TORONTO

STAFF REPORT
ACTION REQUIRED

Impact of July 8, 2013 storm on the City's Sewer and Stormwater Systems

Date:	September 6, 2013
To:	Public Works and Infrastructure Committee
From:	General Manager, Toronto Water
Wards:	All Wards
Reference Number:	P:/2012/Cluster B/TW/pw13017

SUMMARY

The purpose of this report is to advise City Council on the condition of the sewer systems within the areas of the City most affected by the July 8, 2013 storm. The report also seeks Council direction on a proposal to expand, across the entire City, a systematic review of the sanitary and storm sewer systems as they are or may be impacted by severe storm events with a view to reduce the number of basements that may flood.

On the afternoon and evening of July 8, 2013, severe thunderstorms and heavy rains flooded many parts of the City, causing damage to public and private property and infrastructure, stranding thousands of commuters, and leaving tens of thousands of residents and businesses without electricity. More than 4,700 basement flooding complaints were received during and immediately following the storm.

The majority of these complaints came from residents living in the Etobicoke and York areas of the City. Many of the impacted homes are outside of the existing Basement Flooding Protection Program's 34 priority study areas. A preliminary review of the existing sewer drainage systems in Etobicoke and York indicate they have been designed to accommodate typical operating conditions, with sanitary sewer systems being sized to accommodate sanitary flow contributions from residents and businesses, and with storm sewers being designed to collect and convey storm runoff from rainfall and/or snowmelt. It is apparent that incidents of flooding occur where there is a combination of heavy rainfall and local low lying areas and that this can potentially occur at any location across the City.

RECOMMENDATIONS

The General Manager, Toronto Water, recommends that:

1. City Council request the General Manager, Toronto Water, to report back during the 2014 budget process on the capital and operating budget impacts of expanding the Basement Flooding Protection Program on a city-wide basis beyond the existing 34 priority study areas, including methodologies for setting priorities and resource implications, so that the program continues to address urban flooding risks in a fair, well-organized, and efficient manner.

Financial Impact

The approved 10 year Toronto Water Capital Budget Plan (2013-2022) includes a total of $915 million for the construction of Basement Flooding Protection Program (BFPP) over ten years.

Expanding the BFPP across the entire City will require the undertaking of Environmental Assessment (EA) studies to examine capacity of sewer and storm drainage systems and, therefore, an increase to the ten year Capital Budget Plan. The Capital Budget Plan impact for undertaking the studies on a city-wide basis is estimated to be $4 million per year, beginning in 2015, and continuing for an estimated 12-15 years using existing staff resources to project manage the consulting assignments. Accelerating the expanded BFPP, so that it is completed sooner, will require additional annual increases to Toronto Water's Capital and Operating Budgets to hire more engineering consultants and staff within Toronto Water to manage the projects.

The estimated cost to construct projects identified by the EA studies in an expanded city-wide BFPP (includes construction projects not presently within the existing 34 priority study areas) will require additional capital funding beyond the 10 year plan. The capital cost implications are not known at this time, but can be estimated to be well over $1 billion.

This report recommends that any changes to the Basement Flooding Protection Program be examined and submitted as part of Toronto Water's 2014 Capital Budget submission.

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 on July 16 – 19, 2013, requested the City Manager and the General Manager, Toronto Water, to report on the condition of the sewer systems and storm water storage capabilities within the areas of the City that were most affected by the July 8, 2013 storm. The Council decision can be viewed at:
http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.MM37.53

This report responds to the above request in the context of Council's responses to the May 12, 2000 and August 19, 2005 rainstorms and subsequent intense storms in 2008 and 2012 as referenced below.

City Council, at its meeting on April 25 – 27, 2006, adopted a "Work Plan for the Engineering Review Addressing Basement Flooding", which identified 31 chronic basement flooding areas in the City and established an enhanced level of protection against basement flooding. With an enhanced level of service, surcharging within sanitary sewers will be kept below basements during storm events as large as the May 12, 2000 storm event; and properties will be protected from surface flooding during a 100 year storm event where a proper major (overland flow) drainage system does not exist. The Council decision can be viewed at: http://www.toronto.ca/legdocs/2006/agendas/council/cc060425/wks2rpt/cl016.pdf

City Council, at its meeting on September 24 and 25, 2008, adopted an "Update on the Engineering Review Addressing Basement Flooding", which summarized the results of the engineering analysis, completed to date, of the first four of the 31 Basement Flooding Study Areas in accordance with the Basement Flooding Work Plan approved by Council in April 2006; and identified criteria for the prioritization of recommended improvement works coming from the BFPP studies. The noted staff report can be viewed at: http://www.toronto.ca/legdocs/mmis/2008/cc/decisions/2008-09-24-cc24-dd.pdf

City Council, at its meeting on September 21, 2011, adopted the "Wet Weather Flow Master Plan and Basement Flooding Protection Program Update", which identified improving basement flooding protection during extreme storms as one of the main funding priorities for the Wet Weather Flow Master Plan over the next five to ten years. The staff report noted that the costs of implementing works identified in Environmental Assessments completed among the 32 Chronic Basement Flooding Study Areas far exceed the availability of funding, notwithstanding the year over year increases provided to the Program through Toronto Water's annual Capital Budget submissions. Furthermore, while these works represent service improvements which benefit only the affected areas, they compete for funding with other pressing issues facing Toronto Water, namely the state of good repair projects. The Council decision can be viewed at: http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2011.PW7.6

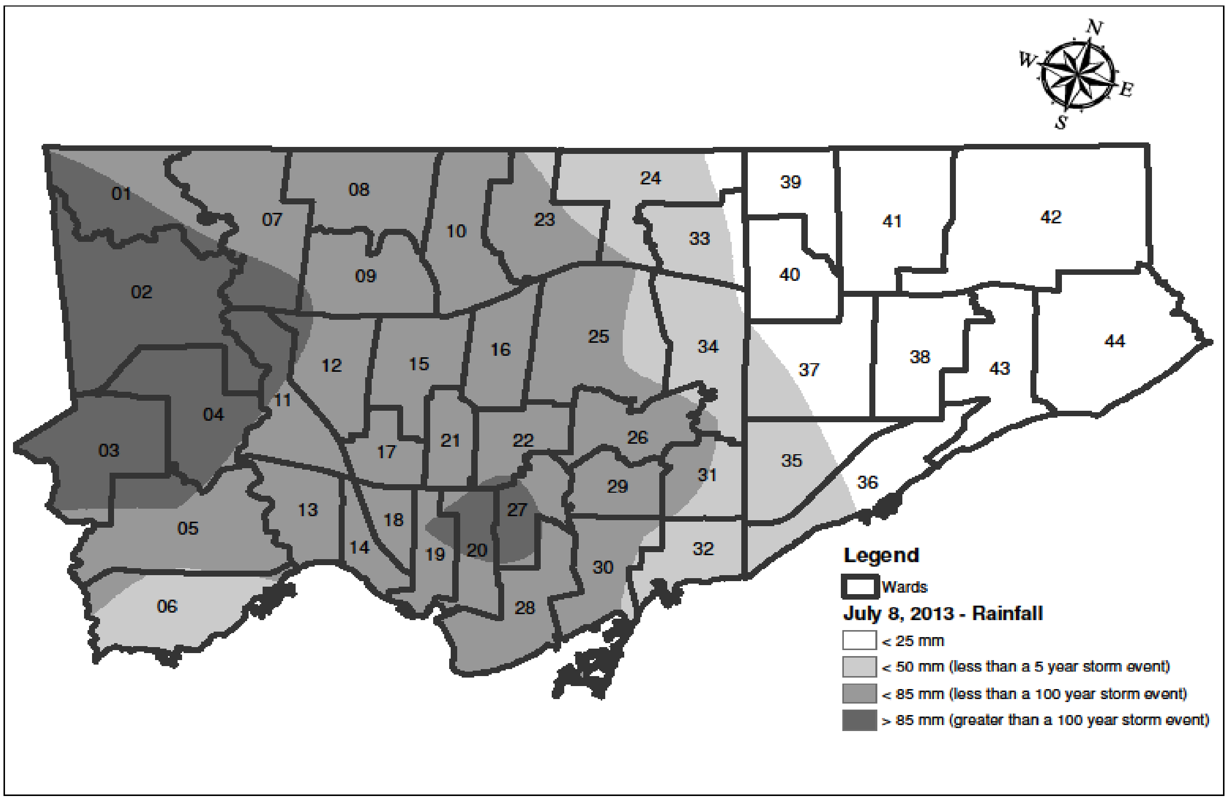
City Council, at its meeting on October 2 – 4, 2012, formally directed that flooding protection projects in the Scarborough Waterfront Combined Sewer Overflow (CSO) and Stormwater Outfalls Control Class Environmental Assessment and Flood Protection Study (Ward 36, Scarborough Southwest) be added to the Basement Flooding Protection Program prioritization list, bringing the number of Basement Flooding Areas to 33. The Council decision can be viewed at: http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.PW17.23

City Council, at its meeting on October 30, 31, and November 1, 2012, formally directed that a new Basement Flooding Study Area be established in Ward 35, bringing the number of Basement Flooding Areas to 34. The Council decision can be viewed at: http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2012.EX23.3

ISSUE BACKGROUND

On the afternoon of July 8, 2013, and extending into the night, thunderstorms and heavy rain showers blanketed the City of Toronto. Within a few short hours, almost 140 mm of rain had fallen in the west part of the city. In several wards, the storm intensity exceeded that of a 100 year return period storm event. Figure 1 shows that rainfall intensity varied across the city and demonstrates how the western portion of the city received the highest amounts of rainfall.

Figure 1: July 8, 2013 Storm Event - Distribution of Rainfall Density



The very high rate of rainfall resulted in the flooding of rivers, creeks, ravines, and low lying areas. Arterial roads and underpasses were flooded, public transit services were disrupted including the GO Train line in the Don Valley, stranding 1,400 passengers for more than seven hours. While various watercourses experienced substantial bank erosion, damage to Toronto Water's infrastructure was minor.

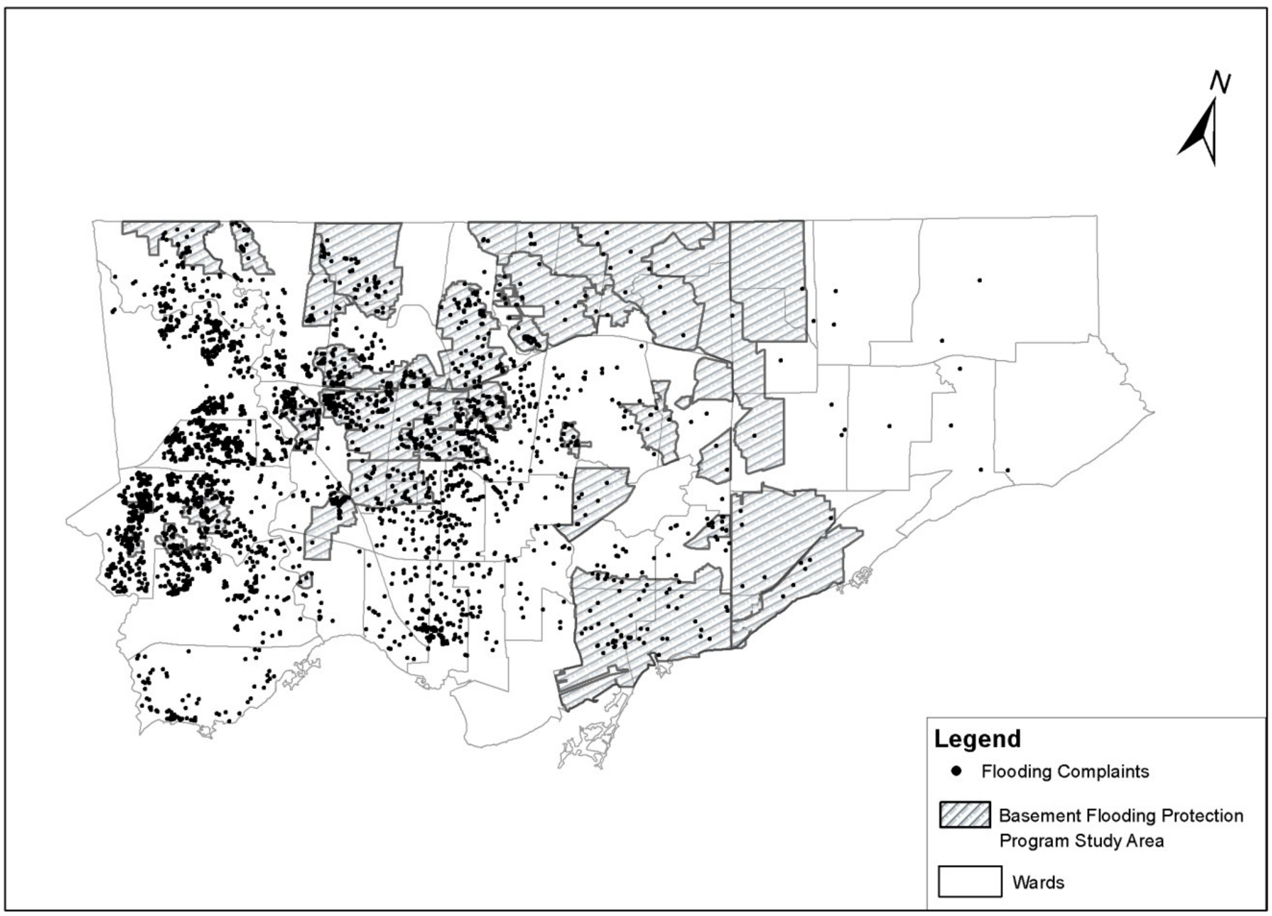
As of August 8, 2013, Toronto Water had received more than 4,700 calls from residents reporting flooded basements during the July 8, 2013 storm. This volume of reported flooding exceeded those received during the August 19, 2005, storm event when over 4,200 basement flooding were reported to the City. The locations where the calls originated for the July 8, 2013, storm event are shown in Table 1.

Table 1. Basement Flooding Calls (as of August 8), resulting from the July 8, 2013 Storm

District	No. of Basement Flooding Calls
North (North York)	991
East (Scarborough)	56
South (Toronto and East York)	607
West (Etobicoke and York)	3,105
Total	4,759

Almost two-thirds of basement flooding complaints were received from the west part of the city, and the majority of complaints occurred outside of the BFPP existing 34 priority study areas. Figure 2 illustrates how the density of flooding complaints varied across the city.

Figure 2: July 8, 2013 Storm Event - Reported Floodings



COMMENTS

Toronto's Existing Sewer and Storm Drainage Systems

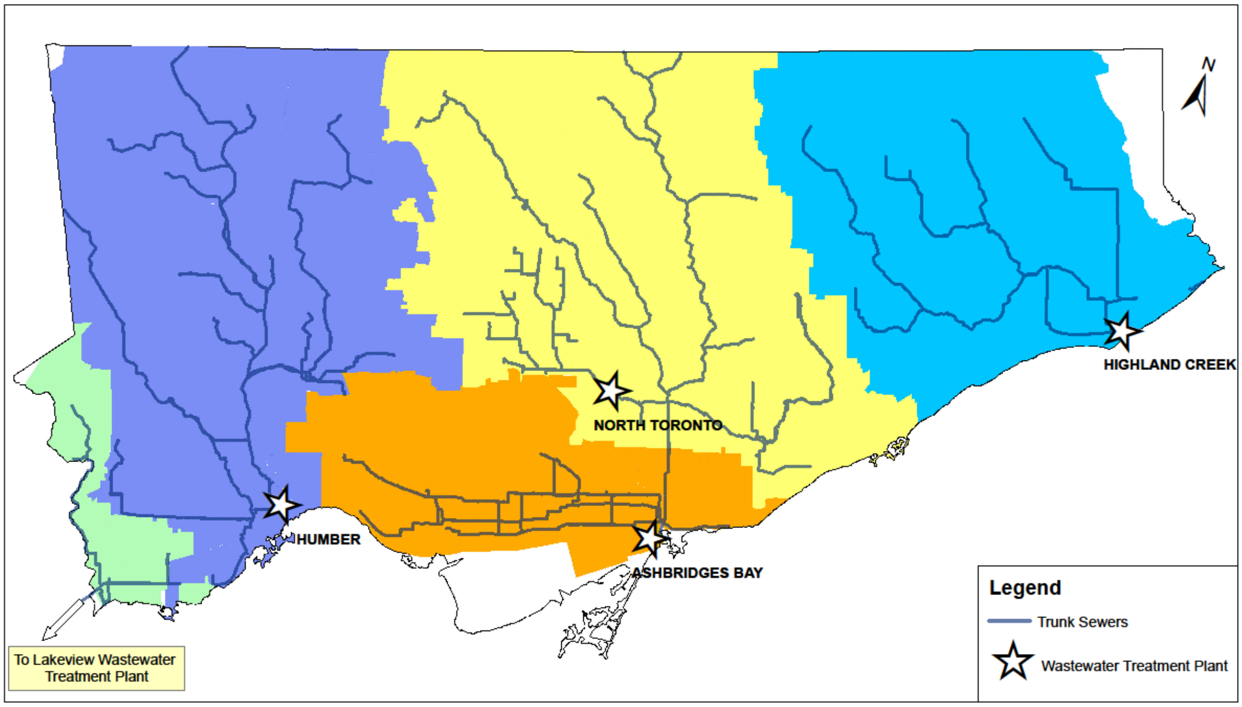
The City of Toronto relies on a network of sewers to serve its storm water and wastewater drainage needs. This network includes;

- 3,930 kilometres of sanitary sewers, that are designed to transport wastewater only to one of the City's four wastewater treatment plants;
- 4,954 kilometres of storm sewers, that are designed to collect stormwater (rainfall and snowmelt) runoff via catchbasins and transport it for discharge into local rivers or Lake Ontario; and
- 1,511 kilometres of combined sewers, that transports both wastewater and stormwater.

The City's Sanitary Sewer System collects wastewater from across the city and delivers it to one of the City's four wastewater treatment plants where it is treated before being discharged to Lake Ontario as shown on Figure 3. Similar to a tree, where leaves are connected to small branches, small branches join into larger branches, and large branches join into a trunk, the entire sanitary system includes:

- Private plumbing systems (washrooms, kitchens, etc.) that discharge through private sanitary sewer services into small City-owned local sewers. Sewer services located on private property, connect into the municipal sewer system at property boundaries, and are required to be maintained by the private property homeowners.
- The City's small local sewers join together and discharge into larger local sewers. These sewers are found under roadways of all sizes.
- The larger local sewers discharge into what are known as sub-trunk sewers. These sewers are often located through green spaces and watercourse corridors, but can also be found under roadways and within easements through private properties.
- The sub-trunk sewers discharge into the City's trunk sewer system. The trunk sewers are quite large, are usually located along watercourse corridors, and in some places can be quite deep.

Figure 3: City of Toronto's Trunk and Sub-Trunk Sanitary Sewer Network

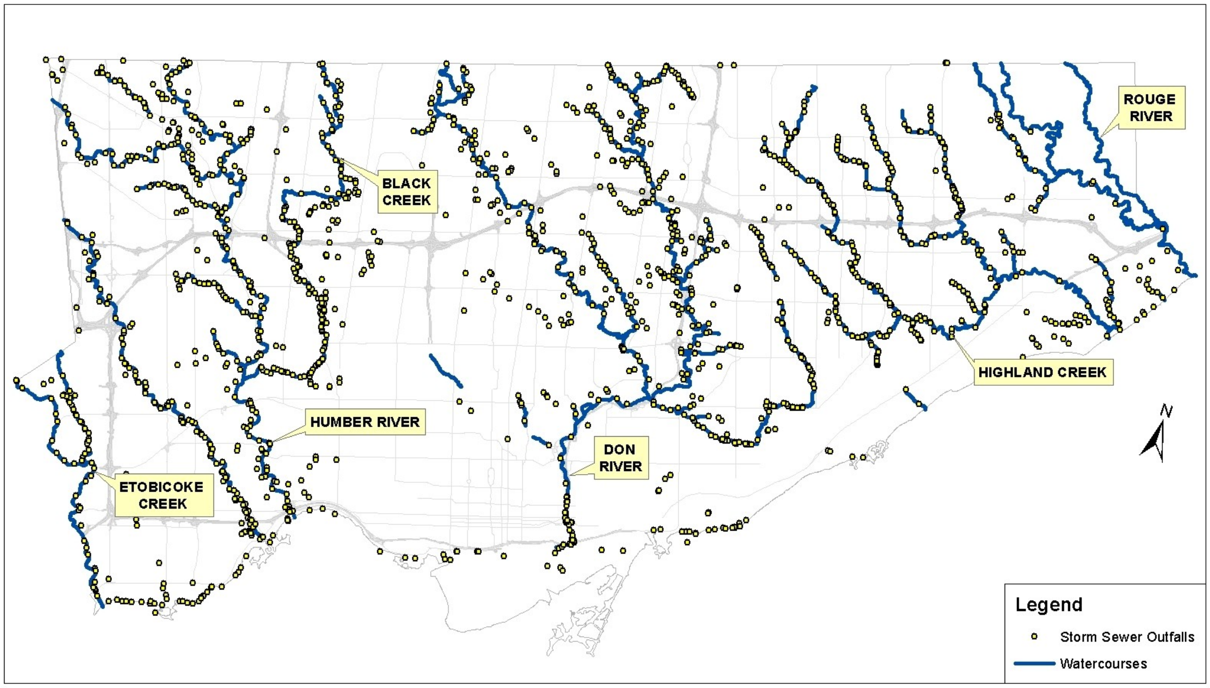


The City's Storm Drainage System is designed to manage rainwater and snow melt runoff across the city. It accomplishes this using storm sewers, ditches, and a variety of overland flow routes to convey storm water runoff from storm events to nearby watercourses. The watercourses act as the spine of the system, delivering large volumes of runoff to Lake Ontario.

During a rain storm, the drainage system receives flows from a variety of sources. In the case of a typical residential subdivision, runoff from private properties enters the sewer system directly (from connected roof leaders, reverse slope driveway drains, and from foundation drainage) and indirectly by flowing across lawns and driveways towards catchbasins along the roadway.

Similar to the sanitary sewer system, the storm drainage system includes a series of smaller local sewers flowing into progressively larger storm sewers. Rather than joining with a trunk sewer system, the local storm sewer systems are directed towards watercourses where they are discharged to the environment through outfalls. There are approximately 2,600 storm outfalls across the city, as demonstrated in Figure 4.

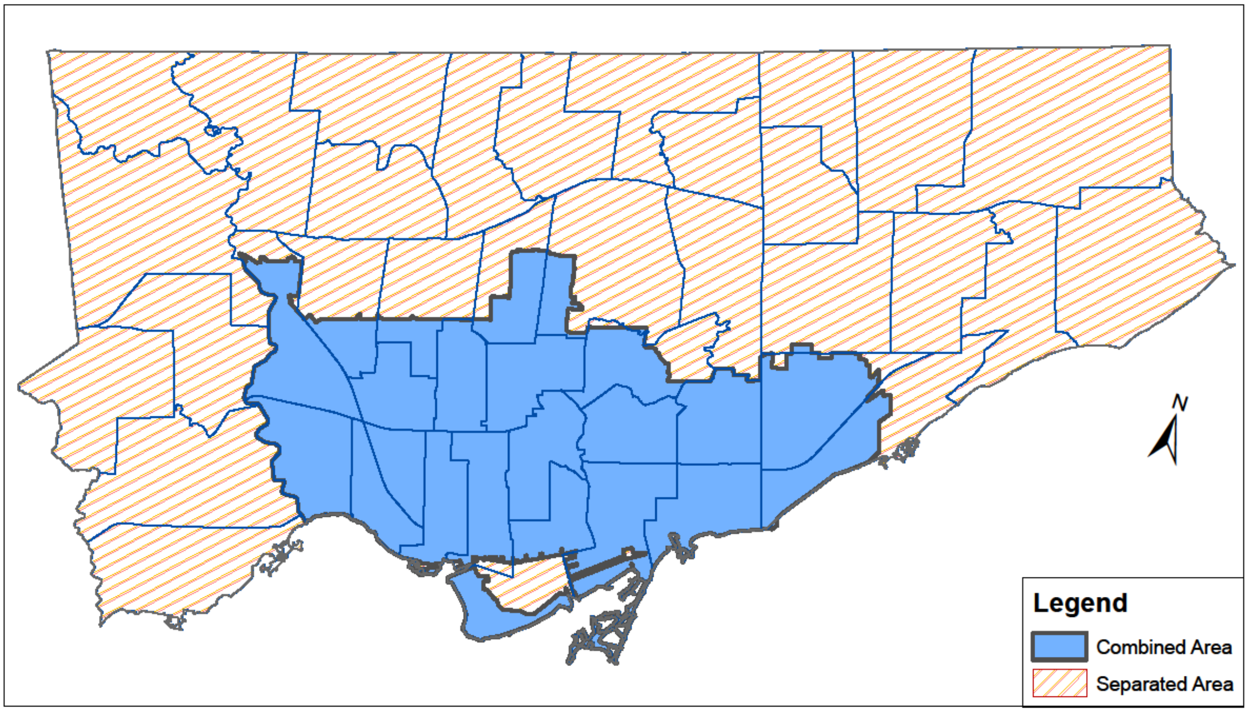
Figure 4: City of Toronto's Watercourses and Storm Sewer Outfalls



In addition to the storm sewer system, rainfall runoff is directed to watercourses along roadways and various open space corridors ranging from walkways between homes, road side ditches, and more elaborate overland flow routes through parks. This overland system is capable of accommodating substantially larger volumes of water than the storm sewer system can and is considerably cheaper to build and maintain. While, it is now a common design practice to properly account for overland flow in new subdivision design this wasn't always the case. As most of the City of Toronto was designed and built before this design practice became common practice, there are many subdivisions in Toronto without an adequate overland drainage system. In these neighbourhoods, flooding risks are more pronounced.

The Combined Sewer System is a drainage system that collects sanitary sewage and storm water runoff in a single pipe system and a significant portion of the City of Toronto is served by a combined sewer system. A shown in Figure 5, the older parts of the City are served by this type of system.

Figure 5: Combined and Separated Sewer Areas for Toronto



Similar to the sanitary sewer system, during dry weather and moderate rainfall or snowmelt the combined sewer system directs flows to one of the City's wastewater treatment plants for treatment prior to being discharged to the Lake. During larger storm events, the combined sewer system can become overloaded and combined sewer overflows (CSO), containing a mixture of stormwater and wastewater can be released from combined sewer outfalls to the city's watercourses and Lake Ontario.

Over the years, the City has undertaken sewer separation in the combined sewer service area and constructed a number of CSO storage/treatment facilities to reduce the frequency and volume of CSOs discharged to Toronto's waterways. The City has completed Environmental Assessment (EA) studies to address almost the entire list of combined sewer outfalls in the city, consistent with the City's 2003 Wet Weather Flow Master Plan, and future projects are planned to further reduce CSOs to the city's waterways.

How much rain can the city's sewers accommodate?

The existing sewer drainage systems have been designed to accommodate typical operating conditions, with sanitary sewer systems being sized to accommodate sanitary flow contributions from residents and businesses, and with storm sewers being designed to collect and convey storm runoff from rainfall and/or snowmelt. The size of a storm sewer is based on the characteristics of the upstream drainage area – essentially its area and degree of imperviousness – and a "design" rainfall. The design rainfall for most of the city is based on the historical maximum rainfall that would occur on an average of once every 2 to 5 years

During storm events larger than a 2 to 5 year return period, stormwater flows can exceed the carrying capacity of the underground storm sewer system and excess water will remain on the road and flow downhill along streets, open channels, and walkways. Ideally, this excess surface runoff will temporarily pond and/or flow towards a nearby watercourse without impacting private properties. While a certain amount of ponding or overland flow can be temporarily inconvenient, it is preferred rather than flooding private properties and/or buildings.

What happens during an extreme storm event?

The July 8, 2013 storm, especially in the Etobicoke and York areas of the city, is an example of an extreme event where surface runoff far exceeded the carrying capacity of the storm sewers, local ditches, roadways, and streams. Once the ability of the city's drainage system is exceeded, basement flooding quickly begins to occur and spread.

A preliminary review of the existing sewer drainage systems in Etobicoke and York indicate they have been designed to accommodate typical operating conditions, with sanitary sewer systems being sized to accommodate sanitary flow contributions from residents and businesses, and with storm sewers being designed to collect and convey storm runoff from rainfall and/or snowmelt. It is apparent that incidents of flooding occur where there is a combination of heavy rainfall and local low lying areas and that this can potentially occur at any location across the City.

The causes of basement flooding during 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:

1) ***Overloaded Sanitary Sewer System*** - Basement flooding can result from an overloaded sanitary sewer when excessive infiltration and/or inflow of storm water into the sanitary sewer causes it to back up through basement floor drains and plumbing fixtures. Sanitary sewers overload when storm runoff enters 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;
    - illegally connected private catchbasins; and
    - floor drains of flooded basements.

2) ***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 pressurizes 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 made worse 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.

3) ***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 stormwater runoff from a one in 2 year to a one in 5 year return storm event. For larger storms, stormwater 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 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 slope driveways since storm water is conveyed directly to the house.

How does the City know the system is functioning properly?

To ensure that the City's sewer systems can continue to provide the level of service that they were designed and built to deliver, the City has developed a rigorous inspection and maintenance program. The City's regular program consists of a two-year cycle for catchbasin cleaning, and a five-year cycle for the flushing of all local storm, sanitary, and combined sewer systems. As sewers reach specific thresholds based on age, location, and type of construction, they are also inspected on a regular cycle using closed circuit video inspections to ensure ongoing structural integrity.

Regular maintenance activities are augmented through additional inspections that occur after large rain events, and through additional activities that are undertaken to address areas in the system that are prone to sediment and debris accumulation.

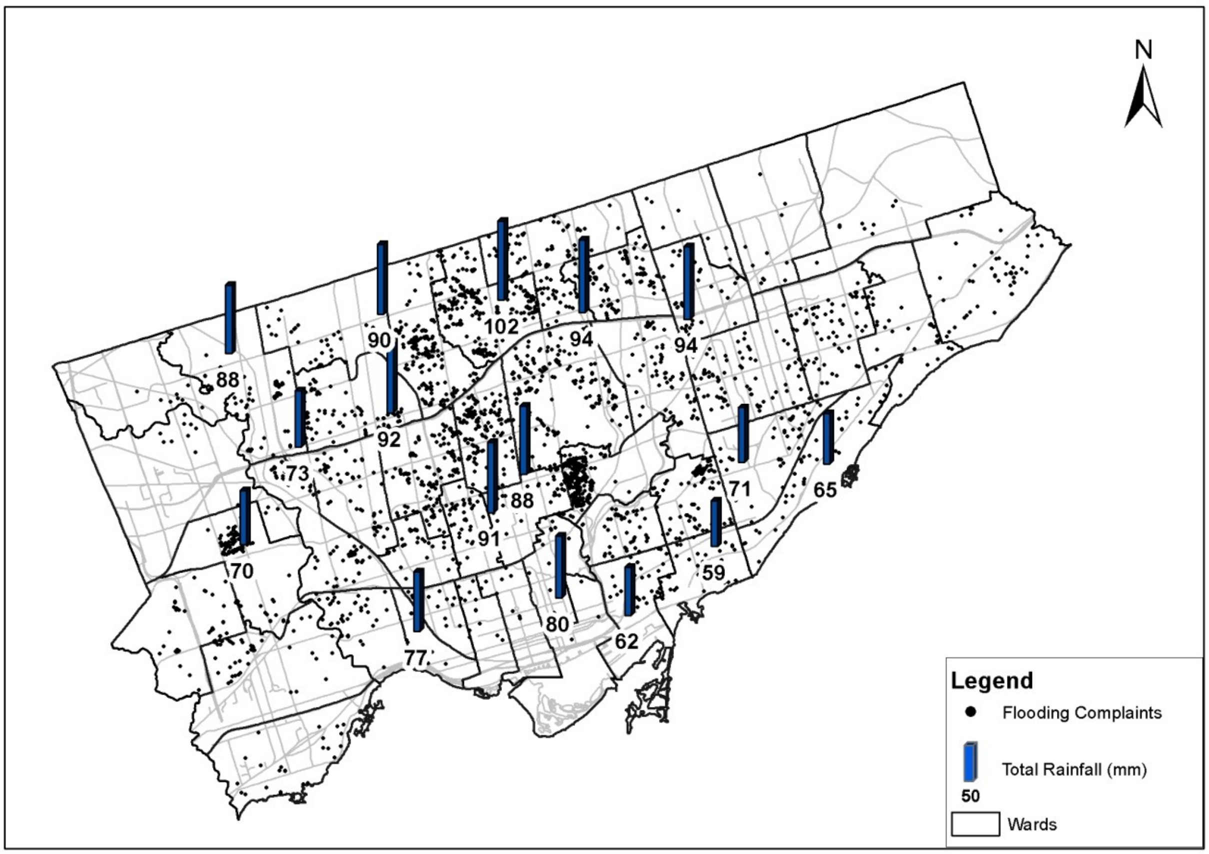
Where sewer systems are found to be compromised or soon to be compromised, capital works are undertaken to resolve the issues that are found. These works can range from sewer cleaning, through to sewer lining, and ultimately to sewer replacement and or enlargement. Toronto Water's annual Capital Budget process ensures sufficient funds are allocated to undertake both urgent repairs (parts of the system are found to be failing) and planned long term system replacements (for portions of the system that are at an elevated risk for failure).

Toronto is Experiencing Extreme Storms More Frequently

Basement flooding occurrences and damages in the city have been on the rise due to both an increasing frequency and severity of storms affecting Toronto, and to an increasing use of basements for storage and liveable space. Three storms experienced since 2000 with considerable impact to the residents of Toronto, are highlighted as follows.

On May 12, 2000, a storm produced an average of 68 mm of rainfall, ranging from 41 mm to 73 mm and representing a one in 25 year to a one in 50 year return period storm, depending on the location within the City. This event generated more than 3,000 basement flooding complaints as shown in Figure 6.

Figure 6: May 12, 2000 Storm Event - Rainfall Data and Flooding Complaints



On August 19, 2005, a storm lasting three hours produced up to 153 mm of rainfall exceeding the one in 100-year return period storm event (which is approximately 79 mm of rainfall within 3 three hours). This storm resulted in more than 4,100 basement flooding complaints, as shown in Figure 7.

During the storm of July 8, Toronto received over 100 mm of rain within a period of 90 minutes resulting in almost 4,800 basement flooding complaints being reported to the City. The distribution of flooding complaints and rainfall can be seen in Figure 8.

Figure 7: August 19, 2005 Storm Event - Rainfall Data and Flooding Complaints

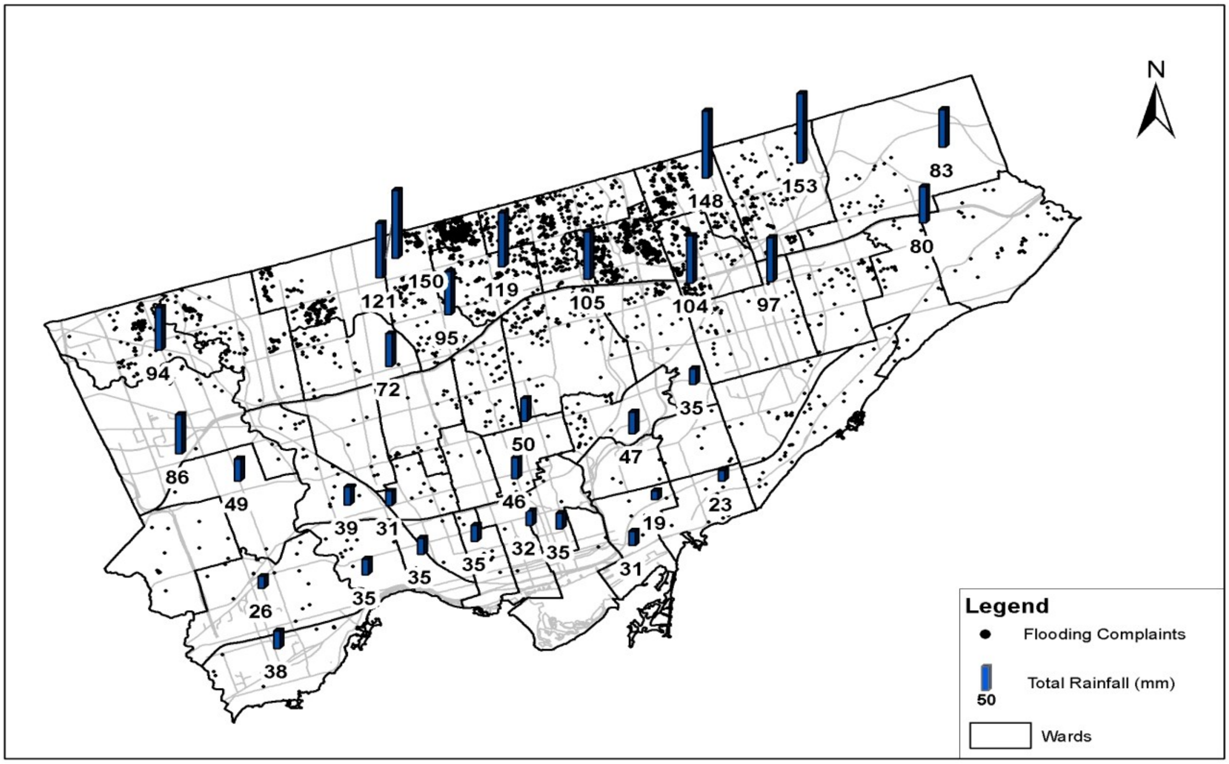
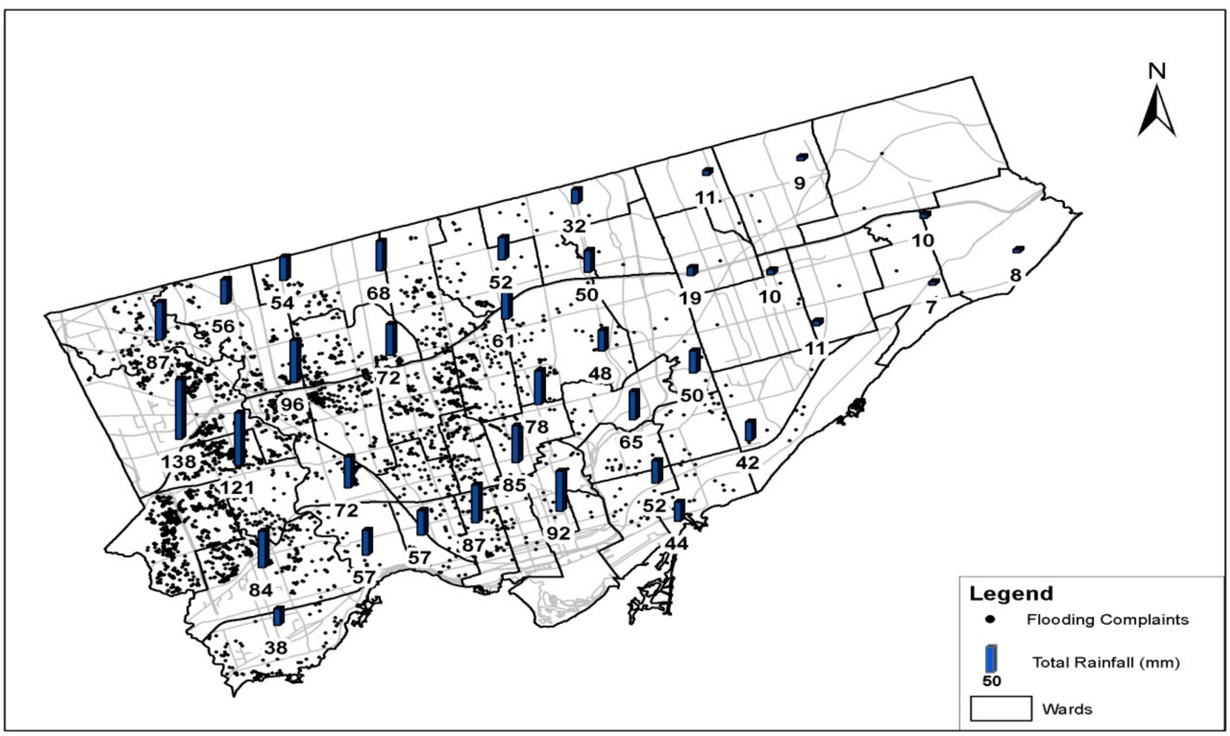


Figure 8: July 8, 2013 Storm Event - Rainfall Data and Flooding Complaints



An important observation of the recent large storm events in the city is that the extent and centre of each storm has been different. During the May 2000, and August 2005, storms, the majority of basement flooding complaints were from the north part of the city, where the heaviest rains occurred, whereas during the July 2013, storm, most basement flooding complaints were from the west part of the city, again where most of the rain fell. Locally intense storms were also experienced in 2008 and 2012, in the south district and east district respectively.

It is difficult to predict when and how the next extreme storm will impact Toronto, but it is reasonable to expect that it could hit any part of the city or multiple parts of the city at the same time. Drawing from the predictions of the 2012 study entitled Toronto's Future Weather and Climate Driver Study prepared by SENES Consultants, more intense "heavy" storms are expected in the future. As well, the study predicts the distribution of rainfall to change with more rainfall volume occurring in July and August and less snowfall occurring in the winter. Recognizing these trends underlines the need to move away from the concept of 'priority' study areas and towards the notion of analysing the entire city with the same level of service expectations.

What is Toronto doing to protect against Future Extreme Storms?

The path to enhance the City's drainage systems began in 2006 when City Council approved Toronto Water's Basement Flooding Protection Program, as part of the 25-year Wet Weather Flow Management Master Plan. This program consists of three parts:

1. A mandatory downspout disconnection program to slow and reduce the volume of runoff reaching storm sewers during a rain event;

2. A subsidy program, offering up to $3,200, to encourage home isolation through the installation of backwater valves on sanitary sewer service lines, the installation of sump pumps to remove foundation drainage, and severing and capping storm sewer service lines to eliminate the risk from storm sewer back-ups; and,

3. Infrastructure upgrades based on detailed Environmental Assessment Studies that investigate the causes of both basement and local surface flooding and identify sewer system improvements to reduce the risk of future basement flooding during extreme events.

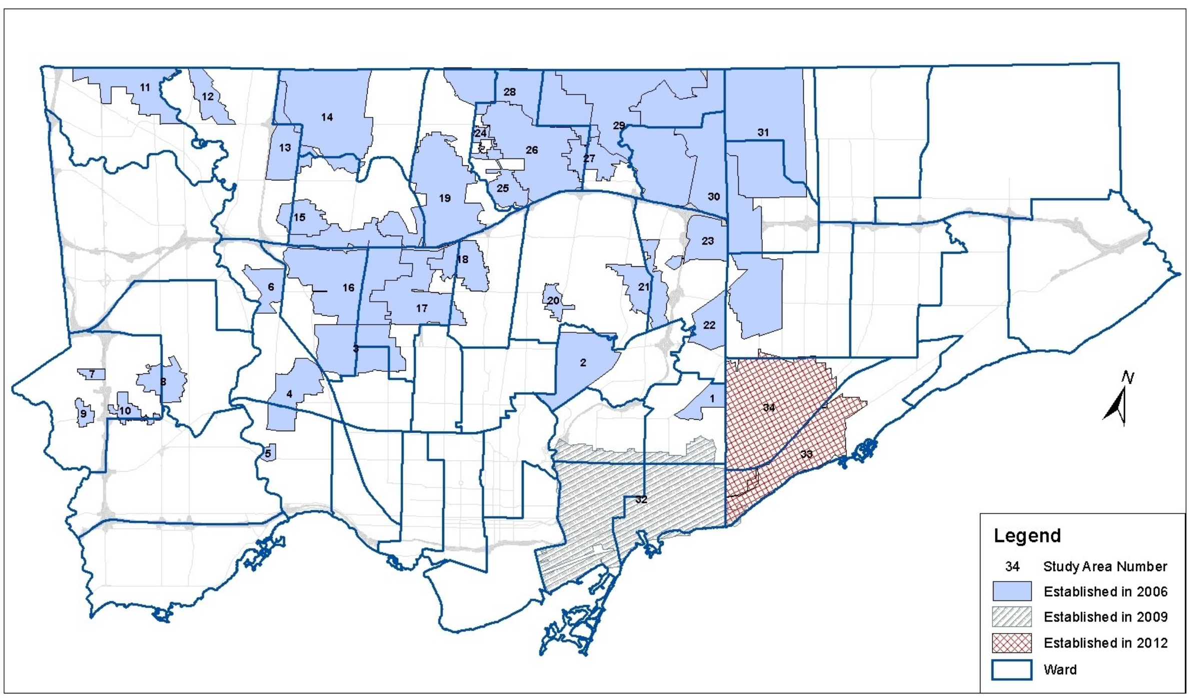
The goal of the program is to reduce the incidences of basement flooding by enhancing both sewer capacity and overland flow design standards in key priority areas. The program provides a an enhanced level of protection, for the 34 priority study areas, against basement flooding from sanitary sewer backup for a storm event equivalent to the May 12, 2000 storm (equivalent to a one in 25 to a one in 50 year storm); and from surface flooding for the one in 100 year storm event, where feasible, in areas where a proper major (overland flow) drainage system does not exist. Any geographic expansion of the Environmental Assessment Study program would require a corresponding geographic expansion of the enhanced level of service expectation.

The BFFP works in unison with a variety of other 'state of good repair' infrastructure renewal programs in the city. Through these programs, drainage systems are continually being studied, recommended for improvement, and upgraded to address the deterioration of older systems and to address the urban growth pressures. For example, the lining and replacement of sewers to address infiltration and inflow through sewer system cracks can reduce basement flooding risks without necessarily upgrading sewers. It is important for these types of works to be well coordinated and to be prioritized in balance with any level of service or capacity increase recommendations from the BFFP's EA studies.

The Basement Flooding Protection Program – Environmental Assessment Study Phase

When the Program was originally introduced, the City had identified 31 priority areas based on homes that had experienced frequent basement flooding as of 2006. Subsequently, based on storm events prior to 2013, the program has grown to include 34 priority areas as shown in Figure 9.

Figure 9: Basement Flooding Study Areas



Of the 34 study areas, as of August 2013, fifteen Class EA studies had been completed. The first 33 of the BFFP EA studies are to be completed by the end of 2014, and the remaining Study Area 34 is planned for completion by the end of 2015.

All of the existing BFFP study areas have been chosen and sized in response to various past extreme storm events. As we have seen, basement floodings are likely to occur wherever extreme rainfall occurs. The frequency and density of flooding has much more to do with the difference between the capacity of the drainage systems and the intensity and duration of the rain event received than with the age or condition of the existing systems. In order to move away from a "storm chasing" program to that of a proactive program that can address basement flooding risks city-wide, the program should be systematically expanded across the city beyond the current 34 priority study areas.

As with the original program, study areas should continue to be established based on the limits of the sanitary sewersheds. Due to the interconnectedness of the City's sanitary sewer system, a bottleneck on one street can influence system capacities in upstream and/or downstream streets. To understand the level of service being provided to one homeowner, a comprehensive system analysis is required. These analyses are best undertaken on a sanitary sewershed basis and it is for this reason that the boundaries of the BFFP Study Areas match that of the sanitary sewershed boundaries.

With 15 of the EA studies completed to date and a number of EA studies that are quickly nearing completion, a variety of lessons have been learned and the efficiency of the program has improved since its inception in 2006. Based on existing staffing levels and the capacity within the consulting sector, an EA study can now be completed, in most cases, within two years, from the point that a consulting team has been retained. The speed at which EA studies can be completed is influenced heavily by the size of the area being examined and the complexity of the drainage systems within the study area. On average, the EA studies are progressing at an average rate of approximately 3,000 ha per year (i.e. every two years about 6,000 ha of the city can be studied.), or approximately $4 million per year in consulting fees. This level of investment and rate of study is sustainable. With the current funding for BFPP EA studies tapering off in 2014, staff recommend considering as part of the 2014 budget process, the addition of funding starting in 2014, to allow for the geographic expansion across the city of the EA study phase of the BFFP.

With the experiences of the July 8, 2013 storm event, there will be pressure to accelerate the EA study program and there will be competing interests regarding the sequencing of future EA studies. Acceleration of the program will require additional staff resources and budget for consulting fees. The sequencing of the EA studies will need to weigh the flooding risks between areas. Staff recommend that the decision for acceleration of the program be deferred until a plan can be presented that illustrates both the boundaries for new EA study areas and the schedule at which they can be completed. Such a plan can be presented in Toronto Water's 2014 budget submission.

The Basement Flooding Protection Program – Implementation Phase

With the first EA studies being completed in 2008, construction efforts began in 2009. To date, $91 million has been spent to upgrade over 1,300 kilometres of storm and sanitary sewers, build 2 surface storage ponds, and build 1 underground storm storage tank to meet the enhanced level of service requirements required under the BFFP. A further $100 million in construction projects has been committed.

Following the completion of EA studies, there is increasing pressure on the component of the program to construct system upgrades as quickly as possible. The acceleration of construction effort is already being witnessed within the ongoing construction program. In order to maintain the already planned rate of growth in the construction program, there may be a need for additional staffing resources.

While the efforts to date have made great strides to upgrade the City's drainage systems, the storm of July 8, 2013 has demonstrated several key lessons, namely:

- If a future rainfall event exceeds the enhanced level of service being pursued by the BFFP, basement flooding could still occur even if the drainage systems of the area have been upgraded.

- Where the City's systems have sufficient capacity to accommodate the size of storm event that occurs, basement flooding can still and do occur due to poor drainage practices or poorly maintained systems within or adjacent to private residences.

- No two storms are the same and storms can strike parts of the city that have not been impacted heavily in the past. In other words, a past history of flooding complaints is not a complete indicator of future risk for basement flooding.

To address these lessons, the BFFP must continue to promote upgrades both within private and within public lands. The approach of the BFFP also needs to change to be capable of providing enhanced protection across the entire city thereby being less reactive to individual events and being more proactive against future events. City-wide risks need to be examined to minimize flooding risks in a prioritized and measured approach.

Issues of affordability and service equity need to be examined to ensure that basement flooding risk reduction is being achieved in the best possible manner. It is much easier to provide flooding protection to homes at the top of a hill than to homes at the bottom of a valley. With few exceptions, homes in Toronto are no longer located in flood plains where they can be inundated by overflowing rivers. However, there are many isolated pockets of low spots where, because of historical development patterns, water can only be removed by pipes and the cost of expanding those pipes to carry runoff from extreme storms can be immense. With the city-wide expansion of the program, prioritization of construction projects may be warranted to better capture the varying degrees of flooding risk and mitigate costs across the city.

The storm of July 8, 2013 showed the need to expand the BFFP across the city. While this will undoubtedly increase the total quantity of construction over the life of the program, staff are not presently recommending an increase to the current annual construction budget beyond what has already been approved, nor are staff recommending a change in how construction projects are being sequenced.

Next Steps

The next step is to develop a study plan for the remainder of the city, to establish the sizing of future EA study areas and to create a prioritization framework to identify the order in which areas will be studied. The likely consequences, advantages, and drawbacks associated with the new approach will need to be assessed to identify a preferred strategy. Impacts on funding, staffing needs, and consultant and contractor availability and capacity, among others, will need to be carefully considered and evaluated. The current program would serve as the baseline against which options for expanding the BFFP could be compared. In order to provide timely and meaningful advice, Toronto Water proposes to return to Council with a report on options for the BFFP in conjunction with the 2014 Budget Submission.

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