Toronto Basement Flooding Capacity Studies – Bundle D Assignment 47-17: EA Project File

Project File

September 29, 2023

Prepared for:

City of Toronto

Prepared by:

Stantec Consulting Ltd.

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TORONTO BASEMENT FLOODING CAPACITY STUDIES – BUNDLE D ASSIGNMENT 47-17: EA PROJECT FILE

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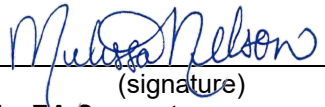
Prepared by 
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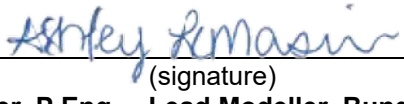
Prepared by 
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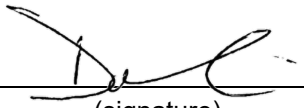
Ashley LeMasurier, P.Eng. – Lead Modeller, Bundle D

Prepared by 
(signature)

Faiz Bhatia, P.Eng., MBA – Deputy Project Manager, Bundle D

Reviewed by 
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Dave Eadie, P.Eng. – Head Modeller

Approved by 
(signature)

Nelson Oliveira, P.Eng. – Project Manager, Bundle D

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Abbreviations

1D	1-Dimensional
2D	2-Dimensional
AA	Archaeological Assessment
ASD	Assignment Scoping Document
BFPP	Basement Flooding Protection Program
CB	Catchbasin
CCTV	Closed-Circuit Television
CET	City's Cost Estimating Tool
CHR	Cultural Heritage Report
CSO	Combined Sewer Overflow
CSR	Customer Service Record
DEM	Digital Elevation Model
EA	Environmental Assessment
EA Act	Ontario Environmental Assessment Act, R.S.O. 1990
ESA	Environmentally Significant Area
ESR	Environmental Study Report
Ex.	Existing
FSIP	Field Survey and Investigation Program
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center's River Analysis System
HGL	Hydraulic Grade Line
ICI	Industrial-Commercial-Institutional (Land Use)
MEA	Municipal Engineers Association

MECP	Ministry of the Environment, Conservation and Parks
MH	Maintenance Hole
OF	Outfall
PIE	Public Information Event
PKDBS	Project Knowledge Database Structure
Pr.	Proposed
QA/QC	Quality Assurance and Quality Control
RG	Rain Gauge
ROW	Right-of-Way
SAN	Sanitary
SASP	Site and Area Specific Policy
SPA	Special Policy Area
SST	Solution Summary Table
STM	Storm
TM	Technical Memorandum
TRCA	Toronto and Region Conservation Authority
TWAG	Toronto Water Asset Geodatabase

Executive Summary

The Basement Flooding Protection Program (BFPP) Capacity Assessment Studies Project for Study Areas 46 to 61 and 63 to 67 seeks to characterize drainage system capacity and develop solutions to reduce the risk of basement and surface flooding within the remaining BFPP Study Areas in the City. The study areas have been grouped together in six Bundles across the City; Stantec Consulting Ltd. (Stantec) is undertaking the Bundle D and Bundle F assignments.

The study was carried out to assess the sanitary and storm/combined drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City under 2041 growth conditions. Based on guidance from the City, the basement flooding protection level has been set to the equivalent of the May 12, 2000 storm event for the sanitary system and the 100-year design storm for the combined/storm minor and major systems.

The City has embarked on a new approach in an effort to meet this objective, incorporating lessons-learned and feedback from previous projects. The overall approach includes two distinct, yet integrated, phases of the project: the initial Study Phase, and the Preliminary Design Phase. The objective of this effort is to reduce the risk of future basement and surface flooding resulting from shortfalls in the capacity of the municipal drainage systems. In other words, the focus of flood remediation efforts is on publicly derived sources, such as back-up of City sewer systems, or surface flooding emanating from the public right-of-way (ROW).

The primary focus from the Study Phase was on the development of Schedule A/A+ assignments where feasible, recognizing there may be a need for additional Schedule B and/or C Environmental Assessment (EA) activities for more involved solutions negatively affecting the social or natural environments. One assignment, 47-17, was identified during the Study Phase to be a Schedule B undertaking due to proposed outfall upgrades that fall outside of the public ROW.

SCOPE OF STUDY

The focus of this EA is Assignment 47-17 in Bundle D, with the geographic context of the entire Study Area 47 presented in **Figure ES. 1** below. This EA Project File reviews the assessments completed through the Study Phase for Area 47 with focus on Schedule B Assignment 47-17, with further elaboration on activities completed after the Study Phase to satisfy the Schedule B EA requirements for the assignment.

The study was carried out to assess the sanitary and storm drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City. To achieve this scope, the study included the following tasks:

- Municipal Class EA project Phase 1 activities, including agency consultation and community questionnaire.
- Comprehensive review of background data and available information to confirm existing field conditions, supplemented as required with additional field investigations.
- Identification and prioritization of the factors contributing to basement and surface flooding including interaction of the storm, sanitary and overland systems.
- Development of a Geographic Information System (GIS)-based topographical model to help define the major system surface drainage patterns and identify and quantify low lying or other problematic areas.
- Development of sanitary and storm drainage system hydrologic and hydraulic modeling tools.
- Confirmation and identification of potential basement flooding areas.
- Evaluation of various flood remediation measures and development of comprehensive cost-effective flood remediation plans to achieve the targeted hydraulic performance under future projected population.
- Where alternative flood remediation measures were developed, an assessment was completed based on hydraulic, environmental, and socio-economic factors to determine the recommended flood solution.
- Development of opinions of probable costs, implementation sequencing, and mitigation measures.

ASSIGNMENT AREA CHARACTERISTICS

Assignment 47-17 is located within the northeast portion of Study Area 47. Area 47 is 1,280 ha in size and is divided into upper and lower portions. The upper portion is roughly bounded by Victoria Park Ave to the west and the TTC Subway Line 3 to the east. It borders with Study Area 30 (EA completed 2008) to the north, Study Area 52 (EA in progress) to the east, Study Area 34 (EA completed 2018) to the south, and Study Area 22 (EA completed 2014) to the east. It also contains segments of Wilson Brook, East Don River tributary, and Massey Creek.

The lower portion is surrounded by Study Area 46 to the west, Study Area 55 (EA in progress) to the north, Study Area 32 (EA completed 2012) to the south, and Study Area 34 (EA completed 2018) to the east. Study Area 1 also cuts into Study Area 47 from the east. The lower portion roughly encapsulates Curity Creek and Taylor / Massey Creek.

Most of Study Area 47 is located in the Taylor / Massey Creek sub-watershed. Part of the East Don and sub-watersheds is also within the bounds of Study Area 47.

The general limits of Assignment 47-17 include Eglinton Ave to the south, Lawrence Ave to the north, Birchmount Rd to the west, and the railway corridor to the east. Storm sewers within Assignment 47-17 discharge to Taylor/Massey Creek.

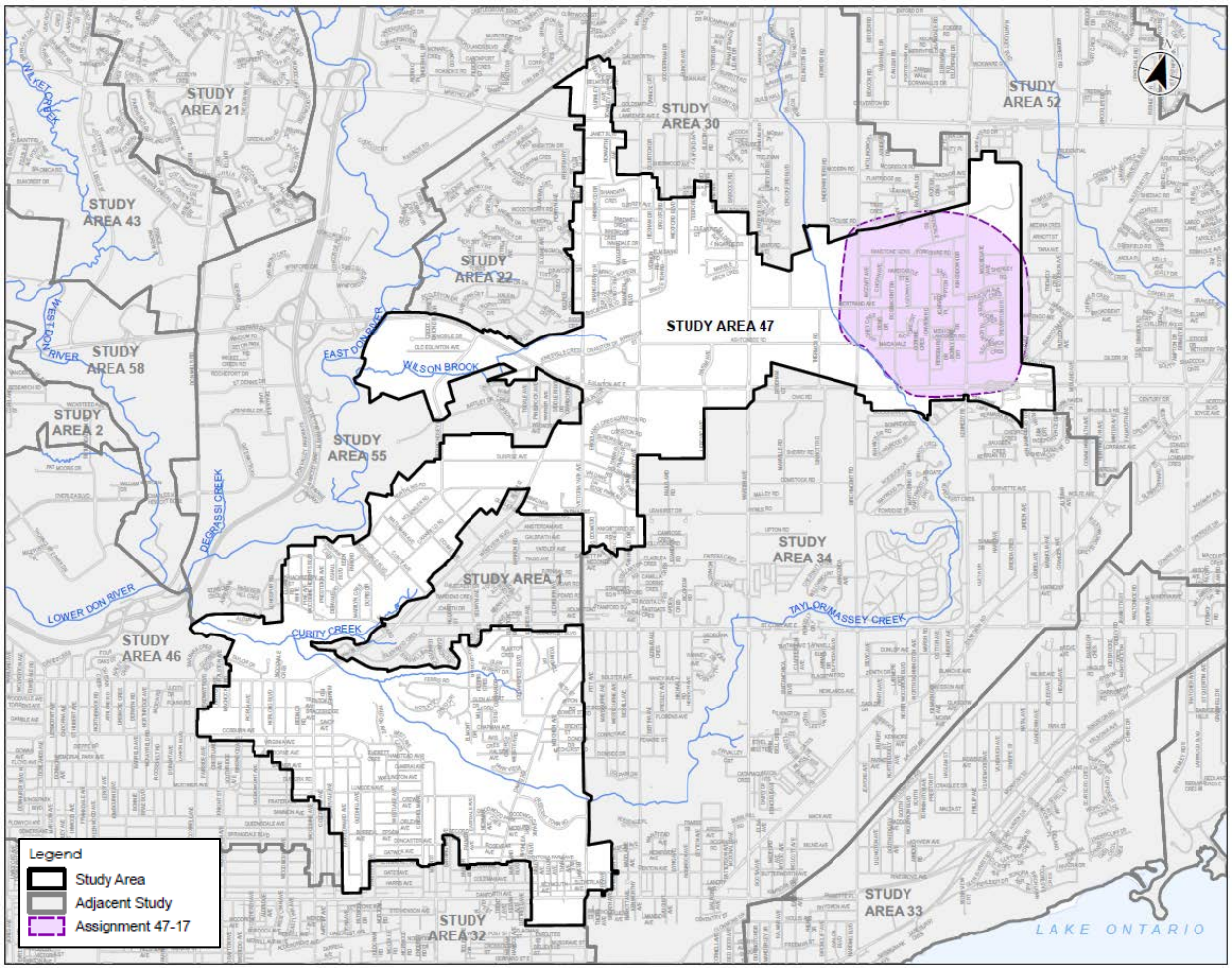


Figure ES. 1: Assignment 47-17 within entire Area 47

ASSESSMENT OF EXISTING CONDITIONS

System performance was assessed based on the Basement Flooding criteria and validated against flood records from historical events. The majority of reported flood issues are private-side related, and not chronic issues resulting from the capacity of the surface drainage or collection system. Some older flood complaints appear to have already been resolved by remediation works constructed after May 2000 and August 2005.

Field investigation and inspection were conducted to identify the specific characteristics of the study area and its drainage systems. An assessment was undertaken of the existing natural and built environments, as well as a review of available data sources and any previous studies. Historical flooding records and the public questionnaire results show that flooding incidents have occurred throughout the entire study area, but there are areas where flooding is clustered at numerous properties which may indicate temporary inadequacy of the sewer systems and/or surface drainage systems as opposed to site-specific issues.

An integrated hydrologic-hydraulic simulation model of the storm and sanitary network was developed, calibrated to flow monitoring data, and validated against historic flood records.

The overall background review, field investigations, public consultation and hydraulic modelling analysis revealed that the issues within in the storm minor system that are likely due to a combination of the presence of undersized sewers, high creek water level assumptions, shallow pipes, reverse driveways and/or cross-connections from dual MHs. The presence of dual MH interconnections between the storm and sanitary systems influence the performance of the collection systems.

The resulting model was used as a tool to assess the hydraulic performance of the existing drainage systems, identify their current performance level, determine potential causes of deficiencies, and develop remedial measures for the basement and surface flooding issues resulting from public drainage system performance. The overland drainage system within the assignment area, while generally showing a large degree of capacity to convey large events in the ROW, does exhibit some issues along portions of arterial / collector roads, where maximum allowable depths are generally lower, triggering exceedances in more frequent events.

Collectively, these factors contribute to episodes of surface and/or basement flooding from the public system under extreme rainfall events that exceed the original design capacity. Additionally, private side drainage issues such as poor lot grading, blocked laterals, reverse-driveways, etc., can also contribute to individual property flooding.

STUDY PROCESS AND CONSULTATION

The framework of the project approach and Study phase followed the guidelines of the Municipal Class EA document disseminated by the Ontario MEA (2000, amended 2007, 2011 & 2015). By following these guidelines, the Study satisfied the requirements of the Ontario Environmental Assessment Act through completion of Phase 1 of the Class EA process and set the framework to undertake Phase 2 activities for projects identified as Schedule B or C.

From the Study phase, Assignment 47-17 was identified as a Schedule B undertaking where the following additional review and consultation measures were taken:

- Detailed alternative review, including development of an additional Alternative 3 solution;
- Public consultation; and
- Advancement in consultation with agency stakeholders.

This Project File document is intended as a summary report, documenting Phase 1 and 2 of the Class EA. A Notice of Completion is submitted to review agencies and the public to allow for comment and input on this Project File for at least 30 calendar days from date of notice. Subject to comments received and the receipt of the necessary approvals, the City of Toronto intends to continue with the preliminary/detailed design and construction of the flood remediation measures to mitigate the risk of basement and surface flooding in Assignment 47-17.

AGENCY AND PUBLIC CONSULTATION

Consultation with agency stakeholders and the public was conducted with the following components:

- Notice of Commencement was issued September 15, 2022 on the City's webpage and in the September 22 and 29 Scarborough Mirror newspaper editions
- A public questionnaire was issued in Fall 2020 to addresses within the study area to help identify public-side flooding concerns.
- A notice of public consultation was issued to properties within the study area by Canada Post to notify them of the opportunity to review the study recommendations. Due to the Covid-19 pandemic, the City posted public consultation materials online from November 7, 2022 to November 25, 2022 as a virtual event hosted on a dedicated City website, including presentation materials with information pertaining to the study, EA process, existing conditions for Assignment 47-17, and alternatives and the preferred solution for the assignment.
- Through the Study Phase, the following groups were engaged: Mississauga's of the Credit First Nation, Toronto Parks, Forestry & Recreation, Toronto Water – Operations, Toronto Water – Stream Restoration Unit, Toronto Transportation Services, and Toronto and Region Conservation Authority (TRCA)
- Throughout the EA Phase, the following agency stakeholders were engaged: Toronto Hydro and TRCA

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

The baseline conditions represented the starting point from which solutions were required. Baseline conditions are represented by the design storm results, incorporating projected 2041 population on the sanitary model and an assumed 75% Downspout Disconnection for the storm model reflecting the intentions of the Wet Weather Flow Management Master Plan for new development to control onsite stormwater discharges to better than pre-development conditions under large storms.

There are several storm sewersheds based on physical outfall location to watercourses or boundary conditions with adjacent Study Areas, and a number of sanitary subsewersheds connecting to the trunk. Within each sewershed, Problem Areas were defined based on the criteria infractions of the baseline condition models and became the initial basis for presentation and communication regarding solutions. These Problem Areas were in some cases compiled into Solution IDs when the problem areas and/or solutions were close in proximity or connected. Through the solutions development process and in planning for construction and solution implementation, these Solution IDs were then compiled into Assignments based on hydraulic connectivity.

The approach to solution development was premised on the principle of conveyance within the municipal ROW as a first iteration, to maximize the number of solutions that fall within the Municipal Class EA Schedule A or A+ categorization. Where the initial solutions were constrained by unfavourable requirements, fell outside of the ROW, or may lead to Schedule B/C implications, alternative solutions were reviewed and assessed. Alternatives were evaluated based on fourteen (14) criteria. Each criterion was ranked either high, medium, or low impact with a corresponding score of 1,2, or 3 respectively. A

"low" ranking represents the lowest impact and most desirable, while a "high" ranking represents the highest impact and least desirable. Once each criterion was evaluated, the score from all criteria was totaled. Based on the total score, the most preferred alternative was the highest scored alternative and was selected for the Assignment ID.

SUMMARY OF ALTERNATIVES

Based on the performance of the storm and sanitary drainage system model, flood remedial measures were conceptually designed in the hydraulic model. Three alternatives were developed for Assignment 47-17 to relieve flooding and improve the storm system while meeting the City's guidelines. All three alternatives involve increased storm inlet capacity, storm conveyance upgrades, redirected storm flows, sanitary and storm inline storage, dropping a section of pipe within the sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrade, and include hydraulically disconnecting all dual MHs. Differences between the alternatives are summarized as follows:

- Alternative's 1 and 3 include redirected storm flows on Maidavale Rd. to Rosemount Dr.
- Alternative 2 includes redirected storm flows on Birchmount Rd. and Bertrand Ave to Reno Dr.
- Alternative's 1 and 3 include upgrades to two storm outfalls on Rosemount Dr and Birchmount Rd. Outfall pipe upgrade on Birchmount Rd north of Massey Creek connects into a 4 m diameter CSP culvert.
- Alternative's 2 and 3 include redirected storm flows into offline storage within Maidavale Park.

Based on the evaluation criteria and ranking, Alternative 1 is the recommended solution that best mitigates surface and basement flood risks, considering impact to the public and natural environment. The effectiveness of the recommended solution in relieving surface and basement flooding problems under the target level of service was determined using the hydraulic model.

RECOMMENDED SOLUTIONS

The recommended solution for Assignment 47-17 corresponds to Alternative 1 and is presented in **Figure ES.2**. A summary of the recommended solution is outlined below:

- Increase storm inlet capacity & provide conveyance upgrades throughout;
- Provide storm inline storage along Kingsdown Dr, Yorkshire Rd, Rosemount Dr, Losoway Dr, Bertrand Ave, Maida Vale Rd, Ranstone Grdns, Birchmount Rd, Chopin Ave, Mozart Ave, Hughey Cres, Reno Dr, Corinne Cres, Ionview Rd, Bonny Lynn Crt, Kennedy Rd, Shenley Rd, Stratton Ave, Treverton Dr, and Eglington Ave E;
- Provide sanitary inline storage along Ionview Rd;
- Redirect flows:
- Maidavale to Rosemount Dr
- Bertrand Rd west to Rosemount Dr
- Bertrand Rd east to Birchmount Dr
- Ionview Rd and Rensburg Dr south to Eglinton Ave E
- Ionview Rd west to Bertrand Ave;
- Upgrade and drop sanitary sewers on Rosemount Dr;

- Drop section of sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrades;
- Hydraulically disconnect all dual MHs; and,
- Upgrade two storm outfalls on Rosemount Dr and Birchmount Rd. Outfall pipe upgrade on Birchmount Rd north of Massey Creek connects into a 4 m diameter CSP culvert.

The opinion of probable costs for the recommended Assignment 47-17 flood solution is $234,049,097 based on version 4.1 of the City's CET. This cost covers the total anticipated construction cost, includes 30% contingency and is exclusive of HST.

With the implementation of flood solutions, there is a change to the quantity of water discharging to Taylor-Massey Creek, attributable to the improvement in drainage efficiency to meet surface depth and pipe water level criteria, even with significant in-line storage implemented. During the 2-yr storm, there is a net reduction in peak flow of 3.03 m^3/s, and during the 100-yr storm, there is a net increase of 0.71 m^3/s.

Based on the Stage 1 Archaeological study completed for the area, the recommended solution with outfall upgrades to Taylor-Massey Creek is considered to retain archaeological potential and requires further investigation at detailed design. All other proposed solutions within the municipal ROW do not require Stage 2 archaeological works.

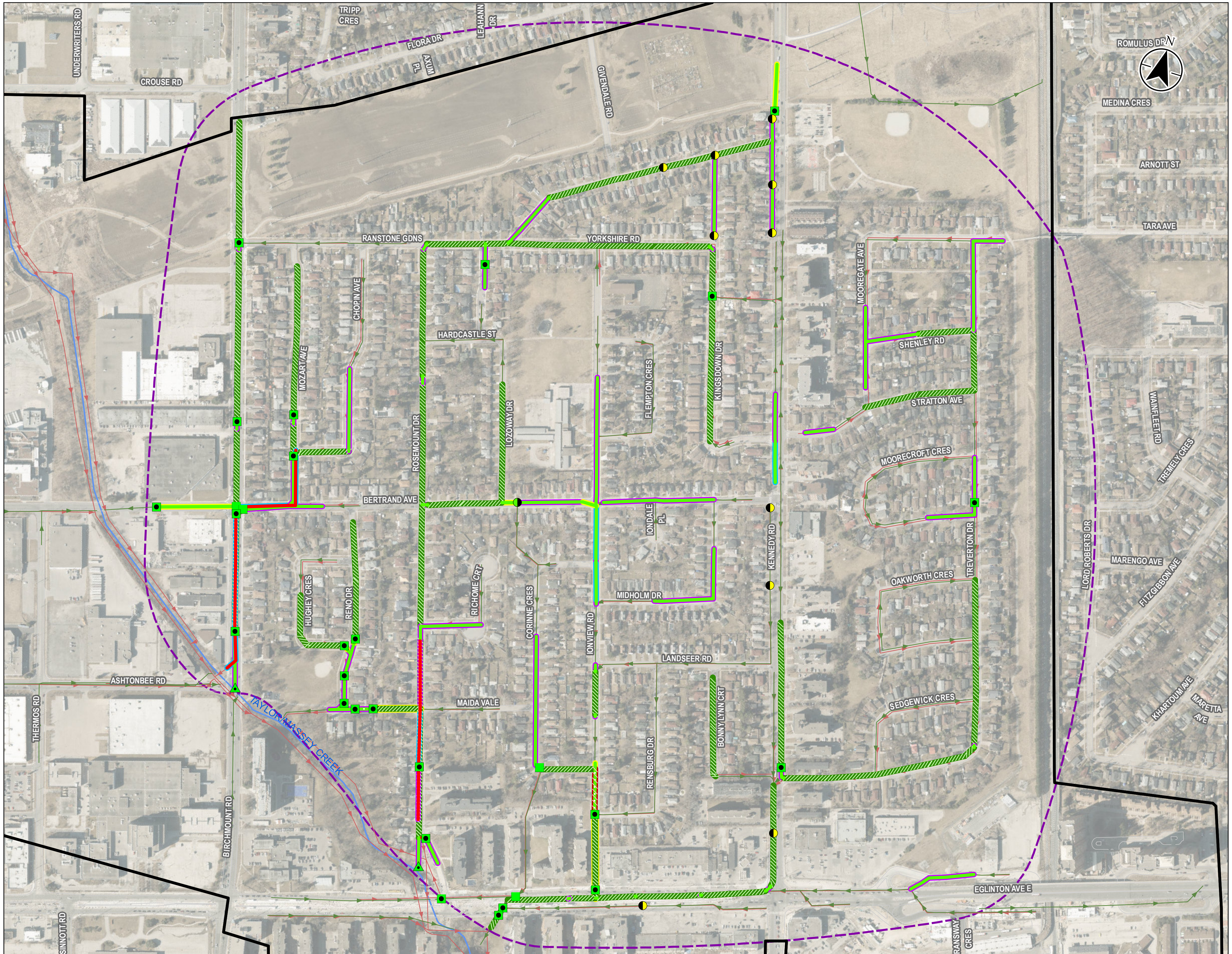
CONCLUSIONS

The following conclusions can be drawn from the completion of this EA Study:

- Through the initial Study Phase completed for the entire Area 47, several capacity issues were identified. Based on the review and interpretation of available background data, field investigations and resident input, the main causes of basement and surface flooding can be attributed to the following factors:
- Overloading of storm sewers, pipe bottlenecks, floodplain influence, presence of dual MHs, and lack of a continuous major system with trapped overland flow paths causing surface flooding.
- Alternative flood risk reduction solutions were identified at the Study Area-scale based on hydraulic connectivity (i.e., Assignments), and initially evaluated at a high-level including agency consultation to select the preferred solutions that would fall within the ROW. Through this process, one Assignment (47-17) was identified as potentially having greater environmental and social impacts due to proposed flood solutions outside of the ROW and proceeded to completion of the Schedule B EA process with additional agency/public consultation, alternative solution review/refinement, and evaluation, as documented in this Project File.
- Through the EA process, an additional flood solution alternative was developed (Alternative 3). All three alternatives were evaluated based on social, economic, environmental and constructability criteria using a scoring method. Due to its comparatively lower cost and maintenance requirements, improved level-of-service, and its limited social and environmental impacts, Alternative 1 was selected as the recommended alternative solution for Assignment 47-17.

- With the implementation of the preferred flood remedial measures, the storm drainage system can convey both the major and minor systems during the 100-year design storm within the City surface depth and HGL criteria with limitations stemming from downstream watercourse levels only. Similarly, with the proposed flood remedial measures, the sanitary drainage system can convey the May 12, 2000, event.
- With the implementation of flood solutions, there is a change to the quantity of water discharging to Taylor-Massey Creek, attributable to the improvement in drainage efficiency to meet surface depth and pipe water level criteria, even with significant in-line storage implemented. During the 2-yr storm, there is a net reduction in peak flow of 3.03 m3/s, and during the 100-yr storm, there is a net increase of 0.71 m3/s.
- The recommended improvement works to help address the flooding problem in 47-17 is estimated at a total construction cost of $234 million (2022 Canadian dollars) net to the City.
- Based on the Stage 1 Archaeological studies, the recommended solution with outfall upgrades to Taylor-Massey Creek is considered to retain archaeological potential (and requires further investigation at detailed design). All other proposed solutions within the municipal ROW do not require Stage 2 works.
- Protected properties and places of cultural heritage value or interest have been identified within the Assignment boundary. As such, additional assessment will need to be completed during the preliminary design phase to identify, evaluate, assess the impacts, and provide recommendation to mitigate the effects of the undertaking on cultural heritage resources including built heritage and cultural landscapes.
- The Municipal Class EA Master Planning process (Phases 1 and 2) has been fulfilled through public consultation including one public information event, agency consultation, and the submission of this Project File document.

It is recommended that the Assignment proceed to preliminary design, subject to City prioritization, additional agency consultation, and commence with implementation as Capital budgeting allows.



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Legend

- Study Area
- Assignment 47-17 Area
- Storm Sewer
- Sanitary Sewer

Proposed Solutions

- Bulkhead Dual MH
- Increase Inlet Capacity
- Isolate MH
- Upgrade Outfall
- New Storm Sewer
- Replace Storm Sewer
- Upgrade Storm Sewer
- Realign and Upgrade Storm Sewer
- Storm Inline Storage
- New Storm Inline Storage
- Replace Sanitary Sewer
- Upgrade Sanitary Sewer
- Sanitary Inline Storage

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Notes

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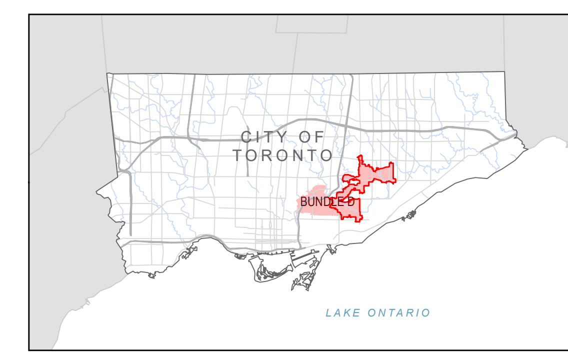


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-15

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
ES.2

Title
Assignment 47-17

1.0 INTRODUCTION

The Basement Flooding Protection Program (BFPP) Capacity Assessment Studies Project for Study Areas 46 to 61 and 63 to 67 seeks to characterize drainage system capacity and develop solutions to reduce the risk of basement and surface flooding within the remaining BFPP Study Areas in the City. The study areas have been grouped together in six Bundles across the City; Stantec Consulting Ltd. (Stantec) is undertaking the Bundle D and Bundle F assignments. The focus of this Environmental Assessment (EA) is Assignment 47-17 in Bundle D, with the geographic context of the entire Study Area 47 presented in **Figure 1**—1.

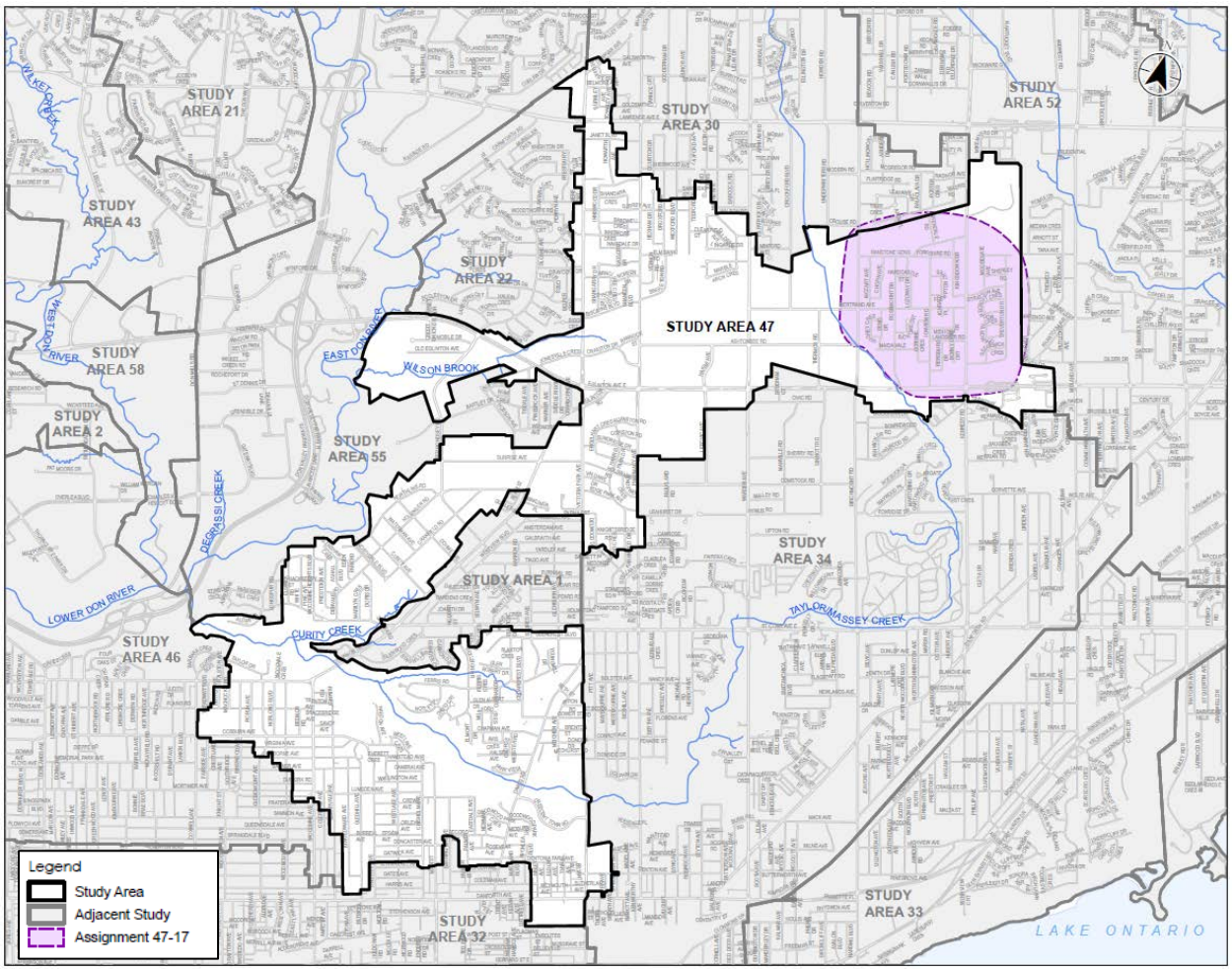


Figure 1—1: Assignment 47-17 within Study Area 47

This EA Project File reviews the assessments completed through the Study Phase for Area 47 with focus on Schedule B Assignment 47-17, with further elaboration on activities completed to satisfy the Schedule B EA requirements for the assignment.

2.0 STUDY OVERVIEW

This section reviews the approach and scope of the Capacity Assessment Study completed for Study Area 47. The elements from this Study provide the basis for the EA for Assignment 47-17.

2.1 PROJECT OBJECTIVES AND APPROACH

The City has embarked on a new approach in an effort to meet this objective, incorporating lessons-learned and feedback from previous projects. The overall approach is demonstrated in Error! Reference source not found., indicating two (2) distinct, yet integrated, phases of the project: the initial Study Phase, and the Preliminary Design Phase. The objective of this effort is to reduce the risk of future basement and surface flooding resulting from shortfalls in the capacity of the municipal drainage systems. In other words, the focus of flood remediation efforts is on publicly derived sources, such as back-up of City sewer systems, or surface flooding emanating from the public right-of-way (ROW).

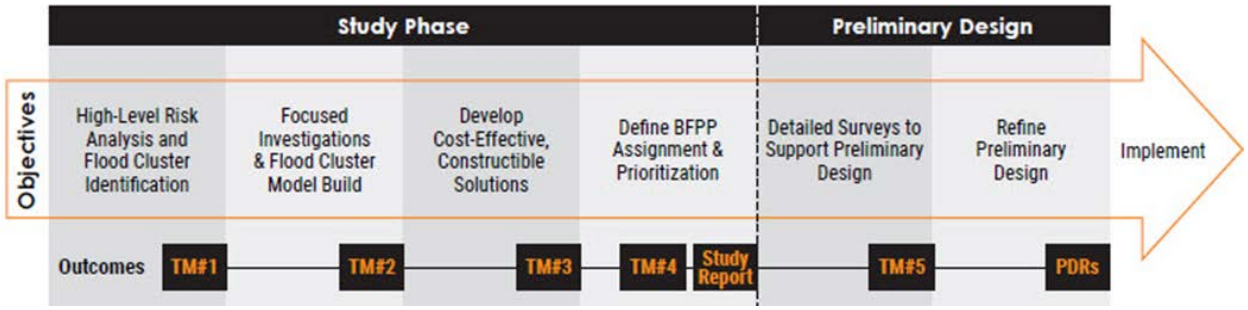


Figure 2—1: Overall Project Approach

The project was supported by a series of four (4) Technical Memoranda (TM) which detail the analysis, findings, and recommendations at the following key stages:

- TM1 – Preliminary Assessment and Flood Cluster Identification (Attachment 1)
- TM2 – Hydrologic and Hydraulic Modelling and Assessment (Attachment 2)
- TM3 – Recommended Solutions Development (Attachment 3)
- TM4 – Assignment Scope Development and Prioritization

The primary focus from the Study Phase was on the development of Schedule A/A+ assignments where feasible, recognizing there may be a need for additional Schedule B and/or C EA activities for more involved solutions negatively affecting the social or natural environments. Select Schedule A/A+ assignments may then proceed to Preliminary Design in consultation with the City. The overall workflow for the Study and Preliminary Design Phases are presented in **Figure 2**—2.

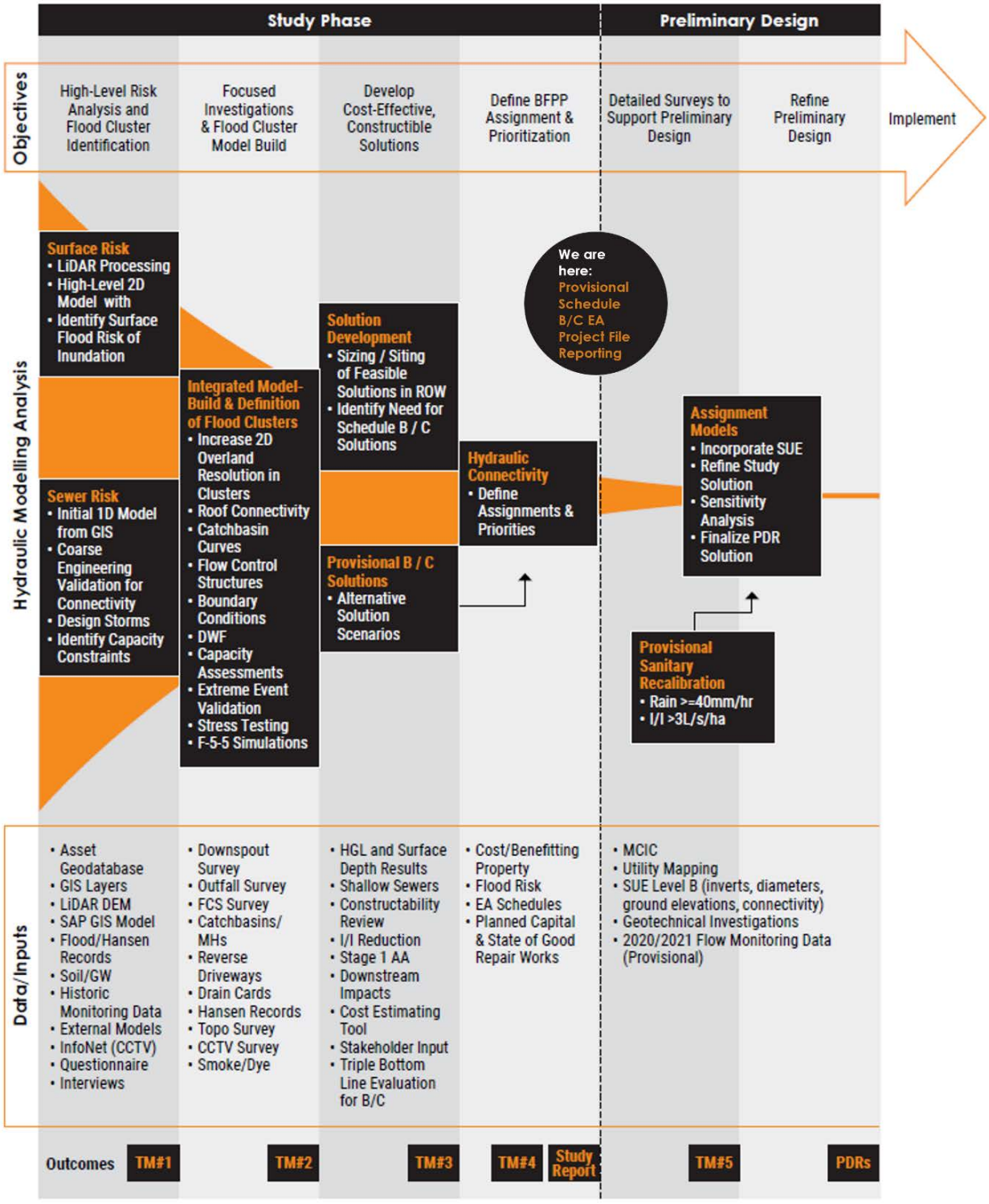


Figure 2—2: Overall Project Workflow

Following the solution development components through TMs 3&4 with summary in the Study Report, 20 assignments were identified, 19 of which were considered Schedule A/A+, while 1, Assignment 47-17, was identified as a Schedule B undertaking and is therefore the focus of this EA report. The Assignments identified within the Study Area are shown in Figure 2—3.

The TMs and Study Report from the Study Phase form the basis of the material used to create this Project File EA report. Each study report was prepared in accordance with Phase 1 of the Municipal Engineers Association's (MEA's) Municipal Class EA Process (October 2000, as amended in 2007, 2011 & 2015).

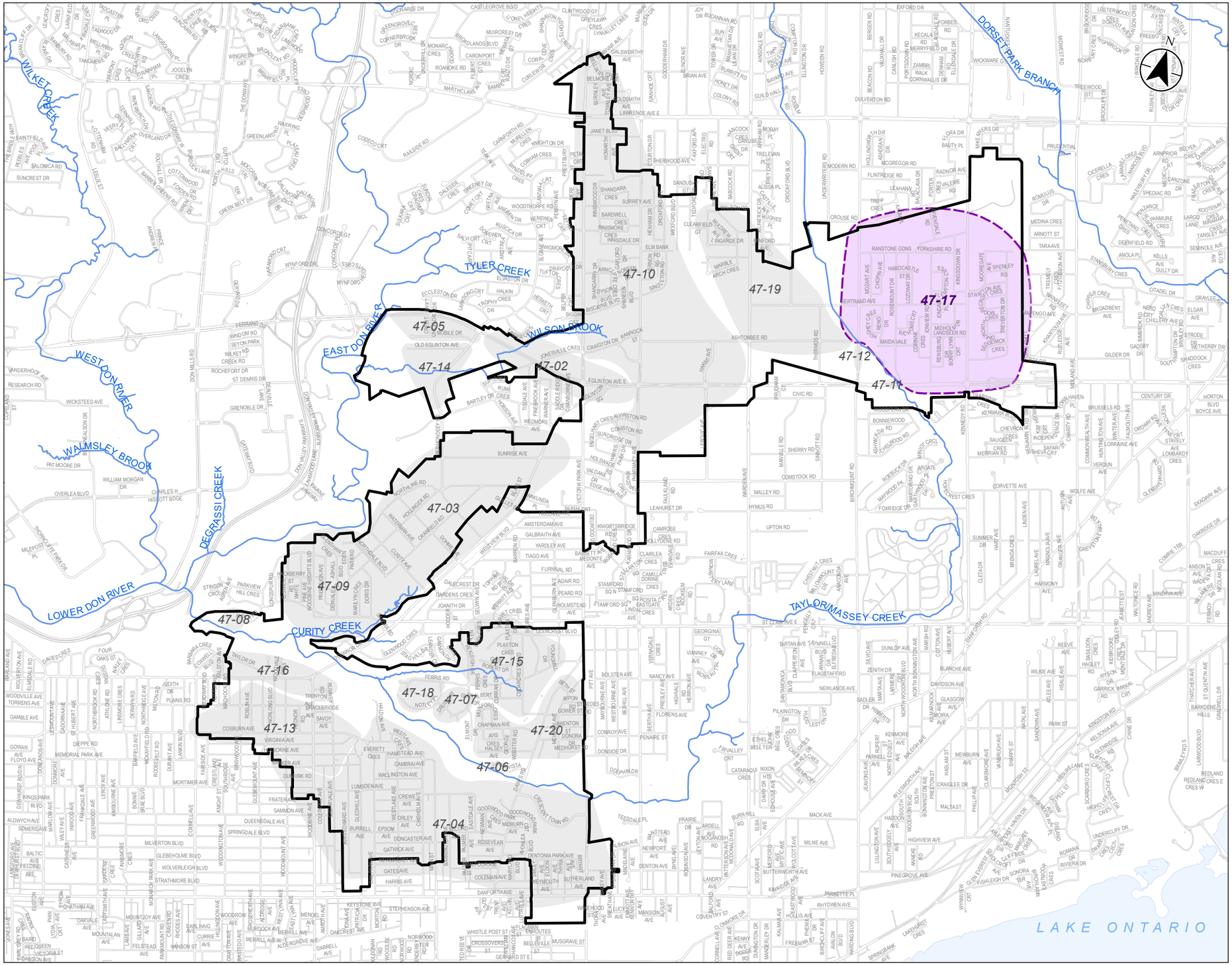
The study report for Area 47 summarizes TM1 to TM4. A brief synopsis of each TM is provided in the following sub-sections. TMs 1-3 are included as attachments to this Project File Report.

2.1.1 Overview of TM1

TM1, developed in Stage 1 of this capacity study, outlined the initial desktop data collection and review process, including the definition of initial high-level, risk-based 2-dimensional (2D) surface and 1-dimensional (1D) sewer models (InfoWorks ICM v.10.0.4) to help define initial capacity restrictions in the drainage systems. Through data overlay and interpretation, focus areas were defined based on data uncertainty and/or elevated risk of surface/basement flooding that were then subject to a Field Survey and Investigation Program (FSIP). The primary objective of the FSIP was to collect additional desktop and field information to help reduce the amount of uncertainty in priority areas of the hydraulic model and study area. The program was undertaken through four components including Additional Desktop Review, Field Survey (Inventory) of Physical Building/Topographic Features, Flow Control Structure Inspections, and Flow Monitoring Plan. The FSIP was a staged process undertaken in parallel activities with Stage 2 (TM2).

2.1.2 Overview of TM2

Based on the high-level analysis and definition of areas at risk from Stage 1 (documented in TM1), Stage 2 involved detailed validation of the Stage 1 model in identified focus areas. TM2 documented the FSIP data collection process and findings; advanced the Stage 1 High-Level model with more detail in the areas of focus as defined by the Stage 1 sub-cluster assessment; incorporated the storm drainage topographic subcatchments and 1D overland network, including FSIP survey data; refined the sanitary model with dry weather flow parameters based on available flow monitoring data; established the existing condition storm and sanitary collection system performance, cross-referencing against available historic customer service records reports of non-private side flooding; interpreted the potential contributing factors to capacity issues, based on the hydraulic model performance against TM1 data; and, provided recommendations for suitability of the storm/combined drainage and sanitary models for proceeding to solution development, and whether any additional field work was warranted.



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Other Assignmnet Area

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Notes

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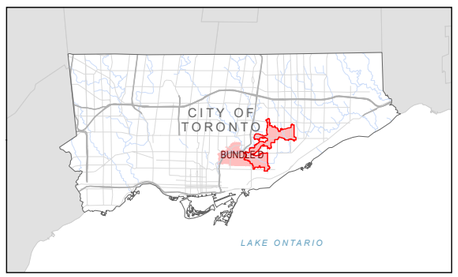


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-10

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
2.3

Title
Study Area 47 Assignments

2.1.3 Overview of TM3

TM3 presents the development and evaluation of various measures for surface and basement flooding remediation completed in Stage 3 of this capacity study. TM3 includes a review of the design criteria, constraints, and approach to solution development; the definition of Problem Areas based on modelled system results; the development of solutions to mitigate modelled capacity constraints in the surface and subsurface system; cost estimation using version 4.1 of the City's Cost Estimating Tool (CET); desktop evaluation of solution constructability; initial assessment of the EA Schedule; list of basement flooding criteria exempted nodes/links and corresponding rationale; initial evaluation of Closed-Circuit Television (CCTV) survey status and potential needs to inform the approach to collecting additional data before the Preliminary Design; and, sets the stage for TM4 prioritization and definition of Preliminary Design Assignments.

The results of this TM provide the basis for the TM3 activities of establishing which projects require additional evaluation under the EA Process, and which Schedule A/A+ projects can be prioritized for advancement to the Preliminary Design stage.

Completion of draft TM3 informed the development of draft TM4, and in turn the draft TM4 elements of grouping Solutions into Assignments and factoring in the cost/benefitting property have been incorporated into the final TM3. Final TM3 and final TM4 are therefore completely integrated.

2.1.4 Overview of TM4

While integrated with TM3, TM4 documents the constructability details and cost per benefitting properties for all considered alternatives. The selected preferred alternative solutions are grouped into assignments based on connectivity and evaluated for eligibility with respect to the cost per benefitting property threshold. Recommended solutions are then compiled in Assignment Scoping Documents (ASDs). ASDs provide a visual overview of the proposed work and area, includes details on the components within the assignment, and outlines constructability considerations and any additional City Capital Works that are part of the scope going forward. As part of TM4, the proposed assignments are also prioritized for implementation based on key criteria that rationalizes the impact, cost, complexity, and capital coordination of each undertaking. In essence, TM4 presents the scope of flooding solution assignments for advancement to the preliminary design stage or identifies where further Phase 2 EA review is required for Schedule B/C assignments. Results of TM4 indicated that 47-17 is a Schedule B assignment due to proposed outfall upgrades that fall outside of the public right-of-way and would therefore require completing an EA.

2.2 SCOPE OF STUDY

The study was carried out to assess the sanitary and storm drainage systems to identify the potential factors, mechanisms and impacts of surface and basement flooding and to develop comprehensive flooding remediation plans that best meet the target level-of-service criteria of the City. To achieve this scope, the study included the following tasks:

- Municipal Class EA project Phase 1 activities, including agency consultation and community questionnaire.
- Comprehensive review of background data and available information to confirm existing field conditions, supplemented as required with additional field investigations.
- Identification and prioritization of the factors contributing to basement and surface flooding including interaction of the storm, sanitary and overland systems.
- Development of a Geographic Information System (GIS)-based topographical model to help define the major system surface drainage patterns and identify and quantify low lying or other problematic areas.
- Development of sanitary and storm drainage system hydrologic and hydraulic modeling tools.
- Confirmation and identification of potential basement flooding areas.
- Evaluation of various flood remediation measures and development of comprehensive cost-effective flood remediation plans to achieve the targeted hydraulic performance under future projected population.
- Where alternative flood remediation measures were developed, an assessment was completed based on hydraulic, environmental, and socio-economic factors to determine the recommended flood solution.
- Development of opinions of probable costs, implementation sequencing, and mitigation measures.

2.3 DESCRIPTION OF THE STUDY AREA AND ASSIGNMENT

As shown in **Figure 1**—1, Assignment 47-17 is located within the northeast portion of Study Area 47. Area 47 is 1,280 ha in size and is divided into upper and lower portions. The upper portion is roughly bounded by Victoria Park Ave to the west and the TTC Subway Line 3 to the east. It borders with Study Area 30 (EA completed 2008) to the north, Study Area 52 (EA in progress) to the east, Study Area 34 (EA completed 2018) to the south, and Study Area 22 (EA completed 2014) to the east. It also contains segments of Wilson Brook, East Don River tributary, and Massey Creek.

The lower portion is surrounded by Study Area 46 to the west, Study Area 55 (EA in progress) to the north, Study Area 32 (EA completed 2012) to the south, and Study Area 34 (EA completed 2018) to the east. Study Area 1 also cuts into Study Area 47 from the east. The lower portion roughly encapsulates Curity Creek and Taylor / Massey Creek.

Most of Study Area 47 is located in the Taylor / Massey Creek sub-watershed. Part of the East Don and sub-watersheds is also within the bounds of Study Area 47.

The general limits of Assignment 47-17 include Eglinton Ave to the south, Lawrence Ave to the north, Birchmount Rd to the west, and the railway corridor to the east. Storm sewers within Assignment 47-17 discharge to Taylor/Massey Creek.

3.0 THE ENVIRONMENTAL ASSESSMENT PROCESS

The Study Phase for Area 47 followed the Ontario Municipal Class (EA) process which has resulted in the submission of this Project File Report for Assignment 47-17. The Ontario Class EA process, Study phase consultation and EA phase consultation is discussed herein.

3.1 ONTARIO ENVIRONMENTAL ASSESSMENT ACT

The planning of major municipal projects or activities (e.g., an upgrade or expansion of an existing water, wastewater, or stormwater servicing area) is subject to the Ontario Environmental Assessment Act, R.S.O. 1990 (EA Act). The EA Act requires the proponent (in this case, the City) to complete a Municipal Class EA, for a basement and surface flooding infrastructure master planning exercise. Environmental impacts that the proposed undertaking may have must be identified, and mitigation measures outlined. The EA Act defines the environment in terms of physical, natural, social, and cultural aspects. The following provides more information on the planning process that governs this undertaking.

3.1.1 Municipal Class Environmental Assessment Process

The Municipal Class EA process was developed by the Municipal Engineers Association (MEA) as an alternative method to Individual EAs for recurring municipal projects that are similar in nature, usually limited in scale, and with a predictable range of environmental effects that are responsive to mitigating measures.

The Class EA procedure does not require application for additional approvals under the EA Act, provided the proponent has complied with the necessary requirements and procedures. These requirements and procedures include a full description of the project, consideration of alternatives, and identification of the impacts resulting from their initiation and continuance. The Class EA process also requires the proponent to inform and consult with the public and concerned agencies.

Projects are classified in four categories under the Municipal Class EA process:

Schedule A Projects: These projects are limited in scale and will result in minimal impact on the environment and consist of normal or emergency maintenance and operational issues. The projects are normally pre-approved and may proceed without following the entire EA planning procedure, such as normal or emergency operational and maintenance activities.

Schedule A+ Projects: These pre-approved projects are limited in scale and will result in minimal impact on the environment; however, the public must be advised prior to project implementation.

Schedule B Projects: When the nature of the project dictates that there is a potential for adverse environmental impact, the proponent is required to follow a process of evaluating alternative solutions to the undertaking which includes mandatory contacts with directly affected public and relevant review agencies, in order to factor in their concerns in the process. Projects defined under this classification must be documented in the form of a Project File and be filed for review by the public and review agencies.

Schedule C Projects: Under the Schedule C classification, there is a potential for significant environmental impacts; therefore, the project must proceed under the full planning evaluation and documentation procedure defined in the Class EA document. Projects defined under this classification must be documented in the form of an Environmental Study Report (ESR) and filed for review by the public and review agencies.

Agreements made or commitments given by the proponent to affected review agencies or the public during the course of the screening process must be followed through and implemented; otherwise, the proponent is in contravention of the EA Act, and may be subject to a penalty.

The EA process in Ontario follows a logical decision-making process and incorporates all aspects of:

- Identification of the problem or need for the project (Phase 1);
- A thorough evaluation of the planning options or alternative solutions to the problem based on defined screening criteria (Phase 2, the last phase for Schedule B projects);
- An assessment of design alternatives (pre-design for Schedule B projects, or Phase 3 for Schedule C projects);
- The completion of documentation for the public record (Project File for Schedule B projects or Phase 4 – ESR for Schedule C projects); and
- The implementation of the project including design with appropriate monitoring during construction (Phase 5).

All projects proceed to Phase 5 once they have been approved. The Class EA guideline document provides a detailed description of the phases and schedule requirements.

3.2 PROJECT EA APPROACH

The framework of the project approach and Study phase followed the guidelines of the Municipal Class EA document disseminated by the Ontario MEA (2000, amended 2007, 2011 & 2015). By following these guidelines, the Study satisfied the requirements of the Ontario EA Act through completion of Phase 1 of the Class EA process and set the framework to undertake Phase 2 activities for projects identified as Schedule B or C.

From the Study phase, Assignment 47-17 was identified as a Schedule B undertaking where the following additional review and consultation measures were taken:

- Detailed alternative review, including development of additional Alternative 3 solution;
- Public consultation; and
- Advancement in consultation with agency stakeholders.

The above measures are discussed in the following sections of this Project File Report.

3.3 STUDY PHASE

Consultation documentation from the Study Phase is provided in Appendix D of **Attachment #3 - TM3**. The following sub-sections discuss the consultation performed during this phase.

3.3.1 Public Consultation

During the Study Phase, the public was notified of the study via the City's website and a mailout seeking public input via online questionnaire regarding their flooding experiences.

A public questionnaire was issued in Fall 2020 to addresses within the study area to help identify public-side flooding concerns. A list of addresses where questionnaire responses may be helpful in identifying public-side flooding concerns was compiled and provided to the City for distribution in the fall of 2020 (refer to Section 2.3.5 of **Attachment #2 – TM#2** for further details).

A total of 56 questionnaires were sent to residents within the Assignment 47-17 area with one respondent. The respondent indicated the presence of a basement with no flooding concerns. There was no other public consultation during the Study Phase.

3.3.2 Agency and Indigenous Communities Consultation

The following stakeholders were engaged through the Study Phase:

- Mississauga's of the Credit First Nation
    - Received July 7, 2021 through archaeology assessment correspondence
    - Received July 14, 2022 through archaeology assessment correspondence and incorporated into assessment documentation (see **Section 4.4.3**).
- Toronto Parks, Forestry & Recreation
    - Workshop #1: held May 20, 2021
- Toronto Water – Operations
    - Workshop #1: held May 20, 2021
- Toronto Transportation Services
    - Workshop #1: held May 20, 2021
- Toronto Water – Stream Restoration Unit
    - Workshop #3: held September 21, 2021
- Toronto and Region Conservation Authority (TRCA)
    - Workshop #2: held June 22, 2021 with TRCA
    - Area 47 Proposed Solutions Memo Review: September 10, 2021
    - Area 47 Study Report Review: October 12, 2021
    - Bundle D Pre-Consultation Meeting and Package for Schedule A/A+ or Schedule B assignments within TRCA regulated limits: May 13, 2022
- Chippewas of Rama First Nation, Chippewas of Scugog Island First Nation, Beausoleil, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation, Alderville First

Nation, Six Nations of the Grand River, and Huron-Wendat for issuance of Stage 1 Archaeological Assessment
    - No comments received

3.4 EA PHASE

Following the Study Phase, additional consultation was undertaken through the EA phase, as documented herein.

3.4.1 Public Consultation

Following the Study Phase, the following public consultation was undertaken:

- Notice of Commencement
    - Issued September 15, 2022 online and in the September 22 and 29 Scarborough Mirror newspaper editions.
- Public Information Event #1
    - A Notice of Commencement and Consultation was issued by Canada Post to all properties in the study area to advise of consultation opportunities. Commenting period was held between November 7, 2022 to November 25, 2022.
    - Consultation material, consisting of a presentation, was posted on the City's dedicated webpage and included information pertaining to the study, EA process, existing conditions for Assignment 47-17, and alternatives and the preferred solution for the assignment. The presentation materials are provided in **Appendix A**.
    - A summary of public consultation for the EAs under Bundles D & F of the BFPP, is provided in **Appendix A**. The following comments were received for Assignment 47-17:
        - One (1) resident asked for location information on BF Study Area 30. The City provided the Area 30 BF solutions map.
        - One (1) resident asked to be kept updated on the progress of the Study. The City recorded the resident’s information for future communication.

3.4.2 Agency and Indigenous Communities Consultation

The following agency stakeholders were engaged through the EA Phase:

- Toronto Hydro – Provided a general letter for clearances. No asset data provided.
- TRCA
    - The TRCA provided comments on the information presented in PIE#1 on February 6, 2023. The City provided responses on March 16, 2023 and additional comments were received from the TRCA on May 16, 2023. The comments and responses are provided in **Appendix A**.
- Chippewas of Rama First Nation, Chippewas of Scugog Island First Nation, Beausoleil, Curve Lake First Nation, Hiawatha First Nation, Mississaugas of Scugog Island First Nation, Alderville First

Nation, Six Nations of the Grand River, Huron-Wendat, and Mississauga's of the Credit First Nation for issuance of Notice of Study Commencement and Public Consultion

- No comments received

3.4.3 Notice Of Completion

The filing of this Project File and the issuance of the Notice of Completion fulfill the requirements for Phases 1 and 2 of the Class EA process. Subject to comments received and the receipt of the necessary approvals, the City of Toronto intends to continue with the preliminary/detailed design and construction of the flood remediation measures to mitigate the risk of basement and surface flooding in Study Area 47-17.

4.0 EXISTING CONDITIONS

Information pertaining to the existing drainage systems, boundary conditions, socio-economic environment, and physical and natural heritage for Assignment 47-17 and the surrounding Area 47 are discussed in the following sections.

4.1 DRAINAGE SYSTEMS

The following sections describe the existing combined / sanitary, storm and overland drainage systems.

4.1.1 Combined and Sanitary Sewer System

As illustrated in **Figure 4**—1, the sanitary sewers drain southeast to the Massey Creek STS. The Massey Creek STS flows through Study Area 34 and back into Study Area 47 at the eastern boundary of its lower portion, from which point the trunk follows the Taylor / Massey Creek from beyond the Study Area 34 boundary to where the East and West Don STSs and the North Toronto STS converge, at the boundary of Study Area 46. The trunk then discharges into the Coxwell STS, flowing south through Study Area 46 and Study Area 32 to the Ashbridges Bay Treatment Plant. There is approximately 13 km of sanitary sewer within Assignment 47-17, with pipe sizes ranging from 200 to 300 mm in diameter. The sanitary sewers date between 1950 and the 1990s, with the majority dating back to the 1950s and 1960s. There are no combined sewers within this assignment area. The age of the system has resulted in a variety of different property connections existing to various systems, with differing design criteria depending on the location. This results in uncertainty in any specific location, given the inconsistency reported in property connectivity and potential for building retrofit over time. It is believed that foundation drains were originally connected to the storm and sanitary sewer system if they existed at all.

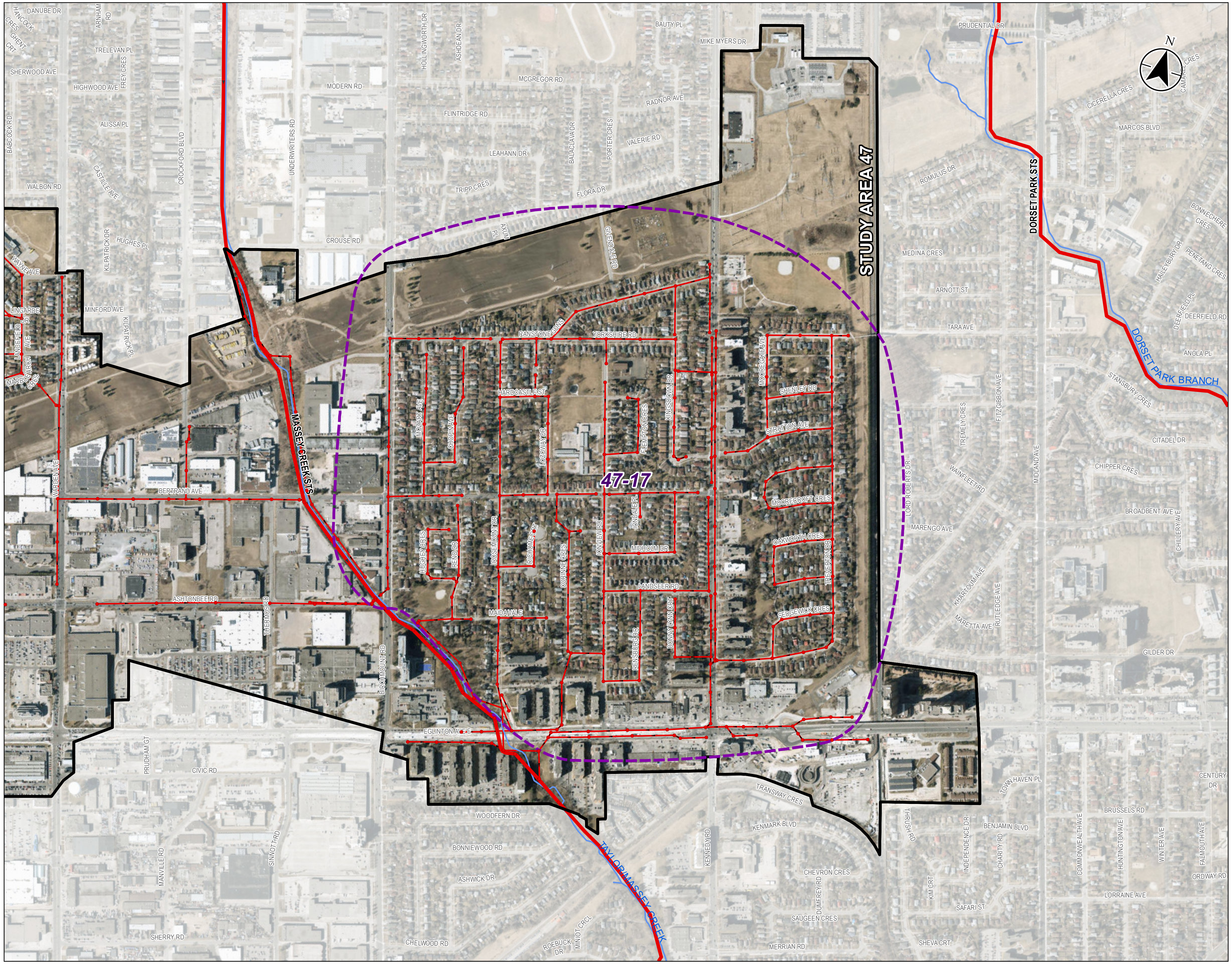
No perforated maintenance holes (MHs) were found in the sanitary system within the Assignment 47-17 extents. A total of 121 dual MHs were also identified in this area; 10 of which were identified as having cross-connections between the two systems. There are no CSOs or municipal sewage pumping stations within the assignment extents.

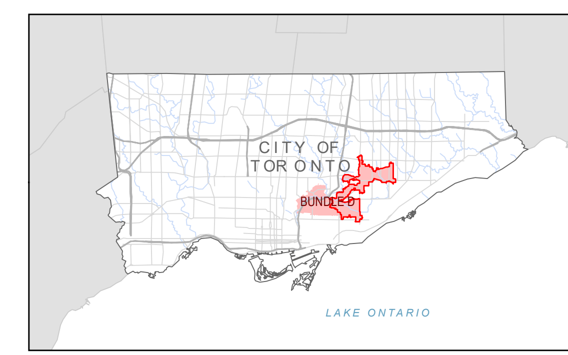
Refer to **Attachment #1 - TM1** for further detail pertaining to the existing sanitary sewer system.

4.1.2 Storm Sewer System

The storm sewer system, shown in **Figure 4**—2**,** consists of smaller networks discharging to Massey Creek and includes six storm outfall structures. There is approximately 15 km of storm sewer within Assignment 47-17, with pipe sizes ranging from 200 to 1050 mm in diameter. The storm sewers date between 1950 and the 1990s, with the majority installed within the 1950s and 1960s.

Attachment #1 - TM1 provides additional detail on the storm sewer system.





Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Sanitary Manholes
- Local Sanitary Sewer (< 600 mm)
- Trunk Sanitary Sewer (≥ 600 mm)

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Contains information licensed under Toronto Water Asset Mapping User Agreement.
3. Contains information made available under the Toronto and Region Conservation Authority Open Data Licence v 1.0, Open Government Licence – Toronto, and Open Government Licence – Ontario.

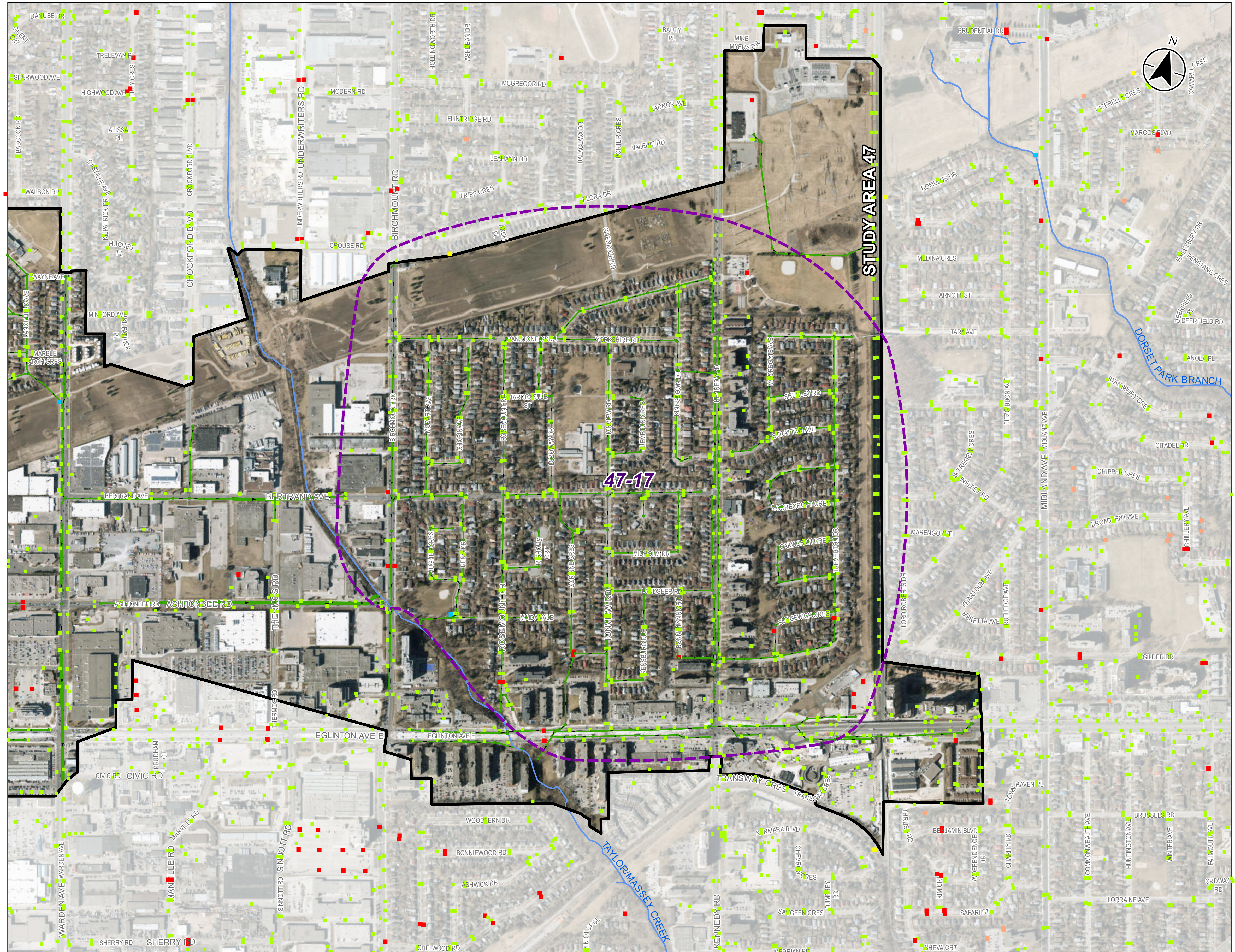
Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-10

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
4.1

Title
Existing Sanitary Sewer System



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Manhole
- Catchbasin
- Double Catchbasin
- Private Catchbasin
- Rear Yard Catchbasin
- Other Inlet
- Local Sewer (< 1200 mm)
- Trunk Sewer (≥ 1200 mm)

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

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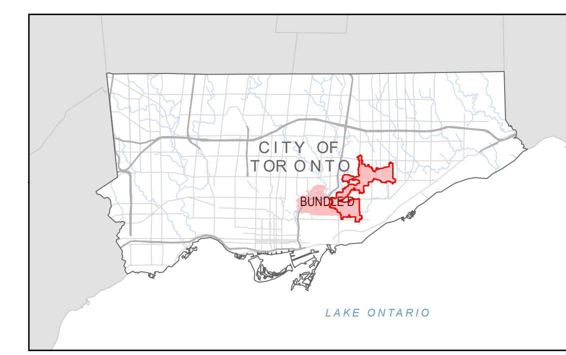

Project Location
City of Toronto

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Prepared by KDB on 2023-03-10

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
4.2

Title
Existing Storm Sewer System

4.1.3 Overland Flow System

The overland/major flow system comprises the network of streets and natural flow paths that can temporarily store and convey runoff during a high-intensity storm and may influence the flow entering the storm, sanitary, and combined sewer systems. This surface flow accumulates at low points causing ponding. The major storm boundary was established based on topographic drainage derived from the digital elevation model (DEM) data along with field survey results regarding low points and downspout connectivity.

As per Scarborough practice post 1970, the major system has been considered as the borough developed, with the majority of main watercourses remaining as open channels for relief above sewer capacity.

Other than the major receiving watercourses, this area does not contain overland conveyance channels and is generally contained within the ROW. **Figure 4**—3 shows the existing overland flow system.

4.2 BOUNDARY CONDITIONS

A component of the hydraulic model is the establishment of boundary conditions for inflows or levels entering or exiting the study area. The boundary conditions applied to the storm, sanitary and overland systems were originally derived in Stage 1 and updated in Stages 2 and 3 as required. Conditions representing adjacent study areas were taken from external models completed by others, while those that represent transitions between study areas that reside within Bundle D (Area 46 in this case), were generated based on the capacity study models. Watercourse level boundaries for the storm system were applied from provided TRCA Hydrologic Engineering Center's River Analysis System (HEC-RAS) assuming the 5-yr levels applied to the storm outfalls for all design events. The boundary condition levels applied to the final recommended alternative solutions 100-yr (storm and overland systems) and May 12, 2000 (sanitary system) models in Stage 3 are presented in **Table 2-3** of **Attachment #3 – TM3**.

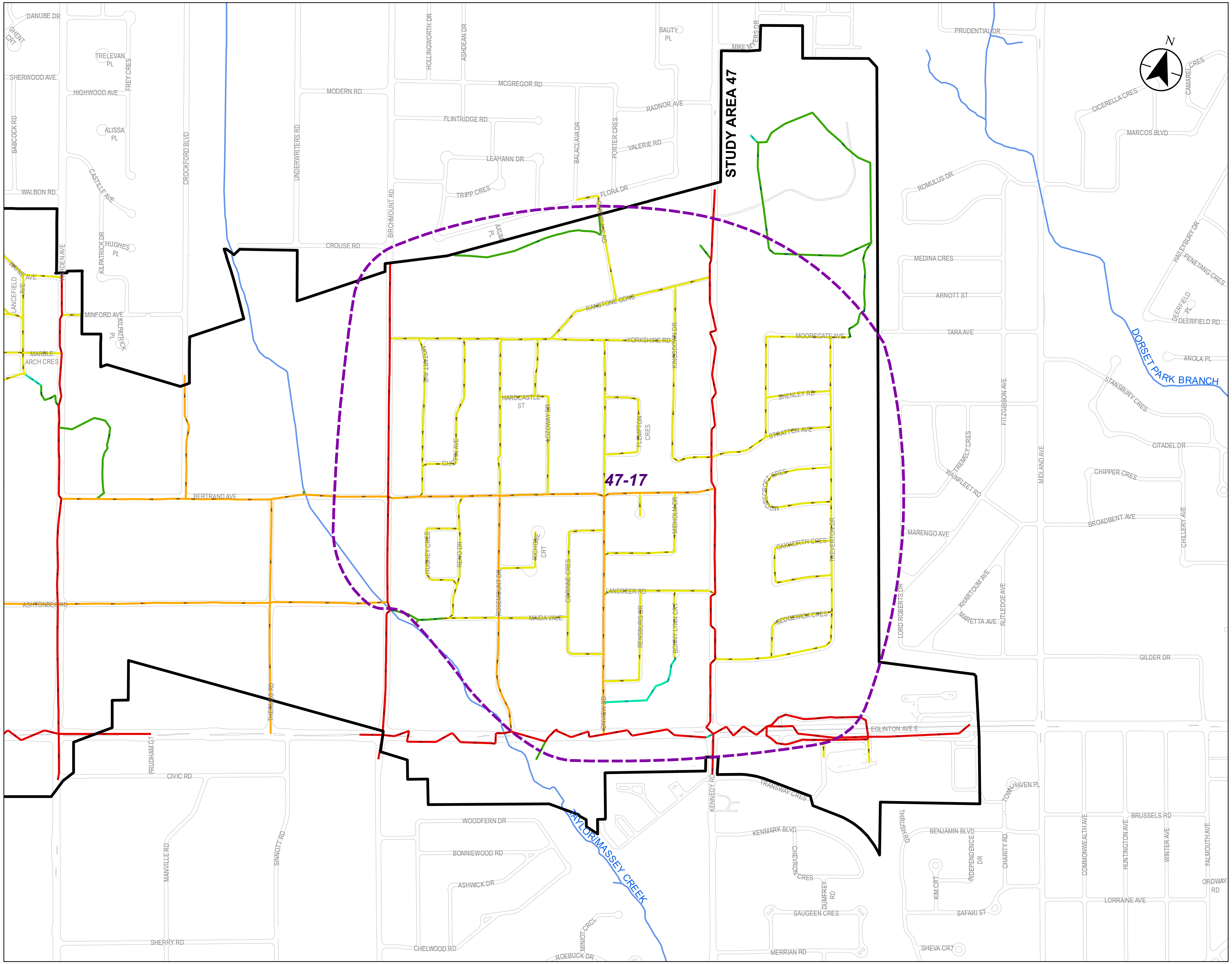
4.3 SOCIO-ECONOMIC ENVIRONMENT

The following sections discuss the land use and potential growth for the assignment area.

4.3.1 Land Use Classification

Study Area 47-17 has diverse land use features. Residential single-family areas represent the highest portion, with smaller sections of residential multi-family areas, institutional areas, and commercial areas throughout the assignment area. The open space that exists in Assignment 47-17 is represented by the small, forested area surrounding Taylor / Massey Creek and two parks.

Notable land features include Taylor / Massey Creek (which borders the south-western part of the assignment area) and the hydro-electric corridor that cuts across the upper portion. See **Figure 2.1** in **Attachment #1 – TM1**.



Stantec

Legend

- Study Area
- Assignment 47-17 Area

Modelled Overland Conduit Type

- Highway
- Arterial Road
- Collector Road
- Local Road
- City Pathway
- Park / Open Space
- Private Property
- Ditch
- Creek

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

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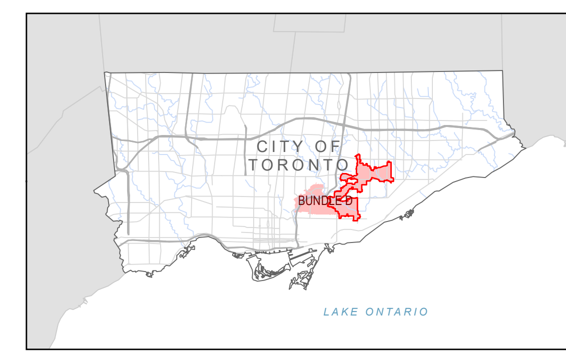


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-14

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
4.3

Title
Existing Overland Flow System

4.3.2 Population and Water Use

Water consumption records were provided per address point on an annual basis for 2018. Populations were also provided as part of the City's Planning Datasets and were used as the basis of the existing conditions sanitary model.

City Planning also provided population projections for residential and employment land use, which forms the basis for future demands on the sewage system. These projections were incorporated into the baseline model in Stage 3 solution sizing for the sanitary system. No capacity issues are indicated by the census growth at the identified population density.

4.4 PHYSICAL AND NATURAL HERITAGE ENVIRONMENT

The following sections discuss the key topographical, hydrogeological, and environmentally significant features within the assignment area. In addition, historical or archaeological potential within the assignment limits are discussed herein.

4.4.1 Topography and Hydrogeology

The Study Area topography was demonstrated in **Figure 2.8** of **Attachment #1 - TM1**, the eastern side of the upper portion (Assignment 47-17) drains south into Taylor / Massey Creek and ultimately into the Don watershed. **Figure 3.1** of **Attachment #1 - TM1** also helps to depict a more micro-level definition of the topography within the assignment area, illustrating detailed flow paths and depressions within the ground surface.

A hydrogeological assessment of the study area's soil and groundwater conditions is also detailed in **Attachment #1 - TM1**, based on information from the City's borehole database, water well records from the Ministry of Environment, Conservation and Parks (MECP), and publications produced by consultants and other government agencies. Key findings suggest that the shallow subsurface in the northeastern half of the study area is characterized as fine-textured soils (silt and clay), which extend from existing grades to depths of approximately 10 m. In the southwestern half of the study area, coarse-textured soils (sand and gravel) are encountered near ground surface. These coarse-textured soils are inferred to be constrained in depth and overlain by impervious surfaces (urbanization).

The depth to water table is depicted in **Figure 4.6** of **Attachment #1 - TM1.** Throughout Assignment 47-17 the depth to the water table is inferred to be greater than 6 m below grade, except at the around the intersection on Birchmount Rd and Bertrand Ave where the depth to the water table is between 0-4 m. Based strictly on hydrogeological data (i.e., soil composition and depth to water table), the relative risk for groundwater migration into the sewer system would be low to moderate throughout most of the study area.

4.4.2 Environmentally Significant Areas and Special Policy Areas

Environmentally Significant Areas (ESA) are the areas of land or water within the natural heritage system that have special characteristics defined in Policy 13 of the City of Toronto Official Plan (June 2006, updated March 2022). They are particularly sensitive and require additional protection to preserve their environmentally significant qualities. A map showing the environmentally significant areas is included in the Toronto Official Plan (Map 12): https://www.toronto.ca/wp-content/uploads/2019/06/987b-cp-official-plan-Map-12A_ESAs_AODA.pdf. There are no environmentally significant areas in the project boundary.

A map showing the Special Policy Areas (SPA) is also included in the Toronto Official Plan (Map 10) available at the following web link: https://www.toronto.ca/wp-content/uploads/2017/11/9048-cp-official-plan-Map-10_Special-Policy-Areas_AODA.pdf

There is one SPA affecting this Assignment identified as SPA #8, Eglinton-Birchmount: Taylor/Massey Creek. Map 11 is repeated in **Figure 4**—4. This policy relates to buildings and structures within the floodplain.

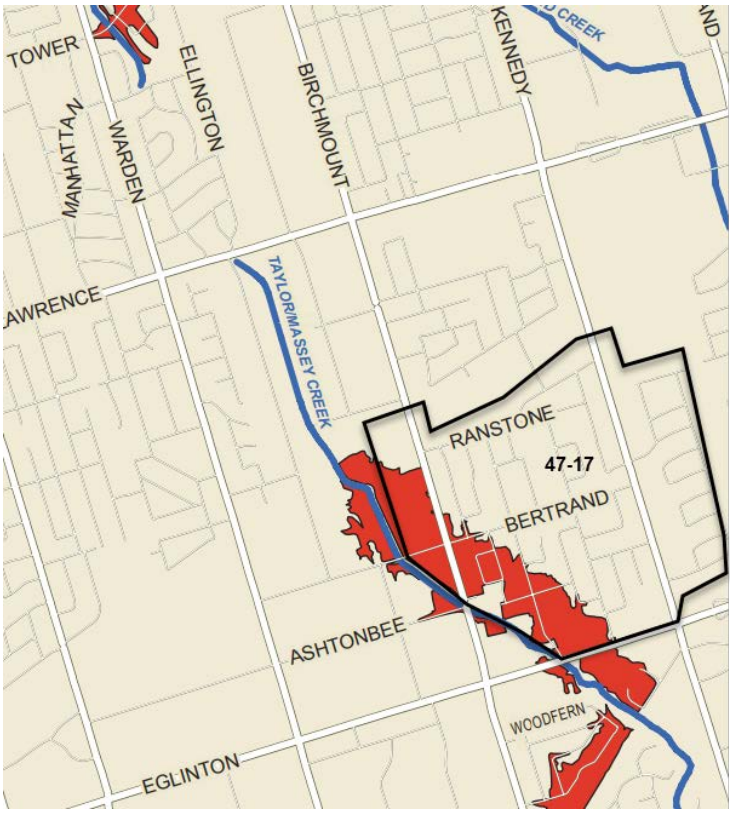


Figure 4—4: Special Policy Area #8 – Eglinton/Birchmount/Taylor-Massey Creek

Additionally, there is an identified Site and Area Specific Policy (SASP) (Map 31) that indicates SASP #129 for Lands South and North of Eglinton Ave, situated immediately west of Birchmount Rd. These lands are also known as the Golden Mile, an area of proposed development intensification.

This ongoing EA Transportation Network Assessment Study is focused on alignment alternatives west of Birchmount Rd and is not directly overlapping with the proposed extents of Assignment 47-17. Nonetheless, during the preliminary design stage for Assignment 47-17, coordination with the EA stakeholders may be required.

4.4.3 Natural Heritage and Archaeological Potential

The natural heritage system consists of all the native land cover in an area. A healthy environment depends on maintaining a network of areas in which the protection, restoration and enhancement of natural features and functions has high priority to help maintain the biodiversity of native plants and animals. Natural heritage system planning needs to be integrated with other municipal land use planning objectives and form a part of the City's building decisions.

The consideration of cultural heritage is a requirement of the MEA Class EA process and the revised 2014 Provincial Policy Statement. In this process, the cultural environment, including built heritage resources and cultural heritage landscapes as well as archaeological resources, is considered as one in a series of environmental factors when undertaking an MEA Class EA. Therefore, a desktop review for the area was reviewed for the presence of protected heritage properties, indicating that there are some protected properties and places of cultural heritage value or interest within the study area boundary. This information was referenced during solution development as proposed solutions within or near these properties requires additional assessment to be completed during the detailed design phase to identify, evaluate, assess the impacts, and provide recommendations to mitigate the effects of the undertaking on cultural heritage resources including built heritage and cultural heritage landscapes. The desktop review of the City of Toronto's Heritage Register is provided in **Figure 4.3** of **Attachment #3 – TM3**, cross-referenced against the proposed solutions. Part IV Designations refer to properties recognized of cultural heritage value or interest, and Listed Properties refer to those where further evaluation of the property will take place if there is an intent to impact or demolish the property.

The *Heritage Overview – Basement Flooding Protection Program, Bundle D: Study Area 47* was undertaken to identify recognized heritage resources within the Bundle D Study Area 47. Based on consultation with the appropriate regulatory bodies, desktop data collection, and a site visit, Assignment 47-17 was determined to contain an identified heritage resource (12 Iondale Place). Accordingly, when the assignment advances to the preliminary design stage, a Cultural Heritage Report: Existing Conditions and Preliminary Impact Assessment (CHR) should be carried out for the assignment area. The CHR will establish the existing conditions of Assignment 47-17 and confirm the presence of additional potential heritage resources. The CHR should be carried out by a qualified heritage professional who is a professional member of the Canadian Association of Heritage Professionals.

Similarly, the City's Archaeological Master Plan identifies areas that may potentially contain archeological resources. As a first step for these areas, a desktop review was completed to identify potential for a Stage 1 Archaeological Assessment (AA), which is required to determine the possible nature and significance of any archeological resources that may be present. A Stage 1 assessment involves a review of geographical and historical land use for the proposed development area.

Mapping from the Toronto Ontario Genealogical Society and records from the Ministry of Heritage, Sport, Tourism and Culture Industries for known archaeological sites were reviewed, which also includes known cemetery locations. This information was referenced during solution development as solutions should generally avoid these cemeteries by 10 m, and if contained within the ROW, should be located on the far side of the ROW from the cemetery. Areas of potential for Aboriginal and Euro-Canadian archaeological remains generally include land adjacent to current and historical watercourses, parks, grassed areas, or other non-paved, undisturbed land. Any solutions that impact these areas may require a Stage 2 AA which involves a shovel test pit survey under the field supervision of a licensed archaeologist prior to any construction activities. The desktop review of the City of Toronto's Heritage Register for Archaeological potential is presented in **Figure 4.3** of **Attachment #3 – TM3**, cross-referenced against the proposed solutions.

The Stage 1 Archaeological Assessment: Basement Flooding Remediation and Water Quality Improvement Master Plan, Class Environmental Assessment, Areas 46 and 47 was undertaken to identify archaeology potential for the proposed solution extents within the study areas. Based on the Stage 1 Assessment, a Stage 2 archaeology assessment is recommended for Assignment 47-17 as the proposed works for the Rosemount outfall fall outside of the road ROW. The Stage 2 assessment shall be undertaken once the assignment progresses to the preliminary design stage.

The full Stage 1 Archaeological and Cultural Heritage reports complete with field photos and review are provided in **Appendix B.** The Stage 1 Archaeological report was shared with indigenous communities and any comments received are also provided in **Appendix B**.

5.0 DATA COLLECTION AND FIELD SURVEY

Data collection provides the foundation for the assessment and analysis of the sewer and drainage systems. Data provided by the City included physical information about the service area and sewer systems, as well as historical information related to development practices, by-laws, topography, hydrogeology, operations and maintenance, and basement flooding reports. A summary of the data collected and reviewed is below, and more details are provided in **Attachment #1 – TM1**.

A Project Knowledge Database Structure (PKDBS) was established in coordination with Toronto Water, to facilitate the management, maintenance, and exchange of information throughout the course of the project. The PKDBS was submitted to the City following the completion of the Area 47 Study Report and will be updated to include files from the EA phase, including this Project File report.

5.1 DATA COLLECTION

The data collected to complete the Study for Area 47 and EA phase for Assignment 47-17 is documented herein.

5.1.1 Summary of Supporting Information

The background information used to understand and describe the physical characteristics of the study area was generally available via reports or in a format suitable for viewing in GIS and included the following:

- Physical sewer network data including MHs, catchbasins (CBs), and pipes (to develop detailed hydraulic model and assess existing and proposed infrastructure performance)
- Sewer Asset Planning dry weather flow InfoWorks model
- Historical flow monitoring and precipitation data (to assess existing system performance in dry and wet weather and provide context for sanitary dry weather flow parameters)
- Land use classification and impervious layers (to determine hydrologic properties of the area)
- 2011-2016 equivalent population data (for model dry weather input)
- Projected 2041 Population Projections (to verify that the proposed sanitary solutions will be effective with future population growth)
- Water consumption records (to estimate wastewater flows and distribute census population data)
- Aerial photographs (to identify structures and classify land use)
- Digital elevation model and topographic data (to delineate drainage areas)
- Current and historical sewer design criteria and sewer use by-law
- Historical surface and basement flooding reports, including Customer Service Records (CSR) from Hansen (to validate hydraulic modeling tool)
- Historical operations and maintenance reports
- CCTV inspections and smoke/dye test results
- Natural surface water drainage information
- Local drainage and sewer system improvements

- Geotechnical reports for groundwater and soil conditions
- Highway 401 drainage drawings from Ministry of Transportation
- Floodplain mapping and GIS layers from TRCA
- Consultation with City operations staff
- Various previous studies

The available CSR data since 2003 are widespread, however, primarily related to service connection blockage and not well correlated with historic rain or clear indicators of public-side capacity issues (back-up, MH overflow, CB overflow).

5.1.2 Data Gap Identification and Correction

In Stage 1, there was a degree of uncertainty in the Toronto Water Asset Geodatabase (TWAG) sewer asset data that was used to develop the storm, sanitary, and combined collection systems. The major uncertainty was with regards to the roof connectivity, as there were very few available Drain Plans, yet exemption records indicate roof connections are pervasive for properties throughout the study area. Address point data from the FSIP (see **Section 5.2** below) was used to update the roof connectivity assumptions of Stage 1, which covered almost all residential roofs; however, this information was limited to curb-view access.

5.2 FIELD SURVEY AND INVESTIGATION PROGRAM

During Stage 1, focus areas were defined where additional desktop information review and field investigation was required to help reduce the amount of uncertainty in priority areas of the hydraulic model and study area. FSIP was undertaken in a staged manner as follows:

1. Additional Desktop Review
2. Field Survey (Inventory) of Physical Building/Topographic Features
3. Additional Data Collection
4. Flow Monitoring Plan

These processes were completed in parallel, with two iterations of the FSIP. The first FSIP included additional desktop review, which entailed review of select record drawings, and existing CCTV/Panaramo reviews for bifurcation or dual MHs. The field data that was collected during the initial field surveys is summarized in **Section 5.2.1**.

5.2.1 Initial Field Surveys

The base scope of field investigations included visible roof downspout connections, reverse sloped driveways, flat sloped (poor drainage) properties, surface topography including street low points and spill locations, CB grate types and locations, storm sewer outfalls, and perforated MH lids. These investigations were undertaken from the public ROW, with no private property access, and were focused on areas of uncertainty and/or identified Flood Clusters, such that the total coverage area was no more

than 50% of the Bundle D area. Infrastructure Intelligence Services Inc was subcontracted to complete the field activities.

Using a hand-held tablet with pre-populated field forms tied to the Address shapefile, field crews input data digitally for ease of daily QA/QC and mapping of progress/findings. Roof connectivity, reverse driveways and lot drainage were surveyed to verify and update assumptions made to inform the model build.

A critical contributor to overloading a sewer system is low point water accumulation, in terms of having sufficient inlets to be able to accept the flow and potential for spill to adjacent properties. Additionally, CB efficiency has the potential to impact expected capture rate, independent of location, and with the proposed change to the CB head-discharge curves to allow more water in at lower heads, having an accurate inventory of the CBs is increasingly important. Therefore, the same inventory area for roof connectivity was allocated for the CB survey, and key low points were flagged for enhanced inspection regarding potential spill points. CB inspections were undertaken with a Global Positioning System-enabled tablet device with +/- 3.0 m or better x-y accuracy, and included surveys of CBs (e.g. quantity, cover type) and MH covers (e.g. presence of perforated lids) including location. The City's TWAG databases (i.e., CB and MH layers) were augmented/updated by the findings of this survey.

All modelled outfalls were inspected to update/augment the existing TRCA data, which was focused on outfall condition and impact on the watercourse. Information collected using tablet field forms included: configuration and condition, shape, size, dimensions, flow conditions on the day of the survey, relative invert depth to the ground surface level, and discharge conditions (free flow outfall, partially/totally submerged). A total of six (6) storm outfalls were investigated in the Assignment 47-17 area. Photographs including views looking upstream and downstream were geo-tagged with captions and are included as part of the PKDBS.

5.2.2 Additional Field Surveys

The second iteration of the FSIP was to complete inspections of existing flow control structures in the study area. Combined sewer overflow (CSO) structures, dual MHs and bifurcation nodes are considered flow control structures, as they offer the potential for flow distribution between the various sewer systems that can affect the performance of the hydraulic model flow distribution. Therefore, in sensitive areas, inspections were undertaken to confirm existence of the flow control, and where significant or complex controls exist, to quantify (by measurement) the characteristic dimensions of any identified cross-connection for use in the hydraulic model. The flow control structure investigations were split into two types of inspections: Level 1 confined space entries and high-level camera inspections.

The Level 1 inspections involved entering MHs to identify the potential for cross-connection between adjoining sewer systems, recording physical dimensions of the structure and overflow components (weir/orifice/opening height, width, length, type, plates, etc.), and providing a sketch and photos/video of the configuration with qualitative interpretation of the structure operation. Level 1 inspections are documented with all findings and provided as part of the PKDBS.

The intent of the high-level camera chamber inspections was to collect information about dual and bifurcation MHs that have not been surveyed by the City. The inspection was intended to confirm the hydraulic connection for the dual MHs, and the orientation of the inverts, bulk-heading, and the flow paths for the bifurcation MHs so that they could be modelled accordingly. The high-level camera inspections were completed for several low-complexity flow control structure locations within Area 47 with all findings and documentation provided as part of the PKDBS.

5.3 RAINFALL AND FLOW MONITORING

The review of historic rainfall and flow monitoring data, and the 2-year rainfall and flow monitoring program conducted through the Study Phase is discussed herein.

5.3.1 Historic Rainfall and Flow Monitoring Data

Flow monitoring data was available for 3 sites in the sanitary local system, and 3 in the local storm sewer systems. During the large storm recorded July 20, 2017, the Assignment 47-17 area saw a rain gauge (RG) response similar to a 2-yr. storm. Unlike the smaller events, this event provides evidence of a quick response with less of a volumetric response, indicating cross-connections throughout the system. In the storm system, the peak and volumetric responses were representative of a separated system. The results were used to help identify the areas of interest for additional field survey and investigation and influenced the selection of hydrologic modelling parameters in Stage 2.

5.3.2 Rainfall and Flow Monitoring Program

To supplement the available flow monitoring data, a 2020/2021 flow monitoring plan was proposed for the sanitary and storm system, with the objective of providing dry weather flow input into the sanitary model parameters and in hopes of capturing an extreme storm event for potential calibration where a minimum intensity of 40 mm within one hour is required. SCG Flowmetrix was subcontracted to provide flow and rainfall monitoring and data management services for the study.

Flow monitors were installed in 2 sites (1 sanitary and 1 storm) within Assignment 47-17 from April 16, 2020, to November 30, 2020, from April 1, 2021 to October 31, 2021, and again from April 1, 2022 to November 24, 2022. The flow monitoring data is reviewed per the provisional TM5 which summarizes the data collected. Rain events that were recorded within the study area did not trigger the intensity threshold of 40 mm within one hour for model calibration and most events were less than a 2-yr storm.

5.4 ADDITIONAL SCOPE AND CCTV REVIEW

To define the complete scope of each Assignment, the City's State of Good Repair for Capital Projects (rehabilitation/replacement) and 5-yr Capital Plan for watermain projects and green infrastructure were overlain with the proposed Assignments. Where the City works geographically aligned with the defined basement flooding Assignments, this scope of work was added to the Assignment. The following assignments had potential Capital Works coordination per the information provided by the City:

- Watermain structural lining, 2022, Eglinton Ave

Capital coordination should be confirmed with known timelines of the BF work during the preliminary design stage.

A CCTV review for the Area 47 assignments was completed 200 m downstream of proposed upgrades to determine potential remediation needs to be completed in the Assignment scope. Areas where CCTV data was not available was recommended for investigation during the preliminary design stage.

A summary of the CCTV review for the assignment requiring action is provided in **Table 5-1**.

Table 5-1: CCTV Per Assignment

Assignment	*Length of Pipe to be Replaced Based on CCTV Score ≥4 (m)			Length of CCTV to be Completed			Downstream Remedial Works to be Completed with Assignment			Total Length of Downstream Sewers Reviewed (m)		
	STM	COMB	SAN	STM	COMB	SAN	STM	COMB	SAN	STM	COMB	SAN
47-17	66	N/A	-	993	N/A	728	Yes - Heavy Cleaning	N/A	Yes - Heavy Cleaning	1,421	N/A	877
* Service/Structure Override Grade Condition Score of 4 or 5 requiring remediation attention												

Thus, the total length of pipe that was required to be reviewed for Assignment 47-17 is 2,414 m of storm and 1,605 m of sanitary sewer. However, CCTV information was only available from City records for 1,421 m of storm and 877 m of sanitary, which were reviewed by Stantec. The remaining amount of 993 m (storm) and 728 m (sanitary) shall be surveyed during the preliminary design stage

6.0 ASSESSMENT OF EXISTING CONDITIONS

The following sections outline the Study Phase assessment of the provided data, the hydrologic and hydraulic model development, the basement flooding criteria used in the systems assessments, and the existing conditions systems performance results.

6.1 HYDROLOGIC AND HYDRAULIC MODEL DEVELOPMENT

Two stages of model development were completed; Stage 1 and Stage 2. The Stage 1 model development targeted a risk-based capacity assessment identifying high-level areas at risk (referred to as modelled Flood Clusters), while Stage 2 sought to confirm and update the details within these areas of focus and improve the model confidence throughout. The Stage 1 and Stage 2 model build, and existing conditions results are documented in the **Attachment #1 - TM1** and **Attachment #2 - TM2**, respectively.

6.1.1 High-Level Risk-Based Models

The Stage 1 analysis was broken up into two main components; the major overland system 2D model build, and the minor sewer system 1D model build. The objective of these initial models was to provide a 'first-cut' representation of the surface and subsurface drainage conditions at a macro-level, and gain an understanding of the system complexity, uncertainties, and initial model results from which to assess the sensitivity to capacity restrictions. Together with other physical and anecdotal characteristics, the model results supported the identification of additional field survey and investigation requirements with the ultimate objective of improving the confidence in the model build and representation of flood risk. **Figure 6.11** in **Attachment #1 -TM1** illustrates the areas defined as high-risk, or modelled Flood Clusters, which were targeted for field surveys and detailed model validation in Stage 2.

6.1.2 Detailed Models in Focused Area

Stage 2 integrated the field survey findings identified based on Stage 1 results, including roof downspout connectivity, dual MH connectivity, perforated MH locations, inlet/CB information, reverse driveways, and outfall structures. Available record drawings (as-built and/or as-designed) were used to validate minor system details in areas identified as high-risk, or to confirm severe uncertainties identified in Stage 1. A 1D dual drainage modelling approach was adopted in Stage 2 to define the major system, integrating findings from the 2D Stage 1 overland results, and surveyed low points. Overall confidence in the model was improved through the Stage 2 model validation and updates.

6.2 BASEMENT FLOODING CRITERIA

The City's Basement Flooding criteria are summarized as follows:

- Design storms for use is assessing system performance:
  - Storm and Combined Drainage System: 100-yr 6-hr Chicago design storm per the City Model Guidelines

  - Sanitary System: equivalent to the May 12, 2000 storm as gauged at the City's Oriole Yard (Station 102) located at Sheppard Ave and Leslie St. This design standard provides an enhanced level of protection against basement flooding from sanitary sewer backup for a storm event with a return frequency between 1 in 25 and 1 in 50 years.
- The maximum hydraulic grade line (HGL) in the sanitary and storm sewer (minor) system shall be maintained below basement elevations (assumed 1.8 m below ground elevation at centerline of road) during the respective system design storms. Measured from model node for simplicity.
- No net increase in peak wet weather flow to the combined or sanitary trunk sewers.
- Sewer Overflows:
  - Flow frequency and volume capture at CSO cannot increase to the environment from existing conditions, using the annual MECP Procedure F-5-5 methodology for the "Typical Year" rain events. Discharge during extreme events (>10-yr) remains acceptable if the F-5-5 "Typical Year" combined sewer overflow criteria are met.
  - Abandonment of overflow preferred, considering resulting flood risk. Raising of overflow levels to reduce spill also considered. Abandonment of overflow or lowering overflow weir levels to relief overflows for extreme rain events (>10-yr) may be considered.
- For shallow storm sewers with obvert less than 1.8 m below ground surface, there shall be no surcharge and the proposed HGL must be lower than or equal in elevation to existing conditions.
- For shallow sanitary sewers with obvert less than 1.8 m below ground surface, the proposed HGL must be lower than pipe centerline.
- Avoid increases to the peak flow discharges into existing external systems. Where unavoidable, consultation with City and adjacent Study Area team may be required.
- Within road underpasses, the minor system shall be sized to convey the 25-yr storm under free flow conditions, and may be exempt from HGL freeboard criteria if no property connections exist.
- The overland flow (major) system depth on local streets shall be maintained within the ROW or not be above 150 mm over the crown of the road, equating to 235 mm for most local roads with paved 8.5 to 9.0 m widths. Where reverse driveways are present, depth on local streets shall not exceed 150 mm over the gutter. Local roads with no curbs or ditches have been set to 150 mm. Ditches and simulated overland flow paths outside the ROW have generally been set to 300 mm. On collector and arterial roads, the depth as measured from the gutter varies based on width of paved area which is estimated based on number of lanes and 2% crossfall. Rural road cross-sections are variable, dependent on local topographic conditions. Arterial roads allow depth to the crown of road, while collectors allow an additional 100 mm above the crown. **Table 6-1** presents the resulting depth exceedance criteria as referenced from road gutter:

Table 6-1: Road Depth Exceedances

Number of Lanes in ROW	Local Roads	Collector Roads	Arterials Roads
Less Than 4 Lanes	235 mm	235 mm	235 mm
4 Lanes (14 m paved width)	N/A	240 mm	140 mm
5 Lanes (17.5 m paved width)	N/A	275 mm	175 mm
6 Lanes (21 m paved width)	N/A	300 mm	210 mm
7 Lanes (24.5 m paved width)	N/A	300 mm	245 mm

Number of Lanes in ROW	Local Roads	Collector Roads	Arterials Roads
8 Lanes (28 m paved width)	N/A	300 mm	280 mm
Depth relative to gutter, based on road width and 2% crossfall. Maximum depth 300 mm to not exceed 150 mm over crown. If reverse driveway present, max depth is 150 mm.			

- Overland flow depths and velocity must be considered for public safety, as outlined in **Table 6-2**:

Table 6-2: Permissible Depths for Submerged Objects

Water Velocity (m/s)	Permissible Depth (m)
2.0	0.21
3.0	0.09
Based on a 20-kg child and a concrete-lined channel	

6.3 SUMMARY OF SYSTEM PERFORMANCE FOR ASSIGNMENT 47-17

System performance was assessed based on the Basement Flooding criteria described in **Section 6.2**, and validated against flood records from historical events. The majority of reported flood issues are private-side related, and not resulting from the capacity of the surface drainage or collection system. Some older flood complaints appear to have already been resolved by remediation works constructed after May 2000 and August 2005. A summary of the storm and sanitary minor systems and overland system is discussed in the following sub-sections.

6.3.1 Minor System (Storm and Sanitary)

The model indicates issues largely in the storm minor system that are likely due to a combination of the presence of undersized sewers, high creek water level assumptions, shallow pipes, reverse driveways and/or cross-connections from dual MHs. The presence of dual MH interconnections between the storm and sanitary systems influence the performance of the collection systems.

Across the three historic events from May 12, 2000, August 19, 2005, and July 8, 2013, shallow storm sewers in Assignment 47-17 near Taylor/Massey Creek experience backwatered or bottlenecked conditions resulting in HGL issues and surface flooding. These HGL and surcharge issues propagate upstream into sewers that are not considered shallow in both the May 2000 and August 2005 events. A few storm sewers on Kennedy Rd and Mooregate Ave in the north also see HGLs within basement level (1.8 m of surface) during all events, due only to their shallow nature.

For the sanitary system, the historic event on May 12, 2000 results in backwater or bottleneck conditions and corresponding HGL issues on Eglington Ave E, Ionview Rd, and Kennedy Rd. During the August 19, 2005 event, these HGL issues are reduced, appearing only on Eglington Ave E just upstream of the discharge point into the trunk sewer and on Kennedy Rd. During the July 8, 2013 event, no HGL issues are observed.

Overall, the historic validation shows a general correlation with modelled flood risks during each of the historic events. Some variances are observed in both location and extent of modelled flood risks versus those identified by flood records, which could be attributed in part to the implementation of backwater valves throughout these areas, potential benefits of rehabilitation work since the historic events, and the correlation of sewer capacity issues in Industrial-Commercial-Institutional (ICI) areas where flooding is less likely to be reported. Notwithstanding these considerations, the model appears to be more conservative than flood records would suggest.

The Sewer Utilization and Performance Levels for the collection systems vary across the network, with a generalized high level of performance in many areas of the sanitary systems, likely attributable to the separated sewer systems generally north of Taylor/Massey Creek. Key pockets of sanitary sewer capacity issues include the downstream portions of systems draining to the Taylor/Massey Creek trunk sewer and in areas with cross-connected dual MHs in Ionview (Birchmount Ave / Rosemount Dr). The storm system experiences a lower performance level in general with areas of more frequent flood risk found throughout the assignment area. The performance of the storm system affects the sanitary system in areas with dual MH cross-connections resulting in excess storm flow discharging into the sanitary system and exacerbating sanitary sewer issues, as well as the overland system as it limits the amount of runoff that can be captured into the minor system resulting in areas of significant ponding.

The design event system performance, when reviewed collectively against historic events, provides improved confidence in the current model set-up, but appears conservative in the storm system compared to available reports.

The increase from existing to future dry weather flow resulted in no obvious change to system performance since the future projected population is distributed throughout. Dry weather flow is not a major influence on flood risk.

Details of the minor system performance analysis are provided in **Attachment #2 – TM2**. Refer to **Figure 3.24** and **Figure 3.26** in **Attachment #2** for the existing conditions combined/sanitary sewer surcharge and HGL performance, respectively. Refer to **Figure 3.25** and **Figure 3.27** in the same Attachment for the existing conditions storm sewer system performance results.

6.3.2 Overland System

The overland drainage system, while generally showing a large degree of capacity to convey large events in the ROW, does exhibit some issues along portions of arterial / collector roads, where maximum allowable depths are generally lower, triggering exceedances in more frequent events.

There are reverse driveways present throughout Area 47, including a few within the Assignment 47-17 area. However, while the reverse driveways draw the exceedance criterion down, they do not appear to cause lower surface drainage performance. Low surface drainage performance occurs mostly along local roads or private flow paths in ICI areas and most surface drainage performance issues correspond to locations where low storm sewer system performance is also observed.

Refer to **Figure 3.2** in **Attachment #3 – TM3**, for the major overland system performance results

7.0 DEVELOPMENT AND ASSESSMENT OF ALTERNATIVES

The following sections describe the development and assessment of alternative solutions for the system performance issues described in previous sections.

7.1 APPROACH AND METHODOLOGY

The baseline conditions represented the starting point from which solutions were required. Baseline conditions are represented by the design storm results, incorporating projected 2041 population on the sanitary model and an assumed 75% Downspout Disconnection for the storm model reflecting the intentions of the Wet Weather Flow Management Master Plan for new development to control onsite stormwater discharges to better than pre-development conditions under large storms. For the purpose of the study, no changes were made to the hydrology to reflect future 2041 conditions. Error! Reference source not found. presents the baseline model results (100-yr) for the combined and storm drainage systems, **Figure 7**—3 presents the baseline major system results (100-yr), and presents the baseline 2041 sanitary system results (May 12, 2000), which form the basis of solution development.

Problem Areas were identified based on the criteria infractions of the baseline condition models. HGL issues that could not be eliminated through model adjustments or those that were deemed low or inconsequential flood risk to private property, were summarized as Exemptions, with justification provided in **Section 3.3** of **Attachment #3 – TM3**.

The approach to solution development was premised on the principle of conveyance within the municipal ROW as a first iteration, to maximize the number of solutions that fall within the Municipal Class EA Schedule A or A+ categorization. Where the initial solutions were constrained by unfavourable requirements, fell outside of the ROW, or may lead to Schedule B/C implications, alternatives were reviewed and assessed. The general approach is presented in the following flow chart.

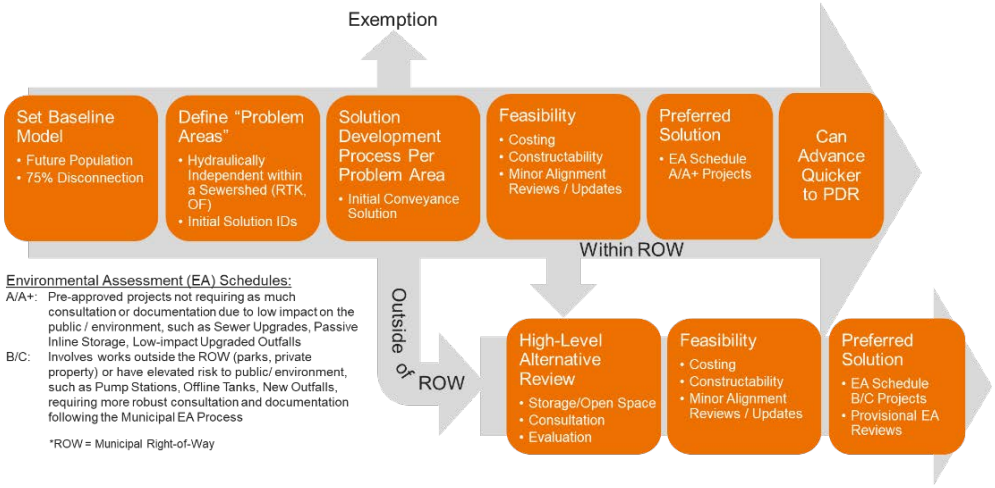
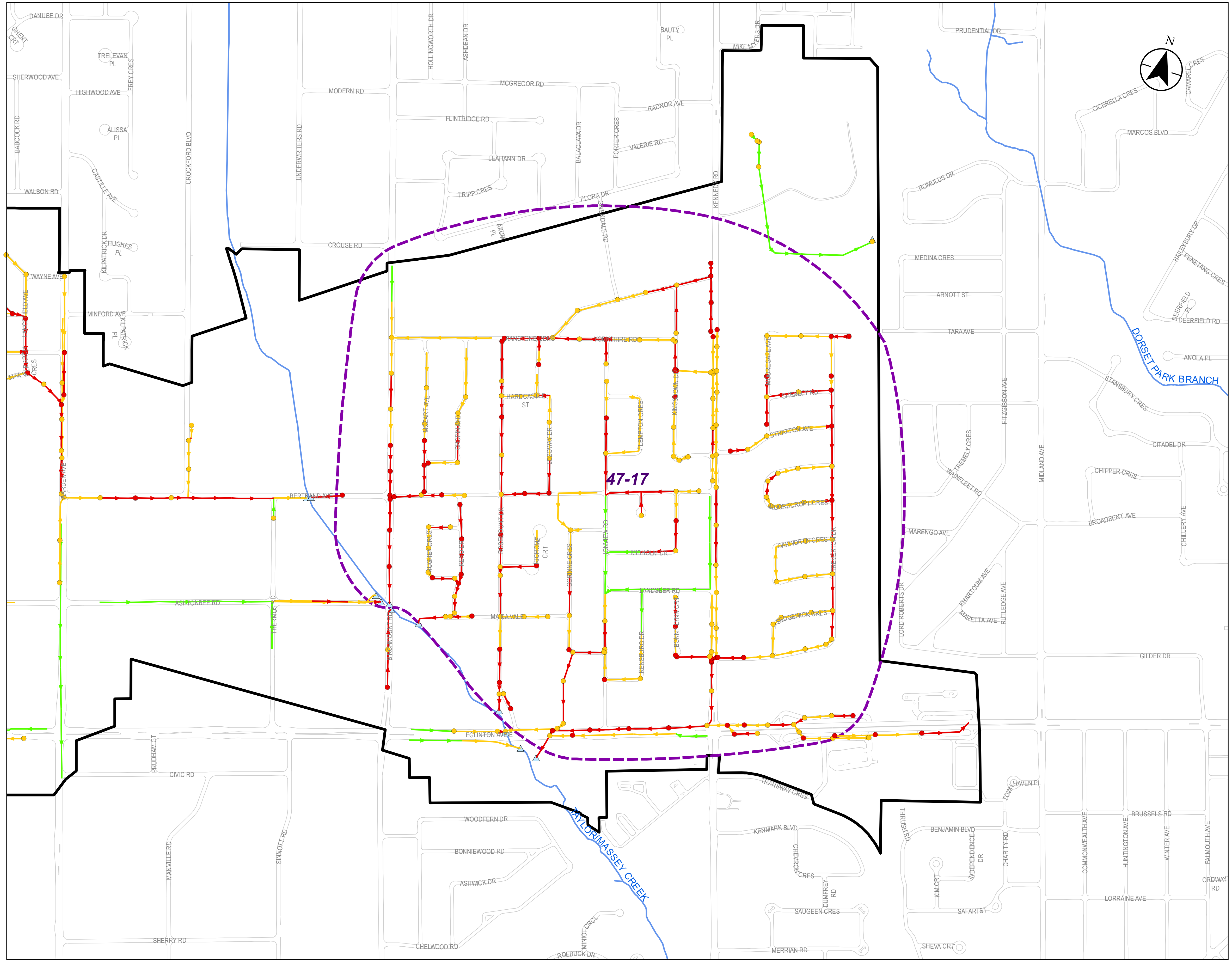


Figure 7—1: General Approach to Solution Development



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Storm Outfall

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

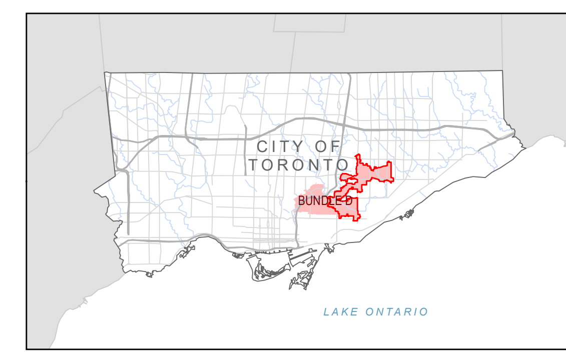
- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Contains information licensed under Toronto Water Asset Mapping User Agreement.
3. Contains information made available under the Toronto and Region Conservation Authority Open Data Licence v 1.0, Open Government Licence – Toronto, and Open Government Licence – Ontario.



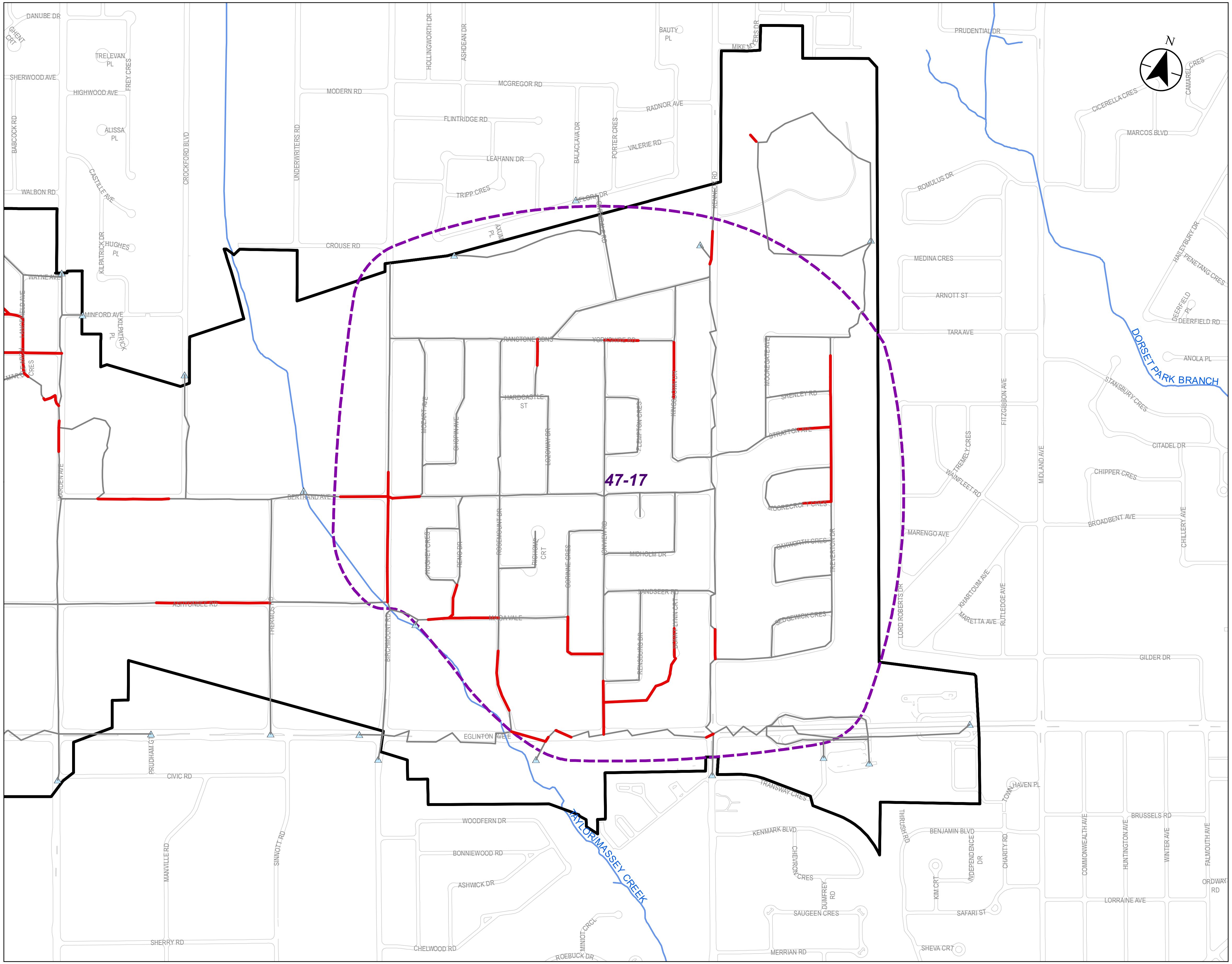
Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-14

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
7.2

Title
Baseline 100-yr Results - Storm Minor System



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Major System Outfall

Overland Depth

- Exceeds Maximum Allowable Depth
- Below Maximum Allowable Depth

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

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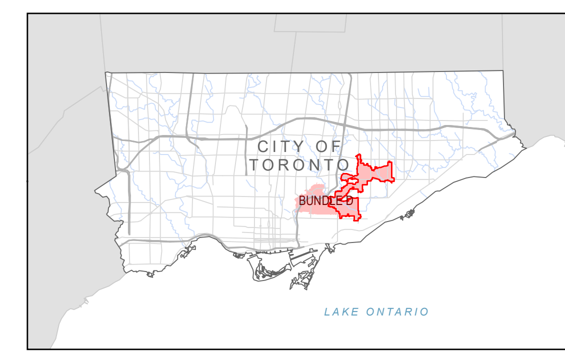


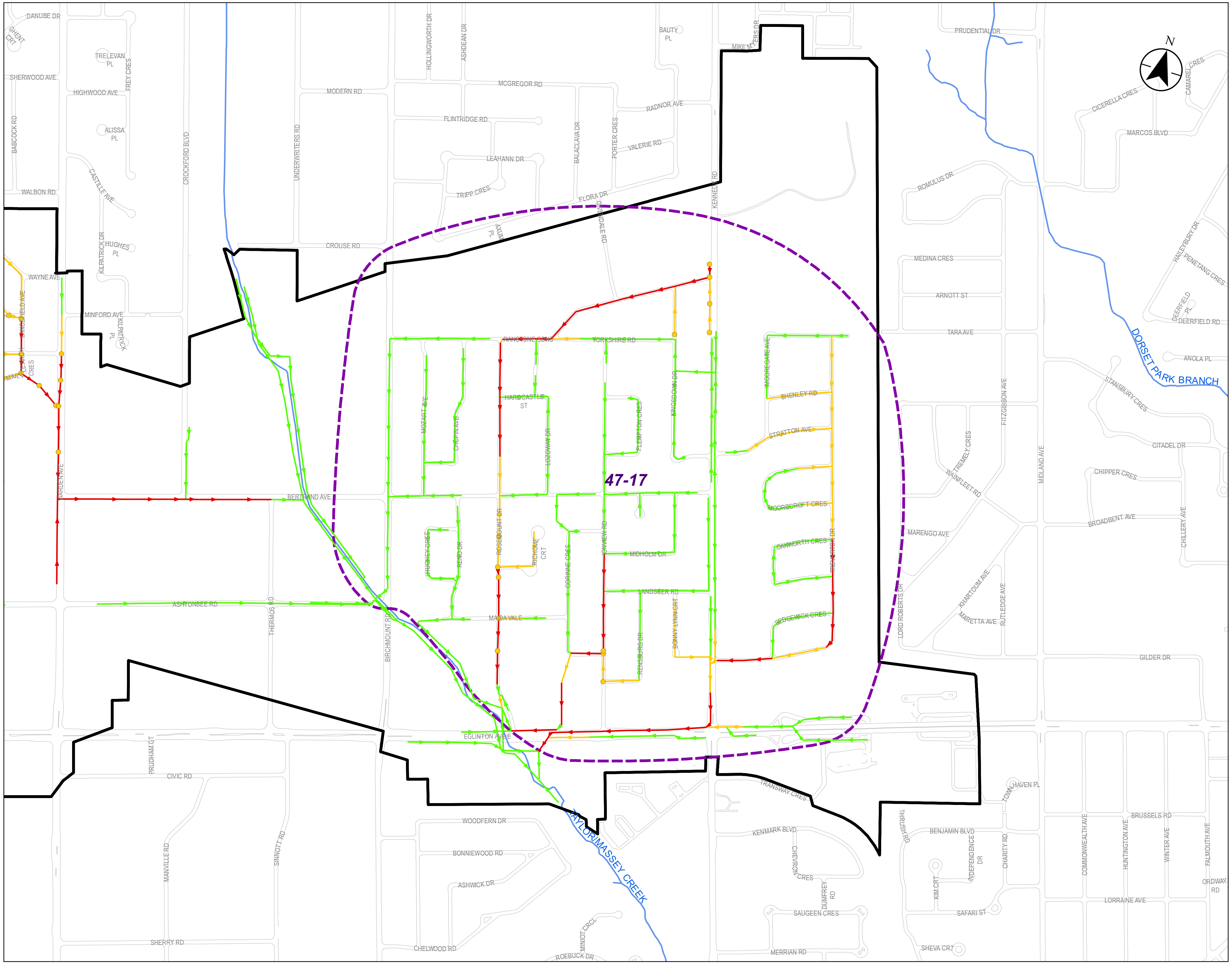
Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-14

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
7.3

Title
Baseline 100-yr Results - Major System



Stantec

Legend

- Study Area
- Assignment 47-17 Area

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

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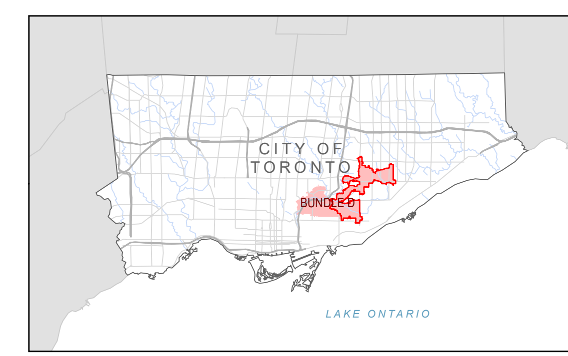


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-14

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
7.4

Title
Sanitary Baseline Future
May 12, 2000 Design Storm Results

Each Problem Area was reviewed following the process outlined in the following flow chart:

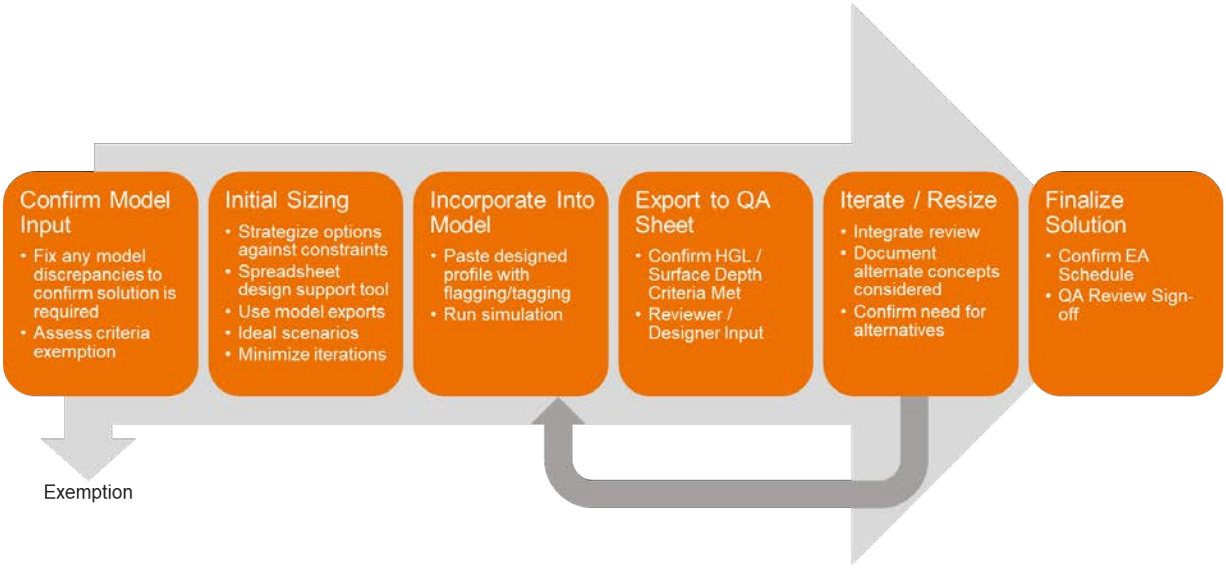


Figure 7—5: Solution Development Process per Problem Area

Confirm Model Input: The first step involved a review of the model input to confirm the problem was represented appropriately, since the entire Study Area was not reviewed to the same scrutiny in TM2, with the Modelled Flood Clusters of TM1 being the basis for focused drawing reviews and model updates. As a result, 50% of the Study Area had the potential for inaccuracies that could lead to false flood criteria exceedances. Therefore, the review rectified any model input issues to confirm the need for a solution. This step also evaluated any potential criteria exemption candidates, such as shallow sewers with no surcharge or other private-side sewers or overland ponding that is outside of City jurisdiction. These exemptions were catalogued with the corresponding rationale for City review and acceptance.

Initial Sizing: Solutions were strategized based on plan and profile review against constraints, including any integration with surrounding Problem Areas. A tracking design support tool was developed to document all considerations and facilitate QA/QC checks, and to undertake pipe profile design accounting for the City's Design Criteria and conflict checking.

Incorporate into Model: The support tool provided data in a format that could be directly imported into the model, including flagging and associated tagging used for later categorization in both the costing and graphics generation.

Export to QA Sheet: Model results were re-exported into the design support tool to confirm surface and/or HGL criteria were met, enabling QA/QC review and documentation.

Iterate/Resize: Where criteria not fully met or issues extended elsewhere in the system, the process of resizing and/or re-evaluating alternative solutions was undertaken. The preliminary design team was consulted for input on feasibility. This process was repeated until satisfactory solution was defined.

Finalize Solution: Before the solution was finalized, the design team confirmed suitability of the solution feasibility and constraints, and the EA Schedule was documented.

7.2 DEVELOPMENT OF ALTERNATIVES

There are several storm sewersheds based on physical outfall location to watercourses or boundary conditions with adjacent Study Areas, and a number of sanitary subsewersheds connecting to the trunk. Within each sewershed, Problem Areas were defined based on the results of the baseline hydraulic models and became the initial basis for presentation and communication regarding solutions. These Problem Areas were in some cases compiled into Solution IDs when the problem areas and/or solutions were close in proximity or connected. Through the solutions development process and in planning for construction and solution implementation, these Solution IDs were then compiled into Assignments based on hydraulic connectivity. Assignment 47-17 consists of the following Solution IDs:

- A47-SLN-08
    - Includes Problem Area IDs: A47-SASTOV-02A. A47-SASTOV-02B, A47-ST-02
- A47-SLN-09
    - Include Problem Area IDs: A47-SASTOV-01A. A47-SASTOV-01B, A47-STOV-21, and A47-STOV-22

Where the acronyms used are defined by:

- SASTOV – Sanitary and storm HGL exceedances, and overland depth exceedances
- SLN – Solution area consisting of a combination of Problem Areas
- ST – Storm sewer minor system HGL exceedance only
- STOV – Storm HGL and overland depth exceedances

Solution details were provided in Solution Summary Tables (SST) which contain graphics and specific elements that comprise the solutions. The SSTs were compiled by Solution ID and provide visual and physical context of the solution, explanation of the solution and its components, a brief constructability review, and discussion on alternatives considered (where deemed required). Where a second alternative was identified for evaluation, an additional SST with the denoted Alternative number was provided. The SSTs for each solution in Area 47 are provided in **Attachment #3 - TM3**. An additional alternative has been developed as part of the EA process that followed TM3 and Study Report and is discussed in the sections below. The preferred alternative SST is presented in **Appendix D** of this report.

7.2.1 Sizing of Flood Mitigation Measures

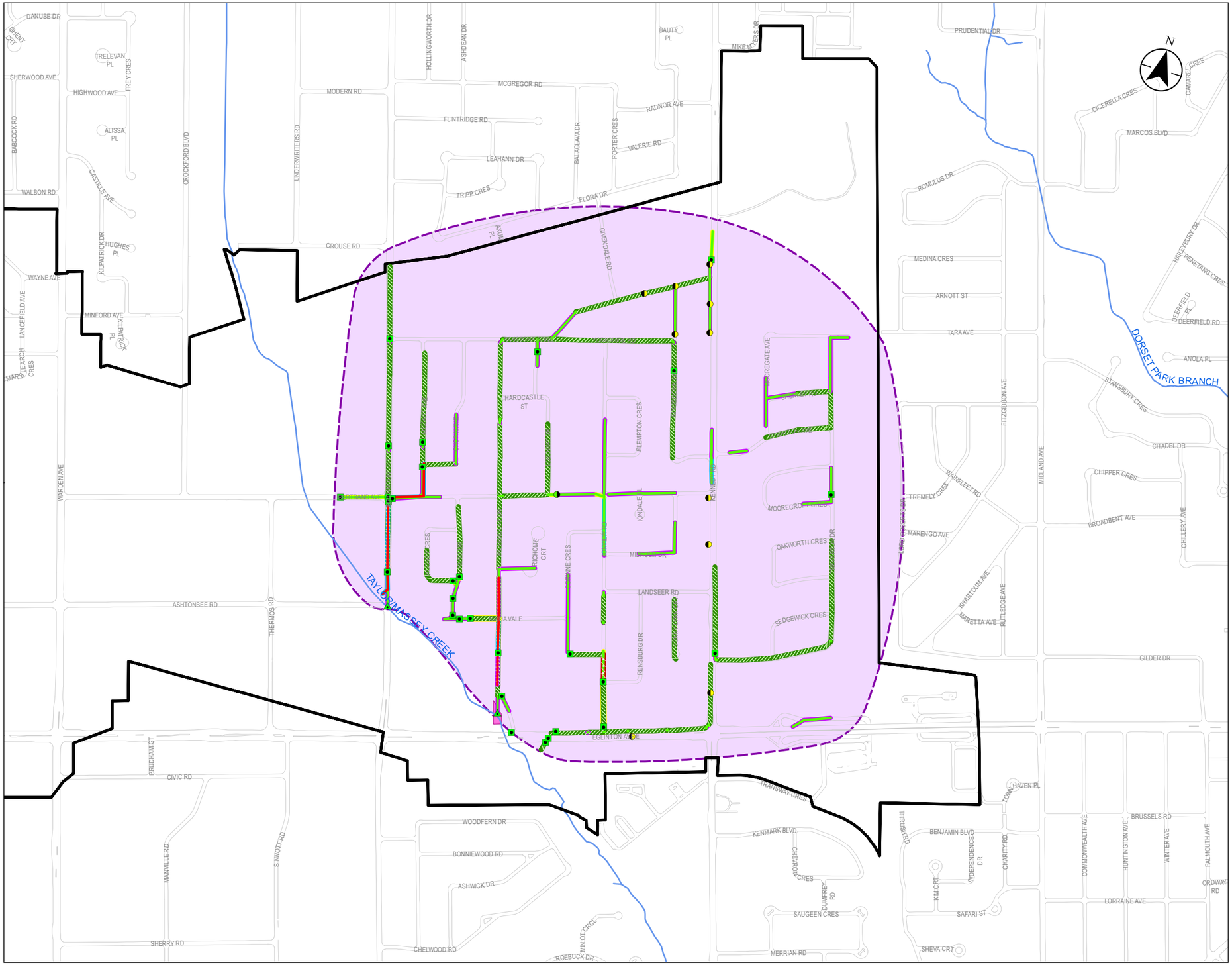
The remedial measures were conceptually designed using a combination of design sheets and the hydrologic/hydraulic models. Additional inlet capacity/control (for storm only) and sewer elements were added to the model and the size, alignment and length were iteratively adjusted until the model showed acceptable results based on the design BFPP criteria. The sizing and siting of proposed infrastructure included the following considerations/preferences: horizontal/vertical alignment, storage, overland

solutions, sanitary-specific considerations, and boundary conditions. Further detail on each of these considerations is provided in **Section 2.4** of **Attachment #3 – TM3**.

7.2.2 Alternative 1

Alternative 1 addresses flood concern for the Assignment 47-17 area by utilizing conveyance upgrades, inline storage, and outfall upgrades, and avoids offline storage requirements. Refer to **Figure 7**—6 for details. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity & provide conveyance upgrades throughout;
- Provide storm inline storage along Kingsdown Dr, Yorkshire Rd, Rosemount Dr, Losoway Dr, Bertrand Ave, Maida Vale Rd, Ranstone Grdns, Birchmount Rd, Chopin Ave, Mozart Ave, Hughey Cres, Reno Dr, Corinne Cres, Ionview Rd, Bonny Lynn Crt, Kennedy Rd, Shenley Rd, Stratton Ave, Treverton Dr, and Eglington Ave E;
- Provide sanitary inline storage along Ionview Rd;
- Redirect storm flows:
  - Maida Vale Rd to Rosemount Dr
  - Bertrand Rd west to Rosemount Dr
  - Bertrand Rd east to Birchmount Dr
  - Ionview Rd and Rensburg Dr south to Eglinton Ave E
  - Ionview Rd west to Bertrand Ave;
- Upgrade and drop sanitary sewers on Rosemount Dr;
- Drop section of sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrades;
- Hydraulically disconnect all dual MHs; and,
- Upgrade two storm outfalls on Rosemount and Birchmount. Outfall pipe upgrade on Birchmount Rd north of Massey Creek connects into a 4 m diameter CSP culvert.



Stantec

Legend

- Study Area
- Assignment 47-17 Area

Proposed Solutions

- Bulkhead Dual MH
- Increase Inlet Capacity
- Isolate MH
- Upgrade Outfall
- New Storm Sewer
- Replace Storm Sewer
- Upgrade Storm Sewer
- Realign and Upgrade Storm Sewer
- Storm Inline Storage
- New Storm Inline Storage
- Replace Sanitary Sewer
- Upgrade Sanitary Sewer
- Sanitary Inline Storage
- Affected Easement

0 250 500 m

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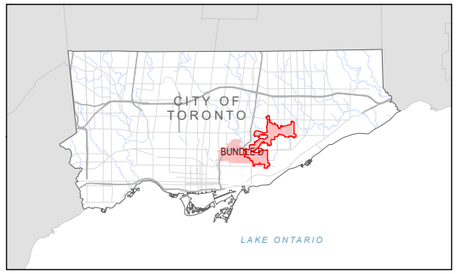


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-15

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

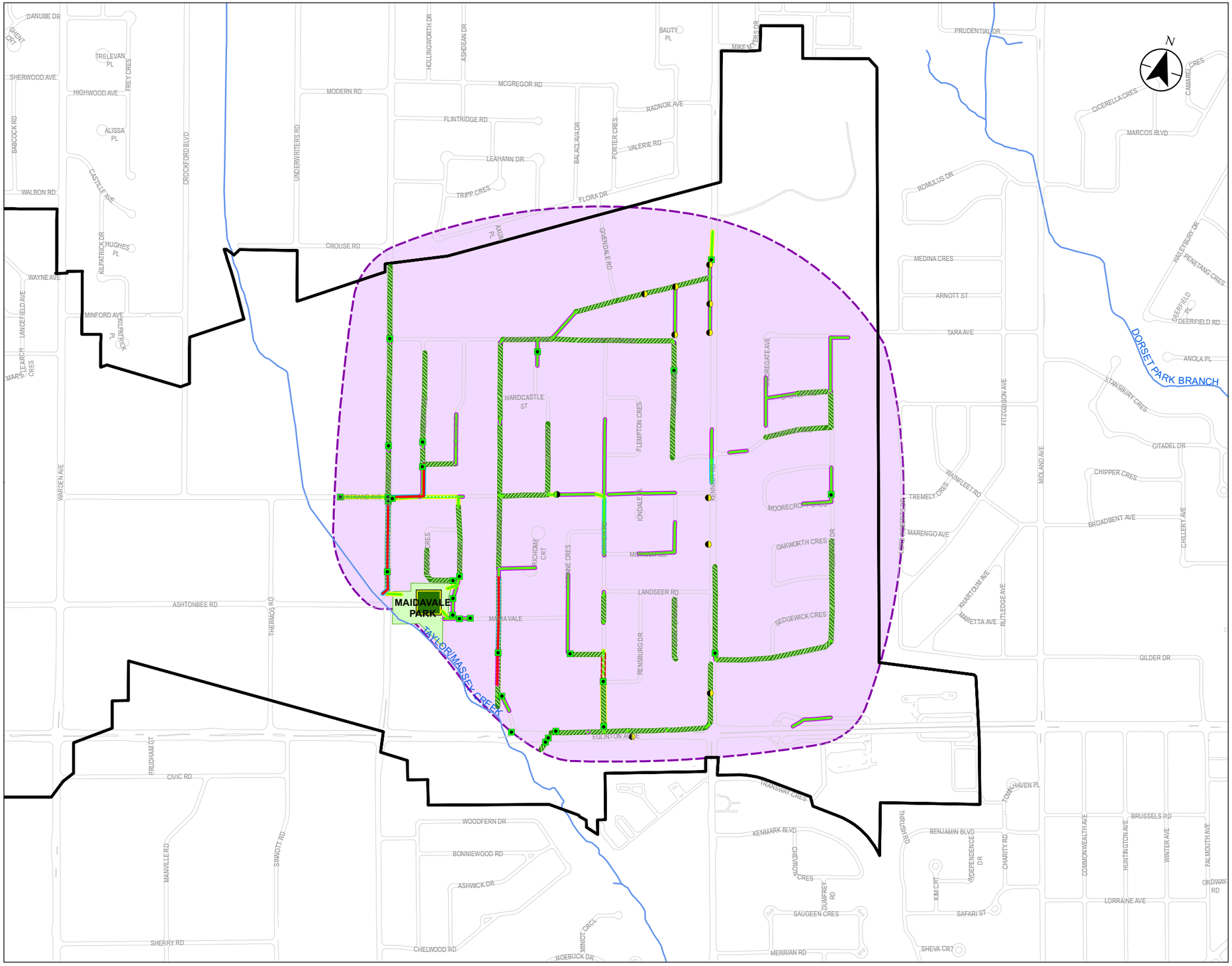
Figure No.
7.6

Title
Alternative 1 Solutions

7.2.3 Alternative 2

Alternative 2 utilizes offline storage enabling a reduction in inline storage and the amount of conveyance upgrades required while avoiding outfall upgrades. Refer to **Figure 7**—7 for details. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity & provide conveyance upgrades throughout;
- Redirect storm flows from Birchmount Rd, Reno Dr and Maida Vale into offline storage within Maidavale Park. Requires approximately 20,000-35,400 m^3 of storage with pump outlet, avoiding all outfall upgrades;
- Provide storm inline storage along Kingsdown Dr, Yorkshire Rd, Rosemount Dr, Losoway Dr, Bertrand Ave, Ranstone Grdns, Birchmount Rd, Chopin Ave, Mozart Ave, Hughey Cres, Reno Dr, Corinne Cres, Ionview Rd, Bonny Lynn Crt, Kennedy Rd, Shenley Rd, Stratton Ave, Treverton Dr, and Eglington Ave E;
- Provide sanitary inline storage along Ionview Rd;
- Redirect storm flows:
- Birchmount Rd and Bertrand Ave to Reno Dr
- Bertrand Rd west to Rosemount Dr
- Bertrand Rd east to Birchmount Rd
- Ionview Rd and Rensburg Dr south to Eglinton Ave E
- Ionview Rd west to Bertrand Ave;
- Upgrade and drop sanitary sewers on Rosemount Dr;
- Drop section of sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrades; and,
- Hydraulically disconnect all dual MHs.



Stantec

Legend

- Study Area
- Assignment 47-17 Area

Proposed Solutions

- Bulkhead Dual MH
- Increase Inlet Capacity
- Isolate MH
- New Storm Sewer
- storm, Realign
- Replace Storm Sewer
- Upgrade Storm Sewer
- Realign and Upgrade Storm Sewer
- Storm Inline Storage
- New Storm Inline Storage
- Replace Sanitary Sewer
- Upgrade Sanitary Sewer
- Sanitary Inline Storage
- Storage
- Affected Park

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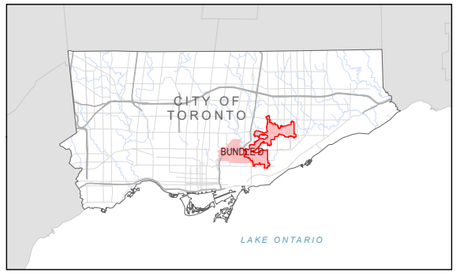

Project Location
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BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

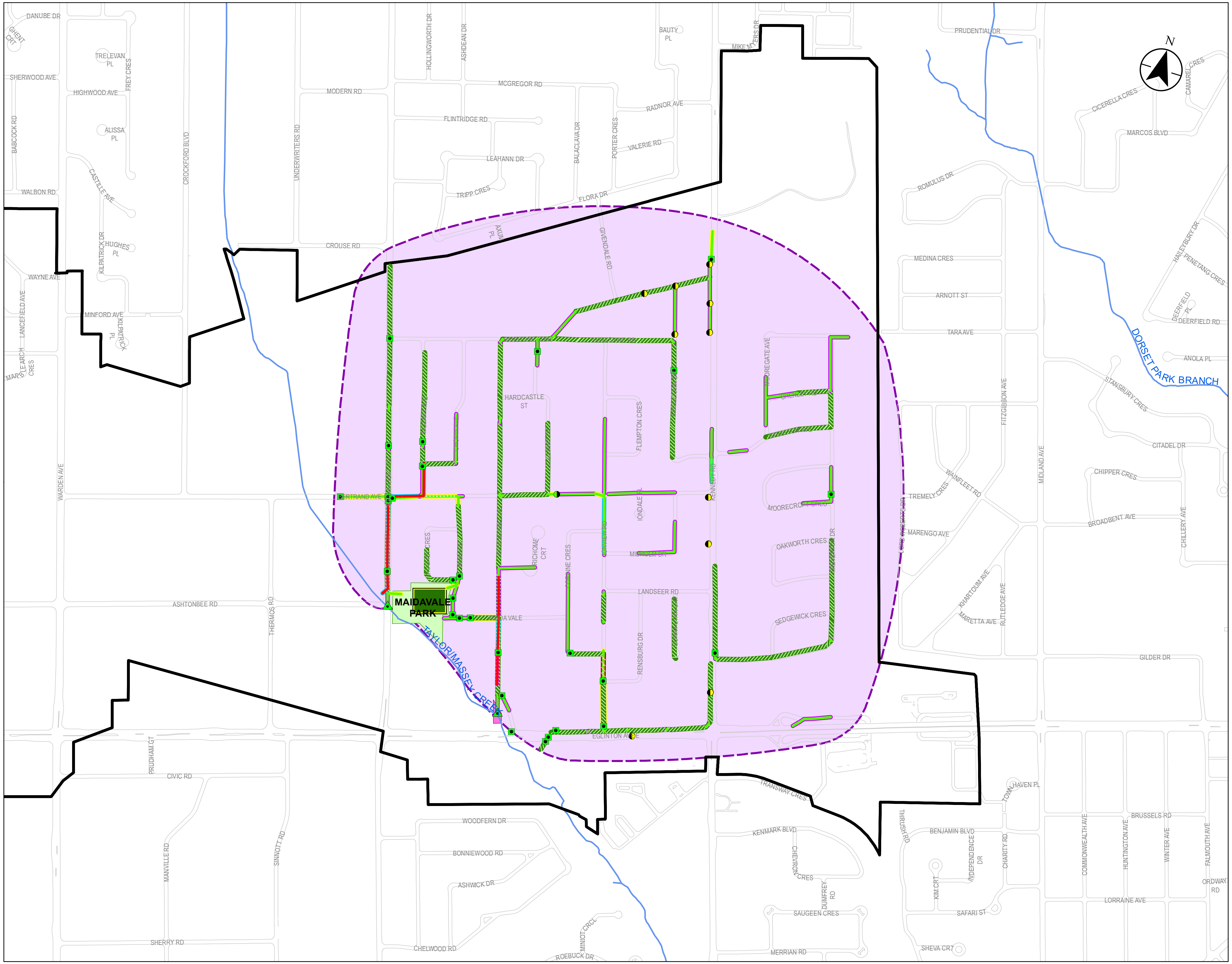
Figure No.
7.7

Title
Alternative 2 Solutions

7.2.4 Alternative 3

An additional alternative was developed as part of the EA process that followed the Area 47 Study Report submission in June 2022. Alternative 3 combines Alternative 1 and 2, consisting of less significant offline storage requirements than Alternative 2, but more flow conveyance upgrades and inline storage than Alternative 1. Refer to **Figure 7**—8 for details. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity & provide conveyance upgrades throughout;
- Redirect storm flows from Birchmount Rd and Reno Dr into offline storage within Maidavale Park (using one less outlet compared to Alternative 2). Storage required reduced to 10,400 m^3 (with backwater valve) to 14,000 m^3 (without backwater valve) with pump outlet (less than Alternative 2).
- Provide storm inline storage along Kingsdown Dr, Yorkshire Rd, Rosemount Dr, Losoway Dr, Bertrand Ave, Maida Vale Rd, Ranstone Grdns, Birchmount Rd, Chopin Ave, Mozart Ave, Hughey Cres, Reno Dr, Corinne Cres, Ionview Rd, Bonny Lynn Crt, Kennedy Rd, Shenley Rd, Stratton Ave, Treverton Dr, and Eglington Ave E;
- Reduced storm in-line storage on Rosemount compared to Alternative 2
- Provide sanitary inline storage along Ionview Rd;
- Redirect storm flows:
- Maidavale to Rosemount Dr
- Bertrand Rd west to Rosemount Dr
- Bertrand Rd east to Birchmount Dr
- Ionview Rd and Rensburg Dr south to Eglinton Ave E
- Ionview Rd west to Bertrand Ave;
- Upgrade and drop sanitary sewers on Rosemount Dr;
- Drop section of sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrades
- Hydraulically disconnect all dual MHs; and,
- Upgrade two storm outfalls on Rosemount and Birchmount. Outfall pipe upgrade on Birchmount Rd north of Massey Creek connects into a 4 m diameter CSP culvert.



Stantec

Legend

- Study Area
- Assignment 47-17 Area

Proposed Solutions

- Bulkhead Dual MH
- Increase Inlet Capacity
- Isolate MH
- Upgrade Outfall
- New Storm Sewer
- storm, Realign
- Replace Storm Sewer
- Upgrade Storm Sewer
- Realign and Upgrade Storm Sewer
- Storm Inline Storage
- New Storm Inline Storage
- Replace Sanitary Sewer
- Upgrade Sanitary Sewer
- Sanitary Inline Storage
- Storage
- Affected Park
- Affected Easement

0 250 500 m

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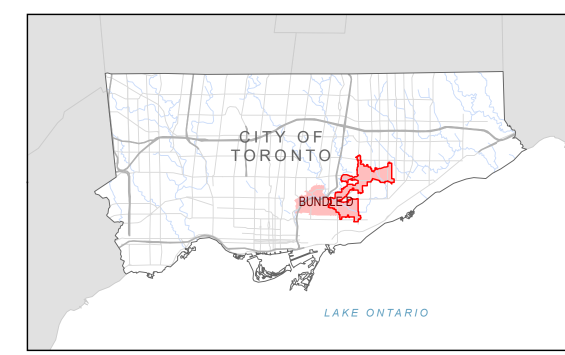

Project Location: City of Toronto

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CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
7.8

Title
Alternative 3 Solutions

7.3 OPINION OF PROBABLE COSTS

The opinion of probable costs for the flood solution alternatives were developed using version 4.1 of the CET and Guidelines. The tool is designed to be used throughout the various stages of each solution including planning, preliminary design, detailed design, and pre-tender. The CET is used for construction costs only, and not engineering fees. Line 8 of the CET was used for the cost estimates, which includes the Total Construction Cost and 30% contingency, and is exclusive of HST. For additional details on the CET, please refer to **Section 6.3** of **Attachment #3 - TM3**.

The total opinion of probable costs using Line 8 of the CET for each alternative for Assignment 47-17 is summarized below:

- Alternative 1 is $234,049,097.
- Alternative 2 is $306,723,272.
- Alternative 3 is $236,056,109.

The CET sheets for each Assignment 47-17 alternative are provided in **Appendix E**.

7.4 EVALUATION OF ALTERNATIVE SOLUTIONS

Alternatives were evaluated based on fourteen (14) criteria. Each criterion was ranked either high, medium, or low impact with a corresponding score of 1,2, or 3 respectively. A “low” ranking represents the lowest impact and most desirable, while a “high” represents the highest impact and least desirable. Once each criterion was evaluation, the score from all criteria was totaled. The evaluation matrix for the three alternatives for Assignment 47-17 is included in **Appendix B**. The criteria that were evaluated are summarized below:

- **Construction risks:** Potential for construction difficulties due to soil, bedrock, and groundwater. Proximity to existing foundations, etc. Maneuverability of equipment during construction. Conflicts with existing infrastructure/other utilities.
- **Operations and Maintenance Requirements:** Complexity/simplicity of infrastructure maintenance. Expected life span.
- **Hydraulic Performance:** Improvement or decline in performance with respect to conveyance and upstream/downstream water levels. Expected Level-of-Service. Ability to meet HGL and flood control criteria. Resiliency and ability to accommodate extreme events.
- **Approvals:** Approvals needed/ risks. Acceptance from city stakeholder/ operators.
- **Terrestrial Systems:** Potential to impact natural Woodlands or significant trees. Potential to impact sensitive vegetative species or wildlife habitat brackets (wildlife linkages) and ESAs.

- **Aquatic Systems:** Potential to impact or enhance aquatic habitat in receiving watercourse. Potential to increase erosion in receiving water course.

- **Effect on Urban Green Space/ Open Space/ Recreational Uses:** Quality and quantity of open space. Urban tree removal. Loss of use during construction. Impacts to recreational activities e.g., pathways, boating, etc.

- **Cultural Heritage Values or Features:** Symbolic cultural value – cultural landscapes. Potential for heritage significance and built heritage. Potential for archaeological significance.

- **Disruption to Community:** Duration of construction. Traffic access and service impacts. Permanent structures that would impact views or aesthetics. Impact. For odor or noise.

- **Impact on Level of Service:** Potential for flooding and ponding during the full range of wet weather events.

- **Property Issues:** Ownership (city owned versus public private possessions), site in ROW or land acquisition. Replacement of existing features (e.g. sheds, etc.).

- **Affordability:** Capital cost, near term affordability. Economic burden on community. Cost of property or easement. Cost relative to other strategies.

- **Sustainability:** Inspection and maintenance cost. Life cycle cost, long term affordability. Economic burden on community. Cost relative to other strategies.

- **Asset Renew Integration Opportunities:** Opportunity to integrate proposed works with asset renewal needs.

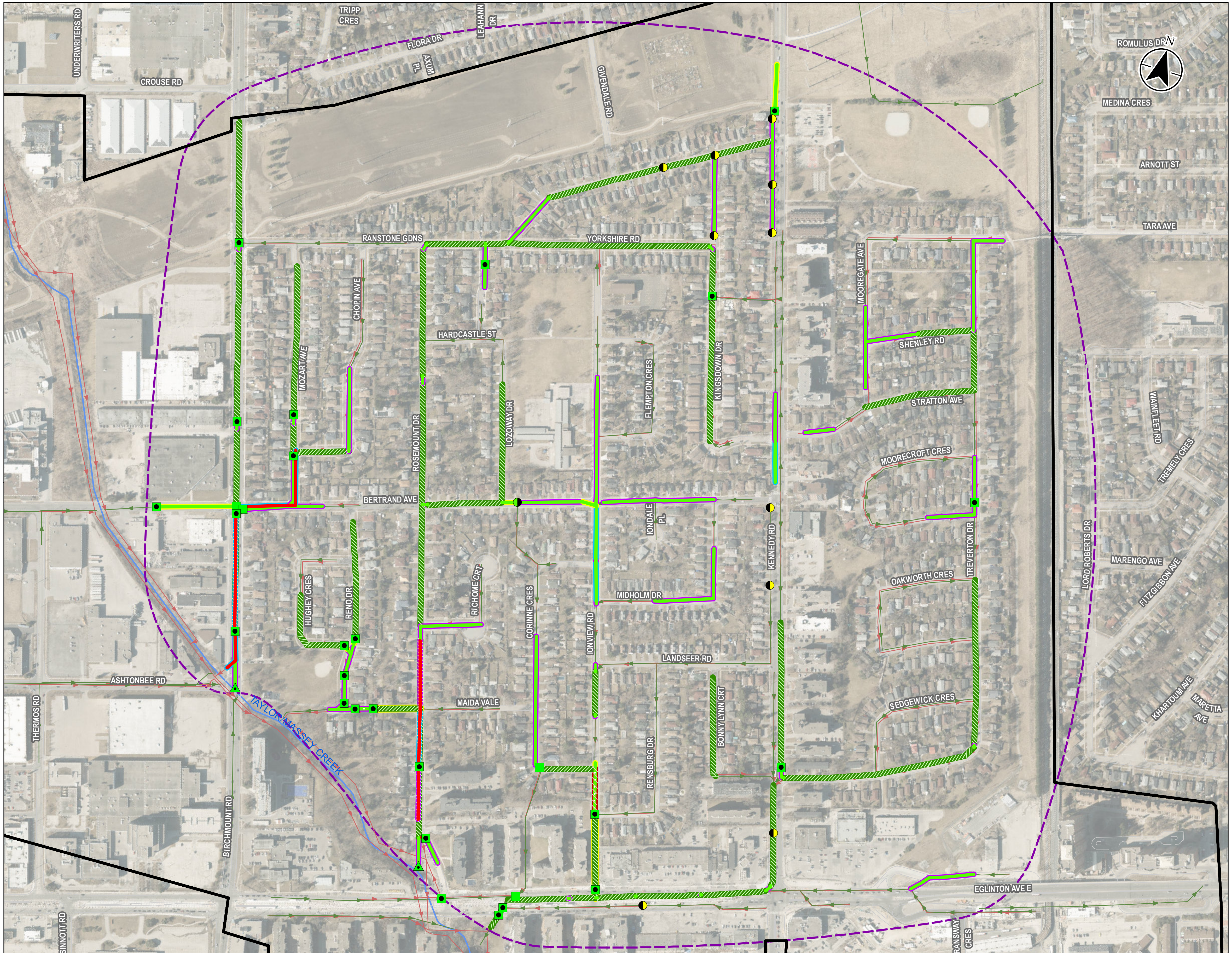
Due to its comparatively low cost and maintenance requirements, improved level-of-service, and its limited social and environmental impacts, Alternative 1 is selected as the recommended alternative solution for Assignment 47-17.

8.0 RECOMMENDED SOLUTION

The recommended solution for Assignment 47-17 meets the City's 100-yr design criteria for both subsurface HGL freeboard from surface (1.8 m), and surface depth (150 mm to 300 mm based on road classification), while minimizing the impact to the receiving watercourses and sewers. The sanitary collection system in this area achieves the 1.8 m freeboard criteria under the May 12, 2000 design storm (as measured at the Oriole RG) with the equivalent 3 L/s/ha wet weather flow generation rate.

The recommended solution corresponds to Alternative 1 discussed in **Section 7.2.2** and utilizes conveyance upgrades, inline storage and outfall upgrades, and avoids offline storage requirements. **Figure 8—1** presents the recommended integrated storm and sanitary solutions for the area. A detailed SST, including the solution description, cost, and EA Schedule, can be found in **Appendix D**. A summary of the recommended solution is outlined below:

- Increase inlet capacity & provide conveyance upgrades throughout;
- Provide inline storage along Kingsdown Dr, Yorkshire Rd, Rosemount Dr, Losoway Dr, Bertrand Ave, Maida Vale Rd, Ranstone Grdns, Birchmount Rd, Chopin Ave, Mozart Ave, Hughey Cres, Reno Dr, Corinne Cres, Ionview Rd, Bonny Lynn Crt, Kennedy Rd, Shenley Rd, Stratton Ave, Treverton Dr, and Eglington Ave E;
- Provide sanitary inline storage along Ionview Rd;
- Redirect flows:
- Maidavale to Rosemount Dr
- Bertrand Rd west to Rosemount Dr
- Bertrand Rd east to Birchmount Dr
- Ionview Rd and Rensburg Dr south to Eglinton Ave E
- Ionview Rd west to Bertrand Ave;
- Upgrade and drop sanitary sewers on Rosemount Dr;
- Drop section of sanitary system on Mozart Ave, Bertrand Ave and Birchmount Rd to allow for storm upgrades;
- Hydraulically disconnect all dual MHs; and,
- Upgrade two outfalls on Rosemount and Birchmount. Outfall pipe upgrade on Birchmount Rd north of Massey Creek connects into a 4 m diameter CSP culvert.



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Storm Sewer
- Sanitary Sewer

Proposed Solutions

- Bulkhead Dual MH
- Increase Inlet Capacity
- Isolate MH
- Upgrade Outfall
- New Storm Sewer
- Replace Storm Sewer
- Upgrade Storm Sewer
- Realign and Upgrade Storm Sewer
- Storm Inline Storage
- New Storm Inline Storage
- Replace Sanitary Sewer
- Upgrade Sanitary Sewer
- Sanitary Inline Storage

0 200 400 m

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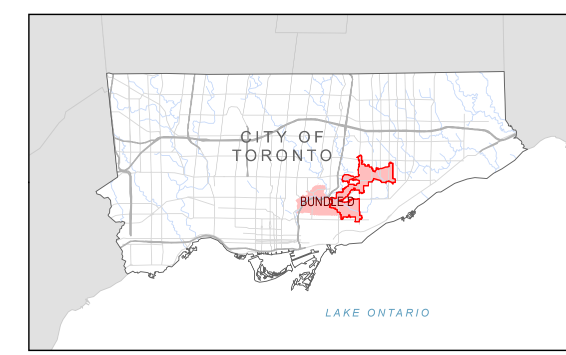


Project Location
City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-15

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
8.1

Title
Recommended Solutions

8.1 ASSIGNMENT 47-17 OPINION OF PROBABLE COSTS

The opinion of probable costs for the recommended Assignment 47-17 flood solution is $234,049,097 based on version 4.1 of the City's CET. This cost covers the total anticipated construction cost, includes 30% contingency and is exclusive of HST. Details regarding the cost estimate are provided in **Section 7.3**, and the Alternative 1 (recommended solution) Assignment 47-17 cost estimate sheets are provided in **Appendix E**.

8.2 PERFORMANCE OF RECOMMENDED ALTERNATIVE AND SOLUTION EXEMPTIONS

The model results of the proposed solution for the100-yr storm minor system, 100-yr storm major system, and May 12, 2000 sanitary system are presented in **Figure 8**—2**, Figure 8**—3, and **Figure 8**—4, respectively. The results are summarized below:

- The storm and sanitary sewer pipes within the ROW meet the HGL depth criteria where properties are connected to the sewer, except where shallow storm sewers within 1.8 m of the surface exist. Here, the water level in the sewers is maintained below the crown of the pipe.
- Overland flow depth is maintained within the street ROW per established criteria for varying road classifications.

While every attempt was made to meet the surface depth, HGL, sewer design, conflict clearance, and shallow pipe criteria throughout the Proposed Solution, there remain a few locations where explicit adherence to all criteria was not possible, nor always required due to limited flood risk to existing or potential future private properties, or because the HGL infraction occurs along the trunk sewer that is outside the purview of this study. A list of the nodes and overland link depths along with supporting rationale for the exemption status is provided in **Appendix C** of the **Attachment #3 – TM3**.

The modelled performance of the recommended solution is summarized below:

- HGL issues in downstream shallow sewers are resolved through outfall upgrade (when boundary condition water level is dropped);
- HGLs have been reduced from baseline where issues remain (observed only when boundary conditions are applied);
- No HGL issues observed along non-shallow pipes when the water level at the boundary condition is dropped;
- Relieving surface flow increases downstream flow to Birchmount outfall in larger events only (+1.7 m^3/s in 100-year);
- HGLs near the Eglington outfall cannot be solved without upgrading and dropping the outfall invert into the watercourse, which has high potential of significantly influencing the watercourse and was not considered further. HGLs have been reduced from baseline; and,
- Otherwise, the targeted sanitary and storm sewer system's level-of-service is achieved.

8.3 HYDRAULIC IMPACT DOWNSTREAM

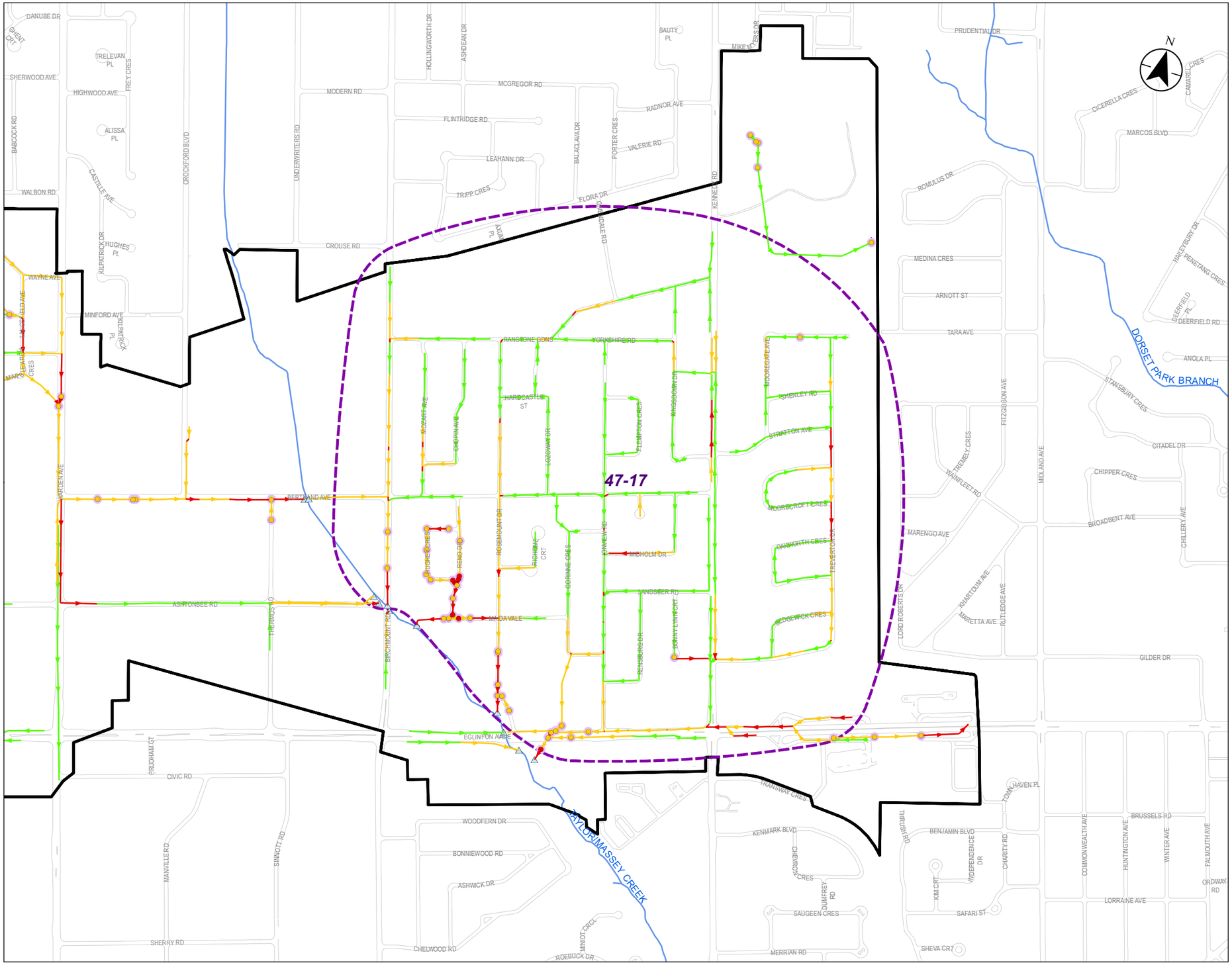
Assignment 47-17 has two minor system connections (1 sanitary, 1 storm) that discharge into Area 34. The 100-yr outflow with solutions has been maintained or reduced to less than baseline conditions at these connection points with the implementation of proposed sewer separation throughout the study area and inline storage. For the sanitary system, the peak flow for the proposed solutions is less than the sanitary Baseline Conditions, with a decrease of 23%. The baseline conditions peak flow at the storm outflow point to Area 34 is maintained with the proposed solutions.

For the storm drainage system, under existing conditions, trapped overland flow paths and sewer conveyance bottlenecks provide a level of flow restriction to receiving watercourses. Relieving many of these bottlenecks and providing conveyance for the trapped overland flow paths will increase the peak flow to these watercourses. Conversely, storage elements for the storm drainage system as well as downspout disconnection will work to decrease impacts to the receiving watercourses from the sewer outfalls. The comparison of storm results of the 2 and 100-yr design storms between existing (Ex.) and proposed (Pr.) conditions is presented in **Table 8-1** for outfalls within the Assignment 47-17 area.

Table 8-1: Storm Outfall Performance

Outfall	2-year Storm						100-year Storm					
	Maximum Flow (m^3/s)				Maximum Velocity (m/s)		Maximum Flow (m^3/s)				Maximum Velocity (m/s)	
	Ex.	Pr.	Dif.	%	Ex.	Pr.	Ex.	Pr.	Dif.	%	Ex.	Pr.
To Taylor / Massey Creek												
OF4319423065	2.64	1.46	-1.18	-44.7	3.9	3.4	4.10	3.77	-0.33	-8.0	5.0	4.6
OF4323722975	1.09	1.01	-0.08	-7.3	2.8	2.7	1.82	2.07	0.25	13.7	3.1	3.2
OF4328022941	1.98	0.81	-1.17	-59.1	2.8	1.7	3.90	3.29	-0.61	-15.6	4.8	2.7
OF4343222681	0.40	0.20	-0.20	-50.0	1.8	1.4	0.70	0.55	-0.15	-21.4	2.3	2.1
OF4345822595	1.73	1.45	-0.28	-16.2	2.6	1.7	3.96	5.66	1.70	42.9	4.8	2.6
OF4365722326	0.12	0.00	-0.12	-100.0	1.8	0.0	0.15	0.00	-0.15	-100.0	2.3	0.0
Total 2-yr Net Change (m^3/s)			-3.03	Total 100-yr Net Change (m^3/s)					0.71			
Ex. = Existing Conditions; Pref. = Proposed Solution Conditions; Dif. = Difference from Proposed to Existing												

On Bertrand Ave, there is a flow reversal east of Massey Creak (OF4365722326) to the new sewer on Birchmount Rd due to depth concerns, which avoids upgrading of this outfall, but does inherently result in an increase in outflow at the Birchmount outfall (OF4345822595). However, by completing wide-spread upgrades to relieve local bottlenecks and surface flooding in the undersized system while also implementing inline storage, an overall increase of only 0.71 m^3/s (4.9%) during the 100-yr design storm to the storm outfalls in the Assignment 47-17 sewershed is observed.



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Outfall

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)
- Sealed MH
- Meets Exemption Criteria

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 250 500 m

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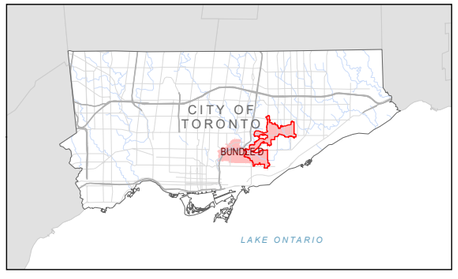

Project Location
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Client/Project
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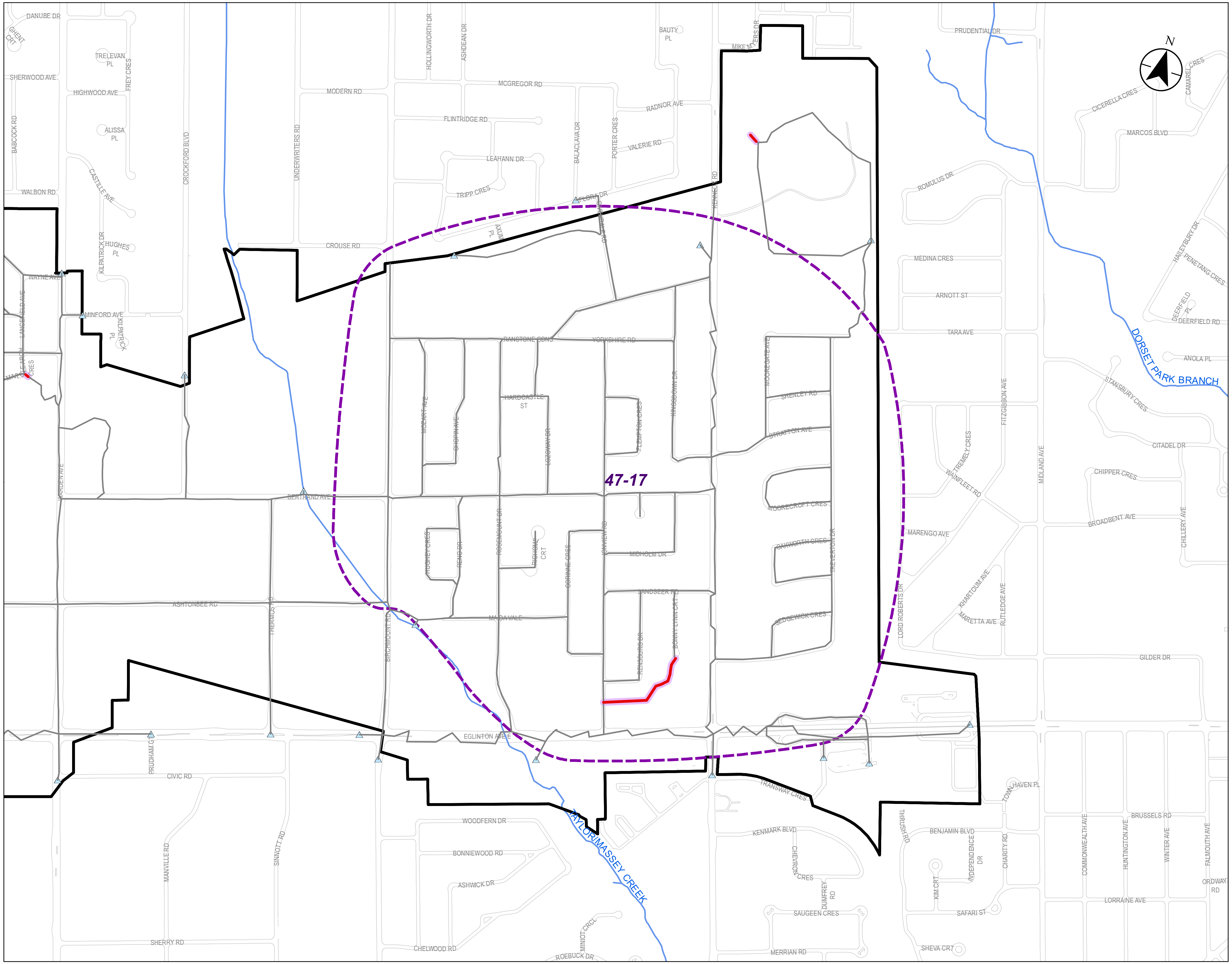
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
8.2

Title
Proposed Storm System Results (100-yr)



Stantec

Legend

- Study Area
- Assignment 47-17 Area
- Major System Outfall

Overland Depth

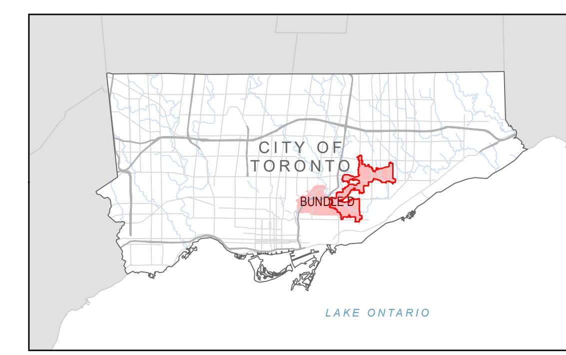
- Exceeds Maximum Allowable Depth
- Below Maximum Allowable Depth
- Meets Exemption Criteria

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 CSRS MTM 10
2. Contains information licensed under Toronto Water Asset Mapping User Agreement.
3. Contains information made available under the Toronto and Region Conservation Authority Open Data Licence v 1.0, Open Government Licence – Toronto, and Open Government Licence – Ontario.



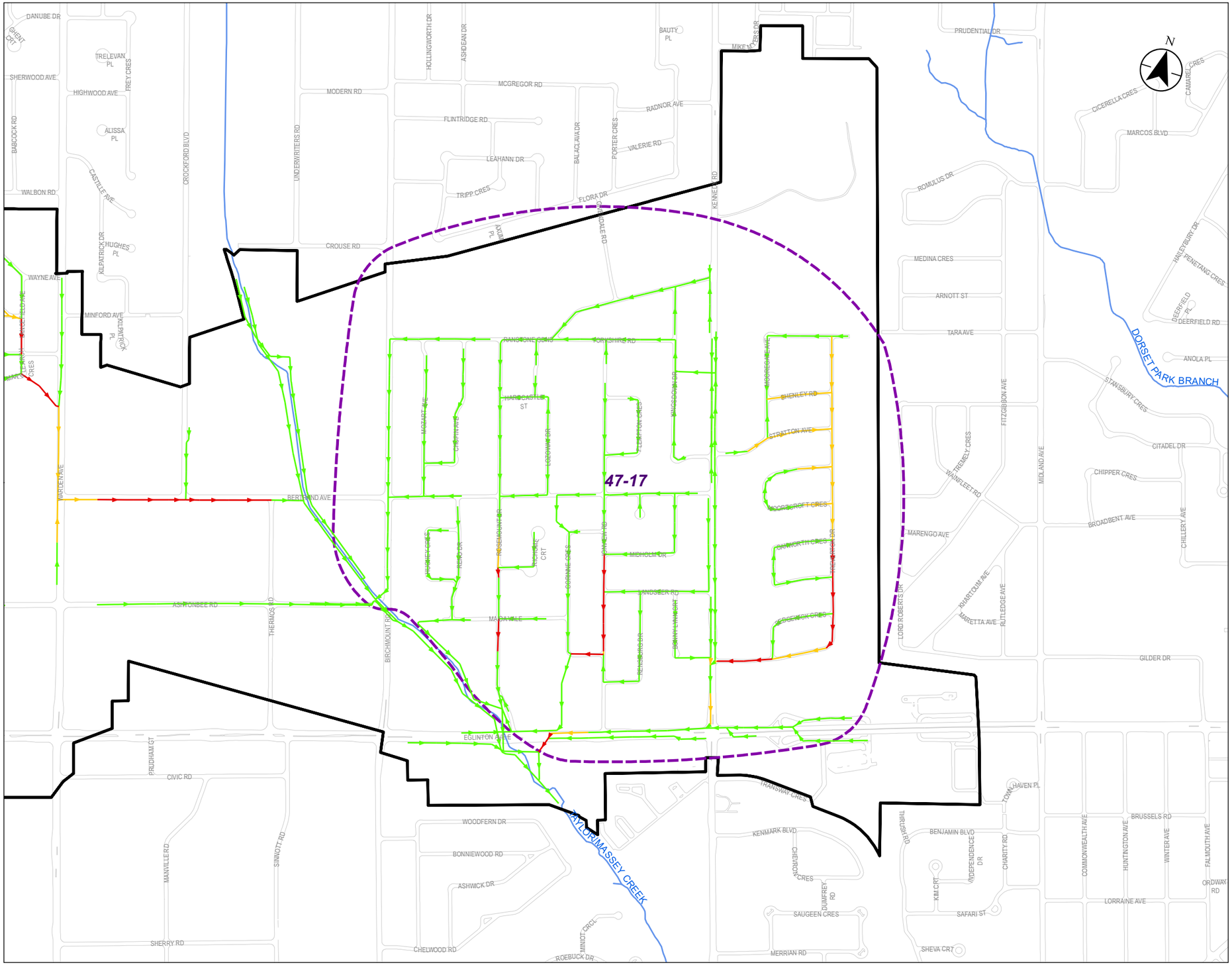
Project Location: City of Toronto

165660138 REVA
Prepared by KDB on 2023-03-14

Client/Project
CITY OF TORONTO
BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
8.3

Title
Proposed Major Overland System Results (100-yr)



Stantec

Legend

- Study Area
- Assignment 47-17 Area

HGL Freeboard

- At or Above Surface
- Within Basement Level (Within 1.8 m of Surface)
- Sealed MH
- Meets Exemption Criteria

Pipe Surcharge State

- Bottleneck (Undersized Sewer)
- Backwater Conditions
- Free-Flowing Conditions

0 250 500 m

1:10,000 (At original document size of 11x17)

Notes

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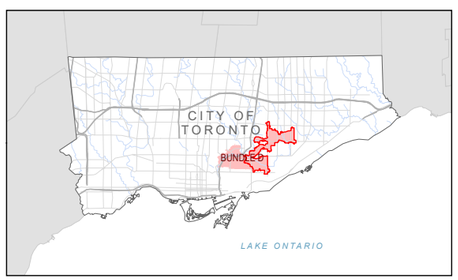

Project Location
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BASEMENT FLOODING CAPACITY STUDIES
BUNDLE D - ASSIGNMENT 47-17

Figure No.
8.4

Title
Proposed Sanitary System Results (May 12, 2000)

The TRCA has expressed in past projects that the potential for flow increases to watercourses due to improved efficiency of the storm remedial measures should not be considered to alter the existing floodplain since the contributing drainage area remains the same with only a redistribution of major and minor system flows under the extreme event. Low point storage and pipe capacity restrictions are not considered when calculating flood flows and flood line mapping for watercourses, since flood lines are generated using a macro-level watershed modelling technique which does not consider the conveyance and storage of the urban drainage system. Without accounting for these flow attenuations, flows used in the HEC-RAS models to determine the design flood levels in the watercourse could be more conservative than those generated in the BFPP detailed InfoWorks models. Therefore, neither increased sewer conveyance nor the presence of upstream storage is expected to negatively impact watercourses in terms of flood risk; however, the TRCA has emphasized concerns with increasing flows to the smaller more sensitive creeks and tributaries; none of which fall within the Assignment 47-17 area.

The resulting peak flows above can be used by the TRCA to evaluate the influence of the proposed change on non-flood situations in their HEC-RAS model, recognizing the limitations of comparing hydrologic runoff generation methods between the subwatershed and local sewershed scales, and the differing rainfall duration/distribution. TRCA consultation materials and responses are included in **Appendix A**.

8.4 CONSIDERATIONS FOR PRELIMINARY DESIGN AND IMPLEMENTATION

The implementation of recommended solutions must consider potential constructability concerns, approvals, and effects on urban green space, cultural heritage, community, and aquatic and terrestrial systems, as discussed in **Section 7.4**. These aspects were evaluated for Assignment 47-17 and documented in **Appendix B**. Notably, these include:

- Constructability challenges surrounding the outfall upgrade on Birchmount Rd as it ties into a 4 m diameter CSP;
- Constructability challenges involving the Eglington Ave E pipe upgrades adjacent to the recent TTC LRT corridor reconstruction;
- Potential effects to the aquatic systems downstream of the outfall upgrades and outfalls observing higher outflows in large storm events (requires consultation with the TRCA);
- Sanitary and storm sewer realignment required to achieve separation between dual systems;
- Construction may be subjected to limited spacing between utilities for maneuvering equipment due to large pipes required for in-line storage throughout the assignment area;
- There is adequate space within the ROW for the recommended upgrades and in-line storage; and,
- No crossing conflicts occur with the recommended solutions based on available information at the time of the Study and EA.

Further to the above, the sequencing of construction from downstream to upstream shall be considered during preliminary and detailed design given the scale of the assignment.

Considerations for agency impacts and future approvals are discussed in the following section.

8.4.1 Mitigation of Potential Impacts, Agency Concerns and Approvals

The potential environmental and social impacts associated with the preferred alternative are related to the construction, implementation, and long-term usage of the remedial measures. The impacts, their potential sources, and methods of mitigation, including agency consultation requirements, are identified below.

The following mitigation measures of potential impacts shall be reviewed and refined during the preliminary and detailed design stages for Assignment 47-17:

- Habitat and trees
- Vegetation removal is to occur outside of the breeding bird season of April to August
- If stockpiles of gravel and sand are required during the active turtle season (April to October), install turtle exclusion fencing around stockpiles prior
- Implement erosion and sediment control mitigation measures
- Spill Prevention and Contingency Plan to be developed prior to construction
- Prepare tree removal and protection plans, along with tree protection barriers and signage where required
- Prepare tree compensation plans for tree removals
- Any damaged trees will be pruned through the implementation of proper arboricultural techniques, under supervision of a certified arborist
- On-site inspection during construction
- Sediment and watercourse protection
- Prior to the installation of a new outfall, determine increase in outlet velocities and flows and design energy dissipation measures as required to prevent erosion
- Consider flow path and outlet orientation with existing bank and potential for bank hardening to prevent erosion
- Construction measures
- Complete Traffic Management Plan
- Use of Best Management Practices for dust control and vibration monitoring during construction
- Use of low noise equipment during construction, where possible
- Notify impacted property owners prior to construction
- Maintain access to fronting properties

The recommended solution for Assignment 47-17 includes an outfall upgrade at Rosemount Dr and an outfall pipe upgrade at Birchmount Rd. During the preliminary and detailed design phases, flow dissipation measures and planting strategies will be required at the outfall upgrade at Rosemount Dr to mitigate sediment and erosion impacts once detailed subsurface and topographic surveys are completed.

Further consultation will also be required with the TRCA and City of Toronto Parks, Forestry and Recreation division required for the proposed upgrades that extend beyond the ROW, such as the outfall upgrade at Rosemount Dr. Per Ontario Regulation 166/06, an Application for Development, Interference with Wetlands and Alteration to Shorelines and Watercourses with the TRCA will need to be submitted and approved prior to construction.

The TRCA noted that the ongoing Golden Mile Transportation Network Assessment EA Study is ongoing but is focused on alignment alternatives west of Birchmount Rd and is not directly overlapping with the proposed extents of Assignment 47-17. During the preliminary design stage for Assignment 47-17, coordination with the EA stakeholders may be required.

9.0 CONCLUSIONS

The following conclusions can be drawn from the completion of this EA Study:

- Through the initial Study Phase completed for the entire Area 47, several capacity issues were identified. Based on the review and interpretation of available background data, field investigations and resident input, the main causes of basement and surface flooding can be attributed to overloading of storm sewers, pipe bottlenecks, floodplain influence, presence of dual MHs, and lack of a continuous major system with trapped overland flow paths causing surface flooding. Alternative flood risk reduction solutions were identified at the Study Area-scale based on hydraulic connectivity (i.e., Assignments), and initially evaluated at a high-level including agency consultation to select the preferred solutions that would fall within the ROW. Through this process, one Assignment (47-17) was identified as potentially having greater environmental and social impacts due to proposed flood solutions outside of the ROW and proceeded to completion of the Schedule B EA process with additional agency/public consultation, alternative solution review/refinement, and evaluation, as documented in this Project File.
- Through the EA process, an additional flood solution alternative was developed (Alternative 3). All three alternatives were evaluated based on social, economic, environmental and constructability criteria using a scoring method. Due to its comparatively low cost and maintenance requirements, improved level-of-service, and its limited social and environmental impacts, Alternative 1 was selected as the recommended alternative solution for Assignment 47-17.
- With the implementation of the preferred flood remedial measures, the storm drainage system can convey both the major and minor systems during the 100-year design storm within the City surface depth and HGL criteria with limitations stemming from downstream watercourse levels only. Similarly, with the proposed flood remedial measures, the sanitary drainage system can convey the May 12, 2000, event.
- With the implementation of flood solutions, there is a change to the quantity of water discharging to Taylor-Massey Creek, attributable to the improvement in drainage efficiency to meet surface depth and pipe water level criteria, even with significant in-line storage implemented. During the 2-yr storm, there is a net reduction in peak flow of 3.03 m^3/s, and during the 100-yr storm, there is a net increase of 0.71 m^3/s.
- The recommended improvement works to help address the flooding problem in 47-17 is estimated at a total construction cost of $234 million (2022 Canadian dollars) net to the City.
- Based on the Stage 1 Archaeological studies, the recommended solution with outfall upgrades to Taylor-Massey Creek is considered to retain archaeological potential (and require further investigation at detailed design). All other proposed solutions within the municipal ROW do not require Stage 2 works.
- Protected properties and places of cultural heritage value or interest have been identified within the Assignment boundary. As such, additional assessment will be completed during the preliminary design phase to identify, evaluate, assess the impacts, and provide recommendation to mitigate the effects of the undertaking on cultural heritage resources including built heritage and cultural landscapes.

Conclusion
September 29, 2023

- The Municipal Class EA Master Planning process (Phases 1 and 2) has been fulfilled through public consultation including one public information event, agency consultation, and the submission of this Project File document.

It is recommended that the Assignment proceed to preliminary design, subject to City prioritization, additional agency consultation, and commence with implementation as Capital budgeting allows.

Appendix A ADDITIONAL CONSULTATION MATERIALS

Appendix B ARCHAEOLOGY AND CULTURAL HERITAGE REPORTS

Appendix C EVALUATION MATRIX

Appendix D RECOMMENDED SOLUTION SUMMARY TABLE

Appendix E ASSIGNMENT 47-17 COST ESTIMATE SHEETS