6. PROJECT DESCRIPTION

The major features for the proposed roadway and active transportation improvements on Dundas Street between Brant Street and Bronte Road are described in **Section 6.1**, and the provision for transit stops along this section of the Dundas Street corridor are described in **Section 6.2**. The preliminary plan is provided in **Plates 1 to 27**. The construction limits of the roadway components are approximately 300 m east of Brant Street to 350 m west of Bronte Road to adjoin 6-lane Dundas Street sections to the west and east, respectively. It should be noted that the Brant Street / Dundas Street intersection is currently undergoing detailed design to be widened to 6 lanes. Provision for transit stops and active transportation facilities at the Brant Street / Dundas Street and Bronte Road / Dundas Street intersections would be implemented as part of the widening of Dundas Street from 4 to 6 lanes even though these intersections are beyond the above construction limits.

This information should be reviewed in conjunction with **Chapter 4** of the ESR which describes the alternative designs. While refinements may occur during detailed design, any changes should not alter the intent of the recommended undertaking or its components. During detailed design, there will be further consultation with technical agencies, including, but not limited to, Conservation Halton, Ministry of Natural Resources and Forestry, Ministry of the Environment and Climate Change, CN Rail, the City of Burlington, Town of Oakville, Burlington Transit, Oakville Transit, utilities and affected property owners.

The recommended undertaking for Dundas Street between Brant Street and Bronte Road includes the following:

- widening of Dundas Street from 4 to 6 lanes to adjoin existing 6-lane section to the east and the planned 6-lane section to the west;
- outside curb lanes include provision for High Occupancy Vehicle (HOV) / Transit lanes in the interim and converted to dedicated bus lanes in the future;
- transforming from rural roadway (i.e. ditches) to urban roadway (i.e. curbs);
- active transportation facilities, including:
  - from Brant Street to Northampton Boulevard: 4.0 m bi-directional multi-use path on the south side only;
  - from Northampton Boulevard to Appleby Line: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (with 0.5 m painted buffer) in each direction;
  - from Appleby Line to Bronte Road: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction;
- introduction of full illumination and enhanced streetscape features;
- provision of enhanced bus stops at signalized intersections;
- structural improvements, including: widening and replacement of Tansley Bridge (Bronte Creek crossing), widening of CN railway bridge east of Appleby Line,

widening of 407 ETR structure, and replacement of Fourteen Mile Creek West culvert crossing with a 20 m span structure west of Colonel William Parkway.

6.1 Roadway Major Features

6.1.1 Design Criteria

Currently, Dundas Street is generally posted at 60 km/h along the four lane section between Brant Street and Bronte Road, except near the Bronte Creek Provincial Park Area (i.e. between Sutton Drive and Tremaine Road) and near the 407 ETR interchange east of Guelph Line, where Dundas Street it is posted at 80 km/h. Once the improvements have been implemented, the posted speed limit on Dundas Street will be reduced to 60 km/h; this is consistent with the transformation of Dundas Street from a rural corridor to a pedestrian and cyclist-friendly Regional arterial road. The geometric details are listed in **Table 6-1**.

As noted in **Section 1.1.1**, the widening of Dundas Street through the Town of Oakville and the City of Burlington will take a number of years to complete. The construction of the widening will be from east to west; timing will be subject to annual Regional Council review and funding priorities. It should be noted that beyond the Study Area, east of Bronte Road, Dundas Street is already widened from 4 to 6 lanes between Highway 403 and Oak Park Boulevard, and the widening between Bronte Road and Neyagawa Boulevard began in 2014; the construction of Dundas Street between Neyagawa Boulevard and Oak Park Boulevard is anticipated to begin in summer 2016.

The improvements on Dundas Street will be implemented through a phased approach for providing incremental transportation improvements. The curb lanes include provision to accommodate future HOV / transit lanes or dedicated BRT lanes in the future. The transition from general purpose to HOV / transit lanes to BRT lanes would not require reconstruction of the roadway. Much of the transition would likely be related to changes in signage, pavement markings, and requirements identified by the local transit authority (in this case, Burlington Transit and Oakville Transit). The timing and limits of higher order transit in Oakville and Burlington will be determined by the local municipalities and the respective transit providers.

Table 6-1: Dundas Street Design Criteria

	Existing Conditions	Design Standard	Proposed Standard
Design Speed	100 km/h	90 km/h	90 km/h
Posted Speed	80 km/h	60 km/h	60 km/h
No. of Lanes and Width: Brant Street to Northampton Boulevard[1,2,3]	4 lanes @ 3.65 m	4 GPL @ 3.5 m 2 curb lanes @ 4.2 m	4 GPL @ 3.5 m 2 curb lanes @ 4.2 m
No. of Lanes and Width: Northampton Boulevard to Bronte Road[1,2]	4 lanes @ 3.65 m	4 GPL @ 3.5 m 2 curb lanes @ 3.5 m	4 GPL @ 3.5 m 2 curb lanes @ 3.5 m
Provision for Pedestrians and	No sidewalks / multi-use path	4.0 m bi-directional multi-use path on both	4.0 m bi-directional multi-use path on both

	Existing Conditions	Design Standard	Proposed Standard
Cyclists: Brant Street to Northampton Boulevard		sides of the road	sides of the road
Provision for Pedestrians and Cyclists: Northampton Boulevard to Appleby Line	Pathway parallel to the north side of Dundas Street between Rotary Way and Appleby Line; pathway on the south side between Millcroft Park Drive and Appleby Line	3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane with a painted 0.5 m buffer	3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane with a painted 0.5 m buffer
Provision for Pedestrians and Cyclists: Appleby Line to Bronte Road	North side curb face sidewalk between Appleby Line and Sutton Drive (except CN structure) South side curb face sidewalk between Appleby Line and Sutton Drive, and on Tansley Bridge	3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction	3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction
Minimum Grade	0.02 %	0.5 %	0.3 %[4]
Maximum Grade	4.2 %	12 %	4.2 %
Minimum Curve Radius	875 m	340 m	875 m
Minimum Stopping Sight Distance	N/A	160 m	160 m
Raised Median	N/A	5.25 m to 6.5 m	5.5 m to 6.5 m, narrows near intersection
Minimum Crest Curve	40	$K_{crest} = 50$	$K_{crest} = 50$
Minimum Sag Curve	25	$K_{sag} = 40$	$K_{sag} = 40$
Basic Right-of-Way[5]	Varies between 35 m to 50 m	50 m	50 m

1. Additional turning lanes provided at identified intersections.
2. Curb lanes include provision for High Occupancy Vehicles (HOV) / Transit use, and dedicated Bus Rapid Transit (BRT) lanes if warranted.
3. Lane width at the Highway 407 structure is proposed to be at 3.75 m consistent with MTO and 407 ETR requirements (see **Section 6.1.8.1**).
4. While the minimum desirable grade is 0.5%, a minimum grade of 0.3% is considered to be acceptable in urban areas.
5. Additional property may be required beyond the right-of-way due to grading, intersections and stormwater management considerations.

See **Section 6.2.1** regarding functional design of bus bays and bus stops.

6.1.2 Typical Cross Section

Exhibits 6-1a to **6-1c** illustrate the typical proposed cross-sections for the Dundas Street corridor improvements between Brant Street and Bronte Road. The following summarizes the basic features of the cross-sections within the Study Area:

- Nominal 50 m right-of-way (varies locally near intersections)
- 6 lanes (three lanes in each direction)
- 5.5 m to 6.5 m raised median (median would narrow near intersections to accommodate left turn lanes) and in areas where property is constrained
- Between Sutton Drive and Tremaine Road, depressed median may be implemented for emergency vehicles; subject to review during detailed design and consultation with emergency services
- Active transportation facilities are provided as follows:
    - from Brant Street to Northampton Boulevard: 4.0 m bi-directional multi-use path on the south side only;
    - from Northampton Boulevard to Appleby Line: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane plus a 0.5 m painted buffer in each direction
    - from Appleby Line to Bronte Road: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction

In areas where there are constraints, for example, Nelson United Church and Cemetery, St. John's Anglican Church and Cemetery, St. Paul's Presbyterian Church and Cemetery, etc., the cross section has been modified to minimize or avoid impact to these features and retaining walls are provided where required; this will be subject to further review and modification during detailed design.

Cross section at bridge structures (407 ETR interchange, CN Railway, Tansley Bridge and Fourteen Mile Creek West crossing) can be found in **Section 6.1.8**.

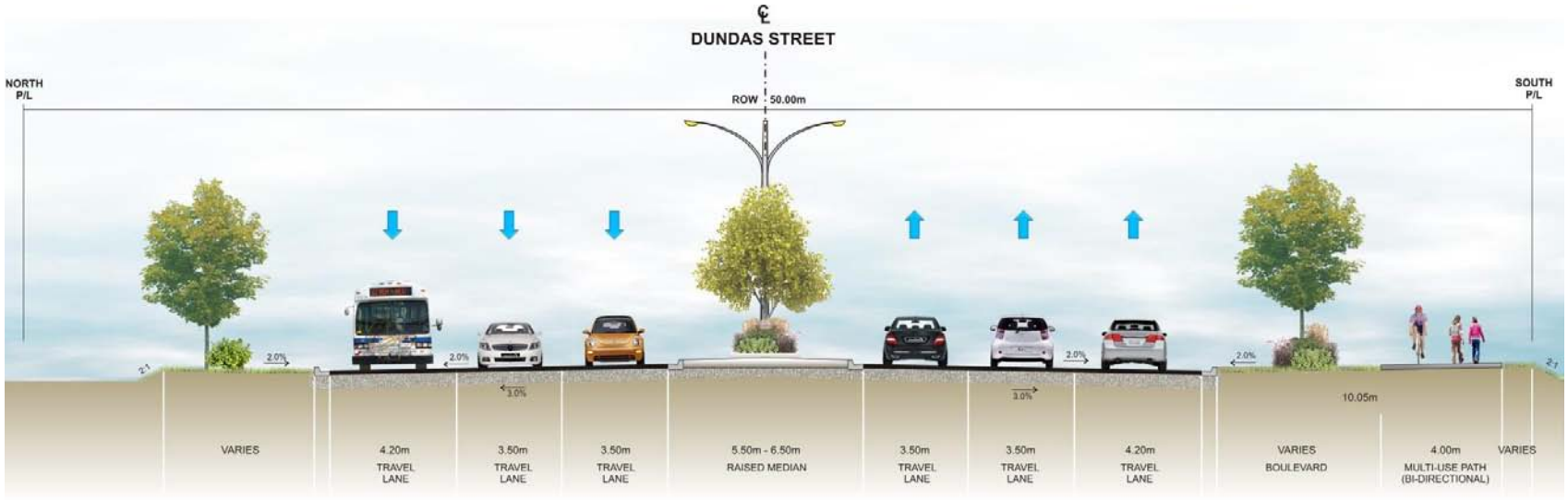
6.1.3 Alignment and Grade

Dundas Street will be widened mainly to the north side between Brant Street and Bronte Road due to mature or existing residential communities on the south side of the road. However, in areas where there are significant constraints, the widening will be shifted to the south or will be accommodated by modification to the typical cross section and transit facilities to minimize impact to adjacent properties / features.

The proposed vertical profile is proposed to generally follow that of the existing Dundas Street profile in order to minimize property requirements. The grading of future developments may be designed to match the proposed grade of Dundas Street.

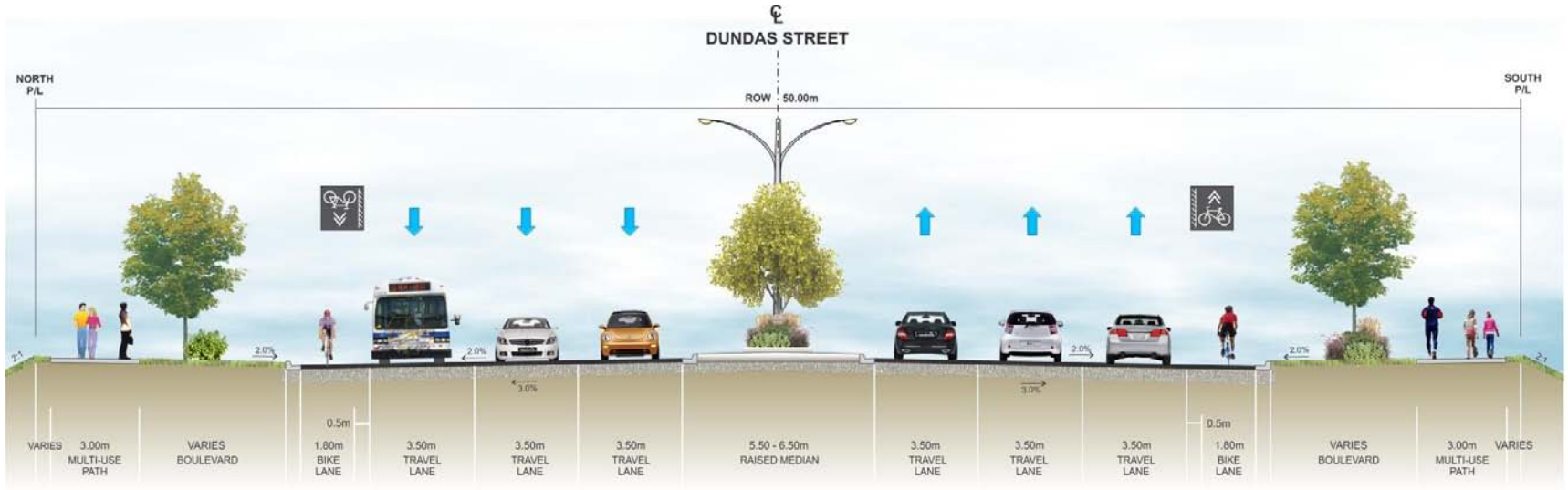
A geotechnical investigation was carried out by Thurber Engineering regarding pavement design and recommendations. A copy of the report is provided in **Appendix J**.

Exhibit 6-1a: Dundas Street Typical Cross Section – Brant Street to Northampton Boulevard



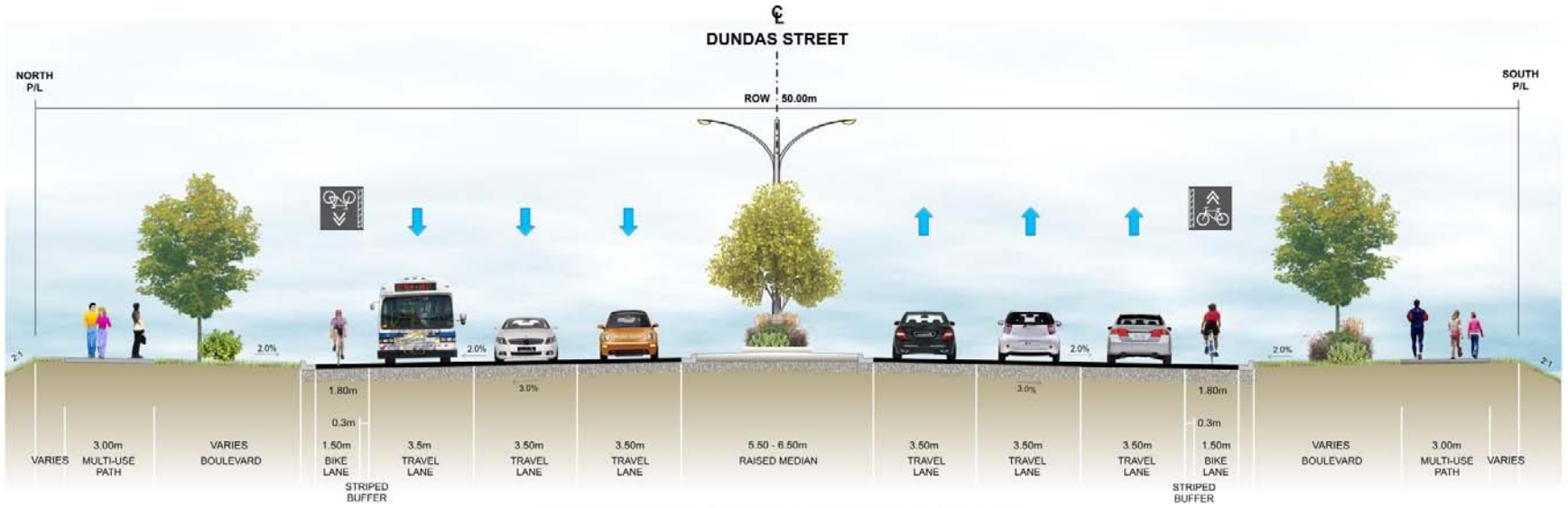
BRANT STREET (10+000) TO NORTHAMPTON BOULEVARD (13+660)
(PROPOSED 6 LANE CROSS-SECTION)

Exhibit 6-1b: Dundas Street Typical Cross Section – Northampton Boulevard to Appleby Line



NORTHAMPTON BOULEVARD (13+660) TO APPLEBY LINE (16+145)
(PROPOSED 6 LANE CROSS-SECTION)

Exhibit 6-1c: Dundas Street Typical Cross Section – Appleby Line to Bronte Road



APPLEBY LINE (16+145) TO BRONTE ROAD (20+100)
(PROPOSED 6 LANE CROSS-SECTION)

6.1.4 Provisions for Cyclists and Pedestrians

Halton Region is planning to implement an active transportation network in the Region to make it easier for people to walk and bike around Halton (as discussed in **Section 2.1.9**) through the ongoing Halton Region Active Transportation Master Plan Study (ATMP). The Halton Region ATMP was developed in consultation with the City of Burlington and Town of Oakville. Consistent with the Active Transportation Master Plan as completed to date, active transportation facilities within the Study Area are proposed as follows:

- from Brant Street to Northampton Boulevard: 4.0 m bi-directional multi-use path on the south side only;
- from Northampton Boulevard to Appleby Line: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane plus a 0.5 m painted buffer in each direction;
- from Appleby Line to Bronte Road: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction

For details regarding the Halton Region ATMP, please go to the study website at: http://www.halton.ca/activetransportation.

In constrained areas, the width of the multi-use path will be confirmed during detailed design in consultation with adjacent land owners, as well as the City of Burlington and the Town of Oakville. The City of Burlington and Town of Oakville also developed a Cycling Master Plan and an Active Transportation Master Plan, respectively, as discussed in **Sections 2.1.11** and **2.1.15**.

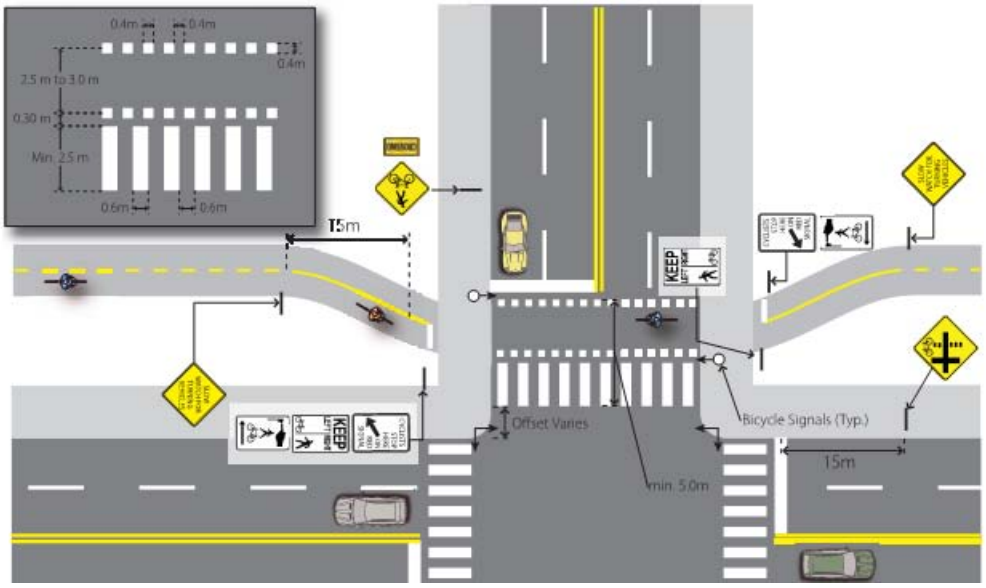
In terms of crossing at signalized intersections, while a standard marked crosswalk would be sufficient to allow pedestrians to cross at a controlled intersection, cyclists on a multi-use trail or shared pathway would be required to dismount and walk their bikes across. To allow cyclists to ride across, a "separate" crossride may be provided at an intersection in place of a standard crosswalk.

While different formats of crossrides are available (e.g. "combined" / "mixed" / "separate"); the "separate" arrangement is proposed. Similar treatment is already being implemented at the Dundas Street / Third Line intersection in the Town of Oakville. The layout will be similar to the example shown in **Exhibit 6-2**, which allows separate space for cyclists and pedestrians when crossing an intersection. This is applicable to sections of Dundas Street where multi-use paths are proposed.

As part of the Town of Oakville Active Transportation Master Plan, the potential for a pedestrian grade separation at Bronte Road was identified. The justification, timing, location, potential impacts, and specific design details associated with the pedestrian grade separation will be subject to further review and confirmation by the Town of Oakville.

It should also be noted that between the completion of the EA Study and construction for the widening of Dundas Street between Brant Street and Bronte Road, there may be new trends in active transportation and the facilities being implemented may be updated at that time. The right-of-way protected through the EA Study (nominally 50 m right-of-way) will be able to accommodate variations of active transportation facilities, as well as intersection treatments.

Exhibit 6-2: Separate Pedestrian and Cyclists Crossride (Signalized Example)



Source: Based on Ontario Traffic Manual Book 18, Figure 4.101

6.1.5 Intersections and Access

As a major arterial road, Dundas Street will include left and right turn lanes at most signalized intersections – within the study limits, the following intersections (from west to east) are or will become signalized.

Existing Signalized Intersections	
Brant Street	Cornerstone Drive / Millcroft Park Drive
Guelph Line	Appleby Line
407 ETR interchange N-E/W off-ramp	Sutton Drive
407 ETR interchange S-E/W off-ramp	Tremaine Road
Northampton Boulevard	Colonel William Parkway
Walkers Line	Valleyridge Drive
Rotary Way / Berwick Drive	Bronte Road
Tim Dobbie Drive / Westlock Common	
Future Signalized Intersections	
Eaglesfield Drive	Blackwood Drive

There are existing commercial and residential properties along Dundas Street that currently have full move access (i.e. can turn left and right) into and out of the entrance and are listed as follows:

***North Side of Dundas Street from West to East*:**

Brant Street to Guelph Line:

- 2111 Dundas Street (residential)
- 2165 Dundas Street (residential)

- 2195 Dundas Street (residential)
- 2217 Dundas Street (business)
- 2273 Dundas Street – Terra Greenhouses
- 2301 Dundas Street (business)
- 2373 Dundas Street (residential)
- 2437 Dundas Street – Nelson United Church
- 2495 Dundas Street – Nelson Variety Store

Guelph Line to Walkers Line:

- 3015 Dundas Street (residential)
- 3031 Dundas Street (business)
- 3043 Dundas Street (residential)
- 3083 Dundas Street (residential)
- 3105 Dundas Street (residential)
- 3115 Dundas Street (residential)
- 3151 Dundas Street (vacant)

Walkers Line to Appleby Line:

- Access to Smart!Centres at northwest quadrant of Dundas Street / Appleby Line

Appleby Line to Tremaine Road:

- 5371 Dundas Street (residential)
- 5401 Dundas Street – First Student (Laidlaw Transit Ltd.)

Tremaine Road to Bronte Road:

- 3445 Dundas Street (business)
- 3367 Dundas Street (residential / business, access via 3365 Dundas Street)
- 3365 Dundas Street (vacant)
- 3269/3271 Dundas Street (residential / business)
- 3185 Dundas Street (business, combined access with 3175 Dundas Street)
- 3175 Dundas Street – Forestview Bible Church
- 3111 Dundas Street (residential/business)

***South Side of Dundas Street from West to East*:**

Brant Street to Guelph Line:

- 2084 Dundas Street (residential)

- 2122 Dundas Street (residential)
- 2344 Dundas Street (residential)
- 2460 Dundas Street (residential)
- 2464 Dundas Street – St. John's Anglican Church and Cemetery

Guelph Line to Walkers Line:

- 3318 Dundas Street – St. Paul's Presbyterian Church and Cemetery

Walkers Line to Appleby Line:

- Millcroft Golf Club maintenance building, west of Millcroft Park Drive
- 4426 Dundas Street – Tansley YMCA Child Care Centre

Appleby Line to Tremaine Road:

- 5352 Dundas Street (residential)
- 5360 Dundas Street (residential)
- 5402 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- 5418 Dundas Street (vacant)
- Maintenance access to Bronte Creek Provincial Park west of Tremaine Road

Tremaine Road to Bronte Road:

- Maintenance access to Bronte Creek Provincial Park east of Tremaine Road
- 3316 Dundas Street – Wag-A-Way Express
- 3114 Dundas Street – St. Luke's Anglican Church

As Dundas Street is widened from 4 to 6 lanes, a raised concrete median will be provided to separate eastbound and westbound traffic for operational and safety purposes. While existing accesses will be maintained, access from Dundas Street will become right-in/right-out only. U-Turns at signalized intersections are permitted and will provide the private residences and affected businesses with an alternate way to replace left turn access.

It should be noted, however, the existing eastbound left turn access into the Smart!Centres at the northwest quadrant of Dundas Street / Appleby Line will remain as this was legally approved when the Dundas Street / Appleby Line intersection was widened to 6 lanes.

Future access to Dundas Street will be subject to review and approval should any properties or currently vacant properties with no direct access to Dundas Street make applications for development / redevelopment.

6.1.6 Drainage and Stormwater Management

The six (6) different watercourse catchments in the Study Area (outlined in **Section 3.5**) have their own specific requirements for quantity and quality treatment that have been defined through various studies including the North Oakville Creeks Subwatershed Study (NOCSS) and also through other site specific stormwater management reports that have been adopted. Proposed stormwater quality and quantity control measures for the Dundas Street are outlined according to each of the six catchment areas. Proposed watercourse considerations, including fluvial geomorphology and culvert characteristics/issues are similarly outlined.

Information regarding watercourse crossings, upstream and downstream fluvial geomorphology, cross-culvert physical characteristics, hydraulics, proposed culvert extensions, replacements and other Stormwater Management (SWM) considerations are discussed in this section. Detailed SWM calculations and supporting documents for Dundas Street widening between Brant Street to Bronte Road are included in **Appendix E**. Additional details are included for hydrologic modelling, stormwater quantity control, quality treatment and downstream conveyance network relevant to the study area.

The proposed widening of Dundas Street generally results in an increase of impervious area beyond existing conditions of 34-65% up to a post development imperviousness of 65-90% in certain stretches of Dundas Street. Expanded pavement areas as a result of the widening of Dundas Street are proposed to be addressed by stormwater quantity control and quality treatment measures designed according to the requirements for each receiving downstream conveyance, whether the receiver is a storm sewer system, swale or a watercourse. The new urbanized roadway will generally be drained by new storm sewer systems to be located within the right-of-way, thus replacing the existing roadside ditch drainage system. The potential implementation of low impact development (LID) approaches to drainage may be investigated during detailed design. The existing storm sewers on Dundas Street within the Sheldon Creek and Fourteen Mile Creek catchments will be maintained. These storm sewers will be assessed for accommodating additional drainage from the widened portions of Dundas Street during detailed design.

The new storm sewers will generally be sized for conveyance of a 1 in 10 year design storm. Where applicable, runoff in excess of that storm will be conveyed to a suitable outlet via overland flow or to a storage facility to provide quantity control. Generally, no overtopping from watercourse and culvert crossings will occur across Dundas Street under Regional Storm conditions within the Study Area. Additionally, major system flow design is predicted to achieve a roadway which is passable with at least the centre two lanes open (i.e. one in each direction) during a 1 in 100 year storm event.

The overall apportionment of runoff from Dundas Street and its external contributing areas will remain consistent with existing watershed catchment boundaries. Small exceptions may be required in the final design stage to accommodate changes from a ditch-based drainage system to a curb and gutter system.

A brief description of the hydrologic modelling methodology used is contained in this section. A summary of the modelled flows and NOCSS flow rates are outlined in **Table 6-2**. A summary of the cross culvert characteristics and hydraulics are outlined in **Table 6-3**.

6.1.6.1 Tuck Creek Tributary Catchment

Tuck Creek and its tributaries cross Dundas Street through eight culverts as shown in **Exhibits 6-3** to **6-7**. This portion of Dundas Street is located from 325 m east of Brant Street to 407 ETR. This Dundas Street portion is divided into eight different sub-catchments as follows:

1. Approximately 325 m east of Brant Street to approximately 600 m east of Brant Street, draining to Culvert C1.
2. Approximately 600 m east of Brant Street to approximately 30 m west of Eaglesfield Drive, draining to Culvert C2.
3. Approximately 30 m west of Eaglesfield Drive to approximately 400m east of Eaglesfield Drive, draining to Culvert C3.
4. Approximately 400 m east of Eaglesfield Drive to approximately 40m west of Blackwood Drive, draining to Culvert C4.
5. Approximately 40 m west of Blackwood Drive to approximately 190m east of Blackwood Drive, draining to Culvert C5.
6. Approximately 190 m east of Blackwood Drive to approximately 390m east of Blackwood Drive, draining to Culvert C6.
7. Approximately 390 m east of Blackwood Drive to approximately 165m east of Guelph Line, draining to Culvert C7.
8. Approximately 165 m east of Guelph Line to 407 ETR, draining to Culvert C8.

Stormwater Management (SWM) requirements for the Tuck Creek tributary include quality treatment and quantity control:

- Quality control of runoff to an Enhanced level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- Quantity control of runoff such that the post-development flows do not exceed the pre-development flows for the full range of design events.

Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street. Flows from all the culverts are conveyed to downstream storm sewer inlets. The capacities of these inlets will be assessed during detailed design.

Table 6-2: Summary of Existing and Post Development Flows and the Required Storage Volumes

Road Catchment ID*	Catchment	Drainage Area (ha)*	Existing Road Area (ha)	% Imp.	Proposed Road Area (ha)	% Imp.	Existing Flows (m^3/s)*							Post Development Uncontrolled Flows (m^3/s)*							Max Storage Volume Required to Attenuate 100 Year Flow (m^3)
							2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	Reg.	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr	Reg.	
D1	Tuck Creek Tributary	1.33	0.45	34	0.94	71	0.097	0.141	0.187	0.236	0.271	0.31	0.181	0.191	0.267	0.325	0.395	0.441	0.495	0.19	400
D2	Tuck Creek Tributary	0.92	0.35	38	0.66	72	0.076	0.116	0.142	0.177	0.202	0.230	0.126	0.138	0.196	0.232	0.280	0.312	0.350	0.131	280
D3	Tuck Creek Tributary	2.27	0.87	38	1.71	75	0.161	0.240	0.292	0.398	0.457	0.522	0.308	0.307	0.435	0.519	0.631	0.706	0.816	0.325	680
D4	Tuck Creek Tributary	0.79	0.31	39	0.59	75	0.064	0.092	0.120	0.150	0.172	0.196	0.108	0.118	0.164	0.199	0.240	0.268	0.301	0.113	240
D5	Tuck Creek Tributary	1.19	0.44	37	0.94	79	0.090	0.130	0.171	0.215	0.246	0.281	0.162	0.179	0.251	0.297	0.366	0.408	0.457	0.171	360
D6	Tuck Creek Tributary	1.07	0.36	34	0.70	65	0.080	0.125	0.153	0.193	0.221	0.253	0.146	0.146	0.211	0.252	0.307	0.343	0.386	0.152	320
D7	Tuck Creek Tributary	2.06	0.97	47	1.73	84	0.173	0.254	0.306	0.404	0.461	0.524	0.283	0.298	0.424	0.504	0.610	0.681	0.764	0.298	620
D8	Tuck Creek Tributary	3.03	1.55	52	2.70	89	0.237	0.397	0.480	0.592	0.671	0.795	0.418	0.342	0.556	0.666	0.812	0.911	1.026	0.432	910
D9	Shoreacres Creek	1.18	0.77	65	1.00	85	0.142	0.201	0.239	0.301	0.337	0.380	0.166	0.185	0.258	0.306	0.368	0.415	0.465	0.171	360
D10	Shoreacres Creek	0.66	0.32	48	0.46	70	0.067	0.098	0.118	0.146	0.165	0.187	0.092	0.096	0.137	0.163	0.197	0.220	0.247	0.094	200
D11	Shoreacres Creek	5.18	2.56	49	4.39	85	0.383	0.618	0.749	0.926	1.050	1.279	0.708	0.626	1.004	1.200	1.459	1.632	1.835	0.748	1550
D12	Appleby Creek	3.05	1.49	48	2.63	86	0.275	0.397	0.488	0.602	0.711	0.807	0.420	0.467	0.656	0.777	0.943	1.050	1.176	0.442	920
D13	Sheldon Creek	4.18	1.93	46	3.5	83	0.284	0.414	0.527	0.727	0.827	0.940	0.567	0.493	0.701	0.849	1.165	1.304	1.468	0.602	1250
D17	Sheldon Creek	1.69	0.75	44	1.41	83	0.134	0.197	0.239	0.318	0.364	0.414	0.231	0.242	0.344	0.410	0.496	0.554	0.622	0.244	Se Note **
DB1	Bronte Creek	1.59	0.96	60	1.98	88	0.172	0.246	0.295	0.375	0.422	0.477	0.222	0.310	0.434	0.514	0.62	0.689	0.781	0.288	480
D18	Bronte Creek	1.09	0.39	36	1.15	77	0.077	0.115	0.152	0.192	0.221	0.252	0.148	0.167	0.235	0.279	0.345	0.385	0.432	0.165	330
D19	Fourteen Mile Creek Tributary	0.94	0.36	38	0.71	76	0.074	0.107	0.139	0.175	0.2	0.228	0.129	0.140	0.195	0.232	0.286	0.319	0.358	0.135	280
D20	Fourteen Mile Creek Tributary	2.00	0.78	39	1.58	79	0.150	0.222	0.269	0.365	0.418	0.477	0.272	0.293	0.412	0.489	0.591	0.673	0.755	0.288	600
D21A***	Fourteen Mile Creek Tributary	1.23	0.49	40	1.05	85	0.101	0.145	0.174	0.213	0.241	0.267	0.112	0.209	0.301	0.362	0.451	0.512	0.571	0.178	370
D21B***	Fourteen Mile Creek Tributary	2.24	0.70	31	1.83	82	0.135	0.200	0.242	0.297	0.337	0.378	0.203	0.321	0.474	0.576	0.714	0.816	0.914	0.323	670
D22***	Fourteen Mile Creek Tributary	1.82	0.69	38	1.45	80	0.129	0.188	0.227	0.279	0.318	0.355	0.156	0.263	0.388	0.470	0.583	0.665	0.745	0.262	550
D22A***	Fourteen Mile Creek Tributary	1.33	0.68	51	1.18	89	0.136	0.196	0.234	0.286	0.325	0.36	0.132	0.234	0.337	0.405	0.501	0.568	0.633	0.193	400
D22B***	Fourteen Mile Creek Tributary	0.56	0.22	39	0.45	80	0.049	0.069	0.082	0.099	0.112	0.124	0.049	0.100	0.143	0.171	0.209	0.237	0.264	0.081	170
D23***	Fourteen Mile Creek Tributary	1.17	0.49	42	0.90	77	0.107	0.153	0.182	0.221	0.248	0.275	0.109	0.198	0.287	0.344	0.422	0.479	0.534	0.168	350

* *Roadway runoff from Dundas Street only - does not include external area flows to culvert*

** *The existing storm sewers on Sutton Drive are designed to convey flows from 1.05 ha area of Dundas Street. The storm sewers drain to a downstream SWM pond located beyond the cul-de-sac of Dutchess Court. During detailed design, the capacity of the storm sewers will be assessed to accommodate the flows from the widened Dundas Street and if required, quality and quantity controls for the storm runoff from Dundas Street (1.69 ha) will be finalised at that time.*

*** *Including NOCSS Flows for the Adjacent Pervious Areas*

Table 6-3: Cross Culvert Characteristics and Hydraulics

Culvert ID	Name of Creek	Existing Culvert Size (mm)	Existing Length (m)	Proposed Improvements	Proposed Length (m)	Proposed Replacement Size (mm)	Upstream Area (ha)	100 year Flow (m^3/s)	Existing 100 year HGL	Proposed 100 year HGL	Regional Storm Flow (m^3/s)	Existing Regional Storm HGL	Proposed Regional Storm HGL
C1	Tuck Creek Tributary	900	36.9	Replacement	45	1050	24.00	3.68	202.14	198.04	3.32	200.70	197.71
C2	Tuck Creek Tributary	1520 x 970	30.2	Replacement	45	2440 x 1220	28.75	3.50	193.26	192.47	3.88	193.54	192.54
C3	Tuck Creek Tributary	1830 x 1220	32.6	Replacement	45	3660 x 1220	42.23	4.69	184.82	184.24	5.53	185.05	184.35
C4	Tuck Creek Tributary	825	39.6	Replacement	45	825	5.30	0.95	182.47	182.02	0.75	182.11	181.88
C5	Tuck Creek Tributary	600	36.3	Replacement	45	825	16.85	1.54	181.87	179.56	2.13	182.57	180.42
C6	Tuck Creek Tributary	525	41.6	Replacement	45	1050	22.74	1.92	181.91	174.97	2.83	181.94	175.49
C7	Tuck Creek	1520 x 1220	40.4	Replacement	45	2440 x 1220	79.30	5.84	166.76	166.59	8.64	167.78	166.80
C8	Tuck Creek	1830 x 910	42.1	Replacement	45	3660 x 1520	130.79	4.40	164.11	163.95	10.47	165.06	164.32
C9	Shoreacres Creek	2440 x 1830	59.1	Replacement	59.1	3660 x 1520	131.40	8.39	157.25	156.78	14.29	158.20	157.42
C10	Shoreacres Creek	1830 x 1600	41.7	Replacement	45	2440 x 1830	156.00	6.45	155.28	155.08	11.97	156.49	155.65
C11	Shoreacres Creek East Branch	3050 x 1520	37.4	Extension	45	-	123.85	7.30	152.71	152.71	13.17	153.07	153.07
C12	Appleby Creek	2440 x 1520	37.0	Replacement	45	7010 x 1520	327.00	17.00	154.40	153.34	31.00	155.49	154.13
C13-1	Sheldon Creek	2440 x 1520	36.6	Extension	45	2440 x 1520	236.00	11.20	153.71	152.00	24.40	153.71	152.92
C13-2	West Branch	-	-	New	45	3050 x 1520							
C14	Sheldon Creek (Local Drainage)	2440 x 1520	42.5	Does not provide any drainage functionality; to be removed.									
C15-1	Main Sheldon Creek	1830 x 1520	40	Remain “as is”	-	-	192.00	12.70	152.12	152.12	20.20	152.82	152.82
C15-2		3660 x 1520	40	Remain “as is”	-	-							
C16	Sheldon Creek Tributary	2440 x 1220	43.2	Extension	45	-	31.88	1.77	151.66	151.66	3.23	151.96	151.96
C17	Sheldon Creek Tributary (Local Drainage)	910 x 910	43.8	Unable to be located onsite; assumed to be abandoned.									
C18	Bronte Creek (Local Drainage)	825	51.8	Replacement	51.8	825	0.89	0.04	156.77	156.75	0.08	156.85	156.81
C19	Fourteen Mile Creek Tributary (Local Drainage)	750	43.2	Extension	45	-	4.07	0.18	158.97	158.97	0.35	159.12	159.12
C20	Fourteen Mile Creek Tributary	900	42.0	Replacement	45	1050	27.31	0.74	155.51	155.36	1.67	156.96	155.79
C21A	Fourteen Mile Creek Tributary	825	30.9	Replacement	45	1050	30.90	1.04	153.36	152.60	2.50	158.48	153.38
C21B	Fourteen Mile Creek Tributary	600	35.0	Replacement	45	825	11.71	0.36	150.69	150.52	0.76	152.42	150.79
C22	Fourteen Mile Creek Tributary	3660 x 2440	44.5	Replacement	-	Replace with 20 m (+/-) span structure	423.70	8.39	144.38	144.17	20.96	145.36	144.57
C22A	Fourteen Mile Creek Tributary	750	40.0	Extension	45	-	8.00	0.16	145.54	145.54	0.39	145.79	145.79
C22B	Fourteen Mile Creek Tributary	750	40.0	Extension	45	-	5.87	0.12	143.98	143.98	0.28	144.18	144.18
C23	Fourteen Mile Creek	4570 x 2440	54.1	Remain “as is”	-	-	340.00	7.56	142.11	142.11	18.73	142.77	142.77

CEDAR SPRINGS ROAD

TUCK CREEK

TUCK CREEK

1
3.86ha

2
24.00ha

3
28.75ha

STORM RUNOFF FROM DUNDAS STREET AREA TO DRAIN TO ROSELAND CREEK AND EXISTING STORM SEWERS ON OVERTON DRIVE.

#3042
THE LEWIS CAMPBELL HOUSE (1830/1870) [HERITAGE INVENTORY–CHL]

9+900

10+000

3019

2019

EXISTING SIGNALIZED INTERSECTION

10+100

THE JACKSON FEATHERSTON HOMESTEAD (1850) [HERITAGE INVENTORY–CHL]

10+200

#2065

10+300

DUNDAS STREET CLASS EA LIMIT

10+400

2111

EXISTING 900mmø CSP CULVERT TO BE REMOVED AND REPLACED BY A 1050mmø CONCRETE CULVERT

10+500

#2181
[MID. 19th CENTURY–IDENTIFIED BY ASI DURING FIELD REVIEW–CHL]

C1

10+600

EXISTING 1520mm x 9
ARCH CULVERT TO B
AND REPLACED BY A
2 1220mm CONCRETE B

D1
1.33ha

OGS

EB BRANT STATION

WB BRANT STATION

BRANT STREET REGIONAL ROAD No.18

2002

ROSELAND CREEK

PROPOSED TEMPORARY GRADING EASEMENT

2084

[POST 1900–IDENTIFIED BY ASI DURING FIELD REVIEW–BHR]

PROPOSED PROPERTY LINE

4m BI–DIRECTIONAL MULTIUSE PATH

#2122
THE FEATHERSTONE FARM (1907) [HERITAGE INVENTORY–BHR]

EXISTING PROPERTY LINE

EXISTING STORM INLET

KIRSTIE CT.

OVERTON DRIVE

EXISTING STORM SEWERS

CAVENDISH DRIVE

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS

- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- EXISTING STORM INLET

Halton REGION

MMM GROUP

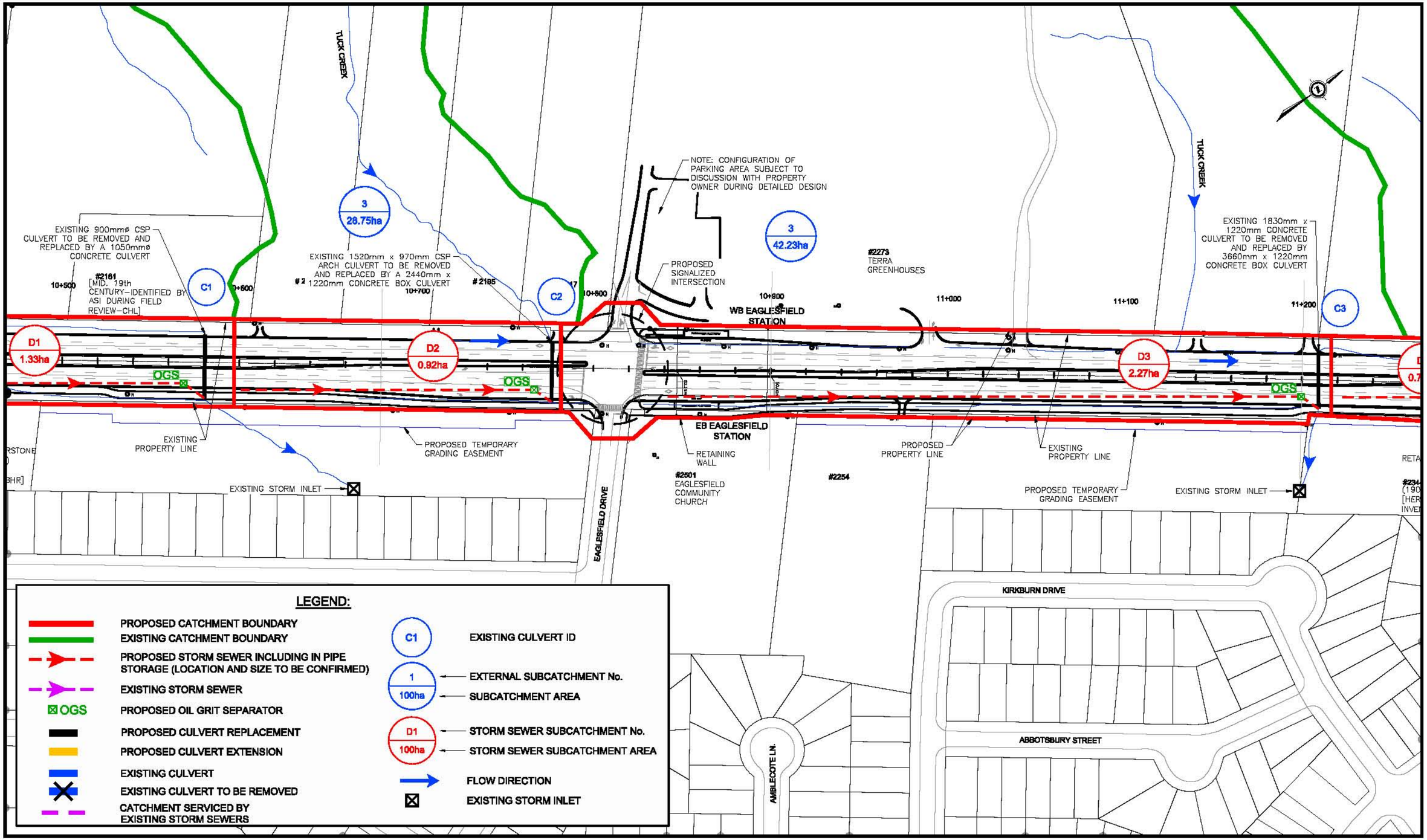
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic Tuck Tributary Catchment

Exhibit
6-3



Halton Region

MMM GROUP

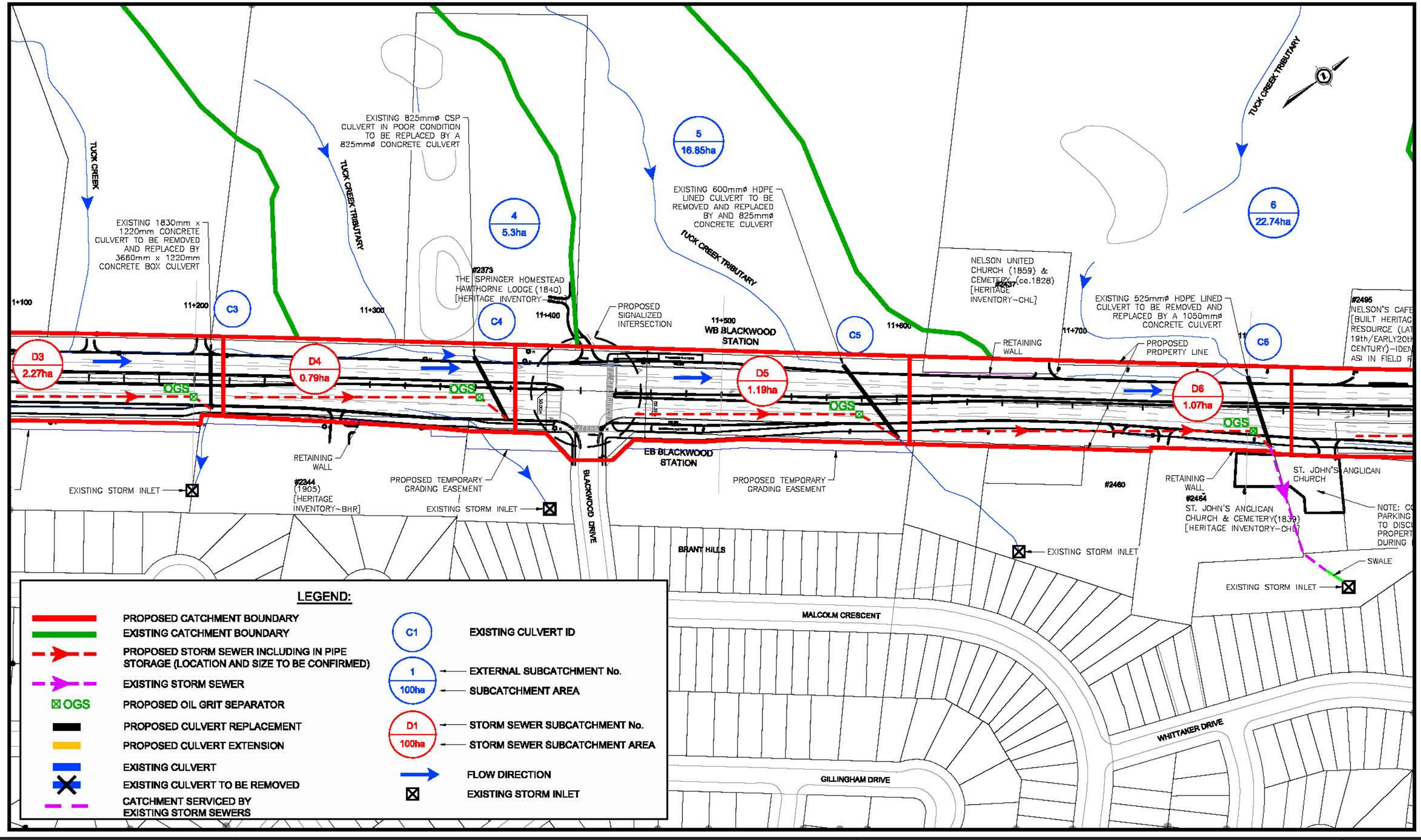
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Tuck Tributary Catchment

Exhibit
6-4



Halton Region | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic Tuck Tributary Catchment

Exhibit
6-5

TUCK CREEK TRIBUTARY

TUCK CREEK

GUELPH LINE

6
22.74ha

7
79.30ha

#3050
WITHIN RANGE
GOLF CENTRE

#3049
NELSON SCHOOL
(1872)
[HERITAGE
INVENTORY–BHR]

EXISTING 1830mm x
CONCRETE CULVERT TO BE
AND REPLACED BY A 36
1520mm CONCRETE

EXISTING 1520mm x 1220mm
CONCRETE CULVERT TO BE
REMOVED AND REPLACED BY A
2440mm x 1220mm CONCRETE
CULVERT

EXISTING SIGNALIZED
INTERSECTION

#3015
12+100
THE McCOLLOCH–GREER
HOUSE (1885) [HERITAGE
INVENTORY–BHR]

#3043
2+200

12+30

NELSON UNITED
CHURCH (1859) &
CEMETERY (ca.1828)
#2437
[HERITAGE
INVENTORY–CHL]

EXISTING 525mmø HDPE LINED
CULVERT TO BE REMOVED AND
REPLACED BY A 1050mmø
CONCRETE CULVERT

#2496
NELSON'S CAFE & VARIETY
[BUILT HERITAGE
RESOURCE (LATE
19th/EARLY20th
CENTURY)–IDENTIFIED BY
ASI IN FIELD REVIEW–BHR]

11+600
11+700
11+800
11+900

C5
C6
C7

RETAINING
WALL

PROPOSED
PROPERTY LINE

WB GUELPH LINE
STATION

D5
1.19ha

D6
1.07ha

D7
2.06ha

D8W
0.69ha

OGS

PROPOSED TEMPORARY
GRADING EASEMENT

#2460

RETAINING
WALL

#2464
ST. JOHN'S ANGLICAN
CHURCH & CEMETERY(1838)
[HERITAGE INVENTORY–CHL]

ST. JOHN'S ANGLICAN
CHURCH

NOTE: CONFIGURATION OF
PARKING AREA SUBJECT
TO DISCUSSION WITH
PROPERTY OWNER
DURING DETAILED DESIGN

EB GUELPH LINE
STATION

EXISTING
PROPERTY LINE

PROPOSED TEMPORARY
GRADING EASEMENT

EXISTING STORM INLET

SWALE

EXISTING STORM INLET

TUCK CREEK

FONTANA COURT

AUTUMN HILL CRESCENT

AUTUMN HILL CR.

WHITTAKER DRIVE

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- ⊠OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS

- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- ⊠ EXISTING STORM INLET

Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS
SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Tuck Tributary Catchment

Exhibit
6-6

#3049
NELSON SCHOOL
(1872)
[HERITAGE
INVENTORY–BHR]

TUCK CREEK

EXISTING 1830mm x 910mm
CONCRETE CULVERT TO BE REMOVED
AND REPLACED BY A 3660mm x
1520mm CONCRETE CULVERT

#3076
THE McCOLLOCH FARM
(1887) [HERITAGE
INVENTORY–CHL]

8
130.79ha

EXISTING 1520mm x 1220mm
CONCRETE CULVERT TO BE
REMOVED AND REPLACED BY A
2440mm x 1220mm CONCRETE
CULVERT

[BUILT HERITAGE RESOURCE
(LATE 19th CENTURY)–
IDENTIFIED BY ASI IN FIELD
REVIEW–BHR]

ISTING SIGNALIZED
TERSECTION

#3015
12+100
THE McCOLLOCH–GREER
HOUSE (1885) [HERITAGE
INVENTORY–BHR]

C7
12+200
#3043
12+300
C8
#3083
#3101
ABANDONED GAS
STATION
12+400
#3105
#3115
12+500
12+600
12+700
12+800

HIGHWAY 407 OFF-RAMP
HIGHWAY 407 ON-RAMP

D7
2.06ha
OGS
D8W
0.69ha
OGS
OGS
D8E
2.34ha

B GUELPH LINE
STATION

EXISTING
PROPERTY LINE

PROPOSED TEMPORARY
GRADING EASEMENT

EXISTING SIGNALIZED
INTERSECTION

LIMIT FOR 407

HIGHWAY 407

TUCK CREEK

DRIFTWOOD
PARK

OURT

AUTUMN HILL CRESCENT

UMN HILL CR.

EXISTING STORM INLET

DRIFTWOOD DRIVE

NOTE:
THE LOCATION AND
LENGTHS OF CULVERTS ARE
SHOWN SCHEMATICALLY
ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS
- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- EXISTING STORM INLET

Halton REGION
MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS
SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Tuck Tributary Catchment

Exhibit
6-7

Culvert C1: Approximately 325 m east of Brant Street to approximately 600 m east of Brant Street

The existing ditch system drains a portion (1.33 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-3**. As indicated in **Section 3.5.4.1**, the storm runoff from the area north of Dundas Street draining to Culvert C1 overtops Dundas Street under storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during the Regional Storm event, the existing 900 mm diameter CSP culvert will be replaced by a 1050 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 330 m^3 to 400 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an oil-grit separator (OGS) at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is shown in **Exhibit 6-3**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 2: Approximately 600 m east of Brant Street to approximately 30 m west of Eaglesfield Drive

The existing ditch system drains a portion (0.92 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-4**. As indicated in **Section 3.5.4.1**, the storm runoff from the area north of Dundas Street, draining to Culvert 2, overtops Dundas Street under storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during the Regional Storm event, the existing 1520 mm by 970 mm CSP arch culvert will be replaced by a 2440 mm by 1220 mm concrete box culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 230 m^3 to 280 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-4**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C3: Approximately 30 m west of Eaglesfield Drive to approximately 400 m east of Eaglesfield Drive

The existing ditch system drains a portion (2.27 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-4**. As indicated in **Section 3.5.4.1**, the storm runoff from the area north of Dundas Street, draining to Culvert C3, overtops Dundas Street under storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during the Regional Storm event, the existing 1830 mm by 1220 mm concrete culvert will be replaced by a 3660 mm by 1220 mm concrete box culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 570 m^3 to 680 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-4**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C4: Approximately 400 m east of Eaglesfield Drive to approximately 40 m west of Blackwood Drive

The existing ditch system drains a portion (0.79 ha) of Dundas Street and will be replaced by a storm sewer system, which is generally shown in **Exhibit 6-5**. As indicated in **Section 3.5.4.1**, Culvert C4 is in poor condition but can convey the Regional Storm flow without overtopping Dundas Street. Due to the poor condition of the culvert, the existing 825 mm diameter CSP culvert will be replaced by an 825 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 200 m^3 to 240 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-5**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C5: Approximately 40 m west of Blackwood Drive to approximately 190 m east of Blackwood Drive

The existing ditch system drains a portion (1.19 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-5**. As indicated in **Section 3.5.4.1**, the storm runoff from the area north of Dundas Street, draining to Culvert C5, overtops Dundas Street under storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during Regional Storm event, the existing 600 mm diameter HDPE lined CSP culvert will be replaced by an 825 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 300 m^3 to 360 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-5**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 6: Approximately 190 m east of Blackwood Drive to approximately 390 m east of Blackwood Drive

The existing ditch system drains a portion (1.07 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibits 6-5** and **6-6**. As indicated in **Section 3.5.4.1**, the storm runoff from the area north of Dundas Street, draining to Culvert C6, overtops Dundas Street under storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during Regional Storm event, the existing 525 mm diameter HDPE lined CSP culvert will be replaced by a 1050 mm diameter concrete culvert. The proposed sizing of the culvert is tabulated in **Table 6-3**.

Culvert C6 is connected to an inlet located on the St. John's Anglican Church's property. From there, the flows are conveyed by a storm sewer system to a swale, which discharges to a storm sewer inlet located south of Whittaker Drive, as indicated in **Exhibits 6-5** and **6-6**. During detailed design, the condition and capacity of the storm sewer on the Church property will be assessed to either clean or replace the storm sewer to address the existing flooding issues.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 270 m^3 to 320 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street,

other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibits 6-5** and **6-6**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C7: Approximately 390 m east of Blackwood Drive to approximately 165 m east of Guelph Line

The existing ditch system drains a portion (2.06 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-6**. As indicated in **Section 3.5.4.1**, Culvert C7 can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow overtops Dundas Street. In order to achieve no overtopping during Regional Storm event, the existing 1520 mm by 122 mm concrete culvert will be replaced by a 2440 mm by 1220 mm concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 520 m^3 to 620 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-6**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C8: Approximately 165 m east of Guelph Line to 407 ETR Overpass

The existing ditch system drains a portion (3.03 ha) of Dundas Street and will be replaced by two storm sewer systems which are generally shown in **Exhibit 6-7**. As indicated in **Section 3.5.4.1**, Culvert C8 can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow overtops Dundas Street. In order to achieve no overtopping during Regional Storm event, the existing 1830 mm by 910 mm concrete culvert will be replaced by a 3660 mm by 1520 mm concrete box culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 760 m^3 to 910 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through two OGSs at the outlets of the storm sewer systems. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed locations of the OGSs are indicated in **Exhibit 6-7**.

The design of quality and quantity control measures will be finalized during detailed design.

6.1.6.2 Shoreacres Creek Tributary Catchment

Shoreacres Creek and its tributaries cross Dundas Street through three culverts as indicated in **Exhibits 6-8**, **6-9** and **6-10**. This portion of Dundas Street is located between the 407 ETR overpass to approximately 250 m east of Walkers Line. The Dundas Street catchment for Shoreacres Creek and its tributaries are divided into three different sub-catchments as follows:

1. 407 ETR overpass to approximately 170 m east of 407 ETR S-E/W Ramp, draining to Culvert C9.
2. Approximately 170 m east of 407 ETR S-E/A Ramp to 330 m east of 407 ETR S-E/W Ramp, draining to Culvert C10.
3. Approximately 330 m east of 407 S-E/W Ramp to approximately 250 m east of Walkers Line, draining to Culvert C11.

Stormwater management (SWM) requirements for the Shoreacres Creek tributary include quality treatment and quantity control:

- Quality control of runoff to an Enhanced level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- Quantity control of runoff such that the post-development flows do not exceed the pre-development flows.

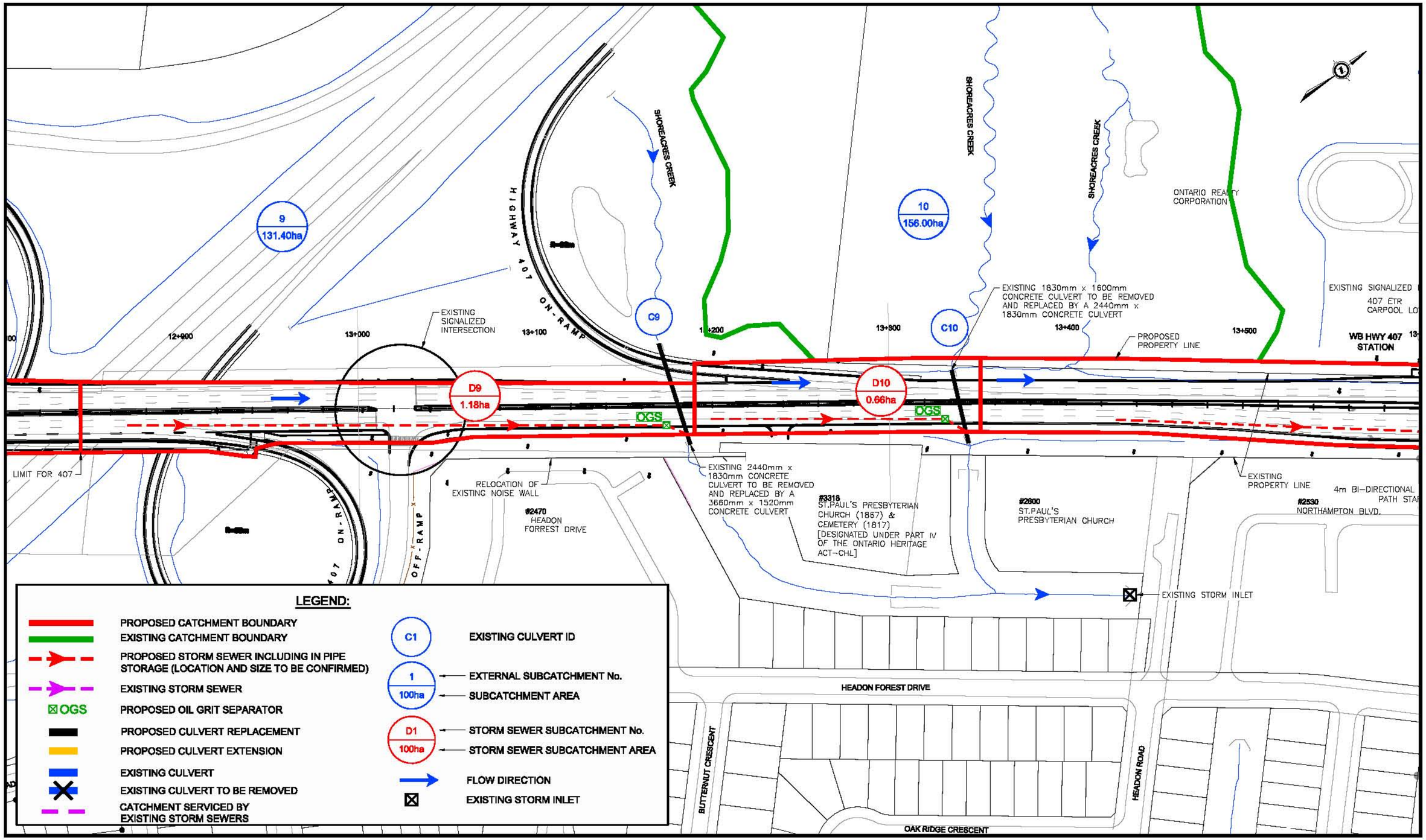
Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street. Flows from Culverts C9 and C10 are conveyed to a downstream storm sewer inlet. The capacity of this inlet will be assessed during the detailed design phase.

Culvert 9: 407 ETR overpass to approximately 170 m east of 407 ETR S-E/W Ramp

The existing ditch system drains a portion (1.18 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-8**. As indicated in **Section 3.5.4.2**, Culvert C9 can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow overtops Dundas Street. In order to achieve no overtopping during the Regional Storm event, the existing 2440 mm by 1830 mm concrete culvert will be replaced by a 3660 mm by 1520 mm concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 300 m^3 to 360 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-8**.



Halton Region

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic Shoreacres Creek Catchment

Exhibit
6-8

SHOREACRES CREEK

SHOREACRES CREEK

SHOREACRES CREEK (EAST BRANCH)

ONTARIO REALTY CORPORATION

10
156.00ha

11
123.85ha

EXISTING 1830mm x 1600mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 2440mm x 1830mm CONCRETE CULVERT

C10

13+200

13+300

13+400

13+500

13+600

13+700

13+800

13+900

PROPOSED PROPERTY LINE

EXISTING SIGNALIZED INTERSECTION

407 ETR CARPOOL LOT

WB HWY 407 STATION

CYCLE TRACK ENDS

EXISTING 3050mm x 1520mm CONCRETE CULVERT TO BE EXTENDED

PROPOSED TEMPORARY GRADING EASEMENT

C11

D10
0.66ha

OGS

D11W
2.48ha

OGS

D11E
2.70ha

OGS

EXISTING 2440mm x 1830mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 3660mm x 1520mm CONCRETE CULVERT

#3316
ST.PAUL'S PRESBYTERIAN CHURCH (1867) & CEMETERY (1817) [DESIGNATED UNDER PART IV OF THE ONTARIO HERITAGE ACT–CHL]

#2600
ST.PAUL'S PRESBYTERIAN CHURCH

EXISTING PROPERTY LINE

4m BI–DIRECTIONAL MULTIUSE PATH STARTS/ENDS

#2530
NORTHAMPTON BLVD.

EB HWY 407 STATION

RETAINING WALL AND LANDSCAPING

#2531
NORTHAMPTON BLVD.

CYCLE TRACK STARTS

NORTHAMPTON BOULEVARD

EXISTING STORM INLET

HEADON FOREST DRIVE

SHOREACRES CREEK

HEADON FOREST PLAZA

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS

- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- EXISTING STORM INLET

Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Shoreacres Creek Catchment

Exhibit
6-9

DONNIC DRIVE

11
123.85ha

12
327ha

EXISTING 3050mm x
1520mm CONCRETE CULVERT
TO BE EXTENDED

PROPOSED TEMPORARY
GRADING EASEMENT

C11

13+800

14+000 WB WALKERS
STATION

WALKERS LINE

EXISTING
SIGNALIZED
INTERSECTION

14+100

14+200

14+300

14+400

WB ROTARY
STATION

ROTARY WAY

D11W
2.48ha

D11E
2.70ha

D12W
1.97ha

OGS

OGS

EB WALKERS
STATION

RETAINING
WALL

RETAINING WALL

RETAINING WALL

#2531
NORTHAMPTON BLVD.

ESSO GAS STATION

McDONALDS

#2968

#4100
CITY OF BURLINGTON FIRE
STATION #7
HALTON REGIONAL POLICE
SERVICES

BERWICK DRIVE

JACKSON DRIVE

GLOVER LANE

HALTON FAMILY HEALTH

D CANADA
RUST

BERTON AVENUE

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS

- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- EXISTING STORM INLET

Halton REGION

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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS
SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Shoreacres Creek Catchment

Exhibit
6-10

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 10: Approximately 170 m east of 407 ETR S-E/W Ramp to 330m east of 407 ETR S-E/W Ramp

The existing ditch system drains a portion (0.66 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-8**. As indicated in **Section 3.5.4.2**, Culvert C10 can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow overtops Dundas Street. In order to achieve no overtopping during the Regional Storm event, the existing 1830 mm by 1600 mm concrete culvert will be replaced by a 2440 mm by 1830 mm concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 170 m^3 to 200 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-8**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 11: Approximately 330 m east of 407 ETR S-E/W Ramp to approximately 250 m east of Walkers Line

The existing ditch systems drains a portion (5.18 ha) of Dundas Street and will be replaced by two storm sewer systems which are generally shown in **Exhibit 6-9**. As indicated in **Section 3.5.4.2**, Culvert C11 has the capacity to convey all flows including the Regional Storm flow without overtopping Dundas Street. In order to accommodate the Dundas Street widening, Culvert C11 will be extended by approximately 8 m. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 1300 m^3 to 1550 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through two OGSs at the outlets of the storm sewer systems. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed locations of the OGSs are indicated in **Exhibits 6-9** and **6-10**.

The design of quality and quantity control measures will be finalized during detailed design.

It should be noted that Metrolinx is planning to expand the carpool lot at Highway 407 and Dundas Street. Consideration for drainage and stormwater management of the carpool lot as a result of the expansion will have to be addressed by Metrolinx.

In addition, lands east of Walkers Line (north of Dundas Street) are expected to be developed in the future. As part of the future development, the upstream of C11

(Shoreacres Creek Tributary) may be realigned to be away from Dundas Street. Drainage and stormwater management strategy will have to be updated to reflect the new land use and new alignment of the tributary.

6.1.6.3 Appleby Creek Catchment

Appleby Creek crosses Dundas Street through Culvert C12 as shown in **Exhibit 6-11**. This portion of Dundas Street is located between approximately 250 m east of Walkers Line to Tim Dobbie Drive / Westlock Common. Stormwater management (SWM) requirements for the Appleby Creek catchment include quality treatment and quantity control:

- Quality control of runoff to an Enhanced level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- Quantity control of runoff such that the post-development flows do not exceed the pre-development flows.

Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street.

The existing ditch systems drains a portion (3.05ha) of Dundas Street and will be replaced by two storm sewer systems which are generally shown in **Exhibit 6-11**. As indicated in **Section 3.5.4.3**, the storm runoff from the area north of Dundas Street, draining to Culvert C12, overtops Dundas Street for storm events equal to or greater than the 50 year storm. In order to achieve no overtopping during the Regional Storm event, the existing 2440 mm by 1520 mm concrete culvert will be replaced by a 7010 mm by 1520 mm concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 760 m^3 to 920 m^3 of storage volume will be required to provide peak flow control.

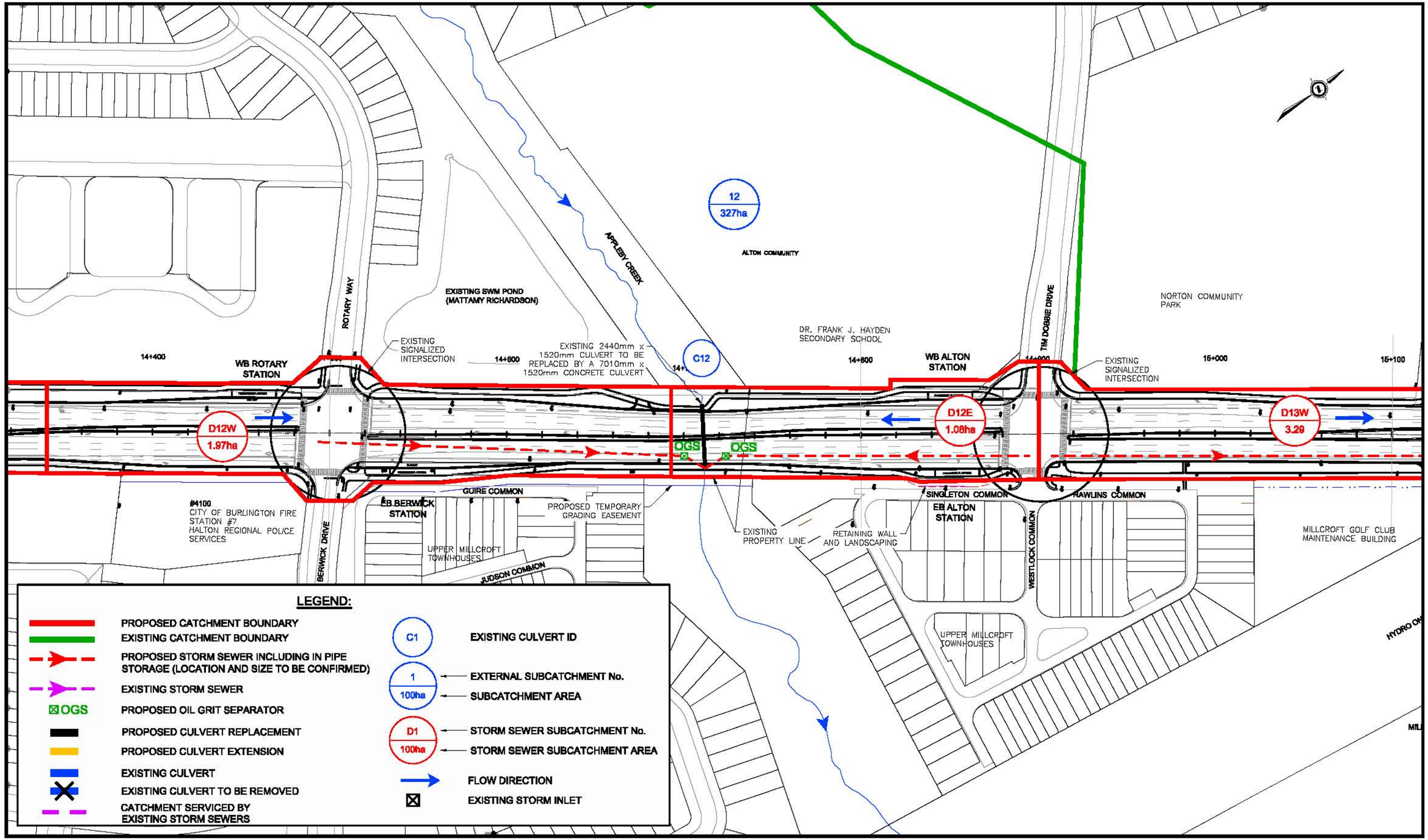
In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through two OGS at the outlets of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGSs is indicated in **Exhibit 6-11**.

The design of quality and quantity control measures will be finalized during detailed design.

6.1.6.4 Sheldon Creek Tributary Catchment

Sheldon Creek and its tributaries cross Dundas Street through culverts C13, C14, C15 and C16 as indicated in **Exhibits 6-12**, **6-13**, **6-14** and **6-15**. This portion of Dundas Street is located between Tim Dobbie Drive / Westlock Common and Sutton Drive. This Dundas Street catchment is divided in four different sub-catchments as follows:

1. Tim Dobbie Drive / Westlock Common to approximately 460 m West of Appleby Line, draining to Culvert C13.



Halton REGION

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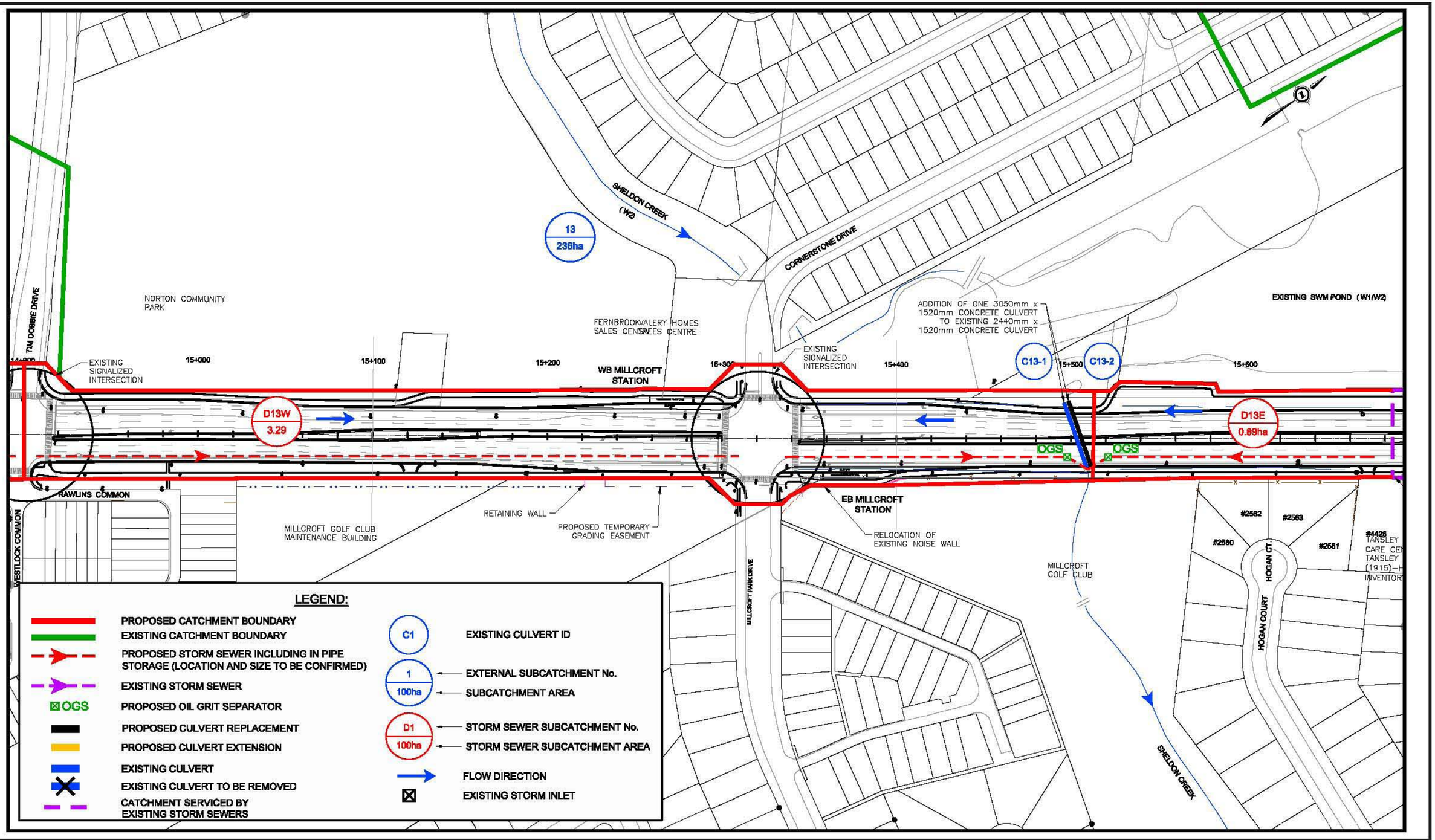
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Appleby Creek Catchment

Exhibit
6-11



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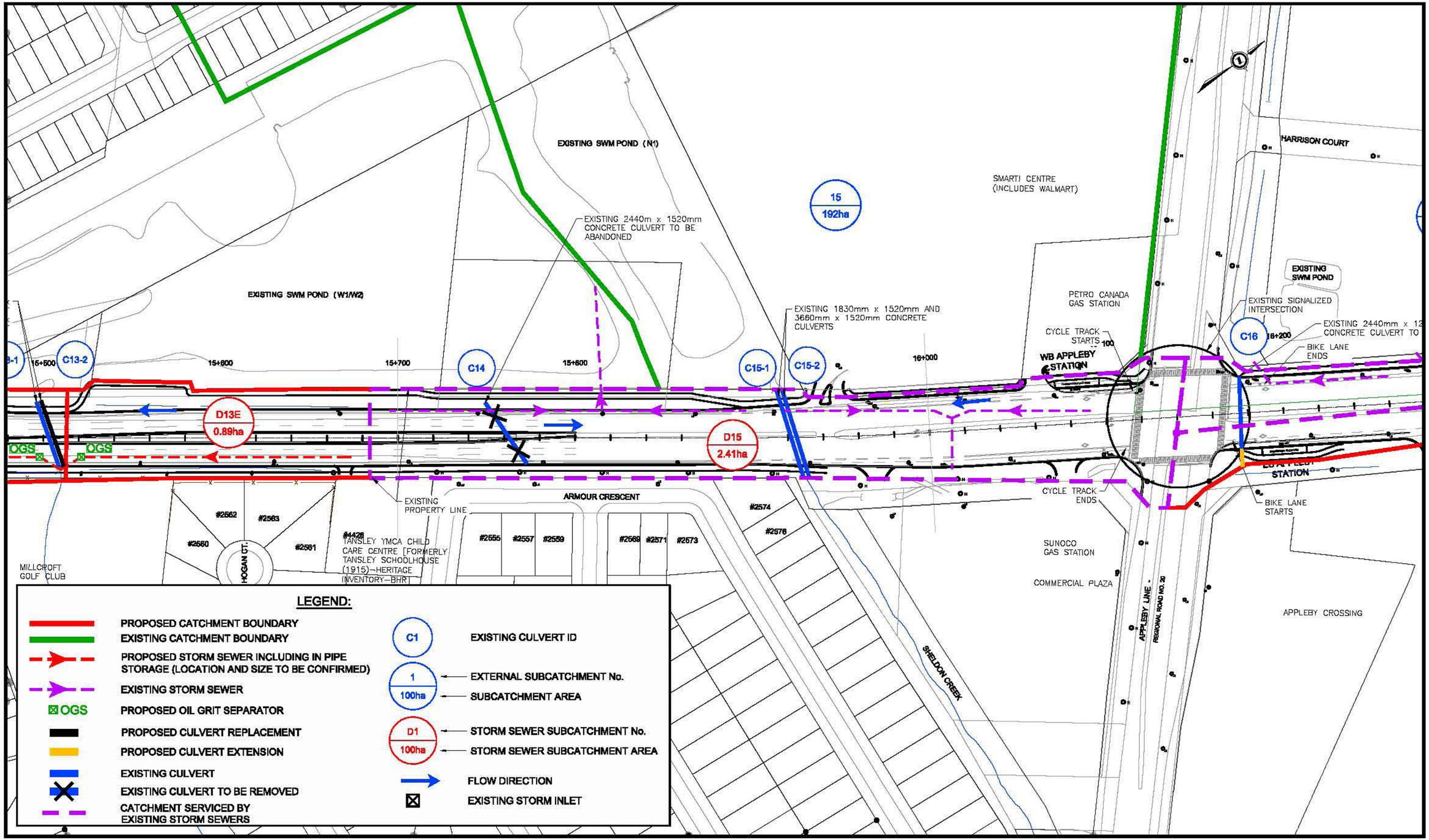
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Sheldon Creek West Tributary Catchment

Exhibit
6-12



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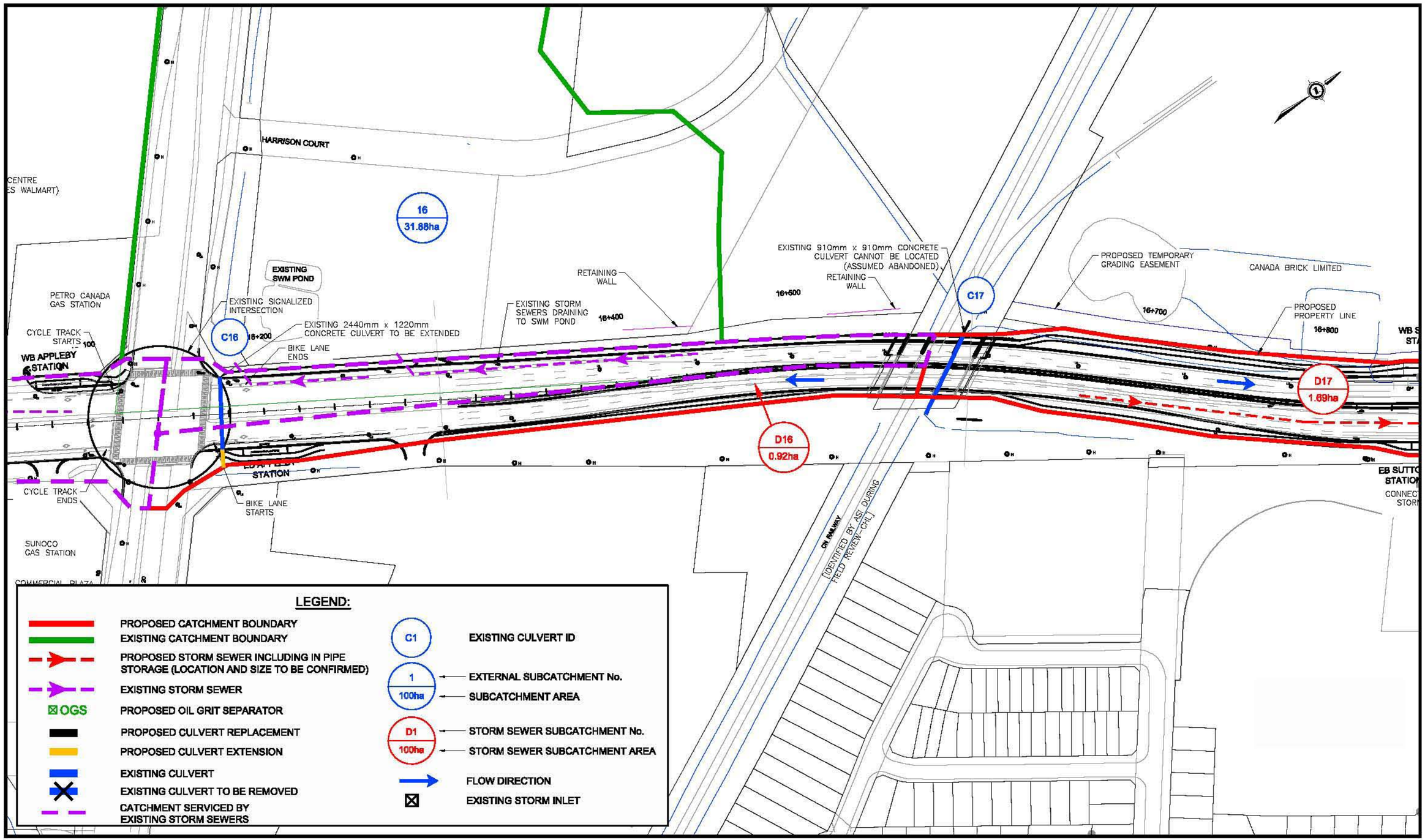
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Sheldon Creek Main Tributary Catchment

Exhibit
6-13



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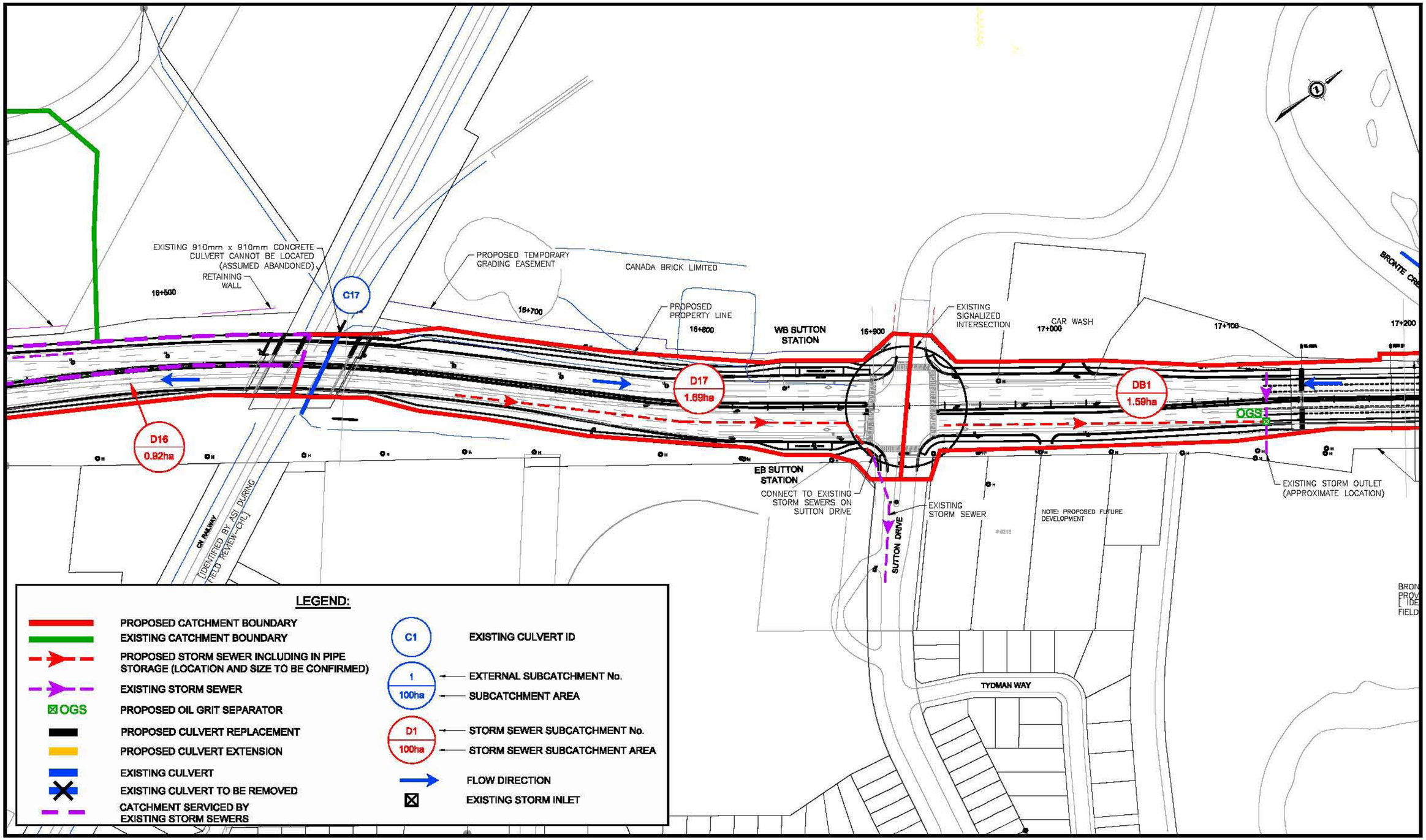
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS
SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Sheldon Creek Tributary Catchment

Exhibit
6-14



Halton Region

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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Sheldon Creek Tributary Catchment

Exhibit
6-15

3. Approximately 460 m west of Appleby Line to Appleby Line, draining to Culverts C14 and C15.
4. Appleby Line to CN Railway overpass, draining to Culvert C16.
5. CN Railway overpass to Sutton Drive, draining to existing storm sewers on Sutton Drive.

Stormwater management (SWM) requirements for the Sheldon Creek tributary catchment are based on the Northeast Alton Community Stormwater Management Master Plan (2008) and the Sheldon Creek Subwatershed Impact Study for the Orchard Community Secondary Plan (1995) which include:

- Quality control of runoff to Normal level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- No quantity controls required, except to meet downstream receiving system constraints. However, for the Dundas Street widening we will provide quantity control of runoff such that the post-development flows do not exceed the pre-development flows.

Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street.

Culvert 13: Tim Dobbie Drive to approximately 460 m West of Appleby Line

The existing ditch systems drains a portion (4.18ha) of Dundas Street and will be replaced by two storm sewer systems which are generally shown in **Exhibit 6-12**. As indicated in **Section 3.5.4.4**, Culvert C13 can convey the 50 year flows without overtopping Dundas Street but the 100 year and Regional Storm flows overtop Dundas Street. In order to achieve no overtopping during the Regional Storm event, an additional 3050 mm by 1520 mm concrete culvert will be placed along with the existing 2440 mm by 1520 mm concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 1050 m^3 to 1250 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Normal level water quality treatment will be through two OGS at the outlets of the storm sewer systems. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGSs is indicated in **Exhibit 6-12**.

The design of quality and quantity control measures will be finalized during detailed design.

Culverts C14 and C15: Approximately 460 m West of Appleby Line to Appleby Line

Approximately 2.41 ha area of Dundas Street, located between approximately 460 m west of Appleby Line to Appleby Line has already been widened to 6 lanes. The storm runoff from a portion of Dundas Street (1.15ha) drains to an existing SWM Pond (W1/W2) located upstream of Culvert C13, as shown in **Exhibit 6-13**. The remaining area (1.25ha) drains to Sheldon Creek tributary as shown in **Exhibit 6-13**. No modifications are

proposed for this area. The area upstream of Culvert C14 has been developed and no flows are conveyed through Culvert C14, thus Culvert C14 will be removed. Runoff from Dundas Street will continue to drain to the existing SWM pond located upstream of Culvert C13 and the Sheldon Creek Tributary, as under existing conditions.

As indicated in **Section 3.5.4.4**, Culvert C15 (twin culvert at 1830 mm by 1520 mm and 3660 mm by 1520 mm) can convey the 50 year, 100 year and Regional Storm flows without overtopping Dundas Street. Culvert C15 will remain the same as existing.

Culvert 16: Appleby Line to CN Railway overpass

This portion (0.92 ha) of Dundas Street is currently serviced by existing storm sewers which drains to an existing SWM pond located in the northeast quadrant of Dundas Street and Appleby Line. During detailed design, the capacity of the existing storm sewers will be assessed to convey the flows from the Dundas Street area to the existing SWM pond and the storage capacity of the existing SWM pond will also be verified for accommodating the flows from the widened portion of Dundas Street. Alternatively, on-site quality and quantity controls for the storm runoff from Dundas Street may also be considered.

As indicated in **Section 3.5.4.4**, Culvert C16 can convey the 50y ear, 100 year and Regional Storm flows without overtopping Dundas Street. Since the Appleby Line intersection is already at 6 lanes, the culvert will be extended nominally (about 2 m) to accommodate the widening of Dundas Street to include active transportation facilities.

Culvert 17: CN Railway overpass to Sutton Drive

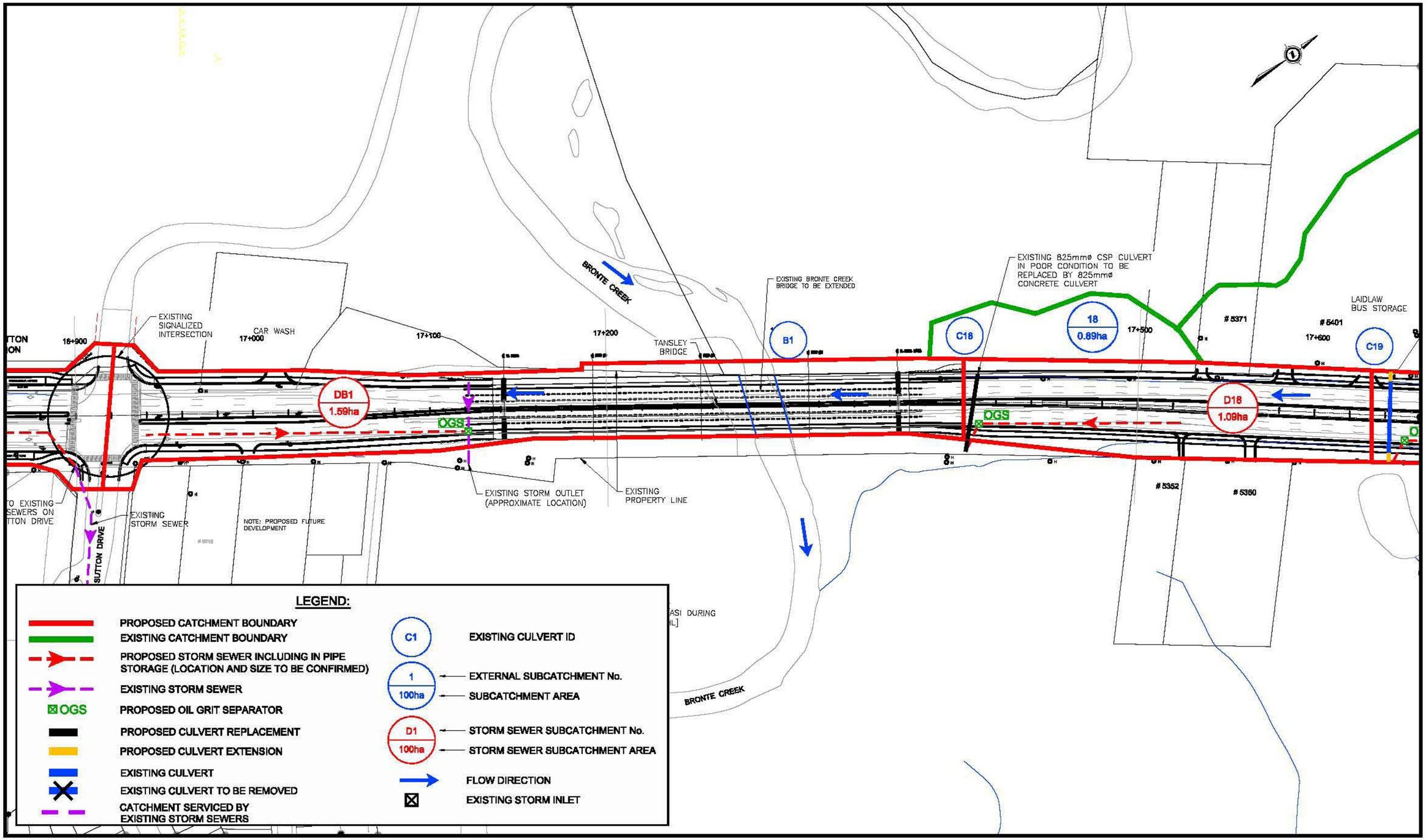
As per the Stormwater Drainage Area Plan-B, dated November 2000, prepared for the Orchards of Burloak Phase 3 development, the existing storm sewers on Sutton Drive are designed to convey flows from 1.05 ha area of Dundas Street. The storm sewers drain to a downstream SWM pond located beyond the cul-de-sac of Dutchess Court (a local area street, approximately 1.2 km south of Dundas Street). During detailed design, the capacity of the storm sewers will be assessed to accommodate the flows from the widened Dundas Street and if required, quality and quantity controls for the storm runoff from Dundas Street (1.69 ha) will be finalised at that time.

As mentioned in **Section 3.5.4.4**, Culvert C17 cannot be located in the field and was assumed to be removed.

6.1.6.5 Bronte Creek Tributary Catchment

Bronte Creek and its tributary cross Dundas Street through one bridge and one culvert as shown in **Exhibit 6-16**. This portion of Dundas Street is located between Sutton Drive and 710 m east of Sutton Drive. The Dundas Street catchment is divided in two different sub-catchments as follows:

1. Sutton Drive to approximately 480 m east of Sutton Drive, draining to Bronte Creek.
2. Approximately 480 m east of Sutton Drive to 710 m east of Sutton Drive, draining to Culverts C18.



Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Bronte Creek Catchment

Exhibit
6-16

Stormwater management (SWM) requirements for the Bronte Creek tributary include quality treatment and quantity control:

- Quality control of runoff to Enhanced level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- Quantity control of runoff such that the post-development flows do not exceed the pre-development flows.

Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street.

Bronte Creek: Sutton Drive to approximately 480 m east of Sutton Drive

The storm runoff from a portion of Dundas Street (1.59 ha) including the bridge deck will be collected in a storm sewer system within the Dundas Street right-of-way which is generally shown in **Exhibits 6-15** and **6-16**. The flows will discharge to an existing storm outlet south of Dundas Street, as indicated on **Exhibits 6-15** and **6-16**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 400 m^3 to 480 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-15**.

The design of quality and quantity control measures, and storm sewer outlet details will be finalized during detailed design.

Culvert 18: Approximately 480 m east of Sutton Drive to 710 m east of Sutton Drive

The existing ditch system drains a portion (1.09 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-16**. As indicated in **Section 3.5.4.5**, Culvert C18 is in poor condition but can convey the Regional Storm flow without overtopping Dundas Street. Due to the poor condition of the culvert, the existing 825 mm diameter CSP culvert will be replaced by an 825 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 275 m^3 to 330 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an oil-grit separator (OGS) at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS and the enhanced grassed swale is indicated in **Exhibit 6-16**.

The design of quality and quantity control measures, and storm sewer outlet details, if required, will be finalized during detailed design.

6.1.6.6 Fourteen Mile Creek Tributary Catchment

Fourteen Mile Creek and its tributaries cross Dundas Street through eight culverts as shown in **Exhibits 6-17**, **6-18**, **6-19** and **6-20**. This portion of Dundas Street is located between approximately 710 m east of Sutton Drive and approximately 90 m west of Valleyridge Drive. This Dundas Street catchment is divided in eight different sub-catchments as follows:

1. Approximately 710 m east of Sutton Drive to approximately 380 m West of Tremaine Road, draining to Culvert C19.
2. Approximately 380 m West of Tremaine Road to Tremaine Road, draining to Culvert C20.
3. Tremaine Road to approximately 220 m East of Tremaine Road, draining to Culvert C21A.
4. Approximately 220 m East of Tremaine Road to approximately 650 m East of Tremaine Road, draining to Culvert C21B.
5. Approximately 650 m East of Tremaine Road to approximately 140 m west of Colonel William Parkway, draining to Culvert C22
6. Approximately 140 m west of Colonel William Parkway to approximately 100 m east of Colonel William Parkway, draining to Culvert C22A.
7. Approximately 100 m east of Colonel William Parkway to approximately 210 m east of Colonel William Parkway, draining to Culvert C22B.
8. Approximately 210 m East of Colonel William Parkway to approximately 330 m west of Bronte Road, draining to Culvert C23.

Stormwater management (SWM) requirements for the Fourteen Mile Creek and its tributaries are as per the NOCSS for the quality treatment and quantity control, which includes:

- Quality control of runoff to Enhanced level of treatment in accordance with the Ministry of the Environment and Climate Change's Stormwater Management Planning and Design Manual, 2003.
- Quantity control of runoff such that the post-development flows do not exceed the pre-development flows.

Due to space constraints within the road right-of-way, no erosion control is proposed for runoff from widened portion of Dundas Street. However, it is anticipated that when the upstream areas are developed, stormwater management and erosion control strategies will be reviewed and explored; there may be opportunities to accommodate runoff from Dundas Street.

EXISTING 825mmø CSP CULVERT IN POOR CONDITION TO BE REPLACED BY 825mmø CONCRETE CULVERT

18
0.89ha

17+500

5371

5401

17+600

C19

EXISTING 750mmø HDPE LINED CULVERT TO BE EXTENDED

LAIDLAW BUS STORAGE

19
4.07ha

THE NORTON HOUSE (1940) [HERITAGE INVENTORY–CHL]

5421

5463

17+800

17+900

5463

THE CROOKS – ALEXANDER HOUSE (1860) [HERITAGE INVENTORY–CHL]

18+000

EXISTING 900mmø CSP CULVERT TO BE REMOVED AND REPLACED BY A 1050mmø CONCRETE CULVERT

20
27.31ha

FOURTEEN MILE CREEK TRIBUTARY

CITY OF BURLINGTON

TREMAINE ROAD

WB TREMAINE STATION

C20

D18
1.09ha

OGS

D19
0.94ha

D20
2.00ha

OGS

5362

5380

5402

5416

(1920) [HERITAGE INVENTORY–BHR]

PROPOSED TEMPORARY GRADING EASEMENT

PROPOSED PROPERTY LINE

EXISTING PROPERTY LINE

NOTE: MOUNTABLE CURB FOR BRONTE CREEK PROVINCIAL PARK MAINTENANCE VEHICLES

LEGEND:

- PROPOSED CATCHMENT BOUNDARY
- EXISTING CATCHMENT BOUNDARY
- PROPOSED STORM SEWER INCLUDING IN PIPE STORAGE (LOCATION AND SIZE TO BE CONFIRMED)
- EXISTING STORM SEWER
- ⊠OGS — PROPOSED OIL GRIT SEPARATOR
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- CATCHMENT SERVICED BY EXISTING STORM SEWERS

- C1 — EXISTING CULVERT ID
- 1 / 100ha — EXTERNAL SUBCATCHMENT No. / SUBCATCHMENT AREA
- D1 / 100ha — STORM SEWER SUBCATCHMENT No. / STORM SEWER SUBCATCHMENT AREA
- FLOW DIRECTION
- ⊠ EXISTING STORM INLET

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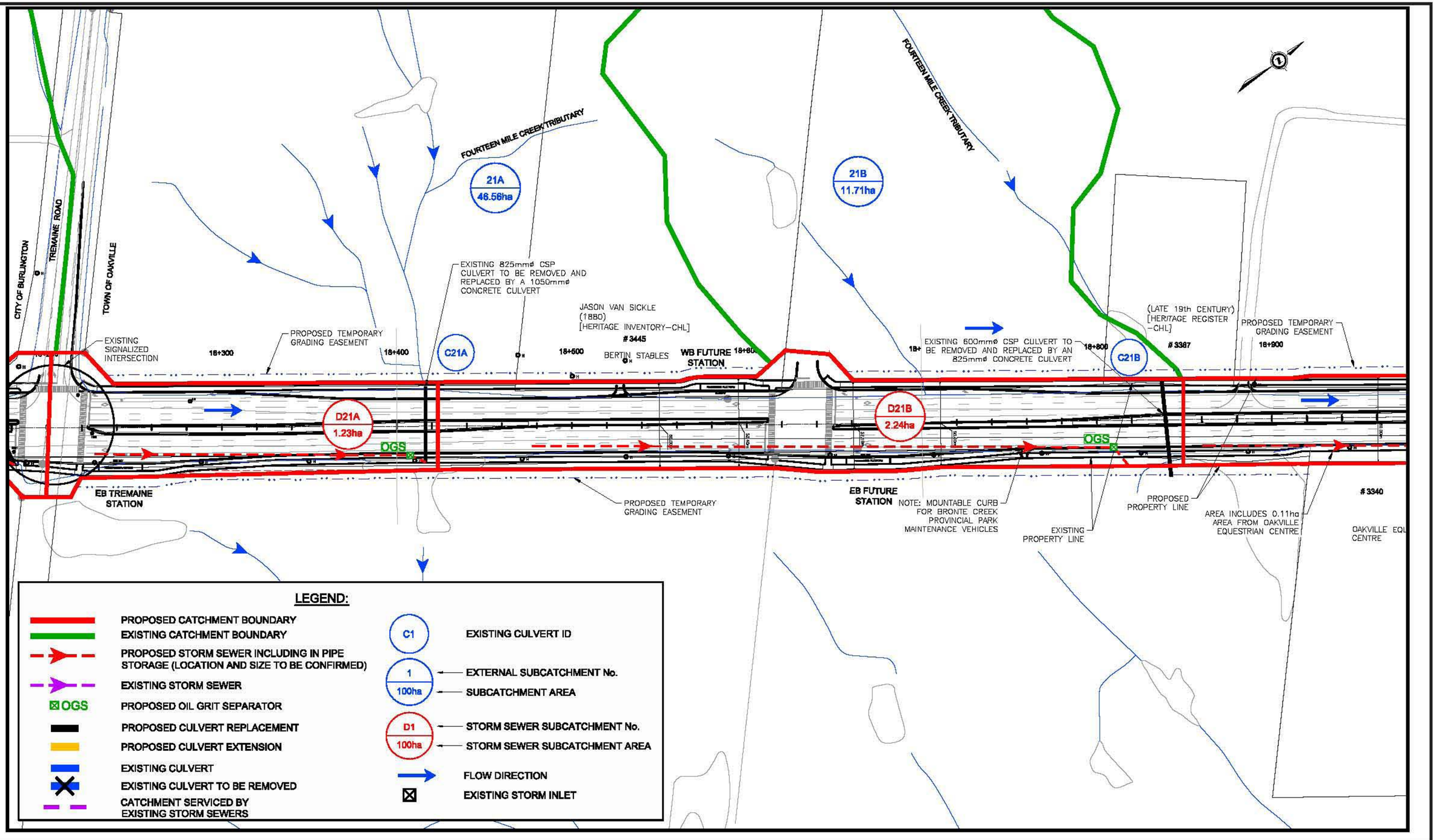
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Fourteen Mile Creek Tributary Catchment

Exhibit
6-17



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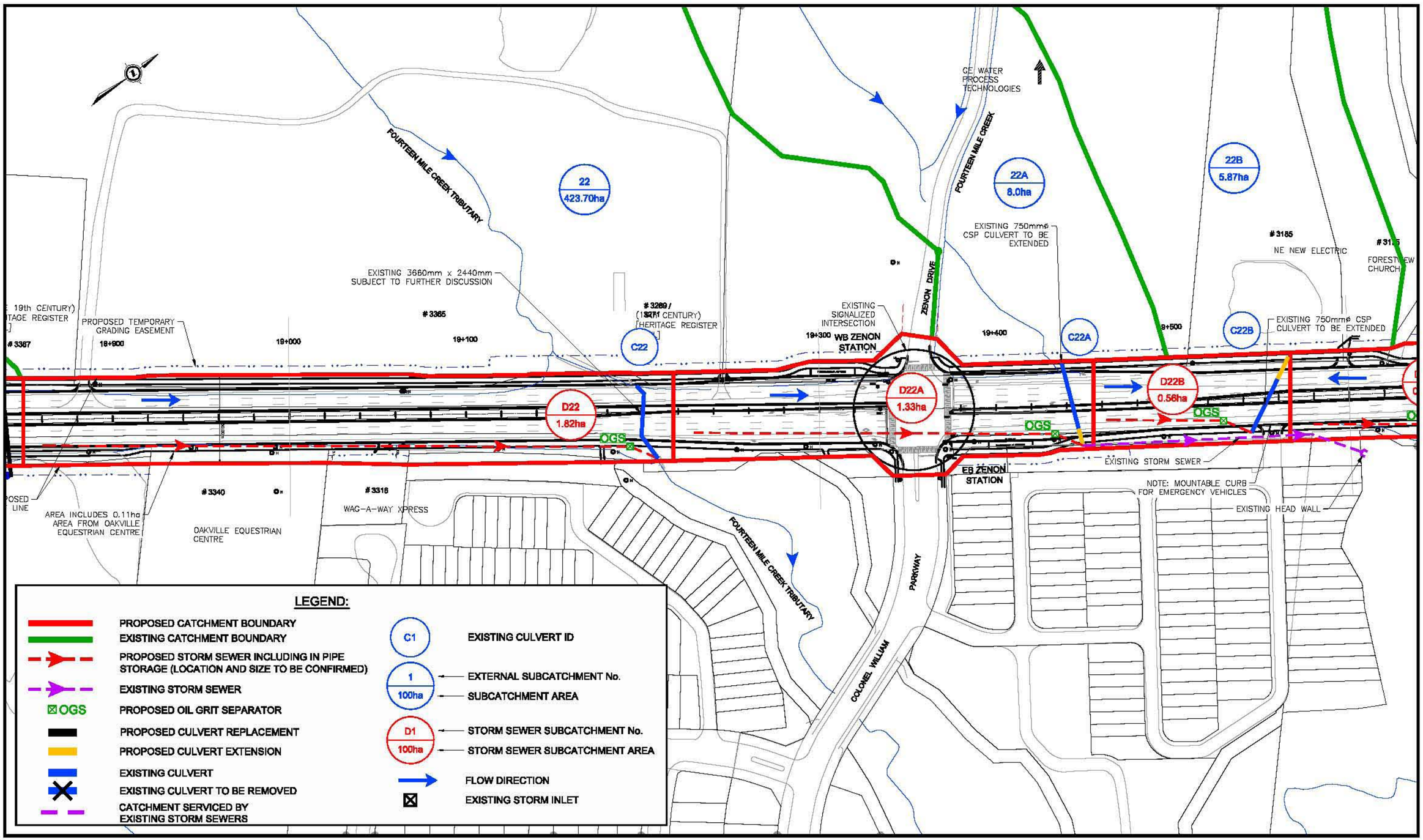
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Fourteen Mile Creek Tributary Catchment

Exhibit
6-18



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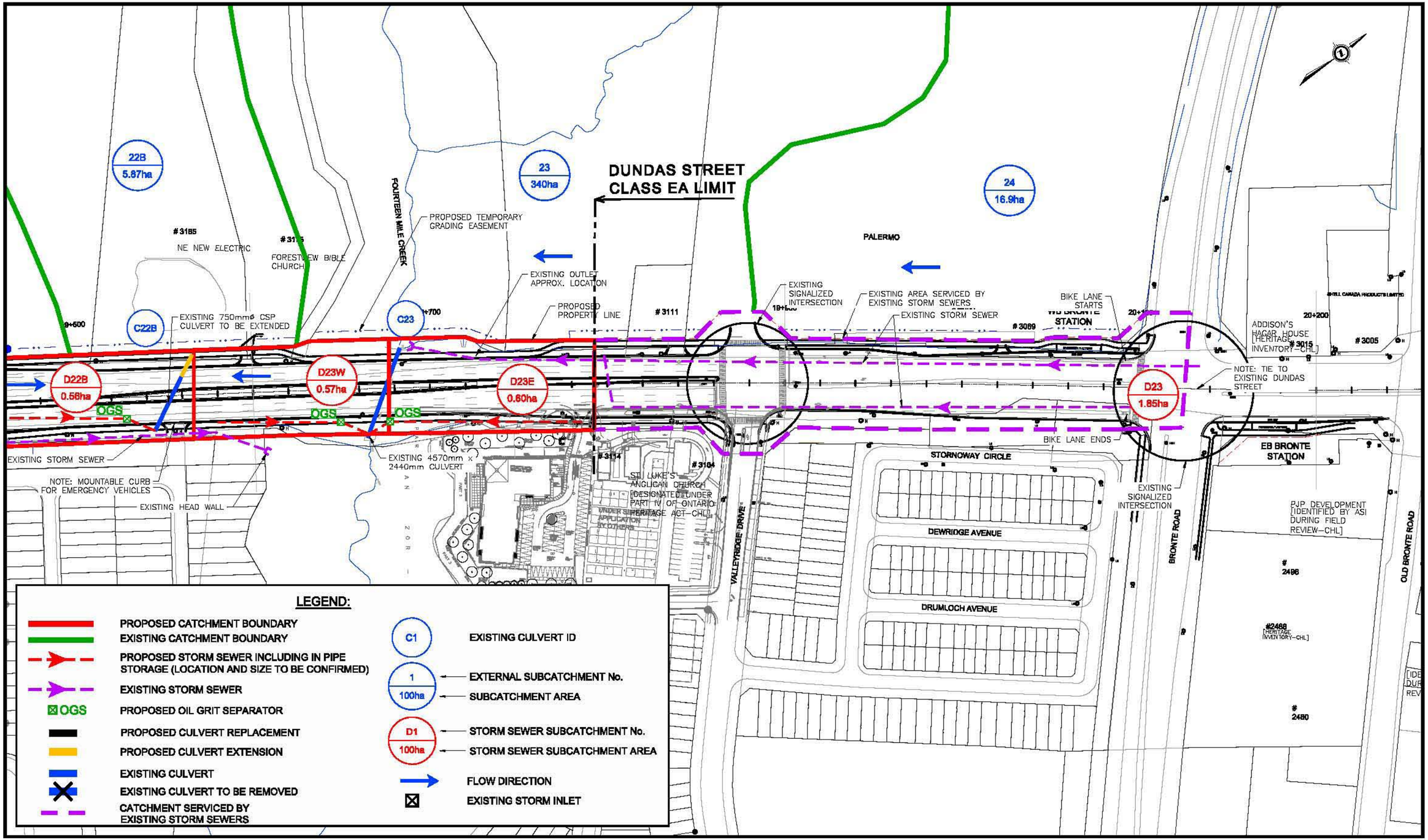
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Fourteen Mile Creek Tributary Catchment

Exhibit
6-19



Halton Region

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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS SHOWN SCHEMATICALLY ONLY (NOT TO SCALE)

Metric Scale
25m 0 50m
Horizontal

Future Drainage Mosaic
Fourteen Mile Creek Catchment

Exhibit
6-20

Culvert 19: Approximately 710 m east of Sutton Drive to approximately 380 m West of Tremaine Road

The existing ditch system drains a portion (0.94 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-17**. As indicated in **Section 3.5.4.6**, Culvert C19 can convey the flows for all storm events including the Regional Storm event without overtopping Dundas Street. Therefore, the existing culvert will be extended by approximately 2 m to accommodate the widening of Dundas Street.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 240 m^3 to 280 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-17**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 20: Approximately 380 m West of Tremaine Road to Tremaine Road

The existing ditch system drains a portion (2.00 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-17**. As indicated in **Section 3.5.4.6**, Culvert C20 can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow will overtop Dundas Street. In order to achieve no overtopping of Dundas Street during a Regional storm event, the existing 900 mm diameter CSP culvert will be replaced by a 1050 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 500 m^3 to 600 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-17**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 21A Tremaine Road to approximately 220 m East of Tremaine Road

The existing ditch system drains a portion (1.23 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-18**. As indicated in **Section 3.5.4.6**, Culvert C21A can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow will overtop Dundas Street. In

order to achieve no overtopping of Dundas Street during a Regional Storm event, the existing 825 mm diameter CSP culvert will be replaced by a 1050 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 310 m^3 to 370 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-18**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 21B: Approximately 220 m East of Tremaine Road to approximately 650 m East of Tremaine Road

The existing ditch system drains a portion (2.24 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-18**. As indicated in **Section 3.5.4.6**, Culvert C21B can convey the 50 year and 100 year flows without overtopping Dundas Street, but the Regional Storm flow will overtop Dundas Street. In order to achieve no overtopping of Dundas Street during a Regional Storm event, the existing 600 mm diameter CSP culvert will be replaced by an 825 mm diameter concrete culvert. The proposed sizing is tabulated in **Table 6-3**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 560 m^3 to 670 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an oil-grit separator (OGS) at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-18**.

The design of quality and quantity control measures will be finalized during detailed design.

It is noted that the Environmental Implementation Report / Functional Servicing Study (EIR/FSS) for the Lazy Pat Farm Development, under review by various approval agencies, indicates that the flows from this portion of Dundas Street can be treated in the proposed SWM Pond 2 (as noted in the EIR/FSS) for the proposed development. Depending on the schedule of the Lazy Pat Farm Development and Dundas Street Widening projects, the runoff from this portion of Dundas Street can be managed within the proposed SWM Pond 2. If the Dundas Street widening proceeds in advance of the Lazy Pat Farm development, the runoff from Dundas Street will be managed within underground pipe storage and treated by OGS.

Culvert 22: Approximately 650 m East of Tremaine Road to approximately 140 m west of Colonel William Parkway

The existing ditch system drains a portion (1.82 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-19**. As indicated in **Section 3.5.4.6**, Culvert C22 can convey the storm runoff under all storm events including the Regional Storm event without overtopping Dundas Street. While the existing culvert is able to meet the hydraulic requirements, this watercourse is a regulated Redside Dace habitat and therefore, enhancement opportunities to improve the watercourse as part of the Dundas Street widening was considered.

Four crossing alternatives were considered, including: 1) extension of existing Culvert C22, 2) replace culvert with a 9 m span structure, 3) replace culvert with a 20 +/-m span structure, and 4) replace culvert with a 60 m span structure. The 20 +/-m span structure alternative was identified as preferred as it would accommodate opportunities for movement of large animals, and also provide significant improvement in fluvial geomorphology compared to existing conditions (e.g. reduced flow velocity, replacing concrete bed and banks with natural channel design, etc.). Therefore, based on the analysis and evaluation and consultation with Conservation Halton (CH) and Ministry of Natural Resources and Forestry (MNRF), the 20 +/-m span bridge is proposed to replace the existing 3660 mm by 2440 mm concrete culvert. The detailed analysis and evaluation table for the crossing of C22 can be found in **Appendix E**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 460 m^3 to 550 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, CH advised to install advanced filtration system at the outlet of the storm sewer system to obtain Enhanced level water quality treatment. Since it is a regulated Redside Dace habitat watercourse, MNRF advised at the December 8, 2014 meeting that the "Jellyfish" filtration system may be acceptable. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the proposed filtration system is indicated in **Exhibit 6-19**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C22A: Approximately 140 m west of Colonel William Parkway to approximately 100 m east of Colonel William Parkway

The existing ditch system drains a portion (1.33 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-19**. As indicated in **Section 3.5.4.6**, Culvert C22A can convey the storm runoff under all storm events including the Regional Storm without overtopping Dundas Street. Therefore, the existing 750 mm diameter CSP culvert will be extended by approximately 5 m to accommodate the Dundas Street widening.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year

to 100 year storm events. About 330 m^3 to 400 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-19**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert C22B: Approximately 100 m east of Colonel William Parkway to approximately 210 m east of Colonel William Parkway

The existing ditch system drains a portion (0.56 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-19**. As indicated in **Section 3.5.4.6**, Culvert C22B can convey the storm runoff under all storm events including the Regional Storm without overtopping Dundas Street. Therefore, the existing 750 mm diameter CSP culvert will be extended by approximately 5 m to accommodate the Dundas Street widening.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 140 m^3 to 170 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, the most feasible method to obtain Enhanced level water quality treatment will be through an OGS at the outlet of the storm sewer system. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the OGS is indicated in **Exhibit 6-19**.

The design of quality and quantity control measures will be finalized during detailed design.

Culvert 23: Approximately 210 m East of Colonel William Parkway to approximately 330 m west of Bronte Road

The existing ditch system drains a portion (1.17 ha) of Dundas Street and will be replaced by a storm sewer system which is generally shown in **Exhibit 6-20**. As indicated in **Section 3.5.4.6**, Culvert C23 can convey the storm runoff under all storm events including the Regional Storm without overtopping Dundas Street. While the existing culvert is able to meet the hydraulic requirements and is in good condition, this watercourse is a regulated Redside Dace habitat and similar to Culvert C22, four alternatives were considered to assess the pros and cons to replace the culvert with a new structure.

The four alternatives considered were: 1) extension of the culvert to accommodate the additional fill as a result of the widening, 2) maintaining the existing length of the culvert with the construction of retaining walls to limit fill into the valley, 3) replace culvert with a 20 m span structure, and 4) replace culvert with a 70 m span structure.

Based on an analysis and evaluation of crossing alternatives, it is proposed that the existing culvert be maintained since the existing length is able to accommodate the widening of Dundas Street; retaining wall will be constructed to reduce the fill slop into the valley. This alternative is preferred since the existing culvert is in good condition and would not have to be extended with the implementation of retaining walls. From a natural environment perspective, there will be limited impacts to the valley due to the retaining walls and it is considered to be acceptable from a geomorphology perspective. Estimated construction cost is more economical compared to the alternatives with the 20 m or 70 m span structures. This alternative is the best balance amongst all factors in the evaluation. The detailed analysis and evaluation table for the crossing of C23 can be found in **Appendix E**.

For quantity control, underground storage in oversized storm sewers will be provided to control the post-development flows to pre-development flows for all storms from 2 year to 100 year storm events. About 290 m^3 to 350 m^3 of storage volume will be required to provide peak flow control.

In terms of quality control of storm runoff from Dundas Street, CH advised to install advanced filtration system at the outlet of the storm sewer system to obtain Enhanced level water quality treatment. Since it is a regulated Redside Dace habitat watercourse, MNRF advised at the December 8, 2014 meeting that the "Jellyfish" filtration system is acceptable. Given the proposed urban cross-section of future Dundas Street, other methodologies are not easily implemented. The proposed location of the proposed filtration system is indicated in **Exhibit 6-20**.

The design of quality and quantity control measures will be finalized during detailed design.

6.1.7 Fluvial Geomorphology

The works proposed to the Tuck Creek, Shoreacres Creek, Appleby Creek, Sheldon Creek and Fourteen Mile Creek systems are summarised in **Table 6-4** and **Exhibits 6-21** to **6-38**. Works include culvert replacements and culvert extensions with associated tie-in requirements and channel realignments. The impact of proposed works on Bronte Creek is also considered in a separate sub section within **Section 6.1.7**. Detailed analysis was carried out for Fourteen Mile Creek tributaries at C22 and C23 (see **Section 6.1.6**).

6.1.7.1 Tuck Creek, Shoreacres Creek, Appleby Creek, Sheldon Creek and Fourteen Mile Creek Systems

No new crossings are proposed as part of the Dundas Street EA Study, so there will be no new interruption to natural processes such as sediment transport. Ten of the thirteen existing structures assessed will be replaced with larger culverts and in the case of the Fourteen Mile Creek Tributary at C22, a clear span bridge (approximately 20 m) is proposed. These allow for improved sediment transport including creating a low flow channel that is not present in all cases under existing conditions. It also allows for reduced velocities through the structures.

Several of the watercourses included in the assessment enter storm sewers downstream of Dundas Street and are therefore disconnected from downstream systems (these include C1, C2 and C3 immediately south of Dundas Street and C7, C8, C9 and C10 farther south of Dundas Street).

Table 6-4: Summary of Proposed Fluvial Geomorphology Work

Culvert ID	Type	Bankfull Width (m)	Upstream / Downstream	Process	Function	Stability Index	Erosion Risk	Conservation Status	Existing Culvert Size (mm)	Proposed Replacement Size (mm)	Existing Length (m)	Proposed Length (m)	Proposed Works
1	CSP	1.3 Representative	U	PL	Source	0.31	Moderate	3	900	3500	36.9	45	Approximately 130 m channel realignment upstream of Dundas Street. Culvert replacement including approximately 8 m extension upstream and 11 m extension downstream. Local channel realignment required to facilitate downstream tie in.
			D	Stable	Transfer	N/A	Moderate	3					
2	CSP Arch	0.5 Representative	U	PL and incision	Exchange	0.11	Low-moderate	4	1520 x 970	2440 x 1220	30.2	45	Culvert replacement including approximately 5 m extension upstream and 8.5 m extension downstream. Local channel realignment required to facilitate upstream tie in. Downstream channel will be piped for approximately 135 m as there is no space between the edge of the church property and the proposed retaining wall. Downstream approximately 320 m of channel to be realigned and enhanced.
			D	Dredged – stable	N/A	N/A	Low-moderate	2					
3	Conc.	0.5 Representative	U	PL	Source	0.13	Moderate	3	1830 x 1220	3660 x 1220	32.6	45	Culvert replacement including approximately 5 m extension upstream and 6.5 m extension downstream. Approximately 100 m of channel realignment required upstream to facilitate road widening. Local channel realignment required to facilitate the downstream tie in.
			D	Incision	Source	N/A	Low	2					
4	CSP	Not included in geomorphology assessment											
5	HDPE Lined	Not included in geomorphology assessment											
6	HDPE Lined	Not included in geomorphology assessment											
7	Conc.	2.7 Average where not affected by structures	U	Incision and widening	Source	0.29	High	2	1520 x 1220	8000 x 1220	40.4	45	Culvert replacement including approximately 5 m extension upstream and 5 m extension downstream. Further assessment required at detailed design to address eroded channel and failed bank protection upstream. Local channel realignment required to facilitate the downstream tie in. Assessment of channel downstream required at detailed design.
		Downstream not included in geomorphology assessment											
8	Conc.	1.5 Average - modified	U	PL	Exchange	0.33	High	2	1830 x 910	3660 x 1520	42.1	45	Culvert replacement including approximately 5 m extension upstream and 2 m extension downstream. Channel realignment upstream of approximately 25 m required to facilitate tie in with skewed culvert extension. Local tie in works required downstream.
		Downstream not included in geomorphology assessment											
9	Conc.	2.0 Representative	U	Aggrading	Sink	0.14	Low	3	2440 x 1830	3660 x 1520	59.1	59.1	Culvert replacement including approximately 2.5 m extension downstream (no extension proposed upstream). Local tie in works required downstream including recreation of scour pool.
			D	PL	Exchange	0.18	Low	4					
C10 ditch	N/A	0.9 Representative	N/A	Incision	Source	0.37	Low	3					Approximately 80 m of ditch realignment required.
10	Conc.	3.0 Representative	U	Aggrading	Sink	0.17	Low-moderate	3	1830 x 1600	5000 x 1830	41.7	45	Culvert replacement including approximately 5.5 m extension upstream (no extension proposed downstream). Local tie in works required upstream. No works required downstream, however, feasibility of creating a low flow channel within the concrete apron and removing the 0.5 m drop to be investigated at detailed design.
			D	Stable	Transfer	0.07	Low-moderate	4					

Culvert ID	Type	Bankfull Width (m)	Upstream / Downstream	Process	Function	Stability Index	Erosion Risk	Conservation Status	Existing Culvert Size (mm)	Proposed Replacement Size (mm)	Existing Length (m)	Proposed Length (m)	Proposed Works
11	Conc.	2 Average - modified	U	Stable	Transfer	0.07	Moderate	3	3050 x 1520	-	37.4	45	Culvert extension including approximately 17.5 m extension upstream and 1.0m extension downstream. Upstream tie in works required to ensure an appropriate skew and confluence with drainage feature flowing from the north west. Approximately 100 m of channel realignment required upstream to facilitate road widening representing an opportunity to improve this degraded system. Local tie in works required downstream. Feasibility of creating a low flow channel within the concrete apron to be investigated at detailed design. Feasibility of lowering scour pool (and water level) to improve wildlife passage to be investigated at detailed design.
			D	Stable	Transfer	0.0	Low	3					
12	Conc.	1.5 Representa-tive	U	Stable	Transfer	0.07	Low-moderate	4	2400 x 1520	7010 x 1520	37.0	45	Culvert replacement including approximately 3.5 m extension upstream and 7.5 m extension downstream. Minimal tie in works required upstream. Local tie in works required downstream including construction of a scour pool.
			D	Stable	Transfer	0.0	Low	4					
13-1	Conc.	1.5 Representat ive	U	N/A	N/A	N/A	Low	N/A	2440 x 1520	2440 x 1520	36.6	45	Culvert extension including approximately 3 m extension upstream and 7.5 m extension downstream. No geomorphology in put required at detailed design upstream as tie in is to a SWM pond. Local tie in works required downstream
	Conc.		D	Stable	Transfer	0.04	Low	5		3660 x 1520			Additional culvert for conveyance.
13-2	Conc.	Not included in geomorphology assessment (overflow culvert)											
14	Conc.	Not included in geomorphology assessment											
15-1	Conc.	Not included in geomorphology assessment											
15-2	Conc.	Not included in geomorphology assessment											
16	Conc.	Not included in geomorphology assessment											
17	Conc.	Not included in geomorphology assessment											
18	CSP	Hill slope/ geotechnical issues, not included in geomorphology assessment											
19	HDPE Lined	Not included in geomorphology assessment											
20	CSP	1.5 Average - modified	U	N/A	N/A	N/A	Low	N/A	900	1050	42.0	45	Culvert replacement including approximately 14 m extension upstream and 10.5 m extension downstream. Minimal grading required upstream as there is no defined channel. Local tie in works to marshy area required downstream. (Note: culvert is proposed to be moved by developers and the Region will work with developers at detailed design).
			D	Stable	Transfer	0.07	Low	2					
21A	CSP	Not included in geomorphology assessment											
21B	CSP	Not included in geomorphology assessment											
22	Conc.	3.0 Representat ive	U/S reference	PL	Exchange	0.24	Moderate	7	3660 x 2440	20000	44.5	-	Existing culvert to be removed and replaced with 20 m clear span structure. Approximately 100 m of channel will be realigned and enhanced, including removal of concrete bed and bank. Low flow channel to be created through structure. Downstream connection with channel will no longer be perched. Requirement for bank protection and scour pool to be investigated at detailed design.
			U	PL	Exchange	0.30	High	3					
			D	PL	Exchange	0.18	Moderate	4					
22A	CSP	Not included in geomorphology assessment											
22B	CSP	Not included in geomorphology assessment											
23	Conc.	1.8 Representa-tive	U	Downcutt-ing and widening	Source	0.49	Low-moderate	5	4570 x 2440	-	54.1	-	No works proposed.
			D	PL	Source	0.39	Low-moderate	5					

Note: The size for Culverts 1, 7 and 10 in Table 6-5 are based on fluvial geomorphology requirement, while the proposed culvert size for Culverts 1, 7, and 10 in Table 6-3 are based on hydraulic analysis. The final size of the culvert will be determined in detailed design in consultation with Conservation Halton.

CULVERT C1		
BANKFULL WIDTH = 1.3m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	PLANIMETRIC ADJUSTMENT	STABLE
FUNCTION	SOURCE	TRANSFER
EROSION RISK	MODERATE	MODERATE
STABILITY INDEX	0.31 (TRANSITIONAL)	N/A
CONSERVATION STATUS	3	3

CHANNEL IS ENTRENCHED. EXTENSIVE BANK EROSION AND SEVERAL KNICKPOINTS ARE PRESENT WHERE INCISION HAS ALREADY OCCURED, PLANFORM ADJUSTMENT IS OCCURING

APPROXIMATELY 130m OF CHANNEL REALIGNMENT PROPOSED TO FACILITATE ROAD WIDENING.

EXISTING 900mmø CSP CULVERT TO BE REMOVED AND REPLACED BY A 3.5m WIDE CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 8m.

DUNDAS STREET CLASS EA LIMIT

C1

INSET 1

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 11m.

MARGINAL IMPROVEMENT TO OUTLET ANGLE.

DEFINED CHANNEL

NO DEFINED CHANNEL

EXISTING STORM INLET

FEASIBILITY OF CONSTRUCTING A MORE DEFINED CHANNEL COMPARED TO EXISTING WILL BE INVESTIGATED AT DETAILED DESIGN.

INCREASE CHANNEL LENGTH COMPARED TO EXISTING THROUGH INCREASING SINUOSITY. THIS WILL HELP TO REDUCE THE CHANNEL SLOPE AND RESULTING ENERGY CURRENTLY LEADING TO THE PRESENCE OF KNICKPOINTS IN THE REACH.

IMPROVE INLET ANGLE FROM 90°.

INSET 1 — 10+500

CREATE AN ASYMETRICAL CROSS SECTION THAT IS BETTER CONNECTED TO THE FLOODPLAIN (ESPECIALLY IN THE DOWNSTREAM PART OF THE REACH WHERE INCISION HAS OCCURED).

MAINTAIN MINIMUM 3.0m BUFFER BETWEEN PROPOSED CHANNEL CENTRELINE AND TOE OF ROAD GRADING.

SHOULD BANK PROTECTION MEASURES BE CONSIDERED NECCESARY AT DETAILED DESIGN, BIOENGINEERING METHODS SHOULD BE USED AS FAR AS POSSIBLE.

RIPARIAN PLANTINGS TO BE INSTALLED ON BOTH SIDES OF REALIGNED WATERCOURSE.

CEDAR SPRINGS ROAD

TUCK CREEK

EB BRANT STATION

WB BRANT STATION

BRANT STREET REGIONAL ROAD No. 18

ROSELAND CREEK

KRISTIE CT.

OVERTON DRIVE

9+900 10+000 10+100 10+200 10+300 10+400 10+500 10+600

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Tuck Creek Tributary Catchment
(Culvert C1)

Exhibit

6-21

CULVERT C2		
BANKFULL WIDTH = 0.5m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	PLANIMETRIC ADHUSTMENT AND INCISION	DREDGED - STABLE
FUNCTION	EXCHANGE	N/A
EROSION RISK	LOW-MODERATE	LOW-MODERATE
STABILITY INDEX	0.11 (IN REGIME)	N/A
CONSERVATION STATUS	4	N/A

TUCK CREEK

CHANNEL HAS A STEEP SLOPE AND A KNICKPOINT IS PRESENT. LARGE IMPORTED STONES ON CHANNEL BED.

CULVERT UNDER DRIVEWAY THAT JOINS CULVERT UNDER DUNDAS STREET STEP IN CULVERT WILL NEED TO BE CONSIDERED AT DETAILED DESIGN AS IT COULD AFFECT CHANNEL SLOPE.

APPROXIMATELY 130m OF CHANNEL REALIGNMENT PROPOSED TO FACILITATE ROAD WIDENING.

EXISTING 1520mm x 970mm CSP ARCH CULVERT TO BE REMOVED AND REPLACED BY A 2440mm x 1220mm CONCRETE BOX CULVERT. LOCALIZSED TIE IN WORKS REQUIRED. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 5m.

EXISTING 900mmø CSP CULVERT TO BE REMOVED AND REPLACED BY A 3.5m WIDE CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 8m.

NOTE: CONFIGURATION OF PARKING AREA SUBJECT TO DISCUSSION WITH PROPERTY OWNER DURING DETAILED DESIGN

EXISTING 1830mm x 1220mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY 3660mm x 1220mm CONCRETE BOX CULVERT. CULVERT LENGTH TO BE INCREASED APPROXIMATELY 5.0m

C1 C2 C3

10+500 10+600 10+700 10+800 10+900 11+000 11+100 11+200

LOCAL TIE-IN WORKS REQUIRED.

WB EAGLESFIELD STATION

APPROXIMATELY 100m OF CHANNEL REALIGNMENT PROPOSED TO FACILITATE ROAD WIDENING.

MARGINAL IMPROVEMENT TO OUTLET ANGLE.

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 11m.

DEFINED CHANNEL

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 8.5m.

EB EAGLESFIELD STATION

RETAINING WALL

EXISTING 90° CONFLUENCE WITH C3 CHANNEL TO BE IMPROVED.

90° BEND ERODING UNDER EXISTING CONDITIONS

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 6.5m.

NO DEFINED CHANNEL

EXISTING STORM INLET

CHANNEL TO BE PIPED FROM C2 TO EDGE OF CHURCH PARKING LOT (135m).

EXISTING STORM INLET

FEASIBILITY OF CONSTRUCTING A MORE DEFINED CHANNEL COMPARED TO EXISTING WILL BE INVESTIGATED AT DETAILED DESIGN.

EXISTING CHANNEL WAS DREDGED IN THE FALL OF 2014. PREVIOUSLY IT WAS A NARROW CHANNEL THAT WAS RECOVERING A SINOUS PLANFORM THROUGH LATERAL ADJUSTMENT. AFTER DREDGING IT IS A UNIFORM TRAPEZOIDAL CHANNEL WITH BARE BANKS.

OPPORTUNITY TO ENHANCE 320m OF HEAVILY MODIFIED CHANNEL LENGTH.

CREATE ASYMETRICAL CROSS SECTION THAT IS WELL CONNECTED TO THE FLOODPLAIN.

KIRKBURN DRIVE

EAGLESFIELD DRIVE

SHOULD BANK PROTECTION MEASURES BE CONSIDERED NECCESARY AT DETAILED DESIGN, BIOENGINEERING METHODS SHOULD BE USED AS FAR AS POSSIBLE.

RIPARIAN PLANTINGS TO BE INSTALLED ON BOTH SIDES OF REALIGNED WATERCOURSE.

CHANNEL TO BE REALIGNED TO A MORE SINUOUS PLANFORM BASED ON PRE-DREDGING CONDITIONS.

MAINTAIN MINIMUM 3.0m BUFFER BETWEEN PROPOSED CHANNEL CENTRELINE AND TOE OF ROAD GRADING.

AMBLECOTE LN.

ABBOTSBURY STREET

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton REGION MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Tuck Creek Tributary Catchment
(Culvert C2)

Exhibit
6-22

CULVERT C3		
BANKFULL WIDTH = 0.5m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	PLANIMETRIC ADJUSTMENT	INCISION
FUNCTION	SOURCE	SOURCE
EROSION RISK	CHANNEL - LOW CULVERT - WITHOUT REPLACING IN-CULVERT DROP, SLOPE/VELOCITY COULD BE AN ISSUE	LOW
STABILITY INDEX	0.13 (IN REGIME)	N/A
CONSERVATION STATUS	3	2

CULVERT UNDER DRIVEWAY THAT JOINS CULVERT UNDER DUNDAS STREET STEP IN CULVERT WILL NEED TO BE CONSIDERED AT DETAILED DESIGN AS IT COULD AFFECT CHANNEL SLOPE.

TUCK CREEK

EXISTING 1830mm x 1220mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY 3660mm x 1220mm CONCRETE BOX CULVERT. CULVERT LENGTH TO BE INCREASED APPROXIMATELY 5.0m

APPROXIMATELY 100m OF CHANNEL REALIGNMENT PROPOSED TO FACILITATE ROAD WIDENING.

TUCK CREEK TRIBUTARY

EXISTING 825mmø CSP CULVERT IN POOR CONDITION TO BE REPLACED BY A 825mmø CONCRETE CULVERT.

EXISTING 600mmø HDPE LINED CULVERT TO BE REMOVED AND REPLACED BY AND 825mmø CONCRETE CULVERT.

EXISTING 525mmø HDPE LINED CULVERT TO BE REMOVED AND REPLACED BY A 1050mmø CONCRETE CULVERT.

1+100 1+200 11+300 11+400 11+500 11+600 11+700 11+800

C3 C4 C5 C6

WB BLACKWOOD STATION

EB BLACKWOOD STATION

RETAINING WALL

INSET 2

EXISTING 90° CONFLUENCE WITH C3 CHANNEL TO BE IMPROVED.

90° BEND ERODING UNDER EXISTING CONDITIONS

SCOUR POOL LIKELY REQUIRED, ESPECIALLY IF IN CULVERT STEP IS REMOVED.

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 6.5m.

EXISTING STORM INLET

BLACKWOOD DRIVE

BRANT HILLS

MALCOLM CRESCENT

WHITTAKER DRIVE

NOTE: CONFIGURATION OF PARKING AREA SUBJECT TO DISCUSSION WITH PROPERTY OWNER DURING DETAILED DESIGN

PROPOSED CULVERTS TO BE PERPINDICULAR TO DRIVEWAYS.

RIPARIAN PLANTINGS TO BE INSTALLED ON BOTH SIDES OF REALIGNED WATERCOURSE.

CHANNEL TO BE REALIGNED TO A MORE SINUOUS PLANFORM.

INSET 2

CREATE ASYMETRICAL CROSS SECTION THAT IS WELL CONNECTED TO THE FLOODPLAIN.

SHOULD BANK PROTECTION MEASURES BE CONSIDERED NECCESARY AT DETAILED DESIGN, BIOENGINEERING METHODS SHOULD BE USED AS FAR AS POSSIBLE.

MAINTAIN MINIMUM 3.0m BUFFER BETWEEN PROPOSED CHANNEL CENTRELINE AND TOE OF ROAD GRADING.

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton Region

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Tuck Creek Tributary Catchment
(Culverts C3, C4, C5, and C6)

Exhibit

6-23

CULVERT C7		
BANKFULL WIDTH = 2.7m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	INCISION AND WIDENING	NOT INCLUDED IN FIELD ASSESSMENT AS NO IMPACTS WERE ANITICIPATED. TO BE COMPLETED AT DETAILED DESIGN
FUNCTION	SOURCE	
EROSION RISK	HIGH	
STABILITY INDEX	0.29 (TRANSITIONAL)	
CONSERVATION STATUS	2	

TUCK CREEK TRIBUTARY

TUCK CREEK

EXISTING 600mmø HDPE LINED CULVERT TO BE REMOVED AND REPLACED BY AND 825mmø CONCRETE CULVERT.

EXISTING 525mmø HDPE LINED CULVERT TO BE REMOVED AND REPLACED BY A 1050mmø CONCRETE CULVERT.

LOCAL TIE–IN WORKS REQUIRED. DUE TO STEEP SLOPE AND EXTENSIVE EROSION UNDER EXISTING CONDITIONS FURTHER ASSESSMENT WILL BE REQUIRED AT DETAILED DESIGN. IT MAY BE NECESSARY TO REMOVE AND REPLACE AN EXISTING FAILED CONCRETE DROP STRUCTURE WHICH ENDS APPROXIMATELY AT TIE–IN LOCATION. PROFILE OF CULVERT EXTENSION UPSTREAM WILL NEED TO BE CAREFULLY CONSIDERED. WORKS MAY NEED TO EXTEND UPSTREAM OF PROPERTY LINE TO ACHIEVE A STABLE CHANNEL PROFILE. BED AND BANK PROTECTION WILL BE REQUIRED AT THE PROPOSED CULVERT INLET.

IN THE VICINITY OF THE CULVERT THE REACH IS DISTURBED. SEVERAL FORMS OF HARD BANK PROTECTION ARE PRESENT AND ARE GENERALLY FAILING.

EXISTING 1520mm x 1220mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 2440mm x 1220mm CONCRETE CULVERT. APPROXIMATE 5m EXTENSION REQUIRED UPSTREAM AS WELL AS LOCAL TIE–IN WORKS.

TWO DROPS IN CHANNEL BED APPROXIMATELY 0.5m HIGH UNDER EXISTING CONDITIONS. WINGWALLS ARE ERODED.

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 5m.

C5 C6 C7

11+600 11+700 11+800 11+900 12+000 12+100 12+30

RETAINING WALL

RETAINING WALL

WB GUELPH LINE STATION

EB GUELPH LINE STATION

GUELPH LINE

EXISTING STORM INLET

NOTE: CONFIGURATION OF PARKING AREA SUBJECT TO DISCUSSION WITH PROPERTY OWNER DURING DETAILED DESIGN

NOT INCLUDED IN GEOMORPHOLOGY ASSESSMENT. LOCAL TIE IN WORKS REQUIRED. DUE TO LOSS IN CHANNEL LENGTH A SCOUR POOL SHOULD BE INCLUDED. GEOMORPHOLOGY SITE VISIT REQUIRED AT DETAILED DESIGN

TUCK CREEK

WHITTAKER DRIVE

FONTANA CR.

AUTUMN HILL CR.

AUTUMN HILL CR.

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton Region

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Tuck Creek Tributary Catchment
(Culverts C6 and C7)

Exhibit

6-24

CULVERT C8		
BANKFULL WIDTH = 1.5m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	PLANIMETRIC ADJUSTMENT	N/A
FUNCTION	EXCHANGE	N/A
EROSION RISK	HIGH	N/A
STABILITY INDEX	0.33 (TRANSITIONAL)	N/A
CONSERVATION STATUS	2	N/A

TUCK CREEK

IN THE VICINITY OF THE CULVERT THE REACH IS DISTURBED. SEVERAL FORMS OF HARD BANK PROTECTION ARE PRESENT AND ARE GENERALLY FAILING.

EXISTING 1520mm x 1220mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 2440mm x 1220mm CONCRETE CULVERT. APPROXIMATE 5m EXTENSION REQUIRED UPSTREAM AS WELL AS LOCAL TIE-IN WORKS.

TWO DROPS IN CHANNEL BED APPROXIMATELY 0.5m HIGH UNDER EXISTING CONDITIONS. WINGWALLS ARE ERODED.

C7

12+100

IN THE VICINITY OF THE CULVERT, THE CHANNEL PLANFORM HAS BEEN STRAIGHTENED. BANKS ARE PROTECTED BY RIP RAP AND BRICK WALLS. KNICKPOINTS ARE PRESENT.

MARGINAL INCREASE IN CHANNEL LENGTH WOULD BE BENEFICIAL AS THE WATERCOURSE IS SHOWING SIGNS OF LATERAL ADJUSTMENT.

12+300

C8

EXISTING CHANNEL APPEARS TO BE STRAIGHTENED. EVIDENCE OF HISTORIC INCISION IS PRESENT (KNICKPOINTS AND ELEVATED TREE ROOTS).

APPROXIMATELY 25m OF CHANNEL REALIGNMENT REQUIRED TO IMPROVE ALIGNMENT WITH CULVERT.

EXISTING 1830mm x 910mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 3660mm x 1520mm CONCRETE CULVERT. APPROXIMATELY 5m EXTENSION REQUIRED AS WELL AS LOCAL TIE-IN WORKS.

12+400

EXISTING CULVERT SKEWED TO THE LEFT BANK.

12+500

12+600

12+700

12+800

HIGHWAY 407 OFF-RAMP

HIGHWAY 407 ON-RAMP

B GUELPH LINE STATION

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 5m.

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 2m. LOCAL TIE-IN WORKS REQUIRED.

NOT INCLUDED IN GEOMORPHOLOGY ASSESSMENT. LOCAL TIE IN WORKS REQUIRED. DUE TO LOSS IN CHANNEL LENGTH A SCOUR POOL SHOULD BE INCLUDED. GEOMORPHOLOGY SITE VISIT REQUIRED AT DETAILED DESIGN

TUCK CREEK

DRIFTWOOD PARK

AUTUMN HILL CR.

AUTUMN HILL CR.

EXISTING STORM INLET

DRIFTWOOD DRIVE

HIGHWAY 407 ETR

LIMIT FOR 407

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

Halton REGION | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Tuck Creek Tributary Catchment
(Culvert C8)

Exhibit
6-25

CULVERT C9		
BANKFULL WIDTH = 2.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	AGGRADING	PLANIMETRIC ADJUSTMENT
FUNCTION	SINK	EXCHANGE
EROSION RISK	MODERATE	LOW-MODERATE
STABILITY INDEX	0.14 (IN REGIME)	0.18 (IN REGIME)
CONSERVATION STATUS	3	4

CULVERT C10		
BANKFULL WIDTH = 3.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	AGGRADING	STABLE
FUNCTION	SINK	TRANSFER
EROSION RISK	LOW-MODERATE	LOW
STABILITY INDEX	0.17 (IN REGIME)	0.07 (IN REGIME)
CONSERVATION STATUS	3	4

CULVERT C11		
BANKFULL WIDTH = 2.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	STABLE	STABLE
FUNCTION	TRANSFER	TRANSFER
EROSION RISK	MODERATE	LOW
STABILITY INDEX	0.07 (IN REGIME)	0.0 (IN REGIME)
CONSERVATION STATUS	3	3

SHOREACRES CREEK

SINUOUS REALIGNED CHANNEL.

NO INCREASE IN CULVERT LENGTH PROPOSED. NO WORKS PROPOSED UPSTREAM

C9

REACH IS TYPICALLY AGGRADATIONAL BUT SCOUR HAS OCCURED AT CULVERT INLET.

REALIGNED, REGULARLY MEANDERING PLANFORM SET BETWEEN TWO BERMS RUNNING PARALLEL TO WATERCOURSE.

EXISTING KNICKPOINT/DROP STRUCTURE WILL LIKELY BE ELIMINATED BY TIE-IN REALIGNMENT. CONSIDERATION TO CHANNEL SLOPE DESIGN WILL BE REQUIRED AT DETAILED DESIGN WITH PARTICULAR REFERENCE TO FISH PASSAGE REQUIREMENTS

EXISTING 1830mm x 1600mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 5.0m WIDE CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 5.5m.

C10

SHOREACRES CREEK

CHANNEL IS REED CHOKED.

HISTORIC COURSE OF TRIBUTARY.

0.5m HIGH KNICKPOINT APPROXIMATELY 5m UPSTREAMM OF CULVERT INLET HAS CAUSED LOCALISED EROSION AND OUTFLANKING OF CULVERT WALLS.

80m DITCH REALIGNMENT REQUIRED TO FACILITATE ROAD WIDENING.

INVESTIGATE REQUIRMENT FOR LOCAL BED/BANK PROTECTION AT PROPOSED CULVERT INLET AT DETAILED DESIGN.

INSET 3

WB HWY 407 STATION

12+900

13+000

13+300

13+400

LIMIT FOR 407

HIGHWAY 407 ON-RAMP

HIGHWAY 407 OFF-RAMP

RELOCATION OF EXISTING NOISE WALL

LOCAL TIE-IN WORKS REQUIRED INCLUDING RECREATION OF A SCOUR POOL.

SCOUR POOL IS PARTLY LINED WITH RIP RAP.

EXISTING 2440mm x 1830mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 3660mm x 1520mm CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 2.5m.

UPSTREAM CHANNEL IS POORLY DEFINED AND REED CHOKED.

NO INCREASE IN CULVERT LENGTH PROPOSED. NO WORKS PROPOSED DOWNSTREAM

DOWNSTREAM CHANNEL IS DEFINED AND INCISING.

CONSTRUCTED SCOUR POOL.

VALLEY FLOOR IS PROTECTED BY CONCRETE APRON. OPPORTUNITY TO REMOVE CONCRETE AND ASSOCIATED WEIR (0.5m HIGH) FEATURE TO CREATE A LOW FLOW CHANNEL TO BE INVESTIGATED AT DETAILED DESIGN.

EXISTING STORM INLET

DOWNSTREAM OF CONCRETE APRON, REACH HAS BEEN REALIGNED. CHANNEL HAS A TWO STAGE CROSS SECTION WITH NARROW LOW FLOW CHANNEL AND WIDER, VEGETATED BANKFUL CHANNEL.

INSET 3

REALIGN CHANNEL WITH A MORE CONSTANT SLOPE COMPARED TO EXISTING (TO MAINTAIN A MORE DEFINED LOW FLOW CHANNEL UPSTREAM AND MINIMIZE INCISION DOWNSTREAM).

MAINTAIN MINIMUM 3m BUFFER BETWEEN PROPOSED CHANNEL CENTRELINE AND TOE OF ROAD GRADING.

IMPROVE CONFLUENCE ANGLE BETWEEN C10 DITCH AND SHOREACRES CREEK TRIBUTARY.

RIPARIAN PLANTINGS TO BE INSTALLED ON BOTH SIDES OF REALIGNED WATERCOURSE.

HEADON ROAD

OAK RIDGE CRESCENT

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Shoreacres Creek Tributary Catchment
(Culverts C9 and C10)

Exhibit

6-26

CULVERT C10 DITCH	
BANKFULL WIDTH = 0.9m	
PROCESS	N/A
FUNCTION	N/A
EROSION RISK	LOW-MODERATE
STABILITY INDEX	0.37 (IN REGIME)
CONSERVATION STATUS	3

CULVERT C10		
BANKFULL WIDTH = 3.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	AGGRADING	STABLE
FUNCTION	SINK	TRANSFER
EROSION RISK	LOW-MODERATE	LOW
STABILITY INDEX	0.17 (IN REGIME)	0.07 (IN REGIME)
CONSERVATION STATUS	3	4

CULVERT C11		
BANKFULL WIDTH = 2.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	STABLE	STABLE
FUNCTION	TRANSFER	TRANSFER
EROSION RISK	MODERATE	LOW
STABILITY INDEX	0.07 (IN REGIME)	0.0 (IN REGIME)
CONSERVATION STATUS	3	3

SHOREACRES CREEK

REALIGNED, REGULARLY MEANDERING PLANFORM SET BETWEEN TWO BERMS RUNNING PARALLEL TO WATERCOURSE.

EXISTING KNICKPOINT/DROP STRUCTURE WILL LIKELY BE ELIMINATED BY TIE-IN REALIGNMENT. CONSIDERATION TO CHANNEL SLOPE DESIGN WILL BE REQUIRED AT DETAILED DESIGN WITH PARTICULAR REFERENCE TO FISH PASSAGE REQUIREMENTS

EXISTING 1830mm x 1600mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 5.0m WIDE CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 5.5m.

C10

13+300

CHANNEL IS REED CHOKED.

SHOREACRES CREEK

HISTORIC COURSE OF TRIBUTARY.

0.5m HIGH KNICKPOINT APPROXIMATELY 5m UPSTREAMM OF CULVERT INLET HAS CAUSED LOCALISED EROSION AND OUTFLANKING OF CULVERT WALLS.

80m DITCH REALIGNMENT REQUIRED TO FACILITATE ROAD WIDENING.

13+400

INVESTIGATE REQUIRMENT FOR LOCAL BED/BANK PROTECTION AT PROPOSED CULVERT INLET AT DETAILED DESIGN.

CHANNEL IS NOT WELL DEFINED. IT RUNS THROUGH A FORESTED BUFFER STRIP.

SHOREACRES CREEK (EAST BRANCH)

CHANNEL HAS BEEN REALIGNED, LENGTHENING THE WATERCOURSE AND REDUCING SLOPE.

WB HWY 407 STATION

13+600

THIS SITE IS SUBJECT TO FUTURE DEVELOPMENT AND CHANNEL REALIGNMENT WILL LIKELY PRECEED THE DUNDAS STREET WIDENING PROJECT. A CONCEPTUAL REALIGNMENT IS SHOWN HERE TO DEMONSTRATE THAT AN ACCEPTABLE SOLUTION IS POSSIBLE.

EXISTING INLET SKEWED TO CHANNEL BY 90°.

EXISTING WATERCOURSE IS TYPICALLY AGGRADATIONAL AND INFILLED BY REEDS.

EXISTING 3050mm x 1520mm CONCRETE CULVERT TO BE EXTENDED BY 17.5m.

13+700

INSET 4

13+800

C11

13+900

SCOUR POOL IS PARTLY LINED WITH RIP RAP.

EXISTING 2440mm x 1830mm CONCRETE CULVERT TO BE REMOVED AND REPLACED BY A 3660mm x 1520mm CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 2.5m.

NO INCREASE IN CULVERT LENGTH PROPOSED. NO WORKS PROPOSED DOWNSTREAM

UPSTREAM CHANNEL IS POORLY DEFINED AND REED CHOKED.

DOWNSTREAM CHANNEL IS DEFINED AND INCISING.

CONSTRUCTED SCOUR POOL.

VALLEY FLOOR IS PROTECTED BY CONCRETE APRON. OPPORTUNITY TO REMOVE CONCRETE AND ASSOCIATED WEIR (0.5m HIGH) FEATURE TO CREATE A LOW FLOW CHANNEL TO BE INVESTIGATED AT DETAILED DESIGN.

EXISTING STORM INLET

DOWNSTREAM OF CONCRETE APRON, REACH HAS BEEN REALIGNED. CHANNEL HAS A TWO STAGE CROSS SECTION WITH NARROW LOW FLOW CHANNEL AND WIDER, VEGETATED BANKFUL CHANNEL.

EB HWY 407 STATION

HIGH FLOW EVENT HAS SCOURED OUT A CHANNEL IN THE FLOODPLAIN.

RETAINING WALL AND LANDSCAPING

215m OF WATERCOURSE REALIGNMENT REQUIRED TO FACILITATE ROAD WIDENING.

CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 1m.

NORTHAMPTON BOULEVARD

SHOREACRES CREEK

HEADON ROAD

OAK RIDGE CRESCENT

INSET 4

13+700

13+800

NO SIGNIFICANT INCREASE IN CHANNEL SINUOSITY IS PROPOSED AS EXISTING WATERCOURSE IS AGGRADATIONAL

EXISTING SLOPE OF CHANNEL TO C11 INLET IS STEEP. GRADING WILL BE REQUIRED TO ENSURE A STABLE PROFILE DESIGN AND MAINTAIN FISH PASSAGE.

MAINTAIN MINIMUM 3m BUFFER BETWEEN PROPOSED CHANNEL CENTRELINE AND TOE OF ROAD GRADING.

90° BENDS AT HWY 407 ACCESS ROAD AND C11 INLET TO BE REMOVED.

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

DATE OF PHOTOGRAPHY - 2013

Halton REGION

MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Shoreacres Creek Tributary Catchment
(Culverts C10 and C11)

Exhibit

6-27

Halton Region | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Shoreacres Creek Tributary Catchment
(Culvert C11)

Exhibit

6-28

CULVERT C12		
BANKFULL WIDTH = 1.5m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	STABLE	STABLE
FUNCTION	TRANSFER	TRANSFER
EROSION RISK	LOW-MODERATE	LOW
STABILITY INDEX	0.07 (IN REGIME)	0.0 (IN REGIME)
CONSERVATION STATUS	4	4

ROTARY WAY
EXISTING SWM POND (MATTAMY RICHARDSON)
APPLEBY CREEK
ALTON COMMUNITY
MINIMAL BANK EROSION AND TYPICALLY WELL VEGETATED BANKS. FLOW SLUGISH DURING THE TWO SITE VISITS UNDERTAKEN.
EXISTING 2440mm x 1520mm CULVERT TO BE REPLACED BY A 7010mm x 1520mm CONCRETE CULVERT. CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 3.5m.
EXISTING INLET IS WELL ALIGNED AND WILL BE MAINTAINED
C12
TIM DOBBIE DRIVE
14+400
WB ROTARY STATION
14+500
14+600
14+700
14+800
WB ALTON STATION
14+900
15+000
15+100
GUIRE COMMON
EB BERWICK STATION
STONE LINED SCOUR POOL.
LOCAL TIE-IN WORKS REQUIRED. A SCOUR POOL WILL BE REQUIRED AT PROPOSED OUTLET.
SINGLETON COMMON
EB ALTON STATION
RAWLINGS COMMON
BERWICK DRIVE
CULVERT LENGTH TO BE INCREASED BY APPROXIMATELY 7.5m.
JUDSON COMMON
RETAINING WALL AND LANDSCAPING
WESTLOCK COMMON
CHANNEL APPEARS MODIFIED AND IS TYPICALLY STRAIGHT AND DEEP.
DOWNSTREAM CHANNEL PLANFORM AND CROSS SECTION ARE MORE VARIED.

LEGEND:
- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

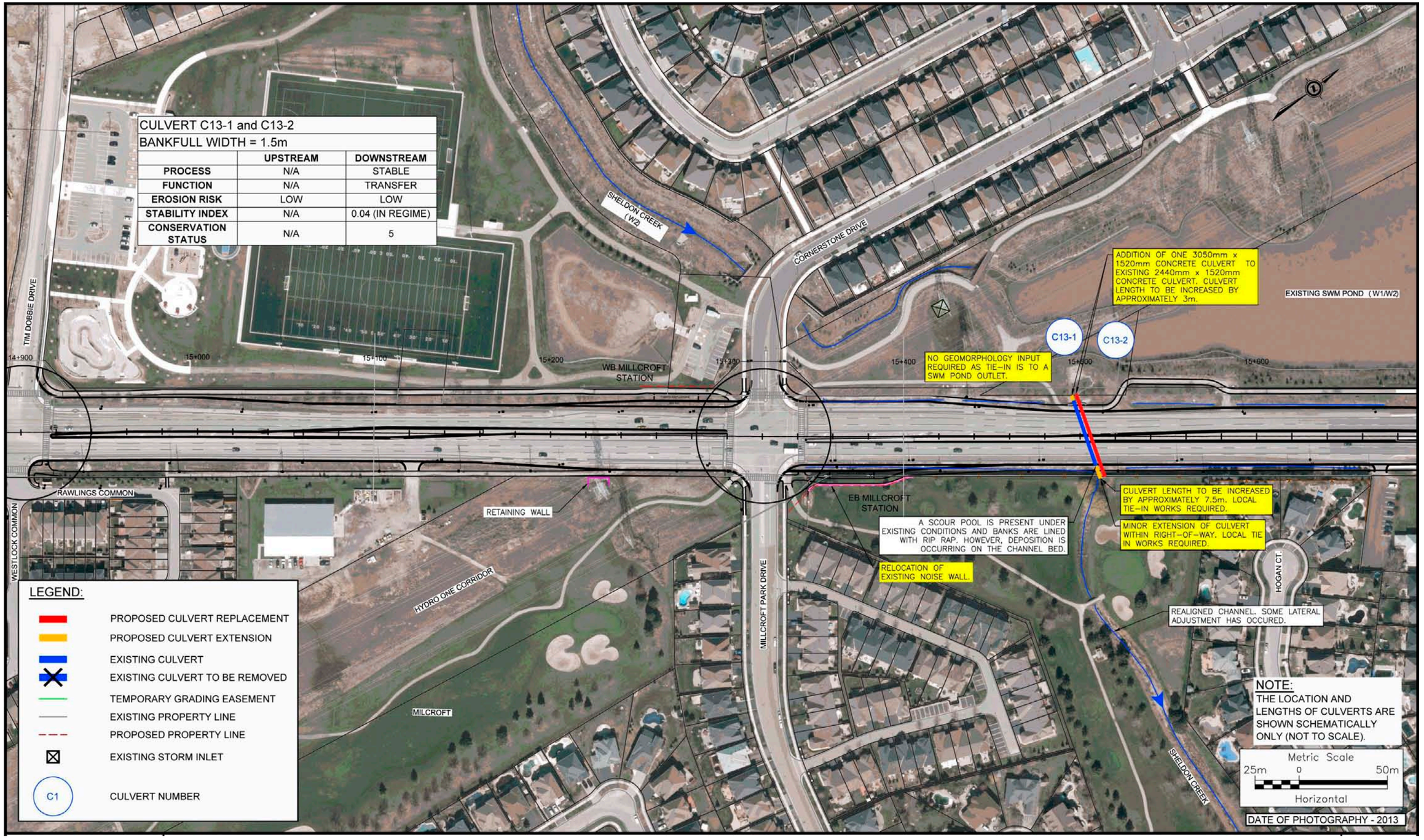
DATE OF PHOTOGRAPHY - 2013

Halton REGION
MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Appleby Creek West Catchment
(Culvert C12)

Exhibit
6-29



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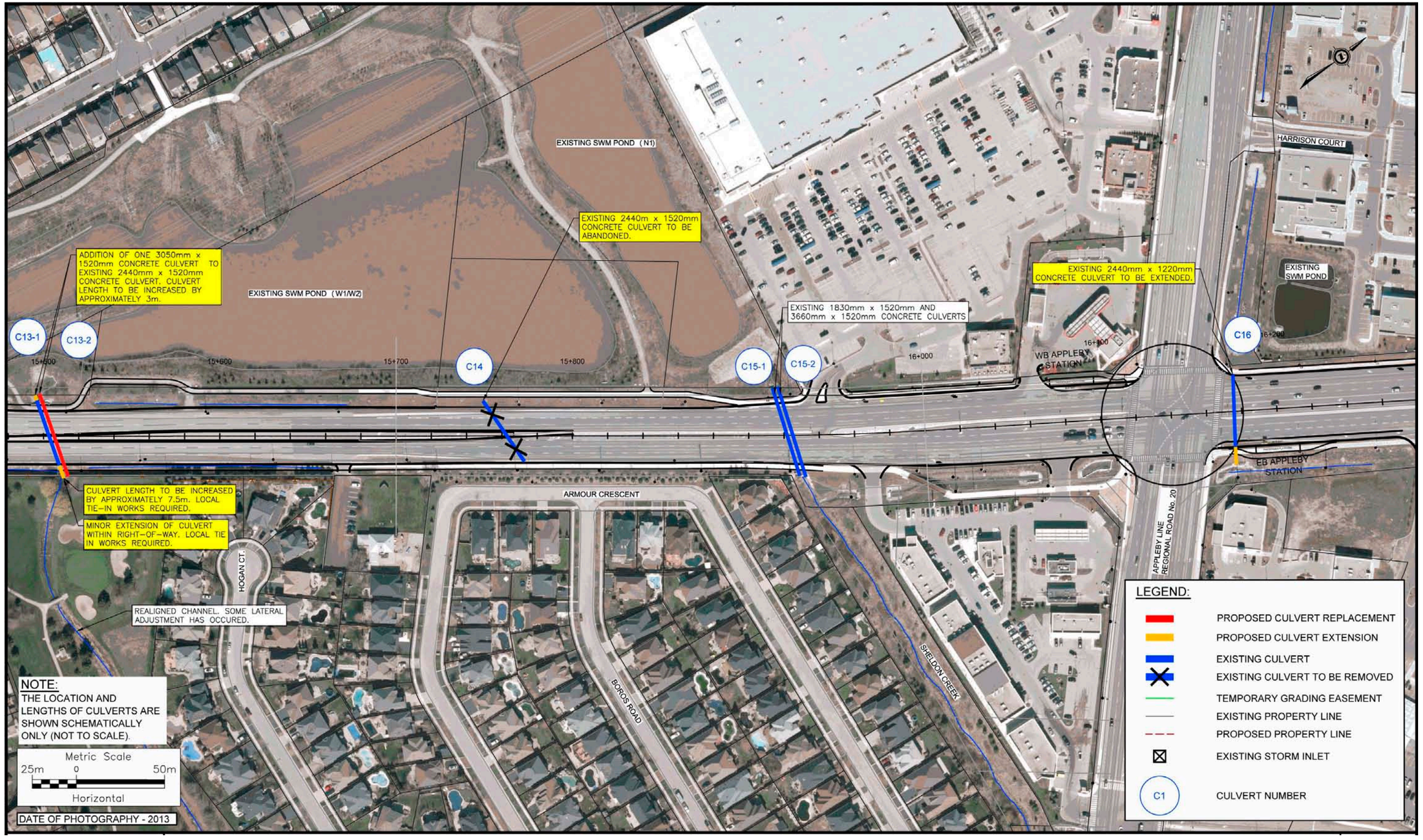
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Sheldon Creek West Tributary Catchment
(Culvert C13)

Exhibit

6-30



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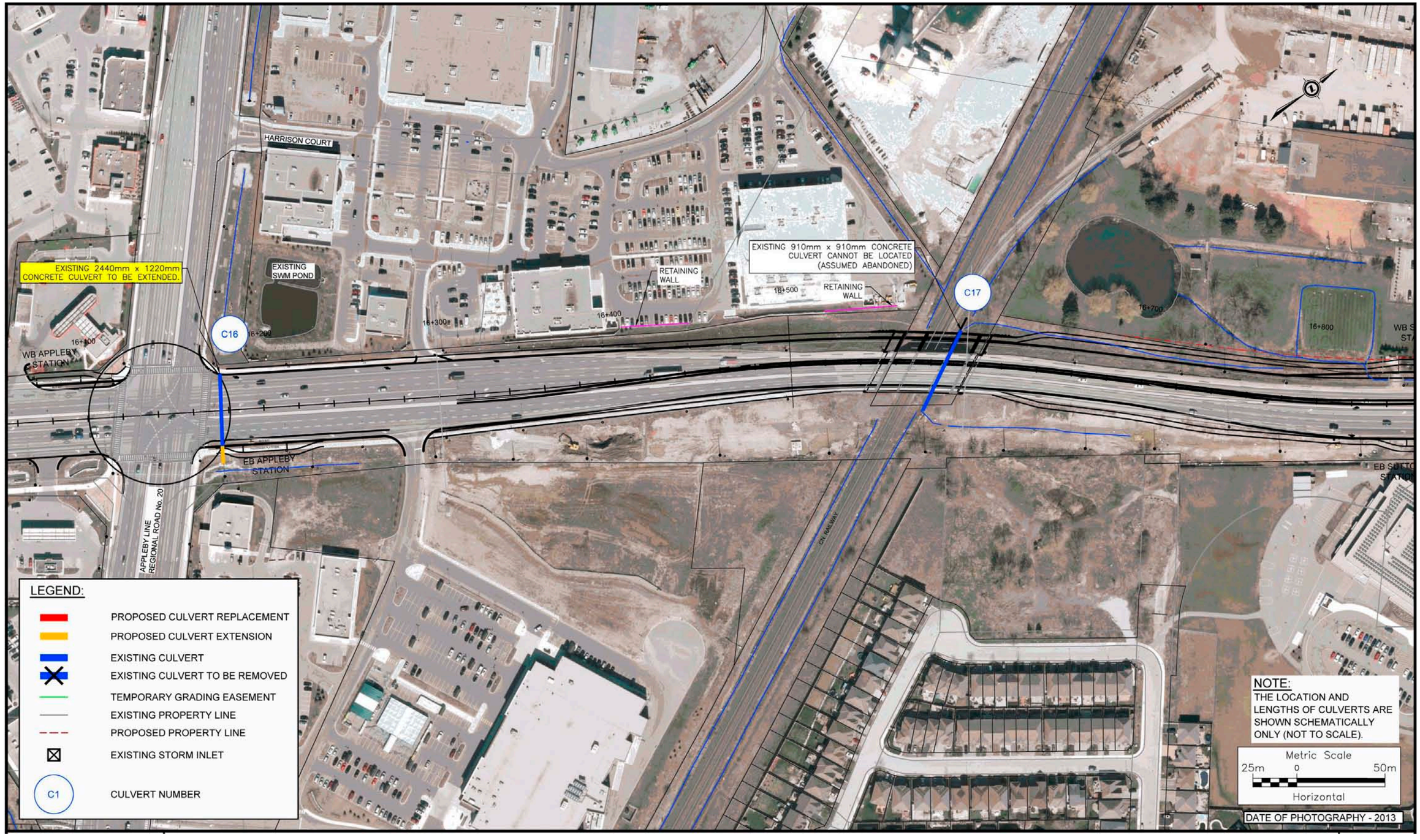
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Sheldon Creek Tributary Catchment
(Culverts C14 and C15)

Exhibit
6-31



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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Sheldon Creek Tributary Catchment
(Culvert C16)

Exhibit
6-32

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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Sheldon Creek Tributary Catchment
(Culvert C17)

Exhibit

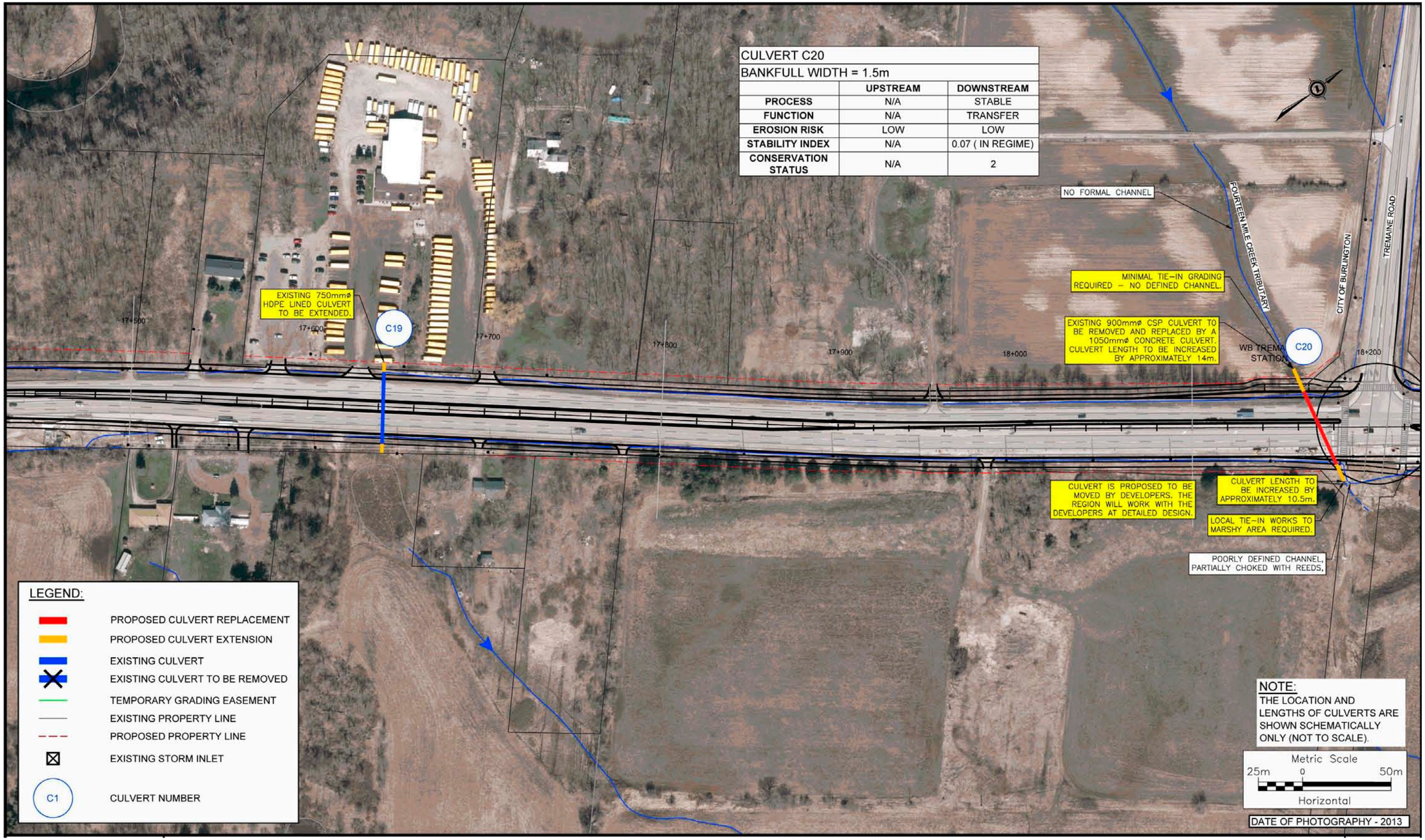
6-33

Halton Region | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Bronte Creek Catchment
(Culvert C18)

Exhibit
6-34



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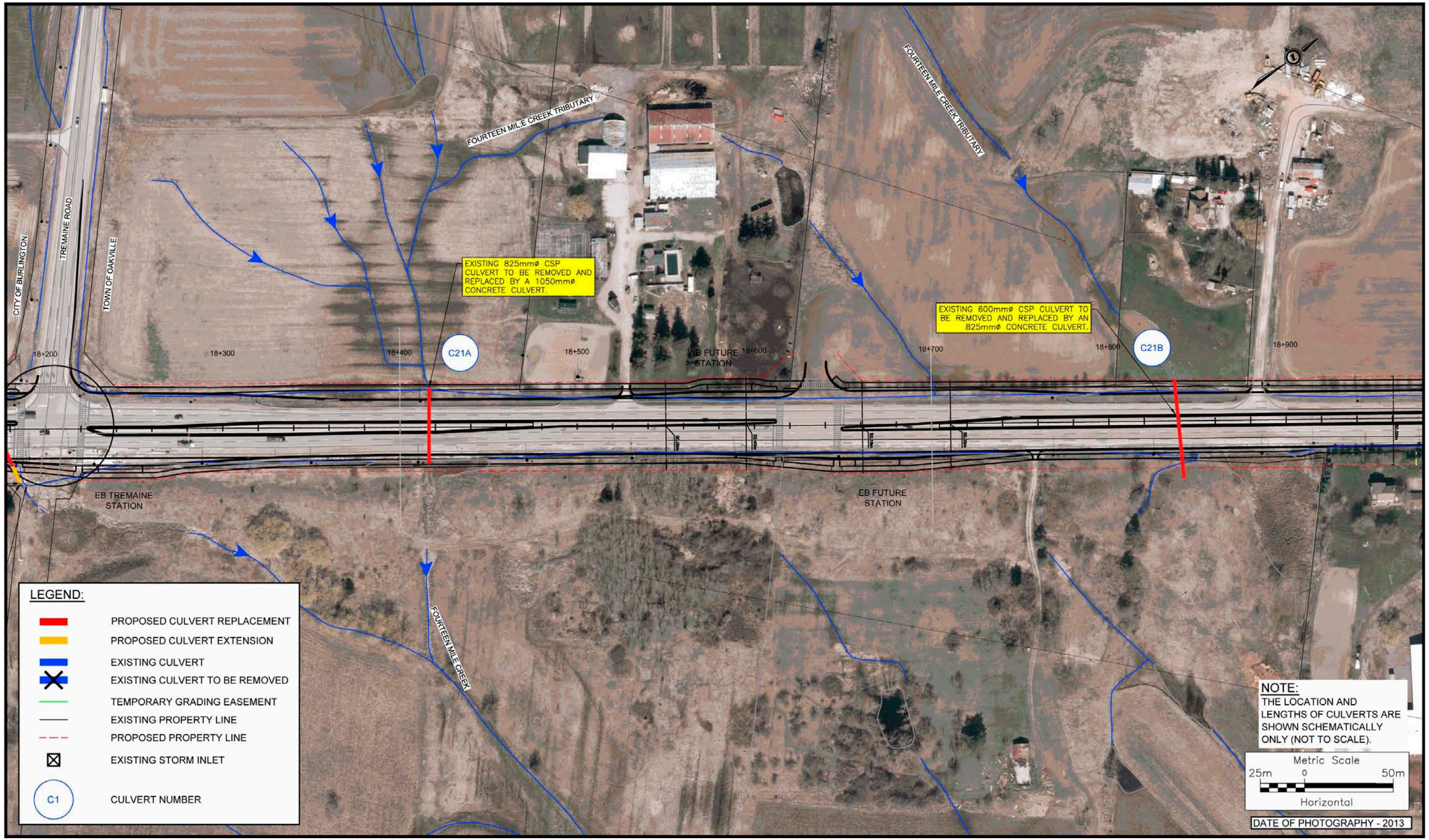
DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Fourteen Mile Creek Tributary Catchment
(Culverts C19 and C20)

Exhibit

6-35



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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Fourteen Mile Creek Tributary Catchment
(Culverts C21A and C21B)

Exhibit

6-36

CULVERT C22		
BANKFULL WIDTH = 3.0m		
	UPSTREAM	**DOWNSTREAM**
PROCESS	PLANIMETRIC ADJUSTMENT	PLANIMETRIC ADJUSTMENT
FUNCTION	EXCHANGE	EXCHANGE
EROSION RISK	HIGH	MODERATE
STABILITY INDEX	0.30 (IN REGIME)	0.18 (IN REGIME)
CONSERVATION STATUS	3	4

FOURTEEN MILE CREEK TRIBUTARY

UPSTREAM OF THE DUNDAS STREET ROW THE CREEK RETAINS MANY NATURAL FEATURES AND FLUVIAL PROCESSES. THE IRREGULARLY MEANDERING PLANFORM SUPPORTS A POOL–RIFFLE MORPHOLOGY AND THE CROSS SECTION VARIES WITH THE PLANFORM. A WELL ESTABLISHED RIPARIAN ZONE IS PRESENT.

A VEGETATED BAR ON THE LEFT BANK INDICATED THAT THE CONCRETE CHANNEL IS OVERWIDE FOR THE NORMAL AND SEDIMENT REGIME.

CHANNEL HAS BEEN REALIGNED INTO A STRAIGHT CONCRETE CHANNEL.

UPSTREAM EXTENT OF CONCRETE WALL IS OUTFLANKED ON THE RIGHT BANK WHICH IS THE OUTSIDE OF A MEANDER.

EXISTING CULVERT POORLY ALIGNED WITH THE CREEK.

C22

18+900 19+000 19+100 19+200 19+300 19+400 19+500 19+600

WB ZENON STATION

INSET 5

ZENON DRIVE

FOURTEEN MILE CREEK

EXISTING 750mmø CSP CULVERT TO BE EXTENDED.

C22A

C22B

EXISTING CULVERT IS PERCHED BY APPROXIMATELY 0.3m

STEEP VALLEY CONFINES THE CREEK.

IMMEDIATELY DOWNSTREAM OF DUNDAS STREET, THE CHANNEL IS OVERWIDE.

EXISTING 3660mm x 2440mm TO BE REMOVED AND REPLACED WITH 20m CLEAR SPAN STRUCTURE.

FOURTEEN MILE CREEK TRIBUTARY

TIE–IN ALIGNMENT TO BE IMPROVED.

PARKWAY

LOCAL OPPORTUNITY TO ENHANCE RIPARIAN AND FLOODPLAIN VEGETATION FUNTIONS.

CHANNEL TO BE REALIGNED USING NATURAL CHANNEL DESIGN PRINCIPLES AS FAR AS POSSIBLE. IMPORT OF ROUNDED RIVER STONE WILL LIKELY BE REQUIRED AS CONSTRUCTION WOULD BE IN DISTURBED GROUND. A TOTAL OF APPROXIMATELY 100m OF CREEK WOULD BE REALIGNED OFFERING AN OPPORTUNITY TO ENHANCE CHANNEL MORPHOLOGY AND IMPROVE SEDIMENT TRANSPORT.

LEGEND:

- PROPOSED CULVERT REPLACEMENT
- PROPOSED CULVERT EXTENSION
- EXISTING CULVERT
- EXISTING CULVERT TO BE REMOVED
- TEMPORARY GRADING EASEMENT
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING STORM INLET
- C1 — CULVERT NUMBER

INSET 5

SOME GRADING INTO HILL SLOPE MAY BE REQUIRED.

CONCRETE BED AND BANKS TO BE REMOVED.

REQUIREMENT FOR BANK PROTECTION TO BE DETERMINED AT DETAILED DESIGN. IF REQUIRED, BIO–ENGINEERING TECHNIQUES TO BE USED AS FAR AS POSSIBLE.

LARGER STRUCTURE WILL PROVIDE OVERBANK AREAS FOR ENERGY DISSIPATION AS WELL AS WILDLIFE PASSAGE.

A SLIGHTLY SINOUS, LOW FLOW CHANNEL TO BE CONSTRUCTED WITHIN THE STRUCTURE.

CREEK PROFILE WILL MATCH THE DOWNSTREAM CREEK BED (WILL NO LONGER BE PERCHED).

RIPARIAN PLANTINGS WITHIN ROW.

NOTE:
THE LOCATION AND LENGTHS OF CULVERTS ARE SHOWN SCHEMATICALLY ONLY (NOT TO SCALE).

Metric Scale
25m 0 50m
Horizontal

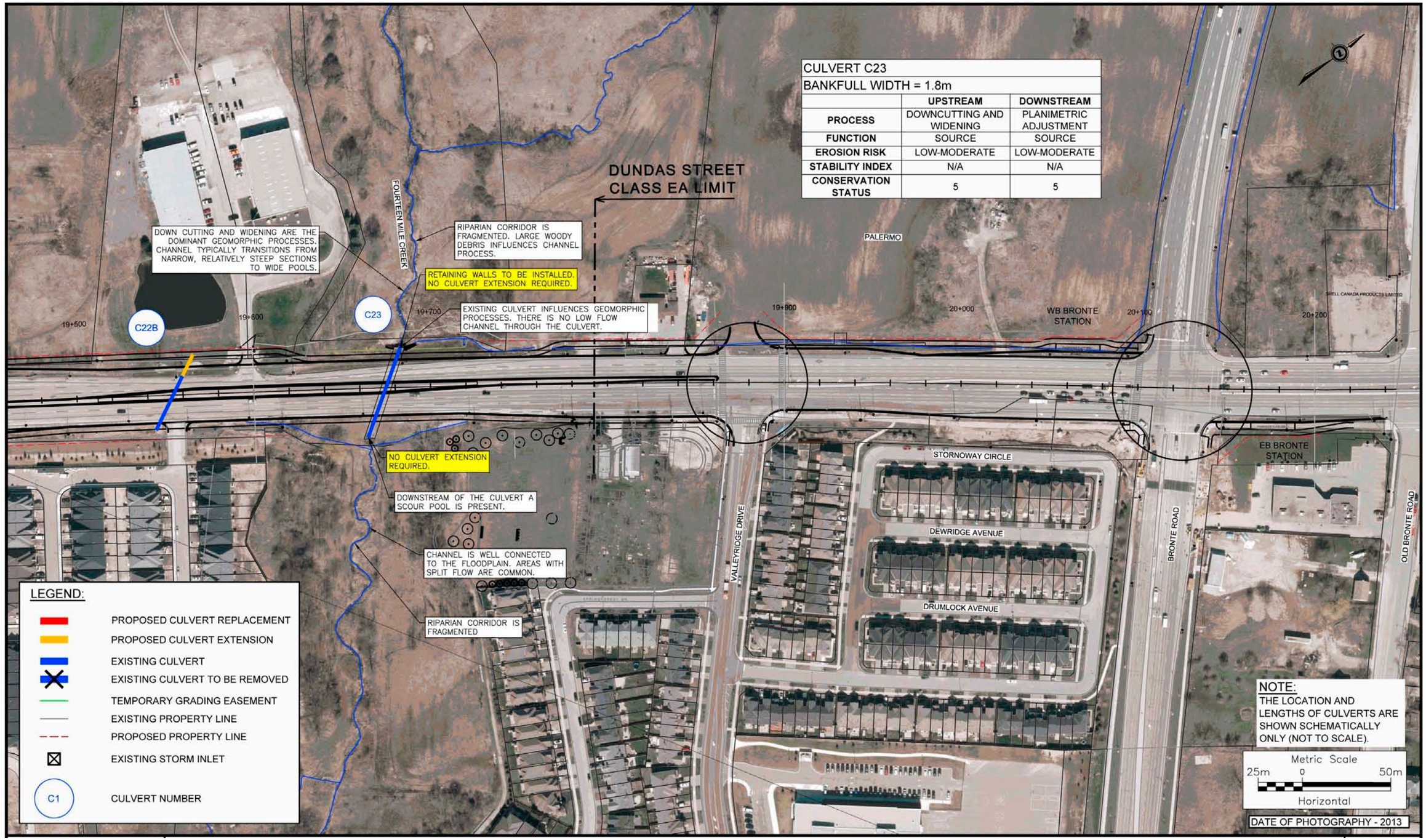
DATE OF PHOTOGRAPHY - 2013

Halton REGION MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Fourteen Mile Creek West Tributary Catchment
(Culverts C22, C22A, C22B)

Exhibit
6-37



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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

Existing and Proposed Fluvial Features
Fourteen Mile Creek West Tributary Catchment
(Culvert 23)

Exhibit
6-38

Loss of Channel Length

The direct loss of channel length associated with the increased culvert lengths will result in a loss of channel morphology and associated habitat. In some cases this may lead to an increased erosion risk and requirement for erosion protection (such as scour pools). This will be determined at detailed design. Approximate proposed culvert extensions are given in **Table 6-3**. In addition, approximately 135 m of the Tuck Creek tributary associated with C2 will be piped for 135 m to facilitate the road widening representing loss in channel length.

Channel Realignment

In some cases, realignment of a watercourse could result in negative impacts. However, in the case of the realignments associated with the widening of Dundas Street, there is an opportunity to enhance existing conditions. Where realignment is proposed on watercourses that have already been modified (and therefore have lower conservation status scores) and rehabilitation to a more natural state, for example through reinstating historic sinuosity, will result in potentially positive geomorphological and ecological effects. In some cases this can also increase channel length to help mitigate loss associated with the culvert extensions and piping.

Realignment is proposed on Tuck Creek at C1, C2, C3 (for the road widening) and C8 (to facilitate tie in). On Shoreacres Creek, realignment is proposed on C10 (drainage ditch) and C11 (to facilitate road widening). Realignment is also proposed on Fourteen Mile Creek tributary at C22 as a clear span structure (approximately 20 m) has been taken forwarded rather than a culvert extension as an enhancement to the system. This will include removal of existing, failing concrete bed and bank structures.

Some more minor and local realignment required to facilitate the tie-ins between the watercourses and proposed culvert extensions is outlined in **Exhibits 6-21** to **6-38**.

In all cases, channel realignment will be undertaken based on natural channel design principles as far as possible. The aim of the detailed design will be to restore the geomorphological functioning of the watercourses to create dynamically stable systems with improved and varied habitat. This is especially true for C2, which is currently a trapezoidal channel with bare banks, and C22 which is a concrete channel under existing conditions. With the exception of C11, which is depositional under existing conditions, the channel realignments will be more sinuous than existing conditions resulting in an increase in channel length and providing an opportunity to design out knickpoints and / or steep slopes that exist in all other cases.

Scour and Bank Protection Requirements

It is likely that some form of bed and bank protection will be required downstream of some of the culverts. This will be investigated further at detailed design. It will be reduced as much as possible through creation of a slightly wider scour pool for a short section at the culvert outlets in anticipation of erosion caused by the “vena contracta” effect. This is based on the response of the existing channels downstream of the culverts which has led to widening.

Where bed and bank protection is necessary, it will be localized and naturalized with bioengineering solutions being used wherever possible. In some cases, notably where the existing erosion risk is high, it may be necessary to employ harder erosion control

measures. This is likely on Tuck Creek at C7 and C8 and possibly on the Fourteen Mile Creek tributary at C22 (depending on the final design configuration).

Temporary Impacts

Increased fine sediment delivery to the system during the construction phase is a potential temporary impact to channel morphology. Adopting best practice during construction phases (keeping spoil away from water courses, timing of works to minimize impacts on the flow regime of the streams etc.) will reduce any construction impacts. These erosion and sediment control measures will be incorporated during the detailed design phase.

Detailed Design

The detailed design for channel realignments, local tie-ins and bed and bank protection for all of the watercourse crossings assessed in this section will be completed by a fluvial geomorphologist in collaboration with other specialists to ensure fisheries, wildlife and engineering requirements are met.

Additional survey data that focuses on the watercourses and surrounding lands is required for detailed design. The survey data for each watercourse should include:

- Detailed survey of channel thalweg at 1.0 m resolution extending at least 20.0 m upstream and downstream of proposed tie in locations to existing watercourses;
- Representative channel cross sections of the existing watercourses selected by a fluvial geomorphologist;
- Detailed floodplain points in proposed realignment corridors to create a surface;
- Any additional site specific features such as constraints, drainage features and existing structures (e.g. storm water inlet elevations);
- Survey of the concrete aprons and valley form downstream of C10 and C11.

The existing HEC-RAS models will be updated based on the additional survey data. Once survey data and updated models are available, it will be possible to determine appropriate planforms, slopes, cross section geometry, in channel morphologies and design details. At this time requirement for bed and bank protection for each watercourse will be determined.

In addition, the feasibility of creating a low flow channel within the existing concrete aprons downstream of C10 and C11 on Shoreacres Creek will be determined at detailed design. In the case of C10 this would include removal of a 0.5 m high weir. In both cases maintaining the structural stability of the remaining concrete apron and adjacent slopes will be essential.

Further work is required on the Tuck Creek tributary downstream of C7 as this was not included in the geomorphology baseline assessment. Due to the existing erosion concerns at C7 upstream of the existing crossing of Dundas Street, further analysis will be required at detailed design to determine an appropriate design configuration.

It is noted that works may extend beyond the identified property limits with temporary grading easements. This will be confirmed at detailed design but at this stage is anticipated at the following crossings:

- C1 downstream
- C2 upstream and downstream
- C3 upstream and downstream
- C7 upstream and downstream

- C8 upstream
- C9 downstream
- C10 upstream
- C11 upstream
- C12 downstream
- C20 downstream
- C22 upstream

6.1.7.2 Bronte Creek

Works are proposed in the Bronte Creek valley to facilitate the widening of Tansley Bridge. A constructability workshop was held on September 23, 2014 and the Constructability Workshop Report is provided in **Appendix L**. It was determined that it is feasible to carry out the majority of the construction by longitudinally pushing (or "launching") the steel girders from the existing bridge using cranes. This will minimize the construction impact and associated disturbance in the valley and ensures that the heaviest equipment will not be in the valley.

The proposed bridge widening includes construction of two new piers in the floodplain in line with the existing piers to the north west of the existing bridge. The piers will be set back from the bankfull channel. Access adjacent to and across Bronte Creek is required for the construction phase which is anticipated to take three to four years.

Detailed survey and hydraulic modelling will be carried out as part of the detailed design.

Temporary Impacts Including Access Road and Bridge

Accessing the Bronte Creek valley with heavy equipment and trucks is considered necessary for a variety of construction purposes. It was agreed at the constructability workshop that access will be from the northwest where there is an existing road. Some grading of this road and the adjacent knoll north of the west pier will be required to facilitate the construction of the new pier.

As there is no feasible access route down the east valley slope, it will be necessary to construct a temporary bridge across Bronte Creek. A temporary access road approximately 5 m wide immediately west of the east pier will also be required.

The temporary crossing will be constructed south of the existing bridge. Banks are more stable downstream of the bridge and this location is preferable from a construction perspective. The exact location of the temporary bridge will be determined at detailed design with input from a fluvial geomorphologist and in consultation with Conservation Halton. As far as possible, the bridge will be used as a platform for advancing new caissons and turning vehicles to minimize disturbance of the river banks.

The temporary bridge span will be determined at detailed design and will be based on flow requirements and flood risk (it is recommended that at a minimum, it would span the bankfull channel; the elevation of the temporary bridge will need to be considered with flood elevation and ice damage as part of the design criteria). Construction is anticipated to take three to four years and the temporary bridge will remain in place for the duration.

In channel works will be minimized as much as possible to minimize disturbance to the creek bed.

Increased fine sediment delivery to the system during the construction phase is a potential temporary impact to channel morphology. Further, there is potential for erosion caused by temporary in channel structures such as the proposed access bridge, valley impacts as a result of construction and access and changes to local runoff. Due to the sensitivity of the site, adopting best practice methodologies during construction phases will be crucial. Keeping spoil away from water courses, timing of works to minimize impacts on the flow regime of the stream etc. will reduce construction impacts. These erosion and sediment control measures will be incorporated during the detailed design phase.

Pier Construction

Works that will take place in the Bronte Creek valley include demolition of the existing south structure including piers to just below ground level. It is recommended that the specifications associated with the removal of the concrete deck include constraints that would prohibit contractors from dropping any of the bridge deck materials or the effluent from cutting the concrete deck into the creek. Disposal or reuse of the demolished concrete has been noted as one of the most significant issues associated with the pier demolition and various recommendations have been made for reusing the material. The material will not be used within Bronte Creek.

It is assumed that using large diameter caissons will make it possible to advance the new pier foundations between the existing south pier twin spread footings. However, further subsurface investigations are recommended at detailed design. Should removal of the existing pier footings be required this would have considerable impact on the floodplain and potentially bank stability and further geomorphological input would be required should this be found necessary at detailed design.

Scour and Bank Protection Requirements

At detailed design, careful consideration will need to be given to the existing processes of erosion at the site as well as the impact of construction and ultimately the new pier structures on these processes. Construction access and the heavy loads on the creek banks have the potential to cause erosion. As outlined above, measures will be taken to minimize these impacts, however, access across and adjacent to the creek is required.

As noted in the baseline conditions, the bridge and heritage piers cross Bronte Creek on a meander. The existing Tansley Bridge has minimal impact on the system as the piers are set well outside of the bankfull channel. Immediately upstream of the bridge, the east bank (which is located on the outside of the meander) is actively eroding. This bank will likely be disturbed during construction and a solution for the restoration of this bank will be required at detailed design.

Beneath the bridge, erosion has been prevented by installing riprap and buried stone protection. The interface of the rip rap bank protection and the natural bank upstream is a weak point in the bank where erosion is occurring. It is recommended that the existing rip rap be left in situ so as not to further exacerbate bank erosion. The interface between the existing bank and the rip rap should be considered at detailed design. Further, a temporary access road is required in this area in close proximity to the top of bank during construction.

Some initial investigations were carried out to consider likely bank protection and erosion management solutions. These were based on an existing conditions HEC-RAS model provided by Conservation Halton and were carried out in flowmaster. They will need to be refined at detailed design once survey data and more detailed modelling become

available. These initial results show that lowering the right (west) floodplain has the potential to locally reduce the bankfull capacity of Bronte Creek and therefore reduce in channel velocities. This area on the right bank is disturbed and will be disturbed again during construction (notably for the construction of a new pier). It is recommended that the possibility of adjusting the final grading plan to lower the floodplain elevation and reduce in channel velocities for lower return period events should be considered at detailed design. This could help to reduce in channel energy and may help to reduce requirements for hard bank protection measures. A defined low flow channel was maintained for this analysis and must be maintained for any detailed design options. During these initial investigations, lowering the left (east) floodplain had little effect on in channel velocities but this should be checked at detailed design.

The likelihood that hard bank protection measures will be required in some locations is increased due to the requirement for a construction access road adjacent to the creek on the left (east) bank. This road will be used by fairly heavy construction equipment such as light cranes and a caisson boring rig (with the largest equipment constrained to the existing Tansley Bridge). These loadings will put additional pressure on the bank that is already eroding immediately upstream of the existing bridge and at the upstream extent of the rip rap protection. Based on the preliminary information available the maximum in channel velocity in the study area at the 100 year event is approximately 3.0 m /s. At these velocities, river stone would be recommended for bank protection works and the D50 would be in the order of 400 mm. It is recommended that bank protection measures put in place for the access road should form the permanent bank protection solution rather than disturbing the river bank on numerous occasions. Riverstone should be buried and ultimately planted – possibly with live stakes if the required depth of river stone protection makes this feasible. The location and extent of any bank protection will be determined by a fluvial geomorphologist. It is recommended that some transition treatment such as planting or bioengineering measures be incorporated at the tie-ins with the natural banks.

Under existing conditions, the base of the heritage pier, which is within the bankfull channel, is scoured. Incorporating more hard bank protection on the opposite bank upstream may exacerbate this scour and necessitate erosion proteciton and this will be investigated at detailed design.

Detailed Design

A detailed survey of the creek and valley will be required at detailed design. This will be used to update and refine the HEC-RAS model and to inform the design. The survey should include:

- Detailed survey of channel thalweg at 1.0 m resolution extending at least one meander upstream and downstream of Tansley Bridge;
- Top and bottom of bank survey points at 5 m resolution extending upstream and downstream of the work area (including the temporary access bridge location);
- Representative channel cross sections of the existing watercourses selected by a fluvial geomorphologist;
- Detailed floodplain points in work area to create a surface;
- The existing piers;
- The extent of existing bank protection works;
- Any other notable features or constraints.

Prior to undertaking detailed design, a slope stability analysis will be carried out on the east embankment. Detailed geology, soil and groundwater information will also be available for detailed design and will be used to inform the geomorphology recommendations.

6.1.8 Structure

As part of the Dundas Street widening from 4 to 6 lanes between Brant Street and Bronte Road, the structure at 407 ETR, CN Railway, and Bronte Creek will have to be widened. In addition, the existing culvert at Fourteen Mile Creek West (Culvert C22) will be replaced with a new 20 m span structure. Details related to each of the structures can be found in this section of the ESR.

6.1.8.1 407 ETR Structure

The existing Dundas Street over 407 ETR structure east of Guelph Line currently carries 4 lanes of through traffic and a dedicated lane in each direction for the W-N ramp and E-S ramp. It is a four span (41 m - 37 m - 37 m - 41 m) concrete slab on CPCI 1900 girder bridge structure with a skew of approximately 48°. The reinforced concrete abutment and piers are founded on spread footings. While the construction of the existing 407 ETR structure considered the future widening of Dundas Street by 3.75 m on the south side and 5.25 m on the north side, it did not account for the provision of a 4.0 m bi-directional multi-use path on the south side of Dundas Street.

The widened structure will match the existing structure type and will have to meet the vertical clearance requirement from 407 ETR. As shown in Plates 7, 8a, 8b and 9, a portion of the W-S, W-N, E-N, E-S, N-E/W and S-E/W ramps will have to be partially reconstructed to accommodate the widening of Dundas Street. It is anticipated that the reconstructed ramps will tie back into the respective existing ramp to not affect the toll equipment; additional detailed survey will be carried out in detailed design to confirm.

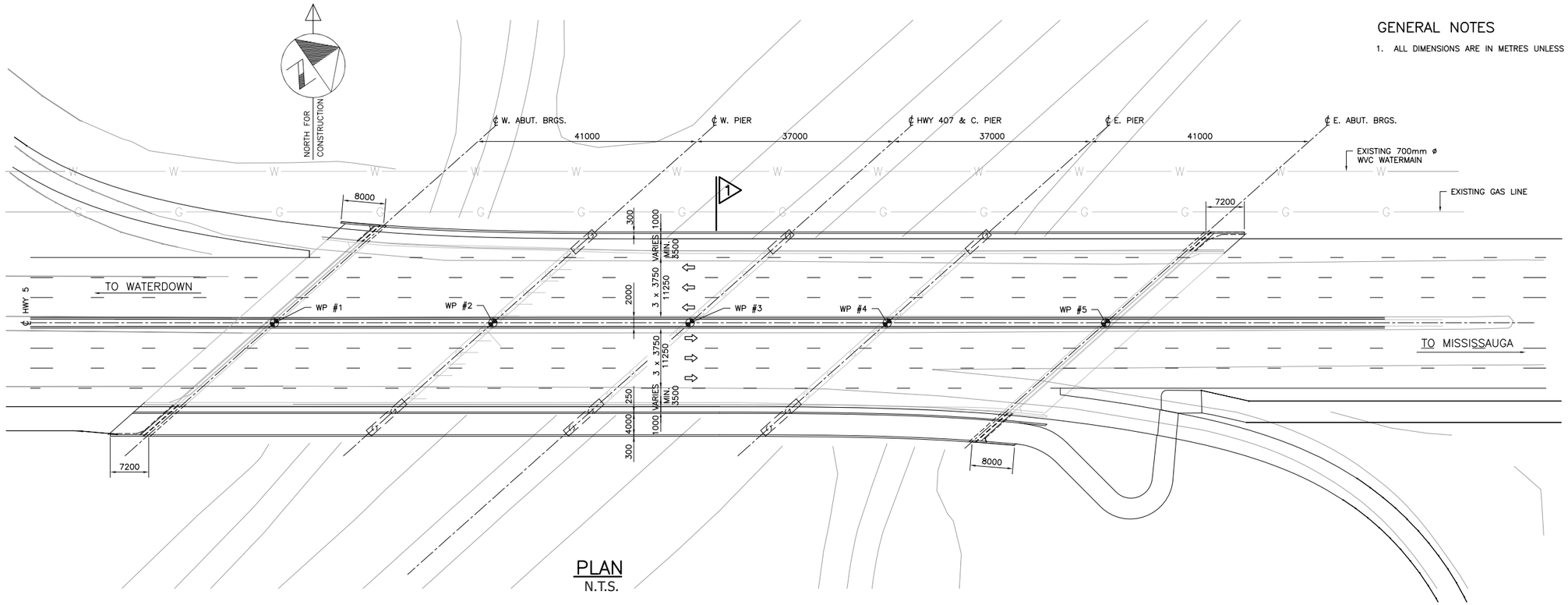
The General Arrangement Drawing (GA) can be found in **Exhibit 6-21**. The proposed structure cross section comprises the following from north to south:

- 0.3 m concrete parapet wall;
- 1.0 m shoulder;
- 3.5 m (min) lane to E-S on-ramp;
- 3 x 3.75 m lanes;
- 2.0 m raised concrete median;
- 3 x 3.75 m lanes;
- 3.5 m (min) lane to W-N on-ramp;
- 1.0 m shoulder;
- 0.25 m concrete parapet wall;
- 4.0 m multi-use path;
- 0.255 m pedestrian and bicycle barrier.

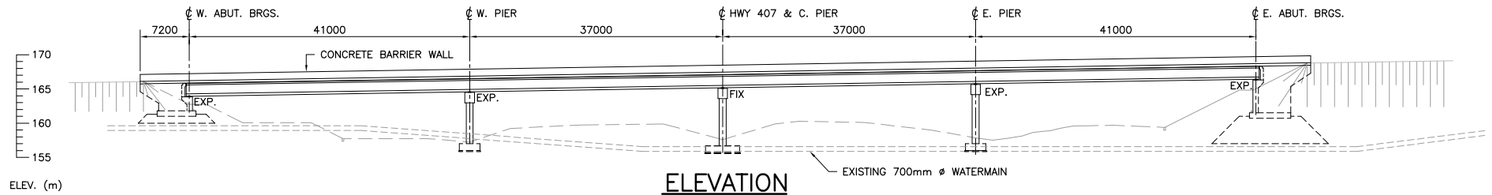
A meeting was held with 407 ETR in December 2014 and the agency generally supported the proposed structure for the widening of Dundas Street. Through consultation with MTO and 407 ETR during the EA Study, both agencies stressed that proper signage will have to be provided in the proximity of the interchange to facilitate the operation of the HOV lanes, as well as active transportation facilities. MTO and 407 ETR will continue to be consulted during the detailed design process.

GENERAL NOTES

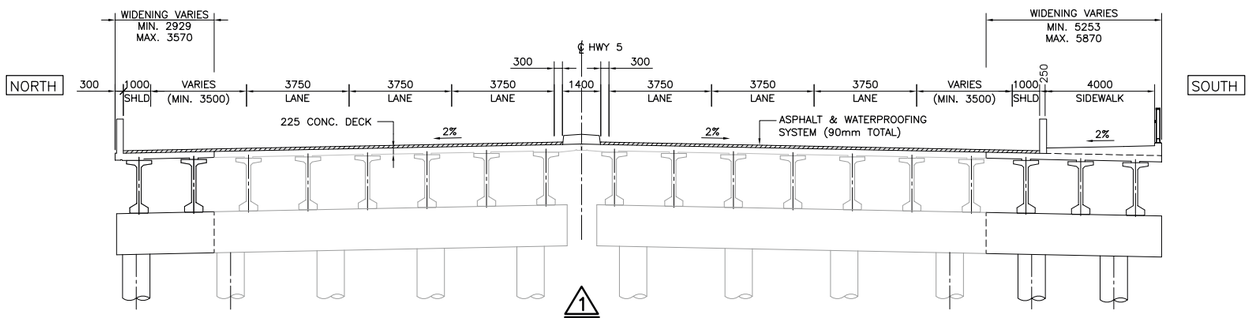
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE SPECIFIED.



PLAN
N.T.S.



ELEVATION
N.T.S.



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PRELIMINARY ONLY

Halton Region | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

General Arrangement
Dundas Street / Highway 407 Overpass

Exhibit
6-39

Construction staging would include the following:

- Stage 1: Widen the substructure and superstructure to the south of the existing bridge. All existing traffic lanes (two through lanes in each direction, and one ramp lane in each direction) will be maintained at all times during this construction stage.
- Stage 2: Remove concrete median to accommodate traffic staging for Stage 3.
- Stage 3: Shift both westbound through lanes and the E-S ramp lane slightly to the south to accommodate the widening of the substructure and superstructure to the north of the existing bridge. All existing eastbound lanes will be maintained at all times during this construction stage.
- Stage 4: Shift all four through lanes and both ramp lanes to the outer limits of the structure to facilitate the reconstruction of the median.
- Stage 5: Place all six (6) through traffic lanes, two ramp lanes, and two (2) sidewalks for pedestrian use onto the structure for permanent use.

6.1.8.2 CN Railway Structure

The existing CN railway structure was described in **Section 3.7.2**. The CN railway structure requires widening to accommodate the widening of Dundas Street from four to six lanes. Four alternatives were considered, including:

1) Widen two lanes to the north

2) Widen four lanes to the north

3) Widen one lane to the north and one lane to the south

4) Widen two lanes to the south

A discussion of the evaluation of the alternatives can be found in **Appendix F**. The criteria used in the evaluation included: impacts on pedestrians, traffic and utilities, constructability, construction duration, future rehabilitation, maintenance and durability, and cost.

Based on the criteria noted above, Alternative 1 is recommended to be the most feasible alternative when considering practicality, constructability, construction duration, property access, traffic impacts, and economy. This solution does not require property acquisition.

The longitudinal joint between the two existing structures has proven to be a source of problems. The elimination of the longitudinal joint in Alternative 1 is considered necessary to enhance long-term performance and durability of the structure, minimize future rehabilitation and maintenance, and allow traffic to cross the joint.

In addition to widening the bridge, the existing superstructure of the CN railway bridge will be replaced with a similar reinforced concrete deck on prestressed concrete girder system.

The General Arrangement Drawing (GA) for the CN railway structure can be found in **Exhibit 6-22**. The cross-section of the widened structure will include the following from north to south:

- 0.255 m wide pedestrian and bicycle barrier;
- 3.0 m wide sidewalk;
- 0.25 m wide parapet wall;

- 0.3 m shoulder
- 1.5 m wide bike lane;
- 0.3 wide bike lane buffer;
- 3 x 3.5 m lanes;
- 2.0 m concrete raised median;
- 3 x 3.5 m lanes;
- 0.3 wide bike lane buffer;
- 1.5 m wide bike lane;
- 0.3 m shoulder
- 0.25 m wide parapet wall;
- 3.0 m wide sidewalk;
- 0.255 m wide pedestrian and bicycle barrier.

CN Rail reviewed the proposed GA at the December 10, 2014 meeting and generally supported the proposed widening of the structure. CN Rail will continue to be consulted during detailed design.

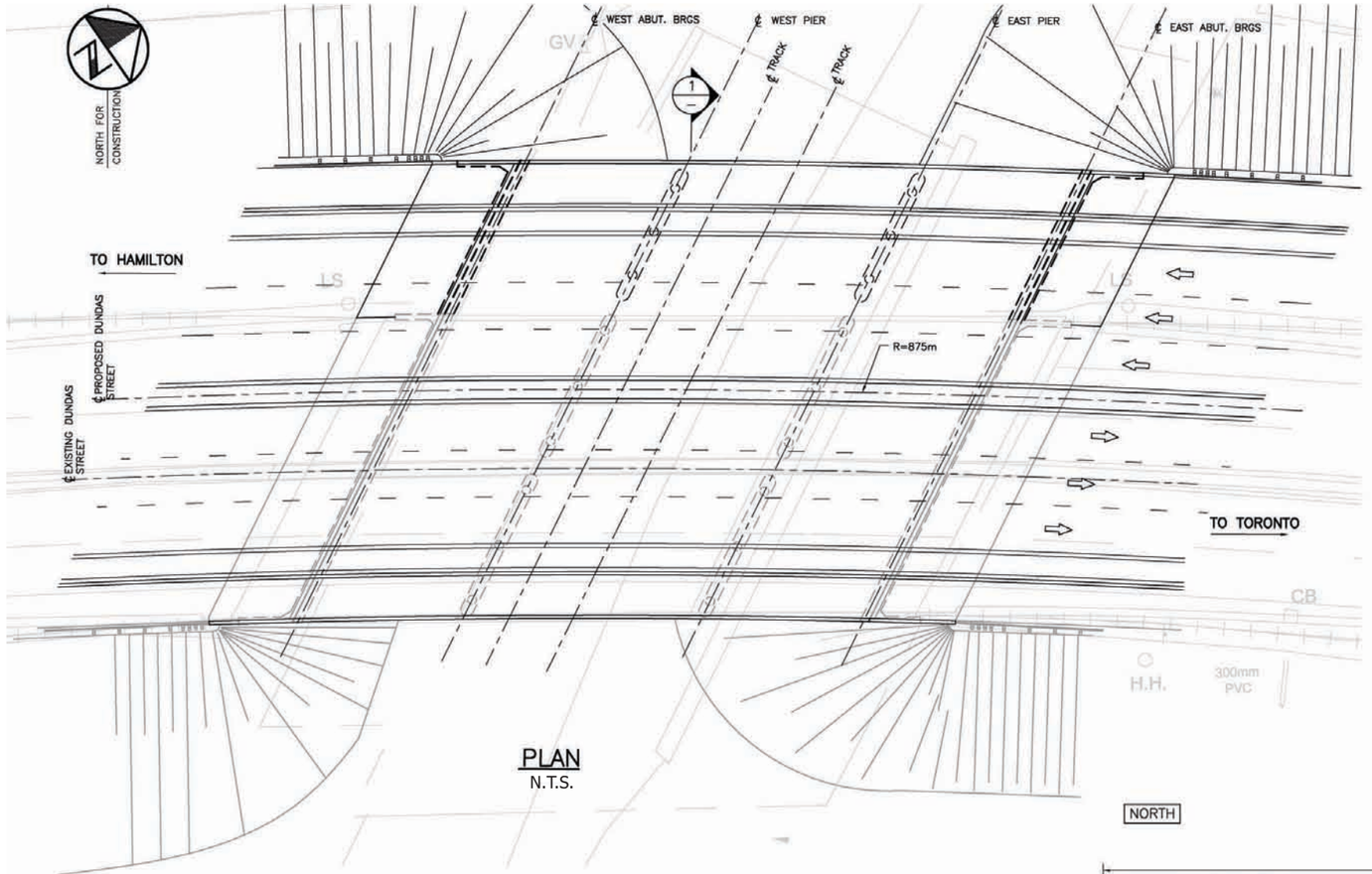
Construction staging would include the follow:

- Stage 1: Construct new substructure and superstructure north of the existing westbound bridge. Vehicular and pedestrian use will be accommodated using the current configuration of the structure. Four (4) traffic lanes and two (2) sidewalks will be maintained at all times during this construction stage.
- Stage 2: Remove/replace the concrete deck over the existing westbound bridge superstructure by shifting two (2) lanes of traffic and one (1) sidewalk for pedestrian use to the newly constructed north structure. The existing eastbound bridge will continue to carry two (2) lanes of traffic and one (1) sidewalk for pedestrians.
- Stage 3: Remove/replace the concrete deck over the existing eastbound superstructure by shifting two (2) lanes of traffic to the newly rehabilitated westbound structure. The north end will continue to accommodate two (2) traffic lanes and one (1) sidewalk for pedestrian use from Stage 2. This construction stage will only accommodate one (1) sidewalk for pedestrian use.
- Stage 4: Place all six (6) traffic lanes and two (2) sidewalks for pedestrian use onto the structure for permanent use.

It is recommended to undertake a survey of the existing railway tracks along with detailed geotechnical investigations to access the constructability of the founding soils north of the existing structure during detailed design. Detailed information such as characteristics of the soils, groundwater, geology, and slope stability is required for design and construction.

Construction will require access to the railway lands, and co-operation and flagging services from CN Railway. Construction of the foundations for the new pier may require working within CN's right-of-way and may impact their operations.

PRELIMINARY ONLY



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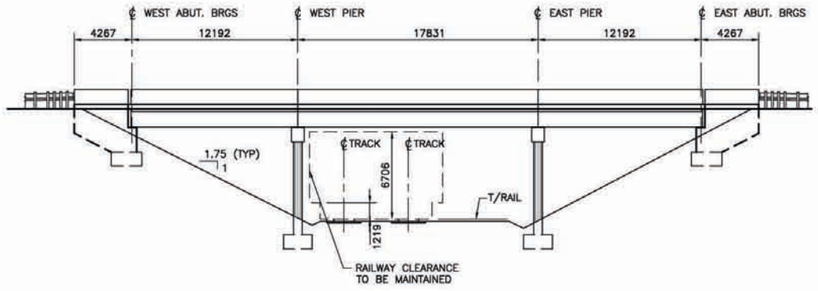

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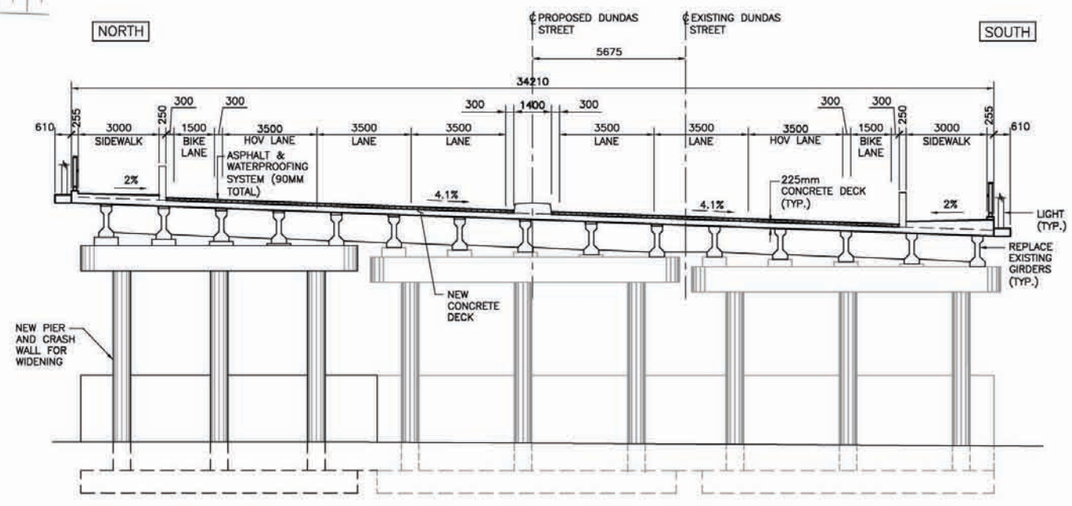


SECTION 1
N.T.S.

Halton Region | MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

General Arrangement
CNR Overhead

Exhibit
6-40

6.1.8.3 Tansley Bridge

The existing Tansley Bridge (Bronte Creek crossing) was described in **Section 3.7.1**. Tansley Bridge requires widening to accommodate the widening of Dundas Street from four to six lanes. Four alternatives were considered, including:

1) Widen two lanes to the north

2) Widen four lanes to the north

3) Widen one lane to the north and one lane to the south

4) Widen two lanes to the south

A discussion of the evaluation of the alternatives can be found in **Appendix F**. The criteria used in the evaluation included: impacts on a heritage asset, pedestrian traffic, traffic and utilities, constructability, construction duration, future rehabilitation, maintenance and durability, and cost.

Based on the criteria noted above, Alternative 1 is recommended to be the most feasible alternative when considering practicality, constructability, construction duration, property access, traffic impacts, and economy. This solution has less construction risk, and avoids the complex and potentially troublesome connections required in Alternatives 3 and 4 to cantilever the steel supporting the sidewalks and traffic lanes to the truss. Furthermore, Alternative 1 better predicts the structural performance and durability of the bridge, while not requiring the relocation of utilities.

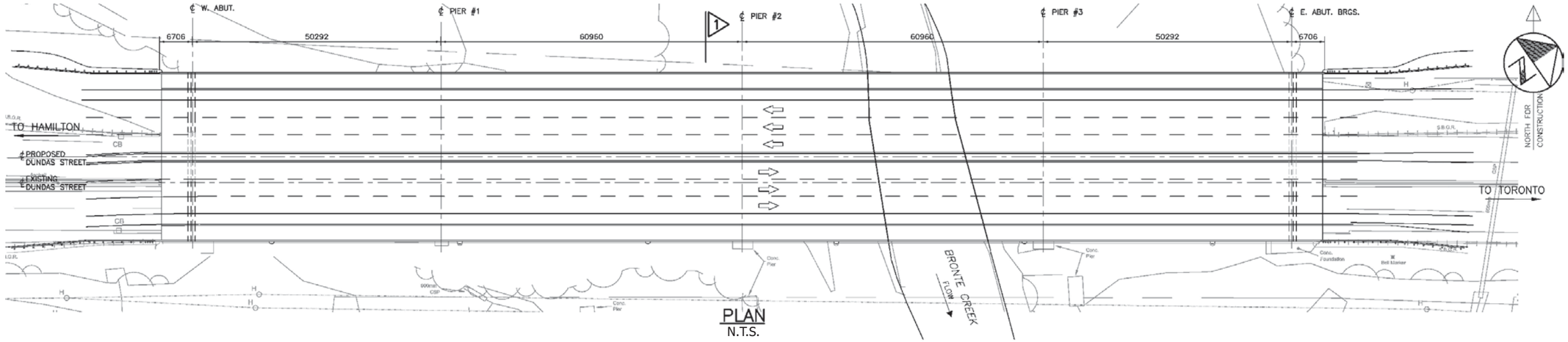
It should be noted that the heritage features located in the southeast quadrant of Dundas Street / Sutton Drive have since been demolished for future development; however, Alternative 1 still remains as the preferred alternative based on the overall evaluation of the other factors.

The longitudinal joint between the two structures has proven to be a source of maintenance problems. The elimination of the longitudinal joint in Alternative 1 is considered necessary to enhance long-term performance and durability, minimize future rehabilitation and maintenance, and allow traffic to cross the joint.

It is recognized that Alternative 1 significantly detracts from the heritage value of the structure. It is recommended that a Heritage Bridge Documentation Report and a plaque recording the heritage significance of this structure be installed near the west abutment.

The General Arrangement Drawing (GA) for the Tansley Bridge structure can be found in **Exhibit 6-23**. The cross-section of the widened structure will include the following from north to south:

- 0.255 m wide pedestrian and bicycle barrier;
- 3.0 m wide sidewalk;
- 0.25 m wide parapet wall;
- 0.3 m shoulder
- 1.5 m wide bike lane;
- 0.3 wide bike lane buffer;
- 3 x 3.5 m lanes;
- 2.0 m concrete raised median;
- 3 x 3.5 m lanes;
- 0.3 wide bike lane buffer;



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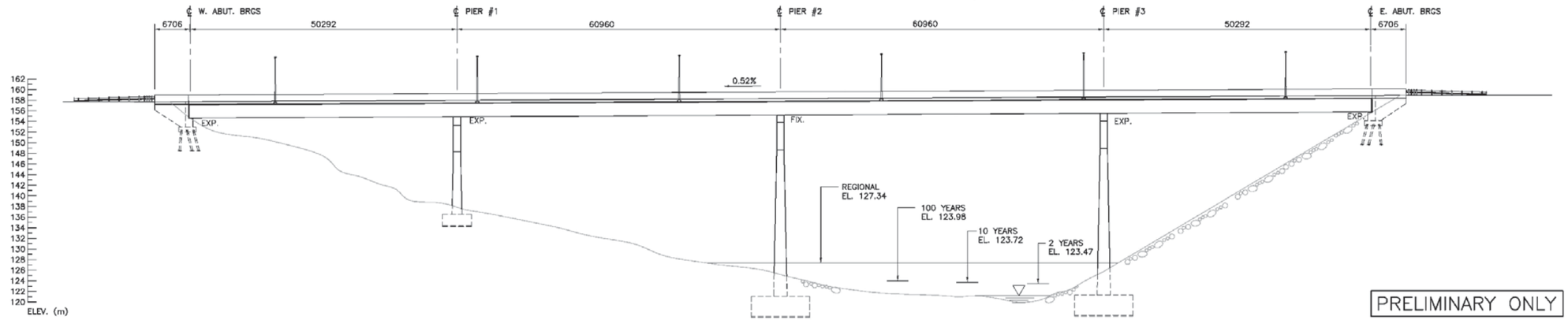

PRELIMINARY ONLY

ELEVATION
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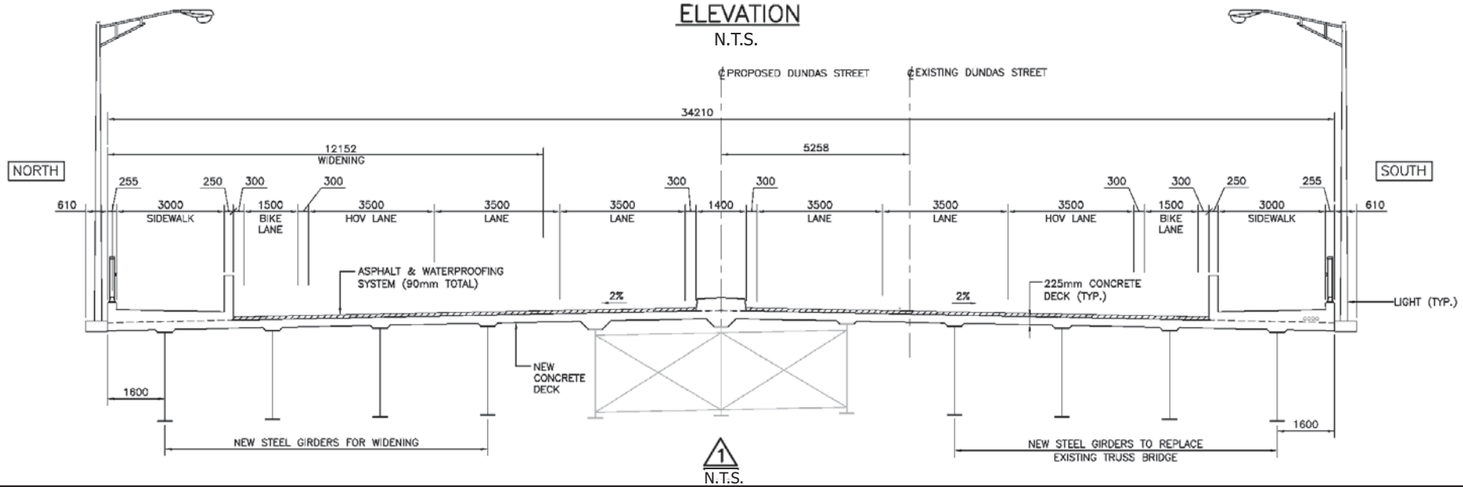

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Halton Region
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DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

General Arrangement
Tansley Bridge Widening Over Bronte Creek

Exhibit
6-41

- 1.5 m wide bike lane;
- 0.3 m shoulder
- 0.25 m wide parapet wall;
- 3.0 m wide sidewalk;
- 0.255 m wide pedestrian and bicycle barrier.

Construction staging would include the following:

- Stage 1: Construct new substructure and steel girder superstructure immediately north of the existing bridge. Vehicular and pedestrian use will be accommodated using the current configuration of Tansley Bridge. Four (4) traffic lanes and one (1) sidewalk will be maintained at all times.
- Stage 2: Remove the existing truss spans and substructure at the south end of the bridge by shifting the existing four (4) traffic lanes north. The existing truss will be replaced with a newly constructed steel girder superstructure, concrete piers, and semi-integral concrete abutments at the south end. Vehicular and pedestrian traffic will be accommodated on the new north structure and over the existing steel girder structure. A temporary concrete median barrier wall is required to separate east-west traffic. Pedestrian traffic will now shift to the north end, over the newly constructed sidewalk. Four (4) traffic lanes and one (1) sidewalk will be maintained at all times.
- Stage 3: Remove/replace the concrete deck over the existing steel girder superstructure by shifting two (2) lanes of traffic to the south end. The north end will continue to accommodate two (2) traffic lanes and one (1) sidewalk for pedestrian use from Stage 2. Traffic will shift to the newly constructed south end to accommodate two (2) traffic lanes and one (1) sidewalk for pedestrian use.
- Stage 4: Place all six (6) traffic lanes and two (2) sidewalks for pedestrian use onto the structure for permanent use.

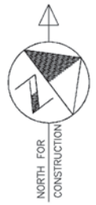
The construction over the deep valley with steep slopes offers a challenge to place the steel girders. To ensure that the preferred alternative can feasibly be constructed, a Constructability Workshop was carried out in September 2014. Details related to the Constructability Workshop are discussed in **Section 5.2.4**.

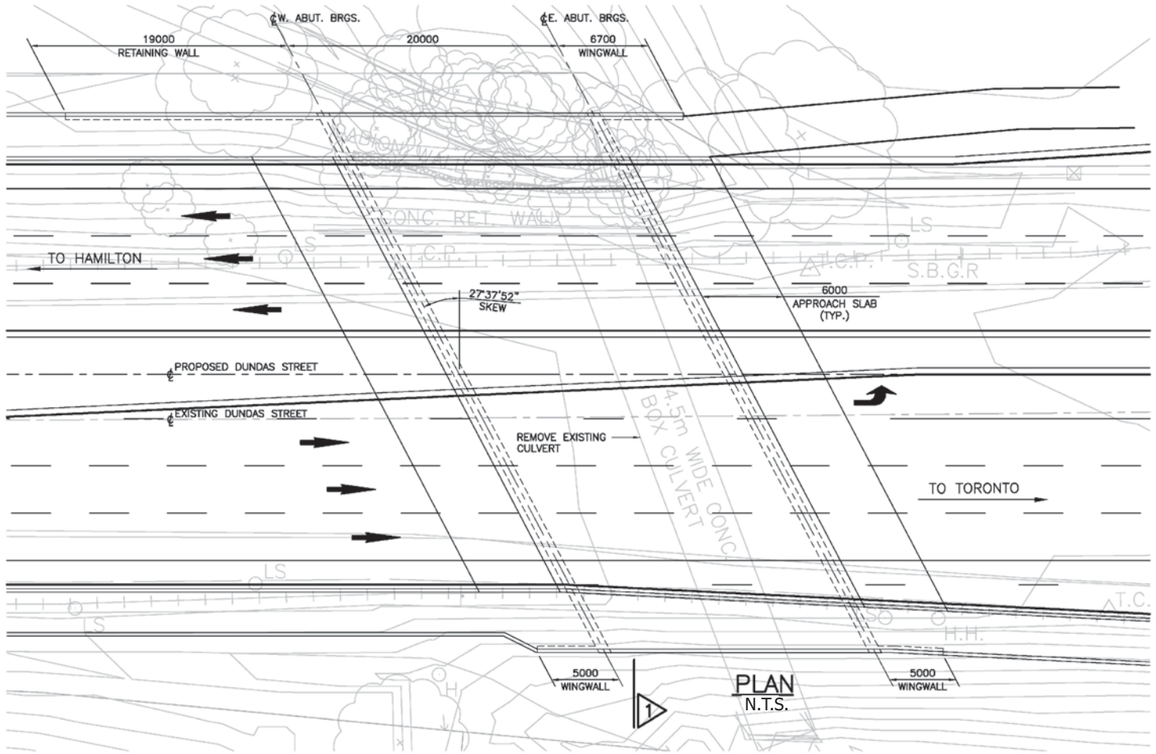
Conservation Halton and the Ministry of Natural Resources and Forestry will be consulted during detailed design.

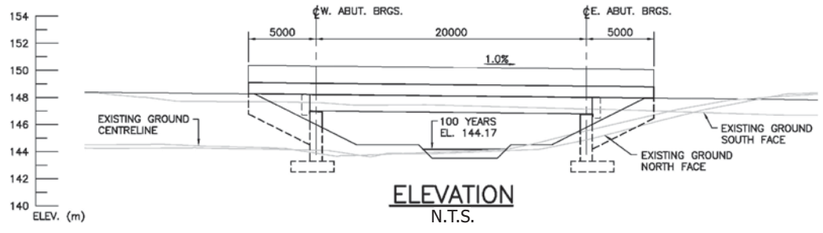
6.1.8.4 Fourteen Mile Creek West Structure

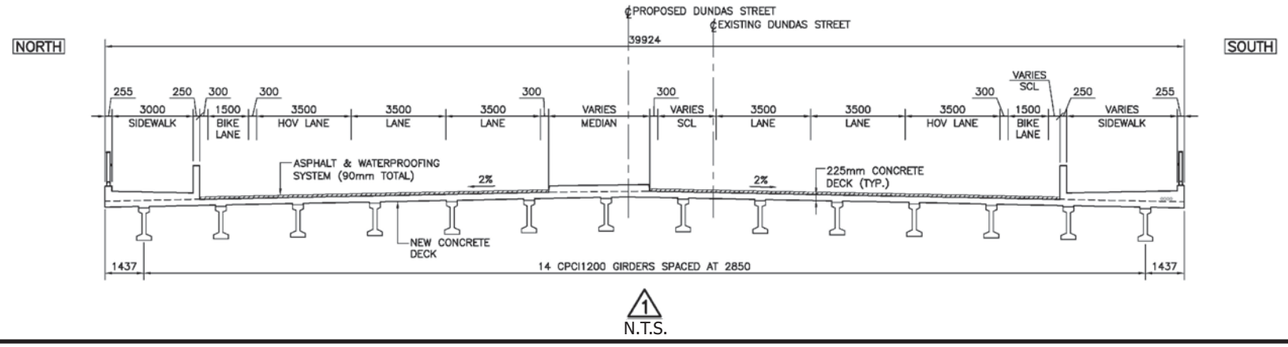
One of the existing crossings of Fourteen Mile Creek West is located just west of Colonel William Parkway (approximately Station 19+180 as shown on **Plate 25**), namely Culvert C22 (as described in **Section 3.5.4**).

Dundas Street at this location currently accommodates two through lanes in each direction with no sidewalks. While the existing culvert is able to convey the storm runoff from all storm events including the Regional Storm event without overtopping Dundas Street, this watercourse is a regulated Redside Dace habitat, as described in **Section 6.1.6**. Based on an analysis and evaluation of crossing alternatives and consultation with Conservation Halton and the Ministry of Natural Resources and Forestry, a 20 m span bridge is proposed to replace the existing concrete culvert. The General Arrangement (GA) for the Tansley Bridge structure can be found in **Exhibit 6-24**.









PRELIMINARY ONLY

Halton REGION MMM GROUP

DUNDAS STREET CLASS EA STUDY
Brant Street to Bronte Road

General Arrangement
Dundas Street Over Fourteen Mile Creek

Exhibit
6-42

The cross-section of the widened structure will include the following from north to south:

- 0.255 m wide pedestrian and bicycle barrier;
- 3.0 m wide sidewalk;
- 0.25 m wide parapet wall;
- 0.3 m shoulder
- 1.5 m wide bike lane;
- 0.3 wide bike lane buffer;
- 3 x 3.5 m lanes;
- Variable width concrete raised median;
- 3 x 3.5 m lanes;
- 0.3 wide bike lane buffer;
- 1.5 m wide bike lane;
- Variable width right turn lane;
- 0.3 m shoulder;
- 0.25 m wide parapet wall;
- 3.0 m wide (minimum) sidewalk;
- 0.255 m wide pedestrian and bicycle barrier.

Conservation Halton and the Ministry of Natural Resources and Forestry will be consulted during detailed design.

6.1.9 Landscaping

A landscape can be defined as the aggregate of all of the visual elements found within a region or area. Each of these elements contributes to the over-arching character of a place, and can define it as distinctive or unique within a neighbourhood or region. The elements of the streetscape such as street trees, lighting, and signage can provide strong visual cues, linking spaces together, often compensating for a lack of cohesion in the built environment. A streetscape that is lined with trees and has a consistent street furniture style will provide the same visual image along its length and reflect a continuous space to the user. The repetition of these elements can also create a rhythm in the streetscape that can spill over to other streets within an area, thus defining a distinct district.

Currently, Dundas Street is a 4-lane rural roadway which had previously (while under jurisdiction of the Ministry of Transportation) been designed to function as a high speed "highway" corridor. As Dundas Street transforms from a rural corridor to a pedestrian and cyclist friendly Regional arterial road that supports all modes of transportation, the future landscaping should also be provided accordingly to complement these changes.

The character of the Dundas Street corridor changes from Brant Street to Bronte Road. Between Brant Street and the 407 ETR interchange, lands south of Dundas Street are mainly residential developments and lands on the north side of Dundas Street are within the Niagara Escarpment Plan. There are intermittent rural residential houses with direct access to Dundas Street. Between the 407 ETR interchange and Sutton Drive (east of Appleby Line), this area is considered to be the "urban area" of Burlington with residential subdivisions on the north and south sides of Dundas Street. At major intersections, there are commercial plazas and big box stores. There are also a number of public and elementary schools in the area together with community centre and parks. Between Sutton Drive and Tremaine Road, majority of the lands on the south side are

within the Bronte Creek Provincial Park; residential subdivisions are located from Colonel William Parkway to Bronte Road. On the north side of Dundas Street, lands are currently largely undeveloped with intermittent residential houses and commercial properties. Lands within this area are within the North Oakville Secondary Plan, which are designated for future development.

Important natural environment features in the Study Area include the Bronte Creek crossing west of Tremaine Road (Tansley Bridge), and the Niagara Escarpment and Greenbelt between Brant Street and 407 ETR. Several creeks and tributaries are crossed by Dundas Street between Brant Street and Bronte Road, including Tuck Creek, Shoreacres Creek, Appleby Creek, Sheldon Creek and Fourteen Mile Creek.

The following describes the defining elements found within the streetscape as part of the improvements to Dundas Street. A landscape plan will be developed based on these defining elements during subsequent detailed design. Landscape concepts are shown in **Exhibits 6-25** to **6-27**, reflecting the various proposed active transportation facilities as described in **Section 6.1.4**.

Protection of Existing Vegetation

There are a few major environmental features within the Study Area including the Niagara Escarpment and Greenbelt. Dundas Street also crosses a number of creeks and tributaries within the Study Area, including Tuck Creek, Shoreacres Creek, Appleby Creek, Sheldon Creek and Fourteen Mile Creek. The natural vegetation at these and other locations is important to both its ecological function, as well as its aesthetic value. In addition, many mature trees, small water features, cultural plantations, and woodlots abut the Dundas Street right-of-way, contributing to its cultural landscape value. The Conservation Halton's Landscaping Guidelines should be applied to the extent possible inside of regulated areas.

Grading will be minimized around existing trees and vegetated communities where possible to retain the existing character of the landscape.

Growing conditions for existing vegetation and proposed enhancement plantings could be improved through long term systematic removal of invasive exotics such as buckthorn by the Region. The Region is encouraged to keep up this practice to maintain the scenic quality of the roadway. Appropriate permits to ensure compliance with local and provincial regulations should be secured.

Opportunities for Enhancements of Corridor Vegetation

In areas where enhanced vegetation would be provided, all enhancement plantings should be native, hardy, drought-tolerant species, salt resistant, and shall be restricted to the road right-of-way. Planting layout will consider denser, more ornamental screenings at locations where residential units abut the roadway, filtered views where warranted, for example, at creek valleys, and open views to maximize vistas of high scenic quality. Enhanced vegetation in heritage areas should complement existing character of the feature.

Exhibit 6-43: Conceptual Landscape Plan – Brant Street to Northampton Boulevard

Exhibit 6-44: Conceptual Landscape Plan – Northampton Boulevard to Appleby Line

Exhibit 6-45: Conceptual Landscape Plan – Appleby Line to Bronte Road

A series of streetscape design techniques have been employed to balance the needs of motorized and non-motorized users.

Shape the driving experience:

- Incorporate lighting and planting features in the central medians to cut off headlight glare from opposing traffic and highlight a pleasing linear space;
- Add clear and consistent signage to assist navigation;
- Conserve the rural landscape abutting the north side of the street to define the local character.

Create comfortable non-motorized zones:

- Incorporate the multi-use path to serve as part of transportation circulation system and support multiple recreation opportunities;
- Add street trees and ornamental grasses along the boulevard where space permits to provide a landscaped buffer and increase the year-round visual interest;
- Enhance the screen plantings on existing berms to establish appropriate interfaces with adjacent land use.

Plant selection for enhancement and infill planting should provide seasonal interest (i.e. spring flowering, interesting bark for winter appeal, attractive fall colours). Selection of plant species should follow the recommendations of Conservation Halton when in regulated areas. Street trees within the urban cross section should be planted with regularity along the length of the corridor where context permits. Particular attention should be paid to the growing conditions of these urban trees, giving consideration to continuous planting trenches and the use of structural soil cell technologies to improve tree health and survivability.

Selection of proposed plantings should reflect changing climate conditions and therefore should consider resistance to drought and winter ice storms as these are becoming potentially more common. Plant materials currently at the southern limit of their natural range should be avoided. The use of ash trees should also be avoided (due to increase in Emerald Ash Borer) until directed otherwise by the forestry representatives of the Region.

Boulevard and Median

Boulevards also play an important role in defining the streetscape, particularly within the urban cross sectional portion of the corridor. The boulevards provide an element of continuity to the streetscape and also offer an area for street trees and other vegetation to grow, further enhancing the street. Maintaining street trees and other ornamental plantings within the boulevard is a continuous challenge. A desirable clearance of 3.0 m to the multi-use path should be provided for snow storage, and salt resistant plants proposed within the road allowance. In some local areas, boulevards are minimized due to significant constraints.

Street trees within the boulevard should also be planted with regularity along the length of the corridor where context permits. Within the boulevard it is imperative that particular attention be paid to the growing conditions of the trees, again giving consideration to continuous planting trenches and the use of structural soil cell technologies to improve tree health and survivability.

Landscaping in the median may be considered where feasible. The main concern with vegetation located in median is maintenance issues. Low maintenance plants / grass may be considered in the median. This will be reviewed in greater detail during detailed design.

Lighting

A defining feature of any street is its illumination. This is not only because the quality of light provided can significantly enhance our night environment, but also because the form of the light standard can affect the character of a street during the day. The lighting that exists along Dundas Street today is the utilitarian Cobra head light fixture mounted on wood hydro poles. A more decorative option can be considered through consultation during detailed design.

Consideration should be given at the detailed design stage towards establishing a lighting hierarchy that is more sensitive to the character of the various heritage features along the corridor. Pedestrian scale lighting (especially at bus stops / stations) should also be introduced where possible to encourage pedestrian connections.

Street Furnishings

Street furniture is often a design element that can have a great impact on the unity of the streetscape, and the overall character of an area. Often if there is a lack of coordination between elements such as lighting, benches, and trash receptacles it can create a sense of discord, and detract from the sense of place that may otherwise exist. Alternatively, if there is a strong link between the street furniture elements, and they are placed strategically throughout an area, they can be used to identify a space, set it apart from other neighbouring areas, and draw visitors into particular spaces.

Street furniture such as benches, trash receptacles, bike racks, etc. should be coordinated, particularly with the design and fittings of the bus shelters. Details regarding street furnishings will be determined through consultation during detailed design (as part of the landscape plan) with the local municipalities.

Active Transportation Connections

Dundas Street is an important regional corridor, and it is important to provide a linkage within the regional active transportation network. Within the Study Area, active transportation facilities are provided as follows:

- from Brant Street to Northampton Boulevard: 4.0 m bi-directional multi-use path on the south side only;
- from Northampton Boulevard to Appleby Line: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane plus a 0.5 m painted buffer in each direction;
- from Appleby Line to Bronte Road: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction.

The proposed facilities are consistent with the recommendations in the draft Halton Region Active Transportation Master Plan. In constrained areas, the width of the multi-use path will be confirmed during detailed design in consultation with adjacent land owners, as well as the City of Burlington and the Town of Oakville. The City of Burlington and Town of Oakville also developed a Cycling Master Plan and an Active Transportation Master Plan, respectively, as discussed in **Sections 2.1.11** and **2.1.15**.

It was also noted that between the completion of the EA Study and construction for the widening of Dundas Street between Brant Street and Bronte Road, there may be new trends in active transportation and the facilities being implemented may be updated at that time. The right-of-way protected through the EA Study (nominally 50 m right-of-way) will be able to accommodate variations of active transportation facilities, as well as intersection treatments.

Many of the adjacent subdivisions currently have trail connections that are adjacent to the corridor. Connections to these trails will be developed at detailed design in partnership with the City of Burlington and Town of Oakville, including providing active transportation connections to bus stops / stations.

Heritage Elements

Along the Dundas Street corridor, there are a number of heritage features including 3318 Dundas Street St. Paul's Presbyterian Church and Cemetery which is designated under Part IV of the Ontario Heritage Act. There are also a number of cultural heritage landscape features that are listed under the City of Burlington's heritage Register (see **Appendix F**). Where the corridor passes by or through a heritage feature, its context will be considered and impacts mitigated. Individual characteristics and impacts should be considered. Site specific landscape plans will be developed in concert with stakeholders during detailed design to reflect the heritage character. See **Section 6.4.2** regarding Potential Environmental Effects, Mitigation Measures and Commitments to Future Work on Cultural Environment.

6.1.10 Utilities

There are a number of existing utilities located along the corridor, including watermain, sanitary sewer, gas main, hydro, and Bell. Most notably, there is a Hydro One corridor that runs in the northeast/southwest direction crossing Dundas Street in the proximity of Millcroft Park Drive. Towers in the corridor will not be impacted with widening, with a retaining wall to be installed near the south road right-of-way. Existing hydro poles along the corridor will have to be relocated as a result of the proposed widening of Dundas Street. This will be pursued during detailed design in consultation with Burlington Hydro, and Oakville Hydro. Other utilities such as Bell, Cogeco, and Enbridge Gas may also be impacted as a result of the widening of Dundas Street. These utilities will be contacted during detailed design to confirm the conflicts and the extent of relocation required.

6.1.11 Illumination

It is proposed that Dundas Street be illuminated in accordance with Halton Region standards. Centre median lighting is proposed due to the width of the roadway. Additional pedestrian-level lighting would also be required at the bus stops, and will be reviewed in further detail as part of the design of bus shelters. Further content on illumination is included in **Section 6.1.9**.

6.1.12 Property Requirements

The nominal proposed right-of-way for Dundas Street is 50 m except where significant constraints or local requirements exist. The Region will be acquiring suitable property where land has not been previously acquired. Additional property may be required at intersections to accommodate turning lanes, as well as for bus stops and grading. The proposed property line is shown on **Plates 1 to 27**.

Property requirements, as shown in the red dash line on **Plates 1 to 27**, are preliminary only and subject to further review and confirmation during detailed design. The approximate property requirements for privately owned or publicly owned (provincial or municipal) properties are summarized in **Table 6-4** (properties are listed from west to east).

Table 6-5: Preliminary Property Requirements

Location	Preliminary Property Requirements (ha)	Location	Preliminary Property Requirements (ha)
2002 Dundas Street	0.006	North side of Dundas Street between 407 ETR and Carpool lot Entrance	*0.21
2065 Dundas Street	0.08	Northeast quadrant Walkers Line / Northampton Boulevard	0.28
South side of Dundas Street: 150 m east of Brant Street to Eaglesfield Drive	*0.12	Guire Common	0.03
2111 Dundas Street	0.01	Singleton Common	0.03
2161 Dundas Street	0.02	North side of Dundas Street: east and west of Cornerstone Drive	*0.04

Location	Preliminary Property Requirements (ha)	Location	Preliminary Property Requirements (ha)
2165 Dundas Street	0.02	Southeast quadrant Dundas Street / Millcroft Park Drive	0.02
2179 Dundas Street	0.01	5155-5235 Dundas Street	0.21
2195 Dundas Street	0.01	5223 Dundas Street	0.04
2217 Dundas Street	0.03	5401 Dundas Street	0.05
2254 Dundas Street - Eaglesfield Community Church	0.05	5402 Dundas Street	0.002
2273 Dundas Street - Terra Greenhouse	0.07	5418 Dundas Street	0.007
2301 Dundas Street	0.02	5421 Dundas Street	0.04
South side of Dundas Street: 170 m east of Eaglesfield Drive to Blackwood Drive	*0.09	5453 Dundas Street	0.02
2373 Dundas Street	0.02	North side of Dundas Street at Bronte Creek Valley	*0.19
2399 Dundas Street	0.06	Northwest quadrant Dundas Street / Tremaine Road	0.15
South side of Dundas Street: Blackwood Drive to Guelph Line	*0.37	Northeast quadrant Dundas Street / Tremaine Road	0.05
3050 Guelph Line	0.06	South side of Dundas Street: east and west of Tremaine Road (Bronte Creek Provincial Park)	0.42
3007 Dundas Street	0.01	3445 Dundas Street West	0.10
3015 Dundas Street	0.01	3367 Dundas Street West	0.02
3031 Dundas Street	0.01	3365 Dundas Street West	0.31
3043 Dundas Street	0.01	3340 Dundas Street West	0.07
3075 Dundas Street	0.03	3239 Dundas Street West	0.22
3083 Dundas Street	0.01	3185 Dundas Street West	0.04
3101 Dundas Street	0.06	3175 Dundas Street West	0.02
3105 Dundas Street	0.01	3111 Dundas Street West	0.02
3115 Dundas Street	0.01	Northwest quadrant Dundas Street / Bronte Road	0.13
3151 Dundas Street	0.03	3004 Dundas Street West	0.02
South side of Dundas Street between Guelph Line and 407 ETR	*0.03		

*Note: * Properties under the ownership of Infrastructure Ontario or City of Burlington. The legal arrangement and actual property requirement will be subject to discussion between Halton Region and Infrastructure Ontario, as well as the City of Burlington during detailed design.*

6.1.13 Natural Hazards

Due consideration will be given to Natural Hazard policy at detailed design. This will include the technical review criteria set out in "Understanding Natural Hazards" (Ministry of Natural Resources and Forestry 2001) and appropriate technical guides.

There will be ongoing consultation with the City of Burlington and Conservation Halton regarding stormwater management strategy and also regarding the ongoing Stormwater Management Master Plan Study being carried out by the City of Burlington.

6.1.14 Preliminary Cost Estimate

A preliminary cost estimate (for construction) was prepared as part of this Class EA Study. The estimated roadway construction cost (excluding property cost) was estimated at approximately $ 135 M, including 15% miscellaneous and 15% contingency costs. A breakdown of the cost estimate is shown in **Table 6-8**. The costs are preliminary; a detailed cost estimate will be prepared during detailed design.

As noted above, property cost is not included in the preliminary cost estimate. Affected property owners (**Section 6.1.12**) will be consulted individually during detailed design to address mitigation measures, property negotiation and to discuss project details. Property as required will be acquired at fair market value.

Within the study limits, it is assumed that "minor" bus stops will be located in both directions at Brant Street, Eaglesfield Drive, Blackwood Drive, Guelph Line, Northampton Boulevard, Walkers Line, Berwick Drive / Rotary Way, Tim Dobbie Drive / Westlock Common, Millcroft Park Drive / Cornerstone Drive, Appleby Line, Sutton Drive, Tremaine Road, future access road (east of Tremaine Road), Colonel William Parkway and Bronte Road. A "Major" bus stop will be located at the GO Transit/Metrolinx carpool lot east of 407 ETR (see **Section 6.2.1** regarding bus stop descriptions). The cost estimates for bus stops within the study limits are shown in **Table 6-7** and are in addition to construction cost estimate shown in **Table 6-8**.

It should be noted that there are plans to implement a major transit hub in the area of Dundas Street and Bronte Road (Palermo). The exact location of the transit hub and the associated details will be planned in future studies beyond the scope of the Dundas Street EA. For the purpose of this Class EA Study, a bus stop is proposed at Bronte Road in both directions.

As noted in **Section 1.1.1**, Halton Region was awarded funding by Metrolinx for transit infrastructure improvements on Dundas Street.

Table 6-6: Preliminary Cost Estimate – Bus Stops*

Station Type	Cost Estimate
Minor Stop $130,000 each (15 locations) – two directions each	$ 3.9 M
Major Stop $200,000 each (1 location) – two directions each	$ 0.4 M
TOTAL Bus Stops Estimated Cost	**$ 4.3 M**

**Includes all works above platform level*

Table 6-7: Preliminary Cost Estimate

No.	Item Description	Total Quantity	Unit	Estimated Unit Price	Total Cost*
1.	Earth Excavation	170000	m^3	$12.00	$2,040,000
2.	Hot Mix DFC (40mm depth)	26000	t	$105.00	$2,730,000
3.	Hot Mix HDBC (140mm depth)	91400	t	$90.00	$8,230,000
4.	19mm Crusher Run Limestone (150mm)	48800	t	$22.00	$1,080,000
5.	50mm Crusher Run Limestone (550mm)	149000	t	$21.00	$3,130,000
6.	Concrete Bus Bay	6500	m^2	$120.00	$780,000
7.	Concrete Curb and Gutter	36500	m	$50.00	$1,830,000
8.	Concrete Sidewalk Pads at Intersections / Median / Platform	18500	m^2	$50.00	$930,000
9.	Concrete Strip	9900	m^2	$55.00	$550,000
10.	Asphalt Pathway	62600	m^2	$25.00	$1,570,000
11.	Storm Sewer		L.S.		$7,210,000
12.	SWM Facilities/Oil Grit Separator	28	each	$50,000.00	$1,400,000
13.	Concrete Culvert				
	• C1 Replacement	45.0	m	$1,850.00	$84,000
	• C2 Replacement	45.0	m	$3,500.00	$158,000
	• C3 Replacement	45.0	m	$7,400.00	$333,000
	• C4 Replacement	45.0	m	$1,850.00	$84,000
	• C5 Replacement	45.0	m	$1,850.00	$84,000
	• C6 Replacement	45.0	m	$1,850.00	$84,000
	• C7 Replacement	45.0	m	$5,300.00	$240,000
	• C8 Replacement	45.0	m	$7,600.00	$342,000
	• C9 Replacement	59.0	m	$7,600.00	$450,000
	• C10 Replacement	45.0	m	$5,500.00	$248,000
	• C11 Extension	8.0	m	$6,700.00	$54,000
	• C12 Replacement	45.0	m	$10,500.00	$473,000
	• C13-2 New	45.0	m	$6,700.00	$302,000
	• C16 Extension	2.0	m	$5,300.00	$11,000
	• C18 Extension	52.0	m	$1,850.00	$97,000
	• C19 Extension	2.0	m	$1,850.00	$4,000
	• C20 Replacement	3.0	m	$1,850.00	$6,000
	• C21A Replacement	45.0	m	$1,850.00	$84,000
	• C21B Replacement	45.0	m	$1,850.00	$84,000
	• C22A Extension	5.0	m	$1,850.00	$10,000
	• C22B Extension	5.0	m	$1,850.00	$10,000
14.	Retaining Walls	620	m^2	$800.00	$500,000
15.	Steel Beam Guide Rail	5023	m	$150.00	$760,000
16.	Topsoil and Sod	57600	m^2	$7.00	$410,000
17.	Cold Plane existing Pavement	187000	m^2	$3.00	$560,000
18.	Removal of Curb and Gutter	5300	m	$15.00	$80,000
19.	Clearing and Grubbing		L.S.		$72,000
20.	Landscaping		L.S.		$1,090,000
21.	Noise Wall	230	m	$1,000.00	$230,000
22.	Illumination				
	• Permanent		L.S.		$3,070,000
	• Temporary		L.S.		$540,000
23.	Traffic Signals				
	• Permanent	2	each int.	$200,000.00	$400,000
	• Temporary	17	each int.	$110,000.00	$1,870,000
24.	Maintenance of Traffic				
	• Traffic Control		L.S.		$540,000
	• Temporary Widening/Staging		L.S.		$720,000
25.	Miscellaneous (15%)		L.S.		$6,820,000
	Subtotal (Construction)				**$52,384,000**
26.	Structures				
	• CN Rail Crossing		L.S.		$6,000,000
	• Tansley Bridge		L.S.		$36,000,000
	• 407 Structure Widening		L.S.		$6,500,000
	• Fourteen Mile Creek Structure		L.S.		$2,800,000
	Utility Relocation (Lump-Sum Estimate)				$3,600,000
	Contingency (15%)				$16,100,000
	Engineering (Detailed Design & CA) (10%)				$10,730,000
	TOTAL (excluding HST)				**$134,114,000**
	*Costs have been rounded to the nearest $10,000 or $1,000 where appropriate.				

*Note: Cost estimate excludes bus stops above pavement level – see **Table 6-***

6.2 Transit Major Features

6.2.1 Bus Stops

6.2.1.1 Functional Design

Bus stops have been protected for at each of the corridor intersections. The number and intersection stops will be determined by the local municipalities and transit authorities (in this case, Oakville Transit and Burlington Transit). Stops have been developed to will operate in a similar fashion to typical curbside bus stops, with a passenger shelter set-back from the curb face by approximately 2.5 m. This allows for passenger circulation and manoeuvering of customers with disabilities. The passenger platform itself would be a reinforced concrete pad of approximately 25 m long x 3.5 m wide, and would support a passenger shelter, bicycle storage (if applicable), landscaping / streetscaping elements, and any passenger information or ticket vending machines. Elements of bus stops will be developed in consultation with Burlington Transit, City of Burlington, as well as Oakville Transit and Town of Oakville during detailed design.

Bus stops will generally be positioned on the far-side of the signalized intersection, with some exceptions where specific site conditions do not allow for a far-side stop. All bus stops on the Dundas Street corridor will be provided with on-line bus bays to allow for express buses to bypass a stopped bus serving passengers. This bay is long enough to accommodate two typical 12 m buses at the platform, or one 18 m articulated bus and one 12 m bus within the bay. Transitions are provided to permit for bus stopping and acceleration as can be accommodated. In the case of the near side bus stops, the bus will use the right-turn lane for stopping.

The multi-use pathway provided on both sides of the road between Northampton Boulevard and Bronte Road will remain continuous through the stops. Between Brant Street and Northampton Boulevard, the multi-use path is only provided continuously on the south side; on the north side, a short pathway will be provided between the bus stop and the signalized intersection to allow access the multi-use path on the other side of the road. In order to prevent conflicts between cyclists and waiting passengers, the multi-use path is proposed to be located behind the bus stop / passenger waiting area. Landscaping elements at the bus stop platform ends will provide positive guidance to all users of the multi-use pathway.

6.2.1.2 Bus Stop Locations

Proposed bus stops will be located at key existing and future passenger activity nodes along the corridor. A bus stop will be designated as either “Major” or “Minor” stops, dependent on the anticipated level of passenger activity at each. The difference between a “Major” and “Minor” bus stop is generally in the type of amenities provided and size of the facility. For example, a “Major” bus stop would have a larger shelter than a “Minor” bus stop. The amenities to be included in a “Major” and “Minor” bus stop are to be determined during detailed design and discussion with Burlington Transit and Oakville Transit (see **Section 6.2.1.3** on potential passenger amenities). Within the Study Area, there is one proposed “major” bus stop at the GO Transit carpool lot east of 407 ETR.

The “minor” bus stops identified in this section may be expanded in the future, if passenger demand warrants increasing the capacity of the stop.

As shown in **Plates 1 to 27**, "minor" bus stops have been protected for on both sides at Brant Street, Eaglesfield Drive, Blackwood Drive, Guelph Line, Northampton Boulevard, Walkers Line, Berwick Drive / Rotary Way, Tim Dobbie Drive / Westlock Common, Millcroft Park Drive / Cornerstone Drive, Appleby Line, Sutton Drive, Tremaine Road, future access road (east of Tremaine Road), Colonel William Parkway and Bronte Road. A bus stop would typically be located on the far side of an intersection where feasible for operation purposes. However, in locations where it is constrained due to property limitations, access, heritage and natural features, etc. the bus stop would be located at the near side of the intersection.

Table 6-7 summarizes the stop locations and designation for all proposed bus stops on Dundas Street between Brant Street and Bronte Road.

Table 6-8: Dundas Street Bus Stop Locations – Brant Street to Bronte Road

Location	Direction	Far Side / Near Side
Brant Street	EB	Far side
	WB	Far side (on southbound Brant Street)
Eaglesfield Drive	EB	Far side
	WB	Near side
Blackwood Drive	EB	Far side
	WB	Near side
Guelph Line	EB	Far side
	WB	Far side
Northampton Boulevard	EB	Far side
	WB	Far side
Walkers Line	EB	Near side
	WB	Far side
Berwick Drive / Rotary Way	EB	Far side
	WB	Far side
Tim Dobbie Drive / Westlock Common	EB	Near side
	WB	Far side
Millcroft Park Drive	EB	Far side
	WB	Far side
Appleby Line	EB	Far side
	WB	Far side
Sutton Drive	EB	Near side
	WB	Far side
Tremaine Road	EB	Far side
	WB	Far side
Future Access Road (east of Tremaine Road	EB	Far side
	WB	Far side
Colonel William Parkway	EB	Far side
	WB	Far side
Bronte Road	EB	Far side
	WB	Far side

6.2.1.3 Passenger Amenities

All bus stops along Dundas Street have been protected to be fully accessible to people with disabilities.

The initial range of stops in the current EA will be comprised of both "major" and "minor" stops, based on the anticipated amount of passenger activity at each stop. The passenger shelters proposed for Dundas Street will be a modular design, allowing future increases in capacity as passenger demand dictates. The shelters, whether major or minor, will generally provide the same range of amenities for passengers, may include a combination of the following:

- **Seating:** Seating will be modular with options for expansion (number of seating opportunities) and meet accessibility standards in terms of height and the provision of back and arm-rests.
- **Multipublication Boxes:** Mutlipublication boxes provide the ability to consolidate all the publications into a single street furniture element, keeping the amenity space free of visual and physical clutter.
- **Waste and Recycling Bins:** Similarly, waste and recycling bins can be organized as modular units for waste, recycling and paper. The number of modular units at a given stop location can vary relative to the projected ridership and number of pedestrians passing by.
- **Bicycle Racks:** The layout for major stops will provide bicycle parking / bicycle racks. Minor stops will be equipped with bicycle storage racks and can be added as warranted. It should also be noted that Burlington Transit and Oakville Transit buses are equipped with front-loading bicycle racks.
- **Information Systems (Printed):** Information systems for printed material such as route maps and schedules will be included at every stop. The specific design of the information material will be determined in the design development phase.
- **Digital Passenger Information and other Intelligent Transportation System (ITS):** These systems are typically mounted and accessible by all users. They would not impact the physical layout of stops. Their design integration and location will be developed in detailed design.
- **CCTV:** Closed circuit television may be provided as required.
- **Landscaping:** Landscaping features may be incorporated at bus stops where feasible.

As noted above, the specific layout of the elements within the stop area will be determined through the detailed design in consultation with Burlington Transit, City of Burlington, as well as Oakville Transit and Town of Oakville.

6.3 Operations of High Occupancy Vehicle / Transit Lanes and Bus Rapid Transit Lanes

With the proposed widening of Dundas Street to 6-lanes, there is opportunity to consider the introduction of High Occupancy Vehicle (HOV) curb lanes allowing a mix of transit and private vehicles with two or more occupants. In parallel, active transportation, bus stops and transit priority measures can be provided at key intersections as required. The

limits of HOV lanes / transit improvements are to be determined in consultation with the local municipalities (i.e. Town of Oakville and City of Burlington, which are the transit operators in their respective areas). As transit ridership builds, there is the opportunity to convert the HOV lanes into dedicated bus lanes in the future.

The curb lanes include provision to accommodate future HOV / transit lanes or dedicated BRT lanes in the future. The transition from general purpose to HOV / transit lanes to BRT lanes would not require reconstruction of the roadway.

6.3.1 HOV Eligibility

The following is a discussion of the key operational guidelines related to vehicle occupancy criteria, hours of operation, and eligibility by vehicle class. An operational plan and supporting infrastructure regarding the HOV program (e.g. guidelines and enforcement) would be subject to consultation with Halton Regional Police Service, City of Burlington and Town of Oakville as part of detailed design. For illustrative purposes HOV elements are discussed in **Sections 6.3.1.1** to **6.3.1.4**.

6.3.1.1 Vehicle Occupancy

A HOV 2+ eligibility criteria would ensure compatibility with other provincial HOV networks in the proximity to the Dundas Street corridor, namely the Ministry of Transportation's freeway HOV network on the Queen Elizabeth Way (Town of Oakville and City of Burlington) and Highway 403 (City of Mississauga).

6.3.1.2 Vehicle Type

Rules regarding HOV lane eligibility attempt to strike a balance between promoting the use by certain types of eligible vehicles and maximizing use of the lane. A secondary objective is ease of public understanding and enforcement. Furthermore, overarching principles of operating efficiency, safety, speed, comfort, and motorist needs apply, just as they do to general traffic lanes.

The following summarizes whether a type of vehicle is permitted in the HOV / transit lanes on Dundas Street.

Permitted Use

- ***Buses*** – public transit buses, intercity buses, chartered buses, school buses, and any other vehicle licensed as a bus. For efficiency and reliability purposes, empty buses should also be allowed to use HOV lanes (being able to quickly shift buses back to the start of a route is very important to transit fleet operations and service), noting also that a public transit bus could have no passengers on board at certain times and locations along its normal route.
- ***Taxis*** – taxis are permitted to use the HOV /transit lanes, with or without passengers. Taxis are generally distinguishable from other traffic and therefore public acceptance and enforcement of taxi use of the HOV lanes have not been major issues.
- ***Carpools and Vanpools*** - Carpools and vanpools should only be allowed if they meet the specified occupancy criteria (i.e HOV 2+).
- ***Motorcycles*** - motorcyclists should follow the same rules and be subject to the same penalties as other motorized vehicles, and therefore be allowed on the HOV / transit

lanes only if the appropriate number of people are on board. This is consistent with the MTO eligibility.

- ***Emergency Vehicles*** – Police, fire, and ambulance vehicles should be able to use HOV / transit lanes at all times, whether on duty or returning to their base. Tow trucks should be allowed to use priority lanes only in responding to an incident (with light flashing).
- ***Bicycles*** - bicycles are inherently allowed to use the right curb lane, an HOV / transit lane or bus lane. The curb lanes on Dundas Street are proposed to be at 4.2 m between Brant Street and Northampton Boulevard. Buffered bike lanes with striped buffer are proposed between Northampton Boulevard and Bronte Road.

Not Permitted

- ***Trucks*** - As a general principle, heavy trucks should not be allowed to use HOV lanes even when they are carrying the required number of passenger(s). The reason is that the operational characteristics of heavy vehicles (acceleration, deceleration) are at odds with the objective of an HOV / transit facility, which is to make HOV / transit travel faster and more reliable than general traffic. Heavy trucks also pose safety and operational concerns in a curb lane which is shared with bicycles. Since the concerns relating to truck usage are independent of the number of occupants in the vehicle, it would be reasonable to exclude trucks with more than two axles from HOV / transit lanes even if they carried the required number of occupants.

6.3.1.3 Access and Intersections

All vehicles traveling may utilize the HOV / transit lane when approaching an intersection to access the right turn lane or if approaching a driveway to access establishments with direct access. Vehicles turning out of a crossing road will first enter the HOV / transit lane before merging into the general purpose lane if it is not eligible to use the HOV / transit lane.

6.3.1.4 Hours and Days of Week Operation

Typically, HOV / transit lanes would operate 24-hours per day and 7-days per week. This would facilitate easier enforcement and instill a sense of permanence in the facility.

6.4 Potential Environmental Effects, Mitigation Measures and Commitments to Future Work

6.4.1 Socio-Economic Environment

The proposed undertaking would:

- maintain 4 through lanes of traffic during construction to minimize traffic delays;
- provide for a future 6 lanes (with provision for 4 general traffic lanes and 2 lanes for transit / high occupancy vehicles);
- accommodate pedestrians and cyclists through provision of multi-use paths connecting to local communities and parks; and,

- meet the Region's corridor "vision" and objectives for Dundas Street (i.e. a pedestrian-friendly regional arterial road which accommodates all modes of transportation).
- address and mitigate against Natural Hazards in the form of flooding and flood plains, watercourse erosion and water quality.

The following is a description of the social environmental effects (**Section 6.4.1.1** Property Requirements, **Section 6.4.1.2** Access, **Section 6.4.1.3** Pedestrians / Cyclists, **Section 6.4.1.4** Noise Analysis, and **Section 6.4.1.5** Air Quality), the proposed mitigation measures and commitments to further address those effects. Items of natural hazards related to water and runoff have been outlined in **Section 6.1.6**.

6.4.1.1 Property Requirements

Proposed property requirements are shown in **Plates 1 to 27**. All adjacent property owners were notified about the Class EA Study and invited to attend the Public Information Centres. The existing right-of-way for Dundas Street between Brant Street and Bronte Road varies between 35 m and 50 m, and the right-of-way for the proposed 6-lane Dundas Street is nominally at 50 m (varies locally near intersections and areas of constraint).

As noted in **Section 6.1.3**, Dundas Street will be widened mainly to the north side between Brant Street and Bronte Road due to mature and existing residential communities on the south side of the road. However, in areas where there are significant constraints, the widening will be shifted to the south or will be accommodated by modification to the typical cross section and transit facilities to minimize impact to adjacent properties / features. Future developments adjacent to Dundas Street within the Study Area could be graded to match the grade of the future Dundas Street.

Affected property owners will be consulted individually during detailed design to address mitigation measures, property negotiation and to discuss project details. Property required will be acquired at fair market value.

Property impacts are generally along the frontage of the properties abutting Dundas Street and are listed in **Section 6.1.12**.

6.4.1.2 Access

As a major Regional arterial road, Dundas Street will include left and right turn lanes at most signalized intersections as listed in **Section 6.1.5**.

There are existing commercial and residential properties along Dundas Street that currently have full move access (i.e. can turn left and right) from the roadway. When Dundas Street is widened from 4 to 6 lanes, a raised median would be provided to separate eastbound and westbound traffic for operational and safety purposes. Access to the properties would become right-in/right-out only from Dundas Street. Private residences and businesses will be affected and will require alternate ways to replace left turn access, including legal U-Turns at signalized intersections. In cases where an existing driveway with direct access from Dundas Street is located near an intersection, the access will be closed and relocated.

Future accesses will be subject to review by Halton Region (as well as City of Burlington and Town of Oakville as applicable) as properties along Dundas Street undergo development / redevelopment, i.e. part of the development application process.

6.4.1.3 Pedestrians / Cyclists

Halton Region is planning to implement an active transportation network in the Region to make it easier for people to walk and bike around Halton (as discussed in **Section 2.1.9**) through the ongoing Halton Region Active Transportation Master Plan Study (ATMP). The Halton Region ATMP was developed in consultation with the City of Burlington and Town of Oakville. Consistent with the Active Transportation Master Plan, active transportation facilities within the Study Area are proposed as follows:

- from Brant Street to Northampton Boulevard: 4.0 m bi-directional multi-use path on the south side only;
- from Northampton Boulevard to Appleby Line: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane with 0.5 m painted buffer in each direction;
- from Appleby Line to Bronte Road: 3.0 m multi-use path on both sides of the road, 1.8 m buffered bike lane (including 0.3 m striped buffer) in each direction

In constrained areas, the width of the multi-use path will be confirmed during detailed design in consultation with adjacent land owners, as well as the City of Burlington and the Town of Oakville. The City of Burlington and Town of Oakville also developed a Cycling Master Plan and an Active Transportation Master Plan, respectively, as discussed in **Sections 2.1.11** and **2.1.15**.

Although a standard marked crosswalk would be sufficient to allow pedestrians to cross at a controlled intersection, cyclists on a multi-use trail or shared pathway would be required to dismount and walk their bikes across. To allow cyclists to ride across, a combined crossride may be provided at an intersection in place of a standard crosswalk.

Different formats of crossride are available; however the 'combined' arrangement is the most appropriate for situations where cyclists and pedestrians will be sharing the same space on the approach to an intersection. The layout will be similar to the example shown in **Exhibit 6-2**. This is applicable to the sections of Dundas Street where multi-use paths are proposed. Where cycling facilities on intersecting streets would justify the provision of crossrides across Dundas Street, combined crossrides should also be used to provide consistency and clarity for users. Intersections where crossride will be implemented are to be identified in detailed design.

It was also noted that between the completion of the EA Study and construction for the widening of Dundas Street between Brant Street and Bronte Road, there may be new trends in active transportation and the facilities being implemented may be updated at that time. The right-of-way protected through the EA Study (nominally 50 m right-of-way) will be able to accommodate variations of active transportation facilities, as well as intersection treatments.

6.4.1.4 Noise Analysis

Based on the Ontario Ministry of Transportation (MTO)/Ministry of the Environment and Climate Change (MOECC) Noise Protocol, where an existing roadway is proposed to be modified / widened adjacent to a Noise Sensitive Area (NSA), MOE requires that the

future noise levels without the proposed improvements be compared to the future noise level with the proposed improvements. A private home is an example of a NSA. The assessment is done at the outdoor living area (typically backyards) of each NSA. The provision of noise mitigation is to be investigated should the future noise level with the proposed improvements result in a greater than 5 dBA increase over the future noise level without the proposed improvements. If noise mitigation is provided, the objective is a minimum 5 dBA reduction. Mitigation will attempt to achieve levels as close to, or lower than, the objective level as is technically, economically and administratively feasible.

Noise Sensitive Areas (NSAs) within the study area were identified in accordance with the criteria outlined in the MTO/MOE Noise Protocol. Based on the review of the study area, seven receiver locations were identified to represent the NSAs along Dundas Street. The noise analysis is provided in **Appendix H**, including an exhibit which identified locations of the receiver locations.

The review of potential noise impacts assumed that the future Dundas Street is the dominant noise source within the study area given the proximity of the NSAs to the roadway. Noise modelling was carried out for the following three scenarios:

i) future noise levels without improvements to Dundas Street (Year 2021 / 2031)

ii) future interim noise levels with HOV lanes on Dundas Street (Year 2021)

iii) future noise levels with BRT lanes on Dundas Street (Year 2031)

It should be noted that existing (2011) traffic volumes on Dundas Street were used to represent the future without widening of Dundas Street scenario as Dundas Street is currently operating at or near capacity.

The potential change in noise levels are predicted to be less than 5 dBA for all receiver locations as a result of the proposed improvements to Dundas Street both in the interim condition (2021) and ultimate condition (2031) when compared to the "future without roadway improvements" condition. Therefore, the consideration of noise mitigation is not required, based on MTO/MOECC criteria.

It should be noted that any future new residential subdivision developments along the Dundas Street corridor will have to carry out noise analyses in accordance with MOE requirements as part of the application process under the Planning Act. These studies would recommend the provision of outdoor and indoor noise attenuation measures and the inclusion of noise warning clauses on title of affected properties; these are outside the scope of the EA Study.

Replacement of Existing Noise Wall East of Highway 407

Noise wall is currently provided for residential houses on Headon Forest Drive in the southeast quadrant of the Highway 407 off ramp (S-E/W ramp) / Dundas Street. As a result of the widening of Dundas Street, the existing noise wall will be replaced and relocated. The placement of the new noise wall will be located approximately 5-10 m to the south of the existing noise wall along Dundas Street (i.e. closer to the residential houses).

6.4.1.5 Air Quality

An air quality assessment was carried out as part of the Dundas Street Class EA Study and is included in **Appendix I**. The contaminants of interest include:

- Nitrogen Dioxide (NO_2)
- Carbon Monoxide (CO)
- Fine Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$)
- Coarse Particulate Matter less than 10 microns in diameter (PM_{10})
- Total Suspended Particulate Matter less than 44 microns in diameter (TSP)

Results of the air quality assessment indicated that all contaminants, with the exception of PM_{10} and TSP were below their respective Ministry of Environment and Climate change Ambient Air Quality Criteria. The number of additional days above the guideline for PM_{10} and TSP for the future build scenario was less than 1% of the time over the 5 year period under the interim (i.e. Dundas Street with 4 general traffic lanes and 2 HOV lanes) and ultimate (i.e. Dundas Street with 4 general traffic lanes and 2 dedicated BRT lanes) conditions. The potential for chronic health concerns would be low under both the interim (i.e. Dundas Street with 4 general traffic lanes and 2 HOV lanes) and ultimate (i.e. Dundas Street with 4 general traffic lanes and 2 dedicated BRT lanes) conditions. Since there is a relatively small increase in the number of days above the Ministry of Environment and Climate Change guideline and Canada Wide Standards, mitigation measures are not warranted based on the air quality assessment.

6.4.2 Cultural Environment

6.4.2.1 Built Heritage Resources

A Cultural Heritage Impact Assessment was carried out and is included in **Appendix G**. A list of the Built Heritage Resources (BHR) and Cultural Heritage Landscape (CHL) features are listed in **Section 3.8**.

Based on the results of background data collection, field review, and a review of the most recent preliminary plan (May 2014), the following recommendations have been developed:

- Where limited encroachment on to BHRs and CHLs in the study corridor has been identified through grading and property acquisition, ensure that construction-related activities located in close proximity to identified heritage resources are suitably planned to conserve the resources and maintain appropriate vehicular access.
- Impacts to the fence lines and the front gates at CHL 12 (3445 Dundas Street) should be avoided. Where this is not feasible, the respective features should be documented and relocated further back onto the property. Where relocation is not possible, the resources should be documented in a Cultural Heritage Landscape Documentation Report to be undertaken by a qualified cultural heritage consultant in advance of construction activities.
- Impacts to the stone entrance pillars at CHL 14 (3269/3271 Dundas Street) should be avoided. Where this is not feasible, the resource should be documented and relocated further back onto the property. Where relocation is not possible, the resources should be documented in a Cultural Heritage Landscape Documentation

Report to be undertaken by a qualified cultural heritage consultant in advance of construction activities.

- Design of the retaining walls at CHL 4 (Nelson United Church and Cemetery) and CHL 5 (St. John's Anglican Church and Cemetery) should be in keeping with the heritage character of the property and construction should be done in a manner that protects the structural integrity and material fabric of the adjacent churches and cemeteries.
- Grading/road construction activities conducted adjacent to CHL 4 (Nelson United Church and Cemetery) CHL 5 (St. John's Anglican Church and Cemetery) and CHL 7 (St. Paul's Presbyterian Church and Cemetery) and the construction of retaining walls at CHL 4 (Nelson United Church and Cemetery) CHL 5 (St. John's Anglican Church and Cemetery) have the potential to impact unmarked grave shafts associated with the respective cemeteries. In the case of CHL 4 (Nelson United Church and Cemetery) CHL 5 (St. John's Anglican Church and Cemetery), the retaining walls are to be constructed along the existing property lines. In the case of CHL 7 (St. Paul's Presbyterian Church and Cemetery), however, it appears that a portion of the existing cemetery extends into the Region's right-of-way.
- A Cemetery Investigation was carried out at CHL 7 (St. Paul's Presbyterian Church and Cemetery) and is included in **Appendix H**. Findings from the Cemetery Investigation noted that no grave shafts were encountered within the subject area adjacent to the St. Paul's Presbyterian Church along the Region's right-of-way.
- Given the sensitive nature of CHL 4 (Nelson United Church and Cemetery) CHL 5 (St. John's Anglican Church and Cemetery), cemetery limits should be identified by a licensed archaeologist through a Cemetery Investigation and steps should be taken to ensure that the site and surrounding fencing (where present) are retained and protected during construction-related activities.
- The property limits of 3114 Dundas Street West (St. Luke's Anglican Church), a designated heritage property, may be encroached upon through grading. Encroachment should be avoided by modifying the cross-section of the road design at this road section. Where grading on this property is unavoidable, the Town of Oakville may require a property-specific heritage impact assessment to be undertaken by a qualified heritage consultant.
- Should future work require an expansion of the current study corridor and/or the development of other alternatives, a qualified heritage consultant should be contacted in order to confirm impacts of the undertakings on cultural heritage resources.

6.4.2.2 Archaeology Resources

As noted in **Section 3.8.2**, a Stage 1 archaeology assessment was carried out. Areas adjacent to Dundas Street between Brant Street and 407 ETR (north and south sides) are largely identified as having archaeological potential. Between 407 ETR and Bronte Road, intermittent areas on either north or south sides of Dundas Street have been identified to have archaeological potential. A Cemetery Investigation is recommended if construction activities are proposed along the existing Dundas Street right-of-way at Nelson United Church and Cemetery, St. John's Anglican Church and Cemetery and St.

Paul's Presbyterian Church and Cemetery. A Cemetery Investigation was already carried out for St. Paul's Presbyterian Church and Cemetery. Details may be found in **Appendix H**.

6.4.3 Natural Environment

Potential impacts and mitigation of the proposed works on natural environmental features along the project limits are described in **Sections 6.4.3.1** to **6.4.3.4**. It should be noted that the works, including the extent of the grading limits, and therefore the assessment of their associated direct impacts, are preliminary only and subject to future review during detailed design. Identification of temporary work requirements, for example, at the Bronte Creek / Tansley Bridge, is also very preliminary and will not be confirmed until detailed design. This impact assessment will be refined and finalized during detailed design once the design is finalized and further details become available. The associated mitigation measures recommended herein, which are designed for avoiding or minimizing intrusion as well as minimizing potential for secondary and indirect effects, will also be refined and finalized at detailed design.

Mitigation of negative effects to the natural environment is applied throughout the EA process, including siting of the works and refinement of grading where there is flexibility, development of the design of culvert/structure crossings (again subject to consideration of all relevant factors) and best management measures to address potential construction impacts. Nonetheless, some negative effects cannot be completely avoided. Following refinement of the design and finalization of the associated mitigation measures, these measures will be included in the Contract documents for implementation during construction. This process will incorporate agency liaison and review.

6.4.3.1 Environmental Policy Plan Areas and Designated Features - Impacts

As described in **Section 3.4** and **Exhibits 3-3a** to **3-3l**, there are several Designated Features associated with natural features present in the Study Area. Detailed descriptions of potential impacts to vegetation communities associated with these designated areas are provided under the heading *Vegetation Resources* in **Section 6.4.3.3**.

Potential impacts to the designated areas as a result of the proposed works are summarized below:

Policy Plan Areas

Niagara Escarpment Plan Area – Works occurring on the north side of Dundas Street, west of Guelph Line will require some permanent vegetation removals and incremental temporary edge disturbance of some natural and semi-natural lands associated with this plan area, the majority of which are designated as 'Escarpment Protection Area' and a very small portion of which are designated 'Escarpment Natural Area' (as detailed in **Section 3.4**), and that are already disturbed by the existing Dundas Street corridor. Site-specific mitigation measures for impacts to these areas, as outlined in the Niagara Escarpment Plan, are provided in **Section 6.4.3.7**, below.

To minimize impact to the Niagara Escarpment Plan area, the widening of Dundas Street between Brant Street and Guelph Line, particularly on the north side of the road, is largely contained within the Region's right-of-way (i.e. the future edge of pavement is located within the Region's right-of-way). The 4.0 m bi-directional multi-use path will

be located on the south side only to minimize impact to Niagara Escarpment lands on the north side. While nominal property requirement along the north side of Dundas Street between Brant Street and Guelph Line is shown on Plates 1 to 6, this is to protect for the 50 m right-of-way of Dundas Street which is consistent with the Halton Region Transportation Master Plan. The physical footprint of the widened Dundas Street is expected to have minimal impact to undisturbed Niagara Escarpment Plan area.

Greenbelt Plan Area – Works occurring on the north side of Dundas Street, west of 407 ETR, as well as north and south of Dundas Street along the Bronte Creek Valley generally will require some permanent vegetation removals and incremental edge disturbance of some natural and semi-natural lands associated with this plan area, which are designated as 'Protected Countryside' and 'Natural Heritage System' (as detailed in **Section 3.4**), and that are already disturbed by the existing Dundas Street corridor.

The construction of two additional lanes on a new bridge across the Bronte Creek Valley north of the existing bridge, will require some permanent vegetation removals within the Greenbelt Plan Area, and some temporary disturbance to vegetation in order to accommodate access and staging requirements during construction. Minor temporary disturbance to vegetation on the south side of Dundas Street will also likely be required during construction. However, no intrusion beyond the right-of-way south of Dundas Street is expected in Bronte Creek Valley, thus impacts to the south will be limited to the edges of the Greenbelt Plan Area, which are already disturbed by the existing Dundas Street corridor.

Provincially Designated Features

North Oakville-Milton West Wetland Complex Provincially Significant Wetland (PSW) – There will be no direct impacts to this PSW, as it is located outside of the Study Area, well beyond the proposed works. However, there is some limited potential for indirect impacts to this feature through associated works on both Fourteen Mile Creek Tributaries – Culverts C22 and C23, which outlet to this wetland complex further downstream of the Study Area. Potential impacts can be managed with implementation of standard mitigation measures outlined in **Section 6.4.3.7**.

Bronte Creek Provincial Park Nature Reserve Life Science ANSI – There will be no permanent vegetation removals within the ANSI, as its boundary is already set-back from the existing corridor enough to allow for the proposed works. There is some potential for minor temporary edge disturbance along the north edge of the ANSI, adjacent to the proposed works.

Bronte Creek Provincial Park– Works occurring in the vicinity of the Bronte Creek Provincial Park (i.e., south of Dundas Street between the Bronte Creek Valley and the development lands west of Colonel William Parkway) will likely include some permanent vegetation removals and temporary edge disturbance. Disturbance within the portion of the Park associated with Bronte Creek Valley will be limited to minor temporary disturbance to edge vegetation, as most of the works in this area are confined to the north of Dundas Street. Any impacts will be limited to the edge of Bronte Creek Provincial Park, which is already disturbed by the existing Dundas Street corridor.

It should be noted that Ontario Parks is planning to expand the Bronte Creek Provincial Park to north of Dundas Street. The proposed expansion has yet to be formalized but a

proposed boundary plan has been prepared and was made available for public review. The expansion of the Provincial Park will require an amendment to the Regulation.

Regional and Municipal Designated Features

Natural Heritage System Area (NHSA) – This designated feature is widespread throughout the Study Area. Generally, portions of the NHSA are associated with watercourses, their valley systems, and other designated areas, for which impacts are already described elsewhere. All of the vegetation communities that are included in the NHSA are listed in **Section 3.4.2.4**. The proposed works will result in encroachments into the majority of these natural and semi-natural vegetation communities. Potential for indirect impacts associated with the proposed road widening to retained adjacent portions of these features can be managed with standard mitigation measures, outlined in **Section 6.4.3.7**.

Nelson Escarpment Woods and Extensions (ESA #6) – Works occurring on the north side of Dundas Street in the vicinity of Tuck Creek Tributary # 8 will result in incremental encroachments into the edge of this ESA that is already disturbed by the existing Dundas Street corridor.

Bronte Creek Valley and Extensions (ESA #10) – This feature extends along the Bronte Creek Valley through the study area and extending north of Britannia Road and south to Lake Ontario. The proposed works in the vicinity of Bronte Creek Valley are generally confined to the north side of Dundas Street. As outlined above, the construction of the two additional lanes on a new bridge across the valley north of the existing bridge will require some permanent vegetation removals within the ESA, and some temporary disturbance to vegetation in order to accommodate access and staging requirements during construction. Minor temporary disturbance to vegetation on the south side of Dundas Street will also likely occur during construction. However, no intrusion beyond the right-of-way is expected, thus impacts will be limited to the edges of the Bronte Creek Valley ESA, which are already disturbed by the existing Dundas Street corridor.

6.4.3.2 Aquatic Resources and Fisheries – Impacts

This section summarizes the preliminary proposed works and associated implications at the 18 water crossings that support fish habitat (direct or indirect) along the Dundas Street study area and their implications on fish and aquatic habitat. As noted, this impact assessment is preliminary and will be refined as required based on the Detailed Design. The proposed works and their associated impacts to fish and aquatic habitat are highlighted below:

- *Replacement of the existing concrete box culverts with longer boxes of similar or larger spans at the majority of the watercourses that support direct fish habitat, (except C15 and C22).* Specifically, at C9, C10, C11, C12, C13, and C16. These longer spans will result in nominal enclosures of the local watercourse features, and slightly decreased nutrient and allochthanous inputs to the receiving watercourses downstream. The affected habitat conditions include:
    - small seasonal flowing channels at C9, 10, and 16
    - small permanently flowing channels at C11, 12, and 13
    - typically, predominantly fine substrates and flat morphology

  - generally historically altered channels through the study area (re-aligned, modified banks, straightened)
  - presence of common warm/cool bait and forage fish species.

- *Replacement of existing concrete box culvert at Fourteen Mile Creek West (C22) with a 20 +/-m clear span structure (preferred alternative as discussed further in* ***Section 6.1.8****)*[6]. Habitat impacted by the proposed works includes highly altered channel section which has been channelized and lined with a concrete slab floor and concrete walls. Flow is discontinuous seasonally, with refuge pools located upstream of the right-of-way reach. The existing Dundas Street culvert poses a barrier to upstream fish movement. In addition to bait/forage species, the study reaches support Redside Dace (see also **Section 6.4.3.5** for additional species specific impacts). Affected riparian vegetation includes common culturally modified communities (cultural meadow) and Fresh-moist Lowland Deciduous Forest.
- *New retaining walls at Fourteen Mile Creek West Tributary (C23) with no change to existing culvert. The existing culvert is in good condition and would not require any extensions to accommodate the widening of Dundas Street*[7]. Flow is continuous. The existing culvert has a minor joint bend in it, but this bend does not appear to impact flows or woody debris/ice movement through the culvert. Affected riparian vegetation includes common culturally modified communities and species (i.e. cultural meadow and thicket, and cattail mineral marsh species). In addition to bait/forage species, these study reaches support Redside Dace (see also **Section 6.4.3.5** for additional species specific impacts).
- *Replacement of the existing CSP, arch or concrete box culverts on five water crossings that support indirect fish habitat (C1, C2, C18, C20 and C21) with longer similar culverts with slightly larger spans.* The majority of these features are drainage features that outlet to storm sewers or buried pipes south of Dundas Street.
- *Extension of two existing concrete box culverts to the north of Dundas Street- C11 and C15-1.* The channels of both of these features have been historically altered upstream of Dundas Street. Culvert C11 now flows along the roadside ditch to the north of Dundas and will require realignment to accommodate the widening of Dundas to the north. This realignment will be done in conjunction with the development to the north.
- *Decommissioning of one culvert – C18 that conveys flows to Bronte Creek via a steep, highly eroding valley feature south of the highway.* The flows will be maintained as land runoff into the Bronte Creek valley but the culvert under Dundas Street will be removed.
- *Two other culverts do not require any works and will also remain in their current state- C20 and C21A.* The associated drainage features support only indirect fish habitat functions.

[6] At CH's and MNRF's request, several crossing alternatives were evaluated to address concerns regarding this species, even though the existing culvert does not require replacement.

[7] Similar to C22, and at CH's and MNRF's request, several crossing alternatives were evaluated for this location to address concerns regarding this species.

- *Replacement of the existing Tansley Bridge over Bronte Creek with a larger mutli-span structure, and addition of a second similar structure to the north to accommodate the two new lanes.* There is a nominal direct footprint impact of the new bridge within the bankfull channel; however, localized disturbance of the channel is required for removal of existing piers, potential bank stabilization works and/or a temporary construction access/staging platform(s) to construct the new bridge. The habitat under the existing and new bridges is comprised of fine and coarse substrates with mainly flat morphology and scattering of riffles and pools. A temporary crossing may also be required upstream of the new bridge in order to access the east side of the channel, since access down the east valley slope is not possible. Construction alternatives and their feasibility will be further evaluated during the detailed design phase. Riparian vegetation removed/disturbed by the bridge works is comprised of hardwood forest species on the valley slopes and floodplain vegetation consisting of cultural, common and meadow wetland species.
- Culvert extensions and longer replacement culverts will enclose incremental lengths of channel, with associated nominal removal of riparian vegetation and localized losses of nutrient and allochthanous inputs. For the most part, the reaches that will be enclosed are somewhat disturbed, and comprised of common habitat elements. No specialized habitat features are affected. The fine substrate component in many locations may be susceptible to downstream transport or disturbance.
- Localized minor channel modifications to transitions to tie-in the upstream, and in some cases downstream (e.g., where new culverts are embedded for substrate placement or low flow channel works undertaken) channel sections at the new outlets of the longer culvert replacements and extensions. These works will involve localized temporary disturbance but should not result in permanent effects with proper design and construction.
- Potential indirect construction related impacts, include erosion and sediment migration to the watercourses, temporary flow transfer and potential for local erosion and sediment generation during flow release, disturbance and downstream migration of fine bed materials, localize de-stabilization of channel beds or banks following construction, and associated disturbance and stress to any fish that may be using the reaches in or downstream of the construction zones in the fish-bearing watercourses. Fish communities in Bronte Creek, Fourteen Mile Creek West and its tributaries are more sensitive than in the other smaller watercourses resulting from the confirmed presence of Silver Shiner and Redside Dace, respectively. However, these potential impacts can be managed with the implementation of standard design and construction-related mitigation measures.
- Localized permanent removal and temporary disturbance of riparian vegetation to accommodate the new culvert sections or longer replacement culverts. The affected vegetation is mainly cultural in nature (cultural meadow) and influenced by the adjacent road and history of agricultural activity. Beyond Bronte Creek and Fourteen Mile Creek West, where scattered tree and/or shrub removals are required, woody riparian removals are limited.

6.4.3.3 Vegetation Resources – Impacts

Existing vegetation conditions within the Study Area are described in **Section 3.4.2.4**. The proposed works will occur within and immediately adjacent to the existing Dundas Street right-of-way, extending either to the edge of the right-of-way, or to the grading limits, as shown on **Plates 1 to 27**. The grading limits vary from being inside the right-of-way to extending slightly beyond it. Direct impacts to vegetation include temporary and permanent disturbance to old field meadow communities the edges of a number of natural and semi-natural vegetation communities present in and adjacent to the right-of-way.

Impacts in the old field meadow communities within the right-of-way will require some localized permanent removal and temporary disturbance of common, disturbance tolerant species. As described in **Section 3.4.2.4**, all of the vegetation in the right-of-way is already disturbed, due to the construction and maintenance of the existing Dundas Street corridor, cross-roads and highways, and existing adjacent commercial and residential developments. None of the vegetation species present in the right-of-way is rare or limiting, and given the present species' high tolerance to disturbance, the temporarily disturbed portions of the right-of-way are expected to regenerate quickly with similar species after construction.

In some locations where the grading limits extend beyond the right-of-way or where natural and semi-natural communities grow into the right-of-way, impacts include localized removal and temporary disturbance to the edges of some natural and semi-natural vegetation communities. The majority of these areas are comprised of cultural meadow, cultural thicket and cultural woodland communities, dominated by typical old field species and a mix of native and exotic tree and shrub species of varying age and quality, however in a few cases, the edges of some natural forest, riparian, and floodplain communities are affected. These more natural communities are generally encompassed in the NHSA and other designated features, as described above in **Section 6.4.3.1**.

As described in **Section 3.4.2.4** one of the vegetation community types present in the Study Area – Fresh-Moist Black Walnut Lowland Deciduous Forest (FOD7-4) – is considered to be 'imperiled-vulnerable' (S2S3) in Ontario. This community type is present in Units N3 (north along Tuck Creek Tributary #8 – C1) and S22b (south along Fourteen Mile Creek West Tributary – C22). Minor incremental disturbances to the edge of Unit N3 may occur during construction. Similarly, at C22, construction of the new bridge should not require removal of any trees from Unit S22b, as the footprint of the structure is within the existing right-of-way, however minor incremental disturbance to the edge of the community may occur during construction.

Bronte Creek Valley is the largest and most significant natural feature within the Study Area, and portions of it fall under a number of designations, as described in **Sections 3.4.2.4** and **6.4.3.1**. The proposed works in the vicinity of Bronte Creek Valley are generally confined to the north side of Dundas Street where the new bridge for the two additional lanes will be constructed across the valley. Some permanent vegetation removals will be required along edges of the existing communities, as well as some temporary disturbance to vegetation in order to accommodate access and staging requirements for construction of the new bridge and rehabilitation of the existing bridge. There is an existing access into the valley from the west, and it has been determined that a new access from the east down the steep valley slope will not be constructed, thereby reducing impacts to the slope forest community to the already disturbed vegetation

located directly under the new bridge. The direct impacts on vegetation will be clarified during detailed design. Generally, the edges of the communities present are already disturbed due to the existing Dundas Street corridor. None of the species recorded in these areas are rare or limiting. Thus, impacts to vegetation in the Bronte Creek Valley will be fairly minor and are addressed through the standard mitigation measures provided in **Section 6.4.3.7**.

Some localized minor temporary disturbance to vegetation on the south side of Dundas Street is expected during rehabilitation of the existing bridge, and possibly for temporary staging/storage areas. However, no intrusion beyond the right-of-way is expected to the south, limiting impacts to existing, disturbed, roadside vegetation present within the right-of-way.

A Constructability Workshop was held on September 23, 2014 to review the constructability of the Bronte Creek crossing, see **Section 5.2.4**.

6.4.3.4 Wildlife Resources – Impacts

Existing wildlife habitats within the Study Area, as described in **Section 3.4.2.5**, are comprised of a mosaic of agricultural, cultural, natural and semi-natural habitats along the existing roadway. The habitats present in the Study Area are generally already disturbed to some degree by the existing Dundas Street corridor and other anthropogenic land uses. These habitats are common throughout the broader landscape, and are tolerant of disturbance. As described in **Sections 6.4.3.1** and **6.4.3.2**, localized removal and temporary disturbance of the edges of some natural and semi-natural habitat areas extending slightly beyond the existing right-of-way will be required to accommodate the proposed road widening and associated works, as well as accommodating staging and access needs during construction. However, no specialized or sensitive habitat features are present in the study area, and no habitat features will be completely removed or impacted in such a way that their function is anticipated to be lost or significantly degraded.

It is expected that most wildlife using habitats in the vicinity of the roadway (e.g., snakes, small mammals, foraging birds, etc.) will generally avoid active construction zones (e.g., due to noise, dust, or other disturbances), and wildlife using habitat near the road are expected to be tolerant generally given the heavy usage of this road corridor and urbanization to the south. However, there is some potential that wildlife could be encountered incidentally during construction. These potential impacts can be addressed with implementation of standard mitigation measures to protect wildlife as recommended in **Section 6.4.3.7**.

No migratory birds were found nesting on Tansley Bridge or in any of the culverts, and no nests were found during the vegetation surveys throughout the Study Area; however, there is some potential for birds to nest on structures or in vegetation within the right-of-way or adjacent habitats during the year of construction. Therefore, it is possible that the proposed works could disrupt nesting activities, depending on timing.

Wildlife Linkages

The majority of the watercourses and their associated 'valley features'/floodplains crossed by Dundas Street along the Study Area, connect remnant scattered habitat features on either side of the road and provide local wildlife linkages for small mammals and herpetofauna. The existing Dundas Street corridor is expected to be an effective

barrier to movement of many species, with the exception of more tolerant animals that use the existing culverts or manage to cross the road surface successfully.

The proposed culvert replacements and/or extensions are not expected to change this pattern substantively. However, in some cases, and specifically at C22, the proposed replacement of the existing structures will improve conditions for wildlife movement. The construction of a new span structure at C22 will provide a significant benefit for movement of both small and large animals, including White-tailed Deer.

6.4.3.5 Species of Conservation Concern – Impacts

As described, the proposed widening will require some localized permanent and temporary disturbance to the vegetation present in the right-of-way and the edges of some natural and semi-natural vegetation communities adjacent to the existing right-of-way. The majority of the vegetation community types present, habitats they provide, and species they support, are common and widespread. The highest potential for presence of Species of Conservation Concern (SCC) is in the Bronte Creek Valley. However, in most cases, these species are expected to be using intact habitat areas located a distance from the existing Dundas Street corridor. Of the species identified as having some potential to occur in the general vicinity of the Study Area, only two fish (Silver Shiner and Redside Dace) and one bird (Bank Swallow) have been confirmed, and the latter was located well beyond the study area, approximately 100 m north of the right-of-way.

Plants

As presented in **Section 3.4.2.6**, none of the 17 plant SCC that were identified as having some potential to occur in the general vicinity of the study area were recorded within the study area during surveys in 2008, 2009 or 2014. Therefore, no impacts to plant SCC are anticipated.

Wildlife

The only wildlife SAR confirmed in the study area vicinity – Bank Swallow (Threatened) – was nesting in holes along the Bronte Creek Valley wall approximately 100 m north of Dundas Street. The proposed works will not impact this area.

Of the other species identified as potentially using habitat in the study area or vicinity, the more sensitive species are expected to move away from the construction disturbance and are generally not expected to be nesting or using habitat directly in the right-of-way (with the possible exception of Monarch and Barn Swallow, should they nest on the bridge in the year of construction).

Although cultural meadow communities also provide potential habitat for Bobolink (and Eastern Meadowlark), the communities along the Dundas Street right-of-way generally provide only marginal habitat conditions and it is very unlikely these birds would nest in the right-of-way.

However, some species, and specifically species such as Eastern Ribbonsnake, Milksnake, and Snapping Turtle could possibly be encountered incidentally during construction as they may move through the right-of-way along some of the watercourse corridors.

Fish

Two fish species, Silver Shiner and Redside Dace were confirmed within the right-of-way reaches of Bronte Creek, and in the Fourteen Mile Creek West and Tributary (Culverts C22 and C23), respectively.

Nominal permanent footprint impacts are anticipated in the bankfull channel of Bronte Creek, including nominal impacts if stabilization works are required along the east bank and cannot be designed to avoid modifying the channel cross section. However, temporary works in the bankfull channel are anticipated to be required during construction. The floodplain area is also defined as a part of the Silver Shiner habitat by MNRF. The new pier columns will occupy some area (to be determined at detailed design) of the floodplain, and additional areas will be disturbed temporarily for construction access, staging and storage. While the relatively small areas of affected vegetation on the banks may provide some terrestrial insects that Silver Shiner feeds on, it is not specialized habitat, and is not limited within the right-of-way reaches.

The replacement of the existing box culvert at Fourteen Mile Creek West (Culvert C22) with a larger 20 +/-m, open footed, clear span structure has only localized and nominal potential to adversely impact Redside Dace and its habitat since the existing channel section that will be enclosed upstream under the longer structure is lined with concrete, and therefore, not likely used by Redside Dace. Impacts include localized loss of solar and nutrient inputs and removal of scattered young hardwoods along the top of the concrete walls.

The new structure will involve removal or disturbance of some (~2670 m^2) 'Category 3 habitat'[8] , most of which is currently grassed road embankment. A small area (110 m^2) of Category 2/meander belt zone habitat will be altered, through shading under the edge of the bridge or conversion to Category 3 grassed embankment habitat. Although the new bridge could be built without directly affecting the bankfull channel ('Category 1 habitat'), the preferred alternative incorporates removal of the culvert and concrete section upstream, and associated realignment and naturalization of the upstream channel section, to maximize enhancement opportunities. This also allows a small area of Category 3 habitat to be opened up as new Category 2 habitat. Further detail is provided in evaluation table of the four alternatives in **Appendix E**. Neither the culvert nor the concreted channel section is anticipated to be used by Redside Dace.

As noted, the primary impetus for the preferred alternative is the opportunity to incorporate significant Redside Dace (and other fish) habitat and movement enhancements by replacing the existing culvert with a bridge; as outlined replacement is not required based on the culvert condition or hydraulics. The new clear span structure will enable placement of natural substrates and re-instatement of a bankfull channel section with a large enough floodplain to re-instate most fluvial geomorphic functions. In addition, the replacement works will remove the existing barrier to fish movement and re-connect up and downstream habitats.

[8] Category 1/Red zone, Category 2/Orange Zone and Category 3/Orange zone habitat per MNRF (2012) *Categorizing and Protecting Habitat under the Endangered Species Act.* Defined for Redside Dace as bankfull channel, meander belt, and 30m each side of meander belt, respectively.

Careful implementation of design and construction mitigation measures is required to avoid potential for transference of construction-related impacts downstream, or possibly upstream through improper design, to occupied reaches.

Works at the Fourteen Mile Creek West Tributary (Culvert C23) will be limited to localized re-grading of the existing grassed road embankments adjacent to the majority of the floodplain, minor re-grading of the valley slopes to extend the embankments slightly, and installation of a retaining wall (within the embankment/inside the existing toe of embankment slope) with 2:1 slopes above, all of which are within the existing road right-of way. No works are required in the bankfull channel/Category 1 habitat. A small portion (~80 m^2) of the outside edges of the Category 2 habitat will be converted to Category 3 habitat as part of the grassed embankment, however approximately 160 m^2 of Category 3 habitat will be re-instated as Category 2 habitat in new floodplain area adjacent to the retaining wall. Approximately 2685 m^2 of Category 3 habitat will be impacted, of which roughly half is removed for road and multi-use path works and the balance altered from valley slope to grassed embankment or temporarily disturbed for re-grading of the existing embankment slopes.

Although there are minimal opportunities to enhance the existing channel and associated habitat conditions through the culvert with this option beyond the small area of new floodplain against the retaining wall, the impacted habitat is already generally disturbed and limited to Category 3 habitat or very small areas of the edges of the Category 2 habitat zones. However, there are opportunities to enhance existing habitat features upstream of the road for Redside Dace through naturalized bank remediation and bank re-grading works to improve floodplain connectivity, in conjunction with appropriate vegetation planting to enhance terrestrial insect production and overhanging cover that can be considered and, as appropriate, integrated during detailed design.

6.4.3.6 Aquatic Resources and Fisheries – Mitigation Measures

The following standard and site specific mitigation measures will be implemented (where feasible) to protect fish and fish habitat at the watercourse crossings supporting fish habitat (directly or indirectly). These mitigation measures will be refined and augmented during detailed design once the details of the design and associated work requirements and potential impacts at each crossing are finalized. This process will continue to integrate review and input from CH and MNRF as appropriate, as well as measures to avoid serious harm to fish.

The final mitigation measures as well as the conditions of CH's Regulatory Permit and the anticipated Endangered Species Act Permit and relevant Exemption Regulation(s) and/or Letter of Advice will be integrated into the Contract documents.

Standard Construction–Related Mitigation Measures

All standard mitigation measures to protect fish and fish habitat will be implemented, including (but not limited to) the following general measures, which will be expanded in detail and incorporated in the Contract specifications during detailed design. Relevant components of these mitigation measures will be applied to indirect habitat as well as direct habitat to ensure potential impacts are not transferred to fish/direct habitat further downstream:

- develop comprehensive erosion and sediment control measures, including during phasing / staging of construction
- application of a warmwater instream construction timing window to protect resident downstream fish communities (no in-stream works between April 1 and June 30 of any given year) at culverts C9, C10, C11, C21, C13, C15, and C16. The timing windows will be verified and finalized during detailed design.
- application of a coldwater instream construction timing window to protect the coldwater migratory and SAR species (no in-water works between September 15th and June 30th of any given year) at culverts C22 and C23, as well as at Bronte Creek. The timing windows will be verified and finalized during detailed design
- review of mitigation measures for all crossings including 'indirect' fish habitat
- construction zone isolation and temporary flow passage around the isolated construction zones
- fish rescue at all fish bearing watercourses if flow is present, and screening of all intake hoses to prevent entrainment of fish, including C9, C10, C11, C12, C13, C15, C16, C22, C23 and Bronte Creek
- reference to "DRAFT Guidance for Development Activities in Redside Dace Protected Habitat" (OMNR, 2011)
- site management, containment and contingency measures (e.g., temporary stockpile siting and containment, debris management and disposal, equipment servicing and storage, Spills Prevention Plan, etc.)
- regular environmental inspection, daily at a minimum, during all in-water works
- re-stabilization of all disturbed areas draining to watercourses following construction, re-vegetation as appropriate with native species, and follow-up inspection.

Design and Site Specific Mitigation Measures

The culvert/structure replacements and extensions will be sized, designed and constructed with input from a fluvial geomorphologist and hydrologist, and to incorporate relevant design mitigation to avoid serious harm to fish. They will be designed and constructed to transition smoothly with the up and downstream channel sections.

Where closed bottom/box culverts are used, they will be appropriately embedded and sized to maintain stable substrates and low flow channels with specific attention to fish movement. Where open footing replacement structures are constructed, stable low/bankfull channel cross sections will be re-instated following the installation, again to ensure fish movement is provided and risk of barrier formation if addressed.

The design of the extensions at all watercourses supporting direct fish use (seasonal and permanent) will integrate measures to maintain and where feasible improve fish movement opportunities.

The design of the replacement structure and new open channel section at C22, the retaining walls at C23, and the design of the Bronte Creek bridge construction and rehabilitation works and associated temporary access requirements will involve specific input from MNRF as the design aspects are developed and to address ESA process

requirements (including overall benefit as may be required (at least at C22, and possibly C23 and Bronte Creek).

Related design elements at C22 include re-stabilization of the open channel section under the new structure and creation of smooth, naturalized transitions to the up and downstream channel sections that will also remove the existing barrier to movement posed by the culvert. Associated challenges include transitioning with the upstream channel section where the retaining wall forms the west channel edge. It is our understanding that there are refuge pools along the channel section flowing adjacent to the retaining wall that may be maintained by groundwater.

Redside Dace habitat elements (e.g., pools, riparian vegetation) will be incorporated to the extent feasible (recognizing shading limitations under the new bridge) in the re-instated open channel section, with input from MNRF. The proposed design also recommends realignment of the upstream concrete channel section that is sharply skewed to the road, to enhance fluvial processes. Naturalized channel design and riparian vegetation enhancements would be incorporated. These enhancements would be designed by appropriate specialists with input from MNRF during detailed design.

Similarly at C23, opportunities to enhance bank stability and cover, improve floodplain connectivity and enhance riparian vegetation upstream of the road will be developed and assessed by appropriate specialists, with input from MNRF, and incorporated during detailed design as appropriate.

All of these aspects require integration into the process of obtaining an Overall Benefit Permit under the ESA. It is anticipated that the re-design of the culvert extension to a 20 +/-m clear-span bridge design at C22, and the associated channel naturalization and enhancement works through and upstream of the structure, significantly improved fluvial functioning and culvert barrier removal, and the local habitat enhancement opportunities at C23 upstream of the existing culvert and re-instatement of the small floodplain area can be integrated into the overall benefit requirements of the Permit. However, this requires confirmation with MNRF.

Stormwater management and opportunities to improve water quality will be key elements of the road design. Erosion and sediment control measures will also be stringently designed and implemented for the works at C22 and C23, in the Bronte Valley, and at all crossing locations.

The design details for the Bronte Creek crossing are still on-going and will not be completed until detailed design is finalized. However, a number of design elements have already been incorporated into the design to address potential impacts to fish and fish habitat, and specifically Silver Shiner present within Bronte Creek. Specifically, the preferred option for the crossing of only two additional lanes to the north limited the amount of additional pier footprint impact into the Bronte Creek Valley, and specifically the bankfull channel of Bronte Creek; some of the other alternatives required larger overall footprint impacts. In addition, the pier designs incorporate the footing of the piers below the existing ground surface, thereby further limiting the permanent footprint impacts within the valley.

The design and installation of the temporary crossing/platform(s) will incorporate all best management practices and fish and fish habitat requirements to minimize the temporary

footprint impacts on the banks and within the channel to maintain fish passage downstream.

If it is determined during detailed design that bank stabilization works are required along the east bank either for the construction of the temporary crossings/platform(s) or to stabilize the banks around the new westbound pier footing, the works will be designed in conjunction with a fluvial geomorphologist, and will minimize the overall impact on the bank and bed of the channel to that required to achieve a stable slope.

Enhancement Opportunities

As outlined in the design-related mitigation measures above, there are numerous opportunities to design the replacement watercourse crossings to enhance fish movement, habitat connectivity and local habitat opportunities.

The construction of low flow/bankfull channel sections with stable substrates through the open footing and embedded box culverts will improve fish passage in several of the smaller watercourses. The embedment of the new culverts will replace the perched outfalls at some locations (i.e. C22).

The realignment at C11 will provide an opportunity to create enhanced habitat elements within the reconstructed portion and ultimately improve fish habitat within the right-of-way reaches of Dundas Street.

As described previously regarding mitigation, there are significant opportunities to enhance fish habitat within Fourteen Mile Creek West through the design process. The removal of the existing culvert, which poses a barrier to fish movement, and the upstream concrete channel section and associated naturalized realignment offers significant habitat enhancement opportunities relative to what is there currently (concrete walls and bed). The upstream and downstream reaches can be reconnected (through elimination of the currently perched culvert). Fluvial processes will improve in turn improving habitat function, and specific Redside Dace habitat elements (pools, riparian vegetation) can be integrated in the design.

As also outlined above, it is recommended that local habitat opportunities be explored and integrated at Fourteen Mile Creek (C23), in the form of naturalized bank remediation and bank re-grading works to improve floodplain connectivity, in conjunction with appropriate vegetation planting to enhance terrestrial insect production and overhanging cover.

Opportunities to enhance riparian vegetation locally are also present at most crossings.

6.4.3.7 Terrestrial Ecosystem – Mitigation Measures

Standard Mitigation Measures

The following mitigation measures are recommended to avoid or minimize effects to the local vegetation communities and their associated habitat functions:

- Ensure a clear delineation of vegetation clearing zones and vegetation retention zones in both the Contract documents and in the field (protective fencing) to minimize the risk of unnecessary vegetation impacts and to avoid incidental impacts during construction (such as temporary stockpiling, debris disposal and access).

- Ensure the use of appropriate vegetation clearing techniques (i.e. felling trees away from retained vegetation communities). Minimize clearing and grubbing to only that necessary to complete the works.
- Design and install stringent erosion and sediment control measures and inspect and maintain them throughout construction.
- Re-stabilize and re-vegetate all exposed surfaces following construction with an appropriate native seed mix.
- Ensure appropriate clearing and disposal of all construction-related debris following construction.
- Avoid all unnecessary traffic, dumping and storage of materials over tree root zones adjacent to the right-of-way.
- In dust-sensitive areas (e.g., near the Bronte Creek Valley, wetlands etc.), control dust using water and not chemical suppressants.
- Employ proper handling of potentially toxic construction materials and ensure proper spills management.

Halton Region Council approved Policy LPS31-08 Tree-Canopy Replacement Policy on Regionally Owned Lands in 2008. A Tree Preservation Plan will be developed as part of the mitigation measures to determine compensation required based on the Regional Policy.

In addition to protecting vegetation, which in turn protects the associated wildlife habitat functions, migratory breeding birds are provided specific legislative protection as outlined below. Any wildlife that may be encountered during construction will also be protected.

Nesting migratory birds[9] are protected under the Migratory Birds Convention Act (MBCA 1994). No work is permitted to proceed that would result in the destruction of active nests (nests with eggs or young birds), or the wounding or killing of birds, of species protected under the Migratory Birds Convention Act, 1994 and/or Regulations under that Act .

In order to protect nesting migratory birds, in accordance with the MBCA:

- The Contractor will implement timing constraints on clearing activities to avoid vegetation clearing (including grubbing) during the breeding bird season (approximately end of March to end of August).
- Assuming the structure works cannot be completed during the migratory bird nesting window, appropriate exclusionary measures (e.g., netting, tarping) should be erected to prevent nesting prior to the end of March at those structures where there is a history or nesting or a risk of nesting some years (e.g., Tansley Bridge, and Fourteen Mile Creek West and Tributary).
- The Contractor shall not destroy active nests (nests with eggs or young birds) of protected migratory birds, including SAR protected under the Provincial Endangered

[9] Species *not* regulated under the act include: Rock Dove, American Crow, Brown-headed Cowbird, Common Grackle, House Sparrow, Red-winged Blackbird, and European Starling. In addition, Raptors are not regulated under the MBCA. However, they are protected under provincial legislation which restricts and regulates the taking or possession of eggs and nests. Furthermore, if the species identified is protected under the Endangered Species Act or the Species at Risk Act, additional restrictions may apply.

Species Act (ESA 2007). If a nesting migratory bird is identified within or adjacent to the construction site and the construction activities are such that continuing construction in that area would result in a contravention of the Migratory Birds Convention Act, all activities will stop and the Contract Administrator will be notified immediately. The Contract Administrator will then contact Environment Canada or MNRF, respectively for direction.

- Regular environmental monitoring/inspection will be implemented throughout construction to ensure that protection measures are implemented, maintained and repaired and remedial measures are initiated where warranted.

Wildlife Encounters and Rescue During Construction

Under no circumstances will any animal (e.g., bird, turtle, snake, and mammal) be knowingly harmed, harassed or otherwise disturbed. If an animal is encountered in a construction area, it will be allowed to move away on its own. If the animal remains and is not injured, it will be persuaded gently to move away on its own if possible.

Small wildlife (e.g. turtles, amphibians) stranded within a contained construction zone will be captured and released by an appropriately qualified individual (e.g. Environmental Inspector, ecologist).

If the animal is a SAR or there is a possibility that the animal is a SAR:

- All construction activities that might harm the animal will cease and it will be allowed to move away on its own accord.
- If it is injured, or does not move away, the Contractor will notify the Contract Administrator immediately and the Contract Administrator will contact MNRF for direction.

Site Specific Mitigation Measures

The standard mitigation measures outlined above will address the majority of the minor effects to the existing edges of the predominantly culturally derived and/or influenced vegetation features along the limits of construction. However, some site-specific mitigation measures, which address impacts to designated and sensitive features, are provided below.

Edge Management

Opportunities to implement edge management measures to mitigate effects of increased sun and wind, changes in humidity and shade, and to reduce invasive species growth in disturbed soils at new vegetation edges in Units N3 (FOD7-4, Tuck Creek Tributary #8), N14 (FOM4 – Bronte Creek Valley northwest slope), N16 (FOD3 – Bronte Creek Valley northeast slope), S22a (FOD2 – C22, Fourteen Mile Creek West Tributary) and S22b (FOD7-4 – C22, Fourteen Mile Creek West Tributary), will be explored during detailed design, based on finalized impacts and review with appropriate agency staff (e.g., MNRF). Measures may include:

- Review of grading requirements to facilitate vegetation retention where possible.
- Incorporation of pit and mound topography (to hold water) in areas where grading will be undertaken and planted.

- Pre-stressing of forest edges (advanced thinning of any future edges), as soon as possible (e.g., during advance clearing), to promote dense young shrub and tree growth in the understory. This dense growth will help buffer the retained vegetation from the effects of the adjacent transportation corridor.
- Pre-stressing roots of retained trees (cut roots prior to grading / filling) to encourage new root growth.
- Flush cut (rather than grubbing) of trees along any newly created edges to facilitate groundcover regeneration from the undisturbed seedbank (where feasible, e.g., in edge of right-of-way areas that are not directly within the road footprint and in areas temporarily disturbed during construction) and stimulate suckering regeneration.
- Maintenance of drainage patterns adjacent to any new edges to avoid changes in soil moisture that may cause vegetation decline.
- Removal of hazard trees / trees with high potential for windthrow to encourage understory regeneration along new edge and promote canopy stabilization.
- Plantings to infill and improve edge continuity.
- Application of wood chip material in the edge plantings to help retain soil moisture and help prevent spread of weeds / invasive species.

Niagara Escarpment Plan Area

Specific mitigation measures (in addition to the standard measures outlined above), for the lands designated under the Niagara Escarpment Plan, developed from **Section 2.15** – Transportation and Utilities – of the plan, are:

- Grading and tree removal should be minimized where possible, through realignment and utilization of devices such as curbs and gutters, retaining walls and tree wells.
- Finished slopes should be graded to a 2 to 1 slope minimum and planted; large cuts should be terraced to minimize surface erosion and slope failure.
- Site rehabilitation should use native species of vegetation and blend into the surrounding landscape.
- Vegetation screens should be used where feasible.
- Transportation structures should be sited and designed to minimize visual impact and impact on the Escarpment environment.

If there are any significant changes during detailed design that would entail more substantial vegetation removal or associated impacts at more sensitive features that are not presently expected, additional appropriate site-specific mitigation measures will be developed at that time.

Enhancement Opportunities

Vegetation Community Improvements

There are opportunities to enhance the existing vegetation communities in Bronte Creek Valley and at the C22 crossing (in conjunction with removal and naturalized realignment of the culvert and concrete channel section upstream) and locally at C23 crossing (local floodplain re-instatement and proposed riparian enhancements upstream), with the

implementation of a new span structure. Details of these recommendations will be further developed during detailed design, following selection and refinement of the preferred design alternative and assessment of its impacts.

The Bronte Creek Valley, which includes several provincial and regional designations, and is part of the Greenbelt Plan Area, is the most sensitive natural feature present in the study area. In addition to the standard mitigation measures and integrated with some of the site-specific edge management opportunities outlined above, the proposed works present an opportunity for enhancing the vegetation currently present in the vicinity of the bridge crossings. Native tree and shrub plantings would be particularly beneficial in on the northwest slope, in the cultural woodland and cultural meadow communities, which are already disturbed by the existing access route, which is proposed to be used during construction. In addition, plantings in the cultural meadow community at the top of the northeast slope would be beneficial in the way of reducing edge impacts to adjacent, natural forested areas.

South of C22, there is currently a small lowland Black Walnut community present, which is provincially ranked S2S3. However, to the north of C22 is a fairly disturbed community, with a strong presence of the non-native, invasive Buckthorn (*Rhamnus cathartica*). In order to improve the quality of the vegetation community at C22, Buckthorn removal and / or native tree and shrub plantings are recommended.

Similarly, the vegetation communities around C23 could be improved during and after construction in association with riparian enhancement works for Redside Dace, through the removal of invasive species (present throughout) such as Black Locust (*Robinia pseudo-acacia*), Buckthorn, Common Lilac (*Syringia vulgaris*), European Privet (*Ligustrum vulgare*) and Tartarian Honeysuckle (*Lonicera tatarica*) and associated native tree and shrub plantings.

Wildlife Linkage

The science of road ecology has been advancing steadily over the past several years. Road ecology is defined as the interactions of organisms and the environment with road systems in the landscape and vehicles (Forman et al. 2003). Dundas Street is a busy existing roadway, and as such has contributed in conjunction with the development of adjacent lands to fragmentation of the landscape and interference with animal movement.

Conversely, however, the ongoing urbanization of the landscape will focus residual animal habitation and movement on the remaining local north-south linkages along the floodplain areas of the watercourses whose corridors extend both north and south of the road. Therefore, it is important to consider opportunities for movement, where feasible.

The existing and proposed structures at Bronte Creek both provide excellent wildlife movement opportunities. The existing culverts at C2, C7, C8, C10, C11, C12, C22 and C23 already provide wildlife passage opportunities for small mammals to some degree, (e.g., based on openness ratio calculations and habitat presence); however, there are usually limitations based on flow conditions (e.g., spreading across full width of culvert). Several other culverts within the Study Area have openness ratios that meet the qualifications for small mammal passage, but are connected to SWM ponds or other man-made features and therefore do not constitute good opportunities for most wildlife movement.

Opportunities to improve wildlife movement will be explored further during Detailed Design, and where feasible, integrated into the design of the naturalized channel sections through the various culvert replacements, in accordance with the general guidance provided in the Halton Region Sustainable Natural Heritage System Area Plan. Specifically: "*Every effort should be made to direct new or upgraded transportation and utility infrastructure away from the Sustainable Halton NHS. However, where such infrastructure is proposed within the SHNHS mitigation measures should be proposed to maintain or where possible enhance existing wildlife linkage functions as part of the infrastructure development."*

Opportunities will be integrated into the design of the open channel section and transitions for the C22 culvert replacement. The proposed C22 bridge span was specifically sized to accommodate movement of White-tailed Deer. Opportunities will also be integrated, where appropriate and feasible, at other culvert replacements to incorporate overbank areas through the culvert with appropriate substrates to encourage wildlife movement, and provide or enhance cover in the upstream and downstream transition zones into the culverts.

Opportunities to enhance vegetation and cover elements, and possibly substrate enhancement, through the Tansley bridges along the Bronte Creek Valley will also be explored, and integrated, if feasible. Details will be developed during detailed design.

6.4.3.8 Commitments to Future Work

Following the review and approval of the EA Study, the proposed undertaking will proceed to detailed design based on recommendations outlined in this ESR. The following works and associated commitments will be undertaken during detailed design:

- Once the grading, culvert and related work requirements are refined and further specified, the assessment of impacts on fish, fish habitat, vegetation and wildlife habitat will be also be refined and detailed further.
- There will be ongoing consultation with the City of Burlington and Conservation Halton regarding stormwater management strategy and also regarding the ongoing Stormwater Management Master Plan Study being carried out by the City of Burlington
- The process of developing the design and mitigation details will continue to integrate agency input.
- Key aspects of the watercourse crossing design process that will continue to integrate specific ecological input, will include the following:
    - design of the culvert extensions and replacements and associated transitions
    - design of the C22 bridge and associated reinstatement/naturalized realignment of an open channel section through the crossing and its up and downstream transitions, incorporating fish habitat (specifically Redside Dace, e.g., naturally functioning bankfull channel section with natural substrates and morphology, appropriate riparian plantings) and movement (e.g., removal of existing perched culvert barrier) enhancements
    - design of fish habitat (specifically for Redside Dace) enhancements in the upstream channel section (e.g., bank remediation and bank re-grading works, vegetation plantings)

  - design of the Bronte Creek bridge works, including any associated bank stabilization works, and the temporary construction access/staging requirements
  - integration of the stormwater management design to ensure fish habitat, and specifically Redside Dace and Silver Shiner sensitivities are considered
  - multidisciplinary design of the culverts, channel/culvert transitions, open channel sections and restoration of disturbed areas (e.g., fluvial geomorphologists, hydrologists, fish biologists, wildlife ecologists, landscape architects), with input from agencies and specifically MNRF where SAR are present
  - Planted vegetation at the crossings and adjacent to existing vegetation units will be comprised of native species compatible with the site conditions, incorporating relevant functions such as cover for wildlife, riparian enhancements, edge treatments, diversification, and bank stabilization, as appropriate

- The appropriate information forms and applications / registrations (if required) will be prepared and submitted to MNRF in support of the anticipated permitting process under the ESA. Following review, MNRF may request field surveys for certain SAR (e.g., Eastern Meadowlark, Bobolink and Barn Swallow) and/or more detailed review of site-specific habitat conditions for Redside Dace or Silver Shiner. It is expected that MNRF will determine that a Permit under 17)2)c) of the ESA will be required for Redside Dace and possibly Silver Shiner. A supporting Avoidance Alternatives Form and Overall Benefit Application will be prepared and submitted.
- Components of the ESA Exemption Regulation will be explored for the other species as the work requirements are finalized and any new SAR information incorporated.
- A Request for Review Form will be prepared and submitted to DFO to address relevant culvert and structure works on fish-bearing streams. It may be possible to address some of the crossings by implementing standard measures to avoid serious harm such that they do not require submission to DFO, however it is anticipated that at a minimum the Bronte Creek bridge works and C22 culvert replacement works will require submission.
- It should also be noted that both Redside Dace and Silver Shiner are pending listing on Schedule 1 of the SARA (although they have been pending listing for some time). If they are listed by the time Detail Design commences, DFO will be integrated into the design process and an Application under the SARA and relevant supporting information submitted to them.
- All of the mitigation measures as well as any relative conditions outlined in agency Permits or Letters of Advice will be incorporated into the Contract documents.
- Edge management opportunities for the protection of natural vegetation communities, especially N3, N14, N16, S22a and S22b, will be refined during Detail Design.
- Vegetation community enhancement and wildlife linkage enhancement opportunities will be further explored and refined during detailed design.

6.4.4 Transportation

The proposed improvements on Dundas Street as described in **Chapter 6** support the transportation goals and objectives of Halton Region, City of Burlington and Town of Oakville. All modes of transportation (transit, auto, walking and cycling) would be accommodated on Dundas Street as the roadway transforms from a rural corridor to a

pedestrian and cyclist friendly Regional arterial road. The proposed undertaking supports Halton Region, City of Burlington and Town of Oakville Transportation Master Plans and Active Transportation Plans.

6.5 Design and Construction Consideration

The mitigation of construction impacts will follow the *Environmental Construction Guidelines for Municipal Road, Sewage and Water Projects*, issued by the Municipal Engineers Association.

6.5.1 Potential Impacts during Construction

The following sections describe the potential environmental impacts during construction and proposed mitigating measures. The following potential adverse effects are identified:

- disruption/removal of existing vegetation
- construction noise and air quality
- disruption to vehicle traffic
- mud and dust during construction
- vibration

The mitigation and monitoring conditions included in the following sections indicate a commitment on the part of the Region to mitigate potential environmental impacts and undertake a monitoring program during and after construction.

During the detailed design stage and prior to construction, Halton Region will be responsible for obtaining approval from the Ministry of the Environment and Climate Change for stormwater management and sewage works. Permit approval will be required from Conservation Halton for all culvert installations, watercourse realignments, structures, site alteration, etc. within areas regulated pursuant to Ontario Regulation 162/06.

A permit will likely be required from MNR under the Endangered Species Act and will be confirmed subject to MNR input to the Information Gathering Form.

It is intended that the works proposed are executed in such a manner, which to the fullest possible extent, minimizes any adverse effects on the natural environment of the project area. The Contractor will be responsible to ensure all his personnel are sufficiently instructed so that the work is carried out in a manner consistent with minimizing environmental impact. The Region will assign a qualified environmental inspector whose responsibility will be to ensure compliance with the environmental objectives.

6.5.2 Disposal of Excess Material

Surplus excavated material shall be removed to locations arranged by the Contractor. Prior to the disposal of any surplus excavated material, the Contractor will provide the Engineer with a sketch of the dumping site(s) showing access thereto. A written statement from the property owner(s) agreeing to allow the disposal of fill on the property must be approved by the Engineer. Furthermore, the placement of fill within any area associated with valleys, wetlands, shorelines and other hazardous lands that are regulated pursuant to Ontario Regulation 162/06 requires the written permission of Conservation Halton.

The Contractor is responsible for obtaining all approvals.

Upon completion of the disposing, levelling and grading of surplus excavated material on any property, the Contractor shall obtain a written statement from the property owner(s) releasing the Contractor and Region from any claims and accepting the condition of the property as satisfactory.

6.5.3 Measures for Proper Tree Removal and Preservation of Residual Plant Communities

A Tree Protection Plan will be developed during detailed design. This plan will provide guidelines for protecting trees during construction, as well as minimizing soil compaction and making wise use of the removed timber resource. The plan should also include recommendations for during and post-construction maintenance including hazard tree monitoring, pruning, insect and disease control, aerating, watering and mulching.

6.5.4 Mud and Dust Control

The Contractor shall take such steps as may be required to prevent dust nuisance resulting from his operations. The Contractor shall be responsible for all dirt and mud that is tracked onto the roadways from vehicles entering or leaving the job site. The Contractor shall, upon request from the Engineer, immediately proceed with cleanup operations, or in the opinion of the Engineer, the Contractor has not or cannot sufficiently remove the mud from the road, the Engineer will proceed with the necessary clean up.

6.6 Monitoring and Maintenance

6.6.1 Monitoring During Construction

During construction, the Region will ensure that the environmental protection recommendations in the ESR and other subsequent agency approval conditions are complied with.

6.7 Detailed Design Commitments

Environmental concerns, anticipated impacts, and proposed mitigation measures as they relate to the project, have been described in **Chapter 6**. Many of the environmental concerns have been mitigated through the process by which the recommended design was selected, as described in the ESR. This section provides an additional list of standard commitments to be carried forward into Phase 5 of the Municipal Class EA process—Implementation Phase. These commitments have been developed through consultation with various agencies throughout the study process. It is recognized that certain decisions require specific agency input (e.g., Fourteen Mile Creek West and Tributary, Bronte Creek, etc.). Therefore, a key component of detailed design is refining and detailing the impact assessment and mitigation measures as the design is developed and refined, in consultation with the agency staff.

Conservation Halton, as well as the Ministry of Natural Resources and Forestry have been consulted throughout the Class EA process, and their comments and preliminary concerns have been integrated. MNRF has been consulted and information provided, including an Information Gathering Form (IGF) as a first step in the ESA (2007) process, but they have not provided any specific input to date other than to indicate that more detailed design information is required before the IGF can be reviewed. The IGF will be re-submitted with the additional design information at the outset of the detailed design

process and further input from MNRF sought to clarify SAR habitat status and any related permitting requirements.

Specific mitigation measures have been selected and committed to by Halton Region to address potential impacts as discussed throughout **Chapter 6**. It is recommended that these commitments, as presented in the ESR, become part of the contract package so that Contractors are aware of the requirements prior to tendering. Monitoring of construction activities must ensure that all environmental standards and commitments for construction are met. Halton Region will work with Conservation Halton and other authorities, during detailed design and prior to the start of construction to ensure that the proposed works are acceptable and to obtain required permits.

Environmental monitoring will be combined with construction supervision to include periodic site visits and inspections throughout the course of the work. Detailed Design and Construction Commitments are discussed in **Sections 6.4.3.6** to **6.4.3.8**.

6.8 Permit Requirements

Permits and approvals that may be required for this project are identified in **Table 6-9**:

Table 6-9: Permit Requirements

Regulatory Agency	Legislation	Permit/Approval	Comments
Federal Government			
Canadian Environmental Assessment Agency (CEAA)	Canadian Environmental Assessment act	Federal Environmental Screening	Screening report not required based on recent change in CEAA
Provincial Government			
Niagara Escarpment Commission	Niagara Escarpment Planning and Development Act	Niagara Escarpment Development Permits	Any works with the Niagara Escarpment Plan area and under Development Control would require approvals from NEC
Ministry of the Environment and Climate Change	Ontario Environmental Assessment Act	Schedule 'C' Class EA (Municipal Engineer's Association Class EA)	Satisfactory completion of EA requirements is a prerequisite for obtaining most other approvals
	Ontario Water Resources Act	Permit to Take Water	Required if >50,000 L/d of surface or groundwater taken, includes temporary dewatering during construction
		Certificate of Approval (CofA) for Industrial Sewage Works	Required if settling pond or other water treatment used during construction
	Environmental Protection Act	Environmental Compliance Approval	Storm water quality controls, including temporary facilities utilized during the project construction phase
		Environmental Compliance Approval	Construction and operation of water quality treatment facilities, including the proposed OGS And advanced filtration systems
Ministry of Natural Resources and Forestry	Endangered Species Act	Permit to Authorize works with potential to affected listed species or Letter of Advice	Decision on requirement of a permit will not be assessed until detailed design.
Ministry of Natural Resources and		A License to Collect Fish for Scientific Purposes	Removal of fish during installation of cofferdams for culvert extensions

Regulatory Agency	Legislation	Permit/Approval	Comments
Forestry			will also be determined at detailed design.
Ministry of Labour	Construction Projects Regulation (O.Reg. 213/91)	Notice of Project	Required before construction commences
Conservation Halton	Development, Interference with Wetlands & Alterations to Shorelines & Watercourses (O.Reg. 162/06)	Permit	Will be required for culvert extensions / replacements and widening of road.
Halton Region/City of Burlington/Town of Oakville			
Halton Region	Tree Bylaw	Permit	Required to remove trees on region-owned property(i.e., within road right-of- way)
City of Burlington	Noise Control By- law (19-2003)	Exemption	Required to allow construction works outside of normal hours (7 pm to 7 am) and on weekends
City of Burlington	Ontario Building Code	Building Permit	Required if temporary site trailers or other facilities are erected on-site
Town of Oakville	Noise Control By- law (2008-098)	Exemption	Required to allow construction works outside of normal hours (7 pm to 7 am) and on weekends
Town of Oakville	Ontario Building Code	Building Permit	Required if temporary site trailers or other facilities are erected on-site

APPENDICES