



# STAFF REPORT ACTION REQUIRED

## Coordinated Watercourse Management Plan

<b>Date:</b>	April 29, 2014
<b>To:</b>	Public Works and Infrastructure Committee
<b>From:</b>	General Manager, Toronto Water
<b>Wards:</b>	All Wards
<b>Reference Number:</b>	P:\2014\Cluster B\TW\pw14004

### SUMMARY

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The valleys, streams and shorelines in the City of Toronto are inhabited and surrounded by roads, trails, utilities, bridges, water infrastructure, natural forests and plant communities, and private property. The City of Toronto and the Toronto and Region Conservation Authority (TRCA) have worked for decades to preserve and restore the ecological integrity of these important landscapes while protecting new and existing development against the hazards of flooding and erosion.

The storms of August 19, 2005 and July 8, 2013 caused significant damage to public and private property and City infrastructure located in valley lands. The purpose of this report is to advise City Council of the existing programs that are in place to manage watercourse erosion risks and to respond to damage caused by accelerated erosion during intense storms. The report will also respond to Council's request to identify the most vulnerable houses that are within the floodplain of the Black Creek, and to report on the status of the Environmental Assessment for the Scarborough Waterfront Trail and Critical Erosion.

### RECOMMENDATIONS

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The General Manager, Toronto Water, recommends that:

1. City Council confirm the following principles for watercourse management in Toronto:
  - a) Each City Division with infrastructure or facilities potentially affected by erosion in ravines, and stream and river valleys will be responsible for the inspection, assessment, design, construction, maintenance and monitoring of erosion control works necessary to protect their infrastructure;

- b) Design and construction of erosion control works should be carried out in collaboration with other potentially affected Divisions and costs for such work can be shared among Divisions where there are mutual benefits;
  - c) Design and construction of new or replacement erosion control works will be consistent with best practices for natural channel design, adaptive management and considerations for climate change;
  - d) Toronto and Region Conservation Authority (TRCA) will assist with the task of receiving and responding to complaints from private property owners concerning erosion which affects loss of property or is a hazard to private structures;
  - e) Toronto and Region Conservation Authority (TRCA) will be responsible for assessing erosion hazard sites affecting private property and designing, constructing and maintaining erosion control works affecting one or more property owners, on a priority basis, in order to protect public safety and to stabilize and limit further damage;
  - f) Costs for design, construction and maintenance of such erosion control works will be shared between the benefitting property owners and TRCA (as per TRCA's Private Landowner Contribution Policy);
  - g) Owners of private property will be responsible for the costs of repair of erosion damage on their property and damage attributed to their unpermitted encroachments or their unpermitted alterations to ravine or valley lands.
2. City Council consider future funding for Toronto and Region Conservation Authority (TRCA) Erosion Management Program in conjunction with the upcoming report by the Deputy City Manager and Chief Financial Officer, and the General Manager, Toronto Water to the Executive Committee on financing strategies to support Toronto Water's long term Capital Plan;
  3. City Council request the General Manager, Toronto Water, to continue to report to City Council, as part of the annual Toronto Water budget submission, the 10 year TRCA/TW coordinated capital plan of erosion improvement works;
  4. City Council request the Toronto and Region Conservation Authority (TRCA), with input from the General Manager of Toronto Water and the General Manager of Parks, Forestry and Recreation, to complete the Class Environmental Assessment (EA) for Black Creek Flood Management and report to Council on preferred measures to further mitigate valley land flooding of the Rockcliffe area in the Black Creek Watershed and a proposed funding mechanism;
  5. City Council request the Toronto and Region Conservation Authority, with input from the General Managers of Toronto Water, Transportation Services and Parks, Forestry and Recreation, to report back prior to finalizing the Class EA for the Scarborough Waterfront

Access Plan with the costs for erosion control components identified separately from the trail and waterfront access components of the plan.

## **Financial Impact**

The regular City contribution to TRCA includes annual funding for their waterfront and valley erosion control program, based on a 50 / 50 share formula between the Toronto Water budget (funded from Toronto Water's Capital Financing Reserve Funds) and the property tax-supported budget.

Starting in 2011, Toronto Water's share was increased by approximately \$2 million per year in order to make faster progress on erosion protection works. Due to the July 8, 2013 storm, during the 2014 Capital Budget Process, this amount was further increased to \$7 million in each of 2014 and 2015, and continued at \$2 million per year to 2023. The increased funding, coming from the Toronto Water's Capital Financing Reserve Funds will be spent primarily on repairing erosion damage adjacent to or affecting private property. Toronto Water's 2014-2023 Capital Budget Plan also allocates funding of approximately \$103 million over the next 10 year horizon for stream restoration and erosion management to carry out works to protect its own infrastructure in valley lands.

Given the considerable unfunded pressures in both TRCA and Toronto Water Capital Programs, it is recommended that funding for TRCA's Erosion Management Program be considered by the Deputy City Manager and Chief Financial Officer and the General Manager of Toronto Water in their upcoming report to the Executive Committee. As a part of the 2015 Budget Submission, this report will address a financing strategy to support Toronto Water's substantial unfunded infrastructure requirements which also include Toronto Water's share for the TRCA's priority projects.

The recommendations of this report will not result in any changes to roles and responsibilities of other City divisions, as describe in body of this report. Any costs associated with coordinated watercourse management projects should be considered with the City's annual budget processes.

An estimate of the costs to reduce flood risks for the Black Creek-Rockcliffe Special Policy Area through improvements to the Black Creek channel and related infrastructure, awaits completion of the TRCA's Environmental Assessment for that area. Costs for local sewer improvements as recommended in the Basement Flooding Environmental Assessment for Area 4 are provided in Toronto Water's Capital Plan and are outside the scope of this report.

The financial impact of the Scarborough Waterfront Access Plan (SWAP) will be known when the SWAP Environmental Assessment is completed in 2016.

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 December 16-18, 2013, requested the General Manager, Toronto Water, to report back in early 2014 on a coordinated, prioritized Toronto Water and Toronto Region Conservation Authority erosion control strategy and projects, such report to consider an Environmental Assessment for the Scarborough Waterfront Trail and Critical Erosion. The Council decision can be viewed at:

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EX36.17>

City Council, at its meeting on November 13, 14, 15, and 18, 2013, requested the City Manager to request staff from the Toronto and Region Conservation Authority to attend a future meeting of the Public Works and Infrastructure Committee to answer questions from Members of Council who have concerns with recent flooding. The Council decision can be viewed at:

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EX35.1>

City Council, at its meeting on October 8 – 11, 2013, requested the Toronto and Region Conservation Authority to forward to the General Manager, Toronto Water, information on houses within the flood plain that are most vulnerable to flooding from the Black Creek Watershed and request the General Manager, Toronto Water to provide this information in a report to the Public Works and Infrastructure Committee in February 2014. The Council decision can be viewed at:

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.PW25.7>

City Council, at its meeting December 16-18, 2013, approved EX.36.17, which reads in part:

*City Council include \$1.5 million for Environmental Assessment work on the Scarborough Waterfront Erosion Control and Access Plan with funding coming from the Toronto Water Capital Reserve.*

The Council decision can be viewed at:

<http://app.toronto.ca/tmmis/viewAgendaItemHistory.do?item=2013.EX36.17> – see item 20.

A common theme to the above requests is how City Departments and TRCA work together to manage risks of erosion and flooding along the valleys, streams and shoreline of Toronto. This report will focus on erosion management, but will also touch on the issue of flood risk management by looking at houses vulnerable to flooding in the Black Creek watershed. The report will also refer to the Scarborough Waterfront Trail EA as an example of how erosion control infrastructure can be configured to provide other benefits.

## **ISSUE BACKGROUND**

### **Watercourse Erosion**

Watercourses are in a continual state of change, with a balance of erosion and deposition characteristics changing the size and location of rivers, creeks and shorelines over time. This rate of change has been accelerated due to changes in land use over the past 100 years and due to the impacts of climate change. Watercourses throughout Toronto are trying to reach a new state of equilibrium with the rate and volume of storm water runoff that is now being directed to them.

Erosion processes are continuous and even small flows over a long period of time will cause significant changes. However, during periods of high flows, changes occur rapidly and can have catastrophic consequences as was experienced on August 19, 2005 with the washout of Finch Avenue and also with the exposure and eventual destruction of a section of trunk sanitary sewer in the Highland Creek valley.

Historically, infrastructure in the city was constructed in valleylands, including bridges and culverts and pipes that traversed or were parallel to watercourses at multiple locations. At the same time, houses and rear yards were constructed close to valleys or channel edges. While regulations, plans and policies regarding the siting and sizing of buildings and infrastructure have drastically changed over the years, the result is that public infrastructure and private property are at risk.

Over the long term, watercourses across the City are experiencing downcutting and lateral movements that are increasing the risk of erosion to private properties close to watercourses, and to infrastructure that is buried beneath or adjacent to many watercourses in the City. In some locations, sewers that were constructed two to three metres below grade are now in danger of being exposed or bridge abutments are in danger of being undermined.

Early efforts to manage watercourse erosion focused on the armouring of watercourses and adjacent lands using concrete, stone, and gabion (rocks in a galvanized wire basket) structures. These efforts, many of which were constructed in the 1960s-1990s, are now showing considerable signs of wear and tear. A backlog of repair and replacement works for these structures is rapidly growing.

The strain on the erosion control structures has increased lately through the increased frequency of large storm events in the City of Toronto, and is expected to increase further by the effects of climate change. The storms of August 19, 2005, and July 8, 2013 resulted in considerable damage and failure to erosion control structures and buried infrastructure. At times, the damages have required emergency intervention to protect life and property.

### **Erosion Management in Toronto**

The City of Toronto and the Toronto and Region Conservation Authority (TRCA) have been and continue to be strong partners in the protection of life, water quality, property, parkland, ecological features and infrastructure from the hazards of erosion. Over the years, roles and responsibilities have evolved to ensure that all critical components are addressed while minimizing overlapping efforts. Together, various divisions within the City of Toronto (Toronto Water, Transportation Services, and Parks, Forestry & Recreation), along with the TRCA, have been relatively successful at addressing the hazards of erosion throughout the City.

An overview of each group's mandate, and roles in the assessment, tracking, and repairs of the impact of erosion within watercourse corridors is provided as follows:

### **Toronto and Region Conservation Authority's Erosion Management Program**

The goal of TRCA's Erosion Management Program is to prevent, eliminate or reduce the risk to life and property from flooding and erosion, and to encourage the protection and regeneration of natural systems. In coordination with the City and in response to various needs over the past three decades, TRCA's Erosion Management Program has evolved to include three main components:

1. Valley and shoreline monitoring and minor maintenance.
2. Major maintenance and rehabilitation of existing erosion control infrastructure.
3. Remedial works at erosion hazard sites, both existing and new.

TRCA's program is responsible for the annual monitoring of over 400 erosion control structures, over 200 erosion hazard sites on public and private lands, approximately 42 kilometres of Lake Ontario shoreline, and over 250 residential dwellings on the Scarborough Bluffs.

#### 1. Valley and shoreline monitoring and minor maintenance

This program provides for the annual inspection of known erosion hazard sites and existing erosion control structures in the City of Toronto, to prioritize remedial or maintenance works. It is currently funded at approximately \$400,000 per year, split 50/50 between the water rates and the general levy.

A TRCA erosion hazard site is a site where a valley wall or the Bluffs has had an erosion scar or slope failure develop, but where no TRCA erosion control structure has been built. An erosion hazard site is controlled when stabilization works such as an erosion control structure is constructed to protect river valley walls from toe erosion caused by river bend migration or bank erosion or other causes of valley wall instability, and to protect structures along the Scarborough Bluffs from toe erosion caused by wave action in Lake Ontario.

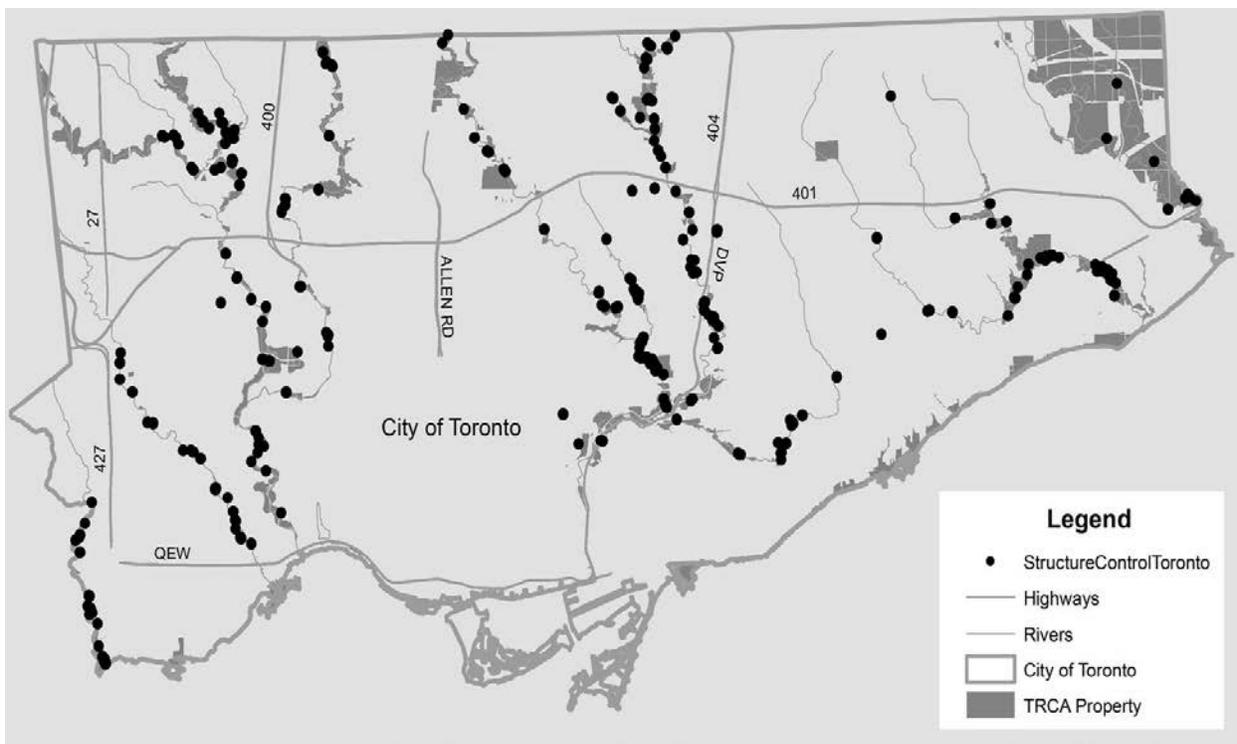
As hazard erosion sites are reported to TRCA, they are assessed at a preliminary level and added to TRCA's existing Stream Erosion and Infrastructure Database (SEID) along with the existing list of sites for ongoing inspection and re-assessment to determine where remedial works are recommended to reduce the risk to life and/or essential structures or property. The determination of whether remedial works are required is based on a numerical ranking assigned based on visual observations recorded at the time of inspection. Sites scoring 70 out of 100 or higher typically indicate a serious erosion hazard that requires intervention over the short-term.

With respect to existing erosion control structures, TRCA utilizes a standardized inspection and assessment form through its web-based SEID to monitor the condition of these structures and to prioritize the repair of such structures. An imminent risk to an essential structure or human life is deemed critical and will be addressed first. On the other end of the spectrum, if no appreciable deterioration has been observed, no restoration or maintenance activities will be recommended, but the site will continue to be monitored over time.

#### 2. Major maintenance and rehabilitation of existing erosion control infrastructure

Past approaches for the management of erosion focused heavily on the armouring of slopes and watercourse banks by constructing a variety of structures to protect against toe erosion, watercourse migration, watercourse downcutting, and shoreline erosion (e.g., Scarborough Bluffs). The locations of erosion control structures constructed by TRCA to date in the City of Toronto are shown in Figure 1. This work is currently funded at \$1.2 million per year, split 50/50 between the water rates and the general levy.

Historically, most funding was directed to the construction of these new measures. In the early 2000s, much of this infrastructure passed the 25-year mark and wide-spread major maintenance needs became apparent. This required a shift in approach, with more funding being allocated to rehabilitation and maintenance works for existing structures. This has reduced the funding available to address new hazards to the point where almost all funding provided now is directed to the maintenance of existing structures.



**Figure 1. Location of TRCA's Valleyland Erosion Control Structures within Toronto.**

Monitoring of these structures focuses on the type and extent of structural deficiencies and the type of repairs required, due to changing site conditions caused by the dynamic nature of rivers and valley systems. Inspections to determine repair need has been standardized; this provides the basis for determining priorities for potential rehabilitation / maintenance, ranging from “none” (where no appreciable deterioration was observed and no restoration or maintenance activities are required), to “critical” (where failure and the risk to an essential structure or human life may be imminent), which will be addressed first.

3. Remedial works at erosion hazard sites, both existing and new.

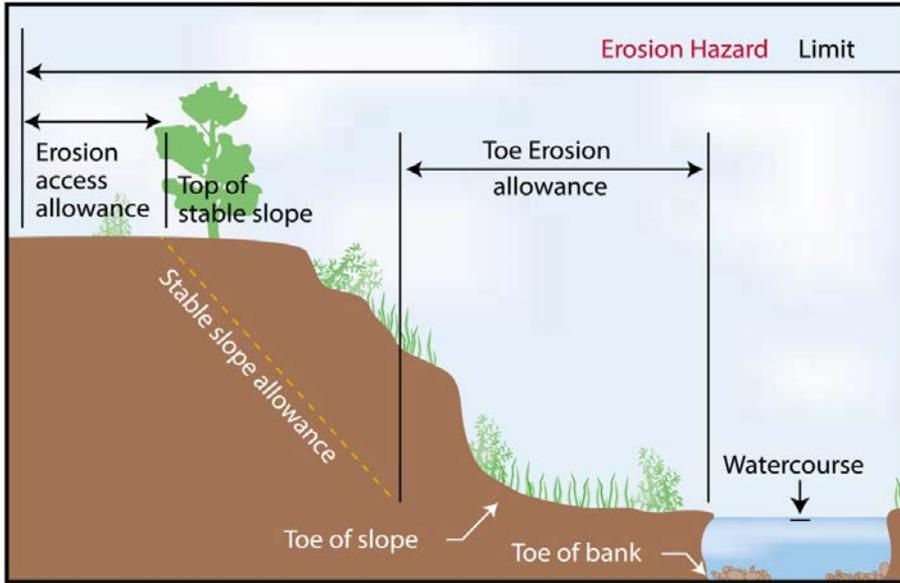
The TRCA monitors the condition of erosion hazard sites and identifies intervention needs. The assessment / monitoring process of erosion hazard sites focuses on a variety of erosion and instability factors at a site. A three step process is used: (i) an initial priority ranking is determined using a numerical ranking model (ii) Top ranking sites from the initial assessment stage are subjected to a detailed risk assessment by a third party engineer to confirm the full extent of risk to life and existing structures, and then (iii) by TRCA to determine the final ranking. On average, one to three detailed assessments are typically carried out annually.

Starting in 2011, the City has provided additional funding to address the growing backlog of critical erosion works at a rate of \$2 million per year. Initial damage estimates from the July 8, 2013 storm, in the order of \$37 million to private property and TRCA infrastructure, resulted in the decision to increase the 2014 and 2105 contribution to \$7 million and continue the \$2 million per year funding for the remainder of the 10-year Capital plan. All of this funding is from Toronto Water reserves.

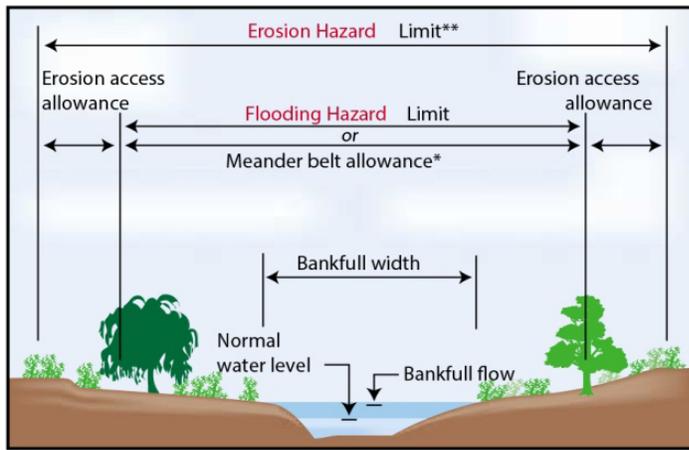
### **Land Use Planning Approaches for the Management of Hazard Lands**

The City of Toronto has limited discretion in the regulation and management of river flooding and erosion. Provincial policy generally directs development to areas outside of hazard lands, such as flood channels and beaches, and imposes strict requirements for new development that may be permitted in a floodplain. Policies in the Toronto Official Plan are consistent with this policy direction, including those of the Provincial Policy Statement (2005), which is based in part on provincial guidance developed in 2001 (Understanding Natural Hazards, MNR, 2001 at [http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@water/documents/document/mnr\\_e002317.pdf](http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@water/documents/document/mnr_e002317.pdf)). In addition, the General Manager of Parks, Forestry and Recreation through their responsibilities under the Ravine and Natural Feature Protection Bylaw (Toronto Municipal Code, Chapter 658) has responsibility for protecting vegetation in City ravines, which includes most hazard lands regulated by the TRCA.

The TRCA administers Ontario Regulation 166/06: Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. This regulation was adopted under the Conservation Authorities Act and includes regulatory responsibilities for hazard lands, including valley slope erosion (Figure 2), floodplains and water course meandering and erosion (Figure 3). The TRCA maintains and updates regulatory floodline mapping, identifies criteria for hazard land management, and regulates public and private development (including infrastructure) within the regulated area. TRCA also has delegated responsibility for implementing the Natural Hazards policies of the Provincial Policy Statement, and does so through their advisory comments on planning applications circulated to the TRCA by the City of Toronto. Permits in accordance with Ontario Regulation 166/06 are obtained from TRCA for private and City projects within regulated areas. Permits are also required from the Ministry of Natural Resources and the Department of Fisheries and Oceans for certain types of stream restoration projects.



**Figure 2. Hazard land requirement for a stable slope used in land use planning. Structures built within the stable slope allowance are at risk. Toe erosion occurs where 'toe of stream bank' erodes into the 'toe of slope' location. (Adapted from figure 9b from MNR, 2001, pp. 26.)**



(NOT TO SCALE)

\* The bankfull channel width with the largest amplitude meander in the reach is used to determine Meander Belt Width.

\*\*Erosion access allowance is also added to the flooding hazard limit, when known, to define the erosion hazard limit.

**Figure 3. Hazard land management of flooding and erosion within a valleyland. During the July 8, 2013 storm, some properties suffered loss of soil where their property is on the floodplain outside the "bankfull width". (Adapted from figure 10 from MNR, 2001, pp. 26.)**

The Valley and Stream Corridor Management Program (VSCMP, 1994) is the main policy document used by TRCA to guide the review of permit and development applications. The overall objective of the VSCMP policies is to prevent new development from occurring within areas that may introduce risk to life and property associated with flooding, erosion, and slope instability, or development that is not compatible with the protection of these areas in their natural state. The TRCA is currently consulting on a comprehensive policy update called the Living City Policies (<http://www.trca.on.ca/the-living-city/public-consultations/the-living-city-policies.dot>). The Living City Policies document is based in part on provincial guidance developed in 2001 (Understanding Natural Hazards, MNR, 2001)

With the advent of the TRCA's policies in 1994, and subsequent provincial guidance and policy statements, most new private and public development is prohibited within natural hazards due to the risk to life and property. Some public or private infrastructure by their nature may need to be constructed or reconstructed in natural hazards, however this infrastructure must be designed to meet strict permitting criteria so as to minimize risk. Based on the policies of the City's Official Plan and those of TRCA, current land use planning policies would have precluded most of the erosion hazard sites caused by the July 8, 2013 storm from occurring, including erosion hazard sites caused by watercourse erosion at the toe of a valley wall and the slumping of fill placed at the top of a valley wall.

## **Toronto Water**

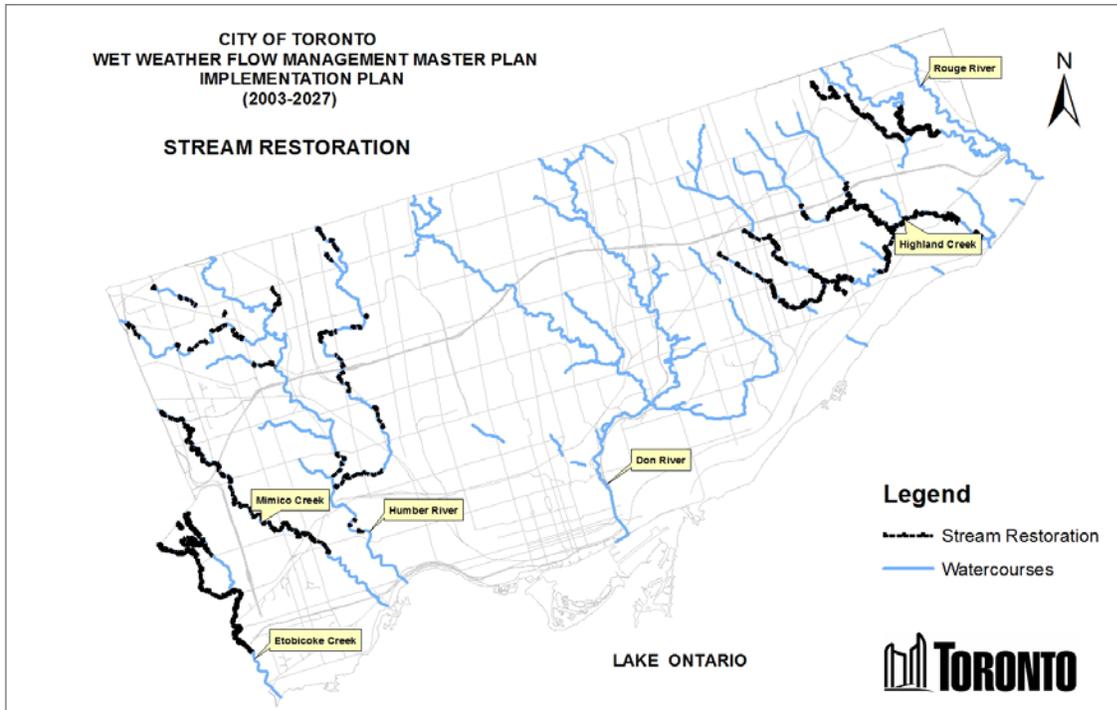
The Wet Weather Flow Management Master Plan (WWFMP; 2003) defined a series of stream restoration projects in all watersheds within the City (Figure 4), for an estimated cost of about \$100 million over primarily the first 15 years of the 25 year span of the WWFMP Implementation Plan. The WWFMP emphasized changing the management philosophy from a reactive approach (i.e., repairing recently created erosion scars) to a pro-active approach. The Plan recommended restoration of approximately 100 km of stream; about one-quarter of all stream lengths within Toronto. The principle rationale for doing this work was to protect Toronto Water infrastructure, but in a manner that was consistent with sustainable design practices and aquatic habitat protection.

Stream Restoration projects focus on remediating three major historical impacts of urbanization which put sewers at risk of breakage:

1. Channel widening caused by the increased volume of runoff from development in the watersheds;
2. Replacing stretches of gabion basket structures which are breaking apart because they are one to three decades beyond their design life; and
3. Raising the channel to approximately one meter above sanitary sewer crossings to reverse the effects of channel down-cutting.

Stream restoration projects are developed through a careful analysis of the hydrology and geology of the watershed, taking into account the impacts of past and future urban development, the implementation of stormwater runoff controls and the impacts of climate change. They are

called Geomorphic Master Plans and are carried out as Environmental Assessments. Such plans have been completed for eleven areas (such as the Highland Creek watershed and Duncan Creek), and are underway for Taylor-Massey Creek and Wilket Creek. Eventually such plans should be completed for all of the main branches of rivers in the City. The projects recommended by these studies will form the basis of an on-going stream restoration program to protect existing infrastructure in valleys and also inform the design of any new infrastructure, whether buried pipes, bridge abutments or culverts.



**Figure 4. City-wide stream restoration plan from the Wet Weather Flow Management Plan (2003).**

The August 19, 2005 storm required the City to shift its focus from pro-active planning to repair of stream erosion caused by storm damage; the reactive method. When the 2005 storm occurred, the City was still responding to erosion damage from the May 12, 2000 storm. The sites identified from the August 19, 2005 storm were prioritized and interim Emergency Repairs were completed by the spring of 2006. In 2009, it was estimated that another three to four years of works were needed to fully catch up to the effects of the August 19, 2005 storm. As of July 2013, approximately 20% of the August 19, 2005 sites remained to be completed.

The 2005 storm damage sites to Toronto Water infrastructure were largely located in the Highland Creek watershed and northern tributaries of the Don River and Humber River. Stream erosion from the July 2013 storm was mainly focused on the main stem of Mimico Creek and Humber River, and tributaries of the Humber River (Berry Creek, Humber Creek) and Don River (Burke Brook, Blue Ridge Creek, Yellow Creek).

The WWFMP (2003) also emphasized the need to implement Source Controls / Low Impact Development (LID) measures. These at-source measures are beneficial for mitigating stream erosion by reducing the volume of runoff from small storms, but can only be implemented through new development or significant reconstruction. The WWFMP also concluded that in-stream restoration projects are needed to control stream erosion to mitigate the impacts of existing urban development on water courses.

### **Transportation Services**

One of Transportation Services' formative responses to stream erosion occurred after the August 19, 2005 storm. Most damage to roadway-roadbed related erosion was repaired within three weeks. Replacement of the Finch Ave culvert collapse, which was the largest erosion damage issue, was largely completed in 2006, but creek work continued into 2008. Erosion of two bridges in Highland Creek whose problems were initiated by the August 19, 2005 storm, were completed in 2007.

The Finch Ave culvert collapse indicated the need to develop an understanding of the potential effect of Climate Change on the integrity of bridge/ culvert infrastructure. Transportation Services initiated and completed a study in conjunction with Engineer's Canada and the City's former Toronto Environmental Office to assess the vulnerability of their road and culvert infrastructure crossing stream valleys/ravines to climate change. Secondly, biennial bridge inspections have had an increased emphasis on assessing the potential for stream erosion to endanger foundations, as a result of erosion around the two Highland Creek bridges. Thirdly, where either Transportation Services has a culvert or bridge needing repair near Toronto Water infrastructure needing repair or vice versa, a consultant study is commissioned to address the needs of both divisions.

### **Parks, Forestry & Recreation**

Toronto's Parks Forestry and Recreation (PF&R) division response to the August 19, 2005 storm necessitated an immediate closure of a variety of bridges and pathways due to erosion around pedestrian bridge foundations, fallen trees causing creek blockage, and sand deposited by floodwaters. Immediate repairs were completed within six months. A comprehensive strategy for repair was developed by compiling all complaints from Parks supervisors, and carrying out a comprehensive inspection of all pathways and bridges after the August 19, 2005 storm. Through acquisition of funds in the 2006-2007 annual budget process, about \$3.5 million was spent on priority repairs by mid-2009. But the June 23, 2008 storm caused erosion at repaired sites in Wilket Creek Park, requiring immediate creek bed repairs to protect pedestrian bridge foundations and an exposed sanitary trunk sewer, and led to the decision to seek funding of \$2 million to replace bridges which are too short and realign channel. A geomorphic study was initiated by PF&R in 2009-2010 with the support of TRCA and TW, to develop both designs for Emergency Repairs and a long term repair plan for the entire Creek. Site scale creek repairs at three pedestrian bridge/sanitary sewer locations were completed in 2011-2013. Other repairs from the longer-term plan are anticipated for the period 2014-2018.

Based on stream erosion and pathway damage from the May 12, 2000 and the August 19, 2005 storms, the City has learned that one of PF&R's largest on-going liabilities is infrastructure (pedestrian bridges and pathways) in flood-plains. Because they are in flood-plains, they are susceptible to erosion. The only immediate way to address these problems is to procure funds for Emergency Repairs. Over the long- term, the financial risk can be mitigated by better positioning of bridges, expanding the span length of bridges to accommodate debris moving downstream with flood waters, moving pathways away from water courses and even eliminating pathways in flood-plains, where feasible.

PF&R leads a team with interdivisional resources dedicated to trash clean-up on ravine and valley slopes, and to tree removal and blockage remediation in water courses, as a maintenance function. This team has been responsible for clearing most of the tree damage and water course blockage removal from July 8, 2013 storm, which was largely completed in December 2013. In addition, PF&R's Forestry lead group will use a portion of TW's annual allocation for tree planting to replace trees lost from the July 8, 2013 storm.

### **Floodplain Management in Toronto**

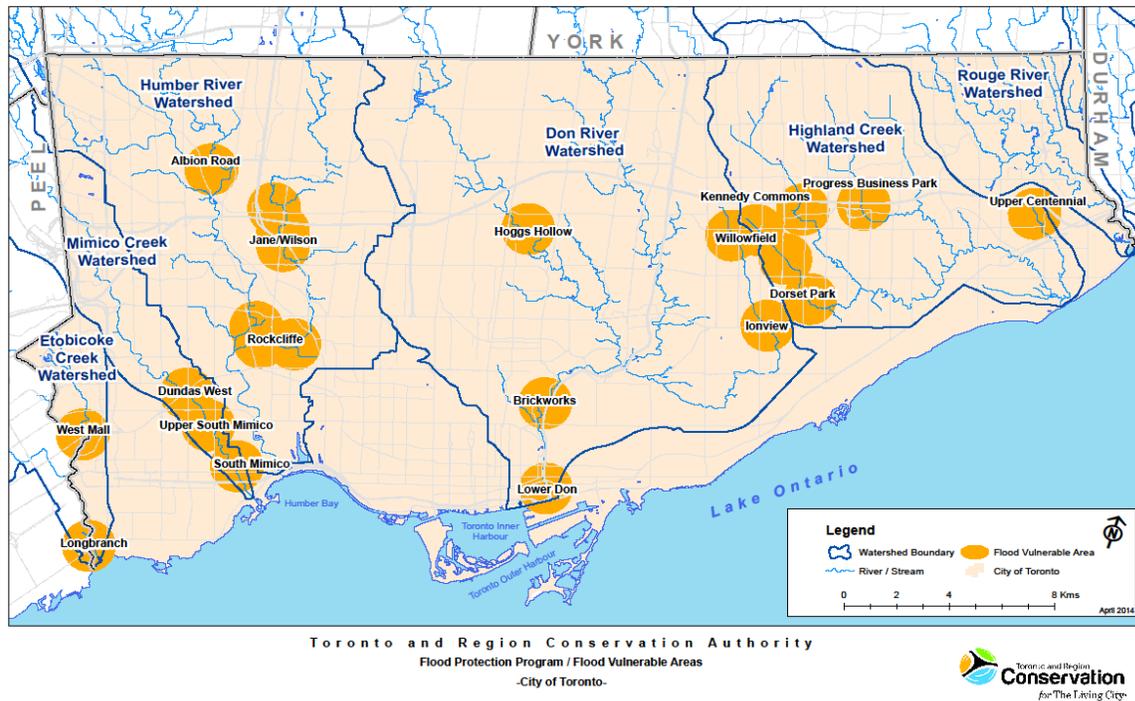
TRCA, working under their delegated and regulatory responsibilities for floodplain management, maintains and updates regulatory floodline mapping, identifies flood hazard areas, and operates a Flood Protection and Remedial Capital Works program, in addition to their regulatory responsibilities for development within floodplains. In 1959, TRCA developed a Flood Plan that saw the construction of the G. Ross Lord Dam as well as other major dams and flood control channels across the GTA. This plan was updated in 1980, and most recently in 2013.

The 2013 plan, known as the Flood Protection Strategy, identified 42 areas of high flood risk, with high risk defined as areas with numerous structures within the floodplain (residential, commercial or institutional structures) and/or a high frequency of flooding, among other criteria. Seventeen (17) of the priority sites are in the City of Toronto where approximately 2,800 structures and 7,000 residents are located within the regulatory floodplain (Figure 5). Development in the majority of the flood vulnerable areas occurred prior to the current floodplain management policies that restrict development within hazardous areas as defined under the Conservation Authorities Act. The Flood Protection Strategy establishes priorities for undertaking flood mitigation studies and remediation projects in order to effectively reduce the risks to life and property due to riverine flooding outside the watercourse channel. It will also inform TRCA's flood risk remediation and management initiatives, ensuring capital works funding is directed to high risk areas, as well as providing the greatest risk reduction per dollar spent.

The risk assessment at the core of the Flood Protection Strategy is based on the methodology developed for the 1980 Flood Control Plan, and considers several factors related to:

- the importance of the area to the larger community;
- the flood risk and exposure associated with the site (depth, warning time, population at risk);
- emergency access (human and vehicular ingress and egress, emergency access routes, roadway design);

- flood damage costs (direct and indirect costs).



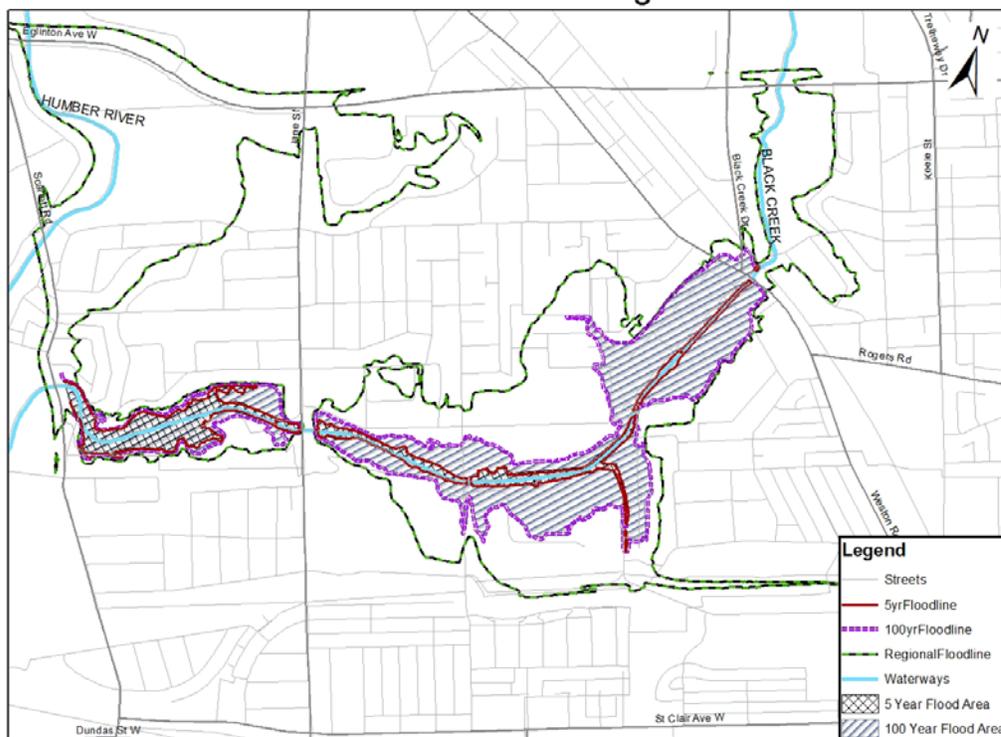
**Figure 5. Priority site areas in Toronto, identified in TRCA’s 2013 Flood Protection Study.**

Some of the 17 potential flood remediation projects will be small in nature (e.g., replacing an undersized culvert to alleviate flooding). However, the majority of the projects will be large scale construction projects involving multiple stakeholders and complex design challenges due to existing land use and environmental and social considerations. Flood remediation projects are expected to be multi-year projects requiring significant capital investment. Partnerships with the City and other stakeholders will be essential for logistical reasons and to secure the required funding over several years.

### **Rockcliffe Area of Black Creek Watershed**

As part of the Flood Protection and Capital Works program, TRCA undertook a pilot project for the Rockcliffe area in the Black Creek Watershed. The goal of the project was to identify the reasons for riverine flooding and potential solutions to mitigate the risks. The study followed the Conservation Ontario Class Environmental Assessment (EA) process and included input from a community liaison committee and opportunities for public engagement. The area is within a Special Policy Area as defined in the City's Official Plan and includes residential, commercial and institutional uses, many built within the floodplain prior to floodplain management policies. A concrete flood control channel was built in the 1960s to control flood waters, however this channel is no longer adequate to convey the flows necessary to prevent flooding in the area. In some reaches the channel will be exceeded during the 5- and 10-year storm events. During the Regulatory storm, approximately 400 residential homes would be situated in the area impacted by flood waters. (Figure 6)

## Black Creek Flood Management



**Figure 6 - Sensitivity of Rockcliffe Flood Plain to different sizes of storms (5 year, 100 year, Regional Storm)**

The Environmental Assessment examined a full suite of mitigation options including: upstream storage, improve capacity (culverts, bridges, channel, floodplain), enclosures, floodproofing, stormwater management and land/property acquisition. The EA is also being coordinated with the City Basement Flooding EA (Study Area 4). TRCA's Rockcliffe area EA will be finalized in the Summer of 2014. It is recommended that TRCA report to Council on preferred measures and estimated costs to further mitigate valley land flooding of the Rockcliffe area in the Black Creek Watershed upon completion of the Class EA.

## COMMENTS

### Impact of the July 8, 2013 Storm

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. This intense rainfall had a variety of impacts across the City, including the flooding of rivers, creeks, ravines, and substantial erosion within and along watercourse corridors.

The impacts of the July 8, 2013 storm have been reported on previously. The following is a brief summary of those impacts relevant to the subject of this report.

### **Toronto and Region Conservation Authority**

Beginning the morning of July 9, 2013, TRCA began receiving calls and emails from landowners, park users and municipal staff about various types of damage sustained during the storm event. These reports ranged from minor damage to asphalt park paths, to debris jams, to major "landslides" and backyards "collapsing". Calls were prioritized for inspection based on information at hand, then added to a storm damage inventory list before inspectors were dispatched to complete preliminary assessments. Staff also prioritized a list of inspections of previously known erosion hazard sites and at-risk erosion control structures which already ranked high on the priority list prior to the storm event.

Recognizing that TRCA has considerable experience and the necessary tools and protocols in place to assess and track erosion and slope instability hazards through its existing Erosion Management Program, on July 10, 2013, City of Toronto staff at Toronto Water, PF&R and 311—who were also receiving an influx of calls following the severe weather event—began referring all erosion-related reports to TRCA for preliminary inspection and addition to the damage inventory. This cross-organizational cooperation facilitated an efficient and timely response to the public's concerns and an organized way to collect and disseminate information to the appropriate departments following initial inspection.

### **Toronto Water**

In contrast to the August 19, 2005 storm where new erosion put at risk a large number of sanitary sewer infrastructure sites, the July 8, 2013 storm caused damage to a much smaller number of sites.

Thirteen new erosion sites were caused by the July 8, 2013 storm. Interim repairs have been completed at six priority sites, but all these sites will require additional work over the next one to three years to bring them to a state of good repair, or to finalize permit requirements. Of the remaining seven new sites, five sites need to be addressed in the next year, and two sites in the next one to three years.

For budgeting purposes, Toronto Water immediately reprioritized the stream erosion control component of the Stream Restoration Program to accommodate these new priorities. Based on regulatory mandates, TW's approach is to, where possible, complete the state of good repair work within –one to three years of the work associated with critical / urgent projects, so that a particular section of valley land is not repeatedly exposed to construction equipment. This factor is also used to prioritize future stream restoration projects.

## **Parks, Forestry & Recreation (PF&R) and Transportation Services**

During the July 8, 2013 storm event PF&R immediately closed parkland and sportfields which were flooded, monitored the flood levels, and slowly re-opened the parks as floodwaters receded over the next ten days. Pathways were cleared of accumulated sand, and buildings and infrastructure inspected for damage. Significant damage occurred to the Rockcliffe Yard, and to a few pedestrian bridges, some of which still await replacement. Much of the damage to buildings within flood plains is covered by insurance, but approximately \$2.8 million has been established in the 2014 PF&R budget to repair damage not covered by insurance – such as pedestrian bridge replacement and pathway repairs.

Approximately 30 priority sites have been completed, where woody debris accumulated and blocked flow in the watercourse or on the flood-plane. However, it was estimated in November 2013 that up to another two years would be required to complete removal of potential woody debris blockages on the flood plain. The additional damage to trees located on flood plains caused by the December 2013 ice storm has largely disguised damage from the July 8, 2013 storm, and a significant amount of tree limbs lost from the ice-storm has been addressed by tree removal crews hired by the City in January 2014. A protocol for addressing debris blockages in watercourses is also being developed, as a result of these storms.

Unlike the August 19, 2005 storm, Transportation Services suffered much smaller damages, estimated at approximately \$0.3 million for the July 8, 2013 storm (<http://www.toronto.ca/legdocs/mmis/2014/cc/bgrd/backgroundfile-65676.pdf>).

### **City and TRCA Coordination from July 8, 2013 Storm**

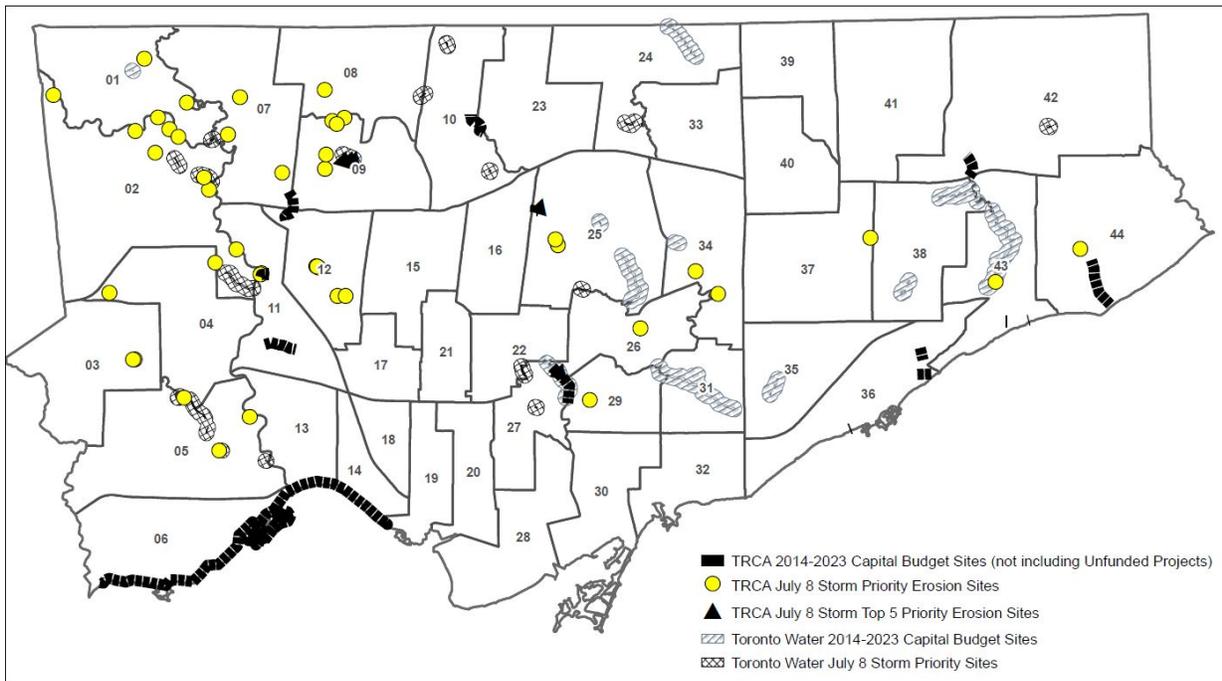
City and TRCA staff have jointly examined the 433 new TRCA Erosion Hazard Sites, additional TW Infrastructure sites, and PF&R damaged sites from the July 8th 2013 storm, for synergies of effort and resources. There are only 10 sites where there is a physical overlap of TRCA's Erosion Hazard Sites and Toronto Water's erosion sites from the July 8th 2013 storm. Lead responsibilities have been defined depending on whether the main works are associated with slope stability (TRCA) or creek repair to protect sanitary sewer infrastructure. Mimico Channel maintenance has been initiated by TRCA in the Fall of 2013. Removal of woody debris blockage from channels has been led by the Parks - Ravines & Watercourses unit.

### **Current Pressures for Erosion Management**

Erosion damage from the storms of 2000, 2005, 2008 and 2013 shows the need for increased attention to erosion control and management. Continued urbanization within the watersheds, climate change and aging of erosion control infrastructure, all contribute to increasing rates of erosion.

Figure 7 shows the locations of all July 8, 2013 priority erosion sites of both TRCA and Toronto Water. It also shows the locations for planned work of the 10-year capital programs of TRCA and Toronto Water.

TRCA’s inventory of erosion-related damages from the July 8, 2013 storm to TRCA and private properties are currently estimated at \$37.3 million. This estimate has been done coarsely using past similar works for reference and order of magnitude estimates provided by third-party engineers where available, and include a significant contingency of 50% to account for unknown information. This estimate includes all of the 433 sites assessed, but based on past evaluations, it can reasonably be assumed that many of the sites with a low priority ranking will not be recommended for remedial works through TRCA’s Erosion Management Program. This is reflected in TRCA's 2013 budget forecast of \$15.3 million for the July 8, 2013 storm erosion hazard sites – repair of the most urgent sites have been assigned a budget of \$7.8 million for 2014-2015 and \$7.5 million for the following eight years (2016-2023).



**Figure 7. Map of stream restoration and erosion control sites (Toronto Water & TRCA).**

Toronto Water’s estimates of stream erosion damage to underground Toronto Water Infrastructure in contact with water courses from the July 8, 2013 storm was \$ 5 million in October 2013. Toronto Water is reprioritizing the immediate needs from the July 8, 2013 storm within the Toronto Water 2014 budget of \$8.7 million. This reprioritization and the effects of future storms will cause additional cost pressures on Toronto Water's Stream Restoration Budget.

Additional pressures include the need to develop a state-of-good repair program, the cost of repair of gabion basket lined watercourses, and new legislative mandates arising from the implementation of Source Water Protection Plans under the Clean Water Act.

Toronto Water is completing a risk assessment for TW infrastructure within water courses, which includes an inventory and assessment of condition from which firm cost estimates for mitigation measures can be generated. Current ball park estimates for the simple replacement of existing erosion control structures needed to protect Toronto Water assets could be as large as

\$1.5-3 billion. To get a more practical estimate, geomorphic risk assessments (potential for erosion processes to create new sanitary sewer exposures) are carried out for river branches to establish a state-of-good-repair program for all water courses within the City. One third of the creeks within the City have had these studies completed to date. The City's Stream Restoration program will aim to develop a complete but preliminary estimate of the erosion control needs for Toronto Water infrastructure for all water courses within the City in the next four years.

Additional prioritization on stream erosion control is emphasized in the Policies of the CTC Source Protection Plan (under the Clean Water Act) to prevent breaks in sub-surface infrastructure such as petroleum pipelines and sanitary sewers. Toronto Water has developed a Draft Contingency Plan to respond to CTC Policy LO-SEW-2, (development of a Spill Prevention and Contingency Plan), and is in the process of developing a plan to respond to CTC Policy LO-G-5, a research policy which emphasizes Risk Reduction. Current activities to address CTC Policy LO-G-5 include locating and mapping access routes to all stream crossings. In addition, tri-annual stream inspections that the City initiated in 2010 provides a foundation for TW staff to carry out a risk assessment of all stream crossings, not assessed to date in tributary specific geomorphic systems studies.

### **Scarborough Waterfront Trail & Erosion Control**

TRCA has been implementing shoreline protection and public access projects along the Scarborough Bluffs, on a sector by sector basis, as funding would allow, over the last 30 years. Various projects have been proceeding through the approvals process, but the capital funding in the base program only allowed completion of short stretches of new toe protection works per year. The augmented capital program of the past three years of \$2 million per year have allowed acceleration of the current program and construction completion of such sectors as Meadowcliffe over a two-year period, rather than over a seven to 10 year period.

The current 10-year capital budget approved for 2014-2023, would allow major capital needs to be addressed for sectors such as 447-449 Guildwood Parkway, 1 Midland to 81-83 Fishleigh, Bellamy Ravine, Denison Drive West, and Beechgrove Drive. But the funds allocated in the approved program (approximately \$7 million over the 10 years) represent a small portion of the estimated cost (\$70-80 million) to complete toe protection works, a trail along the toe of the Bluffs, and trail access points.

The historical 30 year TRCA program of shoreline protection through construction of toe protection projects has provided for a limited amount of public access points to a potential trail system created by the toe protection structures. Large segments of the Scarborough Bluffs shoreline are in public ownership; however, there are a limited number of public access points (pedestrian or vehicular) to the water's edge between Bluffer's Park and East Point Park.

The vision of the Scarborough Waterfront Access Plan (SWAP) is a system of linked scenic landscapes both along the top of the bluffs and at the water's edge for the over 8 kilometre section of the shoreline between Bluffer's Park and East Point Park.

The Plan has three components: (i) completion of toe protection for Scarborough Bluffs, where they currently do not exist, between Brimley Rd (Bluffer Park) east to Highland Creek; (ii) construction of a multipurpose waterfront trail, and (iii) construction of access pathways from the top of the Bluffs to the Lake Ontario Waterfront. In addition, implicit in the concept is the need to enhance Lakefront Parks, such as Bluffer's Park.

TRCA will be carrying out an Environmental Assessment (EA) for the Scarborough Waterfront Erosion Control and Access Plan. It is recommended that the TRCA, with input from the General Managers of Toronto Water, Transportation Services and Parks, Forestry and Recreation, be requested to report back prior to finalizing the EA with the costs for erosion control components identified separately from the trail and waterfront access components of the plan. This multi-use waterfront trail is identified as Project 15 of the Bikeway Trails Implementation Plan, in a Staff Report adopted by City Council on June 6, 7 and 8, 2012. The EA is expected to take two years to complete.

### **Moving Forward**

Both Toronto Water and TRCA have a substantial list of "unfunded budget pressures" which includes erosion control projects. The current 2014 approved budget includes sufficient funding to deal with the most pressing problems, including those created by the most recent storms. However, it is apparent that to move to a pro-active approach to better manage erosion related risks, not only to Toronto Water assets, but also to Parks and Transportation assets as well as private property, it is necessary to increase the effort put into erosion control and stream restoration works. The following principles would help to clarify responsibilities for such work.

1. Each City Division with infrastructure or facilities potentially affected by erosion in ravines, and stream and river valleys should be responsible for the inspection, assessment, design, construction, maintenance and monitoring of erosion control works necessary to protect their infrastructure. Infrastructure located in flood plains is inherently at risk of damage over time due to effects of erosion. The risk includes both the adjacent infrastructure as well as the erosion control measures in the upstream and downstream zone of the watercourse which affect the infrastructure. For example, a project which focuses on protection of a sanitary sewer would be led by Toronto Water, whereas a project that focuses on protection of a bridge pier or culvert would be led by Transportation Services.
2. Design and construction of erosion control works should be carried out in collaboration with other potentially affected Divisions and costs for such work can be shared among Divisions where there are mutual benefits. The TRCA, Parks Forestry and Recreation, Toronto Water, and Transportation Services meet quarterly (or more frequently as required) in a variety of issue specific technical groupings to review new hazards identified, discuss proposed projects and workplans, address permitting and natural feature protection requirements, and promote ongoing collaborative decision-making and efficient use of public funds. Capital repair plans of PF&R (such as erosion of pathways) and Transportation Services (such as road crossings) and TRCA (such as erosion hazard sites) are the respective responsibility of these departments, but co-ordinated with Toronto Water through the capital co-ordination process. Where stream erosion poses a risk to more than one owner group (department), the groups

will continue the present practice of bundling of works (including through Engineering and Construction Services) to minimize impacts on the flora and fauna of valley lands; this may, in addition, cause the acceleration of some lower priority works in order to address the mutual needs of the owner groups.

3. Design and construction of new or replacement erosion control works must be consistent with best practices for natural channel design, adaptive management and considerations for climate change. As down-cutting of the channel bed has been the dominant erosion impact on infrastructure, geomorphic studies which apply the principles of natural channel design and are reach scale are needed to ensure that the proposed works are sustainable and take into account the changes to the watershed and flow regimes caused by urbanization and climate change.
4. TRCA will assist with the task of receiving and responding to complaints from private property owners concerning erosion which affects loss of property or is a hazard to private structures. The public will continue to be encouraged to report erosion damage via 311, who in turn can notify both Toronto Water and TRCA of the pertinent details, indicating whether the damage is affecting water infrastructure, public lands or private property; the latter two will be initially inspected by TRCA and the former by Toronto Water. This was found to be an effective way of managing and coordinating requests for emergency work during the July 8, 2013 storm.
5. TRCA will be responsible for assessing erosion hazard sites affecting private property and designing, constructing and maintaining erosion control works affecting one or more property owners, on a priority basis, in order to protect public safety and to stabilize and limit further damage. This is a continuation of TRCA's present procedure under their Waterfront and Valley Erosion Control plan as described earlier in this report.
6. Costs for design, construction and maintenance of such erosion control works will be shared between the benefitting property owners and TRCA (as per TRCA's Private Landowner Contribution Policy). TRCA will address such costs on a case by case basis, and develop a cost sharing arrangement and any needed easements between the benefitting property owner(s) and TRCA, prior to commencing works.
7. Owners of private property will be responsible for the costs of repair of erosion damage on their property attributed to unpermitted encroachments or their unpermitted alterations to ravine or valley lands. An example of an 'illegal activity' is adding fill and retaining walls to level a landowner's backyard, within regulatory erosion hazard limits (see Figure 3), without obtaining necessary permits. Such fill may surcharge the top of slope and contribute to slope failure, which occurred at some sites during the July 8th storm. An example of an encroachment is extending fill and structures onto public property easements without the agreement of the City or TRCA. Instances of this also contributed to erosion damage at some July 8, 2013 storm damaged sites. TRCA will initiate a study of potential Valley Land Slope Erosion Mitigation Strategy at sites where failure may be experienced due to future storms such as July 8, 2013 storm and include lessons learnt from repairs at July 8, 2013 storm

damaged sites. The study will inform forecasting of potential future valley slope remedial works, and in working toward a proactive approach to erosion hazard site management.

Funding for TRCA's erosion management program, as it pertains to protection of private property in Toronto, has historically been funded 50% from the water rates and 50% from the tax base. Starting in 2011, the City had increased its funding to TRCA by approximately \$2 million per year in order to make faster progress on erosion protection works. Due to the July 8, 2013 storm, this amount was increased to \$7 million in each of 2014 and 2015 and continued at \$2 million per year to 2023. All of this is funded from the Toronto Water Capital –Financing Reserve Funds and will be spent primarily on repairing erosion damage adjacent to or affecting private property. It is recognized that protecting property from erosion is not a core function of Toronto Water and that the historical 50 / 50 split is more reflective of divisional responsibilities. However, given the amount of unfunded pressures in both TRCA and Toronto Water Capital Programs, it would be appropriate for the General Manager of Toronto Water and the Deputy City Manager and Chief Financial Officer to consider this issue in their report to Council on a financing strategy to fund Toronto Water's long term Capital Plan along with detailed implementation plan.

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