EXECUTIVE SUMMARY

ES-1 Introduction

In recent years, basement flooding has occurred in various neighbourhoods across Toronto as a result of severe rainstorms, including August 15, 1986; May 12, 2000; July 26, 2002; August 19, 2005; and July 23, 2006, July 8, 2008, June 26, 2010, July 15, 2012, and July 8, 2013. These storm events caused flooding of many homes, erosion along creek ravines, and damage to City infrastructure such as roads, bridges, culverts and sewers.

As a result of the events of May 12, 2000 and August 19, 2005 in particular, the City initiated engineering reviews to address the basement flooding problem across the entire City. The current program encompasses 67 chronic basement flooding areas.

This study addresses Basement Flooding Area 45; refer to **Figure ES-1**. It is noted that Area 45 has been sub-divided into four separate areas, Areas 45A, 45B, 45C and 45D. The location of each of these sub-areas is also shown in **Figure ES-1**.

This study has assessed the performance of the storm drainage system and the combined and sanitary sewerage system to identify the causes of basement flooding, and to develop a comprehensive flooding remediation plan to meet the City's target level of service. As well, the study as examined how measures recommended as part of the City's Wet Weather Flow Management Master Plan (WWFMMP, 2003) can be integrated into the flood-remediation program for Area 45.

The study has followed the Province's Class Environmental Assessment process for municipal infrastructure (MEA's Municipal Class Environmental Assessment, approved October 7, 2015).

- **ES1.1 Study Area**

  The aggregated Area 45 study area is approximately 1803ha, comprised of sub-areas 45A (252ha), 45B (857ha), 45C (625ha) and 45D (69ha). Area 45 has a significant mix of land use. Area 45A consists of the campus of York University and surrounding area, while Areas 45B, 45C and 45D contain a mix of commercial, low and medium density residential land use. The prevalent land use for Area 45 is residential, representing approximately 30.4% of the total contributing area. Industrial, commercial and institutional lands (ICI) amount to 21.3% and the remainder of the area is open space (parks, natural areas, vacant land) and roadway areas.

  Areas 45A and 45B are serviced by separate storm and sanitary sewers. Areas 45C and 45D are serviced by a combination of separate sanitary and storm and combined sewers. The local sanitary sewer system in sub-areas 45A, 45B and 45C discharge to the Black Creek Trunk Sewer, while 45D local sanitary and combined sewers discharge to the St. Clair Trunk Sewer prior to discharging to the Black Creek Trunk Sewer. The Black Creek Trunk Sewer

discharges into the Humber River Trunk Sewer, which conveys all flows to the Humber Wastewater Treatment Plant. The local storm sewers mainly discharge to Black Creek, which then flows into the Humber River. There are some storm local sewers in the western parts of sub-areas 45B and 45C that discharge directly to the Humber River.

In accordance with the design standards of the time, the storm sewer system was designed to accommodate runoff from a 2-year or 5-year rainstorm.

- **ES1.2 Problem Summary**

  Figure ES-2 shows the history of reported basement flooding locations. Most of the flooding reports were as a result of the severe rainfall of July 8, 2013. The following historical storm event basement flooding reports are noted:

  - July 8, 2013 event: 121 reports;
  - August 8, 2018: 70 reports;
  - May 12, 2000 event: 54 reports;
  - August 19, 2005: 41 reports;
  - October 16, 2014: 33 reports;
  - July 31, 2012: 4 reports;
  - June 27, 2015: 2 reports; and,
  - October 28, 2015: 2 reports.

  It is noteworthy that the July 8, 2013 rainfall was substantially larger than the 100-year rainfall. This event included rainfall of 120mm in 6-hours, with 102mm occurring within 2-hours (City rain gauge RG-014). In contrast, Environment Canada statistics show that for Toronto, at a return period of 100-years, the 6-hour rain amount is 77mm, and the 2-hour amount is 63mm.

- **ES1.3 Assessment of System Performance**

  The performance of Area 45's storm, combined and sanitary drainage systems was assessed through development of computer models using the InfoWorks ICM platform, in accordance with the City's modelling guidelines. The models were calibrated using available sewer flow monitoring data from Area 45 and were then validated by confirming that the models provide a reasonable simulation of the actual reported extent of flooding during the above-noted extreme events.

  The performance assessment has been based on determining whether, according to the model results, the sewer systems meet the City's target level of service. For the sanitary and combined sewer system, the maximum water level is to be below basement elevations during the May 12, 2000 rainfall event, as gauged at the City's Oriole Park rain gauge. This target level of service provides protection against basement flooding from the sanitary or

combined sewer system backups for a storm event with a return period between 25 and 50 years. For the storm and combined sewer system, the maximum water level is to be below basement elevations during a 100-year storm event. For shallow systems, where storm, combined or sanitary sewers, are located within 1.8m of the ground surface, surcharge conditions would not be permitted. For the storm drainage system, overland flow on municipal roadways was to be within the road allowance.

The conclusions were as follows:

- Approximately 3.4% of the 1,602 sanitary maintenance holes and 13% of the 374 combined maintenance holes in Area 45 did not meet the City's target level service for the May 12, 2000 storm event. These locations were all located within Area 45B;
- Approximately 64.1% of the 2,030 storm maintenance holes and 68.5% of the combined maintenance holes in Area 45 did not meet the City's target level of service for the 100-year storm event; and,
- Approximately 19.6% of all overland flow locations did not meet the City's target level of service for the 100-year storm event.

- **ES1.4 Technical Analyses of Flood Remediation Alternatives**

  For purposes of analysis, the Study Area was subdivided into a total of 39 cluster areas and 10 cluster group areas.

  For the sanitary system, alternatives were considered to address sanitary sewer deficiencies in two cluster group areas. In Area 45B1, alternatives included do nothing and upgrades to sanitary sewers on Huxley Road. In 45B3, alternatives considered included do nothing and upgrades to sanitary sewers on Jane Street, Sheppard Avenue and a new sanitary flow storage tank at Jane Street north of Black Creek. It is noted that this flow storage tank was identified as part of the preferred alternative design concept in the Black Creek Sanitary Trunk Sewer Class EA Study.

  For the storm system, a set of alternatives was examined for each cluster group area, to arrive at preferred approach to addressing the extensive storm drainage deficiencies within Area 45. As Area 45C also contains a significant portion of area serviced by combined sewers, alternatives also addressed combined sewer deficiencies in Area 45C. The storm system improvement alternatives were based on considering the following potential measures within each cluster area:

  - Installation of high-capacity inlets and/or more catchbasins at strategic locations to reduce surface ponding;
  - Installation on inlet control devices (ICDs) to limit the rate of flow entering the storm pipe system;
  - Increase in storm sewer pipe sizes;

- Installation of new storm sewers to improve overall system capacity; and,
- Installation of stormwater storage pipes at strategic locations to control the rate of flow discharged to the system downstream and to Black Creek and the Humber River.

For each cluster group area, two storm solution alternatives were formulated, using the computer model to confirm that satisfactory performance could be achieved by each alternative. A preferred alternative was then selected for each cluster group area, by systematically comparing the alternatives using a consistent set of criteria in the following categories listed in **Table ES-1-1** below:

TABLE ES-1-1 SUMMARY OF ALTERNATIVE COMPARISON CRITERIA

CATEGORY	**Criteria**
Natural Environment	• Impacts on Terrestrial System • Impacts on Aquatic System • Impacts on Soil and geology
Social Environment	• Impacts on Urban Greenspaces • Community Impacts During Construction • Post-Construction Community Impacts
Technical Considerations	• Design Concerns • Constructability Concerns • Impacts on Downstream Infrastructure • Operation and Maintenance Requirements
Cost Considerations	• Capital Cost • Operation & Maintenance Costs

To structure the comparison, a simple scoring system was used to give a comparative score for each alternative under each criterion, and to then compute a total score for each alternative. This allowed for the selection of the preferred storm system improvement alternative for each cluster group area, leading to development of the recommended improvement plan for Area 45 as a whole.

ES-2 Sanitary System Improvements

The preferred alternative and recommended improvements to the sanitary sewer system are comprised of the following:

- Replacement of existing sanitary sewers on Jane Street and Sheppard Avenue with new 300mm, 375mm and 525mm diameter sanitary sewers;
- A 135m^3 flow storage tank on Jane Street north of Black Creek; and,
- Replacement of an existing sanitary sewer on Huxley Road with a new 375mm diameter sanitary sewer.

ES-3 Storm System Improvements

- **ES3.1 Overview**

  The preferred alternative and recommended improvements are depicted in **Figure ES-3**. As this map shows, the overall strategy is comprised of extensive storm sewer improvements (i.e. increase in storm pipe size), and installation of ICDs, high-capacity inlets and new catchbasins at various strategic locations. In Area 45C, sewer separation and the installation of new storm sewers has been proposed. Storm sewer improvements also include one project which will benefit both Area 45 and Area 4. In total, 255 component storm projects have been identified. These projects include:

  - Three component projects in Cluster Group Area 45A1 at a total estimated cost of $7.35M. These projects include storm sewer improvements and installation of high-capacity inlets (HCIs);
  - A total 21 component projects in Cluster Group Area 45B1 at an estimated cost of $47.71M. These projects include storm sewer improvements, new storage storm sewers, HCIs, relief sewers, and outfall improvements;
  - A total of 10 component projects in Cluster Group Area 45B2 at an estimated cost of $16.89M. These projects include storm sewer improvements, twin storm sewers and HCIs;
  - A total of 39 component projects in Cluster Group Area 45B3 at an estimated cost of $83.34M. These projects include storm sewer improvements, inlet control devices, HCIs, storm storage sewers and outfall improvements;
  - A total of 48 component projects in Cluster Group Area 45B4 at an estimated cost of $84.0M. These projects include storm sewer improvements, storm relief sewers, HCIs, storm storage sewers and outfall improvements;

- A total of 43 component projects in Cluster Group Area 45C1 at an estimated cost of $60.6M. These projects include storm sewer improvements, new catchbasins, HCIs, storm storage sewers, relief sewers, storm storage sewers and outfall improvements;
- A total of 12 component projects in Cluster Group Area 45C2 at an estimated cost of $21.04M. These projects include storm sewer improvements, HCIs, storm storage sewers and outfall improvements;
- A total of 55 component projects in Cluster Group Area 45C3 at an estimated cost of $121.5M. These projects include combined sewer separation, storm sewer improvements, HCIs, new catchbasins, storm relief sewers, outfall improvements and a 6,300 m^3 storage tank;
- A total of 15 component projects in Cluster Group Area 45C4 at an estimated cost of $30.85M. These projects include storm sewer improvements, new catchbasins, HCIs and outfall improvements; and,
- A total of 8 component projects in Cluster Group Area 45D at an estimated cost of $7.23M. These projects include storm sewer improvements;
- A new storm trunk sewer project located on Alliance Avenue has been identified that will service Area 45C3 and Area 4 at an estimated cost of $22.72M.

- **ES3.2 Storage Facilities**

  In Areas 45C3, sewer separation is part of the preferred alternative. Sewer separation will involve the construction of numerous new storm sewers, conversion of existing combined sewers to sanitary sewers and construction of a new 6,300m^3 storage tank at the southwest corner of Alliance Avenue and Rockcliffe Boulevard. A second smaller storage tank, 135m^3 is identified for Area 45B2 on Jane Street north of Black Creek. Geotechnical investigations will be required to provide necessary information for the design of these storage facilities.

- **ES3.3 Storm Outfall Replacements and New Storm Outfall**

  The preferred alternative includes replacement of a number of existing storm outfall sewers and outfall structure replacement along Black Creek and the Humber River, as listed in **ES-1-2** below.

TABLE ES-1-2 STORM OUTFALL REPLACEMENT

Outfall Location	Description of Recommended Works
Weston Road and Albion Road Ramp (Outfall ID of 4174001569) (Project 45-21)	Remove existing 1050mm diameter outfall sewer and replace with 1200mm diameter outfall sewer. Outfall structure reconstruction required. Additional measures will be needed to protect downstream wetland feature and address local erosion potential.
Jane Street at Oakdale Golf and County Club) (Outfall ID 434903846) (Project 45-29)	Remove existing 1050mm diameter outfall sewer and replace with new 2100mm diameter outfall sewer. Outfall structure reconstruction also required. Additional measures may be required to project downstream property.
South of Northover Street at Black Creek (of 4385605134) (Project 45-29)	Remove existing 450mm diameter outfall sewer and replace with a new 1050mm diameter outfall sewer. Outfall structure to be reconstructed. Relocation also required to extend outfall sewer to Black Creek. Slope stability assessment will be required to support relocation.
South of Sheppard Avenue West, West of Seeley Drive at Black Creek. Existing outfall discharges into existing Black Creek culvert under Sheppard Avenue West (OF4447505029) (Project 45-29)	Remove existing 450mm diameter outfall sewer and replace with a new 675mm diameter outfall sewer. Outfall sewer to discharge into planned upgraded culvert (by others) under Sheppard Avenue West.
Diana Drive (OF4445605215) (Project 45-32)	Remove existing 450mm diameter outfall sewer and replace with a new 600mm diameter outfall sewer. Outfall structure reconstruction required.
Black Creek west of Skipton Court (OF4385605349) (Project 45-33)	Remove existing 250mm diameter outfall sewer and replace with a new 1050mm diameter outfall sewer. Replace/ repair existing outfall structure due to current condition.
Black Creek west of Langholm Drive (OF4348605165) (Project 45-33)	Remove existing 250mm diameter outfall sewer and replace with a new 1200mm diameter outfall sewer. Outfall structure reconstruction and relocation also required as current outfall is located on slope where are slope stability issues.
Black Creek north of Tavistock Road (OF4329804950) (Project45-33)	Remove existing 1050mm diameter outfall sewer and replace with a new 1500mm diameter outfall sewer. Outfall structure reconstruction also required. Erosion control works may be required as per TRCA concerns.

TABLE ES-1-2 STORM OUTFALL REPLACEMENT

Outfall Location	Description of Recommended Works
Black Creek culvert under Lawrence Avenue West (OF4029805138) (Project 45-43)	Remove existing 600mm diameter outfall sewer and replace with a new 1650mm diameter outfall sewer. Existing outfall is located within bridge structure. Outfall to be relocated and reconstructed to avoid impacting bridge structure.
Black Creek at Trethewey Drive (OF5502125000) (Project 45-43)	Remove existing 1200mm diameter outfall sewer and replace with a new 1350mm diameter outfall sewer. Existing outfall structure to be reconstructed.
Black Creek underneath Trethewey Drive (OF391196000) (Project 45-45)	Remove existing 600mm diameter outfall sewer and replace with new 1500mm diameter outfall sewer. Existing outfall structure located within existing bridge. New outfall structure to be relocated away from bridge.
Black Creek south of Eglinton Avenue on Scarlett Woods Golf Course (OF3791504652) (Project 45-47)	Remove existing 900mm diameter outfall sewer and replace with new 1650mm diameter outfall sewer. Existing outfall structure to be reconstructed. Design to consider erosion concerns.
Humber River at Scarlett Road (OF3741404129) (Project 45-50)	Remove existing 450mm diameter outfall sewer and replace with a 900x1800mm box culvert outfall sewer. Outfall structure to be reconstructed. Design to concern erosion control requirements.
Black Creek at Scarlett Road (OF3699204353) (Project 45-50)	Replace existing outfall with new twin 1200mm diameter outfall sewer. Existing outfall discharges through concrete wall of Black Creek channel. Existing outfall to be relocated and reconstructed.
Black Creek south of Sand cliff Road (OF3709704811) (Project 45-51)	Remove existing 300mm diameter outfall sewer and replace with new 1050mm diameter outfall sewer. Outfall located within Smythe Park. Outfall structure to be relocated and reconstructed to a location west of existing pedestrian bridge. Pedestrian access to be maintained during construction.

ES-4 Integrating Measures to Improve Water Quality

The study has also examined the opportunities within Area 45 to implement the various measures recommended in the City's WWFMMP for reducing stormwater volume and stormwater pollution. Opportunities were identified for sewer separation in combined sewer areas. There are additional WWFMMP source-control opportunities within the Black Creek and Humber Creek watershed that are applicable to private properties; continued public outreach and information programs by the City will help promote these measures to property owners.

ES-5 Estimated Costs for Implementation

The following **Table ES-1-3** summarizes the estimated costs for implementation of the recommended works. **These estimates include contingencies of 30%. All cost estimates were developed using the City's BPFF Cost Estimating Tool (Version 3.0).**

TABLE ES-1-3 PREFERRED ALTERNATIVES CAPITAL COST

SYSTEM	Cluster Group Area	Preferred Alternative ID	Capital cost estimate (including construction contingency and estimated design / approvals cost)
Sanitary	Cluster Group 45B1	45B1_SAN1	$0.84M
Sanitary	Cluster Group 45B3	45B3_SAN1	$6.61M
Storm	Cluster Group 45A	45A_STM1	$7.35M
Storm	Cluster Group 45B1	45B1_STM1	$47.72M
Storm	Cluster Group 45B2	45B2_STM1	$16.90M
Storm	Cluster Group 45B3	45B3-STM1	$83.34M
Storm	Cluster Group 45B4	45B4_STM1	$84.0M
Storm	Cluster Group 45C1	45C1_STM1	$60.6M
Storm	Cluster Group 45C2	45C2_STM1	$21.04M
Storm	Cluster Group 45C3	45C3_STM1	$121.5M
Storm	Cluster Group 45C4	45C4_STM1	$30.85M
Storm	Cluster Group 45D	45D_STM1	$7.23M
Storm	Area 45C3 and Area 4	-	$22.71M
		Totals	$ 510.79 million

Note: All cost estimates developed using City of Toronto BFPP Cost Estimating Tool Version 3.0 and include 30% contingencies.

ES-6 Implementation

As part of this study, projects were bundled based on hydraulic conductivity. Within Area 45, works identified within the preferred alternative were grouped to form a total of 28 projects.

- **ES6.1 Completion of Class EA Requirements**

  This report has identified which Municipal Class EA Schedule pertains to each of the individual sewer replacement projects. A total of 26 projects encompass sanitary/ combined/ storm sewer improvements to be constructed within existing municipal road rights-of-way or sewer easements. Therefore, all such projects can proceed as Class EA Schedule “A+” projects. A total of two (2) projects include the construction of storage tanks for wet weather control. These projects can proceed as Class EA Schedule “B” projects.

- **ES6.2 Impact Mitigation Measures**

  This report has identified that various impact mitigation measures are to be considered during final design and construction of the recommend sewer improvement works, to deal with the following concerns:

  - Potential impacts on existing trees;
  - Vehicle traffic management during construction;
  - Noise and vibration during construction; and,
  - Sediment and silt wash-off from construction sites, and potential impact on Humber Creek.

- **ES6.3 Archaeology**

  The completed Stage 1 Archaeological Assessment identified two specific areas of archaeological potential where a Stage 2 Archaeological Assessment would be required. These sites are located overlooking the Humber River at Jane Street and Eglinton Avenue and south of Murray Ross Parkway and west of Sentinal Road. The archaeological assessment concluded that the works included in the preferred alternatives are located in areas that have been disturbed by previous construction activity and utility installation. In the event that isolated or deeply buried archaeological remains are found during construction activities, ASI, the City and the Cultural Programs Unit of the Ministry of Tourism, Culture and Sport are to be notified.

Figure ES-1 Area 45 Study Area

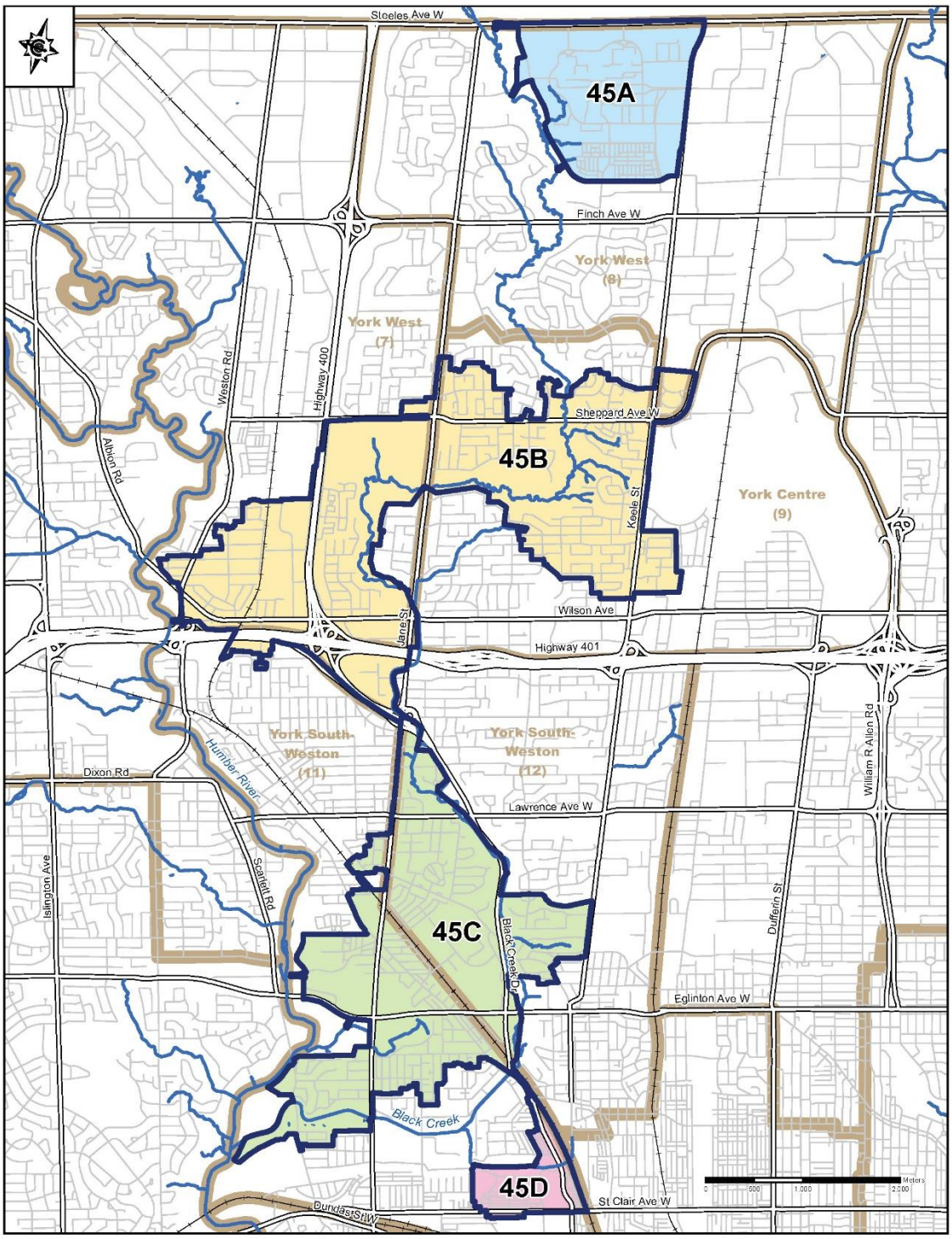

Figure ES.1
Study Area Overview

Basement Flooding EA
Study Area 45
City of Toronto

IBI

Project No: 2017-0659

Date: March 2018

City Wards
City of Toronto Boundary
Area 45A
Area 45B
Area 45C
Area 45D

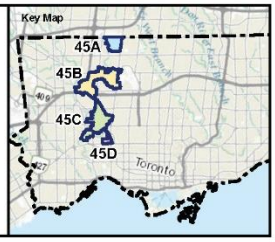

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Figure ES-2 Historical Basement Flooding Reports

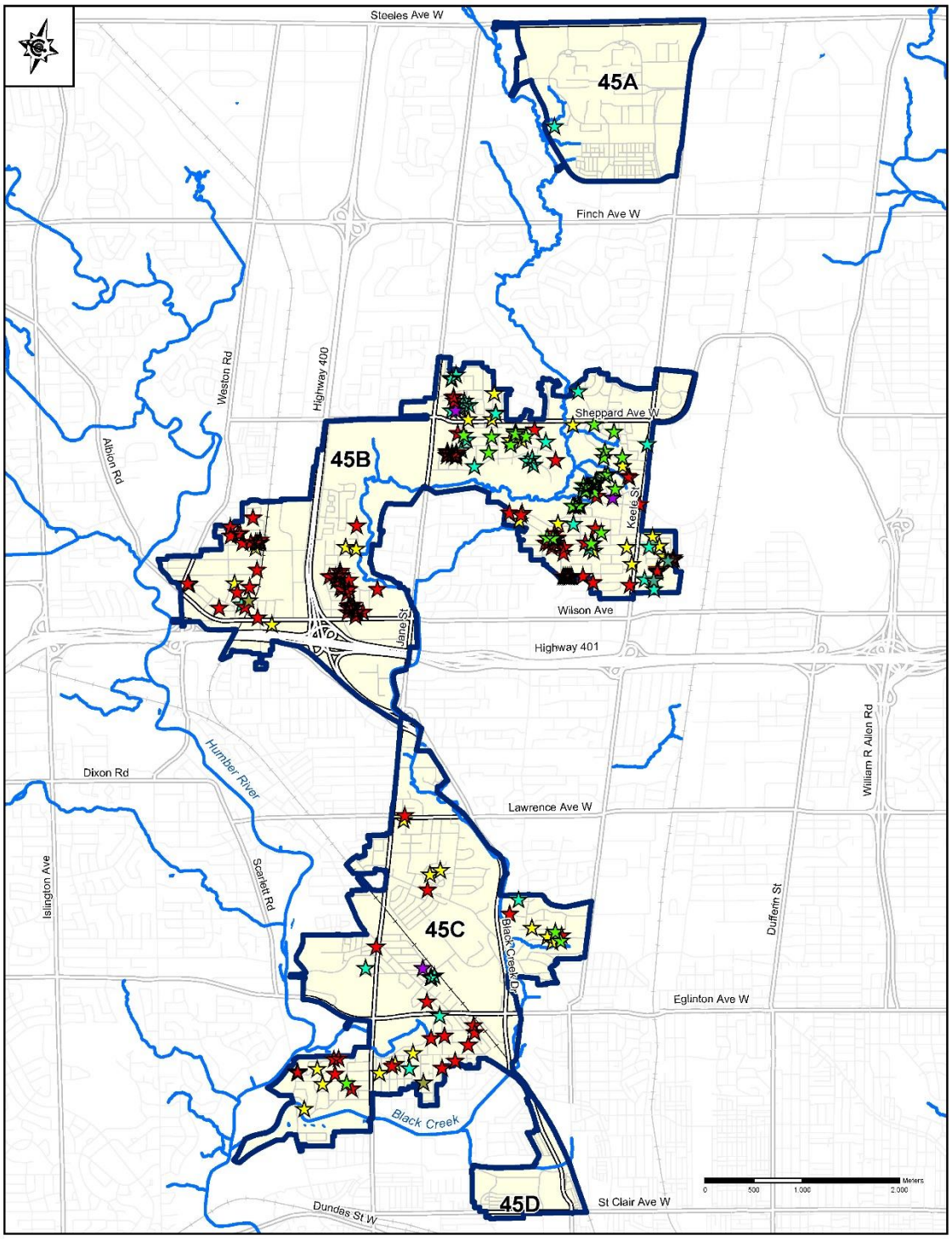

Figure ES-2
Historic Basement Flooding Reported to the City for Extreme Storm Events

Basement Flooding EA Study Area 45 City of Toronto	IBI
Project No. 2017-0659	Date: June 2018

Basement Flooding Complaints
(By Extreme Storm Event)

- 2015-10-28 (2)
- 2015-06-27 (2)
- 2014-10-16 (33)
- 2013-07-08 (121)
- 2012-07-31 (4)
- 2005-08-19 (41)
- 2000-05-12 (54)

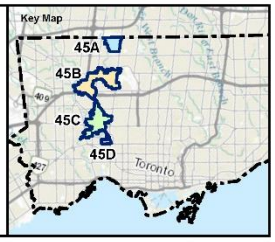

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Figure ES-3 Preferred Alternative

Figure 7-14 Location Map of All Recommended Projects