Project 15-4380

Cawthra Road Class EA
Stormwater Management Report

Prepared for the Region of Peel
by IBI Group Professional Services (Canada) Inc.
March, 2020

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Executive Summary

The Region of Peel is undertaking a Schedule 'B' Municipal Class Environmental Assessment (EA) for the improvements to Cawthra Road between the Queen Elizabeth Way (QEW) and Eastgate Parkway (5.1 Km), located in the City of Mississauga. This Stormwater Management (SWM) Report is prepared in support of the Class EA. It serves to summarize the existing drainage conditions and the proposed SWM Plan to mitigate the potential impacts of the proposed improvements to Cawthra Road on receiving drainage systems.

Cawthra Road is principally a four lane urban arterial road. The existing land uses adjacent to the study area include a mix of residential, commercial and industrial/employment areas. There are no watercourses documented or observed during the site investigations within the project limit. The stormwater runoff from the Cawthra Road corridor is largely drained by storm sewers discharging to Cawthra Creek which ultimately discharges to Cooksville Creek just north of Lakeshore Road. There are no stormwater management facilities for quantity and/or quality control within or adjacent to the project corridor. The drainage infrastructure within the project limit consists of roadside curbs, municipal storm sewers, stormwater drains and roadside ditches. Cawthra Road currently drains in to the seven outlets located along the corridor. The roadway storm sewers also conveying flows from large external areas along Cawthra Road. A storm sewer assessment was conducted to determine the hydraulic performance of the existing Cawthra Road sewers. The results of the hydraulic assessment indicated that twenty one (21) and twenty six (26) sewer legs are deficient in capacity based on latest Region of Peel IDF curves and the 2095 future condition IDF curve, respectively. The deficient sewer legs will require replacement and upsizing. The results of the CCTV inspection recommended thirty (30) sewer legs for replacement due to structural deficiencies.

The proposed roadway improvements will include raised bike lanes/cycle track along both sides of Cawthra Road and localized intersection improvements along the entire corridor. In general, the proposed changes to the existing roadway cross section will have minor increase in the overall pavement area and are not expected to significantly impact drainage along Cawthra Road within the project limits.

A SWM Plan was developed in order to meet Region of Peel, CVC and TRCA design criteria. Under proposed condition, the quantity of runoff resulting from major storms will be conveyed to existing outlets as overland flow. For the minor drainage system, stormwater will continue to be collected by a series of catchbasins and conveyed to the existing storm sewers with eventual discharge to the existing outlets.

The intent is to control post development peak flows to the pre-development level for all storm events up to 100-year storm. The City of Mississauga requirement is to control 100-year post to 2-year pre-development level. The 2-year control is largely applicable for site/subdivision developments and not to a linear road corridor.

As per Region of Peel guidelines, minor roadway developments are defined as,

i) Addition of turning lanes and interchange/intersection improvements
ii) Addition of entrance accesses
iii) Shoulder paving for short cycling network connections

The proposed project fall under the category of minor roadway development and road reconstruction/retrofit. According to the Region of Peel criteria such projects are exempted for quantity controls. The Cawthra Road project is a linear development project (reconstruction) which will include localized intersection improvements and raised bike/cycle lanes on both sides of cawthra Road.

Notwithstanding the above, quantity control to pre-development level has been provided for the areas where there were considerable increase in the imperviousness. Best efforts were made to maintain the existing condition flows for all storm events up to the 100-year storm.

The quantity of runoff from the improved section of the roadway will result minor increase in runoff flow rates and specific measures/techniques to reduce peak flow rates to the pre-development levels were reviewed. Based on the results of the hydrological assessment, the maximum required storage volume for the Cawthra Road is 234.1 m^3 (to attenuate the 100-year storm). This storage volume will be provided through the proposed underground infiltration chambers and the superpipes. Orifice plates will be provided at the outlet locations to control flows before discharging stormwater to the municipal storm sewer system.

For the water quality control, a total of four Oil/Grit Separator (OGS) units, underground infiltration chambers and the existing roadside ditches will be used to achieve water quality objectives at outlets C1, C2, C6 and C7. There is no significant increase in imperviousness within catchments C3. C4 and C5. Currently there is no quality treatment at any of the outlets that receive flows from Cawthra Road. The size of roadway area is more than 2.0 ha, so it is not practical to install OGS units at C3 and C4 outlets. The municipal storm sewer systems that collects flow from Cawthra Road do not have any quality control measures. In addition to the above, the proposed project falls under the category of minor roadway development and road reconstruction/retrofit, and the water quality is not warranted for minor roadway improvements.

The proposed underground infiltration chambers and the green areas within the Right-of-Way will provide infiltration to meet water balance and runoff volume control criteria of on-site retention of all runoff from the first 27-28 mm of each rainfall event.

A flow spread analysis was conducted at the low point located under railway crossing to determine the flow spread onto travel lanes under both minor and major system flows. The results of the analysis indicated that the ponding depth at the low point exceeds 150 mm requirement during the 100-year storm event and the criteria of “leaving at least one traffic lane free of water in each direction” was not satisfied. The storm sewer conveyance at the roadway sag area will require upgrades to the 100-year storm capacity to eliminate flooding at the low/sag point.

1 Introduction

The Region of Peel is undertaking a Schedule 'B' Municipal Class Environmental Assessment (EA) for improvements to Cawthra Road (Regional Road 17) between the Queen Elizabeth Way (QEW) and Eastgate Parkway (5.1 km), located in the City of Mississauga. The project limits are illustrated in **Figure 1**.

This Stormwater Management (SWM) Report was prepared in support of the Class EA. It serves to summarize the existing drainage conditions and the proposed SWM Plan to mitigate the potential impacts of the proposed improvements to Cawthra Road on receiving drainage systems.

2 Existing Site Conditions Characterization

Within the project limits, Cawthra Road is principally a four lane urban arterial with a flush median or centre turn lane, auxiliary lanes at intersections, and an additional southbound through lane between the Queensway and QEW. The existing right-of-way (ROW) generally varies from 36 to 45m. Sidewalks are available on both sides of Cawthra Road from the QEW to Burnhamthorpe Road. North of Burnhamthorpe Road, a multi-use trail (MUT) is provided on the west side of Cawthra Road.

Existing land uses within the study area include a mix of residential, commercial and industrial/employment areas. Given the urban context of the study area, natural heritage features are generally limited to ornamental plantings, manicured lawns, grassed strips, and roadside ditches, although natural areas of Cultural Meadow and Common Reed dominated marsh are present in the vicinity of Eastgate Parkway.

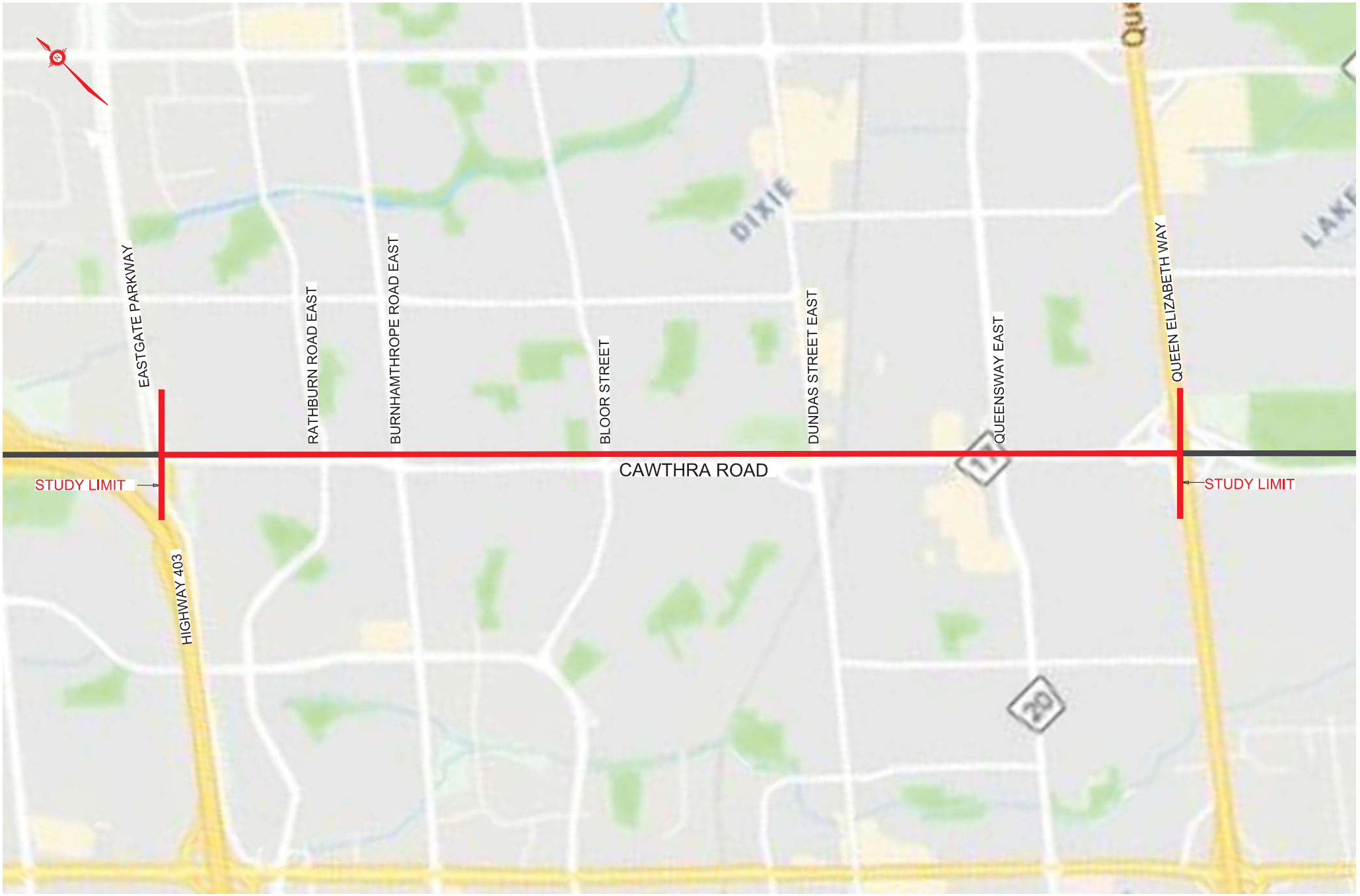
Within the project limits, there are no aquatic features (watercourses) or areas that would be designated as Areas of Natural and Scientific Interest (ANSI), Environmentally Sensitive Areas (ESA), or Provincially Significant Wetlands (PSW); however, Cawthra Woods (ANSI and 21 hectare PSW comprised of deciduous forest and wetlands) is located on the east side of Cawthra Road immediately south of the project.

2.1 Tributary Areas, Outlets and Drainage Patterns

Drainage within the study area is principally influenced by topography, land cover, and grade changes along Cawthra Road. Overall, drainage infrastructure within the study area consists of roadside curbs, stormwater drains, and municipal storm sewers, with limited ditching present. Roadside ditches which are present on the east and west sides of Cawthra Road at the north end of the project direct flow into the Common Reed dominated marshes located south of Eastgate Parkway.

There are no watercourses documented or observed during site investigations within the study area, so consequently there are no watercourse crossings within the drainage scope of work for the Cawthra Road improvements.

Drawings SWM E1, **SWM E2 and SWM E3**, presented in **Appendix A**, depict the existing condition within the project limits, including existing infrastructure and landscaping, drainage area discretization, outlets, and the direction of overland flow routes. The Cawthra Road corridor was sub-divided into seven drainage catchments. **Table 1** provides a summary of catchment areas that are currently draining to the seven outlets located along the corridor.



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Client	THE REGION OF PEEL
Project	CAWTHRA ROAD EA STUDY FROM QEW TO EASTGATE PARKWAY
Drawing Title	KEYPLAN
Project No.	24RX16.0014
Drawing No.	FIGURE-1

LEGEND

STUDY AREA

Table 1: Existing Storm Sewer Catchment Areas

CATCHMENT ID	AREA (ha)	FLOW DIRECTIONS	DRAINAGE OUTLET	DRAINAGE RECEIVER
C1	1.02	South	Outlet 1	450 mm Municipal Storm Sewer
C2	2.14	North/South	Outlet 2	750 mm Municipal Storm Sewer
C3	11.10	South	Outlet 3	1125 mm x 2250 mm Municipal Storm Sewer
C4	2.95	South	Outlet 4	1050 mm Municipal Storm Sewer
C5	1.65	South	Outlet 5	900 mm Municipal Storm Sewer
C6	1.51	South	Outlet 6	1200 mm Municipal Storm Sewer
C7	1.03	South	Outlet 7	525 mm Municipal Storm Sewer

The roadway storm sewers located within Catchments C2, C3, C4 and C5 are conveying large external areas along Cawthra Road. **Table 2** identifies external catchment areas along with receiving storm sewers. **Drawings SWM E1**, **SWM E2 and SWM E3**, presented in **Appendix A** illustrates location of the external catchment areas.

Table 2: Existing Storm Sewer External Catchment Areas

CATCHMENT ID	AREA (ha)	FLOW DIRECTIONS	DRAINAGE OUTLET	DRAINAGE RECEIVER
EX-C2A	0.27	North	Outlet 2	750 mm Municipal Storm Sewer
EX-C2B	2.74	South	Outlet 2	750 mm Municipal Storm Sewer
EX-C3A	2.14	South	Outlet 3	1125 mm x 2250 mm Municipal Storm Sewer
EX-C3B	179.80	South	Outlet 3	1125 mm x 2250 mm Municipal Storm Sewer
EX-C4A	12.3	South	Outlet 4	1050 mm Municipal Storm Sewer
EX-C4B	6.35	South	Outlet 4	1050 mm Municipal Storm Sewer
EX-C5	1.20	South	Outlet 5	900 mm Municipal Storm Sewer

All outlets within the study area discharge into existing municipal storm sewers ranging in diameter from 450 mm to 1200 mm, which convey runoff westerly, ultimately discharging into Cooksville Creek. From Cooksville Creek, runoff flows southerly into Lake Ontario.

There are no stormwater management facilities for quantity and/or quality control within or adjacent to the project corridor. Internal drainage catchments were divided into pervious and impervious areas to compute runoff coefficients. Area characterization within the external drainage catchments was difficult because of the high density of residential developments, therefore, assumptions were made pertaining to the percent pervious/impervious for the external areas. Under existing conditions, the total imperviousness within the project limits is approximately 84**%**, with an overall site runoff coefficient of 0.79. **Table 3** summarizes the existing impervious areas along Cawthra Road.

Table 3: Existing Impervious Areas

CATCHMENT ID	AREA (ha)	IMPERVIOUS AREA (ha)	PERCENT IMPERV. (%)	RUNOFF COEFFICIENT	OUTLET
C1	1.02	0.95	93	0.86	Outlet 1
C2	2.14	1.75	82	0.78	Outlet 2
C3	11.10	9.40	85	0.80	Outlet 3
C4	2.95	2.36	80	0.77	Outlet 4
C5	1.65	1.27	77	0.75	Outlet 5
C6	1.51	1.14	75	0.74	Outlet 6
C7	1.03	1.03	100	0.90	Outlet 7
Total	**21.40**	**17.90**	**84**	**0.79**	**-**

2.2 Condition of Receiving Watercourses

Although there are no watercourses within the project limits, runoff from the Cawthra Road corridor is largely drained by storm sewers discharging to Cawthra Creek. Cawthra Creek rises in the vicinity of Cawthra Road and Dundas Street and flows southeast, reaching Cooksville Creek just north of Lakeshore Road. All but a 320 metre stretch of Cawthra Creek in Dellwood Park has been buried. The Creek was progressively channelized and buried as the lands around it developed. South of the Queensway, much of the subdivisions were built as the creek was still open, but as flooding from north became a problem, in the late 1970s, all but the Dellwood Park stretch was put underground and the southern tip was diverted west to Cooksville Creek from its original route directly into Lake Ontario. The last above-ground reach north of Dundas was buried in 2014 as part of an expansion to Dixie Union Cemetery.

In order to identify and assess drainage areas within Cooksville Creek watershed, sub-catchments were delineated for Cooksville Creek and Cawthra Creek, as depicted in **Figure 2.** Cawthra Road contributes approximately 20.37 ha of drainage area to Cawthra Creek watershed. The total watershed area of Cawthra Creek is 503 ha. Cawthra Creek ultimately discharges to Cooksville Creek just north of Lakeshore Road.

2.3 Soil and Groundwater Conditions

According to Chapman and Putnam's "The Physiography of Southern Ontario, Third Edition" (1984), the area is located within the physiographic region known as the South Slope. The South Slope is the southern slope of the Oak Ridges Moraine but it includes the

Cooksville Creek Watershed and Sewer Network Map

N

Burnhamthorpe Road

Bloor Street

Cawthra Creek (Piped Section)

Cawthra Road

City of Toronto

City of Mississauga

Queen Elizabeth Way

Catchment Area 3565 Ha.

Hurontario Street

Queensway E

Dundas Street

Queensway W

Cawthra

Lakeshore Road

Lake Ontario

Legend

- Municipal Boundary
- Cooksville watershed 3565 Ha.
- Cawthra Watershed 503 Ha.
- Water Bodies
- Creek/Stream
- Piped System
- Storm Sewer
- Queensway Road
- Cawthra Road

0 0.5 1 2 3 4 Kilometers

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Client: Region of Peel

Project: Expansion of Cawthra Road EA

Drawing Title: Cooksville Creek Watershed and Sewer Network Map

Figure No. 2

strip south of the Peel Plain. The South Slope contains a variety of soils, some of which have proven to be excellent for agricultural use. They developed upon tills which are more sandy in the east and clayey in the west. According to the "Surficial Geology of Southern Ontario" (OGS, 2010), clay to silt-textured till (Halton Till) is present within the area.

A detailed geotechnical investigation of the entire project site was not available at the time of preparing this report. However, as part of the "Hydrogeological Data Report and Impact Assessment, Cawthra Road Sanitary and Watermain Project, 17-2452S (Phase 2), dated March 21, 2019" prepared by WSP, a number of boreholes/monitoring wells were installed at Cawthra Road within this project corridor. The results of groundwater level measurements indicated that groundwater elevation of 130.0m at Cawthra Road north of Silver Creek Boulevard and increases up to 140.0m at south of Burnhamthorpe Road. This result showed that groundwater flows toward the south/southwest within this area.

2.4 Significant Natural Features

With exception of the Cultural Meadow and Common Reed dominated marsh lands which are located on both sides of Cawthra Road at the north end of the project (between Meadows Boulevard and Eastgate Parkway), there are no significant natural features within the project limits. There are no aquatic features (watercourses) within the study area to function as fish habitat, so consequently there are no aquatic species at risk (SAR) that could directly impact drainage within the corridor with regards to water quality (thermal and total suspended solids (TSS) impact). Furthermore, other than the Cawthra Woods site which is located immediately south of the project limits, there are no areas that would be designated as ANSI, ESA, or PSW within the study area.

3 Stormwater Objectives

The study area traverses both the Credit Valley Conservation Authority (CVC) and Toronto and Region Conservation Authority (TRCA) jurisdictions. Specifically, the segment south of Burnhamthorpe Road falls under the jurisdiction of CVC and is part of the Cooksville Creek watershed. The portion north of Burnhamthorpe Road falls within the jurisdiction of TRCA and is part of the Etobicoke Creek watershed. Cooksville Creek and Etobicoke Creek are located approximately 1.5 km west and 4 km east of Cawthra Road, respectively and both flowing southerly towards Lake Ontario. Based upon review of TRCA and CVC sub-watershed mapping, no watercourses or watercourse crossings were identified within the study limits. Since Cooksville Creek is the receiving watercourse for runoff generated within the Cawthra Road corridor, CVC guidelines were applied. The SWM Plan for the Cawthra Road improvements has been completed in accordance with the following guidelines:

- Ministry of the Environment, Conservation and Parks (MECP) Stormwater Management Planning and Design Manual (SMPDM, 2003)
- Ministry of Transportation Ontario (MTO) Highway Drainage Design Standards (HDDS, 2008)
- MTO Drainage Management Manual (DMM, 1997)
- Region of Peel, "Public Works Stormwater Design Criteria and Procedures Manual, June 2019, Version 2.1"
- City of Mississauga Development Requirements Manual (DRM, 2016)
- CVC Stormwater Management Criteria (2012)

- CVC & TRCA Low Impact Development Stormwater Management Planning and Design Guide (2010)
- CVC Grey to Green Road Right-of-Way Retrofit Guide: Optimizing Your Infrastructure Assets through Low Impact Development (2014)

In conformance with the Region of Peel current policies and guidelines, the following design criteria have been adopted in the development of drainage and stormwater management strategies for this project.

Storm Sewer System

- In accordance with the Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019), the minor drainage system to be sized to convey runoff from a 10-year storm event.

Major System Drainage

- In accordance with the Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019), major system flows (i.e. storms in excess of a 10-year event) will be conveyed overland to receiving drainage watercourses.

Water Quality

- Where possible retain rural cross-section using low-impact development
- Level 1 Enhanced treatment through the long-term removal of 80% Total Suspended Solids (TSS)
- Grass Swales are to be designed to meet the following MECP criteria for quality control;

Minimum length of swale:	5 m
Allowable velocity (25 mm 4-hour Chicago storm):	0.5 m/s
Minimum bottom width of swale:	0.75 m
Maximum flow depth:	0.5 m

Runoff Volume Control

To control the runoff from the Regional specific 90th percentile volume (27-28mm) using LIDs infiltration techniques.

Stormwater Quantity (Flood) Control

At a minimum post-development flows must be equal to pre-development level for 2 to 100-year design storms.

Water Balance

To provide a minimum post development recharge of the first 5 mm for any precipitation event.

IDF Curves

In accordance with the Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019), the Region of Peel 2019 IDF curves have been used for all hydrological analysis.

Allowable Flow Spread

In accordance with the Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019), the proposed design for the Cawthra Road corridor (Urban Arterial roadway) will adhere to the following:

DESIGN CRITERIA	CRITERIA TO FOLLOW
MINOR SYSTEM	
25 mm	No Surface Ponding
10-year	• No Barrier Curb Overtopping • Flow spread must leave at least one lane free of water in each direction
MAJOR SYSTEM	
Greater than 10-year up to 100-year	• No Barrier Curb Overtopping • Flow spread must leave at least one lane free of water in each direction • Preferred Criteria: no greater than 150 mm under 100-year storm event

4 Approval and Review Requirements

The Region of Peel is subject to all Federal, Provincial and Local legislation related to stormwater management, runoff control and flood control. As mentioned previously, there are no watercourse crossings within the study area and all outlets within the study area discharge into existing municipal storm sewers. Also, there are no significant natural features present with the project limits.

5 Proposed Drainage Conditions

5.1 Tributary Areas, Outlets and Drainage Patterns

The roadway improvements being proposed as part of this project will include raised bike lanes/cycle track along both sides of Cawthra Road between the South Service Road and Burnhamthorpe Road, and localized intersection improvements along the entire corridor. Existing catchbasins will require minor adjustment or relocation where curb lines are to be shifted as part of the proposed design. **Appendix B** includes typical cross-sections which represent the proposed condition. In general, the proposed changes to the existing cross section will have minor increase in the overall pavement area and are not expected to significantly impact drainage along Cawthra Road within the project limits. Further details in this regard are provided below.

Drawings SWM P1, SWM P2 and SWM P3, presented in **Appendix C**, depict the proposed condition within the project limits, drainage area discretization, outlets, and the direction of overland flow routes. The existing internal and external catchment areas have been maintained in the proposed condition, as well as the existing outlets and drainage patterns. Proposed runoff will continue to drain into existing outlets and flow westerly along existing municipal storm sewers towards Cooksville Creek.

A pavement area analysis was conducted for the Cawthra Road corridor to determine the impervious area in the existing and proposed conditions within the seven internal roadway

drainage areas for the site. Peak flow rates were also determined and compared for various storm events using the Rational Method for flow calculation. The Region of Peel 2019 Intensity-Duration-Frequency (IDF) curves were used for determination of rainfall intensity. The results of the pavement area analysis and peak flow calculations are presented in the following **Table 4**. Detailed Calculations are provided in **Appendix D**.

Table 4: Pavement Area Analysis and Peak Flow Calculations

Catchment ID	Total Area (ha)	Pavement Area (ha)	Percent Imperv. (%)	Runoff Coeff.	Flow (m^3/sec)					
					2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
EXISTING CONDITION										
C1	1.02	0.95	93	0.86	0.17	0.22	0.27	0.35	0.43	0.50
C2	2.14	1.75	82	0.78	0.34	0.44	0.54	0.71	0.87	1.01
C3	11.10	9.40	85	0.80	0.39	0.56	0.67	0.91	1.12	1.31
C4	2.95	2.36	80	0.77	0.22	0.31	0.38	0.51	0.63	0.74
C5	1.65	1.27	77	0.75	0.19	0.26	0.32	0.42	0.52	0.61
C6	1.51	1.14	75	0.74	0.15	0.21	0.25	0.34	0.42	0.49
C7	1.03	1.03	100	0.90	0.14	0.19	0.24	0.31	0.39	0.45
Total	**21.40**	**17.90**	**84**	**0.79**	**1.60**	**2.19**	**2.67**	**3.55**	**4.38**	**5.11**
PROPOSED CONDITION										
C1	1.02	0.95	93	0.86	0.17	0.22	0.27	0.35	0.43	0.50
C2	2.14	1.93	90	0.84	0.36	0.48	0.58	0.76	0.93	1.09
C3	11.10	9.53	86	0.81	0.39	0.56	0.68	0.92	1.13	1.33
C4	2.96	2.54	86	0.81	0.23	0.33	0.40	0.53	0.66	0.77
C5	1.65	1.26	76	0.75	0.19	0.26	0.32	0.42	0.52	0.61
C6	1.51	1.13	75	0.74	0.15	0.21	0.25	0.34	0.42	0.49
C7	1.03	1.03	100	0.90	0.14	0.19	0.24	0.31	0.39	0.45
Total	**21.41**	**18.37**	**86**	**0.81**	**1.63**	**2.25**	**2.74**	**3.63**	**4.48**	**5.24**

Note: [(1)] 25-year, 50-year and 100-year flow rates calculated using Runoff Coefficient Adjustment Factors to account for increase in runoff due to saturation of catchment surface as stipulated in Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019).

As indicated in **Table 4**, the quantity of runoff from the improved section of the roadway will result in an increase in runoff flow rates. Therefore, specific measures/techniques to reduce peak runoff flow rates are required within catchment C2, C3 and C4 before discharging to the receiving municipal storm sewer system.

5.2 Storm Sewers

A storm sewer assessment was conducted to determine the hydraulic performance of the existing Cawthra Road sewers. The new Region of Peel IDF curves for 10-year storm event with 10 minutes inlet time was used for the flow calculations. The Manning's Equation was used to calculate the storm sewer capacity. The results of the hydraulic assessment demonstrated that there are twenty one (21) sewer legs that are deficient in capacity and require replacement and upsizing. Following **Table 5** presents a summary of the deficient storm sewer legs. The deficient sewer legs that require replacement and upsizing are

shown on **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C.** The details of the storm sewer design sheets are presented in **Appendix E**.

Based on the results of the CCTV inspection, thirty (30) sewer legs have been recommended for replacement due to structural deficiencies. The detail summary of the CCTV inspection are presented in **Appendix F**.

5.2.1 Sewer Analysis Using Climate Change IDF Curves

The existing cawthra Road sewers were also evaluated using the 2095 future condition IDF curve to assess the impact of climate change on the storm sewer system. The results of the assessment indicate that a total of twenty six (26) sewer legs were inadequate in capacity and will require replacement and upsizing. Following **Table 5** presents a summary of the deficient storm sewer legs. The deficient sewer legs require replacement and upsizing are shown on **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C.** The details of the storm sewer design sheets are presented in **Appendix E**.

Table 5: Summary of Deficient Storm Sewers

EXISTING STORM SEWER LEGS TO BE REPLACED				TYPE OF DEFICIENCY
CATCHMENT AREA NO.	FROM MH	TO MH	PIPE SIZE (MM)	
C1	MH8265114451	MH8264714474	200	Bad CCTV
	MH8264714474	MH8264714473	300	Bad CCTV/Under Capacity
	MH8264714473	MH8264114502	375	Failure CCTV
	MH8264114504	MH8264114504A	375	Poor CCTV
C2	MH2690513991	MH2686714032	375	Abandoned CCTV
	MH2686714032	MH2685214020	375	Abandoned CCTV
	MH2685214020	MH2682514051	375	Abandoned CCTV /Under Capacity
	MH2679614089	MH2679614089A	450	Under Capacity
	MH2662714356	MH2665814319	200	Abandoned CCTV/Under Capacity
	MH2671114244	MH2670314257	300	Abandoned CCTV
	MH2670314257	MH2668914246	300	Abandoned CCTV
	MH2665814319A	MH2666614287	300	Abandoned CCTV
	MH2674214162	MH2679614089B	450	Abandoned CCTV/Under Capacity
	MH2665814319	MH2665814319A	300	Poor CCTV
	MH2668914246	MH2672114191	375	Poor CCTV
	MH2672114191	MH2674214162	450	Under Capacity
C3	MH2847512300	MH2843212346	300	Under Capacity
	MH2843212346	MH2838912393	375	Poor CCTV
	MH2782912954	MH2781212976	1050	Failure CCTV

Table 5: Summary of Deficient Storm Sewers (Continued..)

EXISTING STORM SEWER LEGS TO BE REPLACED				TYPE OF DEFICIENCY
CATCHMENT AREA NO.	FROM MH	TO MH	PIPE SIZE (MM)	
C3	MH2781212976	MH2779312998	1050	Poor CCTV
	MH2764813167	MH2757513247	1350	Poor CCTV
	MH2748713342	MH2740013435	1350	Poor CCTV
	MH2863612108	MH2857612172	450	Abandoned CCTV
	MH2847512300	MH2843212346	300	Abandoned CCTV
	MH2719013707	MH2717013708	375	Abandoned CCTV
	MH2870712032	MH2863612108	375	Under Capacity
	MH2857612172	MH2853412217	450	Under Capacity
	MH2853412217	MH2846712290	450	Under Capacity
	MH2846712290	MH2840512356	525	Under Capacity
	MH2840512356	MH2834612419	525	Under Capacity
	MH2834612419	MH2828112490	525	Under Capacity
	MH2826712505	MH2823612538	525	Under Capacity
	MH2815712622	MH2809112693	600	Failure CCTV/Under Capacity
	MH2734513494	MH2726213583	1350	Poor CCTV/Under Capacity
	MH2726213583	MH2719913650	1350	Poor CCTV/Under Capacity
	MH2716513685	MH2704813814	1350	Poor CCTV
	MH2704813814	Missing MH	1350	Poor CCTV
C4	MH2907911633	MH2905511660	900	Under Capacity
	MH2905511660	MH2899811719	900	Under Capacity
	MH2899811719	MH2896211760	900	Under Capacity
	MH2896211760	MH2886911860	1050	Under Capacity
	MH2886911860	MH2877511960	1050	Under Capacity
	MH2923611465	MH2922511472	N/A	Abandoned CCTV
C5	MH2946811287	MH2946811287A	525	Under Capacity
	MH2946811287A	MH2940011351	525	Under Capacity
	MH2930811429	MH2922511472	750	Under Capacity
	MH2954211221	MH2952711227	600	Abandoned CCTV
	MH2940911372	CB2939211356	300	Abandoned CCTV
C6	MH2981910930	MH2972911023	300	Under Capacity

6 SWM Plan and Design

6.1 Proposed Drainage System

Under proposed conditions, the quantity of runoff resulting from major storms will be conveyed to existing outlets as overland flow. The general direction of roadway overland flow is shown on **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C.**

As part of the minor drainage system, stormwater will continue to be collected by a series of catchbasins and conveyed to the current storm sewers with eventual discharge to the existing outlets as shown in **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C**. A hydraulic assessment of existing sewers by using the Region of Peel IDF curve demonstrate that there are twenty one (21) sewer legs that are deficient in capacity and require replacement and upsizing.

A detailed hydrologic analysis was conducted to calculate pre and post development condition flow within the right-of-way at all outlet locations. The analysis indicated that the quantity of runoff from the improved section of the roadway will result minor increase in runoff flow rates and specific measures/techniques to reduce peak flow rates of runoff are required.

The required storage volumes were calculated using Modified Rational Method and the storage will be provided through the proposed underground infiltration chambers and the superpipes. **Table 6** provides a summary of flow comparisons and the storage required to offset the increase in flows. The proposed infiltration chambers and the superpipes will offset increase in flows before discharging to the receiving systems. **Table 7** provides the location of stormwater outlets and associated mitigation measures required to control post-development flows to pre-development level. The storage calculations at each drainage outlet are provided in **Appendix D**.

To control post development flow to the pre-development level for all storm events up to 100-year storm, orifice plates will be provided at the outlet locations before discharging stormwater to the receiving municipal storm sewer system. The summary of storage requirement, allowable release rate for all the storm events are provided in **Appendix D**. The storage chamber and orifice sizing calculations will be provided in the detailed design stage.

The quantity control measures along with the recommended storage volumes are shown on **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C.**

Table 6: Existing and Proposed Conditions Flow and Storage Requirements (100 Year)

Catchment ID	OUTLET	PROPOSED ROADWAY DRAINAGE AREA (HA)	100- YEAR FLOW (m^3/sec)			QUANTITY CONTROL STORAGE REQUIRED (m^3)
			Existing	Proposed	Increase in Flow	
C1	Outlet 1	1.02	0.50	0.50	0.00	0.0
C2	Outlet 2	2.14	1.01	1.09	0.08	57.4
C3	Outlet 3	11.10	1.31	1.33	0.02	86.5
C4	Outlet 4	2.96	0.74	0.77	0.03	90.2
C5	Outlet 5	1.65	0.61	0.61	0.00	0.0
C6	Outlet 6	1.51	0.49	0.49	0.00	0.0
C7	Outlet 7	1.03	0.45	0.45	0.00	0.0

Table 7: Mitigation Measures Provided at Outlets

CATCHMENT ID	OUTLET	STORAGE PROVIDED (m^3)	MITIGATION MEASURES
C2	Outlet 2	57.4	Infiltration Chamber
C3	Outlet 3	86.5	Superpipe
C4	Outlet 4	90.2	Superpipe

Low Impact Development (LID) Measures

Low Impact Development measures such as underground infiltration chambers will be used within the roadway right-of-way (R-O-W) areas to offset any negative impacts due to the proposed improvements. Infiltration chambers capture runoff for infiltration to groundwater and reduces the rates of runoff to the receiving drainage systems. It also provides water quality treatment through the capture of both particulate and dissolved constituents.

As part of the “Hydrogeological Data Report and Impact Assessment, Cawthra Road Sanitary Sewer and Watermain Project 17-2452S (Phase 2), Mississauga, ON, dated March 21, 2019”, prepared by WSP, groundwater level is between 2.4 m to 2.6 m below the surface of the road at the monitoring wells located at Cawthra Road within this project corridor. According to the above-referenced report, the hydraulic conductivity of soils at BH2-13 (located on Cawthra Road approx. 310 m south of Burnhamthorpe Road) is $1.63X10^{-7}$ m/sec. This hydraulic conductivity at BH2-13 is equivalent to an approximate infiltration rate of 30 mm/hour (Reference: Table C2, Appendix C, Water Balance and Recharge, Stormwater Management Criteria, Toronto and Region Conservation Authority, August 2012, Version 1.0) and is suitable for implementation of the underground infiltration chambers within the project area. Therefore, the proposed LID measure is supported by the currently available geotechnical/hydrogeological information. However, once the new geotechnical investigation report for this study area will be available, the proposed LID measures need to be evaluated based on the new geotechnical/hydrogeological information.

Ministry of Transportation (MTO) Policy for Stormwater Storage Facility

According to the MTO policy, underground infiltration chambers are not considered for storage and is not allowed as mitigation measure for quantity controls for the areas that are draining to MTO's right-of-way. In order to meet MTO policy objective, an evaluation of SWM system was performed assuming that underground storage system is lost and the road improvements still meets the quantity control criteria.

The proposed underground storage chambers within Catchment C2 will provide approximately 57.4 m^3 of storage volume to control 100-year post development flow to the pre-development 100-year level. However, the storm sewers (proposed upsized/existing) located within Catchment C2 will have approximately 69 m^3 volume available for storage when flowing full. Therefore, if the underground storage system is lost, the proposed improvements will still meet the quantity control criteria and there will be no impact on MTO's drainage system.

6.2 Water Quality Control Measures

Under existing conditions, almost all the right-of-way (ROW) drains directly to the storm sewers and no specific water quality treatment measures currently exist within the project limit.

Water quality control is required for any additional paved areas associated with the proposed improvements of the Cawthra Road. A number of stormwater quality control practices were reviewed and assessed for their applicability on this project. Due to the nature of this facility (i.e. linear transportation corridor), limited space within the roadway right-of-way, it is determined that the possible SWM measure through Oil/Grit Separator (OGS), underground infiltration chambers and the existing roadside ditches will be used to achieve water quality control objectives. Due to large external catchment areas draining through the existing outlets 3, 4 and 5, it is not practical to install Oil/Grit Separators at these outlets.

The following measures are proposed to enhance the existing water quality:

- Four (4) Oil/Grit Separator (OGS) units have been proposed within the project area and the location of proposed Oil/Grit Separators is shown on **Drawings SWM P1, SWM P2 and SWM P3** in **Appendix C**
- Underground infiltration chambers will enhance infiltration and thus provide water quality treatment;
- Existing roadside ditches north of Meadows Boulevard will be maintained which will provide further enhancement to the water quality.

Following **Table 8** provides summary of treatment measures that are proposed for water quality treatment.

Table 8: Summary of Treatment Measures

CATCHMENT ID	OUTLET	PROPOSED TREATMENT MEASURES	DRAINAGE RECEIVER
C1	Outlet 1	Oil/Grit Separator	450 mm Municipal Storm Sewer
C2	Outlet 2	Oil/Grit Separator and Infiltration Chambers	750 mm Municipal Storm Sewer
C6	Outlet 6	Oil/Grit Separator and Roadside Ditch	1200 mm Municipal Storm Sewer
C7	Outlet 7	Oil/Grit Separator and Roadside Ditch	525 mm Municipal Storm Sewer

6.3 Water Balance and Runoff Volume Control Measures

Based on the water balance and runoff volume control criteria outlined in the Region of Peel Draft Stormwater Design Criteria and Procedural Manual (June 2019), the proposed design for the Cawthra Road corridor must provide, at a minimum, on-site retention of all run-off from the first 27-28 mm of each rainfall event through infiltration, re-use and/or evapotranspiration. On this basis, it is calculated that 5783 m^3 of water is to be infiltrated and stored within the corridor to meet the water balance criteria, as noted in **Table 9**.

Table 9: Water Balance Storage Requirement

FACILITY	AREA (hseca)	STORAGE REQUIREMENT TO RETAIN 27 mm OF RAINFALL (m^3)
Cawthra Road Corridor	21.42	5783

Best efforts will be made to meet the water balance on-site. The underground infiltration chambers and the green areas within the Right-of-Way will provide infiltration for the water balance requirement. Details on water balance calculations are provided in **Appendix G**.

6.4 Flow Spread

A flow spread analysis was conducted by using the Region of Peel IDF Curves (2019) at the low point located under railway crossing. The analysis was conducted to determine the flow spread onto travel lanes under both minor and major system flows at the low point/sag along the roadway.

Table 10: Summary of Low Point Spread Analysis (Using Region of Peel IDF Curves)

LOW POINT STATION	PONDING DEPTH (m)	FLOW SPREAD (m)	ENCROACHMENT ONTO 1ST TRAVEL LANE (m)	CLEAR WIDTH OF 1ST TRAVEL LANE (m)
MAJOR SYSTEM (100-Year)				
12+040	0.247	12.35	11.86	-4.85

The results of the analysis indicated that the ponding depth at the low point exceeds 150 mm requirement during the 100-year storm event. The criteria of "leaving at least one traffic lane free of water in each direction" was not satisfied. The storm sewer conveyance for roadway sag area will require upgrades to the 100-year storm capacity to eliminate flooding at the low/sag point. The results of the flow spread analysis are presented in **APPENDIX H**. A summary of the results is provided in **Table 10**.

6.4.1 Flow Spread Analysis Using Climate Change IDF Curves

The flow spread analysis was also conducted by using the future climate change IDF curves (2095). A summary of the results is provided in following **Table 11**.

Table 11: Summary of Low Point Spread Analysis (Using 2095 Climate Change IDF Curves)

LOW POINT STATION	PONDING DEPTH (m)	FLOW SPREAD (m)	ENCROACHMENT ONTO 1ST TRAVEL LANE (m)	CLEAR WIDTH OF 1ST TRAVEL LANE (m)
MAJOR SYSTEM (100-Year)				
12+040	0.269	13.44	12.94	-5.94

As seen in **Table 10** and **Table 11** above, the ponding depth at the low point exceeds 150 mm limit during major storm events when using the Region of Peel IDF curves (2019) and future climate change IDF curves (2095). The current design does not meet the requirement of flow spread criteria during major storm events. The storm sewer conveyance for roadway sag area will require upgrades to 100-year storm capacity to eliminate flooding at the low/sag point**. Drawings SWM P1, SWM P2** and **SWM P3** in **Appendix C** indicates the location of the storm sewer requiring the 100-year upgrade at the sag.

7 Erosion and Sediment Control

If uncontrolled, the construction activities associated with Cawthra Road improvements could result in increased rates of erosion and sedimentation within and adjacent to the study area and Cooksville Creek subwatersheds. Erosion, for the purposes of this discussion, is described as the process whereby soil particles are detached from an exposed surface and transported by water, wind or some other agent. Sedimentation is defined as the deposition of (eroded) particles at a "downstream" point, typically a watercourse. The potential environmental impacts from increased erosion and sedimentation include: degradation of water quality; destruction of fisheries habitat; and, increased flooding potential.

Erosion and sedimentation processes are typically accelerated due to construction activities. Literature indicates that construction activities can increase erosion and sedimentation rates by 2 to 3 orders of magnitude over that expected from a natural forested area. Erosion and sedimentation control are therefore an integral and important component in the design and construction of any project.

7.1 Erosion and Sediment Control Measures

To minimize the potential environmental impacts, the following erosion and sedimentation control practices will serve to guide the design and implementation phase of the Erosion and Sedimentation Control Plan:

- limit size of disturbed area,
- limit duration of soil exposure,
- retain existing vegetation where feasible,
- limit slope length and gradient of disturbed areas,
- preserve overland sheet flow and micro-drainage (avoid concentrated channel flows),
- break and redirect flows to lower gradients,
- design and implement staged stripping,
- prevent disturbance of previously stripped and stabilized parcels, and
- stabilize stripped parcels with temporary vegetative controls.

Appropriate permanent/temporary erosion control measures to be considered in the design and implementation of the Erosion and Sedimentation Control Plan are:

- **Hydroseeding** - One step application of seed and hydraulic slurry with adhesive binder (provides permanent stabilization for moderate to steep slopes).
- **Seed and Straw Mulch** - Alternative two step application that will be applied to provide permanent/temporary vegetative stabilization of disturbed areas.
- **Mulch (straw, wood etc.)** - Used to provide temporary erosion protection of exposed slopes during over-wintering and for disturbed areas inactive for greater than 45 days.
- **Sod** - Utilized to provide quick permanent stabilization of disturbed areas. Applications include lateral ditches with gradients < 5% and slopes with steep to moderate grades (i.e. 3% to 5%).
- **Erosion Control Blanket** - Applied as temporary/permanent erosion protection for slopes greater than 2:1 or as a ditch liner. For permanent applications, seed will be applied prior to installation.
- **Aggregate Stone** - Appropriate material, such as rip rap will be used to provide immediate permanent erosion protection of lateral ditches > 5% gradient; and along chute/spillways. Geotextile fabric will be applied prior to placement of any aggregate material.

7.2 Sediment Control

The following elements should be included in the sediment control plan:

- provision of a series of temporary interceptor/conveyor ditches to direct runoff to the siltation/watercourses;
- provision of rock or straw bale within drainage swales/ditches; and
- placement of a series of silt control fencing for the interception of sheet flow drainage.

All sediment control measures should not be removed until final stabilization of the site. In addition, any accumulated sediment shall be removed, as part of a maintenance program, from all control measures when accumulation reaches 50% of the height or volume of the control structure.

Environmental Inspection Process - As a component of erosion and sedimentation control, environmental inspections of the construction site will be conducted. Environmental inspections will be conducted to assess the performance of erosion and sedimentation control measures and identify any required maintenance. The frequent inspections will also permit the identification of localized erosion and sedimentation control issues that require site specific attention.

Implementation and Recommendation - A 200 m standby supply of prefabricated silt fence barrier, in addition to silt fence requirements, shall be maintained at the construction site prior to commencement of grading operations and throughout the duration of the contract.

- Where interceptor ditches and/or subsurface drains are specified, they shall be constructed prior to commencement of any related cut or fill activities.
- Cut and fill earth slopes and ditches, shall be treated with the specified cover material (seed and mulch, seed and erosion control blanket, seed and sod, rip rap, etc.) within 45 days from the commencement of the cut, fill or ditching operation. Commencement of a cut, fill or ditching operation shall be considered to have occurred when the original stabilizing cover has been removed, including grubbing, or has been covered with fill material.
- Run-off from the site and stockpiles shall be controlled to the extent possible to minimize sediment entry to the adjacent watercourses.
- Where dewatering is required, and where culverts are cleaned by hydraulic means, the effluent shall be discharged in a manner that prevents the entry of sediments to watercourses, or scouring and erosion at the outlet.
- All erosion and sediment control measures will be clearly stated in the contract drawings and documents.
- Erosion and sediment control plan for the project must adhere to Erosion and Sediment Control (ESC) Guidelines for Urban Construction, December 2006, Greater Golden Horseshoe Area Conservation Authorities.

8 Conclusions and Recommendations

This report documents the stormwater management aspects associated with the improvements to Cawthra Road. It describes the existing and proposed drainage conditions within the study limits and outlines the proposed SWM Plan to mitigate the potential impacts of the proposed roadway improvements on receiving drainage systems. The findings of this study are summarized as follows:

- Existing drainage patterns will be maintained in the proposed condition, with runoff continuing to drain into existing outlets and flow westerly along existing municipal storm sewers towards Cooksville Creek.
- The quantity of runoff from the improved section of the roadway will result minor increase in runoff flow rates and specific measures/techniques to reduce peak flow rates of runoff are required.
- Hydraulic assessment of storm sewers with the Region of Peel IDF curve (2019) and the future climate change condition (2095) IDF curve indicated deficiency in capacity at a number of storm sewer legs and require replacement and upsizing.
- Quantity control will be provided at the outlets where flow increases from the existing condition. The proposed infiltration chambers and the superpipe will provide the required storage volume for quantity control. The storage provided in the infiltration chambers/superpipe will be controlled through an orifice plate before discharging to the outlet.
- Four (4) Oil/Grit Separator (OGS) units have been proposed within the project area in order to provide runoff quality controls. In addition, proposed underground infiltration chambers and the existing roadside ditches will provide further water quality treatment.
- Under proposed conditions, the existing catchbasins will require relocation to the new curbs.
- Water balance will be attained through use of proposed underground infiltration chambers and the existing green areas.
- The ponding depth at the railway underpass exceeds 150 mm limit during major storm events and the current design does not meet the requirement of flow spread criteria during major storm events. The storm sewer conveyance at the sag will require upgrades to the 100-year storm capacity to eliminate flooding at the low/sag point.

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Respectfully Submitted,
IBI Group

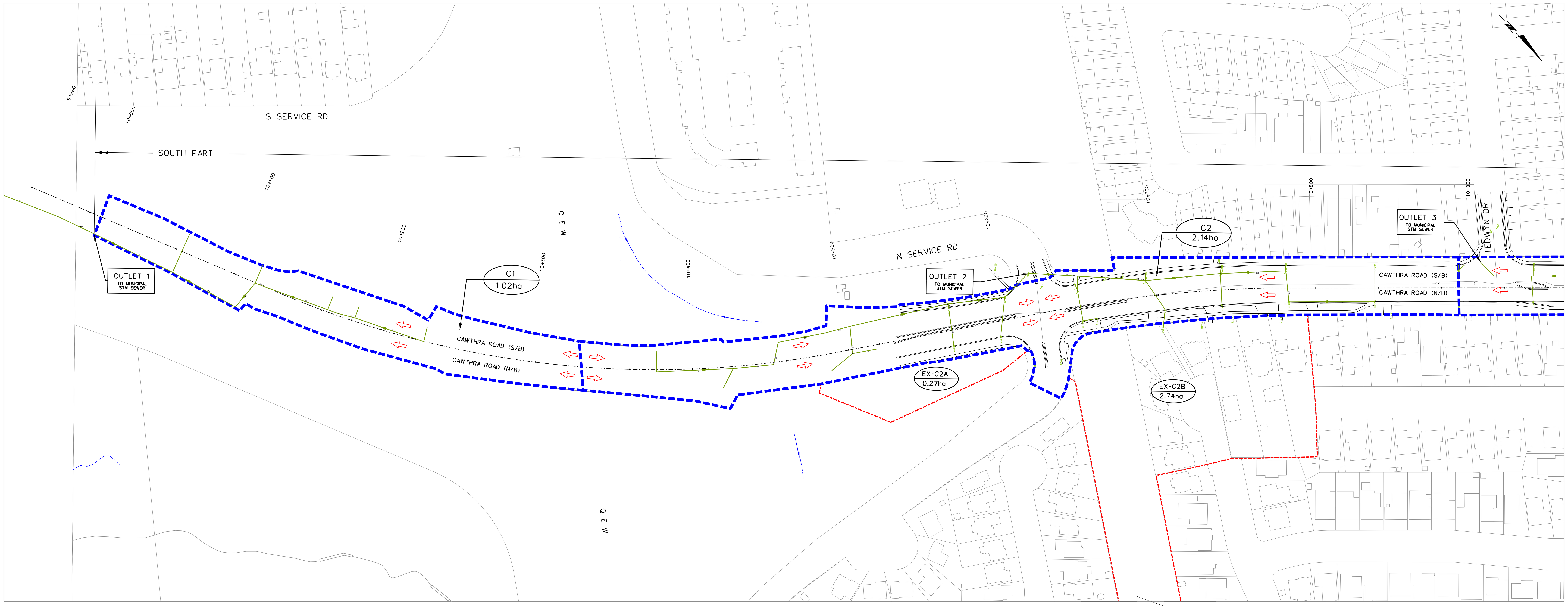
September 18, 2020

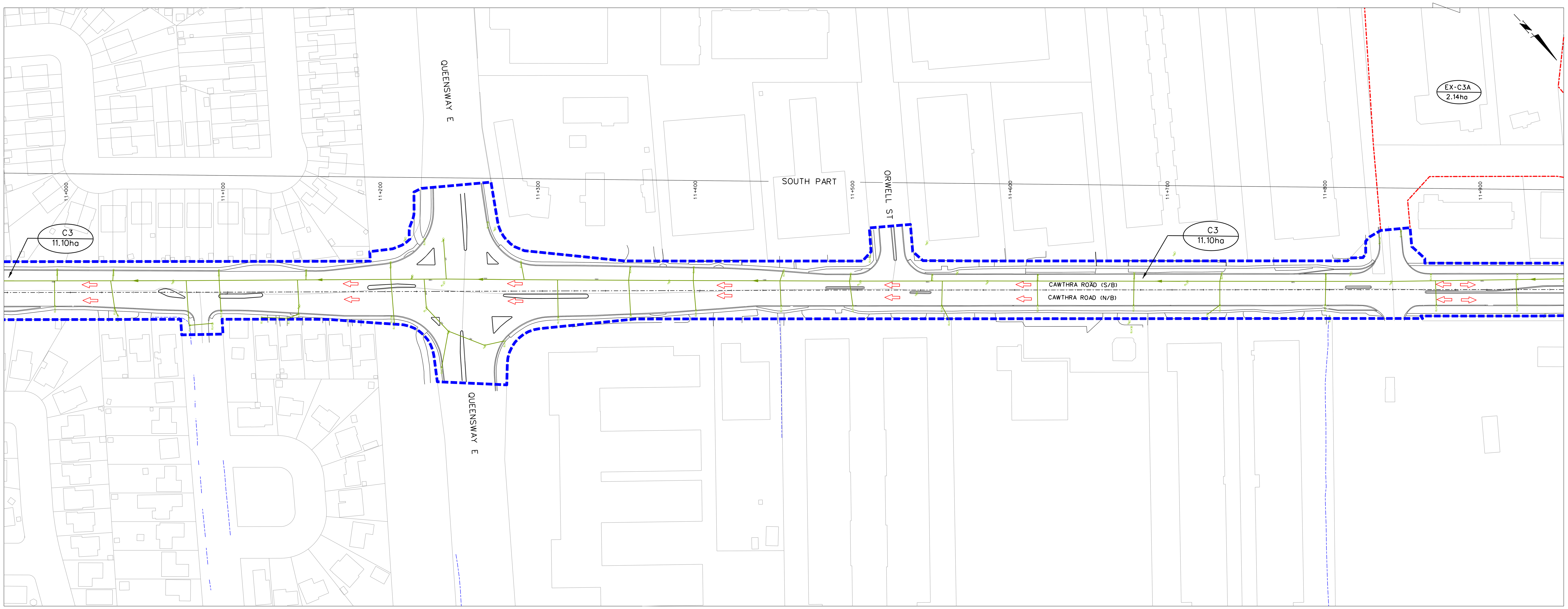
Rakesh Pandey, Ph.D., P.Eng.
Water Resources Engineer

Manager, Municipal Engineering
IBI Group

APPENDIX A

EXISTING CONDITION DRAWINGS





DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- CATCHMENT ID (C1) / CATCHMENT AREA (0.71ha)
- MAJOR FLOW
- STM

CONSULTANTS

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ibigroup.com

North Arrow

Detail Symbol

DETAIL NUMBER
LOCATION OR DETAIL SHEET

Project Manager	Architect/Engineer
Project Leader	Drawn N. M
Date 2019/03/06	Checked

Client

REGION OF PEEL

Project

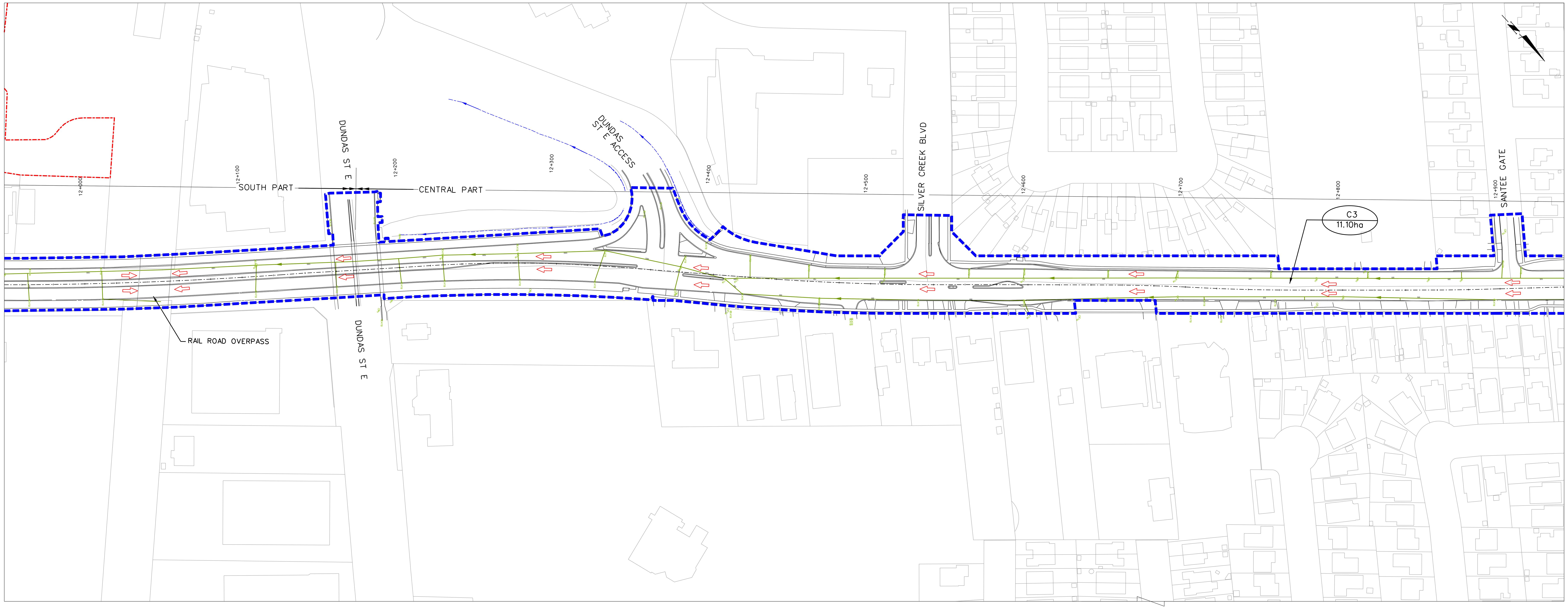
CAWTHRA ROAD EXPANSION EA

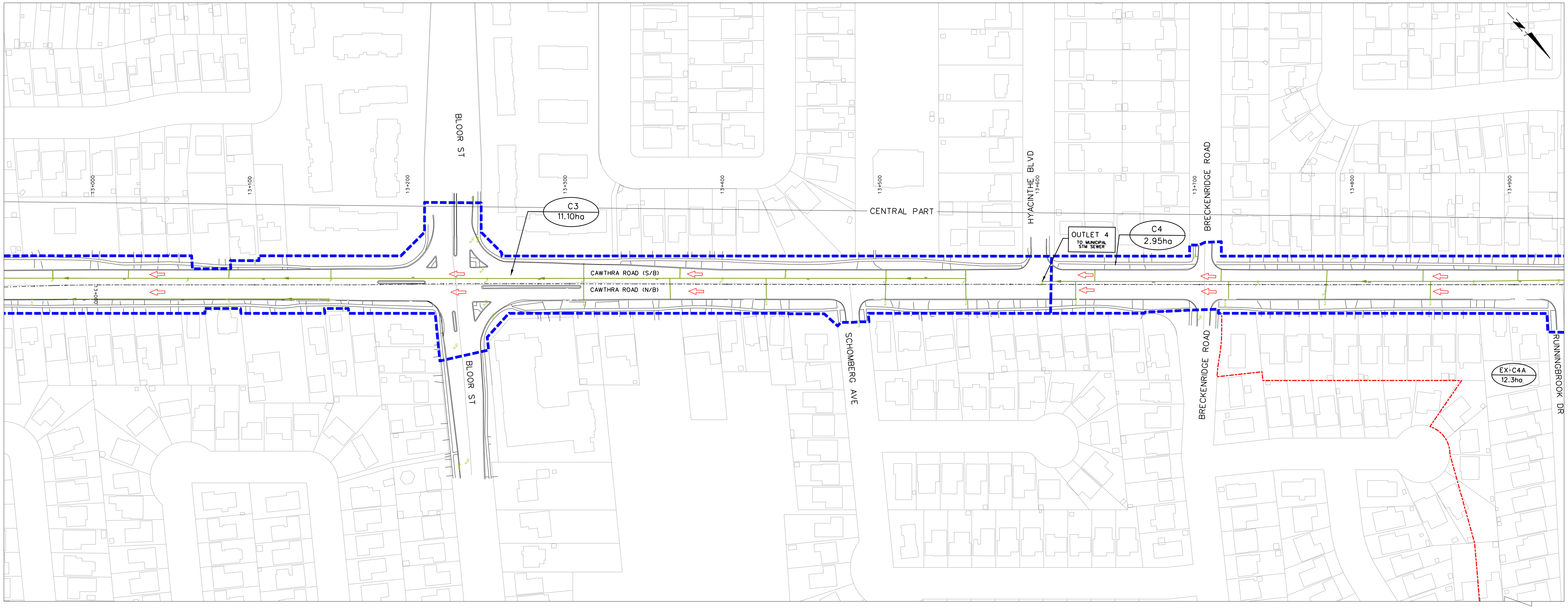
Drawing Title

EXISTING CONDITION DRAINAGE PLAN

Check Scale (may be photo-reduced) 0 1 inch 0 10mm

Project No.	Drawing No.
24rx16.0014	SWM E1





DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- C1 / 0.71ha — CATCHMENT ID / CATCHMENT AREA
- MAJOR FLOW
- STM

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North Arrow — True North

Detail Symbol — DETAIL NUMBER / LOCATION OR DETAIL SHEET

Project Manager	Architect/Engineer
Project Leader	Drawn N. M
Date 2019/03/06	Checked

Client
REGION OF PEEL

Project
CAWTHRA ROAD EXPANSION EA

Drawing Title
EXISTING CONDITION DRAINAGE PLAN

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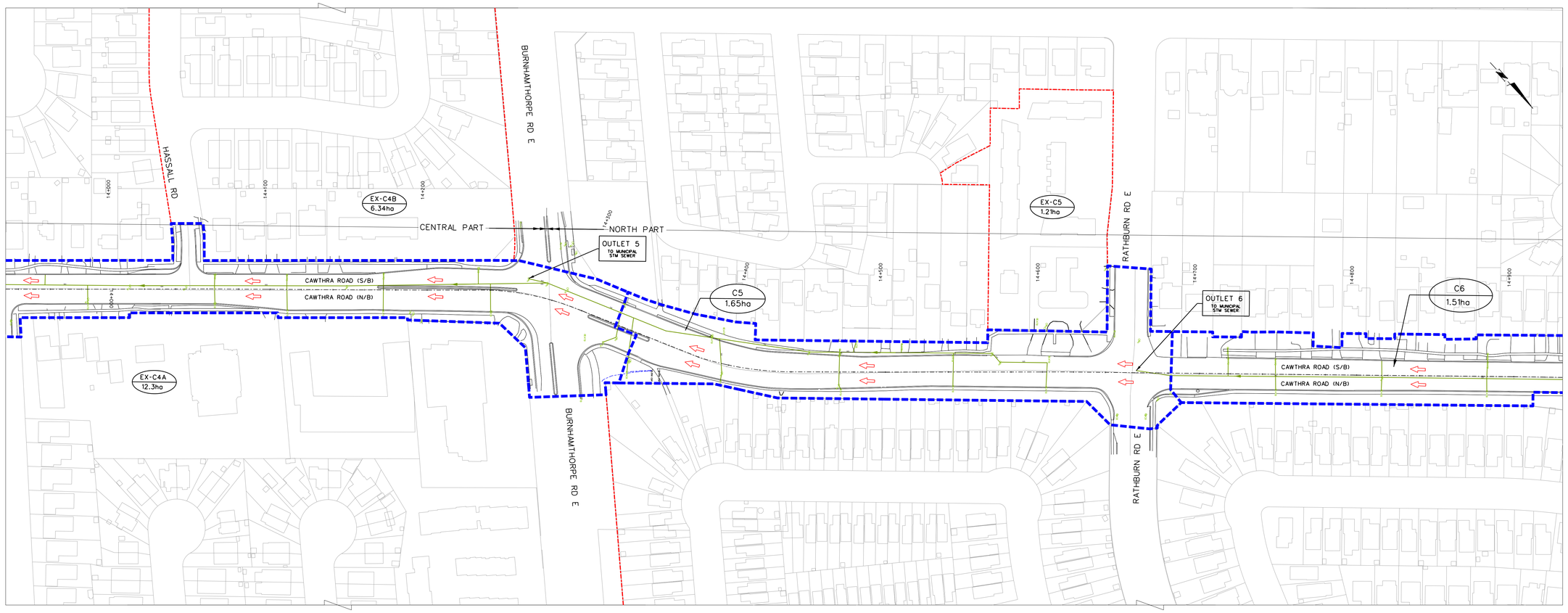
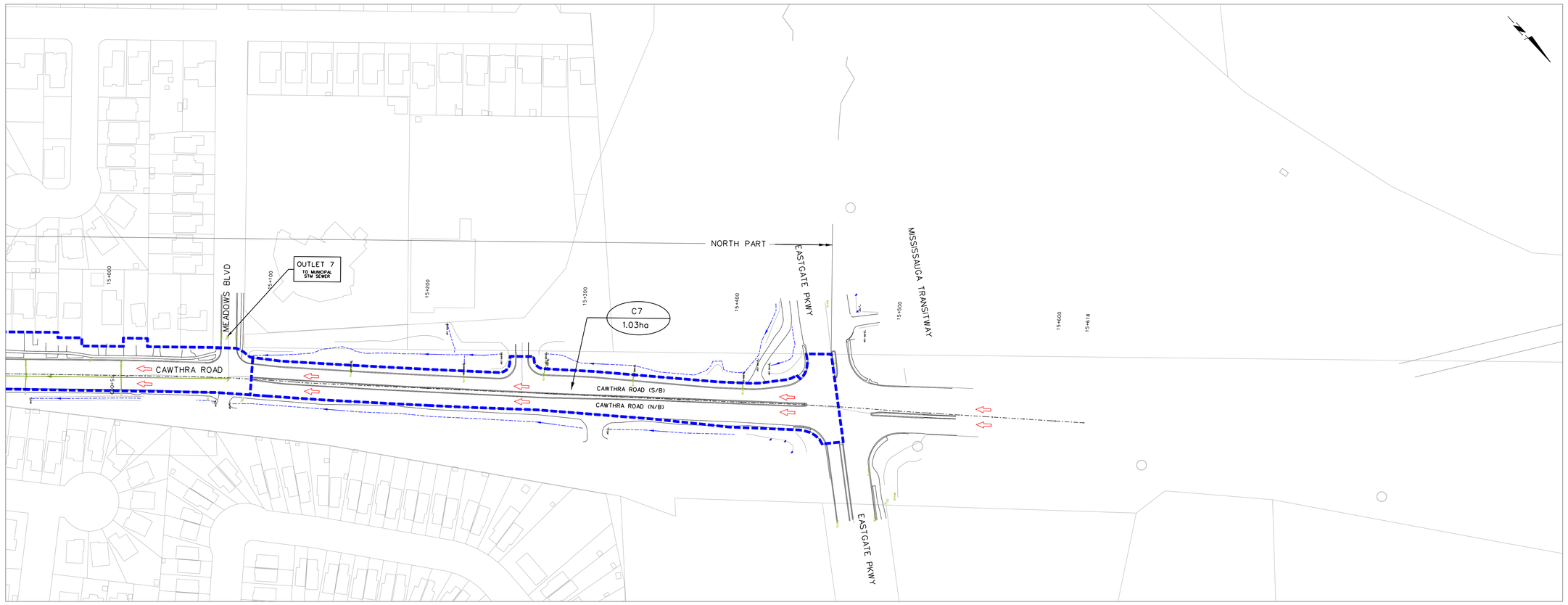
Project No.	Drawing No.
24rx16.0014	SWM E2





DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- C1 / 0.7ha — CATCHMENT ID / CATCHMENT AREA
- MAJOR FLOW
- STM

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North Arrow: True North

Detail Symbol: DETAIL NUMBER / LOCATION OR DETAIL SHEET

Project Manager	Architect/Engineer
Project Leader	Drawn: N. M
Date: 2019/03/06	Checked

Client: REGION OF PEEL

Project: CAWTHRA ROAD EXPANSION EA

Drawing Title: EXISTING CONDITION DRAINAGE PLAN

Check Scale (may be photo-reduced): 0 — 1 inch; 0 — 10mm

Project No.	Drawing No.
24rx16.0014	SWM E3

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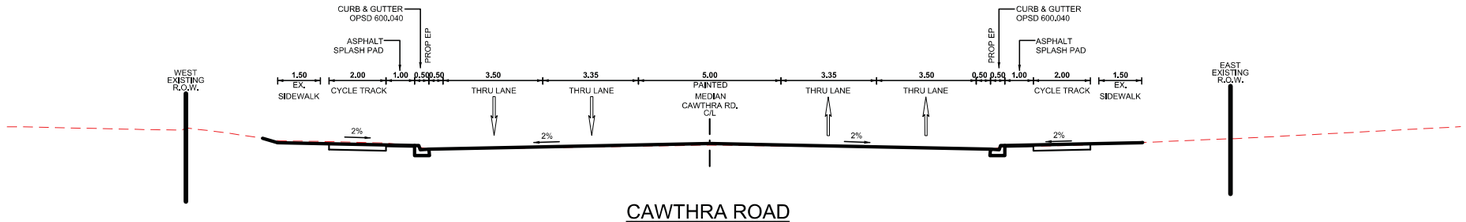
APPENDIX B

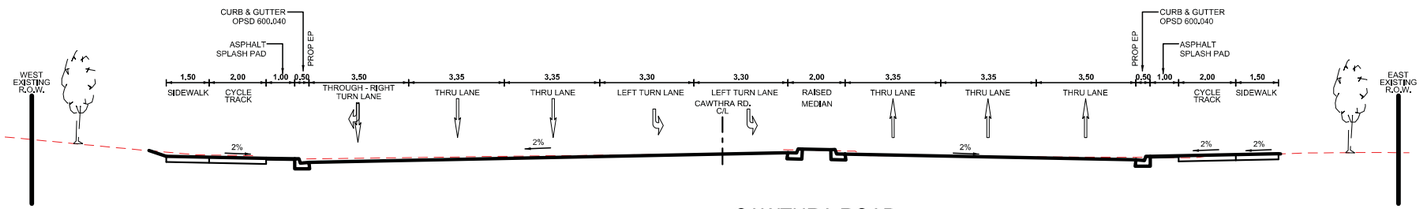
PROPOSED CONDITION ROADWAY CROSS SECTIONS

11+700



CAWTHRA ROAD
ORWELL ST TO NEEDHAM LN
(FROM STA 11+580 TO 11+820)

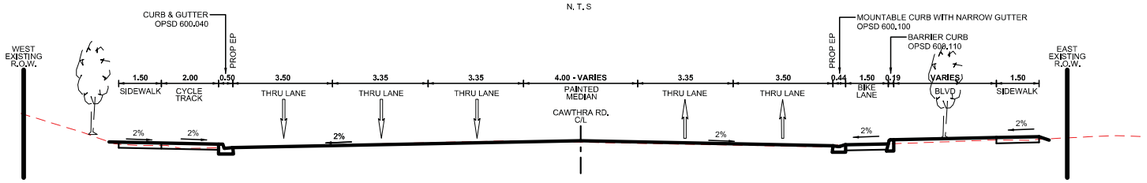
11+300



CAWTHRA ROAD
NORTH OF QUEENSWAY E
(FROM STA 11+280 TO 11+325)

N. T. S

10+800

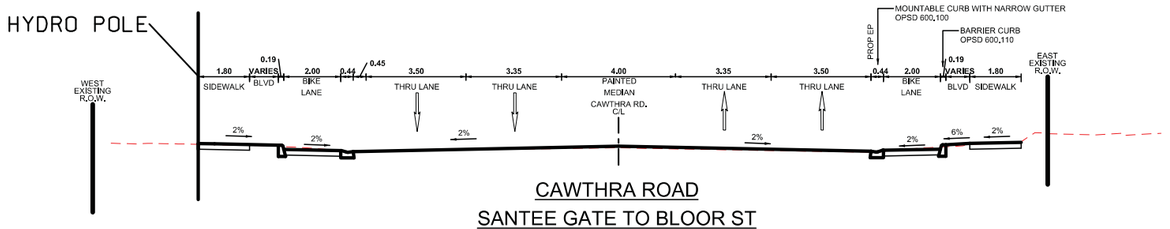


CAWTHRA ROAD (FROM STA 10+640 TO 11+100)

N. T. S

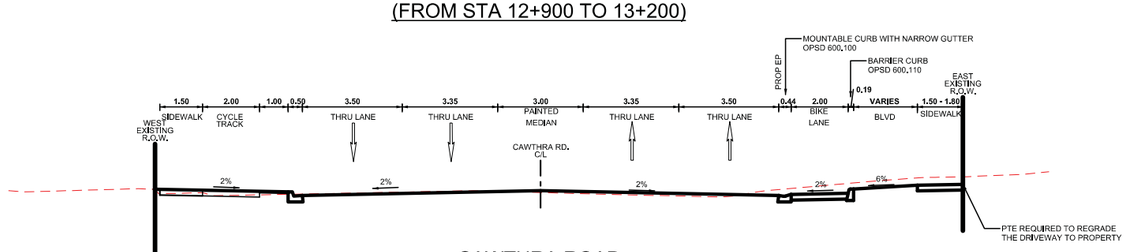
PRELIMINARY

13+080



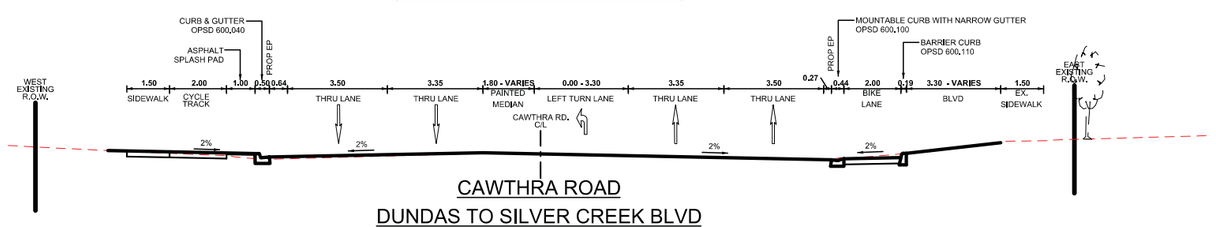
CAWTHRA ROAD
SANTEE GATE TO BLOOR ST
(FROM STA 12+900 TO 13+200)

12+800



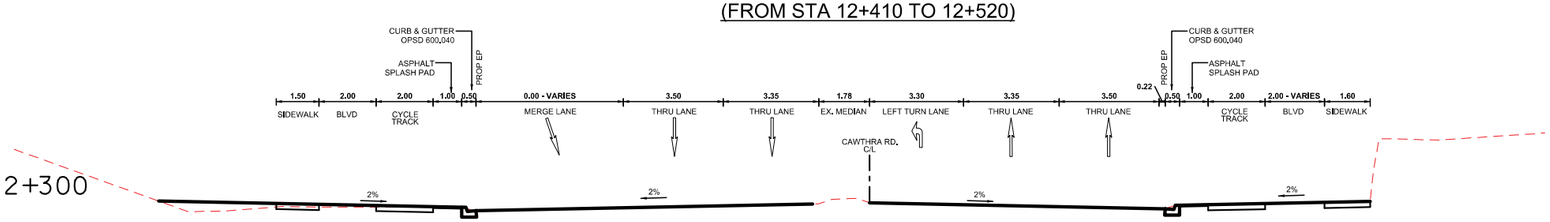
CAWTHRA ROAD
CEMETARY
(FROM STA 12+760 TO 12+860)

12+500



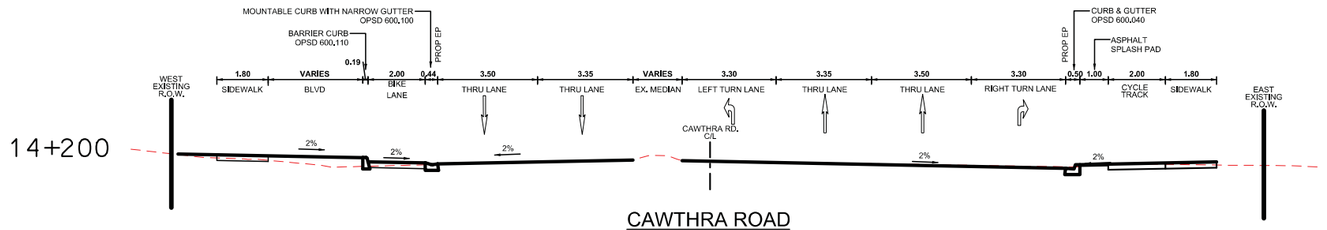
CAWTHRA ROAD
DUNDAS TO SILVER CREEK BLVD
(FROM STA 12+410 TO 12+520)

12+300

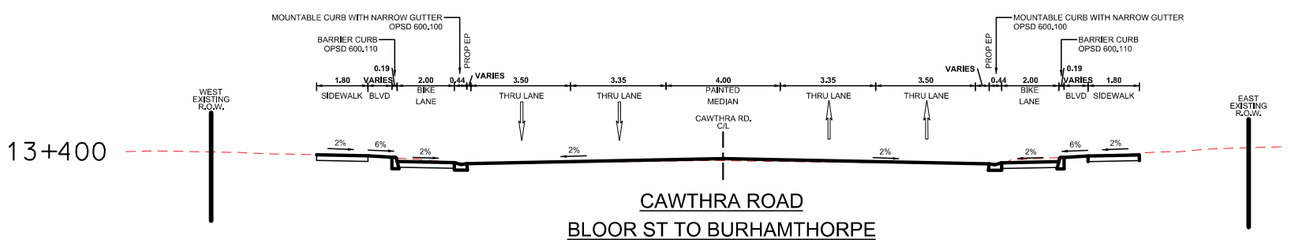


CAWTHRA ROAD
DUNDAS INTERSECTION SOUTH

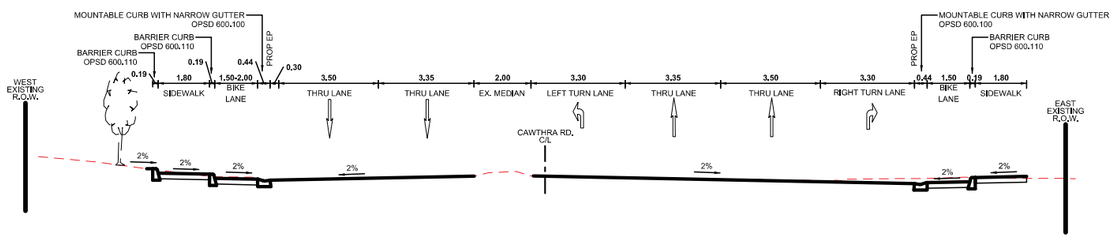
PRELIMINARY



CAWTHRA ROAD
BURHAMTHORPE INTERSECTION SOUTH
(FROM STA 14+150 TO 14+255)



CAWTHRA ROAD
BLOOR ST TO BURHAMTHORPE
(FROM STA 13+380 TO 14+120)

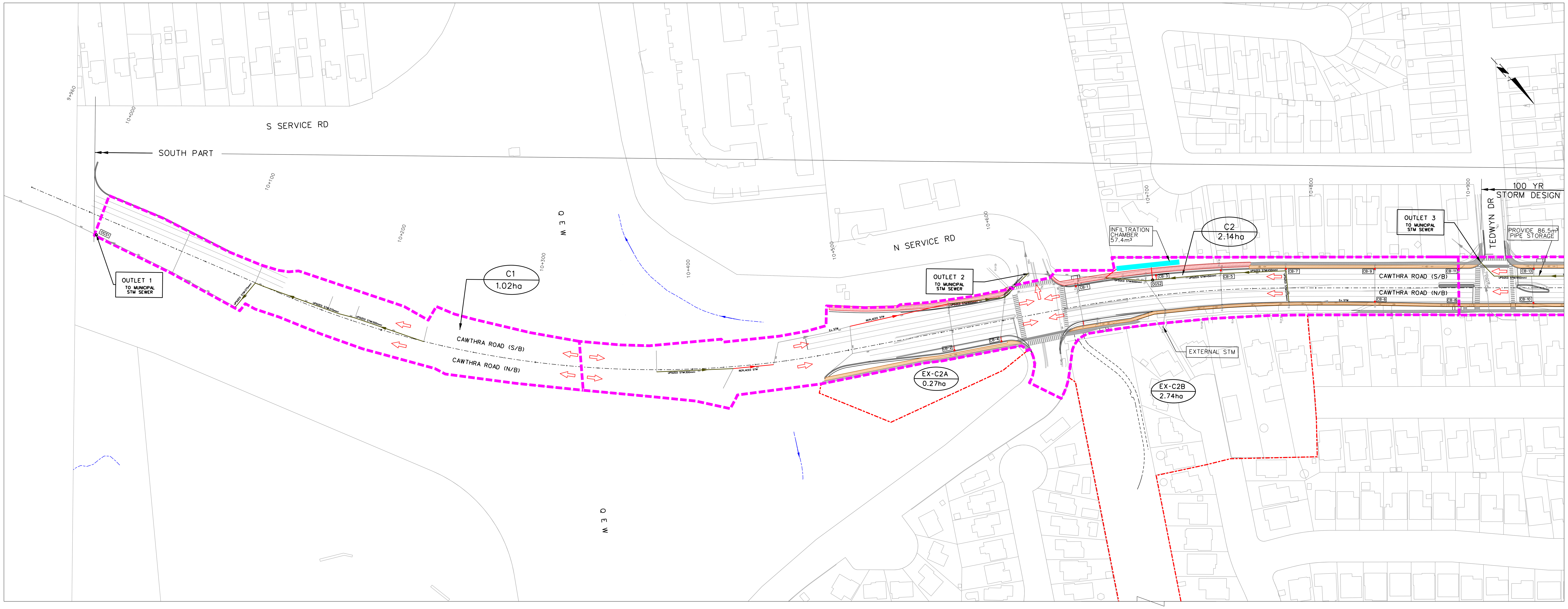


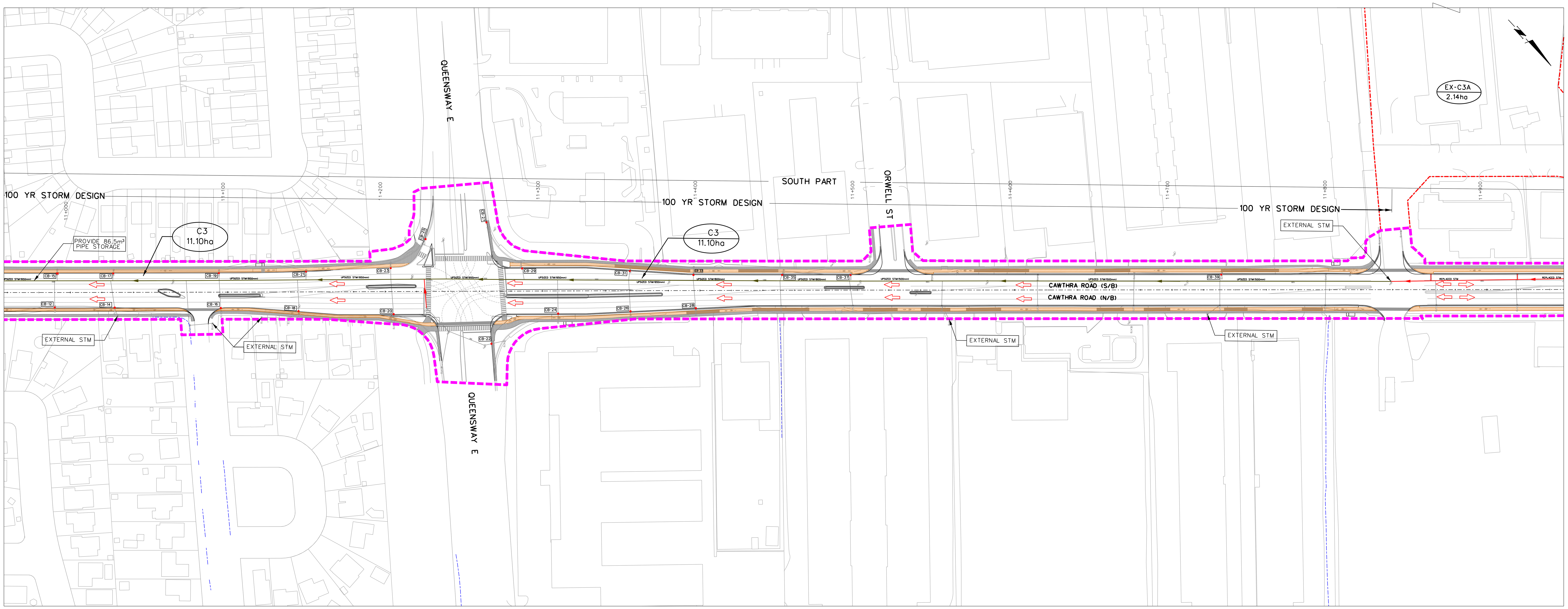
CAWTHRA ROAD
SOUTH OF BLOOR STREET INTERSECTION

PRELIMINARY

APPENDIX C

PROPOSED CONDITION DRAWINGS





DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- SIDEWALK
- BIKE LANE
- MUP
- C1 / 0.71ha — CATCHMENT ID / CATCHMENT AREA
- MAJOR FLOW
- Ex. STM
- Ex. CB
- Ex. MH
- REPLACED STM PIPE
- UPSIZED STM PIPE
- RELOCATED CB
- RELOCATED DCB
- REPLACED FRAME & GRATE
- DITCH

CONSULTANTS

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tel 416 679 1930 fax 416 675 4620
ibigroup.com

North Arrow

Detail Symbol: DETAIL NUMBER / LOCATION OR DETAIL SHEET

Project Manager	Architect/Engineer
Project Leader	Drawn N. M
Date 2019/10/07	Checked

Client

REGION OF PEEL

Project

CAWTHRA ROAD EXPANSION EA

Drawing Title

PROPOSED CONDITION DRAINAGE PLAN

Check Scale (may be photo-reduced) 0 — 1 inch; 0 — 10mm

Project No.	Drawing No.
24rx16.0014	SWM P1

USER:nafiseh.motevalli:24RX16.0014_Peel-CawthraRd-EA\5.9 Drawing\59civil\Drainage\layouts\Prop-Drainage-Sheet 1(SWM P1).dgn
2019-10-08 5:07:16 PM

DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- SIDEWALK
- BIKE LANE
- MUP
- CATCHMENT ID / CATCHMENT AREA (e.g. C1, 0.71ha)
- MAJOR FLOW
- Ex. STM
- Ex. CB
- Ex. MH
- REPLACED STM PIPE
- UPSIZED STM PIPE
- RELOCATED CB
- RELOCATED DCB
- REPLACED FRAME & GRATE
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North Arrow

Detail Symbol: DETAIL NUMBER / LOCATION OR DETAIL SHEET

Project Manager	Architect/Engineer
Project Leader	Drawn: N. M
Date: 2019/10/07	Checked

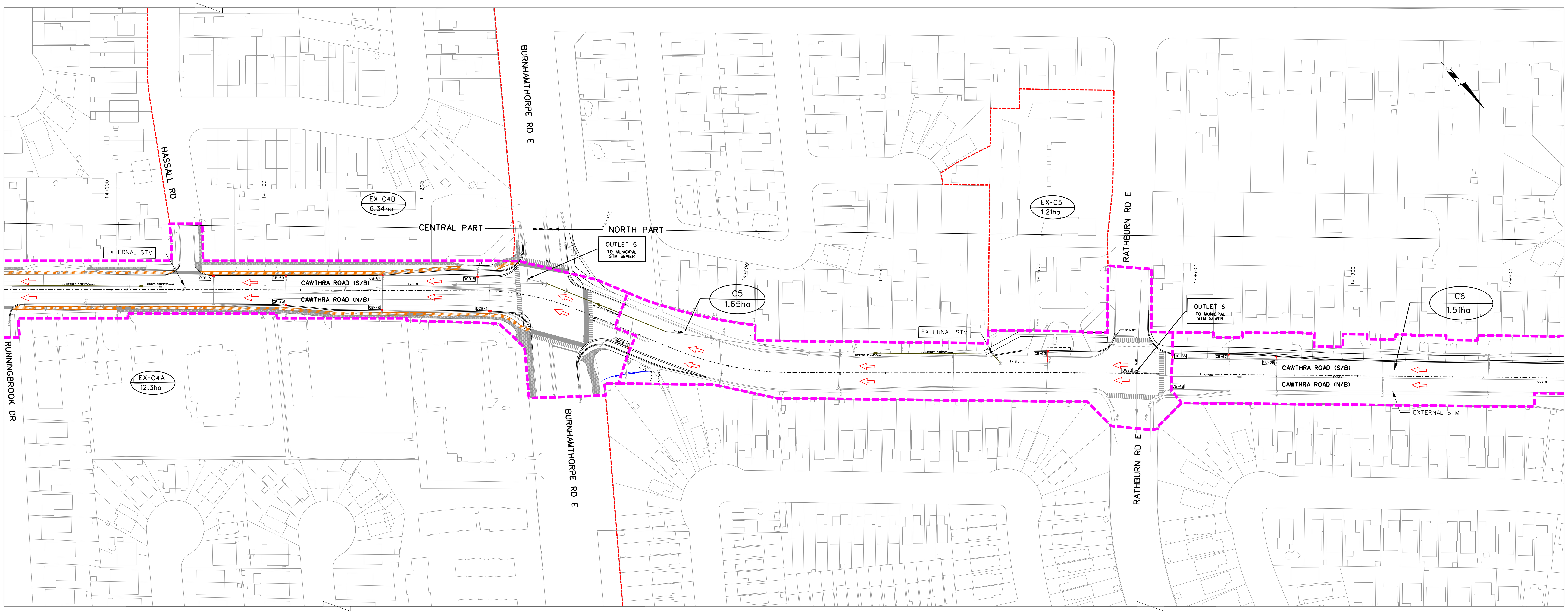
Client: REGION OF PEEL

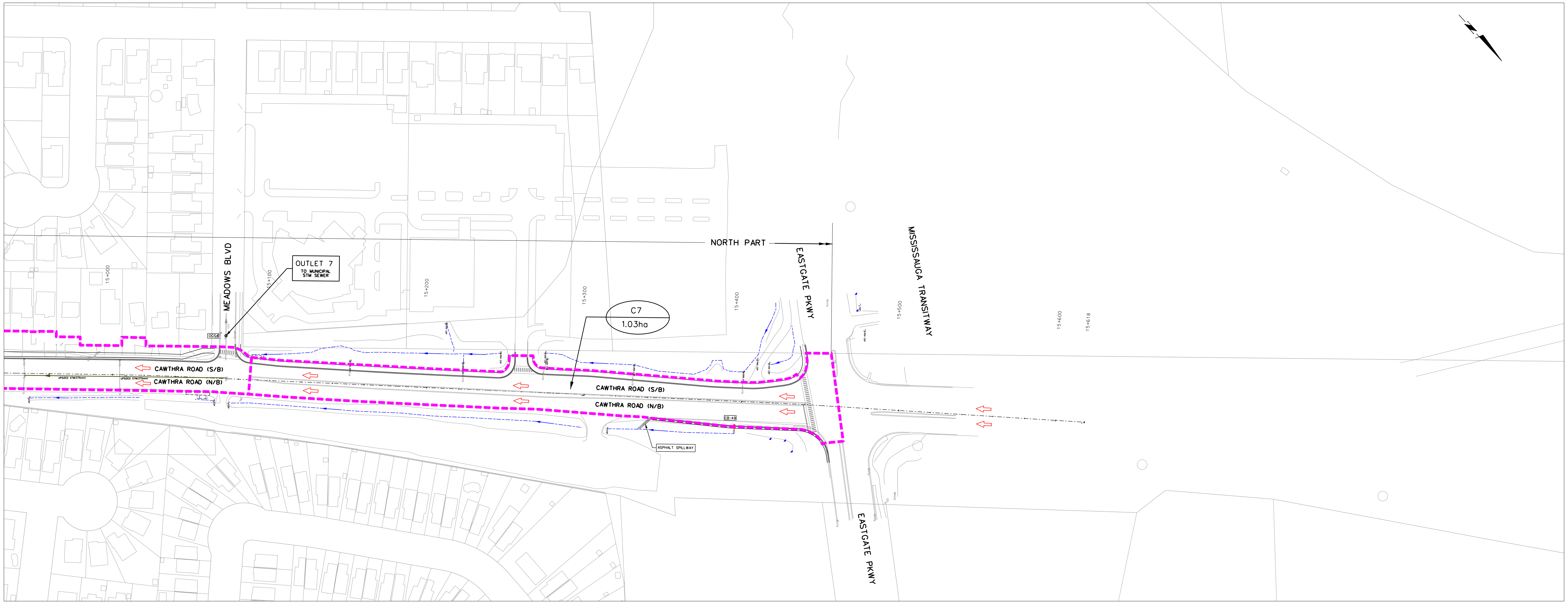
Project: CAWTHRA ROAD EXPANSION EA

Drawing Title: PROPOSED CONDITION DRAINAGE PLAN

Check Scale (may be photo-reduced): 0 1 inch / 0 10mm

Project No.	Drawing No.
24rx16.0014	SWM P2





DATE (mmm dd yyyy)	ISSUED FOR	REV

LEGEND

- INTERNAL CATCHMENT BOUNDARY
- EXTERNAL CATCHMENT BOUNDARY
- SIDEWALK
- BIKE LANE
- MUP
- CATCHMENT ID (C1)
- CATCHMENT AREA (0.71ha)
- MAJOR FLOW
- Ex. STM
- Ex. CB
- Ex. MH
- REPLACED STM PIPE
- UPSIZED STM PIPE
- RELOCATED CB
- RELOCATED DCB
- REPLACED FRAME & GRATE
- DITCH

CONSULTANTS

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ibigroup.com

North Arrow

Detail Symbol: DETAIL NUMBER / LOCATION OR DETAIL SHEET

Project Manager | Architect/Engineer

Project Leader | Drawn: N. M

Date: 2019/10/07 | Checked

Client: REGION OF PEEL

Project: CAWTHRA ROAD EXPANSION EA

Drawing Title: PROPOSED CONDITION DRAINAGE PLAN

Check Scale (may be photo-reduced): 0 — 1 inch; 0 — 10mm

Project No.: 24rx16.0014

Drawing No.: SWM P3

2019-12-17 3:52:50 PM USER:nafiseh.motevali U:\24RX16.0014_Peel-CawthraRd-EA\5.9 Drawings\59civil\Drainage\layouts\Prop-Drainage-Sheet3 (SWM P3).dgn

APPENDIX D

PEAK FLOW AND STORAGE CALCULATIONS

Calculations for storage for the 2 year storm

Location: Outfall 1

Rainfall data

Post-development
2 year storm

A=	1070	
T=	15.35	minutes
B=	7.85	
C=	0.8759	
i2 =	68.13	mm/hr
Area =	1.0200	ha
R.C=	0.86	
Q2 =	0.1651	

Pre-development
2 year storm

Area =	1.0200	ha		
A=	1070			
T=	15.35	minutes		
B=	7.85			
C=	0.8759			
i2 =	68.13	mm/hr	R.C=	0.86
Q2 =	0.165112	m^3/s		

Calculations for storage for the 2 year storm

Location: Outfall 2

Rainfall data

Post-development
2 year storm

A=	1070	
T=	13.52	minutes
B=	7.85	
C=	0.8759	
i2 =	73.23	mm/hr
Area =	2.1400	ha
R.C=	0.84	
Q2 =	0.3640	

Pre-development
2 year storm

Area =	2.1400	ha		
A=	1070			
T=	13.52	minutes		
B=	7.85			
C=	0.8759			
i2 =	73.23	mm/hr	R.C=	0.78
Q2 =	0.340200177	m^3/s		

Calculations for storage for the 2 year storm

Location: Outfall 3

Rainfall data

Post-development
2 year storm

A=	1070	
T=	115.33	minutes
B=	7.85	
C=	0.8759	
i2 =	15.79	mm/hr
Area =	11.1000	ha
R.C=	0.81	
Q2 =	0.3933	

Pre-development
2 year storm

Area =	11.1000	ha		
A=	1070			
T=	115.33	minutes		
B=	7.85			
C=	0.8759			
i2 =	15.79	mm/hr	R.C=	0.80
Q2 =	0.38961158	m^3/s		

Calculations for storage for the 2 year storm

Location: Outfall 4

Rainfall data

Post-development			**Pre-development**				
2 year storm			**2 year storm**				
A=	1070		Area =	2.9600	ha		
T=	41.56	minutes	A=	1070			
B=	7.85		T=	41.56	minutes		
C=	0.8759		B=	7.85			
i2 =	35.14	mm/hr	C=	0.8759			
Area =	2.9600	ha	i2 =	35.14	mm/hr	R.C=	0.77
R.C=	0.81		Q2 =	0.22247461	m^3/s		
Q2 =	0.2334						

Calculations for storage for the 2 year storm

Location: Outfall 5

Rainfall data

Post-development			**Pre-development**				
2 year storm			**2 year storm**				
A=	1070		Area =	1.6500	ha		
T=	20.76	minutes	A=	1070			
B=	7.85		T=	20.76	minutes		
C=	0.8759		B=	7.85			
i2 =	56.70	mm/hr	C=	0.8759			
Area =	1.6500	ha	i2 =	56.70	mm/hr	R.C=	0.75
R.C=	0.75		Q2 =	0.194984	m^3/s		
Q2 =	0.1940						

Calculations for storage for the 2 year storm

Location: Outfall 6

Rainfall data

Post-development			**Pre-development**				
2 year storm			**2 year storm**				
A=	1070		Area =	1.5200	ha		
T=	26.18	minutes	A=	1070			
B=	7.85		T=	26.18	minutes		
C=	0.8759		B=	7.85			
i2 =	48.70	mm/hr	C=	0.8759			
Area =	1.5200	ha	i2 =	48.70	mm/hr	R.C=	0.74
R.C=	0.74		Q2 =	0.1523251	m^3/s		
Q2 =	0.1517						

Calculations for storage for the 2 year storm

Location: Outfall 7

Rainfall data

Post-development
2 year storm

A=	1070	
T=	21.16	minutes
B=	7.85	
C=	0.8759	
i2 =	56.02	mm/hr
Area =	1.0300	ha
R.C=	0.90	
Q2 =	0.1442	

Pre-development
2 year storm

Area =	1.0300	ha		
A=	1070			
T=	21.16	minutes		
B=	7.85			
C=	0.8759			
i2 =	56.02	mm/hr	R.C=	0.90
Q2 =	0.144249	m^3/s		

Calculations for storage for the 5 year storm

Location: Outfall 1

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	1.0200	ha		
T=	15.35	minutes	A=	1593			
B=	11		T=	15.35	minutes		
C=	0.8789		B=	11			
i5 =	89.84	mm/hr	C=	0.8789			
Area =	1.0200	ha	i5 =	89.84	mm/hr	R.C=	0.86
R.C=	0.86		Q5 =	0.21773227	m^3/s		
Q5 =	0.2177						

Calculations for storage for the 5 year storm

Location: Outfall 2

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	2.1400	ha		
T=	13.52	minutes	A=	1593			
B=	11		T=	13.52	minutes		
C=	0.8789		B=	11			
i5 =	95.72	mm/hr	C=	0.8789			
Area =	2.1400	ha	i5 =	95.72	mm/hr	R.C=	0.78
R.C=	0.84		Q5 =	0.4447182	m^3/s		
Q5 =	0.4758						

Calculations for storage for the 5 year storm

Location: Outfall 3

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	11.1000	ha		
T=	115.33	minutes	A=	1593			
B=	11		T=	115.33	minutes		
C=	0.8789		B=	11			
i5 =	22.66	mm/hr	C=	0.8789			
Area =	11.1000	ha	i5 =	22.66	mm/hr	R.C=	0.80
R.C=	0.81		Q5 =	0.5591831	m^3/s		
Q5 =	0.5645						

Calculations for storage for the 5 year storm

Location: Outfall 4

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	2.9600	ha		
T=	41.56	minutes	A=	1593			
B=	11		T=	41.56	minutes		
C=	0.8789		B=	11			
i5 =	48.97	mm/hr	C=	0.8789			
Area =	2.9600	ha	i5 =	48.97	mm/hr	R.C=	0.77
R.C=	0.81		Q5 =	0.31005536	m^3/s		
Q5 =	0.3253						

Calculations for storage for the 5 year storm

Location: Outfall 5

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	1.6500	ha		
T=	20.76	minutes	A=	1593			
B=	11		T=	20.76	minutes		
C=	0.8789		B=	11			
i5 =	76.24	mm/hr	C=	0.8789			
Area =	1.6500	ha	i5 =	76.24	mm/hr	R.C=	0.75
R.C=	0.75		Q5 =	0.262177	m^3/s		
Q5 =	0.2608						

Calculations for storage for the 5 year storm

Location: Outfall 6

Rainfall data

Post-development 5 year storm			**Pre-development 5 year storm**				
A=	1593		Area =	1.5200	ha		
T=	26.18	minutes	A=	1593			
B=	11		T=	26.18	minutes		
C=	0.8789		B=	11			
i5 =	66.38	mm/hr	C=	0.8789			
Area =	1.5200	ha	i5 =	66.38	mm/hr	R.C=	0.74
R.C=	0.74		Q5 =	0.207597	m^3/s		
Q5 =	0.2067						

Calculations for storage for the 5 year storm

Location: Outfall 7

Rainfall data

Post-development
5 year storm

A=	1593	
T=	21.16	minutes
B=	11	
C=	0.8789	
i5 =	75.41	mm/hr
Area =	1.0300	ha
R.C=	0.90	
Q5 =	0.1942	

Pre-development
5 year storm

Area =	1.0300	ha		
A=	1593			
T=	21.16	minutes		
B=	11			
C=	0.8789			
i5 =	75.41	mm/hr	R.C=	0.90
Q5 =	0.194183	m^3/s		

Calculations for storage for the 10 year storm

Location: Outfall 1

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	1.0200	ha		
T=	15.35	minutes	A=	2221			
B=	12		T=	15.35	minutes		
C=	0.908		B=	12			
i10 =	110.09	mm/hr	C=	0.908			
Area =	1.0200	ha	i10 =	110.09	mm/hr	R.C=	0.86
R.C=	0.86		Q10 =	0.26682257	m^3/s		
Q10 =	0.2668						

Calculations for storage for the 10 year storm

Location: Outfall 2

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	2.1400	ha		
T=	13.52	minutes	A=	2221			
B=	12		T=	13.52	minutes		
C=	0.908		B=	12			
i10 =	117.26	mm/hr	C=	0.908			
Area =	2.1400	ha	i10 =	117.26	mm/hr	R.C=	0.78
R.C=	0.84		Q10 =	0.5447775	m^3/s		
Q10 =	0.5829						

Calculations for storage for the 10 year storm

Location: Outfall 3

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	11.1000	ha		
T=	115.33	minutes	A=	2221			
B=	12		T=	115.33	minutes		
C=	0.908		B=	12			
i10 =	27.24	mm/hr	C=	0.908			
Area =	11.1000	ha	i10 =	27.24	mm/hr	R.C=	0.80
R.C=	0.81		Q10 =	0.6723938	m^3/s		
Q10 =	0.6788						

Calculations for storage for the 10 year storm

Location: Outfall 4

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	2.9600	ha		
T=	41.56	minutes	A=	2221			
B=	12		T=	41.56	minutes		
C=	0.908		B=	12			
i10 =	59.81	mm/hr	C=	0.908			
Area =	2.9600	ha	i10 =	59.81	mm/hr	R.C=	0.77
R.C=	0.81		Q10 =	0.3786772	m^3/s		
Q10 =	0.3973						

Calculations for storage for the 10 year storm

Location: Outfall 5

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	1.6500	ha		
T=	20.76	minutes	A=	2221			
B=	12		T=	20.76	minutes		
C=	0.908		B=	12			
i10 =	93.45	mm/hr	C=	0.908			
Area =	1.6500	ha	i10 =	93.45	mm/hr	R.C=	0.75
R.C=	0.75		Q10 =	0.32136	m^3/s		
Q10 =	0.3197						

Calculations for storage for the 10 year storm

Location: Outfall 6

Rainfall data

Post-development 10 year storm			**Pre-development 10 year storm**				
A=	2221		Area =	1.5200	ha		
T=	26.18	minutes	A=	2221			
B=	12		T=	26.18	minutes		
C=	0.908		B=	12			
i10 =	81.32	mm/hr	C=	0.908			
Area =	1.5200	ha	i10 =	81.32	mm/hr	R.C=	0.74
R.C=	0.74		Q10 =	0.254326	m^3/s		
Q10 =	0.2532						

Calculations for storage for the 10 year storm

Location: Outfall 7

Rainfall data

Post-development
10 year storm

A=	2221	
T=	21.16	minutes
B=	12	
C=	0.908	
i10 =	92.43	mm/hr
Area =	1.0300	ha
R.C=	0.90	
Q10 =	0.2380	

Pre-development
10 year storm

Area =	1.0300	ha		
A=	2221			
T=	21.16	minutes		
B=	12			
C=	0.908			
i10 =	92.43	mm/hr	R.C=	0.90
Q10 =	0.238016	m^3/s		

Calculations for storage for the 25 year storm

Location: Outfall 1

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	1.0200	ha		
T=	15.35	minutes	A=	3158			
B=	15		T=	15.35	minutes		
C=	0.9335		B=	15			
i25 =	130.55	mm/hr	C=	0.9335			
Area =	1.0200	ha	i25 =	130.55	mm/hr	R.C=	0.86
R.C=	0.86		Q25 =	0.348051	m^3/s		
Q25 =	0.3481						

Calculations for storage for the 25 year storm

Location: Outfall 2

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	2.1400	ha		
T=	13.52	minutes	A=	3158			
B=	15		T=	13.52	minutes		
C=	0.9335		B=	15			
i25 =	138.38	mm/hr	C=	0.9335			
Area =	2.1400	ha	i25 =	138.38	mm/hr	R.C=	0.78
R.C=	0.84		Q25 =	0.707191	m^3/s		
Q25 =	0.7567						

Calculations for storage for the 25 year storm

Location: Outfall 3

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	11.1000	ha		
T=	115.33	minutes	A=	3158			
B=	15		T=	115.33	minutes		
C=	0.9335		B=	15			
i25 =	33.50	mm/hr	C=	0.9335			
Area =	11.1000	ha	i25 =	33.50	mm/hr	R.C=	0.80
R.C=	0.81		Q25 =	0.909417	m^3/s		
Q25 =	0.9181						

Calculations for storage for the 25 year storm

Location: Outfall 4

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	2.9600	ha		
T=	41.56	minutes	A=	3158			
B=	15		T=	41.56	minutes		
C=	0.9335		B=	15			
i25 =	73.03	mm/hr	C=	0.9335			
Area =	2.9600	ha	i25 =	73.03	mm/hr	R.C=	0.77
R.C=	0.81		Q25 =	0.5085626	m^3/s		
Q25 =	0.5335						

Calculations for storage for the 25 year storm

Location: Outfall 5

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	1.6500	ha		
T=	20.76	minutes	A=	3158			
B=	15		T=	20.76	minutes		
C=	0.9335		B=	15			
i25 =	112.02	mm/hr	C=	0.9335			
Area =	1.6500	ha	i25 =	112.02	mm/hr	R.C=	0.75
R.C=	0.75		Q25 =	0.4237333	m^3/s		
Q25 =	0.4215						

Calculations for storage for the 25 year storm

Location: Outfall 6

Rainfall data

Post-development 25 year storm			**Pre-development 25 year storm**				
A=	3158		Area =	1.5200	ha		
T=	26.18	minutes	A=	3158			
B=	15		T=	26.18	minutes		
C=	0.9335		B=	15			
i25 =	98.19	mm/hr	C=	0.9335			
Area =	1.5200	ha	i25 =	98.19	mm/hr	R.C=	0.74
R.C=	0.74		Q25 =	0.3377904	m^3/s		
Q25 =	0.3363						

Calculations for storage for the 25 year storm

Location: Outfall 7

Rainfall data

Post-development
25 year storm

A=	3158	
T=	21.16	minutes
B=	15	
C=	0.9335	
i25 =	110.87	mm/hr
Area =	1.0300	ha
R.C=	0.90	
Q25 =	0.3140	

Pre-development
25 year storm

Area =	1.0300	ha		
A=	3158			
T=	21.16	minutes		
B=	15			
C=	0.9335			
i25 =	110.87	mm/hr	R.C=	0.90
Q25 =	0.3140317	m^3/s		

Calculations for storage for the 50 year storm

Location: Outfall 1

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	1.0200	ha		
T=	15.35	minutes	A=	3886			
B=	16		T=	15.35	minutes		
C=	0.9495		B=	16			
i50 =	147.50	mm/hr	C=	0.9495			
Area =	1.0200	ha	i50 =	147.50	mm/hr	R.C=	0.86
R.C=	0.86		Q50 =	0.428983	m^3/s		
Q50 =	0.4290						

Calculations for storage for the 50 year storm

Location: Outfall 2

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	2.1400	ha		
T=	13.52	minutes	A=	3886			
B=	16		T=	13.52	minutes		
C=	0.9495		B=	16			
i50 =	156.20	mm/hr	C=	0.9495			
Area =	2.1400	ha	i50 =	156.20	mm/hr	R.C=	0.78
R.C=	0.84		Q50 =	0.870806	m^3/s		
Q50 =	0.9317						

Calculations for storage for the 50 year storm

Location: Outfall 3

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	11.1000	ha		
T=	115.33	minutes	A=	3886			
B=	16		T=	115.33	minutes		
C=	0.9495		B=	16			
i50 =	37.85	mm/hr	C=	0.9495			
Area =	11.1000	ha	i50 =	37.85	mm/hr	R.C=	0.80
R.C=	0.81		Q50 =	1.1211137	m^3/s		
Q50 =	1.1318						

Calculations for storage for the 50 year storm

Location: Outfall 4

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	2.9600	ha		
T=	41.56	minutes	A=	3886			
B=	16		T=	41.56	minutes		
C=	0.9495		B=	16			
i50 =	82.85	mm/hr	C=	0.9495			
Area =	2.9600	ha	i50 =	82.85	mm/hr	R.C=	0.77
R.C=	0.81		Q50 =	0.629443	m^3/s		
Q50 =	0.6603						

Calculations for storage for the 50 year storm

Location: Outfall 5

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	1.6500	ha		
T=	20.76	minutes	A=	3886			
B=	16		T=	20.76	minutes		
C=	0.9495		B=	16			
i50 =	126.81	mm/hr	C=	0.9495			
Area =	1.6500	ha	i50 =	126.81	mm/hr	R.C=	0.75
R.C=	0.75		Q50 =	0.5232927	m^3/s		
Q50 =	0.5205						

Calculations for storage for the 50 year storm

Location: Outfall 6

Rainfall data

Post-development 50 year storm			**Pre-development 50 year storm**				
A=	3886		Area =	1.5200	ha		
T=	26.18	minutes	A=	3886			
B=	16		T=	26.18	minutes		
C=	0.9495		B=	16			
i50 =	111.28	mm/hr	C=	0.9495			
Area =	1.5200	ha	i50 =	111.28	mm/hr	R.C=	0.74
R.C=	0.74		Q50 =	0.4176359	m^3/s		
Q50 =	0.4158						

Calculations for storage for the 50 year storm

Location: Outfall 7

Rainfall data

Post-development
50 year storm

A=	3886	
T=	21.16	minutes
B=	16	
C=	0.9495	
i50 =	125.52	mm/hr
Area =	1.0300	ha
R.C=	0.90	
Q50 =	0.3879	

Pre-development
50 year storm

Area =	1.0300	ha		
A=	3886			
T=	21.16	minutes		
B=	16			
C=	0.9495			
i50 =	125.52	mm/hr	R.C=	0.90
Q50 =	0.3878574	m^3/s		

PEAK FLOW AND STORAGE CALCULATIONS (100-YEAR)

Calculations for storage for the 100 year storm

Location: Outfall 1

Rainfall data

Post-development 100 year storm			**Pre-development 100 year storm**				
A=	4688		Area =	1.0200	ha		
T=	15.35	minutes	A=	4688			
B=	17		T=	15.35	minutes		
C=	0.9624		B=	17			
i100 =	165.14	mm/hr	C=	0.9624			
Area =	1.0200	ha	i100 =	165.14	mm/hr	R.C=	0.86
R.C=	0.86		Q100 =	0.500298	m^3/s		
Q100 =	0.5003						

$Q_{allow\ storm\ runoff}$ = 0.5003 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
15.35	165.15	0.5003	0.5003	460.80	460.77	0.00
16.35	160.38	0.5003	0.4859	476.65	490.79	-14.14
Storage required to control 100 year post to 100 year pre-development (m^3) =						**0.00**

Calculations for storage for the 100 year storm

Location: Outfall 2

Rainfall data

Post-development 100 year storm			**Pre-development 100 year storm**				
A=	4688		Area =	2.1400	ha		
T=	13.52	minutes	A=	4688			
B=	17		T=	13.52	minutes		
C=	0.9624		B=	17			
i100 =	174.69	mm/hr	C=	0.9624			
Area =	2.1400	ha	i100 =	174.69	mm/hr	R.C=	0.78
R.C=	0.84		Q100 =	1.014485	m^3/s		
Q100 =	1.0855						

$Q_{allow\ storm\ runoff}$ = 1.0145 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
13.52	174.67	1.0145	1.0853	880.42	822.95	57.47
14.52	169.34	1.0145	1.0522	916.65	883.82	32.83
15.52	164.32	1.0145	1.0210	950.77	944.69	6.08
Storage required to control 100 year post to 100 year pre-development (m^3) =						**57.47**

Calculations for storage for the 100 year storm

Location: Outfall 3

Rainfall data

Post-development
100 year storm

A=	4688	
T=	115.33	minutes
B=	17	
C=	0.9624	
i100 =	42.57	mm/hr
Area =	11.1000	ha
R.C=	0.81	
Q100 =	1.3258	

Pre-development
100 year storm

Area =	11.1000	ha		
A=	4688			
T=	115.33	minutes		
B=	17			
C=	0.9624			
i100 =	42.57	mm/hr	R.C=	0.80
Q100 =	1.3133057	m^3/s		

$Q_{allow\ storm\ runoff}$ = 1.3133 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
115.33	42.57	1.3133	1.3258	9174.30	9087.81	86.49
116.33	42.26	1.3133	1.3162	9187.04	9166.61	20.43
Storage required to control 100 year post to 100 year pre-development (m^3) =						**86.49**

Calculations for storage for the 100 year storm

Location: Outfall 4

Rainfall data

Post-development
100 year storm

A=	4688	
T=	41.56	minutes
B=	17	
C=	0.9624	
i100 =	93.30	mm/hr
Area =	2.9600	ha
R.C=	0.81	
Q100 =	0.7746	

Pre-development
100 year storm

Area =	2.9600	ha		
A=	4688			
T=	41.56	minutes		
B=	17			
C=	0.9624			
i100 =	93.30	mm/hr	R.C=	0.77
Q100 =	0.7383552	m^3/s		

$Q_{allow\ storm\ runoff}$ = 0.7384 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
41.56	93.29	0.7384	0.7745	1931.36	1841.16	90.19
42.56	91.78	0.7384	0.7620	1945.86	1885.46	60.39
Storage required to control 100 year post to 100 year pre-development (m^3) =						**90.19**

Calculations for storage for the 100 year storm

Location: Outfall 5

Rainfall data

Post-development 100 year storm			**Pre-development 100 year storm**				
A=	4688		Area =	1.6500	ha		
T=	20.76	minutes	A=	4688			
B=	17		T=	20.76	minutes		
C=	0.9624		B=	17			
i100 =	142.30	mm/hr	C=	0.9624			
Area =	1.6500	ha	i100 =	142.30	mm/hr	R.C=	0.75
R.C=	0.75		Q100 =	0.6117	m^3/s		
Q100 =	0.6117						

$Q_{allow\ storm\ runoff}$ = 0.6117 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
20.76	142.32	0.6117	0.6085	758.01	758.01	0.00
21.76	138.78	0.6117	0.5934	774.78	798.64	-23.85
Storage required to control 100 year post to 100 year pre-development (m^3) =						**0.00**

Calculations for storage for the 100 year storm

Location: Outfall 6

Rainfall data

Post-development 100 year storm			**Pre-development 100 year storm**				
A=	4688		Area =	1.5200	ha		
T=	26.18	minutes	A=	4688			
B=	17		T=	26.18	minutes		
C=	0.9624		B=	17			
i100 =	125.07	mm/hr	C=	0.9624			
Area =	1.5200	ha	i100 =	125.07	mm/hr	R.C=	0.74
R.C=	0.74		Q100 =	0.4868	m^3/s		
Q100 =	0.4868						

$Q_{allow\ storm\ runoff}$ = 0.4868 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
26.18	125.08	0.4868	0.4869	764.76	767.76	0.00
27.18	122.36	0.4868	0.4763	776.67	793.87	-17.20
Storage required to control 100 year post to 100 year pre-development (m^3) =						**-0.00**

Calculations for storage for the 100 year storm

Location: Outfall 7

Rainfall data

Post-development 100 year storm			**Pre-development 100 year storm**				
A=	4688		Area =	1.0300	ha		
T=	21.16	minutes	A=	4688			
B=	17		T=	21.16	minutes		
C=	0.9624		B=	17			
i100 =	140.88	mm/hr	C=	0.9624			
Area =	1.0300	ha	i100 =	140.88	mm/hr	R.C=	0.90
R.C=	0.90		Q100 =	0.4535	m^3/s		
Q100 =	0.4535						

$Q_{allow\ storm\ runoff}$ = 0.4535 m^3/s

Time (min)	Intensity (mm/hr)	Total Release (m^3/s)	Peak Flow (m^3/s)	Inflow Volume (m^3)	Outflow Volume (m^3)	Storage (m^3)
21.16	140.88	0.4535	0.4535	575.71	575.76	0.00
22.16	137.42	0.4535	0.4423	588.09	602.97	-14.88
Storage required to control 100 year post to 100 year pre-development (m^3) =						**0.00**

APPENDIX E

STORM SEWER DESIGN SHEETS

STORM SEWER DESIGN SHEETS

EXISTING CONDITION WITH REGION OF PEEL IDF CURVE

STORM SEWER DESIGN SHEET — IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel

Inlet time 10 min

A=	1010	1450
B=	4.6	5
C=	0.780	0.780
124.77 = I =	124.77	176.31

Location			Subareas			Compoiste	Total	Design Flow					Sewer Characteristics								Sewer Verification
Catchment	From MH	To MH	for C= 0.900 (ha)	0.50 (ha)	0.20	C	Area (ha)	Indiv. AC (ha)	Acc AC (ha)	Time of Conc. (min)	Rain fall I (mm/h)	Peak flow q (L/s)	Length (m)	Pipe Dia (mm)	Pipe Type	n	Slope %	Cap full Q (L/s)	Vel. V (m/s)	Travel Time (min)	q/Q
Cawthra	MH8265114451	MH8264714474	0.249		0.013	0.865	0.262	0.227	0.227	10.00	124.77	78.5	46.3	200	CP	0.013	3.510	61.4	1.96	0.39	1.28
Cawthra	MH8264714474	MH8264714473	0.114		0.036	0.733	0.150	0.110	0.336	10.39	122.21	114.2	10.8	300	CP	0.013	1.299	110.2	1.56	0.12	1.04
Cawthra	MH8264714473	MH8264114502	0.047		0.016	0.719	0.063	0.046	0.382	10.51	121.48	128.8	49.6	375	CP	0.013	3.584	331.9	3.01	0.28	0.39
Cawthra	MH8264114502	MH8264114504	0.057		0.005	0.847	0.061	0.052	0.434	10.79	119.78	144.3	6.7	375	CP	0.013	7.764	488.5	4.42	0.03	0.30
Cawthra	MH8264114504	MH8264114504A	0.091		0.002	0.883	0.093	0.082	0.516	10.81	119.63	171.5	19.7	375	CP	0.013	2.000	248.0	2.25	0.15	0.69
Cawthra	MH8264114504A	MH8264114504B	0.078		0.000	0.900	0.078	0.070	0.586	10.96	118.75	193.4	45.7	450	CP	0.013	1.500	349.2	2.20	0.35	0.55
Cawthra	MH8264114504B	MH8264114504C	0.149		0.000	0.900	0.149	0.134	0.720	11.30	116.72	233.6	54.0	450	CP	0.013	1.500	349.2	2.20	0.41	0.67
Cawthra	MH8264114504C	MH8262914567	0.161		0.000	0.900	0.161	0.145	0.865	11.71	114.43	275.1	27.3	450	CP	0.013	2.000	403.2	2.54	0.18	0.68
		Outlet 1	0.785		0.072		1.017						260.1								
Cawthra	MH2690513991	MH2686714032	0.146		0.049	0.723	0.195	0.141	0.141	10.00	124.77	48.9	54.7	375	CP	0.013	0.980	173.6	1.57	0.58	0.28
Cawthra	MH2686714032	MH2685214020	0.075		0.027	0.712	0.102	0.073	0.214	10.58	121.04	71.9	24.0	375	CP	0.013	0.283	93.3	0.84	0.47	0.77
Cawthra	MH2685214020	MH2682514051	0.084		0.018	0.776	0.102	0.079	0.293	11.05	118.17	96.2	41.6	375	CP	0.013	0.200	78.4	0.71	0.98	1.23
Cawthra	MH2682514051	MH2679614089	0.125		0.031	0.760	0.156	0.119	0.412	12.03	112.72	129.0	47.9	450	CP	0.013	0.908	271.7	1.71	0.47	0.47
Cawthra	MH2679614089	MH2679614089A	0.529		2.381	0.327	2.911	0.953	1.365	12.50	110.31	418.2	25.1	450	CP	0.013	1.430	340.9	2.14	0.20	1.23
Cawthra	MH2679614089A	MH2679614089B	0.146		0.056	0.707	0.202	0.143	1.508	12.69	109.34	457.9	48.2	600	CP	0.013	1.200	672.6	2.38	0.34	0.68
													241.5								
	Ext.Area	2.74																			
Cawthra	Low Area	MH2679614089B	0.249		0.029	0.826	0.278	0.230	0.230	10.00	124.77	79.7									
Cawthra	MH2662714356	MH2665814319	0.149		0.000	0.900	0.149	0.135	0.135	10.00	124.77	46.6	48.7	200	CP	0.013	1.774	43.7	1.39	0.58	1.07
Cawthra	MH2665814319	MH2665814319A	0.169		0.021	0.822	0.191	0.157	0.291	10.58	121.02	97.9	26.2	300	CP	0.013	3.552	182.2	2.58	0.17	0.54
Cawthra	MH2665814319A	MH2666614287	0.058		0.025	0.691	0.082	0.057	0.348	10.75	119.97	116.0	13.6	300	CP	0.013	3.552	182.2	2.58	0.09	0.64
Cawthra	MH2666614287	MH2668114261	0.012		0.005	0.704	0.017	0.012	0.360	10.84	119.44	119.5	17.4	300	CP	0.013	4.214	198.5	2.81	0.10	0.60
Cawthra	MH2668114261	MH2668914246	0.093		0.013	0.812	0.106	0.086	0.446	10.94	118.82	147.3	16.6	375	CP	0.013	5.143	397.6	3.60	0.08	0.37
Cawthra	MH2668914246	MH2672114191	0.061		0.284	0.324	0.345	0.112	0.558	11.02	118.37	183.5	64.2	375	CP	0.013	1.783	234.1	2.12	0.50	0.78
Cawthra	MH2672114191	MH2674214162	0.206		0.044	0.776	0.250	0.194	0.752	11.53	115.47	241.3	35.9	450	CP	0.013	0.580	217.1	1.37	0.44	1.11
Cawthra	MH2674214162	MH2679614089B	0.100		0.022	0.774	0.122	0.094	0.847	11.96	113.08	265.9	22.5	450	CP	0.013	0.580	217.1	1.37	0.27	1.22
			2.203		3.007								245.1								
	Ext.Area***	0.27																			
Cawthra	MH2679614089B	**Outlet 2**	2.203		3.007	0.496	5.210	2.584	2.584	10.00	124.77	895.6	26.0	750	CP	0.013					
Cawthra	MH2847512300	MH2843212346	0.249		0.042	0.800	0.291	0.232	0.232	10.00	124.77	80.5	63.3	300	CP	0.013	0.671	79.2	1.12	0.94	1.02
Cawthra	MH2843212346	MH2838912393	0.074		0.030	0.698	0.104	0.072	0.305	10.94	118.84	100.6	63.8	375	CP	0.013	0.642	140.5	1.27	0.84	0.72

STORM SEWER DESIGN SHEET — IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel

Inlet time 10 min

A=	1010	1450
B=	4.6	5
C=	0.780	0.780
124.77 = I =	124.77	176.31

Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To	for C=			C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2838912393	MH2834712438	0.084		0.027	0.727	0.111	0.081	0.385	11.78	114.08	122.1	61.5	450	CP	0.013	0.614	223.5	1.41	0.73	0.55
Cawthra	MH2834712438	MH2830512484	0.085		0.024	0.743	0.109	0.081	0.467	12.51	110.26	143.0	62.1	450	CP	0.013	0.577	216.5	1.36	0.76	0.66
Cawthra	MH2830512484	MH2823812553	0.077		0.025	0.729	0.102	0.074	0.541	13.27	106.59	160.1	95.9	525	CP	0.013	0.986	427.1	1.97	0.81	0.37
Cawthra	MH2823812553	MH2816712630	0.179		0.186	0.544	0.364	0.198	0.739	14.08	102.97	211.4	105.2	525	CP	0.013	1.338	497.5	2.30	0.76	0.42
Cawthra	MH2816712630	MH2813712663	0.088		0.029	0.726	0.117	0.085	0.824	14.84	99.80	228.4	44.7	525	CP	0.013	1.814	579.3	2.68	0.28	0.39
Cawthra	MH2813712663	MH2810212703	0.371		0.491	0.502	0.862	0.432	1.256	15.12	98.70	344.5	53.1	525	CP	0.013	1.343	498.5	2.30	0.38	0.69
Cawthra	MH2810212703	MH2805612752	0.550		0.660	0.518	1.211	0.627	1.884	15.50	97.23	508.8	67.2	600	CP	0.013	1.722	805.8	2.85	0.39	0.63
Cawthra	MH2805612752	MH2801212797	0.284		0.303	0.538	0.587	0.316	2.200	15.90	95.77	585.2	62.8	600	CP	0.013	1.700	800.6	2.83	0.37	0.73
Cawthra	MH2801212797	MH2797712831	0.231		0.229	0.552	0.460	0.253	2.453	16.27	94.44	643.6	49.0	600	CP	0.013	3.820	1200.1	4.24	0.19	0.54
Cawthra	MH2797712831	MH2796212833	0.075		0.018	0.763	0.094	0.072	2.525	16.46	93.77	657.6	14.6	600	CP	0.013	5.764	1474.1	5.21	0.05	0.45
			2.346		2.064								743.2								
	Ext.Area	0.27																			
	Ext.Area	0.79																			
	Ext.Area	1.05																			
	Ext.Area	0.46																			
	Ext.Area	0.34																			
Cawthra	MH2874111995	MH2870712032	0.173		0.054	0.733	0.227	0.166	0.166	10.00	124.77	57.7	50.6	300	CP	0.013	0.814	87.3	1.23	0.68	0.66
Cawthra	MH2870712032	MH2863612108	0.328		0.126	0.705	0.454	0.320	0.487	10.68	120.40	162.8	103.9	375	CP	0.013	0.844	161.1	1.46	1.19	1.01
Cawthra	MH2863612108	MH2857612172	0.173		0.060	0.719	0.233	0.167	0.654	11.87	113.58	206.4	88.1	450	CP	0.013	0.844	261.9	1.65	0.89	0.79
Cawthra	MH2857612172	MH2853412217	0.174		0.037	0.777	0.211	0.164	0.818	12.76	109.00	247.8	61.5	450	CP	0.013	0.740	245.3	1.54	0.66	1.01
Cawthra	MH2853412217	MH2846712290	0.206		0.038	0.792	0.244	0.193	1.011	13.43	105.85	297.4	99.0	450	CP	0.013	0.740	245.3	1.54	1.07	1.21
Cawthra	MH2846712290	MH2840512356	0.322		0.089	0.749	0.411	0.308	1.319	14.50	101.20	370.8	90.9	525	CP	0.013	0.631	341.7	1.58	0.96	1.09
Cawthra	MH2840512356	MH2834612419	0.141		0.047	0.724	0.188	0.136	1.455	15.46	97.40	393.6	85.8	525	CP	0.013	0.580	327.6	1.51	0.95	1.20
Cawthra	MH2834612419	MH2828112490	0.136		0.057	0.694	0.193	0.134	1.589	16.40	93.96	414.7	96.1	525	CP	0.013	0.682	355.1	1.64	0.98	1.17
Cawthra	MH2828112490	MH2826712505	0.040		0.015	0.706	0.056	0.039	1.628	17.38	90.69	410.1	21.1	525	CP	0.013	1.881	589.9	2.73	0.13	0.70
Cawthra	MH2826712505	MH2823612538	0.080		0.013	0.805	0.093	0.075	1.703	17.51	90.28	427.0	45.1	525	CP	0.013	1.283	487.1	2.25	0.33	0.88
Cawthra	MH2823612538	MH2821812557	0.000		0.000	0.000	0.000	0.000	1.703	17.84	89.23	422.0	26.1	600	CP	0.013	1.398	726.1	2.57	0.17	0.58
Cawthra	MH2821812557	MH2815712622	0.224		0.214	0.558	0.437	0.244	1.947	18.01	88.71	479.7	89.3	600	CP	0.013	1.368	718.1	2.54	0.59	0.67
Cawthra	MH2815712622	MH2809112693	0.130		0.077	0.641	0.207	0.133	2.079	18.60	86.95	502.2	96.8	600	CP	0.013	1.064	633.4	2.24	0.72	0.79
Cawthra	MH2809112693	MH2809112693A	0.119		0.043	0.715	0.162	0.116	2.195	19.32	84.90	517.7	88.3	600	CP	0.013	1.641	786.6	2.78	0.53	0.66
Cawthra	MH2809112693A	MH2796612828	0.204		0.082	0.699	0.286	0.200	2.395	19.85	83.47	555.3	93.7	750	CP	0.013	1.641	1426.1	3.23	0.48	0.39
Cawthra	MH2796612828	MH2796212833	0.052		0.026	0.666	0.079	0.052	2.447	20.33	82.20	558.8	7.8	600	CP	0.013	9.593	1901.8	6.73	0.02	0.29
Cawthra	MH2796212833	MH2793812848	2.346		2.064	0.572	4.411	2.525	4.972	20.35	82.15	1134.6	29.2	1050	CP	0.013	5.981	6678.1	7.71	0.06	0.17
Cawthra	MH2793812848	MH2789712876	0.119		0.047	0.700	0.167	0.117	5.089	20.41	81.99	1158.9	48.9	1050	CP	0.013	4.706	5923.6	6.84	0.12	0.20

STORM SEWER DESIGN SHEET — IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel

Inlet time 10 min

A=	1010	1450
B=	4.6	5
C=	0.780	0.780
124.77 = I =	124.77	176.31

Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To	for C=			C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2789712876	MH2786112918	0.298		0.035	0.827	0.333	0.275	5.364	20.53	81.69	1217.1	55.4	1050	CP	0.013	5.729	6536.0	7.55	0.12	0.19
Cawthra	MH2786112918	MH2782912954	0.175		0.000	0.900	0.175	0.158	5.521	20.65	81.38	1248.1	47.9	1050	CP	0.013	5.008	6110.7	7.06	0.11	0.20
Cawthra	MH2782912954	MH2781212976	0.178		0.000	0.900	0.178	0.160	5.682	20.77	81.09	1279.9	27.9	1050	CP	0.013	6.131	6761.4	7.81	0.06	0.19
Cawthra	MH2781212976	MH2779312998	0.052		0.000	0.900	0.052	0.047	5.729	20.83	80.95	1288.1	29.2	1050	CP	0.013	7.501	7479.0	8.64	0.06	0.17
Cawthra	MH2779312998	MH2775313045	0.165		0.000	0.900	0.165	0.149	5.877	20.88	80.81	1319.2	61.3	1050	CP	0.013	1.986	3848.5	4.44	0.23	0.34
Cawthra	MH2775313045	MH2771513090	0.193		0.000	0.900	0.193	0.174	6.051	21.11	80.24	1348.8	59.7	1200	CP	0.013	1.242	4344.9	3.84	0.26	0.31
Cawthra	MH2771513090	MH2764813167	0.601		0.032	0.865	0.632	0.547	6.598	21.37	79.62	1459.3	99.5	1350	CP	0.013	0.995	5324.8	3.72	0.45	0.27
Cawthra	MH2764813167	MH2757513247	0.178		0.000	0.900	0.178	0.160	6.759	21.82	78.57	1475.1	110.8	1350	CP	0.013	0.397	3363.5	2.35	0.79	0.44
Cawthra	MH2757513247	MH2748713342	2.251		2.747	0.515	4.998	2.575	9.334	22.60	76.79	1991.1	129.5	1350	CP	0.013	0.405	3397.9	2.37	0.91	0.59
Cawthra	MH2748713342	MH2740013435	1.319		1.562	0.520	2.882	1.500	10.834	23.51	74.85	2252.5	127.0	1350	CP	0.013	1.007	5356.7	3.74	0.57	0.42
Cawthra	MH2740013435	MH2734513494	1.052		1.318	0.511	2.370	1.210	12.044	24.08	104.94	3511.0	80.8	1350	CP	0.013	0.703	4475.1	3.13	0.43	0.78
Cawthra	MH2734513494	MH2726213583	0.532		0.095	0.794	0.627	0.498	12.542	24.51	72.84	2537.7	121.5	1350	CP	0.013	0.248	2656.1	1.86	1.09	0.96
Cawthra	MH2726213583	MH2719913650	0.219		0.019	0.843	0.238	0.201	12.743	25.60	70.78	2505.3	91.9	1350	CP	0.013	0.182	2275.7	1.59	0.96	1.10
Cawthra	MH2719913650	MH2716513685	0.138		0.026	0.791	0.164	0.129	12.872	26.56	69.07	2469.5	49.5	1350	CP	0.013	0.772	4688.9	3.28	0.25	0.53
Cawthra	MH2716513685	MH2704813814	1.224		0.165	0.817	1.390	1.135	14.007	26.82	68.64	2670.5	173.5	1350	CP	0.013	0.893	5044.3	3.52	0.82	0.53
Cawthra	MH2704813814	Missing MH	0.476		0.126	0.753	0.602	0.453	14.460	27.64	67.27	2702.0	166.0	1350	CP	0.013	0.700	4465.6	3.12	0.89	0.61
Cawthra	Missing MH	**Outlet 3**	183.875		111.03								2653.8								
	Ext.Area	0.35																			
	Ext.Area	0.05																			
	Ext.Area	169.62																			
	Ext.Area	2.14																			
	Ext.Area	2.30																			
	Ext.Area	2.46																			
	Ext.Area	2.13																			
Cawthra	MH2923611465	MH2914911559	1.370		0.598	0.687	1.968	1.352	1.352	10.00	124.77	468.7	127.9	900	CP	0.013	0.339	1054.6	1.66	1.29	0.44
Cawthra	MH2914911559	MH2907911633	0.317		0.061	0.787	0.378	0.298	1.650	11.29	116.82	535.4	102.2	900	CP	0.013	0.309	1006.7	1.58	1.08	0.53
Cawthra	MH2907911633	MH2905511660	2.54		3.804	0.480	6.340	3.043	4.693	12.36	111.00	1447.1	35.8	900	CP	0.013	0.425	1180.3	1.86	0.32	1.23
Cawthra	MH2905511660	MH2899811719	0.298		0.077	0.756	0.375	0.283	4.977	12.68	109.39	1512.2	82.5	900	CP	0.013	0.393	1134.5	1.78	0.77	1.33
Cawthra	MH2899811719	MH2896211760	4.195		6.589	0.472	10.784	5.093	10.070	13.45	105.73	2957.4	54.1	900	CP	0.013	0.296	984.1	1.55	0.58	3.01
Cawthra	MH2896211760	MH2886911860	0.813		0.292	0.715	1.105	0.790	10.860	14.04	103.14	3111.2	137.0	1050	CP	0.013	0.172	1131.1	1.31	1.75	2.75
Cawthra	MH2886911860	MH2877511960	0.463		0.148	0.730	0.612	0.447	11.306	15.79	96.17	3020.5	137.1	1050	CP	0.013	0.167	1116.1	1.29	1.77	2.71
		Outlet 4	9.992		11.569																
0.13	Ext.Area	1.2649																			

STORM SEWER DESIGN SHEET — IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel

Inlet time 10 min

A=	1010	1450
B=	4.6	5
C=	0.780	0.780
124.77 = I =	124.77	176.31

Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To	for C=			C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
	Ext.Area	6.34																			
0.30	Ext.Area	10.981																			
0.49	Ext.Area	0.9722																			
	Ext.Area	1.2																			
Cawthra	MH2948911265	MH2946811287	0.432		0.105	0.764	0.537	0.410	0.410	10.00	124.77	142.1	30.2	525	CP	0.013	0.458	290.9	1.34	0.37	0.49
Cawthra	MH2946811287	MH2946811287A	0.48		0.720	0.480	1.200	0.576	0.986	10.37	122.34	335.1	8.9	525	CP	0.013	0.660	349.4	1.61	0.09	0.96
Cawthra	MH2946811287A	MH2940011351	0.170		0.082	0.672	0.253	0.170	1.156	10.47	121.76	390.9	86.6	525	CP	0.013	0.660	349.4	1.61	0.89	1.12
Cawthra	MH2940011351	MH2940911372	0.195		0.068	0.719	0.263	0.189	1.345	11.36	116.40	434.9	28.2	600	CP	0.013	1.290	697.4	2.47	0.19	0.62
Cawthra	MH2940911372	MH2930811429	0.086		0.027	0.732	0.113	0.083	1.428	11.55	115.33	457.4	92.1	750	CP	0.013	0.789	988.7	2.24	0.69	0.46
Cawthra	MH2930811429	MH2922511472	0.352		0.123	0.719	0.476	0.342	1.770	12.24	111.65	548.8	81.3	750	CP	0.013	0.166	453.6	1.03	1.32	1.21
		Outlet 5	1.716		1.125																
Cawthra	MH2981910930	MH2972911023	0.181		0.026	0.812	0.207	0.168	0.168	10.00	124.77	58.2	128.5	300	CP	0.013	0.404	61.5	0.87	2.46	0.95
Cawthra	MH2972911023	MH2964011116	0.334		0.108	0.728	0.442	0.322	0.490	12.46	110.49	150.3	128.1	525	CP	0.013	0.837	393.4	1.82	1.17	0.38
Cawthra	MH2964011116	MH2954211221	0.622		0.246	0.702	0.868	0.609	1.099	13.64	104.90	320.2	134.9	525	CP	0.013	3.069	753.4	3.48	0.65	0.43
Cawthra	MH2954211221	MH2952711227	0.000		0.000					14.28	102.09	0.0	21.7	600	CP	0.013	3.526	1153.0	4.08	0.09	0.00
		Outlet 6	1.137		0.380	0.725	1.517	1.099													

STORM SEWER DESIGN SHEETS

EXISTING CONDITION WITH CLIMATE CHANGE IDF CURVE 2095

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel-Climate Change 2095

Inlet time 10 min

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas for C=			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To	0.900	0.50	0.20	C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	(ha)	(ha)			(ha)	AC (ha)	AC (ha)	Conc. (min)	I (mm/h)	q (L/s)	(m)	Dia (mm)	Type		%	Q (L/s)	V (m/s)	Time (min)	
Cawthra	MH8265114451	MH8264714474	0.249		0.013	0.865	0.262	0.227	0.227	10.00	150.72	94.9	46.3	200	CP	0.013	3.510	61.4	1.96	0.39	1.54
Cawthra	MH8264714474	MH8264714473	0.114		0.036	0.733	0.150	0.110	0.336	10.39	148.43	138.7	10.8	300	CP	0.013	1.299	110.2	1.56	0.12	1.26
Cawthra	MH8264714473	MH8264114502	0.047		0.016	0.719	0.063	0.046	0.382	10.51	147.77	156.7	49.6	375	CP	0.013	3.584	331.9	3.01	0.28	0.47
Cawthra	MH8264114502	MH8264114504	0.060		0.005	0.850	0.064	0.055	0.436	10.79	146.23	177.3	6.7	375	CP	0.013	7.764	488.5	4.42	0.03	0.36
Cawthra	MH8264114504	MH8264114504A	0.091		0.002	0.883	0.093	0.082	0.519	10.81	146.09	210.5	19.7	375	CP	0.013	2.000	248.0	2.25	0.15	0.85
Cawthra	MH8264114504A	MH8264114504B	0.078		0.000	0.900	0.078	0.070	0.589	10.96	145.29	237.7	45.7	450	CP	0.013	2.000	403.2	2.54	0.30	0.59
Cawthra	MH8264114504B	MH8264114504C	0.149		0.000	0.900	0.149	0.134	0.723	11.26	143.68	288.6	54.0	450	CP	0.013	2.000	403.2	2.54	0.36	0.72
Cawthra	MH8264114504C	MH8262914567	0.161		0.000	0.900	0.161	0.145	0.868	11.61	141.83	342.0	27.3	450	CP	0.013	2.000	403.2	2.54	0.18	0.85
		Outlet 1	0.788		0.072		1.020						260.1								
Cawthra	MH2690513991	MH2686714032	0.146		0.049	0.723	0.195	0.141	0.141	10.00	150.72	59.1	54.7	375	CP	0.013	0.980	173.6	1.57	0.58	0.34
Cawthra	MH2686714032	MH2685214020	0.075		0.027	0.712	0.102	0.073	0.214	10.58	147.38	87.5	24.0	375	CP	0.013	0.283	93.3	0.84	0.47	0.94
Cawthra	MH2685214020	MH2682514051	0.084		0.018	0.776	0.102	0.079	0.293	11.05	144.77	117.9	41.6	375	CP	0.013	0.200	78.4	0.71	0.98	1.50
Cawthra	MH2682514051	MH2679614089	0.125		0.031	0.760	0.156	0.119	0.412	12.03	139.72	159.9	47.9	450	CP	0.013	0.908	271.7	1.71	0.47	0.59
Cawthra	MH2679614089	MH2679614089A	0.529		2.381	0.327	2.911	0.953	1.365	12.50	137.44	521.0	25.1	450	CP	0.013	1.430	340.9	2.14	0.20	1.53
Cawthra	MH2679614089A	MH2679614089B	0.146		0.056	0.707	0.202	0.143	1.508	12.69	136.52	571.7	48.2	600	CP	0.013	1.200	672.6	2.38	0.34	0.85
													241.5								
	C2B-Ext.Area	2.74																			
Cawthra	Low Area	MH2679614089B	0.249		0.029	0.826	0.278	0.230	0.230	10.00	150.72	96.3									
Cawthra	MH2662714356	MH2665814319	0.149		0.000	0.900	0.149	0.135	0.135	10.00	150.72	56.3	48.7	200	CP	0.013	1.774	43.7	1.39	0.58	1.29
Cawthra	MH2665814319	MH2665814319A	0.169		0.021	0.822	0.191	0.157	0.291	10.58	147.36	119.2	26.2	300	CP	0.013	3.552	182.2	2.58	0.17	0.65
Cawthra	MH2665814319A	MH2666614287	0.058		0.025	0.691	0.082	0.057	0.348	10.75	146.41	141.6	13.6	300	CP	0.013	3.552	182.2	2.58	0.09	0.78
Cawthra	MH2666614287	MH2668114261	0.012		0.005	0.704	0.017	0.012	0.360	10.84	145.93	146.0	17.4	300	CP	0.013	4.214	198.5	2.81	0.10	0.74
Cawthra	MH2668114261	MH2668914246	0.093		0.013	0.812	0.106	0.086	0.446	10.94	145.36	180.2	16.6	375	CP	0.013	5.143	397.6	3.60	0.08	0.45
Cawthra	MH2668914246	MH2672114191	0.061		0.284	0.324	0.345	0.112	0.558	11.02	144.94	224.7	64.2	375	CP	0.013	1.783	234.1	2.12	0.50	0.96
Cawthra	MH2672114191	MH2674214162	0.206		0.044	0.776	0.250	0.194	0.752	11.53	142.27	297.3	35.9	450	CP	0.013	0.580	217.1	1.37	0.44	1.37
Cawthra	MH2674214162	MH2679614089B	0.100		0.022	0.774	0.122	0.094	0.847	11.96	140.05	329.3	22.5	450	CP	0.013	0.580	217.1	1.37	0.27	1.52
			2.203		3.007								245.1								
	C2A-Ext.Area	0.27																			
Cawthra	MH2679614089B	**Outlet 2**	2.203		3.007	0.496	5.210	2.584	2.584	10.00	150.72	1081.9	26.0	750	CP	0.013					
Cawthra	MH2847512300	MH2843212346	0.249		0.042	0.800	0.291	0.232	0.232	10.00	150.72	97.3	63.3	300	CP	0.013	0.671	79.2	1.12	0.94	1.23
Cawthra	MH2843212346	MH2838912393	0.074		0.030	0.698	0.104	0.072	0.305	10.94	145.38	123.1	63.8	375	CP	0.013	0.642	140.5	1.27	0.84	0.88

STORM SEWER DESIGN SHEET

IBI GROUP

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Storm Return Period (years) = 10 | 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel-Climate Change 2095

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow					Sewer Characteristics								Sewer Verification
Catchment	From	To	Subareas for C=			Compoiste	Total	Indiv.	Acc	Time of	Rain fall	Peak flow	Length	Pipe	Pipe	n	Slope	Cap full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20	C	Area	AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2838912393	MH2834712438	0.084		0.027	0.727	0.111	0.081	0.385	11.78	140.98	151.0	61.5	450	CP	0.013	0.614	223.5	1.41	0.73	0.68
Cawthra	MH2834712438	MH2830512484	0.085		0.024	0.743	0.109	0.081	0.467	12.51	137.40	178.1	62.1	450	CP	0.013	0.577	216.5	1.36	0.76	0.82
Cawthra	MH2830512484	MH2823812553	0.077		0.025	0.729	0.102	0.074	0.541	13.27	133.88	201.2	95.9	525	CP	0.013	0.986	427.1	1.97	0.81	0.47
Cawthra	MH2823812553	MH2816712630	0.179		0.186	0.544	0.364	0.198	0.739	14.08	130.36	267.6	105.2	525	CP	0.013	1.338	497.5	2.30	0.76	0.54
Cawthra	MH2816712630	MH2813712663	0.088		0.029	0.726	0.117	0.085	0.824	14.84	127.24	291.2	44.7	525	CP	0.013	1.814	579.3	2.68	0.28	0.50
Cawthra	MH2813712663	MH2810212703	0.371		0.491	0.502	0.862	0.432	1.256	15.12	126.14	440.2	53.1	525	CP	0.013	1.343	498.5	2.30	0.38	0.88
Cawthra	MH2810212703	MH2805612752	0.550		0.660	0.518	1.211	0.627	1.884	15.50	124.66	652.3	67.2	600	CP	0.013	1.722	805.8	2.85	0.39	0.81
Cawthra	MH2805612752	MH2801212797	0.284		0.303	0.538	0.587	0.316	2.200	15.90	123.19	752.7	62.8	600	CP	0.013	1.700	800.6	2.83	0.37	0.94
Cawthra	MH2801212797	MH2797712831	0.231		0.229	0.552	0.460	0.253	2.453	16.27	121.84	830.3	49.0	600	CP	0.013	3.820	1200.1	4.24	0.19	0.69
Cawthra	MH2797712831	MH2796212833	0.075		0.018	0.763	0.094	0.072	2.525	16.46	121.15	849.7	14.6	600	CP	0.013	5.764	1474.1	5.21	0.05	0.58
			2.346		2.064								743.2								
	Ext.Area	0.27																			
	Ext.Area	0.79																			
	Ext.Area	1.05																			
	Ext.Area	0.46																			
	Ext.Area	0.34																			
Cawthra	MH2874111995	MH2870712032	0.173		0.054	0.733	0.227	0.166	0.166	10.00	150.72	69.7	50.6	300	CP	0.013	0.814	87.3	1.23	0.68	0.80
Cawthra	MH2870712032	MH2863612108	0.328		0.126	0.705	0.454	0.320	0.487	10.68	146.80	198.5	103.9	375	CP	0.013	0.844	161.1	1.46	1.19	1.23
Cawthra	MH2863612108	MH2857612172	0.173		0.060	0.719	0.233	0.167	0.654	11.87	140.52	255.4	88.1	450	CP	0.013	0.844	261.9	1.65	0.89	0.97
Cawthra	MH2857612172	MH2853412217	0.174		0.037	0.777	0.211	0.164	0.818	12.76	136.20	309.7	61.5	450	CP	0.013	0.740	245.3	1.54	0.66	1.26
Cawthra	MH2853412217	MH2846712290	0.206		0.038	0.792	0.244	0.193	1.011	13.43	133.17	374.1	99.0	450	CP	0.013	0.740	245.3	1.54	1.07	1.53
Cawthra	MH2846712290	MH2840512356	0.322		0.089	0.749	0.411	0.308	1.319	14.50	128.62	471.2	90.9	525	CP	0.013	0.631	341.7	1.58	0.96	1.38
Cawthra	MH2840512356	MH2834612419	0.141		0.047	0.724	0.188	0.136	1.455	15.46	124.83	504.5	85.8	525	CP	0.013	0.580	327.6	1.51	0.95	1.54
Cawthra	MH2834612419	MH2828112490	0.136		0.057	0.694	0.193	0.134	1.589	16.40	121.35	535.5	96.1	525	CP	0.013	0.682	355.1	1.64	0.98	1.51
Cawthra	MH2828112490	MH2826712505	0.040		0.015	0.706	0.056	0.039	1.628	17.38	117.99	533.6	21.1	525	CP	0.013	1.881	589.9	2.73	0.13	0.90
Cawthra	MH2826712505	MH2823612538	0.080		0.013	0.805	0.093	0.075	1.703	17.51	117.56	556.0	45.1	525	CP	0.013	1.283	487.1	2.25	0.33	1.14
Cawthra	MH2823612538	MH2821812557	0.000		0.000	0.000	0.000	0.000	1.703	17.84	116.46	550.9	26.1	600	CP	0.013	1.398	726.1	2.57	0.17	0.76
Cawthra	MH2821812557	MH2815712622	0.224		0.214	0.558	0.437	0.244	1.947	18.01	115.92	626.8	89.3	600	CP	0.013	1.368	718.1	2.54	0.59	0.87
Cawthra	MH2815712622	MH2809112693	0.130		0.077	0.641	0.207	0.133	2.079	18.60	114.08	658.9	96.8	600	CP	0.013	1.064	633.4	2.24	0.72	1.04
Cawthra	MH2809112693	MH2809112693A	0.119		0.043	0.715	0.162	0.116	2.195	19.32	111.91	682.3	88.3	600	CP	0.013	1.641	786.6	2.78	0.53	0.87
Cawthra	MH2809112693A	MH2796612828	0.204		0.082	0.699	0.286	0.200	2.395	19.85	110.38	734.3	93.7	750	CP	0.013	1.641	1426.1	3.23	0.48	0.51
Cawthra	MH2796612828	MH2796212833	0.052		0.026	0.666	0.079	0.052	2.447	20.33	109.02	741.1	7.8	600	CP	0.013	9.593	1901.8	6.73	0.02	0.39
Cawthra	MH2796212833	MH2793812848	2.346		2.064	0.572	4.411	2.525	4.972	20.35	108.96	1504.9	29.2	1050	CP	0.013	5.981	6678.1	7.71	0.06	0.23
Cawthra	MH2793812848	MH2789712876	0.119		0.047	0.700	0.167	0.117	5.089	20.41	108.79	1537.7	48.9	1050	CP	0.013	4.706	5923.6	6.84	0.12	0.26
Cawthra	MH2789712876	MH2786112918	0.298		0.035	0.827	0.333	0.275	5.364	20.53	108.46	1616.0	55.4	1050	CP	0.013	5.729	6536.0	7.55	0.12	0.25

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel-Climate Change 2095

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow					Sewer Characteristics								Sewer Verification
Catchment	From	To	Subareas for C=			Compoiste	Total	Indiv.	Acc	Time of	Rain fall	Peak flow	Length	Pipe	Pipe	n	Slope	Cap full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20	C	Area	AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2786112918	MH2782912954	0.175		0.000	0.900	0.175	0.158	5.521	20.65	108.13	1658.4	47.9	1050	CP	0.013	5.008	6110.7	7.06	0.11	0.27
Cawthra	MH2782912954	MH2781212976	0.178		0.000	0.900	0.178	0.160	5.682	20.77	107.82	1701.6	27.9	1050	CP	0.013	6.131	6761.4	7.81	0.06	0.25
Cawthra	MH2781212976	MH2779312998	0.052		0.000	0.900	0.052	0.047	5.729	20.83	107.66	1713.2	29.2	1050	CP	0.013	7.501	7479.0	8.64	0.06	0.23
Cawthra	MH2779312998	MH2775313045	0.165		0.000	0.900	0.165	0.149	5.877	20.88	107.51	1755.2	61.3	1050	CP	0.013	1.986	3848.5	4.44	0.23	0.46
Cawthra	MH2775313045	MH2771513090	0.193		0.000	0.900	0.193	0.174	6.051	21.11	106.90	1796.8	59.7	1200	CP	0.013	1.242	4344.9	3.84	0.26	0.41
Cawthra	MH2771513090	MH2764813167	0.601		0.032	0.865	0.632	0.547	6.598	21.37	106.21	1946.8	99.5	1350	CP	0.013	0.995	5324.8	3.72	0.45	0.37
Cawthra	MH2764813167	MH2757513247	0.178		0.000	0.900	0.178	0.160	6.759	21.82	105.07	1972.6	110.8	1350	CP	0.013	0.397	3363.5	2.35	0.79	0.59
Cawthra	MH2757513247	MH2748713342	2.251		2.747	0.515	4.998	2.575	9.334	22.60	103.11	2673.5	129.5	1350	CP	0.013	0.405	3397.9	2.37	0.91	0.79
Cawthra	MH2748713342	MH2740013435	1.319		1.562	0.520	2.882	1.500	10.834	23.51	100.96	3038.2	127.0	1350	CP	0.013	1.007	5356.7	3.74	0.57	0.57
Cawthra	MH2740013435	MH2734513494	1.052		1.318	0.511	2.370	1.210	12.044	24.08	99.67	3334.5	80.8	1350	CP	0.013	0.703	4475.1	3.13	0.43	0.75
Cawthra	MH2734513494	MH2726213583	0.532		0.095	0.794	0.627	0.498	12.542	24.51	98.71	3438.9	121.5	1350	CP	0.013	0.248	2656.1	1.86	1.09	1.29
Cawthra	MH2726213583	MH2719913650	0.219		0.019	0.843	0.238	0.201	12.743	25.60	96.38	3411.5	91.9	1350	CP	0.013	0.182	2275.7	1.59	0.96	1.50
Cawthra	MH2719913650	MH2716513685	0.138		0.026	0.791	0.164	0.129	12.872	26.56	94.43	3376.3	49.5	1350	CP	0.013	0.772	4688.9	3.28	0.25	0.72
Cawthra	MH2716513685	MH2704813814	1.224		0.165	0.817	1.390	1.135	14.007	26.82	93.93	3654.8	173.5	1350	CP	0.013	0.893	5044.3	3.52	0.82	0.72
Cawthra	MH2704813814	Missing MH	0.476		0.126	0.753	0.602	0.453	14.460	27.64	92.36	3709.9	166.0	1350	CP	0.013	0.700	4465.6	3.12	0.89	0.83
Cawthra	Missing MH	**Outlet 3**	183.875		111.03	0.636	294.908	187.694					2653.8								
	Ext.Area	0.35																			
	Ext.Area	0.05																			
	Ext.Area	169.62																			
	Ext.Area	2.14																			
	Ext.Area	2.30																			
	Ext.Area	2.46																			
	Ext.Area	2.13																			
Cawthra	MH2923611465	MH2914911559	1.370		0.598	0.687	1.968	1.352	1.352	10.00	150.72	566.2	127.9	900	CP	0.013	0.339	1054.6	1.66	1.29	0.54
Cawthra	MH2914911559	MH2907911633	0.317		0.061	0.787	0.378	0.298	1.650	11.29	143.53	657.8	102.2	900	CP	0.013	0.309	1006.7	1.58	1.08	0.65
Cawthra	MH2907911633	MH2905511660	2.54		3.804	0.480	6.340	3.043	4.693	12.36	138.10	1800.3	35.8	900	CP	0.013	0.425	1180.3	1.86	0.32	1.53
Cawthra	MH2905511660	MH2899811719	0.298		0.077	0.756	0.375	0.283	4.977	12.68	136.57	1887.9	82.5	900	CP	0.013	0.393	1134.5	1.78	0.77	1.66
Cawthra	MH2899811719	MH2896211760	4.195		6.589	0.472	10.784	5.093	10.070	13.45	133.05	3721.6	54.1	900	CP	0.013	0.296	984.1	1.55	0.58	3.78
Cawthra	MH2896211760	MH2886911860	0.813		0.292	0.715	1.105	0.790	10.860	14.04	130.53	3937.5	137.0	1050	CP	0.013	0.172	1131.1	1.31	1.75	3.48
Cawthra	MH2886911860	MH2877511960	0.463		0.148	0.730	0.612	0.447	11.306	15.79	123.60	3881.8	137.1	1050	CP	0.013	0.167	1116.1	1.29	1.77	3.48
		Outlet 4	9.992		11.569	0.524	21.561	11.306													
0.13	Ext.Area	1.2649																			
	Ext.Area	6.34																			
0.30	Ext.Area	10.981																			

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel-Climate Change 2095

Inlet time 10 min

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas for C=			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To				C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
0.49	Ext.Area	0.9722																			
	Ext.Area	1.2																			
Cawthra	MH2948911265	MH2946811287	0.432		0.105	0.764	0.537	0.410	0.410	10.00	150.72	171.6	30.2	525	CP	0.013	0.458	290.9	1.34	0.37	0.59
Cawthra	MH2946811287	MH2946811287A	0.48		0.720	0.480	1.200	0.576	0.986	10.37	148.54	406.8	8.9	525	CP	0.013	0.660	349.4	1.61	0.09	1.16
Cawthra	MH2946811287A	MH2940011351	0.170		0.082	0.672	0.253	0.170	1.156	10.47	148.02	475.2	86.6	525	CP	0.013	0.660	349.4	1.61	0.89	1.36
Cawthra	MH2940011351	MH2940911372	0.195		0.068	0.719	0.263	0.189	1.345	11.36	143.14	534.8	28.2	600	CP	0.013	1.290	697.4	2.47	0.19	0.77
Cawthra	MH2940911372	MH2930811429	0.086		0.027	0.732	0.113	0.083	1.428	11.55	142.15	563.8	92.1	750	CP	0.013	0.789	988.7	2.24	0.69	0.57
Cawthra	MH2930811429	MH2922511472	0.352		0.123	0.719	0.476	0.342	1.770	12.24	138.71	681.8	81.3	750	CP	0.013	0.166	453.6	1.03	1.32	1.50
		Outlet 5	1.716		1.125	0.623	2.842	1.770													
Cawthra	MH2981910930	MH2972911023	0.181		0.026	0.812	0.207	0.168	0.168	10.00	150.72	70.2	128.5	300	CP	0.013	0.404	61.5	0.87	2.46	1.14
Cawthra	MH2972911023	MH2964011116	0.334		0.108	0.728	0.442	0.322	0.490	12.46	137.61	187.2	128.1	525	CP	0.013	0.837	393.4	1.82	1.17	0.48
Cawthra	MH2964011116	MH2954211221	0.622		0.246	0.702	0.868	0.609	1.099	13.64	132.24	403.7	134.9	525	CP	0.013	3.069	753.4	3.48	0.65	0.54
Cawthra	MH2954211221	MH2952711227	0.000		0.000					14.28	129.50	0.0	21.7	600	CP	0.013	3.526	1153.0	4.08	0.09	0.00
		Outlet 6	1.137		0.380	0.725	1.517	1.099													

STORM SEWER DESIGN SHEETS

PROPOSED CONDITION WITH CLIMATE CHANGE IDF CURVE 2095

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel- Climate Change 2095

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow						Sewer Characteristics								Sewer Verification
		Subareas				Compoiste	Total			Time	Rain	Peak						Cap				
Catchment	From	To	for C=			C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH8265114451	MH8264714474	0.249		0.013	0.865	0.262	0.227	0.227	10.00	150.72	94.9	46.3	300	CP	0.013	3.510	181.2	2.56	0.30	0.52
Cawthra	MH8264714474	MH8264714473	0.114		0.036	0.733	0.150	0.110	0.336	10.30	148.96	139.2	10.8	375	CP	0.013	1.299	199.8	1.81	0.10	0.70
Cawthra	MH8264714473	MH8264114502	0.047		0.016	0.719	0.063	0.046	0.382	10.40	148.39	157.4	49.6	375	CP	0.013	3.584	331.9	3.01	0.28	0.47
Cawthra	MH8264114502	MH8264114504	0.060		0.005	0.850	0.064	0.055	0.436	10.68	146.84	178.0	6.7	375	CP	0.013	7.764	488.5	4.42	0.03	0.36
Cawthra	MH8264114504	MH8264114504A	0.091		0.002	0.883	0.093	0.082	0.519	10.70	146.70	211.4	19.7	375	CP	0.013	2.000	248.0	2.25	0.15	0.85
Cawthra	MH8264114504A	MH8264114504B	0.078		0.000	0.900	0.078	0.070	0.589	10.85	145.89	238.6	45.7	450	CP	0.013	2.000	403.2	2.54	0.30	0.59
Cawthra	MH8264114504B	MH8264114504C	0.149		0.000	0.900	0.149	0.134	0.723	11.15	144.26	289.8	54.0	450	CP	0.013	2.000	403.2	2.54	0.36	0.72
Cawthra	MH8264114504C	MH8262914567	0.161		0.000	0.900	0.161	0.145	0.868	11.50	142.40	343.3	27.3	450	CP	0.013	2.000	403.2	2.54	0.18	0.85
		Outlet 1	0.788		0.072		1.020						260.1								
Cawthra	MH2690513991	MH2686714032	0.146		0.049	0.723	0.195	0.141	0.141	10.00	150.72	59.1	54.7	375	CP	0.013	0.980	173.6	1.57	0.58	0.34
Cawthra	MH2686714032	MH2685214020	0.075		0.027	0.712	0.102	0.073	0.214	10.58	147.38	87.5	24.0	375	CP	0.013	0.283	93.3	0.84	0.47	0.94
Cawthra	MH2685214020	MH2682514051	0.084		0.018	0.776	0.102	0.079	0.293	11.05	144.77	117.9	41.6	450	CP	0.013	0.200	127.5	0.80	0.86	0.92
Cawthra	MH2682514051	MH2679614089	0.125		0.031	0.760	0.156	0.119	0.412	11.92	140.28	160.5	47.9	450	CP	0.013	0.908	271.7	1.71	0.47	0.59
Cawthra	MH2679614089	MH2679614089A	0.529		2.381	0.327	2.911	0.953	1.365	12.39	137.98	523.0	25.1	600	CP	0.013	1.430	734.3	2.60	0.16	0.71
Cawthra	MH2679614089A	MH2679614089B	0.146		0.056	0.707	0.202	0.143	1.508	12.55	137.21	574.6	48.2	600	CP	0.013	1.200	672.6	2.38	0.34	0.85
													241.5								
	Ext.Area	2.74																			
Cawthra	Low Area	MH2679614089B	0.249		0.029	0.826	0.278	0.230	0.230	10.00	150.72	96.3									
Cawthra	MH2662714356	MH2665814319	0.149		0.000	0.900	0.149	0.135	0.135	10.00	150.72	56.3	48.7	300	CP	0.013	1.774	128.8	1.82	0.45	0.44
Cawthra	MH2665814319	MH2665814319A	0.169		0.021	0.822	0.191	0.157	0.291	10.45	148.14	119.8	26.2	300	CP	0.013	3.552	182.2	2.58	0.17	0.66
Cawthra	MH2665814319A	MH2666614287	0.058		0.025	0.691	0.082	0.057	0.348	10.61	147.18	142.3	13.6	300	CP	0.013	3.552	182.2	2.58	0.09	0.78
Cawthra	MH2666614287	MH2668114261	0.012		0.005	0.704	0.017	0.012	0.360	10.70	146.69	146.7	17.4	300	CP	0.013	4.214	198.5	2.81	0.10	0.74
Cawthra	MH2668114261	MH2668914246	0.093		0.013	0.812	0.106	0.086	0.446	10.81	146.12	181.1	16.6	375	CP	0.013	5.143	397.6	3.60	0.08	0.46
Cawthra	MH2668914246	MH2672114191	0.061		0.284	0.324	0.345	0.112	0.558	10.88	145.70	225.8	64.2	375	CP	0.013	1.783	234.1	2.12	0.50	0.96
Cawthra	MH2672114191	MH2674214162	0.206		0.044	0.776	0.250	0.194	0.752	11.39	142.99	298.8	35.9	600	CP	0.013	0.580	467.6	1.65	0.36	0.64
Cawthra	MH2674214162	MH2679614089B	0.100		0.022	0.774	0.122	0.094	0.847	11.75	141.13	331.9	22.5	600	CP	0.013	0.580	467.6	1.65	0.23	0.71
			2.203		3.007								245.1								
	Ext.Area***	0.27																			
Cawthra	MH2679614089B	**Outlet 2**	2.203		3.007	0.496	5.210	2.584	2.584	10.00	150.72	1081.9	26.0	750	CP	0.013					
Cawthra	MH2847512300	MH2843212346	0.249		0.042	0.800	0.291	0.232	0.232	10.00	150.72	97.3	63.3	375	CP	0.013	0.671	143.6	1.30	0.81	0.68
Cawthra	MH2843212346	MH2838912393	0.074		0.030	0.698	0.104	0.072	0.305	10.81	146.09	123.7	63.8	375	CP	0.013	0.642	140.5	1.27	0.84	0.88

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:
IDF Used: Region of Peel- Climate Change 2095

Inlet time 10 min

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow						Sewer Characteristics								Sewer Verification
Catchment	From	To	Subareas for C=			Compoiste C	Total Area	Indiv. AC	Acc AC	Time of Conc.	Rain fall I	Peak flow q	Length	Pipe Dia	Pipe Type	n	Slope	Cap full Q	Vel. V	Travel Time	q/Q
	MH	MH	0.900 (ha)	0.50 (ha)	0.20		(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2838912393	MH2834712438	0.084		0.027	0.727	0.111	0.081	0.385	11.65	141.65	151.7	61.5	450	CP	0.013	0.614	223.5	1.41	0.73	0.68
Cawthra	MH2834712438	MH2830512484	0.085		0.024	0.743	0.109	0.081	0.467	12.38	138.02	179.0	62.1	450	CP	0.013	0.577	216.5	1.36	0.76	0.83
Cawthra	MH2830512484	MH2823812553	0.077		0.025	0.729	0.102	0.074	0.541	13.14	134.47	202.0	95.9	525	CP	0.013	0.986	427.1	1.97	0.81	0.47
Cawthra	MH2823812553	MH2816712630	0.179		0.186	0.544	0.364	0.198	0.739	13.95	130.91	268.7	105.2	525	CP	0.013	1.338	497.5	2.30	0.76	0.54
Cawthra	MH2816712630	MH2813712663	0.088		0.029	0.726	0.117	0.085	0.824	14.71	127.76	292.4	44.7	525	CP	0.013	1.814	579.3	2.68	0.28	0.50
Cawthra	MH2813712663	MH2810212703	0.371		0.491	0.502	0.862	0.432	1.256	14.99	126.65	442.0	53.1	525	CP	0.013	1.343	498.5	2.30	0.38	0.89
Cawthra	MH2810212703	MH2805612752	0.550		0.660	0.518	1.211	0.627	1.884	15.37	125.16	654.9	67.2	600	CP	0.013	1.722	805.8	2.85	0.39	0.81
Cawthra	MH2805612752	MH2801212797	0.284		0.303	0.538	0.587	0.316	2.200	15.77	123.67	755.7	62.8	600	CP	0.013	1.700	800.6	2.83	0.37	0.94
Cawthra	MH2801212797	MH2797712831	0.231		0.229	0.552	0.460	0.253	2.453	16.14	122.31	833.5	49.0	600	CP	0.013	3.820	1200.1	4.24	0.19	0.69
Cawthra	MH2797712831	MH2796212833	0.075		0.018	0.763	0.094	0.072	2.525	16.33	121.62	852.9	14.6	600	CP	0.013	5.764	1474.1	5.21	0.05	0.58
			2.346		2.064								743.2								
	Ext.Area	0.27																			
	Ext.Area	0.79																			
	Ext.Area	1.05																			
	Ext.Area	0.46																			
	Ext.Area	0.34																			
Cawthra	MH2874111995	MH2870712032	0.173		0.054	0.733	0.227	0.166	0.166	10.00	150.72	69.7	50.6	300	CP	0.013	0.814	87.3	1.23	0.68	0.80
Cawthra	MH2870712032	MH2863612108	0.328		0.126	0.705	0.454	0.320	0.487	10.68	146.80	198.5	103.9	450	CP	0.013	0.844	261.9	1.65	1.05	0.76
Cawthra	MH2863612108	MH2857612172	0.173		0.060	0.719	0.233	0.167	0.654	11.73	141.20	256.6	88.1	450	CP	0.013	0.844	261.9	1.65	0.89	0.98
Cawthra	MH2857612172	MH2853412217	0.174		0.037	0.777	0.211	0.164	0.818	12.63	136.84	311.1	61.5	525	CP	0.013	0.740	370.0	1.71	0.60	0.84
Cawthra	MH2853412217	MH2846712290	0.206		0.038	0.792	0.244	0.193	1.011	13.23	134.07	376.7	99.0	600	CP	0.013	0.740	528.2	1.87	0.88	0.71
Cawthra	MH2846712290	MH2840512356	0.322		0.089	0.749	0.411	0.308	1.319	14.11	130.23	477.1	90.9	600	CP	0.013	0.631	487.9	1.73	0.88	0.98
Cawthra	MH2840512356	MH2834612419	0.141		0.047	0.724	0.188	0.136	1.455	14.99	126.65	511.9	85.8	675	CP	0.013	0.580	640.3	1.79	0.80	0.80
Cawthra	MH2834612419	MH2828112490	0.136		0.057	0.694	0.193	0.134	1.589	15.79	123.59	545.4	96.1	675	CP	0.013	0.682	694.1	1.94	0.83	0.79
Cawthra	MH2828112490	MH2826712505	0.040		0.015	0.706	0.056	0.039	1.628	16.61	120.61	545.4	21.1	675	CP	0.013	1.881	1153.0	3.22	0.11	0.47
Cawthra	MH2826712505	MH2823612538	0.080		0.013	0.805	0.093	0.075	1.703	16.72	120.23	568.6	45.1	675	CP	0.013	1.283	952.1	2.66	0.28	0.60
Cawthra	MH2823612538	MH2821812557	0.000		0.000	0.000	0.000	0.000	1.703	17.00	119.25	564.0	26.1	675	CP	0.013	1.398	994.1	2.78	0.16	0.57
Cawthra	MH2821812557	MH2815712622	0.224		0.214	0.558	0.437	0.244	1.947	17.16	118.72	642.0	89.3	675	CP	0.013	1.368	983.0	2.75	0.54	0.65
Cawthra	MH2815712622	MH2809112693	0.130		0.077	0.641	0.207	0.133	2.079	17.70	116.92	675.3	96.8	675	CP	0.013	1.064	867.2	2.42	0.67	0.78
Cawthra	MH2809112693	MH2809112693A	0.119		0.043	0.715	0.162	0.116	2.195	18.37	114.79	699.9	88.3	675	CP	0.013	1.641	1076.8	3.01	0.49	0.65
Cawthra	MH2809112693A	MH2796612828	0.204		0.082	0.699	0.286	0.200	2.395	18.86	113.28	753.6	93.7	750	CP	0.013	1.641	1426.1	3.23	0.48	0.53
Cawthra	MH2796612828	MH2796212833	0.052		0.026	0.666	0.079	0.052	2.447	19.34	111.84	760.3	7.8	600	CP	0.013	9.593	1901.8	6.73	0.02	0.40
Cawthra	MH2796212833	MH2793812848	2.346		2.064	0.572	4.411	2.525	4.972	19.36	111.78	1543.8	29.2	1050	CP	0.013	5.981	6678.1	7.71	0.06	0.23
Cawthra	MH2793812848	MH2789712876	0.119		0.047	0.700	0.167	0.117	5.089	19.42	111.60	1577.4	48.9	1050	CP	0.013	4.706	5923.6	6.84	0.12	0.27
Cawthra	MH2789712876	MH2786112918	0.298		0.035	0.827	0.333	0.275	5.364	19.54	111.25	1657.6	55.4	1050	CP	0.013	5.729	6536.0	7.55	0.12	0.25

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel- Climate Change 2095

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow						Sewer Characteristics								Sewer Verification
Catchment	From	To	Subareas for C=			Compoiste C	Total Area	Indiv. AC	Acc AC	Time of Conc.	Rain fall I	Peak flow q	Length	Pipe Dia	Pipe Type	n	Slope	Cap full Q	Vel. V	Travel Time	q/Q
	MH	MH	0.900 (ha)	0.50 (ha)	0.20		(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
Cawthra	MH2786112918	MH2782912954	0.175		0.000	0.900	0.175	0.158	5.521	19.67	110.89	1700.8	47.9	1050	CP	0.013	5.008	6110.7	7.06	0.11	0.28
Cawthra	MH2782912954	MH2781212976	0.178		0.000	0.900	0.178	0.160	5.682	19.78	110.57	1745.0	27.9	1050	CP	0.013	6.131	6761.4	7.81	0.06	0.26
Cawthra	MH2781212976	MH2779312998	0.052		0.000	0.900	0.052	0.047	5.729	19.84	110.40	1756.8	29.2	1050	CP	0.013	7.501	7479.0	8.64	0.06	0.23
Cawthra	MH2779312998	MH2775313045	0.165		0.000	0.900	0.165	0.149	5.877	19.89	110.24	1799.7	61.3	1050	CP	0.013	1.986	3848.5	4.44	0.23	0.47
Cawthra	MH2775313045	MH2771513090	0.193		0.000	0.900	0.193	0.174	6.051	20.12	109.59	1842.1	59.7	1200	CP	0.013	1.242	4344.9	3.84	0.26	0.42
Cawthra	MH2771513090	MH2764813167	0.601		0.032	0.865	0.632	0.547	6.598	20.38	108.87	1995.4	99.5	1350	CP	0.013	0.995	5324.8	3.72	0.45	0.37
Cawthra	MH2764813167	MH2757513247	0.178		0.000	0.900	0.178	0.160	6.759	20.83	107.65	2021.1	110.8	1350	CP	0.013	0.397	3363.5	2.35	0.79	0.60
Cawthra	MH2757513247	MH2748713342	2.251		2.747	0.515	4.998	2.575	9.334	21.61	105.59	2737.6	129.5	1350	CP	0.013	0.405	3397.9	2.37	0.91	0.81
Cawthra	MH2748713342	MH2740013435	1.319		1.562	0.520	2.882	1.500	10.834	22.52	103.31	3108.9	127.0	1350	CP	0.013	1.007	5356.7	3.74	0.57	0.58
Cawthra	MH2740013435	MH2734513494	1.052		1.318	0.511	2.370	1.210	12.044	23.09	101.95	3410.8	80.8	1350	CP	0.013	0.703	4475.1	3.13	0.43	0.76
Cawthra	MH2734513494	MH2726213583	0.532		0.095	0.794	0.627	0.498	12.542	23.52	100.94	3516.5	121.5	1500	CP	0.013	0.248	3517.7	1.99	1.02	1.00
Cawthra	MH2726213583	MH2719913650	0.219		0.019	0.843	0.238	0.201	12.743	24.54	98.65	3491.7	91.9	1650	CP	0.013	0.182	3886.1	1.82	0.84	0.90
Cawthra	MH2719913650	MH2716513685	0.138		0.026	0.791	0.164	0.129	12.872	25.38	96.84	3462.6	49.5	1650	CP	0.013	0.772	8007.1	3.74	0.22	0.43
Cawthra	MH2716513685	MH2704813814	1.224		0.165	0.817	1.390	1.135	14.007	25.60	96.38	3750.0	173.5	1650	CP	0.013	0.893	8613.9	4.03	0.72	0.44
Cawthra	MH2704813814	Missing MH	0.476		0.126	0.753	0.602	0.453	14.460	26.32	94.92	3812.6	166.0	1650	CP	0.013	0.700	7625.7	3.57	0.78	0.50
Cawthra	Missing MH	**Outlet 3**	183.875		111.03								2653.8								
	Ext.Area	0.35																			
	Ext.Area	0.05																			
	Ext.Area	169.62																			
	Ext.Area	2.14																			
	Ext.Area	2.30																			
	Ext.Area	2.46																			
	Ext.Area	2.13																			
Cawthra	MH2923611465	MH2914911559	1.370		0.598	0.687	1.968	1.352	1.352	10.00	150.72	566.2	127.9	900	CP	0.013	0.339	1054.6	1.66	1.29	0.54
Cawthra	MH2914911559	MH2907911633	0.317		0.061	0.787	0.378	0.298	1.650	11.29	143.53	657.8	102.2	900	CP	0.013	0.309	1006.7	1.58	1.08	0.65
Cawthra	MH2907911633	MH2905511660	2.54		3.804	0.480	6.340	3.043	4.693	12.36	138.10	1800.3	35.8	1050	CP	0.013	0.425	1780.4	2.06	0.29	1.01
Cawthra	MH2905511660	MH2899811719	0.298		0.077	0.756	0.375	0.283	4.977	12.65	136.71	1889.9	82.5	1050	CP	0.013	0.393	1711.3	1.98	0.70	1.10
Cawthra	MH2899811719	MH2896211760	4.195		6.589	0.472	10.784	5.093	10.070	13.35	133.52	3734.9	54.1	1050	CP	0.013	0.296	1484.4	1.71	0.53	2.52
Cawthra	MH2896211760	MH2886911860	0.813		0.292	0.715	1.105	0.790	10.860	13.87	131.22	3958.5	137.0	1050	CP	0.013	0.172	1131.1	1.31	1.75	3.50
Cawthra	MH2886911860	MH2877511960	0.463		0.148	0.730	0.612	0.447	11.306	15.62	124.21	3901.0	137.1	1050	CP	0.013	0.167	1116.1	1.29	1.77	3.50
		Outlet 4	9.992		11.569	Ex. 1050mm Oulet Pipe is beyond project limit & it's not possible to upsize the pipes larger than 1050mm															
0.13	Ext.Area	1.2649																			
	Ext.Area	6.34																			
0.30	Ext.Area	10.981																			

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 10 | 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel- Climate Change 2095

A= 1338
B= 8.9
C= 0.743
150.72 = I = 150.72

Location								Design Flow					Sewer Characteristics								Sewer Verification
		Subareas				Compoiste	Total	Indiv.	Acc	Time	Rain	Peak						Cap			
Catchment	From	To	for C=			C	Area			of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900	0.50	0.20			AC	AC	Conc.	I	q		Dia	Type			Q	V	Time	
			(ha)	(ha)			(ha)	(ha)	(ha)	(min)	(mm/h)	(L/s)	(m)	(mm)			%	(L/s)	(m/s)	(min)	
0.49	Ext.Area	0.9722																			
	Ext.Area	1.2																			
Cawthra	MH2948911265	MH2946811287	0.432		0.105	0.764	0.537	0.410	0.410	10.00	150.72	171.6	30.2	525	CP	0.013	0.458	290.9	1.34	0.37	0.59
Cawthra	MH2946811287	MH2946811287A	0.48		0.720	0.480	1.200	0.576	0.986	10.37	148.54	406.8	8.9	600	CP	0.013	0.660	498.8	1.76	0.08	0.82
Cawthra	MH2946811287A	MH2940011351	0.170		0.082	0.672	0.253	0.170	1.156	10.46	148.07	475.4	86.6	600	CP	0.013	0.660	498.8	1.76	0.82	0.95
Cawthra	MH2940011351	MH2940911372	0.195		0.068	0.719	0.263	0.189	1.345	11.28	143.58	536.5	28.2	600	CP	0.013	1.290	697.4	2.47	0.19	0.77
Cawthra	MH2940911372	MH2930811429	0.086		0.027	0.732	0.113	0.083	1.428	11.47	142.58	565.5	92.1	750	CP	0.013	0.789	988.7	2.24	0.69	0.57
Cawthra	MH2930811429	MH2922511472	0.352		0.123	0.719	0.476	0.342	1.770	12.15	139.12	683.9	81.3	900	CP	0.013	0.166	737.6	1.16	1.17	0.93
		Outlet 5	1.716		1.125																
Cawthra	MH2981910930	MH2972911023	0.181		0.026	0.812	0.207	0.168	0.168	10.00	150.72	70.2	128.5	375	CP	0.013	0.404	111.4	1.01	2.12	0.63
Cawthra	MH2972911023	MH2964011116	0.334		0.108	0.728	0.442	0.322	0.490	12.12	139.26	189.4	128.1	525	CP	0.013	0.837	393.4	1.82	1.17	0.48
Cawthra	MH2964011116	MH2954211221	0.622		0.246	0.702	0.868	0.609	1.099	13.30	133.75	408.3	134.9	525	CP	0.013	3.069	753.4	3.48	0.65	0.54
Cawthra	MH2954211221	MH2952711227	0.000		0.000					13.94	130.93	0.0	21.7	600	CP	0.013	3.526	1153.0	4.08	0.09	0.00
		Outlet 6	1.137		0.380	0.725	1.517	1.099													

STORM SEWER DESIGN SHEETS

100-YEAR STORM SEWER DESIGN AT RAILWAY UNDERPASS

STORM SEWER DESIGN SHEET

IBI GROUP

Project Name: Cawthra Road
Project Number: 24RX16.0014
Date /Rev July 22 2019

Rainfall Intensity: I = 1010/(TC+4.6)^0.78

Storm Return Period (years) = 100

Initial Time of Concentration:

Inlet time 10 min

IDF Used: Region of Peel-Climate Change 2095

A= 2272
B= 9.0
C= 0.755
246.12 = I = 246.12

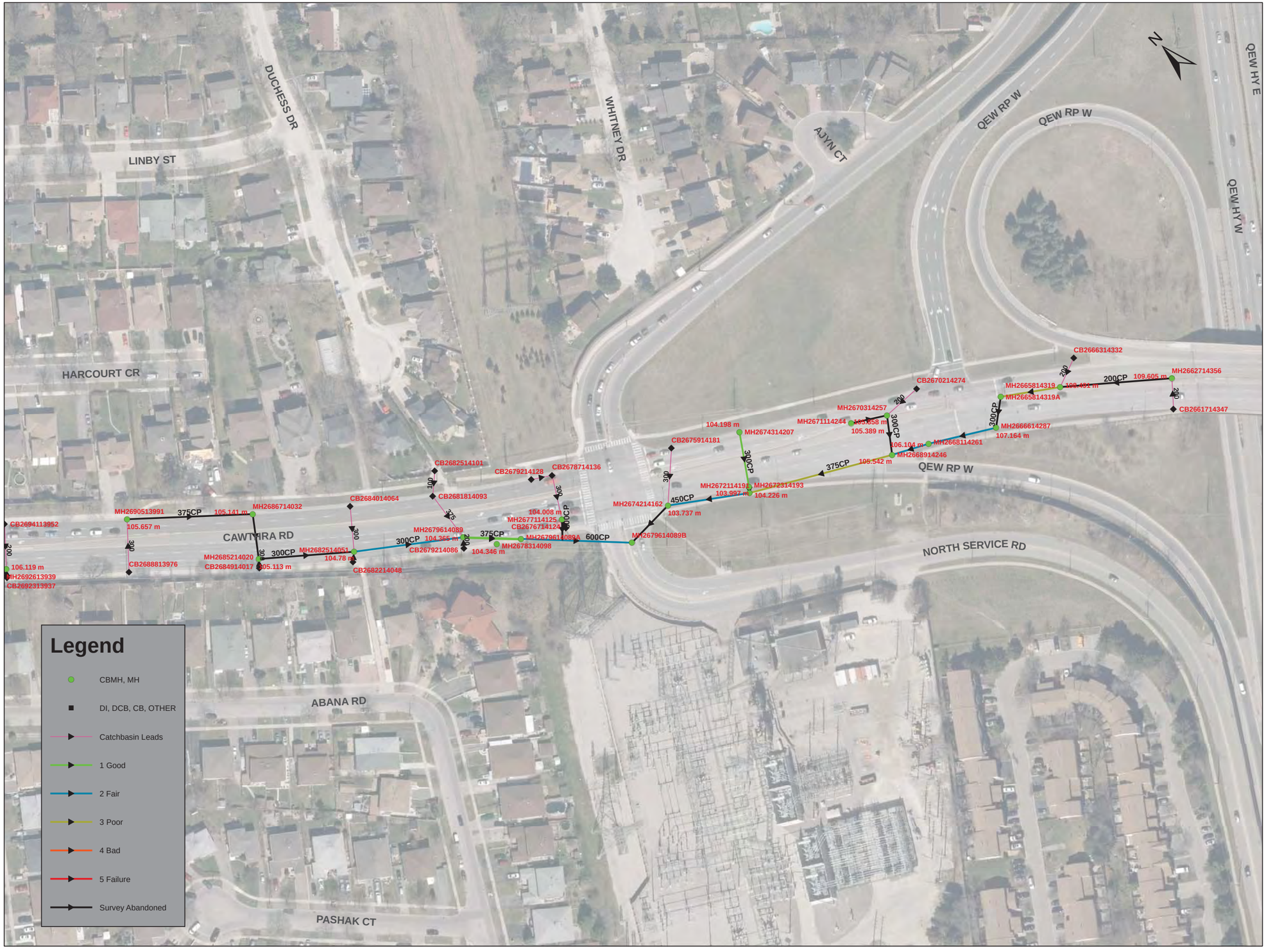
Location								Design Flow					Sewer Characteristics								Sewer Verification
			Subareas for C=			Compoiste	Total			Time	Rain	Peak						Cap			
Catchment	From	To				C	Area	Indiv.	Acc	of	fall	flow	Length	Pipe	Pipe	n	Slope	full	Vel.	Travel	q/Q
	MH	MH	0.900 (ha)	0.50 (ha)	0.20		(ha)	AC (ha)	AC (ha)	Conc. (min)	I (mm/h)	q (L/s)	(m)	Dia (mm)	Type		%	Q (L/s)	V (m/s)	Time (min)	
Cawthra	MH2757513247	MH2748713342	2.251		2.747	0.515	4.998	2.575	9.334	22.60	167.62	4346.2	129.5	1500	CP	0.013	0.405	4500.2	2.55	0.85	0.97
Cawthra	MH2748713342	MH2740013435	1.319		1.562	0.520	2.882	1.500	10.834	23.45	164.31	4944.7	127.0	1500	CP	0.013	1.007	7094.4	4.01	0.53	0.70
Cawthra	MH2740013435	MH2734513494	1.052		1.318	0.511	2.370	1.210	12.044	23.98	162.32	5430.7	80.8	1500	CP	0.013	0.703	5926.8	3.35	0.40	0.92
Cawthra	MH2734513494	MH2726213583	0.532		0.095	0.794	0.627	0.498	12.542	24.38	160.84	5603.6	121.5	1800	CP	0.013	0.248	5720.2	2.25	0.90	0.98
Cawthra	MH2726213583	MH2719913650	0.219		0.019	0.843	0.238	0.201	12.743	25.28	157.64	5579.9	91.9	1950	CP	0.013	0.182	6067.1	2.03	0.75	0.92
Cawthra	MH2719913650	MH2716513685	0.138		0.026	0.791	0.164	0.129	12.872	26.03	155.08	5544.8	49.5	1950	CP	0.013	0.772	12500.9	4.19	0.20	0.44
Cawthra	MH2716513685	MH2704813814	1.224		0.165	0.817	1.390	1.135	14.007	26.23	154.42	6008.2	173.5	1950	CP	0.013	0.893	13448.4	4.50	0.64	0.45
Cawthra	MH2704813814	Missing MH	0.476		0.126	0.753	0.602	0.453	14.460	26.87	152.33	6118.7	166.0	1950	CP	0.013	0.700	11905.5	3.99	0.69	0.51
Cawthra	Missing MH	**Outlet 3**	183.875		111.03								2653.8								

APPENDIX F

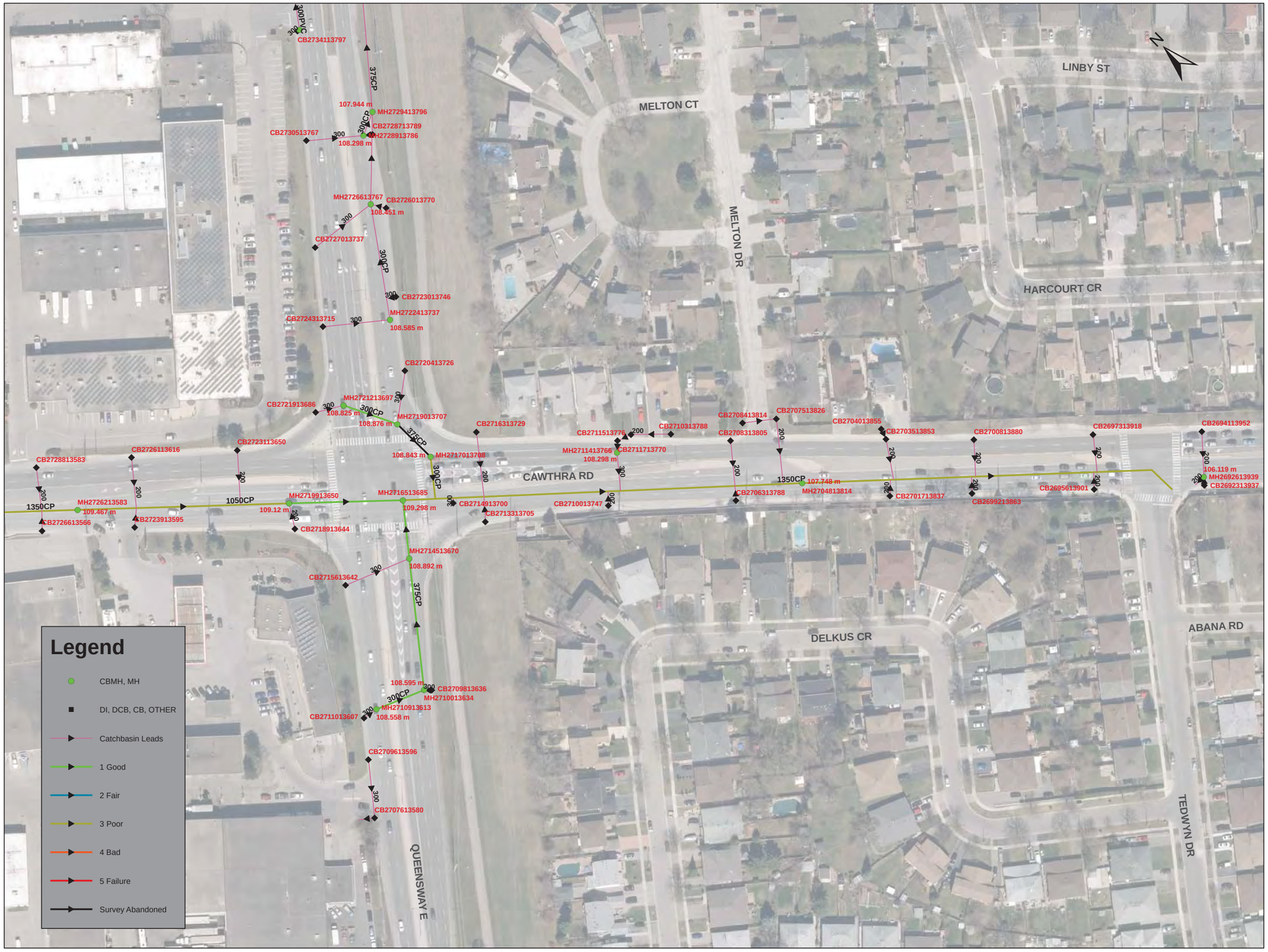
SUMMARY OF CCTV INSPECTION

Cawthra Road (Eastgate Parkway to South Service Road)

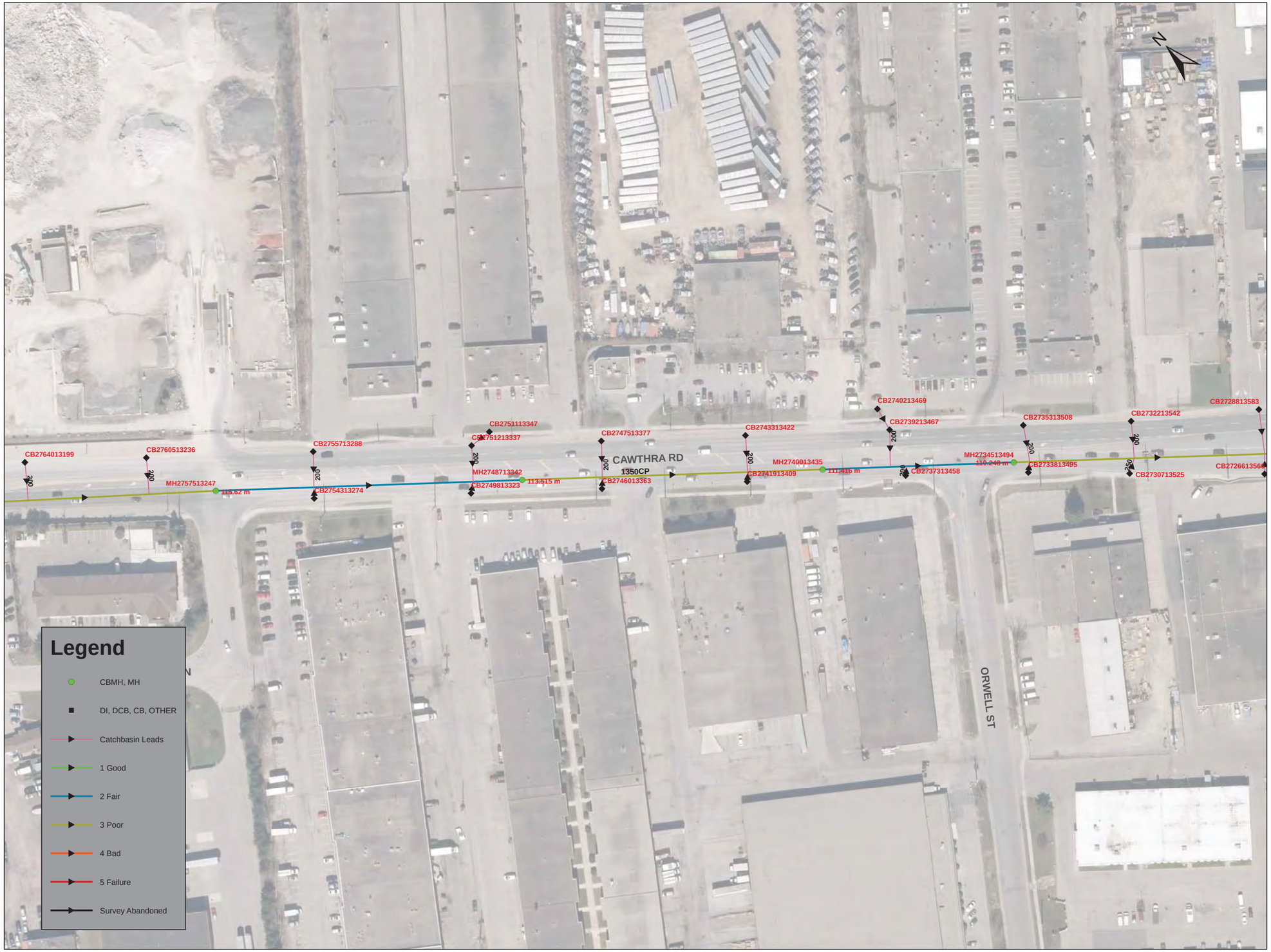
Cawthra Road (Eastgate Parkway to South Service Road)



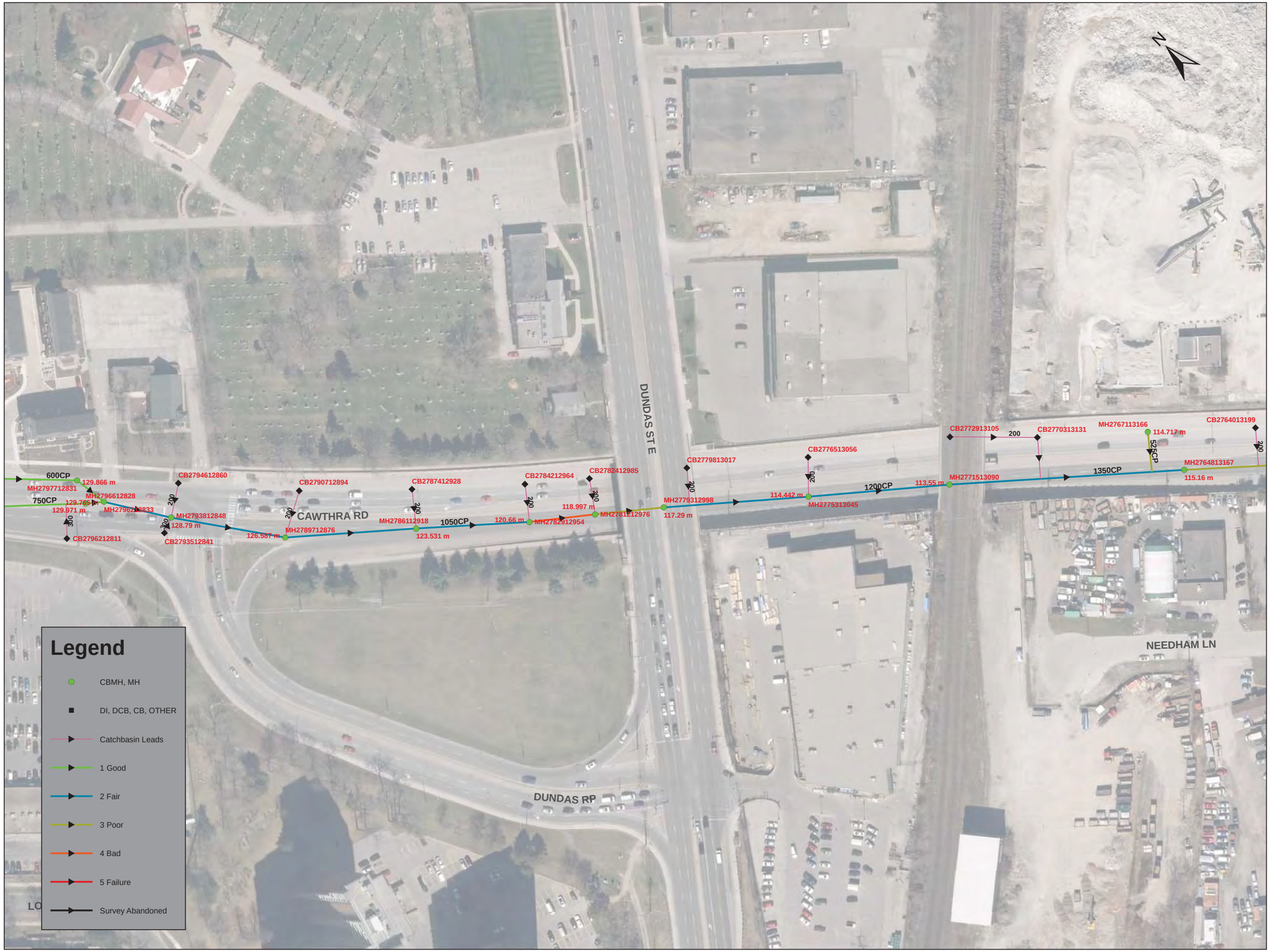
Cawthra Road (Eastgate Parkway to South Service Road)



Cawthra Road (Eastgate Parkway to South Service Road)

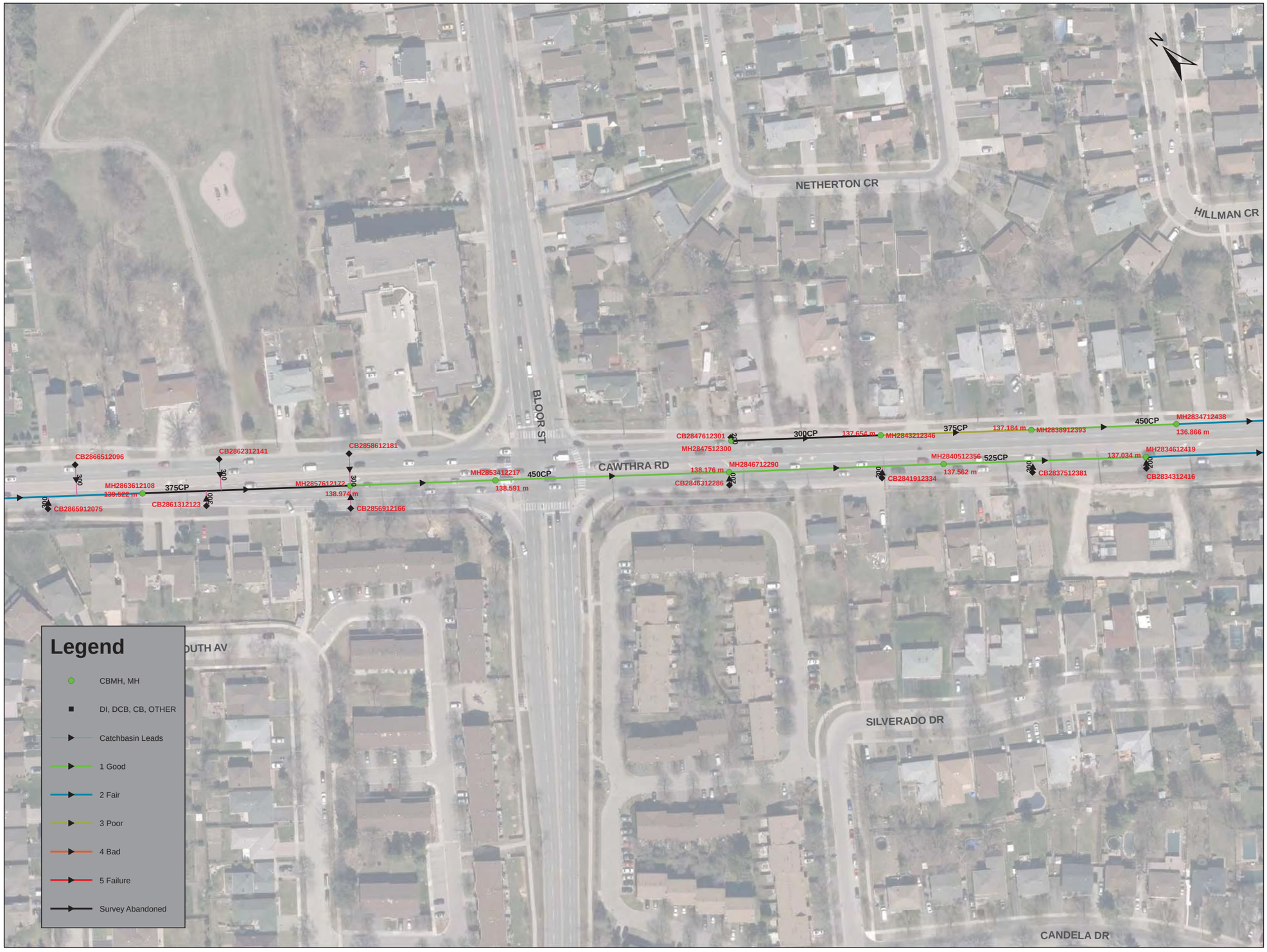


Cawthra Road (Eastgate Parkway to South Service Road)

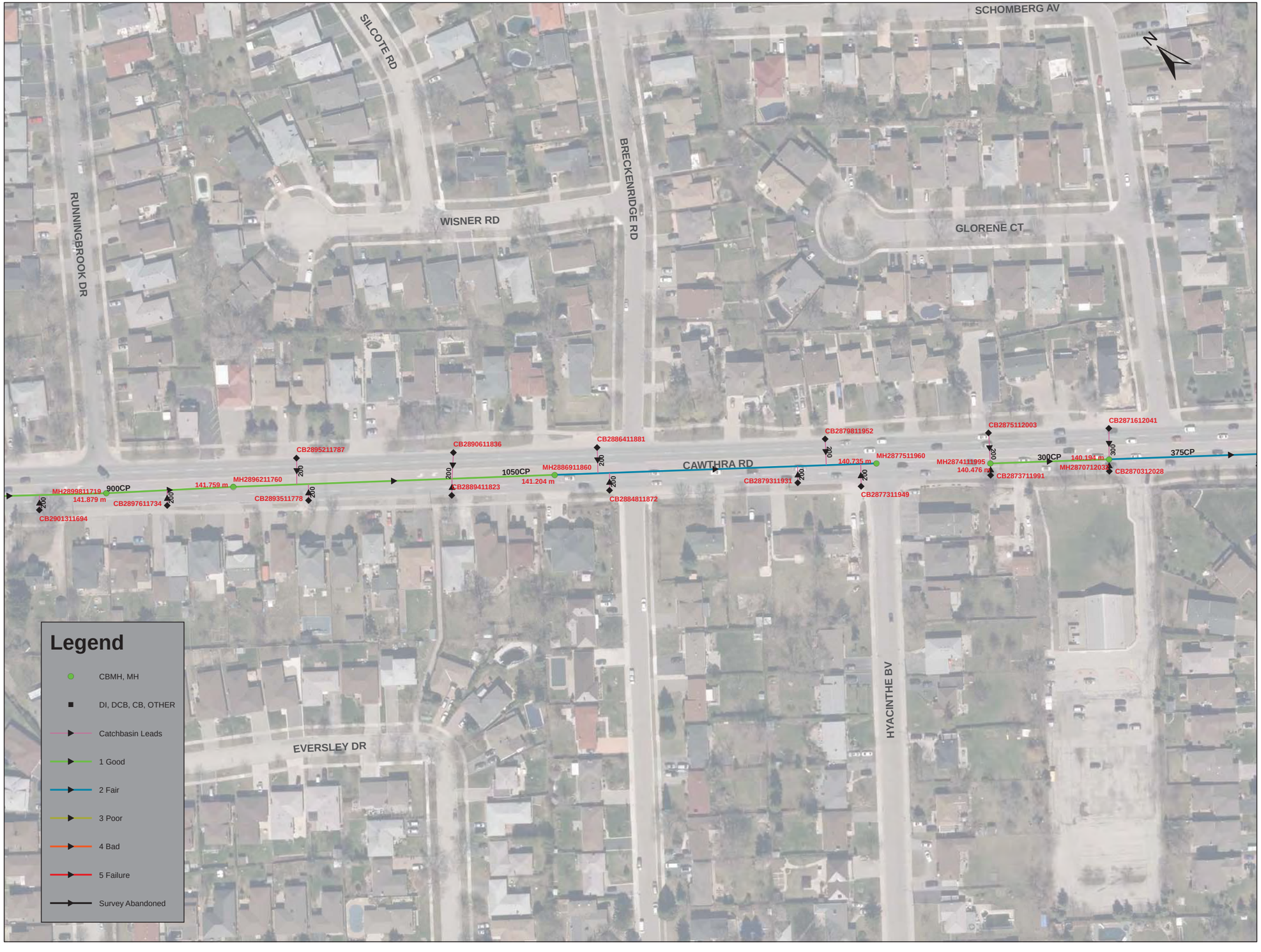


Cawthra Road (Eastgate Parkway to South Service Road)

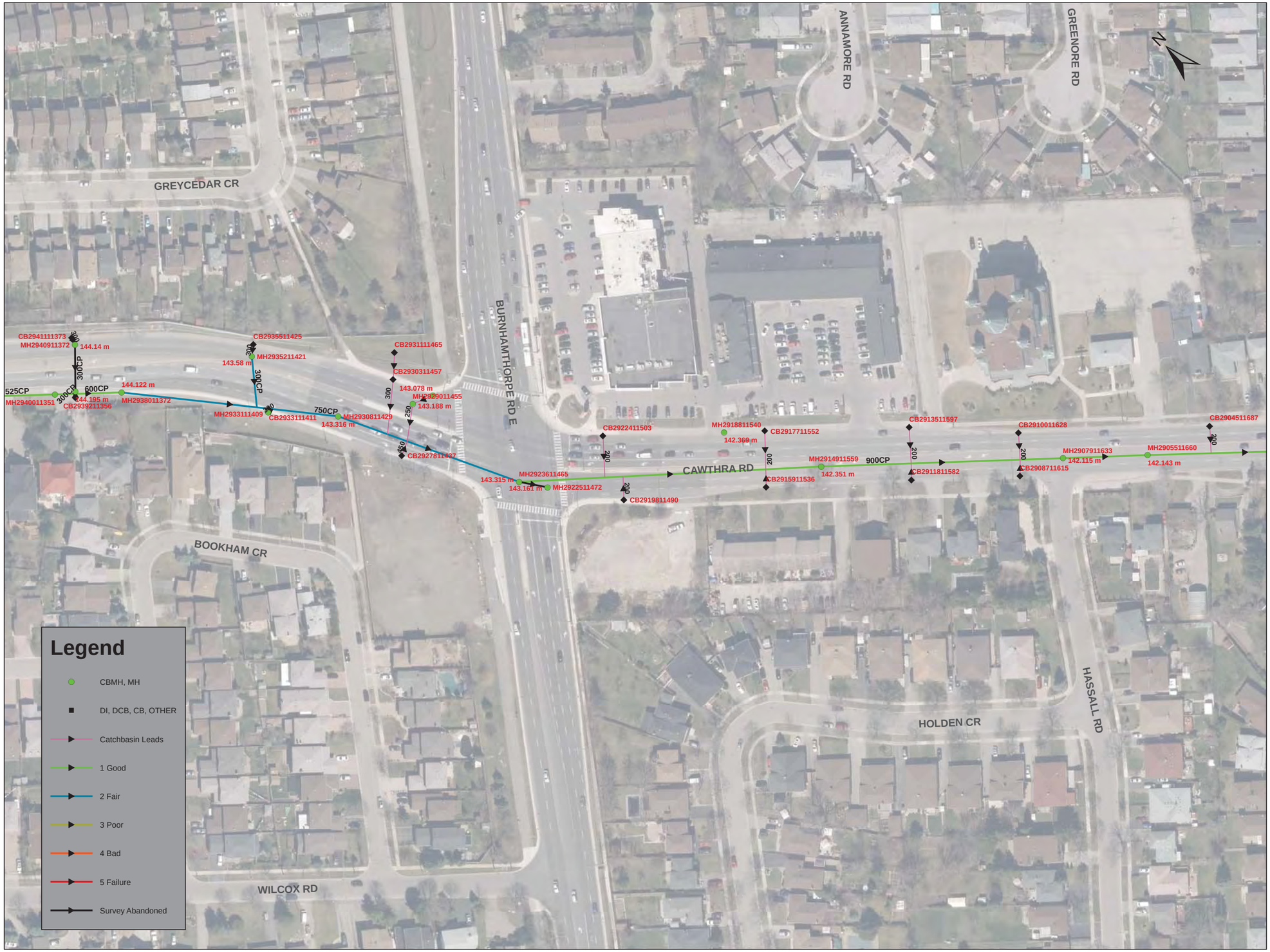
Cawthra Road (Eastgate Parkway to South Service Road)



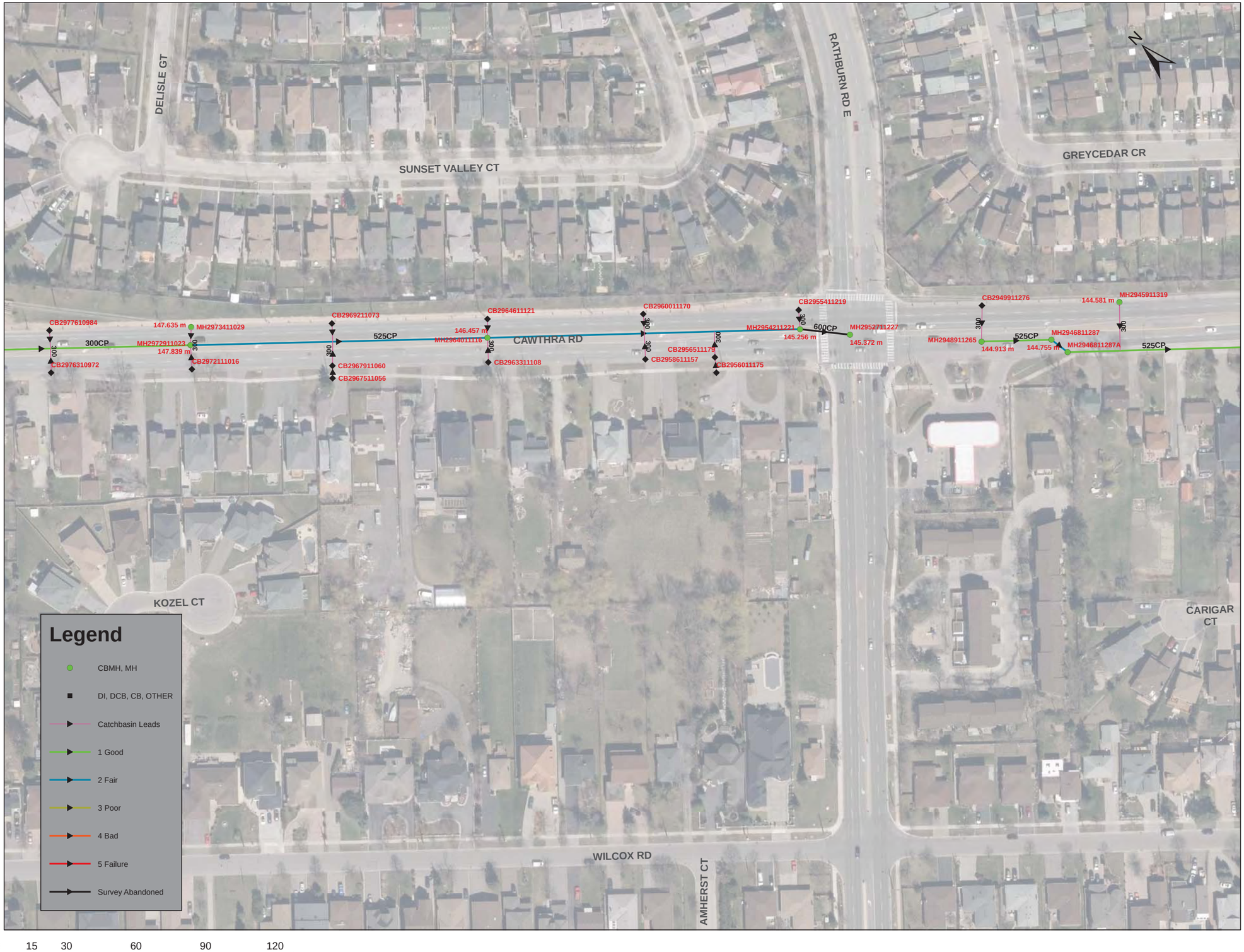
Cawthra Road (Eastgate Parkway to South Service Road)



Cawthra Road (Eastgate Parkway to South Service Road)



Cawthra Road (Eastgate Parkway to South Service Road)



Cawthra Road (Eastgate Parkway to South Service Road)

APPENDIX G

WATER BALANCE CALCULATIONS

Water Balance Calculations:

Cawthra Road (From QEW to Eastgate Parkway)

1. **Water Balance Required (to retain 27 mm of Rainfall):**

Site	Area	Storage Required to Retain 27 mm Rainfall
	(ha)	(m^3)
Cawthra Road (Corridor Area)	21.40	5780

2. **Water Balance Provided:**

Water Balance is provided through proposed Underground Infiltration Chambers and the Green Areas:

Check for Infiltration Volume:

Segment	Area (A)	Infiltration Rate*	Time	Infiltration Volume (V)
	m^2	mm/hr	hr	m^3
Underground Infiltration Chambers	56.7	12	72**	48.9
Green Area	30300	12	24	8726
Total Volume:				**8775**

Notes: Approach
*According to "Hydrogeological Data Report and Impact Assessment, Cawthra Road Sanitary Sewer and Watermain Project 17-2452S (Phase 2), Mississauga, ON, dated March 21, 2019", prepared by WSP, the hydraulic conductivity of soils at BH2-13 (located on Cawthra Road approx. 310 m south of Burnhamthorpe Road) is $1.63X10^{-7}$ m/sec. This hydraulic conductivity at BH2-13 is equivalent to an approximate infiltration rate of 30 mm/hour (Reference: Table C2, Appendix C, Water Balance and Recharge, Stormwater Management Criteria, Toronto and Region Conservation Authority, August 2012, Version 1.0). Assuming a safety correction factor of 2.5, the design infiltration rate of the soil would be 12 mm/hour and is considered in the analysis.

**According to City of Toronto Wet Weather Flow Management Guidelines
(note under Table 4 in page 12)

Water Balance Required in Cawthra Road	**5780**	**m^3**
Water Balance Provided in Cawthra Road	**8775**	**m^3**

APPENDIX H

FLOW SPREAD ANALYSIS
(USING REGION OF PEEL IDF CURVES)

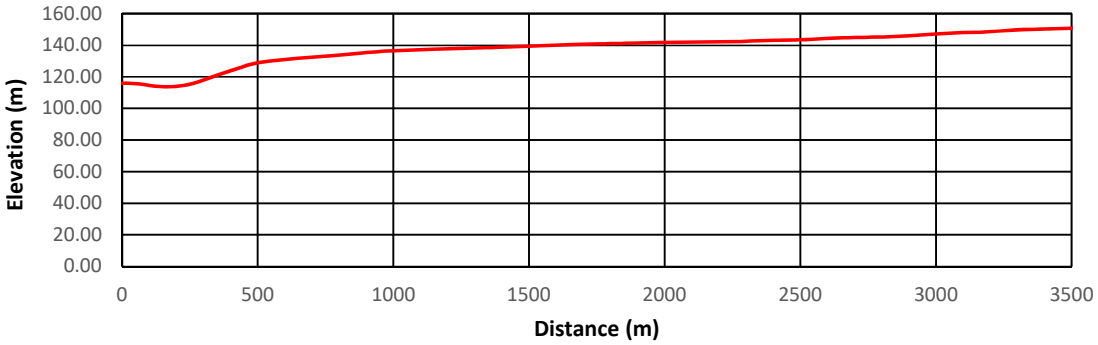
Location: Railway Underpass				
Station Range	11+880	to	15+520	
Lowpoint Station	12+040			
PROPERTIES OF THE ROAD				
Crossfall	2.0%			
PROFILE DATA				
Station	Distance from Start (m)	Span (m)	Elevation (m)	Slope
11.880	0.00	-	116.03	-
11.900	20.00	20.00	115.99	0.20%
11.920	40.00	20.00	115.91	0.40%
11.940	60.00	20.00	115.56	1.75%
11.960	80.00	20.00	115.15	2.05%
11.980	100.00	20.00	114.62	2.65%
12.000	120.00	20.00	114.14	2.40%
12.020	140.00	20.00	113.83	1.55%
12.040	160.00	20.00	113.71	0.60%
12.060	180.00	20.00	113.74	0.15%
12.080	200.00	20.00	113.99	1.25%
12.100	220.00	20.00	114.41	2.10%
12.120	240.00	20.00	115.05	3.20%
12.140	260.00	20.00	115.89	4.20%
12.160	280.00	20.00	116.89	5.00%
12.180	300.00	20.00	118.06	5.85%
12.200	320.00	20.00	119.25	5.95%
12.220	340.00	20.00	120.46	6.05%
12.240	360.00	20.00	121.66	6.00%
12.260	380.00	20.00	122.75	5.45%
12.280	400.00	20.00	123.95	6.00%
12.300	420.00	20.00	125.10	5.75%
12.320	440.00	20.00	126.24	5.70%
12.340	460.00	20.00	127.29	5.25%
12.360	480.00	20.00	128.18	4.45%
12.380	500.00	20.00	128.94	3.80%
12.400	520.00	20.00	129.58	3.20%
12.420	540.00	20.00	130.06	2.40%
12.440	560.00	20.00	130.45	1.95%
12.460	580.00	20.00	130.77	1.60%
12.480	600.00	20.00	131.06	1.45%
12.500	620.00	20.00	131.31	1.25%
12.520	640.00	20.00	131.65	1.70%
12.540	660.00	20.00	131.87	1.10%
12.560	680.00	20.00	132.18	1.55%
12.580	700.00	20.00	132.65	2.35%
12.600	720.00	20.00	132.76	0.55%
12.620	740.00	20.00	133.04	1.40%
12.640	760.00	20.00	133.33	1.45%
12.660	780.00	20.00	133.60	1.35%
12.680	800.00	20.00	133.86	1.30%
12.700	820.00	20.00	134.15	1.45%
12.720	840.00	20.00	134.47	1.60%
12.740	860.00	20.00	134.76	1.45%
12.760	880.00	20.00	135.08	1.60%
12.780	900.00	20.00	135.57	2.45%
12.800	920.00	20.00	135.65	0.40%
12.820	940.00	20.00	135.94	1.45%
12.840	960.00	20.00	136.22	1.40%

12.860	980.00	20.00	136.48	1.30%
12.880	1000.00	20.00	136.67	0.95%
12.900	1020.00	20.00	136.81	0.70%
12.920	1040.00	20.00	136.93	0.60%
12.940	1060.00	20.00	137.02	0.45%
12.960	1080.00	20.00	137.10	0.40%
12.980	1100.00	20.00	137.18	0.40%
13.000	1120.00	20.00	137.28	0.50%
13.020	1140.00	20.00	137.37	0.45%
13.040	1160.00	20.00	137.52	0.75%
13.060	1180.00	20.00	137.66	0.70%
13.080	1200.00	20.00	137.81	0.75%
13.100	1220.00	20.00	137.97	0.80%
13.120	1240.00	20.00	138.12	0.75%
13.140	1260.00	20.00	138.21	0.45%
13.160	1280.00	20.00	138.27	0.30%
13.180	1300.00	20.00	138.37	0.50%
13.200	1320.00	20.00	138.47	0.50%
13.220	1340.00	20.00	138.55	0.40%
13.240	1360.00	20.00	138.62	0.35%
13.260	1380.00	20.00	138.75	0.65%
13.280	1400.00	20.00	138.89	0.70%
13.300	1420.00	20.00	139.01	0.60%
13.320	1440.00	20.00	139.08	0.35%
13.340	1460.00	20.00	139.19	0.55%
13.360	1480.00	20.00	139.34	0.75%
13.380	1500.00	20.00	139.49	0.75%
13.400	1520.00	20.00	139.60	0.55%
13.420	1540.00	20.00	139.75	0.75%
13.440	1560.00	20.00	139.92	0.85%
13.460	1580.00	20.00	140.03	0.55%
13.480	1600.00	20.00	140.17	0.70%
13.500	1620.00	20.00	140.28	0.55%
13.520	1640.00	20.00	140.38	0.50%
13.540	1660.00	20.00	140.49	0.55%
13.560	1680.00	20.00	140.59	0.50%
13.580	1700.00	20.00	140.68	0.45%
13.600	1720.00	20.00	140.78	0.50%
13.620	1740.00	20.00	140.83	0.25%
13.640	1760.00	20.00	140.90	0.35%
13.660	1780.00	20.00	141.00	0.50%
13.680	1800.00	20.00	141.07	0.35%
13.700	1820.00	20.00	141.09	0.10%
13.720	1840.00	20.00	141.21	0.60%
13.740	1860.00	20.00	141.28	0.35%
13.760	1880.00	20.00	141.36	0.40%
13.780	1900.00	20.00	141.43	0.35%
13.800	1920.00	20.00	141.51	0.40%
13.820	1940.00	20.00	141.60	0.45%
13.840	1960.00	20.00	141.68	0.40%
13.860	1980.00	20.00	141.73	0.25%
13.880	2000.00	20.00	141.83	0.50%
13.900	2020.00	20.00	141.89	0.30%
13.920	2040.00	20.00	141.93	0.20%
13.940	2060.00	20.00	141.98	0.25%
13.960	2080.00	20.00	142.03	0.25%

13.980	2100.00	20.00	142.10	0.35%
14.000	2120.00	20.00	142.17	0.35%
14.020	2140.00	20.00	142.18	0.05%
14.040	2160.00	20.00	142.16	-0.10%
14.060	2180.00	20.00	142.11	-0.25%
14.080	2200.00	20.00	142.13	0.10%
14.100	2220.00	20.00	142.19	0.30%
14.120	2240.00	20.00	142.28	0.45%
14.140	2260.00	20.00	142.39	0.55%
14.160	2280.00	20.00	142.44	0.25%
14.180	2300.00	20.00	142.55	0.55%
14.200	2320.00	20.00	142.69	0.70%
14.220	2340.00	20.00	142.85	0.80%
14.240	2360.00	20.00	142.97	0.60%
14.260	2380.00	20.00	143.12	0.75%
14.280	2400.00	20.00	143.18	0.30%
14.300	2420.00	20.00	143.19	0.05%
14.320	2440.00	20.00	143.27	0.40%
14.340	2460.00	20.00	143.37	0.50%
14.360	2480.00	20.00	143.45	0.40%
14.380	2500.00	20.00	143.54	0.45%
14.400	2520.00	20.00	143.64	0.50%
14.420	2540.00	20.00	143.83	0.95%
14.440	2560.00	20.00	144.00	0.85%
14.460	2580.00	20.00	144.20	1.00%
14.480	2600.00	20.00	144.37	0.85%
14.500	2620.00	20.00	144.52	0.75%
14.520	2640.00	20.00	144.66	0.70%
14.540	2660.00	20.00	144.76	0.50%
14.560	2680.00	20.00	144.84	0.40%
14.580	2700.00	20.00	144.93	0.45%
14.600	2720.00	20.00	145.01	0.40%
14.620	2740.00	20.00	145.09	0.40%
14.640	2760.00	20.00	145.16	0.35%
14.660	2780.00	20.00	145.25	0.45%
14.680	2800.00	20.00	145.33	0.40%
14.700	2820.00	20.00	145.39	0.30%
14.720	2840.00	20.00	145.47	0.40%
14.740	2860.00	20.00	145.60	0.65%
14.760	2880.00	20.00	145.75	0.75%
14.780	2900.00	20.00	145.97	1.10%
14.800	2920.00	20.00	146.22	1.25%
14.820	2940.00	20.00	146.48	1.30%
14.840	2960.00	20.00	146.74	1.30%
14.860	2980.00	20.00	147.02	1.40%
14.880	3000.00	20.00	147.29	1.35%
14.900	3020.00	20.00	147.51	1.10%
14.920	3040.00	20.00	147.67	0.80%
14.940	3060.00	20.00	147.79	0.60%
14.960	3080.00	20.00	147.89	0.50%
14.980	3100.00	20.00	148.01	0.60%
15.000	3120.00	20.00	148.12	0.55%
15.020	3140.00	20.00	148.20	0.40%
15.040	3160.00	20.00	148.29	0.45%
15.060	3180.00	20.00	148.40	0.55%
15.080	3200.00	20.00	148.62	1.10%

15.100	3220.00	20.00	148.94	1.60%
15.120	3240.00	20.00	149.12	0.90%
15.140	3260.00	20.00	149.33	1.05%
15.160	3280.00	20.00	149.60	1.35%
15.180	3300.00	20.00	149.82	1.10%
15.200	3320.00	20.00	149.98	0.80%
15.220	3340.00	20.00	150.07	0.45%
15.240	3360.00	20.00	150.14	0.35%
15.260	3380.00	20.00	150.22	0.40%
15.280	3400.00	20.00	150.27	0.25%
15.300	3420.00	20.00	150.43	0.80%
15.320	3440.00	20.00	150.51	0.40%
15.340	3460.00	20.00	150.59	0.40%
15.360	3480.00	20.00	150.70	0.55%
15.380	3500.00	20.00	150.79	0.45%
15.400	3520.00	20.00	150.86	0.35%
15.420	3540.00	20.00	150.98	0.60%
15.440	3560.00	20.00	151.12	0.70%
15.460	3580.00	20.00	151.12	0.00%
15.480	3600.00	20.00	151.25	0.65%
15.500	3620.00	20.00	151.37	0.60%
15.520	3640.00	20.00	151.57	1.00%
			Average Longitudinal Grade:	1.10%

Longitudinal Road Profile



PARAMETERS			
S_X	0.0200	m/m	*Crossfall*
S_O	0.0110	m/m	*Longitudinal Grade*
i_{10}	134.16	mm/hr	*Rainfall Intensity 2019 (10-Year)*
i_{100}	196.54	mm/hr	*Rainfall Intensity 2019 (100-Year)*
n	0.013		*Manning's Roughness Coeff.*
C	0.95		*Runoff Coefficient*
W	19.14	m	*Drainage Area Width*
L	3640.00	m	*Drainage Area Length*

DISCHARGE CALCULATIONS (from Eq.3.5)

W (m)	L (m)	C	I (mm/hr)	Q_{10} (m^3/s)
19.14	3640.00	0.95	134.16	2.486

W (m)	L (m)	C	I (mm/hr)	Q_{100} (m^3/s)
19.14	3640.00	0.95	196.54	3.642

Q (m^3/s)	3.642

SPREAD CHECK (MAJOR SYSTEM)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q_{90} (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
3.642	0.013	0.0200	0.0110	0.247
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.247	0.0200	12.356		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	12.3557	11.856		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	11.8557	-4.856		
SPREAD CHECK (MINOR SYSTEM)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q_{10} (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
2.486	0.013	0.0200	0.0110	0.214
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.214	0.0200	10.708		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	10.7077	10.208		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	10.2077	-3.208		
SPREAD CHECK (25 mm Storm Event - 4 Hour Chicago Storm)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
0.121	0.013	0.0200	0.0110	0.069
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.069	0.0200	3.447		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	3.4467	2.947		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	2.9467	4.053		

FLOW SPREAD ANALYSIS
(USING 2095 CLIMATE CHANGE IDF CURVES)

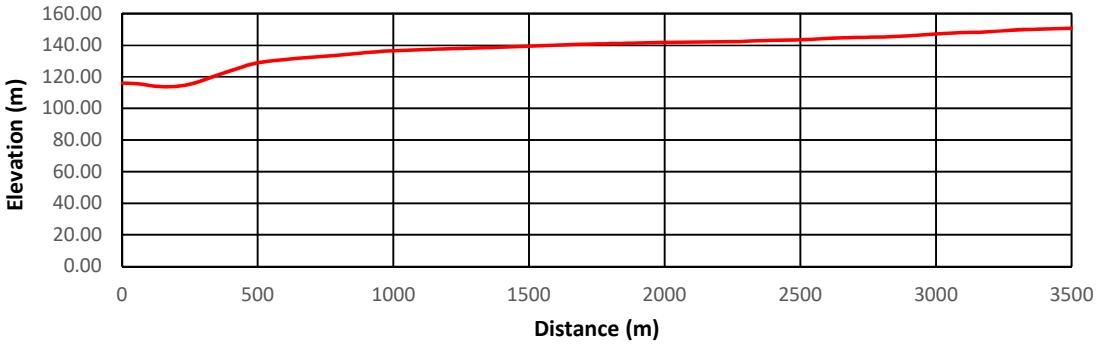
Location: Railway Underpass				
Station Range	11+880	to	15+520	
Lowpoint Station	12+040			
PROPERTIES OF THE ROAD				
Crossfall	2.0%			
PROFILE DATA				
Station	Distance from Start (m)	Span (m)	Elevation (m)	Slope
11.880	0.00	-	116.03	-
11.900	20.00	20.00	115.99	0.20%
11.920	40.00	20.00	115.91	0.40%
11.940	60.00	20.00	115.56	1.75%
11.960	80.00	20.00	115.15	2.05%
11.980	100.00	20.00	114.62	2.65%
12.000	120.00	20.00	114.14	2.40%
12.020	140.00	20.00	113.83	1.55%
12.040	160.00	20.00	113.71	0.60%
12.060	180.00	20.00	113.74	0.15%
12.080	200.00	20.00	113.99	1.25%
12.100	220.00	20.00	114.41	2.10%
12.120	240.00	20.00	115.05	3.20%
12.140	260.00	20.00	115.89	4.20%
12.160	280.00	20.00	116.89	5.00%
12.180	300.00	20.00	118.06	5.85%
12.200	320.00	20.00	119.25	5.95%
12.220	340.00	20.00	120.46	6.05%
12.240	360.00	20.00	121.66	6.00%
12.260	380.00	20.00	122.75	5.45%
12.280	400.00	20.00	123.95	6.00%
12.300	420.00	20.00	125.10	5.75%
12.320	440.00	20.00	126.24	5.70%
12.340	460.00	20.00	127.29	5.25%
12.360	480.00	20.00	128.18	4.45%
12.380	500.00	20.00	128.94	3.80%
12.400	520.00	20.00	129.58	3.20%
12.420	540.00	20.00	130.06	2.40%
12.440	560.00	20.00	130.45	1.95%
12.460	580.00	20.00	130.77	1.60%
12.480	600.00	20.00	131.06	1.45%
12.500	620.00	20.00	131.31	1.25%
12.520	640.00	20.00	131.65	1.70%
12.540	660.00	20.00	131.87	1.10%
12.560	680.00	20.00	132.18	1.55%
12.580	700.00	20.00	132.65	2.35%
12.600	720.00	20.00	132.76	0.55%
12.620	740.00	20.00	133.04	1.40%
12.640	760.00	20.00	133.33	1.45%
12.660	780.00	20.00	133.60	1.35%
12.680	800.00	20.00	133.86	1.30%
12.700	820.00	20.00	134.15	1.45%
12.720	840.00	20.00	134.47	1.60%
12.740	860.00	20.00	134.76	1.45%
12.760	880.00	20.00	135.08	1.60%
12.780	900.00	20.00	135.57	2.45%
12.800	920.00	20.00	135.65	0.40%
12.820	940.00	20.00	135.94	1.45%
12.840	960.00	20.00	136.22	1.40%

12.860	980.00	20.00	136.48	1.30%
12.880	1000.00	20.00	136.67	0.95%
12.900	1020.00	20.00	136.81	0.70%
12.920	1040.00	20.00	136.93	0.60%
12.940	1060.00	20.00	137.02	0.45%
12.960	1080.00	20.00	137.10	0.40%
12.980	1100.00	20.00	137.18	0.40%
13.000	1120.00	20.00	137.28	0.50%
13.020	1140.00	20.00	137.37	0.45%
13.040	1160.00	20.00	137.52	0.75%
13.060	1180.00	20.00	137.66	0.70%
13.080	1200.00	20.00	137.81	0.75%
13.100	1220.00	20.00	137.97	0.80%
13.120	1240.00	20.00	138.12	0.75%
13.140	1260.00	20.00	138.21	0.45%
13.160	1280.00	20.00	138.27	0.30%
13.180	1300.00	20.00	138.37	0.50%
13.200	1320.00	20.00	138.47	0.50%
13.220	1340.00	20.00	138.55	0.40%
13.240	1360.00	20.00	138.62	0.35%
13.260	1380.00	20.00	138.75	0.65%
13.280	1400.00	20.00	138.89	0.70%
13.300	1420.00	20.00	139.01	0.60%
13.320	1440.00	20.00	139.08	0.35%
13.340	1460.00	20.00	139.19	0.55%
13.360	1480.00	20.00	139.34	0.75%
13.380	1500.00	20.00	139.49	0.75%
13.400	1520.00	20.00	139.60	0.55%
13.420	1540.00	20.00	139.75	0.75%
13.440	1560.00	20.00	139.92	0.85%
13.460	1580.00	20.00	140.03	0.55%
13.480	1600.00	20.00	140.17	0.70%
13.500	1620.00	20.00	140.28	0.55%
13.520	1640.00	20.00	140.38	0.50%
13.540	1660.00	20.00	140.49	0.55%
13.560	1680.00	20.00	140.59	0.50%
13.580	1700.00	20.00	140.68	0.45%
13.600	1720.00	20.00	140.78	0.50%
13.620	1740.00	20.00	140.83	0.25%
13.640	1760.00	20.00	140.90	0.35%
13.660	1780.00	20.00	141.00	0.50%
13.680	1800.00	20.00	141.07	0.35%
13.700	1820.00	20.00	141.09	0.10%
13.720	1840.00	20.00	141.21	0.60%
13.740	1860.00	20.00	141.28	0.35%
13.760	1880.00	20.00	141.36	0.40%
13.780	1900.00	20.00	141.43	0.35%
13.800	1920.00	20.00	141.51	0.40%
13.820	1940.00	20.00	141.60	0.45%
13.840	1960.00	20.00	141.68	0.40%
13.860	1980.00	20.00	141.73	0.25%
13.880	2000.00	20.00	141.83	0.50%
13.900	2020.00	20.00	141.89	0.30%
13.920	2040.00	20.00	141.93	0.20%
13.940	2060.00	20.00	141.98	0.25%
13.960	2080.00	20.00	142.03	0.25%

13.980	2100.00	20.00	142.10	0.35%
14.000	2120.00	20.00	142.17	0.35%
14.020	2140.00	20.00	142.18	0.05%
14.040	2160.00	20.00	142.16	-0.10%
14.060	2180.00	20.00	142.11	-0.25%
14.080	2200.00	20.00	142.13	0.10%
14.100	2220.00	20.00	142.19	0.30%
14.120	2240.00	20.00	142.28	0.45%
14.140	2260.00	20.00	142.39	0.55%
14.160	2280.00	20.00	142.44	0.25%
14.180	2300.00	20.00	142.55	0.55%
14.200	2320.00	20.00	142.69	0.70%
14.220	2340.00	20.00	142.85	0.80%
14.240	2360.00	20.00	142.97	0.60%
14.260	2380.00	20.00	143.12	0.75%
14.280	2400.00	20.00	143.18	0.30%
14.300	2420.00	20.00	143.19	0.05%
14.320	2440.00	20.00	143.27	0.40%
14.340	2460.00	20.00	143.37	0.50%
14.360	2480.00	20.00	143.45	0.40%
14.380	2500.00	20.00	143.54	0.45%
14.400	2520.00	20.00	143.64	0.50%
14.420	2540.00	20.00	143.83	0.95%
14.440	2560.00	20.00	144.00	0.85%
14.460	2580.00	20.00	144.20	1.00%
14.480	2600.00	20.00	144.37	0.85%
14.500	2620.00	20.00	144.52	0.75%
14.520	2640.00	20.00	144.66	0.70%
14.540	2660.00	20.00	144.76	0.50%
14.560	2680.00	20.00	144.84	0.40%
14.580	2700.00	20.00	144.93	0.45%
14.600	2720.00	20.00	145.01	0.40%
14.620	2740.00	20.00	145.09	0.40%
14.640	2760.00	20.00	145.16	0.35%
14.660	2780.00	20.00	145.25	0.45%
14.680	2800.00	20.00	145.33	0.40%
14.700	2820.00	20.00	145.39	0.30%
14.720	2840.00	20.00	145.47	0.40%
14.740	2860.00	20.00	145.60	0.65%
14.760	2880.00	20.00	145.75	0.75%
14.780	2900.00	20.00	145.97	1.10%
14.800	2920.00	20.00	146.22	1.25%
14.820	2940.00	20.00	146.48	1.30%
14.840	2960.00	20.00	146.74	1.30%
14.860	2980.00	20.00	147.02	1.40%
14.880	3000.00	20.00	147.29	1.35%
14.900	3020.00	20.00	147.51	1.10%
14.920	3040.00	20.00	147.67	0.80%
14.940	3060.00	20.00	147.79	0.60%
14.960	3080.00	20.00	147.89	0.50%
14.980	3100.00	20.00	148.01	0.60%
15.000	3120.00	20.00	148.12	0.55%
15.020	3140.00	20.00	148.20	0.40%
15.040	3160.00	20.00	148.29	0.45%
15.060	3180.00	20.00	148.40	0.55%
15.080	3200.00	20.00	148.62	1.10%

15.100	3220.00	20.00	148.94	1.60%
15.120	3240.00	20.00	149.12	0.90%
15.140	3260.00	20.00	149.33	1.05%
15.160	3280.00	20.00	149.60	1.35%
15.180	3300.00	20.00	149.82	1.10%
15.200	3320.00	20.00	149.98	0.80%
15.220	3340.00	20.00	150.07	0.45%
15.240	3360.00	20.00	150.14	0.35%
15.260	3380.00	20.00	150.22	0.40%
15.280	3400.00	20.00	150.27	0.25%
15.300	3420.00	20.00	150.43	0.80%
15.320	3440.00	20.00	150.51	0.40%
15.340	3460.00	20.00	150.59	0.40%
15.360	3480.00	20.00	150.70	0.55%
15.380	3500.00	20.00	150.79	0.45%
15.400	3520.00	20.00	150.86	0.35%
15.420	3540.00	20.00	150.98	0.60%
15.440	3560.00	20.00	151.12	0.70%
15.460	3580.00	20.00	151.12	0.00%
15.480	3600.00	20.00	151.25	0.65%
15.500	3620.00	20.00	151.37	0.60%
15.520	3640.00	20.00	151.57	1.00%
			Average Longitudinal Grade:	1.10%

Longitudinal Road Profile



PARAMETERS			
S_X	0.0200	m/m	*Crossfall*
S_O	0.0110	m/m	*Longitudinal Grade*
i_{10}	150.76	mm/hr	*Rainfall Intensity 2095 (10-Year)*
i_{100}	246.12	mm/hr	*Rainfall Intensity 2095 (100-Year)*
n	0.013		*Manning's Roughness Coeff.*
C	0.95		*Runoff Coefficient*
W	19.14	m	*Drainage Area Width*
L	3640.00	m	*Drainage Area Length*

DISCHARGE CALCULATIONS (from Eq.3.5)

W (m)	L (m)	C	I (mm/hr)	Q_{10} (m^3/s)
19.14	3640.00	0.95	150.76	2.794

W (m)	L (m)	C	I (mm/hr)	Q_{100} (m^3/s)
19.14	3640.00	0.95	246.12	4.561

Q (m^3/s)	4.561

SPREAD CHECK (MAJOR SYSTEM)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q_{90} (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
4.561	0.013	0.0200	0.0110	0.269
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.269	0.0200	13.443		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	13.4432	12.943		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	12.9432	-5.943		
SPREAD CHECK (MINOR SYSTEM)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q_{10} (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
2.794	0.013	0.0200	0.0110	0.224
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.224	0.0200	11.186		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	11.1863	10.686		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	10.6863	-3.686		
SPREAD CHECK (25 mm Storm Event - 4 Hour Chicago Storm)				
Maximum Flow Depth Calculation (from Eq.3.4)				
Q (m^3/s)	n	S_X (m/m)	S_O (m/m)	d (m)
0.121	0.013	0.0200	0.0110	0.069
Max Spread of Flow Calculation (from Figure 1)				
d (m)	S_X (m/m)	T (m)		
0.069	0.0200	3.447		
Encroachment into Traffic Lane				
Gutter Width (m)	T (m)	E (m)		
0.500	3.4467	2.947		
Clear Width of Traffic Lane				
1st Traffic Lane Width (m)	E (m)	C (m)		
7.000	2.9467	4.053		