LITTLE ETOBICOKE CREEK FLOOD EVALUATION STUDY
SUMMARY REPORT

Prepared for:
CITY OF MISSISSAUGA

Prepared by:
MATRIX SOLUTIONS INC.

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Prepared for City of Mississauga, July 2021

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1 INTRODUCTION

The Little Etobicoke Creek watershed in the City of Mississauga (the City) has experienced flooding and erosion concerns recorded back to at least the 1970s. The recent large flood event on July 8, 2013, which corresponded approximately to a 350-year storm (MMM 2015), resulted in many reports of flooding-related incidents and damage, particularly in the Dixie Road and Dundas Street East area. The focus of this flood evaluation study is to characterize flooding within the Little Etobicoke Creek watershed, identify preliminary flood cluster areas, and develop flood remediation alternatives.

The Little Etobicoke Creek Flood Evaluation Study is being conducted in two phases as part of a final Master Plan for the City. Phase 1 was completed in January 2018 and expanded on previous studies of the overland spill from Little Etobicoke Creek, particularly focused on the Dixie-Dundas Special Policy Area (SPA), where flood flows spill from Toronto and Region Conservation Authority (TRCA) jurisdiction lands into Credit Valley Conservation (CVC) jurisdiction lands. Phase 2 of the study was completed in February 2021 and is the subject of this report. Phase 2 of the study is focused on the Little Etobicoke Creek watershed as a whole and includes characterization of overland urban flood risk, as well as development, assessment, and recommendations for flood remediation measures. Figure 1 shows the study area, including the 2,260 ha Little Etobicoke Creek watershed.

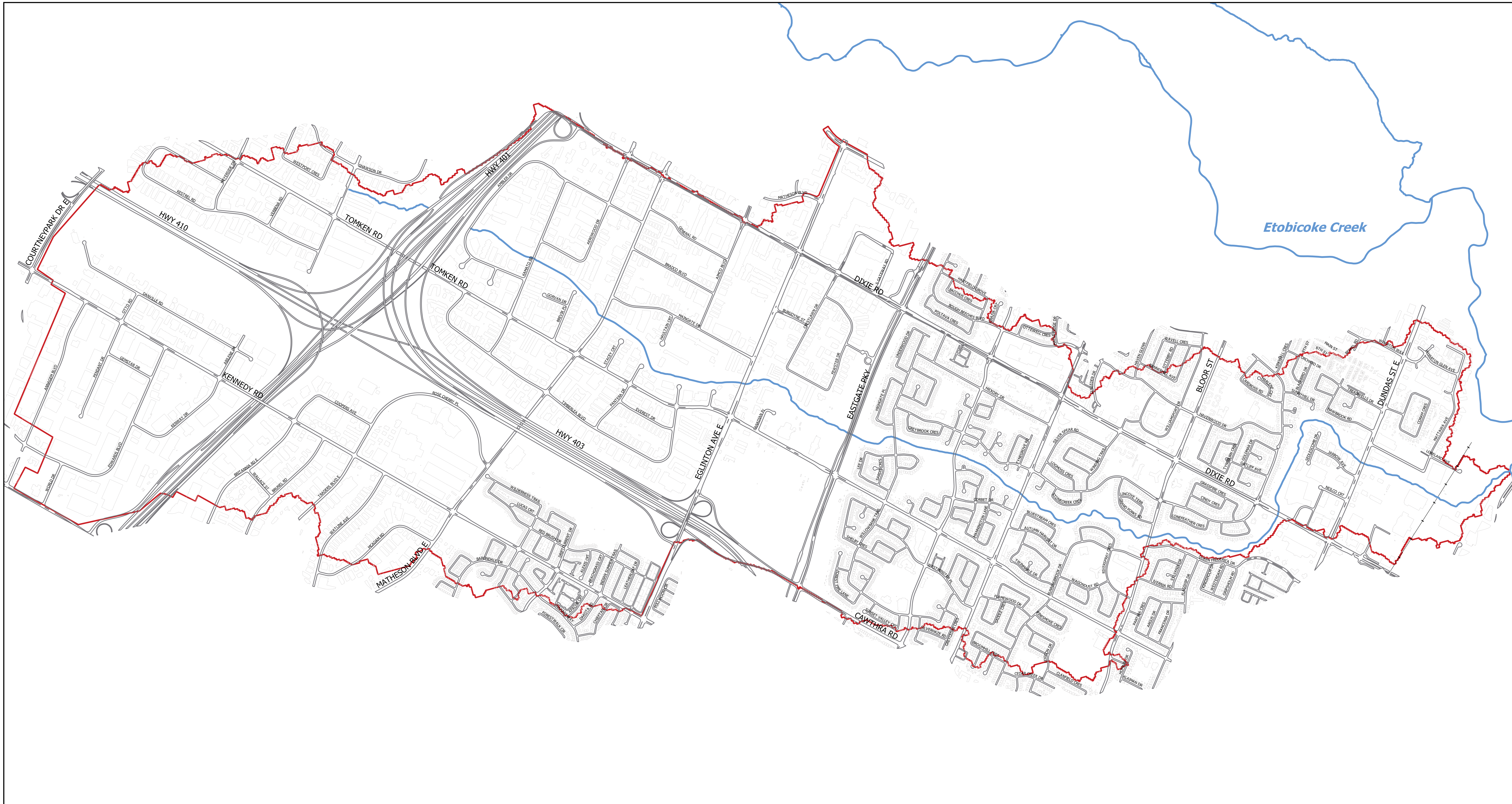

Figure Date: July 6, 2020

- Roads
- Watercourse
- Railway
- Buildings
- Little Etobicoke Catchment

This drawing must be used in conjuction with the attached memorandum, 'Progress Report #7: Flood Alternatives Evaluation (June 2020)' is subject to the same limitations and conditions stated in the memorandum.

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Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Little Etobicoke Creek Phase 2
Flood Evaluation Study

Project #: 24603-155562

Phase 2 Study Limit

P. Bishop
K. Hofbauer

Figure 1

1.1 Purpose of this Report

Matrix has completed the Little Etobicoke Creek Flood Evaluation Study in seven sections, which are summarized in five progress reports. Due to the distinct aspects of the flood considerations throughout the watershed, these progress reports have been compiled as independent sections of this final summary report instead of consolidated into a single project report. Each of these progress reports provides details of methods and results for specific tasks within the overall project. Table 1 displays the key contents of each progress report. This summary report is intended to function as a guide to the project; each section provides a summary of each progress report to assist the reader in finding desired information.

TABLE 1 Summary of Progress Reports

Progress Report No.	Topic	Content
1	Floodplain Spill Assessment (Matrix 2018)	• background review • Phase 1
2	Modelling for Flood Characterization and Analysis (Matrix 2020a)	• details of two-dimensional (2D) PCSWMM model development • 2D model validation • flood risk results
3 and 4	Flood Cluster Areas and General Causes of Flooding (Matrix 2020b)	• characterization of flooding • identification of flood cluster areas • identification of mechanisms of flooding • recommendations for each cluster area for further assessment
5 and 6	Flood Remediation Modelling and Assessment (Matrix 2020c)	• minor system assessment (level of service modelling) • three-way coupled modelling methods • description and analysis of six key focus areas
7	Flood Alternatives Evaluation (Matrix 2020d)	• evaluation table of remediation alternatives for the six focus areas • summary of recommendations for additional flood clusters • flood remediation plan

2 MASTER PLAN PROCESS

The Little Etobicoke Creek Flood Evaluation Study was completed following Approach 2 of the Master Plan process (MEA 2000). Phases 1 and 2 of the Municipal Class Environmental Assessment (EA) process are included in Approach 2, as described in Figure 2. This report and the attached progress reports form the Master Plan document for the conclusion of phases 1 and 2.

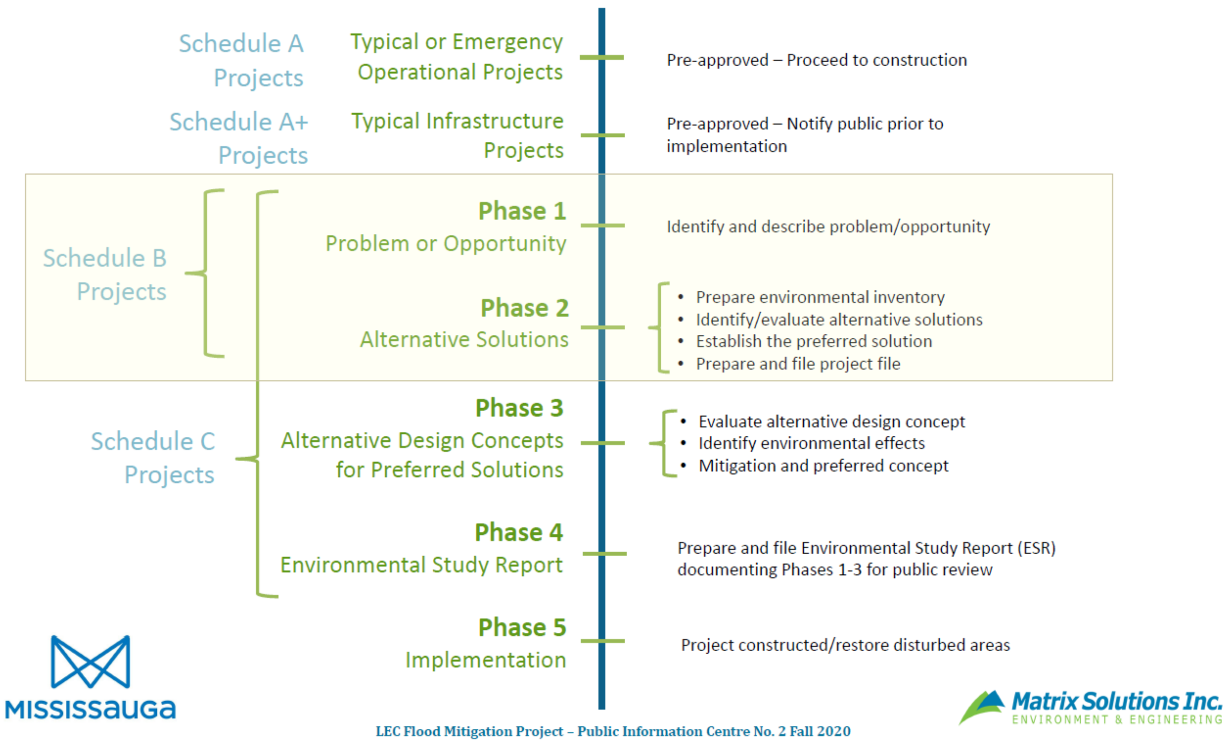

FIGURE 2 Municipal Class Environmental Assessment Process

The level of investigation, consultation, and documentation completed within this study are sufficient to fulfil the requirements for Schedule B projects. Given the extent of the study area environmental inventories for all projects were not feasible within this project. Instead, environmental inventories will be completed during the implementation stage of the Schedule B projects. Any additional potential environmental impacts and mitigation measures will be identified during that time. Further details of the assessments, evaluations, and recommendations are provided in Progress Report Nos. 5 and 6 (Matrix 2020c) and Progress Report No. 7 (Matrix 2020d).

2.1 Planning Context

Several plans and policies govern development in the study area, including the Provincial Policy Statement (PPS 2020) and other flood related policy and guidelines. These plans and their respective policies are summarized below as they relate to the Little Etobicoke Creek Flood Evaluation Study.

2.1.1 Planning Act and Provincial Policy Statement

The most recent Provincial Policy Statement (PPS; MMAH 2020) came into effect on in May 2020. The PPS provides policy direction on matters of provincial interest related to land use planning and development and intends to protect resources, public health and safety and the quality of the natural and built environment. The PPS informs land use planning decisions under the *Planning Act*, 1990, in Ontario and requires that infrastructure be provided in a coordinated, efficient and cost-effective manner. The PPS recognizes the complex relationships between economic, environmental and social factors in planning, and embodies good planning principles. It includes policies on issues that affect our communities and infrastructure such as transportation, connectivity and sensitivity of natural features, species and habitats, and protecting health and safety.

The intent of the Little Etobicoke Creek Flood Evaluation Study is to reduce the risk to life and property from riverine and urban flooding and enable the City to remove or reduce hazardous flood conditions within the watershed. Improving the performance of the City's storm sewer systems will in turn allow growth and urban development within the City that would help achieve the policy objectives of the PPS.

PPS components applicable to this study include:

- focusing growth within settlement areas away from significant or sensitive resources and areas that may pose a risk to public health and safety
- efficient management of resources (such as land use) to direct, promote and/or sustain growth.
- protecting life and property from hazards such as flooding and considering the potential effects of climate change that may increase the risk associated with natural hazards
- ensuring that resources are managed in a sustainable manner to protect essential ecological processes and public health and safety, while minimizing environmental and social effects to meet its long-term needs

2.1.2 Official Plan

The study area is situated within the City of Mississauga. The City is responsible for regulating land use and establishing policies for physical, economic, and social development within its jurisdiction. The Mississauga Official Plan (the Official Plan) sets out the vision for where and how Mississauga will grow to the year 2031. The *Planning Act*, 1990, requires that the Official Plan conforms to, or does not conflict with, provincial plans. Moreover, Section 3 of the *Planning Act* requires that all decisions affecting planning matters "shall be consistent with" policy statements issued under the *Planning Act*, including the PPS (MMAH 2020).

The Official Plan sets out the vision and direction for how the City will grow and develop into the future. It provides guidance and standards for how development applications will be reviewed and approved by the City. New buildings and structures need to be protected from flooding and allow both access and egress during emergencies. When the velocities and depths during flood events exceed the Ontario Ministry of Natural Resources and Forestry (MNRF) criteria, it can cause hazards to human life and structures. The intent of the Official Plan is preserved through the implementation of this project as it identifies and assessment alternative flood mitigation solutions for the Little Etobicoke Creek watershed.

2.1.3 Ontario Ministry of Natural Resources and Forestry Floodplain Policy

The MNRF has a set of policies and performance standards to support land use planning in areas susceptible to flooding hazards. The Little Etobicoke Creek Flood Evaluation Study is aimed at developing alternatives to support a comprehensive flood mitigation plan to reduce flood risk within Little Etobicoke Creek watershed. The MNRF classifies alternative solutions for reducing flood risk as passive or active, dry or wet, and temporary or permanent.

2.2 Public Consultation

In accordance with the Municipal Class EA process, public consultation was completed throughout this project. Two Public Information Centers (PICs) were held during this project. PIC No. 1 was held at the beginning of the project to introduce the study and collect information. Details of PIC No. 1 are provided in Progress Report No. 1 (Matrix 2018). PIC No. 2 was held near the conclusion of the study to present study results and preliminary recommendations. Following PIC No. 2, feedback was gathered for finalizing recommendations. Details of PIC No. 2 are provided in Progress Report No. 7 (Matrix 2020d).

3 PROGRESS REPORT NO. 1: FLOODPLAIN SPILL ASSESSMENT

Progress Report No. 1 encapsulates the Phase 1 study result. Matrix expanded TRCA's existing MIKE FLOOD model (MMM 2015) of the riverine spill from Little Etobicoke Creek through the Applewood and Dixie-Dundas Special Policy Areas (SPAs). This spill crosses the creek's regular watershed boundary, which is maintained under normal flow conditions. During major storm events, flow from Little Etobicoke Creek spills from TRCA into CVC jurisdiction. Based on review of the subwatershed boundaries within the City, the flow spills from the Little Etobicoke Creek subwatershed into the Applewood Creek subwatershed; no spill into the Cooksville Creek or Serson Creek subwatersheds is observed based on the model results. The flow hydrographs from the spill to these watersheds are of particular interest, as the spill crosses the jurisdictional boundary from TRCA into CVC.

A background review was conducted, including hydrologic and hydraulic models, previous study reports, historical flooding information (including July 8, 2013), aerial photography, light detection and raging (LiDAR) data, and GIS layers. Matrix expanded the existing MIKE FLOOD model to assess the predicted spill response to these various storm events, assuming existing conditions in the study area. As part of the Phase 1 study, a characterization of the riverine spill was conducted for the following:

- Regional storm (steady state)
- Regional storm (unsteady state)
- July 8, 2013 event
- 25- through 100-year design storms (based on City, TRCA, and CVC standards) using both the 12-hour Atmospheric Environmental Service (AES) and 24-hour Chicago distributions.

Flood risk characterization was completed for the 25-year through 100-year design storms as well as the Regional and July 8, 2013, events. The risk characterization is based on the factors defined by the Ministry of Natural Resources and Forestry (MNRF; previously the Ministry of Natural Resources; MNR 2002): depth, velocity, and depth x velocity product. An extensive set of flood risk characterization maps are provided in Progress Report No. 1 (Matrix 2018).

Flow hydrographs of spill from Little Etobicoke Creek in the neighbouring watershed of Applewood, Serson, and Cooksville creeks were key outputs of this phase of the project. The vast majority of the spilled flow enters the upper reaches of Applewood Creek. To account for the spill from TRCA into CVC jurisdiction, it is recommended to incorporate the spill hydrographs into the Applewood Creek hydrologic model at the most upstream flow node in the Applewood Creek watershed. Note that runoff from within the Applewood Creek watershed was not considered in the analysis; only spill flow from Little Etobicoke Creek has been incorporated into the modelling.

Since the completion of the Phase 1 report, the City has proceeded with the Dixie-Dundas Flood Mitigation Municipal Class EA. The purpose of the EA is to assess alternatives for mitigation of the spill from Little Etobicoke Creek and minimize flood risk in the existing spill area.

4 PROGRESS REPORT NO. 1A: FLOODPLAIN SPILL ASSESSMENT

Following the completion of Progress Report No. 1, Matrix refined the hydraulic model to incorporate the trunk storm sewers from Tonolli Road to Dixie Mall (Harvest Drive trunk sewer) as well as the Queen Elizabeth Way (QEW) crossing at Insley Road. CVC requested this assessment to review of the capacity of the trunk sewer to reduce water levels north of the QEW. This resulted in a three-way coupled MIKE FLOOD model, including the one-dimensional (1D) MIKE 11 model, the 1D MIKE URBAN model, and the two-dimensional (2D) MIKE 21 model. All three components are dynamically linked to allow flow exchange between each component.

The floodplain spill assessment included the required hydrologic and hydraulic modelling components to determine the effects of this sewer on the overland flow conditions resulting from the spill from Little Etobicoke Creek. The Harvest Drive and Insley Road trunk sewers were included in the model. The collector sewers are represented by their catch basins and lumped sewershed catchments connected directly to the trunk sewer. This enables two-way integration between the sewers and the surface at the mapped locations of the catch basins, without the complexities associated with modelling all sewers in the sewershed. Data for the trunk sewers and the collector sewers were provided by the City.

To determine the impact that the urban drainage system has on overland flooding from the Little Etobicoke Creek spill, two sets of assessments were done for each design storm event:

- steady-state riverine flows with the 10-year rainfall event applied to the MIKE URBAN system:
  - This scenario was developed to simulate a worst-case scenario, as it was assumed that the local sewers (which were not included in the model) have a 10-year capacity. Steady-state riverine flows ensure that the peak in the urban system aligns with the peak in the riverine system.
- unsteady-state riverine flows with the no rainfall applied to the MIKE URBAN system
  - This scenario simulates the event where the riverine and urban system peaks do not coincide. The unsteady-state runs were completed using hydrograph input to the riverine system and no runoff applied to the urban network; therefore, it is assumed the sewers are empty prior to receiving surface flow from riverine spill and conveyed through the 2D overland component.

Due to the variability in event-based rainfall patterns, it is difficult to comment on the available capacity in the sewer system during an event. The simulations completed for this study were intended to describe the bounds of potential events within the study area. In the unsteady-state runs, the lack of runoff applied to the urban system may overestimate the ability of the minor system to capture overland flow. In the steady-state runs, the steady influx of overland surface flow into the minor system may underestimate the ability of the minor system to capture overland flow and/or overestimate surcharge.

Both of the steady- and unsteady-state modelled flow scenarios indicate that the sewer system provides minimal benefit to the maximum flow depth in the rear yards along the Harvest Drive trunk sewer easement. As these scenarios were developed to provide the potential range of expected conditions, it is concluded that the storm sewer systems in this area provide an insignificant amount flood relief during Little Etobicoke Creek spill conditions.

5 PROGRESS REPORT NO. 2: MODELLING FOR FLOOD CHARACTERIZATION AND ANALYSIS

Progress Report No. 2 summarizes the development and preliminary results of a PCSWMM hydraulic model for the Little Etobicoke Creek watershed. Matrix developed a 2D surface drainage model of the Little Etobicoke Creek watershed, including the creek and the urban overland drainage system. A dual drainage model, including the storm sewer system, was not within the scope of this study.

The 2,260 ha model domain includes the entire watershed. Due to the size, and the inherent software limitations of PCSWMM, the model was split into two segments: the Upper Model (1,730 ha), from the headwaters of the Little Etobicoke Creek watershed to Eastgate Parkway, and the Lower Model (960 ha), from Eastgate Parkway to the confluence with Little Etobicoke Creek. Riverine flows from the Upper Model were input to the Lower Model as a point source boundary condition. No significant overland flows were found between the two models.

Flows in the hydraulic model are generated from catchments included in the PCSWMM model. A portion of the flow from each catchment was removed from the overland flow system to simulate the capacity of the minor system, which is not directly included in this model. Using this setup, the model was inherently ready to incorporate storm sewers in the flood cluster areas for the next stage of the study.

The development of the 2D hydraulic model was built upon the digital elevation model (DEM) layer based on LiDAR data provided by TRCA, with enhancements to represent the HEC-RAS cross-section geometry to define the low-flow channel not picked up by LiDAR, river centreline layer to provide directional mesh alignment along the river, curb lines and other abrupt topographic changes, and buildings and other flow path obstructions.

Data was not available for model calibration. Matrix validated the 2D model by comparing 100-year peak flows and volumes to existing Visual OTTHYMO v4 models, comparing 100-year and 5-year water levels to existing HEC-RAS models and comparing visually the July 8, 2013 storm event results to flooding reports.

Given the size of the study area, the PCSWMM model was developed for use as a high-level screening tool. The PCSWMM 2D model was used to simulate the 2- through 100-year 4-hour Chicago design storm events as well at the Regional storm, the July 8, 2013 event, and a climate change scenario. The results of these simulations were used to complete flood risk characterization based on the factors defined by the MNRF (MNR 2002): depth, velocity, and depth x velocity product. An extensive set of flood risk characterization maps are provided in Progress Report No. 2 (Matrix 2020a). The flood risk results were used to prepare for the next step of the project, which included preliminary screening of flood cluster areas and identification of flooding mechanisms as well as potential mitigation measures.

6 PROGRESS REPORTS NO. 3 AND NO. 4: FLOOD CLUSTER AREAS AND GENERAL CAUSES OF FLOODING

Progress Report No. 3 and No. 4 summarized the identified flood cluster areas and discussed the causes of flooding, respectively. Due to the timing of the project, these progress reports were published together, known as Progress Report Nos. 3 and 4 (Matrix 2020b). In this report, flood cluster areas were identified in areas of elevated flood risk based on the flood risk characterization (Progress Report No. 2), with consideration of locations with reported flooding on July 8, 2013, and TRCA's flood vulnerable area mapping (TRCA 2019). The identified flood clusters were assessed to determine primary sources of flood risk and frequency of flooding.

Seventy-two flood cluster areas were identified within the Little Etobicoke Creek watershed. While the majority of the high-risk flood areas are found in the main channel and valley corridor of Little Etobicoke Creek, additional high-risk areas are found at stormwater management ponds at low points on roads and at underpasses, reverse-sloped driveways, and in neighbourhoods adjacent to the creek. General causes of flooding throughout the watershed include major flow route deficiencies; reversed-sloped driveways;

properties located adjacent to the river; flow obstructions, including buildings, undersized channel structures (culverts and bridges), and undersized channels and floodplains. These potential causes of flooding were considered at each of the identified flood cluster areas.

In the upper portion of the watershed, the majority of flood clusters were caused by depths >0.8 m in loading bays and high velocities (>1.7 m/s) along the roadways. Many of the cluster areas in the lower portion of the watershed were identified as high risk due a combination of depth, velocity, and depth x velocity. The findings from the characterization led to a recommended assessment approach for each flood cluster. Each cluster area fell into one of six categories which included:

- **Additional modelling/assessment**: requires additional modelling to understand the flooding sensitivity and assess remediation alternatives. (21 flood clusters).
- **Modification to major flow route:** requires additional analysis to confirm remediation alternatives and ensure that the recommended modification will not cause flooding elsewhere (6 flood clusters).
- **Channel capacity:** flooding is associated with limited channel capacity. These areas are located in TRCA jurisdiction and have already been flagged through flood hazard mapping (3 flood clusters).
- **Monitor:** Matrix advises that the City not proceed to additional analysis at this time, but to monitor these areas during future flood events (15 flood clusters). This includes areas where one of the following occurs:
    - high-risk flooding is reduced with increased assumed capacity of the minor system
    - model limitations reduce the ability to accurately represent the minor or major system (thus reducing our confidence in flood severity at the given location)
- **Notification:** flooding occurs on private, commercial, or industrial property. The City can notify the owners, but no further action would be completed by City (25 flood clusters).
- **Separate study:** the Dixie-Dundas spill location cluster will be addressed within alternatives identified in a separate and future EA study (1 flood cluster).

Four locations in the upper watershed were marked for additional analysis either though additional modelling/assessment or modification to the major flow route. The highest-priority flood clusters in the upper watershed are the UP22 and UP21. Both these cluster areas show high-risk flooding during the 10-year event due to high velocities and depth x velocities. The flooding identified in UP22 affects over 50 residential houses by preventing safe egress to vehicles and pedestrians.

The majority of areas in the lower watershed (23 clusters) require some additional analysis, either through modelling or major flow route modification, to determine alternatives for flood remediation. Clusters LW11, LW26, and LW34 all affect more than 25 buildings from safe egress during a flood event.

However, these clusters will need to be considered in tandem with adjacent clusters to ensure flood remediation alternatives do not increase flooding in another area. Many flood clusters in the Lower Model have several flooding mechanisms that require development of a dual drainage model to test the effects of different remediation alternatives. Based on these findings and input from the City and TRCA, the locations of the dual-drainage model were chosen to be evaluated in the next stage of the project.

7 PROGRESS REPORTS NO. 5 AND NO. 6: FLOOD REMEDIATION MODELLING AND ASSESSMENT

Progress Reports No. 5 and No. 6 documented the flood remediation modelling and assessment of the remediation alternatives, respectively. Due to the timing of the project, these progress reports were published together, known as Progress Report Nos. 5 and 6 (Matrix 2020c). This progress report provides discussion on modelling and assessment of remediation measures at six focus areas encompassing 14 flood cluster areas. In addition, Progress Report Nos. 5 and 6 details completed assessments of the functionality of the City's current infrastructure on its own (level of service assessment) and in relation to Little Etobicoke Creek (riverine assessment).

To support the watershed scale flood evaluation study for Little Etobicoke Creek, an assessment of the existing minor drainage system was completed to determine the current level of service. Matrix developed a MIKE URBAN, including all the sewers and mapped catch basins within the watershed. Through the use of this model, the sewers were evaluated in terms of both water level in individual manholes and the capacity of individual sewer pipes. Level of service mapping was provided for the entire watershed. The level of service assessment was used to supplement the 2D surface modelling to understand urban flooding throughout each sewershed and facilitate the City's future planning and remediation efforts.

An additional analysis was conducted to determine the effects of high-water levels in Little Etobicoke Creek on the function of the storm sewer system. The storm sewers were mapped to determine the extents of backwater effects from Little Etobicoke Creek (without coincidental local flow) for the 2-year through 100-year design storms and the Regional storm. The riverine assessment was also used to supplement the 2D surface modelling to understand urban flooding throughout each sewershed to facilitate the City's future planning and remediation efforts.

Six focus areas were chosen based on the flood cluster designation general flood risk and potential to be remedied through City initiatives, as provided in Progress Report Nos. 3 and 4 (Matrix 2020b). Flood remediation alternatives for flood clusters within these six focus areas were developed based on the 2D PCSWMM model. The minor system was incorporated into two of these focus areas, where appropriate, creating a three-way coupled PCSWMM model. Specifically, the three-way coupled model was conducted in the two focus areas with identified potential to alleviate flood risk through future stormwater management facilities.

The existing conditions of the six focus areas are described in more detail in previous reports, with the existing condition used as the basis for assessment of various simulated remediation alternatives. A summary of the assessed remediation alternatives for each focus area is provided below:

Focus Area 1

This focus area was analyzed using the three-way coupled model. The remediation alternatives included the effects of adding a stormwater management facility in Golden Orchard Park through two potential sewer connections, upsizing of select sewers, additional inlets, and localized regrading. Various configurations were assessed; however, the additional storage yielded little reduction in flood risk at this location. The cost-benefit assessment indicated that a storage facility at Golden Orchard Park is not a feasible solution to alleviate flood risk. The most effective alternative was the addition of catch basins combined with localized regrading on Rathburn Road near Hickory Drive to better direct surface ponding into the sewer system. The additional inlets showed minimal impact to the capacity of the sewer system downstream.

Focus Area 2

This focus area was analyzed using a three-way coupled model to assess similar remediation alternatives as Focus Area 1, including a stormwater management facility at Kennedy Park and increased inlet capacity. Various adjustments were made to optimize conveyance to the stormwater management facility; however, the storage provided little reduction in flood risk at this location. The most effective alternative found to alleviate flood risk was the addition of inlets along Winding Trail and Dixie Road, coupled with localized regrading to direct flow into the sewer system. An additional alternative that also proved to be effective at reducing flood risk along Winding Trail was adding an overland flow route through Kennedy Park.

Focus Area 3

A potential sewer outlet from Runningbrook Drive via Cedarbrook Park was simulated using the 2D model to alleviate the flooding on Runningbrook Drive and surrounding streets. The model results indicate that this sewer outlet would provide a reduction in flood risk severity, particularly the high-risk areas along Runningbrook Drive and the Westwood Luxury Apartments. Increasing inlet capacity, adding additional inlets, or upsizing the sewer near Tomken Road could also help alleviate flooding further upstream, however additional assessment is required to evaluate this alternative. The recommended outlet pipe through Cedarbrook Park would need to be implemented before the minor system capacity upstream is increased.

Focus Area 4

Surface flooding in this focus area could potentially be reduced through minor regrading to improve overland flow routes. A series of curb cuts at Highgate Crescent and Greybrook Crescent were simulated in the 2D model. The results show that the curb cuts at each of the crescents are effective at reducing flood risk; however, the curb cut at Highgate Crescent contributes to areas of increased flood risk on

Golden Orchard Drive and Greybrook Crescent. To reduce flood risk on Highgate Crescent and avoid exacerbating issues downstream, another alternative would be to create storage on the St. Basil School property. Storing storm sewer and overland flows upstream would be more effective in reducing the flood risk downstream than providing an overland flow path alone. However, Matrix recognizes that there would be significant challenges to creating a storage facility within the school property and would likely involve property acquisition.

Focus Area 5

The 2D model was used to assess the benefits of creating an overland flow pathway from Hedgestone Court to Little Etobicoke Creek by regrading the easement. This remediation solution was successful in reducing some of the flood risk through Hedgestone Court. High-risk flooding remains in some areas and in the reverse sloped driveways. Some of the increases in flood risk can likely be mitigated through further refinement during detailed design as well as public education about floodproofing to the local residents. It is also recommended that additional inlets be placed at the entrance of the easement to capture flow into minor system before travelling between the residential developments. The City should also consider upsizing the current 750 mm outlet to Little Etobicoke Creek in coordination with regrading of the easement.

Focus Area 6:

Regrading of the easement from Taviton Court to Little Etobicoke Creek was simulated in the 2D model to provide a more direct major conveyance route to the Creek. The results show an overall reduction in flood risk within the court, but some high-risk areas are created by high velocities as water moves through the easement. Increases can likely be isolated to the easement and not impact the adjacent properties through detailed design, making it acceptable. Additional alternatives to mitigate flooding in this area include increasing inlet capacity on Taviton Court by adding catch basins or upsizing the single catch basin to a double catch basin on Taviton Court. The 1,350 mm outlet pipe would also need to be upsized to accommodate the additional inflows as it currently shows a reduce level of service.

8 PROGRESS REPORT NO 7: FLOOD ALTERNATIVES EVALUATION AND REMEDIATION PLAN

In the final installment of the Little Etobicoke Creek study, Matrix evaluated the remediation alternatives for the focus areas defined in Progress Report Nos. 5 and 6 (Matrix 2020c) and summarized the recommended works for the City’s consideration based on critical decision-making criteria. In addition to the focus areas, the 72 flood clusters initially identified in Progress Report Nos. 3 and 4 (Matrix 2020b) were reviewed to confirm the appropriate next steps, remediation strategies, and priority.

Remediation alternatives were evaluated based on flood risk reduction, social impacts, downstream impacts/residual flooding, and capital costs. Each criterion was ranked as none (no change), low, medium, and high. Flood risk reduction and downstream impacts/residual flooding were analyzed based on the area increase/decrease in flood risk severity (lowering the risk in flood areas), as defined by the MNRF (MNR 2002). The social impacts were assessed considering the short-term and long-term impacts (i.e., construction and final implementation) as well as likelihood of stakeholder acceptance. Planning level capital costs were based on general construction and do not include items such as property acquisition, lifecycle costs, flood damages, or operation and maintenance.

Recommendations from the criteria evaluation resulted in one of three options: not recommended, further study, and recommended. The recommended solutions for the City to pursue are provided in Table 2.

TABLE 2 Focus Area Recommendations Summary

Focus Area	Recommended Solution ID	Description	Priority	Approximate Cost
1	1c	Additional inlets and localized regrading	High	$185,000
2	2c	Additional inlets and localized regrading	High	$154,000
	2d	Overland flow path through Kennedy Park	Medium	$133,000
3	3a	Outlet pipe from Runningbrook Drive through Cedarbrook Park	Medium	$360,000
4	4b	Overland flow path from Greybrook Crescent to Little Etobicoke Creek	Medium	$63,000
5	5a, 5c	Curb cut to improve the overland drainage pathway from Hedgestone Court to the Creek, Public education about flood proofing (reverse sloped driveways)	Medium	$85,000
5	5b	Increase the number of catch basins on Fieldgate Drive and Hedgestone Court	Low	$60,000 $290,000[1,2]
6	6a	Creating an overland drainage pathway from Taviton Court to the Creek	Low	$85,000
6	6b	Increase the number of catch basins on Taviton Court and upsize the sewer outlet	Low	$450,000[3]

Notes:
Costs do not include construction items such as traffic control, access and staging, and erosion and sediment control.
[1] Cost with additional sewer and outfall upsizing.
[2] Recommend if Solution 5a is not carried out or if additional remediation is required to further reduce flood risk.
[3] Recommend if Solution 6a is not carried out or if additional remediation is required to further reduce flood risk.

9 CONCLUSION

The Little Etobicoke Creek Flood Evaluation Study was conducted in two phases as part of a final Master Plan for the City. Phase 1 was completed in January 2018 and expanded on previous studies of the overland spill from Little Etobicoke Creek, particularly focused on the Dixie-Dundas SPA. Since the completion of Phase 1, the City has proceeded with the Dixie-Dundas Flood Mitigation Municipal Class EA to assess alternatives for mitigation of the spill from Little Etobicoke Creek and minimize flood risk in the existing spill area.

Phase 2 of this study encompassed the Little Etobicoke Creek watershed as a whole: characterizing overland urban flood risk, developing and assessing flood remediation measures, and recommending alternatives the City can implement. Several modelling tools were used to assess flooding conditions in Little Etobicoke Creek watershed and determine the constraints of the existing storm sewer network. While the tools and formal assessment of alternatives focused on six localized areas in the watershed, the high-level analysis will help the City address flooding risk and infrastructure capacity issues throughout the watershed.

The detailed design of for the recommended alternatives from Phase 2 can now be moved through to implementation stages. Designs should consider other ongoing construction works and infrastructure upgrades planned by the City such as road widening or utility replacement to optimize the use of City budgets. In addition to implementing flood remediation measures, the City should continue public awareness and engagement with the local resident making them aware of flood risks. Encouraging the public to also notify the City when there is flooding will help to direct and prioritize future flood remediation efforts.

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