



## STAFF REPORT ACTION REQUIRED

### Update on the Engineering Review Addressing Basement Flooding

<b>Date:</b>	August 18, 2008
<b>To:</b>	Executive Committee
<b>From:</b>	Lou Di Gironimo, General Manager, Toronto Water
<b>Wards:</b>	City-wide
<b>Reference Number:</b>	P:\2008\Cluster B\TW\ec08014

#### SUMMARY

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This report summarizes the results of the engineering analysis, completed to date of the first four of 31 Basement Flooding Study Areas in accordance with the Basement Flooding Work Plan approved by Council in April 2006; and proposes an adaptive management strategy to help reduce the risk of basement flooding, on a City-wide basis. This report also provides an update on the financial implications and estimated time required to process all of the applications received under the former Voluntary Downspout Disconnection Program.

#### RECOMMENDATIONS

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**The General Manager, Toronto Water recommends that:**

1. Subject to the adoption of Recommendation 2 and the conditions set out therein, the implementation of City sewer infrastructure improvement projects that result from the various Municipal Class Environmental Assessments (the “Environmental Assessments”) undertaken to address basement flooding in the 31 Basement Flooding Study Areas, as identified in the Basement Flooding Work Plan, be prioritized as follows:
  - a) City sanitary sewer improvement projects are to be given the highest priority for implementation;
  - b) City storm drainage system improvement projects are to be implemented in the following order of priority based on a consideration of the total number of benefiting

- properties and the estimated cost of the work to the City apportioned to each property as determined by and in the sole discretion of the General Manager, Toronto Water:
- i. Improvement projects where the cost of the work to the City apportioned to each benefiting property is estimated to be \$25,000 or less, and prioritized, from highest to lowest, based on the greater number of benefiting properties involved; and
  - ii. Improvement projects where the cost of the work to the City apportioned to each benefiting property is estimated to be greater than \$25,000; provided that given the significantly higher cost of these improvement projects, are to be implemented only as appropriate funding opportunities are available, as determined by the General Manager of Toronto Water, through other City infrastructure renewal programs such as Toronto Water's Sewer Rehabilitation and Reconstruction Program and Transportation Service's Road Reconstruction Program; or should third party funding which reduces materially the City's cost per benefiting property;
2. The General Manager, Toronto Water, include the works identified in Recommendation 1 into the forthcoming Toronto Water 2009-2013 Capital Plan; and implement the works subject to satisfactory completion of the Municipal Class Environmental Assessments corresponding to the works, and Council's approval of Toronto Water's proposed 2009-2013 Capital Plan;
  3. The General Manager, Toronto Water, in developing the annual multi-year Sewer Rehabilitation and Reconstruction Program:
    - a) reassess the list of projects compiled, as Class Environmental Assessment Projects are completed in other Basement Flooding Study Areas, and prioritize the implementation of projects, across all Basement Flooding Study Areas combined, in accordance with the criteria contained in Recommendation 1; and
    - b) identify emerging basement flooding prone areas; and undertake Class Environmental Assessment Studies, as may be necessary, incorporating the level of protection, consistent with that applied for the current 31 Basement Flooding Study Areas, to help mitigate the impacts of basement flooding, in support of the City's Climate Change Adaptation Strategy, representing:
      - i. a storm event equivalent to the May 12, 2000 storm (i.e. equivalent to a storm event with a return frequency of between one in 25 to one in 50 years) for the sanitary sewer system design; and
      - ii. the 100 year storm event for the storm drainage system, where feasible, where a proper major (overland flow) drainage system does not exist;
  4. The Municipal Code Chapter 681, Sewers be amended such that:

- a) The connection of downspouts to storm sewers in the Basement Flooding Study Areas, as identified on the map attached as Attachment 1 of this Report, is prohibited;
  - b) The amendment in Recommendation 4 a) shall come into force five years from the date of its enactment;
  - c) The connection of downspouts to storm sewers in any areas of the City, not previously prohibited under Municipal Code Chapter 681, Sewers, as at the effective date of this recommendation, is prohibited;
  - d) The amendment in Recommendation 4 c) shall come into force eight years from the date of its enactment;
  - e) The General Manager, Toronto Water, be authorized to exempt properties from the prohibition set out in Recommendations 4 a) and c) where the General Manager, in the General Manager's sole discretion, determines that, in respect of the property, the disconnection of the downspout or downspouts would create a hazardous condition or is not technically feasible.
5. Authority be granted to the City Solicitor to submit any Bills required to enact the amendments to Municipal Code Chapter 681, Sewers, proposed in Recommendation 4 of this Report, subject to any necessary refinements, including stylistic, format and organization, as may be identified by the City Solicitor and General Manager, Toronto Water;
6. Due to the forecasted length of time required for the City to process and implement all of the applications received under the former Voluntary Downspout Disconnection Program, the General Manager, Toronto Water, enhance the Voluntary Downspout Disconnection Program by allowing eligible property owners on the existing waiting list to opt out of the existing City-performed program and disconnect their downspout(s) themselves; and where an eligible property owner does so, the City will reimburse the property owner for the reasonable cost of labour and materials for completing the eligible work to an upset limit of \$500.00 per property, provided that:
- a) The property owner submits, to the City's Toronto Water, Business Operations Management office, a completed and compliant application form, together with all invoices and other supporting information substantiating the completion of the work and costs of same;
  - b) The completed application form and all required supporting documentation is received by Toronto Water, Business Operations Management office, within one year of the work being completed;

- c) The property owner assumes all responsibility for the work, including installation, performance, maintenance, repair and use, and any other financial responsibility; and
  - d) The City reserves the right to conduct an inspection of the completed work, should it be deemed necessary, to ensure compliance with City requirements.
- 7. The General Manager, Toronto Water, develop and employ an extensive communication and public education program to inform homeowners and contractors about:
  - a) climate change impacts, associated with intense storms, related to basement flooding;
  - b) the importance of downspout disconnection and “home isolation” consisting of the installation of sewer backwater valves and the capping off of storm sewer laterals with the installation of a sump pump to help prevent basement flooding;
  - c) the importance of other lot level controls (e.g. proper lot grading); and
  - d) the City’s Basement Flooding Protection Subsidy Program;
  - e) the enhanced Voluntary Downspout Disconnection Program whereby residents can complete the work themselves and be reimbursed for labour and materials up to \$500.
- 8. The Basement Flooding Protection Subsidy Program be amended such that:
  - a) No subsidy will be provided for downspout disconnection; and
  - b) The maximum total, per property, subsidy available under the program remain at \$3,200 by increasing the subsidy provided for sewer backwater valves and sump pumps by \$250 each, to an upset limit of \$1,250 and \$1,750 respectively;
- 9. The General Manager, Toronto Water include an increase of 5 permanent professional/technical staff to provide technical support for the design and construction of the improvement works associated with Recommendations 1 and 3, in Toronto Water’s Recommended 2009 Operating Budget;
- 10. The Acting General Manager, Parks, Forestry and Recreation include an increase of one permanent professional/technical staff to support the design and construction of the improvement works associated with Recommendation 1 and 3, in the forthcoming 2009 Parks, Forestry and Recreation Operating Budget;
- 11. The General Manager, Toronto Water include an increase of 16 permanent technical and clerical staff to support servicing of the disconnection of downspouts for eligible properties included in the City’s former Voluntary Downspout Disconnection Program;

the expansion, City-wide, of the Mandatory Downspout Disconnection Program; and the promotion of and service in anticipation of increased public demand for the Basement Flooding Protection Subsidy Program;

12. The General Manager, Toronto Water, report to Budget Committee on the cost estimate and schedule for the implementation of the capital works necessary to provide basement flooding relief across the 31 Basement Flooding Study Areas, with the submission of Toronto Water's proposed 2010-2014 Capital Budget;
13. The whole City be declared at risk of basement flooding in the event of unusually severe or extreme precipitation, and the Chief Building Official, in collaboration with the General Manager, Toronto Water, the Chief Planner, the Executive Director of Municipal Licensing & Standards, and the City Solicitor, in accordance with the Ontario Building Code, require any applicant of a Plumbing Permit related to the sewer drain where there is a below grade living area anywhere in the City of Toronto to install a backwater valve on their sanitary sewer lateral;
14. The Chief Planner and Executive Director of City Planning, in consultation with the General Manager, Toronto Water, the Chief Building Official and the City Solicitor, consider zoning regulations, in his report on the new Zoning Bylaw, that restrict the construction of any new reverse sloped and below grade driveways;
15. The Executive Director of Municipal Licensing & Standards, in consultation with the General Manager, Toronto Water, the Chief Building Official and the City Solicitor, report on any appropriate amendments to the Property Standards Bylaw to create consistency with any proposed zoning bylaw changes respecting reverse sloped driveways; and
16. The appropriate City officials be authorized and directed to take the necessary actions to give effect thereto.

## **Financial Impact**

The financial impact associated with implementing the recommended priority projects to relieve basement flooding in Basement Flooding Study Areas 14, 28, 29 and 30, alone, represents a cash flow increase of \$118.0 million over the \$76.4 million currently included in Toronto Water's approved 2008-2012 Capital Plan for basement flooding relief, City-wide. These costs will be reflected in an increased forecast cost for basement flooding in Toronto Water's proposed 2009-2013 Capital Budget. It is anticipated that expenditures in the range of several \$100 million dollars will be required to fully implement projects identified in the Class Environmental Studies, supporting all 31 Basement Flooding Study Areas; and the total implementation cost estimates will be refined once Class Environmental Assessments are completed for 23 of the 31 Basement Flooding Study Areas, expected by mid 2009; and incorporated in Toronto Water's forthcoming 2010-2014 Capital Plan and Forecast submissions.

The financial impact associated with the City's disconnection of downspouts of the estimated 37,600 properties whose owners applied to the City's former Voluntary Downspout Disconnection Program, in accordance with the Council Decision of November, 2007, has been estimated to be \$41.0 million for capital over an eight year period from 2008 to 2016. This represents an increase of \$26.2 million to funding levels approved within Toronto Water's 2008 to 2017 Capital Plan.

A permanent increase is required in Toronto Water's annual Operating Budget of an estimated \$548,000 for 5 professional/technical staff in Toronto Water; and there will be an impact of \$113,900 per year to Toronto Water's annual Capital Budget which will provide the required funding to support one (1) professional/technical staff in the Parks, Forestry and Recreation Services Division's Operating Budget, for the design and construction of basement flooding protection works.

A permanent increase is required in Toronto Water's annual Operating Budget of an estimated \$1,478,052 for 16 technical, clerical and financial control staff to support the disconnection of downspouts on the City's former Voluntary Downspout Disconnection Program; the expansion of the Mandatory Downspout Disconnection Program across the City; and to increase the promotion of and service the anticipated increased public demand for the City's Basement Flooding Protection Subsidy Program.

Assuming that the hiring of these staff commences on July 1, 2009, the financial impact on the 2009 and 2010 Operating Budgets is as follows:

<b>Description</b>	<b>FTEs Required</b>	<b>2009 Budget Request</b>	<b>Incremental Impact on 2010 Budget</b>	<b>Annual Impact of Salaries*</b>
Professional/technical staff – Basement Flooding Remediation Work Plan	5	\$ 274,155	\$ 274,155	\$ 548,310
Inspectors for Mandatory Downspout Disconnection, including Contract Administration	11	\$ 676,647	\$ 503,647	\$ 1,007,294
Subsidy and/or Grant Administration Program Support	5	\$ 235,379	\$ 235,379	\$ 470,758

\* based on 2009 estimated salaries

The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information.

## DECISION HISTORY

City Council, at its meeting of April 25, 26 and 27, 2006, in adopting a report from the General Manager of Toronto Water titled “Work Plan for the Engineering Review Addressing Basement Flooding”, approved a work plan to undertake the necessary engineering investigations and develop remedial options to address basement flooding problems in the chronic basement flooding areas across the City (the “Basement Flooding Work Plan”); and further requested the General Manager, Toronto Water to report on the number and cost of storage facilities to provide sufficient protection in areas that have experienced chronic flood occurrences.

The noted staff report can be viewed at:

<http://www.toronto.ca/legdocs/2006/agendas/committees/wks/wks060307/it025.pdf>; and the corresponding Council Decision Document can be viewed at:  
<http://www.toronto.ca/legdocs/2006/agendas/council/cc060425/wks2rpt/cl016.pdf>

City Council, at its meeting of November 19 and 20, 2007 in adopting a report from the General Manager of Toronto Water titled “Implementing a Mandatory Downspout Disconnection Program”, requested that the General Manager, Toronto Water and Chief Financial Officer to report to the Public Works and Infrastructure Committee on January 9, 2008, on:

- a) the financial impact of processing all applications received by November 20, 2007;
- b) the estimated time and schedule to process all applications, taking into consideration the priorities of managing stormwater in combined sewer areas and areas of the City experiencing chronic basement flooding first;
- c) the changes required in the project cashflows contained in Toronto Water’s approved 2008-2012 Capital Budget; and
- d) the program in relation to the City’s evolving climate adaptation strategy.

The noted staff report can be viewed at:

<http://www.toronto.ca/legdocs/mmis/2007/pw/bgrd/backgroundfile-7842.pdf>; and the corresponding Council Decision Document can be viewed at:  
<http://www.toronto.ca/legdocs/mmis/2007/cc/decisions/2007-11-19-cc14-dd.pdf>

## ISSUE BACKGROUND

The City of Toronto has experienced wide spread surface and basement flooding as a result of extreme storm events. On August 19, 2005, over 4,200 basement flooding complaints were received by Toronto Water, as a result of an extreme storm which exceeded a 100 year event. In April 2006, City Council approved the Basement Flooding Work Plan requiring a comprehensive engineering review be undertaken to address chronic basement flooding problems in 31 separate Basement Flooding Study Areas located across the City. The location of the Basement Flooding Study Areas is shown on Attachment 1.

### **(A) Engineering Review of Basement Flooding Study Areas**

The status of the various engineering analysis and Environmental Assessments of the sanitary sewer and storm drainage systems for the 31 Basement Flooding Study Areas is provided in Attachment 2.

A key feature of the Basement Flooding Work Plan is the adoption of enhancements to existing sewer capacity and overland flow design standards in areas experiencing chronic basement flooding in recognition of the increased frequency and intensity of storm events. These enhancements provide a level of protection against basement flooding from sanitary sewer backup for a storm event equivalent to a return frequency of between one in 25 to one in 50 years; and from surface flooding for the one in 100 year storm event, where feasible, in areas where a proper major (i.e. overland flow) drainage system does not exist.

The causes of basement flooding resulting from an extreme storm event vary and depend on site conditions. Generally, there are three main categories of issues that can lead to basement flooding and they are listed as follows:

***Overloaded Sanitary Sewer System*** - Basement flooding can result from an overloaded sanitary sewer due to excessive infiltration and/or inflow of storm water into the sanitary sewer causing it to back up through the basement floor drains. Sanitary sewers overload as a result of storm runoff entering the system through:

- maintenance hole (MH) covers and cracked MH walls;
- sewer connections, pipe joints and cracked or broken pipes;
- surcharged storm sewers leaking water through cracked pipes;
- foundation drains connected to the sanitary sewer;
- illegally connected downspouts to sanitary sewers; and
- illegally connected private catchbasins.

***Overloaded Storm Sewer System*** - During extreme rain events, storm water runoff flows exceed the design capacity of the storm sewer system. As the system becomes overloaded, the storm sewers surcharge (i.e. the flows back up and pressurize the storm sewer system) and can become another major source of basement flooding. Surcharged storm sewers can create a high water table condition around foundation walls, which under extreme storm conditions is further compounded by the additional contribution of roof runoff through downspouts discharging to the storm sewer. Poor lot grading can also create ponding around foundation walls and contribute to elevated water tables. This results in water leaking into the basement through windows, doors and cracked walls and floors. Surcharged storm sewers will also backup catchbasins in reverse slope driveways and in drains outside of basement stairwells, resulting in flooding conditions, and water entering the basement through doorways. Once the water is in the basement, it enters the floor drain and overloads the sanitary sewer system.

***Surface Flooding Problems*** - Surface flooding on streets is mainly the result of poor street grading and is another source of basement flooding. Current design standards for storm drainage developed in the mid 1970s include a design for the storm sewer system to intercept and convey



the storm water runoff from a one in 2 year to a one in 5 year return storm event. For larger storms, storm water that can't be intercepted by the storm sewer remains on the road surface and flows along the streets, typically to a low point where it outlets via an overland flow route to the nearest watercourse. However, in many of the older areas of the City developed prior to 1970, many of the streets do not provide a continuous flow route, are very flat or have low points with no place for the water to outlet. Significant ponding can occur on the street, particularly during heavy rain conditions, overtopping the curb and flowing onto private property. This is particularly problematic in areas where the lots are poorly graded or where homes have reverse sloped driveways since storm water is conveyed directly to the house.

**(B) Implementing a City-Wide Mandatory Downspout Disconnection Program**

Since 2000, the Sewer Use By-Law has not permitted the direct connection of downspouts in new homes to any sewer system. In accordance with the By-Law, property owners are responsible for complying with these requirements, which includes the cost of disconnecting illegally connected downspouts.

Subject to specified exceptions, the connection of downspouts:

- (a) of any building to the City's sanitary sewer system is prohibited [see Sections 11 A (2) and Q (1) of Chapter 681 (the City's "Sewer Use By-Law") of the Municipal Code];
- (b) of a new or reconstructed building to any City sewer system is prohibited [see Section 11 S. (1) of the Sewer Use By-Law]; and
- (c) of a building in the combined storm sewer area of the City is prohibited [see Section 11 S. (3) of the Sewer Use By-Law].

***Environmental Benefits:*** It is estimated that over 350,000 residential properties (70 percent of the approximately 500,000 residential properties in the City) were constructed before these provisions were added to the Sewer Use By-law and therefore are still directly connected to the City's sewer systems including 120,000 properties which are connected to combined sewers.

Recognizing the environmental benefits associated with reducing the volume of storm water runoff entering the combined sewer system, City Council at its meeting of November 19 and 20, 2007, approved amendments to Chapter 681 which require all existing downspouts to be disconnected from the sewer system in the combined sewer service area of the City (see Attachment 3), which includes most of the former City of Toronto, York and East York and the south-west portion of former Scarborough.

These By-law amendments for the combined sewer service area take effect on November 20, 2010. Affected property owners have to carry out any required disconnections by this deadline at their sole expense. Exemptions will be permitted for extenuating, site specific conditions, as determined by the General Manager, Toronto Water, where disconnecting the downspouts would create a hazardous condition such as flooding of adjacent properties or contributing to slope failures or erosion in ravines; or where the disconnection is technically not feasible. No financial subsidies are provided to affected property owners, but financial support is available to low income property owners.

Detailed engineering analysis has demonstrated that reducing the amount of storm water entering into the City's sewer systems during extreme storm events reduces the risk of basement flooding. Given this benefit, and the more frequent occurrences of extreme storm events in the City, the disconnection of downspouts across the City, should form part of the City's overall climate change adaptation strategy.

### **(C) Phasing-Out of the Voluntary Downspout Disconnection Program**

In approving the Mandatory Downspout Disconnection Program, Council also agreed to process all applications to the City's former Voluntary Downspout Disconnection Program, received by November 20, 2007. There were an estimated 47,000 requests for the Voluntary Downspout Disconnection Program received by Toronto Water through e-mail, mail and voice-mail messages up to November 20, 2007. Based on past experience, it is estimated that it will be feasible to disconnect the downspouts of about 80% of these properties corresponding to an estimated 37,600 properties that will have to be disconnected under the former Voluntary Downspout Disconnection Program. The cost to the City to service those on the waiting list, as well as the cost to provide assistance to eligible low income property owners is estimated to be \$41.0 million in Capital costs and \$16.2 million in Operating costs over the eight year period of 2009 to 2016. Additional staff is required to process the waiting list for the former Voluntary Downspout Disconnection Program and assist with the roll-out and enforcement of the new by-law requirements for mandatory downspout disconnection.

## **COMMENTS**

### **Engineering Review of Basement Flooding Study Areas**

Toronto Water has completed the engineering review for 4 (Basement Flooding Study Areas 14, 28, 29 & 30) of the 31 Study Areas. The Work Plan reviewed these four Study Areas first as a significant number of properties within this part of the City have been chronically impacted by extreme storm events. Combined, these 4 areas:

- represent an area of 4,955 hectares, or 8 % of the City;
- are serviced by 847 kilometers of sewers, or 9.5% of the City's sewer system;
- have an average estimated service life remaining for sewers of 50 years;
- represent an estimated 35,500 properties, or 7% of City properties;
- received 1,923 basement flooding complaints from the August 2005 storm, representing 46% of the 4,200 basement flooding complaints received; and
- have an estimated 13,700 properties vulnerable to basement flooding during extreme storm conditions based on computer simulation modeling.

The engineering reviews focused on the assessment of the sanitary sewer and storm drainage systems and included extensive flow monitoring to establish existing sewer flow conditions. Closed Circuit Television inspections were completed to identify pipe defects and dye and smoke testing of sewers was used to identify illegal connections. Detailed computer simulation models were developed and calibrated of the sanitary, storm, and overland drainage systems to help assess the effectiveness of remedial options and evaluate a range of alternatives. This work was undertaken through a Class Environmental Assessment process, in accordance with the

Province of Ontario's Environmental Assessment Act, where a number of alternatives to address the flooding problems were developed and assessed, and where the local community was consulted in the development of the preferred solutions.

There were a number of separate meetings with Ward Councilors, the public and review agencies (e.g. Toronto and Region Conservation Authority, Parks, Forestry and Recreation Division and the Toronto District School Board) at key stages of the process. While Toronto Water staff led these projects, staff from the affected divisions including Transportation Services, Technical Services and Parks, Forestry and Recreation was also engaged in the development and assessment of options. In accordance with the Environmental Assessment Act, the project files for Basement Flooding Study Areas 14, 28, 29 & 30 must now be submitted for the compulsory 30 day public review and comment period before the studies can be completed.

The engineering reviews have determined that to provide the enhanced level of basement flooding protection approved by Council in the Basement Flooding Work Plan (2006), a multi-pronged approach is necessary. This requires the implementation of at source (lot level) controls and improvements to the sanitary sewer system, the storm sewer system and overland flow drainage system.

### **Overview of Measures for Relief in Basement Flooding Study Areas 14, 28, 29 and 30**

It is noted that under normal conditions, where the rainfall characteristics fall within the design parameters of the local sewer systems (i.e. one in 2 year to a one in 5 year return frequency), basement flooding complaints are rare occurrences, across the City. However, the incidences of basement flooding complaints is usually commensurate with the severity of the rainfall event as sewer systems become overloaded and there is significant ponding of storm water on public and private properties.

As a result, preventing basement flooding is complex as it can be caused by many factors requiring solutions that consist of several components which vary depending on site specific conditions. The preferred strategies to basement flooding relief in Basement Flooding Study Areas 14, 28, 29 and 30 consist of the following components:

#### **a) Source (Lot level) Controls**

It is essential that individual homeowners take the appropriate action to reduce the risk of basement flooding as infrastructure improvements alone will not eliminate basement flooding given that many sources of the problem reside on private property and the implementation of in-system works may take many years to implement. Homeowners can significantly reduce the risk of basement flooding by:

1. Installing a backwater valve on their sanitary house connection. Installing backwater valves on the sanitary sewer connections is a measure that significantly reduces the risk of basement flooding. Given that the risk of basement flooding exists anywhere in the City, from either a sewer blockage or from a major storm, and that the Ontario Building Code has provisions to allow municipalities to request the installation of backwater valves in areas where there is a risk of basement flooding which can lead to building contamination, it is recommended that the Chief Building Official, in accordance with the

Ontario Building Code, require any applicant of a Plumbing Permit related to the sewer drain where there is a below grade living area anywhere in the City of Toronto to install a backwater valve on their sanitary sewer lateral.

2. Disconnecting their foundation drains from the sewer system and have them connected to a sump pump which discharges to the surface. The City's Basement Flooding Protection Subsidy Program is available to all eligible property owners, providing subsidies, to an upset limit of \$3,200 for the implementation of various measures to help isolate the home from the City's sewer system including the installation of a backwater valve, the disconnection and capping of foundation drains and storm sewer connections and installation of a sump pump, and the disconnection of roof downspouts when coupled with the installation of a backwater valve.
3. Disconnecting their downspouts and ensure that they are draining properly away from basement walls. Disconnecting downspouts is an effective means of helping to prevent surcharging of the storm sewer system by reducing flows to the system. Also, by disconnecting downspouts it is possible to discharge a significant amount of roof runoff to back yards which will not reach the streets thus reducing the surface flooding problems associated with the ponding of water at the low points on streets. To be effective, it is not sufficient to disconnect downspouts from only those houses that are flooded, as all houses (roof tops) within the sewershed (i.e. drainage area) contribute to and exacerbate the flooding problem within the sewer system. Based on computer simulation modeling used in the engineering review, it has been estimated that at least 70% of the houses in a given sewershed must be disconnected from the storm sewer before a significant reduction in sewer surcharging can be achieved. Therefore, mandatory downspout disconnection throughout the basement flooding areas is recommended.
4. Disconnecting the catchbasins on reverse slope driveways from the sewer system and connecting them to a sump pump that discharges to the surface. Reverse slope driveways are a significant factor contributing to basement flooding as the catchbasins that drain the driveway are at a lower elevation in relation to the road and therefore are susceptible to flooding from even minor surcharging of the storm sewers. Reverse slope driveways are also susceptible to surface flooding in low lying areas. When ponding occurs on the road, storm water can overtop the curb, flowing down the driveway directly into the garage and basement. Due to the significant impact reverse sloped driveways can have on basement flooding; it is recommended that reverse sloped driveways be banned in any future home construction.
5. Repairing cracks and leaks in walls, floors, windows, doors and foundations.
6. Ensuring lot grading around the home is sloped away from all exterior walls.
7. Considering soft-surface landscaping that allows storm water to soak into the ground rather than runoff directly into the sewer system (e.g. increased sodded areas or porous surfaces rather than pavement).

***Amending the Basement Flooding Protection Subsidy Program*** - An amendment to the program is required at this time due to the By-law amendments making downspout disconnection mandatory. It is recommended that the existing subsidy of 80% of the cost of downspout disconnection up to a cap of \$500.00 be eliminated. However, in order to help further encourage property owners to implement other effective “home isolation” measures, it is recommended that the total per property subsidy available remain capped at \$3,200, but the subsidies for the installation of backwater valves and sump pumps be increased by \$250.00 each, to provide a maximum subsidy of \$1,250 and \$1,750, for each respectively. Please note that the disconnection of roof downspouts will remain a precondition for the subsidy program, but that no financial subsidy will be available for the disconnection work except for eligible low income property owners.

To date, 3,125 Basement Flooding Subsidy pre-approval applications have been received by the City and 872 property owners have submitted invoices for work completed, totalling \$1,123,445. To improve the uptake of the program, it is recommended that, in addition to the existing communication program for the Basement Flooding Protection Subsidy Program, that a targeted campaign be developed and employed to help inform homeowners and contractors about climate change impacts related to basement flooding. The campaign will provide methods to isolate a home from the sewer system during extreme storm conditions and outline the importance of implementing measures contained within the Basement Flooding Protection Subsidy Program.

An additional 5 permanent staff, at an annual estimated cost of \$470,758, consisting of financial control and administration staff are required on a permanent basis, in support of responding to and processing the expected increase in demand for the City’s Basement Flooding Protection Subsidy Program and the companion Drain Grant Program (i.e. which may help reduce the incidence of basement flooding in cases where the sewer lateral may be blocked by tree roots from trees within the municipal road allowance).

***Expanding the Mandatory Downspout Disconnection Program*** - Given the noted benefits, it is recommended that the City’s Mandatory Downspout Disconnection Program be extended across all 31 Basement Flooding Study Areas to take effect by 2012. Furthermore, given the accrued benefit and the more frequent occurrences of extreme storm events in the City which may lead to basement flooding in other areas of the City, the disconnection of downspouts should form part of the City’s climate change adaptation strategy; and it is recommended that the program be extended across all parts of the City to take effect by 2015 (see Attachment 4).

An additional 11 permanent staff, at an annual estimated cost of \$1,007,294, consisting of contract managers, inspectors and administration staff are required on a permanent basis, in support of processing the estimated 37,600 eligible applications on the Voluntary Downspout Disconnection Program by 2016 at a target disconnection rate of 5,000 per year (i.e. up from the historical 2,500 to 3,000 disconnections per year); administering the Mandatory Downspout Disconnection Program to target the combined sewer service area to take effect by November 20, 2010; the rolling out of the Mandatory Downspout Disconnection Program across 31 Basement Flooding Study Areas to take effect by 2012; and the City-wide rolling out to take effect by 2015.

***Improving the Phase-Out of the Voluntary Downspout Disconnection Program*** - Due to the length of time forecasted by the City to process all of the applications received from eligible property owners on the existing Voluntary Downspout Disconnection Program waiting list, staff believe that there may be some situations in which individual property owners may wish to opt out of the Voluntary Downspout Disconnection Program and disconnect their downspout(s) themselves. It is recommended that Council approve a minor amendment to the phase-out of the Voluntary Downspout Disconnection Program by allowing eligible property owners to complete the work themselves, and if they choose to do so, the City will reimburse the property owner for the reasonable cost of labour and materials for completing the eligible work to an upset limit of \$500.00 per property.

To ensure proper administration of the City's financial reimbursement to property owners, it is recommended that they submit a completed and compliant application form, together with all invoices and other supporting information substantiating the completion of the work and costs of same. Furthermore, the applications and accompanying documents should be received within one year of the work being completed and the property owner assumes all responsibility for the work, including installation, performance, maintenance, repair and use, and any other financial responsibility. The City should reserve the right to conduct an inspection of the completed work, should it be deemed necessary, to ensure compliance with all City requirements.

**b) Sanitary Sewer System Improvement**

A total of 29 projects, at an estimated cost of \$20 million, have been identified to prevent basement flooding from sanitary sewer backup which include:

1. Reducing infiltration/inflow through the continuation of the City's smoke and dye testing studies to identify and eliminate illegal connections, sealing maintenance hole covers in surface flooding areas and focusing the maintenance hole and pipe rehabilitation program in the chronic basement flooding areas;
2. Eliminating hydraulic bottlenecks through sewer system upgrades; and
3. Providing additional storage capacity for excess levels of infiltration/inflow through inline and offline underground storage.

The sanitary sewer system improvements are given highest priority due to health and safety reasons. Concurrent with the implementation of the sanitary sewer remedial works, the City will focus its maintenance hole and sewer rehabilitation program and infiltration/inflow reduction programs in the Basement Flooding Study Areas.

**c) Storm Sewer Inlet Controls**

The engineering review confirmed that most of the storm sewers surcharged during the August 19, 2005 storm. To reduce surcharging of the storm sewers it is recommended that storm sewer inlet controls consisting of flow controls installed within roadside catchbasins, restricting the storm water runoff entering the sewer system to the system design capacity, be installed, in cases where the overland flow can be routed away from low lying areas; and/or where storm water detention facilities are proposed. It is estimated that \$30 million is required to provide the necessary inlet controls across the four Basement Flooding Study Areas.

#### **d) Storm Drainage System Improvements**

In some locations downspout disconnection and/or catchbasin flow controls may not be feasible. In these instances sewer upgrades or under ground storage facilities are recommended to prevent storm sewers from surcharging. Also, many of the streets in the four Basement Flooding Study Areas are very flat or have low points with no overland flow path for the water to outlet resulting in surface flooding during major storms. The most practical solutions to eliminate surface flooding at these locations are minor street regrading and/or creation of overland flow diversion channels.

However, with the areas being fully built up, there is little opportunity to implement these types of measures. Therefore, extensive sewer system upgrades are required. In addition, many above-ground dry ponds and under-ground storage facilities are required to provide the necessary storage volumes during these extreme storms. Combined, in Basement Flooding Study Areas 14, 28, 29 and 30, a total of 271 projects (i.e. 261 storm sewer upgrades and 10 storm water storage facilities) at an estimated cost of \$210 million (i.e. \$163 million and \$47 million for storm sewer upgrades and storage facilities, respectively) are required to provide the necessary storm drainage system improvements.

Through the comprehensive engineering review, computer simulation modeling was used as an objective tool to help identify those properties which would receive the greatest benefit from the proposed works. For example, not all properties within a given study area benefit from the works proposed, as most properties are not impacted during extreme storms. However, those properties in low lying areas, or which have basements at lower elevations would benefit through reduced risk of flooding.

However, some of the projects were found to have a high cost to benefit ratio, that is, they are very expensive relative to the number of properties that would benefit from the project, in some cases the cost per “benefiting property” can exceed \$100,000. By way of comparison, providing new water and wastewater servicing, which would be used continuously (i.e. rather than just during extreme storm events), to an unserviced lot with a 15 metre frontage (i.e. abutting a serviced area) is estimated to be \$45,000. Also, many of the facilities would only be used on an infrequent basis during extreme storm events which, in the past, would be expected to occur once every 25 to 50 years.

Therefore, it is being recommended that only the storm drainage system improvement projects that address areas with a history of basement flooding and where the cost of the project is \$25,000 or less per benefiting property be given priority for implementation at this time. Based on the above-noted analysis, at this level of investment, an estimated 82% (12,500 properties) of the impacted properties would benefit at a total estimated cost of \$153 million.

Projects with a cost exceeding \$25,000 per benefiting property, are not considered to be cost effective on their own and are to be implemented only as opportunities are available, as determined by and in the sole discretion of the General Manager, Toronto Water through other City infrastructure renewal programs such as Toronto Water’s Sewer Rehabilitation and Reconstruction Program and Transportation Service’s Road Reconstruction Program; through third party funding which reduces materially the City’s cost per benefiting property.

An additional 5 permanent staff, at an annual estimated cost of \$548,310, consisting of professional and technical staff are required to support the design and construction of the several hundred recommended basement flooding remedial measures associated with Basement Flooding Study Areas 14, 28, 29 & 30 plus the hundreds of additional projects anticipated to be generated by the Environmental Assessment Studies for the other 26 Basement Flooding Study Areas yet to be completed.

### Summary of Capital Projects Recommended

Overall, the priority projects for the 4 Basement Flooding Study Areas consist of several hundred infrastructure improvement projects with an estimated total cost of \$195 million. A summary of the recommended improvement works and their costs are provided in Table 1.

**Table 1 – Summary of Recommended Basement Flooding Remedial Measures  
(Basement Flooding Study Areas: 14, 28, 29 & 30)**

<b>Overall System Improvements</b>	<b>Recommended Priority Projects</b>	<b>Identified Projects in Environmental Assessments</b>
Sanitary Sewer Upgrades (16 projects totalling 4.5 km)	\$6 million	\$6 million
Sanitary Storage Tanks (13 projects, 2 in Parks, 1 with Pump)	\$14 million	\$14 million
Storm Drainage System Upgrades (261 projects totalling 54 km)	\$100 million	\$163 million
Storm Sewer Storage Facilities (10 projects, 4 surface, 6 underground, 6 in Parks, 2 with Pumps)	\$33 million	\$47 million
<b>SUB TOTAL</b>	<b>\$153 million</b>	<b>\$230 million</b>
Lot Level & Storm Sewer Inlet Controls		
• Basement Flooding Protection Subsidy Program	\$12 million	\$12 million
• Mandatory Downspout Disconnection Program	Nil	Nil
• Catchbasin Inlet Controls, MH Sealing, Surface Flow Diversion	\$30 million	\$30 million
<b>SUB TOTAL</b>	<b>\$42 million</b>	<b>\$42 million</b>
<b>TOTAL</b>	<b>\$195 million</b>	<b>\$272 million</b>

Note: \* Storm drainage system improvement projects where the cost of the project is \$25,000 or less per benefiting property.

\*\* Consistent with the Mandatory Downspout Disconnection Program approved by Council in 2007, for the combined sewer service area, a Mandatory Downspout Disconnection Program for the 31 Basement Flooding Study Areas, would be the responsibility of the private property owner.



The implementation of the above-noted elements, in an existing fully developed area, presents many challenges in terms of cost, scheduling and disruption to the local communities. Open space opportunities to construct storage facilities (i.e. above or below ground) are very limited, and only a few opportunities existing within City Park areas. A total of eight underground and surface storage facilities have been recommended for placement in City Parks. Parks, Forestry & Recreation staff have reviewed each of the recommended sites and several discussions have been held to date to address issues regarding temporary disruption to park use and recreational programming, tree removal, and longer term operations and maintenance requirements.

Locations have been selected so as to retain all existing park use, although some temporary disruption may occur during the construction phase. To address the temporary disruption, attempts will be made to construct the facilities during the off-season to eliminate the impact on recreational programming. In circumstances, whereby, construction will require the short-term displacement of recreational programming, such as baseball or soccer, Toronto Water has committed to providing the necessary funds to Parks, Forestry & Recreation to acquire permits for alternative playfields. Following construction, each site will be reinstated to its original use along with additional and/or upgrading of new landscaping and parks amenities, where required. Toronto Water will continue to work closely with Parks, Forestry & Recreation staff during the detailed design and construction phase to ensure that the planning of each facility is properly incorporated into the park setting. Parks, Forestry & Recreation have also indicated that they will require at least 1 additional staff to coordinate the work proposed, and provide input on the design of facilities planned to be constructed within Park Lands.

Furthermore, consultation and communication with the local community and affected stakeholders will also continue to take place during the detailed design and construction phase.

## **CONTACT**

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## **SIGNATURE**

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Lou Di Gironimo  
General Manager, Toronto Water

## **ATTACHMENTS**

Attachment 1 – 31 Basement Flooding Study Areas

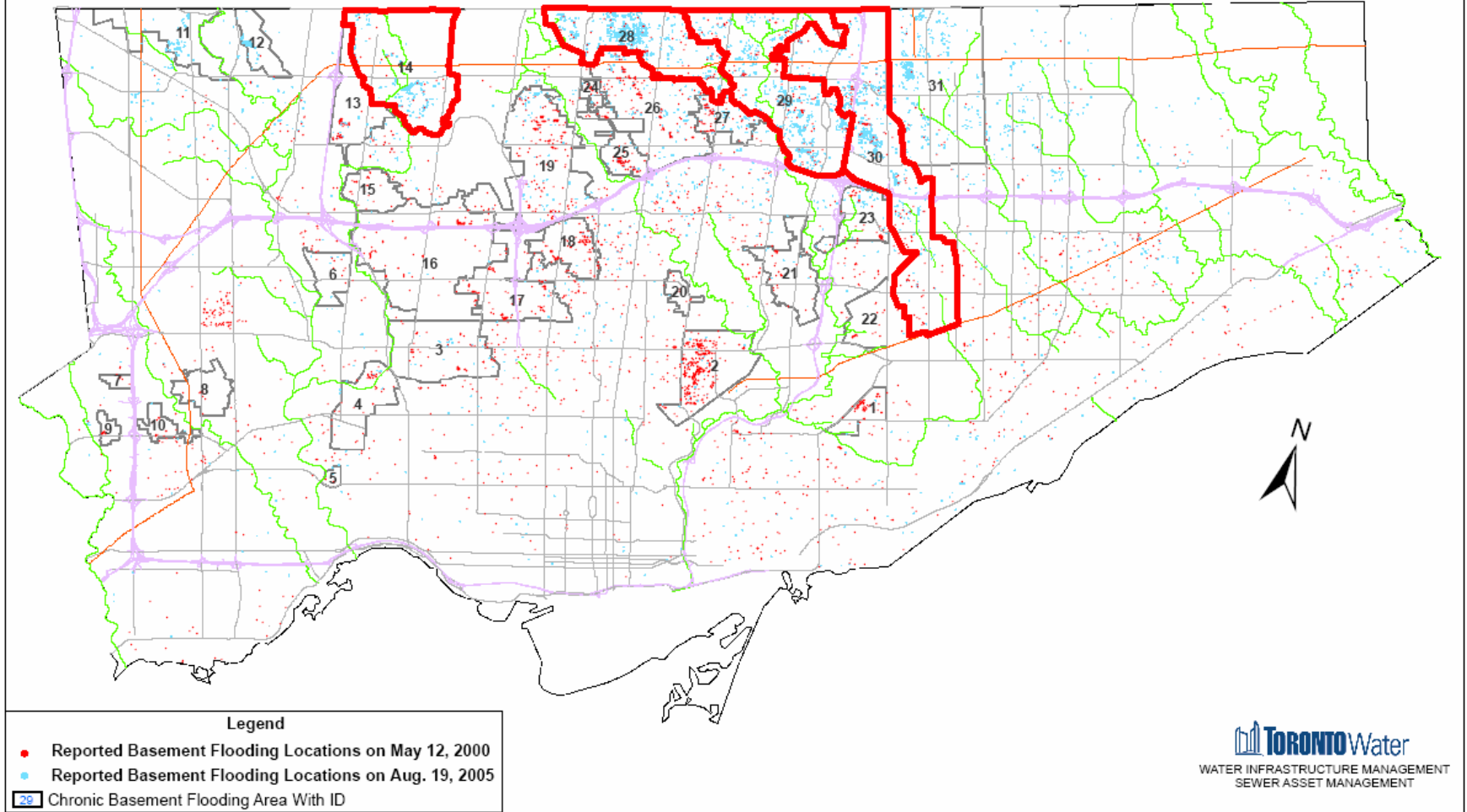
Attachment 2 – Basement Flooding Work Plan Update – Engineering Analysis & Environmental Assessment

Attachment 3 – Combined Sewer Service Area

Attachment 4 – Areas of the City Outside of the 31 Basement Flooding Study Areas and the Combined Sewer Service Area

# ATTACHMENT1

## 31 Basement Flooding Study Areas



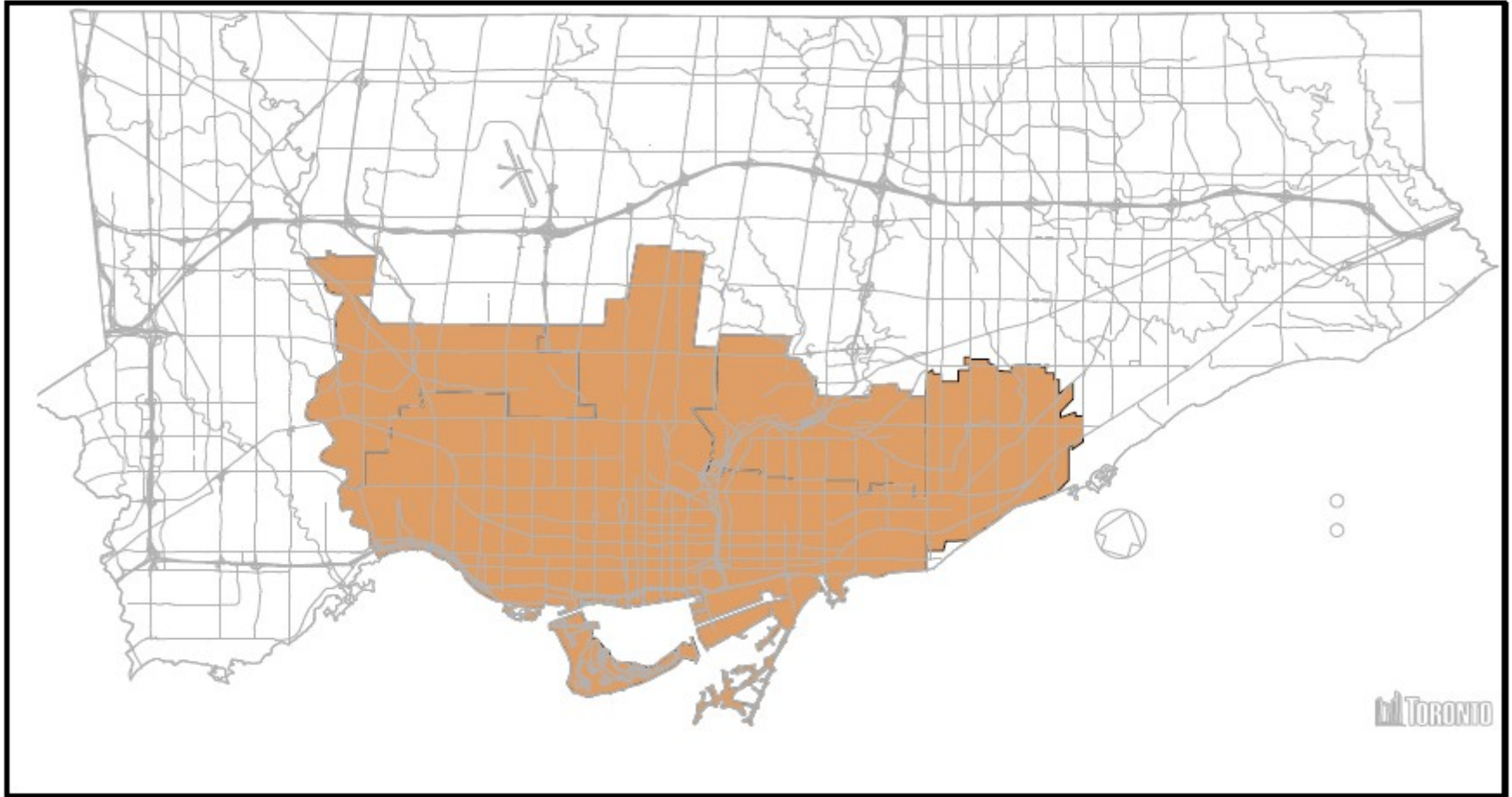
## ATTACHMENT 2

Basement Flooding Work Plan Update Engineering Analysis & Environmental Assessment								
Study Area	Ward	Drainage System	2006	2007	2008	2009	2010	
1	3	Combined Sewer Storm Sewer & Overland Flow						
2	26	Combined Sewer Storm Sewer & Overland Flow						
3	12,15,17	Combined Sewer Storm Sewer & Overland Flow						
4	11,13	Combined Sewer Storm Sewer & Overland Flow						
5	13	Combined Sewer Storm Sewer & Overland Flow						
6	11	Combined Sewer Storm Sewer & Overland Flow						
7	3	Sanitary Sewer Storm Sewer & Overland Flow						
8	3,4	Sanitary Sewer Storm Sewer & Overland Flow						
9	3	Sanitary Sewer Storm Sewer & Overland Flow						
10	3	Sanitary Sewer Storm Sewer & Overland Flow						
11	1	Sanitary Sewer Storm Sewer & Overland Flow						
12	7	Sanitary Sewer Storm Sewer & Overland Flow						
13	7,8,9	Sanitary Sewer Storm Sewer & Overland Flow						
14	8,9	Sanitary Sewer Storm Sewer & Overland Flow						
15	7,9	Sanitary Sewer Storm Sewer & Overland Flow						
16	9, 12,15	Sanitary Sewer Storm Sewer & Overland Flow						
17	15,16	Sanitary Sewer Storm Sewer & Overland Flow						
18	15,16	Sanitary Sewer Storm Sewer & Overland Flow	(improvement works have been implemented)					
19	9,10	Sanitary Sewer Storm Sewer & Overland Flow						
20	25	Sanitary Sewer Storm Sewer & Overland Flow						
21	25,34	Sanitary Sewer Storm Sewer & Overland Flow	(improvement works have been implemented)					
22	34	Sanitary Sewer Storm Sewer & Overland Flow						
23	34	Sanitary Sewer Storm Sewer & Overland Flow						
24	23	Sanitary Sewer Storm Sewer & Overland Flow	(study completed, no improvement required for Sanitary Sewer sewers)					
25	23	Sanitary Sewer Storm Sewer & Overland Flow						
26	23	Sanitary Sewer Storm Sewer & Overland Flow						
27	23,24	Sanitary Sewer Storm Sewer & Overland Flow						
28	10,23,24	Sanitary Sewer Storm Sewer & Overland Flow						
29	24,33	Sanitary Sewer Storm Sewer & Overland Flow						
30	24,33,37,40	Sanitary Sewer Storm Sewer & Overland Flow						
31	39,40	Sanitary Sewer Storm Sewer & Overland Flow						
Pilot study area - Roywood		Sanitary Sewer/Storm Sewer /Overland Flow						

Sanitary Sewer Assessment  
 Storm Sewer & Overland Flow  
 Work under implementation

# ATTACHMENT 3

## City of Toronto Combined Sewer Service Area

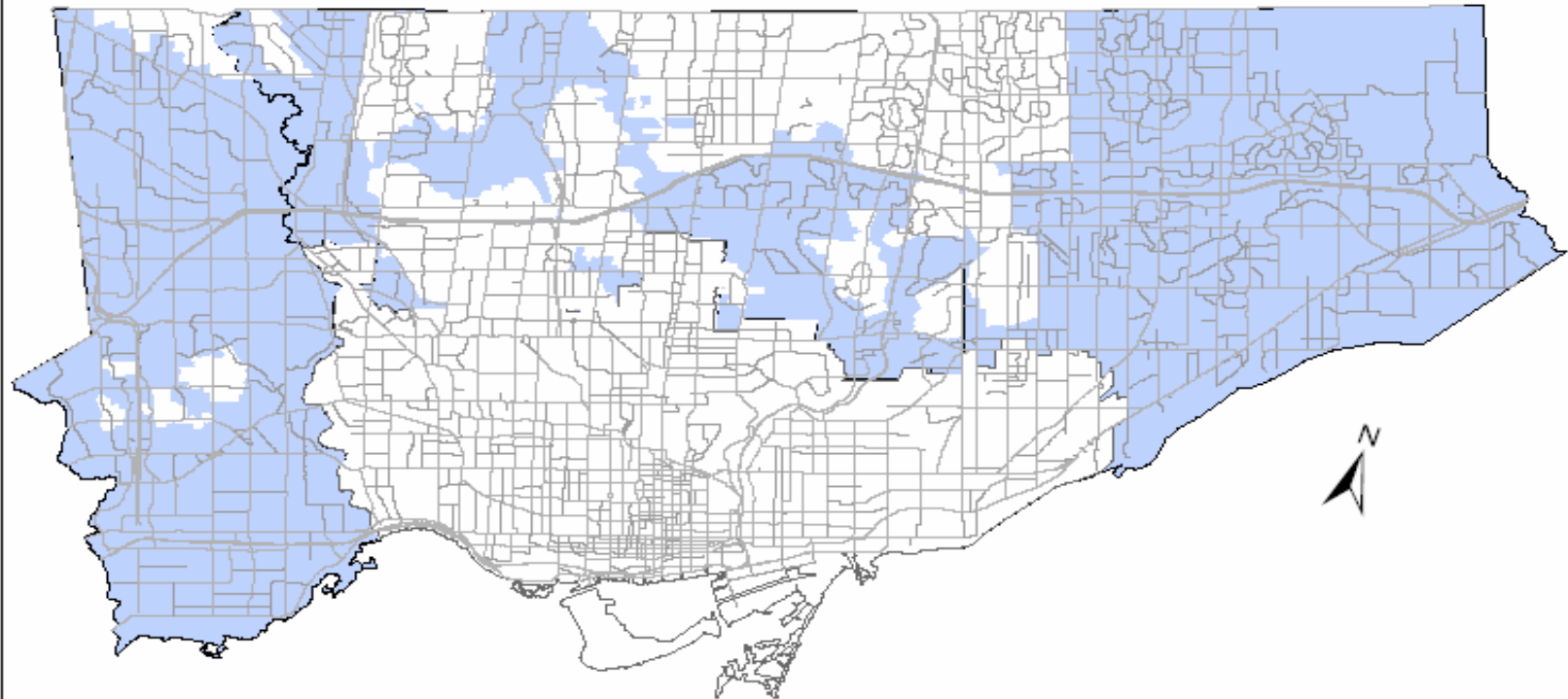


 Combined Sewer Area


0 3,000 6,000 12,000 Meters

## ATTACHMENT4

### Area of City outside the Basement Flooding Study Areas & Combined Sewer Areas



#### Legend

 Non combined & non flooding areas

  
WATER INFRASTRUCTURE MANAGEMENT  
SEWER ASSET MANAGEMENT