2)	Runoff Volume for 27mm storage (m^3)	Ratio Imperv to Facility Area
SEC8	17100	5130	138.5	20

Bioswales will receive sufficient runoff volume to be fully utilized for 27 mm retention.