

TORONTO BASEMENT FLOODING CAPACITY STUDIES – BUNDLE F STUDY AREA 60: EA PROJECT FILE

Executive Summary
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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 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. From the Study Phase, 10 assignments were identified to be Schedule B undertakings due to their involvement with outfall upgrades, work around Highway 401, and overland flow re-routing.

SCOPE OF STUDY

The focus of this EA is on Area 60 within Bundle F, with the geographic context of the entire Study Area 60 presented in. This EA Project File reviews the assessments completed through the Study Phase for Area 60 with focus on Schedule B Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27, with further elaboration on activities completed after the Study Phase to satisfy the Schedule B EA requirements for the assignments.

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.



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- 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.

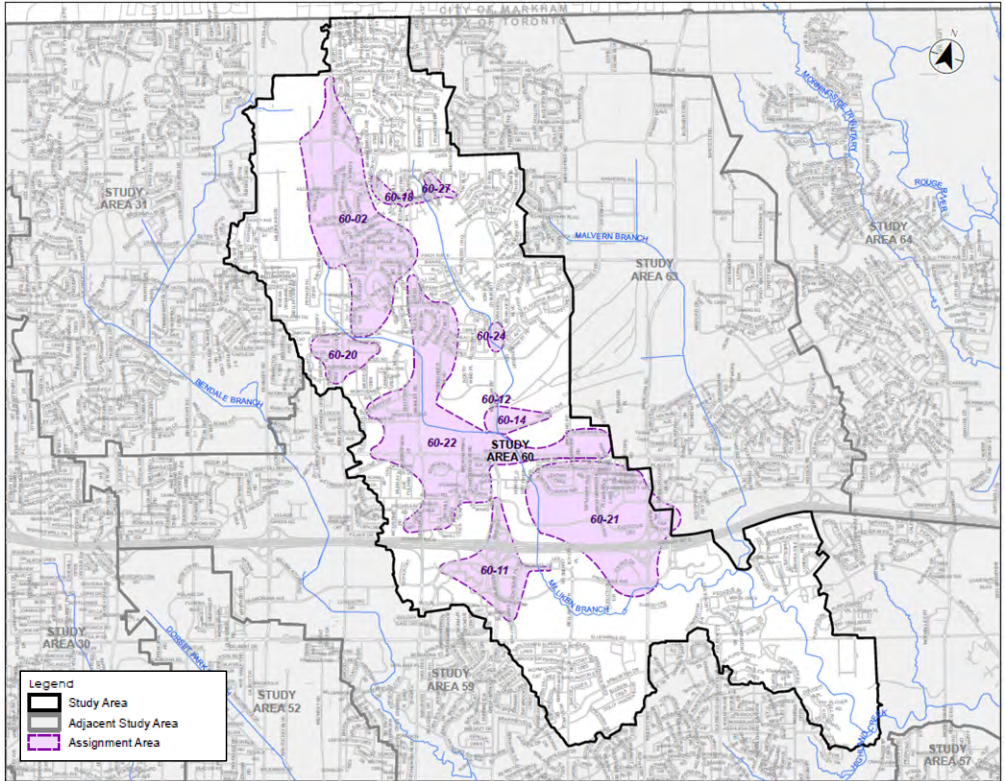
ASSIGNMENT AREA CHARACTERISTICS

Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27 are located within Study Area 60. Generally, the assignments are bounded by Ellesmere Rd to the south, Steeles Ave to the north, Kennedy Rd to the west, and Malvern St to the east.



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ES.1 Area 60 EA Assignments



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Assessment of Existing Conditions

The majority of reported flooding issues are private-side related, and not chronic issues resulting from surface drainage or collection system capacity. The relatively few flood complaints can be attributed to long-standing collection system and stormwater management practices in Scarborough, which include having foundation drains not connected to the sanitary sewer, implementation of the dual drainage principle in urban design since the 1970s, and consideration of the HGL in the design of storm sewer systems.

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 storm drainage system in the assignment area does operate well with almost 70% of pipes indicating over 100-yr level of service.

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. In general, the major system standards in Scarborough have resulted in a resilient overland system for conveying flows to SWM facilities and the East Highland Creek tributaries. Surface depth exceedances are also observed in low points on local roads, where ponding is directed from the arterial/collector roadways into the local low points to reduce depths and promote safe vehicular passage on major arteries. These locations often coincide with overtaxed minor systems, limiting the amount of flow that can be removed from the surface.

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 and 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.



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From the Study phase, 10 assignments were 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 Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-21, 60-22, 60-24, and 60-27.

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, online 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 Consultation was issued by Canada Post to all properties in the study area to advise of consultation opportunities. Due to the Covid-19 pandemic, the City posted public consultation materials online from December 27, 2022, to January 27, 2023, on a dedicated City webpage, including presentation materials with information pertaining to the study, EA process, existing conditions, and alternatives and the preferred solution for the ten assignments.
- Through the Study Phase, the following groups were engaged with feedback provided and incorporated: Mississauga's of the Credit First Nation, Toronto Parks, Forestry and 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 with feedback provided and incorporated: TRCA, Bell, Rogers, Hydro One, Toronto Hydro, and Trans-Northern Pipelines

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



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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. Four alternatives were developed for Assignment 60-24, two alternatives were developed for Assignment 60-12, and for the remaining 8 EA assignments, three alternatives were developed to relieve flooding and improve the storm and sanitary system while meeting the City's guidelines. In general, the alternatives incorporate elements of inlet capacity and conveyance upgrades, in-line storage, relief/diversion sewers, outfall upgrades, and park storage to mitigate surface and basement flood risk for the identified Schedule B assignments.

RECOMMENDED SOLUTIONS

The recommended solution for each of the EA assignments is presented in **Figure ES.2**. A summary of the recommended solution for each of the assignments is outlined below.

Recommended Solution for Assignment 60-02

Alternative 1 is the recommended solution for Assignment 60-02. This alternative utilizes conveyance upgrades, in-line storage, relief/diversion sewers, as well as an outfall upgrade on City property to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades;
- Provide sanitary in-line storage on:
 - Crockamhill Dr with a realignment;
 - Chartland Blvd S;
 - McNicoll Ave;
 - Haven Hill Sq;
 - Midland Ave (between South Shields Ave and Finch Ave E);



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- Divert sanitary flows along Midland Ave, north of the HEPC, south towards Kilcullen Castle Gt to avoid upgrades through HEPC;
- Realign sanitary and storm sewers along Midland Ave to disconnect dual manhole;
- Redirect storm flows west on McNicoll Ave towards Midland Ave to avoid HEPC pipe upgrades, continuing south on Midland Ave to avoid easement upgrades;
- Redirect storm flows west on South Shields Ave to Midland Ave, and south on Alexmuir Blvd from Dunmall Dr towards Finch Ave E, to avoid easement pipe upgrades;
- Provide storm in-line storage on:
 - McNicoll Ave upstream of HEPC;
 - Valdor Dr upstream of easement;
 - Bushmills Sq upstream of easement;
 - Crookamhill Dr just north of Huntingwood Dr;
- Realign sewers on northern stretch of Bushmills Sq south of sanitary to avoid conflicts;
- Redirect flows west on Finch Ave E from Brimley Rd and realign sewers along Finch Ave E north into the ROW; and,
- Outfall upgrade on City property south of Finch Ave E.

Recommended Solution for Assignment 60-11

Alternative 2 is the recommended solution for Assignment 60-11. This alternative utilizes increased inlet capacity, conveyance upgrades, and in-line storage to avoid upgrades under Highway 401 to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- In-line storm storage on McCowan Rd to avoid upgrades under Highway 401;
- Storm sewer conveyance upgrades along Progress Ave, Consilium Pl, and Bushby Dr; and,
- Increased storm inlet capacity on Progress Ave, Consilium Pl, Corporate Dr, and Bushby Dr.

Recommended Solution for Assignment 60-12

Alternative 2 is the recommended solution for Assignment 60-12. This alternative is to do nothing. A summary of this alternative solution is outlined below:

- Do Nothing;
- Only a single HGL infraction exists at the bottom of a steep slope near the outfall, thus it is considered a low flood risk.

Recommended Solution for Assignment 60-14

Alternative 3 is the recommended solution for Assignment 60-14. This alternative utilizes increased inlet capacity to mitigate surface and basement flood risk, and a “do nothing” approach on McCowan Rd due to low perceived risk and few benefitting properties. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- A “Do Nothing” alternative for sewers on McCowan Rd due to low perceived risk and few benefitting properties; and,



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- Increased storm inlet capacity on Nugget Ave.

Recommended Solution for Assignment 60-18

Alternative 3 is the recommended solution for Assignment 60-18. This alternative is a hybrid alternative of Alternatives 1 and 2 and utilizes conveyance upgrades, similar to Alternative 1 except without upgrading the pipe immediately upstream of the outfall or the outfall itself, to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades as per Alternative 1; and,
- Realign storm and sanitary sewers to achieve required hydraulic separation.

Recommended Solution for Assignment 60-20

Alternative 1 is the recommended solution for Assignment 60-20. This alternative utilizes conveyance upgrades, sewer/flow redirection, in-line storage, and an outfall upgrade on City property to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades;
- Redirect storm flow from Stubbswood Sq and Glen Watford Dr west towards Midland Ave;
- New storm sewers on Havendale Rd between Glen Watford Dr and Midland Ave;
- Provide in-line storm storage on Stubbswood Sq upstream of easement;
- Realign and redirect storm sewers on Scotland Rd north from Stainforth Dr towards Emmeline Cres;
- Outfall upgrade in City-owned property; and,
- Realign sanitary and storm sewers to achieve required hydraulic separation.

Recommended Solution for Assignment 60-21

Alternative 2 is the recommended solution for Assignment 60-21. This alternative utilizes increased inlet capacity, conveyance upgrades, flow redirection, and in-line storage to avoid an outfall upgrade to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades along Milner Ave, Crown Acres Crt, Forest Crt, Scunthrope Rd, Pennybrook Ln, Spring Forest Sq, Prince William Crt, Wyper Sq, Havenview Rd, Carlingwood Crt, Glenstroke Dr, Invergordan Ave, Massie St, Plum Brook Cr, Mid-Dominion Acres, and Progress Ave;
- Redirect storm flows west on Crown Acres Crt to Scunthrope Rd to avoid private property;
- Redirect storm flows south along Scunthrope Rd to Milner Ave and east to Markham Rd* Redirect flows from Havenview Rd east along Invergordan Ave;
- Provide in-line storm storage on Kentish Cres and Invergordan Ave upstream of private property and easement with outfall, respectively, on Carlingwood Crt and Invergordan Ave upstream of private properties, and on Milner Ave between Scunthrope Rd and Markham Rd and between Mid-Dominion Acres and the outfall to avoid outfall upgrade;



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- Disconnect sanitary flow to Invergordan Ave and divert flow south along Scunthrope Rd to Milner Ave; and,
- Sanitary conveyance upgrades along Milner Ave west of Executive Crt.

Recommended Solution for Assignment 60-22

Alternative 2 is the recommended solution for Assignment 60-22. This alternative utilizes increased inlet capacity, conveyance upgrades, flow redirection, and additional in-line storage to avoid outfall upgrades and to mitigate surface and basement flood risk. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades along Leeswood Cres, Chartland Blvd S, Brimley Rd, Dibgate Blvd, Idehill Cres, Broomfield Dr, Commander Blvd, McGriskin Rd, Sheppard Ave E, Shorting Rd, McCowan Rd, Pitfield Rd, Charterhouse Rd, Brownspring Rd, Terryhill Cres, Cleethorpes Blvd, Keyworth Trl, Gritanni Ln, Dennet Dr, Marydon Cres, Shilton Rd, and Heather Rd;
- Provide storm in-line storage on Hoseyhill Cres upsteam of easement; on Dibgate Blvd, Huntingwood Dr and Brimley Rd to avoid the outfall upgrade; on Sheppard Ave E just west of Shorting Rd; on Harrisfarm Gt just south of Sheppard Ave E; on Rubic Cres across Brimley Rd near Gritanni Ln; on Redbud Cres upstream of easements and private property; on Pitfield Rd between Terryhill Cres and Brownspring Rd; cascading in-line storage along Sheppard Ave E between Brimley Rd and the outfall; on Dennet Dr west of Shilton Rd, on Heather Rd west of Shilton Rd; on Shilton Rd north of Frances Cres; and on Brimley Rd north of Heather Rd;
- Redirect storm flows west from Dibgate Blvd on Huntingwood Dr to Brimley Rd, on McGriskin Rd west to Shorting Rd to avoid private property, on Sheppard Ave E and Brimley Rd towards outfall on Sheppard Ave E to avoid sewers within CPR property, on McCowan Rd south to Sheppard Ave E to avoid outfall upgrades, and on Dennet Dr east to Brimley Rd;
- Sanitary conveyance upgrades on Sheppard Ave E east of Brimley Rd; and,
- Provide in-line storage for sanitary system on Terryhill Cres, Brownspring Rd, Sheppard Ave E, Dennet Dr, and on Commander Blvd.

Recommended Solution for Assignment 60-24

Alternative 3 is the recommended solution for Assignment 60-24. This alternative utilizes conveyance upgrades, inlet restriction by catchbasin removal, overland flow re-routing, and no outfall upgrades to mitigate surface and basement flood risk. Due to the proposed overland flow re-routing work, this alternative is Schedule B. A summary of this alternative solution is outlined below:

- Increase storm inlet capacity and provide conveyance upgrades upstream of northern outfall;
- Catchbasins at intersection of Kenhatch Blvd and McCowan Rd removed;
- Decrease storm inlet capacity by removing catchbasins upstream of southern outfall; and,
- Remove curb and provide overland flow route to watercourse.



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Recommended Solution for Assignment 60-27

Alternative 3 is the recommended solution for Assignment 60-27. This alternative utilizes adjusted inlet capacity and conveyance upgrades. Due to the proposed work, this alternative is Schedule A/A+. A summary of this alternative solution is outlined below:

- Storm conveyance upgrades along Brimwood Blvd (between Macklingate Crt and Amanda Dr) and Melva Cres;
- Increased storm inlet capacity on Melva Cres and Wellpark Blvd at Brimwood Blvd; and
- Remove CBs on Brimwood Blvd at Amanda Dr.

Based on the Stage 1 Assessment, there is no further work required for Assignments 60-02, 60-11, 60-12, 60-18, 60-21, 60-24 and 60-27. However, should the work extents change beyond the recommended solution footprint as proposed in this Project File, further Stage 1 archaeology assessment may be required.

Based on the Stage 1 Assessment, a Stage 2 archaeology assessment is recommended for Assignment 60-20. The Stage 2 assessment shall be undertaken once the assignment progresses to the preliminary design stage.

CONCLUSIONS

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

- Through the initial Study Phase completed for Area 60, 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:
 - Sanitary trunk sewer aligned with major watercourses, offering potential for infiltration;
 - Elevated baseflows in the sanitary sewer taking up flow capacity;
 - Rural lot drainage and flow paths on private property;
 - Sewers not sized to handle high flows during extreme events;
 - Shallow sewers with less potential for freeboard from basements;
 - Insufficient overland flow drainage and ponding at low points; and
 - Large industrial-commercial-institutional sector with high imperviousness ratios;
- 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, 10 assignments were identified as potentially having greater environmental and social impacts due to solutions involving outfall upgrades, work around Highway 401, and overland flow re-routing. These solutions triggered an EA review 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.



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- Through the EA process, an additional flood solution alternative was developed for each assignment (Alternative 3). All three alternatives were evaluated based on social, economic, environmental and constructability criteria using a scoring method. For each of the assignments the recommended alternative is listed below:
 - Alternative 1 was selected as the recommended solution for Assignment 60-02;
 - Alternative 2 was selected as the recommended solution for Assignment 60-11;
 - Alternative 2 was selected as the recommended solution for Assignment 60-12;
 - Alternative 3 was selected as the recommended solution for Assignment 60-14;
 - Alternative 3 was selected as the recommended solution for Assignment 60-18;
 - Alternative 1 was selected as the recommended solution for Assignment 60-20;
 - Alternative 2 was selected as the recommended solution for Assignment 60-21;
 - Alternative 2 was selected as the recommended solution for Assignment 60-22;
 - Alternative 3 was selected as the recommended solution for Assignment 60-24; and
 - Alternative 3 was selected as the recommended solution for Assignment 60-27.
- From the recommended alternative selection process, only three (3) of the 10 assignments are considered Schedule B undertakings. These assignments are as follows:
 - Assignment 60-02 – Work outside of the ROW for an outfall upgrade;
 - Assignment 60-20 – Work outside of the ROW for an outfall upgrade; and
 - Assignment 60-24 – Work requiring regrading of the overland subject to additional consultation with TRCA and the City's Transportation Services group to confirm allowable gradient of overland flow.
- One assignment, Assignment 60-12, was selected as a Do Nothing solution (Alternative 2) due to very limited flood risk.
- With the implementation of the recommended 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 the recommended solutions for each of the 10 EA assignments there is an overall net decrease to East Highland Creek (Markham Branch) of 1.15 m³/s during the 2-yr storm events and an overall net increase of 14.98 m³/s during the 100-yr storm events. In addition, below is a summary of the hydraulic performances at an assignment level:
 - Under the 2-yr storm, the velocity change is generally minimal for most outfalls. However, within assignments 60-21 and 60-24 there are significant decreases in velocities during the 100-yr storm event at OF4949224780 (Assignment 60-21) and OF5090523870 (Assignment 60-24). Within Assignment 60-02 there is an increase of velocity at OF5056222382 during the 100-yr storm event.
 - During the 100-yr design there are multiple locations where the flow at the outfalls has significantly increased or decreased due to a diversion of flow away from capacity restricted outfalls to another along the same branch of Highland Creek. One of these examples of where flow was redistributed is in Assignment 60-20, between OF5061922648 and OF5054722272.



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- This results in the overall outflow to East Highland Creek (Markham Branch) remaining as per existing conditions during the 2-yr storm event, and the overall flow increases during the 100-yr storm event by 1.79 m³/s.
- The upgrades within the recommended solution for Assignment 60-21 partially re-direct storm flows from their existing sewershed to an adjacent one. The most significant diversion, with respect to creek chainage, within Assignment 60-21 diverts flow from OF4915024887 to OF4888326242, located over 2 km downstream. The overall outflows to East Highland Creek (Markham Branch) decrease during the 2-yr storm events by 0.21 m³/s and increase by 2.17 m³/s during the 100-yr storm events.
 - Assignment 60-22 has a total of seven outfall, three of which have a minimal velocity change. Three outfalls within this assignment, OF4986323484, OF5056323121, and OF4999924148, experience a significant decrease in velocity in both the 2-yr and 100-yr storm events and one outfall, OF5057123101, experiences significant increases in velocity during the 2-yr and 100-yr storm events. Also, at OF5057123101 the flow has increased by 0.74 m³/s (112%) during the 2-yr storm event due to increased inlet capacity added upstream. While this represents a significant increase in flow as a percentage, it aligns with the inlet capacity changes required to solve overland flooding at these locations during the 100-yr event. Overall, within Assignment 60-22 there is a decrease in outflows to East Highland Creek (Markham Branch) during the 2-yr storm events of 1.38 m³/s and an increase in outflows during the 100-yr storm events of 1.91 m³/s.
 - Within Assignments 60-02, 60-11, 60-18, and 60-24 the overall flow to outfalls in East Highland Creek (Markham Branch) increase in both the 2-yr and 100-yr storm events. The overall peak flow to the outfalls within Assignments 60-14 increases by 0.02 m³/s during the 2-yr storm event and decreases by 0.71 m³/s during the 100-yr storm event. Within Assignment 60-27 the peak outfall decreases by 0.08 m³/s during 2-yr storm event and increases by 0.17 m³/s during the 100-yr storm event.
 - The recommended improvement for the assignments work to help address the flooding problem, listed below in 2020 Canadian dollars, net to the City:
 - Assignment 60-02 estimated at a total construction cost of \$96.9 million;
 - Assignment 60-11 estimated at a total construction cost of \$5.0 million;
 - Assignment 60-12 estimated at a total construction cost of \$0;
 - Assignment 60-14 estimated at a total construction cost of \$113 thousand;
 - Assignment 60-18 estimated at a total construction cost of \$10.5 million;
 - Assignment 60-20 estimated at a total construction cost of \$24.8 million;
 - Assignment 60-21 estimated at a total construction cost of \$73.1 million;
 - Assignment 60-22 estimated at a total construction cost of \$206.4 million;
 - Assignment 60-24 estimated at a total construction cost of \$1.7 million; and
 - Assignment 60-27 estimated at a total construction cost of \$3,1 million;
 - Based on the Stage 1 Archaeology Assessment, there is no further work required for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-21, 60-22, 60-24 and 60-27. However, should the work extents change beyond the recommended solution footprint as proposed in this Project File, further Stage 1 archaeology assessment may be required.



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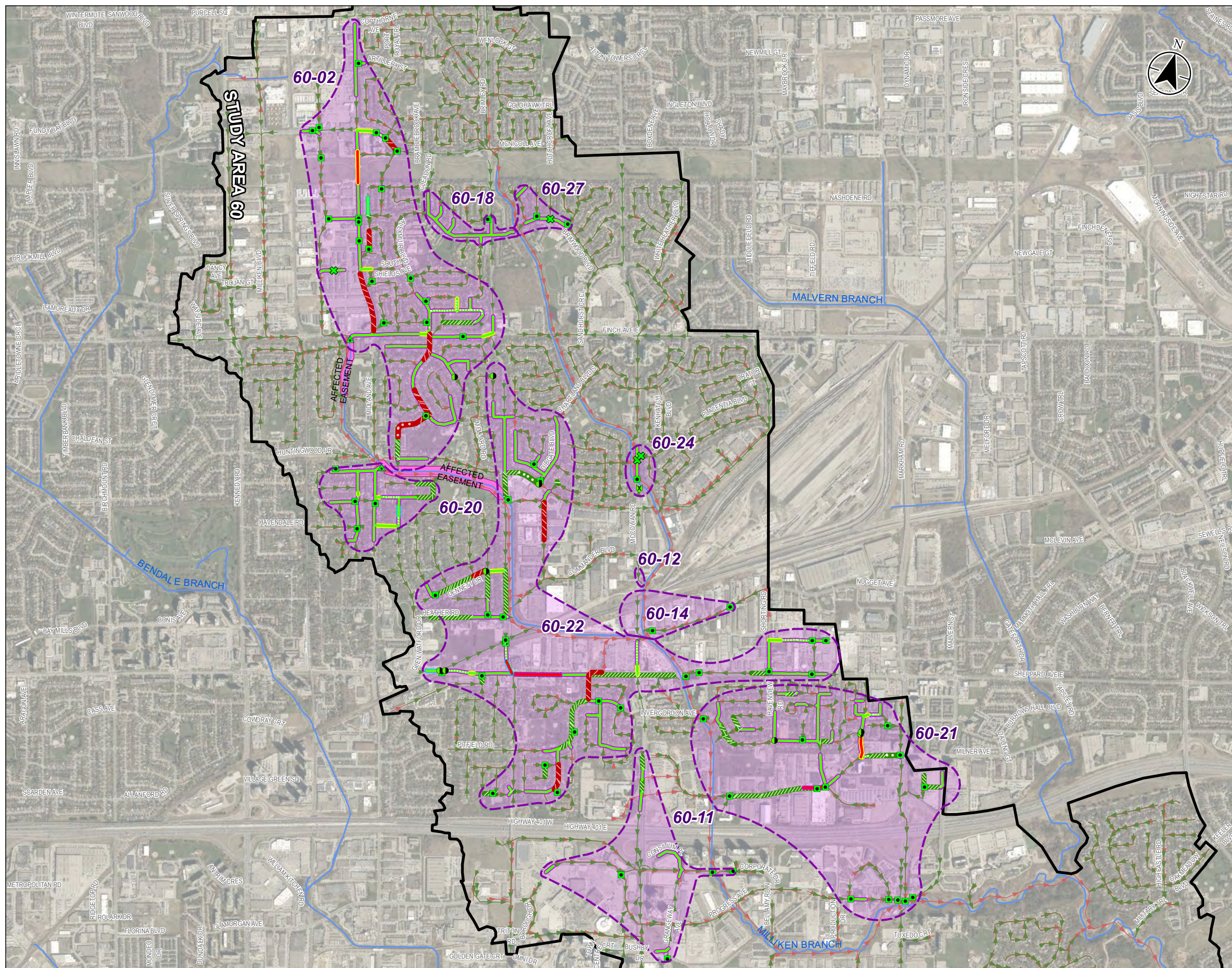
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- Based on the Stage 1 Assessment, a Stage 2 archaeology assessment is recommended for Assignment 60-20. The Stage 2 assessment shall be undertaken once the assignment progresses to the preliminary design stage.
- Protected properties and places of cultural heritage value or interest have been identified within the Assignment boundaries. As such, additional assessment and/or monitoring should be completed as described in this report.
- 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.

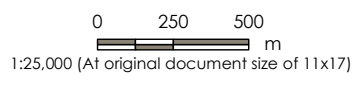
The recommended solutions are provided in **Figure 1—1** Schedule B Assignments within Study Area 60 and **Figure ES. 2: Recommended Solutions for Assignments 60-02, 60-11, 60-12, 60-14, 60-18, 60-20, 60-22, 60-24, and 60-27**. It is recommended that the Assignments proceed to preliminary design, subject to City prioritization, additional agency consultation, and commence with implementation as Capital budgeting allows.



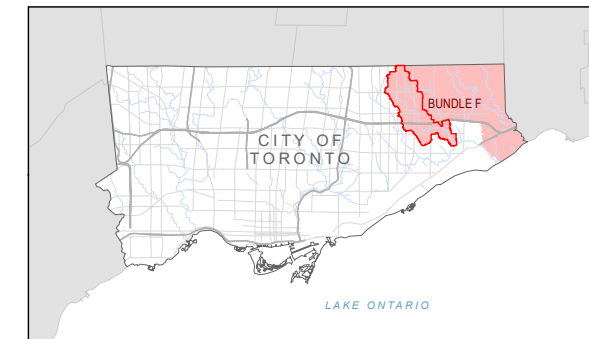
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 Revised: 2023-07-28 By: tebuchanan



- Legend**
- Study Area
 - Assignment Area
 - Storm Sewer
 - Sanitary Sewer
 - Increase Inlet Capacity
 - Increase Inlet Capacity, Isolate MH
 - Isolate MH
 - ✕ Remove CBs
 - ✕ Remove CBs, Depress Curb
 - ▲ Upgrade Outfall
 - New
 - - - Realign
 - Replace
 - Upgrade
 - - - Realign and Upgrade
 - - - Inline Storage
 - - - Realign and Inline Storage
 - New
 - Replace
 - Upgrade
 - - - Inline Storage
 - - - Realign and Inline Storage
 - Affected Easement



- 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
 Prepared by: KDB on 2023-07-28

Client/Project: CITY OF TORONTO
 BASEMENT FLOODING CAPACITY STUDIES
 BUNDLE F - STUDY AREA 60

Figure No.: **ES.2**

Title: **Recommended Solutions**