6 DESCRIPTION OF THE RECOMMENDED PLAN

The major features for the Mavis Road Recommended Plan including the road widening, active transportation facilities, and intersection and streetscaping improvements are described in **Sections 6.1 to 6.10**. The Recommended Plan plates are provided in **Section 6.11**.

This information should be reviewed in conjunction with **Chapter 5** of the ESR, which describes the design alternatives considered and how the overall plan was developed. While refinements may occur during the future detailed design phase, any changes should not alter the intent of the recommended undertaking or its components. During the future detailed design phase, there will be further consultation with technical agencies, including, but not limited to, the Ministry of Transportation, the Ministry of the Environment and Climate Change, City of Brampton, Region of Peel, 407ETR, Credit Valley Conservation, utilities, and affected property owners.

The recommended undertaking for Mavis Road from Courtneypark Drive West to Ray Lawson Boulevard includes the following:

- Widening to 6 through-lanes;
- Reducing the posted speed from 70 km/hr to 60 km/hr within the City of Mississauga section of Mavis Road;
- A sidewalk on the east side and multi-use trail on the west side;
- Widening the Highway 407 Bridge to accommodate the proposed additional lanes, sidewalk and multi-use trail;
- Modifications to existing 407 ramps to accommodate widened road and bridge;
- No impacts to natural features within the Fletcher's Creek valley;
- Intersection design compliant with Accessibility for Ontarians with Disabilities Act (AODA);
- Improvements at local road intersections without impacting property;
- Intersection improvements at Derry Road and Sombrero Way / Courtneypark West Drive;
- A southbound transit queue jump lane at Derry Road West;
- Streetscape / landscape enhancements that identify opportunities for landscaping, mitigation / replacement for street tree removals and other benefits amenities; and

- Minimized property impacts by design refinements including the use of retaining walls.

6.1 Roadway Geometry

6.1.1 Design Criteria

Currently, Mavis Road is posted at 70 km/hr through the Study Area. Once the Recommended Plan has been implemented, the posted speed limit on Mavis Road will be reduced to 60 km/hr within the City of Mississauga. The posted speed will remain 70 km/hr between the North City Limits and Ray Lawson Boulevard. The reduced posted speed limit within the City of Mississauga allows for greater flexibility with respect to geometric design in that it allows for reduced lane widths, thereby minimizing property impacts to the extent possible. This change also is also consistent with the goal of transforming Mavis Road into a pedestrian and cyclist friendly corridor.

The geometric details for a typical section of Mavis Road between Courtneypark Drive West and the North City Limits, and between the North City Limits and Ray Lawson Boulevard are listed in **Table 6-1** and **Table 6-2**, respectively. Geometric details for the Mavis Road / Highway 407 Interchange are provided in **Section 6.2.1**.

MTO review of the Recommended Plan with respect to design between Courtneypark Drive West and Highway 401 is documented in **Appendix I**. The Recommended Plan reflects a design that is agreeable to MTO.

6.1.2 Horizontal Alignment

In order to minimize the extent of property impacts, the widening of Mavis Road from four to six lanes will be accommodated primarily within the existing road right-of-way through a “best fit” approach between Courtneypark Drive West and the North City Limit, as described in **Chapter 5**. This will be achieved by:

- Reducing the posted speed to 60 km/hr, thereby allowing a reduction in travel lane widths to 3.35 m for the inner lanes and 3.5 m for the curb lanes;
- Widening into the existing median between Courtneypark Drive and Twain Avenue (with the exception of constrained areas such as intersections), and widening into the existing boulevard north of Twain Avenue; and
- Employing mitigation measures (e.g. retaining walls) to minimize / avoid property impacts due to grading.

Table 6-1: Mavis Road Design Criteria – Courtneypark Drive West to North City Limits

Criteria	Existing Conditions	City of Mississauga Design Standard	Proposed Standard
Design Speed	80 km/hr	70 km/hr	70 km/hr
Posted Speed	70 km/hr	60 km/hr	60 km/hr
No. of Lanes and Width	4 lanes @ 3.75 m	4 lanes @ 3.35 m 2 lanes @ 3.50 m	4 lanes @ 3.35 m 2 lanes @ 3.50 m
Provision for Pedestrians and Cyclists (from Courtneypark Drive to Derry Road)	1.5 m sidewalk on both sides of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road
Provision for Pedestrians and Cyclists (from Derry Road to 200 m north of Twain Avenue)	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road
Provision for Pedestrians and Cyclists (from 200 m north of Twain Avenue to North City Limit)	No sidewalks / multi-use trail	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road
Minimum Grade (%)	0.25	0.5	0.25
Maximum Grade (%)	3.38	6.0	3.38
Minimum Curve Radius (m)	500	325	500
Minimum Crest Curve Kmin	25	16-23	25
Minimum Sag Curve Kmin	20	10-12	20
Minimum Stopping Sight Distance (m)	95	120	95
Raised Median (m)	2.0 – 12.0 (Varies)	2.0	2.0
Basic Right-of-Way (m)	35.0	35.0	35.0

Table 6-2: Mavis Road Design Criteria – North City Limits to Ray Lawson Boulevard

Criteria	Existing Conditions	TACC Design Standard	Proposed Standard
Design Speed	80 km/hr	80 km/hr	80 km/hr
Posted Speed	70 km/hr	70 km/hr	70 km/hr
No. of Lanes and Width (from North City Limits to 600 m south of Ray Lawson Blvd	2 lanes @ 3.50 m 2 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m
No. of Lanes and Width (from 600 m to 300 m south of Ray Lawson Boulevard)	4 lanes @ 3.50 m 1 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m
No. of Lanes and Width (from 300 m south of Ray Lawson Boulevard to Ray Lawson Boulevard)	4 lanes @ 3.50 m 2 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m	4 lanes @ 3.50 m 2 lanes @ 3.75 m
Provision for Pedestrians and Cyclists (from North City Limits to 450 m south of Ray Lawson Blvd	No sidewalks / multi-use trail	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road
Provision for Pedestrians and Cyclists (from 450 m south of Ray Lawson Boulevard to Ray Lawson Boulevard)	1.5 m sidewalk on the east side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road	1.5 m sidewalk on east side of road 3.5 m multi-use trail on west side of road
Minimum Grade (%)	0.84	0.50	0.84
Maximum Grade (%)	3.21	3.00	3.21
Minimum Curve Radius (m)	700	400	700
Minimum Crest Curve Kmin	35	24	35
Minimum Sag Curve Kmin	40	16	40
Minimum Stopping Sight Distance (m)	93	112.8 – 139.4	93
Raised Median (m)	0 – 4.0	2.0	2.0
Basic Right-of-Way (m)	35.0	35.0	35.0

6.1.3 Profile

The proposed vertical profile is generally consistent with that of the existing Mavis Road profile. The profile is provided on the Recommended Plan plates at the end of this chapter.

A preliminary geotechnical investigation was carried out by Thurber Engineering regarding pavement design and recommendations. The report is provided in **Appendix J** and is summarized in **Section 6.3**.

6.1.4 Typical Cross Sections

Exhibits 6-1a to 6-1g illustrate the proposed cross-sections for the Recommended Plan. The station numbers that appear on the cross-section illustrations relate to the Recommended Plan plates found at the end of **Chapter 6**. The following summarizes the basic features of the cross-sections within the study area:

- Nominal 35 m right-of-way urban road cross-section (varies locally near intersections);
- 6 lanes (3 lanes in each direction);
- 2.0 m raised median (median would narrow near some intersections to accommodate left-turn lanes);
- 1.0 m to 2.0 m splash strip, or a 1.0 m splash strip plus 1.0 m or greater grass boulevard where space permits;
- Active transportation facilities are provided as follows from Courtneypark Drive West to Ray Lawson Boulevard:
    - 3.50 m multi-use trail on the west side; and
    - 1.50 m sidewalk on the east side.

In areas where there are constraints (e.g. intersections), the cross-section has been modified to minimize or avoid impacts to private property and retaining walls are provided where required. This will be subject to further review during detailed design.

The cross-section at the Highway 407 Bridge can be found in **Section 6.2.1**.

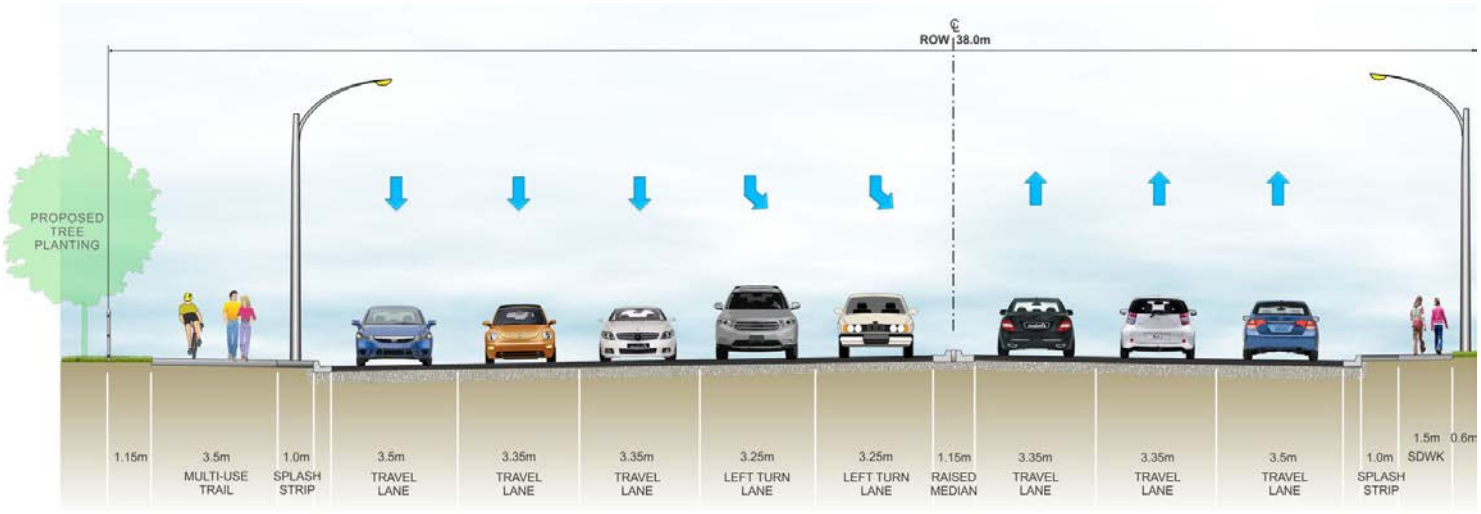

Exhibit 6-1a: Proposed Cross-Section for Mavis Road - Station 10+570 North of Courtneypark Drive

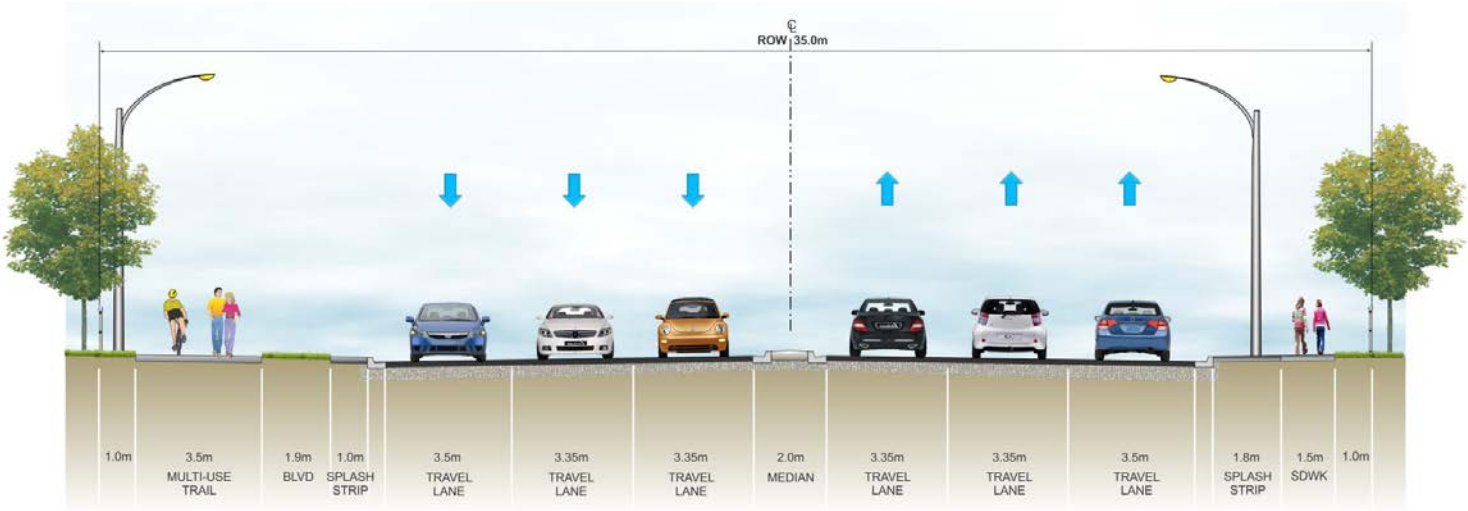

Exhibit 6-1b: Proposed Cross-Section for Mavis Road - Station 11+279 Mid-Block between Craig Carrier Ct. and Crawford Mill Ave.

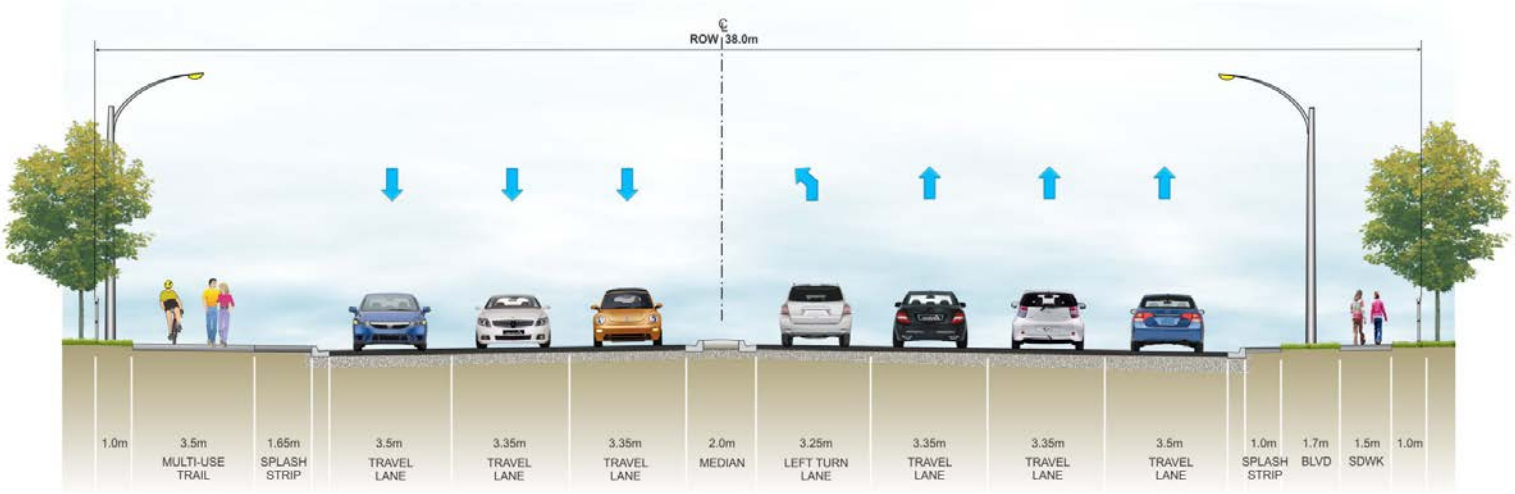

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Exhibit 6-1c: Proposed Cross-Section for Mavis Road - Station 11+620 Mid-Block between Crawford Mill Ave. and Derry Road

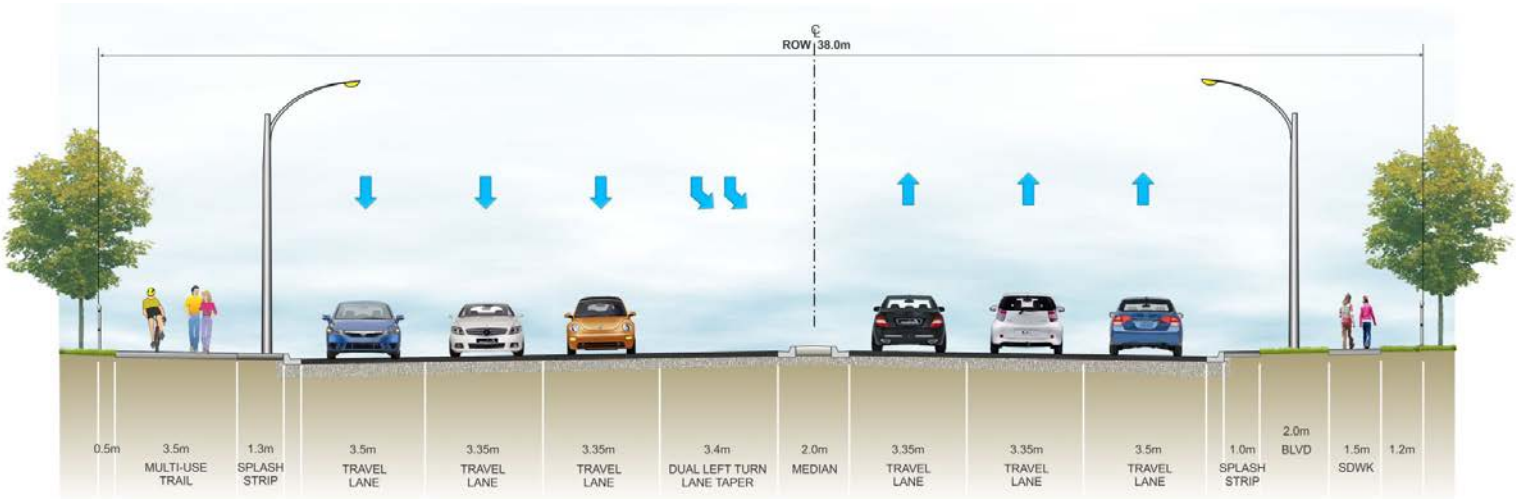

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Exhibit 6-1d: Proposed Cross-Section for Mavis Road - Station 12+000 Mid-Block between Derry Road and Envoy Drive

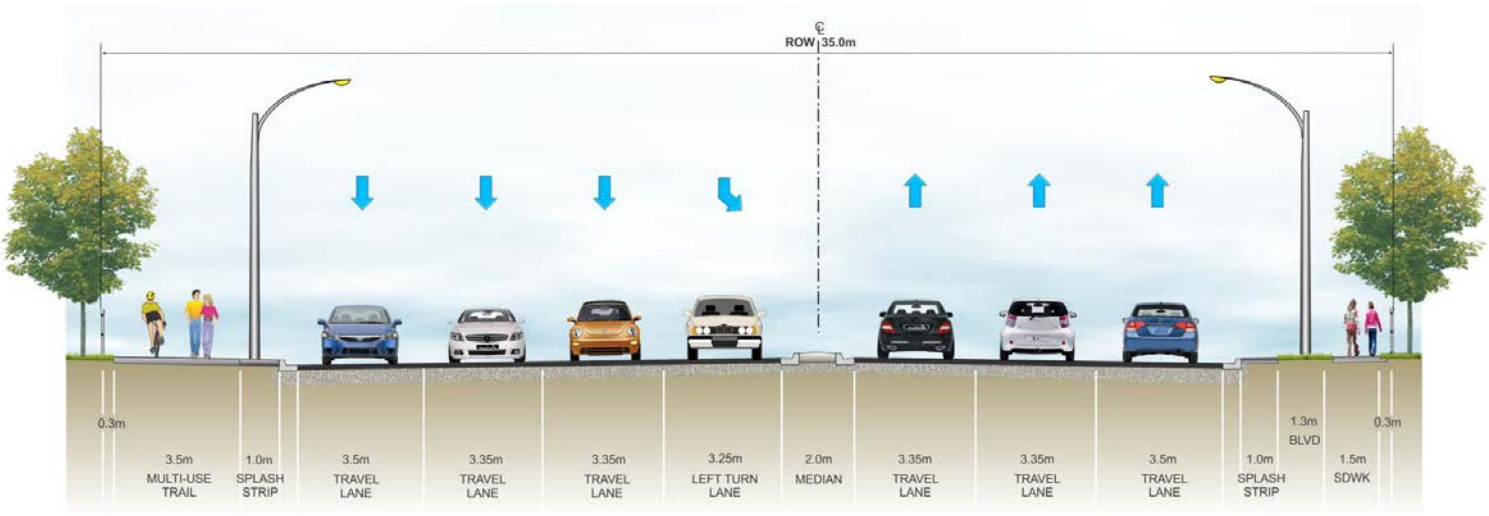

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Exhibit 6-1e: Proposed Cross-Section for Mavis Road - Station 12+336 Mid-Block between Envoy Drive and Twain Avenue

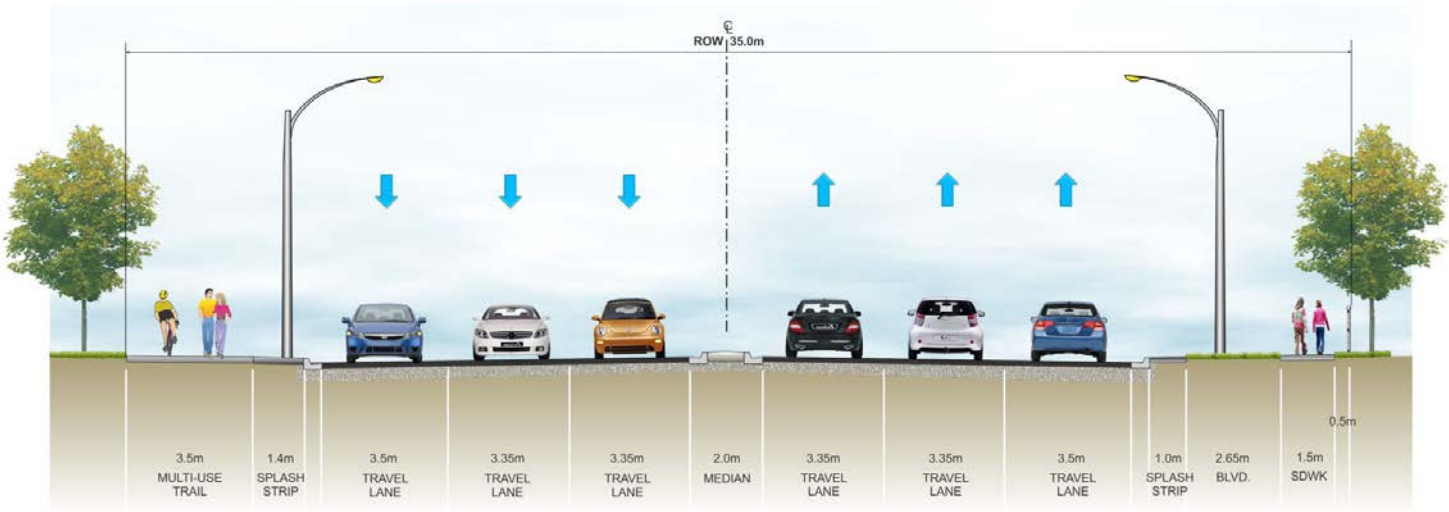

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Exhibit 6-1f: Proposed Cross-Section for Mavis Road - Station 12+771 Mid-Block between Twain Avenue and North City Limit

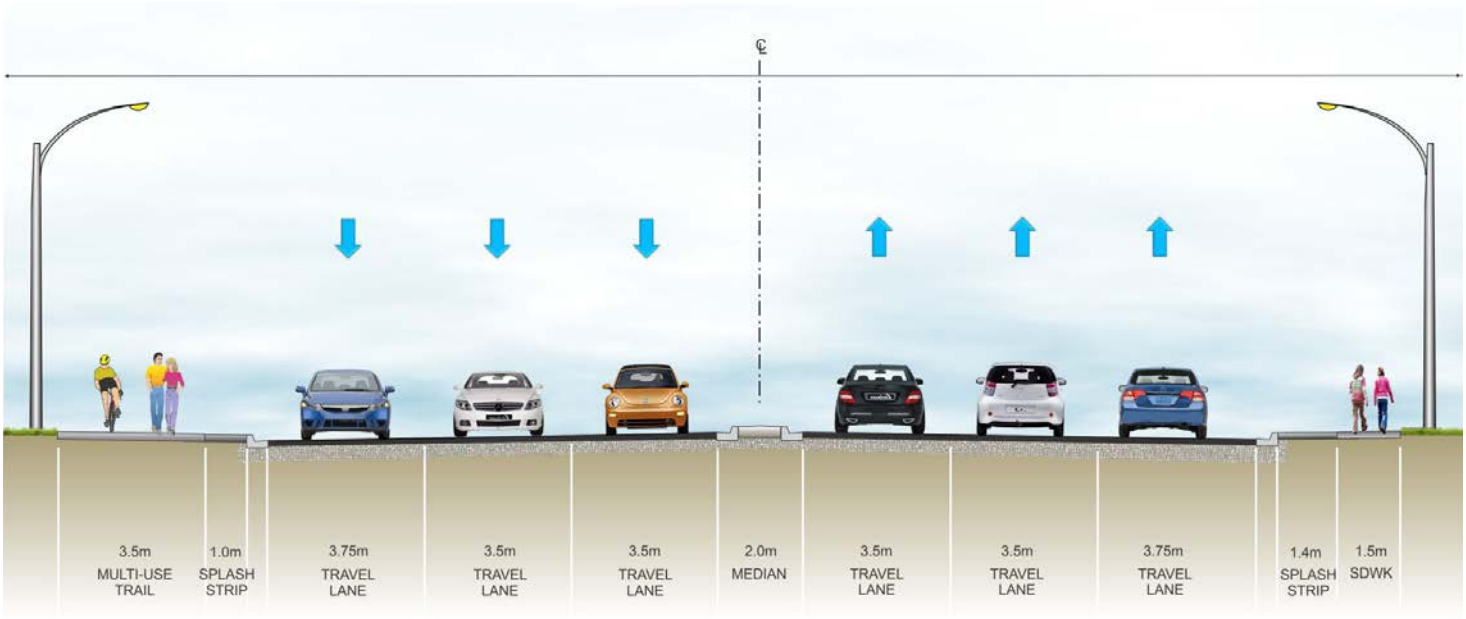

Exhibit 6-1g: Proposed Cross-Section
for Mavis Road - Station 13+600
North of Highway 407ETR Interchange

6.1.5 Provisions for Cyclists and Pedestrians

As part of an overall effort to improve continuity and connectivity of existing pedestrian and cycling facilities within the study area, the Recommended Plan includes:

- A continuous 1.5 m sidewalk and 5 m multi-use trail on the east and west side of Mavis Road, respectively, between Courtneypark Drive West and Ray Lawson Boulevard;
- Provision of a 1.5 m sidewalk and 4.0 m multi-use trail on the east and west side of the Mavis Road / Highway 407 Bridge, respectively, to provide an improved, safer connection between Mississauga and Brampton (cross-section details for this structure are described further in **Section 6.2.2**). In conjunction with the above, the following improvements are also being proposed within the Highway 407 Interchange:
    - East-North/South off-ramp terminal: zebra-stripe crosswalks on the east and north sides of the intersection to connect the sidewalk on the east side of crossing structure with the sidewalk to the north and multi-use trail to the west.
    - West-North/South off-ramp terminal: zebra-stripe crosswalks on the west and north sides of the intersection to connect the multi-use trail on the west side of crossing structure with the multi-use trail to the south and sidewalk to the east.
    - Marked pedestrian crossings where the sidewalk crosses over the South-East and South-West on-ramps.
    - Marked crossings and pedestrian bump-outs where the multi-use trail crosses the North-West and North-East on-ramps.
    - Exact locations/configurations of these crossing facilities are subject to further consultation with 407ETR during detailed design.
- Additional mid-block access points between active transportation facilities along Mavis Road and adjacent communities at:
    - Golden Farmer Way (Stations 11+190 and 11+350)[9];
    - Tassel Crescent (Station 11+700);
    - Macbeth Heights (Station 12+360); and
    - Magistrate Terrace (Station 12+930).

[9] Stations are indicated on the Recommended Plan plates found at the end of Chapter 6 of this ESR

In addition to the above improvements, crosswalk setbacks at signalized intersections were increased where feasible to reduce crossing distances for pedestrians and improve visibility and safety.

6.1.6 Intersections

Mavis Road between Courtneypark Drive West and Ray Lawson Boulevard includes nine intersections, all of which are signalized:

- Sombrero Way / Courtneypark Drive
- Craig Carrier Court / Western Skies Way
- Crawford Mill Avenue / Novo Star Drive
- Derry Road West
- Envoy Drive / Kaiser Drive
- Knotty Pine Grove / Twain Avenue
- Highway 407ETR W-N/S Off-Ramp Terminal
- Highway 407ETR E-N/S Off-Ramp Terminal
- Chinguacousy Road / Ray Lawson Boulevard

Chapter 2 provides the intersection recommendations of the Traffic Analysis (**Appendix B**), based on the future (2041) intersection operational analysis results, a review of the existing available road right-of-way and the desire to avoid impacts to properties. This section summarizes the key intersection elements of the Recommended Plan.

Derry Road West

The Recommended Plan includes the following elements at the Derry Road West intersection, which are depicted on the Recommended Plan plates at the end of **Chapter 6** and on **Exhibit 6-2**:

- dual lanes for northbound and southbound left turn movements, with storage lengths of 160 m for the northbound left movement and 175 m for the southbound left movement;
- removal of channelized right turn movements, and provide dedicated right turn lanes with a storage length of 100 m for the northbound right turn movement, 85 m for the southbound right turn lane;

- proposed corner radii for these new, non-channelized right-turn movements designed to accommodate truck turning movements;
- the southbound right-turn movement to be right-turn only on red due to sightline deficiencies; and
- a southbound queue jump lane (QJL) for MiWay transit vehicles, including a concrete layby lane south of the intersection. An alternative design with reduced layby lane length is provided in the design plates should future MiWay routes no longer require westbound left-turn movements through this intersection. This will be confirmed through further consultation with MiWay during the detailed design phase.

The proposed road cross-sections for Mavis Road immediately north and south of the Derry Road West intersection are provided on **Exhibit 6-3.**

Sombrero Way/Courtneypark Drive West

The Recommended Plan includes the following elements at the Sombrero Way / Courtneypark Drive West intersection, depicted on the Recommended Plan plates in **Section 6.11** and on **Exhibit 6-4.**

- Dual left-turn lane for southbound traffic turning left with a storage length of 140 m; and
- Increasing storage length (approximately 150 m) for the northbound left turn lane.

The multi-use trail narrows approaching Sombrero Way to accommodate the bus shelter and pad. Cyclists will be required to dismount. This design avoids impacts to the adjacent residential property.

As discussed in **Chapter 5**, a lengthened right-turn lane and left-turn lane were both explored for Sombrero Way. These potential improvements were set aside from further consideration due to property impacts to adjacent residences.

Collector Road Intersections

The key objective at collector road intersections is improving operations by separating left-turning traffic from through / right traffic. The Recommended Plan proposes increasing storage length for the eastbound and westbound left turn movements at:

- At Knotty Pine Grove/Twain Avenue intersection - providing storage length of 40 m for the eastbound left turn lane and 65 m for westbound left turn lane;

- At Envoy Drive/Kaiser Drive intersection – providing storage length of 45 m for the eastbound left turn lane and 35 m for westbound left turn lane;
- At Crawford Mill Avenue/Novo Star Drive intersection - providing storage length of 50 m for the eastbound left turn lane and 60 m for the westbound left turn lane;
- Craig Carrier Court/Western Skies Way – providing storage length of 20 m for the eastbound left turn lane and 25 m for westbound left turn lane.

Details of each intersection are provided as part of the Recommended Plan in **Section 6.11**.

Auto Turn Analysis

An 'AutoTurn' analysis was conducted to ensure appropriate radii for turning movements will be accommodated at each intersection. As the Derry Road West and Courtneypark Drive West intersections are part of primary truck routes in the Region of Peel, they were assessed to ensure truck movements will be accommodated. All other intersections in the study area are at residential roads where the wider turning radii do not need to be accommodated. Overall, it was determined that existing conditions meet appropriate turning radii standards at all intersections except for Derry Road West. Required turning radii were accommodated as part of proposed design changes at this intersection.

City of Mississauga and Region of Peel
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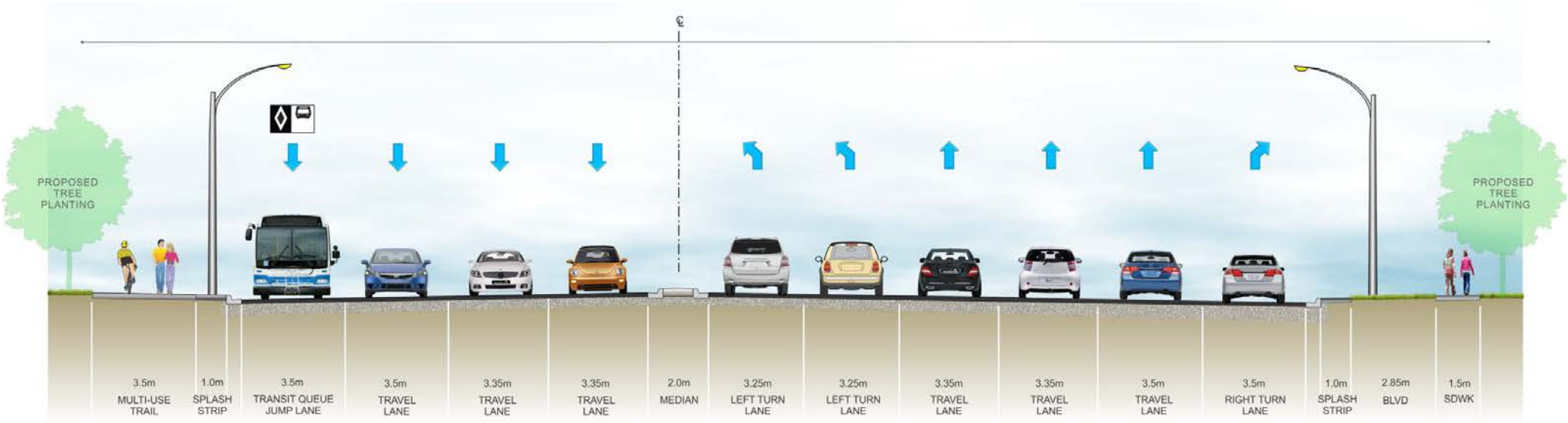
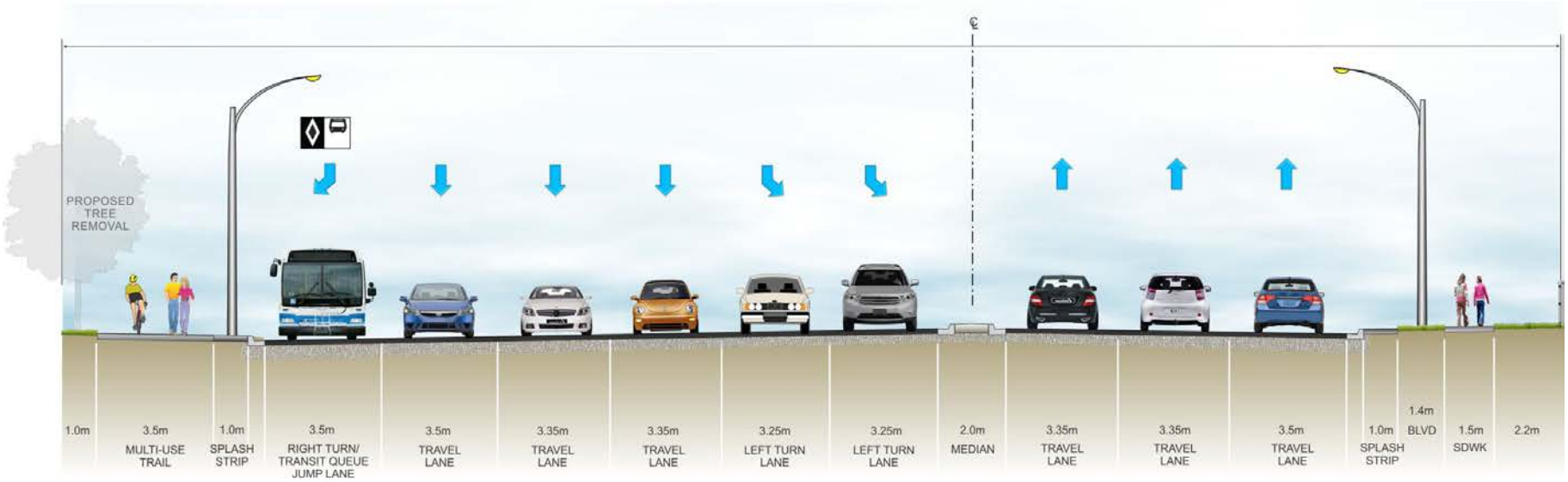
Exhibit 6-2 Derry Road West
Intersection Plan and Rendering



City of Mississauga and Region of Peel
Mavis Road - Courtneypark Drive West to Ray Lawson Boulevard
Environmental Study Report

Exhibit 6-3a: Mavis Road at Derry Road West Cross-Section (South)



City of Mississauga and Region of Peel
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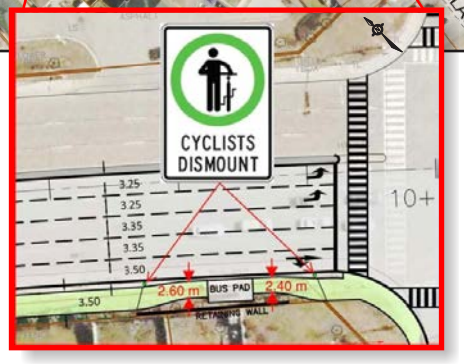
Exhibit 6-3b: Mavis Road at Derry Road West Cross-Section (North)



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Mavis Road - Courtneypark Drive West to Ray Lawson Boulevard
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Exhibit 6-4 Sombrero Way / Courtneypark Drive West Intersection Plan and Rendering

6.2 Structures

The study area includes structures at Fletcher's Creek and Highway 407:

- The existing Fletcher's Creek Bridge is able to accommodate the proposed Mavis Road cross-section and no structural modifications will be required. The proposed road cross-section over Fletcher's Creek is shown in **Exhibit 6-5**.
- The existing Highway 407 Bridge will need to be widened in order to accommodate the proposed Mavis Road cross-section, details of which are provided in **Section 6.2.1**.

6.2.1 Highway 407 Bridge

The existing Highway 407 Bridge consists of four 3.75 m travel lanes plus two auxiliary lanes of varying width, and 2.2 m sidewalks with no buffers on both sides. In order to accommodate the Recommended Plan, the bridge will need to be widened to provide two additional lanes of traffic, a 2.0 m raised median, a sidewalk to the east, and a multi-use trail with barrier wall to the west. As described in **Section 5.3.3**, an analysis and evaluation of widening alternatives was completed as part of the consultation process with 407ETR, with widening entirely to the west being chosen as the preferred.

A preliminary structural drawing for the Highway 407 Bridge is provided in **Exhibit 6-6**. The road cross-section (**Exhibit 6-7**) consists of: four 3.5 m travel lanes, two 3.75 m shoulder lanes, two auxiliary lanes of varying width, and a 2.0 m raised median. This roadway design is consistent with the existing cross-section for Mavis Road north of the interchange, which also consists of four 3.5 m travel lanes plus two 3.75 m shoulder lanes, 2.0 m raised median, and 1.0 m shoulders on both sides.

The following active transportation facilities are also provided, along with barrier walls to separate pedestrians and cyclists from traffic and provide a safe, continuous link between the City of Mississauga and City of Brampton:

- 4.0 m multi-use trail to the west with barrier wall and marked crossings at on-ramps; and
- 1.5 m sidewalk to the east plus marked pedestrian crossings at the ramp terminals.

The design of the sidewalks and multi-use trail through the Highway 407 Interchange follows MTO design standards and similar proposed improvements at other Highway 407 crossing structures. Design Criteria for Mavis Road through the interchange is provided in **Appendix K.**

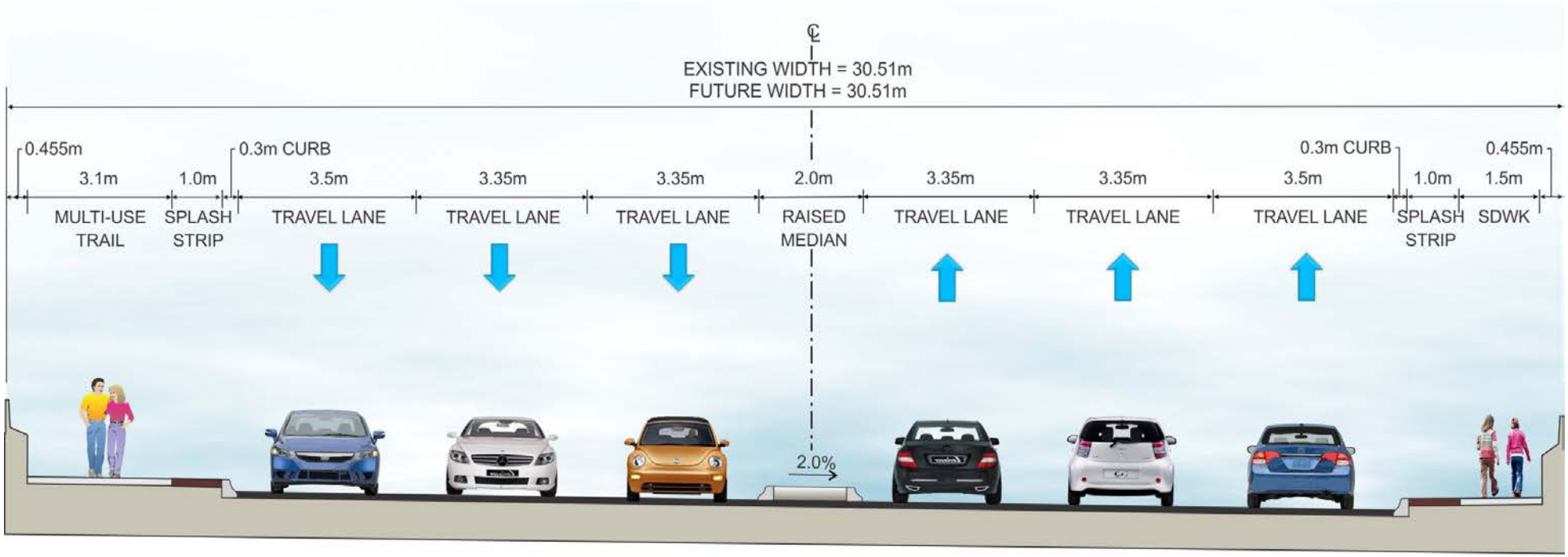
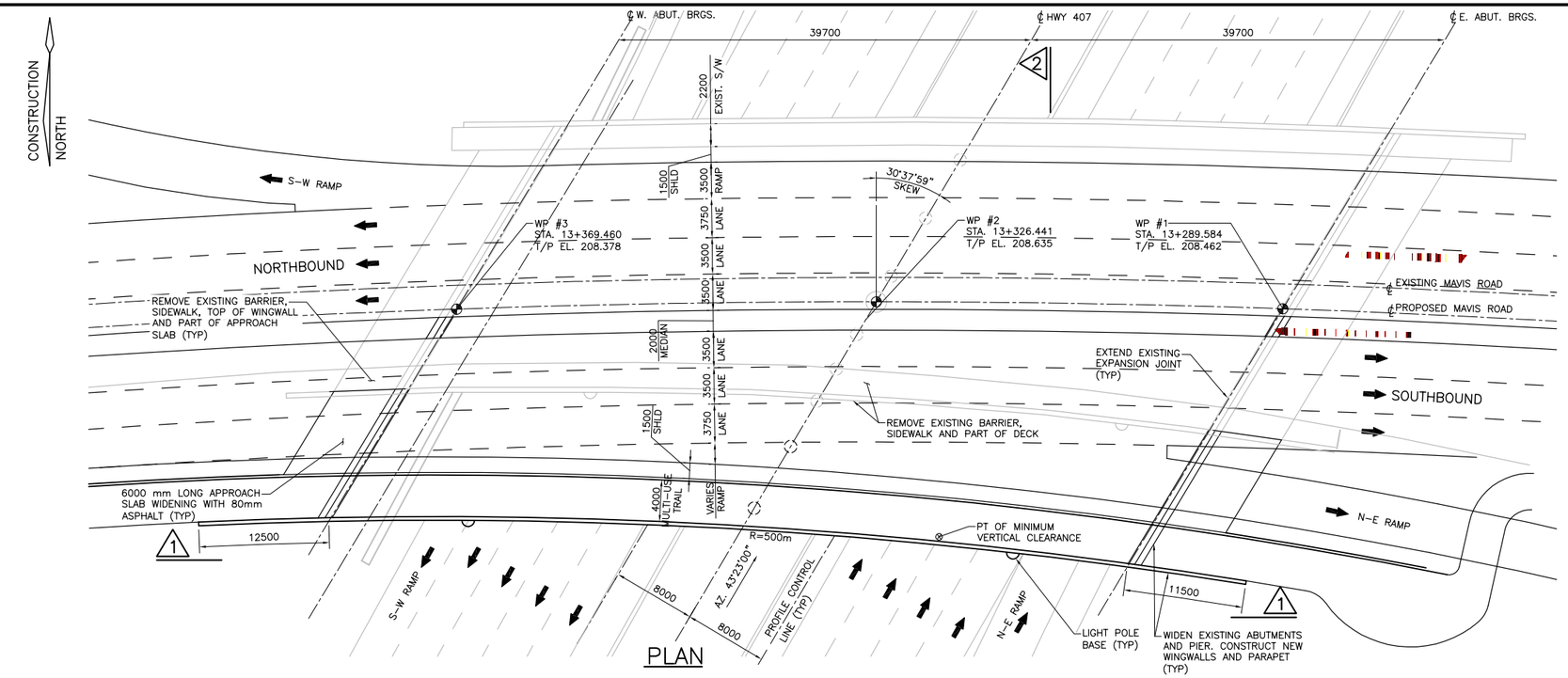
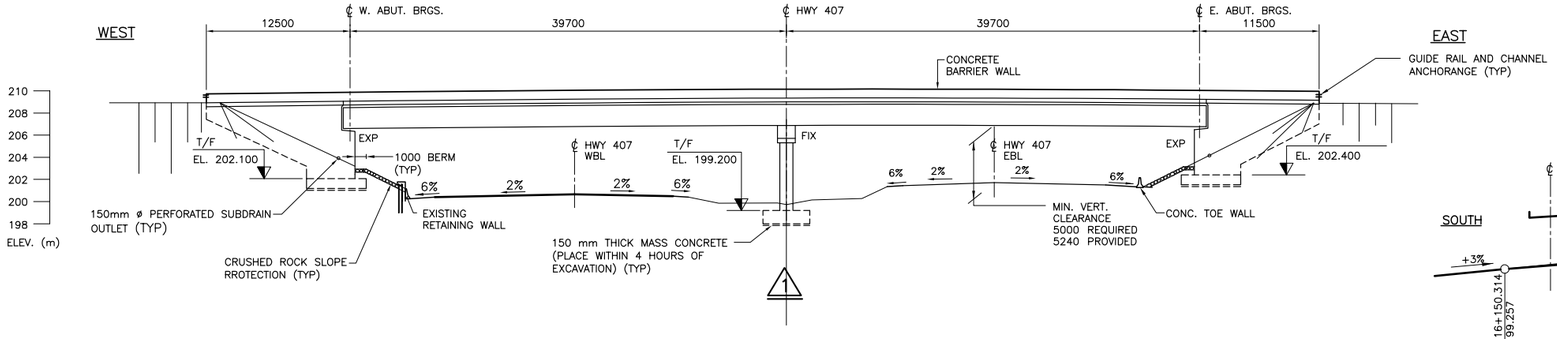
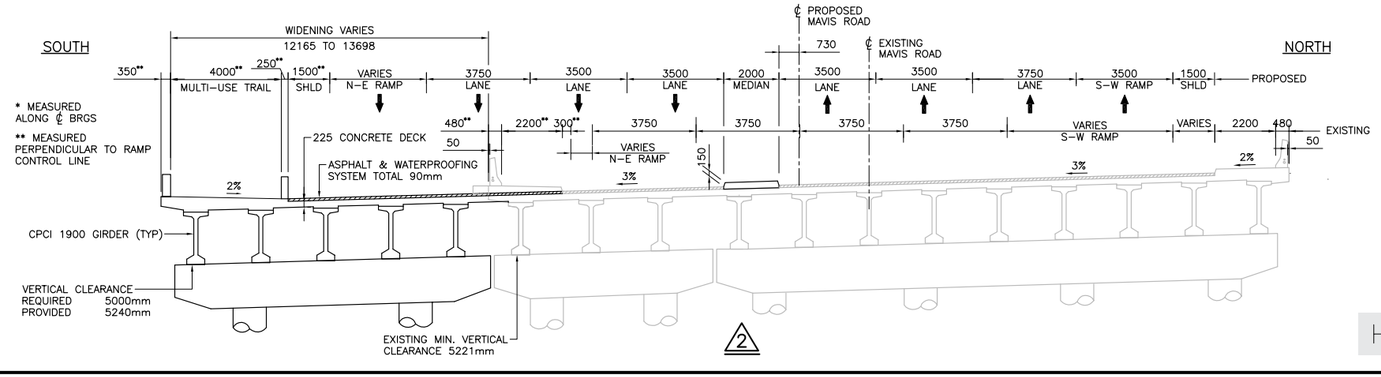
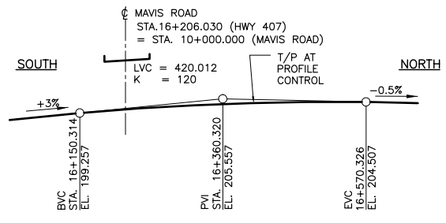


Exhibit 6-5: Fletcher's Creek Bridge Cross-Section



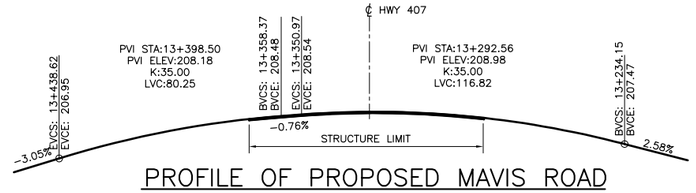






PROFILE OF HWY 407

N.T.S.



PROFILE OF PROPOSED MAVIS ROAD

DRAWING NOT TO BE SCALED
100mm ON ORIGINAL DRAWING

DISTRICT CONT. No. WP No.	
HIGHWAY 407 MAVIS ROAD UNDERPASS WIDENING	SHEET
PRELIMINARY GENERAL ARRANGEMENT	
WSP | MMM GROUP	METRIC

GENERAL NOTES:

CLASS OF CONCRETE:

PRESTRESSED CONCRETE GIRDERS	50 MPa
REMAINDER (UNLESS NOTED OTHERWISE)	30 MPa

CLEAR COVER TO REINFORCING STEEL:

CLEAR COVER TO REINFORCING STEEL	
FOOTINGS	100±25mm
DECK:	
TOP	70±20mm
BOTTOM	40±10mm
REMAINDER (UNLESS NOTED OTHERWISE)	70±20mm

REINFORCING STEEL:

1. REINFORCING STEEL SHALL BE GRADE 400W UNLESS OTHERWISE SPECIFIED.
2. UNLESS SHOWN OTHERWISE, TENSION LAP SPLICES FOR REINFORCING STEEL BAR SHALL BE CLASS B.

CONSTRUCTION NOTES:

1. MASS CONCRETE SHALL NOT BE PLACED FOR FOOTINGS UNTIL THE DEPTH AND CHARACTER OF THE FOUNDATION HAVE BEEN INSPECTED AND APPROVED BY THE GEO-TECHNICAL ENGINEER. IF REQUIRED, THE CONTRACTOR SHALL PERFORM ADDITIONAL EXCAVATION UNDER THE DIRECTION OF THE GEOTECHNICAL ENGINEER. ADDITIONAL EXCAVATION IS TO BE BACKFILLED TO THE UNDERSIDE OF FOOTING WITH MASS CONCRETE OR COMPACTED GRANULAR 'A' AS DIRECTED BY THE GEOTECHNICAL ENGINEER.
2. THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.
3. BALLAST WALLS SHALL NOT BE CAST UNTIL GIRDERS ARE ERECTED.
4. UNLESS SHOWN OTHERWISE SAWCUTS SHALL BE 25 mm DEEP OR TO FIRST LAYER OF REINFORCING STEEL, WHICHEVER IS LESS.
5. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF EXISTING WORK AND SHALL REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH FABRICATION OF JOINT ASSEMBLIES AND PRESTRESSED GIRDERS.

LIST OF ABBREVIATIONS:

T/P	DENOTES TOP OF PAVEMENT
T/FTG	DENOTES TOP OF FOOTING
WP	DENOTES WORKING POINT

LIST OF DRAWINGS:

1. GENERAL ARRANGEMENT

APPLICABLE STANDARD DRAWINGS:

OPSD 3914.100	BARRIERS AND RAILING STEEL GUIDERAIL AND CHANNEL ANCHORAGE

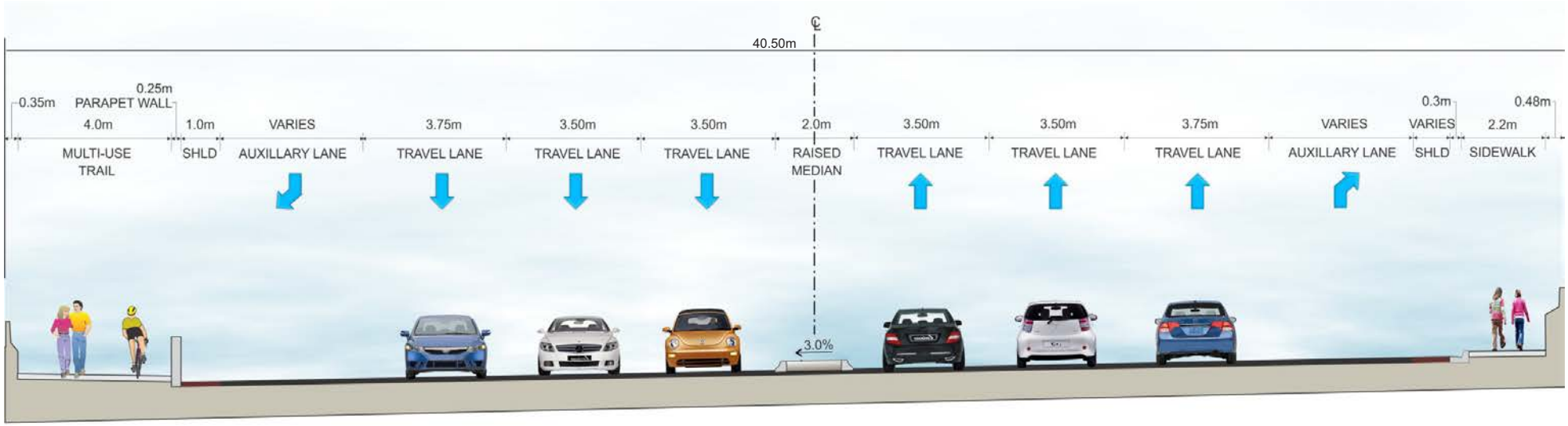


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Exhibit 6-7: Highway 407
Bridge Cross-Section

6.3 Geotechnical

A geotechnical investigation was completed in support of the Mavis Road Class EA. The purpose of the investigation was to obtain pavement structure and subgrade information along the roadway corridor and based on the findings, to provide preliminary geotechnical recommendations regarding pavement rehabilitation/widening and municipal service installation. Foundation comments are also provided regarding potential widening of the Highway 407 Bridge contained within the project limits. The Geotechnical Report is provided in **Appendix J** and the key recommendations are summarized below.

6.3.1 Pavement Design and Construction

6.3.1.1 Pavement Design for Widening

Based on the borehole data, the anticipated traffic volumes, and assuming adequate subgrade drainage, the following preliminary pavement design is recommended for widening of Mavis Road:

	Northbound Widening	Southbound Widening
HL1	50 mm	50 mm
HDBC (2 lifts)	120 mm	120 mm
Granular A Base	150 mm	150 mm
Granular B Type 1 Subbase	600 mm	900 mm

Note, the thickness of the Granular B subbase has been increased to match the total depth of existing pavement, in order to maintain lateral drainage of the existing granular materials. The total depth of the existing pavement is typically about 900 mm in the northbound lanes and 1200 mm in the southbound lanes.

6.3.1.2 Rehabilitation of Existing Pavement

The recommended pavement rehabilitation strategy for the existing pavement on Mavis Road is as follows:

	South Limit to Hwy 407 Eastbound Off-ramp	Hwy 407 Eastbound Off-ramp to Westbound Off-ramp
Partial Depth Milling	50 mm	50 mm
HL1	50 mm	50 mm
HDBC	50 mm	-

Localized areas of structural distress (alligator/ fatigue cracking) as well as severe transverse and longitudinal cracking along construction joints were observed during the visual condition survey. An additional 50 mm depth of asphalt milling and replacement is recommended to strengthen highly distressed areas and to delay reflection of deteriorated construction joint cracks up into the new asphalt overlay surface.

The locations and extent of repair areas will need to be determined by visual examination of the exposed surface following surface milling during construction. For preliminary costing purposes, it may be assumed that approximately 5% of the existing pavement will require full-depth asphalt repair. Non-destructive (FWD) testing of the existing pavement structure should be carried out during detailed design to confirm the structural capacity of the existing pavement structure and assist identification of areas requiring strengthening.

6.3.1.3 Other Pavement Aspects

Preliminary recommendations on pavement materials, transition treatments, and pavement drainage and subgrade preparation are found in the full report in **Appendix J**.

6.3.2 Municipal Services Installation

Excavation for open cut installation of municipal services within urban sections of roadway will primarily extend through the existing roadway pavement structure and embankment fill, and into native sandy silty clay till and localized sand deposits. Use of a hydraulic excavator should be suitable for trench excavation within these materials.

All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario and local regulations. In general, the fill and native soils are classified as Type 3 soils above the groundwater level, and Type 4 soils if excavation extends below the water level without prior dewatering. Groundwater is not expected to pose construction issues during excavation of relatively shallow trenches.

Where space restrictions preclude excavation of inclined slopes, installation may be carried out using a trench box or temporary shoring. If the trench depth exceeds 6 m, the support system must be designed specifically for this project by an experienced Professional Engineer.

Prior to placement of the pipe bedding, the base of the trench should be maintained in a dry condition, free of loose or disturbed material. The pipe must be placed on a uniformly competent subgrade. Pipe bedding materials, compaction and cover should follow OPSD 802.030 to 803.034, and/or Region of Peel specifications.

Trench backfill materials should be placed in loose lift thicknesses not exceeding 200 mm and compacted to at least 98% of its SPMMD. Where utility trenches are located beneath the roadway, OPSS Granular A or B material, or unshrinkable fill should be employed as backfill.

For trenches located outside of the roadway, the portion of the trench above the pipe cover can be backfilled with excavated soil provided it is unfrozen and free of organics, debris and other deleterious materials. The placement moisture content should be within about 2% of the optimum moisture content for efficient compaction, and the till must be adequately broken down and compacted in the trench.

6.3.3 Highway 407 Bridge

A geotechnical investigation was carried out in 1999 for a previous widening of the Mavis Road / Highway 407 Bridge. Six boreholes were drilled at the level of Highway 407, one at both ends of each foundation unit. The Record of Borehole sheets and Borehole Location Plan from the investigation are reproduced in the Geotechnical Report in **Appendix J**. The subsurface stratigraphy encountered in the boreholes generally consisted of a surficial 0.3 to 0.6 m thick layer of crusher run limestone or silty sand fill, locally a 50 mm topsoil layer, overlying very dense native sandy silt to the borehole termination depths of 6.1 to 6.4 m.

Review of the General Arrangement drawing for the previous bridge widening indicates that the existing structure is supported on spread footings.

Based on the review of the previous widening, the existing abutment footings are assumed to be founded near Elev. 201 on either mass concrete or compacted Granular ‘A’ material overlying very dense native sandy silt encountered below all existing fill and topsoil. The existing pier is considered to be founded directly on the very dense native soil at approximate Elev. 198. For preliminary design purposes, use of a similar foundation system is recommended for the widened portion of the bridge, comprising

extension of the existing spread footings at the same founding level and designed using the same resistance values as the existing foundation units.

The horizontal resistance against sliding can be computed using an ultimate friction factor of 0.4 between cast-in-place concrete and the undisturbed sandy silt, or 0.55 between the concrete and Granular 'A'.

For frost protection purposes, a minimum earth cover of 1.2 m or its thermal equivalent should be provided for all footing bases.

6.3.3.1 Results of Environmental Testing

In general, visual and olfactory examination of the soil samples recovered from the field investigation program revealed no unusual staining or odours indicative of hydrocarbon impact or other contamination.

To provide a preliminary evaluation of the environmental quality of the soils potentially requiring disposal during construction, six samples recovered from the boreholes were submitted to AGAT Laboratories Limited for analysis of selected parameters outlined in Ontario Regulation 153/04 (as amended by O.Reg. 511/09) and O.Reg. 558/00. The sample locations, material types and results of the analyses are provided in **Appendix J**.

Based on the available subsurface information and the analytical results of selected samples, excess soil from the project may generally be classified as a "non-subject waste" in accordance with O.Reg. 558/00 and disposed of at a suitable receiving site or reused on-site as general fill.

Additional analytical testing will be required during detailed design to further assess the requirements for re-use or disposal of excavated materials when further details of the project are established.

Where excavation of existing pavement structures is required, asphalt should be removed separately from granular materials and recycled at an approved recycling facility or disposed of appropriately off-site. Asphalt should not be mixed with excess excavated soil; fill receivers may not accept excess excavated soils if it contains asphalt. Excavated granular material may be reused on site for general fill purposes subject to geotechnical approval.

6.3.4 Future Detailed Investigations

Detailed geotechnical investigation will be required to confirm the subsurface conditions and recommendations. This work should include:

- additional boreholes within the existing roadway pavement and widening areas to confirm the existing pavement thicknesses, subgrade conditions and preliminary pavement design recommendations;
- deflection testing (FWD) of the existing roadway if sections of the existing pavement are to be rehabilitated;
- additional boreholes at the proposed Highway 407 Bridge and any retaining walls or fill embankments to confirm geotechnical recommendations for foundation and embankment design;
- further assessment of dewatering requirements and the need for a PTTW; and
- chemical testing to evaluate excess material disposal.

6.4 Drainage and Stormwater Management

The Recommended Plan will result in increases to impervious area within all catchment areas. There is no change in the drainage patterns from the existing conditions to proposed conditions. The catchment areas are depicted on **Exhibit 6-8** through **Exhibit 6-11.** Detailed analysis and results are provided in **Appendix F**.

Quantity and quality treatment of runoff from roadway Catchments A1 to A36 will be provided through the existing SWM Facility No. 5 which will provide an Enhanced level of water quality treatment and quantity control.

Quality treatment of runoff from roadway Catchments C1 to C6 will be provided through the existing SWM Facility No. 4 which will provide an Enhanced level of water quality treatment.

Quantity and quality treatment of runoff from roadway Catchments B1 to B10 will be provided through the existing grassed swales in Highway 407 interchange area.

As in existing conditions, the major storm runoff flows overland along Mavis Road towards the road low point, which is ultimately captured by catch basins and conveyed to SWM Facilities No. 4 and 5 via storm sewers.

6.4.1 Hydrologic Assessment

The proposed improvements to Mavis Road will result in very minor increases in imperviousness, post-development flows from every roadway catchments remain the same as in existing conditions and runoff from the roadway catchments will be directed to the existing SWM facilities to provide both quality and quantity control. These changes are deemed not significant. The post-development flows at flow node locations and at culverts are provided in **Appendix F.**

Stormwater Management Facilities

Pre and post-development flows for stormwater management facilities were examined and results are provided in **Table 6-3**. The results indicate that the post-development flows will not significantly increase compared to the pre-development flows at the stormwater facility outlets.

Table 6-3: Comparison of Pre- and Post-development Flows for SWM facilities

Outlet Location	Drainage Area (ha)	10-Year Flow (m^3/s)		
		Existing	Proposed	Change
Flow to Stormwater Management Facility No. 5	**139.25**	14.26	14.54	+0.28
Flow to Stormwater Management Facility No. 4	**73.35**	7.39	7.40	+0.01

The flows draining to the Stormwater Facility No. 5 will increase by 0.28 m^3/s only which is considered negligible.

The flows draining to the Stormwater Facility No. 4 will increase by 0.01m^3/s only which is considered negligible.

SWM Facilities No. 4 and 5 both have an orifice to control the flow and the minor increase in drainage area and flow to these SWM facilities will not affect the discharge to Fletcher's Creek. The drawings (C39484 and C42551) related to the control system of SWM Facilities No. 4 and 5 are included in Appendix D.

Storm Sewer System

Based on the Rational Method storm sewer design sheets (**Appendix F**) it can be concluded that the existing storm sewer system has been designed for the future widening of Mavis Road. The existing storm sewers have adequate capacity to accommodate small increases in runoff.

Culverts

Table 6-4 provides a comparison of the pre-development and post-development flows for culverts.

The total roadway drainage area to Highway 407 has increased from 12.97 ha under existing conditions to 13.69 ha under proposed conditions, resulting from the widening of the overpass bridge.

The flow draining to Culvert CV1, CV3, CV5, CV6 and CV7 will increase by 0.01 m3/s only which is considered negligible. The flow draining to Culvert CV4 will increase by 0.04 m3/s and flow draining to Culvert CV2 will increase by0.06 m^3/s.

The Rational Method design sheet for each culvert is included in **Appendix F**.

Table 6-4: Comparison of Pre- and Post-development Flows for Culverts

Culvert Location	Drainage Area (ha)	Event (year)	Flow (m^3/s)		
			Existing	Proposed	Change
CV1	2.40 (Existing) 2.47 (Proposed)	10	0.27	0.28	+0.00
		50	0.35	0.36	+0.01
		100	0.39	0.40	+0.01
CV2	4.38 (Existing) 4.52 (Proposed)	10	0.49	0.53	+0.04
		50	0.63	0.68	+0.05
		100	0.70	0.76	+0.06
CV3	3.25 (Existing) 3.33 (Proposed)	10	0.31	0.32	+0.01
		50	0.40	0.41	+0.01
		100	0.45	0.46	+0.01
CV4	2.99 (Existing) 3.42 (Proposed)	10	0.36	0.39	+0.03
		50	0.46	0.50	+0.04
		100	0.51	0.55	+0.04
CV5	0.41 (Existing and Proposed)	10	0.056	0.066	+0.01
		50	0.072	0.085	+0.01
		100	0.080	0.094	+0.01
CV6	1.3 (Existing and Proposed)	10	0.097	0.107	+0.01
		50	0.125	0.138	+0.01
		100	0.138	0.152	+0.01
CV7	0.70 (Existing and Proposed)	10	0.078	0.084	+0.01
		50	0.101	0.107	+0.01
		100	0.111	0.119	+0.01

6.4.2 Hydraulic Capacity Analysis

The hydraulic assessment at Fletcher's Creek is not undertaken since the existing bridge can accommodate the roadway widening.

There are five culverts within Highway 407 Interchange and two culverts across Mavis Road north of Highway 407. Invert elevations of existing Highway 407 ramp culverts were estimated from the existing contract drawings, which needs to be confirmed during the detail design phase.

The design standard for the hydraulic analyses of culverts is based on the MTO Highway Drainage Design Standards (HDDS; February 2008). The hydraulic modelling was used to estimate the headwater elevation and to assess the hydraulic capacity of each of the existing culverts within the study area. Specifically, the modelling:

- Evaluates inlet and outlet controlled headwater depths;
- Simulates the hydraulic performance of culverts based on user-specific flows;
- Considers variable tail water depths bases on either outlet channel geometry or user specified depth discharge rating curves; and
- Incorporates an extensive database of standard culvert sizes, shapes and materials, and allows for the addition of custom culvert types and sizes.

The existing conditions hydraulic analysis was carried out for seven existing culverts (CV1 to CV7). Due to the extension of multiuse path on the west side of Mavis Road, Culvert CV7 may require some modification. It is likely that a culvert extension can be avoided by providing a wing or headwall at the downstream end. This will be confirmed during the detailed design phase.

Culverts in the Highway 407 Interchange area are classified as freeway ramp culverts. Mavis Road is classified as an urban arterial road. Therefore, design flow for the culverts located in Highway 407 ramps and Mavis Road is the 50-year flow. The 100-year flow will be used to check for no overtopping requirement.

Table 6-5 and **Table 6-6** provide the hydraulic assessment for culverts under existing and future conditions, respectively. Based on the analysis, it can be concluded that:

- Culvert CV1 does not meet the required freeboard of 1.0 m for 50-year design storm under existing and future conditions. However, the 100-year storm does not overtop the road. There is no increase in the headwater elevation for the 50-year design flow under proposed conditions; however, the headwater

elevation for the 100-year flow increased by 0.01 m under the proposed conditions. This increase is considered negligible.

- Culvert CV2 meets all hydraulic requirements. The 100-year flow does not overtop the road. There is no increase in the headwater elevation for the 50-year design flow. The headwater elevation for the 100-year flow increased by 0.02 m under the proposed conditions. This increase is considered negligible.
- Culvert CV3 does not meet the required freeboard of 1.0 m for 50-year design storm under current or future conditions. However, the 100-year storm does not overtop the road. The headwater elevation of the 50-year design flow and the 100-year flow increased by 0.01 m under the proposed conditions. These increases are considered negligible.
- Culvert CV4 meets all hydraulic requirements. The 100-year flow does not overtop the road. The headwater elevation for the 50-year design flow increased by 0.05 m and the 100-year flow increased by 0.07 m under the proposed conditions. The increases in headwater elevations are within the ramp loop and the available freeboard is more than 2.0 m, therefore, the increase in headwater elevations will not impact the ramp.
- Culvert CV5 meets all hydraulic requirements. The 100-year flow does not overtop the road. The headwater elevation for the 50-year design flow and the 100-year design flow increased by 0.03 m under the proposed conditions. These increases are considered negligible.
- Culvert CV6 meets all hydraulic requirements. The 100-year flow does not overtop the road. The headwater elevation for the 50-year design flow increased by 0.02 m and the 100-year flow increased by 0.01 m under the proposed conditions. These increases are considered negligible.
- Culvert CV7 meet all hydraulic requirements. The 100-year flow does not overtop the road. The headwater elevation for the 50-year design flow increased by 0.01 m and the 100-year flow increased by 0.02 m under the proposed conditions. These increases are considered negligible.

Table 6-5: Hydraulic Assessment Culverts – Existing Conditions

Culvert ID	Size (mm) / Type	Length (m)	U/s Invert (m)	D/s Invert (m)	EOP Elev. at Low Point / Spill Elev. (m)	Events	Flow (m^3/s)	Computed HWL (m)	Exit Velocity (m/s)	Upstream Velocity Head (m)	EGL (m)	Freeboard (m)	HW/D	Meets requirements?
CV1	900mm Ø CSP Circular	23.0	198.60	184.40	199.75	50-year	0.316	199.15	5.94	0.12	199.27	0.48	0.61	Freeboard > 1m → No HW/D ≤ 1.5 → Yes
						100-year	0.350	199.18	6.12	0.13	199.31	0.44	0.64	No Overtopping → Yes
CV2	1200mm Ø CSP Circular	25.7	191.00	190.80	194.00	50-year	0.588	191.67	1.71	0.11	191.78	2.22	0.56	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.650	191.70	1.76	0.11	191.81	2.19	0.58	No Overtopping → Yes
CV3	1200mm Ø CSP Circular	26.9	196.30	196.10	197.50	50-year	0.403	196.84	1.54	0.09	196.93	0.57	0.45	Freeboard > 1m → No HW/D ≤ 1.5 → Yes
						100-year	0.446	196.87	1.58	0.09	196.96	0.54	0.47	No Overtopping → Yes
CV4	600mm Ø CSP Circular	30.0	196.20	195.90	200.00	50-year	0.457	196.99	2.26	0.21	197.20	2.80	1.13	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.506	197.04	2.30	0.23	197.27	2.73	1.20	No Overtopping → Yes
CV5	600mm Ø CSP Circular	25.8	204.90	204.70	207.50	50-year	0.072	205.14	1.40	0.06	205.20	2.30	0.34	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.080	205.16	1.45	0.06	205.22	2.28	0.37	No Overtopping → Yes
CV6	1050mm Ø Concrete Circular	51.5	201.70	199.65	203.50	50-year	0.125	201.97	2.59	0.07	202.04	1.46	0.39	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.138	201.99	2.67	0.07	202.06	1.44	0.41	No Overtopping → Yes
CV7	900mm Ø CSP Circular	46.7	194.60	192.30	196.00	50-year	0.101	194.90	1.74	0.06	194.96	1.04	0.43	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.111	194.91	1.79	0.07	194.98	1.02	0.44	No Overtopping → Yes

U/s - Upstream
D/s - Downstream
EOP - Edge of pavement
HWL - Headwater Elevation
EGL - Energy Grade Line
HW/D - Headwater over Depth Ratio

Table 6-6: Hydraulic Assessment Culverts – Proposed Conditions

Culvert ID	Size (mm) / Type	Length (m)	U/s Invert (m)	D/s Invert (m)	EOP Elev. at Low Point / Spill Elev. (m)	Events	Flow (m^3/s)	Computed HWL (m)	Exit Velocity (m/s)	Upstream Velocity Head (m)	EGL (m)	Freeboard (m)	HW/D	Meets requirements?
CV1	900mm Ø CSP Circular	23.0	198.60	184.40	199.75	50-year	0.322	199.15	5.97	0.12	199.27	0.48	0.61	Freeboard > 1m → No HW/D ≤ 1.5 → Yes
						100-year	0.357	199.19	6.16	0.13	199.32	0.43	0.66	No Overtopping → Yes
CV2	1200mm Ø CSP Circular	25.7	191.00	190.80	194.00	50-year	0.599	191.67	1.72	0.11	191.78	2.22	0.56	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.663	191.71	1.77	0.12	191.83	2.17	0.59	No Overtopping → Yes
CV3	1200mm Ø CSP Circular	26.9	196.30	196.10	197.50	50-year	0.411	196.85	1.55	0.09	196.94	0.56	0.46	Freeboard > 1m → No HW/D ≤ 1.5 → Yes
						100-year	0.455	196.88	1.59	0.09	196.97	0.53	0.48	No Overtopping → Yes
CV4	600mm Ø CSP Circular	30.0	196.20	195.90	200.00	50-year	0.495	197.03	2.29	0.22	197.25	2.75	1.19	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.548	197.09	2.32	0.25	197.34	2.66	1.27	No Overtopping → Yes
CV5	600mm Ø CSP Circular	25.8	204.90	204.70	207.50	50-year	0.085	205.16	1.47	0.07	205.23	2.27	0.37	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.094	205.18	1.52	0.07	205.25	2.25	0.40	No Overtopping → Yes
CV6	1050mm Ø Concrete Circular	51.5	201.70	199.65	203.50	50-year	0.138	201.99	2.67	0.07	202.06	1.44	0.41	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.152	202.00	2.75	0.07	202.07	1.43	0.43	No Overtopping → Yes
CV7	900mm Ø CSP Circular	46.7	194.60	192.30	196.00	50-year	0.107	194.91	1.77	0.06	194.97	1.03	0.44	Freeboard > 1m → Yes HW/D ≤ 1.5 → Yes
						100-year	0.119	194.93	1.83	0.07	195.00	1.00	0.47	No Overtopping → Yes

U/s - Upstream
D/s - Downstream
EOP - Edge of pavement
HWL - Headwater Elevation
EGL - Energy Grade Line
HW/D - Headwater over Depth Ratio

6.4.3 Stormwater Management

As discussed above, there are two existing stormwater management facilities in place: Facility No. 4 and Facility No. 5 for quality control and quantity control and extended detention of the roadway runoff for the residential areas on both sides of Mavis Road from Highway 401 to Highway 407. Under proposed conditions, quality and quantity control are maintained by directing the widened roadway areas to the two existing SWM facilities.

Fletcher's Creek Stormwater Management Facility No. 5

Under proposed conditions, 134.9 ha of catchment area drains to existing SWM Facility No. 5 with a directly connected impervious level of 43%. According to the MOECC design guidelines, approximately 16,200 m^3 of permanent pool volume is required for the Enhanced level of quality treatment. The existing SWM facility has a permanent pool volume of 20,000 m^3. Therefore, the existing SWM Facility No. 5 meets the requirement under proposed conditions.

Fletcher's Creek Stormwater Management Facility No. 4

Under proposed conditions, 73.4 ha of catchment area drains to existing SWM Facility No. 4 with an average impervious level of 46%. According to the MOECC design guidelines, approximately 10,130 m3 of permanent pool volume is required for the Enhanced level of quality treatment. The existing SWM facility has a permanent pool volume of 10,280 m3. Therefore, the existing SWM Facility No. 4 meets the requirement under proposed conditions.

As noted previously, SWM Facilities No. 4 and 5 both have an orifice to control the flow and the minor increase in drainage area and flow to these SWM facilities will not affect the discharge to Fletcher's Creek. The drawings (C39484 and C42551) related to the control system of SWM Facilities No. 4 and 5 are included in **Appendix F**.

Runoff of the existing Highway 407 Bridge area is collected by catch basins and ditch inlets and drains towards grassed swales and culverts which further drain to receiving ditches. The receiving ditches convey runoff along long vegetative path before discharging into the regulated features, including the Credit River. As discussed in Section 3.4, peak flow controls are not required. Quality treatment will be maintained by the existing grassed swales within the Highway 407 Interchange area and the vegetative ditches (flow path) on both sides of Highway 407.

The existing drainage system at the Highway 407 interchange is under the ownership / operation of MTO and 407ETR. While changes to the existing drainage system within the

interchange are not proposed as part of the Mavis Road Class EA, the Region of Peel will work with MTO and 407ETR during detailed design phase to ensure that water quality is appropriately managed that the final design meets MTO and MOECC requirements.

6.4.4 Water Balance Requirements Low Impact Development Opportunities

The Recommended Stormwater Management Strategy for Mavis Road largely utilizes the existing boulevard and median areas to accommodate the road widening and the completion of the multi-use path, and therefore minimizes property impacts to the extent possible. The existing storm sewer systems and stormwater management facilities have capacity to accommodate the nominal increases in runoff from the additional impervious areas. However, there are some Low Impact Development (LID) measures that may be considered during detailed design in an effort to offset the minor increase in runoff and provide for stormwater management in terms of water balance requirement within the City's right-of-way.

The water balance requirement is the retention of a minimum of 5 mm of runoff from the site to mitigate the impacts of increased runoff volume. Infiltration would be the ideal management technique for handling this water but filtration is also beneficial where soils or other constraints limit infiltration. The feasibility of water infiltration depends on the soil materials and the area available to construct the infiltration galleries. Sandy soils will allow faster infiltration than clayey soils. Sandy soils will not require a large gallery to retain the runoff. For a contributing area of 1.0 ha, the 5 mm retention requires 50 m^3 of available volume in the infiltration gallery which consists of clear stones with 0.4 void ratio. The dimensions (length, width and depth) of the infiltration gallery will be designed such that water can be infiltrated within a 24-hour or 48-hour period.

Table 6-7 provides the details of water balance requirement based on the increased impervious area at different storm sewer outlet nodes.

Based on a review of the study area and the Recommended Plan, there are potential opportunities for LID measures that include the following:

- Permeable pavement on the multi-use trail would achieve the required storage volume.
- Infiltration galleries could be introduced beneath the permeable pavement of the multi-use trail to enhance infiltration. With 0.30 m depth of clear stone below the 1750 m^2 surface area of permeable pavement approximately 210 m^3 of storage volume can be achieved.

- Where catchbasins are to be relocated, localized water quality treatment (e.g. CB Shield) and lateral pipes could be included to direct some road runoff to the adjacent infiltration gallery (per item 2).
- Grassed swales / bioswales and infiltration galleries may be considered in some intersections and roadside areas contingent upon the presence of buried utilities and the ability to direct road runoff to these areas. Possible areas include the northwest quadrant of Mavis Road / Derry Road intersection, and within the road right-of-way of Mavis Road adjacent to Magistrate Terrace.

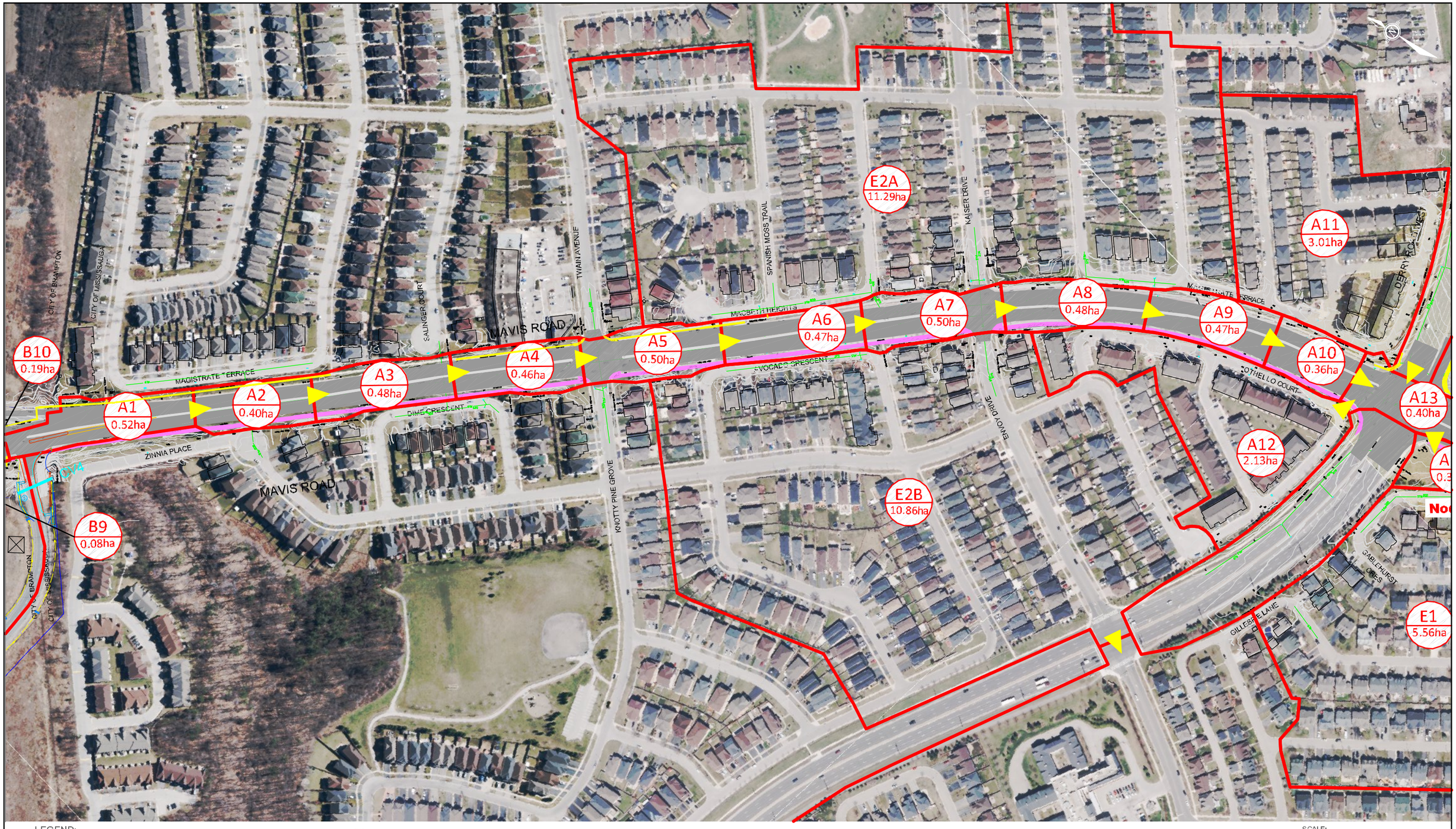
The feasibility of these measures, or other viable alternatives to achieve the runoff volume reduction targets, will be further explored during detailed design phase.

6.4.5 Drainage and Stormwater Management Summary

- Increase in flows resulting from the increased impervious area are nominal.
- The existing storm sewer system has adequate capacity.
- Increase headwater depth at all culverts is considered negligible.
- The Culvert CV7 outlet (west side of Mavis Road) will need to be modified to accommodate the extension of multiuse path. A culvert extension can likely be avoided by the use of wing wall or head wall. This needs to be confirmed during the detail design phase.
- Existing stormwater management facilities have adequate pool, storage volume to accommodate minor increases in road runoff.
- Use of permeable pavement material in the construction of the multi-use trail and infiltration galleries below the permeable pavement could be considered as LID measures to achieve the water balance requirement. The feasibility of these measures will be further explored during detailed design phase.

Table 6-7: Water Balance Requirements With Respect to Increased Impervious Area

Node ID	Total Drainage Area	Existing Conditions Imperviousness		Proposed Conditions Imperviousness		Increase in Imperviousness		5 mm Runoff Volume of Increased Impervious area for water balance	Required Volume for Infiltration Gallery with 40% Void Ratio
		Area	%	Area	%	Area	%		
	(ha)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(m^3)	(m^3)
Node 1 (Catchments A1 to A10 and A13	5.04	2.84	56%	3.97	79%	1.12	22%	56	140
Node 3 (Catchments A24 to A26)	1.215	0.53	43%	1.06	87%	0.53	44%	27	67
Node 5 (Catchments A30, A31 and A34 to A36)	1.964	0.94	48%	1.55	79%	0.61	31%	31	77
Node 8 (Catchments C1 to C6)	2.76	2.23	81%	2.51	91%	0.29	10%	14	36



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Mavis Road - Courtneypark Drive West to Ray Lawson Boulevard
Environmental Study Report

Exhibit 6-8: Future Conditions Mosaic
Plate 1

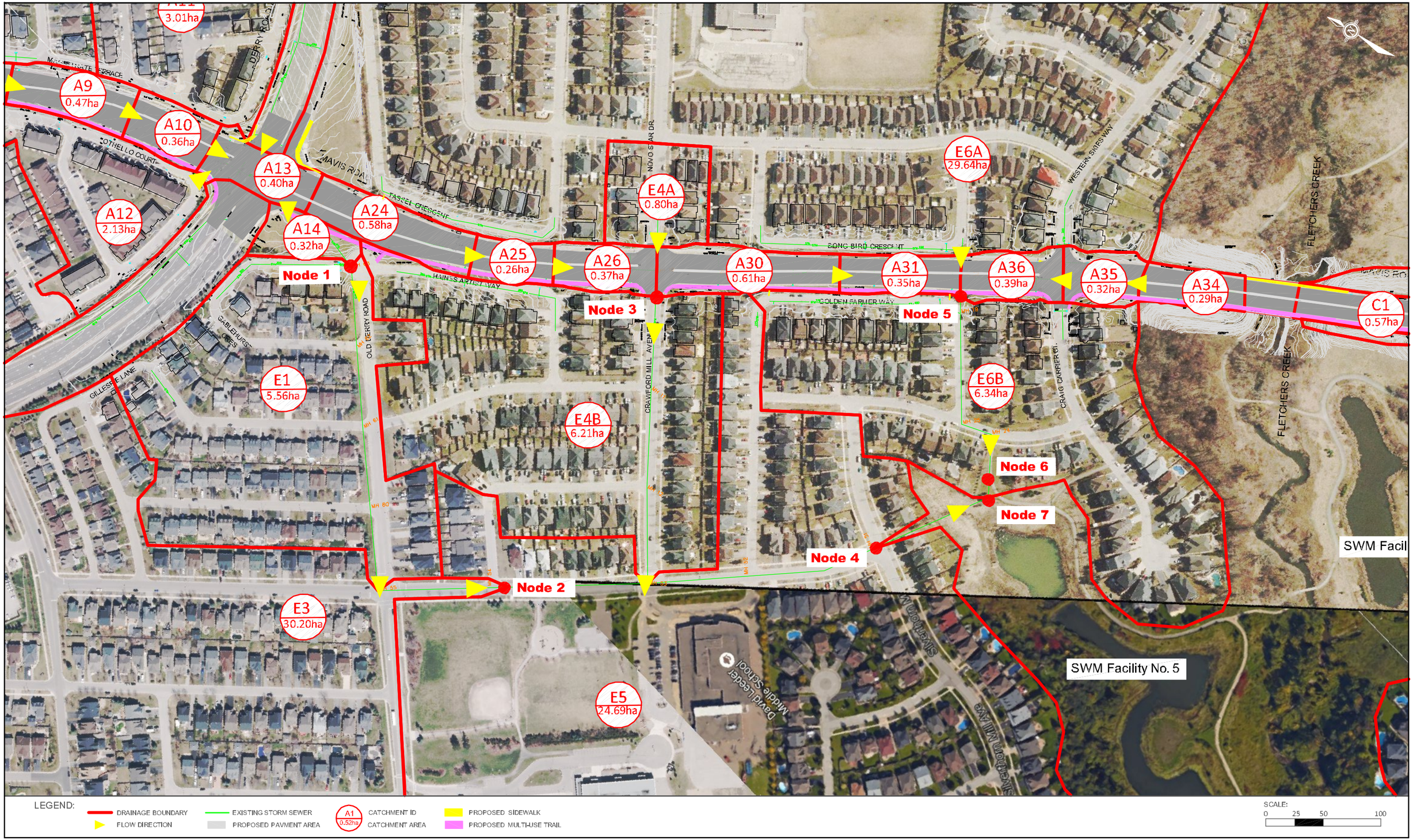

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Exhibit 6-9: Future Conditions Mosaic
Plate 2

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Exhibit 6-10: Future Conditions Mosaic
Plate 3

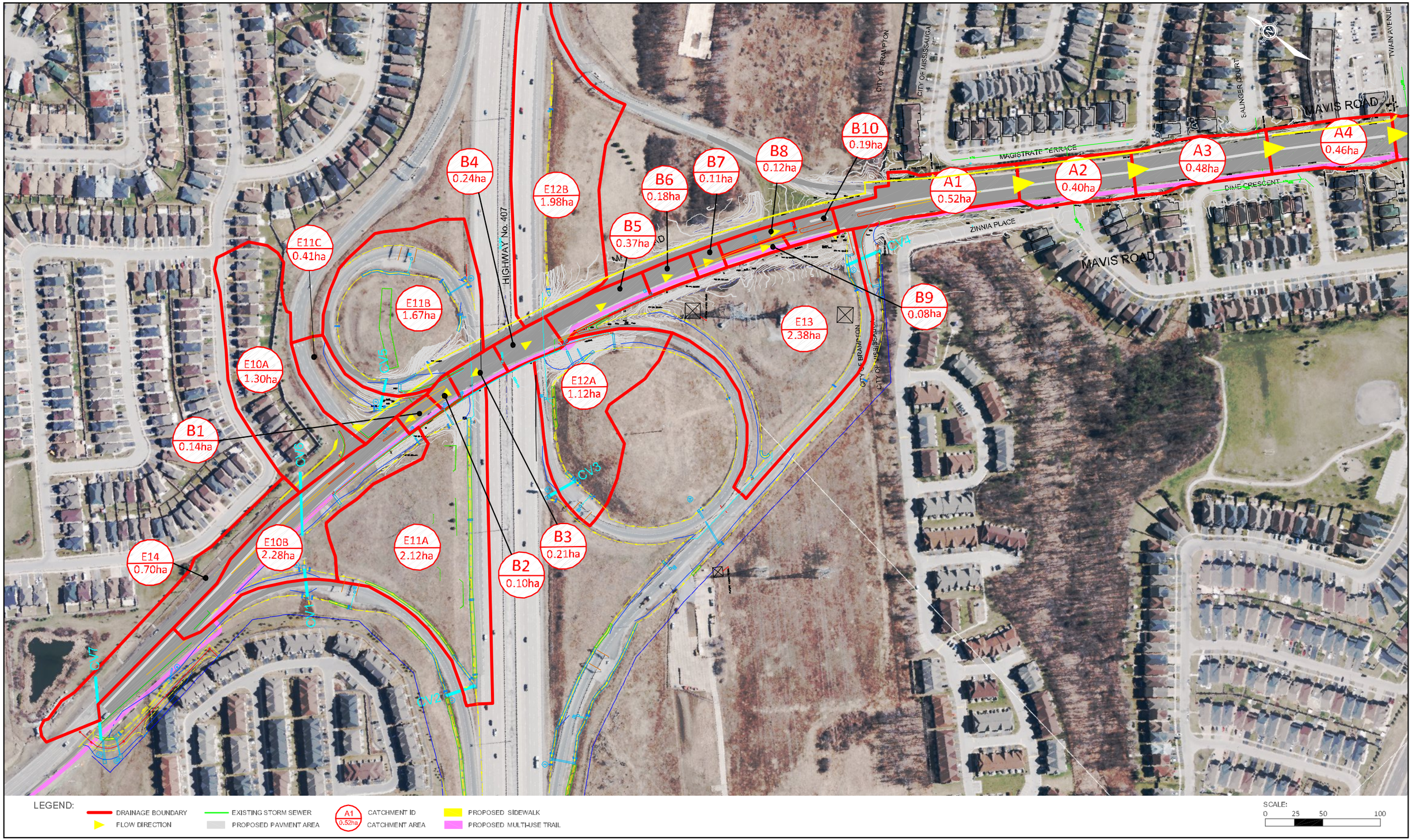

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Exhibit 6-11: Future Conditions Mosaic
Plate 4

6.5 Streetscape Concept

Mavis Road and its streetscape will be designed to recognize the community setting and the various activities that occur within the corridor (vehicle trips, access to transit, walking and cycling).

The Streetscape Concept, provided in **Section 6.11** with the Recommended Plan, considers:

- The constrained nature of the road corridor and the desire to avoid/minimize impacts to private property;
- Opportunities for innovative design at key areas where the existing road right-of-way is available;
- Mitigation for any tree removals where possible, from the recommended improvements;
- Incorporate low maintenance planting where space permits to enhance the natural environment and pedestrian experience.
- Enhancing pedestrian and cycling linkages within the corridor and to neighbourhoods, schools, parks and other public spaces; and
- Integrating public transit infrastructure into the overall streetscape environment.

Rendered images depicting the streetscape concept at select locations are provided on **Exhibits 6-12 to 6-15.** Please note, the Streetscape Coentp for Derry Road West Intersection is provided in **Exhibit 6-2.**

The Tree Management Plan has informed the development fo the Streetscape Concept. The Tree Management Plan, provided in **Appendix E** and summarized in **Section 8.4** of this ESR, identifies tree removals and tree preservation strategies.

6.5.1 Overall Approach

The streetscape design for Mavis Road uses a complete street approach to enhance transit, bicycling and pedestrian opportunities along the corridor. Public art, gateway enhancements, public transit improvements, active transportation and upgraded public spaces enhance the streetscape, upgrade the sustainability of the neighbourhood and integrate the street more fully into the surrounding neighbourhood.

A key challenge facing the design is that narrow boulevards and limited space within the right-of-way restrict planting opportunities along the corridor. This is addressed through strategic planting with bold form and colour to frame views and gateways, including

columnar and smaller plantings where space does not allow for typical streetscape planting. Key locations are highlighted with diverse native, ornamental and columnar species.

Active transportation is addressed through a multi-use trail separated by a boulevard. To enhance the accessibility of the trail, seating areas are provided at key intersections and near transit stops. These locations can be personalized with distinct paving patterns and site furniture, contributing to neighbourhood identity. Through these improvements, Mavis Road is re-imagined as a vital active transportation artery, contributing to the multi-modal transportation goals and objectives of the City of Mississauga.

Key elements of the streetscape design include:

Gateway and Bridge Features

- The existing Mississauga and Brampton gateway markers are enhanced with columnar planting with bold form and colour, welcoming visitors and citizens to the city.
- At the Highway 407 Interchange, planting opportunities are limited to mitigation for disturbance during construction. Currently the area is seeded with no existing trees or shrubs. Seeding opportunities can incorporate colourful perennials, distinctive grasses and plants that provide pollinator benefit.
- The Fletcher's Creek Bridge will not be replaced as part of the project, but provides an opportunity to celebrate the creek, ravine and natural area below. Public art along the guiderails and areas leading up to the Fletcher's Creek Bridge can tell the story of the ravine and its importance to the surrounding community.

Slope Stabilization and Enhancement

- Naturalization and stabilization of banks reduce the long term costs for maintenance while improving aesthetics and providing local wildlife with additional habitat and cover.
- Berms and slopes around bridge structures and along the transportation corridor should be vegetated with colony forming / suckering and deep rooted plant species to assist with slope stabilization, increase infiltration and reduce overland flow.
- Native plant species are used exclusively to preserve ecological diversity.

- Slopes are highly visible and aesthetic plantings are a priority. Large masses of low maintenance, salt tolerant, and hardy materials promote dense colony formation and enhance visual quality.

Protection Of Existing Vegetation

- There is minimal space for tree planting along the corridor; by saving existing vegetation where possible, the character and ecological integrity of the corridor can be preserved and enhanced.
- Limiting the size of the construction area to what is needed and carefully clearing vegetation and trees designated for removal will reduce the chance of further damage to existing trees.
- All trees and vegetation located on adjacent properties are to be protected and preserved; vegetation clearing is not permitted beyond the established work area.
- A Tree Protection Zone and the installation of tree protection fencing which follows standard arboricultural procedures will ensure that existing trees are not damaged during construction.

Low-Impact Development (LID) and Stormwater Management

- Potential opportunities exist for incorporating LID practises into the design of Mavis Road (**Section 6.4.4**) to increase infiltration, including vegetated filter strips, enhanced grass swales and bioretention areas. These slow run-off velocities and filter out sediment and other pollutants through soil infiltration and absorption by plant materials.
- LID techniques have an added benefit of increasing ecological sustainability and improving aesthetics. Through use of native species with aesthetic value, and planting in an efficient and appealing way, LID techniques benefit both the water / waste water processes and provide an aesthetically appealing environment.

Highlighting Key Areas and Intersections

- Highly ornamental species (tolerant of roadside conditions) are used near intersections and high visibility areas. A variety of plant species provides visual interest, frames views and punctuates the driving and pedestrian experience along the streetscape. The sequencing of ornamental columnar ‘character’ trees with larger canopy trees defines the corridor and provides year-round interest.

- Using a variety of species that attract pollinators in open areas will contribute to continued ecological diversity and connectivity, particularly in the area surrounding Fletcher's Creek.
- Despite sometimes narrow boulevards, a diversity of native / salt-tolerant deciduous and coniferous trees are arranged to create a variety of textures and colours. Plant material with changing foliage colour, decorative bark and blossoms for seasonal visual, textural and aromatic interest enhance the driving, cyclist and pedestrian experiences.
- Narrow boulevards can be planted with groundcovers rather than turf. This approach is more ecologically sustainable. Reduces mowing and provides visual interest.
- Planting is avoided in medians and areas that would be difficult to maintain.

Complete Streets

- Active transportation is encouraged through the provision of safe, comfortable and well-connected multi-use trails. By tying into the existing cycling network, the multi-use trail contributes to the overall cycling network and connectivity between neighbourhood destinations.
- Street furniture and small resting areas at high traffic junctions, such as the Derry Road intersection, Sombrero Way (Courtney Park Drive West), Crawford Mill Avenue, and Knotty Pine Grove, will provide rest areas for pedestrians, cyclists and people using other modes of active transportation.

Highlighting Intersections and Transit Stops

- Pedestrian crossings are enhanced by low-height, highly visible plantings and can be further accentuated by varying pavement texture and colour.
- Intersections are enlivened with low-maintenance, colourful plantings outside of sight triangles.
- Where space allows, street trees are positioned between the curb and sidewalk to provide a separation between motorized traffic and pedestrians, increasing comfort of users and providing traffic-calming value.
- Low-growing species are placed under overhead wires to prevent future conflicts, and smaller plantings are positioned to screen utility boxes and unsightly views, but still allow access to these important features.

Reclaimed Public Space

- Trails, seating and enhanced plantings improve the previously under-utilized and vacant public space at the Derry Road and Mavis Road intersection. This new space will serve the neighbourhood as a stopping point along the multi-use trail.
- Transit stop improvements are complimented by plantings which increase the visibility of these elements and provide an aesthetic enhancement to the public realm.
- Planting at the terminus of Old Derry Road creates a needed visual screen between Mavis Road and the residential neighbourhood to the south.

Educational Planting

- Educational plantings at the southwest section of Derry Road and Mavis Road can include regionally native species, pollinator gardens, a variety of ecological land classifications and accompanying educational signs/plaques.
- Protecting the existing educational garden and it's variety of native species, planted by the Region in partnership with local school children, is an ongoing priority.

Exhibit 6-12: View North at Mid-Block
between Magistrate Terrace and Salinger Court

Exhibit 6-13: View South
at Sombrero Way / Courtneypark Drive West Intersection

Exhibit 6-14: View West
at Novo Star Drive / Crawford Mill Avenue

Exhibit 6-15: Fletcher's Creek Bridge
View South

6.6 Utilities

As outlined in **Section 3.6**, there are a number of existing utilities located along the corridor, including watermain, sanitary sewer, gas main, hydro, and telecom. A Utility Plan is found following the Recommended Plan Plates in **Section 6.11** of this ESR. The Utility Plan reflects the information received to date. The plan will need to updated and confirmed in detailed design. Based on preliminary utility information, potential areas of conflict have been identified. Utility design and construction is the responsibility of the respective utility owner. Subsurface engineering investigations during the detailed design phase of the road project will determine if, and to what extent, any conflicts exist or if utility modifications will be required by the road works (or if the utility owner wishes to take advantage of the road construction period to make changes to their plant). The City of Mississauga and Region of Peel will build upon the contacts established during this study to continue to engage with utility owners during the detailed design phase.

A Hydro One corridor runs in the east/west direction crossing Mavis Road just south of Highway 407. These towers will not be directly impacted by the Mavis Road improvements. Since the grade of Mavis Road is not expected to change significantly, it is likely that vertical clearance requirements will also be maintained. Consutlation with Hydro One will occur during detailed design.

Existing Alectra hydro poles are located on the west side of Mavis Road and will need to be relocated, as outlined in **Table 6-8** below. These are primarily located north of Derry Road West and at constrained areas such as intersections. Relocation of these poles will be pursued further during detailed design in consultation with Alectra.

Other utilities such as Bell, Rogers, Telus, and Enbridge Gas may also be impacted as a result of the widening of Mavis Road. These utilities will be contacted during detailed design to confirm the conflicts including third party attachments on hydro poles and the extent of relocation required. During detailed design, the location of any potential utility conflicts with the proposed construction should be verified by field test holes investigation.

Table 6-8: Hydro Poles Requiring Relocation

Location (Station #)	Location (Station #)	Location (Station #)
12+976	12+360	11+705
12+955	12+310	11+680
12+906	12+260	11+628
12+855	12+210	11+580
12+806	12+160	11+428
12+755	12+110	11+072
12+706	12+055	11+030
12+660	12+005	10+650
12+606	11+952	10+600
12+560	11+902	10+550
12+486	11+845	10+515
12+460	11+780	
12+410	11+730	

6.7 Illumination

Continuous illumination will be maintained on Mavis Road for the entire limits of the study. Current practice does not permit the installation of median illumination in a 2.0 m wide median island. The presence of hydro utility poles and their proximity to the roadway allows for dedicated lighting poles on both sides of the road. Therefore, dedicated lighting poles will be utilized on one side and luminaires will be installed on the utility poles on the other side of the road.

The lighting design criteria and equipment selection will be based on the standards and practices of the Region of Peel, City of Mississauga, and Alectra.

6.8 Property Requirements

The Recommended Plan has been developed such that property impacts have been minimized to the extent possible. However, the Recommended Plan will still result in the need to private property in two locations and easements in other locations. The preliminary property impacts are summarized in **Table 6-9**.

Small portions of two properties will need to be severed and purchased to accommodate the Recommend Plan:

- West side of Mavis Road from Station 11+852 to 11+922 – impacted property is a privately owned townhouse/condominium strata (770 Othello Court) located in the northwest quadrant of the Mavis Road / Derry Road West intersection. The impact involves the reduction of the landscaped boulevard adjacent to the intersection, the relocation of the existing property line fence and removal of adjacent trees. It may be feasible to reduce or avoid this property impact by reducing or eliminating the boulevard separating the multi-use path from the roadway. However, this will not be determined until detailed design and the completion of the utility relocation plan.
- West side of Mavis Road from Station 12+840 to 12+980 – Impacted property is a privately owned townhouse/condominium strata located 7360 Zinnia Place, adjacent to Mavis Road. The impact is limited to a reduction in the boulevard / common area between Zinnia Place and Mavis Road, and the removal of mature landscape plantings.

The Recommended Plan will also result in encroachments into City of Mississauga, Region of Peel and MTO properties in 13 locations. One MTO parcel is located at Station 13+680 to 13+760 adjacent to the Highway 407 N-W on-ramp. Although the full parcel will be impacted, it is not known whether this will be a purchased by the Region of Peel or if MTO will retain the property and issue and easement. The Region of Peel will determine the appropriate course of action (property purchase or easement) of the MTO property, in consultation with MTO during detailed design.

The Recommended Plan will result in the need for easements at four private properties in order to accommodate grading, remove landscape plantings where roots will be impacted by adjacent construction activity and reconstruct a noise barrier. Again, the City of Mississauga and Region of Peel will work closely with property owners during detailed design to confirm impacts and develop mitigation measures.

Table 6-9: Preliminary Property Requirements

Location	Preliminary Property Requirements (ha)	Nature of Impact
Private Property		
Condominium Corp: PSCC708 770 Othello Court, Mississauga ON L5W 1H3 C/O Larlyn Management Ltd., 7370 Bramalea Road, Suite 20 Mississauga ON L5S 1N6	0.0022	**Property:** Minor edge encroachment into common area. The property line fence will need to be set back from its existing location and some landscape plantings will be removed. Buildings / residences will not be impacted. **Trees:** 15 trees may require removal; and additional 2 trees may be impacted by grading. Potential for mitigation or replacements (per tree management plan) to be determined in detailed design. **Temporary Easement:** Additional property may be required on a temporary basis during construction for grading purposes; to be confirmed during detailed design. This easement is not included in the preliminary property requirement total.
Condominium Corp: PSCC755 7360 Zinnia Place, Mississauga ON L5W 2A1 C/O Downing Street Property Management Inc. 668 Millway Avenue, Unit 7, Vaughan ON L4K 3V2	0.080	**Property:** 4 to 7 m encroachment into boulevard / common area between Mavis Road and Zinnia Place consisting of guard rail and landscape plantings. Buildings / residences will not be impacted. **Trees:** 33 trees may require removal. The trees appear to be on private and public property. Potential for mitigation or replacements (per tree management plan) to be confirmed in detailed design. **Temporary Easement:** Additional property may be required on a temporary basis during construction for grading purposes; to be confirmed during detailed design. This easement is not included in the preliminary property requirement total.
Public Property (Municipal, Regional, & Provincial)		
City of Mississauga property west of Mavis Road from Station 10+520 to 10+585 PIN: 132132885	0.018	Minor edge encroachment into landscaped area west of Mavis Road consisting of MiWay transit stop, noise wall berm, and plantings.
City of Mississauga property west of Mavis Road from Station 10+585 to 10+610 PIN: 132132894	0.006	Minor edge encroachment into landscaped area west of Mavis Road.
City of Mississauga property west of Mavis Road from Station 10+585 to 10+610 PIN: 132132888	0.001	Full parcel required to accommodate widening of Mavis Road and multi-use trail through this section.

Location	Preliminary Property Requirements (ha)	Nature of Impact
City of Mississauga property west of Mavis Road from Station 10+610 to 10+665 PIN: 132132884	0.005	Minor edge encroachment into landscaped area west of Mavis Road.
City of Mississauga property west of Mavis Road from Station 11+660 to 11+690 PIN: 132131795	0.007	Minor edge encroachment into landscaped area west of Mavis Road.
City of Mississauga property west of Mavis Road at Station 11+680 PIN: 132131794	0.002	Minor edge encroachment into landscaped area west of Mavis Road.
City of Mississauga property west of Mavis Road from Station 12+750 to 12+795 PIN: 140843419	0.003	Minor edge encroachment into landscaped area west of Mavis Road consisting of fence line and plantings.
City of Mississauga property west of Mavis Road from Station 12+800 to 12+840 PIN: 140844882	0.007	Minor edge encroachment into landscaped area west of Mavis Road consisting of fence line and plantings.
City of Mississauga property west of Mavis Road from Station 12+800 to 12+984 PIN: 140844884	0.006	Full parcel required to accommodate widening of Mavis Road and multi-use trail through this section.
MTO property west of Mavis Road from Station 12+978 to 12+984 PIN: 140845068	0.001	Minor edge encroachment into vegetated area adjacent to the Highway 407 E-N/S off-ramp intersection to accommodate widening of Mavis Road and multi-use trail through this section.
MTO property west of Mavis Road from Station 12+978 to 12+984 PIN: 140845070	0.004	Minor edge encroachment into vegetated area adjacent to the Highway 407 E-N/S off-ramp intersection to accommodate widening of Mavis Road and multi-use trail through this section.
Region of Peel property west of Mavis Road at Station 13+680 PIN: 140845450	0.001	Minor edge encroachment into landscaped area adjacent to the Highway 407 S-W on-ramp.
MTO property west of Mavis Road from Station 13+680 to 13+760 PIN: 140845082	0.039	Full parcel required to accommodate widening of Mavis Road and multi-use trail through this section.
Temporary Easements and Tree Removals on Private Property		
759 Sombrero Way, Mississauga ON L5W 1S8	To be determined during detailed design	**Temporary Easement**: Access to property may be required on a temporary basis during construction for

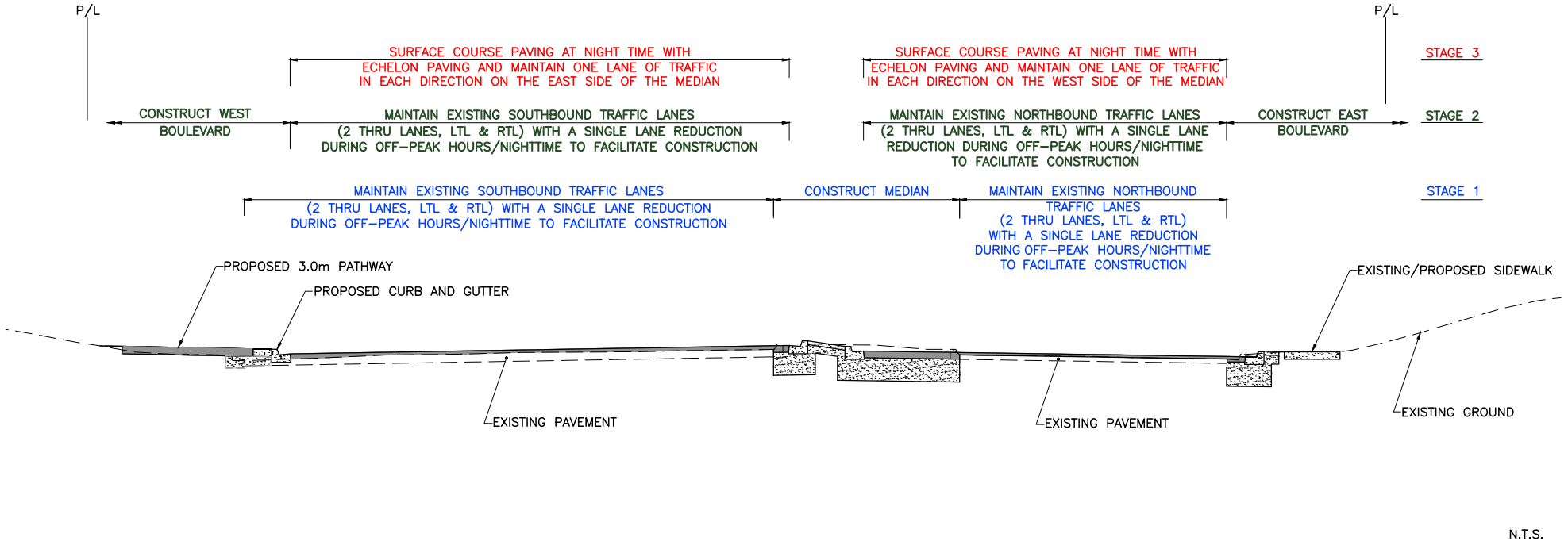
Location	Preliminary Property Requirements (ha)	Nature of Impact
PIN: 132132804		grading purposes and to reconstruct the noise wall; to be confirmed during detailed design.
766 Brass Winds Place, Mississauga ON L5W 1T4 PIN: 132132766	To be determined during detailed design	**Temporary Easement:** Access to property may be required on a temporary basis during construction for grading purposes and to reconstruct the noise wall; to be confirmed during detailed design
735 Twain Avenue, Mississauga ON L5W 1X1 PIN: 140843412	To be determined during detailed design	**Trees:** 5 trees may require removal due to grading. Potential for mitigation or replacements (per Tree Management Plan) to be determined in detailed design. **Temporary Easement:** Access to property may be required on a temporary basis during construction for grading purposes and to construct a new sound wall; to be confirmed during detailed design.
Condominium Corp: PSCC857 Cailiff Street, Brampton ON L6Y 0P9 C/O Orion Management 7-17575 Trinity Drive, Mississauga ON L5T 1K4	To be determined during detailed design	**Trees:** 15 trees may require removal; one additional tree may be impacted due to grading. Potential for mitigation or replacements (per Tree Management Plan) to be determined in detailed design. **Temporary Easement:** Access to property may be required on a temporary basis during construction for grading purposes; to be confirmed in detailed design.

6.9 Construction Staging

No major construction staging concerns have been identified at this time. As a result, high-level construction staging plans for widening Mavis Road from four to six lanes were developed for two typical widening scenarios:

- **Widening both sides, primarily via narrowing of the median:** primary approach for widening Mavis Road between Courtneypark Drive West and Twain Avenue where the proposed road cross-section can be largely accommodated within the existing pavement limits. The typical construction staging plan for this approach is illustrated in **Exhibit 6-16.**
    - **Stage 1 –** maintain existing traffic lanes with a single lane reduction in both directions during off peak hours to facilitate construction of the median.
    - **Stage 2 –** maintain existing traffic lanes with a single lane reduction in both directions during off peak hours to facilitate construction of the median.
    - **Stage 3 –** surface course paving at night time with echelon paving and maintain one lane of traffic in each direction on the opposite side of the median as the paving operation.
- **Widening one side:** approach for widening Mavis Road north of Twain Avenue to Ray Lawson Boulevard where Mavis Road will tie into the existing six lane cross-section.
    - **Stage 1 –** maintain existing traffic lanes to facilitate construction of the bridge structure widening over Hwy 407/ETR, widening one side of Mavis Road and ramp realignments.
    - **Stage 2 –** maintain existing southbound traffic lanes and shift northbound traffic lanes to facilitate construction of the median.
    - **Stage 3 –** surface course paving at night time with echelon paving and maintain one lane of traffic in each direction on the opposite side of the median as the paving operation.

Detailed construction staging plans will be confirmed during the detailed design phase.



N.T.S.

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Exhibit 6-16: Construction Staging for Typical Cross-Section of Mavis Road between Courtneypark Drive West and Twain Avenue

6.10 Preliminary Construction Cost Estimate

A preliminary construction cost estimate summary is presented in **Table 6-10** and the detailed breakdown is included in **Appendix L**.

The costs are in 2017 dollars and include the roadway construction costs, illumination, landscaping, cut/fill, basic utility relocation and structures where applicable. Examples of the minor items included in this estimate are: stormwater management, utility relocation, removals, fencing/noise wall replacements, bus platforms, roadside barriers, pavement marking and signing, etc. The estimate does not include property acquisition costs. For the purposes of this cost estimate the following assumptions are made:

- The coarse layer for the existing pavement limits (i.e. 4 lane cross-section) was assumed to be maintained, with only asphalt resurfacing being required (as per recommendations made in the Geotechnical Report)
- Earth excavation and grading value based on proposed pavement widening area and associated base layer depths (as per recommendations made in the Geotechnical Report)
- An inflation rate of 3% per year was assumed for pricing sources where applicable
- Where pavement work is required along corridor it was assumed that all catch basins will need to be replaced, and that half of all lateral pipe connections will require full-length replacements (25 m) and half will require extensions (8 m).

Table 6-10: Preliminary Cost Estimate for Mavis Road from Courtneypark Drive West to Ray Lawson Boulevard

Mavis Road Limits	Proposed Improvements	Length (km)	Construction Cost (M)
Courtneypark Drive to North City Limits (City of Mississauga)	Road widening from 4-lane urban to 6-lane urban cross-section 3.5 m MUT to west, 1.5 m sidewalk to east	2.75 km	$13.04
North City Limits to Ray Lawson Boulevard (City of Brampton)	Road widening from 4-lane urban to 6-lane urban cross-section 3.5 m MUT to west, 1.5 m sidewalk to east Widening of Highway 407 crossing structure from 4 to 6 lanes	1.15 km	$9.08
	Total	**3.90**	**$22.12**

6.11 Recommended Plan and Streetscape Concept

The Recommended Plan, Streetscape Concept and Utility Relocation Concept Plan are presented at the end of this Chapter.