APPENDIX G
Hydraulic Modelling Report

The naming and description of the Alternative Solutions and Alternative Design Concepts presented in this report may differ from the Environmental Study Report. The hydraulic results and technical conclusions remain valid.

Matrix Solutions Inc.
A Montrose Environmental Company

DIXIE DUNDAS FLOOD MITIGATION PROJECT
HYDRAULIC MODELLING REPORT
LITTLE ETOBICOKE CREEK
CITY OF MISSISSAUGA

Prepared for:
THE CITY OF MISSISSAUGA

Prepared by:
MATRIX SOLUTIONS INC.

Version 1.0
March 2024
Mississauga, Ontario

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DIXIE DUNDAS FLOOD MITIGATION PROJECT

HYDRAULIC MODELLING REPORT

LITTLE ETOBICOKE CREEK

CITY OF MISSISSAUGA

Prepared for City of Mississauga, March 2024

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1 INTRODUCTION

Matrix Solutions Inc. is completing the Dixie Dundas Flood Mitigation Schedule C Municipal Class Environmental Assessment Project (the Project) for the City of Mississauga (the City). The purpose of the Project is to develop and evaluate flood mitigation alternatives for the Dixie Dundas area. A significant flood spill occurs along Little Etobicoke Creek upstream of Dixie Road toward Queen Frederica Drive, crossing the watershed divide from Toronto and Region Conservation Authority (TRCA) jurisdiction into the Applewood Creek watershed in Credit Valley Conservation (CVC) jurisdiction. The spill puts hundreds of downstream properties at risk of flooding, which were not formally identified as at-risk until recently. The City is interested in intensifying development in portions of the Dixie Dundas lands to fulfill a vision for growth. However, due to the flood risk, portions of the Dixie Dundas lands are within an existing Special Policy Area (SPA) as defined in the City's Official Plan. The envisioned growth cannot be fully realized without better defining and potentially reducing risks and impacts within the SPA.

The objective for the Project is to manage spill from Little Etobicoke Creek to reduce flood risks, to protect existing properties, and to enable growth. The Project will provide a comprehensive flood remediation plan for the Dixie Dundas area through investigating feasible alternatives including replacement of the Dixie Road bridge and capacity improvements within Little Etobicoke Creek.

1.1 Project Location Overview

The Project area consists of two main areas. The first portion of the study area (Dixie Area) consists of the Little Etobicoke Creek channel and adjacent floodplain lands from 500 m upstream of Dixie Road to approximately 750 m downstream at the channel bend channel bend (Figure 1). The second portion of the study area (Dundas Area) consists of the Little Etobicoke Creek channel and adjacent floodplain lands from the channel bend 500 m upstream of Dundas Street to 600 m downstream of Dundas Street- just upstream of the Canadian Pacific (CP) railway crossing (Figure 2). Together these two distinct and related portions of the study comprise the overall study area of the Project.

Alternative solutions explored for the Dixie Area, further outlined in this report, ideally will mitigate the large existing spill to the Applewood Creek watershed, via City streets, that occurs under conditions of flooding. Mitigated flood flows would instead be contained within the Little Etobicoke Creek channel only. Containing the full flood flow within the channel at the Dixie Area; however, will increase flood flows downstream at the Dundas Area. Accordingly, the Project also involves mitigative solutions for the Dundas Area to ensure the effects of the increased flow in the watercourse do not cause negative impacts.

Analysis outlined in later sections of this report indicates that the alternative solutions proposed for the Dundas Area and Dixie Area are hydraulically distinct. The two portions of the overall study area are far enough apart in grade and distance that a change to the Dundas Area does not translate its hydraulic effects upstream to the Dixie Area. The hydraulic separation of the two areas has allowed for alternative solutions for each area to be progressed independently, with the overall solution for the Project being the combination of the two.

The lands surrounding the entire study areas (i.e., both Dixie Area and Dundas Area) are urban, consisting of a variety of park, commercial, industrial, and residential land uses, including designated SPAs which regulate future development due to flood risks. The Dixie Area includes the Applewood SPA and the Dixie/Dundas SPA.

Special Policy Area (SPA)
Dixie Road Study Area (500m upstream of the Dixie Road Bridge to the channel bend)
Spill Direction
Flow Direction
Watercourse
Regional Road
Road

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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ENVIRONMENT & ENGINEERING

City of Mississauga
Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

Dixie Road Study Area

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 1

Special Policy Area (SPA)
Dundas Street Study Area (Channel bend to CP Rail)
Spill Direction
Flow Direction
Watercourse
CN Railway

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:6,500 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Dundas Street Study Area

Date: June 2022	Project: 24603	Submitter: N. Burrows	Reviewer: K. Hofbauer

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Figure 2

1.2 Purpose of this Report

This hydraulic modelling report is intended to provide the required technical analysis that supports Phases II and III of the Project. This report builds on the findings of the *High-Level Alternative Solutions and Preliminary Hydraulic Model Screening* (Matrix 2019a) and the *Dixie Dundas Flood Mitigation Project Phase 1 Feasibility Study Final Report* (Matrix 2020). This report presents the methods and the results of the hydraulic assessment for the alternative solutions and the alternative design concepts.

This technical report summarizes the following:

- Previous studies
- Existing conditions
- High-level screening
- Assessment methods
- Alternative solutions
- Design concepts

2 PREVIOUS STUDIES

2.1 Etobicoke Creek Hydrology Update

The Etobicoke Creek Hydrology Update study (MMM 2013), prepared for the TRCA, updated the hydrologic models for the Etobicoke Creek watershed to assess existing and future land use conditions. The TRCA's approved hydrologic model was used to develop the estimated peak flows for the 2-year to 350-year design storms and the Regional storm under existing and future land use scenarios. These flow values support the hydraulic modelling and mapping updates and the assessment of mitigation alternatives in the subsequent studies described below, including this Project.

2.2 Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area

The Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area study (MMM 2015) produced a 1D-2D integrated MIKE FLOOD hydraulic model of Little Etobicoke Creek. This model was used to define Regional flood maps at Applewood SPA and Dixie/Dundas SPA. A 1D-2D model was required to capture the complex nature of the overland flow patterns within the study area, which could not otherwise be adequately delineated using traditional 1D hydraulic modelling techniques (e.g., HEC-RAS). The study also identified and assessed several preliminary flood mitigation alternatives based on the modelling results.

2.3 Special Policy Areas - Preliminary Flood Mitigation and Remediation Assessment Dundas Street Transportation Master Plan

The Dundas Street Transportation Master Plan (AECOM 2019) reviewed potential flood mitigation measures to support eliminating or reducing the restrictions of the SPAs in the Dixie Dundas study area. Removing the SPA restrictions would enable intensification and transportation improvements along the Dundas Street corridor. The assessment identified that Little Etobicoke Creek flooding is caused by an undersized main channel and floodplain, undersized bridges and culverts, and large contributing upstream flows which have been intensified by the effects of upstream urbanization. A long list of alternatives was developed, and of these, five flood mitigation measures were carried forward for modelling in MIKE FLOOD. The recommended alternatives from the AECOM (2019) study were considered in the high-level screening phase of this Project.

2.4 Little Etobicoke Creek Flood Evaluation Study and Master Plan

Phase 1 of the Little Etobicoke Creek Flood Evaluation Study and Master Plan (Matrix 2021) expanded upon the MMM (2015) modelling to further characterize flood risk in the Dixie Dundas area and provide guidance for the TRCA and CVC. In Phase 2 of that project, Matrix developed an urban dual drainage model using PCSWMM 2D for the entire Little Etobicoke Creek watershed to assess areas at risk to both urban and riverine flooding. Portions of the study area were further modelled using a three-way integrated 1D-2D model to evaluate the feasibility and effectiveness of implementing stormwater management ponds in two flood prone areas. Overall, the Flood Evaluation Study included flood characterization, recognition of flood mechanisms, identification of flood risk areas, and assessment of flood remediation plans.

Phase 1 of the Little Etobicoke Creek Flood Evaluation Study and Master Plan included an expansion of the 1D-2D integrated MIKE FLOOD model developed for the Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area (MMM 2015). The purpose of the expanded model was to understand the extents of the impact of the overland spill from Little Etobicoke Creek.

3 EXISTING CONDITIONS

TRCA and the City of Mississauga have been studying existing flood risk in this area for many years. Existing conditions flood risk and characterization have not been directly repeated within the current project but instead rely on the work completed for other recent projects including Etobicoke Creek Hydrology Update (MMM 2013), Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek (MMM 2015), and the Little Etobicoke Creek Flood Evaluation Study, Master Plan Report (Matrix 2021), summarized in Section 2.

3.1 Hydrology

MMM completed the hydrology update for Etobicoke Creek in 2013 for TRCA. A VisualOtthymo model was developed for the Etobicoke Creek watershed. The hydrologic model development included: computing catchment parameters, identifying suitable rainfall events, and calibrating and validating the model. A total of 280 subcatchments are included in the hydrologic model with an average catchment area of 80 ha. The model used precipitation from rain gauges at Heart Lake and Mississauga Yard Works and was calibrated to three streamflow gauges in the Etobicoke Creek watershed. The 2-year through 350-year design storms were simulated using the 12-hour AES distribution. Consistent with hydrologic modelling principles that align with provincial policy, the Regional storm (Hurricane Hazel) was simulated using a 12-hour storm period with antecedent moisture conditions represented by an AMC III condition. Additionally, all SWM facilities were removed. A frequency analysis and sensitivity analysis were conducted to compare against statistically derived flows at hydrometric stations with long periods of record and to further understand the calibrated watershed model and compare flows to previous studies.

The watershed catchment and flow nodes within the Dixie Dundas study area are shown in Figure 3. Flows for the design storms and Regional storm within the study area for future conditions are presented in Table 1.

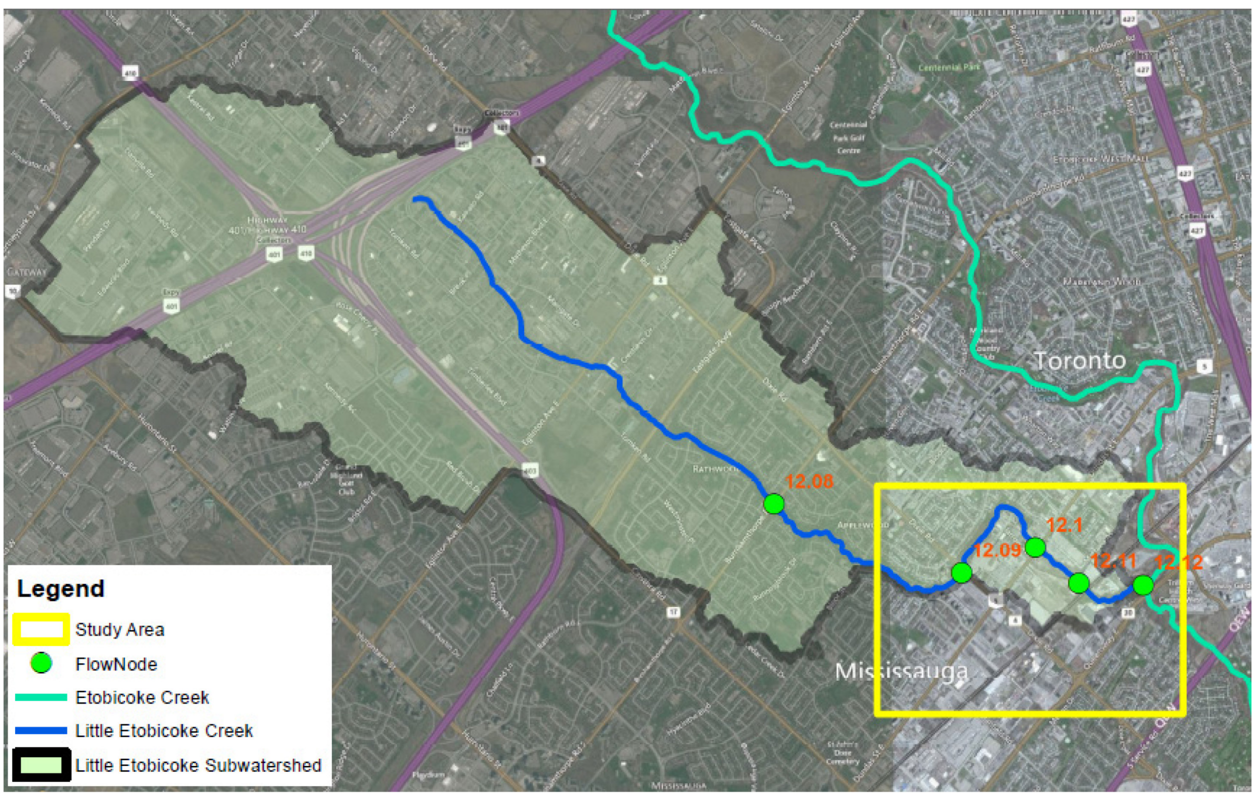

FIGURE 3 Little Etobicoke Creek Watershed and Flow Nodes (MMM 2015)

TABLE 1 Summary of Peak Flows for Little Etobicoke Creek (MMM 2015, Table 1.1)

Flow Location		Peak Flow Rate[1] (m^3/s)							
Location	Node	2-year	5-year	10-year	25-year	50-year	100-year	350-year	Regional Storm
Bloor Street	12.08	42.9	55.4	63.9	75.6	84.5	93.7	141.4	193.6
Dixie Road	12.09	41.8	54.5	62.9	74.5	83.3	92.4	140.6	191.9
Dundas Street	12.10	42.9	56.5	65.5	77.6	86.8	96.3	146.6	201.8
Queensway	12.12	44.7	58.7	68.3	80.9	90.4	100.2	152.3	209.5

1: Peak flow for future conditions. Source Etobicoke Creek Hydrology Update (MMM 2013), based on 12-hour AES storm

The flows from the 2013 Etobicoke Creek Hydrology Update (MMM 2013) have been used to support the hydraulic modelling and mapping updates and the assessment of mitigation alternatives in the subsequent studies described in Section 3. The future conditions peak flows from the 2013 study presented in Table 1 are also used in this Project.

3.2 Riverine Flood Characterization

Following the hydrology study, MMM completed the Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek Report (2015) to map existing conditions within the SPA. Figure 4 illustrates the location of key hydraulic features within the study area (e.g., bridges, berms and flood walls) including photographs for each feature. The flood wall and flood berm are not considered permanent flood control and therefore, consistent with current Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry (MNDMNRF) practice, should not be included in assessment of Regional storm conditions. As such, the flood control features were removed from the Regional and 350-year storm models.

Special Policy Area (SPA)
Spill Direction
Flow Direction
Watercourse
Regional Road
Road

Notes:
Figures: MMM Group Limited. 2015. Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area, Little Etobicoke Creek. Prepared for Toronto and Region Conservation Authority, Report No. 1412606-000. Mississauga, Ontario. January 2015.

1. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

Key Hydraulic Features (Bridges, Flood Walls, and Berms)

Date: June 2022	Project: 24603	Submitter: N. Burrows	Reviewer: K. Hofbauer

Figure 4

The Applewood and Dundas/Dixie Special Policy Area Study (MMM 2015) found that spill from Little Etobicoke Creek to Queen Frederica Drive starts to occur during a 5-year event in the watercourse. The spill occurs just upstream of the existing flood wall and between the two pedestrian bridges (see Figure 4). The magnitude of the spill during the 5-year event is small at approximately 1.0 m^3/s of the total peak flow of 58 m^3/s. However, the fraction of flow that spills from Little Etobicoke Creek to Queen Frederica Drive increases significantly for larger flow events. The percentage of spill flow to total flow increases from near zero for the 5-year event to 49% for the 350-year event with the existing flood wall and flood berm in place (MMM 2015). The breakdown of spill flow to total flow for each of the assessed events is presented in TABLE 1.

TABLE 1 Spill to Queen Frederica (MMM 2015, Table 6.1)

Condition	Return Period	Flow Rate (m^3/s)			Spill to Queen Frederica Drive (%)
		Total Flow	Flow in channel at Dixie Road	Spill to Queen Frederica Drive	
With Existing Berm and Flood Wall	5-year 25-year 100-year 350-year	59 81 100 152	58 65 70 78	1 16 30 74	<2 20 30 49
Without Existing Berm and Flood Wall	350-year Regional	152 210	74 80	78 130	51 62

The wall and berm has a small impact on the fraction of spill from Little Etobicoke Creek to Queen Frederica Drive during the 350-year event; increasing the spill rate from 49% of the total flow to 51% of the total flow. For the Regional storm event, 62% of the total flow spills into the Applewood SPA, primarily along Queen Frederica Drive. The magnitude of the spill means that only approximately 80 m^3/s is conveyed by Little Etobicoke Creek through the Dixie Road bridge during a Regional event, which is equivalent to the peak flow generated by the 25-year event (MMM 2015).

Although the location of the spill is predominately upstream of Dixie Road, there is also some spill between Dixie Road and Dundas Street to the Dixie Dundas SPA (refer to Figure 4). There is no spill on the downstream side of Dixie Road under existing conditions with the berm in place for all events up to and including the 350-year event. However, if the existing berm is removed from the analysis (following provincial policy), spill occurs for both the 350-year event and the Regional storm. The existing conditions Regional storm depths are presented in Figure 5. The spill flow exits the Little Etobicoke Creek floodplain between buildings downstream of Dixie Road, and then flows southeasterly to Dundas Street and back to Little Etobicoke Creek. Flows downstream of Dixie Road will increase as the upstream spill between Queen Frederica Drive and Dixie Road is mitigated and contained. As such, flows downstream of Dixie Road, including the secondary spill area within the Dixie Area and all of the Dundas Area, will experience increased flows when the primary spill is mitigated. This is a key consideration in the Project.

The Dixie Road bridge is a recognized flow constraint within the study area (MMM 2015, AECOM 2019, Matrix 2021). Although the bridge's impacts have not been quantified separately from the channel capacity, the bridge flow capacity is a key factor in the flood levels and associated spill at Queen Frederica Drive. The pedestrian bridges upstream of Dixie Road have not been assessed in detail as part of the current project. The costs and other implications related to maintaining or replacing these bridges are minor relative to other works within this study and not considered a constraint.

The Dundas Street bridge is situated within a deeper valley along a steeper portion of the channel than the Dixie Road bridge. Currently, the Dundas Street bridge is not overtopped under any flow, up to the Regional event. The current level of service provided by Dundas Street bridge is due to the spill upstream which reduces the peaks flow up to 62% under existing conditions. Once the flow is contained within the Little Etobicoke Creek channel through mitigation works, the Dundas Street bridge would be overtopped during flood flows in the range of the 50-year flow event.

Flow Direction

Property Boundary

Existing Conditions Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:

Run completed by TRCA. Run Date: October 20th, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:5,000 metres

50 0 50 100

NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Existing Conditions Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 5

3.2.1 Flood Risk Assessment

A risk assessment was completed as part of the Little Etobicoke Creek Flood Evaluation Study (Matrix 2021) to characterize the overland flooding resulting from the spill. The 2021 study extended the model domain to further map the extent of the overland flow path for nine different storms. Flood hazard and risk mapping for the extended area are presented in Appendix A. The results of the 2021 study were reviewed as part of this Project and considered acceptable for use as the existing conditions of the Project.

The flood risk assessment considers three risk factors: depth, velocity, and depth-velocity product. In accordance with current MNRF practices, the following risk criteria apply (Table 3). Low risk flooding includes areas that are inundated but where vehicular and pedestrian ingress and egress are still feasible. Medium risk areas do not permit vehicular ingress and egress, but pedestrian ingress and egress is possible. High risk areas do not facilitate safe land access of any kind. These flood risk criteria were used to develop the flood risk mapping presented as Sheet 4 in each of Maps 1 through 9 in Appendix A.

TABLE 3 Flood Risk Criteria

Risk Level	Low	Medium	High *
Depth	≤ 0.3 m	> 0.3 m and ≤ 0.8 m	> 0.8 m
Velocity	≤ 1.7 m/s	≤ 1.7 m/s	> 1.7 m/s
Depth-Velocity Product	≤ 0.37 m^2/s	≤ 0.37 m^2/s	> 0.37 m^2/s
* Exceedance of any one of the criteria results in high risk.			

3.3 Constraints

Key project constraints within the study area were identified during the background review, technical studies, and through data received from the TRCA, City of Mississauga, and Region of Peel. The constraints were documented in the Feasibility Study and will be documented in the forthcoming Environmental Study Report (ESR). These constraints were considered and accommodated as much as practical in the development of alternative solutions and design concepts. The key constraints include property, infrastructure, natural heritage, and archaeology constraints, and are summarized in the following subsections.

3.3.1 Property

Residential, commercial, and industrial properties are adjacent to the channel corridor in the study area. Immediately upstream of Dixie Road, parking lots abut the creek along both the north and south sides. These parking lots have been identified as property constraints to be considered within the investigation of flood mitigation solution and are summarized as follows:

- **Dixie Area - North of Little Etobicoke Creek:** Along the north side of the Creek and within 100 m upstream of Dixie Road, surface parking for the nearby apartment towers is approximately 10 m from the Creek bank, and an underground parking structure is approximately 20 m from the Creek bank.

- **Dixie Area - South of Little Etobicoke Creek:** Within 190 m upstream of Dixie Road, the surface parking of the commercial plaza is typically 20 m to 30 m from the Creek bank. Between 190 m and 400 m upstream of Dixie Road, the surface parking for the nearby apartment towers is within 10 m from the Creek bank.

Commercial and industrial properties abut the Little Etobicoke Creek corridor within the Dundas Area. These parking lots have been identified as property constraints to be considered within the investigation of flood mitigation solution and are summarized as follows:

- **Dundas Area - Upstream (north) of Dundas Street:** The Creek valley is particularly narrow over its 150 m section upstream of Dundas Street East. The total valley width in this area is typically only 25 m wide compared to a typical valley width of 90 m in the 500 m downstream of Dixie Road and 60 m over the 550 m downstream Dundas Street East. The parking lots of adjacent properties are within about 5 m of Creek, and buildings are located within about 20 m.

- **Dundas Area - Downstream (south) of Dundas Street:** The Creek valley widens compared to the upstream area to a typical width of 60 m from Dundas Street East to the CN Rail located approximately 550 m downstream. The parking lot of the commercial property along the east side of the Creek is within approximately 12 m of the channel.

3.3.2 Utilities and Water Infrastructure

Key linear infrastructure crossing Little Etobicoke Creek within the Dixie Area are identified as follows:

- **400 m upstream of Dixie Road:** a 2,100 mm feeder main crosses the Creek with approximately 2 m of cover between pipe obvert and the existing channel bed.

- **Dixie Road right-of-way:** a 900 mm diameter sanitary sewer crosses the Creek with approximately 0.5 m of cover depth and a 400 mm watermain with approximately 1.9 m of cover; a concrete utility conduit is exposed (CH2M Hill 2013). A 2,400 mm diameter feeder main crosses below the Creek at this location with over 20 m of cover depth (CH2M Hill 2013) and is not considered a constraint to flood mitigation solution.

- **550 m downstream of Dixie Road:** the fluvial geomorphology assessment (Matrix 2019b) and a TRCA infrastructure hazard monitoring record (2018) identified a 450 mm sanitary sewer that is exposed.

- **Storm outlets:** ten storm sewer outlets discharge into the Creek within the study area.

- **Overhead Utilities** include power lines that cross the Creek along the east (downstream) side of Dixie Road and run parallel along the south side of the Creek from 300 m downstream of Dixie Road to 180 m upstream.

Key linear infrastructure crossing Little Etobicoke Creek within the Dundas Area are identified as follows:

- **Proposed Watermain:** The Region is planning to install a 200 mm diameter watermain along Dundas Street East and crossing approximately 1.8 m below the Creek.
- **Siphon Sanitary Sewer:** A 200 mm, 450 mm, and 600 mm diameter siphon sanitary sewer crosses at Dundas Street Bridge. The vertical siphons have a length of approximately 33 m.
- **Sanitary Sewer:** The Region shared plans to install a trunk sanitary immediately east of the Creek. Within the expanded study area, approximately 150 m upstream of the CN Rail.
- **Storm outlets:** There are three storm outlets along Dundas Street that outlet at the bridge. There is one storm outlet each on the west side of the upstream and downstream banks.

3.3.3 Natural Heritage and Archaeology

The natural heritage and archaeology studies identified the following key flood mitigation constraints:

- The Significant Natural Area including the significant wildlife habitat for the confirmed Eastern Wood Pewee (Species at Risk) and potential bat maternity roosting (Species at Risk).
- A minimum 25 m radius around the Butternut (if it is confirmed to be a pure species) downstream of Dixie Road.
- The requirements for a Stage 2 archaeology assessment with test pits at previously undisturbed areas that would potentially be disturbed as part of the flood mitigation. No further action is required in the Dundas Area for the archaeology assessment.

4 HIGH-LEVEL SCREENING

High-level flood mitigation solutions were identified collaboratively by Matrix, the TRCA, and City of Mississauga. These high-level solutions included those presented in the *Dundas Street Transportation Master Plan* (AECOM 2019). High-level solutions considered for screening include:

- conveyance improvements
- flood containment
- flow diversions
- Regional storage
- policy measures

A summary of the screening results with detailed descriptions are provided in the technical memorandum *High-Level Alternative Solutions and Preliminary Hydraulic Model Screening* (Matrix 2019a), included as Appendix B of this report, and the *Dixie Dundas Flood Mitigation Project Phase 1 Feasibility Study Final Report* (Matrix 2020). Several variations were screened for each high-level alternative solution. Flow storage and flow diversion design options were not deemed feasible nor are they practical for reasons that include land constraints, provincial policy, and the vast storage requirements needed to reduce the Regional flows enough prevent spills. The hydraulic screening concluded that containing flows within the Little Etobicoke Creek valley corridor is the best mitigation approach to fit the land constraints imposed by the highly urbanized watershed. While the high-level alternative solutions presented in Appendix B are focused on the Dixie Area, the conclusions are appropriate for the Dundas Area as well.

The results of the *High-Level Alternative Solutions and Preliminary Hydraulic Model Screening* informed the selection of alternative solutions for the Project. Conveyance improvements and flood containment alternatives are carried forward to the Alternatives Solutions phase of the Project (refer to Section 6 for Dixie Area, and Section 7 for Dundas Area).

5 ASSESSMENT METHODS

5.1 MIKE FLOOD Modelling

Matrix concurred with TRCA and the City that MIKE FLOOD is an appropriate model for assessing alternative solutions due to the hydraulically complex study areas resulting from the Little Etobicoke Creek spills. The MIKE FLOOD model is able to accommodate and process the complex interaction between the Creek and the urban area by combining a MIKE 11 1D riverine model and a MIKE 21 2D overland flood model. Matrix developed alternative solutions to mitigate the Little Etobicoke Creek spill and assessed them using the MIKE FLOOD hydraulic model previously created by MMM (2015) and updated by TRCA (2020). The extended MIKE FLOOD model created for the Little Etobicoke Creek Flood Evaluation Study (Matrix 2021) was not used for the Project. The extended model was created to understand the extents and impacts of the overland spill after it leaves Little Etobicoke Creek. The purpose of this current Project is to eliminate the spill therefore, tracking the spill extents over a larger area is not required for the Project.

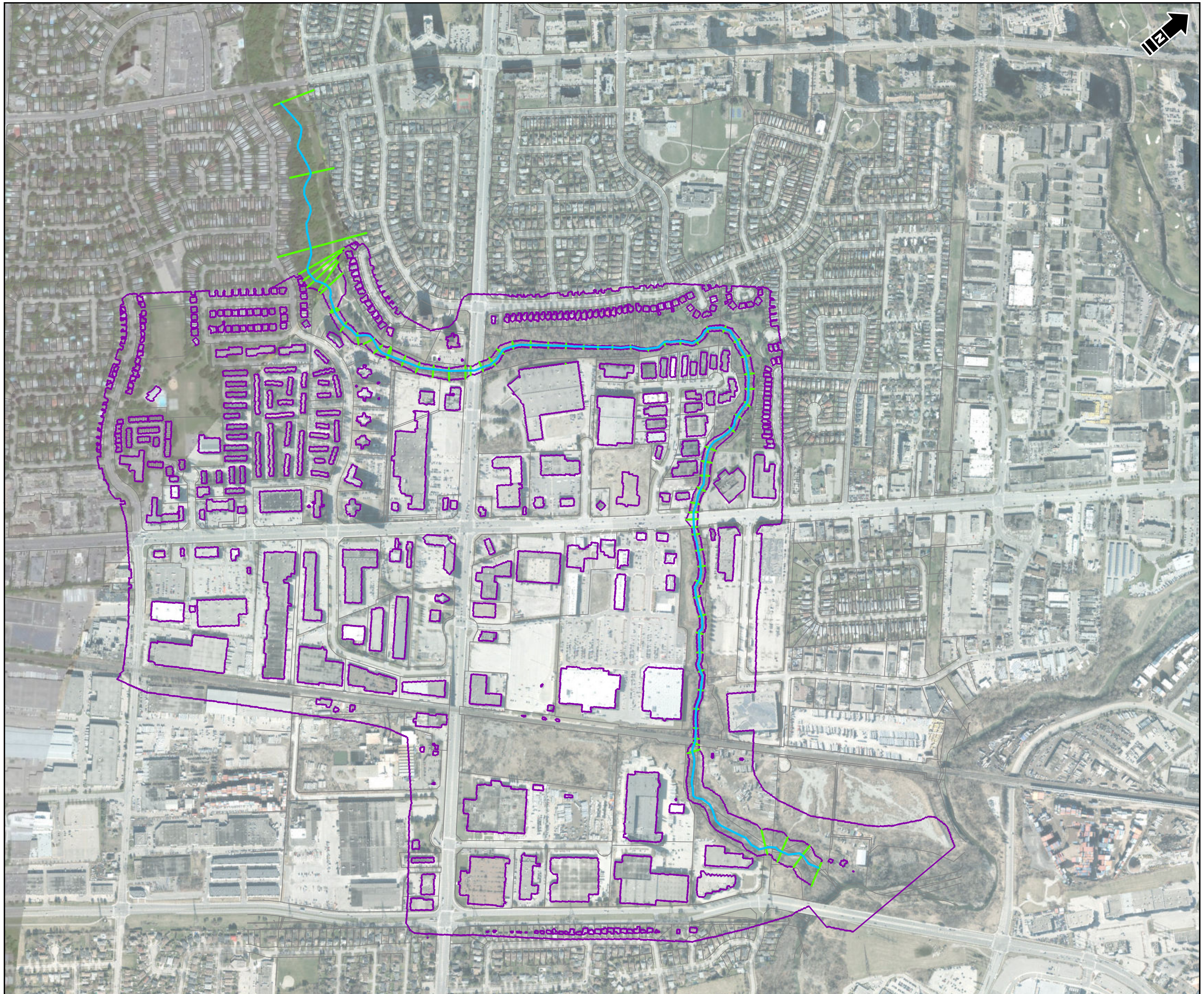
All analyses completed for the Project are based in NAD 83 zone 17 and Canadian Vertical Geodetic Datum 1928 with 1978 adjustment (CVGD 28:78). The MIKE 21 2D model used in this study is based on 2012 LiDAR data provided by TRCA and CVC. A review of the local topography and development was completed for the Project to ensure the continued appropriateness of using the model. No hydraulically significant changes have occurred within the study area since 2012. Accordingly, the 2012 LiDAR data is sufficient for use in the Project.

The 1D riverine model is comprised of channel cross-sections that are coupled to a 2D model surface at the top of bank. The 2D portion allows for a detailed representation of spill locations along the channel and spill flow paths throughout the study area as it provides a detailed representation of the bank profile, overland flow paths, and obstructions. Figure 6 illustrates the MIKE FLOOD model set-up including 2D model domain and 1D cross-sections.

The boundary condition for the 1D riverine portion of the MIKE FLOOD model is consistent with the approved HEC-RAS model (TRCA 2016) for Etobicoke Creek, which includes Little Etobicoke Creek. The model has cross-sections spaced approximately every 50 m with cross-sections situated from left to right looking downstream. The existing MIKE 11 model extends from approximately 450 m south of Bloor Street at the upstream end, to the confluence with the main branch of Etobicoke Creek at the downstream end. The MIKE 11 model extents are sufficient to represent the spill from Little Etobicoke Creek. The flow from flow node 12.12 at The Queensway (refer to Table 1) is applied at the upstream extent of the study area to provide a conservative peak flow. The model was run to represent a steady state flow in accordance with MNRF policy.

The MIKE 21 and uses a 2 m × 2 m grid to represent the surface topography and incorporates building footprints as blocked obstructions to ensure water cannot flow through the buildings. Boundary conditions are assigned to the 2D model at the south edge of the model domain along the rail west of Dixie Road and along The Queensway east of Dixie Road. 2D boundary conditions are also assigned along the channel beyond the extents of the 1D channel along the main branch of Etobicoke Creek upstream and downstream of the confluence with Little Etobicoke Creek.

The model does not include the existing floodwall located upstream of Dixie Road, nor does it include the existing berm downstream as the objective of the Project is to mitigate flood risk in the Regional event. Both existing barriers are removed from the model. MNRF policy is to assume flood barriers could fail during the Regional event (i.e., non-permanent solutions; MNR 2002). Therefore, alternative solutions evaluated in this Project also do not rely on the existing, non-permanent flood protection located in the study area. The primary goal of this assessment is to evaluate the alternative solutions for capability and feasibility to address the spill resulting from the Regional storm. Additional flow event simulations will be completed at subsequent stages in the Project for the preferred alternative.



Model Domain
Property Boundary
Water Course
Cross Section

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

1:10,500 metres
150 0 150 300
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
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City of Mississauga
Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

MIKE Flood Model Setup

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

Figure 6

5.2 Assessments for Each Study Area

As outlined in Section 1.1 of this report, the Project area consists of two main portions: the Dixie Area and the Dundas Area. Matrix used the MIKE FLOOD model to assess the alternative solutions for each study area as described further in Section 6 for the Dixie Area, and Section 7 for the Dundas Area. Due to the distance and elevation difference between the two study areas, the alternative solutions at the Dundas Area (downstream) do not impact the alternative solutions identified for the Dixie Area. As the study areas are hydraulically independent, the assessment of alternative solutions at each area were completed independently. The upstream Dixie Area was assessed first followed by alternatives for the Dundas Area.

5.2.1 Modelling of Alternative Solutions - Dixie Area

For the Dixie Area, modifications were made to the existing MIKE model to represent various proposed conditions associated with the different alternative solutions being considered. Model changes included channel cross-sections, coupling locations, 2D surface within the floodplain, and bridges. For some of the alternative solutions, the Dixie Road bridge was removed conceptually from the model to allow assessment of idealized conditions. If a clear span bridge design could not be achieved within an alternative solution being evaluated, instream piers were represented in the model using a flow area reduction factor. Additionally, the two existing pedestrian bridges within the Dixie Area were removed from the model to accommodate channel widening. It is assumed that pedestrian bridges incorporated into the future design will have minimal impact on flood levels.

5.2.2 Modelling of Alternative Solutions - Dundas Area

Spill remediation at the Dixie Area results in an additional 130 m^3/s of flow being conveyed in the Little Etobicoke Creek channel to the Dundas Area. This increased flow, if left unmitigated, would result in increased flood levels at the Dundas Area, including an overtopping of the existing Dundas Street bridge. Alternative Solutions have therefore been examined at the Dundas Area, with these solutions also analyzed using hydraulic modelling.

Alternatives for the Dundas Area were first screened using a 1D model (the uncoupled MIKE 11 model from the MIKE FLOOD model). Alternatives were identified that contained the flow at Dundas Street. These alternatives were later verified in the coupled 1D-2D MIKE FLOOD model. Interpolated cross-sections downstream of Dundas were recut from terrain in the floodplain to improve mapping using 1D.

6 ALTERNATIVE SOLUTIONS - DIXIE AREA

Based on the conclusions of the high-level screening outlined here and in the Feasibility Study, three alternative solutions, each representing a different approach to keeping flow within the valley corridor, were identified and developed for assessment and evaluation as follows:

- Alternative 1 - Improved Conveyance with Minimized Footprint
- Alternative 2 - Improved Conveyance by Making Room for the Creek
- Alternative 3 - Flood Containment with Mitigation for Upstream Impacts

These alternative solutions each combine channel works with a replacement of the Dixie Road bridge. Drawings 1-1 to 3-5 (Appendix C) illustrate the alternative solutions in plan, profile, and cross-section.

The above-referenced flood mitigation channel concepts and bridge replacement concepts were also translated by R.V. Anderson Associates into conceptual designs for the new larger bridge and required changes to Dixie Road for each alternative solution are summarized in Appendix D.

6.1 Dixie Alternative 1 - Improved Conveyance with Minimized Footprint

Alternative 1 (Figure 7) creates an oversized and incised channel, from 500 m upstream of Dixie Road to 700 m downstream. This alternative includes lowering 600 m of the channel approximately 1 m on average from the location of the upstream existing pedestrian bridge (#1) downstream through Dixie Road for approximately 100 m. The wider channel does not have a well-connected floodplain, but instead resembles more of a gully-like configuration where it is being lowered. At the upstream tie-in, a steeper transition is made to the upstream existing channel.

The combination of lowering and widening (including implementing the wider Dixie Road bridge) is sufficient to achieve objectives of containing the spill at Queen Frederica Drive. The alternative solution achieves this by lowering levels upstream of Dixie Road. Beyond 100 m downstream of Dixie Road the channel bed profile for Alternative 1 extends to meet the existing channel slope at the downstream extent of works where the slope continues naturally at a higher gradient downstream. The alternative channel invert ties into the existing channel invert with a drop near the existing pedestrian bridge 1.

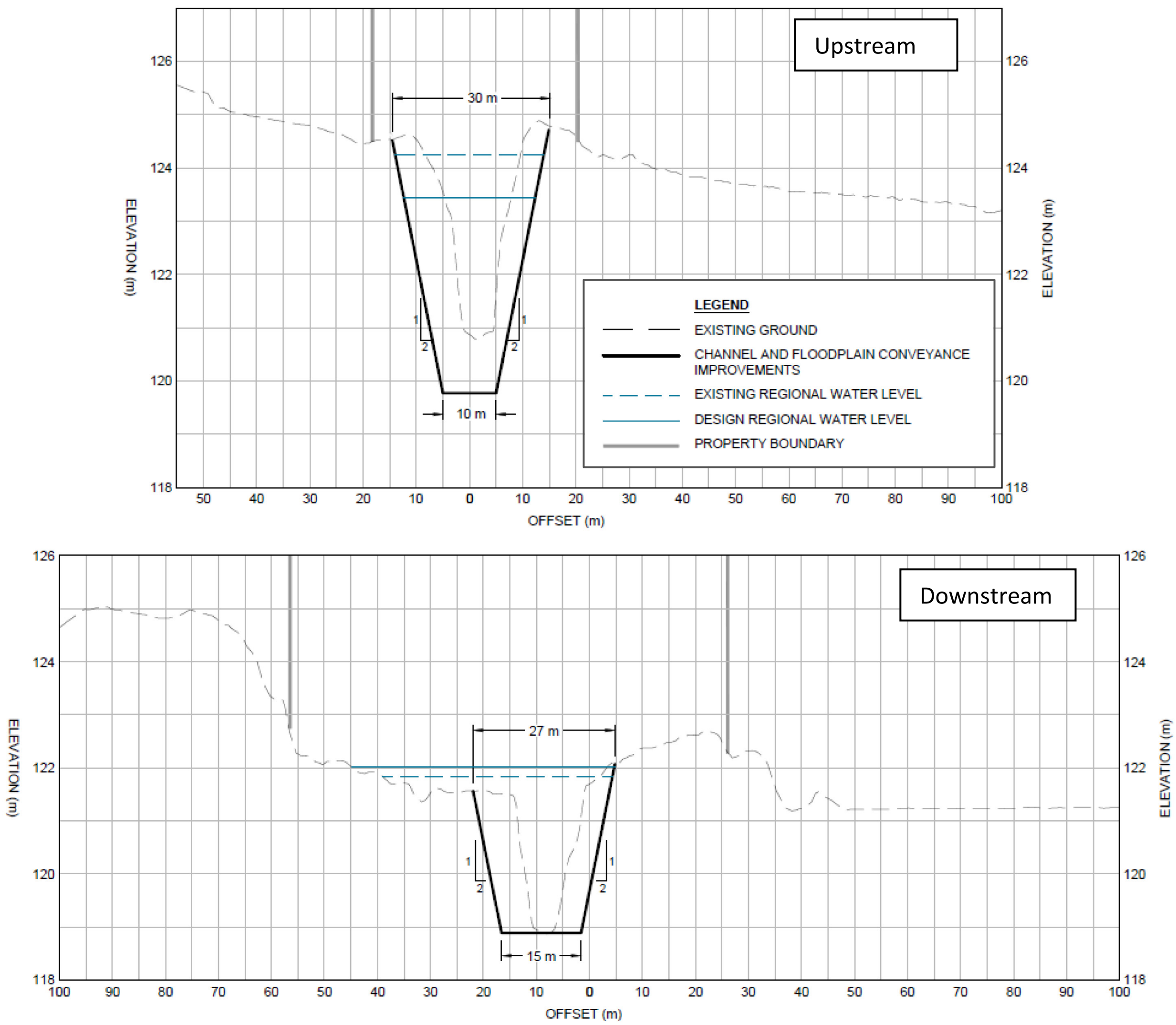


FIGURE 7 Dixie Alternative 1 - Typical Cross-Section Upstream and Downstream of Dixie Road

The Alternative 1 channel includes a 10 to 15 m bottom width with 2:1 side slopes. It has a wider and deeper footprint than the existing conditions channel. Refer to Drawings 1-1 to 1-5 in Appendix C for additional cross-sections as well as plan and profile drawings.

Alternative 1 requires an approximate 26 m bridge span at Dixie Road. Dixie Road would need to be raised approximately 1.7 m to accommodate the proposed bridge. The significantly raised road would impact the Dixie Road profile all the way to the intersection at Golden Orchard Drive and perhaps also affect that intersection. It would also require the construction of retaining walls along much of Dixie Road in the vicinity of the bridge, as the roadway here is already raised and the grade difference could not be accommodated in the boulevards by typical methods. Existing hydro poles would also likely be affected by this alternative, requiring some relocation or vertical reconfiguration.

6.2 Dixie Alternative 2 - Improved Conveyance by Making Room for the Creek:

Alternative 2 (Figure 8) is based on natural channel design concepts, with a widened channel and a connected and lowered floodplain adjacent to the channel. This channel and valley configuration would be implemented from 500 m upstream of Dixie Road to approximately 700 m downstream. This alternative also includes lowering 600 m of the channel about 1 m on average to drop water levels at and upstream of Dixie Road. The lowered watercourse invert profile for Alternative 2 is the same as Alternative 1.

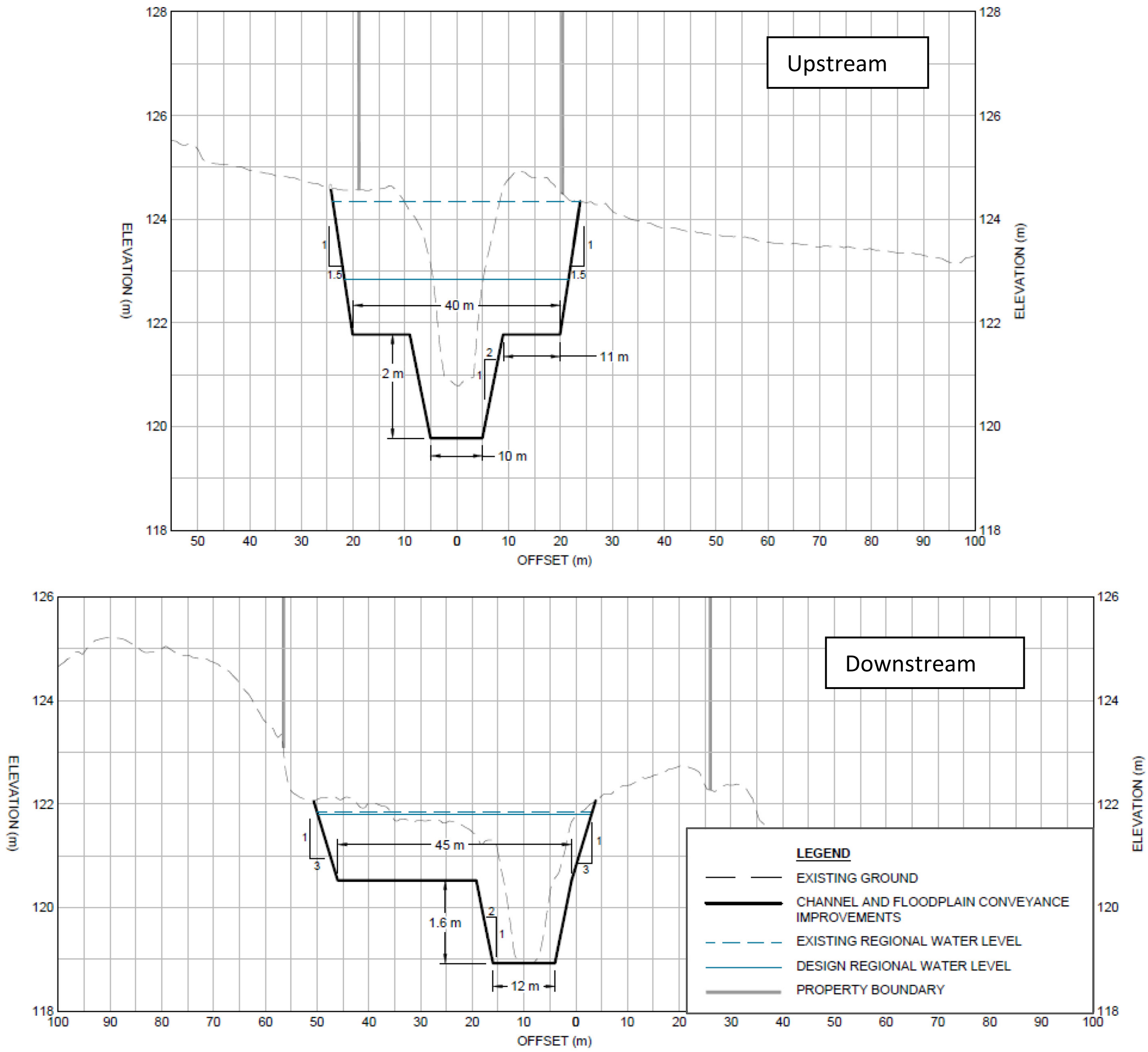


FIGURE 8 Dixie Alternative 2 - Typical Cross-Section Upstream and Downstream of Dixie Road

The channel design includes a 1.6 to 2.0 m deep low flow channel with a 10 to 12 m bottom width and 2:1 side slopes. This design includes floodplain shelves above the low flow channel to allow for additional conveyance when the low flow channel capacity is exceeded. The side slopes for the wider floodplain section are generally matched back to existing valley extents at 3:1 H:V, with some steeper sections nearer to property constraints. The channel design has a wider and deeper footprint than the existing conditions channel to accommodate the required flow. Refer to Drawings 2-1 to 2-5 in Appendix C for additional cross-sections as well as plan and profile drawings.

Alternative 2 requires a two-span bridge at Dixie Road that is approximately 45 m in span length. Under this alterative Dixie Road would need to be raised by approximately 0.7 m to accommodate the anticipated top of bridge. The raised road profile would tie-into the existing grade well south of Golden Orchard Drive, thereby avoiding impacts to the intersection. Additionally, the roadway profile associated with this alternative would have little if any requirement for retaining walls as well as less hydro utility impact.

6.3 Dixie Alternative 3 - Flood Containment

Alternative 3 (Figure 9) would contain the Regional storm within the existing valley corridor by using a flood protection landform (FPL). An FPL is a permanent massive earthen structure with a highly constrained and specialized configuration, including an engineered clay core and a requirement for no services crossing it. The FPL would extend from 500 m upstream of Dixie Road to 750 m downstream. This alternative includes minor channel widening for the 500 m upstream of Dixie Road. Channel widening is added to this alternative to offset the backwater impacts caused by flow containment by the FPL and minimize water level increases upstream.

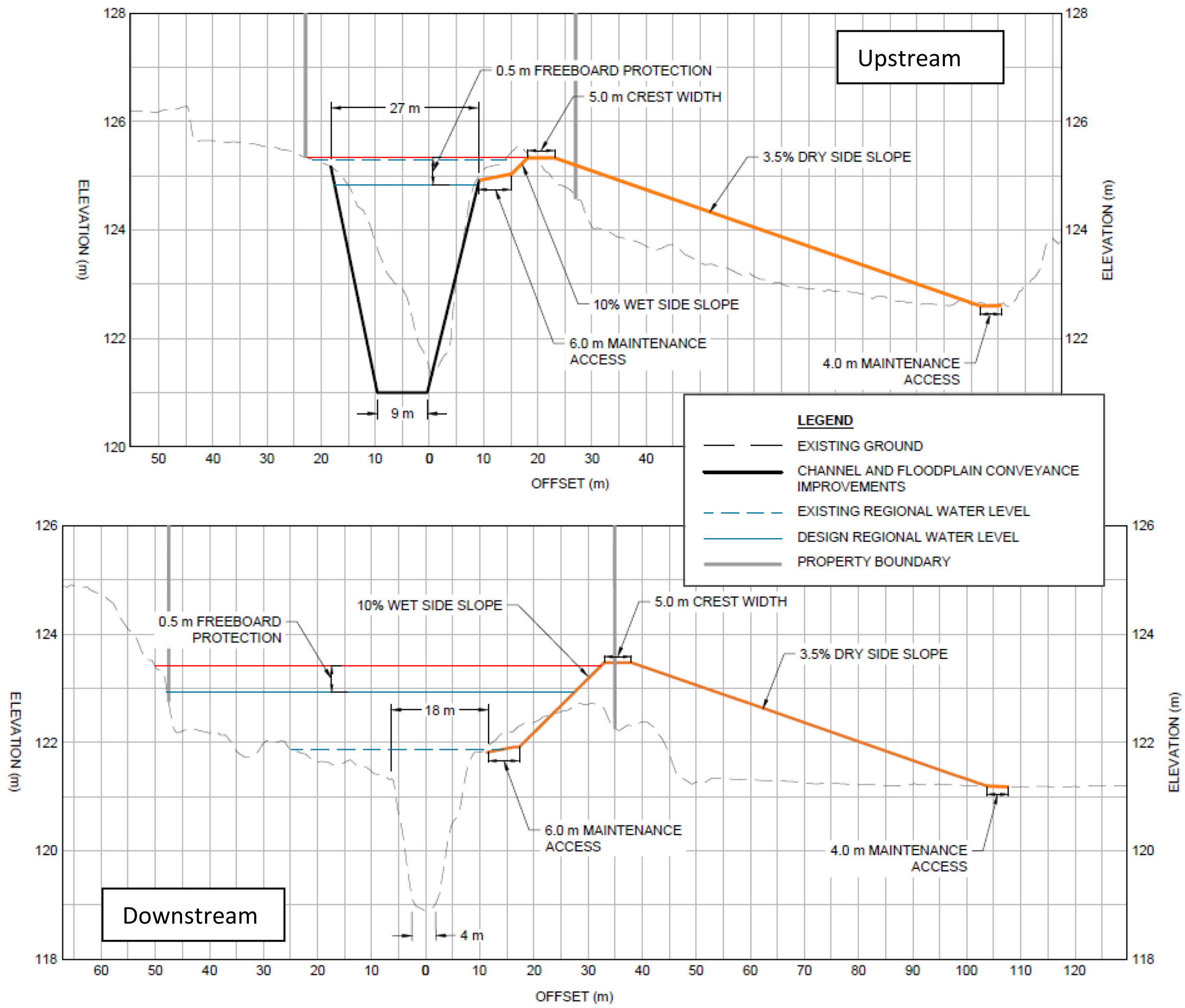


FIGURE 9 Dixie Alternative 3 - Cross-Section Upstream and Downstream of Dixie Road

The Alternative 3 design maintains the existing channel invert. The channel is widened upstream of Dixie to have a 4 to 10 m bottom width. There are no conveyance improvements or channel widening downstream of Dixie Road bridge. The FPL design includes 6 m maintenance access adjacent to the channel right bank, 10% wet side slope, 5 m crest width, 3.5% dry side slope, and 4 m maintenance access at the toe. The top of the FPL is designed 0.5 m above the Regional water level to provide freeboard for protection. The footprint of the FPL is approximately 90,000 m^2. Refer to Drawings 3-1 to 3-5 in Appendix C for additional cross-sections as well as plan and profile drawings.

Alternative 3 requires a Dixie Road bridge with a span of approximately 28 m. Dixie Road would need to be raised by approximately 2.6 m to accommodate the required bridge configuration over the Regional water levels. The raised road would require major construction works on Dixie Road, including significant modifications to the Golden Orchard Drive intersection.

Consideration of this alternative must also include TRCA's recognition that the Province of Ontario has not approved technical guidelines for FPLs and has not indicated whether FPLs will be accepted as permanent flood mitigation measures. The FPL concept was included as a feasible technical option to explore the option of flood containment for this area. It is based on draft technical guidelines (AECOM 2018) and also the design approaches developed for the existing FPL constructed along the Don River in the City of Toronto. Applying the FPL guidelines to the Dixie Area results in a large footprint area with significant property impacts. The large footprint is caused by the estimated height of the FPL needed to contain flows coupled with the minimum shallow dry-side slope requirement (3.5%). Furthermore, the use of an FPL has to date only been accepted on the Don River, and thus its proposed use would have to be viewed as a significant regulatory risk (i.e., it might not ever get approved).

6.4 Hydraulic Assessment to Support Evaluation of Alternative Solutions

6.4.1 Spill Mitigation

The three Dixie alternative solutions were designed to contain the spill from Little Etobicoke Creek at Queen Frederica Drive under Regional storm flooding conditions. Where possible, alternatives will also include a freeboard amount to provide resiliency against future higher flow levels resulting from climate change. Maps of the Regional flood depths for the three alternatives are shown in Figures 10 to 12. A comparison of the water levels resulting from the Regional storm for each of the alternative solutions is shown on Figure 13 along with the natural right (i.e., south) channel bank elevations where spill occurs under existing conditions. The right bank elevation shown does not include the berm elevations downstream of Dixie Road as the berm is considered non-permanent protection, unlike the FPL.

Flow Direction
Property Boundary
Study Area Extents (500m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 1 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: April 22nd, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 1-1 to 1-5.
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

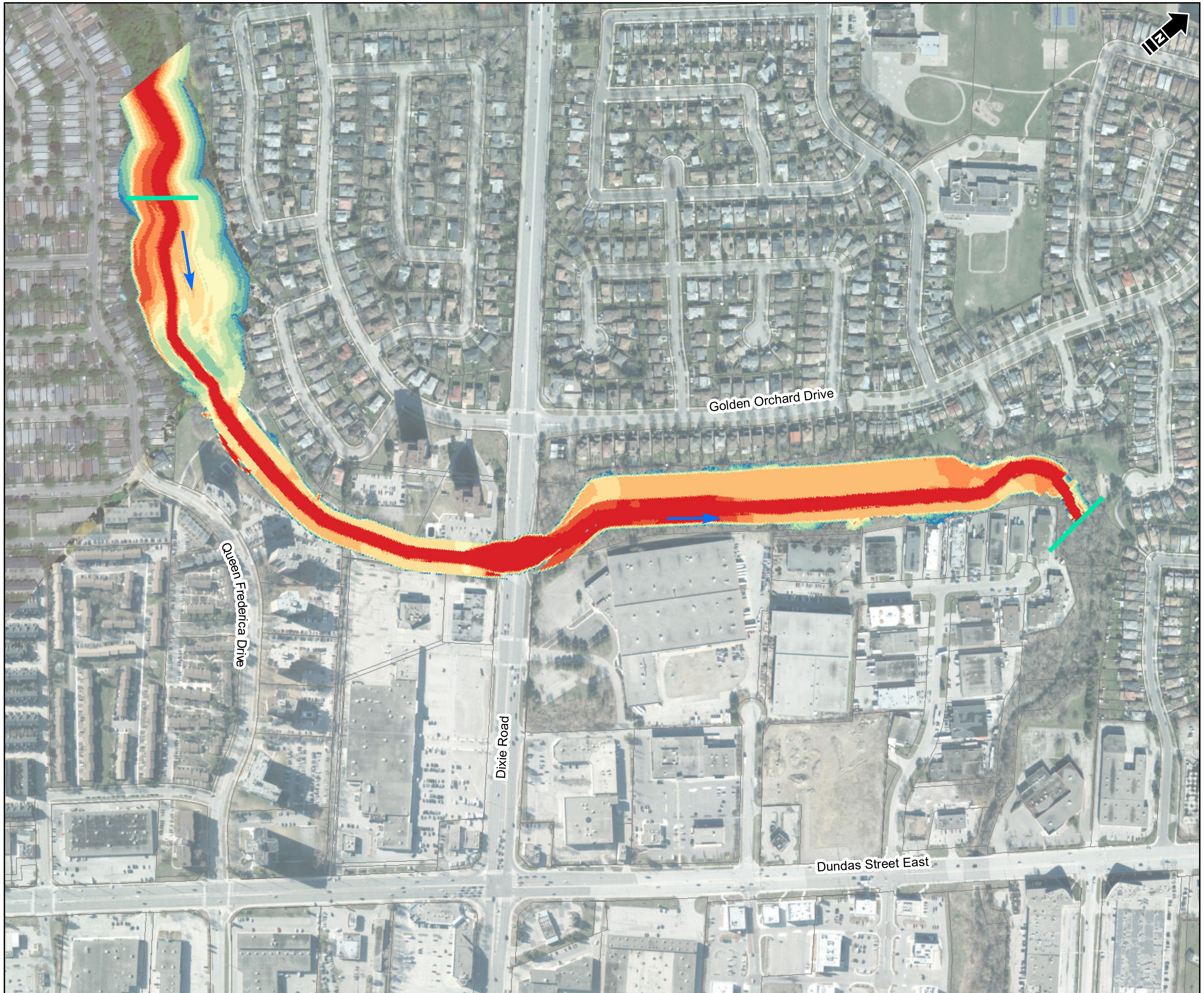
City of Mississauga
Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

Dixie Road: Alternative Solution 1 - Minimized Footprint Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 10

I:\CityofMississauga\24603\FiguresandTables\HYD\2022\Report\HydraulicModellingReport\Figure-6-Alternative_1_Minimized_Footprint_Conceptual_Regional_Flood_Depths.mxd - Tabloid_L - 07-Jun-22, 01:34 PM - RhScott - TID005



Flow Direction

Property Boundary

Study Area Extents (500m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 2 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:

Run Date: Mar 31st, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 2-1 to 2-5.
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

1:5,000 metres

50 0 50 100

NAD 1983 UTM Zone 17N

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City of Mississauga

Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

Dixie Road: Alternative Solution 2 - Making Room for the Creek Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 11

Flow Direction
Property Boundary
Study Area Extents (500m upstream of the Dixie Road Bridge to the channel bend)

Alternative Solution 3 - Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: March 29th, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. The conceptual channel plan, profile, and cross-sections are detailed in Drawings 3-1 to 3-5
4. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Matrix Solutions Inc.
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City of Mississauga
Dixie-Dundas Flood Mitigation Project - Hydraulic Modelling Report

Dixie Road: Alternative Solution 3 - Flood Containment Conceptual Regional Flood Depths

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 12

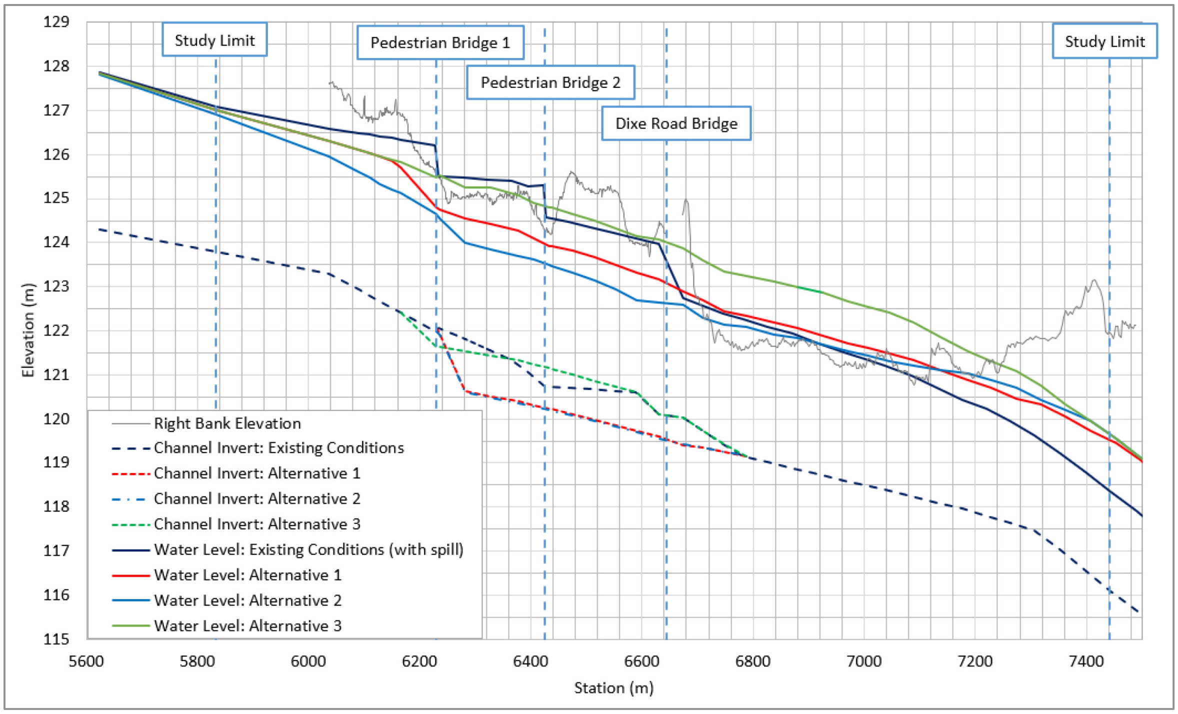


FIGURE 13 Dixie Alternatives - Regional Water Level Profiles through the Dixie Study Area

Under existing conditions, water levels exceed the right bank at several locations within the study area, resulting in the spill. The three undersized crossings (Dixie Road and the two pedestrian bridges) also contribute to the spill due to backwater impacts resulting in increased water levels upstream of the crossings. The two pedestrian bridges are only present in the existing conditions model as it is assumed that they would be replaced under all alternatives such that flood mitigation objectives were still achieved.

Alternative 1 and Alternative 2 achieve similar water levels downstream of Dixie Road; however, Alternative 2 water levels are approximately 0.5 m lower than Alternative 1 upstream of Dixie Road, in the area is where the primary spill occurs to Queen Frederica Drive under existing conditions. The lower water levels of Alternative 2 (Making Room for the Creek) in this area provide additional freeboard to provide further resilience against future higher flow levels resulting from climate change. Alternative 3 aims to contain the spill through a permanent FPL and only provides widening upstream of Dixie Road to mitigate the increased elevations that result from keeping the flow in the channel. As a result, water levels are increased downstream of Dixie Road by approximately 1 m relative to existing conditions.

All three alternatives result in water levels downstream of Dixie Road exceeding the natural bank elevation. Alternative 3 would be contained within an FPL. Alternatives 1 and 2 water levels are similar to existing conditions resulting in some relatively small areas of spill downstream of Dixie Road under the 350-year and Regional storm when the existing berm and wall are removed from consideration (as they are not permanent flood protection by MNRF standards). These small areas of spill would generally be prevented by localized grading (i.e., heights less than 0.5 m). Further design refinements will also be explored in Phase 3 of the EA (refer to Section 9) to lower flood levels further and to better define required minor changes to grades in this area.

6.4.2 Dixie Road Bridge Design Considerations

The proposed bridge replacement at Dixie Road needs to fit within the constraints of the surrounding road network. The key consideration at the bridge location is the top of road elevation of the bridge. As outlined in previous sections, changes in road profile at the bridge could impact the nearby intersections. The closest intersections are Golden Orchard Drive 200 m to the north and Dundas Street approximately 400 m to the south. Any profile changes must comply with Region standards (and City standards).

The top of road elevation at the bridge is a factor of bridge deck thickness and the allowable soffit (underside of bridge deck) elevation. The Canadian Highway Bridge Design Code (CSA 2019) requires 1 m of clearance from the 100-year water level to the bridge soffit. For this project, Matrix has also identified a requirement for the soffit (Table 4) to be above the Regional water level to develop a robust solution. In recognition of the impacts this bridge has on the spill immediately upstream, an additional freeboard requirement of 0.4 to 0.5 m has been placed at this location to provide resilience to potential climate change effects.

TABLE 4 Hydraulic Requirements for the Alternative Solutions

Alternative		Water Surface Elevation (m)		Bridge Soffit(2)
		100-year(1)	Regional	
1	Minimized Footprint	122.1	123.2	123.7
2	Making Room for the Creek	121.8	122.7	123.1
3	Flood Containment	123.2	124.1	124.5

(1) Preliminary numbers were provided to RVA for use in Dixie Road Feasibility Review. These values have since been updated.
(2) The proposed elevation includes ~0.5 m of additional freeboard to provide climate change resiliency.

Conceptual bridge designs were prepared for all three alternative solutions based on the hydraulic modelling results. Conceptual Dixie Road bridge design drawings are provided in Appendix D. Alternative 1 requires a single span 26 m long bridge. Alternative 2 requires a 2-span bridge with a total span of 45 m. Alternative 3 requires a single span 28 m bridge.

The wider span for Alternative 2 (2-span bridge vs. a single span for Alternatives 1 and 3), results in a much larger hydraulic opening (113.4 m^2 compared to 74.8 m^2 and 83.5 m^2). The three alternatives raise the current road crown vertical alignment at the Dixie Road bridge location by 1.7 m, 0.7 m, and 2.6 m for Alternatives 1, 2, and 3, respectively (RVA 2020). Alternative 2 has the lowest water levels through the bridge resulting in the lowest bridge soffit.

6.4.3 Sewer System Outfall Impacts

Municipal storm sewers are hydraulically connected to the river at their outlet(s) and so any changes made to the river must consider potential impacts to the connected infrastructure. High river water levels at sewer outlets can prevent the sewer from functioning as its intended design. This can result in reduced sewer capacity, sewer backup, and basement flooding.

There are 11 storm sewer outlets to Little Etobicoke Creek within the Dixie Road study area. Table 5 summarizes the 100-year water levels at each sewer outlet for the existing conditions and the alternative solutions. Water levels that are higher than the existing condition are underlined.

TABLE 5 100-Year Water Levels at Storm Sewer Outfalls

Outfall			100-Year Water Surface Elevation (m)			
City ID	Location	Invert (m)	Existing Condition	Alternative Solution 1 Minimized Footprint	Alternative Solution 2 Making Room for the Creek	Alternative Solution 3 Flood Containment
11263	Bloor Street	124.6	127.1	127.0	127.0	127.0
11264	Bloor Street	124.8	127.1	127.0	127.0	127.0
11305	Flagship Drive Outfall	123.4	125.9	125.8	125.6	125.7
11304	Westerdam Road outfall	122.2	125.5	124.3	124.1	124.6
11301	Downstream of Upstream pedestrian bridge	121.7	125.2	123.3	123.1	124.2
11302	Upstream of Downstream pedestrian bridge	121.9	125.1	123.1	122.8	124.0
11312	Dixie Road	121.7	122.6	121.9	121.7	123.0
11309	Goldmar Drive Outfall	119.5	120.8	120.4	120.3	121.2
11308	Taviton Court Outfall	119.3	120.0	119.7	119.8	120.3
11307	Willowcreek Park	119.1	119.1	119.1	119.2	119.4
11306	Willowcreek Park	118.6	118.7	118.9	119.0	119.1

Note: Underlined water levels indicate an increase from existing conditions.

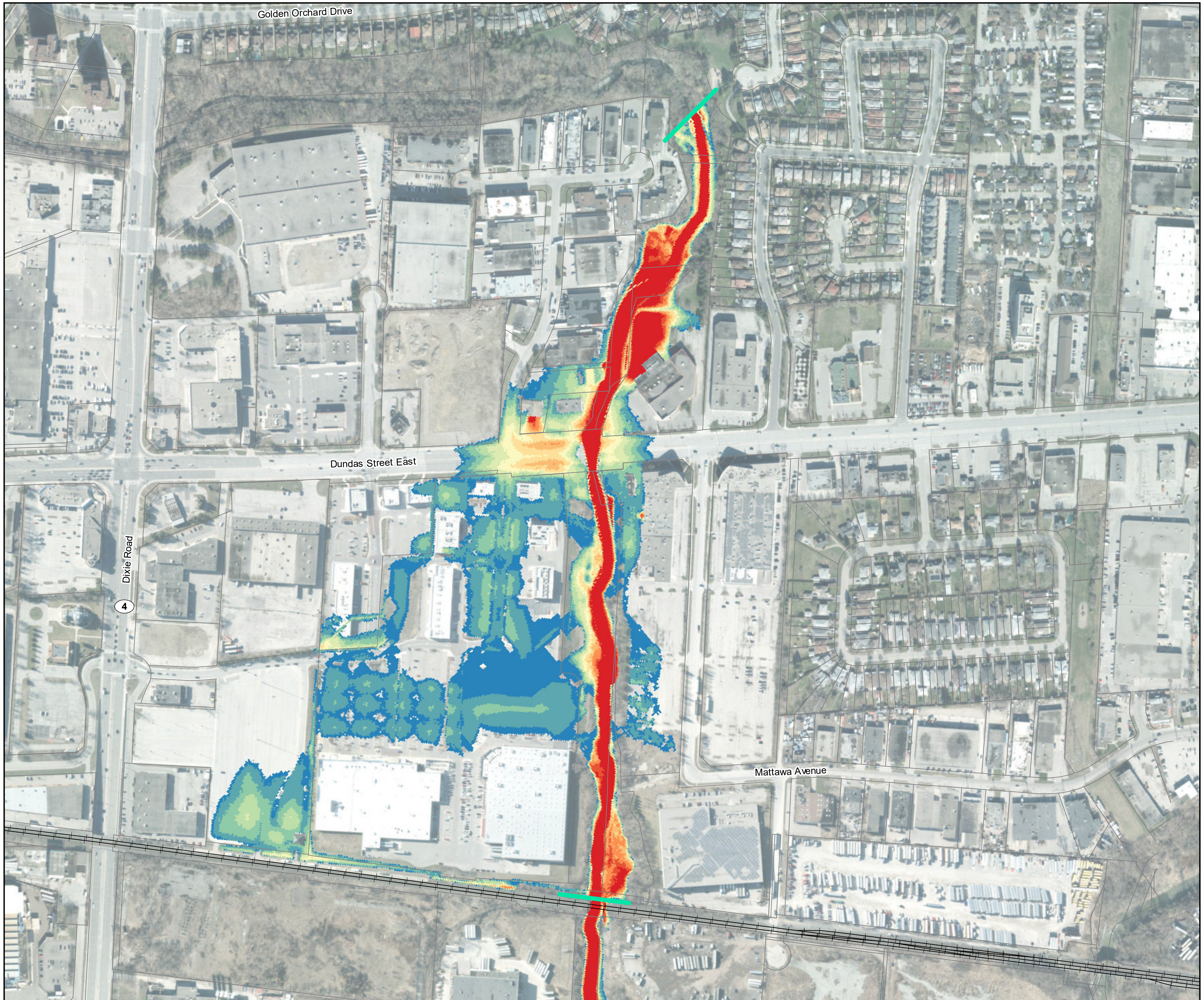
The results demonstrate that under each scenario, including existing conditions, Little Etobicoke Creek 100-year water levels are above the current sewer system outfall elevations. Upstream of Dixie Road, the existing conditions 100-year water levels are above the sewer outfall by to 2.2 m to 3.5 m. A comparison of each of the alternative solutions to the baseline existing conditions reveal an overall decrease in 100-year water levels at storm sewer outfalls, with a few exceptions underlined in Table 5.

Alternative Solution 2, Making Room for the Creek, results in the overall lowest water levels at the sewer outfalls. Water levels decrease through most of the study area, to a maximum of 2.3 m above the outfall. Increases in water levels downstream due to spill mitigation are small and range between +0.1 m and 0.3 m. Among the alternative solutions, Alternative 2 will have the lowest risk of sewer backup and associated basement flooding, relative to existing conditions.

6.4.4 Downstream Impacts

By mitigating the spills within the Dixie Area, the flows downstream in the Dundas Area are necessarily increased. This is the intended outcome of the alternative solutions for the Dixie Area; however, it will increase flood levels at Dundas Street if suitable mitigation measures are not implemented. Accordingly, this outcome needs to be mitigated as part of the overall flood improvement strategy.

If flooding in the Dixie Area is mitigated by maintaining the flow within the channel, an additional 130 m^3/s would be conveyed within Little Etobicoke Creek during the Regional storm. Figure 14 shows the resulting flood depths and spill at Dundas Street that would otherwise result from full flow conditions if no further mitigation measures were implemented at that location. Accordingly, the existing Dundas Street bridge and corresponding channel will require additional hydraulic consideration and modification to accommodate this larger flow. A larger Dundas Street bridge and associated channel works will be required and must be facilitated prior to improvements at Dixie Road. Dundas Area works must precede Dixie Area works in order for future larger flows to be suitably accommodated. The requirement for Dundas Area works is addressed in the following section.



Expanded Study Area (Dundas Street to 600 m downstream to the channel bend)

CN Railway

Property Boundary

Existing Conditions Regional Flood Depths (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: Nov 26th, 2020

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Regional Flood Depths for Dundas Study Area with Upstream Spill Mitigated

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 14

7 ALTERNATIVE SOLUTIONS - DUNDAS AREA

The results of mitigating the flood spill in the Dixie Area, described in the section above and illustrated in Figure 14, indicated that further mitigation measures are required in the Dundas Area. Alternative Solutions were identified for Dundas Area specifically for the Dundas Street bridge which presents a significant hydraulic restraint. The Project Team chose three bridge alternatives for Dundas Street that include different bridge spans and downstream regrading for conveyance improvements. Hydraulic assessment of the alternative solutions at the Dundas Area was also based on existing MIKE modelling (refer to Section 5). The modelling was adjusted, however, to ensure a more suitable modelling approach and description at the Dundas Street bridge crossing. Parameters were adjusted to ensure the model would provide good representation of the larger flood flows that would be directed to the Dundas Area in the watercourse once Dixie Area works have been completed.

The importance of ensuring Dundas Area works are completed prior to Dixie Area works is worth repeating. Although works completed at Dundas Street do not have a hydraulic effect on the Dixie Area solution, hydraulic conditions at the Dundas Street crossing are very much impacted by the construction of mitigation works at the Dixie Area. Therefore, and as outlined at the end of Section 6, Dundas Area conveyance improvements are required to be constructed before the Dixie Area solution can be implemented.

The Dundas Area is also currently affected by plans associated with the City's Bus Rapid Transit (BRT) project. Coordination has occurred between the Project Team and City's BRT project members. An opportunity exists to align the BRT's construction plans for an expanded Dundas Street bridge at the Little Etobicoke Creek with the objectives of the Project. Accordingly, the BRT requirements were woven into the Project as an important stakeholder; moreover, the BRT team also obtained information from this study.

Hydraulic assessment of existing conditions indicates that improving hydraulic conveyance at Dundas Street would be necessary to ensure no adverse impacts result from the increased upstream flow. The hydraulic assessment confirmed that the Dundas Street bridge is the primary flow constraint within the Dundas Area. By replacing the Dundas bridge crossing with a larger one, along with completing some associated channel improvements, the increased channel flow can be accommodated. The following alternative solutions have been identified to increase conveyance in the Dundas Area.

- Dundas Alternative 1 - 25 m Span Bridge with Downstream Floodplain Conveyance Improvements
- Dundas Alternative 2 - 38 m Span Bridge without Downstream Floodplain Conveyance Improvements
- Dundas Alternative 3 - 38 m Span Bridge with Downstream Floodplain Conveyance Improvements

A fulsome evaluation of these alternatives was completed including considerations for BRT, utilities and infrastructure, ecology, and geomorphology, as outlined in other EA project documentation. This review of considerations by the Project Team indicated that these bridge alternatives represent appropriate approaches to increase hydraulic conveyance at Dundas Street. Each of the alternatives was discussed with the BRT team and other key stakeholders. Additionally, conceptual designs for the bridge replacements and associated roadway transitions to accommodate the bridges were developed by R.V. Anderson Associates, as summarized in Appendix E and briefly described in the following sections.

7.1 Dundas Alternative 1 - 25 m Span with Downstream Floodplain Conveyance Improvements

Dundas Alternative 1 (Figure 15) includes a 25 m bridge with downstream floodplain conveyance improvements. The 25 m span was deemed the smallest appropriate option as it fully spans the existing valley at Dundas Street. Smaller bridges were screened out as potential conceptual options as they would continue to create a hydraulic pinch point at this location. Additionally, a smaller span bridge structure would require a higher soffit elevation to provide the same flow area to convey the Regional flood. The bridge soffit, deck thickness, and extent of road profile impacted by Alternative Solution 1 are detailed on Figure 15.

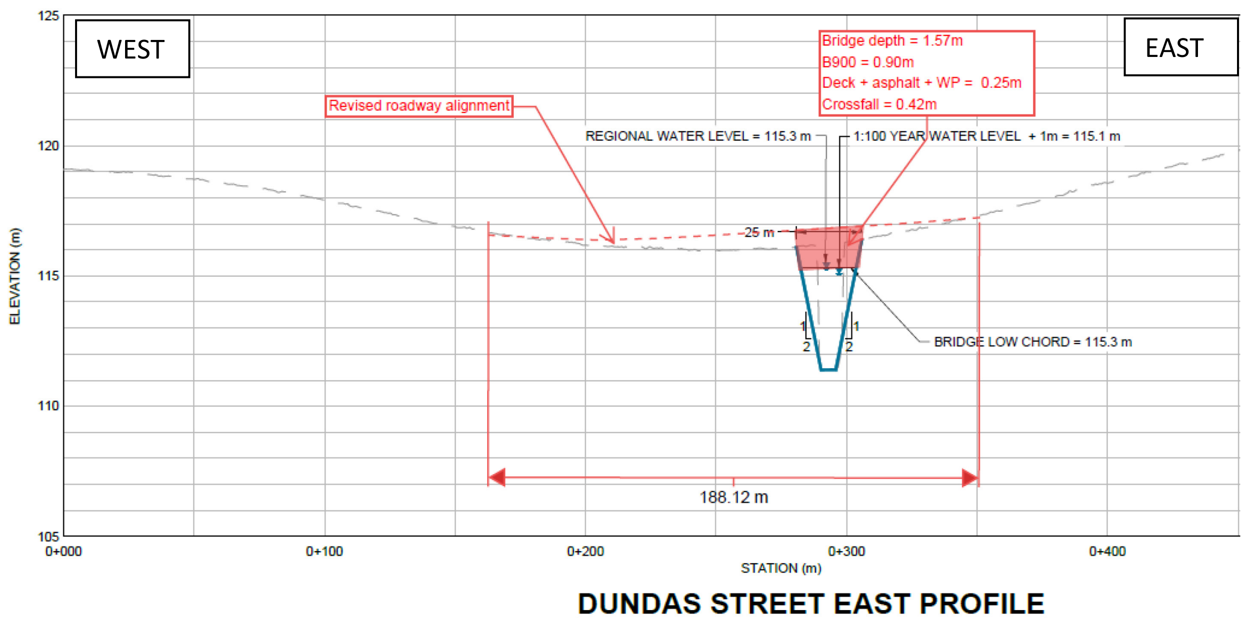


FIGURE 15 Dundas Alternative 1 25 m Span with Downstream Floodplain Conveyance Improvements

The 25 m bridge opening design has 2:1 side slopes that are consistent with the adjacent steep channel valley. Additional conveyance improvements including floodplain improvements and channel widening were included downstream to further reduce water levels through the bridge and allow for a lower road profile. This bridge replacement alternative requires Dundas Street East to be raised 0.75 m at the crossing location and requires a road disturbance length of 190 m.

7.2 Dundas Alternative 2 - 38 m Span Without Downstream Floodplain Conveyance Improvements

Dundas Alternative 2 (Figure 16) includes a 38 m bridge without downstream floodplain conveyance improvements. A 38 m bridge was the largest span assessed due to limited additional hydraulic benefits beyond that length due to a narrow channel valley upstream of the bridge, and the additional property takings required for a larger span. The bridge soffit, deck thickness, and extent of road profile impacted for the 38 m bridge are detailed on Figure 16.

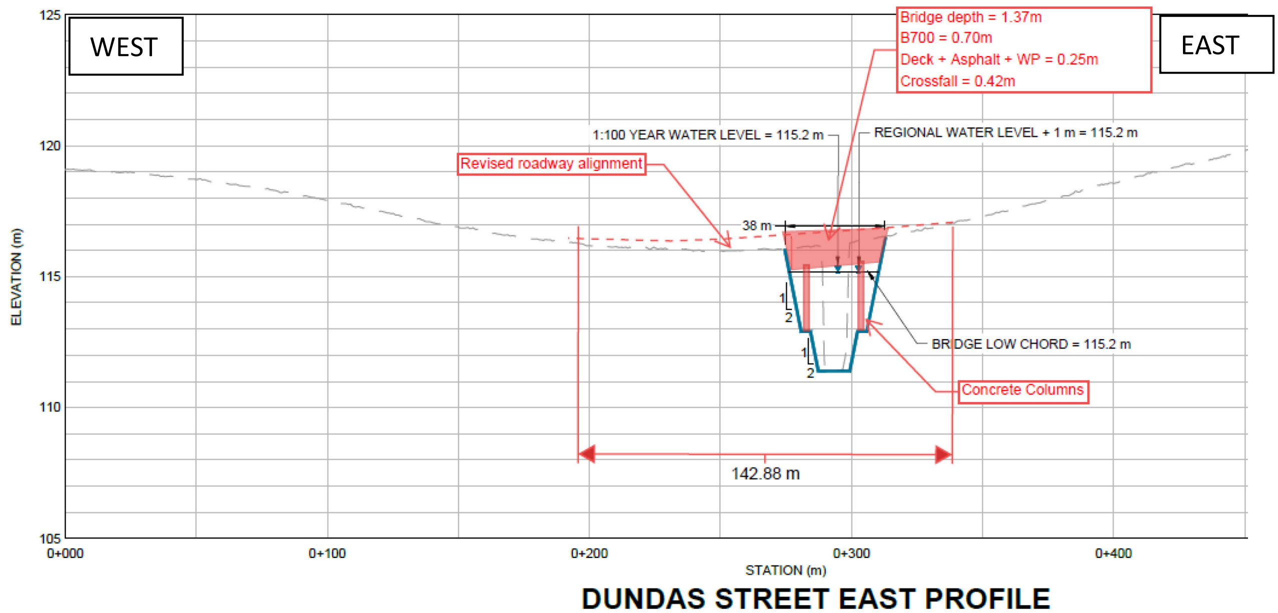


FIGURE 16 Dundas Alternative 2 38 m Span without Downstream Floodplain Conveyance Improvements

The bridge design opening includes a low flow channel, shelves above the low flow channel with concrete piers. The bridge opening has 2:1 side slopes in the main section and the low flow section. The wider bridge has a lower profile due to lower resulting water levels upstream of the bridge. The bridge replacement option requires Dundas Street East to be raised 0.5 m at the crossing location. This elevation increase corresponds to 140 m of road disturbance.

7.3 Dundas Alternative 3 - 38 m Span with Downstream Floodplain Conveyance Improvements

Alternative 3 combines the downstream floodplain conveyance improvements from Alternative 1 with the 38 m bridge design from Alternative 2. The reduced water levels from the downstream conveyance improvements relative to Alternative 2 results in a slightly lower bridge soffit and reduced road disturbance extents.

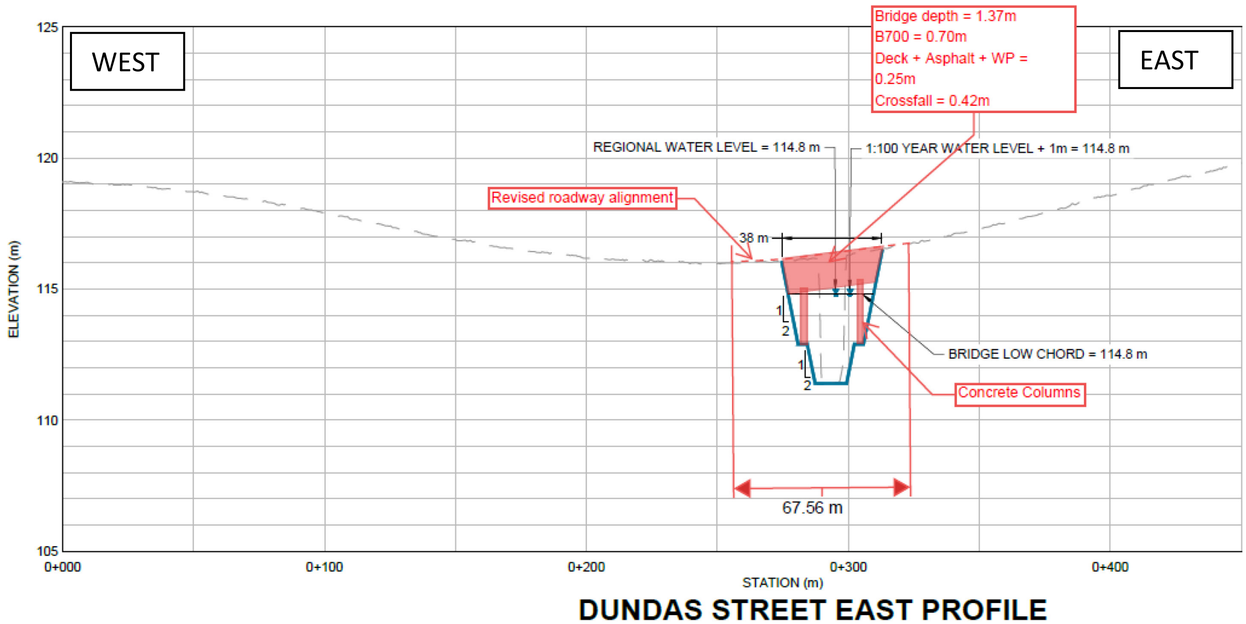


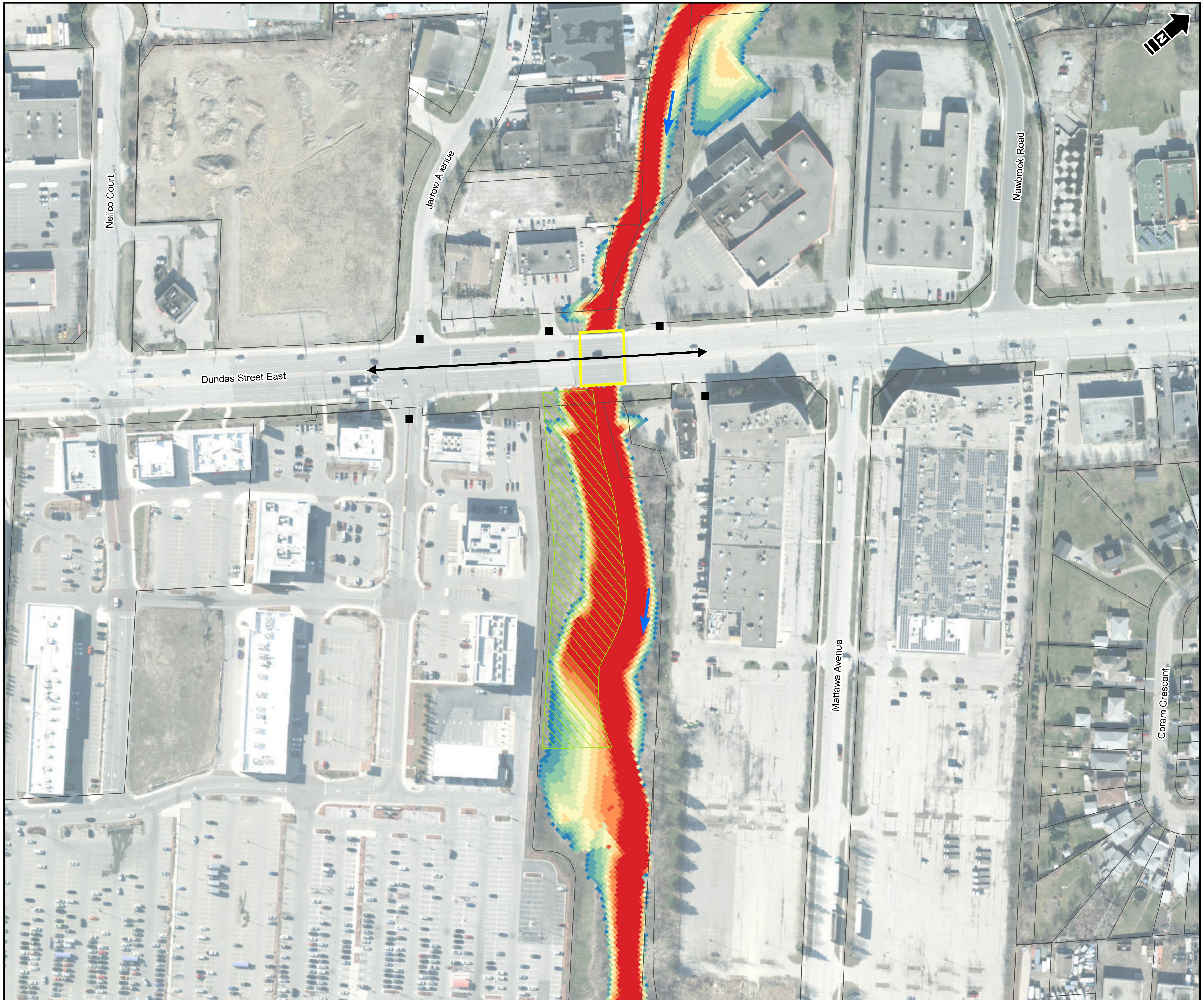
FIGURE 17 Dundas Alternative 3 38 m Span with Downstream Floodplain Conveyance Improvements

The bridge replacement option requires the Dundas Street roadway profile to be raised 0.2 m at the crossing location which corresponds to a road disturbance length of 70 m.

7.4 Hydraulic Assessment to Support Evaluation of Alternative Solutions

7.4.1 Flood Risk Reduction

Three alternatives with a larger bridge at Dundas Street were assessed and compared against existing conditions. Maps of the Regional flood depths for the three alternatives are shown in Figures 18 to 20. The Regional water levels are shown in Figure 21 through the Dundas Area. Note that the existing conditions results do not include the extra 130 m^3/s spill from upstream of Dixie Road, as that flow is currently lost from Little Etobicoke Creek and transferred to the adjacent Applewood Creek watershed. Therefore, existing conditions are not representative of future full flow conditions in the watercourse. Conversely, all three Dundas Area alternative solutions do include full flow conditions (i.e., no upstream spill).



- 25 m Span Length Bridge Replacement
- Floodplain Regrading
- Flow Direction
- Extent of Road Disturbance (190 m)
- Property Boundary
- Driveway Tie-in Required

Alternative Solution 1 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 3rd, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

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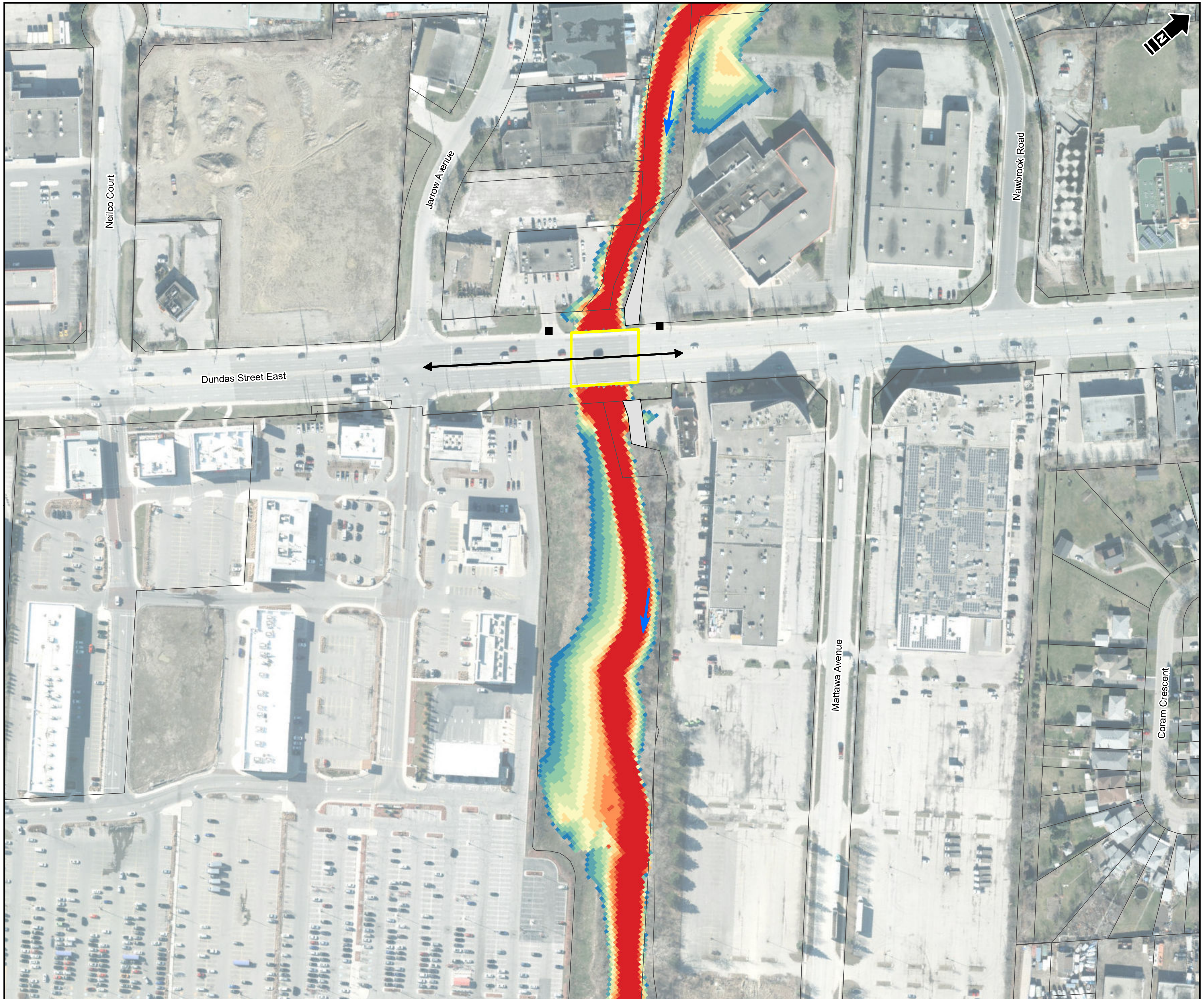
ENVIRONMENT & ENGINEERING

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Dundas Street: Alternative Solution 1 - 25 m Span Length Bridge with Downstream Floodplain Conveyance Improvements

Date: June 2022	Project: 24603	Submitter: N. Burrows	Reviewer: K. Hofbauer

Figure 18



38 m Span Length Bridge Replacement
Potential Property Impact
Flow Direction
Extent of Road Disturbance (140 m)
Property Boundary
Driveway Tie-in Required

Alternative Solution 2 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 14th, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m³/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Dundas Street: Alternative Solution 2 - 38 m Span Length Bridge without Downstream Floodplain Conveyance Improvements

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 19

38 m Span Length Bridge Replacement
Potential Property Impact
Floodplain Regrading
Flow Direction
Extent of Road Disturbance (70 m)
Property Boundary
Driveway Tie-in Required

Alternative Solution 3 - Regional Flood Depth (m)

- 0
- < 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.70
- 0.70 - 0.90
- 0.90 - 1.10
- 1.10 - 1.30
- 1.30 - 1.50
- 1.50 - 1.70
- 1.70 - 1.90
- > 1.90

Notes:
Run Date: December 14th, 2021

1. The Regional flood depths are modelled using the 1D-2D MIKE FLOOD model developed by MMM (2015) and expanded by Matrix (2018). The Regional event is 200 m^3/s at Dixie-Dundas.
2. Base digital information obtained from the City of Mississauga (SHP and DGN format).
3. Conceptual Dixie Road bridge replacement by R.V. Anderson Associates Limited (Appendix E).

1:2,250 metres
20 0 20 40
NAD 1983 UTM Zone 17N

Reference: Contains information licensed under the Open Government Licence – Ontario. Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community.

Matrix Solutions Inc.
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City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Dundas Street: Alternative Solution 3 - 38 m Span Length Bridge with Downstream Floodplain Conveyance Improvements

Date:	Project:	Submitter:	Reviewer:
June 2022	24603	N. Burrows	K. Hofbauer

Figure 20

I:\CityofMississauga\24603\FiguresandTables\HYD\2022\Report\HydraulicModellingReport\Figure-12-Alternative_3_38m_Span_Length_Bridge_with_Downstream_Floodplain_Conveyance_Improvements.mxd - Tabloid_L - 07-Jun-22, 11:58 AM - RhScott - TID005

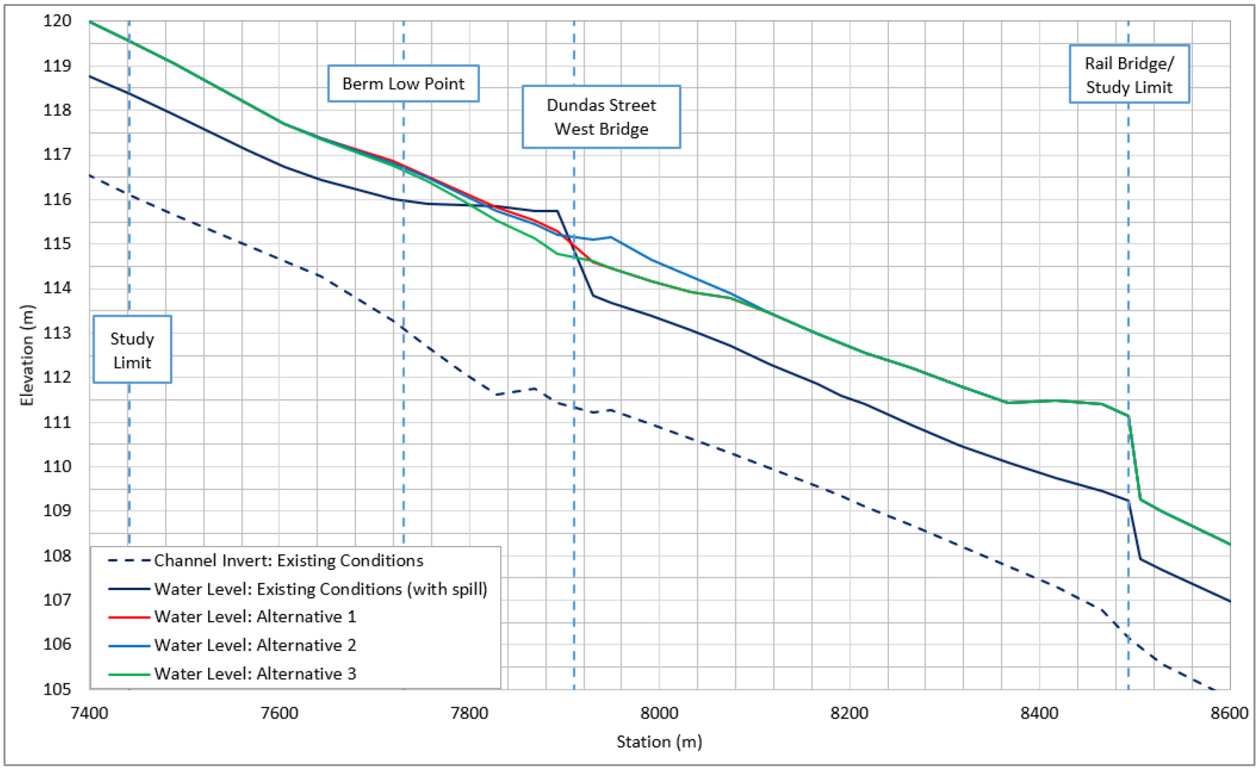


FIGURE 21 Dundas Alternatives - Regional Water Level Profiles

The existing conditions results show a 2 m head loss (i.e., backwater effect) through the existing Dundas Street bridge. This highlights the existing flow constriction of the existing bridge. The shown higher water levels for the alternative solutions are the expected result of the return to full flow conditions in the Dundas Area. All three Alternatives Solutions eliminate the backwater effect seen from the existing bridge.

Alternative 1 results in a slightly higher water level upstream of Dundas Street than Alternative 2. Alternatives 1 and 3, which include downstream floodplain conveyance improvements, result in approximately 0.5 m lower water levels downstream of Dundas Street than Alternative 2. The benefits of downstream grading are observed with Alternative 3 providing a 0.5 m lower water level than Alternative 1 immediately upstream of Dundas Street. A key location 200 m upstream of Dundas, at the low point in the existing berm, all three alternatives result in very similar water levels.

The existing berm upstream of Dundas Street provides non-permanent flood protection to private lands that are situated in the floodplain with a “hazard” designation. The increase in Regional water levels at this location (resulting from the full flow condition) were not sufficiently mitigated by any of the alternative solutions. Further mitigation for this property is considered in Phase 3 of the Project. Refer to Section 9 for a summary of the design concepts for this location.

7.4.2 Dundas Street Bridge Design Considerations

Conceptual bridge designs for each alternative solution (Appendix E) and for the associated floodplain improvements were developed by the Project Team. The top of road elevation at the bridge is a factor of the required bridge deck thickness and the allowable soffit (underside of bridge deck) elevation. The Canadian Highway Bridge Design Code (CSA 2019) requires 1 m of clearance from the 100-year water level to the bridge soffit. For this project, Matrix has also identified a requirement for the soffit to be above the Regional water level to develop a robust solution. The water levels at the Dundas Street bridge and required soffit elevation for each alternative is summarized in Table 6.

TABLE 6 Hydraulic Requirements for the Alternative Solutions

Alternative		Water Surface Elevation (m)		Bridge Soffit
		100-year	Regional	
1	25 m span	114.1	115.3	115.3
2	38 m span without downstream conveyance improvements	114.2	115.2	115.2
3	38 m span with downstream conveyance improvements	113.8	114.8	114.8

Works within the Dundas Street right-of-way are being coordinated with the requirements of the BRT team. Initial coordination discussions with the BRT team indicated that a road raise of 0.5 m would be acceptable; however, it was confirmed that a road raise of 0.7 m was deemed to be acceptable at this section of Dundas Street (RVA 2021). Additionally, potential watermain and sanitary sewers impacts associated with the bridge replacement are being coordinated with the Region (refer to Section 9.5).

7.4.3 Sewer System Outfall Impacts

Within the Dundas Area, there are nine municipal storm sewer outlets to Little Etobicoke Creek. The existing conditions Little Etobicoke Creek water levels are generally above the sewer invert. Table 7 summarizes the 100-year water levels at each sewer outlet for the existing conditions and alternative solutions.

TABLE 7 100-Year Water Levels at Storm Sewer Outfalls

Outfall			100-Year Water Surface Elevation (m)			
City ID	Location	Invert (m)	Existing with Upstream Spill	25 m Bridge with Downstream Grading	38 m Bridge	38 m Bridge with Downstream Grading
11296	275 m upstream of Dundas Street	116.9	116.6	116.8	116.8	116.8
11297	90 m upstream of Dundas Street	113.4	115.5	114.9	114.9	114.8
11295	10 m upstream of Dundas Street	112.7	115.4	114.2	114.3	114.0
11294	Dundas Street	112.2	114.6	113.9	114.1	113.8
11328	Dundas Street	113.2	114.6	113.9	114.1	113.8
11298	400 m downstream of Dundas Street, 150 m upstream of rail	109.9	110.1	110.5	110.5	110.5
11329	50 m downstream of rail	105.1	107.3	107.7	107.7	107.7
11315	Caterpillar Road outfall (125 m downstream of rail)	106.4	106.4	106.8	106.8	106.8
11316	220 m downstream of rail	104.4	105.3	105.8	105.8	105.8

Note: Underlined water levels indicate an increase from existing conditions.

The results demonstrate the varying 100-year water levels compared to existing conditions. Just as in the Dixie Area, a portion of these higher water levels (underlined in Table 7) can be attributed to spill mitigation and the water level increases are a reflection of full flow conditions. All of the alternative solutions result in similar 100-year water levels and backwater impacts may continue. Additionally, the 100-year water levels at the four outfalls nearest Dundas Street are lower than existing conditions as the alternative solutions for Dundas Area lower water levels in this area.

8 PREFERRED ALTERNATIVE SOLUTION

The alternative solutions were evaluated based on hydraulics considerations in combination with other technical studies and costs. The preferred alternative solution is shown in Figure 22. Alternative 2 Making Room for the Creek was selected as preferred for the Dixie Area. The 25 m bridge with downstream conveyance was selected as preferred for the Dundas Area. The selection of the preferred alternative solution was summarized in public meetings and will be documented in the main ESR.

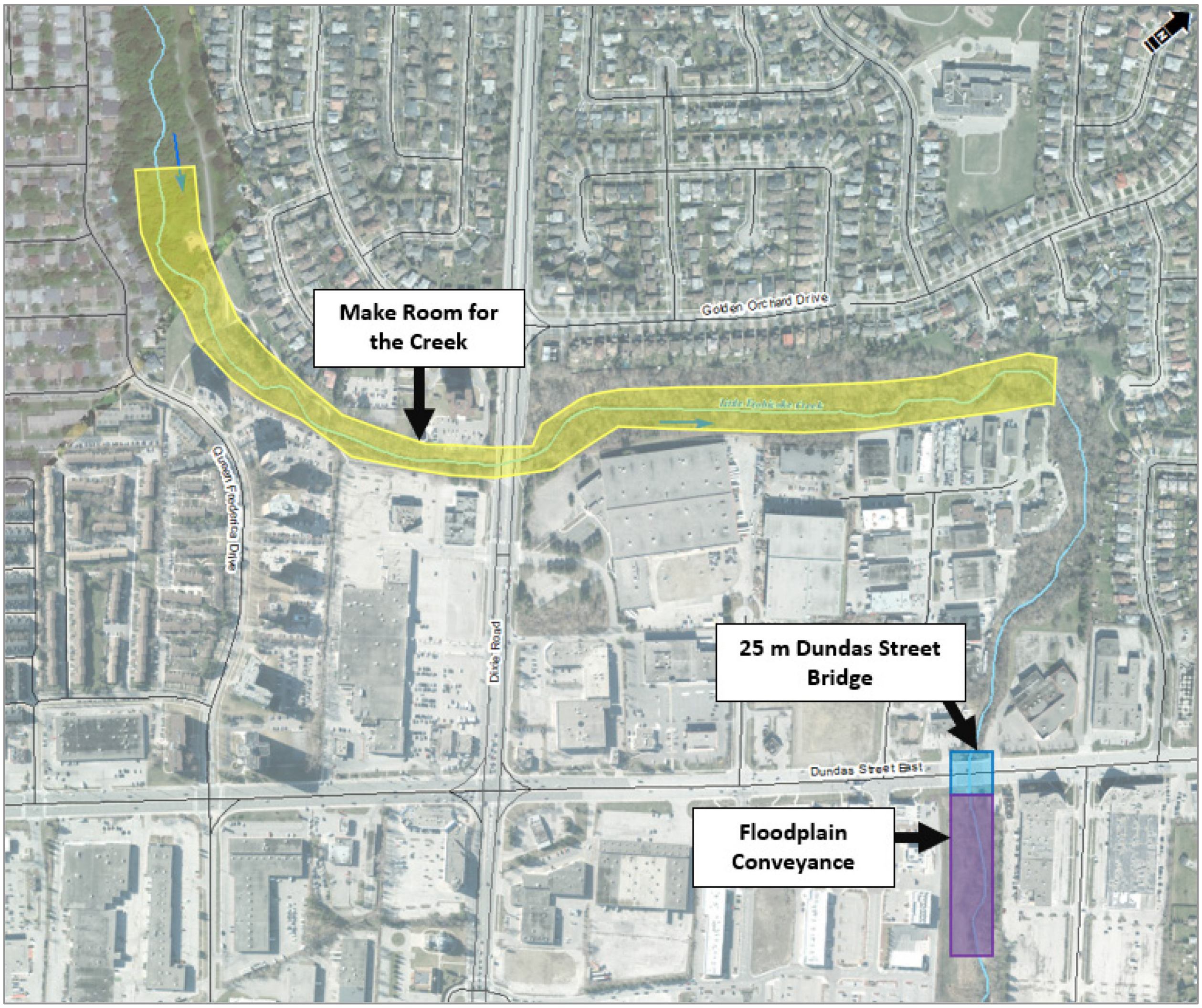


FIGURE 22 Preferred Alternative Solution

9 DESIGN CONCEPTS (BOTH AREAS)

Following the selection of the preferred alternative solution, alternative design concepts were developed for each aspect of the preferred alternative solution. Discussion of alternative design concepts are provided in the sections below. For the Dixie Area, the design concepts include channel elevation around Dixie Road, the Dixie Road bridge and road design, refined channel cross-sections and profile, and considerations for the sanitary sewer crossing downstream of Dixie Road (refer to Figure 23). For the Dundas Area, design concepts include: the berm upstream of Dundas Street, the sanitary siphon at Dundas Street, and downstream floodplain widening (refer to Figure 24). The new Regional watermain at Dundas Street was accommodated within the 25 m bridge section being proposed and is not anticipated to cause future constraints in the Dundas Area flood works.

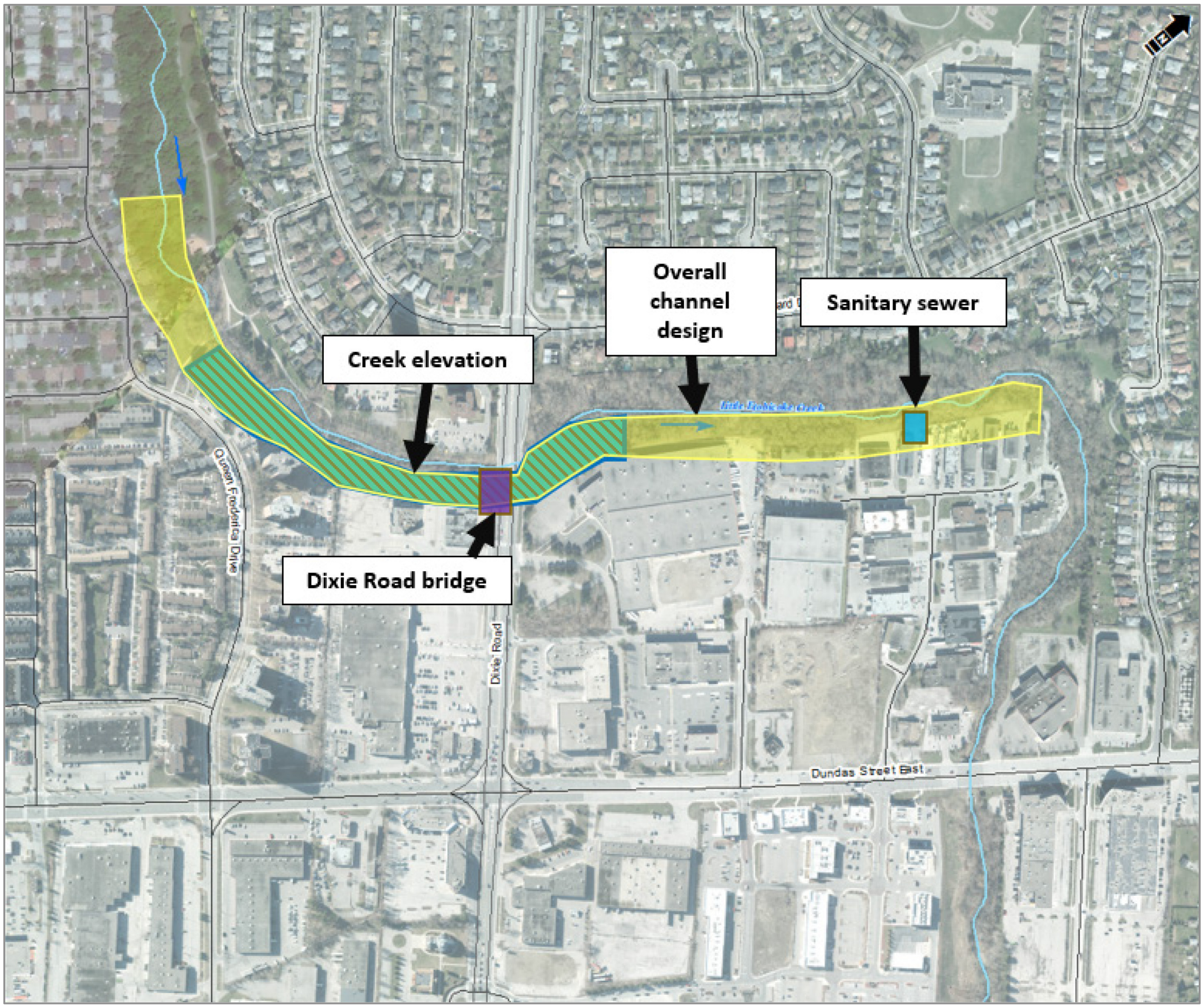


FIGURE 23 Dixie Area Design Concept Locations

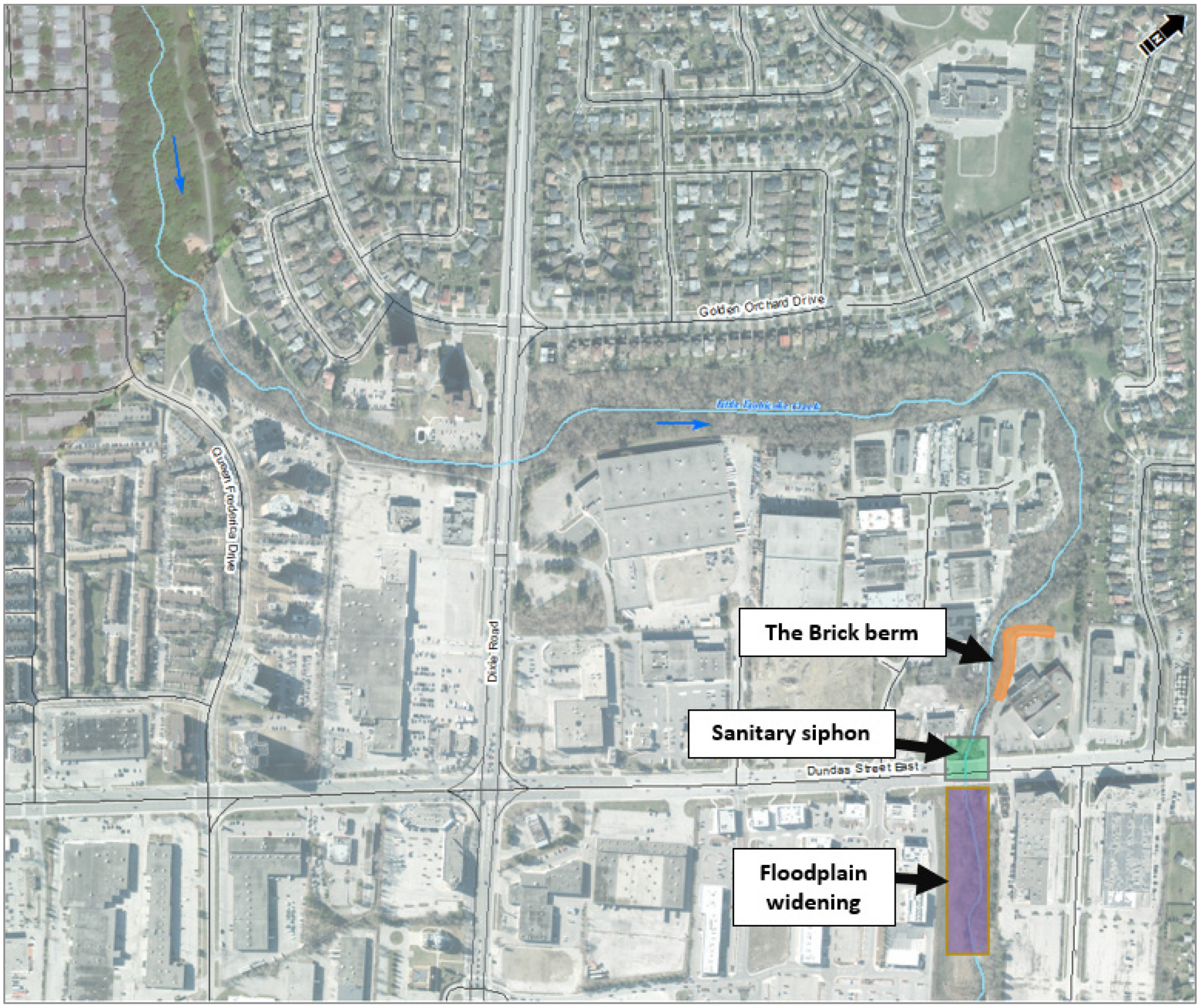


FIGURE 24 Dundas Road Area Design Concept Locations

9.1 Channel Elevation at Dixie Bridge

The channel invert elevation at Dixie Road bridge is a key design consideration. Therefore, this component of the Project was reviewed first in the design concepts phase. The channel invert elevation has significant impacts on:

- the Dixie Road bridge design
- the existing trunk sanitary sewer under Dixie Road
- property takings required to prevent the upstream spill

The preferred alternative solution presented in Section 8, includes a channel design based on an invert at Dixie Road that is approximately 0.5 m lower than the existing channel invert at this location. Three design concepts were considered including the base case used within the preferred alternative solution. The design concepts for this portion of the Project are as follows:

- Invert Concept 1 - Channel design based on invert at Dixie Road similar to existing conditions.
- Invert Concept 2 - Channel design based on invert at Dixie Road approximately 0.5 m lower than existing conditions. This Design Concept is the base case from the preferred alternative solution.
- Invert Concept 3 - Channel design based on invert at Dixie Road approximately 1.0 m lower than existing conditions.

Each of the invert concepts extend from the upstream pedestrian bridge (approximately 400 m upstream of Dixie) to approximately 200 m downstream of Dixie Road. Further channel design concepts outside of this short reach were developed and are summarized in Section 9.3. The channel profiles and resulting Regional water levels for Invert Concepts 1 to 3 are shown on Figure 25. Hydraulic results at key locations are provided in Table 8.

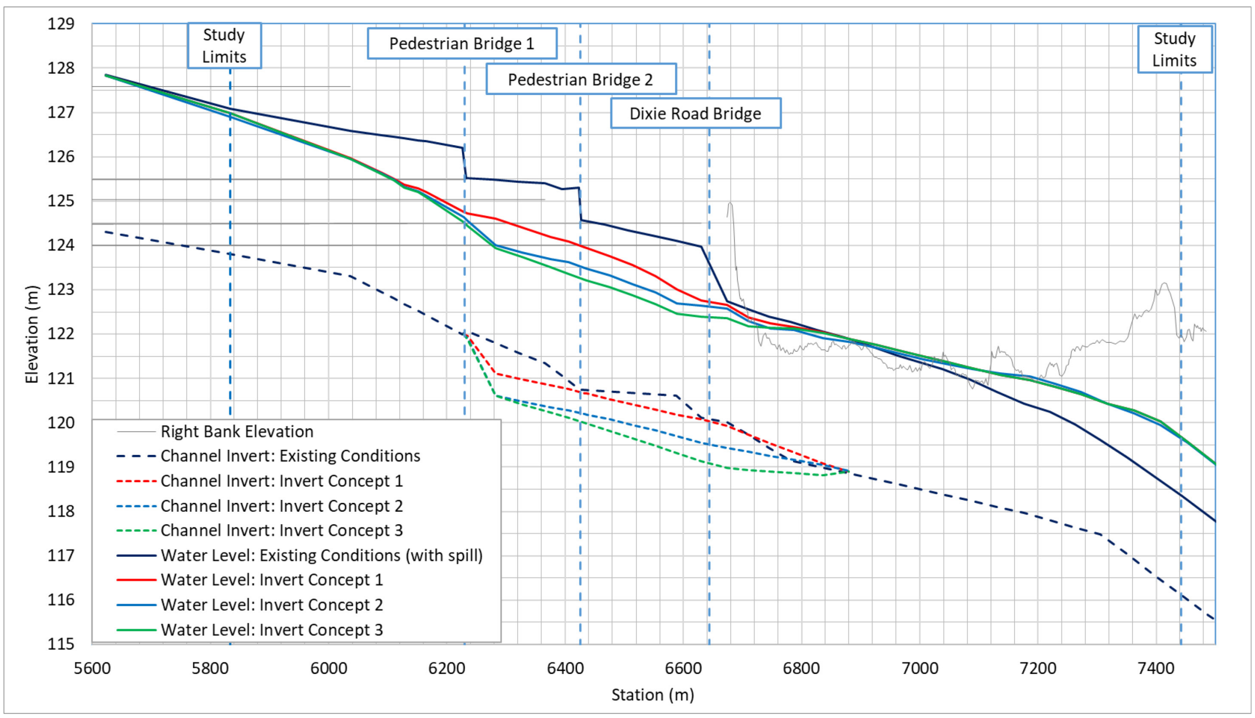


FIGURE 25 Invert Design Concepts - Regional Water Level Profiles

TABLE 8 Key Hydraulic Results for Invert Design Concepts (Regional Event)

Design Concept	Water Surface Elevation Upstream of Dixie Road Bridge	Water Surface Elevation - Pedestrian Bridge 2	Water Surface Elevation - Pedestrian Bridge 1	Minimum Freeboard
Invert Concept 1	122.76	123.94	124.75	0.20
Invert Concept 2	122.65	123.48	124.65	0.66
Invert Concept 3	122.40	123.20	124.53	0.94

Each of the design concepts result in water levels below the low point in the right bank, thus preventing spill during the Regional flow event. Invert Concepts 2 and 3 provide at least 0.5 m of freeboard which is the minimum freeboard for climate change resiliency identified for the Project. Invert Concept 3 provides the most freeboard against flood spill at the primary spill location near Queen Frederica Drive. Invert Concept 3 is preferred based on hydraulic technical and flood risk reduction criteria.

9.2 Dixie Road Bridge

Design concepts were developed for the Dixie Road bridge following the selection of Invert Concept 3. The objective of these design concepts is to develop a bridge concept that minimizes the impacts to top of road elevation, while providing a bridge soffit that is above the Regional water level including freeboard to provide resiliency to climate change. The following design concepts were developed with the input of the Project's structural engineer.

- Dixie Bridge Concept 1 - 38 m span, 600 mm deck, single 1 m pier
- Dixie Bridge Concept 2 - 45 m span, 900 mm deck, single 1 m pier
- Dixie Bridge Concept 3 - 50 m span, 600 mm deck, two 1 m piers
- Dixie Bridge Concept 4 - 55 m span, 600 mm deck, two 1 m piers

Components of the Dixie Bridge Concepts, such as number of piers, will affect water levels upstream of the bridge. Hydraulic assessment was required to confirm that design concepts comply with the overall goal of the Project to prevent flood spill upstream of Dixie Road. The Regional water level results from the hydraulic assessment also provide input to the required bridge soffit elevation. Each of the Dixie Bridge Concepts was assessed using the MIKE Flood model as described in Section 5. The results presented in Table 9 show that the Regional water levels in the reach upstream of the bridge only vary by a few centimeters.

TABLE 9 Regional Water Levels Upstream of Dixie Bridge Design Concepts

Design Concept	Water Surface Elevation Upstream of Bridge (1)	Results in Spill Upstream	Minimum Soffit Elevation (2)
Dixie Bridge Concept 1	122.46	No	122.81
Dixie Bridge Concept 2	122.39	No	122.79
Dixie Bridge Concept 3	122.37	No	122.80
Dixie Bridge Concept 4	122.35	No	122.80

(1) Water surface elevations from model cross-section 6588, approximately 40 m upstream of Dixie Road bridge.
(2) Region water level at upstream bridge face plus 0.5 m freeboard

All of the Dixie Bridge concepts result in similar water elevations for the Regional event. All of the Dixie Bridge Concepts support the primary project objective of prevent flood spill upstream of Dixie Road. There is not a strong preference for any of these design concepts based on hydraulic assessment alone. The smaller 38 m bridge span (Dixie Bridge Concept 1) is preferred due to lower costs and less infrastructure and roadway impacts than the other concepts. The original estimates of bridge and roadway configuration associated with supporting documentation for the preferred alternative (RVA 2020, Appendix C) will continue to apply.

9.3 Sanitary Sewer Crossing Downstream of Dixie Road

An existing 450 mm diameter sewer crosses Little Etobicoke Creek approximately 500 m east and downstream of the Dixie Road bridge. The crossing location is marked in red on Figure 26. The sewer pipe is exposed within the Creek and is currently acting as a weir in the channel. Five design concepts were developed for the protection or relocation of this sanitary sewer. The design concepts for the sanitary sewer are presented in two letter reports to the City and Region contained in Appendix F. Discussions between the City and Region regarding the preferred design concept for this sanitary sewer crossing are ongoing.

The selection of a preferred design concept will impact the channel design. If the sanitary sewer crossing is protected in place the channel profile at the crossing will need to be raised relative to the preferred alternative solution. If the sewer crossing is lowered or relocated the channel design can proceed as planned in preferred alternative solution. The following section describes the potential channel design concepts with consideration for the sanitary sewer crossing.

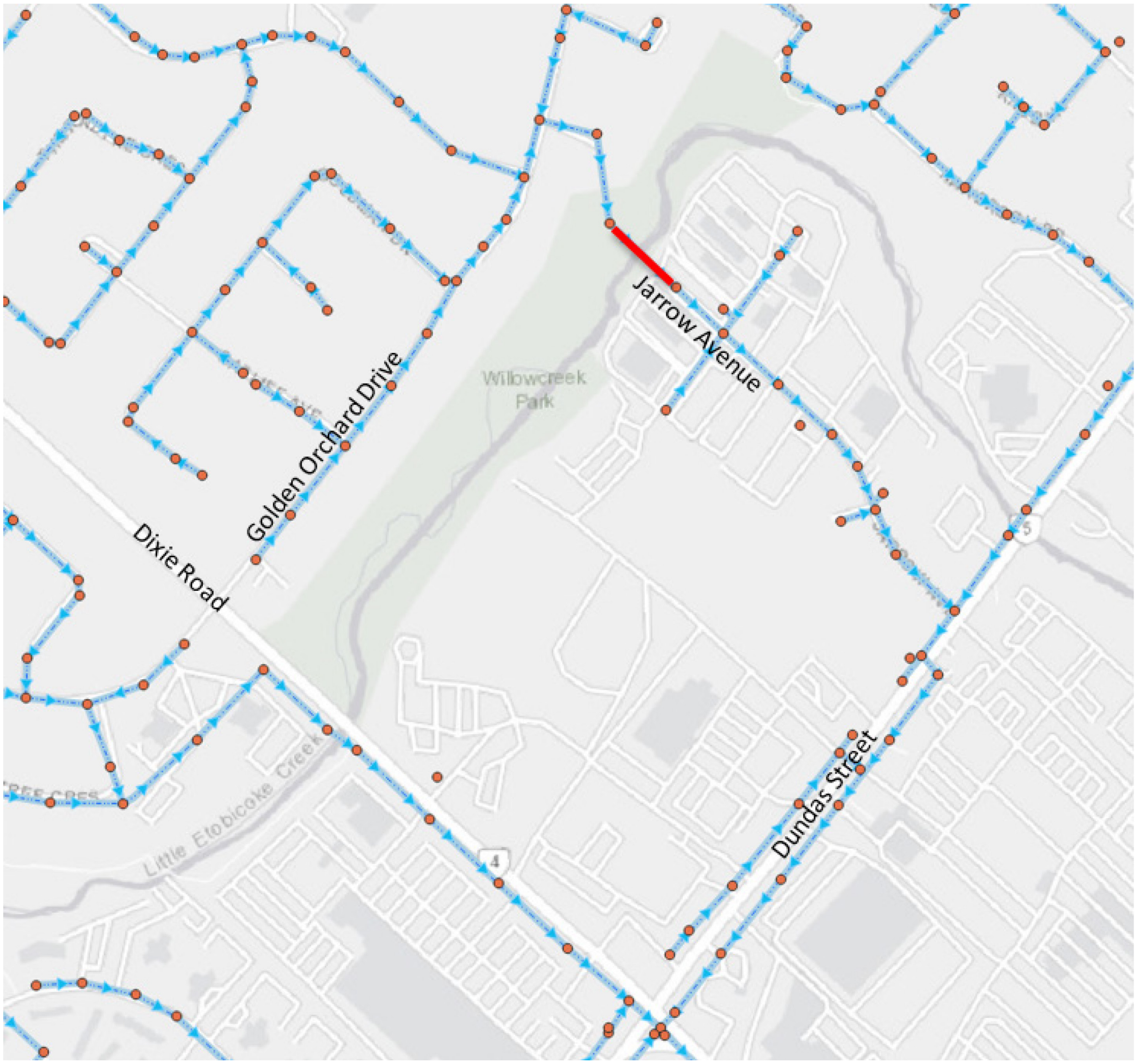


FIGURE 26 Sanitary Sewer Alternatives

9.4 Overall Channel Design

Design concepts for the overall channel design were developed to improve upon the preferred alternative solution presented in Section 8. These design concepts build upon Invert Concept 3 and Dixie Bridge Concept 1 which are the preliminary preferred design concepts for the area around the Dixie Road bridge. The overall channel design concepts presented in this section are intended to maximize the following benefits within the preferred alternative solution:

- Improved fluvial geomorphic conditions
- Improved aquatic habitat
- Improved flood conveyance, particularly at the spill location downstream of Dixie Road
- Recognition of infrastructure constraints

The preferred Alternative Solution presented in Section 8, includes a simplistic channel cross-section to represent the overall Making Room for the Creek alternative solution. The preferred alternative solution remediated the primary spill near Queen Frederica upstream of Dixie Road; however, the water levels remained approximately 0.5 m above the right bank at the secondary spill point downstream of Dixie Road. A key objective of the channel design concepts is to further lower Regional water levels and keep the downstream spill within the channel. The design concepts presented below also consider the potential constraints and opportunities associated with the existing exposed sanitary sewer crossing downstream of Dixie Road from Fieldgate Drive to Jarrow Avenue (refer to Section 9.3). Two design concepts were considered for this portion of the Project are as follows.

- Channel Concept 1 - Assumes the existing sanitary crossing is relocated
- Channel Concept 2 - Assumes the existing sanitary crossing is protected in place

The channel design concepts extend from approximately 550 m upstream of Dixie Road to approximately 650 m downstream of Dixie Road. Both design concepts provide a 6 m offset from the property line behind Golden Orchard Drive, and tie into the existing grade on the right channel bank at the existing berm. The natural ground in this area slopes down away from the channel bank. Maintaining a relatively narrow channel design concept here maintains the existing high point elevation. Refer to Figures 27a and 27b for illustration of the channel design concepts cross-sections. The channel design concepts tie-in with the existing channel invert adjacent to the existing sanitary sewer crossing.

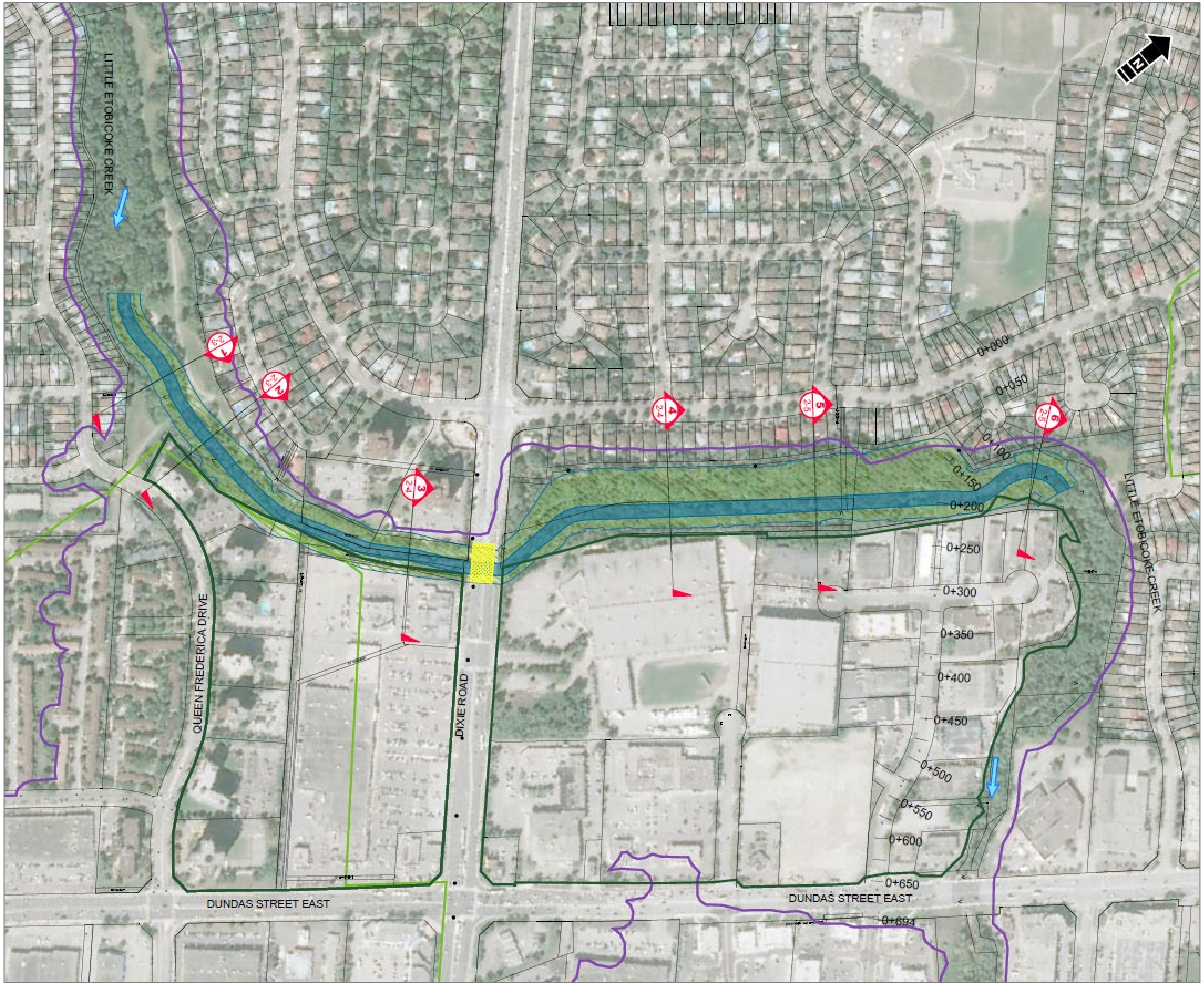
Channel Concept 1 assumes that the sanitary sewer crossing would be removed from the Creek in this area and therefore will have no impact on the channel hydraulics. This design concept extends the channel lowering from Invert Concept 3 (refer to Section 9.1) to improve hydraulic capacity at the spill location downstream of Dixie Road. The shape of the cross-section upstream and downstream of Dixie Road is designed to improve fluvial geomorphic conditions and aquatic habitat during normal flow conditions.

The low flow channel in Channel Concept 1 is designed to convey the peak flows from an average year. Larger flows will utilize the wider main base of the Creek corridor like a natural floodplain. Energy within the channel is reduced during high flow conditions by connecting the flow to a floodplain. This reduces erosion potential and improves fish habitat. The low flow channel design for Channel Concept 1 is 1 m deep with 2:1 side slopes. There are two floodplain shelves, the first of which is 0.5 m deep. Side slopes vary throughout the reach based on constraints. The cross-sections used in the assessment of Channel Concept 1 are simplified with completely flat slopes on each of the floodplain shelves.

Channel Concept 2 is included in case the preferred design concept for the existing sanitary sewer is to protect the existing crossing in place. Currently the sewer is exposed, sits within the creek flow area and acts as a weir. The profile of Channel Concept 2 is relatively flat downstream of Invert Concept 3 (refer to Section 9.1). This is required as the channel would naturally fill in behind the protected in place sewer, which would continue to act as a weir. No riprap cover is assumed over the sewer encasement. As a result, there is approximately 1 m difference in invert elevation between Channel Concept 1 and Channel

Concept 2 for nearly 400 m upstream of the existing sanitary sewer crossing (refer to Figures 27a, 27b, and 28).

Channel Concept 2 has less area to convey flood flows than Channel Concept 1 because of the higher profile. To compensate for this loss, the floodplain shelves have been lowered to provide more flood flow conveyance. However, this loses much of the low flow channel, which is only 20 cm deep upstream the sewer in this concept. This is less preferred from an ecological or geomorphic perspective (additionally described in other EA documentation). Where Channel Concept 1 had simplified flat slopes on the floodplain shelves, Channel Concept 2 includes conservative cross-slopes on the floodplain shelves (refer to Figures 27a and 27b). The cross-slopes on these shelves were included to confirm the hydraulic feasibility of Channel Concept 2, in recognition of the reduced flow area resulting from the higher invert (compared to Channel Concept 1). A longitudinal profile of channel inverts and resulting Regional water levels is provided in Figure 28.



LEGEND

- CREEK CENTRELINE
- PROPERTY LINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

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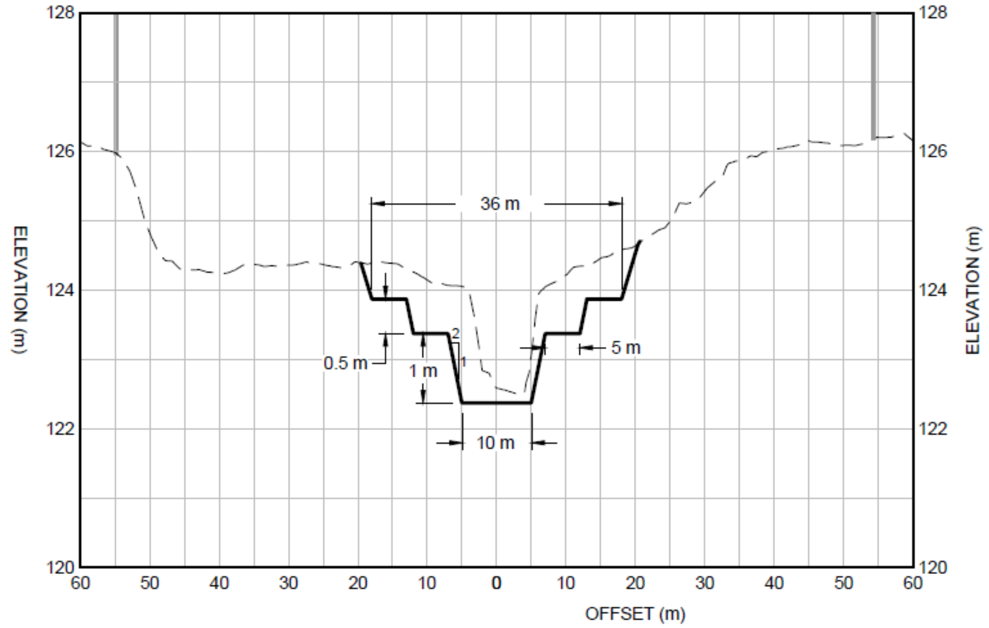
City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Channel Design Concepts Conceptual Plan

Date:	Project:	Submitter:	Reviewer:
October 2022	24603	N. Burrows	K. Hofbauer

Figure 27a



1 Section 2-1
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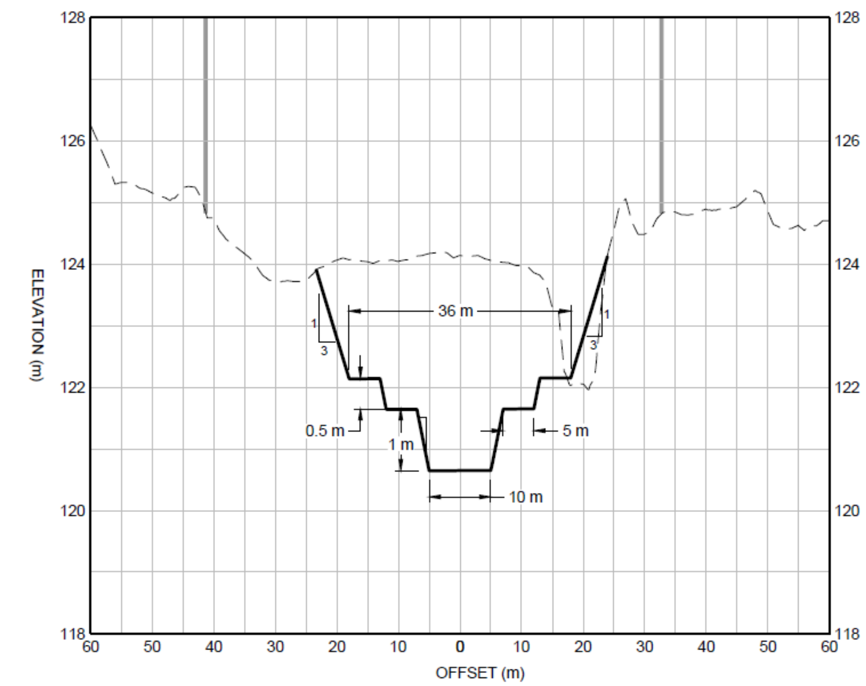
VERTICAL SCALE 1:100



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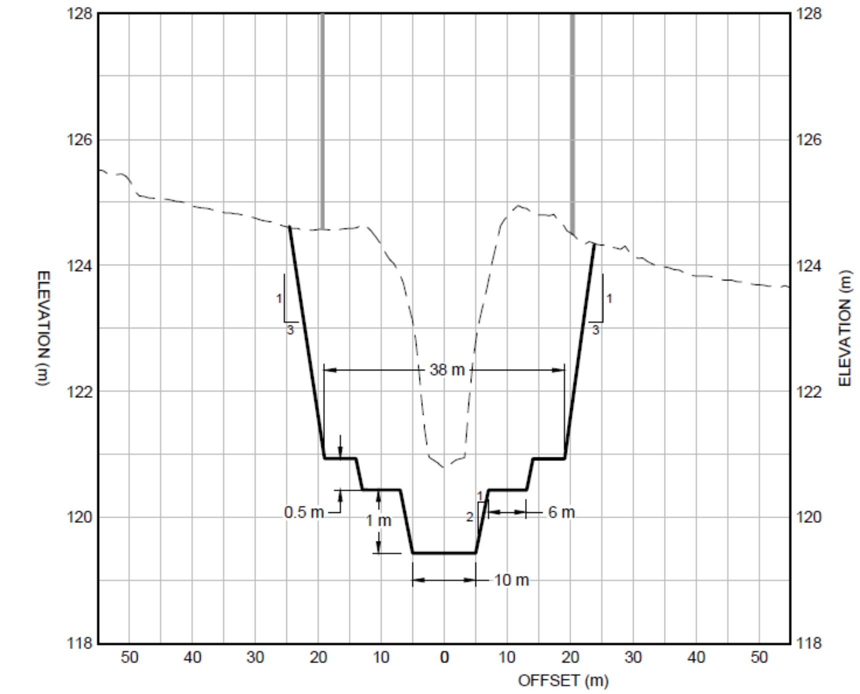
VERTICAL SCALE 1:100



3 Section 2-1
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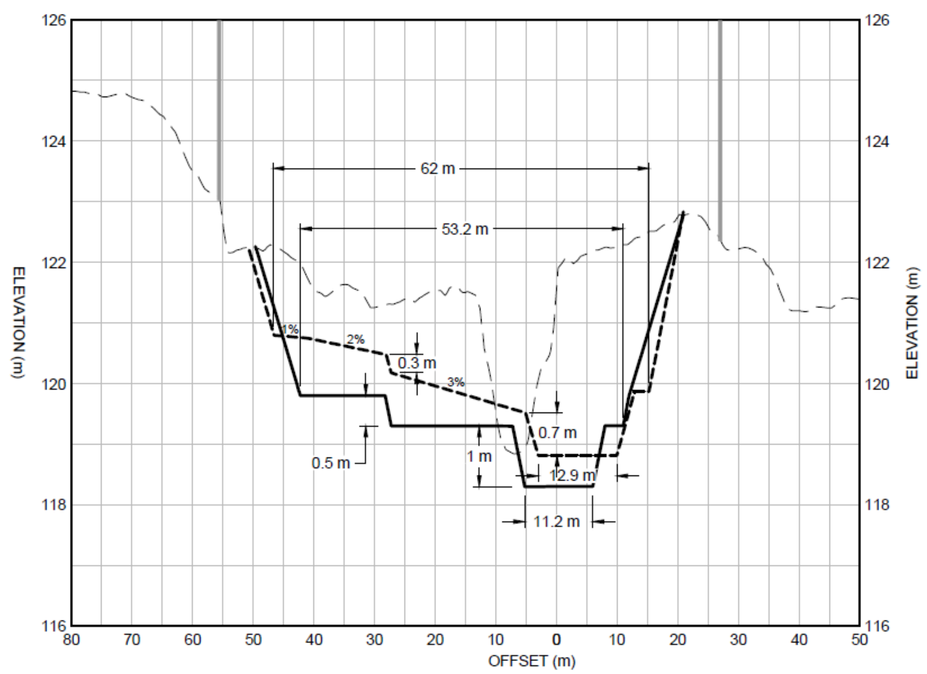
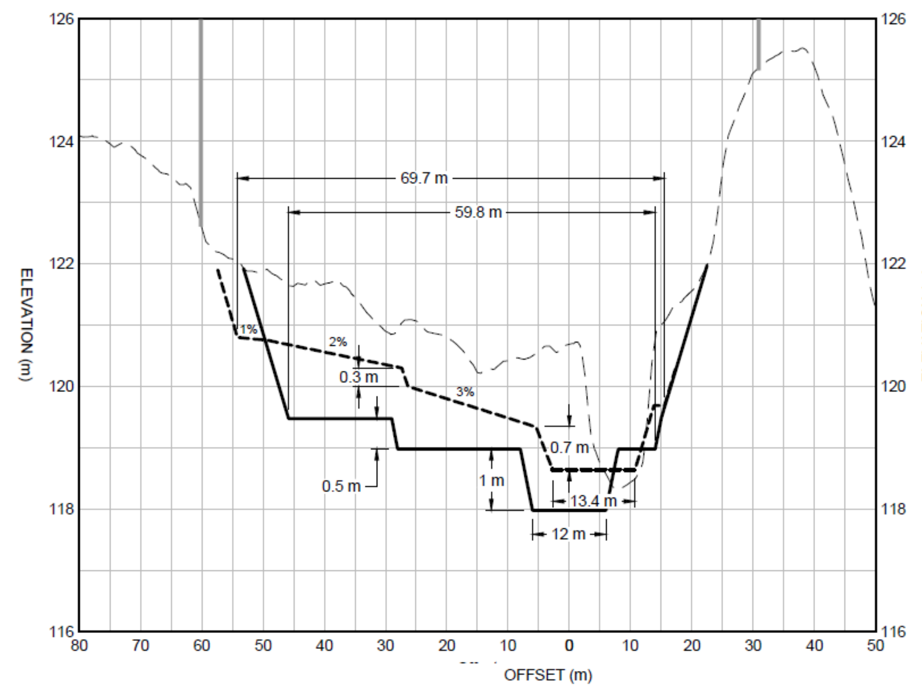
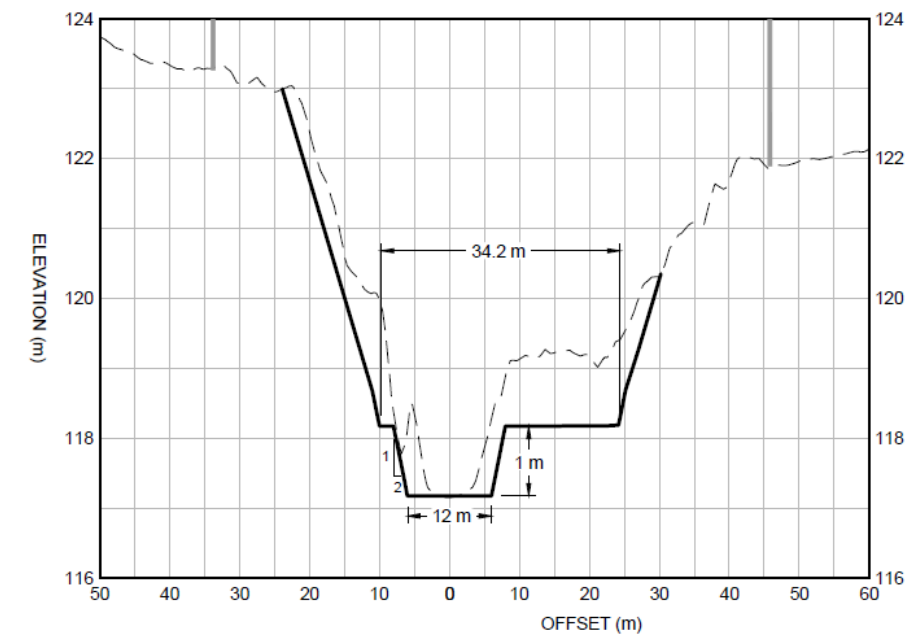
VERTICAL SCALE 1:100



4 Section 2-1
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:100



5 Section 2-1
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:100



6 Section 2-1
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:100

LEGEND

- EXISTING GROUND
- CHANNEL CONCEPT 1
- CHANNEL CONCEPT 2
- PROPERTY BOUNDARY

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City of Mississauga
Dixie-Dundas Flood Mitigation Project – Hydraulic Modelling Report

Channel Design Concepts Cross-Sections

Date:	Project:	Submitter:	Reviewer:
October 2022	24603	N. Burrows	K. Hofbauer

Figure 27b

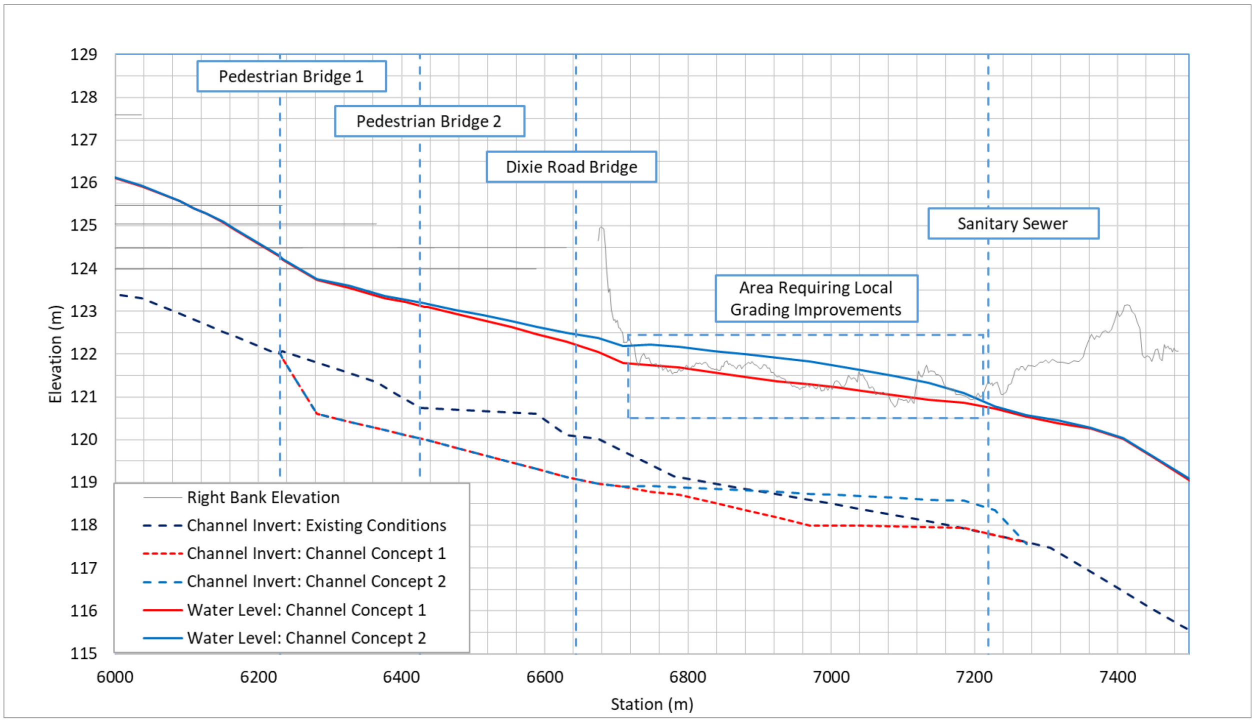

FIGURE 28 Regional Water Level Profiles - Channel Concept 1 and Channel Concept 2

The hydraulic assessment of Channel Concept 1 indicates that Regional water levels are reduced by an average of 30 cm throughout the Dixie Area. The water levels in the downstream spill area remain above the right bank indicating that some spill would still occur in this area without further mitigation. However, with Channel Concept 1 the Regional water levels are very close to the elevations of the right bank (less than 10 cm overtopping). This minor overtopping could be mitigated with local grading improvements. Additionally, these right bank areas include assumed elevations corresponding to removal of the existing berm at this location.

Channel Concept 2 results in Regional Water levels up to 54 cm higher than Channel Concept 1. This results in Regional water levels which are slightly more than 0.5 m above the spill point, when the sewer is protected in place. This is the upper limit of local grading improvements. Much of the hydraulic improvements from the channel lowering are lost by keeping the existing sewer in place.

Channel Concept 1 is preferred based on hydraulic technical and flood risk reduction criteria. However, the selection of a channel design concept is dependant on the selection of a design concept for the sanitary sewer crossing. At the time of writing the Project Team is waiting for input from the Region regarding the sanitary sewer crossing.

9.5 Upstream of Dundas Street

The preferred alternative solution in the Dixie Area will increase flows at the Dundas Area by conveying flood flows within the channel under future conditions. The preferred alternative solution in the Dundas

Area reduces the impacts of the increased flow at this location, however, hydraulic analysis shows that water levels upstream of the Dundas Street bridge are still up to 1 m higher than in existing conditions.

A private property on the east side of the Creek upstream of Dundas Street is currently situated in the floodplain with a “hazard” designation. There is an existing engineered berm protecting the property, however, this is considered a non-permanent flood solution under Ontario regulations. Since the berm is considered non-permanent flood protection it is not considered when assessing Regional flood conditions. However, if the current engineered berm could structurally withstand a Regional event (not determined within this study), the property would be protected. Three design concepts were assessed upstream of Dundas Street to provide equivalent or better flood protection for the affected property. The design concepts for the berm in this area are as follows and are illustrated in Figure 29.

- Dundas Berm Concept 1: Raise the existing berm
- Dundas Berm Concept 2: Widen the downstream channel
- Dundas Berm Concept 3: Move the berm back and widen the upstream channel

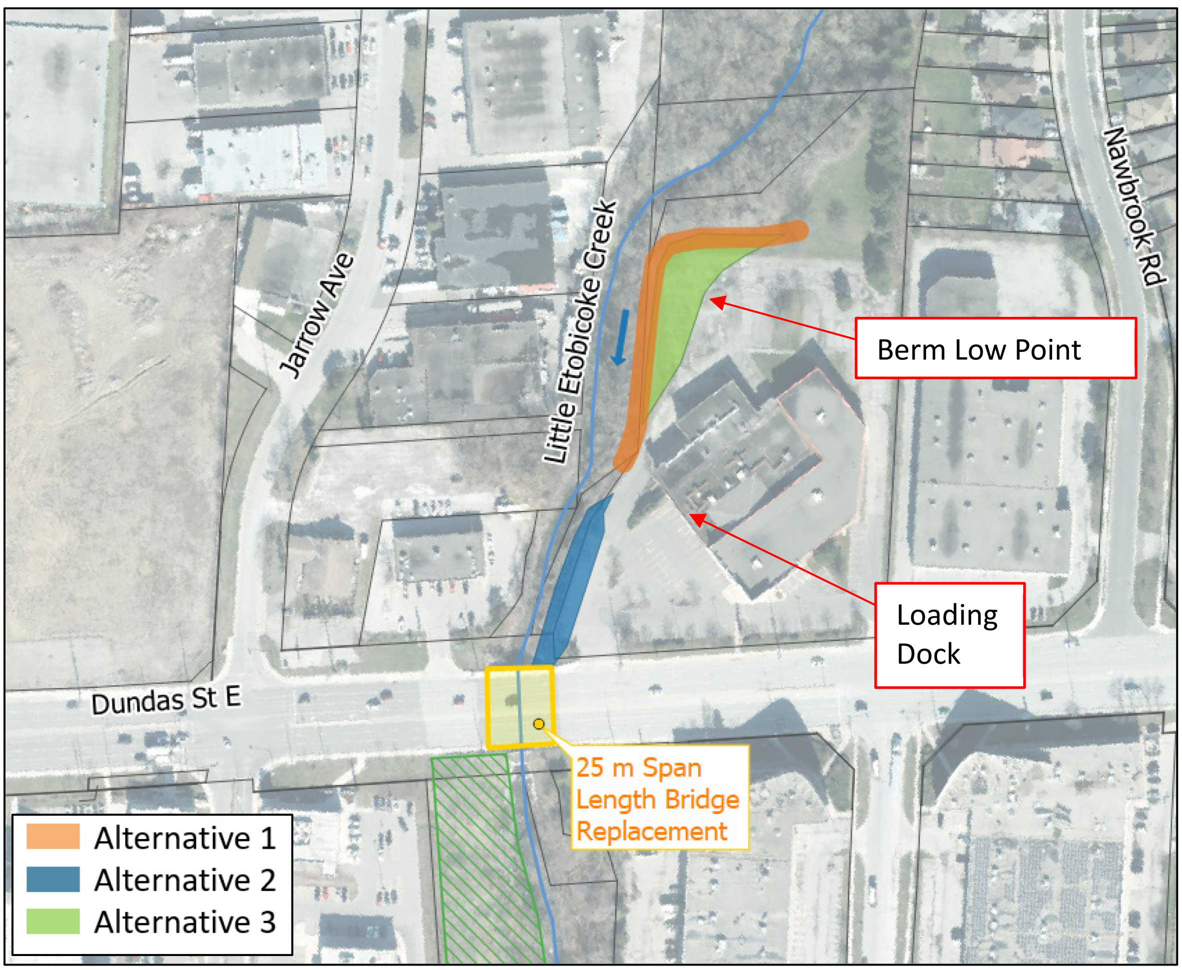

FIGURE 29 Dundas Berm Design Concepts

The existing berm follows the channel and parking lot boundary and extends from between the channel bend and the north edge of the parking lot, to approximately 50 m upstream of Dundas Street. The narrow valley corridor in this area limits the options for mitigation. The loading dock on the existing building has been identified as a key constraint as access needs to be maintained for the current business operation. The existing loading dock is located at a pinch point in the channel. The proximity of the loading dock access to the existing berm and channel limits widening potential in this area.

Dundas Berm Concept 1 maintains the current berm location and alignment. The berm would be raised by 1 m at its low point to provide 0.5 m freeboard above the Regional water level. This intent is to match the freeboard available at this location under existing conditions.

Design Concept 2 widens the channel in the parking lot area immediately adjacent to Dundas Street. Channel widening is limited in order to maintain driveway access to Dundas Street East and maintain access to the loading dock area. A single row of parking spaces would need to be removed to allow the channel to be widened approximately 5 m at the top of bank.

Design Concept 3 moves the berm back approximately 20 m away from the Creek at the upstream corner of the property. This enables some channel widening below the future berm location. This option would require removing existing parking in the northwest corner of the property but would maintain access to the loading dock.

The Regional water levels of the three design concepts are compared to the existing conditions water level and the berm elevation in Figure 30. The berm low spot, hydraulic restriction near the loading dock, and the Dundas Street bridge are highlighted for reference.

Due to the hydraulic restriction caused at the pinch point in this area, Dundas Berm Concept 3 and Dundas Berm Concept 2 do not significantly lower water levels and overtopping of the berm during the Regional event would continue. Therefore, the hydraulically preferred solution is Dundas Berm Concept 1.

The required top of berm is anticipated to be up to 1.0 m higher than the existing berm. This elevation includes freeboard to provide resiliency to climate change and maintain the level of freeboard provided under existing conditions. Note that agreements (and easements etc.) to allow this berm work will be required. The current structural integrity of the berm will also need to be reviewed.

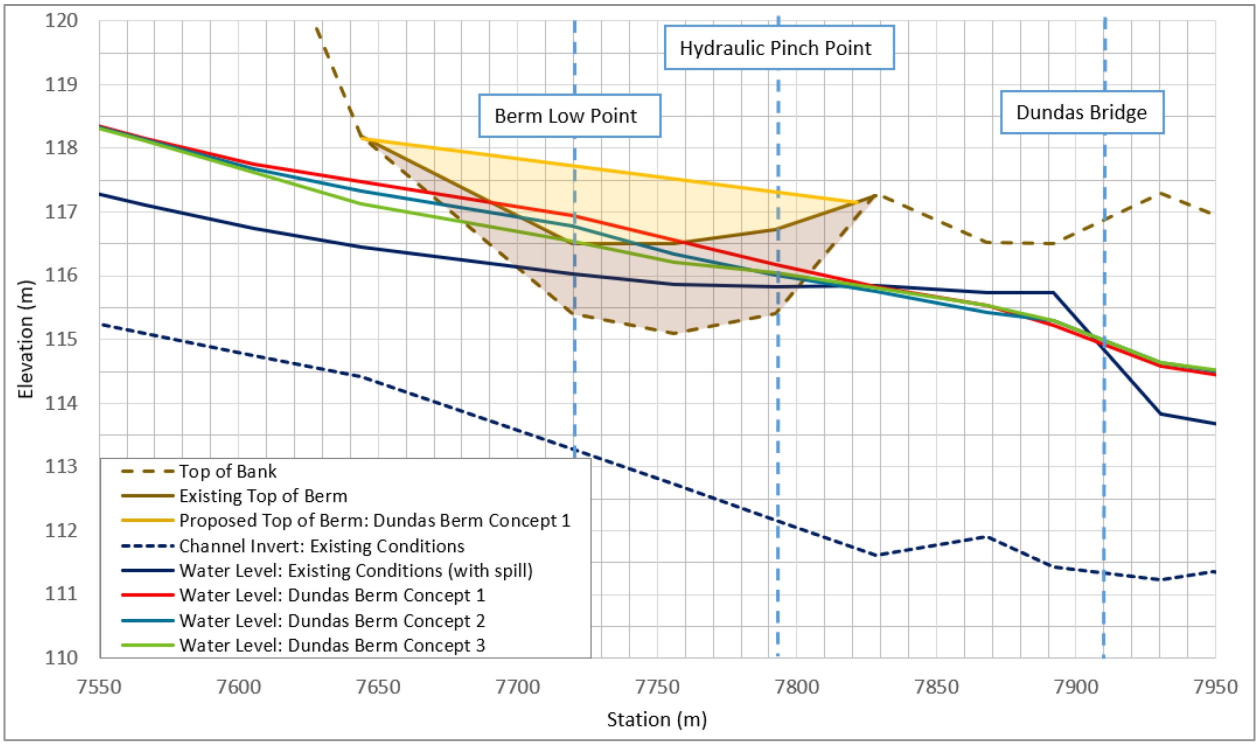

FIGURE 30 Regional Event Water Level Profiles Upstream of Dundas

9.6 Sanitary Sewer Siphon at Dundas Street

A sanitary sewer along Dundas Street is conveyed across Little Etobicoke Creek via a siphon under the Creek on the upstream side of the Dundas Street bridge. The siphon will need to be relocated in coordination with the proposed bridge design for Dundas Street. Design concepts for this siphon may affect costs and other infrastructure considerations. However, it is anticipated that the sanitary sewers will be placed outside of the creek flow area, and therefore will not impact the hydraulic evaluation of the Project.

9.7 Floodplain Widening Downstream of Dundas

The existing creek valley downstream of Dundas Street is relatively narrow with steep slopes below the Regional water level. In this area the channel is confined without functional access to its floodplain. Confined channels have limited ability to dissipate energy during high flow conditions, which can result in erosion and reduced aquatic habitat. There are locations along the Creek corridor downstream of Dundas Street with existing erosion concerns, and stream restoration opportunities. The preferred alternative solution includes floodplain widening downstream of the proposed bridge at Dundas Street with the intent of reducing energy and water levels during high flow conditions and improve geomorphic and aquatic habitat conditions. Two design concepts were considered for the downstream floodplain improvements as follows.

- Downstream Concept 1 - Maximized floodplain area downstream of Dundas Street
- Downstream Concept 2 - No floodplain improvements downstream of Dundas Street

The City owns lands within the Creek corridor, above the Regional water level, on the west side of the channel (refer to Figure 31). Downstream Concept 1 has been developed to maximize the potential floodplain within the available property, while providing a 6 m offset from the property line. Downstream Concept 1 provides approximately 25 m of floodplain adjacent to a 1 m deep low flow channel.

Downstream Concept 2 is representative of a Do Nothing alternative for this portion of the Project. Therefore, Downstream Concept 2 is the same as existing conditions downstream of Dundas Street. With this design concept in place, any erosion site repairs would have to be completed as isolated local repairs. Figure 32 shows the Regional water level comparison for Downstream Concepts 1 and 2, and existing conditions.

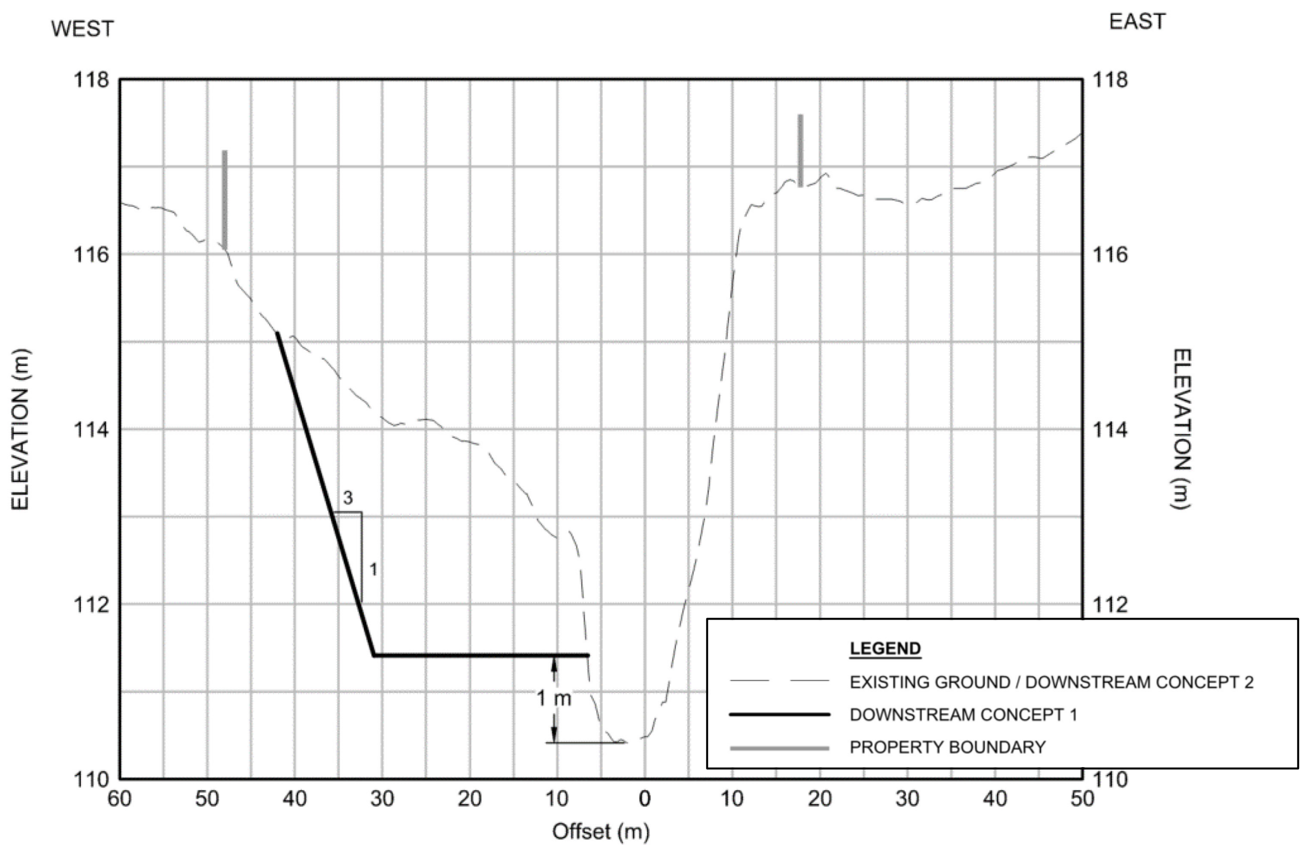

FIGURE 31 Cross-Section - Downstream Concept 1 and Downstream Concept 2

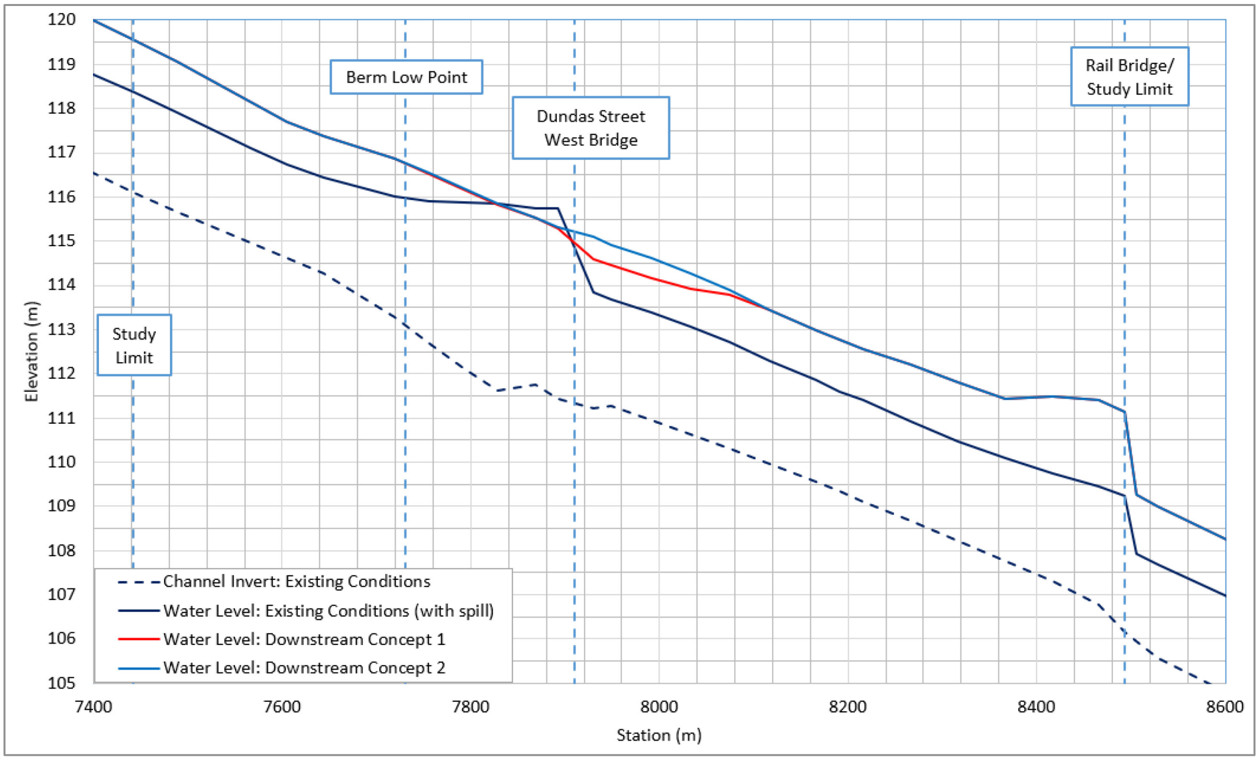

FIGURE 32 Floodplain Widening Alternatives - Regional Water Levels

Both design concepts result in Regional water levels higher than existing conditions because the peak flows have changed as a result of the preferred alternative solution in the Dixie Area. Downstream Concept 1 reduces Regional water levels by up to 0.5 m downstream of Dundas Street. However, there are minimal risks related to the higher water levels in this area. Downstream Concept 1 reduces Regional water levels only 2 cm at the upstream side of Dundas Street and provides no benefit flood risk at the low point in the Dundas Berm (refer to Section 9.5). Therefore, Downstream Concept 1 does not provide enough hydraulic benefit at key locations to warrant a preference based on flood risk reduction alone.

10 HYDRAULIC TECHNICAL INPUT FOR DESIGN CONCEPT EVALUATION

The design concepts have been evaluated based on hydraulics considerations. Evaluation input for other categories of evaluation criteria are ongoing. Final selection of the preferred design concepts will be based on a fulsome evaluation including other technical studies and costs. The full evaluation of the design concepts and selection of a preferred design concept will be summarized in the upcoming PIC and detailed in the forthcoming ESR.

The hydraulic assessments presented in Section 9 of this report indicate preference to the following design concepts based on hydraulic technical and flood risk reduction criteria.

- Invert Concept 3 - This concept provides the most freeboard against flood spill at the primary spill location near Queen Frederica Drive.

- Dixie Bridge Concepts - There is not a strong preference for any of these design concepts based on hydraulic assessment alone.

- Sanitary Sewer Crossing - Hydraulic assessment is not applicable to these concepts. However, the selection of a preferred design concept for addressing the existing exposed 450 mm diameter sewer will impact upon the channel design. At the time of writing the Project Team is waiting for input from the Region regarding the sanitary sewer crossing.

- Channel Concept 1 - This concept is preferred based on hydraulic technical and flood risk reduction criteria. However, the selection of a channel design concept is dependant on the selection of a design concept for the sanitary sewer crossing.

- Dundas Berm Concept 1 - This concept is preferred as it was the only design concept shown to sufficiently protect the adjacent private property.

- Downstream Concepts - Downstream Concept 1 does not provide enough hydraulic benefit at key locations to warrant a preference based on flood risk reduction alone.

11 SUMMARY AND CONCLUSIONS

Matrix Solutions Inc. is completing the Dixie Dundas Flood Mitigation Schedule C Municipal Class Environmental Assessment Project for the City of Mississauga to develop and evaluate flood mitigation alternatives for the Dixie Dundas area. The objective for the Project is to manage existing Regional storm spill from Little Etobicoke Creek to reduce flood risks, to protect existing properties, and enable growth.

Three alternative solutions were evaluated based on hydraulics considerations in combination with other technical studies and costs for both the Dixie Area and the Dundas Area. Dixie Alternative 2 Making Room for the Creek was selected as preferred for the Dixie Area. By mitigating the spills within the Dixie Road study area, the flows downstream in the Dundas Street study area are increased. This is the intended outcome of the alternative solutions for the Dixie Area; however, it increases flood levels at Dundas Street. Three separate alternative solutions were evaluated to mitigate flooding in the Dundas Area. The Dundas Alternative 1 25 m bridge with downstream conveyance was selected as preferred alternative for accommodating the increased flows and effectively mitigating flooding in the Dundas Area.

A number of design concepts were developed to maximize benefits and optimize each aspect of the overall preferred alternative solution (i.e., the combined Dixie Area and Dundas Area preferred solutions together). For the Dixie Area, the design concepts include channel elevation around Dixie Road, the Dixie Road bridge and road design, refined channel cross-sections and profile, and considerations for the sanitary sewer crossing downstream of Dixie Road. For the Dundas Area, design concepts include: the berm upstream of Dundas Street, the sanitary siphon at Dundas Street, and downstream floodplain widening. Evaluation input for other categories of evaluation criteria are ongoing. Final selection of the preferred design concepts will be based on a fulsome evaluation including other technical studies and costs and will be summarized in the upcoming PIC and detailed in the forthcoming ESR.

12 REFERENCES

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APPENDIX A
Little Etobicoke Creek Floodplain Spill Assessment Maps

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017
Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Steady State
Depth

K. Molnar
K. Hofbauer

Map 1.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017

Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Steady State Velocity

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K. Hofbauer

Map 1.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth x Velocity (m²/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017
Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

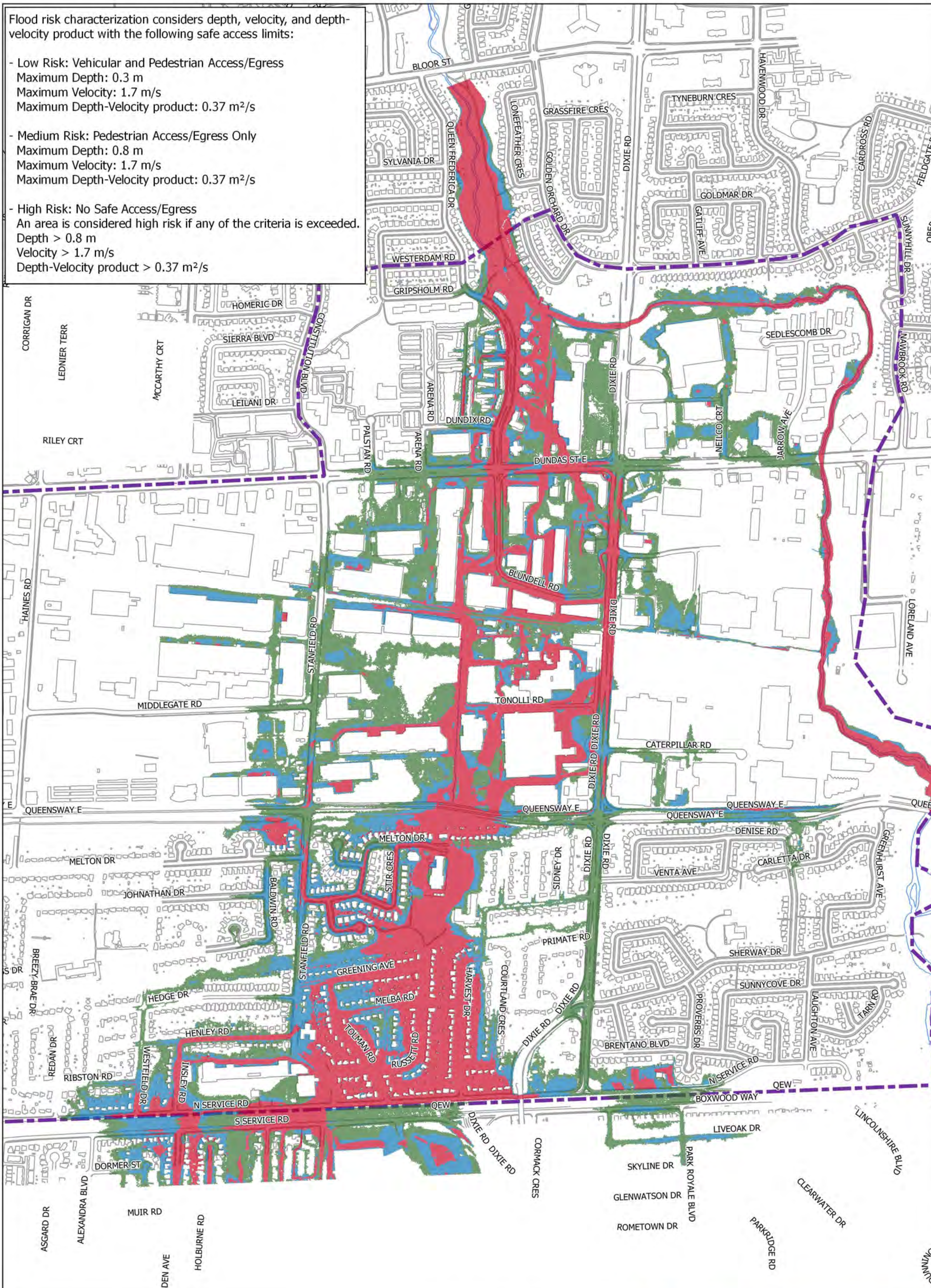
Project #24603

Regional Storm - Steady State
Depth x Velocity Product

K. Molnar
K. Hofbauer

Map 1.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Risk

Low (Vehicular and Pedestrian Access/Egress)

Medium (Pedestrian Access/Egress Only)

High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017

Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Steady State
Flood Risk

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Map 1.4

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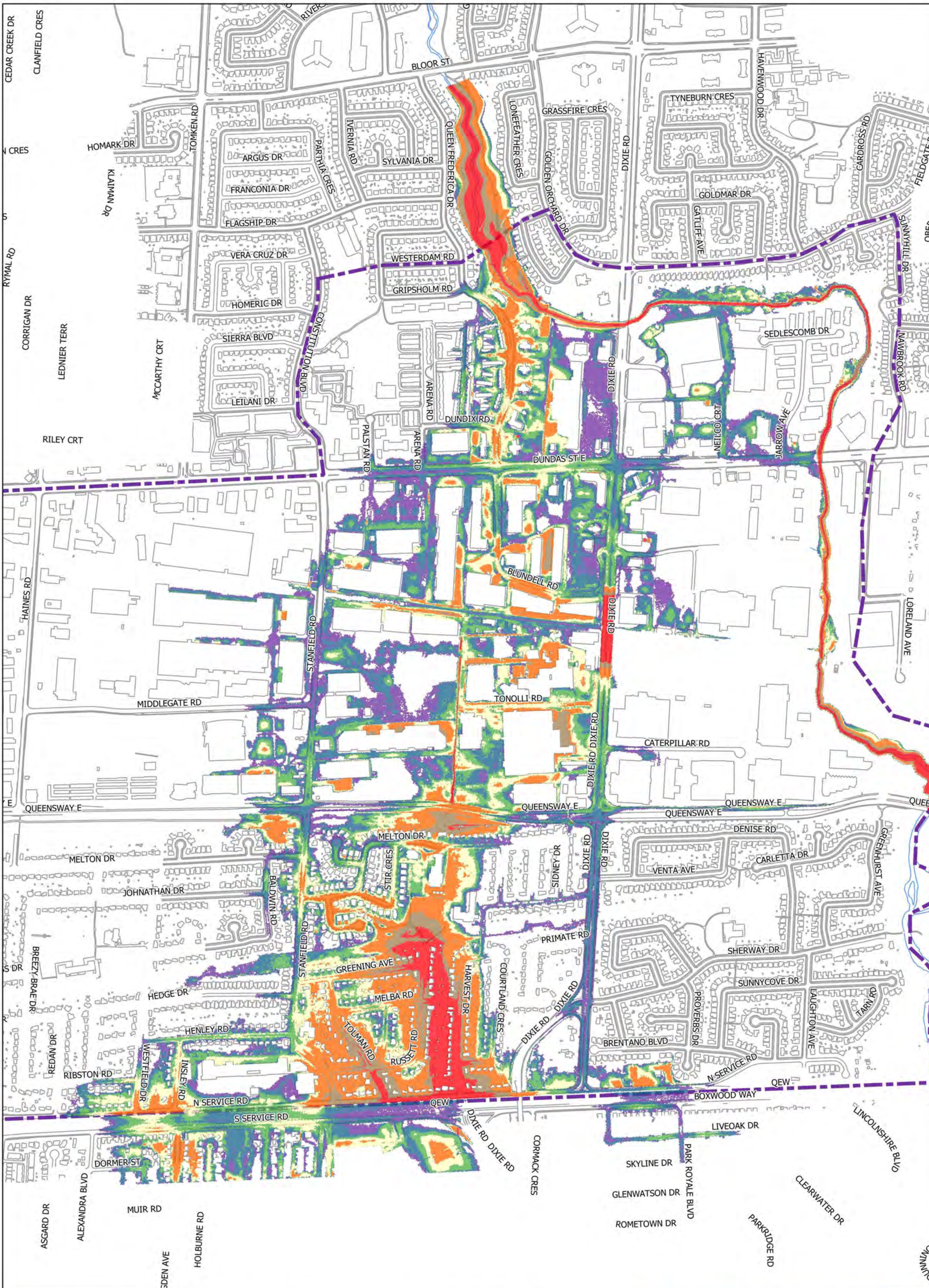

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017
Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Unsteady State
Depth

K. Molnar
K. Hofbauer

Map 2.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- \> 2.00

0 100 200 300 400 500 m

1:10,000

N

Run Date: August 14, 2017
Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Unsteady State
Velocity

K. Molnar
K. Hofbauer

Map 2.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth x Velocity (m²/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.37
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017

Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Unsteady State
Depth x Velocity Product

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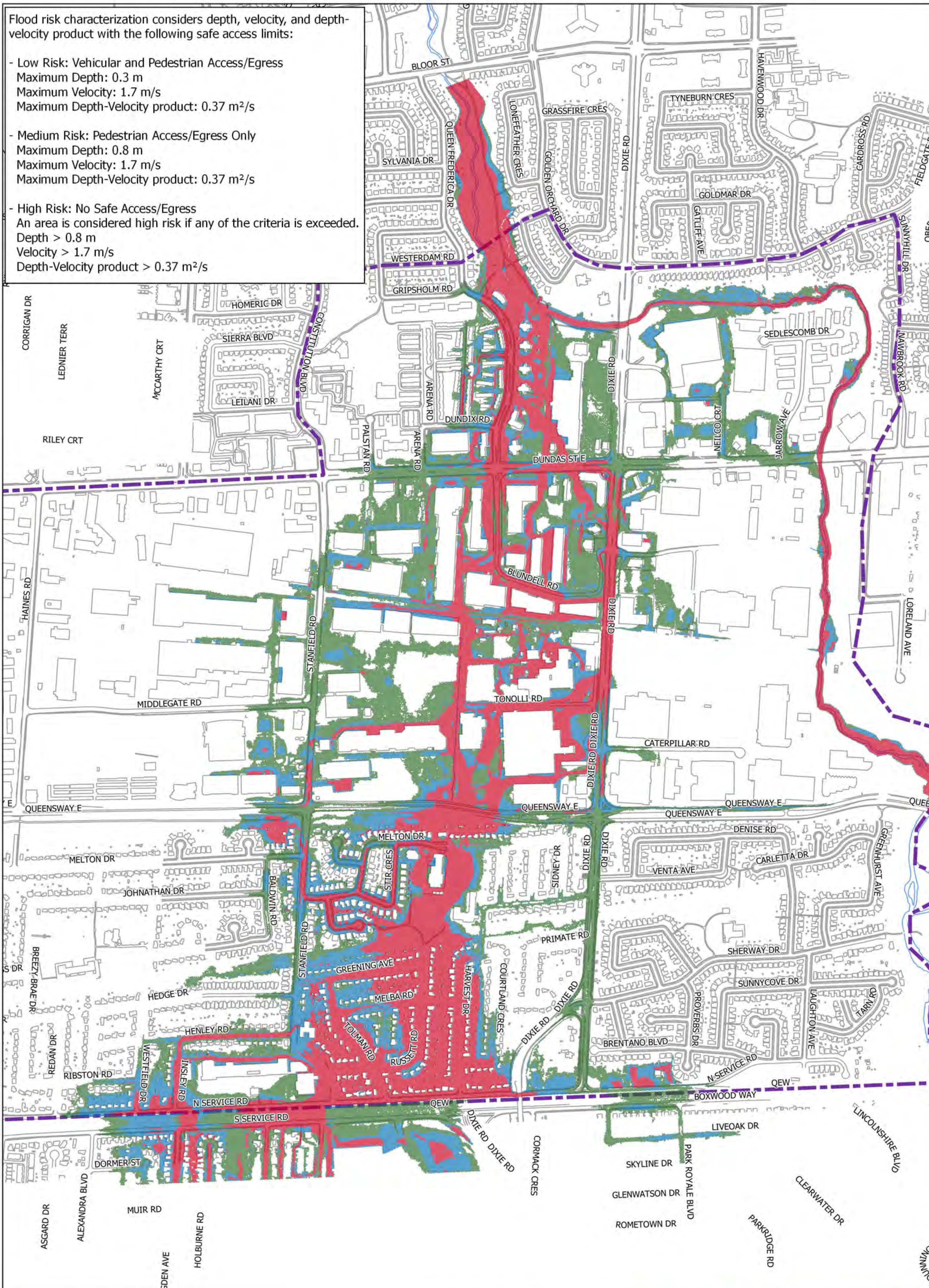
Map 2.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Flood risk characterization considers depth, velocity, and depth-velocity product with the following safe access limits:

- Low Risk: Vehicular and Pedestrian Access/Egress
  Maximum Depth: 0.3 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m²/s
- Medium Risk: Pedestrian Access/Egress Only
  Maximum Depth: 0.8 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m²/s
- High Risk: No Safe Access/Egress
  An area is considered high risk if any of the criteria is exceeded.
  Depth > 0.8 m
  Velocity > 1.7 m/s
  Depth-Velocity product > 0.37 m²/s



Phase 1 Study Area

Risk

Low (Vehicular and Pedestrian Access/Egress)

Medium (Pedestrian Access/Egress Only)

High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

Run Date: August 14, 2017

Figure Date: August 17, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

Regional Storm - Unsteady State
Flood Risk

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Map 2.4

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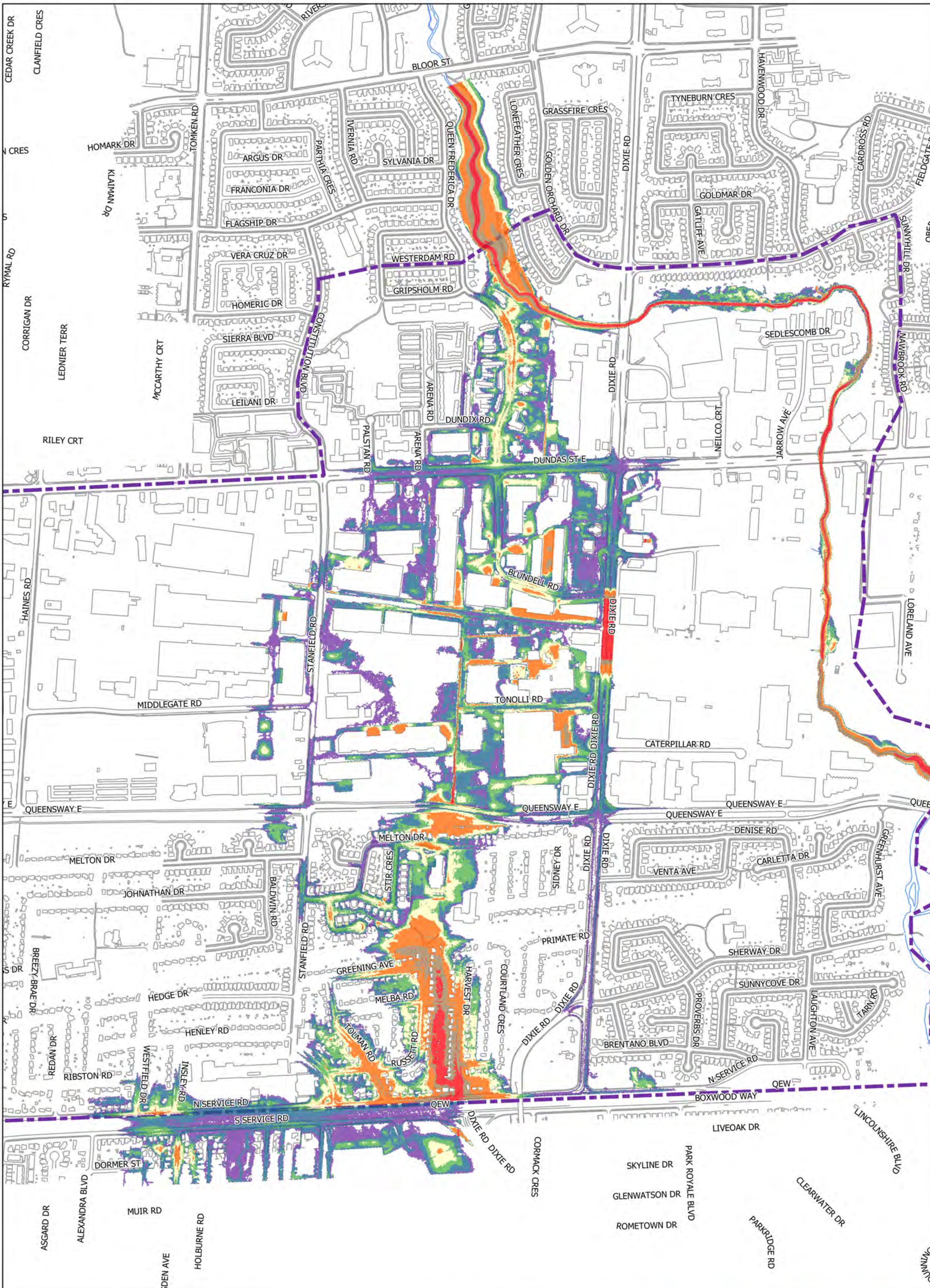

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: October 1, 2017

Figure Date: October 2, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 24-hour Chicago - Unsteady State Depth

K. Molnar
K. Hofbauer

Map 3.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Run Date: October 1, 2017
Figure Date: October 2, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 24-hour Chicago - Unsteady State Velocity

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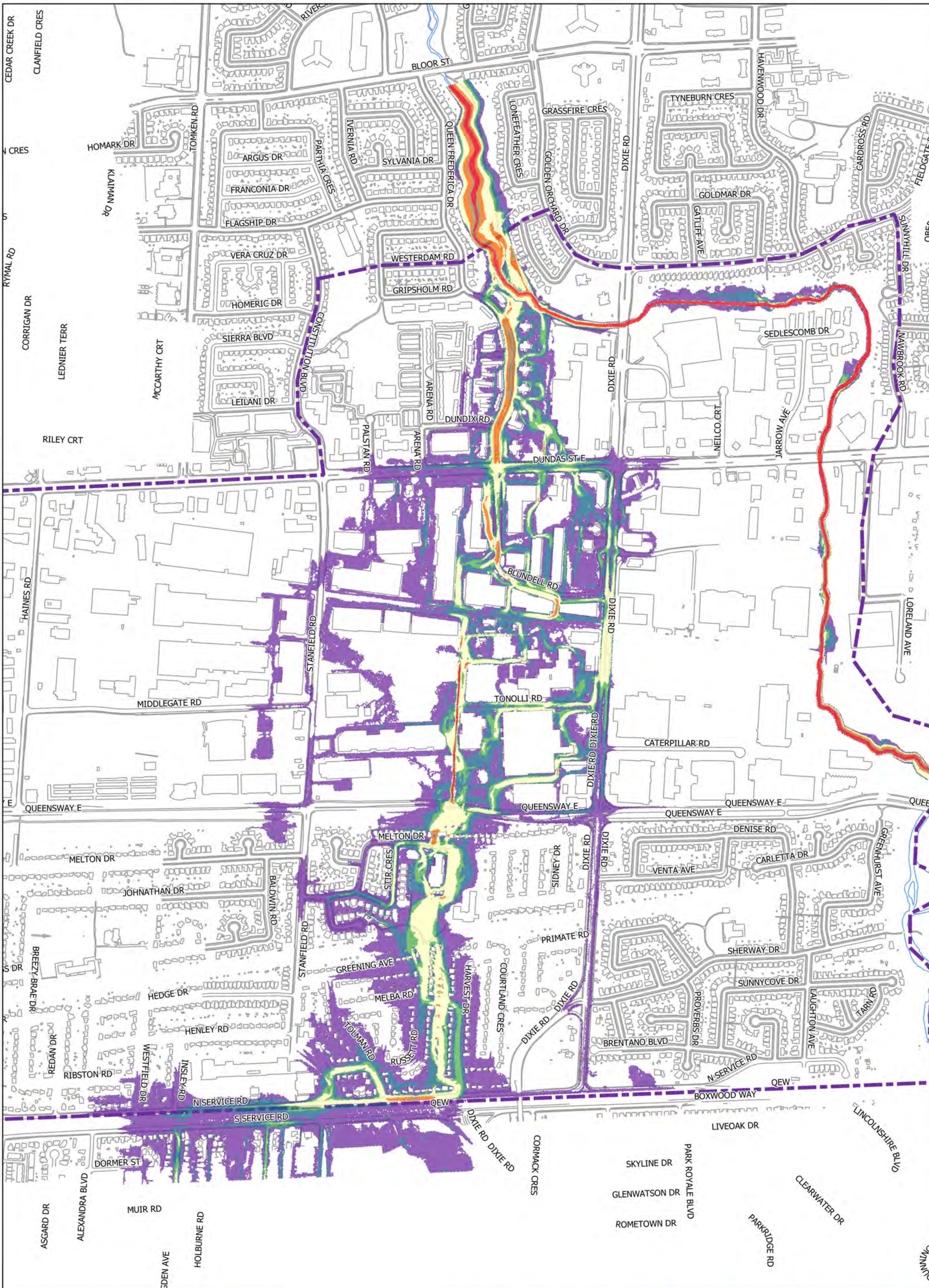
K. Molnar
K. Hofbauer

Map 3.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m^2/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: October 1, 2017
Figure Date: October 2, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 24-hour Chicago - Unsteady State
Depth x Velocity Product

Disclaimer: The information contained herein may be compiled from numerous third party materials that are subject to periodic change without prior notification. While every effort has been made by Matrix Solutions Inc. to ensure the accuracy of the information presented at the time of publication, Matrix Solutions Inc. assumes no liability for any errors, omissions, or inaccuracies in the third party material.

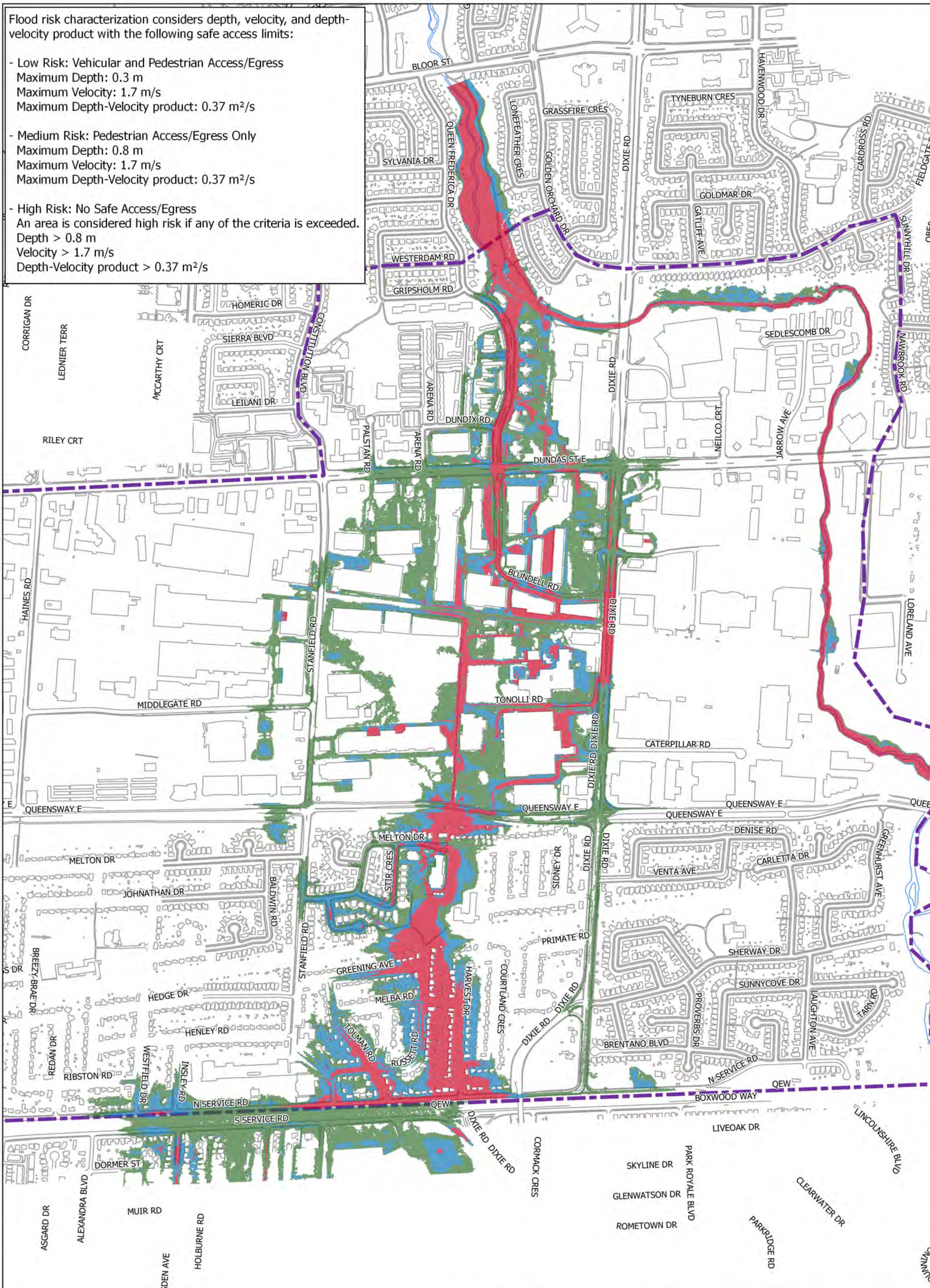
K. Molnar
K. Hofbauer

Map 3.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Flood risk characterization considers depth, velocity, and depth-velocity product with the following safe access limits:

- Low Risk: Vehicular and Pedestrian Access/Egress
  Maximum Depth: 0.3 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m²/s
- Medium Risk: Pedestrian Access/Egress Only
  Maximum Depth: 0.8 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m²/s
- High Risk: No Safe Access/Egress
  An area is considered high risk if any of the criteria is exceeded.
  Depth > 0.8 m
  Velocity > 1.7 m/s
  Depth-Velocity product > 0.37 m²/s



Phase 1 Study Area

Risk

- Low (Vehicular and Pedestrian Access/Egress)
- Medium (Pedestrian Access/Egress Only)
- High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

N

Run Date: October 1, 2017
Figure Date: October 2, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 24-hour Chicago - Unsteady State
Flood Risk

K. Molnar
K. Hofbauer

Map 3.4

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 29, 2017
Figure Date: October 2, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

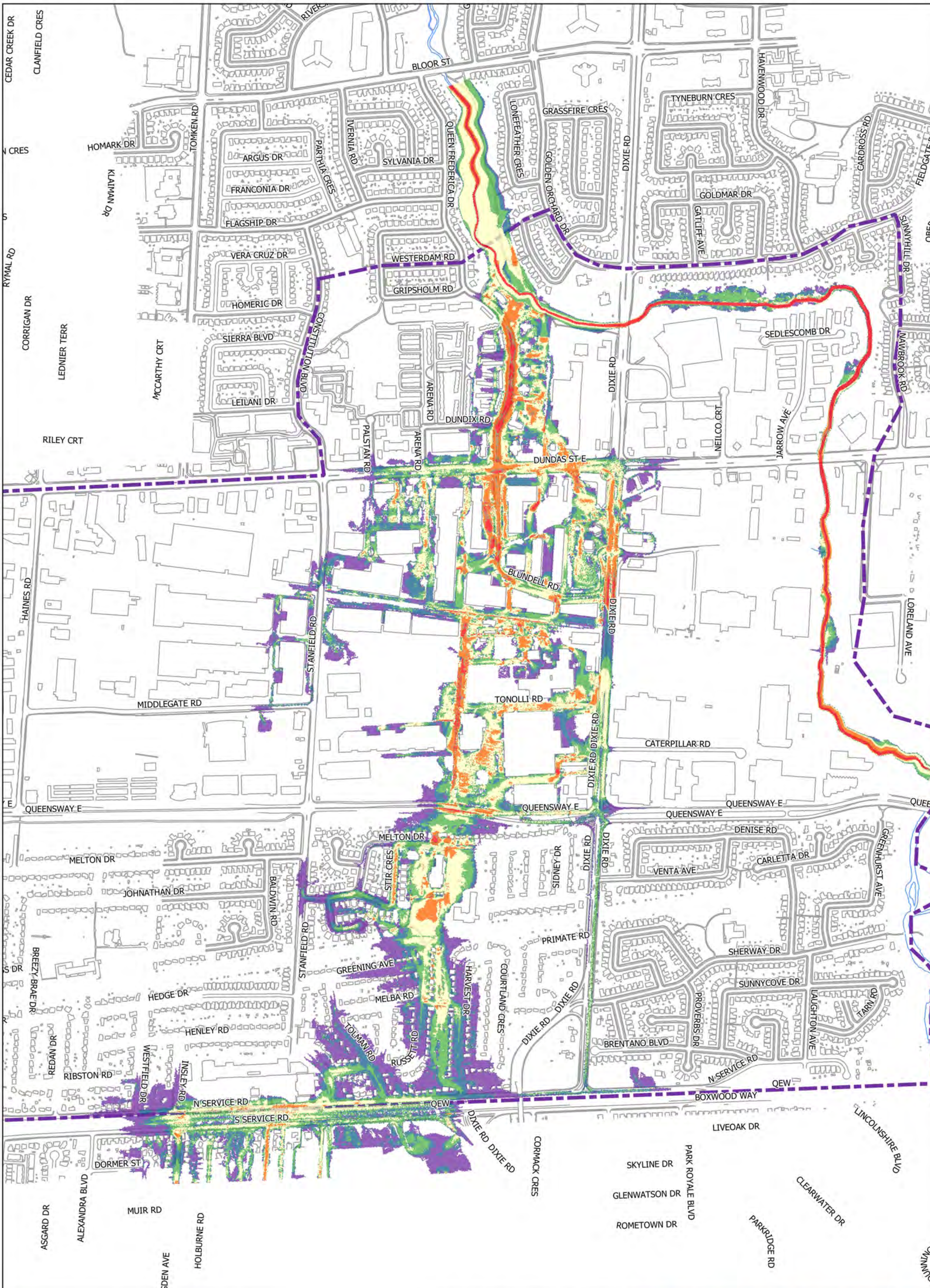
Project #24603

50-year 24-hour Chicago - Unsteady State
Depth

K. Molnar
K. Hofbauer

Map 4.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 29, 2017
Figure Date: October 2, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

50-year 24-hour Chicago - Unsteady State Velocity

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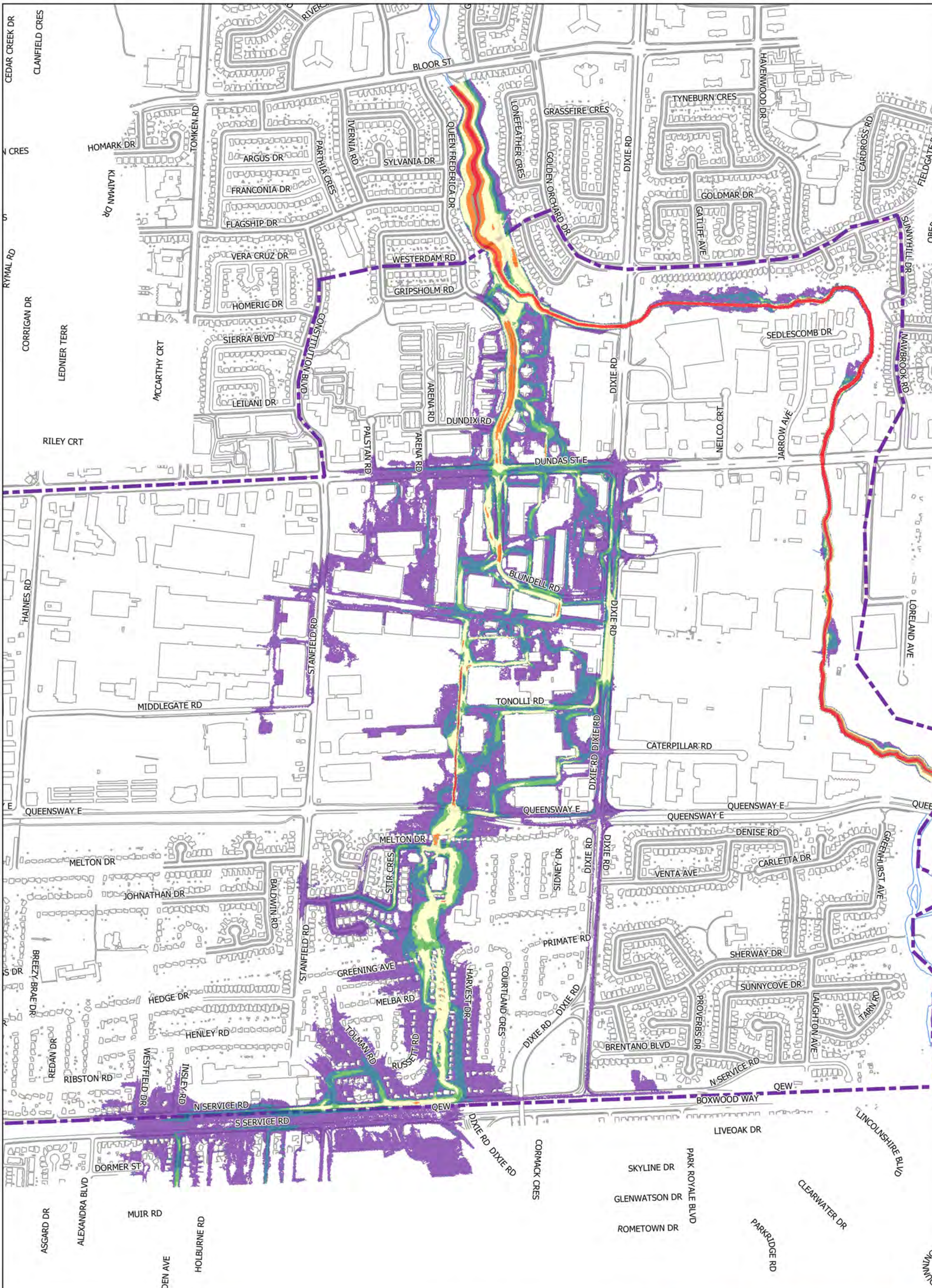
K. Molnar
K. Hofbauer

Map 4.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m²/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

N

Run Date: September 29, 2017
Figure Date: October 2, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

50-year 24-hour Chicago - Unsteady State Depth x Velocity Product

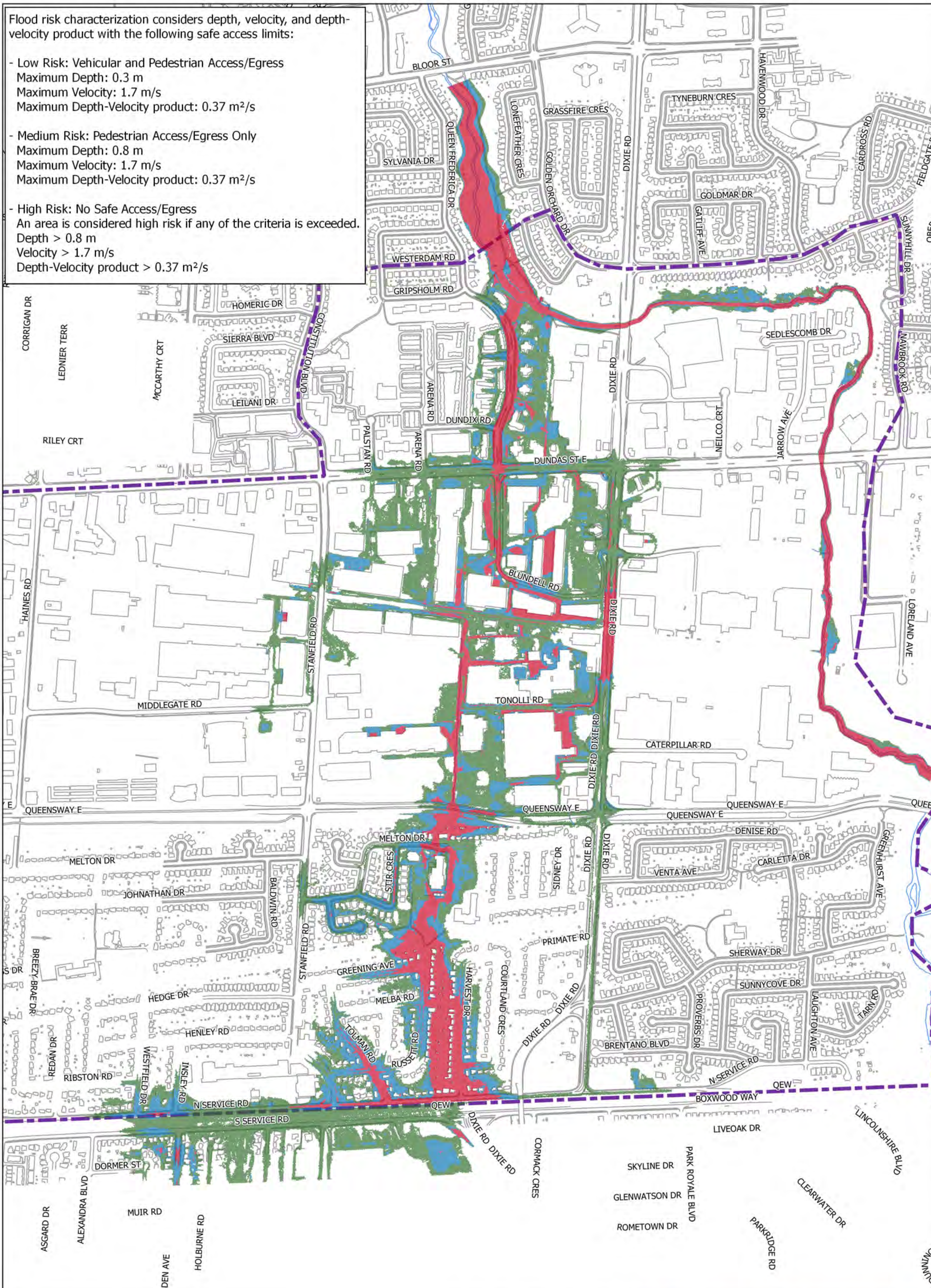
K. Molnar
K. Hofbauer

Map 4.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Flood risk characterization considers depth, velocity, and depth-velocity product with the following safe access limits:

- Low Risk: Vehicular and Pedestrian Access/Egress
  Maximum Depth: 0.3 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m^2/s
- Medium Risk: Pedestrian Access/Egress Only
  Maximum Depth: 0.8 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m^2/s
- High Risk: No Safe Access/Egress
  An area is considered high risk if any of the criteria is exceeded.
  Depth > 0.8 m
  Velocity > 1.7 m/s
  Depth-Velocity product > 0.37 m^2/s



Phase 1 Study Area

Risk

- Low (Vehicular and Pedestrian Access/Egress)
- Medium (Pedestrian Access/Egress Only)
- High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

N

Run Date: September 29, 2017
Figure Date: October 2, 2017

Matrix Solutions Inc.
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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

50-year 24-hour Chicago - Unsteady State
Flood Risk

K. Molnar
K. Hofbauer

Map 4.4

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: October 3, 2017

Figure Date: October 12, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

25-year 24-hour Chicago - Unsteady State Depth

K. Molnar
K. Hofbauer

Map 5.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

N

Run Date: October 3, 2017

Figure Date: October 12, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

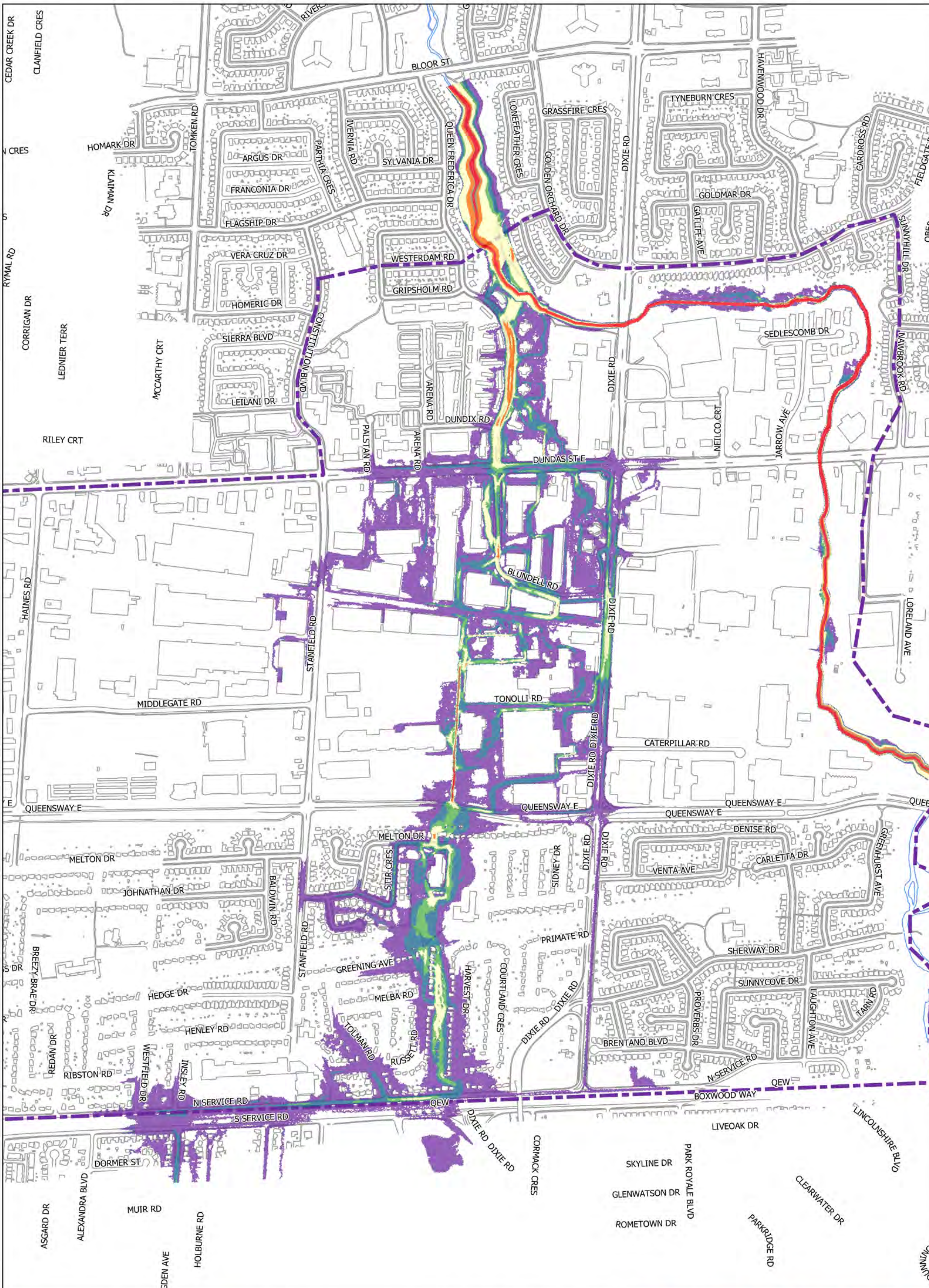
Project #24603

25-year 24-hour Chicago - Unsteady State Velocity

K. Molnar
K. Hofbauer

Map 5.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m^2/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: October 3, 2017

Figure Date: October 12, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

25-year 24-hour Chicago - Unsteady State
Depth x Velocity Product

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K. Molnar
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Map 5.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Flood risk characterization considers depth, velocity, and depth-velocity product with the following safe access limits:

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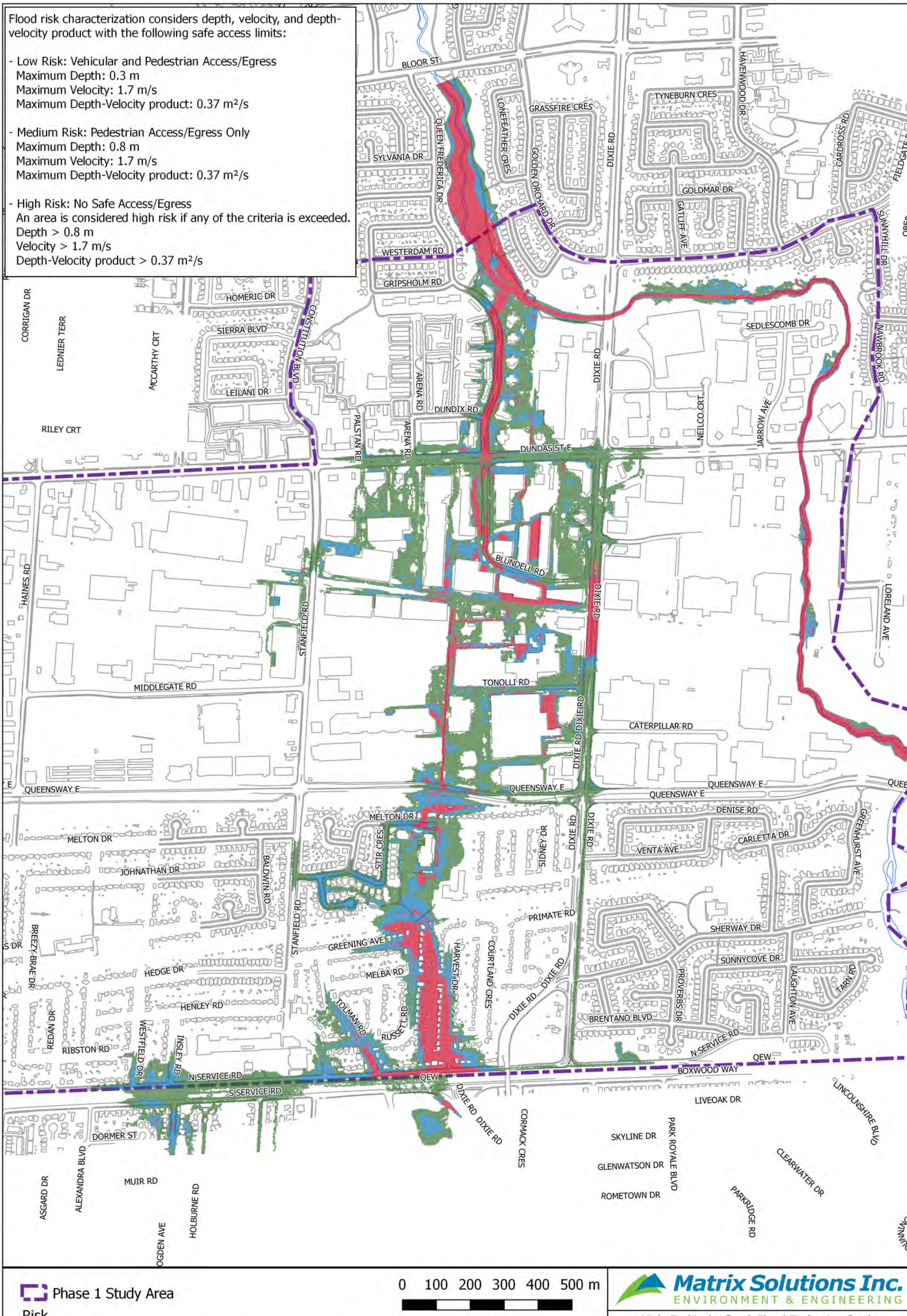
  Maximum Depth: 0.3 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m^2/s

- Medium Risk: Pedestrian Access/Egress Only
  Maximum Depth: 0.8 m
  Maximum Velocity: 1.7 m/s
  Maximum Depth-Velocity product: 0.37 m^2/s

- High Risk: No Safe Access/Egress
  An area is considered high risk if any of the criteria is exceeded.
  Depth > 0.8 m
  Velocity > 1.7 m/s
  Depth-Velocity product > 0.37 m^2/s



Phase 1 Study Area

Risk

Low (Vehicular and Pedestrian Access/Egress)

Medium (Pedestrian Access/Egress Only)

High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

Run Date: October 3, 2017
Figure Date: October 12, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

25-year 24-hour Chicago - Unsteady State
Flood Risk

K. Molnar
K. Hofbauer

Map 5.4

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017
Figure Date: September 20, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 12-hour AES - Unsteady State
Depth

K. Molnar
K. Hofbauer

Map 6.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017
Figure Date: September 20, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 12-hour AES - Unsteady State Velocity

K. Molnar
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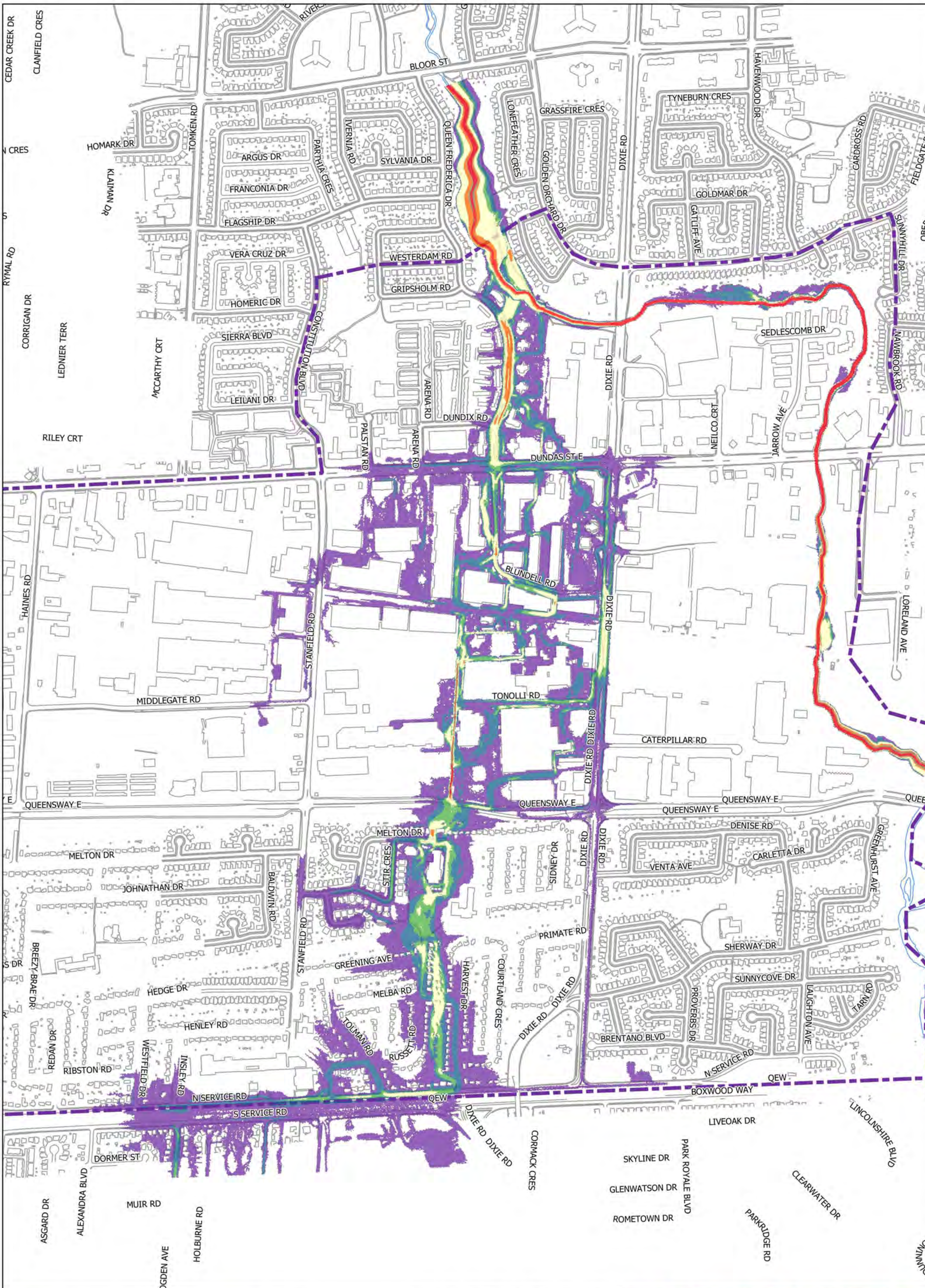
Map 6.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m^2/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017
Figure Date: September 20, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

100-year 12-hour AES - Unsteady State Depth x Velocity Product

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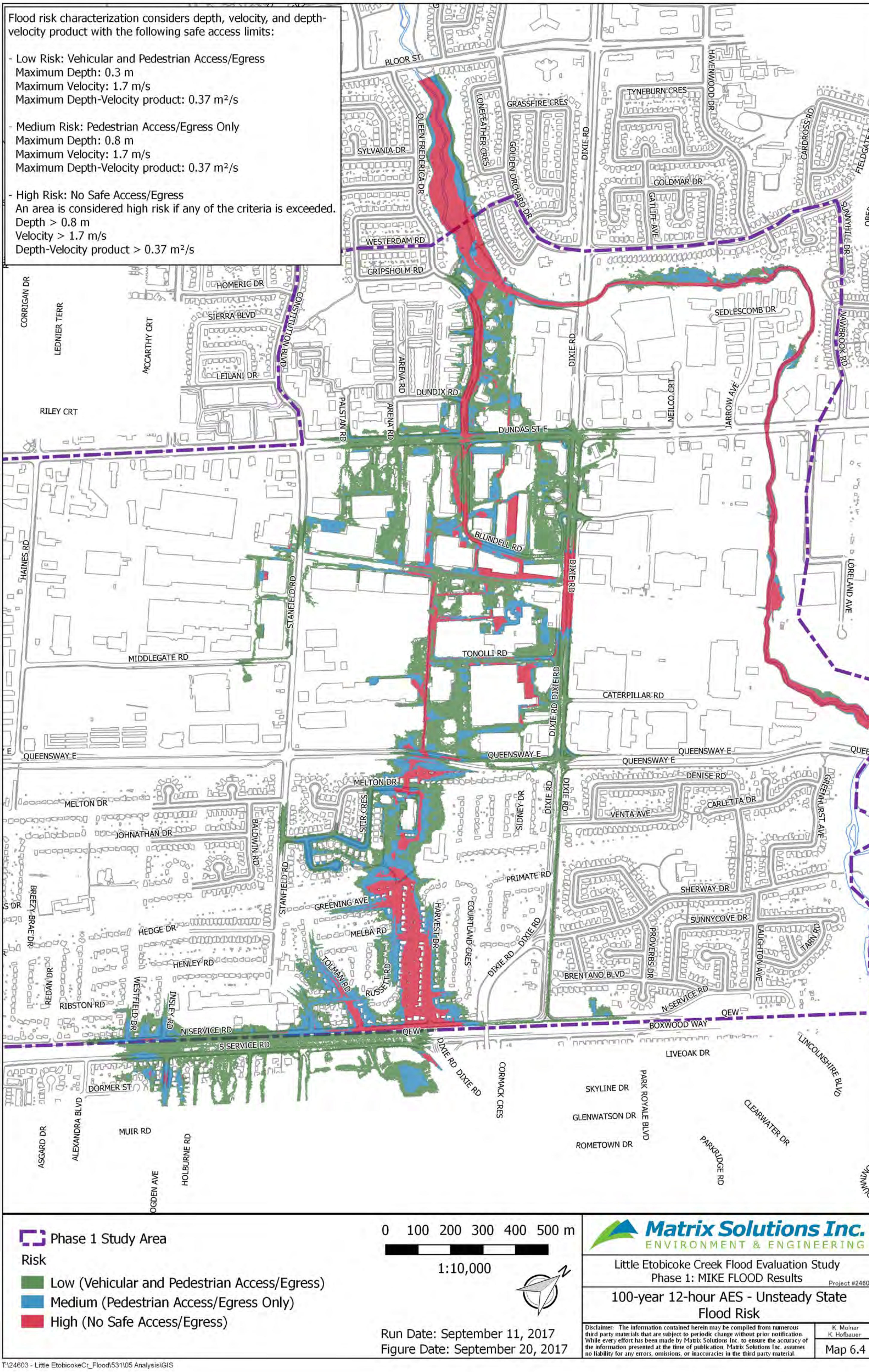
K. Molnar
K. Hofbauer

Map 6.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017

Figure Date: September 20, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

50-year 12-hour AES - Unsteady State
Depth

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K. Molnar
K. Hofbauer

Map 7.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017
Figure Date: September 20, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

50-year 12-hour AES - Unsteady State
Velocity

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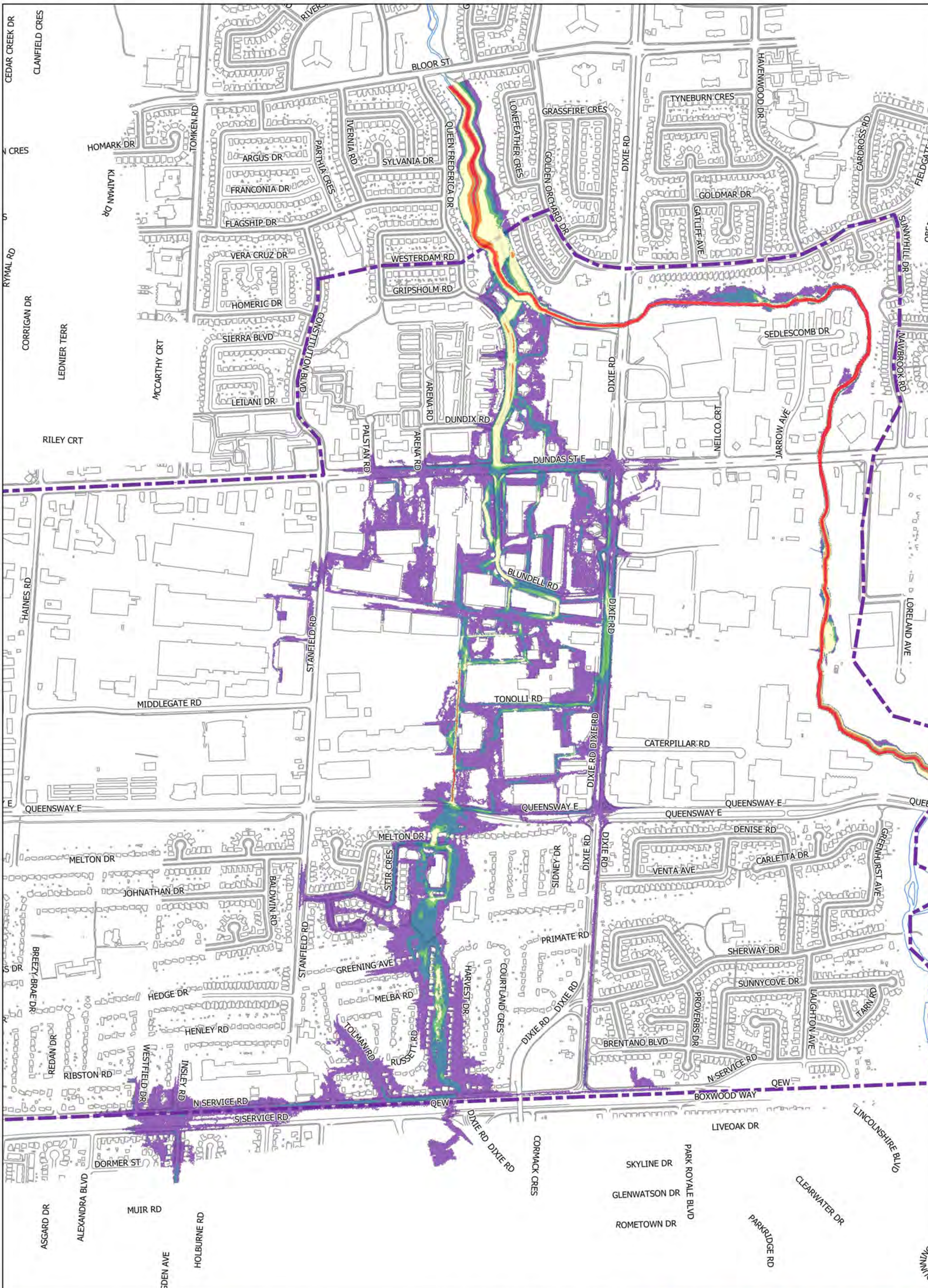
K. Molnar
K. Hofbauer

Map 7.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m^2/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 11, 2017

Figure Date: September 20, 2017

Matrix Solutions Inc.
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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

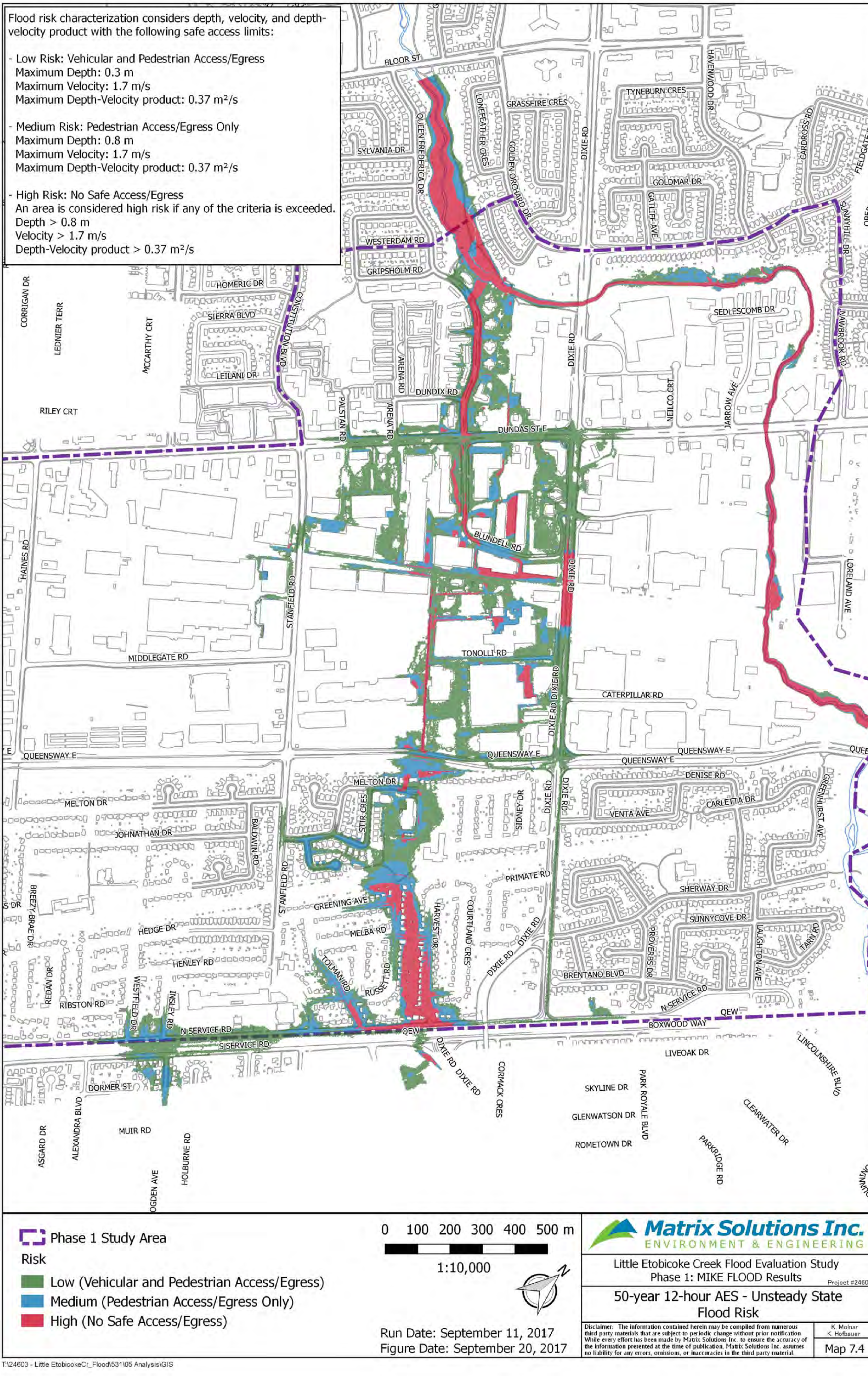
Project #24603

50-year 12-hour AES - Unsteady State
Depth x Velocity Product

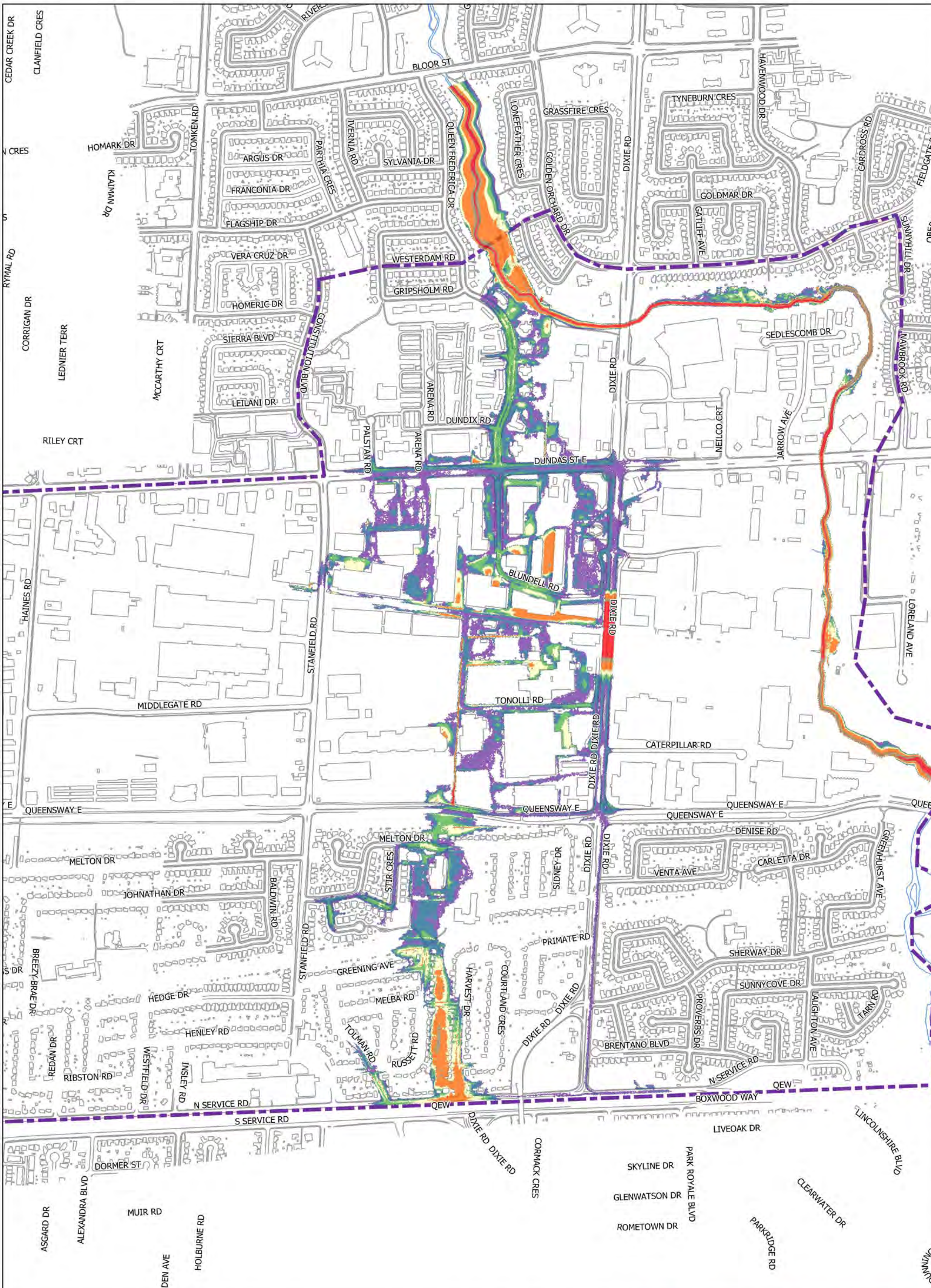
K. Molnar
K. Hofbauer

Map 7.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 4, 2017
Figure Date: September 19, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

25-year 12-hour AES - Unsteady State Depth

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K. Molnar
K. Hofbauer

Map 8.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS

Phase 1 Study Area
Max. Velocity (m/s)
<= 0.10
0.10 - 0.25
0.25 - 0.50
0.50 - 1.00
1.00 - 1.70
1.70 - 2.00
> 2.00

0 100 200 300 400 500 m
1:10,000

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results
Project #24603

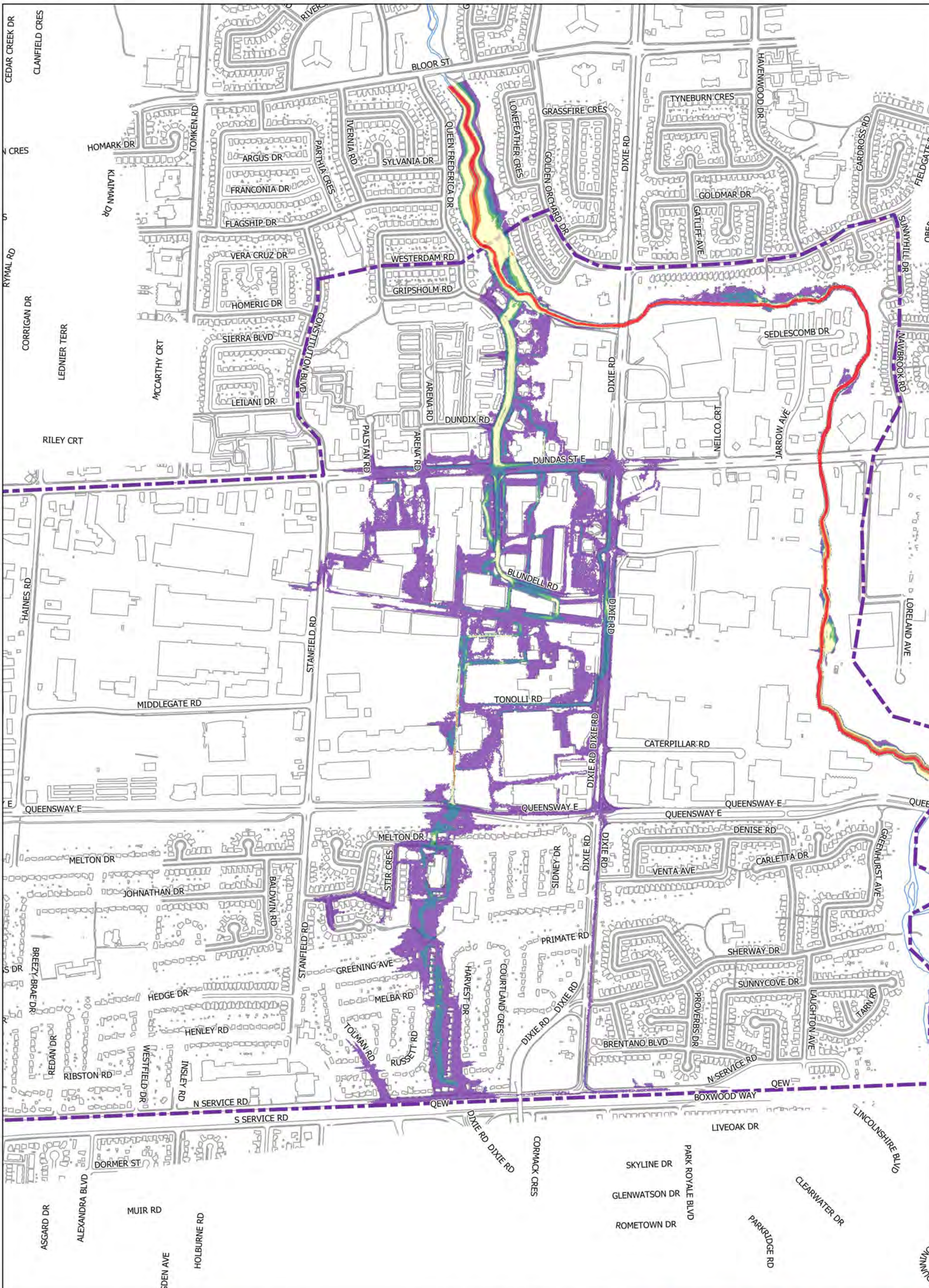
25-year 12-hour AES - Unsteady State Velocity

Run Date: September 4, 2017
Figure Date: September 19, 2017

K. Molnar
K. Hofbauer

Map 8.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m²/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

N

Run Date: September 4, 2017

Figure Date: September 19, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

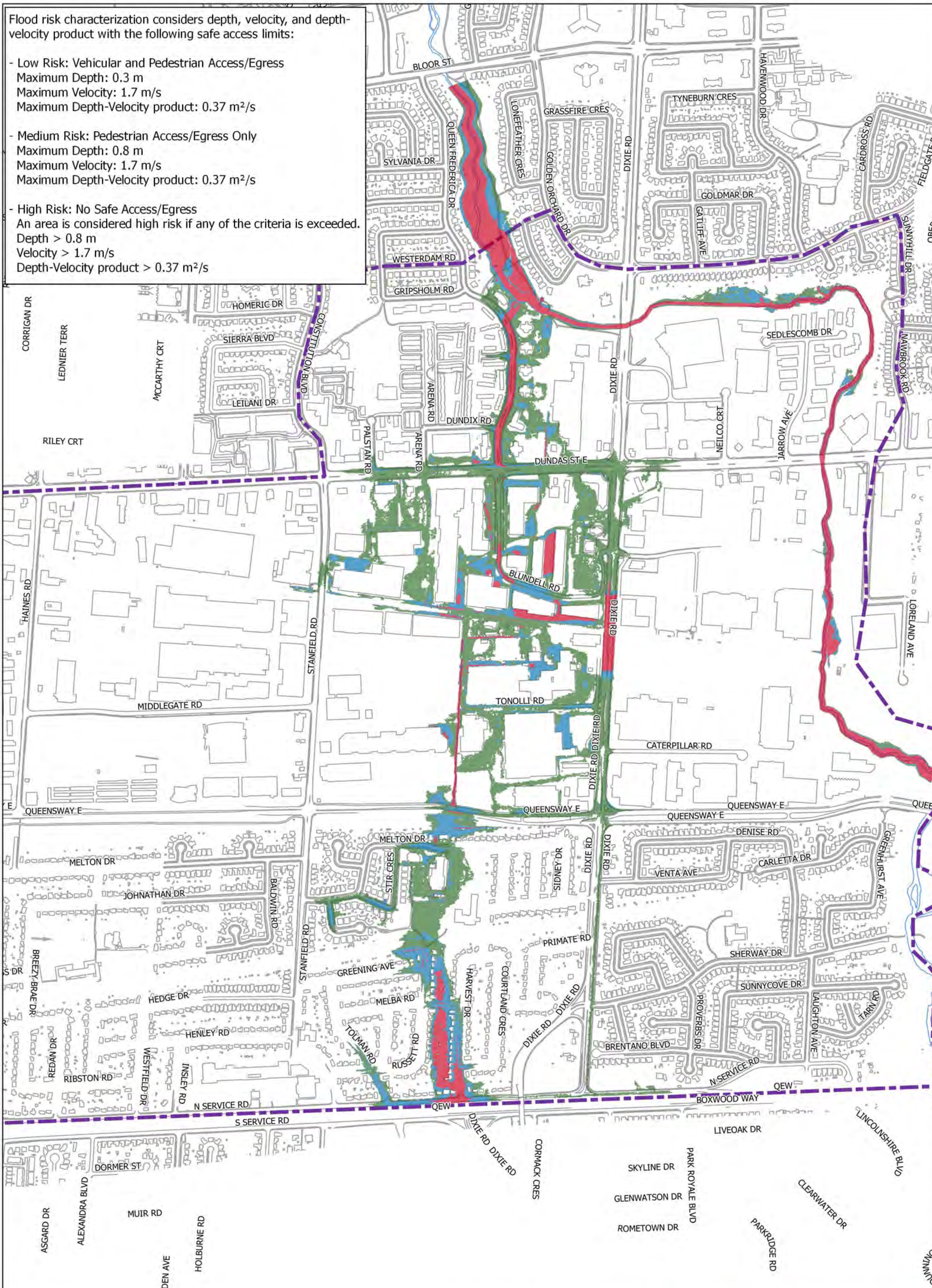
Project #24603

25-year 12-hour AES - Unsteady State Depth x Velocity Product

K. Molnar
K. Hofbauer

Map 8.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Risk

Low (Vehicular and Pedestrian Access/Egress)

Medium (Pedestrian Access/Egress Only)

High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

N

Run Date: September 4, 2017

Figure Date: September 19, 2017

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

25-year 12-hour AES - Unsteady State
Flood Risk

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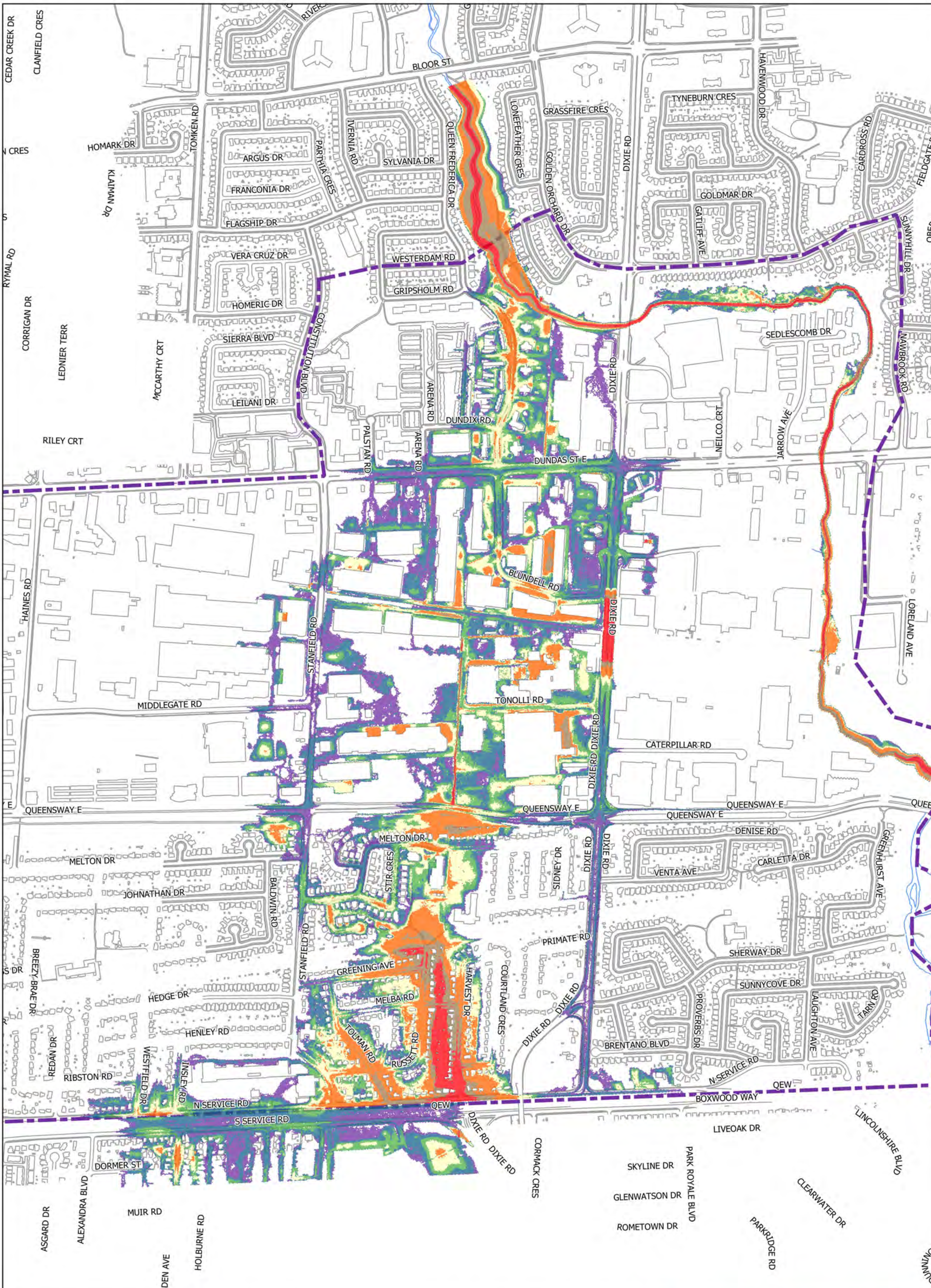
K. Molnar
K. Hofbauer

Map 8.4

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth (m)

- <= 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 0.80
- 0.80 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 17, 2017

Figure Date: October 10, 2017

Matrix Solutions Inc.
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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

July 8, 2013 Storm Event
Depth

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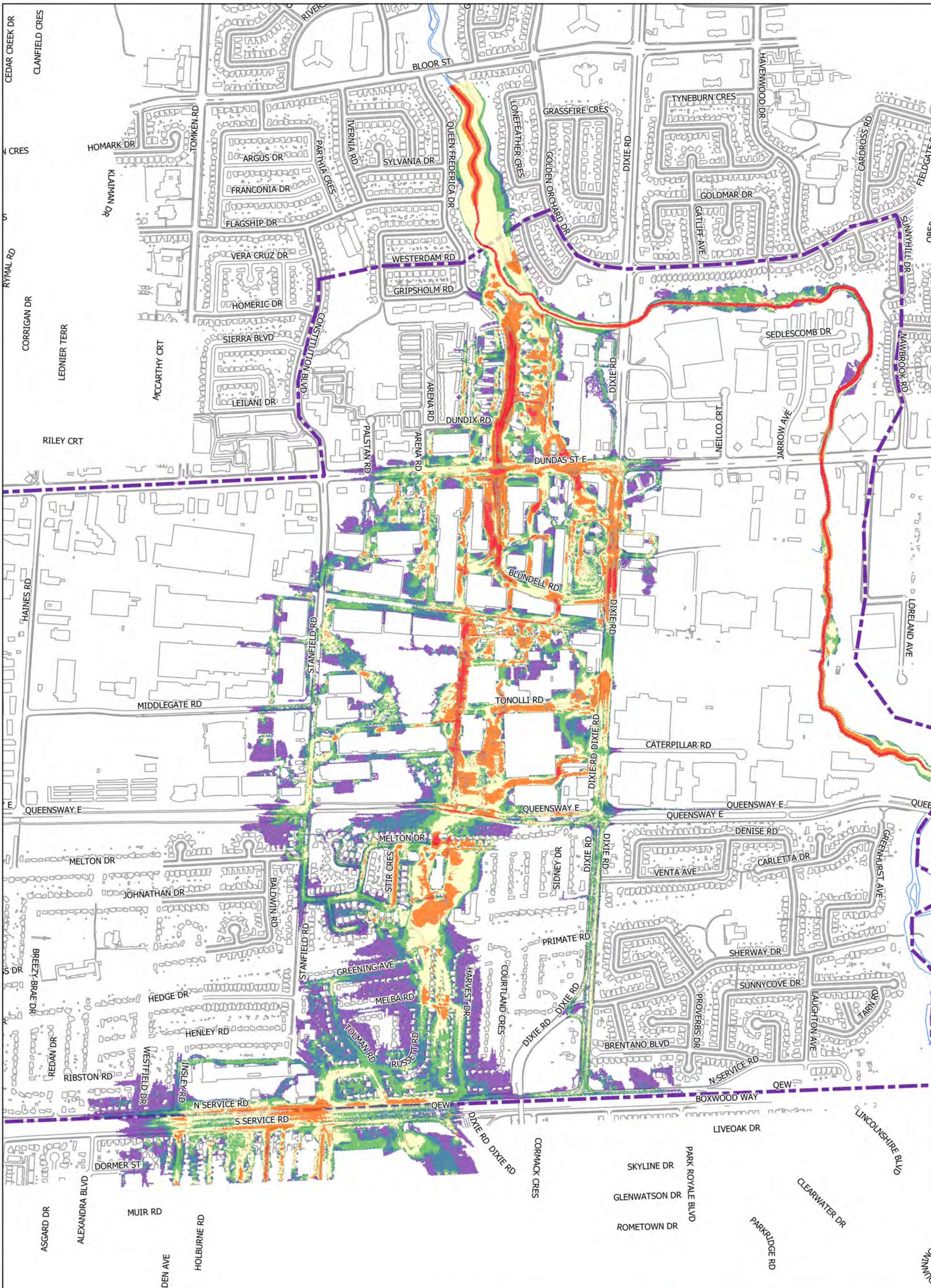
K. Molnar
K. Hofbauer

Map 9.1

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Velocity (m/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.70
- 1.70 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 17, 2017

Figure Date: October 10, 2017

Matrix Solutions Inc.
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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

July 8, 2013 Storm Event
Velocity

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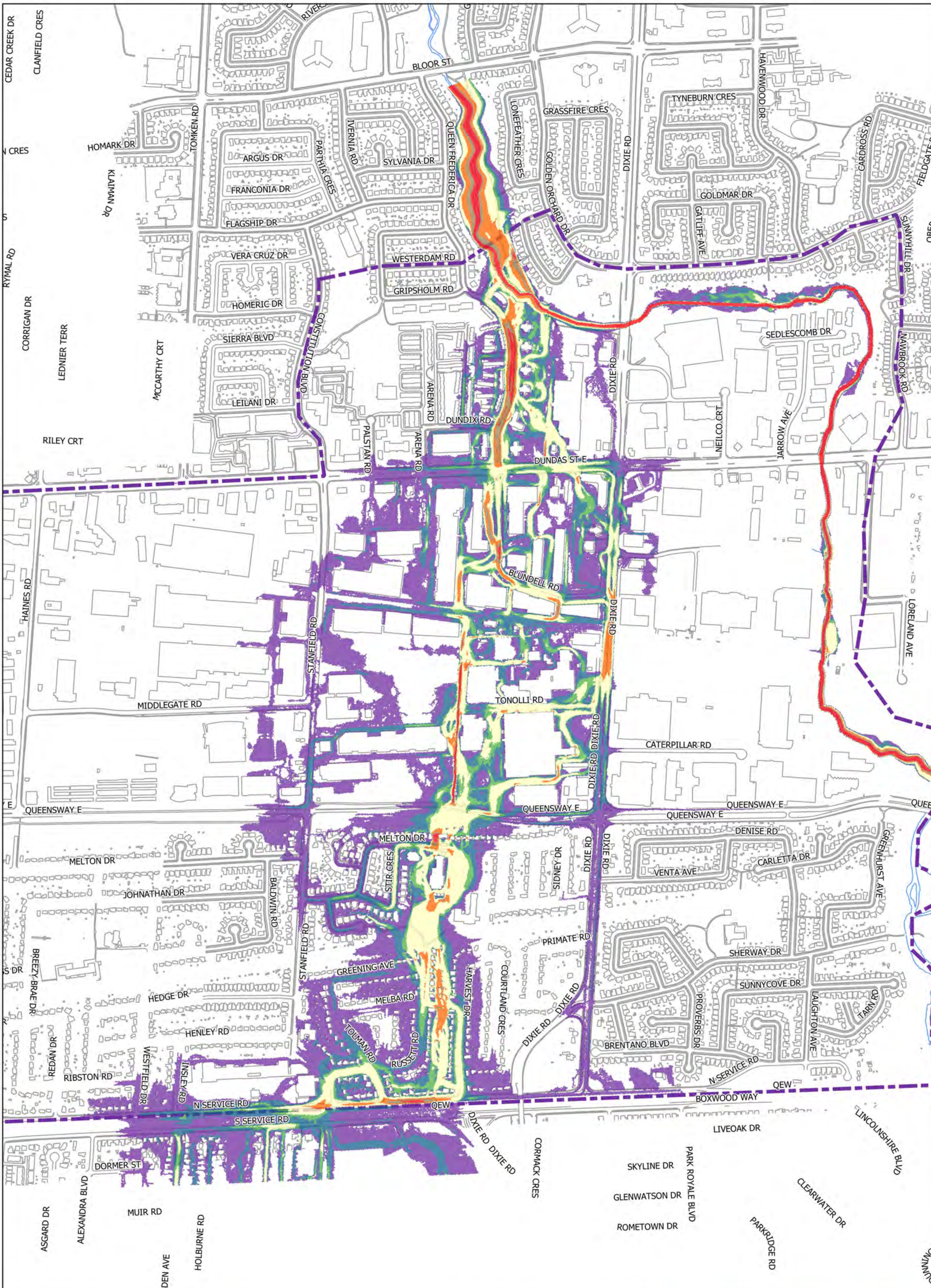
K. Molnar
K. Hofbauer

Map 9.2

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Max. Depth x Velocity (m²/s)

- <= 0.10
- 0.10 - 0.25
- 0.25 - 0.370
- 0.37 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- > 2.00

0 100 200 300 400 500 m

1:10,000

Run Date: September 17, 2017
Figure Date: October 10, 2017

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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

July 8, 2013 Storm Event
Depth x Velocity Product

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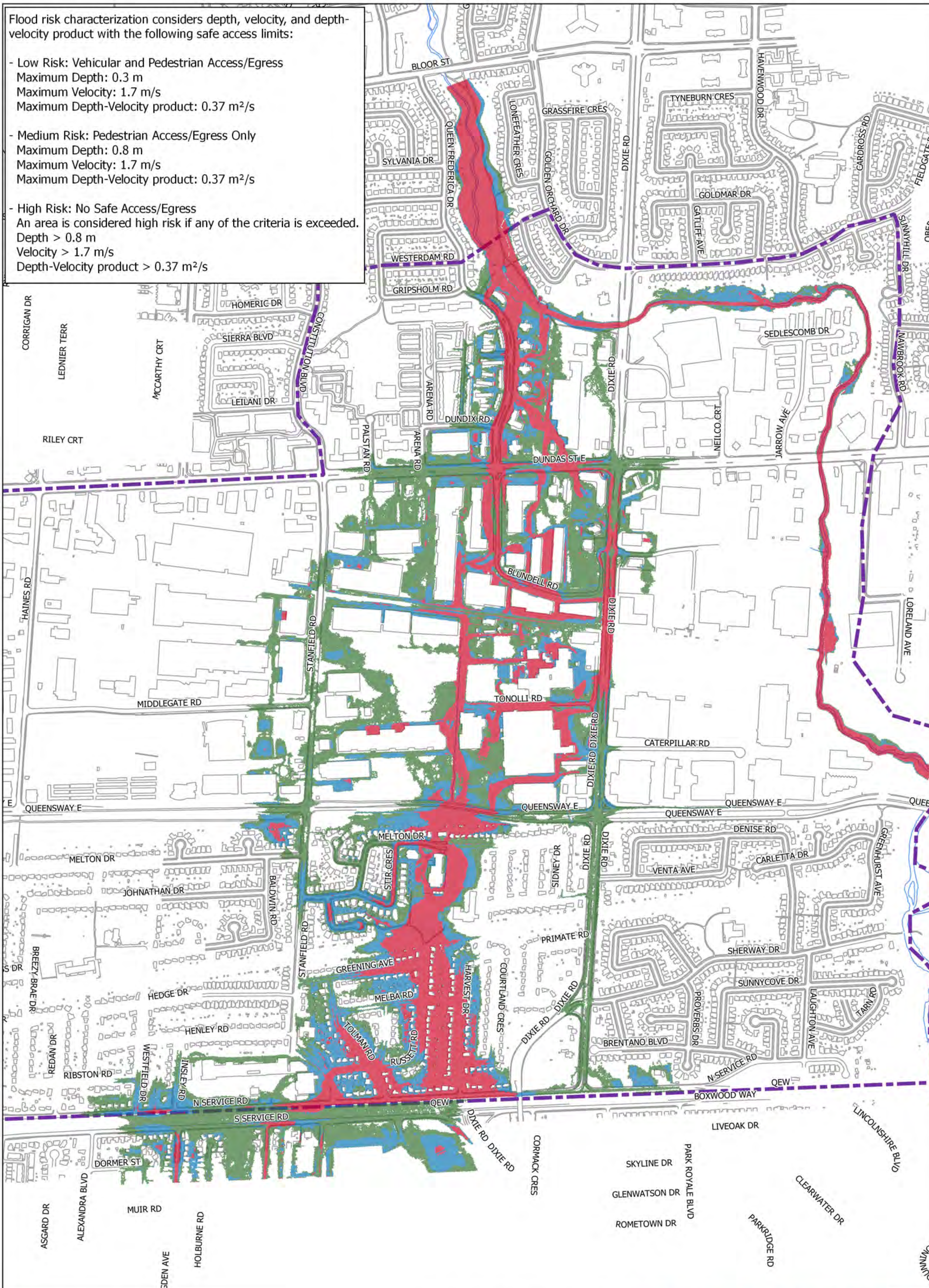
K. Molnar
K. Hofbauer

Map 9.3

T:\24603 - Little EtobicokeCr_Flood\531\05 Analysis\GIS



Phase 1 Study Area

Risk

Low (Vehicular and Pedestrian Access/Egress)

Medium (Pedestrian Access/Egress Only)

High (No Safe Access/Egress)

0 100 200 300 400 500 m

1:10,000

Run Date: September 17, 2017

Figure Date: October 10, 2017

Matrix Solutions Inc.
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Little Etobicoke Creek Flood Evaluation Study
Phase 1: MIKE FLOOD Results

Project #24603

July 8, 2013 Storm Event
Flood Risk

K. Molnar
K. Hofbauer

Map 9.4

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APPENDIX B
Hydraulic Screening Report

HIGH-LEVEL ALTERNATIVE SOLUTIONS AND PRELIMINARY HYDRAULIC MODEL SCREENING

DIXIE-DUNDAS FLOOD MITIGATION PROJECT

Report Prepared for:
CITY OF MISSISSAUGA

Prepared by:
MATRIX SOLUTIONS INC.

Version 0.1
August 2019
Guelph, Ontario

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HIGH-LEVEL ALTERNATIVE SOLUTIONS AND PRELIMINARY HYDRAULIC MODEL SCREENING

DIXIE-DUNDAS FLOOD MITIGATION PROJECT

Report prepared for City of Mississauga, August 2019

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Kelly Molnar, P.Eng.
Water Resources Engineer

reviewed by ______________________________

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1 INTRODUCTION

Matrix Solutions Inc. is pleased to provide hydraulic engineering services for the City of Mississauga's (the City) Dixie-Dundas Flood Mitigation project. A significant spill occurs along Little Etobicoke Creek upstream of Dixie Road toward Queen Frederica Drive, crossing the watershed divide from Toronto and Region Conservation Authority (TRCA) jurisdiction into the Applewood Creek watershed in Credit Valley Conservation (CVC) jurisdiction. The spill puts hundreds of downstream properties at risk of flooding, which were not formally identified as such until recently. The City is interested in intensifying portions of the Dixie-Dundas lands to fulfill a vision for growth. However, due to the spill, relevant portions of the Dixie-Dundas lands are within an existing Special Policy Area (SPA), and the envisioned growth cannot be fully realized without better defining and potentially reducing risks and impacts within the SPA.

The objective for this project is to manage spill from Little Etobicoke Creek to reduce flood risks, thereby protecting existing properties, and to enable growth. To achieve this objective, the project aims to develop a comprehensive flood remediation plan for the Dixie-Dundas area through investigating feasible alternatives including replacement of the Dixie Road bridge and capacity improvements within Little Etobicoke Creek.

1.1 Scope and Purpose

The project's Stage 1 feasibility study is underway in preparation for Phases I and II of the Municipal Class environmental assessment (EA) process scheduled to begin in 2020. The purpose of the feasibility study is to identify the problem and opportunity summary statement, to identify and assess high-level alternative solutions, and to develop conceptual designs for a short-list of alternative solutions. This report summarizes the preliminary hydraulic model screening undertaken to assess the identified high-level alternative solutions.

These high-level alternative solutions will be further assessed to develop a short-list of alternative solutions following the completion of additional technical feasibility studies in the coming months. These will include geotechnical, geomorphic, archaeologic, and ecologic studies. Refined hydraulic modelling will be completed for the short-list of alternative solutions that will be developed into conceptual designs.

1.2 Problem and Opportunity Summary Statement

Matrix and Prime Strategy & Planning Inc. developed the following problem and opportunity summary statement in consultation with the City. This summary statement will stand as a placeholder until the start of the EA process and establishes a basis from which to assess the high-level alternative solutions.

Summary Statement

Frequent flooding from the Little Etobicoke Creek affects existing residential areas, with significantly increased risk experienced during more infrequent events. The growth-oriented transit hub area within the Dixie-Dundas area is also flood vulnerable and is impinging development potential. Relevant portions of the Dixie-Dundas lands are within an existing SPA-managed floodplain and the envisioned growth cannot be fully realized without better defining and reducing the flood risk and impacts within the SPA. The Dixie-Dundas Flood Mitigation Feasibility Study and Class EA will assess and recommend a future solution and implementation of infrastructure such that a suitable solution for reduction of flood risks is achieved.

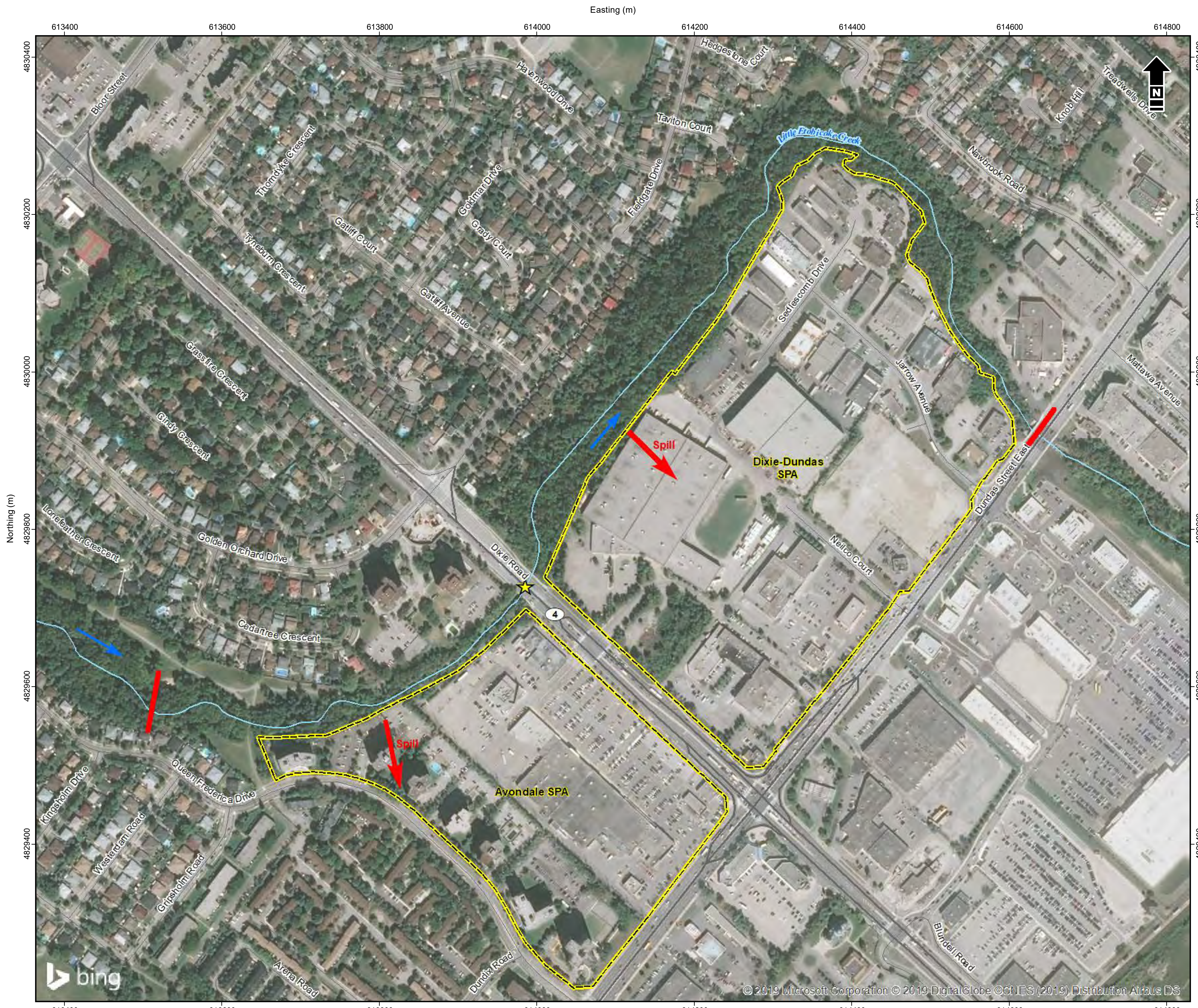
1.3 Project Area

The project area is centered around the intersection of Dixie Road and Dundas Street in the City of Mississauga. In this area, two spills occur from Little Etobicoke Creek which convey flood flows through developed areas and put over 1,000 properties between the spill location and the QEW at risk of flood damage. The main spill location is upstream of Dixie Road near Queen Frederica Drive, where approximately 130 m^3/s spills from Little Etobicoke Creek during the Regional storm event. This location is known as the Applewood SPA. Based on the findings of previous studies (MMM 2015, Matrix 2018), spill from the channel occurs in as little as the 5-year event with high-risk flooding observed along Queen Frederica Drive. A smaller amount of spill occurs on the east side of Dixie Road in an area known as the Dixie-Dundas SPA. Previous studies (MMM 2015, Matrix 2018) indicate that spill in this location occurs during the Regional storm event.

Little Etobicoke Creek upstream of the project area consists of a slightly meandering channel bordered by mature trees and shrubs. Riffle-pool sequences have been constructed with riffle features comprised of large boulders. In several places the banks are armoured with riprap and include stone deflector weirs and rootwad treatments which have been outflanked in numerous locations. Where riprap was not placed, bank erosion of fine materials is prevalent. For 500 m of channel upstream of Dixie Road, the creek is generally straight and is lined with stacked armourstone blocks. The bed is also stabilized with armourstone blocks, arranged in drop structure features that act as grade control and concentrate low flows to the center of the channel. For approximately 400 m downstream of Dixie Road, there are similar bed and bank treatments to those observed upstream; however, the channel is less stable with failing treatments noted. Further downstream to Dundas Street, bank materials are more natural with bank erosion and channel widening observed. There are gabion baskets and armourstone blocks at select locations.

Existing land use adjacent to Little Etobicoke Creek through the study corridor consists of residential and commercial land uses. Upstream of Dixie Road is predominantly residential neighbourhoods on both sides of the creek. Downstream of Dixie Road, the left (north) side of the creek consists of residential properties, while the right (south) side of the creek consists primarily of commercial and industrial lands.

The project area is shown on Figure 1.



- Special Policy Area
- Watercourse
- Highway
- Road
- Study Area Extents (500m upstream of the Dixie Road Bridge to Dundas Street)
- Spill Direction
- Flow Direction
- Dixie Road Bridge

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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City of Mississauga
Dixie-Dundas Flood Mitigation

Project Area

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Figure 1

2 BACKGROUND REVIEW

Matrix completed a background review of data and relevant hydraulic and hydrologic work conducted in the project area to identify potential data gaps and to avoid redundancies in data collection. Following review and consolidation of data, a gap analysis was conducted to ensure additional data needs were filled prior to proceeding with the high-level alternative solution screening.

2.1 Previous and Ongoing Studies

2.1.1 Etobicoke Creek Hydrology Update

The *Etobicoke Creek Hydrology Update* study (MMM 2013), prepared for the TRCA, updated the hydrologic models for the Etobicoke Creek watershed to assess existing and future land use conditions. The study also developed a stormwater quantity control strategy for upstream developments to improve flood risk management and to mitigate impacts caused by future conditions. The Visual OTTHYMO (VO) hydrologic models developed through the Etobicoke Creek hydrology update were used to extract inflow data for the current project.

2.1.2 Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area

The *Floodplain Mapping in Applewood and Dundas/Dixie Special Policy Area* study (MMM 2015) produced a 1D-2D integrated MIKE FLOOD hydraulic model of Little Etobicoke Creek and used this model to define Regional storm flood maps for flood conditions within the Dixie-Dundas SPA and Applewood SPA. A 1D-2D model was required to capture the complex nature of the overland flow patterns within the study area, which could not be definitively delineated using traditional 1D modelling techniques. Little Etobicoke Creek overtops its banks during major flood events, which causes flooding throughout the urban areas downstream. The study identified and assessed several preliminary flood mitigation alternatives based on the modelling results. Information from the 1D-2D integrated MIKE FLOOD model completed for the MMM (2015) study was used as a basis for the current project.

2.1.3 Little Etobicoke Creek Flood Evaluation Study and Master Plan

Following the MMM (2015) study, Matrix is undertaking the Little Etobicoke Creek Flood Evaluation Study and Master Plan. The objectives of this study are to recognize and account for flow leaving TRCA jurisdiction and entering CVC jurisdiction due to a spill originating near Dixie Road at Queen Frederica Drive. The project is being completed in two phases. Phase 1 was completed in 2018 and expanded upon the MMM (2015) modelling to further characterize flood risk in the Dixie-Dundas area and to provide guidance on how both watershed managers (TRCA and CVC) should handle spilled flows from a regulatory context. In Phase 2, Matrix developed an urban dual drainage model using PCSWMM 2D for the entire Little Etobicoke Creek watershed to assess areas at risk to both urban and riverine flooding. The PCSWMM 2D model was used for flood characterization, to recognize flood mechanisms, to identify flood cluster areas, and to develop and assess flood remediation plans.

2.1.4 Draft Special Policy Area and Flood Mitigation Review – Dundas Street Transportation Master Plan

The *Dundas Street Transportation Master Plan* study (AECOM 2016) was completed to review the existing SPA boundaries along the Dundas Street corridor: Applewood SPA, Dixie District West Side SPA (adjacent to Little Etobicoke Creek), and Dixie District East Side SPA (adjacent to the main branch of Etobicoke Creek). The goal of the study was to review potential flood mitigation measures to support eliminating or reducing the restrictions of the SPAs on intensification and transportation improvements along the Dundas Street corridor. The Applewood SPA and Dixie District West Side SPA are impacted by the spill from Little Etobicoke Creek which is directly related to the present study. AECOM (2016) identified that the flooding is caused by undersized main channel and floodplain, undersized bridges and culverts, and large flows from a largely urbanized catchment upstream. A long list of alternatives was developed and of these, five flood mitigation measures were carried forward for detailed modelling in MIKE FLOOD. The recommended alternatives from the AECOM (2016) study were considered in the high-level screening for the current project.

2.2 Available Information

The following information was considered as part of this screening level assessment:

- Relevant hydrologic and hydraulic models including:
    - MMM (2015) integrated 1D-2D MIKE FLOOD model
    - Matrix (2018) expanded 1D-2D MIKE FLOOD model
    - TRCA (2010) HEC-RAS model
    - TRCA (2016) HEC-RAS model
- 2017 LiDAR topographic data
- Channel survey (MMM 2013)
- GIS data including:
    - roads
    - buildings
    - land parcels
    - storm sewers

The information listed below was not available at the time of writing this report and will be required for future stages:

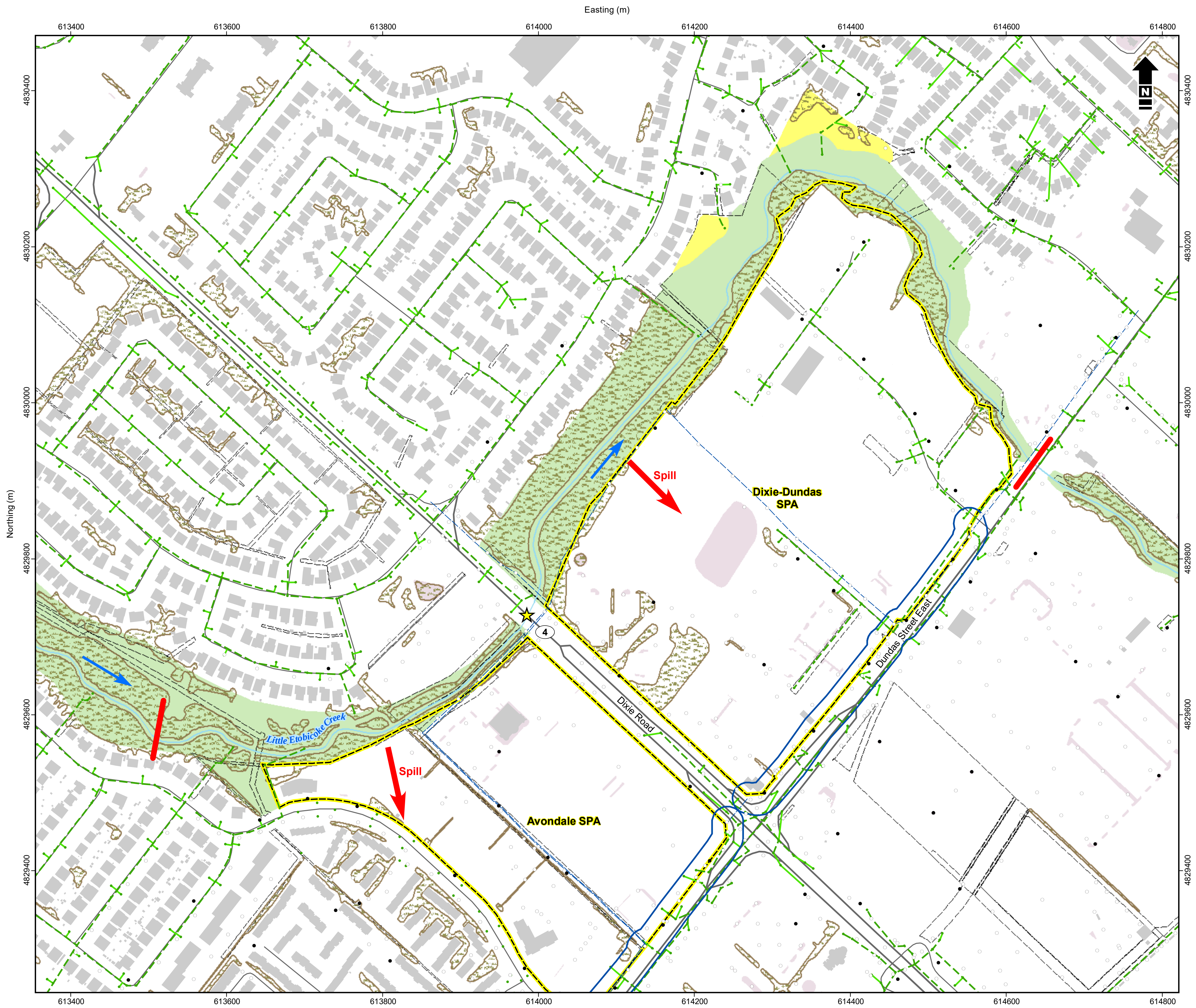
- sanitary sewers including inverts
- watermains

3 SCREENING ASSESSMENT APPROACH

This screening level assessment of potential solutions was based on constraint mapping and a limited preliminary hydraulic analysis. Our methods are described in the following subsections.

3.1 Constraint Mapping

Constraint mapping was prepared for the project area using available information compiled during the background review. The constraint mapping provided on Figure 2 includes existing infrastructure, utilities, property boundaries, and natural areas and was used to help identify solution opportunities.



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City of Mississauga
Dixie-Dundas Flood Mitigation

Constraints

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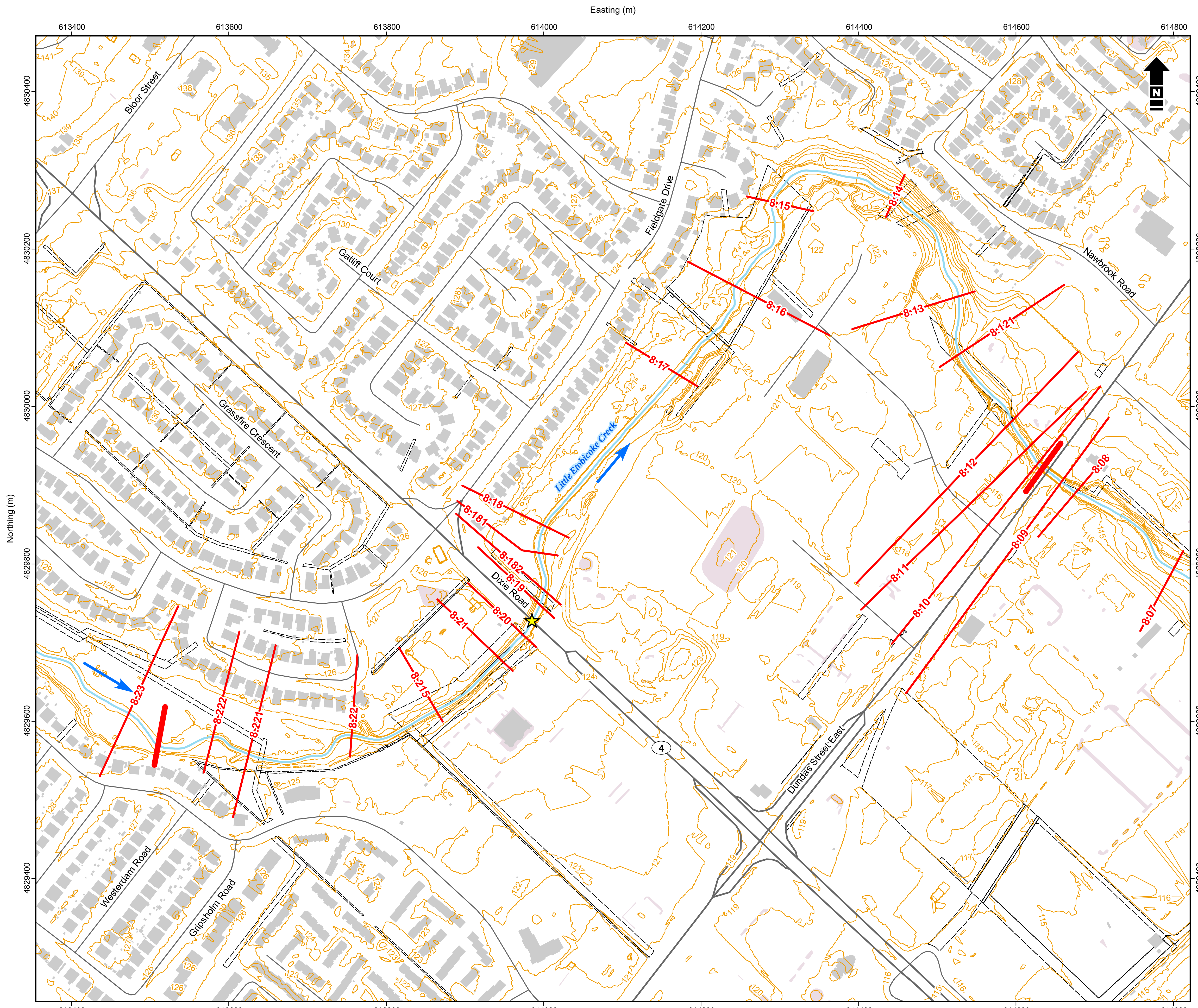
Figure 2

3.2 Preliminary Hydraulic Screening

Preliminary hydraulic modelling using a 1D HEC-RAS model was completed to assess high-level alternatives. The 1D-2D MIKE FLOOD model previously developed by Matrix is a better tool for assessing flood risk within the complex project area. However, the long run times and complex nature of model setup makes it impractical for the screening level assessment. Matrix therefore developed a HEC-RAS model for existing conditions using background information and data from the previously completed models. The 1D-2D MIKE FLOOD model will be used to complete subsequent analyses at later stages in the project.

The HEC-RAS model used cross-section geometry from the MIKE FLOOD model, which incorporates survey data (MMM 2013) through the project reach. Since the MIKE FLOOD model used a 1D-2D integrated approach, the riverine portion of the model had been trimmed to the top of banks to avoid double counting floodplain conveyance in the 2D model. Therefore, the cross-sections in the HEC-RAS model developed for hydraulic screening were extended outside the channel to incorporate the floodplain. The geometry of floodplain areas was based on LiDAR topography. In addition, the MIKE FLOOD model includes cross-sections at fine spacing (approximately 20 m) to enhance model stability. This fine spacing is not required for 1D HEC RAS models; therefore, the cross-section locations from the existing TRCA HEC-RAS model (2010) were used. This ensures consistency with previous models for comparison purposes. A schematic of the HEC-RAS model including river centreline and cross sections is provided on Figure 3.

The HEC-RAS model extends upstream and downstream to encompass the project area while ensuring the location of the boundaries does not impact the results in the area of interest. The upstream end of the model is just downstream of Burnhamthorpe Road and includes inflow from node 12.12 of the hydrology model (MMM 2013). The downstream end of the model is the confluence with Etobicoke Creek. A rating curve boundary condition was applied to the downstream end using water elevations from the TRCA (2016) HEC-RAS model.



- Easements
- Building
- Parking Lot
- Watercourse
- Highway
- Road
- Study Area Extents (500m upstream of the Dixie Road Bridge to Dundas Street)
- HEC-RAS Cross-section
- Contour (masl) - 1m Interval
- Flow Direction
- Dixie Road Bridge

1:5,000 metres
50 0 50 100
NAD 1983 UTM Zone 17N

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HEC-RAS Model Schematic

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July 2019	24603	K. Molnar	K. Hofbauer

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Figure 3

4 FLOOD MITIGATION OPTIONS

High-level alternative solutions for this screening-level assessment were based on the findings of the *Dundas Street Transportation Master Plan* (AECOM 2016) plus additional solutions identified by Matrix. The following high-level solutions were considered for the assessment:

- conveyance improvements
- flood containment
- diversions
- Regional storage
- policy measures

Several alternatives were assessed for each type of solution, but each option was assessed on its own merit and not in combination with other options.

The screening assessment results are summarized in Table 1 with detailed descriptions and hydraulic screening results discussed in the following subsections.

TABLE 1 High-level Alternative Solutions

Solution No.	High-level Solution	High-level Solution Screening Criteria	Screening Approach	Screening Outcome
Conveyance Improvement				
1	Increase Channel Conveyance	• Determine appropriate channel width and limits of widening to mitigate spill.	• Model various channel widths with no bridge in model. • Review additional widening options downstream of Dixie Road to minimize widening requirements upstream of Dixie Road where land availability is an issue.	• Widening upstream of Dixie Road does not mitigate spill on its own. • Widening upstream (to 10 m) and downstream (to 10 or 15 m) of Dixie Road do not mitigate spill on their own.
1b	Channel Lowering	• Review infrastructure and bathymetry in channel corridor to see if feasible.	• Lower channel to remove drop through Dixie Road bridge • Modelled in combination with widening as appropriate.	• Channel lowering combined with 10 m bottom width upstream and 10 or 15 m bottom downstream mitigates upstream spill with adequate freeboard. • Would have to be combined with other alternatives to mitigate downstream spill.
2	Bridge Replacement	• Determine appropriate bridge dimensions and associated channel widening (width and limits of widening) to mitigate spill.	• Model this after solution No. 1. • Increase bridge at Dixie Road to match selected width.	• Proposed bridge will be sized to span Regional flow for selected widening scenario after potential utility conflicts are reviewed.
Flood Containment				
3	Flood Protection Landform (FPL)	• An FPL would be considered in combination with conveyance improvements if these solutions are not sufficient on their own.	• Estimate FPL heights using model results from solution No. 1 and solution No. 2.	• Not feasible on its own due to significant footprint requirements. • FPL requirements to be determined at a later stage following confirmation of conveyance improvements.
4	Floodwall	• A floodwall would be considered in combination with conveyance improvements if these solutions are not sufficient on their own.	• Estimate floodwall heights using model results from solution No. 1 and solution No. 2.	• Not a permanent solution. • Floodwall requirements to be determined at a later stage following confirmation of conveyance improvements.
5	Berm/Dyke	• A berm/dyke would be considered in combination with conveyance improvements if these solutions are not sufficient on their own.	• Estimate berm/dyke heights using model results from solution No. 1 and solution No. 2.	• Not a permanent solution. • Berm requirements to be determined at a later stage following confirmation of conveyance improvements.
Diversions				
6	Upstream Flow Diversion	• A flow diversion system to direct flows to Etobicoke Creek may be considered in combination with conveyance improvements if these solutions are not sufficient on their own.	• Review hydrology to determine whether enough flow can be diverted to Etobicoke Creek to maintain Regional flows at Dixie Road below 86 m^3/s to mitigate spill.	• Feasible in theory. • Further review of practical feasibility and potential conflicts would be required.
7	Local Flow Diversion	• Not feasible on its own. • A flow diversion system may be considered in combination with conveyance improvements if these solutions are not sufficient on their own. • Review potential locations for overland flow (e.g., north side of rail).	• If required, estimate required size of flow diversion channel or conduit/tunnel based on remaining spill rate (in combination with other solutions).	• Not feasible on its own due to significant land and pipe size requirements. • May be considered in combination with conveyance improvements.
Storage				
8	Regional Flood Control	• Identify potential pond/tank locations (as close to project area as possible). • Reduce conveyance of upstream bridges to provide online storage.	• Confirm storage volume required to reduce peak regulatory flow to prevent spill using VO model.	• Not feasible on its own due to significant storage volume requirements. • May be considered in combination with conveyance improvements.
9	Online Storage	• Reduce conveyance of upstream bridges to provide online storage. • Decrease each upstream bridge conveyance by approximately 10%.	• Significant policy implications. • This will not be acceptable in Ontario.	• Not recommended and excluded from further analysis.
Policy Measures				
10	Floodproofing	• Confirm number of properties in flood risk zones. • Provide commentary on flood proofing requirements.	• Confirm number of properties in existing flood risk zones and in combination with other solutions.	• Over 1,000 homes in the existing Regional floodplain would require floodproofing. • May be considered in combination with conveyance improvements at a later stage.
11	Land Acquisition	• Confirm number of properties in flood risk zones and quantify costs.	• Confirm number of properties in existing flood risk zones and in combination with other solutions.	• 1,011 homes in the existing Regional floodplain (north of QEW, potentially more to the south). • May be considered in combination with conveyance improvements at a later stage.

4.1 Conveyance Improvement

Conveyance improvements consist of alternatives that increase the hydraulic conveyance capacity of the existing riverine system through the project reach. The existing channel through the project area ranges from approximately 7 to 8 m wide with nearly vertical, eroding banks and is lined with armourstone in some locations. The following subsections describe the high-level conveyance improvement alternatives focussed on widening the armourstone-lined sections of the channel.

4.1.1 Channel Widening

This alternative consists of increasing the channel width to mitigate spills from Little Etobicoke Creek. The property currently available for channel corridor in the reach from Dixie Road to 400 m upstream is quite limited. While this is not considered a firm constraint at this time, we recognize that future designs may be limited by this narrow corridor and therefore this was considered through the high-level screening. Widening in this upstream reach can improve the conditions at the main spill location in the Applewood SPA, but will not provide benefits to the area downstream of Dixie Road in the Dixie-Dundas SPA.

During Milestone Meeting No. 1 held on June 27, 2019, the project team discussed flood risk downstream of Dixie Road. During this meeting it was noted that if the spill upstream of Dixie Road is addressed, flood risk downstream of Dixie Road may increase, notably, the additional existing spill approximately 350 m downstream of Dixie Road (HEC-RAS cross-section 8.17). Therefore, to mitigate this downstream spill potential, the feasibility of increasing channel capacity downstream of Dixie Road was also examined.

The available corridor for channel widening downstream of Dixie Road is significantly wider than in the upstream reach. Additionally, widening in this reach can improve the conditions in the area downstream of Dixie Road in the Dixie-Dundas SPA but also at the main spill location in the Applewood SPA through a reduced tailwater condition at the Dixie Road bridge. To date this alternative assumes the widened channel will have 2:1 side slopes.

4.1.2 Channel Lowering

The existing channel profile includes two drops in bed elevation through the Dixie Road bridge. Hydraulic benefits could be realized by removing these drops to provide a smooth channel profile through the Dixie Road bridge, thereby lowering the channel at the spill location upstream of Dixie Road. A rocky ramp structure could be designed to tie into the upstream channel bed.

4.1.3 Conveyance Improvements Hydraulic Screening Results

Matrix reviewed the hydraulic benefits of conveyance improvement alternatives. The range of considered channel widening options included widths that could fit within the existing public corridor to those that would require significant property takings.

The HEC-RAS model results for the channel widening alternatives with 2:1 side slopes and bottom widths as noted are summarized in Table 2. Minimum freeboard values from the existing condition scenario have also been included for comparison purposes.

The upstream widening was limited to a 10 m bottom width, as this fits reasonably well within the current property limits. Matrix reviewed two additional widening alternatives to further expand the reach downstream of Dixie Road to 10 m and 15 m bottom widths in combination with the 10 m widening upstream. In addition to these, Matrix also reviewed lowering the channel through the Dixie Road crossing in combination with the various widening alternatives.

TABLE 2 Channel Conveyance Results Summary

Alternative	Maximum Reduction in Water Elevation Upstream (m)	Minimum Freeboard Upstream of Dixie Rd (m)	Maximum Reduction in Water Elevation Downstream (m)	Minimum Freeboard Downstream of Dixie Road (m)
Existing	n/a	-1.76	n/a	-1.27
10 m Bottom Width	2.01	0.02	1.19	-0.64
10 m Bottom Width + Lowering	2.49	0.69	1.09	-0.64
10 m U/S + 15 m D/S	2.01	0.02	1.41	-0.32
10 m U/S + 15 m D/S + Lowering	2.49	0.69	1.63	-0.32

U/S – upstream
D/S - downstream

As indicated, widening the entire reach to a 10 m bottom width is sufficient to mitigate spill upstream (but does not achieve standard freeboard of 0.5 m and/or consider climate change). The additional widening to 15 m downstream of Dixie Road provides benefit to downstream water levels but does not provide additional benefit to upstream water levels. Lowering the channel bed provides a significant benefit to upstream water levels and will mitigate spill (meeting required freeboard but without consideration for climate change).

None of the options presented in Table 2 are effective at mitigating all of the spill and therefore lowering the channel profile through the Dixie Road bridge plus widening upstream and downstream of Dixie Road will have to be considered in combination with other alternatives to fully mitigate the spill downstream of Dixie Road.

4.1.4 Bridge Replacement

The existing Dixie Road bridge consists of a 12 m span concrete arch bridge. Due to the nature of the watercourse and spill location in the project area, the existing bridge is not overtopped during the modelled storm events because the spill elevation near Queen Frederica Drive is lower than the bridge deck elevation. Nonetheless, the existing bridge presents a hydraulic restriction and therefore widening the bridge in conjunction with channel widening was considered. This alternative was not specifically modelled in HEC-RAS; the proposed bridge dimensions will be confirmed at a later stage. However, the HEC-RAS model incorporates the hydraulic losses (i.e., contraction and expansion) through the bridge location, but the actual bridge structure was removed. The recommended bridge design will be such that it spans the entire Regional flow and therefore the results of the widening alternatives should not change significantly when the bridge is incorporated into the hydraulic model.

4.2 Flood Containment

Flood containment consists of alternatives to prevent spill from occurring through the construction of flood barriers at key spill locations. The following subsections summarize three potential flood barrier alternatives and methods for estimating design requirements. Under current Ministry of Natural Resources and Forestry (MNRF) policy, most flood barriers are assumed to fail under regulatory flow conditions and therefore are not considered permanent flood protection measures. In addition, flood containment alternatives would increase water levels upstream as it forces flow to stay in the channel corridor. For these reasons, the flood containment alternatives are only considered in conjunction with conveyance improvements.

4.2.1 Flood Protection Landform

A flood protection landform (FPL) is a berm-like structure that incorporates design features to protect against structural failure due to water seepage and erosion. TRCA is currently developing guidelines for the siting and structural design components for FPLs for the MNRF to recognize these structures as providing permanent flood protection. The key design features that improve the structural integrity of FPLs include:

- a clay core with an elevation 0.5 m above the Regional storm elevation
- a wide crest width ranging from 3 to 5 m
- maximum 5 to 10% slopes on the wet side
- shallow slopes of 1.5 to 2.5% on the dry side
- no hydraulic connection through the FPL
- no structures or foundations within the FPL

Due to the grading requirements for FPLs, a large footprint is required for construction; therefore, this alternative should also consider available lands. The FPL elevation and footprint requirements will be confirmed at a later stage once the details of conveyance improvement alternatives are known.

4.2.2 Floodwall

There is an existing floodwall located approximately 200 m upstream of Dixie Road with a top elevation of approximately 125.0 m (MMM 2015). This alternative includes consideration for an additional floodwall(s) in combination with conveyance improvement solutions if the conveyance improvements do not mitigate spill on their own.

4.2.3 Berm/Dyke

There is an existing flood control berm located on the right bank of the river downstream of the Dixie Road bridge and is approximately 400 m long with a minimum elevation of 122.7 m (MMM 2015). This alternative includes consideration for an additional flood control berm(s) in combination with conveyance improvement solutions if the conveyance improvements do not mitigate spill on their own.

As with the FPL and floodwall, details of the berm (i.e., height and footprint requirements) will be confirmed at a later stage once additional details of conveyance improvement alternatives are known.

4.2.4 Summary of Flood Containment Alternative Requirements

Flood containment alternatives will only be considered in combination with conveyance improvements if the conveyance improvements alone are not sufficient to mitigate spill. Therefore, modelling of flood containment alternatives was not completed at this stage. These requirements will be reviewed in further detail in subsequent stages.

4.3 Diversions

Under existing conditions, approximately 60% of the Regional flow spills from Little Etobicoke Creek at Queen Frederica Drive. Various flow diversion alternatives were considered to reduce the amount of flow being conveyed in Little Etobicoke Creek at the spill location, thereby reducing the spill. Alternatives included diversions upstream and downstream of Dixie Road as well as piped and overland flow diversion options.

4.3.1 Upstream Flow Diversion

During Milestone Meeting No. 1 held on June 27, 2019, TRCA enquired about the feasibility of diverting flow upstream of the project area (around the open corridor at Eastgate Parkway) in attempt to reduce the peak flows in Little Etobicoke Creek. The diverted flow would be directed to the main branch of Etobicoke Creek.

Matrix revisited the Etobicoke Creek VO hydrology model to determine whether enough flows can be diverted at Eastgate Parkway to limit Regional flows at Dixie Road to below 86 m^3/s, as this flow would then be contained within the existing channel and therefore mitigate spill. In the VO model, Eastgate Parkway is located between VO ID 314 and VO ID 349. A “DivertHYD” function was inserted into the model at this location. For the Regional storm event, approximately 130 m^3/s would have to be directed toward the Etobicoke Creek system leaving 20 m^3/s in the Little Etobicoke Creek system at Eastgate Parkway. This would produce a Regional storm peak flow of 82 m^3/s at Dixie Road. Using FlowMaster hydraulic software, this would require a 3.2 m diameter pipe at a slope of 1.5% to effectively divert flows to Etobicoke Creek. Review of topography in this area suggests that the diversion pipe could be up to 20 m deep at the watershed divide.

Upstream flow diversion is feasible from a theoretical standpoint. However, a more detailed review of feasibility would be required including the size of the diversion system, whether it would be an open channel or pipe, utility conflicts, or presence of underpasses, as well as the ecological impact associated with diverting a significant amount of flow from Little Etobicoke Creek at Eastgate Parkway. It is assumed that this alternative will be deemed impractical and infeasible for cost, utility, and ecology purposes. This alternative will not be considered further.

4.3.2 Local Flow Diversion

A flow diversion conduit was considered in the *Dundas Street Transportation Master Plan* study (AECOM 2016) to convey the 130 m^3/s of spilled flow. To eliminate riverine spill upstream of Dixie Road, the diversion conduit in the vicinity of the project area would require: a 530 m long 7.5 m × 2.5 m box along Queen Frederica Drive and a 930 m long 10 m × 2.5 m box conduit along Dundas Street. While this is feasible from a technical standpoint, it was ruled out as a standalone alternative based on practical feasibility associated with the existing right-of-way and utility and servicing conflicts.

If flow diversion were combined with channel conveyance improvement alternatives, the required pipe size may be significantly reduced. Therefore, partial diversion will be considered during future stages in combination with other alternatives.

4.4 Water Storage

4.4.1 Regional Flood Control

Based on the existing MIKE FLOOD hydraulic modelling results available from the Matrix 2018 study, approximately 130 m^3/s spills from Little Etobicoke Creek during the Regional storm event. The Regional storm peak flow in the project area is approximately 215 m^3/s based on the existing condition VO hydrology model (MMM 2013). To mitigate the spill through Regional flood control, Matrix used SWMHYMO to estimate the required storage volume to reduce the peak flow enough to prevent spill. The resulting storage volume was 227 ha-m (2,270,000 m^3). Due to land availability and policy constraints this option is not considered feasible on its own. Regional flood control could be considered for minor reductions in peak flows in combination with other solutions which would greatly reduce the required storage volume.

4.4.2 Online Storage

This alternative includes consideration for decreasing upstream bridge conveyance to provide online storage. This solution is not feasible in an urbanized area but has been used in rural areas in western Canada where land is available for storage. There are significant policy implications associated with this alternative as it relates to accommodating storage in hydraulic modelling for floodplain mapping purposes. In addition, reducing bridge capacity may have undesirable impacts to flood risk in upstream properties. This option would not be acceptable under Ontario policy and therefore will not be considered further.

4.5 Policy Alternatives

The following two alternatives were considered in case a viable solution cannot be accommodated to reduce the current riverine spill and remove the SPA designation from Dixie-Dundas area. Using the MIKE FLOOD hydraulic modelling results available from the Matrix 2018 study, there are 1,011 buildings located within the existing flood risk zone north of QEW. The modelled 2D boundary terminated at the QEW and therefore the number of additional buildings impacted by the riverine spill south of QEW is unknown. Of these, 461 buildings are in a high-risk flood zone.

4.5.1 Floodproofing

Floodproofing includes a combination of structural changes, design adjustments, and/or construction or alteration of buildings, structures, or properties subject to flooding so as to reduce flood damages (MNRF 2002). Floodproofing can be categorized as active or passive and providing wet or dry protection. Active floodproofing requires action and advance warning to be effective and may include placing sandbags or sealing doors, windows, and other openings. Passive floodproofing measures do not require additional actions and may include building structures above the flood elevation and/or constructing berms, floodwalls, etc. Dry floodproofing is intended to keep buildings and their contents completely dry though installing water tight doors, windows, etc. Wet floodproofing measures allow building contents to get wet and therefore require basements and lower levels to be uninhabited and unfinished in order to minimize damages. Details of floodproofing would be determined at a later stage, if required, and would be based on current MNRF floodproofing guidelines and the Mississauga Official Plan requirements.

If a viable solution cannot be accommodated to reduce the current riverine spill and remove the SPA designation from Dixie-Dundas area, floodproofing would be required for the 1,011 buildings in the floodplain. If this alternative were to be combined with other solutions as discussed in previous sections, the number of buildings that require floodproofing would be reduced.

4.5.2 Land Acquisition

Land acquisition was considered as a means of reducing flood risk to residents and businesses through property purchase and/or expropriation. Considering that 1,011 buildings are currently in the floodplain, it is not realistic to acquire/expropriate all these buildings. However, property acquisition could be considered in key areas to accommodate various other flood mitigation alternatives (i.e., channel widening, FPL, berm, etc.). Similar to the floodproofing alternative, details of land acquisition requirements would be dependent on resulting flood risk after considering other flood mitigation alternatives.

4.5.3 Summary of Policy Alternatives

Floodproofing and land acquisitions are not considered viable alternatives on their own as neither meet the primary objective of this project. These measures would only be implemented if the riverine spill was not eliminated. In this case the SPA designation would remain and the envisaged growth for the Dixie-Dundas area would not be fully realized due to development restrictions. Therefore, floodproofing and land acquisition will not be considered on their own but may be considered in combination with other alternatives.

5 ASSESSMENT RESULTS

The results of the high-level screening are summarized as follows:

- The assessed conveyance improvement alternatives are not effective at mitigating all spill and therefore combination with other alternatives is required.
  - Widening to 10 m bottom width mitigates upstream spill (with minimal freeboard and no climate change consideration).
  - Further widening to 15 m downstream of Dixie Road provides additional benefit to downstream water levels but no additional benefit upstream.
  - The addition of lowering the channel bed through the Dixie Road bridge mitigates upstream spill and provides adequate freeboard for the Regional storm event but does not mitigate the downstream spill.
- The proposed Dixie Road bridge dimensions will be confirmed when further details of the conveyance improvement alternatives are known but the bridge will be sized to span the Regional flow.
- Flood containment alternatives are not feasible on their own due to upstream impacts and policy limitations. These may be considered in combination with conveyance improvements. Further details of flood containment requirements will be completed at a later stage when details of the conveyance improvements are known.
- Upstream flow diversion to Etobicoke Creek is feasible in theory; however, review of practical feasibility and impacts indicates it should not be assessed further.

- Regional flood control is not feasible on its own due to significant storage volume requirements; this may be considered in combination with conveyance improvements.
- Online storage through a reduction in bridge capacity introduces significant policy implications and will not be acceptable in Ontario. This has been excluded from further analysis.
- Floodproofing and land acquisition on their own do not meet the objectives of the project and therefore would have to be combined with other alternatives, if required.

6 NEXT STEPS

The goal of the screening assessment was to identify and evaluate a long list of options in the context of hydraulic performance compared to the primary project goals of flood relief. The next steps include technical studies to support the evaluation of options that appear promising including: an archaeological assessment; geotechnical and hydrogeological studies; inventory of natural, social, economic and planning environment; and a fluvial geomorphology assessment. The resulting EA evaluation matrix will provide a rationale for a short list of options to be considered through conceptual design. Refined hydraulic modelling will be completed for the short list of options.

7 REFERENCES

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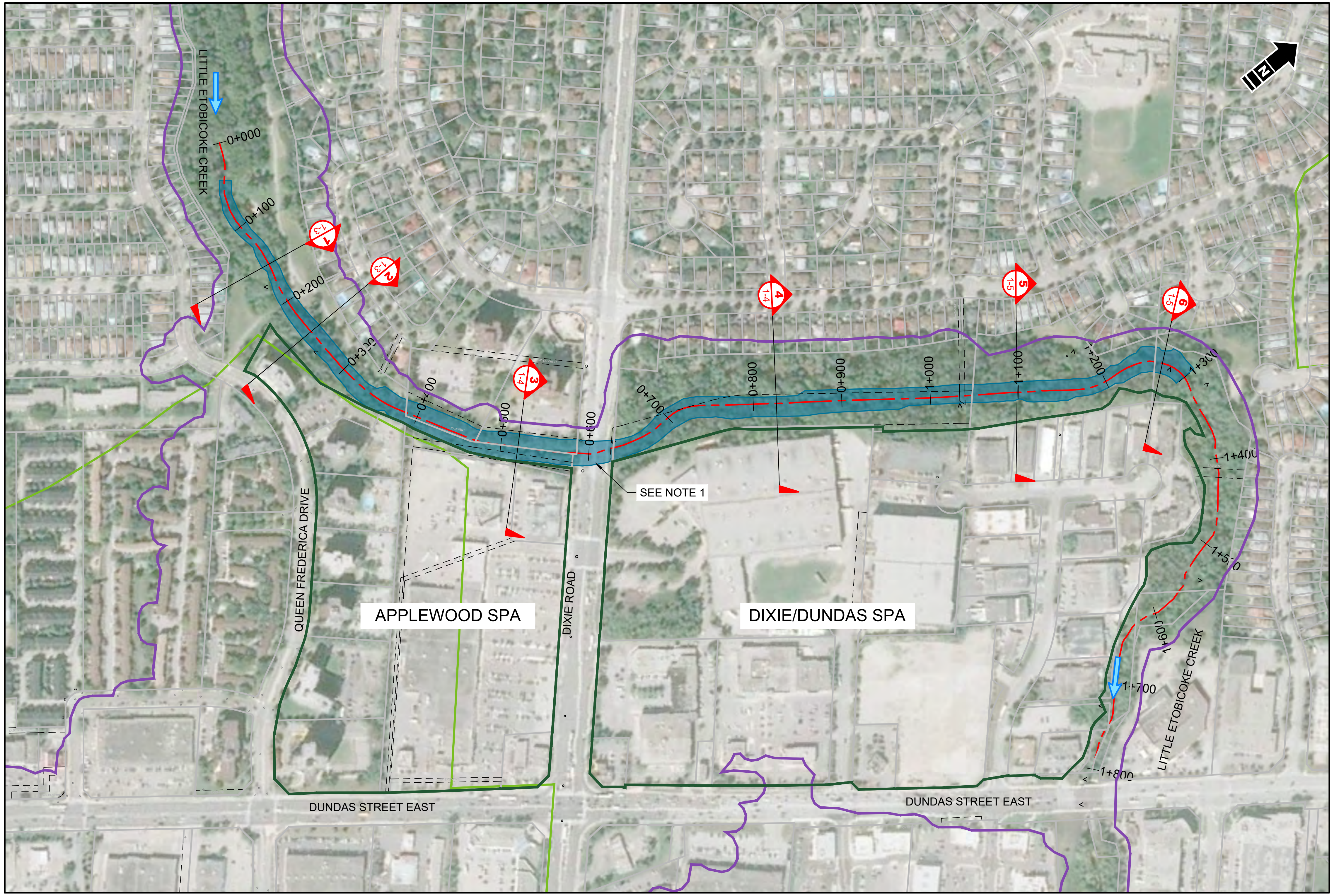
Toronto and Region Conservation Authority (TRCA). 2010. *Etobicoke Creek HEC-RAS Model*. Compiled by Toronto and Region Conservation Authority. 2010.

APPENDIX C
Dixie Area Alternative Solutions Drawings



LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 5,000 metres
50 0 50 100
DATUM

NOTES:

1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. REGULATORY BOUNDARIES PROVIDED BY THE TRCA.
4. KEY MITIGATION CONSTRAINTS ARE MAPPED ON FIGURES 3 TO 5.

PLAN

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B	2020-08-14	CONCEPTUAL 10% DESIGN	AD	SB	KW
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CITY OF MISSISSAUGA
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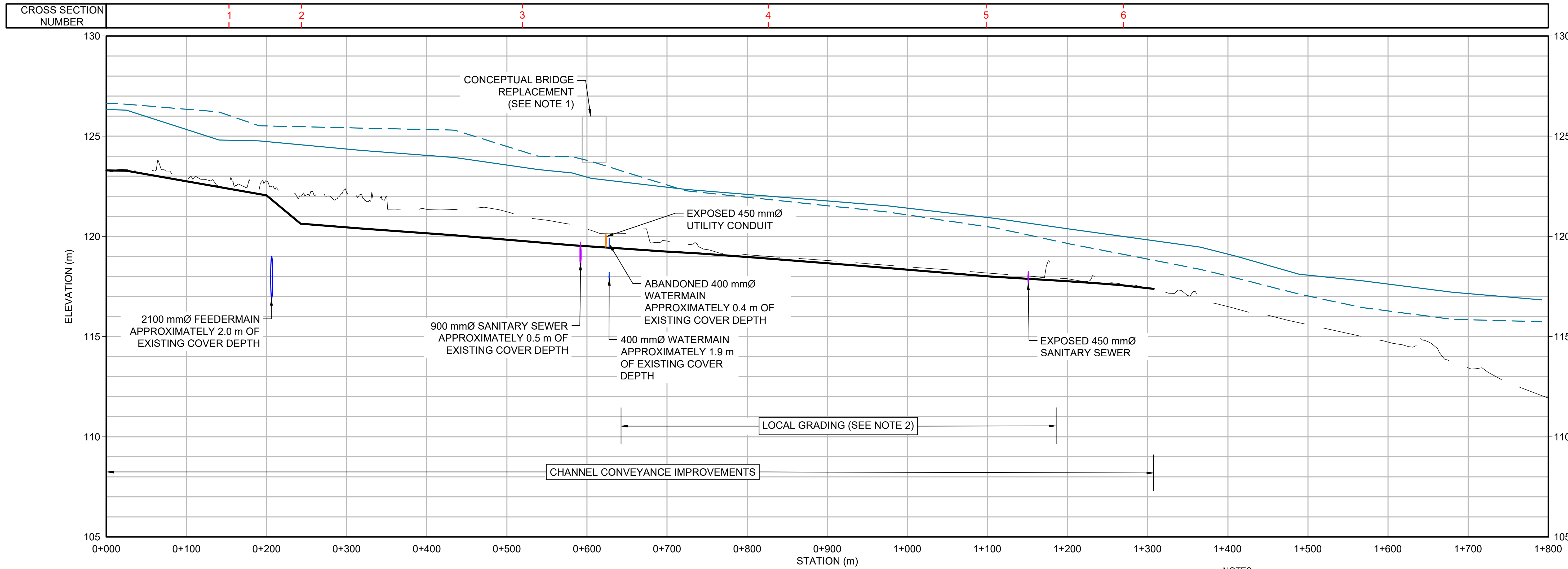
OPTION 1 MINIMIZED FOOTPRINT CONCEPTUAL PLAN

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
AUGUST 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	B	1-1



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OPTION 1 - PROFILE

SCALE HORZ. 1:5000
VERT 1:200

LEGEND

- EXISTING CHANNEL THALWEG
- CONCEPTUAL CHANNEL THALWEG
- EXISTING REGIONAL WATER LEVEL
- DESIGN REGIONAL WATER LEVEL

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CONCEPTUAL PROFILE

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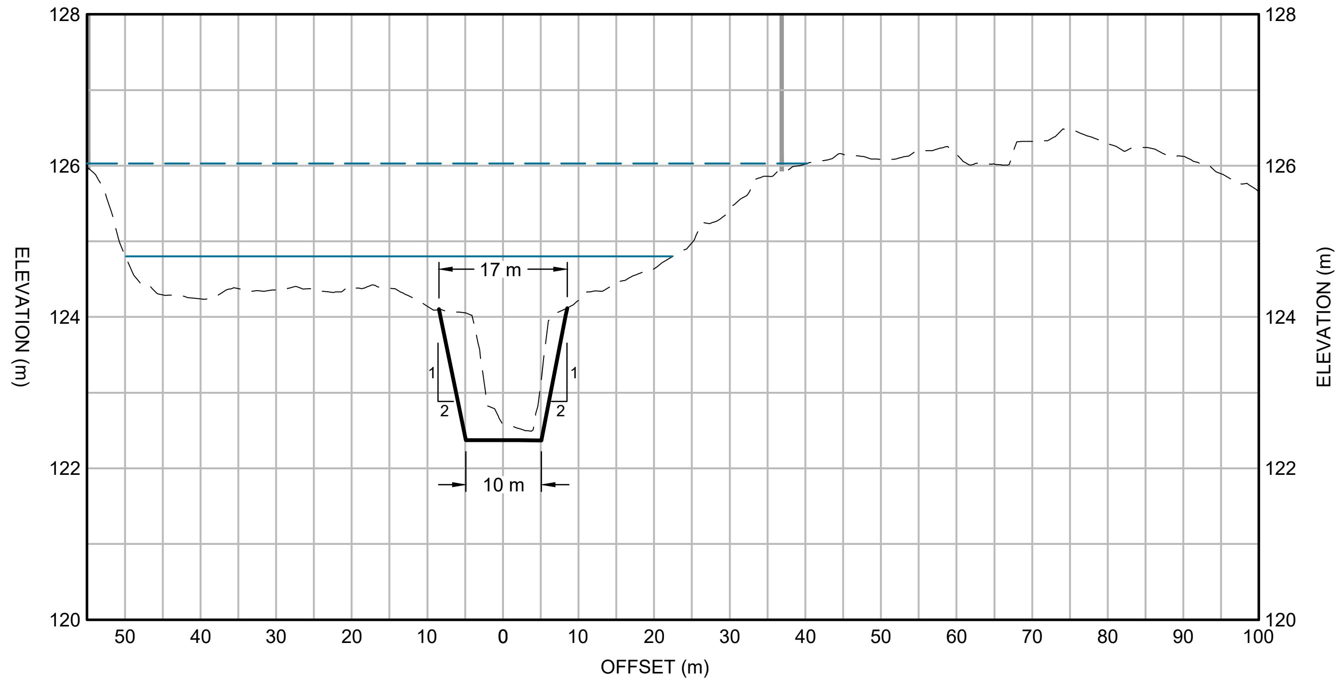
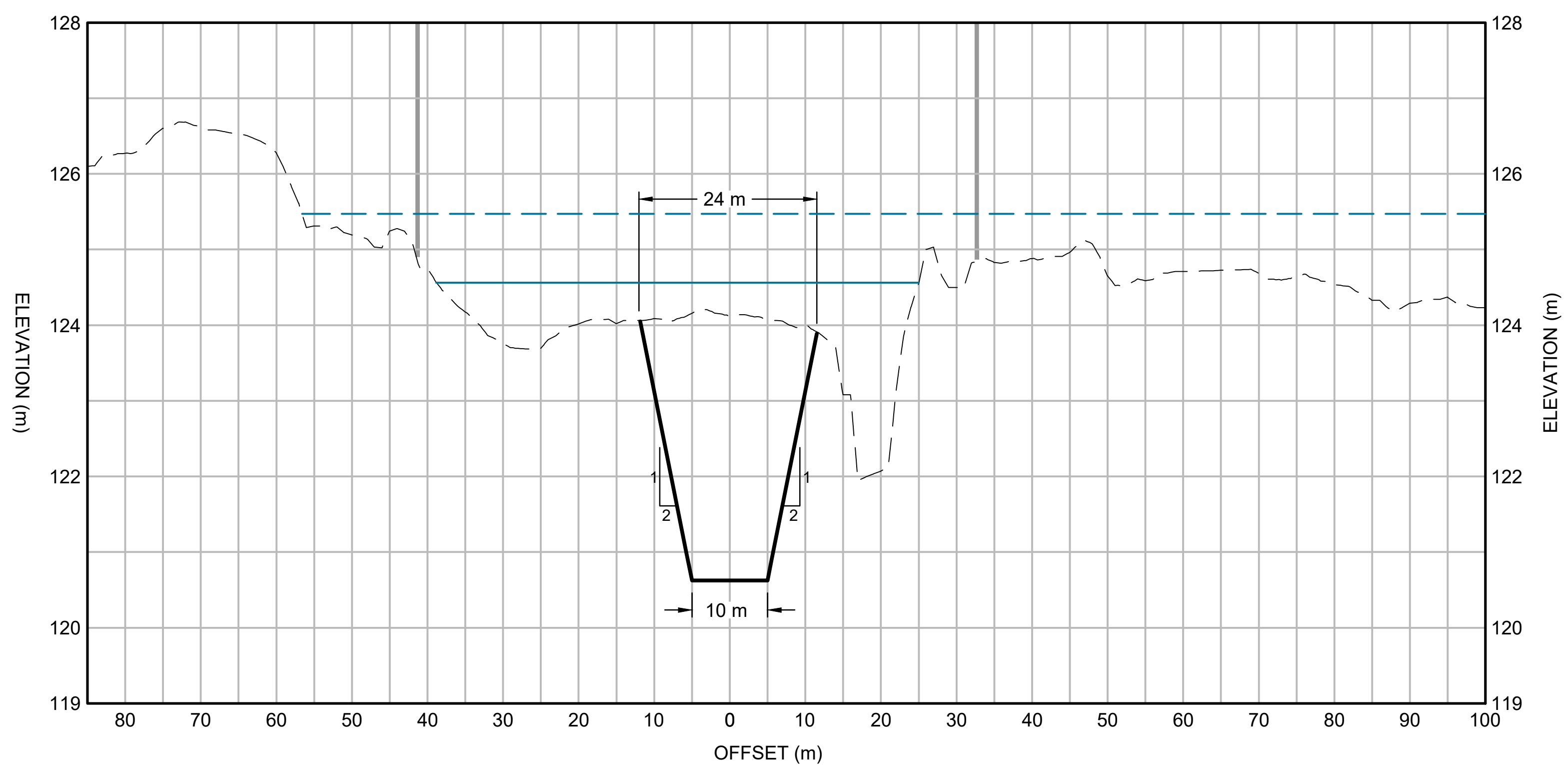


1 Section
1-1
HORIZONTAL SCALE 1:1000
VERTICAL SCALE 1:100

LEGEND

- EXISTING GROUND
- CHANNEL CONVEYANCE IMPROVEMENTS
- EXISTING REGIONAL WATER LEVEL
- DESIGN REGIONAL WATER LEVEL
- PROPERTY BOUNDARY



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VERTICAL SCALE 1:100

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4. PROPERTY BOUNDARIES BASED ON GIS DATA OBTAINED FROM THE CITY OF MISSISSAUGA.

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CONCEPTUAL CROSS-SECTIONS

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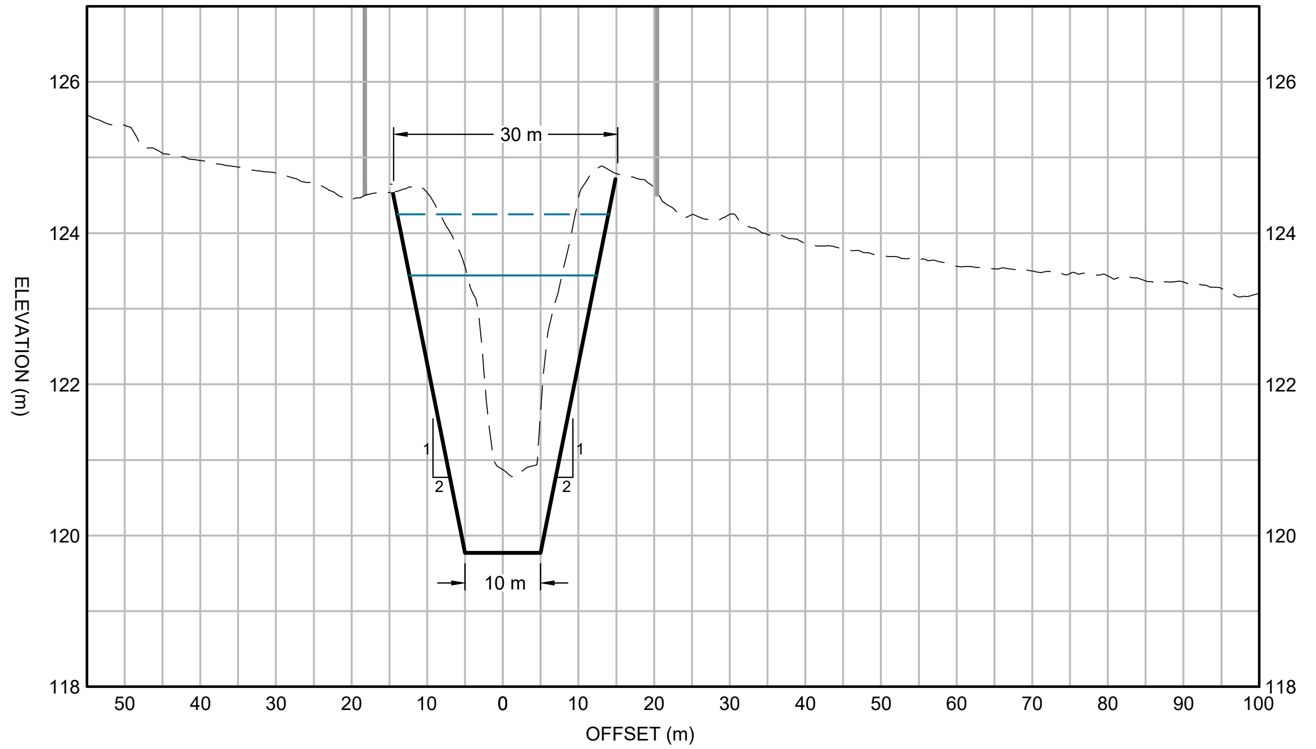

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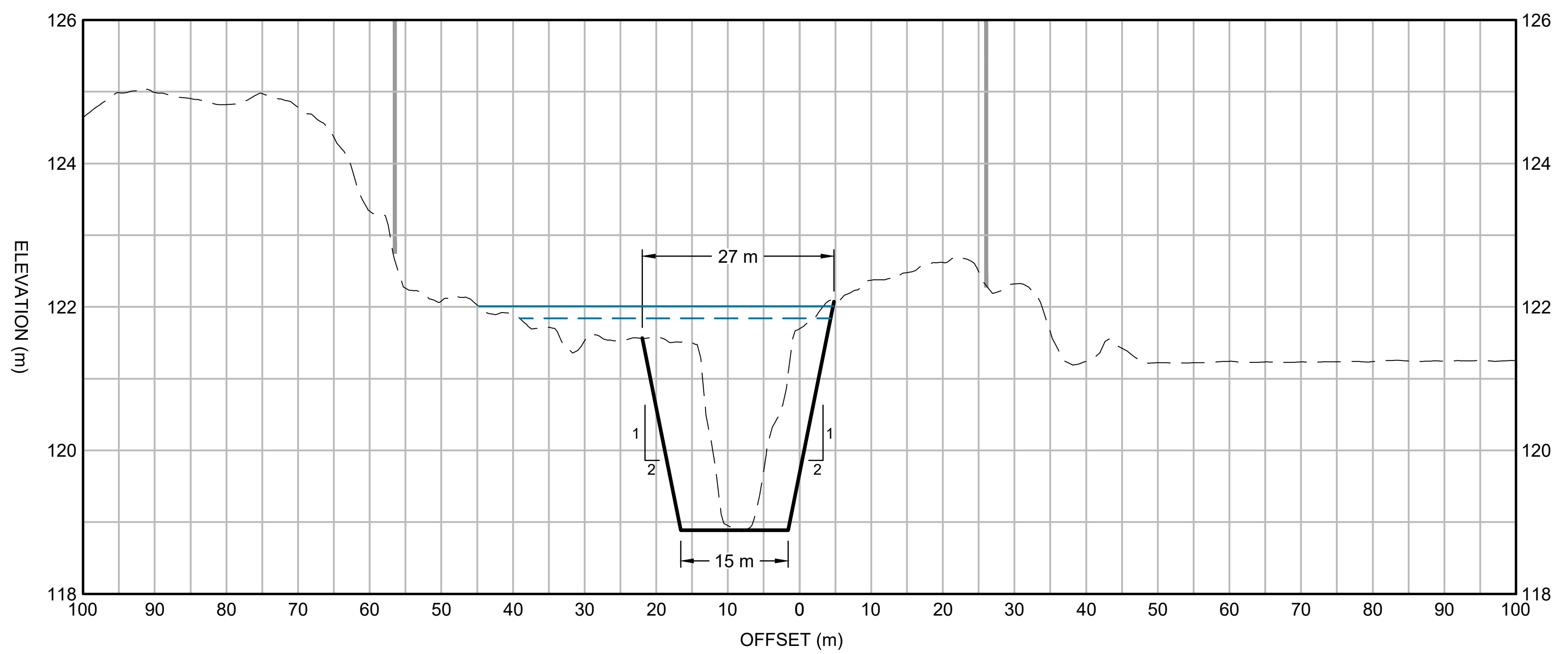

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VERTICAL SCALE 1:100

LEGEND

- EXISTING THALWEG
- DESIGN THALWEG
- EXISTING REGIONAL FLOOD WATER LEVEL
- DESIGN REGIONAL FLOOD WATER LEVEL
- PROPERTY BOUNDARY

NOTES:

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DIXIE-DUNDAS FLOOD MITIGATION PROJECT - PHASE 1 FEASIBILITY STUDY

OPTION 1
MINIMIZED FOOTPRINT
CONCEPTUAL CROSS-SECTIONS

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PROJECT:	REVISION:	DRAWING:
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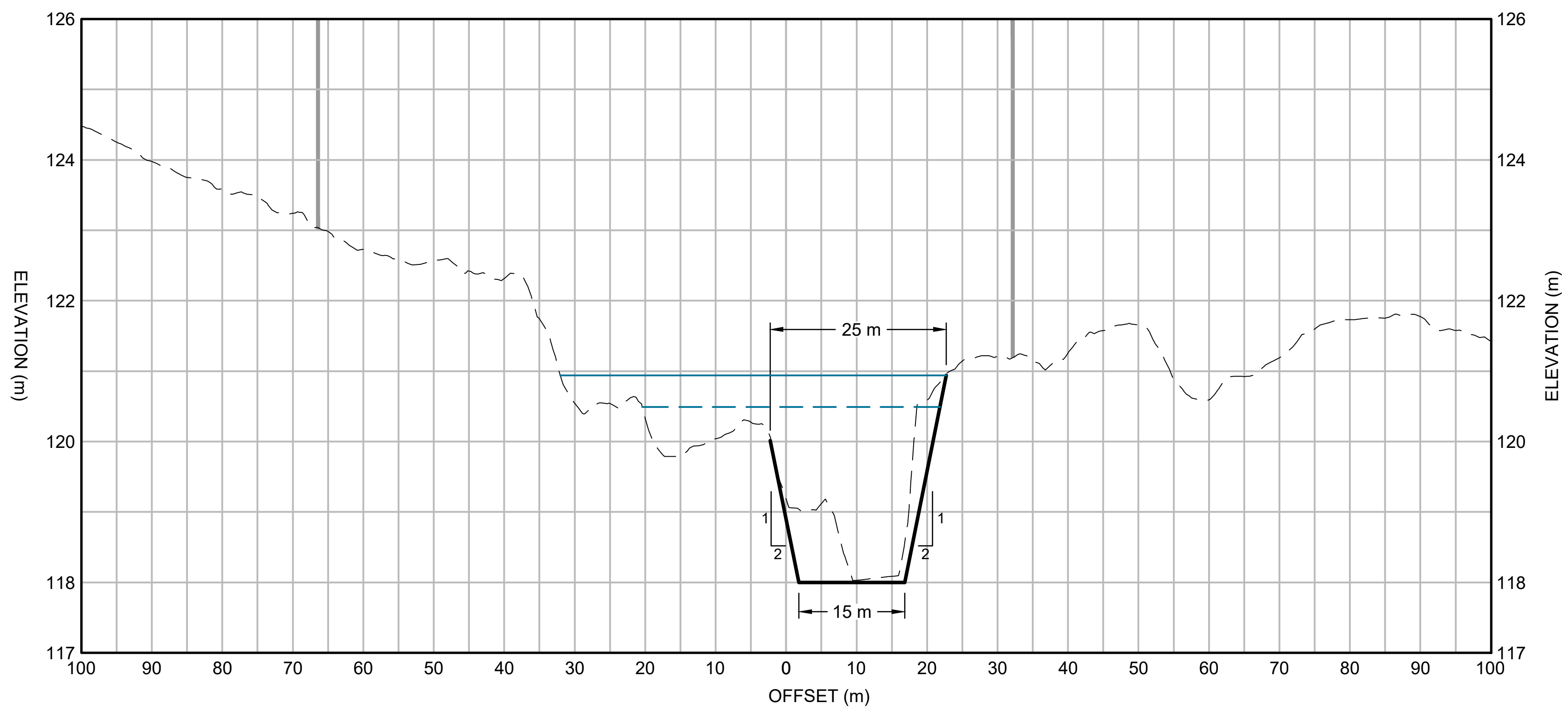

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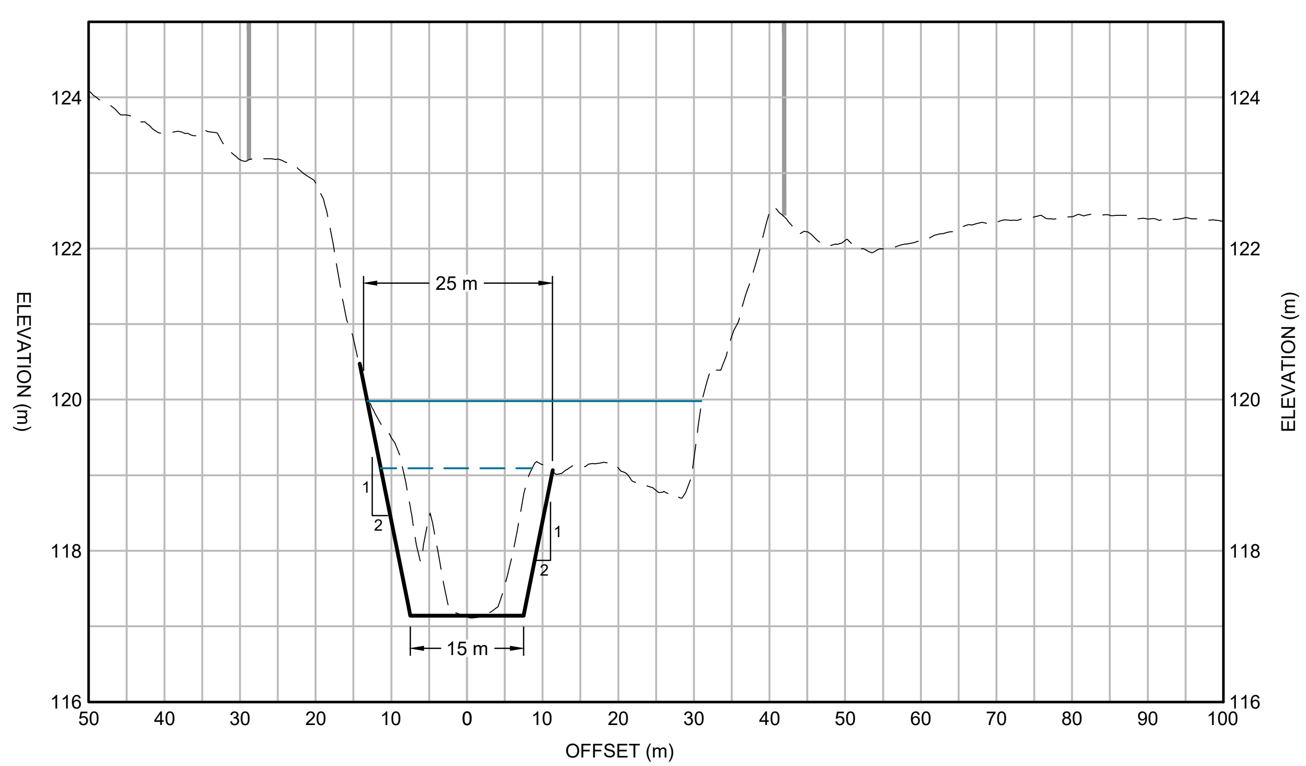

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VERTICAL SCALE 1:100

LEGEND

- EXISTING THALWEG
- DESIGN THALWEG
- EXISTING REGIONAL FLOOD WATER LEVEL
- DESIGN REGIONAL FLOOD WATER LEVEL
- PROPERTY BOUNDARY

NOTES:

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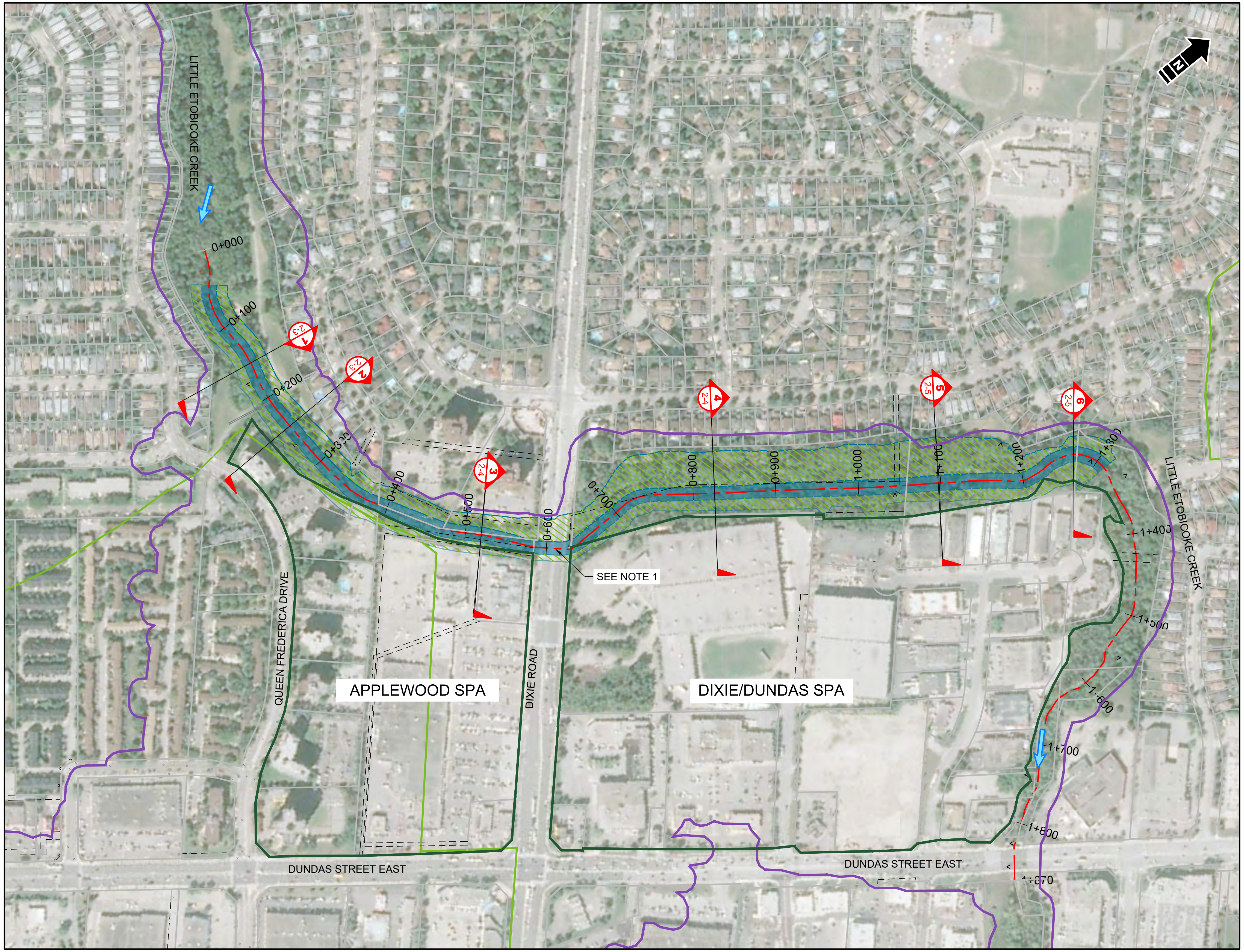

PLAN

NOT FOR CONSTRUCTION

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 5,000 metres
50 0 50 100
DATUM

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Matrix Solutions Inc.
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CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION PROJECT - PHASE 1 FEASIBILITY STUDY

OPTION 2
MAKING ROOM FOR THE CREEK
CONCEPTUAL PLAN

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
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PROJECT:	REVISION:	DRAWING:
24603-531	B	2-1

REVISION

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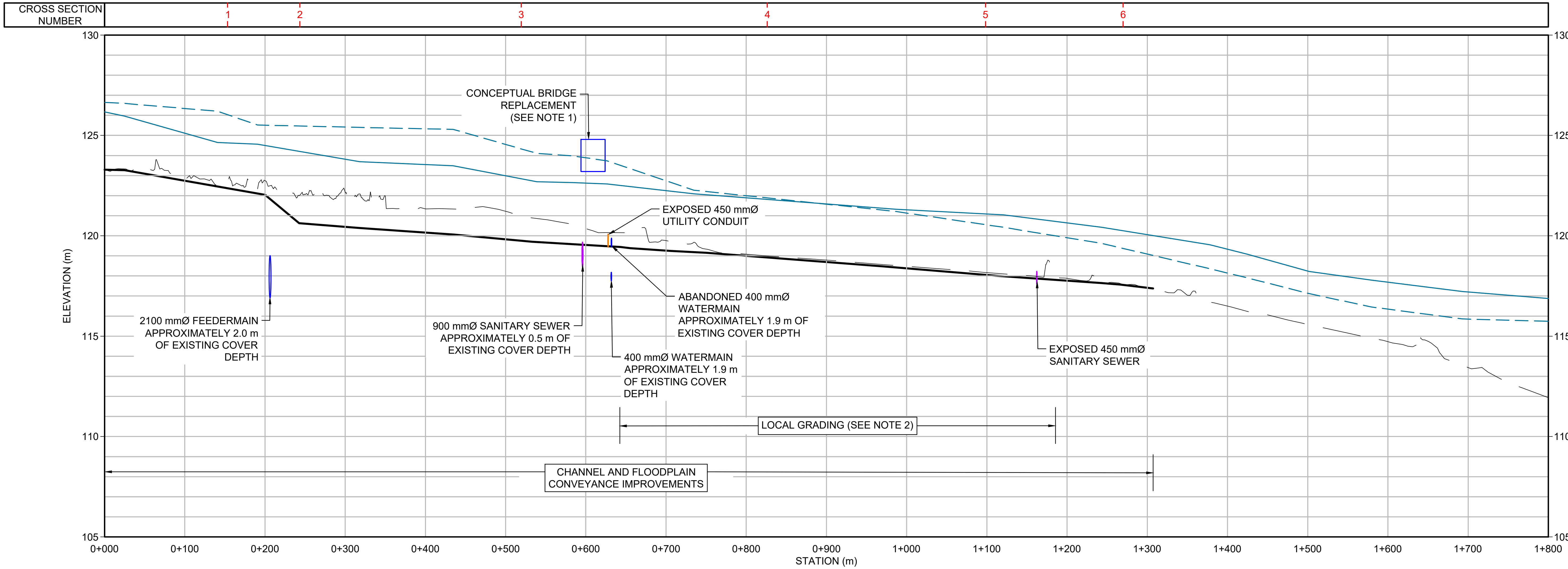

OPTION 2 - PROFILE

SCALE HORZ. 1:5000
VERT 1:200

NOTES:

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LEGEND

- EXISTING CHANNEL THALWEG
- CONCEPTUAL CHANNEL THALWEG
- EXISTING REGIONAL WATER LEVEL
- DESIGN REGIONAL WATER LEVEL

NOT FOR CONSTRUCTION

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CITY OF MISSISSAUGA

DIXIE-DUNDAS FLOOD MITIGATION PROJECT - PHASE 1 FEASIBILITY STUDY

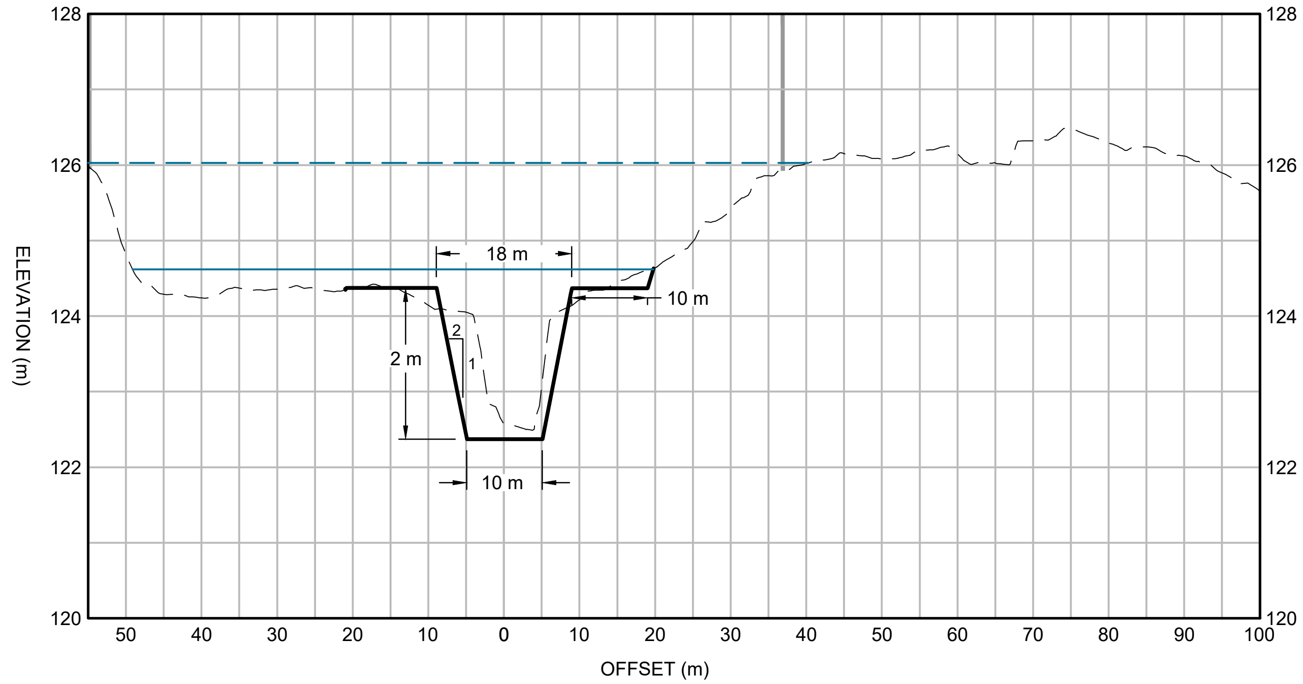
OPTION 2
MAKING ROOM FOR THE CREEK
CONCEPTUAL PROFILE

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
AUGUST 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT: 24603-531 | REVISION: B | DRAWING: 2-2

LEGEND

- EXISTING GROUND
- CHANNEL AND FLOODPLAIN CONVEYANCE IMPROVEMENTS
- EXISTING REGIONAL WATER LEVEL
- DESIGN REGIONAL WATER LEVEL
- PROPERTY BOUNDARY



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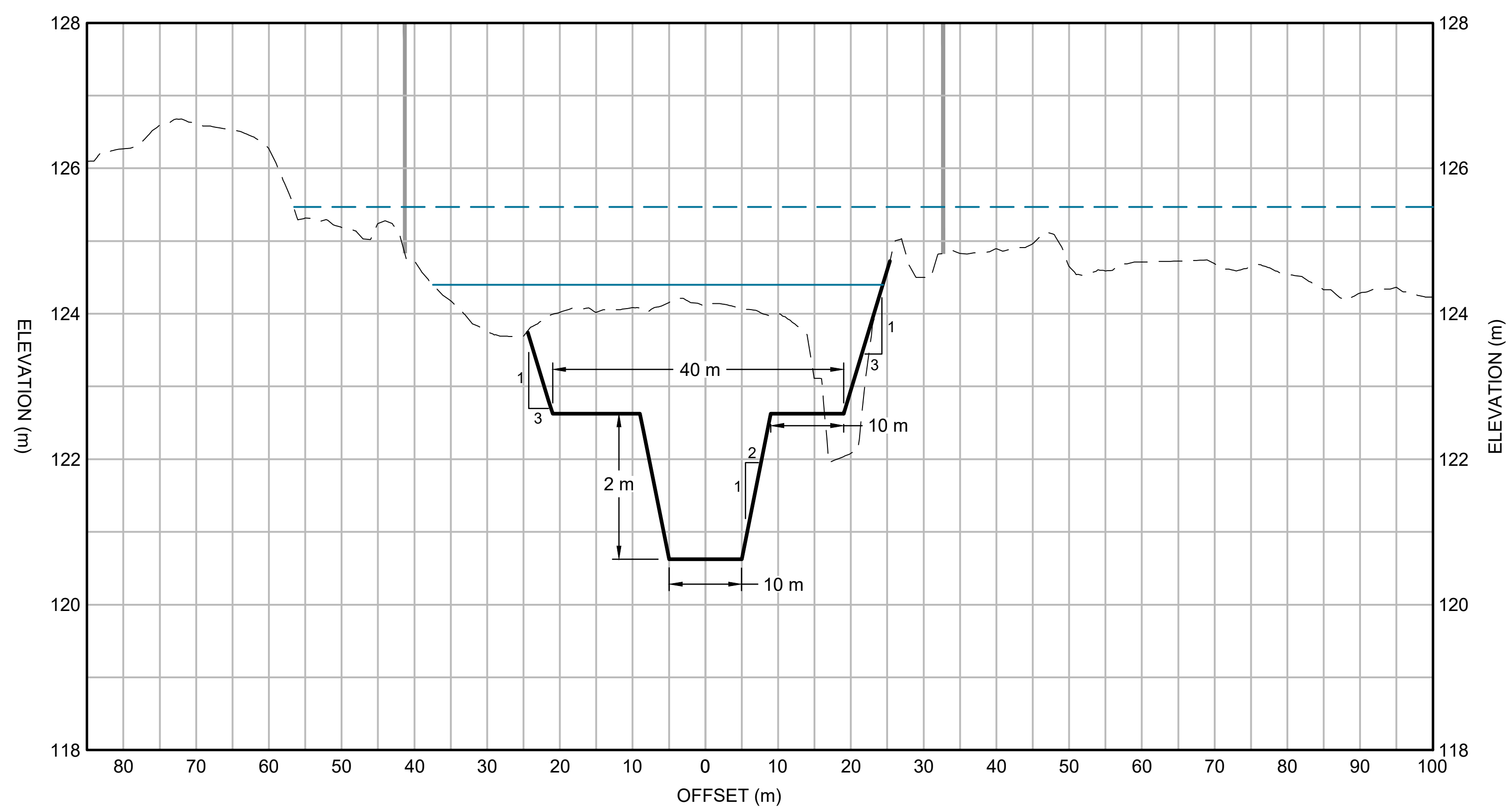

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OPTION 2
MAKING ROOM FOR THE CREEK
CONCEPTUAL CROSS-SECTIONS

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PROJECT:	REVISION:	DRAWING:
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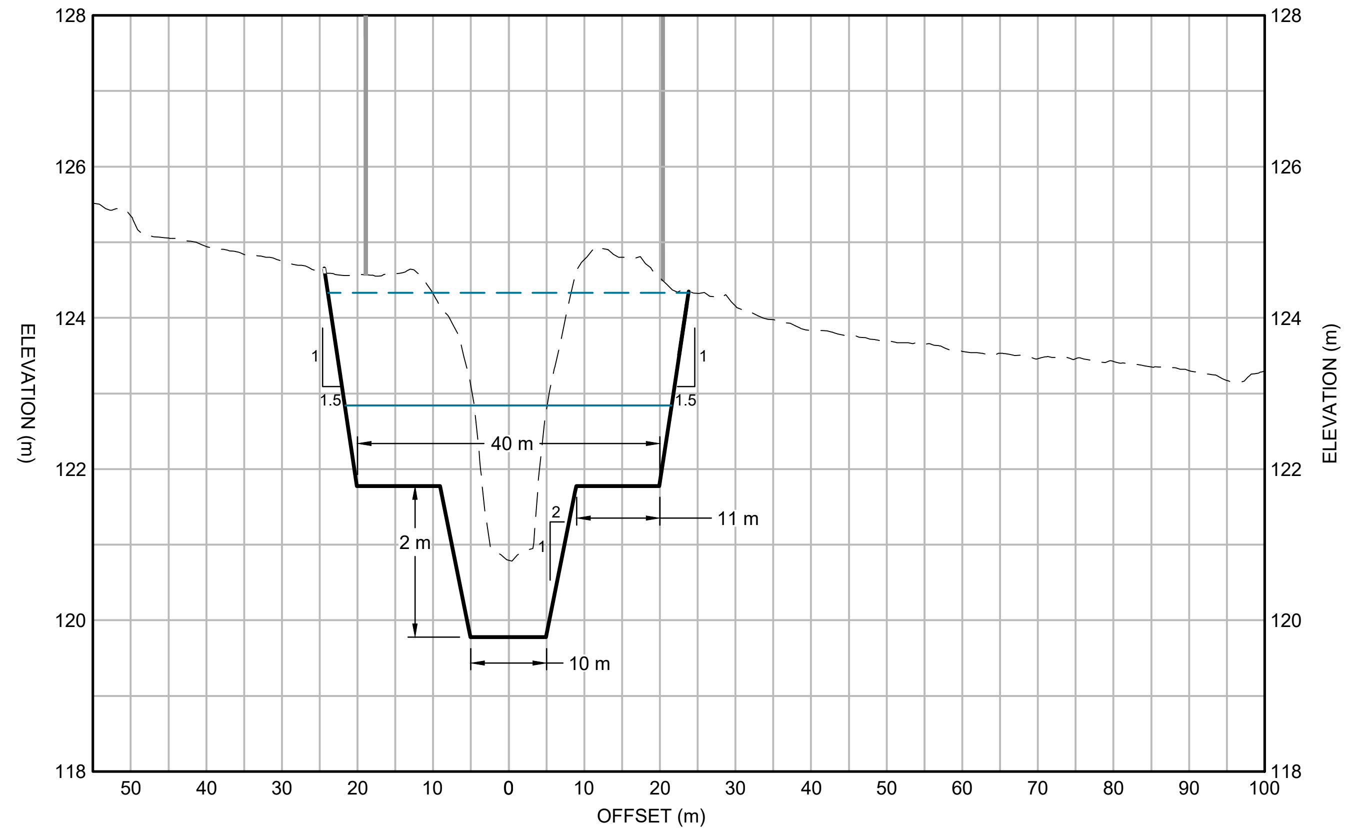

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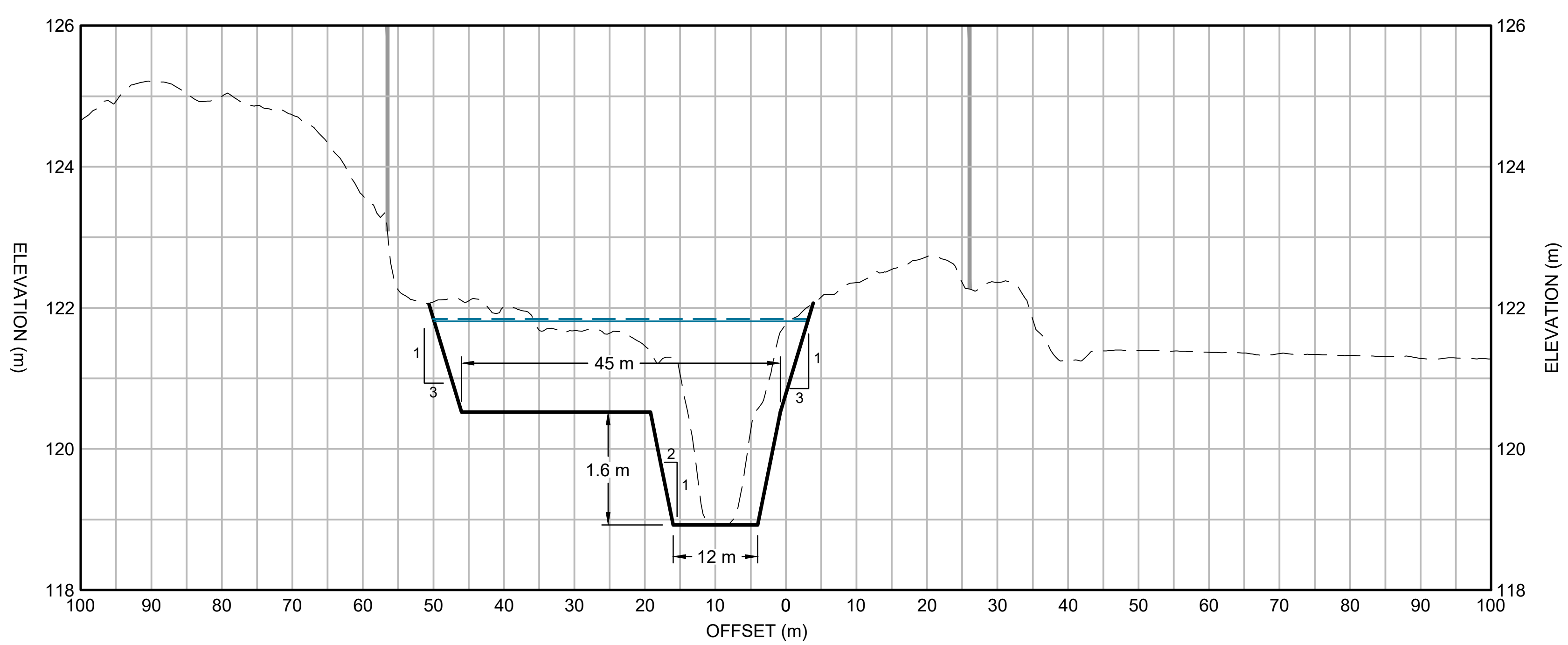

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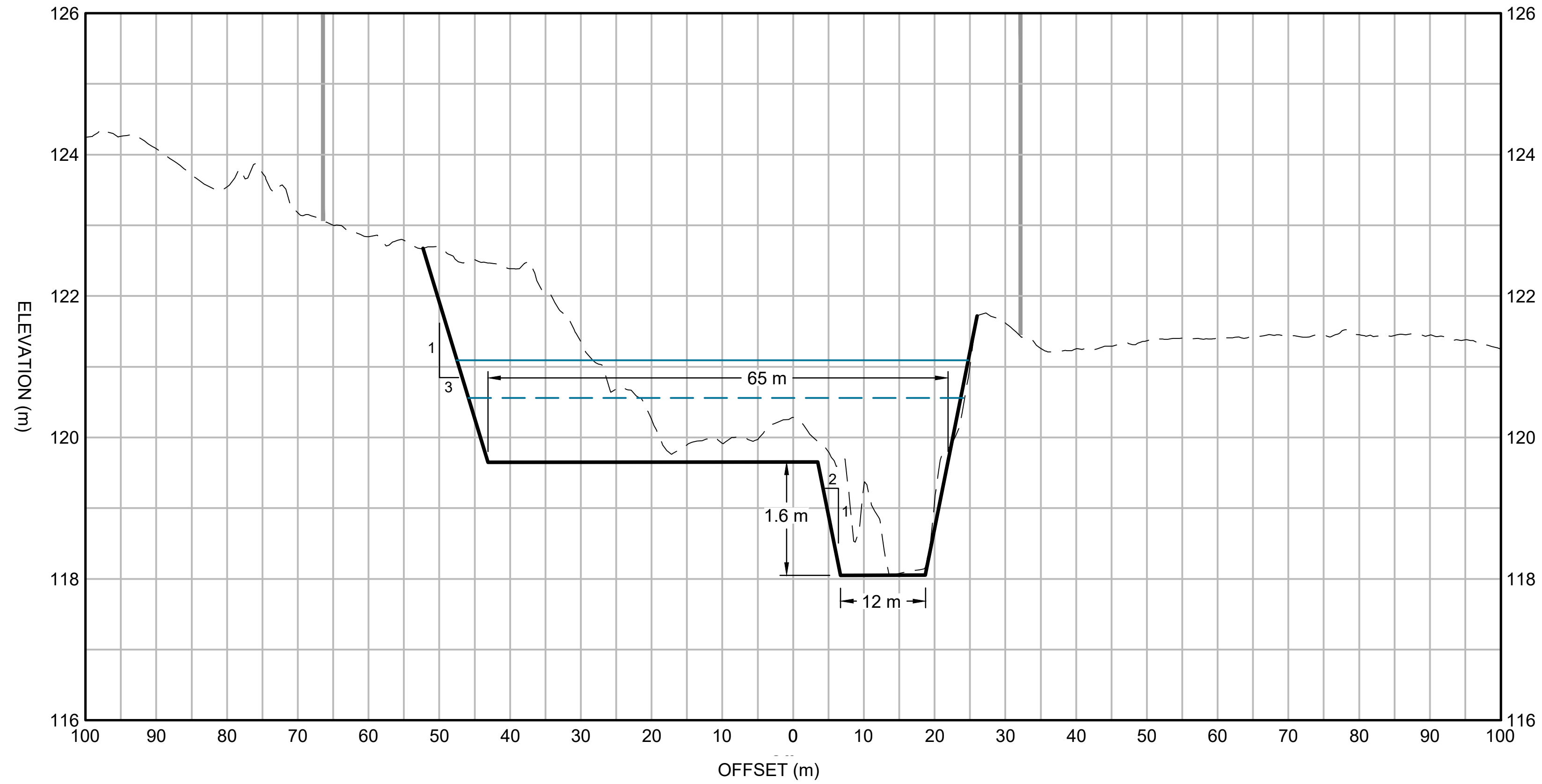

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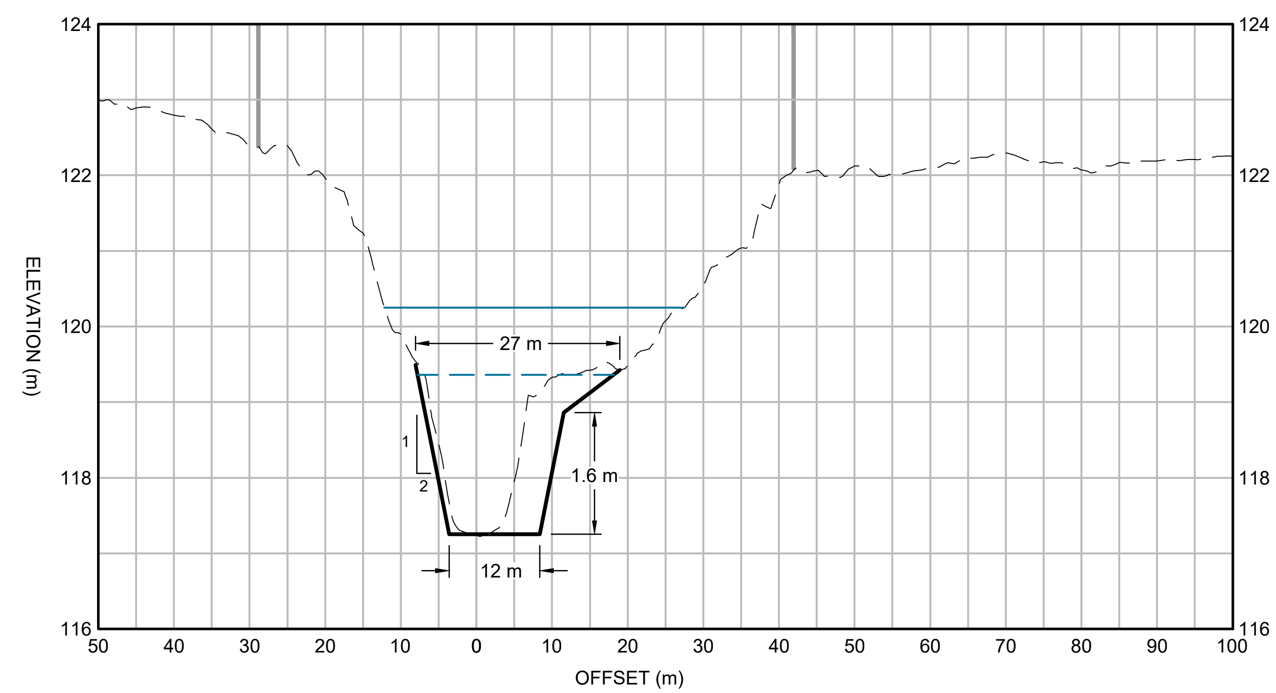

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LEGEND

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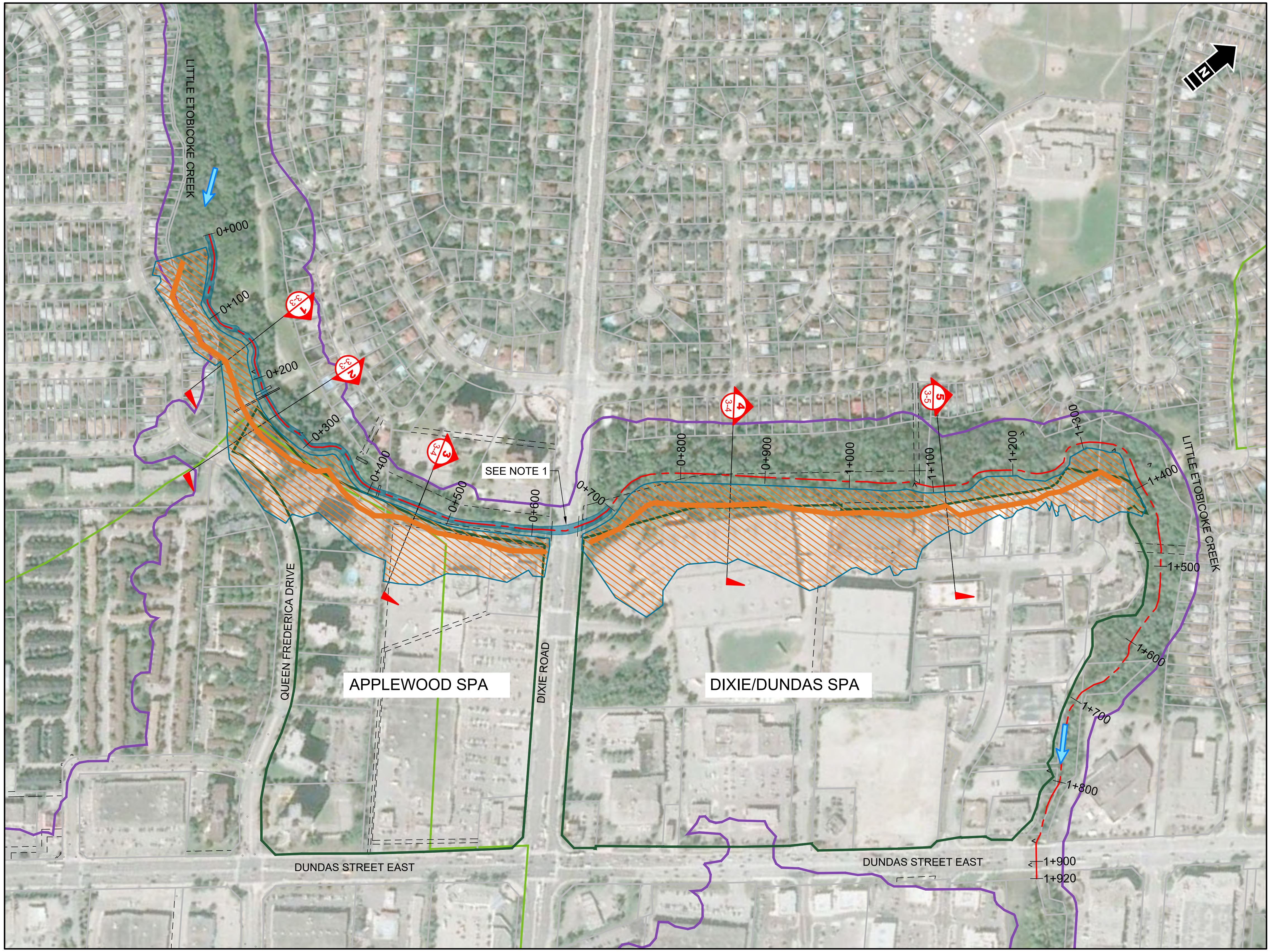

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 5,000 metres
50 0 50 100
DATUM

NOTES:

1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. REGULATORY BOUNDARIES PROVIDED BY THE TRCA.
4. KEY MITIGATION CONSTRAINTS ARE MAPPED ON FIGURES 3 TO 5.

PLAN

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DIXIE-DUNDAS FLOOD MITIGATION PROJECT - PHASE 1 FEASIBILITY STUDY

OPTION 3 FLOOD CONTAINMENT CONCEPTUAL PLAN

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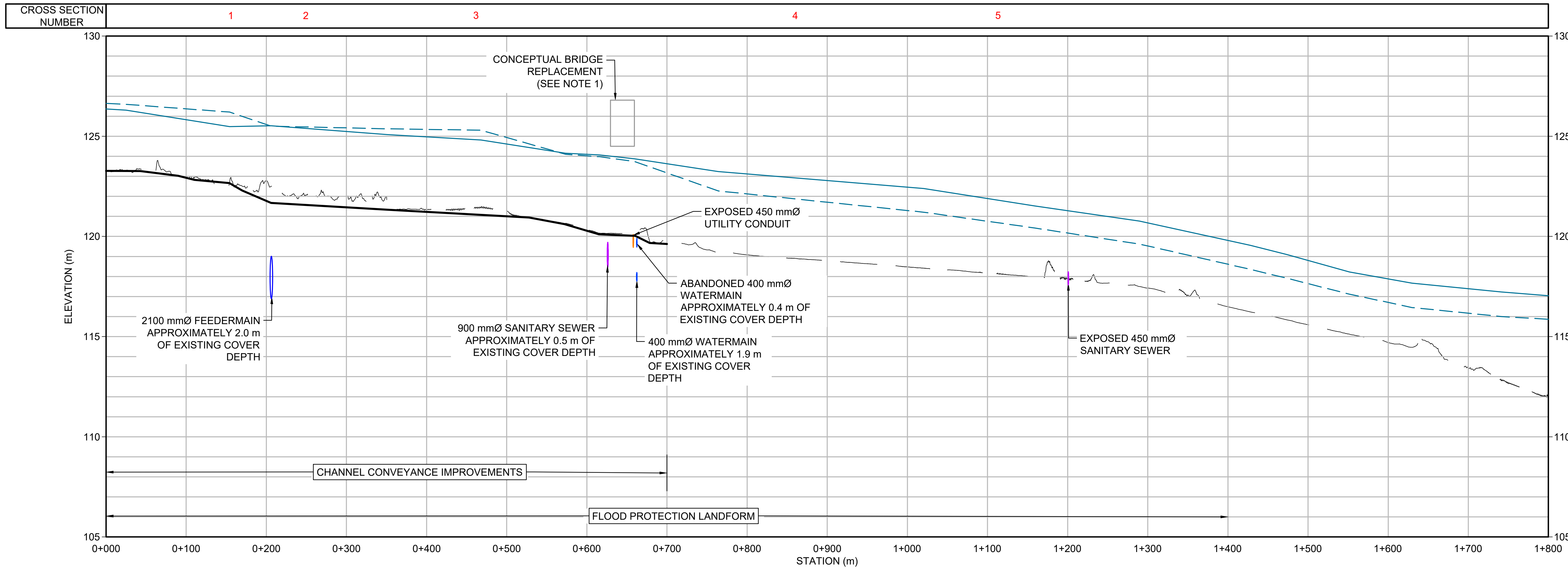

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SCALE HORZ. 1:5000
VERT 1:200

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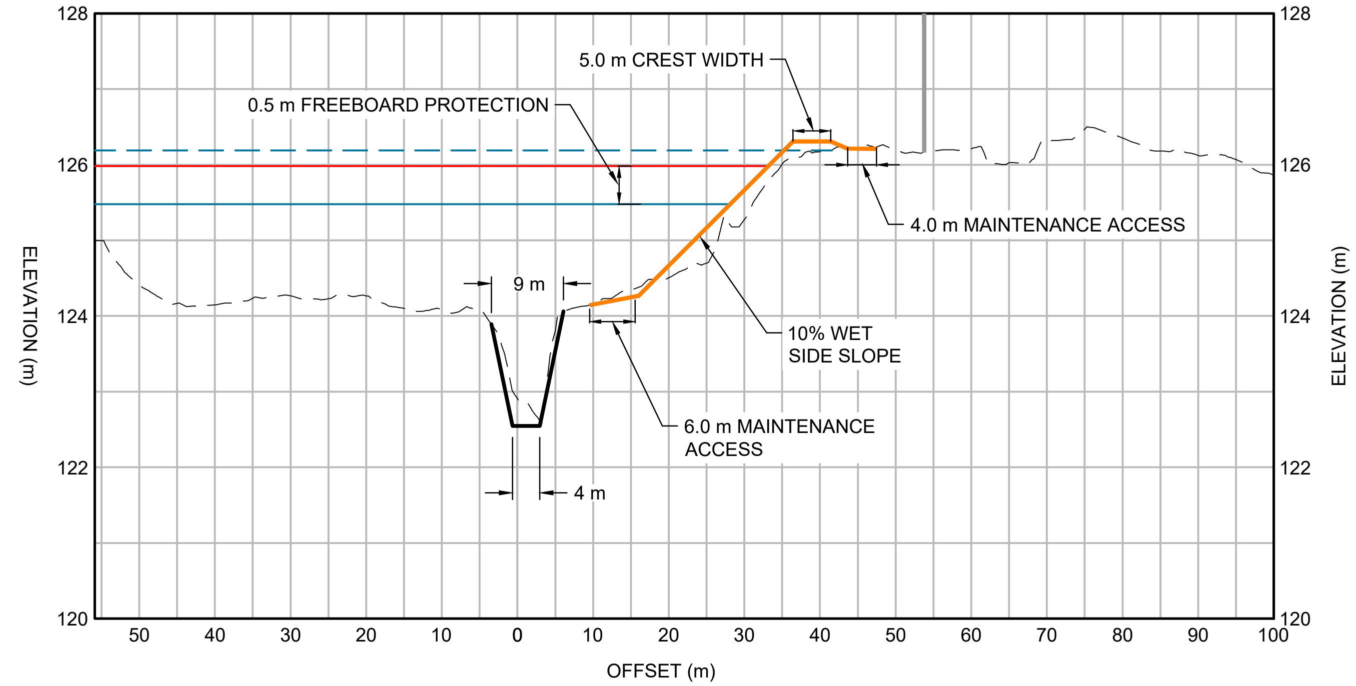

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CHANNEL CONVEYANCE IMPROVEMENTS
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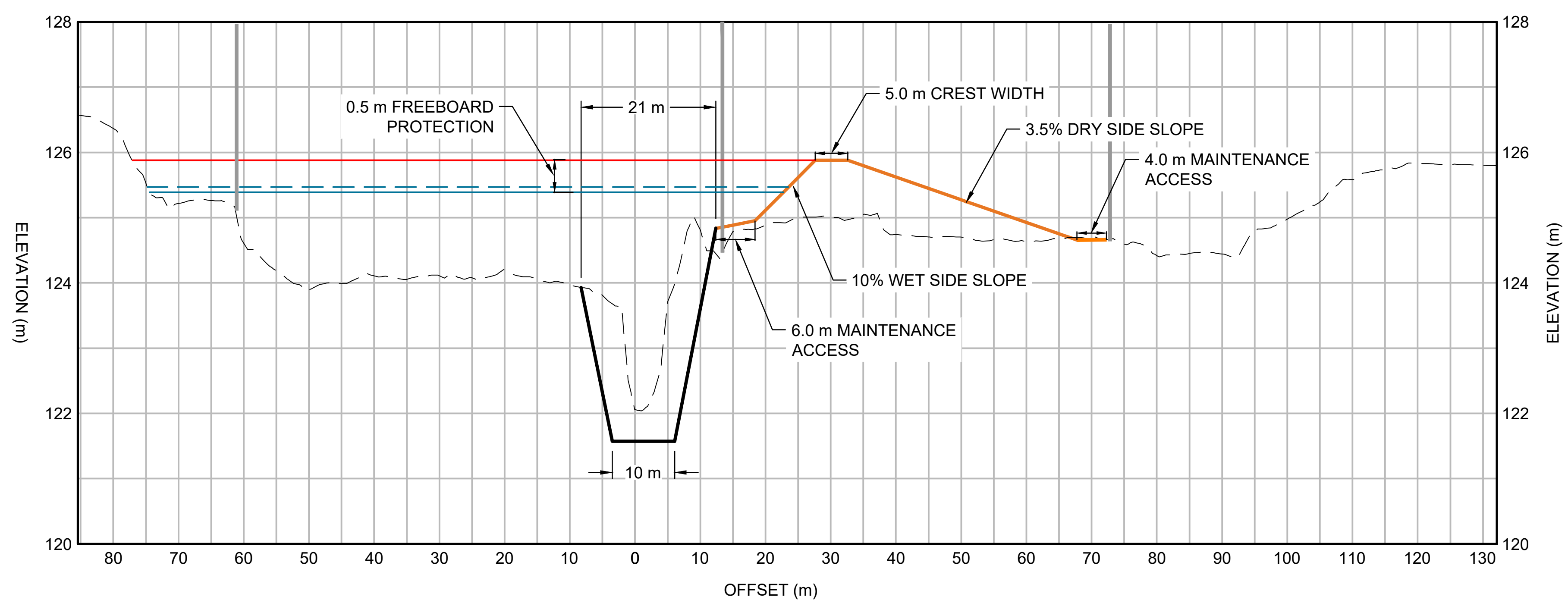

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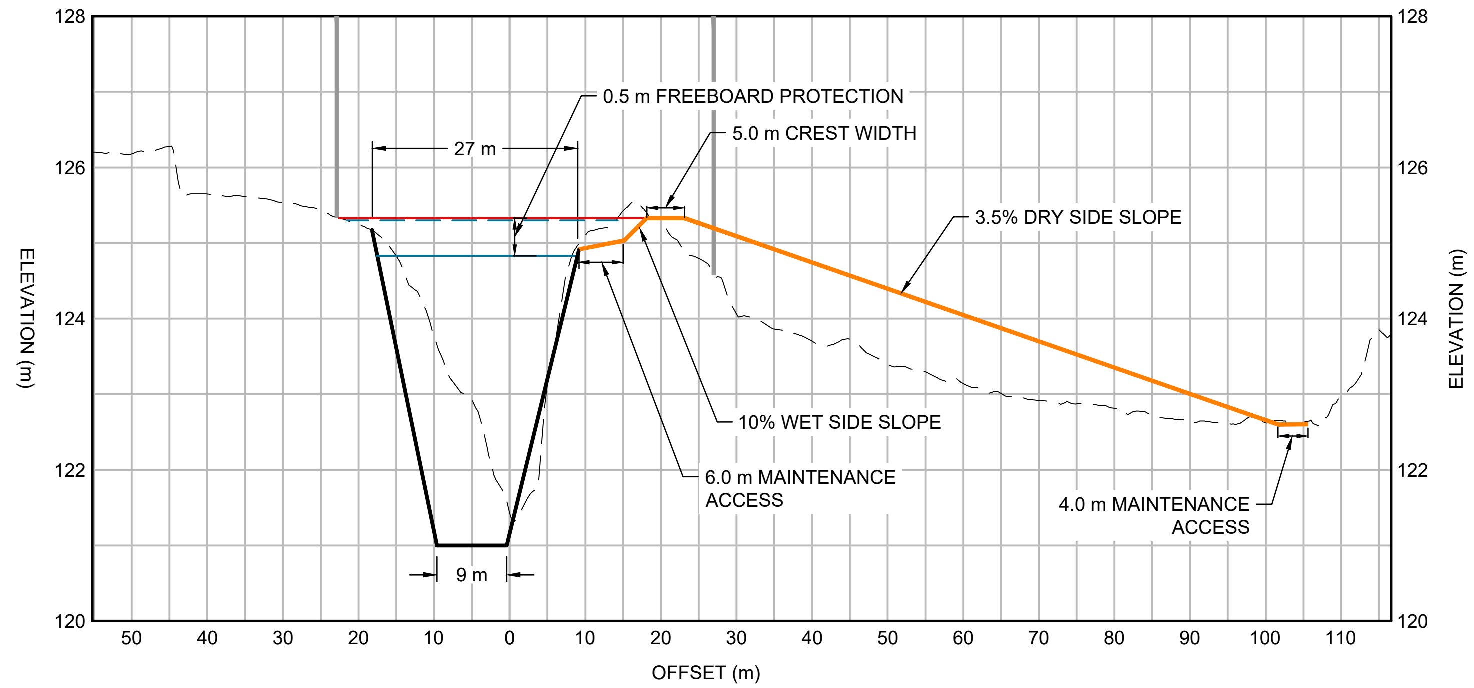

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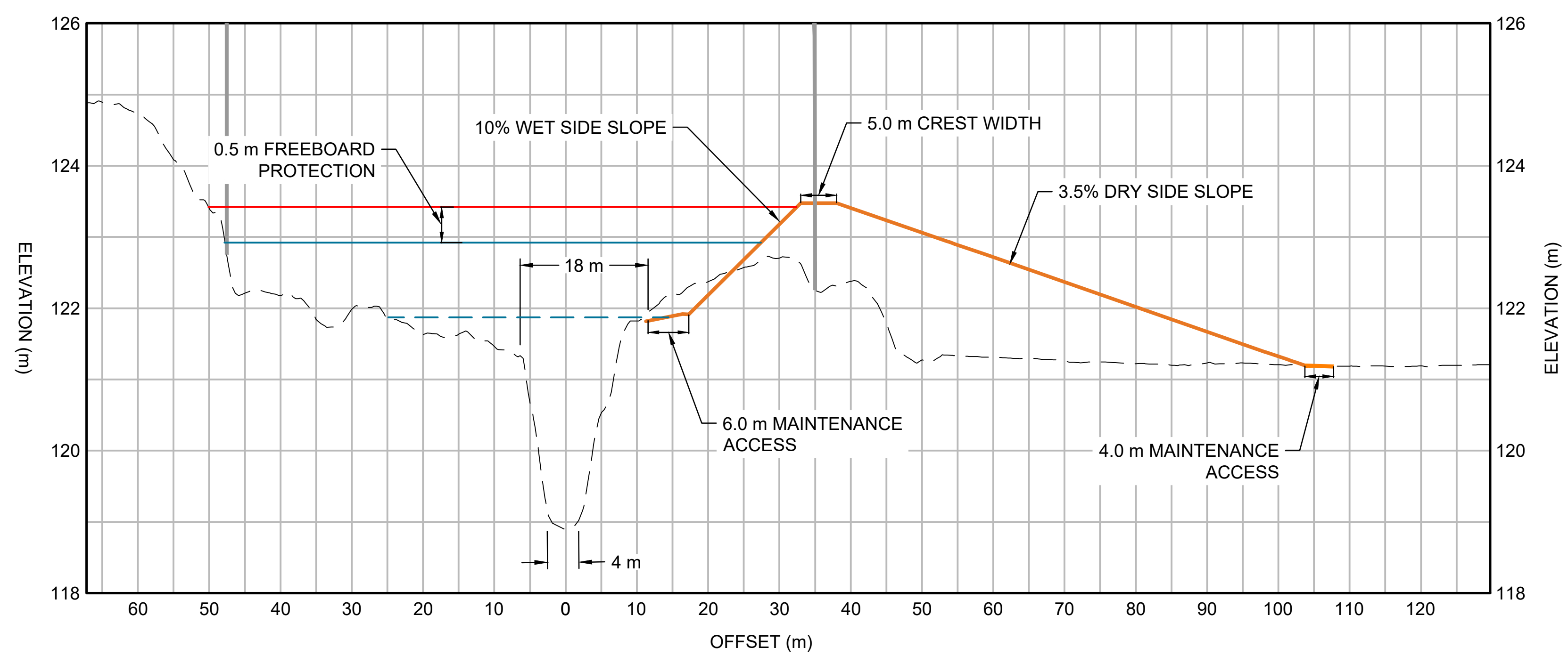

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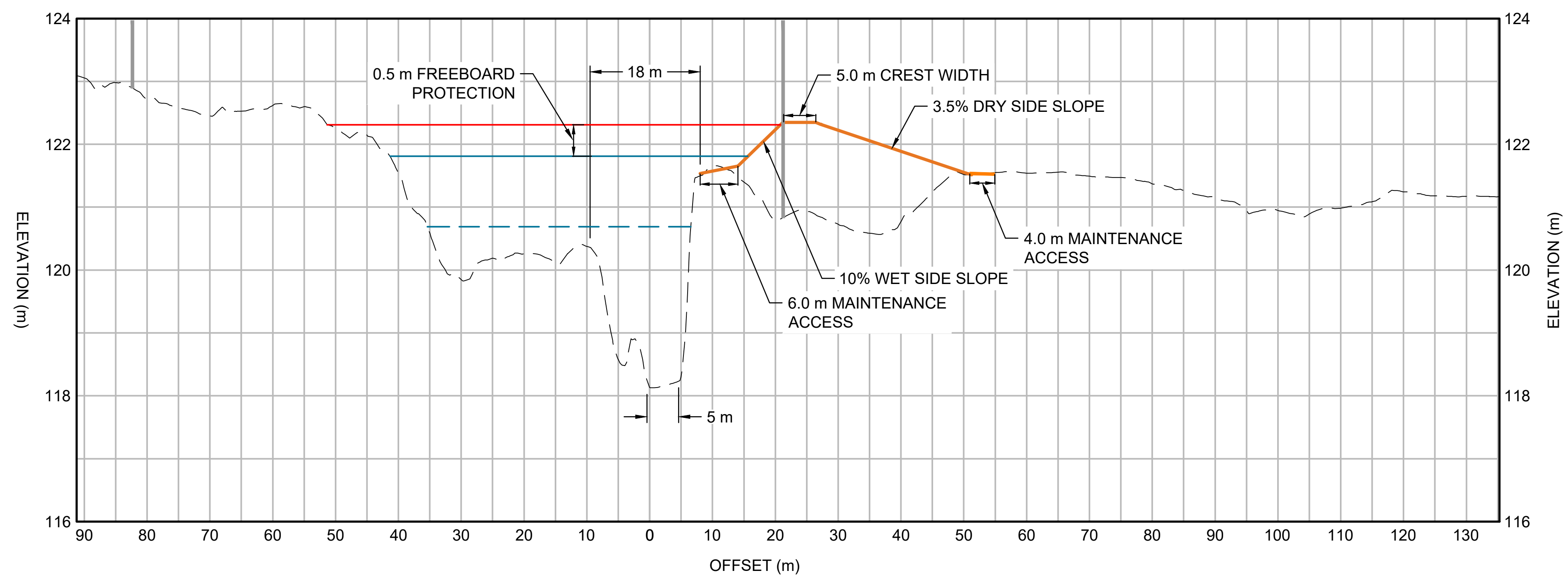

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APPENDIX D
Conceptual Dixie Road Bridge Memo

Dixie-Dundas Flood Mitigation

Dixie Road Bridge Feasibility Report

Prepared for:
Matrix Solutions Inc.

RVA 184319

May 26, 2020

R.V. Anderson Associates Limited
2001 Sheppard Avenue East Suite 300
Toronto Ontario M2J 4Z8 Canada
Tel 416 497 8600 Fax 855 833 4022
www.rvanderson.com

May 26, 2020 RVA 184319

Matrix Solutions Inc.
6865 Century Ave, Unit 3001
Mississauga, ON L5N 7K2

Attention: Mr. Andrew Doherty, P.Eng.

Dear Mr. Doherty:

Re: Dixie Road Bridge Feasibility Review

R.V. Anderson Associates Limited (RVA) is pleased to submit this Technical Memorandum to **Matrix Solutions Inc. (Matrix)** regarding the above project.

The purpose of this Technical Memorandum is to assess the best replacement structure for the Dixie Road Bridge. This includes evaluating the optimal structure as well as the required road work associated with said structure for each of the proposed channel options provided by Matrix. RVA is well suited to undertake this project since we can leverage our experience in structural and road design. Our team understands the project requirements for design and is confident in that our recommendations provide the best option with the information available.

Please do not hesitate to contact the undersigned if you have any further questions or comments.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

François Duguay, M.Eng., P.Eng.
Intermediate Structural Engineer

David O'Sullivan, P.Eng., PMP
Senior Associate, Structural Engineer

Dixie-Dundas Flood Mitigation
Dixie Road Bridge Feasibility Report

TABLE OF CONTENTS

LIST OF TABLES

1.0 BACKGROUND INFORMATION

An extreme rainfall event flooded the east side of the City of Mississauga on July 8, 2018. In coordination with Matrix Solutions Incorporated (Matrix) and R.V. Anderson Associates Limited (RVA), the City of Mississauga is carrying out a Feasibility Study to determine options for preventing future flooding upstream of the bridge.

Matrix have prepared three potential alternatives for the approach to flood mitigation:

Option 1: Channel conveyance with minimized footprint.

Option 2: Channel conveyance by making room for the creek.

Option 3: Flood containment with mitigation for upstream impacts.

RVA was tasked with proposing a conceptual replacement structure for Dixie Road Bridge for each of those options. The following sections will present the proposed replacement structure for each of the options. The span configuration for the proposed bridge structure, hydraulic improvements at the structure location, new road profile associated with each bridge option and their impacts, constructability for each option, and structure costs will be presented.

2.0 RECOMMENDED SPAN CONFIGURATION

The following section will present the three (3) proposed bridge span configuration to replace the existing Dixie Road Bridge crossing the Little Etobicoke Creek. Preliminary profiles for all three (3) options can be found in APPENDIX A.

2.1 Option 1 – Minimize footprint

The proposed span configuration for Option 1 is a 26 metres single-span precast prestressed concrete girder bridge. NU1600 girders would be used for the superstructure, bringing the depth of the new superstructure to approximately 2.3 metres. The bottom of the new superstructure would be at an elevation of approximately 123.7 metres. This elevation established by Matrix Solutions would provide a 0.5 metre freeboard for climate change resiliency above the regional flood level of 123.2 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current road crown vertical alignment, at the Dixie Road Bridge location, by approximately 1.7 metres.

2.2 Option 2 – Making room for the creek

The proposed span configuration for Option 2 is a 45 metres two-span precast prestressed concrete girder bridge. NU900 girders would be used for the superstructure, bringing the depth of the new superstructure to 1.6 metres. The bottom of the new superstructure would be located at elevation 123.1 metres. This elevation established by Matrix Solutions would provide a 0.4 metre freeboard for climate change resiliency above the regional flood level of 122.7 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current alignment, at the Dixie Road Bridge location, by approximately 0.7 metres. This option would require the construction of a pier and foundation in the proposed new larger hydraulic channel.

2.3 Option 3 – Flood containment with mitigation for upstream impacts

The proposed span configuration for Option 3 is a 28 metres single-span precast prestressed concrete girder bridge. NU1600 girders would be used for the superstructure, bringing the depth of the new superstructure to 2.3 metres. The bottom of the new superstructure would be located at elevation 124.5 metres. This elevation established by Matrix Solutions would provide a 0.4 metre freeboard for climate change resiliency above the regional flood level of 124.1 metres and would meet current CAN/CSA-S6-14 requirements. This option would raise the current alignment, at the Dixie Road Bridge location, by approximately 2.6 metres.

3.0 HYDRAULICS

The following section will explain how all three (3) options are improving the hydraulic opening at the Dixie Road Bridge location.

Like previously shown in Section 2, all three (3) options would replace the existing structure with a new structure with a longer span than the current one. Assuming 2:1 slope from the bridge abutment down to the bottom of the new improved channel, all three options would provide a significant increase to the hydraulic opening compared to the existing conditions. Table 3-1 summarizes the water elevation for all three (3) options during a 1-in-100 years storm, for the Regional Flood Level, and the elevation at the bottom the superstructure. These elevations were provided by Matrix Solution Inc. based on the hydraulic modelling of the three (3) conceptual designs.

Table 3.1 – Critical water level for each option

	1-in-100 years Level	Regional Flood Level	Bottom of superstructure
Option 1	122.1 m	123.2 m	123.7 m
Option 2	122.0 m	122.7 m	123.1 m
Option 3	123.1 m	124.1 m	124.5 m

Option 1, with a 26 metres span, would result in an opening of approximately 74.8 m^2. With a 45 metres two-span structure, Option 2 would result in the largest hydraulic opening of all options with an area of 113.4 m^2. This area is divided in two sections, one for the smaller channel at the bottom of the creek which would be 13.4 m^2 for normal water flows, then an additional 100 m^2 capacity during storm events. Finally, the hydraulic opening for Option 3 would be of 83.5 m^2. The larger opening compared to Option 1 is due to the higher elevation of the structure and longer span, creating a larger opening.

It should be noted that all the previously mentioned areas include the freeboard elevation for climate change resiliency.

4.0 IMPACTS

The following section will give a brief description of the anticipated impacts for each of the proposed options.

4.1 Option 1 – Minimize footprint

According to RVA's conceptual design, the length of the construction zone for Option 1 would be in excess of 500 metres long. At this stage of design, the final road alignment has not yet been confirmed. With the new structure being approximately 1.7 metres higher than the existing top of roadway, significant vertical road realignment would be required to match the existing road to the new structure. Some retaining walls would be required at specific locations to realign the road. Substantial temporary road protection shoring, including mechanically stabilized earth walls, is also expected to be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

4.2 Option 2 – Make room for the creek

The length of the construction zone for Option 2 is anticipated to be approximately 300 metres long. The small increase in elevation, especially compared to Option 1 and 3, would require a shorter length of the existing road to be realigned vertically. At this stage, it's anticipated that no retaining walls will be required to realign the roadway and that no significant shoring will be required as well. Excavation to increase the hydraulic opening for the Little Etobicoke Creek will require more effort compared to Option 1 and 3. Minimal road protection shoring is anticipated with this option in order to stage construction while maintaining traffic.

4.3 Option 3 – Flood containment with mitigation for upstream impacts

At this stage, the construction zone for Option 3 is estimated to be in excess of 600 metres long. The final value could be much larger as the new propose structure would be 2.3 metres higher than existing top of roadway. Significant vertical road realignment over a long distance would be required to bring the roadway to the new structure height. Some retaining walls would be required at specific locations to realign the road. Substantial temporary road protection shoring, including mechanically stabilized earth walls, is also expected to be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

5.0 CONSTRUCTABILITY

All three (3) options presented would be constructed using a staged approach. This approach is required to maintain a minimum of four lanes of traffic and a left-turning lane throughout the construction of the new structure. Three main stages would be required to construct the new structure while maintaining an acceptable level of traffic on Dixie road. The three proposed stages are as follows:

Stage 1. Traffic will be moved on the western two thirds of the existing bridge. Proper traffic control would be implemented and the eastern third of the existing bridge would be demolished and removed. The first third of the new structure would then be constructed all the while maintaining traffic on the remaining two thirds of the existing structure.

Stage 2. Once Stage 1 is completed, traffic will be diverted onto the first third of the new structure and the western third of the existing structure. The middle section of the existing bridge will be demolished and removed. The middle third of the new structure will be constructed.

Stage 3. Once Stage 2 is completed, traffic will be diverted on the eastern two third of the new structure. The remaining section of the existing structure will be demolished and removed. The final third of the new structure would then be constructed, and traffic allowed on the full structure once Stage 3 was completed.

Following the opening of the completed new Dixie Road Bridge, channel work as well as site work could be completed while maintaining a safe work site for the workers and the through traffic.

All three (3) options will require the existing channel to be excavated to create a larger hydraulic opening.

The road elevation at the location of the structure will be raised by approximately 1.7 metres for Option 1, and by about 2.6 metres for Option 3. This difference in elevation between the new road alignment and the existing will require some shoring to be in place during the staged construction to stabilize the new higher embankment next to the existing road until the construction is over. Having proper shoring in place while maintaining adequate lane width for the traffic will be an additional challenge for these two options.

Option 2 will require a bridge pier to be constructed in the newly excavated channel to support to the two spans of the structure. This pier and its foundation will require access to construction equipment to bottom. Since the road alignment will only be raised by 0.7m, it is anticipated that minimum or no shoring will be required to retain the new road embankment during construction.

6.0 COST ESTIMATE

Based on the proposed geometry for the three (3) options, a preliminary cost estimate was prepared for each new structure. Table 6-1 presents a high-level cost estimates for all three structures. The cost presented in Table 6-1 includes the new replacement structure as well the anticipated items required for the realign the existing road with the new bridge structure. A preliminary breakdown of the items and cost can be found in Appendix B.

Table 6.1 – Cost estimate for three (3) options.

	Configuration	Cost
Option 1	One span, 26m	$ 7,600,000
Option 2	Two spans, 45m	$ 5,400,000
Option 3	One span, 28m	$ 8,400,000

7.0 SUMMARY AND PREFERRED OPTION

As discussed previously in this report, all three options presented increased the hydraulic opening to various degrees. While Options 1 and 3 involved a smaller bridge structure, it was noted that the impact on the surrounding area would be much larger compared to Option 2. The increase in final elevation for the roadway would require significant vertical road realignment compared to Option 2 and in turn increase the cost of Options 1 and 3. Table 7-1 summarizes the differences between the three (3) proposed options.

Table 7.1 – Comparison of the three (3) options

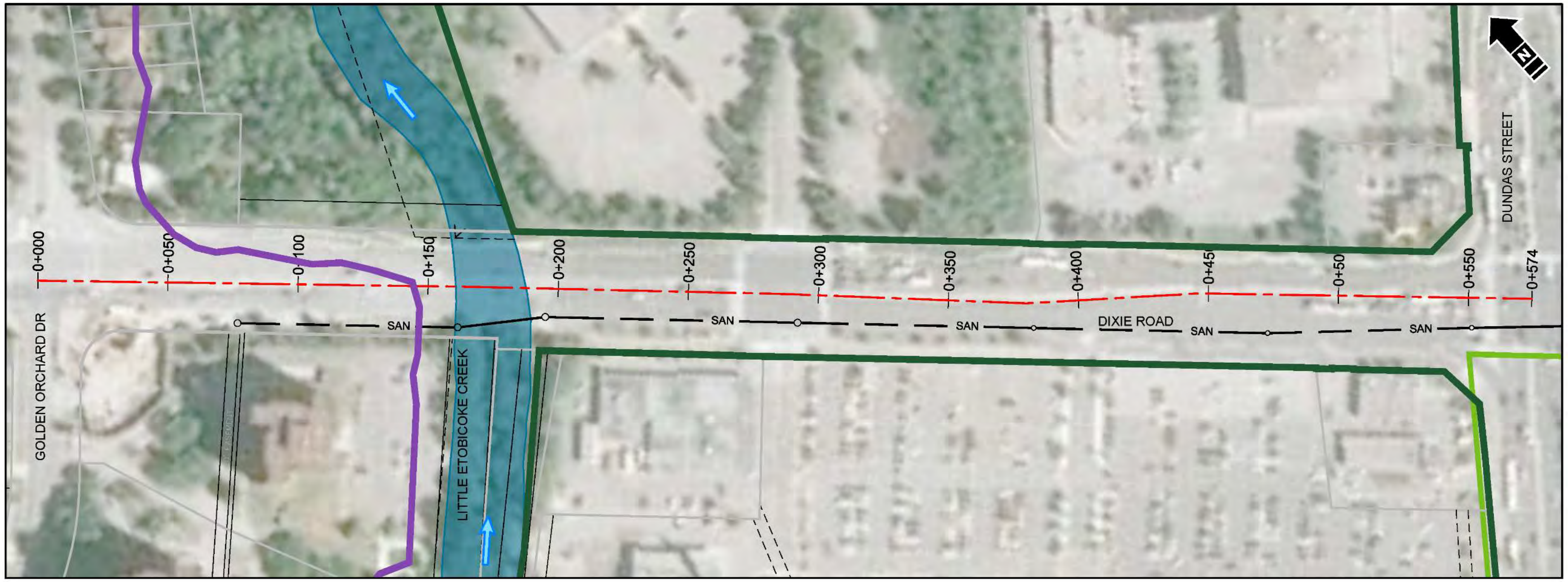
	Option 1	Option 2	Option 3
Span configuration	1 Span – 26 m	2 Spans – 45 m	1 Span – 28 m
Freeboard	0.5 m	0.4 m	0.4 m
Hydraulic opening	74.8 m^2	113.4 m^2	83.5 m^2
Constructability	Standard	Standard	Standard
Impact	Large	Small	Largest
Price	$ 7,600,000	$ 5,400,000	$ 8,200,000

After evaluating all three options, RVA believes that the two-span structure (Option 2) is the best option. When comparing all three proposed option, it becomes clear that Option 2 present the best value. The shallower superstructure will provide the least impact on the vicinity of the project while also providing the largest hydraulic opening as well as the lowest cost.

The next step of this project will be to proceed with the Environmental Assessment (EA). Each option will be evaluated, with input from the public and regulatory agencies, to select the preferred option. Once the preferred option has been chosen, the project will move forward with the preliminary design.

Appendix A

ALIGNMENTS



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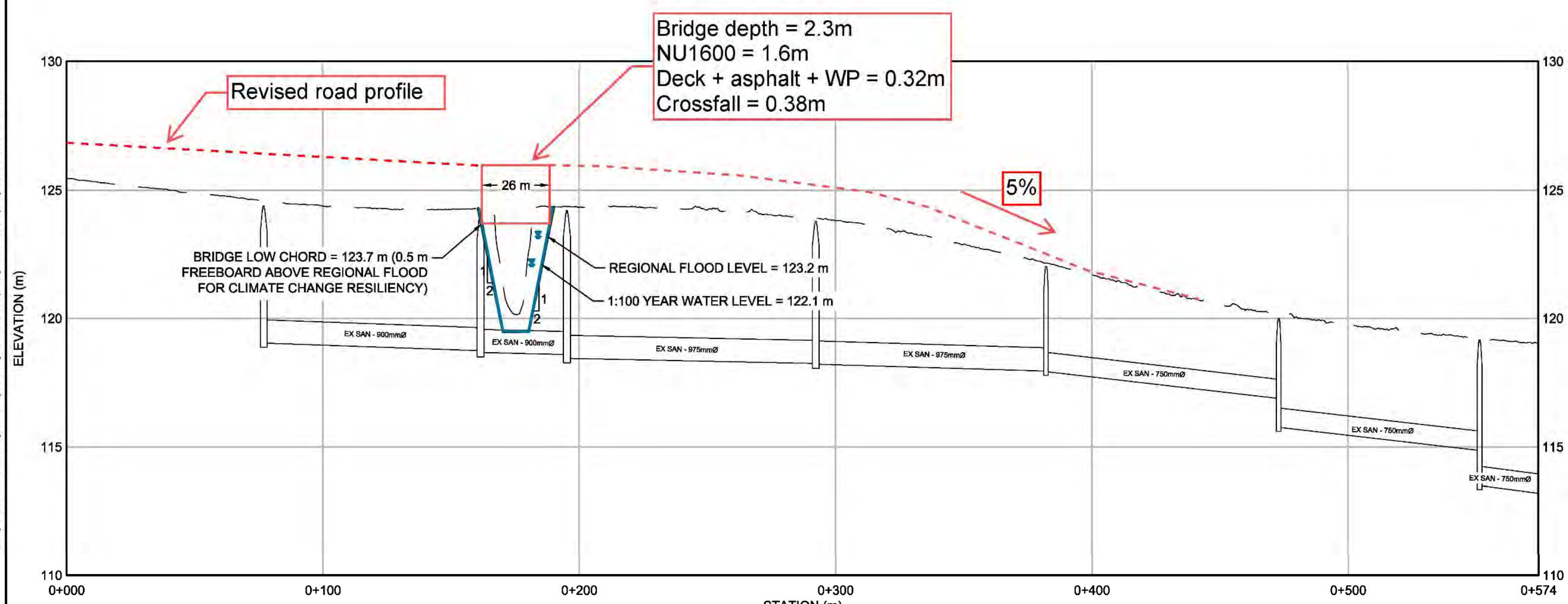

DIXIE ROAD PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

1 : 2,000 metres — 20 0 20 40 — HORIZONTAL SCALE

1 : 200 metres — 2 0 2 4 — VERTICAL SCALE

NOT FOR CONSTRUCTION

REFERENCE:

1. EXISTING CHANNEL ELEVATIONS BASED ON SURVEY BY MMM (2013). FLOODPLAIN AND DIXIE ROAD ELEVATIONS BASED ON TRCA LIDAR SURVEY (2017).
2. THE 900 mm DIAMETER SANITARY SEWER IS HIGHLIGHTED ON THIS DRAWING AS A KEY INFRASTRUCTURE CONFLICT AT DIXIE ROAD. THE SANITARY SEWER INFORMATION WAS OBTAINED FROM REGION OF PEEL GIS DATA. ADDITIONAL LINEAR INFRASTRUCTURE CROSSING BELOW LEC ARE SHOWN ON THE CONCEPTUAL PROFILE DRAWINGS 1-2, 2-2, 3-2 BASED ON REGION OF PEEL GIS DATA AND DRAWING RECORDS.
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5. THE 1:100 YEAR WATER LEVEL IS ESTIMATED FROM MODELLING THE CONCEPTUAL ALTERNATIVE SOLUTIONS USING THE TRCA HEC-RAS MODEL (2016).

REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

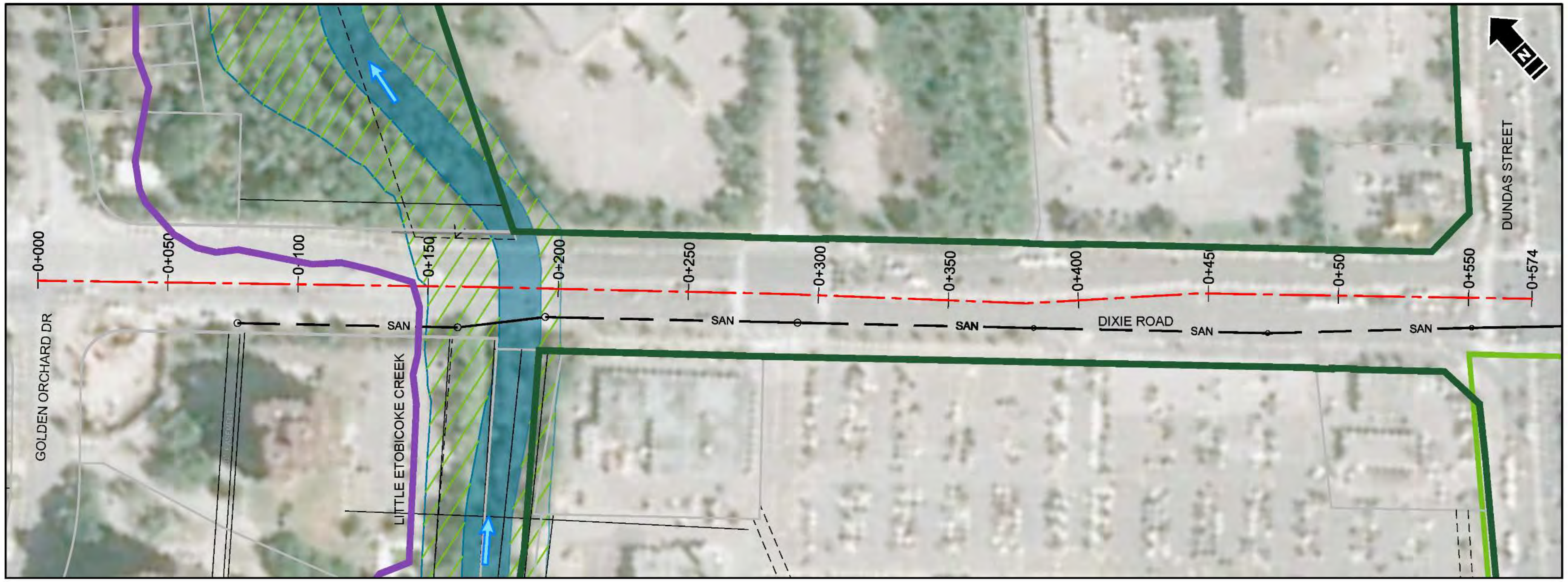
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 1
MINIMIZED FOOTPRINT
CONCEPTUAL DIXIE ROAD CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-1



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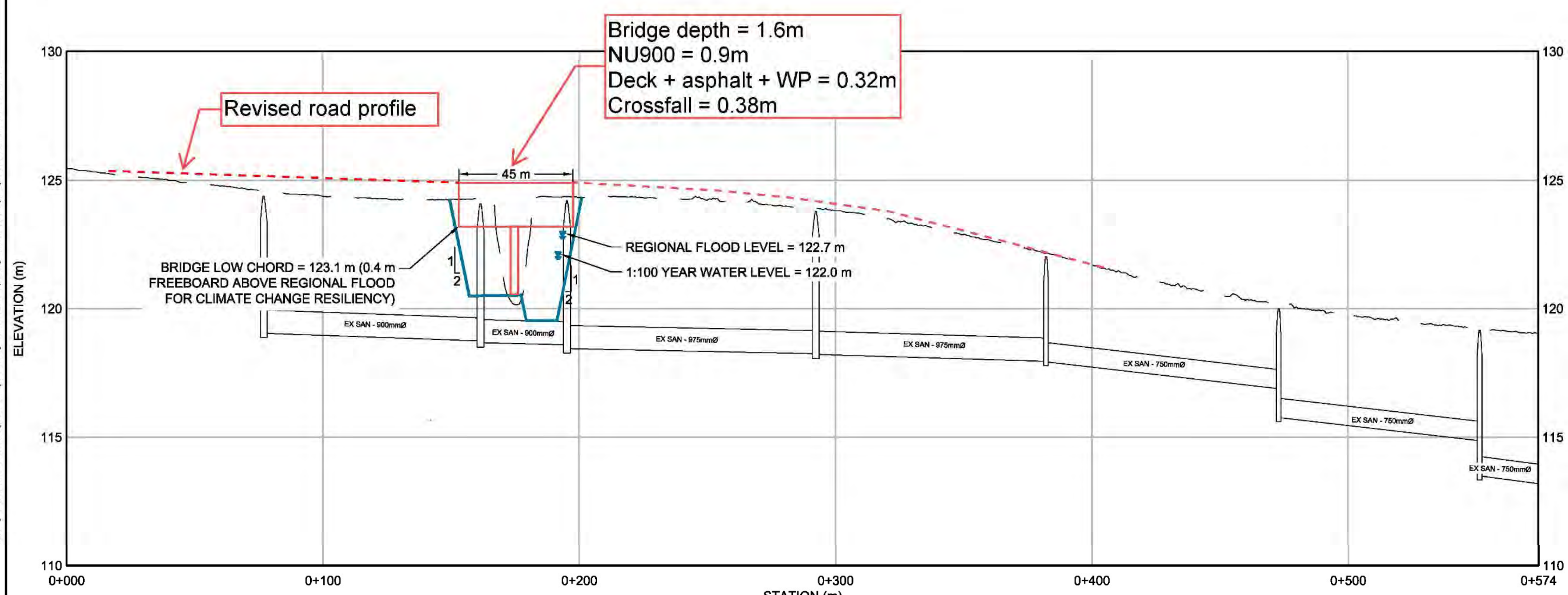

DIXIE ROAD PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
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- EASEMENT
- FLOW DIRECTION
- CROSS-SECTION

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1 : 200 metres — VERTICAL SCALE

NOT FOR CONSTRUCTION

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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

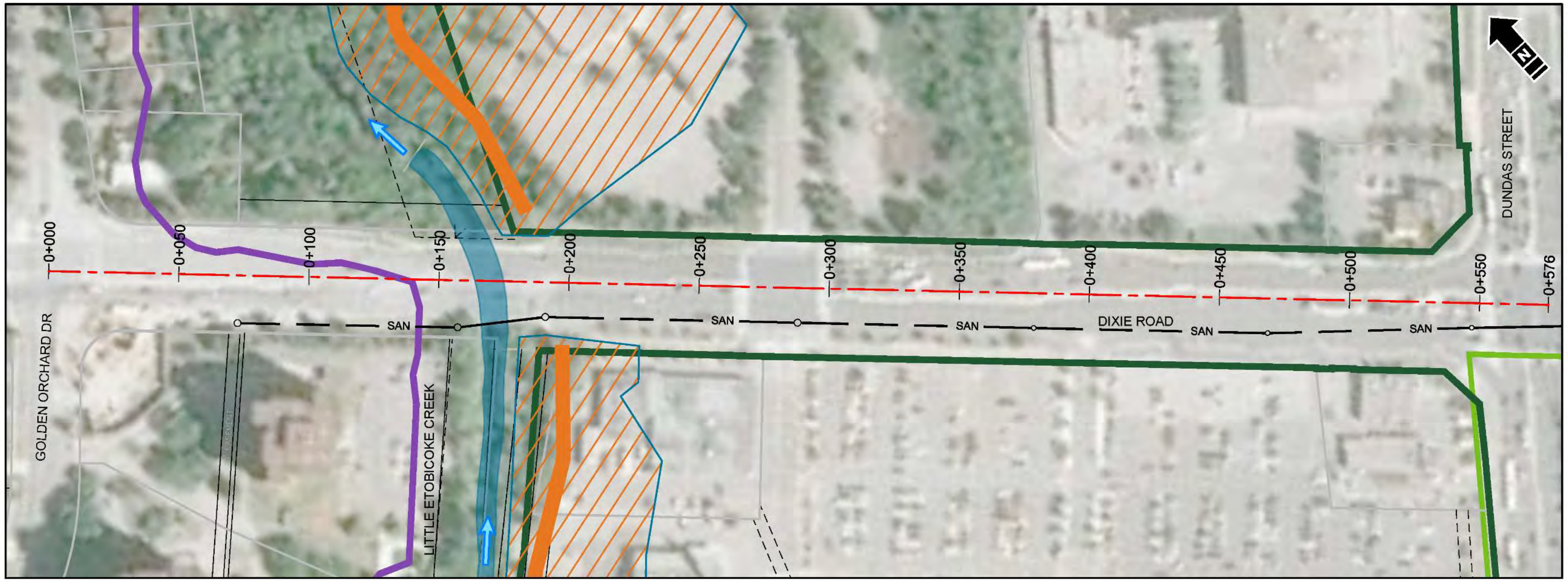
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 2
MAKE ROOM FOR THE CREEK
CONCEPTUAL DIXIE ROAD CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-2



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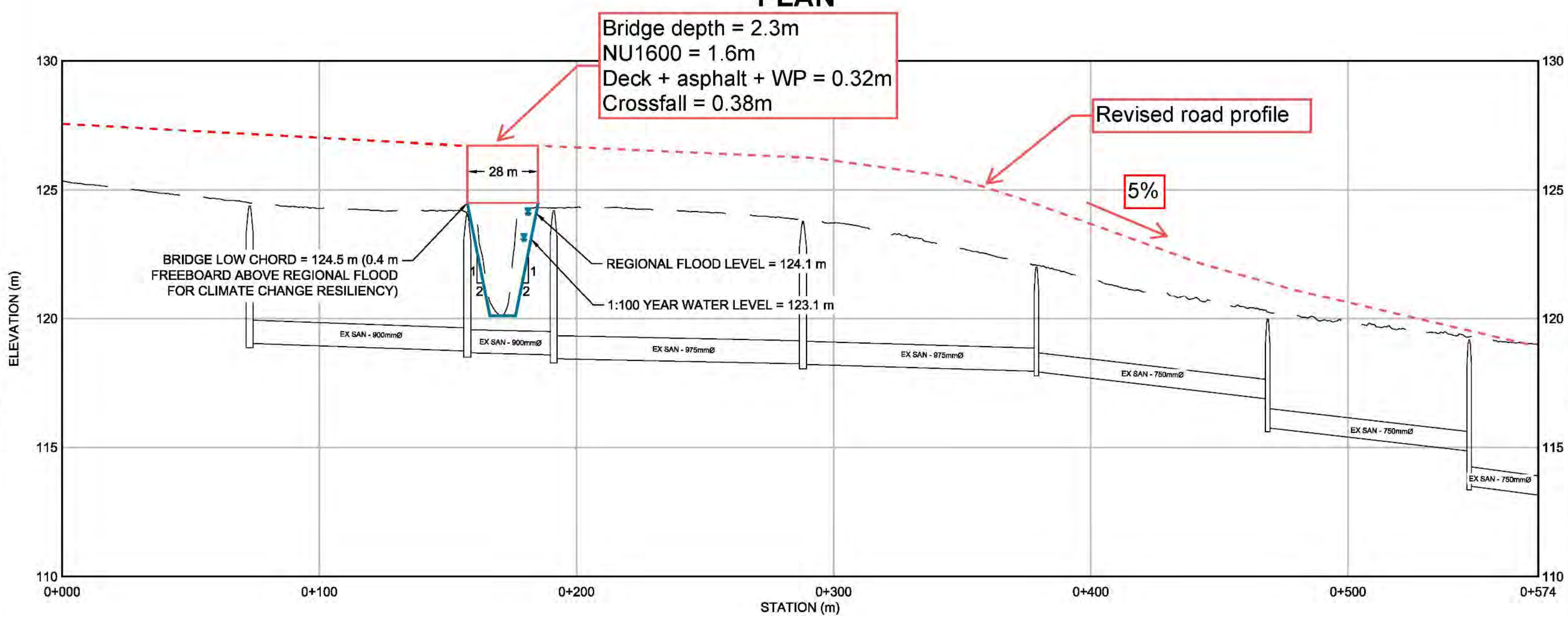

DIXIE ROAD PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CREEK MODIFICATIONS (BANKFULL CHANNEL)
- CREEK MODIFICATIONS (FLOODPLAIN)
- SPECIAL POLICY AREA (SPA)
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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2020-05-12	ISSUED FOR REVIEW	AD	SB	KW

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 3
FLOOD CONTAINMENT
CONCEPTUAL DIXIE ROAD CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
MAY 2020	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	RVA-3

Appendix B

COST ESTIMATE

BRIDGE STRUCTURE			Option 1		Option 2		Option 3	
	UNIT	PRICE	QTY	TOTAL	QTY	TOTAL	QTY	TOTAL
Dewatering & Shoring	LS	$40,000	1	$40,000.00	1	$40,000.00	1	$40,000.00
Demolish Existing Bridge (in three stages)	LS	$500,000	1	$500,000.00	1	$500,000.00	1	$500,000.00
Piles	m	$400	1200	$480,000.00	1200	$480,000.00	1200	$480,000.00
Concrete in Piers	m^3	$1,700	0	$	120	$204,000.00		$
Concrete in Abutment	m^3	$1,700	550	$935,000.00	500	$850,000.00	650	$1,105,000.00
Concrete in Wing Walls	m^3	$1,700	100	$170,000.00	50	$85,000.00	150	$255,000.00
Backfill to Structure	m^3	$90	2500	$225,000.00	500	$45,000.00	3000	$270,000.00
Bearings	ea	$800	34	$27,200.00	51	$40,800.00	34	$27,200.00
Precast Girders	LS	-	1	$442,000.00	1	$573,750.00	1	$476,000.00
Concrete in Deck, Diaphragms and Approach Slabs	m^3	$1,700	450	$765,000.00	750	$1,275,000.00	480	$816,000.00
Sidewalks on Bridge	m^3	$1,700	70	$119,000.00	120	$204,000.00	80	$136,000.00
Bridge Deck Waterproofing	m^2	$50	780	$39,000.00	1350	$67,500.00	820	$41,000.00
Parapet Walls	m^3	$2,500	13	$32,500.00	22	$55,000.00	14	$35,000.00
Railings	m	$500	52	$26,000.00	90	$45,000.00	54	$27,000.00
Paving - HL1	tn	$110	126	$13,860.00	220	$24,200.00	136	$14,960.00
TOTAL FOR BRIDGE STRUCTURE				$3,814,560.00		$4,489,250.00		$4,223,160.00

Roads / Civil	UNIT	PRICE	QTY	TOTAL	QTY	TOTAL	QTY	TOTAL
Temporary Roadway Protection - TL-2	LS	$40,000	1	$500,000.00	1	$100,000.00	1	$600,000.00
Excavation	LS	$100	7500	$750,000.00	750	$75,000.00	8500	$850,000.00
Fill	tn	$15	38000	$570,000.00	3800	$57,000.00	38000	$570,000.00
Granular A and B for Roadway	tn	$20	12960	$259,200.00	6480	$129,600.00	12960	$259,200.00
Asphalt (Top and Base)	tn	$95	3420	$324,900.00	1710	$162,450.00	3420	$324,900.00
Curb, Gutter and Subdrain	m3	$75	800	$60,000.00	400	$30,000.00	800	$60,000.00
MH and CB Structures	ea	$3,000	16	$48,000.00	8	$24,000.00	16	$48,000.00
Top Soil and Sod	m2	$6	3200	$19,200.00	1600	$9,600.00	3200	$19,200.00
Guiderails	m	$150	450	$67,500.00	750	$112,500.00	450	$67,500.00
Biowalls / Retaining Walls	m2	$750	350	$262,500.00	0	$	500	$375,000.00
Traffic Staging / Control	LS	-	1	$150,000.00	1	$75,000.00	1	$200,000.00
Erosion and Sediment Controls	LS	-	1	$50,000.00	1	$25,000.00	1	$50,000.00
Utility Relocations (mainly o/h hydro)	LS	-	1	$700,000.00	1	$150,000.00	1	$700,000.00
Trees / Plantings	LS	-	1	$30,000.00	1	$10,000.00	1	$30,000.00
TOTAL FOR ROADS / CIVIL				$3,791,300.00		$960,150.00		$4,153,800.00

TOTAL AMOUNT	**$7,605,860.00**	**$5,449,400.00**	**$8,376,960.00**

Does NOT include Harmonized Sales Tax (HST)

APPENDIX E
Conceptual Dundas Street Bridge Memo

Dixie-Dundas Flood Mitigation

Dundas Street Bridge Feasibility Report

Prepared for:
Matrix Solutions Inc.

RVA 184319

August 27, 2021

R.V. Anderson Associates Limited
2001 Sheppard Avenue East Suite 300
Toronto Ontario M2J 4Z8 Canada
Tel 416 497 8600 Fax 855 833 4022
www.rvanderson.com

August 27, 2021 RVA 184319

Matrix Solutions Inc.
6865 Century Ave, Unit 3001
Mississauga, ON L5N 7K2

Attention: Mr. Andrew Doherty, P.Eng.

Dear Mr. Doherty:

Re: Dundas Street Bridge Feasibility Review

R.V. Anderson Associates Limited (RVA) is pleased to submit this Technical Memorandum to **Matrix Solutions Inc. (Matrix)** regarding the above project.

The purpose of this Technical Memorandum is to assess the best replacement structure for the Dundas Street Bridge. This includes evaluating the optimal structure as well as the required road work associated with said structure for each of the proposed channel options provided by Matrix. RVA is well suited to undertake this project since we can leverage our experience in structural and road design. Our team understands the project requirements for design and is confident in that our recommendations provide the best option with the information available.

Please do not hesitate to contact the undersigned if you have any further questions or comments.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

François Duguay, M.Eng., P.Eng.
Intermediate Structural Engineer

David O'Sullivan, P.Eng., PMP
Senior Associate, Structural Engineer

Dixie-Dundas Flood Mitigation
Dundas Street Bridge Feasibility Report

TABLE OF CONTENTS

LIST OF TABLES

1.0 BACKGROUND INFORMATION

An extreme rainfall event flooded the east side of the City of Mississauga on July 8, 2018. In coordination with Matrix Solutions Incorporated (Matrix) and R.V. Anderson Associates Limited (RVA), the City of Mississauga is carrying out a Feasibility Study to determine options for preventing future flooding upstream of the Dundas Street Bridge at Little Etobicoke Creek.

Matrix has prepared three potential alternatives for the approach to flood mitigation:

Option 1: 25 m span with downstream floodplain conveyance improvements.

Option 2: 38 m span without downstream floodplain conveyance improvements.

Option 3: 38 m span with downstream floodplain conveyance improvements.

RVA was tasked with proposing a conceptual replacement structure for the Dundas Street Bridge for each of those options. The following sections will present the proposed replacement structure for each of the options. The span configuration for the proposed bridge structure, hydraulic improvements at the structure location, new road profile associated with each bridge option and their impacts, constructability for each option, and structure costs will be presented.

2.0 RECOMMENDED SPAN CONFIGURATION

The following section will present the three (3) proposed bridge span configuration to replace the existing Dundas Street Bridge crossing the Little Etobicoke Creek . Preliminary profiles for all three (3) options can be found in APPENDIX A.

The configuration for each bridge option assumes that the bridge is built out to the ultimate required widening to accommodate the Dundas BRT, a width of approximately 43 metres.

2.1 Option 1 – 25 m Span With Downstream Floodplain Conveyance Improvements

The proposed span configuration for Option 1 is a 25-metre single-span precast prestressed concrete box girder bridge. B900 box girders would be used for the superstructure, bringing the depth of the new superstructure to approximately 1.6 metres. The bottom of the new superstructure would be at an elevation of approximately 115.3 metres. This option would raise the current road crown vertical alignment, at the Dundas Street Bridge location, by approximately 0.75 metres.

2.2 Option 2 – 38 m Span Without Downstream Floodplain Conveyance Improvements

The proposed span configuration for Option 2 is a 38 metres three-span precast prestressed concrete box-girder bridge. B700 box-girders would be used for the superstructure, bringing the depth of the new superstructure to 1.37 metres. The bottom of the new superstructure would be located at elevation 115.2 metres. This option would raise the current alignment, at the Dundas Street Bridge location, by approximately 0.5 metres. This option would require the construction of a pier and foundation in the proposed new larger hydraulic channel.

2.3 Option 3 – 38 m Span With Downstream Floodplain Conveyance Improvements

The proposed span configuration for Option 3 is a 38 metres three-span precast prestressed concrete box-girder bridge. B700 box-girders would be used for the superstructure, bringing the depth of the new superstructure to 1.37 metres. The bottom of the new superstructure would be located at elevation 114.8 metres. This option would raise the current alignment, at the Dundas Street Bridge location, by approximately 0.2 metres. This option would require the construction of a pier and foundation in the proposed new larger hydraulic channel.

3.0 HYDRAULICS

The following section will explain how all three (3) options are improving the hydraulic opening at the Dundas Street Bridge location.

Like previously shown in Section 2, all three (3) options would replace the existing structure with a new structure with a longer span than the current one. Assuming 2:1 slope from the bridge abutment down to the bottom of the new improved channel, all three options would provide a significant increase to the hydraulic opening compared to the existing conditions. Table 3-1 summarizes the water elevation for all three (3) options during a 1-in-100 years storm, for the Regional Flood Level, and the elevation at the bottom the superstructure. These elevations were provided by Matrix Solution Inc. based on the hydraulic modelling of the three (3) conceptual designs.

Table 3.1 – Critical water level for each option

	1-in-100 years + 1m Level	Regional Flood Level	Bottom of superstructure
Option 1	115.1 m	115.3 m	115.3 m
Option 2	115.2 m	115.2 m	115.2 m
Option 3	114.8 m	114.8 m	114.8 m

Option 1, with a 25-metre span, would result in a hydraulic opening of approximately 52 m^2. With a 38 metres three-spans structure, Option 2 would result in a hydraulic opening of approximately 89m^2. This area is divided in two sections, one for the smaller channel at the bottom of the creek which would be 22 m^2 for normal water flows, then an additional 67 m^2 capacity during storm events. Finally, the hydraulic opening for Option 3 would be of 76 m^2. This area is divided in two sections, one for the smaller channel at the bottom of the creek which would be 22 m^2 for normal water flows, then an additional 54 m^2 capacity during storm events.

It should be noted that all the previously mentioned areas for Option 2 and 3 does not consider the reduction in cross-sectional area due to the concrete piers.

4.0 IMPACTS

The following section will give a brief description of the anticipated impacts for each of the proposed options. It should be noted that the final road alignments have not yet been confirmed.

4.1 Option 1

According to the conceptual design, the length of the construction zone for Option 1 would be approximately 190 metres in length. With the new structure being approximately 0.75 metres higher than the existing top of roadway, some vertical road realignment would be required to match the existing road to the new structure. Some small retaining walls or additional property may be required west of the structure on the north and south sides to maintain the impact of the new structure to the right-of-way. Some temporary road protection shoring may be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

4.2 Option 2

The length of the construction zone for Option 2 is anticipated to be approximately 140 metres in length. With the new structure being approximately 0.5 metres higher than the existing top of roadway, some vertical road realignment would be required to match the existing road to the new structure. Some small retaining walls or additional property may be required west of the structure on the north and south side to maintain the impact of the new structure to the right-of-way. Minimal road protection shoring is anticipated with this option for stage construction while maintaining traffic.

4.3 Option 3

At this stage, the construction zone for Option 3 is estimated to be approximately 70 metres in length. A small vertical profile raise would be required to bring the roadway to the new structure height. No retaining walls would be required at specific locations to realign the road. No road protection shoring is expected to be required to maintain traffic during removal of existing structure, construction of new structure and realignment of the road during the different stages of construction.

5.0 CONSTRUCTABILITY

All three (3) options presented would be constructed using a staged approach. This approach is required to maintain a minimum of three lanes of traffic throughout the construction of the new structure. Three main stages would be required to construct the new structure while maintaining an acceptable level of traffic on Dundas Street. The three proposed stages are as follows:

Stage 1. Traffic will be moved on the northern two thirds of the existing bridge. Proper traffic control would be implemented and the southern third of the existing bridge would be demolished and removed. The first third of the new structure would then be constructed all the while maintaining traffic on the remaining two thirds of the existing structure.

Stage 2. Once Stage 1 is completed, traffic will be diverted onto the first third of the new structure and the northern third of the existing structure. The middle section of the existing bridge will be demolished and removed. The middle third of the new structure will be constructed.

Stage 3. Once Stage 2 is completed, traffic will be diverted on the southern two thirds of the new structure. The remaining section of the existing structure will be demolished and removed. The final third of the new structure would then be constructed, and traffic allowed on the full structure once Stage 3 was completed.

Following the opening of the completed new Dundas Street Bridge, channel work as well as site work could be completed while maintaining a safe work site for the workers and the through traffic.

All three (3) options will require the existing channel to be excavated to create a larger hydraulic opening.

The road elevation at the location of the structure will be raised by approximately 0.75 metres for Option 1, and by about 0.5 metres for Option 2. This difference in elevation between the new road alignment and the existing, for Option 1, may require some additional shoring to be in place during the staged construction to stabilize the new higher embankment next to the existing road until the construction is over.

Option 2 and 3 will require bridge piers to be constructed in the newly excavated channel to support to the two spans of the structure. This pier and its foundation will require access to construction equipment to bottom. Since the road alignment will only be raised by 0.5 m and 0.2 m respectively, it is anticipated that minimal or no shoring will be required to retain the new road embankment during construction.

6.0 COST ESTIMATE

Based on the proposed geometry for the three (3) options, a preliminary cost estimate was prepared for each new structure. Table 6-1 presents a high-level cost estimates for all three structures. The cost presented in Table 6-1 includes the new replacement structure built out to the ultimate 43 metre width to accommodate the Dundas BRT, as well the anticipated items required for the realign the existing road with the new bridge structure. A preliminary breakdown of the items and cost can be found in Appendix B.

Table 6.1 – Cost estimate for three (3) options.

	Configuration	Cost
Option 1	One span, 25m	$ 7,800,000
Option 2	Three spans, 38m	$ 9,300,000
Option 3	Three spans, 38m	$ 8,800,000

7.0 SUMMARY AND PREFERRED OPTION

As discussed previously in this report, all three options presented increased the hydraulic opening to various degrees. While Option 1 involves a smaller bridge structure, it was noted that the impacted area would larger compared to Option 2 and Option 3. The increase in final elevation for the roadway would require greater vertical road realignment compared to Option 2 and in turn increase the cost of the roadworks for Option 1. The overall cost for Option 1 remains the lowest when the smaller structure costs are considered. Table 7-1 summarizes the differences between the three (3) proposed options.

Table 7.1 – Comparison of the three (3) options

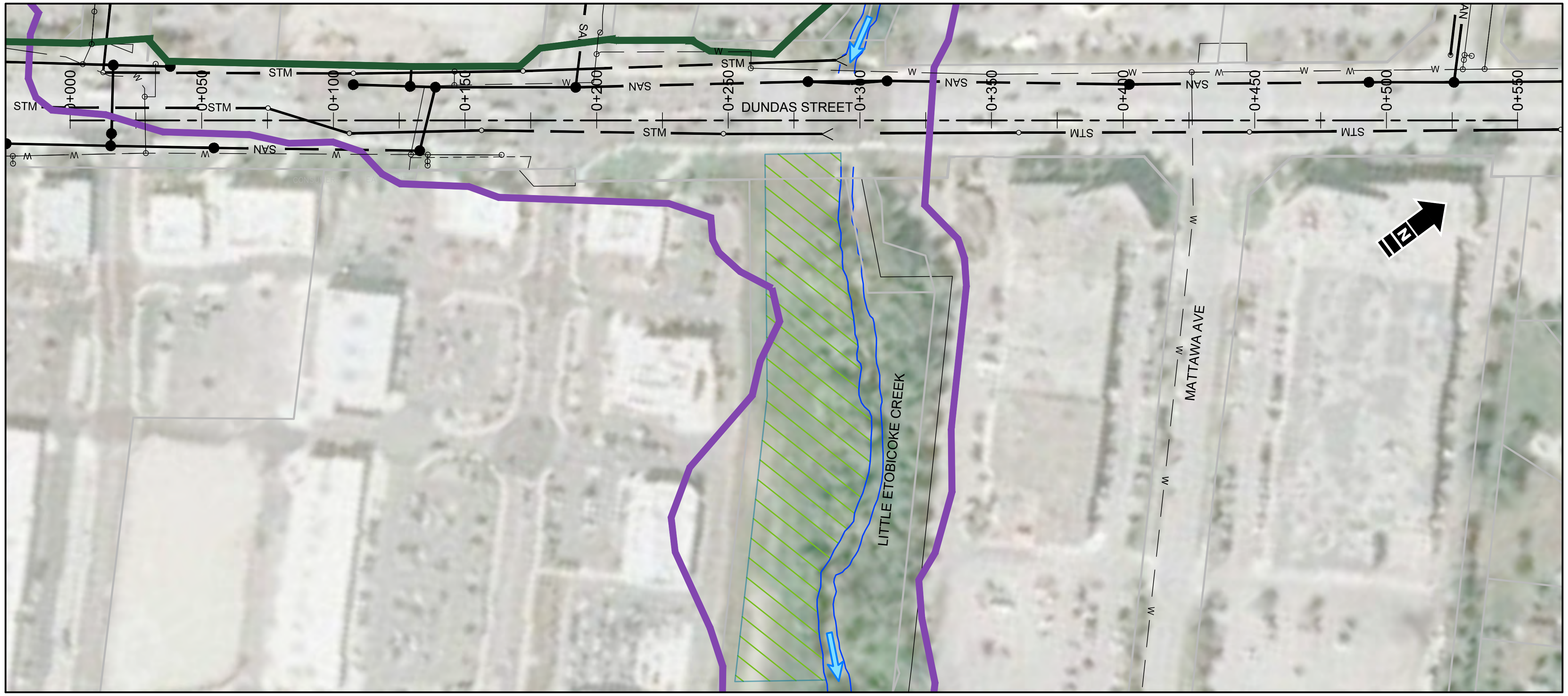
	Option 1	**Option 2**	**Option 3**
Span configuration	1 Span – 25 m	3 Spans – 38 m	3 Spans – 38 m
Freeboard	0.0 m	0.0 m	0.0 m
Hydraulic opening	52 m^2	89 m^2	76 m^2
Constructability	Standard	Standard	Standard
Impacted Area	Medium	Smaller	Smallest
Price	$ 7,800,000	$ 9,300,000	$ 8,800,000

After evaluating all three options, RVA believes that the Option 1 (25 metre single-span structure with downstream floodplain conveyance improvements) is the lowest cost option. The difference in price should be weighed against the impacts on costs of channel works to determine the best option. The single span option will provide a significant increase in hydraulic opening as well as the lowest cost. It should also be noted that the single span structure would also have the lowest long-term maintenance costs.

The next step of this project will be to proceed with the Environmental Assessment (EA). Each option will be evaluated, with input from the public and regulatory agencies, to select the preferred option. Once the preferred option has been chosen, the project will move forward with the preliminary design.

Appendix A

ALIGNMENTS



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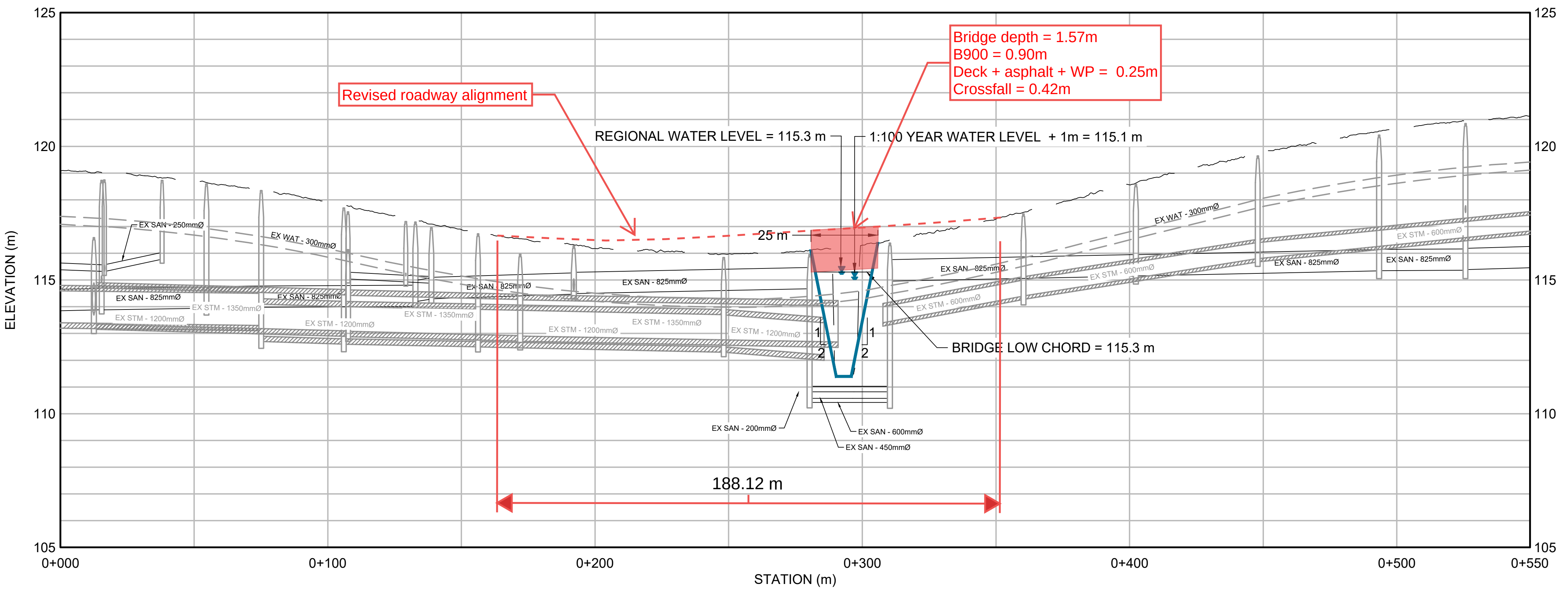

DUNDAS STREET EAST PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
- LITTLE ETOBICOKE CREEK WATERSHED BOUNDARY
- TRCA REGULATION LIMIT
- EASEMENT
- SAN — SANITARY SEWER
- STM — STORM SEWER
- W — WATERMAIN
- FLOW DIRECTION

1 : 2,000 metres — 20 0 20 40 — HORIZONTAL SCALE

1 : 200 metres — 2 0 2 4 — VERTICAL SCALE

NOT FOR CONSTRUCTION

REFERENCE:

1. EXISTING CHANNEL ELEVATIONS BASED ON SURVEY BY MMM (2013). FLOODPLAIN AND DUNDAS STREET ELEVATIONS BASED ON TRCA LIDAR SURVEY (2017).
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5. THE 1:100 YEAR WATER LEVEL IS ESTIMATED FROM MODELLING THE CONCEPTUAL ALTERNATIVE SOLUTIONS USING THE TRCA HEC-RAS MODEL (2016).

REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2021-07-13	ISSUED FOR CLIENT REVIEW	AD	SB	KW

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 1 - 25 m SPAN LENGHT WITH DOWNSTREAM FLOODPLAIN CONVEYANCE IMPROVEMENTS CONCEPTUAL DUNDAS STREET EAST CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
JULY 2021	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	1

Plot 1:1 = Tabloid (L)

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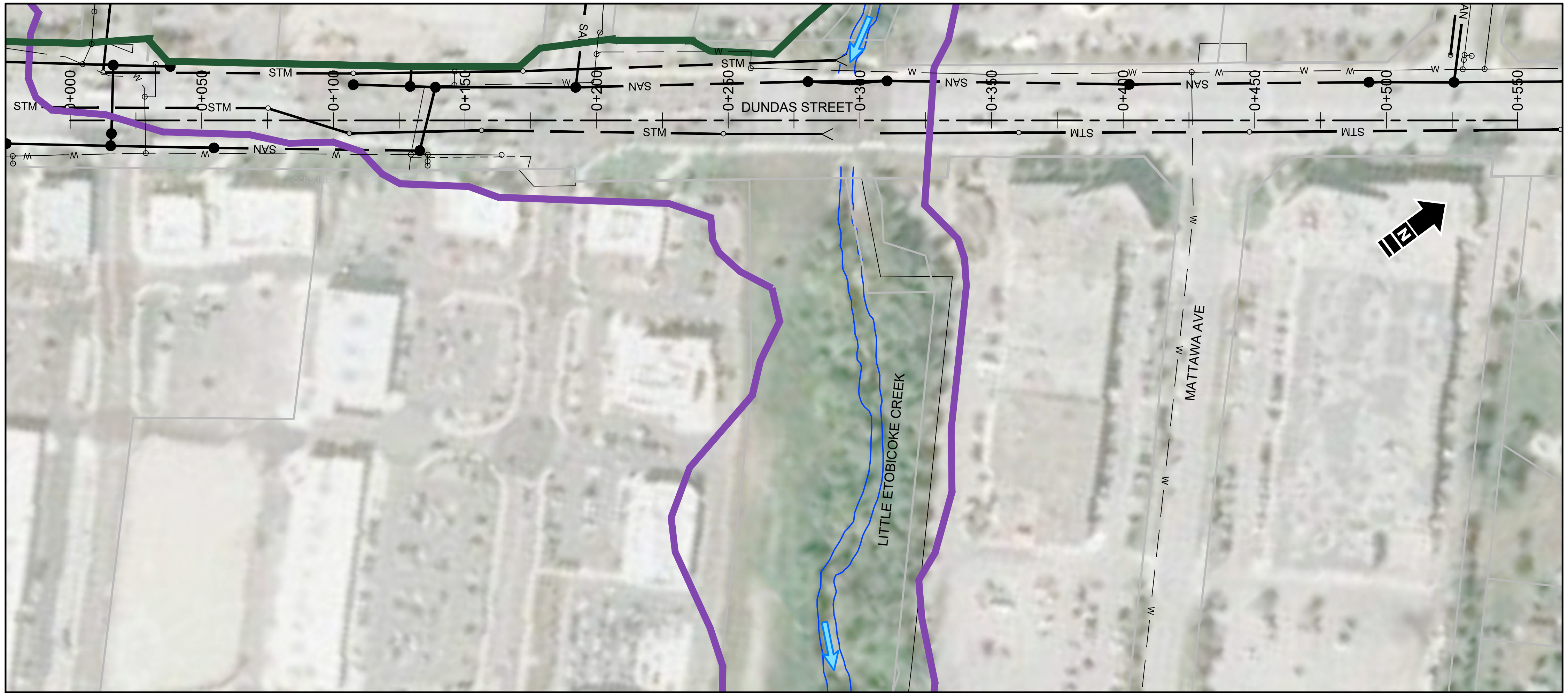
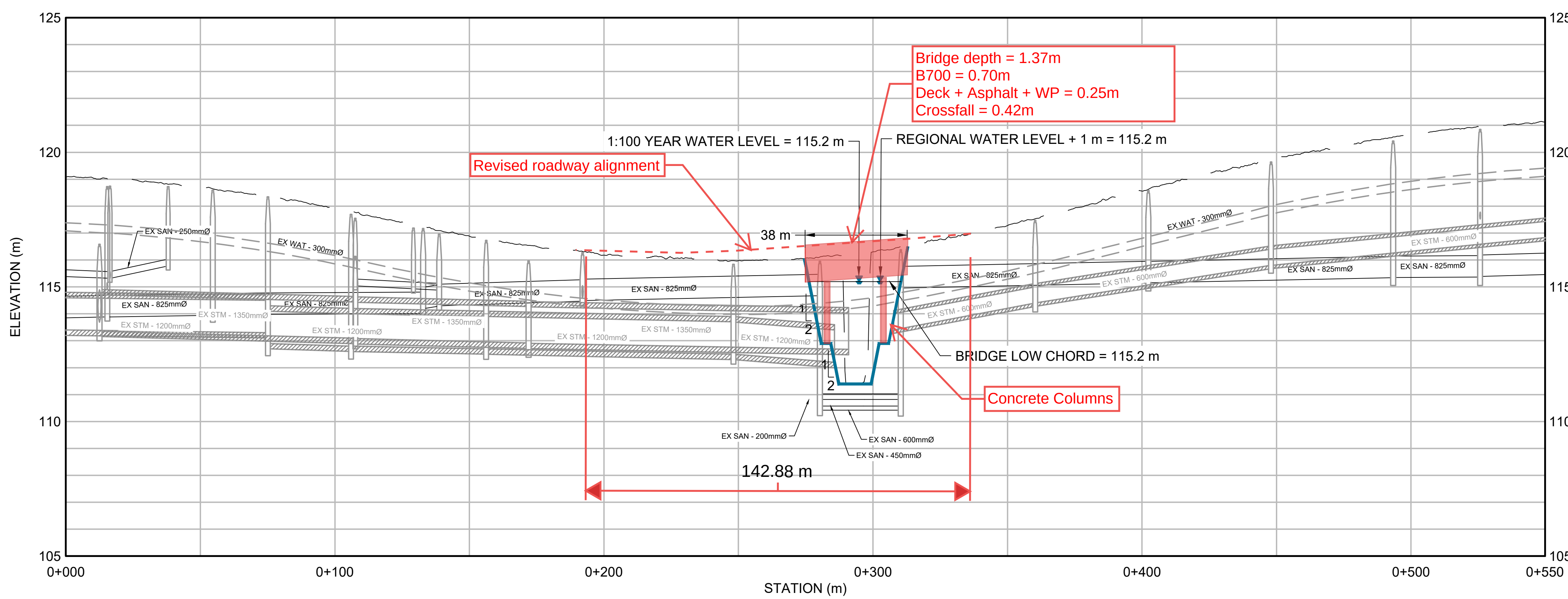


PLAN



DUNDAS STREET EAST PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2021-07-13	FOR RVA - CONCEPTUAL DESIGN	AD	SB	KW

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

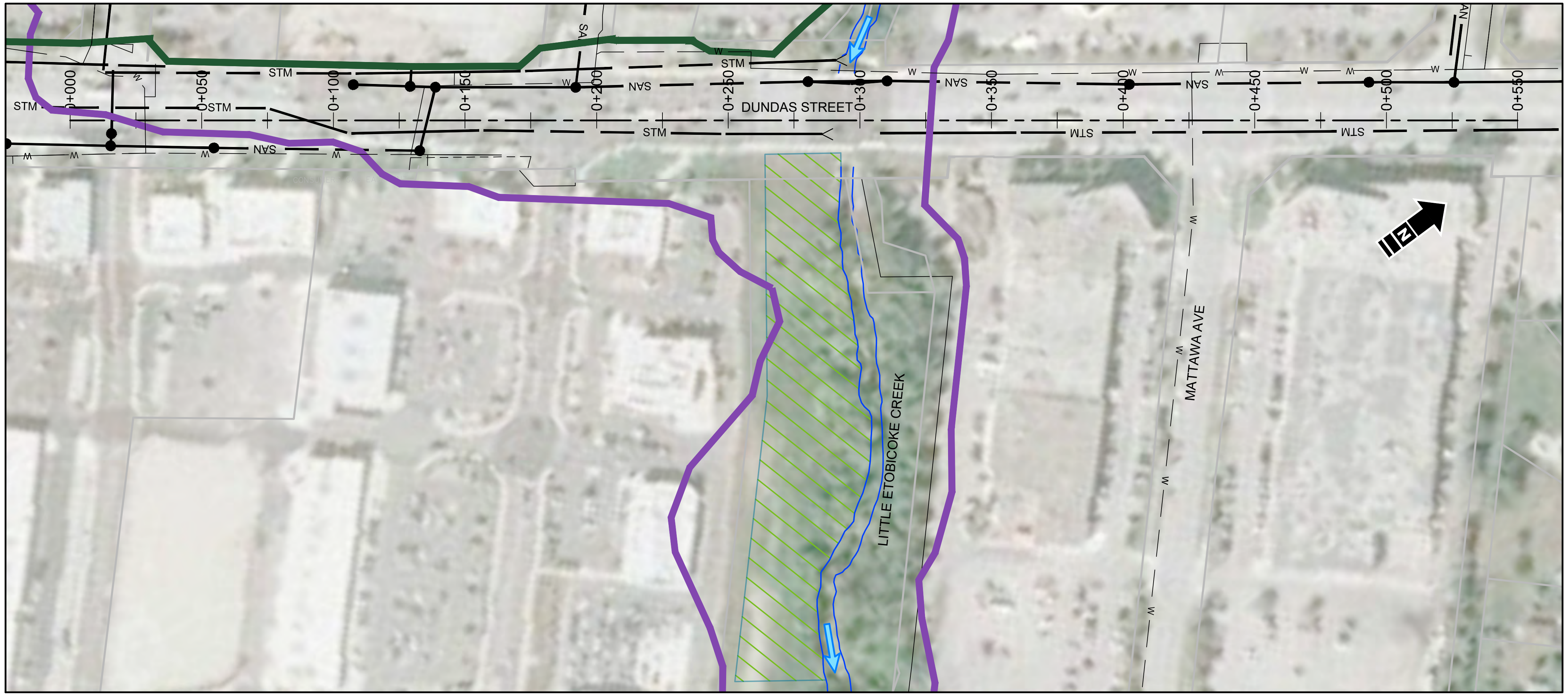
CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 2 - 38 m SPAN LENGHT WITHOUT DOWNSTREAM FLOODPLAIN CONVEYANCE IMPROVEMENTS
CONCEPTUAL DUNDAS STREET EAST CROSSING

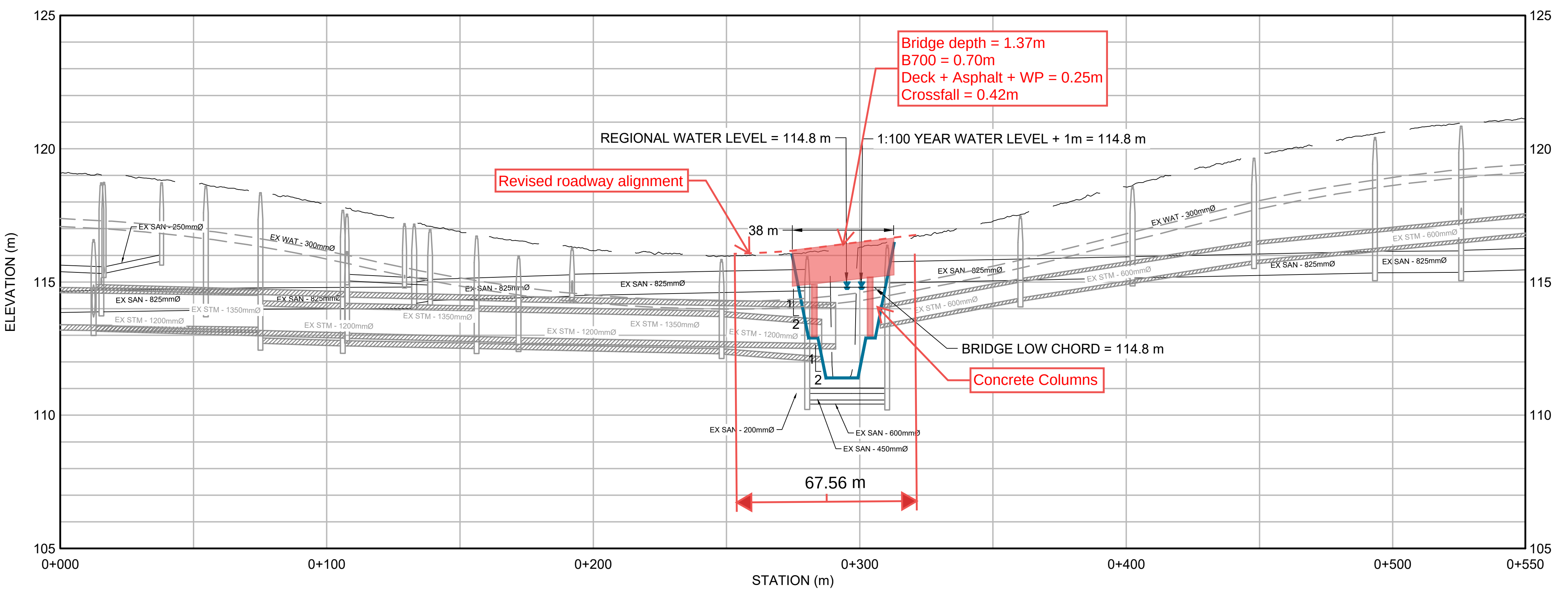
DATE:	TECHNICAL:	REVIEWER:	DRAWN:
JULY 2021	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	2

Plot 1:1 = Tabloid (L)



PLAN



DUNDAS STREET EAST PROFILE

LEGEND

- FLOOD PROTECTION LANDFORM
- CREEK CENTRELINE
- CHANNEL CONVEYANCE IMPROVEMENTS
- FLOODPLAIN CONVEYANCE IMPROVEMENTS
- SPECIAL POLICY AREA (SPA)
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HORIZONTAL SCALE

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REVISION

No.	DATE	DESCRIPTION	BY	CHK.	DRN.
A	2021-07-13	FOR RVA - CONCEPTUAL DESIGN	AD	SB	KW

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
DIXIE-DUNDAS FLOOD MITIGATION

OPTION 3 - 38 m SPAN LENGHT WITH DOWNSTREAM FLOODPLAIN CONVEYANCE IMPROVEMENTS CONCEPTUAL DUNDAS STREET EAST CROSSING

DATE:	TECHNICAL:	REVIEWER:	DRAWN:
JULY 2021	A.DOHERTY	S.BRAUN	K.WEILER

PROJECT:	REVISION:	DRAWING:
24603-531	A	3

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Appendix B

COST ESTIMATE

BRIDGE STRUCTURE			Option 1		Option 2		Option 3	
	UNIT	PRICE	QTY	TOTAL	QTY	TOTAL	QTY	TOTAL
Dewatering & Shoring	LS	$40,000	1	$40,000.00	1	$40,000.00	1	$40,000.00
Demolish Existing Bridge (in three stages)	LS	$500,000	1	$500,000.00	1	$500,000.00	1	$500,000.00
Piles	m	$450	1600	$720,000.00	1600	$720,000.00	1600	$720,000.00
Concrete in Piers	m^3	$1,800	0	-	165	$297,000.00	165	$297,000.00
Concrete in Abutment	m^3	$1,800	760	$1,368,000.00	760	$1,368,000.00	760	$1,368,000.00
Concrete in Wing Walls	m^3	$1,800	50	$90,000.00	50	$90,000.00	50	$90,000.00
Backfill to Structure	m^3	$95	500	$48,000.00	500	$48,000.00	500	$48,000.00
Bearings	ea	$850	72	$61,000.00	144	$122,000.00	144	$122,000.00
Precast Girders	LS	-	1	$2,340,000.00	1	$3,557,000.00	1	$3,557,000.00
Concrete in Deck, Diaphragms and Approach Slabs	m^3	$1,800	407	$733,000.00	545	$981,000.00	545	$981,000.00
Sidewalks on Bridge	m^3	$1,800	78	$140,000.00	102	$184,000.00	102	$184,000.00
Bridge Deck Waterproofing	m^2	$55	1020	$56,000.00	1790	$99,000.00	1790	$98,000.00
Parapet Walls	m^3	$2,600	24	$62,000.00	32	$83,000.00	32	$83,000.00
Railings	m	$600	76	$46,000.00	102	$61,000.00	102	$61,000.00
Paving - HL1	tn	$120	301	$36,000.00	403	$48,000.00	403	$48,000.00
TOTAL FOR BRIDGE STRUCTURE				$6,240,000.00		$8,198,000.00		$8,197,000.00

ROADS / CIVIL			Option 1		Option 2		Option 3	
	UNIT	PRICE	QTY	TOTAL	QTY	TOTAL	QTY	TOTAL
Temporary Roadway Protection - TL-2	LS	$40,000	1	$100,000.00	1	$80,000.00	1	-
Excavation	LS	-	1	$290,000.00	1	$180,000.00	1	$70,000.00
Fill	tn	$17	6100	$105,000.00	2300	$40,000.00	200	$5,000.00
Granular A and B for Roadway	tn	$22	7700	$169,000.00	4700	$104,000.00	1500	$33,000.00
Asphalt (Top and Base)	tn	$95	1650	$157,000.00	1020	$97,000.00	320	$30,000.00
Curb, Gutter and Subdrain	m	$80	330	$26,000.00	200	$16,000.00	40	$3,000.00
Sidewalks	m2	$75	1320	$99,000.00	820	$62,000.00	260	$20,000.00
MH and CB Structures	ea	$3,300	11	$36,000.00	8	$26,000.00	2	$7,000.00
Top Soil and Sod	m2	$7	1520	$11,000.00	1120	$8,000.00	560	$4,000.00
Guiderails	m	$1,800	150	$270,000.00	120	$216,000.00	90	$162,000.00
Biowalls / Retaining Walls	m2	$800	50	$40,000.00	20	$16,000.00	0	-
Traffic Staging / Control	LS	-	1	$150,000.00	1	$150,000.00	1	$100,000.00
Erosion and Sediment Controls	LS	-	13	$40,000.00	22	$30,000.00	13	$20,000.00
Utility Relocations (mainly o/h hydro)	LS	-	1	$100,000.00	1	$100,000.00	1	$100,000.00
Trees / Plantings	LS	-	126	$30,000.00	220	$20,000.00	126	$10,000.00
TOTAL FOR ROADS / CIVIL				$1,623,000.00		$1,145,000.00		$564,000.00

TOTAL AMOUNT	**$7,900,000**	**$9,300,000**	**$8,800,000**

Does NOT include Harmonized Sales Tax (HST)

APPENDIX F
Sanitary Sewer Analysis

Version 1.0
March 25, 2022 Matrix 24603-531

Syeda Banuri, M.Eng., P.Eng.
Project Manager, Infrastructure Programming and Studies
Transportation, Public Works
REGION MUNICIPALITY OF PEEL
Fourth Floor, Suite B, 10 Peel Centre Dr.
Brampton, ON L6T 4B9

Subject: Dixie-Dundas Flood Mitigation Study and Municipal Class Environmental Assessment Sanitary Sewer Discussion - Technical Items for Region of Peel Input and Consideration

Dear Syeda Banuri:

A meeting was held December 8, 2021, with representatives of the Region of Peel regarding the above-referenced project (Minutes of Meeting attached to this letter). One of the main action items arising from the meeting was a requirement that additional technical material be made available to the Region to allow further consideration of sanitary sewer items affecting potential alternative flood mitigation solutions being considered in the City's environmental assessment (EA).

The following letter report has been prepared to outline two separate but interrelated sanitary sewer items requiring additional consideration within the EA. These are as follows:

- An exposed 450 mm diameter sewer which crosses the Little Etobicoke Creek approximately 500 m east (i.e., downstream) of the Dixie Road bridge. The pipe is currently acting as a weir in the channel.

- A 900 mm diameter trunk sanitary sewer which crosses the Little Etobicoke Creek at a location just upstream of the Dixie Road bridge. Current cover over the trunk pipe is less than 1.2 m, with different flood mitigation alternative solutions at the bridge requiring consideration of different amounts of pipe lowering to accommodate a potentially lowered creek channel invert.

A new Dixie Road bridge is being proposed within all the potential design alternatives of the preferred flood mitigation solution for the EA. Discussion of the Dixie Road and how its design is integrated into the sanitary sewer items identified above is also contained in this letter-report.

The technical items outlined in this letter-report would also support EA requirements for the integration of potential mitigation designs for the exposed 450 mm diameter sanitary sewer (i.e., Item 1 identified above) into the overall Dixie-Dundas Flood Mitigation project.

We recommend that this letter-report be forwarded to other applicable individuals at the Region of Peel, including those who attended the meeting on December 8, 2021. The Region's review and consideration will allow input toward alternative design solutions being completed in the vicinity of the Dixie Road portion of the City of Mississauga's EA study area.

1 INTRODUCTION

The City of Mississauga retained Matrix Solutions Inc. to complete the Dixie-Dundas Flood Mitigation Project. The project is being completed as a Schedule C Municipal Class Environmental Assessment. The City's website and the location of key study documents completed to date are located at the following link: [City of Mississauga Project Website - Key Documents]

The following project overview is taken from the City's website:

> *The Dixie-Dundas community consists of a variety of residential, commercial, industrial and park and trail land uses and includes designated Special Policy Areas (SPAs) which regulate future development due to flood risks. This area is subject to flooding as a result of spilling from Little Etobicoke Creek near the Dixie Road bridge during high flow conditions including the storm event that occurred on July 8th, 2013.*
>
> *The goal of this study is to find solutions to provide flood protection to residences and businesses as well as to enable future growth in the Dixie-Dundas community as envisioned in the Dundas Connects Master Plan.*

Completion of flood mitigation works through this EA project is anticipated to allow significant reduction of existing flood risk within the City, including the removal of over 1,000 existing structures from potential Regional Storm flooding inundation.

2 RELEVANT SANITARY SEWER INFRASTRUCTURE

Potential flood mitigation works associated with the Dixie-Dundas Class EA would create changes to the Little Etobicoke Creek channel and floodplain. Changes being considered have the potential for impacts to Region of Peel sanitary sewer infrastructure.

The following letter-report has been prepared to outline two distinct but interrelated sanitary sewer items requiring additional consideration within the EA. These two items are:

- an existing exposed 450 mm diameter sewer which crosses the Little Etobicoke Creek approximately 500 m east (i.e., downstream) of the Dixie Road bridge.
- an existing 900 mm diameter trunk sanitary sewer which crosses the Little Etobicoke Creek at a location just upstream of the Dixie Road bridge.

A significant amount of additional sanitary sewer infrastructure exists within the overall Dixie-Dundas Flood Mitigation EA study area; however, only infrastructure related to the above two items is addressed within this letter-report. Additionally, other impacted Region of Peel infrastructure will be addressed through other on-going discussions, including the bridge crossing of Little Etobicoke Creek, other watermains, and sanitary sewer works.

2.1 Location Plan and Sanitary Sewers of Interest

Figure 1 adjacent outlines the current study area of the Dixie-Dundas Flood Mitigation EA Project.

It includes the Expanded Study Area, which is outlined in a recent Project Bulletin prepared for the project in October 2021.

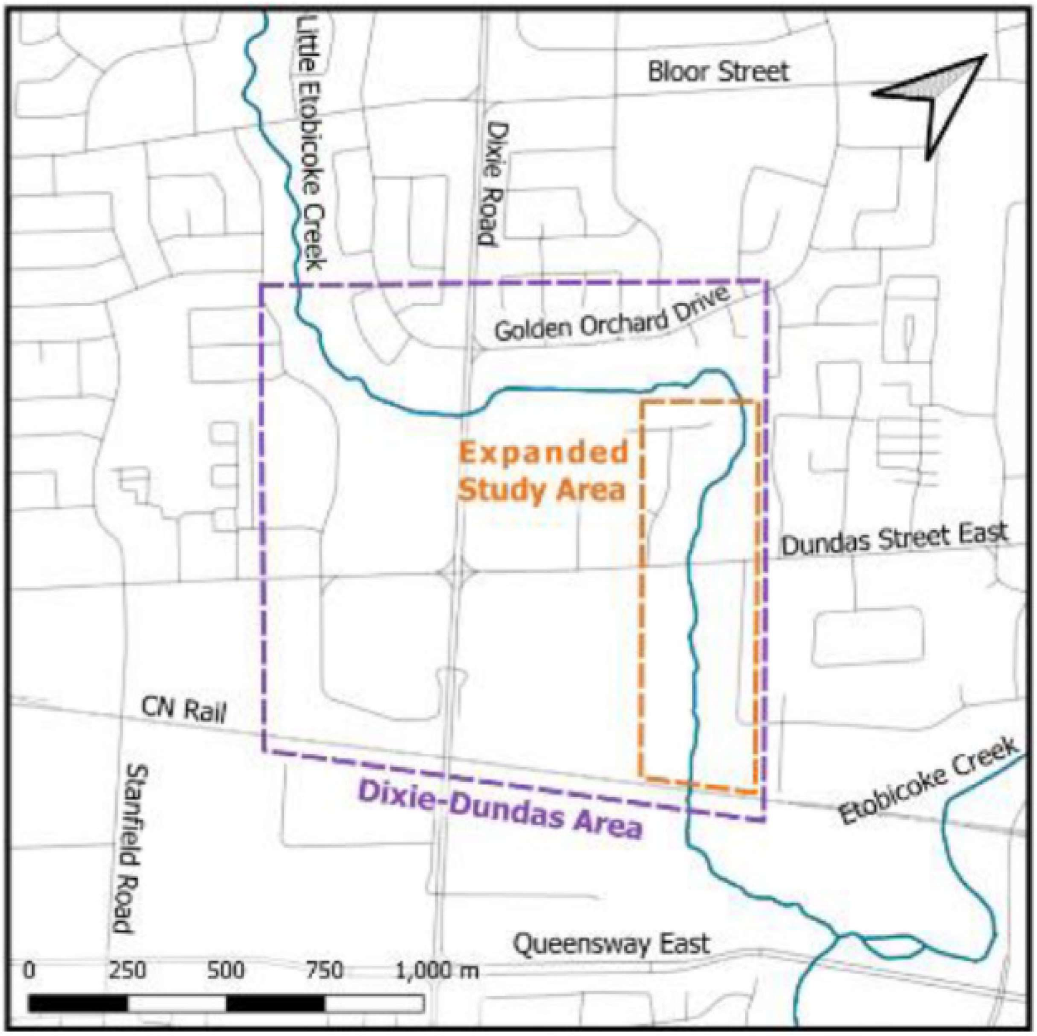

FIGURE 1 Environmental Assessment Study Area Location

Figure 2 below outlines locations of sanitary sewers of interest in the EA study area addressed in this letter-report. Reference points are outlined at key locations of interest.

Sanitary sewers of interest include the network located upstream of the exposed 450 mm diameter crossing of the Little Etobicoke Creek from the Golden Orchard Drive neighbourhood. The current outlet of the network is via Jarrow Drive to Dundas Street.

The existing sanitary trunk along Dixie Road between Little Etobicoke Creek and Dundas Street is also indicated in the figure.

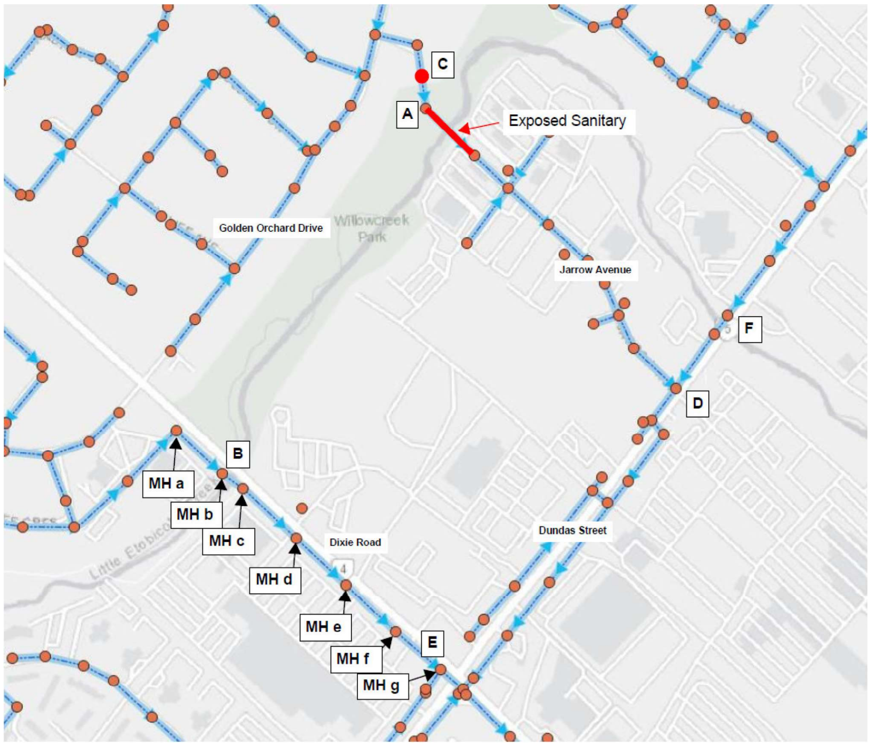

FIGURE 2 Sanitary Sewers of Interest and Reference Points

3 EXPOSED 450 MM DIAMETER SANITARY SEWER

An existing 450 mm diameter sewer crosses the Little Etobicoke Creek approximately 500 m east and downstream of the Dixie Road bridge. The crossing location is marked in red located from Reference Point 'A' in Figure 2. The sewer pipe is exposed to the creek and is currently acting as a weir in the channel. A photograph taken in 2019 is presented in Figure 3.

FIGURE 3 Exposed 450 mm Sewer in Little Etobicoke Creek

The exposed 450 mm diameter sewer is located close to the alternative solutions and works being contemplated to mitigate flooding. The exposed sewer was confirmed (and above photograph taken) while completing supporting field work as part of the overall Dixie-Dundas Flood Mitigation EA project.

When the EA project received expanded scope to increase the study area to downstream of Dundas Street, specific additional scope was outlined to allow investigation of design solutions that would best address the exposed sanitary sewer. Accordingly, potential synergies were explored for completing mitigation designs for the exposed sanitary sewer within the larger EA project.

Various design solutions to address the exposed sanitary sewer are outlined in the following sections. Each design solution's relationship to the overall Flood Mitigation EA project is also outlined.

It should be noted that a new Dixie Road bridge is being proposed within all of the potential design alternatives of the preferred flood mitigation solution for the EA. Discussion of the Dixie Road bridge and how its design is related to various design solutions for the exposed sanitary sewer is also outlined.

3.1 Design Objectives and EA Process

The objectives of this sanitary sewer analysis are to:

- Identify potential design solutions to mitigate the risks associated with the exposed sanitary sewer
- Provide information that will allow the Region of Peel and other relevant stakeholders of the larger Dixie-Dundas Flood Mitigation EA project (including the City of Mississauga) to evaluate potential design solutions based on desired outcome, anticipated feasibility, integration with other proposed works, and limiting environmental impacts
- Work and analysis completed within this memo will assist the Region in satisfying EA requirements related to implementing mitigation works for the exposed sanitary sewer crossing

The approach to identifying potential mitigation strategies for the exposed sewer involved the following steps:

- Review proposed works within the larger Dixie-Dundas Flood Mitigation EA study area to identify potential efficiencies in concurrent construction of mitigating sanitary sewer infrastructure
- Review Region of Peel sanitary standards to gauge feasible rerouting options
- Calculate slope, total drop, and integration with existing infrastructure for each alternate option

The approach for developing the mitigation strategies for the sanitary sewer included the preliminary meeting with the Region to receive their initial feedback regarding the potential alternatives being considered.

3.2 Design Solutions Explored

Based on discussions held at the December 8, 2021, meeting with representatives of the Region of Peel and other Flood Mitigation EA project study team, the following four alternative design solutions were examined to address the exposed sanitary line:

1. Protect the exposed line and leave it in place. It is noted that this alternative might also be implemented as a temporary one, thereby allowing future design alternatives to be completed later.

2. Lower the sewer on Jarrow Avenue (i.e., reconstruct) from upstream of the exposed sewer to the existing connection at Dundas Street and Jarrow Avenue (Figure 2: A - D).

3. Realign the sewer upstream of the exposed section through a realigned Little Etobicoke Creek valley corridor to connect at Dixie Road (Figure 2: A - B). This option requires the lowering of the Dixie Road trunk sanitary sewer.

4. Realign the sewer upstream of the exposed section through a realigned Little Etobicoke Creek valley corridor and continue with new sewer down Dixie Road to Dundas Street (Figure 2: A to E).

5. Realign the sewer east along watercourse valley to Dundas Street (Figure 2: A to F).

3.3 Method of Analysis

The exposed 450 mm diameter pipe originates from a manhole (MH) on the northwest side of Little Etobicoke Creek (see Figure 2, point "A").

Analysis of proposed options utilized the existing sanitary layout as identified within Region of Peel sanitary main data created on QGIS using open data downloaded from the Region of Peel data portal (https://data.peelregion.ca/). Sanitary Main and Sanitary Node regional data was used.

Regional standards for sanitary sewers as defined by the Region (Peel 2009) were used to determine potential designs. Design discharge by pipe diameter at a given grade was determined from Std. Dwg 2-9-4. Unless otherwise specified, maximum spacing between MHs was assumed as 120 m and minimum drop at a MH was calculated as per Region of Peel standards.

Minimum drop on all MH greater than 300 mm was assumed to be 0.02 m. Where possible, a minimum slope of 0.35% was maintained, but for pipes larger than 300 mm diameter, minimum slope was lowered as shallow as 0.30% if required to match into existing infrastructure.

3.4 Design Solution 1: Protect Existing Line

The first design solution involves protecting and reinforcing the existing line while leaving it in place at its existing crossing of the Little Etobicoke Creek. This option would involve modifying the channel to provide a degree of cover (e.g., a riffle-like structure) and resistance to mechanical scour/impact. This option would not modify the existing obvert or grade of the existing sanitary sewer. It would therefore remain a potential obstruction to flow for the Little Etobicoke Creek over the longer term. Additionally, it would not have adequate cover and would likely remain a long-term maintenance challenge for the Region.

Bank stabilization and localized channel modification, such as placement of upstream and downstream riffle structures, would be required. Design alternatives being contemplated for the overall Flood Mitigation EA are anticipated to be able to accommodate protection of the sanitary sewer crossing, as it is located at the downstream end of proposed works.

Potentially this design solution could provide a temporary solution for the Region, allowing later lowering of the sewer across the creek. For example, Design Solution 2 could then be implemented at a later date. Although the timing of redevelopment of the lands fronting Jarrow Avenue down to Dundas Street is not known, their redevelopment may provide better (i.e., more economical) opportunity for the sewer to lowered.

3.5 Design Solution 2: Reconstruct lowered sewer on Jarrow Avenue to Dundas Street

A potential design solution is available by reconstructing the sanitary sewer downstream of the creek crossing (from A to D on Figure 2). The sewer could be lowered on Jarrow Avenue, and also potentially reconstructed at a shallower slope, all the way down to the existing sewer on Dundas Street. The lower invert elevation available on Dundas Street could potentially provide as much as a 1.39 m lowering through the creek crossing.

The potential for completing this work more economically may arise in association with future redevelopment plans for the lands located northeast of the Dixie Rd and Dundas St intersection. The timing of this future potential redevelopment is not known at this time but is anticipated to be longer term.

The sewer across Little Etobicoke Creek and running down Jarrow Ave. to Dundas Street was assumed to be lowered along its existing alignment and constructed at a new grade of 0.35% (Figure 4; Table 1). Because obverts would have to be matched at Dundas Street from the new sewer into the existing manhole, additional capacity could be provided by a larger pipe if required due to a lowered grade potentially being used up Jarrow Avenue. The larger pipe would be able to achieve the same cover at the creek crossing.

TABLE 1 Design Solution 2: Lower Sewer on Jarrow Ave to Dundas Street

Calculated Potential Upstream Invert Elevation (m)	Ex. Downstream Invert Elevation (at Dundas) (m)	MHs (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)	Achieved Lowering at Creek Crossing (m)
116.39	114.489	8	0.160	0.35%	499	1.91	1.39

FIGURE 4 Design Solution 2: Lower Sewer between Dundas Street and Jarrow Avenue Scenario

3.6 Design Solution 3: Realignment through flood plain to a lowered Dixie Road Trunk Sanitary Sewer

This potential design solution is made available within the anticipated preferred solution of the Flood Mitigation EA. The sanitary sewer upstream of the existing Little Etobicoke Creek crossing, specifically from just downstream of Taviton Court, could be realigned to Dixie Road (Points A to B on Figure 2). Manholes for the realigned sewer could potentially be located adjacent to a proposed City trail that could be constructed as part of the flood mitigation works.

This solution becomes feasible given that the following design items will be completed in conjunction with the Dixie-Dundas Flood Mitigation EA project:

- The preferred solution at the upstream (Dixie Road) portion of required flood mitigation works includes complete reconfiguration and restoration of the flood plain between Taviton Court and Dixie Road.

- The existing trunk sanitary sewer on Dixie Road does not currently have sufficient cover at its existing crossing of Little Etobicoke Creek. Flood mitigation alternative solutions being examined at the Dixie Road crossing may require additional lowering of the Dixie Road trunk sewer to best suit the economics of the required Dixie Road bridge replacement and associated road reconstruction.

The second bullet point above is discussed in additional detail in Section 4 of this letter report; however, the opportunity to have a sanitary sewer at sufficient elevation at Dixie Road to potentially accommodate this realigned sewer from Taviton Court seems feasible.

A realigned sanitary sewer from Taviton Court would allow construction to occur in a “green field” situation, without traffic considerations for most of its construction. The sewer could be readily integrated into the floodplain design, with manholes for the realigned sewer located on or close to a trail that could be constructed to ensure its effective use as a maintenance access road.

The existing sanitary trunk sewer on Dixie Road is 900 mm diameter at the crossing of Little Etobicoke Creek and varies in size as it flows downstream to Dundas Street. No capacity analysis has been completed on the Dixie Rd trunk sewer or its outlet beyond Dundas Street. At the previously referenced December 8, 2021, meeting, Region of Peel representatives indicated this capacity may be available, although it must be confirmed prior to further consideration of this design solution.

The proposed connection of the realigned 450 mm diameter sewer through the reconfigured and rehabilitated flood plain downstream of Dixie Road is indicated below in Figure 5. Hydraulic capacity considerations for the realigned 450 mm diameter sewer are contained in Table 2, with the assumption that an effective receiving sewer elevation will be provided at Dixie Road via the implementation of flood plain works per the Flood Mitigation EA. Additional discussion of the Dixie Road trunk sewer and its potential lowering associated with the Dixie-Dundas Flood Mitigation Project is contained in Section 4 of this letter report.

The alignment of the 450 mm diameter sewer pipe and manholes in the floodplain for this Design Solution 3 would require significant consideration of the trail design such that it could also serve as a maintenance road. The maintenance road’s vertical placement above certain flood levels would also have to be effectively achieved. Additionally, the long-term lateral stability of the new creek alignment would have to be assured in order that no risk of erosion would be presented to the new 450 mm diameter sewer alignment. Key considerations of the required lowering of the existing Dixie Road trunk sewer to accommodate the realigned 450 mm diameter sewer are outlined in Section 4 of this letter report.

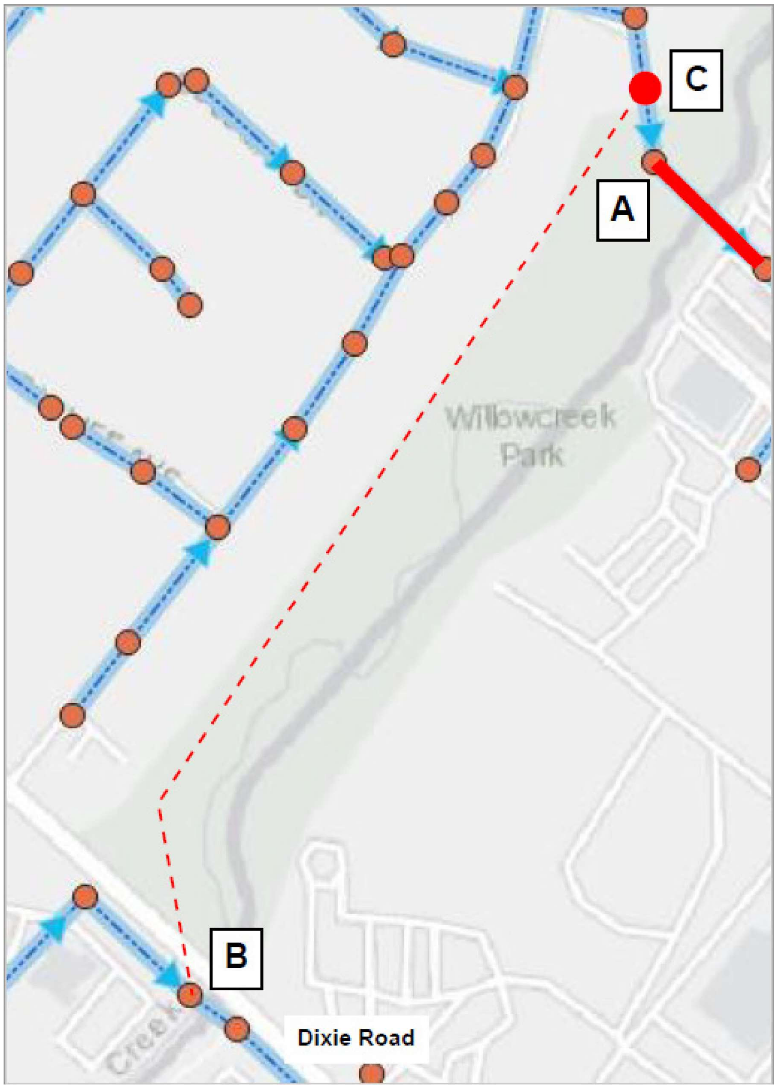

FIGURE 5 Design Solution 3: Realign Sewer to a Lowered Dixie Road Trunk Sanitary

TABLE 2 Design Solution 3: Realign Sewer to a lowered Dixie Road Trunk Sanitary

Upstream		Downstream		Dixie Sanitary (Lowered)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.910	118.360	115.970	116.420	115.373	116.348	7	0.140	0.30%	600	1.940

3.7 Design Solution 4 – Realignment through flood plain and new sewer on Dixie Road Trunk

Option 4 is similar to Option 3, but instead of outletting a realigned 450 mm diameter sewer at Dixie Road, a parallel 450 mm line could be constructed on Dixie Road to outlet at existing MH E on the northwestern side of the Dixie-Dundas intersection. The viability of this option does not depend on a lowered Dixie Road sanitary trunk, but rather takes advantage of the lower-elevation sanitary near the intersection (Figure 6; Table 5).

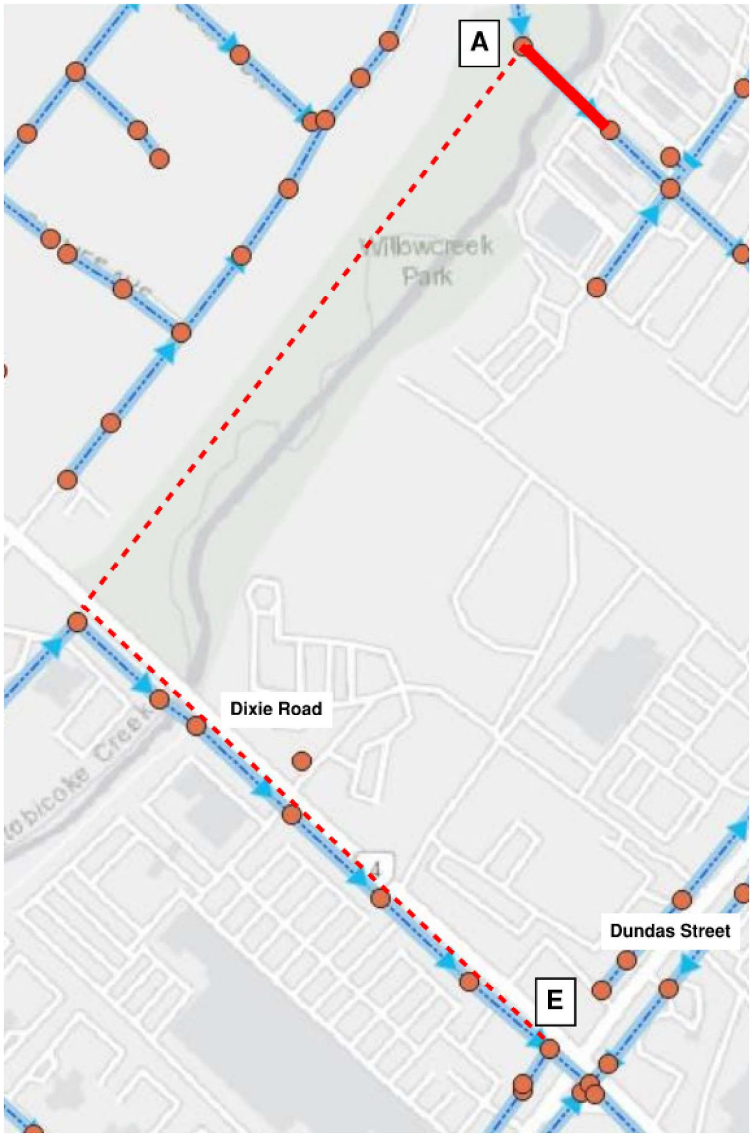

FIGURE 6 Design Solution 4: Realign Through Floodplain to Dixie-Dundas Intersection with New 450 mm sewer

TABLE 3 Design Solution 4: Realign to Dixie-Dundas Intersection with new 450 mm sewer

Upstream		Downstream		Dixie-Dundas Sanitary Outlet (Existing 750 mm)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.787	118.237	114.064	114.514	113.501	114.251	11	0.209	0.35%	1004	3.723

Analysis of this scenario indicates that realignment of the exposed sanitary to integrate with the existing sanitary trunk on the northwest side of the Dixie Road and Dundas Street intersection is technically feasible.

3.8 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

Option 5 proposes to realign the sanitary line upstream of the exposed section east along the existing Little Etobicoke Creek valley corridor to Dundas Street (Figure 7; Table 4).

FIGURE 7 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

TABLE 4 Design Solution 5: Realign Sewer East Along Watercourse Valley to Dundas Street

Upstream		Downstream		Dundas Sanitary Outlet (Existing 600 mm)		MH (#)	Total MH Drop (m)	Slope (%)	ΔX (m)	ΔY (m)
Invert (m)	Obvert (m)	Invert (m)	Obvert (m)	Invert (m)	Obvert (m)					
117.787	118.237	115.185	115.635	114.958	115.558	9	0.210	0.35%	695	2.602

This design option indicates that realignment of A-F is physically feasible; however, the ecological impacts of disturbing the natural corridor, the majority of which is not otherwise anticipated for rehabilitation within the Flood Mitigation EA works, must be considered.

4 DIXIE ROAD TRUNK SANITARY SEWER LOWERING CONSIDERATIONS

The existing 900 mm diameter trunk sanitary sewer crossing the Little Etobicoke Creek at Dixie Road has been a focus of design solutions and alternative designs of the preferred solution for the Dixie-Dundas Flood Mitigation EA Project. The existing sewer currently has less than the standard desired 1.2 m of cover at the crossing. Depth of cover from outside barrel of trunk sanitary to existing invert of watercourse in this location may be as low as 0.5 m. Accordingly, some type of remediation to ensure better resilience against the effects of long-term erosion has been contemplated to be completed as part of the Flood Mitigation EA project.

The preferred solution to achieve optimum flood mitigation within the Dixie-Dundas EA project (and a solution that will allow the eventual complete removal of the SPAs that stipulate flood policy in this area) is to “Make Room for the Creek.” Within that design solution, a new and much longer span for the Dixie Road bridge is required to convey flood flows. The larger bridge and other Region infrastructure that will have to be considered at this creek crossing location, including an existing 400 mm diameter watermain, are not addressed specifically in this letter report; however, these items will require significant consideration within the overall evaluation of potential sanitary sewer mitigation options.

Current design alternatives being investigated within the Flood Mitigation EA project include different options for the elevation of the channel invert through the bridge crossing. Significant cost savings appear to be available if the invert of the creek were to be lowered by up to 1.0 m; however, this would have direct impact on the existing trunk sanitary sewer. Although the sewer would likely best be lowered to some degree to accommodate long-term maintenance through sufficient depth of cover, extra lowering of the trunk sewer could allow significant savings in the works associated with the Dixie Road bridge and associated roadworks.

Given the advantage of this additional trunk sewer lowering, the option of accepting flows from the realigned 450 mm diameter sewer (per Design Solution 3 this letter report) potentially becomes a more cost-effective method to mitigate its current exposure to the creek. The feasibility of further lowering the Dixie Rd trunk sewer to also accommodate this 450 mm diameter requires further consideration.

The sanitary trunk sewer along Dixie Road is indicated in Figure 8, and a summary of vertical realignment elevations are summarized in Table 5.

The Region of Peel will likely want to confirm these design elevations, potentially also through survey. Other design constraints, such as the existing 400 mm diameter watermain, will be required to be considered within the Flood Control EA Project and the alternative design of the Dixie Road bridge and associated roadworks. Additional analysis for sanitary sewer design, depending on the design solution being considered, will likely have to include an analysis of pipe capacities available downstream of Dundas Street. This additional analysis has not been completed as part of this current work.

TABLE 5 Dixie Road Sanitary Trunk Lowering

MH name	Existing		*Proposed - for Creek cover		**Proposed (Des. Solution 3)		Length of Pipe to d/s MH (m)	Slope of Existing Pipe to d/s MH	Size of Existing pipe to d/s MH	Capacity of Existing pipe to d/s MH (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv	u/s inv	d/s inv				
a	*119.07*	*119.04*	*119.07*	*119.04*	*119.07*	*119.04*	82.3	0.367%	900	1097
b	*118.74*	*118.67*	*118.74*	117.24	*118.74*	115.38	35.1	0.242%	900	891
c	*118.59*	*118.45*	117.11	117.06	115.26	115.21	101.0	0.205%	975	1015
d	*118.24*	*118.22*	116.71	116.66	114.86	114.81	89.6	0.302%	975	1232
e	*117.95*	*117.93*	116.35	116.30	114.49	114.44	81.6	1.292%	750	1265
f	*116.88*	*115.76*	116.01	*115.76*	114.16	114.11	76.4	1.181%	750	1210
g	*114.86*	*113.50*	*114.86*	*113.50*	113.84	*113.50*			750	check required for downstream of MH g

* Lowering required to achieve 1.2 m cover at new creek invert level of 119.5 m (approx.)

** Lowering required to accept 450 mm dia. sewer from east; 450 mm sewer inlets at MH b; matching obverts allows an invert elev of 450 mm dia.: 115.91

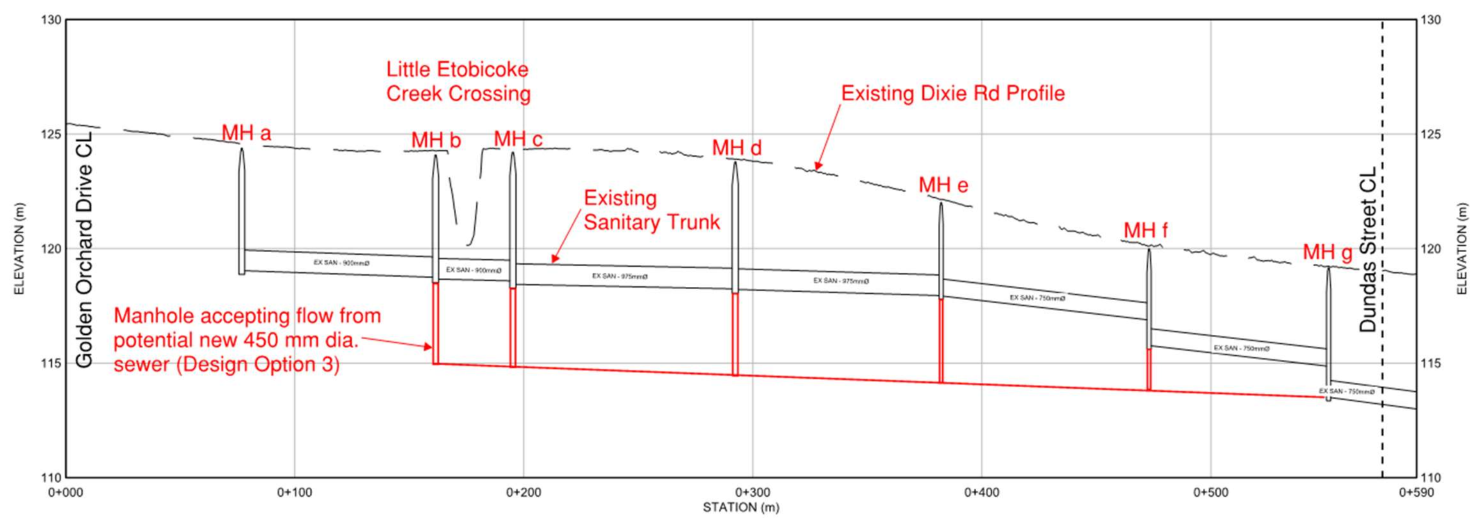

FIGURE 8 Dixie Road Trunk Sanitary Sewer

5 EVALUATION OF DESIGN SOLUTIONS

Each of the mitigation options described in Section 3 can be evaluated in terms of the following aspects:

- Risk reduction to exposed Sanitary Sewer
- Feasibility of Integration with Existing Infrastructure
- Synergy with Other Planned Flood Mitigation EA Works
- Environmental Impact

A formal evaluation process will be undertaken given additional input from the Region of Peel. The Dixie-Dundas Flood Mitigation Project EA likely provides significant additional cost-effective options for the Region in addressing the exposed 450 mm diameter sanitary sewer. Although the existing 900 mm diameter trunk sewer crossing of the creek at Dixie Road is not exposed, its cover is not ideal. Flood mitigation works will also provide opportunity to improve this infrastructure.

6 SUMMARY AND RECOMMENDATIONS

The objectives of this sanitary sewer analysis were to identify potential design solutions that could feasibly mitigate risks associated with the exposed 450 mm diameter sanitary sewer.

It is recommended that the Region of Peel further consider the benefits of pursuing realignment of the exposed 450 mm diameter sewer. Additionally, Matrix Solutions recommends that the design option through the reconfigured flood plain to Dixie Road, per Design Solution 3 outlined in this letter report, should be examined further.

7 CLOSURE

We trust that this letter report suits your present requirements. If you have any questions or comments, please call Steve Braun at 289.323.0975.

Yours truly,

MATRIX SOLUTIONS INC.

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Reviewed by

Steve Braun, P.Eng.
Principal Water Resources Engineer

SB/vc
Attachments

copy: Anthony DiGiandomenico, City of Mississauga

VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V0.1	17-Feb-2022	Draft	24603-531 Sanitary Sewer Analysis LR 2022-02-17 draft V0.1.docx	Issued to client for review
V1.0	25-Mar-2022	Final	24603-531 Sanitary Sewer Analysis LR 2022-03-25 final V1.0.docx	Issued to Region (and client copied)

REFERENCES

Region of Peel (Peel). 2009. Public Works. Design, specifications & procedures manual - Linear infrastructure. Accessed October 1, 2021. https://www.peelregion.ca/public-works/design-standards/pdf/sanitary-sewer-design-criteria.pdf

Version 1.0
October 7, 2022 Matrix 24603-531

Anthony Di Giandomenico
CITY OF MISSISSAUGA
300 City Centre Dr.
Mississauga, ON L5B 3C1

Subject: Dixie-Dundas Flood Mitigation Environmental Assessment Project Sanitary Sewer Addendum Report, Regional Municipality of Peel, Dixie Road Infrastructure

Dear Anthony Di Giandomenico:

Further to Matrix Solutions Inc.'s report sent to the Regional Municipality of Peel (the Region) on March 25, 2022, we are pleased to provide additional information in this addendum report addressing sanitary sewers and other Region infrastructure relevant to the flood mitigation environmental assessment (EA) study. Discussion items in this addendum report relate primarily to sanitary sewers but also include consideration of roadway, bridge, and other infrastructure within the Dixie Road portion of the EA study area, including infrastructure located at the Dixie Road and Dundas Street intersection. Items related to the Dundas Street East crossing of Little Etobicoke Creek, located further to the east of Dixie Road, are not the focus of this addendum report.

This addendum report provides additional detail regarding the configuration, constructability, and costs of potential modifications to the Region's Dixie Road infrastructure. This report is intended to guide optimum design alternatives for the EA's preferred alternative flood mitigation solution, which is "Improved Conveyance by Making Room for the Creek." Some review of the EA process to date that led to determining the preferred alternative solution is also included, with a focus on the proposed changes at Dixie Road.

The report promotes a partnership approach for the City of Mississauga (the City) and the Region in considering conceptual designs for Dixie Road items within the EA project study area. Effective collaboration is required to best achieve the City's objectives for flood mitigation within their EA, the Region's objectives for ongoing optimum operation of their infrastructure and roadways, and overall best value for the City and the Region together.

1 ENVIRONMENTAL ASSESSMENT STAGE AND BACKGROUND

The current stage of the Dixie-Dundas flood mitigation project is in Phase 3 of the EA process. This phase defines alternative design concepts for the preferred solution, which has been determined as "Improved Conveyance by Making Room for the Creek."

At the first Public Information Centre (PIC) for the EA project, the following modifications to the Dixie Road crossing of Little Etobicoke Creek were presented for the preferred alternative solution:

- lengthening the bridge span significantly from existing (to 45 m from existing 12 m)
- lowering the Little Etobicoke Creek channel by 0.5 to 1.0 m
- widening the creek channel upstream and downstream of the Dixie Road bridge

PIC No. 1 identified that a longer, but lower, bridge has a cost advantage. A shorter bridge requires a significantly higher road profile. In comparing a 26 m bridge span to the preferred 45 m bridge, an overall cost savings for the longer bridge was estimated at $2.2 million dollars.

Lowering the elevation of the channel, which is required to effectively achieve flood mitigation objectives, will affect the existing large diameter trunk sanitary sewer (size varies from 750 to 975 mm in diameter but is herein referenced as the 900 mm diameter sanitary trunk sewer) that crosses the watercourse immediately upstream of Dixie Road.

Both viable EA alternative solutions (Phase 2 of the EA), and their respective 26 m and 45 m bridge options, required the same lowering of creek invert and, therefore, had the same potential effect on the 900 mm trunk sanitary sewer. The exact amount of creek invert lowering required at Dixie Road (i.e., required for hydraulic reasons for either alternative solution) will need to be adjusted to suit other hydraulic parameters, including channel width, within subsequent portions of the EA (i.e., Phase 3).

Complexities related to future 900 mm trunk sanitary sewer treatments within future designs were not outlined in greater detail in PIC No. 1. Optimum ways to address the 900 mm diameter trunk sewer were left to Phase 3 of the EA, where design alternatives could be further adjusted and confirmed. Considerations surrounding the 900 mm diameter trunk sewer not presented to date are addressed specifically in this current addendum report (see subsequent portions of this addendum report).

At the start of the EA project, an exposed 450 mm diameter sanitary sewer was identified. The location of the exposed crossing is approximately 500 m downstream (i.e., east) of Dixie Road. Matrix's previously referenced technical report dated March 25, 2022, summarized meeting discussions and presented further technical details that focused primarily on available solutions to mitigate the exposed 450 mm diameter sanitary sewer crossing. Various options were presented, including high-level technical details of feasibility and functionality. Some options involve modifications (i.e., additional modifications beyond otherwise required) to the previously referenced 900 mm diameter sanitary trunk sewer crossing the creek at Dixie Road. This latter point is addressed in more detail in this current addendum report to provide clarity.

Subsequent meetings and discussions held with the City, the Region, and consulting team made clear that additional details were still required to ensure optimum decision-making could be made within the EA process. Given the location of the exposed 450 mm diameter crossing, works to mitigate it could potentially be implemented concurrently with EA flood mitigation works. Additionally, the potential advantages of realigning the 450 mm diameter sewer to facilitate and/or improve the function of flood mitigation works needed to be further explored and understood. The potential for design synergies and overall cost savings for mitigating the 450 mm diameter sanitary sewer crossing are considered within the EA project.

2 DIXIE ROAD 900 MM DIAMETER TRUNK SANITARY SEWER

The decision-making process and additional considerations for proposed treatment of the 900 mm diameter trunk sewer within the EA project requires consideration of many items collectively. Each area of focus, and its relationship to other considerations, is outlined subsequently.

2.1 Existing Conditions and Desired Cover

Currently there exists approximately 0.6 m of cover over the trunk sewer from the Little Etobicoke Creek invert at the Dixie Road crossing.

This amount of existing cover is not ideal and does not conform to the Region's standard (which is 1.4 m above pipe obvert). Lowering the trunk sewer for the sole reason of achieving additional/standard cover would not be warranted as a standalone project. Value will be achieved if the sewer were to be lowered for additional reasons (e.g., such as mitigating flooding through the corridor). Accordingly, any lowering of the trunk sewer being considered (for other reasons) should provide the standard amount of cover, per the Region standard, as a goal.

2.2 Dixie Road Profile and Environmental Assessment Preferred Alternative Solution

The preferred EA flood mitigation alternative solution identified that the creek invert of Little Etobicoke Creek through the Dixie Road crossing needs to be lowered by 0.5 to 1.0 m. This amount of lowering facilitates an optimum configuration and effectiveness for channel works and their resulting flood mitigation function. A successful flood mitigation approach is not available without lowering the creek at least 0.5 m. One of the other EA alternative solutions originally investigated (that was not preferred) also required a lowering of the creek by at least 0.5 m to ensure viability. A third EA alternative solution, which did not necessarily require the creek to be lowered, was eliminated from consideration due to costs, which were an order of magnitude higher than the other two alternative solutions.

Additional hydraulic analysis completed more recently indicates that a cost benefit is achieved by lowering the creek invert by even more than 0.5 m, as it reduces the vertical profile increase at the Dixie Road bridge and the roadway transitions up to it. A lowered Dixie Road profile, and its lower costs, was one of the main reasons the EA preferred solution of "Improved Conveyance by Making Room for the Creek" was originally seen to be a good approach. Higher bridge decks associated with other alternative solutions being considered within Phase 2 of the EA indicated roadway costs increasing by as much as $2.2 million dollars (see R.V. Anderson Associates Limited [RVA] memo for additional details [Appendix A]).

In terms of pure hydraulics, an acceptable flood solution can be achieved by lowering the creek by only approximately 0.5 m, but this minimum lowering amount must be combined with other configuration changes to the channel and with a larger bridge structure used than identified in the preferred solution (i.e., larger than 45 m). Additional lowering of the creek up to 1.0 m has been seen to be more advantageous hydraulically according to the most recent work completed for EA Phase 3 hydraulic modelling. As well, it has the potential to bring the proposed Dixie Road roadway profile down even further.

A key issue identified at the Dixie Road crossing of the creek is the existing 900 mm diameter trunk sanitary sewer and its current positioning. A solution could "technically" be achieved by lowering the creek to just above the outer barrel of this pipe, thereby allowing the creek lowering to proceed without lowering of the trunk sewer. This would require specialized design, with permanent lateral protection in the creek channel both upstream and downstream. Generally, the approach of protecting the trunk sewer, and not lowering it, was abandoned as better options are available. These are outlined subsequently.

2.3 Proposed Lowering Configuration

The extent of the travelled roadway portion of Dixie Road anticipated for profile adjustment within the EA preferred alternative solution, which is "Improved Conveyance by Making Room for the Creek" is approximately 340 m, including new bridge. The original RVA report outlining preliminary details of the roadway improvements (included in Appendix A) puts bridge and roadway costs at $2.2 million dollars less expensive than the next least expensive alternative solution. That non-preferred solution, which has a smaller bridge, would also require over 500 m of roadway reconstruction due to the higher required vertical profile of the bridge. As well, unless a "no-cover" option were deemed to be acceptable for the 900 mm diameter trunk sewer, both of these alternate solutions would also require a lowering of the sanitary sewer for their viability.

As outlined explored in the original sanitary report of March 25, 2022, the Dixie Road trunk sanitary sewer has downstream elevation drops which could allow for a lower sewer to built in the upstream direction. By removing the drop(s), the lower sewer would ensure sufficient cover is achieved at the creek crossing. Figure A1 indicates in plan and profile views the length and positioning of the trunk sewer that would be required to be lowered to accommodate the required lower channel invert. The figure also outlines various other servicing present in the Dixie Road right-of-way (RoW) per City GIS files, which in turn reflect the Region's servicing drawings (EXP 2008, Dixie Road 400 mm watermain concrete pressure pipe). Sewer inverts elevations and lengths are also generally consistent with the original 1964 construction drawings.

Specifically, sewers connecting manholes b through f will have to be lowered to achieve a lowered channel at Little Etobicoke Creek. The significant existing drop occurring at manhole f can be utilized to keep the sewer grades much flatter up to manhole b. It should also be noted that the larger bridge structure at Dixie Road will require the adjustment of manholes b and c away from the new bridge, as indicated in Figure A1.

Table B1 in Appendix B indicates all existing and proposed invert elevations for sewer pipes in the Dixie Road alignment, along with existing and proposed capacities. Lengths of sewer and invert elevations indicated in Figure A1 and in Table B1 will require confirmation through survey prior to completing final design.

In terms of servicing conflicts, Figure A1 indicates a limited potential for them, not including those services that may require temporary support due to open trenching associated with construction. The complexity of addressing anticipated construction techniques will require a greater level of detailed design than completed to date for this EA sanitary addendum report. Potential bridge-related servicing conflicts are also not addressed in this present discussion. In summary, no direct conflicts with a lowered trunk sanitary sewer appear to be anticipated, other than potential trenching conflicts and the required need to provide temporary support to some items.

Recent hydraulic modelling work for the creek and flood plain confirms a proposed creek invert elevation of 119.10 m as providing good overall characteristics and related configuration. A lowered trunk sanitary sewer using a pipe size of 975 mm diameter, can just achieve an obvert elevation of 117.70 m at the Dixie Road creek crossing, thereby providing a cover of 1.4 m over obvert. This obvert elevation can be achieved using a slope of 0.28%, which provides a full pipe velocity of 1.59 m/s.

In terms of capacity provided by that trunk sewer configuration, it is 1,186 L/s, which is close to the largest existing capacity provided by the existing configuration (1,228 L/s). In order to achieve the larger existing capacity with the new 975 mm diameter sewer, a slope of 0.30% would have to be used, resulting in a depth of cover over obvert at the creek being slightly less at 1.36 m.

See Tables B1 and B2 for detailed calculations of velocity, capacity, and invert elevations for achieving the Region standard cover and achieving preservation of capacity. Both existing and proposed conditions are outlined.

2.4 Costs and Potential Constraints

Preliminary estimated costs for the lowering of the Dixie Road 900 mm diameter sanitary trunk sewer are contained in Table C1. Items included:

- drop structure at manhole b
- creek crossing costs (open cut and restoration)
- new 975 mm diameter sewer from manhole b to manhole f
- maintenance hole structures
- service relocations
- restoration (within Dixie Road reconstruction and for approximately 60 m beyond)
- bypass costs

The preliminary total cost obtained of approximately $4.3 million will require confirmation through additional design process outlining construction techniques and constructability. The cost estimate assumes construction nearby to the existing corridor/trench of the trunk sewer.

Coordination and timing of construction considerations with other Dixie Road bridge and roadway works will be essential to capture the benefits of roadway restoration costs that are already required.

Further discussion of alternate construction approaches (i.e., trenchless) is contained in later portions of this addendum report.

3 DOWNSTREAM 450 MM DIAMETER SEWER CROSSING

An existing exposed 450 mm diameter sewer crossing of Little Etobicoke Creek is located approximately 500 m east of Dixie Road and is described in the previously referenced original document sent by Matrix to the Region dated March 25, 2022. The following sections add additional detail to the available solutions previously described for the crossing.

3.1 Existing Conditions and Overview

The existing sewer currently acts as a weir in the creek. It has no cover and has been determined to be at risk.

3.2 Effect of 450 mm Sewer Realignment on Environmental Assessment Flood Mitigation Works

The most recent creek hydraulic analysis completed for flood mitigation works indicates that the 450 mm diameter exposed sanitary sewer does not necessarily require lowering or realignment by the City in order to complete the EA preferred flood mitigation works. The 450 mm diameter sewer would be left in a less than ideal configuration; however, with no cover in the creek and would require regular monitoring by the Region to ensure its ongoing successful operation. Additionally, leaving the sewer in place will make the design of the watercourse and flood plain more constrained and less able to emulate natural channel-type conditions.

3.3 Mitigation Options Examined

Mitigation options available for the sewer include:

- Realignment of the sewer to Dixie Road and to a lowered Dixie Road 900 mm diameter trunk sewer. The sewer would have to be lowered beyond that required just for obtaining sufficient cover for implementing the preferred flood mitigation alternative solution "Improved Conveyance by Making Room for the Creek."

- Realignment (i.e., lowering) of the exposed sewer's current outlet, which is the existing Jarrow Avenue sewer. Lowering would be required from approximately 80 m north of Dundas Street upstream to the north side of the Little Etobicoke Creek.

- Protecting in place within the proposed EA flood mitigation works. Discussion of potential future mitigation options also included here.

These three options are discussed in subsequent sections of this addendum report.

3.4 Realign to Dixie Road to a Further Lowered Dixie Road Trunk Sanitary

As outlined in the original March 25, 2022 sanitary technical report, the existing creek crossing of the 450 mm diameter sewer can be feasibly realigned from just downstream of Taviton Court to Dixie Road. A new sewer would be constructed within the City-owned valley that is otherwise being used to facilitate the City's flood mitigation requirements. Figure A2 indicates a plan and profile view of this option. Maintenance access structures for the realigned sewer could be located adjacent to or within a proposed City trail that would be constructed as part of the flood mitigation works. Recent creek hydraulic work has determined that this pathway and maintenance access structures could be located above the 1:100-year flood level.

Table B3 indicates technical details for the required extra trunk sewer lowering that would be required on Dixie Road in order to accommodate receiving flows from this newly realigned 450 mm diameter sewer. Additionally, the 975 mm diameter trunk sewer on Dixie Road has been increased in capacity (i.e., higher slope) in order that the additive capacity of the realigned 450 mm diameter sewer is accommodated. Note that capacity calculations only include to manhole g, and further calculations will be required downstream of that manhole in order that required capacity is confirmed. Table B4 indicates calculations for the 450 mm diameter sewer depicted in Figure A2.

Anticipated costs for this mitigation option are listed in Tables C2 and C3 in Appendix C.

Potential servicing conflicts for the portion of 450 mm diameter sewer through the new area of floodplain will be limited to some known storm sewer crossings, but otherwise are not anticipated to be extensive as this area is relatively “green field” and has not been urbanized to date.

3.5 Lowering Jarrow Ave Sewer

A technical alternative exists, which is to lower the existing sanitary sewer that provides existing outlet to the exposed 450 mm diameter sewer (i.e., lowering the existing Jarrow Avenue sewer). As outlined in Figure A3, lowering would be required from approximately 80 m north of Dundas Street upstream to the north side of the Little Etobicoke Creek. Table B5 outlines that technically, the lowering available could provide cover over the sewer of approximately 1.0 m from channel invert to pipe obvert. This amount of achievable cover is 0.4 m less than the the Region recommended standard of 1.4 m.

If the Jarrow Avenue sewer lowering were to be completed now, requiring the restoration of the Jarrow Avenue roadway, costs are estimated in Table C5 of this addendum report. This cost may be hard to justify given the Jarrow Avenue sewer alignment might eventually be determined to be abandoned within future development scenarios associated with the City’s Dundas Connects plan.

3.6 Protect in Place - Potential Future Lowering/Realignment

The most recent creek-related hydraulic analysis addressing design alternatives for EA flood mitigation indicates that the 450 mm diameter exposed sanitary sewer does not necessarily require lowering or realignment in order for the flood mitigation solution to be viable. Design of the preferred EA flood mitigation design solution works would, however, be less constrained and likely more able to emulate natural channel-type conditions if the 450 mm diameter sewer were to be moved away (i.e., realigned) or sufficiently lowered. Additionally, without realignment, the 450 mm diameter sewer would be left in a less than ideal configuration with no cover in the creek. It would regular monitoring by the Region to ensure its ongoing successful operation.

Leaving the sewer in place will require its incorporation into a riffle-type structure within the newly constructed creek works associated with the preferred flood mitigation alternative solution. Additionally, the riffle will be strengthened such that pipe may not be moved as part of river processes, likely requiring implementation of buried upstream and downstream armourstone protection or hardened approach otherwise. Costs associated with installing this permanent protection for the pipe are likely in the $100,000 to $200,000 range, given design and installation of works is coincident with other flood mitigation creek works. Other factors (such investigation and potential mitigation of inflows and infiltration) are not included in the estimate but will need to be considered.

The potential to eventually lower the 450 mm diameter sewer through the creek crossing at some point in the future could also be considered within the context of potential redevelopment of lands abutting the Jarrow Avenue (per the City’s Dundas Connects plan).

3.7 Summary of Available Options and Considerations

Lowering the Dixie Road trunk sanitary sewer (900 mm diameter) is required to achieve sufficient cover at the Little Etobicoke Creek crossing for the preferred EA alternative solution. The cost for this lowering is estimated at approximately $4.3 million.

Options identified in this letter-report to address the existing exposed downstream 450 mm diameter sanitary sewer located approximately 500 m downstream of Dixie Road include the following:

- Realign the exposed 450 mm diameter sewer through the new floodplain works associated with the flood mitigation project. The Dixie Road trunk sanitary would require additional lowering to accept these flows. Total cost for these works is estimated at $2.7 million (over and above the Dixie Road trunk lowering otherwise required). The total cost of all sanitary works is $7.0 million ($4.3 million + $2.7 million).

- Lower the Jarrow Avenue sewer to achieve approximately 1.0 m of cover for 450 mm diameter sewer at watercourse crossing. Cost estimated at $2.7 million for Jarrow Avenue works. The total cost of sanitary works including Dixie Road lowering is $7.0 million ($4.3 million + $2.7 million).

- Protect the 450 mm diameter sewer in place within flood mitigation works. Cost estimated at $0.2 million to allow for erosion protection. The total cost of sanitary works including Dixie Road lowering is $4.5 million ($4.3 million + 0.2 million).

Other considerations associated with these three options are outlined as follows:

- Operational costs and ongoing risk will be higher for the leave-in-place option for the 450 mm diameter sewer.

- Bus Rapid Transit (BRT) project coordination will be required with the option of extra lowering on Dixie Road (if required for accommodating a new 450 mm diameter through the floodplain). BRT coordination would not be required for other two options.

- Lower cost options may exist for the Dixie Road trunk extra lowering option by potentially using trenchless approaches such as micro-tunnelling and jack and bore. Potential cost savings have been identified as approximately $1.0 million if constructability will allow. This cost saving would bring the cost of the new 450 mm diameter sewer realignment through the floodplain to $6 million.

- Trenchless approaches for constructing the less deep trunk sanitary sewer on Dixie Road will also be investigated and may be warranted for various operational reasons. Some cost savings may be obtained through a jack and bore or micro-tunnelling approach for all or some portions of the lowering, but the estimate of $4.3 million for the lowering should be maintained. Potential cost savings for the shorter and less deep trunk sewer will not be as significant.

4 SUMMARY AND ENVIRONMENTAL ASSESSMENT NEXT STEPS

The Dixie-Dundas flood mitigation project EA was obliged to examine potential synergistic design alternatives that address the existing exposed 450 mm diameter sanitary sewer. Given how important the lowered 900 mm diameter trunk sanitary sewer crossing at Dixie Road is to the flood mitigation design, additional technical analysis was also warranted at that location.

This addendum report is intended to provide the City and the Region with the required level of technical information that will allow a decision to be made regarding proposed approach. We recommend the proposed approach for these sanitary sewers be determined collaboratively between the City and the Region. The EA will then be able to integrate the direction provided.

5 CLOSURE

If you have any other questions or comments, or if an in-person or video conference would be beneficial to clarify any aspects of the enclosed items, please contact the undersigned at 289.323.0975 or by email at sbraun@matrix-solutions.com.

Yours truly,

MATRIX SOLUTIONS INC.

Stephen Braun, P.Eng.
Principal Water Resources Engineer

Reviewed by

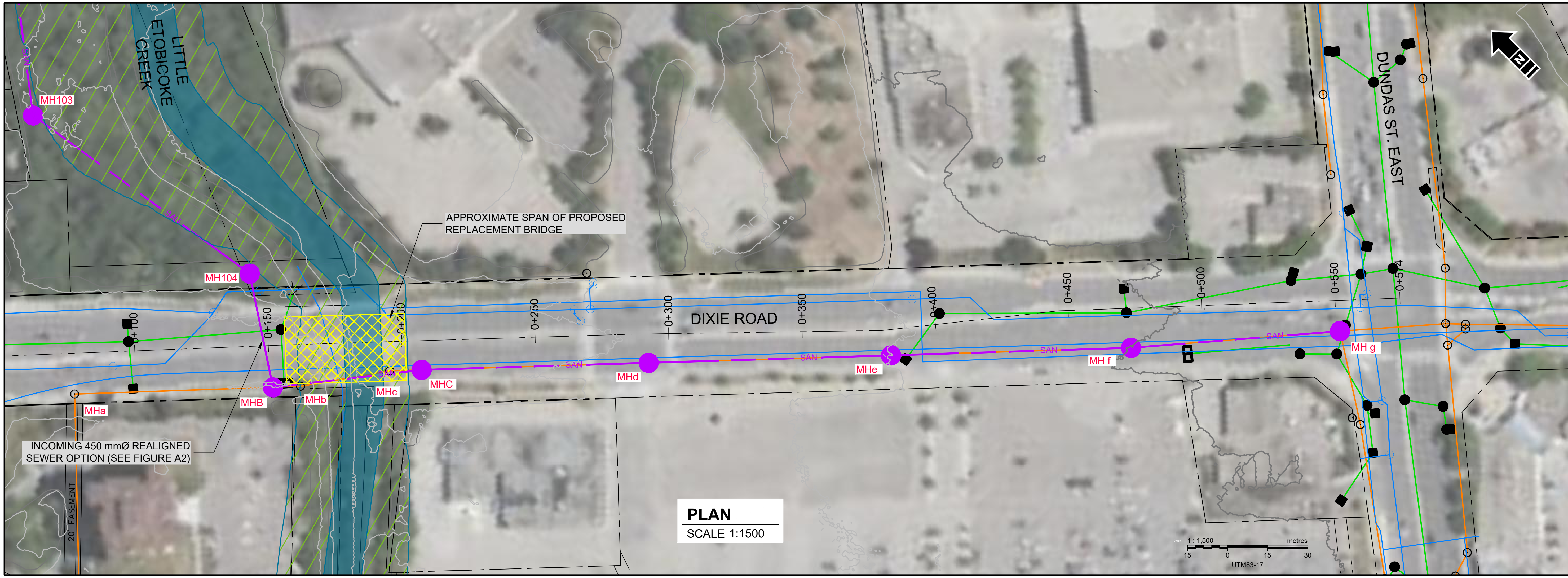
Phil Campbell, B.Eng., P.Eng.
Senior Civil Engineer

SB/vc
Attachments

VERSION CONTROL

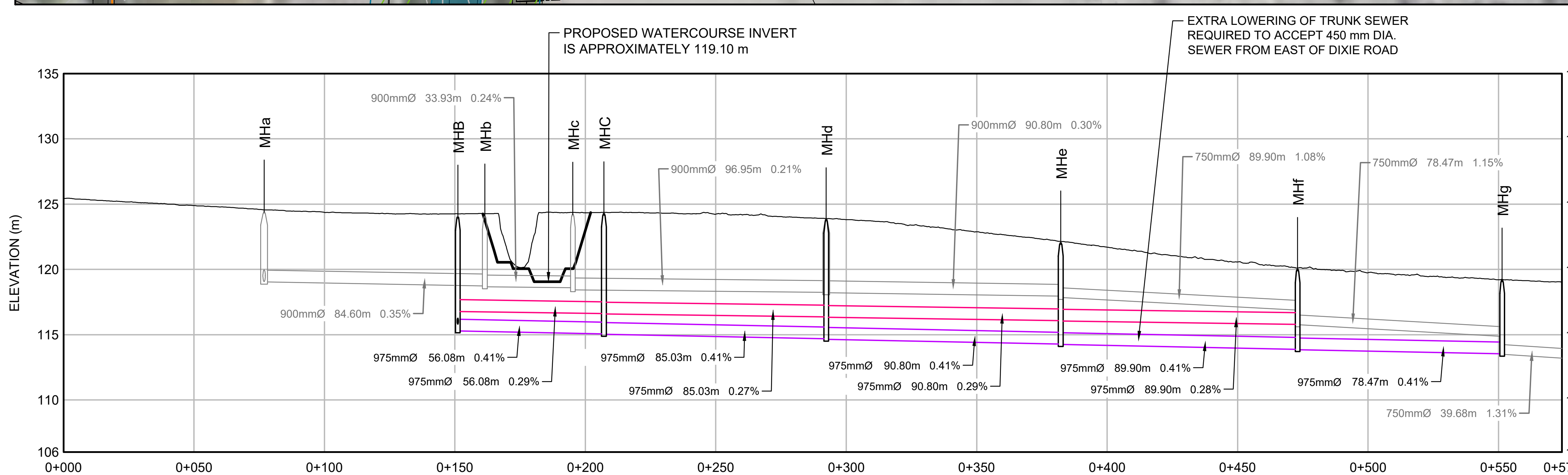
Version	Date	Issue Type	Filename	Description
V0.1	05-Oct-2022	Draft	24603-531 Sanitary Addendum Report 2022-10-05 draft V0.1.docx	Issued to client for review
V1.0	07-Oct-2022	Final	24603-531 Sanitary Addendum Report 2022-10-07 final V1.0.docx	Issued to client

APPENDIX A
Figures



PLAN

SCALE 1:1500



PROFILE

HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:400

LEGEND

- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN

REFERENCE:
1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. WORLD IMAGERY DATED MARCH 19 TO NOVEMBER 07 , 2021.

Note: Figure(s) must be used in conjunction with the attached report and is subject to the limitations and conditions stated in the report.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

DIXIE ROAD SANITARY SEWER

Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A1

Plot 1:1 = Tabloid (L)

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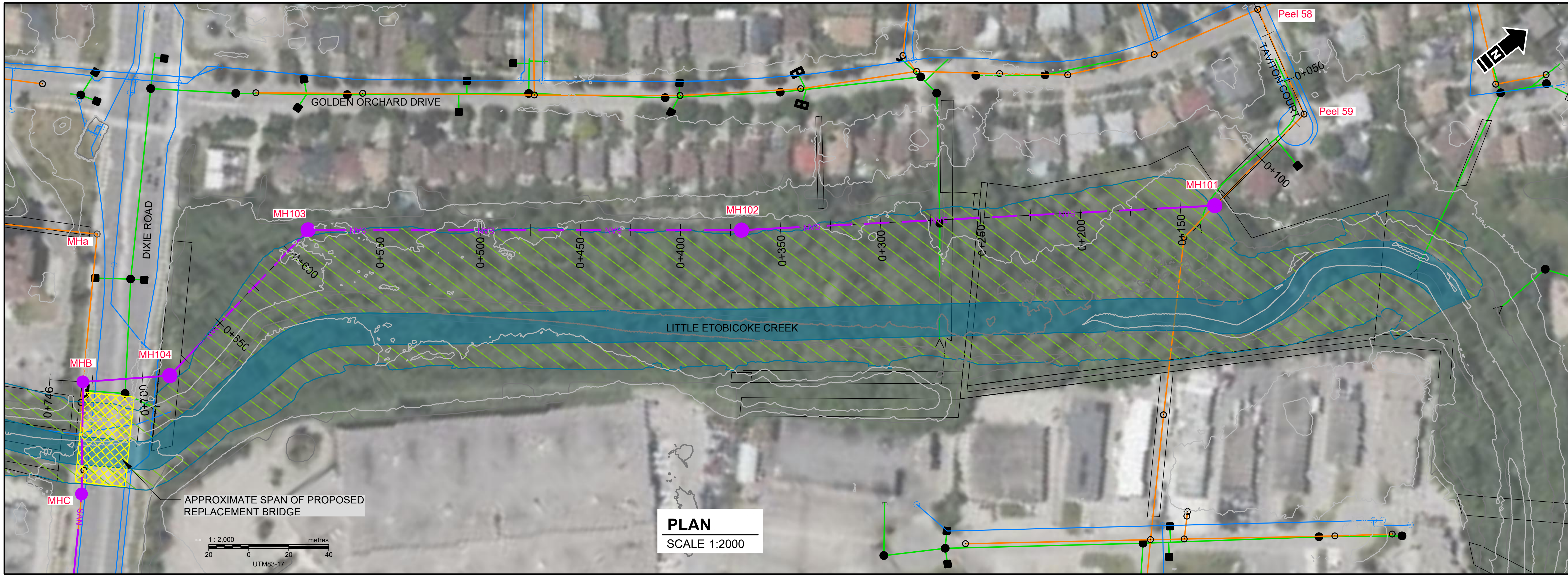
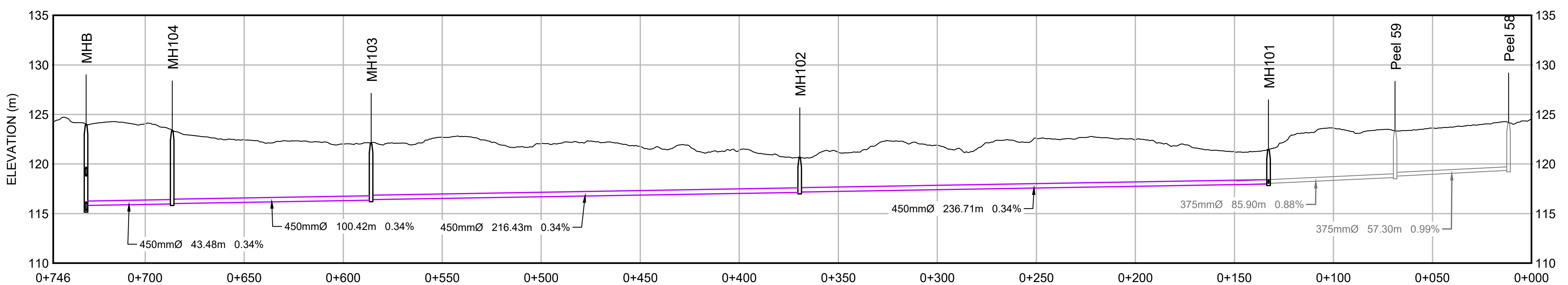




PROFILE

HORIZONTAL SCALE 1:2500
VERTICAL SCALE 1:500

LEGEND

- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN

REFERENCE:
1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. WORLD IMAGERY DATED MARCH 19 TO NOVEMBER 07 , 2021.

Note: Figure(s) must be used in conjunction with the attached report and is subject to the limitations and conditions stated in the report.

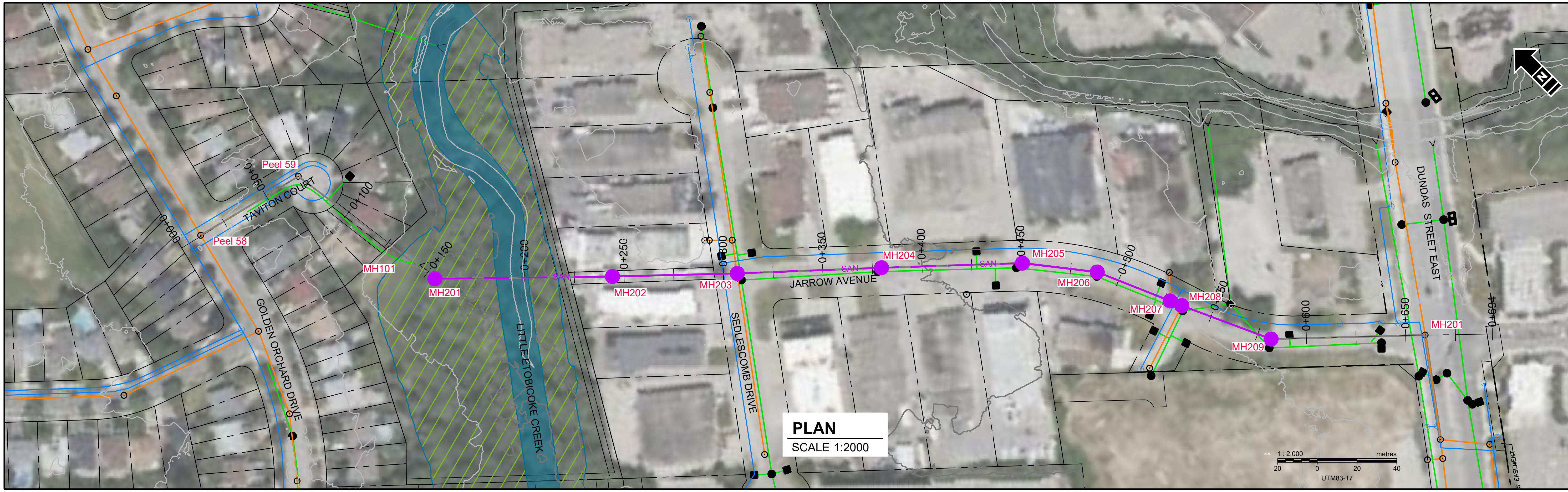
Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

FLOODPLAIN SANITARY SEWER REALIGNMENT

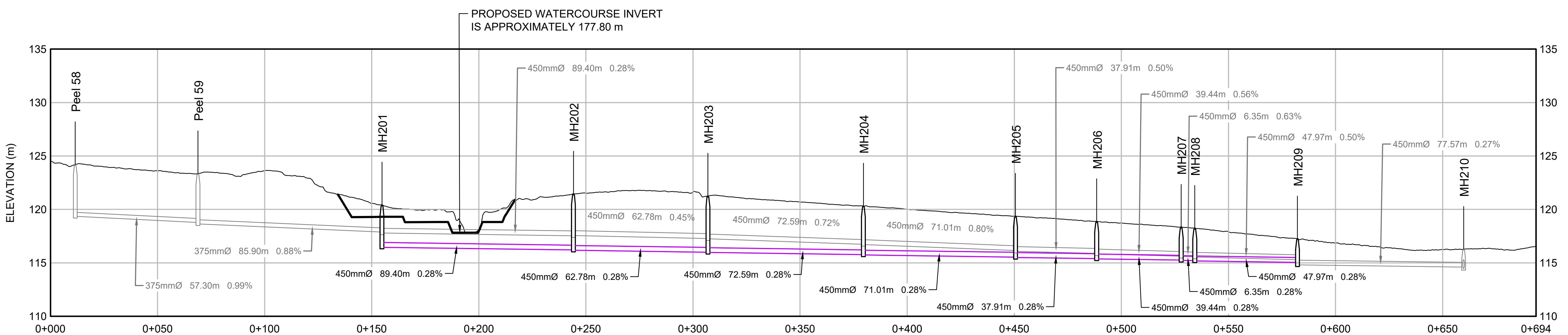
Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A2



PLAN

SCALE 1:2000



PROFILE

HORIZONTAL SCALE 1:2000
VERTICAL SCALE 1:400

LEGEND

- PROPOSED SANITARY MANHOLES
- PROPOSED SANITARY SEWER
- EXISTING SANITARY MANHOLES
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER
- EXISTING WATERMAIN

REFERENCE:
1. CONCEPTUAL DIXIE ROAD BRIDGE REPLACEMENT BY R.V. ANDERSON ASSOCIATES LIMITED (APPENDIX E).
2. BASE DIGITAL INFORMATION OBTAINED FROM THE CITY OF MISSISSAUGA (SHP AND DGN FORMAT).
3. WORLD IMAGERY DATED MARCH 19 TO NOVEMBER 07 , 2021.

Note: Figure(s) must be used in conjunction with the attached report and is subject to the limitations and conditions stated in the report.

Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

CITY OF MISSISSAUGA
SANITARY ADDENDUM REPORT

LOWERING OF JARROW AVENUE SANITARY SEWER

Date:	Project:	Submitter:	Reviewer:
September 2022	24603-531	M. Samson	S. Braun

Figure A3

Plot 1:1 = Tabloid (L)

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APPENDIX B
Tables

Table B1

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Sufficient Lowering to gain standard cover at Little Etobicoke Creek crossing

MH name	Existing		Proposed*		Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	116.78	33.9	0.24%	900	1.39	887	56.1	0.28%	975	1.59	1186
c	*118.59*	*118.44*	116.62	116.59	97.0	0.21%	975	1.38	1027	85.0	0.28%	975	1.59	1186
d	*118.24*	*118.22*	116.36	116.33	90.8	0.30%	975	1.64	1228	90.8	0.28%	975	1.59	1186
e	*117.95*	*117.93*	116.07	116.04	89.9	1.17%	750	2.73	1204	89.9	0.28%	975	1.59	1186
f	*116.88*	*115.76*	115.79	*115.76*	78.5	1.15%	750	2.70	1194	78.5	1.15%	750	2.70	1194
g	*114.86*	*113.50*	*114.86*	*113.50*										

* Lowering required to achieve 1.4 m cover above sewer obvert to **new creek invert level of 119.10 m** (approx.)

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m (all are straight-though)

NOTE 6: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.0028

Pipe Obvert at Creek: 117.68 m

Target: 117.70 m

Table B2

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Maximum Lowering and retaining Capacity, cover at Little Etobicoke Creek crossing maximized

MH name	Existing		Proposed*		Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	116.85	33.9	0.24%	900	1.39	887	56.1	0.30%	975	1.64	1228
c	*118.59*	*118.44*	116.68	116.65	97.0	0.21%	975	1.38	1027	85.0	0.30%	975	1.64	1228
d	*118.24*	*118.22*	116.39	116.36	90.8	0.30%	975	1.64	1228	90.8	0.30%	975	1.64	1228
e	*117.95*	*117.93*	116.09	116.06	89.9	1.17%	750	2.73	1204	89.9	0.30%	975	1.64	1228
f	*116.88*	*115.76*	115.79	*115.76*	78.5	1.15%	750	2.70	1194	78.5	1.15%	750	2.82	1246
g	*114.86*	*113.50*	*114.86*	*113.50*										

* Lowering to maximize cover above sewer obvert to **new creek invert level of 119.10 m** (approx.) but retain maximum capacity

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH in row. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m (all are straight-though)

NOTE 6: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.003

Pipe Obvert at Creek: 117.74 m

Target: 117.70 m

Table B3

Existing and Proposed Dixie Road Trunk Sanitary Sewer (upstream/north of Dundas Street)

Sufficient Lowering to allow realigned 450 mm dia. pipe to contribute flow (matching obverts)

MH name	Existing		Proposed*		Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
	u/s inv	d/s inv	u/s inv	d/s inv										
a	*119.07*	*119.04*	*119.07*	*119.04*	84.6	0.35%	900	1.68	1071	74.2	0.35%	900	1.68	1071
b	*118.74*	*118.67*	118.78	115.29	33.9	0.24%	900	1.39	887	56.1	0.41%	975	1.922	1435
c	*118.59*	*118.44*	115.06	115.03	97.0	0.21%	975	1.38	1027	85.0	0.41%	975	1.922	1435
d	*118.24*	*118.22*	114.68	114.65	90.8	0.30%	975	1.64	1228	90.8	0.41%	975	1.922	1435
e	*117.95*	*117.93*	114.28	114.25	89.9	1.17%	750	2.73	1204	89.9	0.41%	975	1.922	1435
f	*116.88*	*115.76*	113.88	113.85	78.5	1.15%	750	2.7	1194	78.5	0.41%	975	1.922	1435
g	*114.86*	*113.50*	113.53	*113.50*										

* Lowering required to achieve **invert level of new incoming 450 mm sewer from east** (approx.)

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH b and MH c, assumed halfway

NOTE 3: All Proposed trunk sanitary sewer assumed to be 975 mm dia. at slope indicated;

NOTE 4: Pipe information and calculations are for pipe downstream of MH. Nominal sizes used.

NOTE 5: All drops through Proposed MHs at 0.03 m

NOTE 6: Additional capacity in trunk provided for full pipe 450 mm dia, assumed at approx 170 L/s, total Flow req'd = 170 L/s + 1248 L/s = 1418 L/s

NOTE 7: 'Target' pipe obvert is required obv elev at trunk sewer to accept 450 mm dia. sewer

NOTE 8: MHs b and c moved to accommodate new creek valley

Slope to drive pipes 0.0041

Pipe Obvert at Creek: 116.15 m

Target: 116.35 m

Table B4

Proposed 450 mm dia. realigned through floodplain

MH name	Inverts		Distance to	Slope %	Pipe Size	Vel. (m/s)	Cap. (L/s)
	u/s inv	d/s inv	d/s MH (m)		(mm)		
Peel 58	-	*119.35*	57.3	0.99%	375	1.58	175
Peel 59	*118.78*	*118.65*	63.9	0.94%	375	1.54	170
101*	*118.05*	**117.97**	236.7	0.34%	450	1.05	166
102	117.17	117.14	216.4	0.34%	450	1.05	166
103	116.40	116.35	100.4	0.34%	450	1.05	166
104	116.01	115.96	43.5	0.34%	450	1.05	166
B	115.82	**115.29**					

* New MH cut into existing line

NOTE 1: Existing inverts maintained are marked in Italics with shading

NOTE 2: Downstream MH B invert obtained from lowered Dixie Rd trunk calculations

NOTE 3: Upstream MH B invert (new 450 mm in) obtained by matching obverts to 975 out

Slope to drive pipes: 0.0034 m/m

Outgoing Invert at MH 101: **117.97** m

Target: 117.97 m

Table B5

Existing and Proposed Jarrow Ave Sanitary Sewer (upstream/north of Dundas Street)

Lowering to gain maximum potential cover at Little Etobicoke Creek crossing

MH name	Existing u/s inv	Existing d/s inv	Proposed* u/s inv	Proposed* d/s inv	Ex. Distance to d/s MH (m)	Ex Slope %	Ex Pipe Size (mm)	Ex. Vel. (m/s)	Ex Cap. (L/s)	Prop. Distance to d/s MH (m)	Prop Slope %	Prop. Pipe Size (mm)	Prop. Vel. (m/s)	Prop. Cap. (L/s)
Peel 59	*118.78*	*118.65*	*118.78*	*118.65*	85.9	0.94%	375	1.54	170	85.9	0.94%	375	1.54	170
201	*117.89*	*117.79*	*117.89*	116.46	89.4	0.28%	450	0.95	151	89.4	0.28%	450	0.95	151
202	*117.54*	*117.56*	116.21	116.18	62.8	0.45%	450	1.20	191	62.8	0.28%	450	0.95	151
203	*117.28*	*117.25*	116.01	115.98	72.6	0.72%	450	1.52	242	72.6	0.28%	450	0.95	151
204	*116.73*	*116.72*	115.77	115.74	71.0	0.80%	450	1.60	255	71.0	0.28%	450	0.95	151
205	*116.15*	*116.08*	115.54	115.51	37.9	0.50%	450	1.27	202	37.9	0.28%	450	0.95	151
206	*115.89*	*115.83*	115.41	115.38	39.4	0.56%	450	1.34	213	39.4	0.28%	450	0.95	151
207	*115.61*	*115.60*	115.27	115.24	6.4	0.63%	450	1.42	226	6.4	0.28%	450	0.95	151
208	*115.56*	*115.54*	115.22	115.19	48.0	0.50%	450	1.27	202	48.0	0.28%	450	0.95	151
209	*115.30*	*114.81*	**115.05**	*114.81*	77.6	0.27%	450	0.93	148	77.6	0.27%	450	0.93	148
210	*114.60*	*114.47*	*114.60*	*114.47*										

* Lowering to maximize cover above sewer obvert to creek invert as indicated in calculations below
NOTE 1: Existing inverts maintained are marked in Italics with shading
NOTE 2: Little Etobicoke Creek crossing occurs at pipe between MH 201 and MH 202, assumed halfway
NOTE 3: All Proposed trunk sanitary sewer assumed to be 450 mm dia. at slope indicated;
NOTE 4: Pipe information and calculations are for pipe downstream of MH in row. Nominal sizes used.
NOTE 5: All drops through Proposed MHs at 0.03 m (assumed all are straight-though)
NOTE 6: Invert elev at MH 209 set to achieve invert required IF pipe obverts had been matched at ex. MH 210 (not the case) and existing pipe grade between (0.27%)

Slope to drive pipes 0.0028 m/m

Proposed Pipe Obvert at watercourse: 116.79 m
Ex. Pipe Obvert at watercourse: 118.11 m — Estimated top elev of encasement from hydraulic modelling: **118.53 m** (assumes 0.457 m internal dia. + 0.083 wall thickness + 0.200 encasing thickness)
Invert of watercourse (estimated): 117.80 m — This watercourse invert being immed. downstream of san sewer crossing, to be used ideally in proposed creek design.

Calc. cover over prop. obvert: 1.01 m

APPENDIX C
Cost Estimate Tables

Table C1 - Costs of lowering Dixie Road Trunk Sanitary Sewer

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C1 - Dixie Road Sanitary Trunk Lowering
Description	Dixie Road (MH f to MH B)
Prepared By	Phil Campbell
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	56	m	MH B to MH C
Open Cut In Roadway Length	266	m	MH B to MH f
Drop Structure Maintenance Hole	1	ea	MH B
Maintenance Holes	4	ea	MH C, d, e, f

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	975mm diameter sewer	322	m	$ 3,000	$ 966,000
	Extra Over Costs for Channel Crossing Treatment/Install	56	m	$ 2,500	$ 140,000
	Drop Structure MH	1	LS	$ 250,000	$ 250,000
	1800mm dia MHs	4	ea	$ 50,000	$ 200,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	322	m	$ 200	$ 64,400
	Maintenance of Flow During Construction	322	m	$ 250	$ 80,500
	Testing, CCTV and Commissioning	322	m	$ 100	$ 32,200
	Trench Restoration within Floodplain Reconstruction Limits	56	m	$ 100	$ 5,600
	Trench Restoration within Road Reconstruction Limits	206	m	$ 500	$ 103,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	60	m	$ 2,000	$ 120,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**				**$ 2,061,700**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 2,061,700	5%	$ 103,100
	Traffic Control	$ 2,061,700	5%	$ 103,100
	Erosion/Sediment Control	$ 2,061,700	3%	$ 61,900
	Dewatering and Water Management	$ 2,061,700	3%	$ 61,900
	Access and Staging	$ 2,061,700	3%	$ 61,900
	General Items	$ 2,061,700	3%	$ 61,900
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**			**$ 453,800**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 2,515,500	8%	$ 201,240
	Engineering CA and Inspection	$ 2,515,500	5%	$ 125,775
	Inflation (2022 $ to 2025 $)	$ 2,515,500	12%	$ 301,860
	Contingency	$ 2,515,500	20%	$ 503,100
SUBTOTAL	**SOFT COSTS**			**$ 1,131,975**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
Y	Urban Area	$ 2,515,500	10%		$ 251,600
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 2,515,500	10%		$ 251,600
N	Private Surface Features				
Y	Naturalized Area	$ 2,515,500	2.5%	Partial	$ 62,900
N	Railway Area				
Y	Regional Influence Area	$ 2,515,500	5%		$ 125,800
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**				**$ 691,900**

C1	**GRAND TOTAL (excl HST)**	**$ 4,339,375**

Table C2 - Costs of "Extra" Lowering of Dixie Road Trunk Sanitary Sewer to accommodate 450 mm Sanitary Sewer Realignment from East

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C2 - Extra Dixie Road Sanitary Trunk Lowering to Accommodate 450mm Re-alignment from east
Description	Dixie Road (MH g to MH B)
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	56	m	MH B to MH C
Open Cut In Roadway Length	345	m	MH B to MH g
Drop Structure Maintenance Hole	1	ea	MHB
Maintenance Holes	5	ea	MH C, d, e, f, g

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	975mm diameter sewer	401	m	$ 3,500	$ 1,403,500
	Extra Over Costs for Channel Crossing Treatment/Install	56	m	$ 2,500	$ 140,000
	Drop Structure MH	1	LS	$ 300,000	$ 300,000
	1800mm dia MHs	5	ea	$ 60,000	$ 300,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	401	m	$ 200	$ 80,200
	Maintenance of Flow During Construction	401	m	$ 250	$ 100,250
	Testing, CCTV and Commissioning	401	m	$ 100	$ 40,100
	Trench Restoration within Floodplain Reconstruction Limits	56	m	$ 100	$ 5,600
	Trench Restoration within Road Reconstruction Limits	206	m	$ 500	$ 103,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	139	m	$ 2,000	$ 278,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**	....			**$ 2,850,650**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor	Total
	Minor Items	$ 2,850,650	5%	$ 142,600
	Traffic Control	$ 2,850,650	5%	$ 142,600
	Erosion/Sediment Control	$ 2,850,650	3%	$ 85,600
	Dewatering and Water Management	$ 2,850,650	3%	$ 85,600
	Access and Staging	$ 2,850,650	3%	$ 85,600
	General Items	$ 2,850,650	3%	$ 85,600
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**	....		**$ 627,600**

Section 3	SOFT COSTS	Quantity	Factor	Total
	Engineering Study/Design/Approvals	$ 3,478,250	8%	$ 278,260
	Engineering CA and Inspection	$ 3,478,250	5%	$ 173,913
	Inflation (2022 $ to 2025 $)	$ 3,478,250	12%	$ 417,390
	Contingency	$ 3,478,250	20%	$ 695,650
SUBTOTAL	**SOFT COSTS**	....		**$ 1,565,213**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
Y	Urban Area	$ 3,478,250	10%		$ 347,900
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 3,478,250	10%		$ 347,900
N	Private Surface Features				
Y	Naturalized Area	$ 3,478,250	2.5%	Partial	$ 87,000
N	Railway Area				
Y	Regional Influence Area	$ 3,478,250	5%		$ 174,000
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**	....			**$ 956,800**

C2	**GRAND TOTAL (excl HST)**	....	**$ 6,000,263**

Table C3 - Costs of 450mm Sanitary Sewer Re-alignment through Little Etobicoke Creek Corridor from Taviton Court to Dixie Road

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C3 - 450mm Sanitary Sewer Re-alignment through Little Etobicoke Creek Corridor from Taviton Court to Dixie Road
Description	Little Etobicoke Creek Corridor (MHB to MH101) * See table C2 for Dixie Road Sewer lowering required to accommodate 450mm re-alignment*
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	0	m	
Open Cut In Floodplain, under prop. Pathway Length	555	m	MH 101 to MH 104
Open Cut In Roadway Length	44	m	MH 104 to MHB
Drop Structure Maintenance Hole	0	ea	
Maintenance Holes	4	ea	MH 104, 103, 102, 101

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	450mm diameter sewer	599	m	$ 600	$ 359,400
	Extra Over Costs for Channel Crossing Treatment/Install	0	m	$ 2,500	$ -
	Drop Structure MH	0	LS	$ 300,000	$ -
	1200mm dia MHs	4	ea	$ 20,000	$ 80,000
	Existing Sewer Servicing Connections	1	LS	$ 40,000	$ 40,000
	Existing Sewer Removals/Abandonment	0	m	$ 200	$ -
	Maintenance of Flow During Construction	0	m	$ 250	$ -
	Testing, CCTV and Commissioning	599	m	$ 100	$ 59,900
	Trench Restoration within Floodplain Reconstruction Limits	555	m	$ 100	$ 55,500
	Trench Restoration within Road Reconstruction Limits	44	m	$ 500	$ 22,000
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	0	m	$ 1,500	$ -
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**	....			**$ 616,800**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor		Total
	Minor Items	$ 616,800	5%		$ 30,900
	Traffic Control	$ 616,800	2%		$ 12,400
	Erosion/Sediment Control	$ 616,800	2%		$ 12,400
	Dewatering and Water Management	$ 616,800	2%		$ 12,400
	Access and Staging	$ 616,800	2%		$ 12,400
	General Items	$ 616,800	3%		$ 18,600
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**	....			**$ 99,100**

Section 3	SOFT COSTS	Quantity	Factor		Total
	Engineering Study/Design/Approvals	$ 715,900	8%		$ 57,272
	Engineering CA and Inspection	$ 715,900	5%		$ 35,795
	Inflation (2022 $ to 2025 $)	$ 715,900	12%		$ 85,908
	Contingency	$ 715,900	20%		$ 143,180
SUBTOTAL	**SOFT COSTS**	....			**$ 322,155**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
Y	Greenfield Area	$ 715,900	-10%		-$ 71,600
N	Brownfield Area				
N	Urban Area				
N	Semi-Urban Area				
N	Rural Area				
Y	Utilities Present	$ 715,900	5%	Partial	$ 35,800
N	Private Surface Features				
Y	Naturalized Area	$ 715,900	0%	Co-incident with Channel Work	
N	Railway Area				
N	Regional Influence Area				
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**	....			**-$ 35,800**

C3	**GRAND TOTAL (excl HST)**	....	**$ 1,002,255**
C2	**GRAND TOTAL (excl HST)**	....	**$ 6,000,263**
C3 + C2	**GRAND TOTAL (excl HST)**	....	**$ 7,002,518**
C3 + C2 - C1	**Extra Over C1 Cost to accommodate Taviton Ct. 450mm Sanitary Re-Alignment**		**$ 2,663,143**

Table C4 - Costs of 450 mm Sanitary Sewer Lowering from Taviton Ct to Dundas St via Jarrow Ave

Matrix Solutions Inc. ENVIRONMENT & ENGINEERING

Project Name	Dixie-Dundas Flood Mitigation EA - Sanitary Addendum Report
Project Location	Dixie Road, City of Mississauga, Region of Peel
Project Number	24603
Option ID	C4 - 450 mm Sanitary Sewer Lowering from Taviton Ct to Dundas St via Jarrow Ave
Description	Jarrow Avenue (MH 209 to MH 201)
Prepared By	Phil Campbell/S Braun
Date	05-Oct-22

Input Parameters

Open Cut Creek Crossing Length	90	m	MH 201 to MH 202
Open Cut in Easement Length	63	m	MH 202 to MH 203
Open Cut In Roadway Length	276	m	MH 203 to MH 209
Drop Structure Maintenance Hole	1	ea	MH 201
Maintenance Holes	8	ea	MH 202 to MH 209

Section 1	MAJOR CONSTRUCTION ITEMS	Estimated Quantity	Unit	Estimated Unit Cost	Total
	450mm diameter sewer	429	m	$ 600	$ 257,400
	Extra Over Costs for Channel Crossing Treatment/Install	90	m	$ 2,500	$ 225,000
	Extra Over Costs for Easement Treatment/Install	63	m	$ 1,000	$ 63,000
	Drop Structure MH	1	LS	$ 100,000	$ 100,000
	1200mm dia MHs	8	ea	$ 20,000	$ 160,000
	Existing Sewer Servicing Connections	1	LS	$ 100,000	$ 100,000
	Existing Sewer Removals/Abandonment	429	m	$ 200	$ 85,800
	Maintenance of Flow During Construction	429	m	$ 100	$ 42,900
	Testing, CCTV and Commissioning	429	m	$ 100	$ 42,900
	Trench Restoration within Floodplain Reconstruction Limits	90	m	$ 100	$ 9,000
	Trench Restoration within Road Reconstruction Limits	0	m	$ 500	$ -
	Trench Restoration beyond Floodplain and Road Reconstruction Limits	339	m	$ 1,000	$ 339,000
SUBTOTAL	**MAJOR CONSTRUCTION ITEMS**	....			**$ 1,425,000**

Section 2	OTHER CONSTRUCTION ITEMS	Estimated Quantity	Factor		Total
	Minor Items	$ 1,425,000	5%		$ 71,300
	Traffic Control	$ 1,425,000	3%		$ 42,800
	Erosion/Sediment Control	$ 1,425,000	3%		$ 42,800
	Dewatering and Water Management	$ 1,425,000	3%		$ 42,800
	Access and Staging	$ 1,425,000	3%		$ 42,800
	General Items	$ 1,425,000	3%		$ 42,800
SUBTOTAL	**OTHER CONSTRUCTION ITEMS**	....			**$ 285,300**

Section 3	SOFT COSTS	Quantity	Factor		Total
	Engineering Study/Design/Approvals	$ 1,710,300	8%		$ 136,824
	Engineering CA and Inspection	$ 1,710,300	5%		$ 85,515
	Inflation (2022 $ to 2025 $)	$ 1,710,300	12%		$ 205,236
	Contingency	$ 1,710,300	20%		$ 342,060
SUBTOTAL	**SOFT COSTS**	....			**$ 769,635**

Section 4	CONTEXT ADJUSTMENTS FACTORS	Quantity	Factor		Total
N	Greenfield Area				
N	Brownfield Area				
N	Urban Area				
Y	Semi-Urban Area	$ 1,710,300	8%		$ 136,900
N	Rural Area				
Y	Utilities Present	$ 1,710,300	5%	Local Road	$ 85,600
N	Private Surface Features				
Y	Naturalized Area	$ 1,710,300	2.5%	Partial	$ 42,800
N	Railway Area				
N	Regional Influence Area				
N	Provincial Influence Area				
N	Cost Sharing Applicable				
SUBTOTAL	**CONTEXT ADJUSTMENTS FACTORS**	....			**$ 265,300**
C4	**GRAND TOTAL (excl HST)**	....			**$ 2,745,235**

APPENDIX D
R.V. Anderson and Associates Limited Report

Note: This report is not reproduced here as it is contained within Appendix D of the main hydraulic report