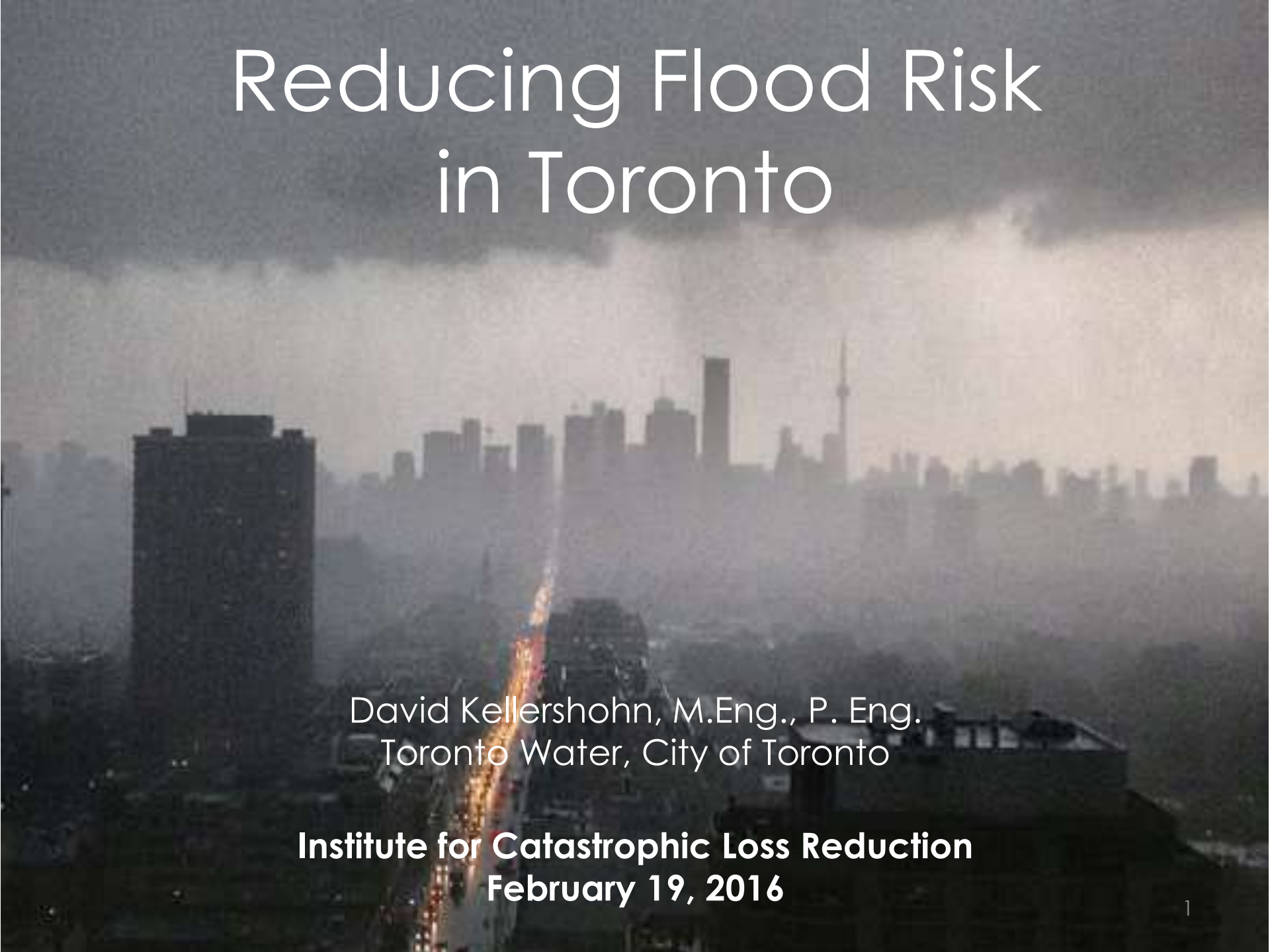
Reducing Flood Risk in Toronto



David Kellershohn, M.Eng., P. Eng.
Toronto Water, City of Toronto

Institute for Catastrophic Loss Reduction
February 19, 2016

Reducing Flood Risk in Toronto

Agenda

1) Overview & Program History
2) City's Strategy
3) What's New (since we last spoke)
4) In the works….
5) Summary

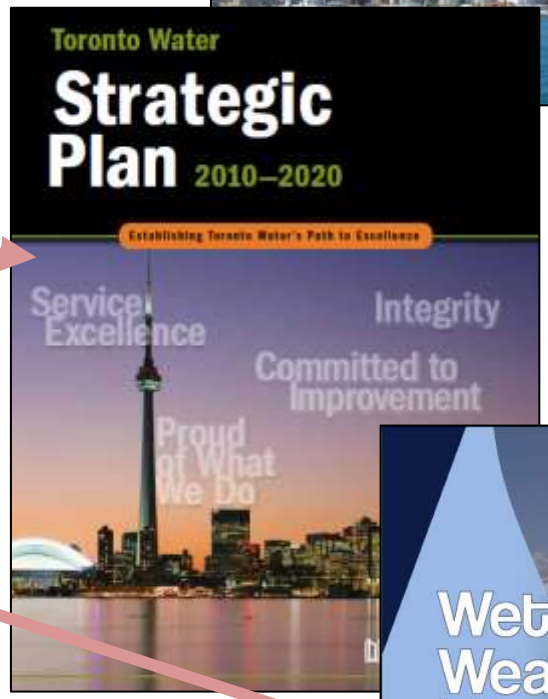
Overview

City of Toronto

Toronto Water Strategic Plan

Wet Weather Flow Master Plan

Basement Flooding Protection Program



Toronto Water – What We Do

Mission Statement

To provide quality water services through supplying drinking water and the treatment of wastewater and stormwater to residents, businesses and visitors in order to protect public health, safety and property in an environmentally and a fiscally responsible manner.

Guiding Principles

I. Continuous Service Delivery Improvement

II. Financial Vitality, Viability and Sustainability

III. Operational Excellence

IV. Infrastructure Management

V. Employer of Choice

Overview

Toronto Water

- Serves over 3.4 million residents and businesses in Toronto, York and Peel
- More than $28.3 billion in infrastructure assets, including over 10,700 km of storm, sanitary, and combined sewers
- We are 100% rate-supported: no reliance on the property tax base

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Toronto Water's Infrastructure Challenges

Competing Priorities for Capital Program

- Renewal of aging infrastructure – reducing the $1.6 billion State of Good Repair Backlog
- Servicing growth
- Environmental stewardship – water quality improvements
- Climate Change Resilience and Urban Flooding Protection

Why did we create a Basement Flooding Protection Program?

History

Key Storm Events

102 mm
May 12
2000

153 mm
August 19
2005

81 mm
July 15
2012

138 mm
July 8
2013

Increasing Awareness & Increasing Effort

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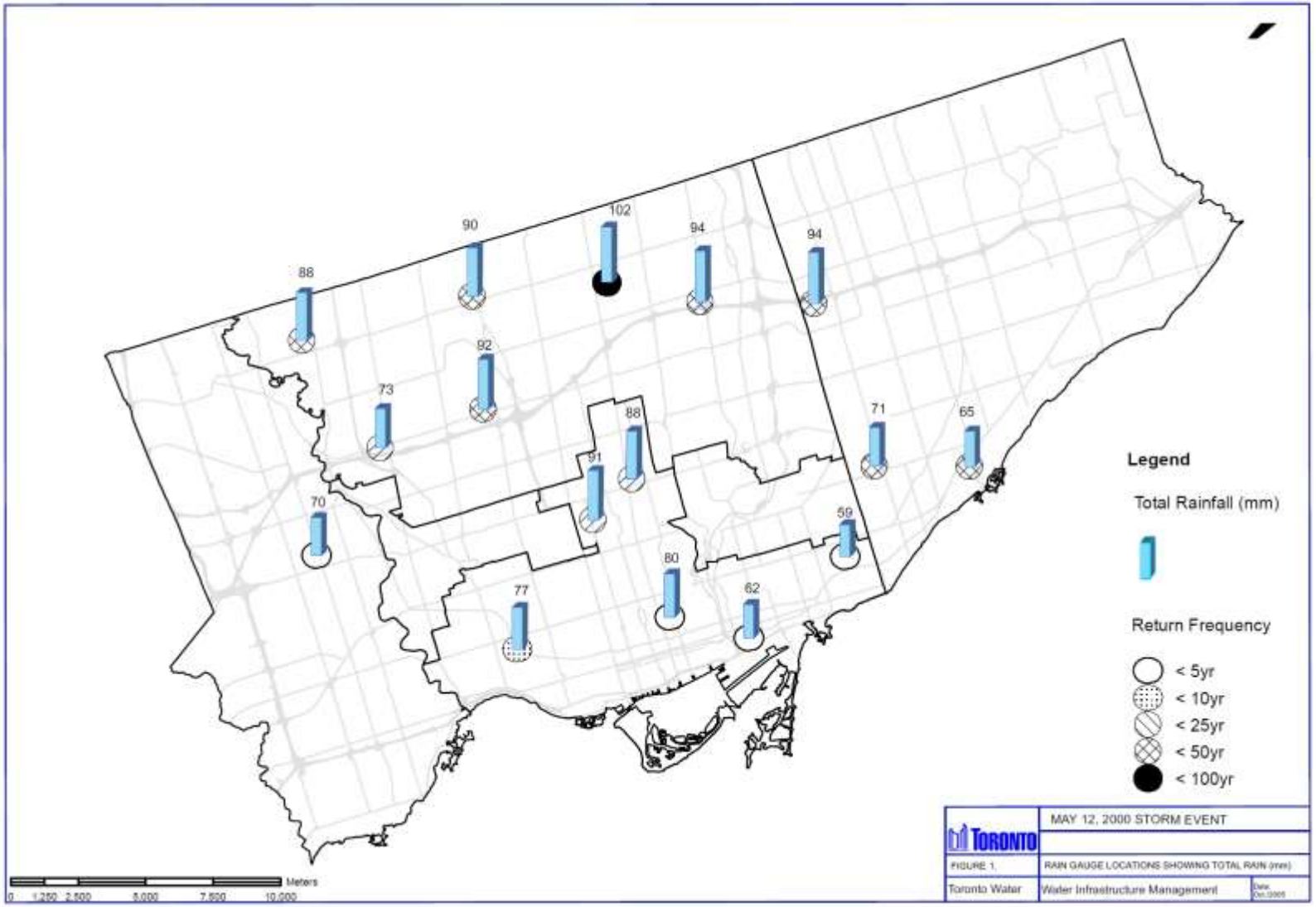
History

May 12, 2000 Storm



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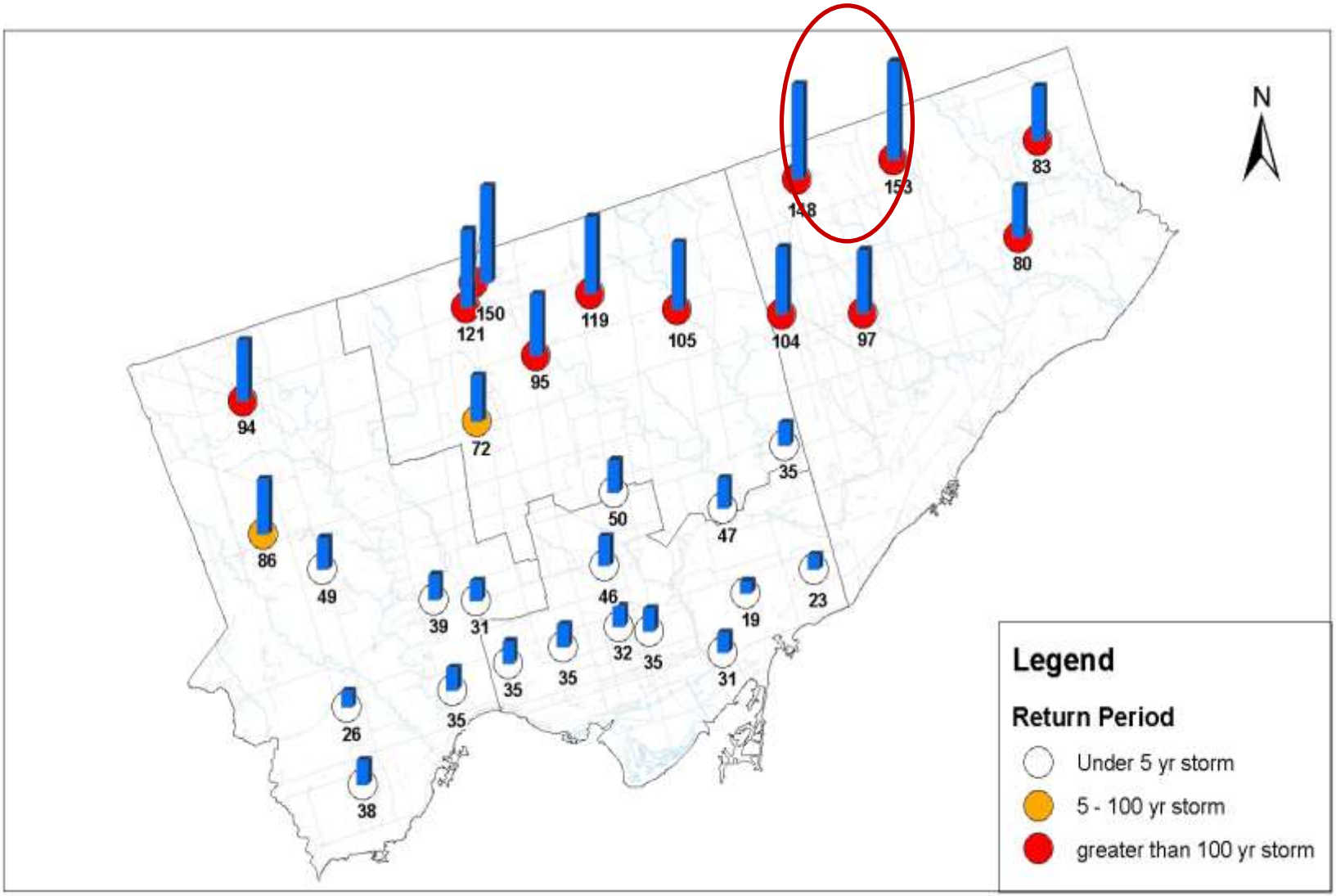
August 19, 2005

- Flash floods of rivers and ravines
- Overflowed stream banks
- Watercourse bank erosion
- Damage to public and private infrastructure and property
- Sewer backups

History

August 19, 2005 Storm



History

Catastrophic Failure
Finch Avenue West at Black Creek

History

Surface Flooding – Steeles Avenue

Collapse of the Birkdale Ravine

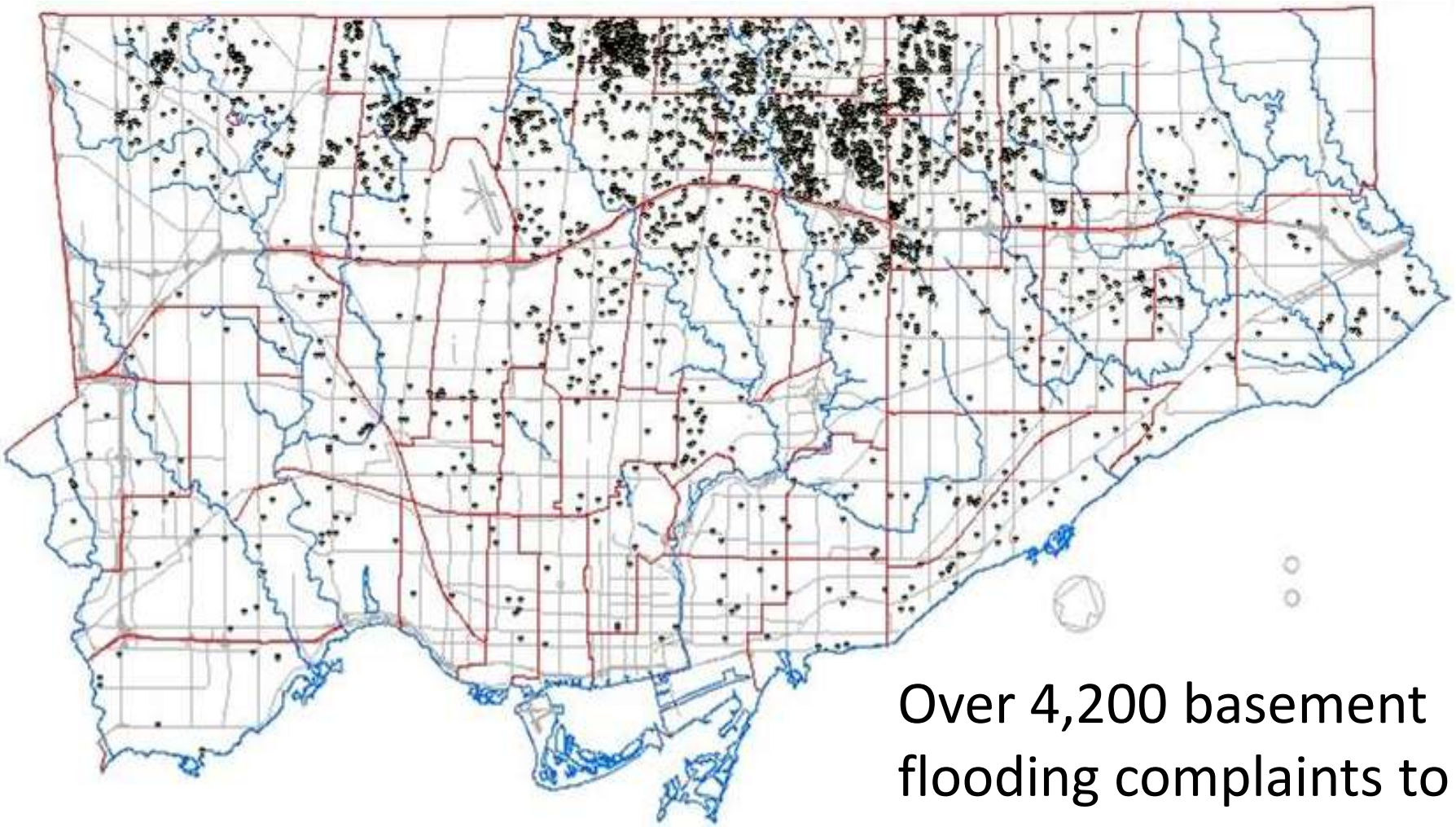
Highland Creek Sanitary Trunk Sewer

Exposed Trunk Sanitary Sewer

Basement Flooding Damage

History

Basement Flooding Complaints (August 19, 2005)



Over 4,200 basement flooding complaints to the City

July 8, 2013

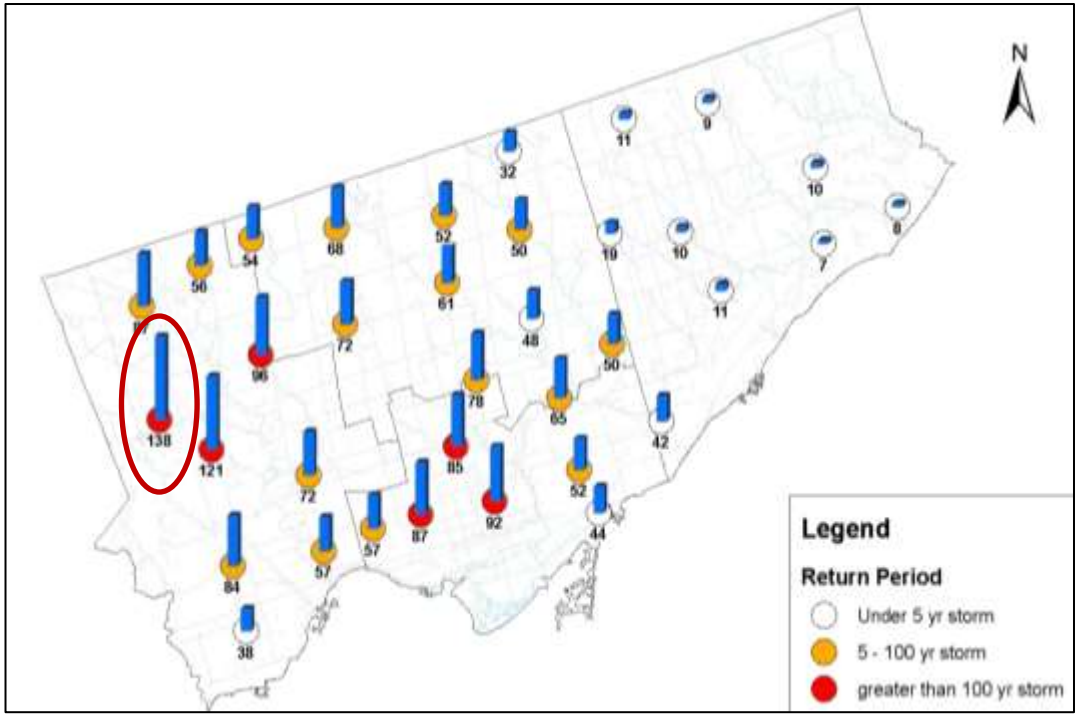
> 4,700 Reported Basement Floodings

> 450 watercourse erosion sites

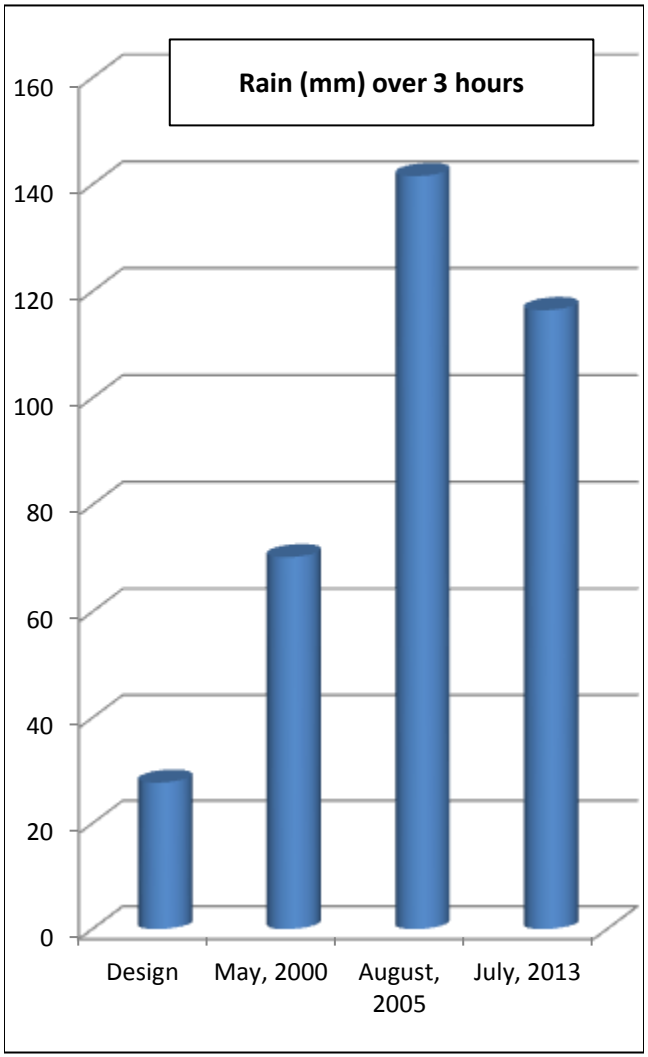
> 300,000 properties without power

History

July 8, 2013 – Rainfall Amounts



- City of Toronto rain gauge recorded 138 mm.
- Exceeded 1 in 100 year storm in the west part of the City.



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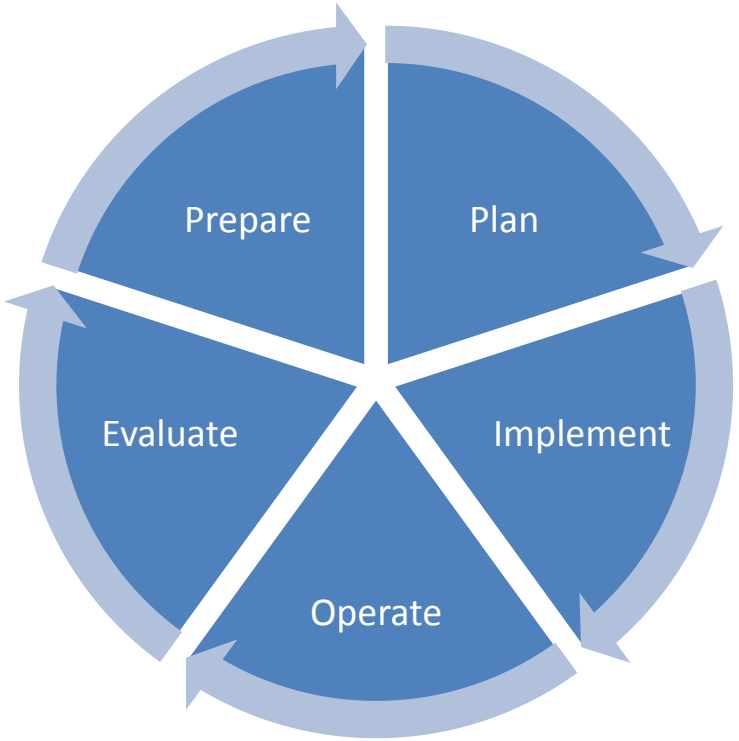
City's Strategy to Reduce Urban Flood Risks

Multi-pronged approach:

- As quickly as possible, reduce existing risks for as many residents as possible.
- Minimize the creation of new risks as the City grows and builds.
- Be prepared to respond during extreme events

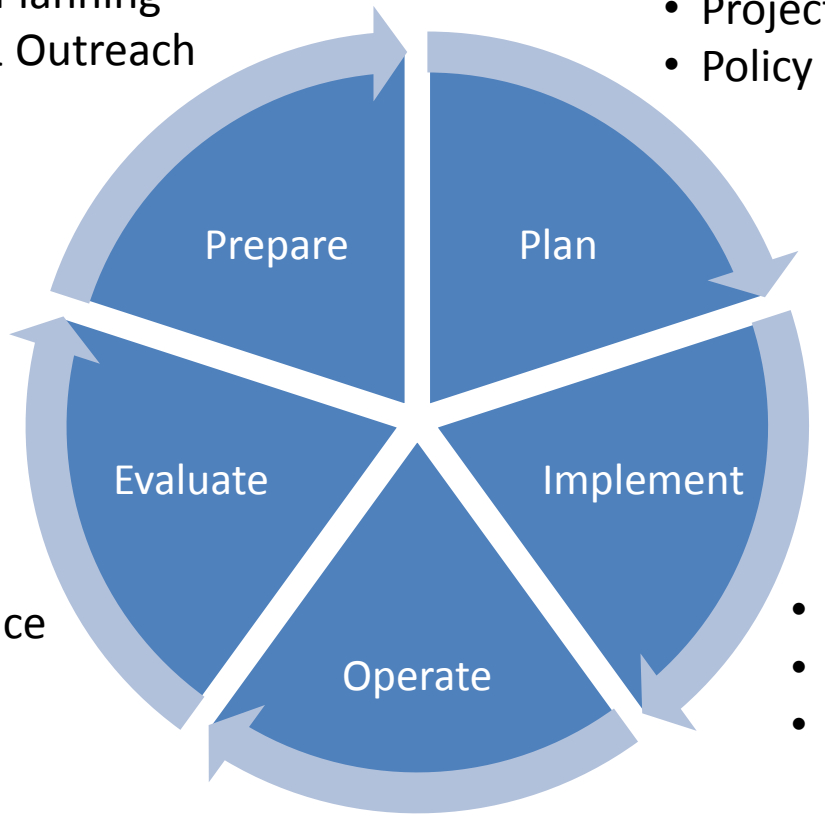


Lifecycle Asset Management:

Strategy

- Emergency Planning
- Education & Outreach

- Capacity Studies
- Project Prioritization
- Policy Development



- Performance Verification
- Customer Service

- Construction
- Subsidy Programs
- Downspout Disconnection

- Inspections
- Monitoring
- Maintenance

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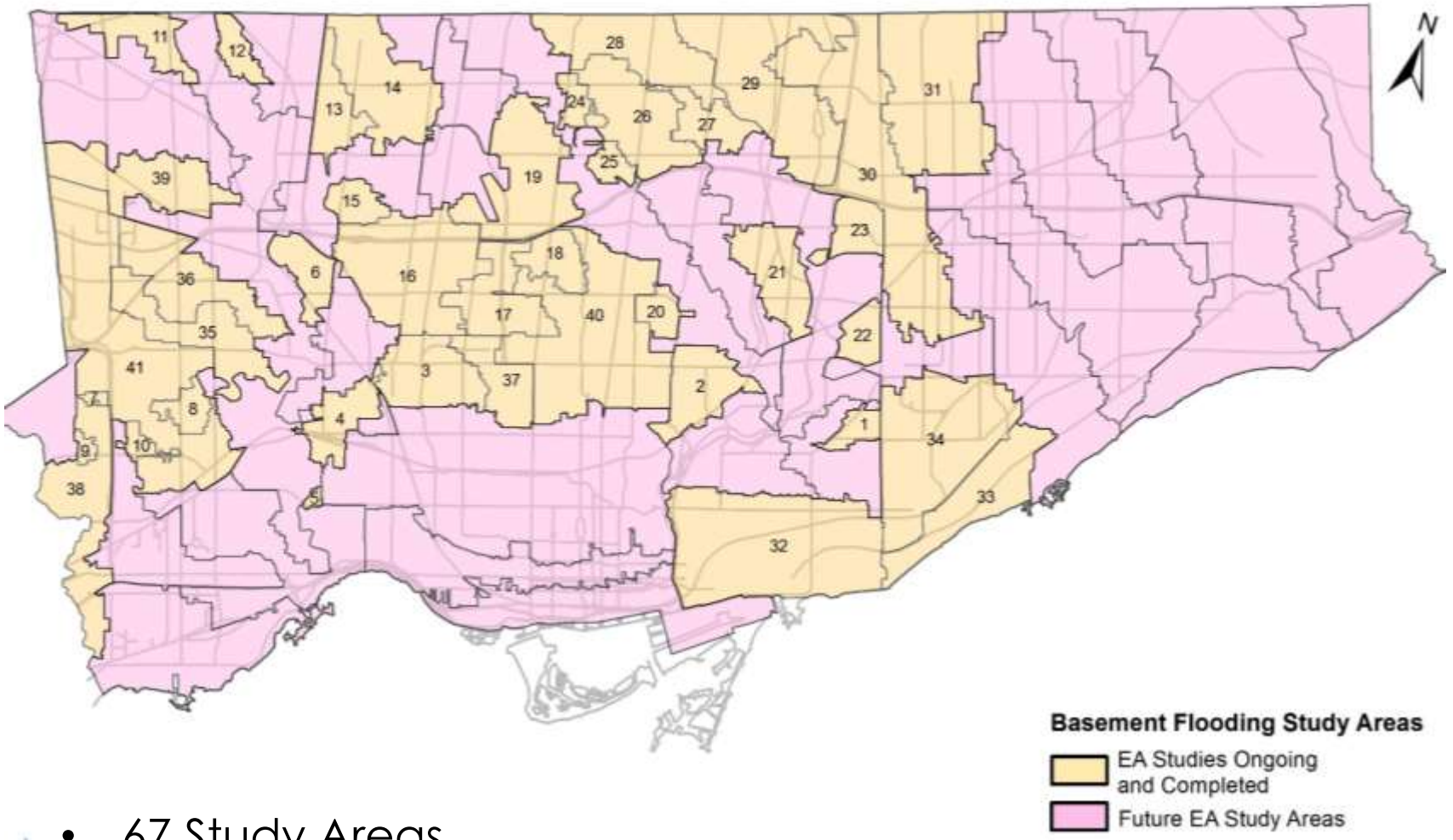
Infrastructure Upgrades

Program Overview:

- Started in 2006; expanded city-wide in 2013
- Multi-year program to reduce the risk of basement and surface flooding through municipal infrastructure upgrades
- Capacity Assessment studies follow Municipal Class EA process;
- Incorporates enhanced design standards:
  - ❖ Sanitary sewer design standard increased to May 2000 storm (25-50 year storm)
  - ❖ Storm drainage system standard increased to 100 year design storm level of protection

Infrastructure Upgrades - Study Areas

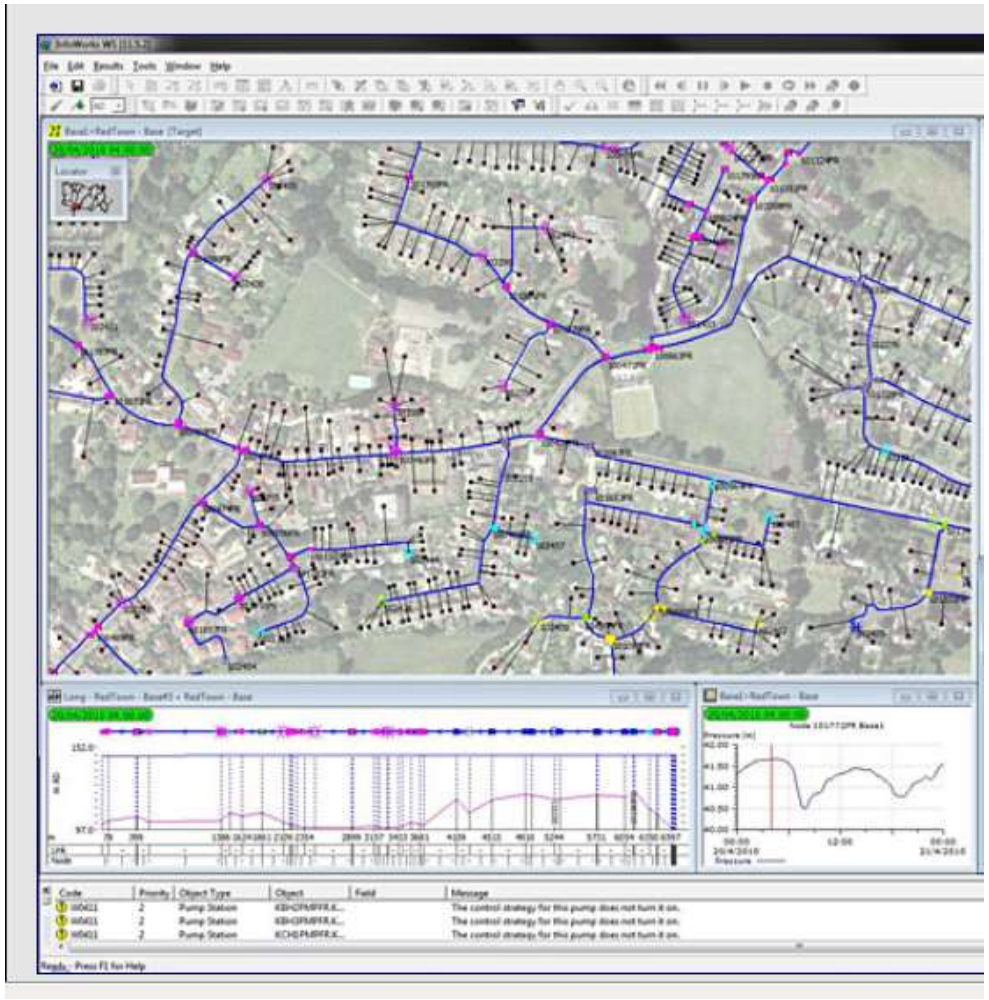


- 67 Study Areas
- 26 Studies have been completed

Strategy

Capacity Assessment

- Drainage system capacities are determined through detailed assessment of infrastructure and the built form.
- Existing conditions are simulated using Infoworks.
- Models are calibrated with sewer flow monitoring data and validated using resident flooding history.



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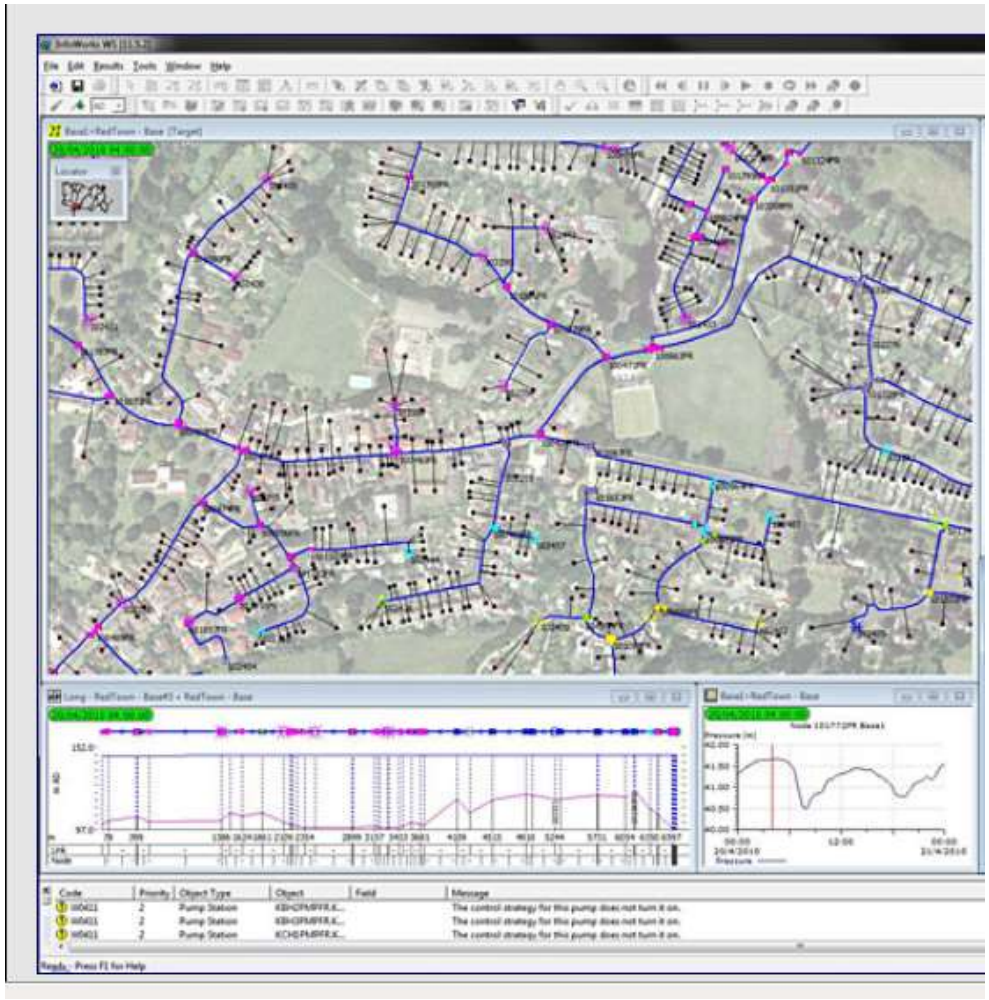
Strategy

Capacity Assessment

- Studies take an estimated 2-3 years to complete.
- Infoworks is the hydraulic modelling tool used by the City.
- It can determine where bottlenecks and lower levels of service exist in a community.
- Scenario analysis is used to identify the preferred upgrades needed to meet the targeted levels of service.



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Project Prioritization: Updated Annually

Strategy

- Fair and equitable prioritization is important to the program's success.
- Study Principle – *"Study the City in order of decreasing density of flooding complaints"*
- Implementation Principle – *"implement projects that benefit the most properties at the lowest costs first"*
- Council adopted $32,000 cost per benefitting property threshold.

2015

Projects Confirmed to Start Construction in 2015

Project #	Location	Project Description	Ward	Councillor	Preliminary Design Cost Estimate ($)	Cost / Benefitting Home
16-01	North Park Ravine	Sanitary Sewer Replacements / Upgrades	12	Di Giorgio	$790,630	N/A[5]

Projects Undergoing Preliminary Design

Project #	Location	Project Description	Ward	Councillor	EA Study Cost Estimate ($)	Cost / Benefitting Home
14-05	Gosford Blvd Fletcherdon Cres. Hullmar (east of Gosford) York Gate Blvd.	Storm Sewer Replacements / Upgrades	8	Perruzza	$4,043,600	$25,116
14-10	Kennerly Crt.	Storm Sewer Replacements / Upgrades	8	Perruzza	$2,137,000	$92,913
3-03	The "Tunnel"	New Storm Tunnel New Storm Sewers & Additional Inlet Capacity	12, 15, 17	Di Giorgio Colle Palacio	$101,600,000	$39,441[6]
28-01	Hilda Ave. (at Drewry & Connaught)	Storm & Sanitary Sewer Replacements / Upgrades	23	Filion	$3,576,430	$22,636
29-07 A	Bestview Dr. Harrington Cres. Kentland Cres. Goldenwood Rd.	Storm Sewer Replacements / Upgrades	24	Shiner	$7,728,800	$34,814
29-12	James Gray Dr. Mallaby Rd.	Trench Drain Installation & Storm Sewer Upsizing	24	Shiner	$1,393,700	$17,206
29-19	Woodthrush Crt. Page Ave. Easement	Trench Drain Installation & Storm Sewer Upsizing	24	Shiner	$335,500	$17,658
29-21	Beardmore Cres.	Trench Drain Installation & Storm Sewer Upsizing	24	Shiner	$577,500	$24,063
29-25	Saddletree Dr. Easement	Trench Drain Installation & Storm Sewer Upsizing	24	Shiner	$316,800	$17,600
32-16 A	Eastern Ave.	Storm Sewer & Combined Sewer Replacements / Upgrades, & New Storm Sewer Installations	32	McMahon	$1,171,000	$9,678
29-02 C	Kempsell Cres. Houston Cres. Deerford Rd. Hobart Dr. Ashstead Pl. Easements	Trench Drain Installation and Storm Sewer Upsizing	33	Carroll	$9,013,378	$20,626
29-11	Seneca Hill Dr. Angus Dr. Silas Hill Dr.	Storm Sewer Replacements / Upgrades, Trench Drain Installation, & Road Regrading	33	Carroll	$7,346,724	$28,257
29-26	Parkway Forest	Regrading of Intersection	33	Carroll	$84,150	$5,610

$237 million in infrastructure upgrades have been implemented since 2009

Sewer Upgrades

- Installation of large diameter storm pipes to increase conveyance capacity

Installation of large storm sewer pipes - North York

Stormwater Tanks

- Underground stormwater tanks in City Parks to provide temporary storage and relief during severe storms

Stormwater Storage Tank in Old Sheppard Park – North York

Stormwater Ponds

Dry Ponds in Muirhead Park and Moore Park – North York

Strategy

Watercourse Improvements

- Improved channel hydraulics, water quality, aquatic and riparian habitat.
- Improved Protection of Infrastructure Crossings
- Better protection of private property.
- Amenity to local community

Watercourse Restoration

Exposed Sanitary Trunk Manhole

Berry Creek – After Restoration

Berry Creek - Before Restoration

Sanitary Trunk Manhole No Longer Exposed

Strategy

WATERCOURSES & PUBLIC INFRASTRUCTURE

- Increasing impacts due to watercourse down cutting over the span of decades.
- Failure rates are difficult to predict and budget for.
- Yearly watercourse inspections and efforts are continually re-prioritized.
- Health and safety threats are addressed immediately.

Strategy

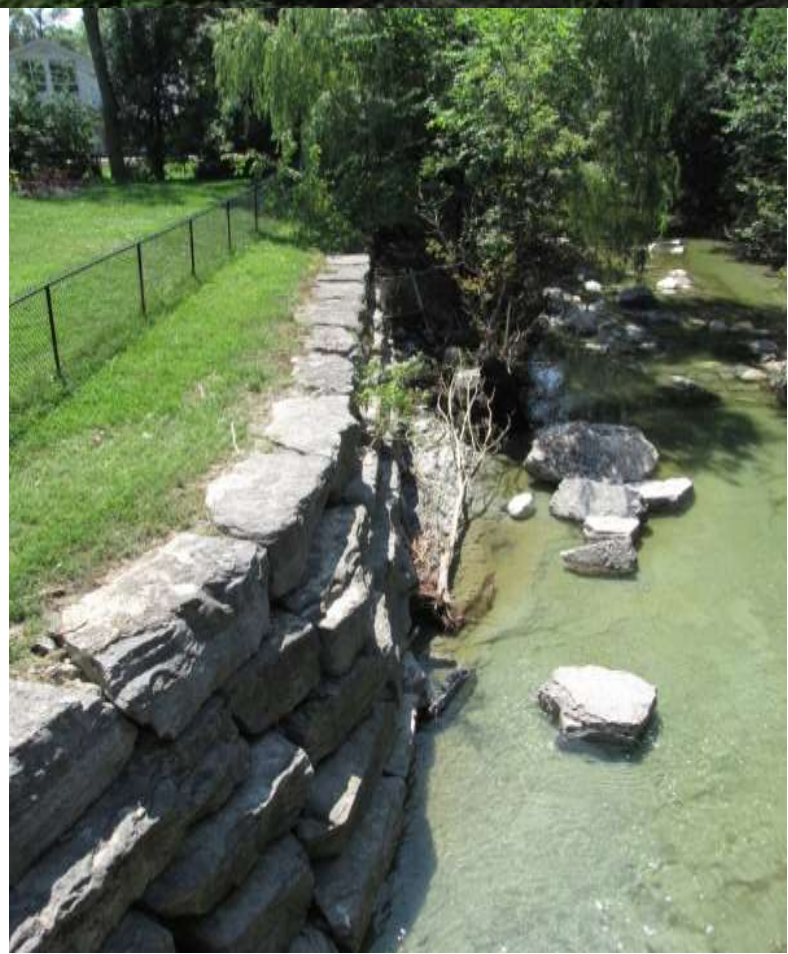
WATERCOURSES & PRIVATE PROPERTY

- Private property can experience significant impacts due to erosion from watercourses.
- The Toronto and Region Conservation Authority takes the lead on assessing, documenting, and prioritizing repairs where public infrastructure is not at risk.

Strategy

WATERCOURSES & PRIVATE PROPERTY

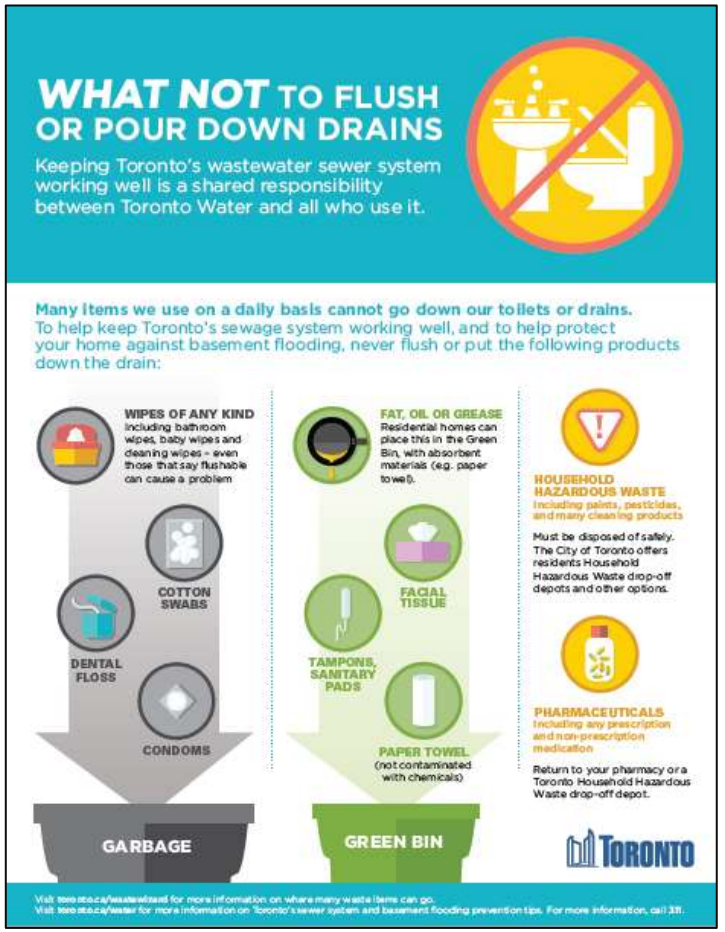
- Costs for repairs are shared between private property owners and the City.
- Transfers of affected lands into public ownership is often pursued.
- Health and safety threats are addressed immediately.
- Most damages are considered to be low and medium risk and will take many years (10+ years) to complete.



Strategy

Operations and Maintenance

- CCTV inspection program for City's sewers
- Cleaning, flushing of sanitary and combined sewers on a 5 year cycle (storm sewers are cleaned as required); more frequently in certain parts of the city
- Education and outreach on grease disposal
- Environmental compliance monitoring – Sewers bylaw



Strategy

Private Property Incentives

- Financial subsidy of up to $3,400 per property;
  - Backwater valve (max $1,250)
  - Sump pump (max $1,750)
  - Disconnection of a home's foundation drains from the sewer system (max $400)
- >16,500 applications processed to date.
- > $27 million in subsidies issued to homeowners

Mandatory Downspout Disconnection

The bylaw comes into effect on:

- **November 20, 2011** for properties in the combined sewer area
- **December 3, 2013** for properties in basement flooding areas
- **December 3, 2016** for properties outside basement flooding and combined sewer service area

If disconnection is not technically feasible or would create a hazardous condition, owners can apply to the City for an exemption.

City Bylaws – Lot Level Controls

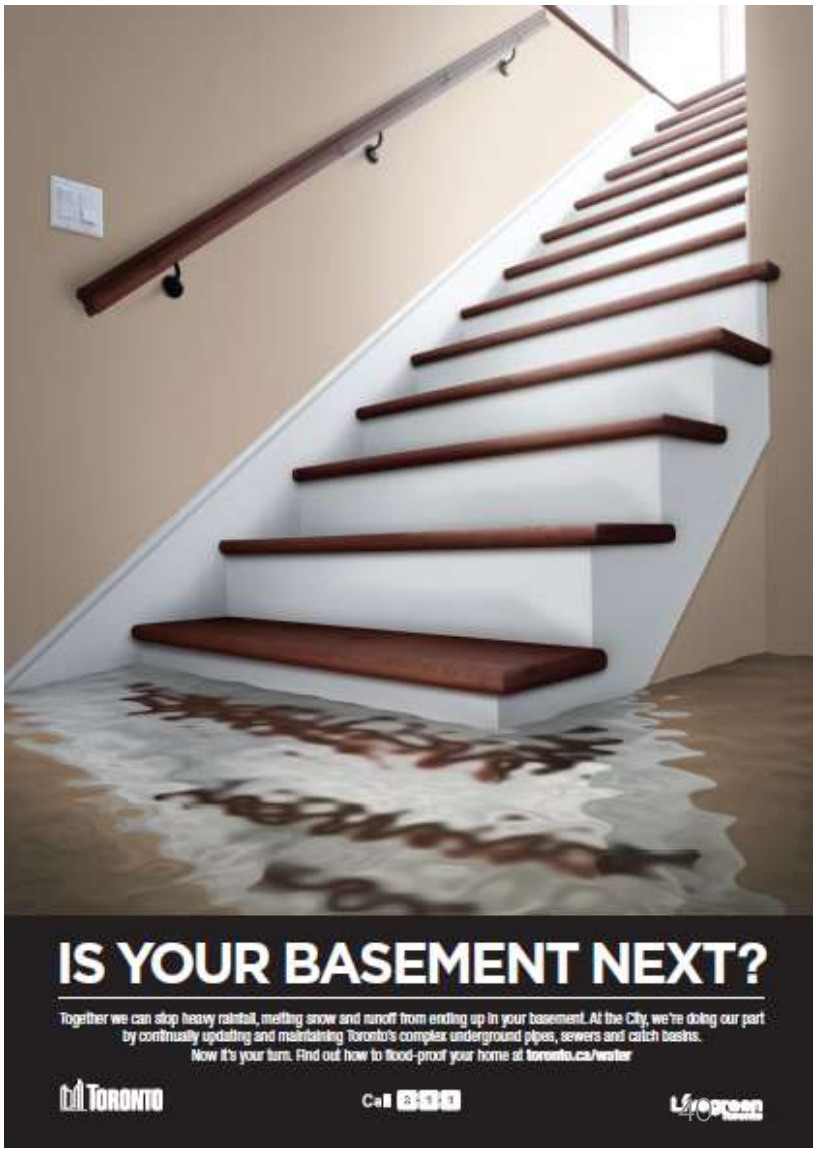
Strategy

- City-Wide Zoning Bylaw (569-2013)
  - Reverse slope driveways are no longer permitted
  - Maximum lot coverage values are specified, including minimum values for front yard soft landscaping
- Sewers Bylaw - No new connections to storm sewers from private property
- Entire City at risk of flooding - Backwater valves mandated for all new developments

Strategy

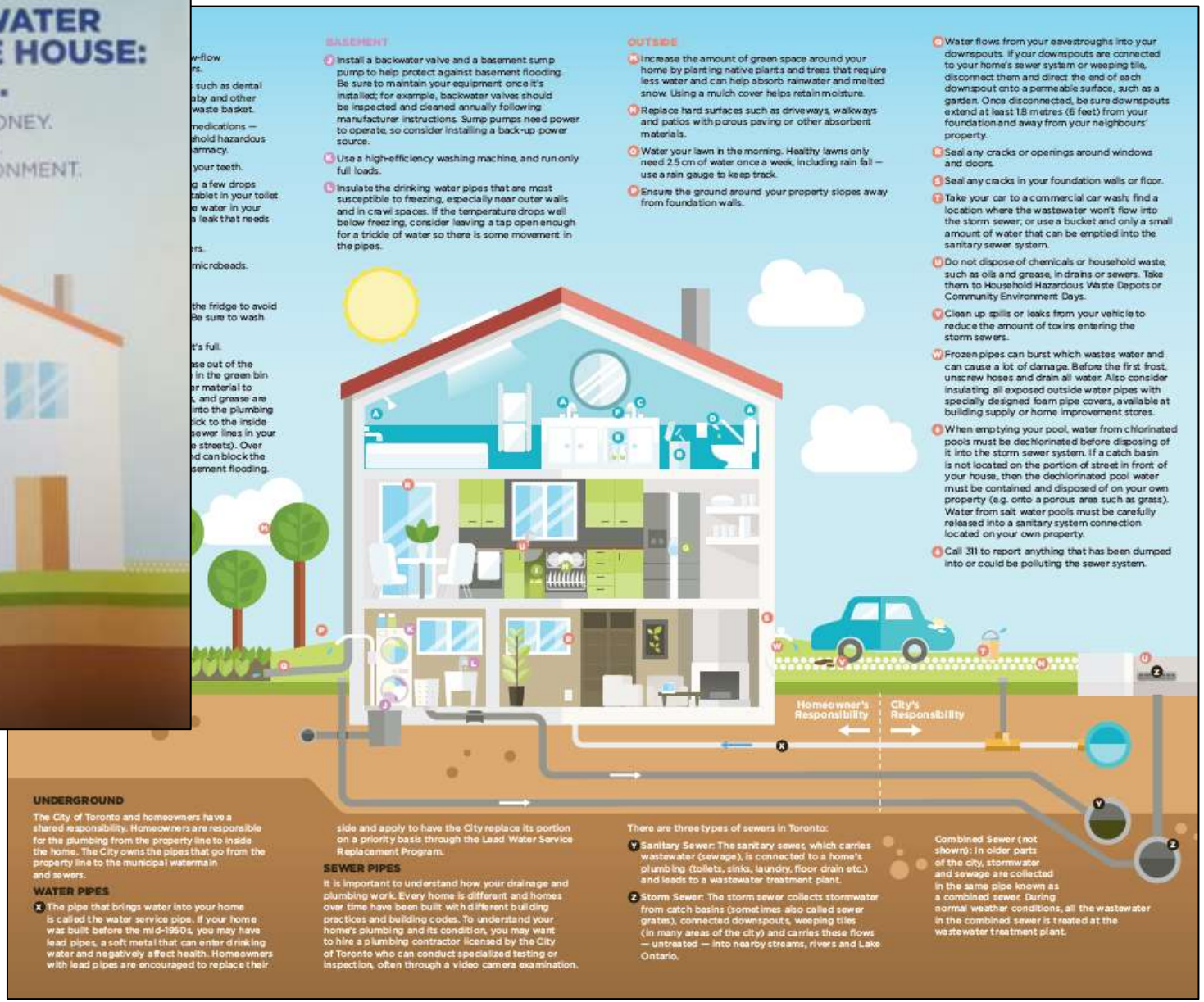
Education and Outreach

- **Advertisement campaigns –** print ads, targeted web ads, TTC shelter ads
- **Brochures –** Managing Water Around the House from A to Z
- **City of Toronto website** www.toronto.ca/basementflooding
- **Social Media** (Twitter etc…)
- **Construction Notices**



Education and Outreach

Strategy



Strategy

Working with the Community

- **Construction Notices and Signage** issued to communicate community disruptions and mitigation measures
- **Basement Flooding Field Ambassador** - liaises with residents and contractor; provides direct and timely responses to issues raised by local residents
- **Community Meetings** to address contentious issues

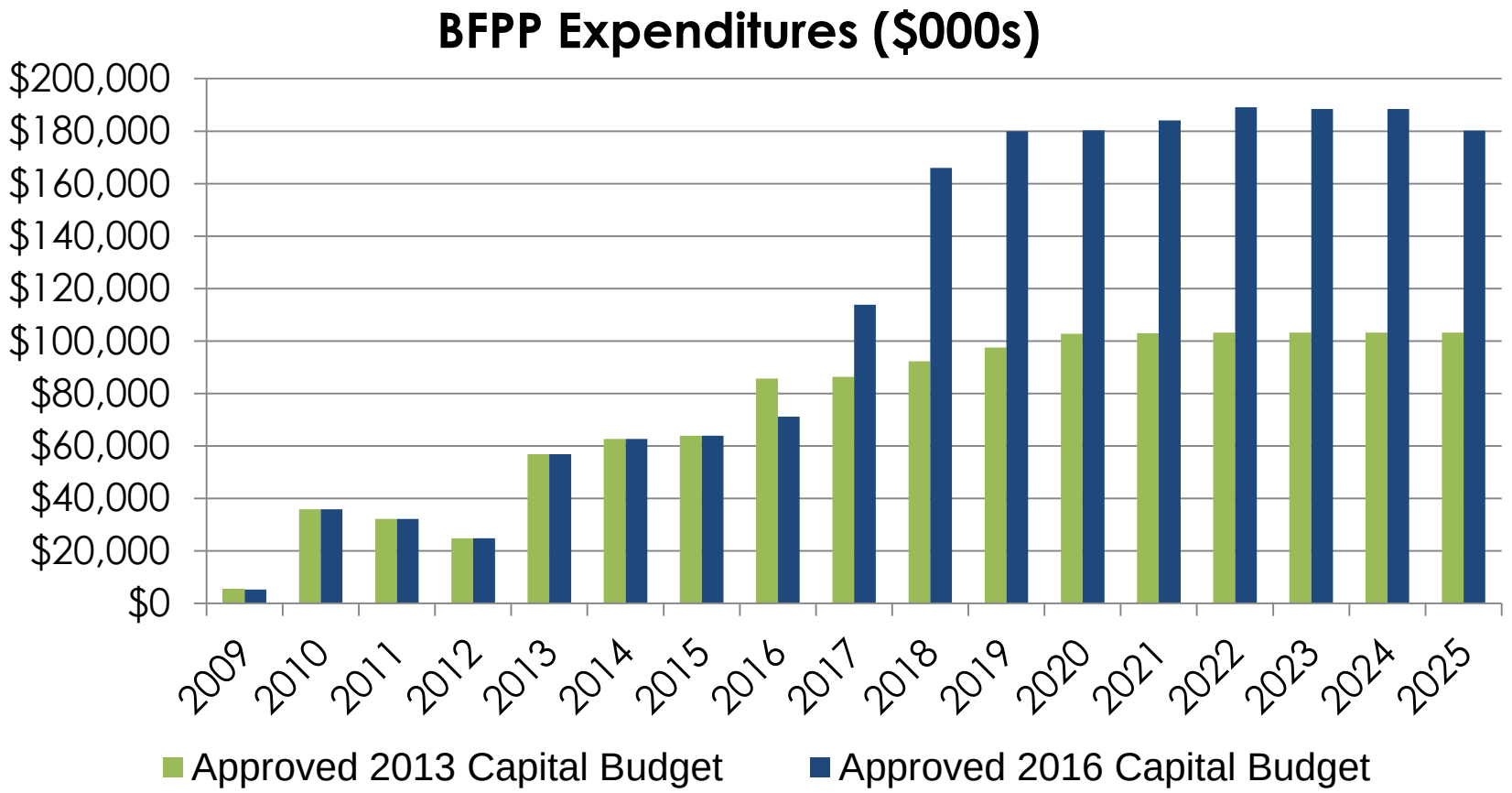
Basement Flooding Ambassador

What's New in the Program?
(since our last presentation in 2011)

- Bigger Goals
- More Resources
- Improved Coordination
- Improved Calibration & Validation
- More Experience

Bigger Goals

- 10 year Capital Plan (2013-2022) - $915 million
- 10 year Capital Plan (2016-2025) - over $1.5 billion



More Resources

- **3 X as many internal staff** through reassignments and new hiring.
- **"Basement Flooding 4":** a new Program Management Delivery Model.
  - In August 2014, City Council approved a program management capital delivery model for the Basement Flooding Protection Program
  - For streamlining, Engineering consultants were granted authority to act as agents of the City to approve routine contract change orders (reduction of burearcracy).

More Resources

- **"Basement Flooding 4" (cont'd);**
  - New structure is designed to capitalize on economies of scale.
  - International world leading experience and resources is brought to the City.
  - Quickly scalable through the use of multiple consulting firms.
  - City staff provide oversight and management of the program.
  - Long term commitment. 5 Year contract with option to extend to 10 years.

Improved Coordination

Stormwater Management Steering Committee:

- Established in 2014 to coordinate City efforts to mitigate stormwater impacts on private property
- Reviews and identifies improvements to processes, regulations, and bylaws that govern stormwater management on private property
- Membership includes: City Planning, Engineering and Construction Services, Municipal Licensing and Standards, Toronto Water, Toronto Building, and Transportation Services

PLANNING A GREAT CITY TOGETHER

TORONTO Water

TORONTO Engineering & Construction Services

What's New

Improved Calibration & Validation

Better Data = Greater Confidence

- Expanded Sewer Flow Monitoring program initiated in 2014.
- Longer period of record and more locations to support hydraulic model calibration and validation
- Post construction flow monitoring on selected sites to verify performance.

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Post-Construction Investigations

What's New

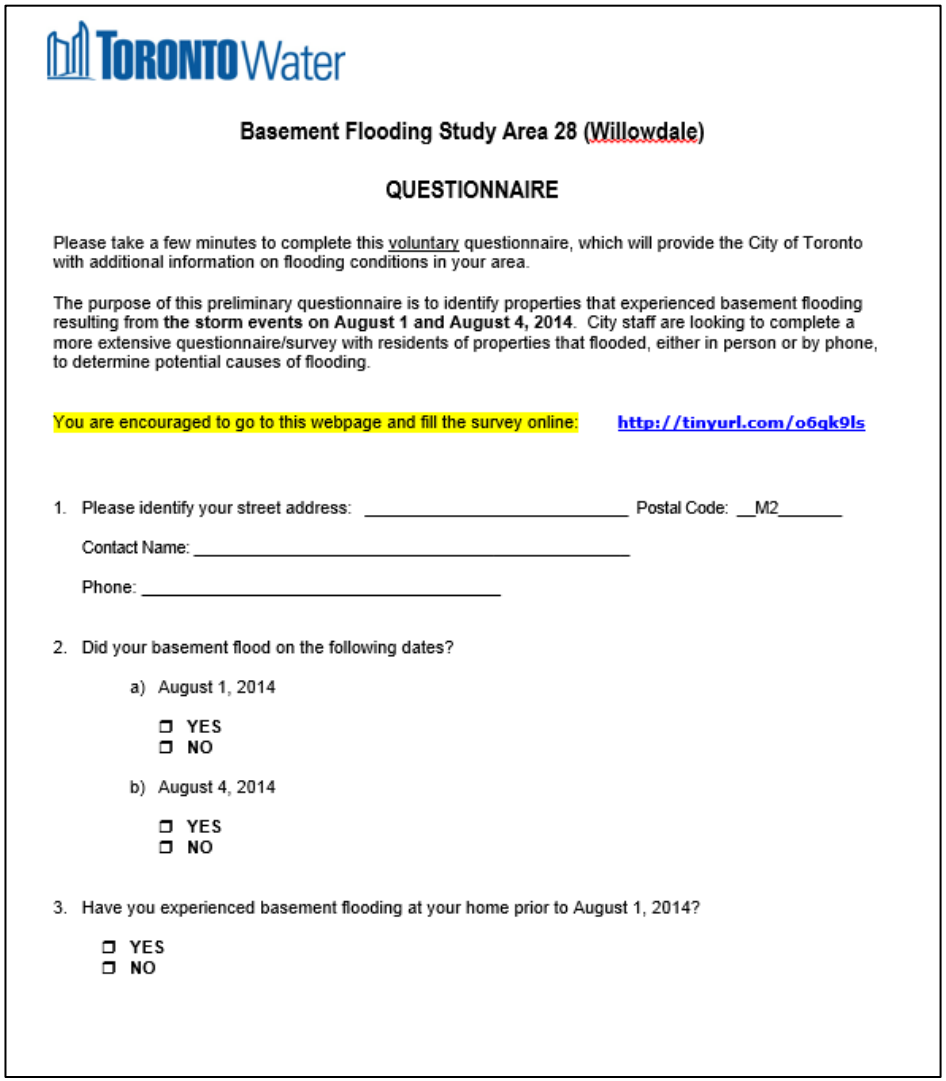
- Sewers upgraded in 2012
- Homes flooded in August 2014. Storms were smaller than what the new sewers had been upgraded to serve

Why did the homes flood?

Post-Construction Investigations

What's New

- Detailed Investigations included:
  - Detailed resident surveys and interviews.
  - Rainfall, sewer flow monitoring, and modelling
  - Topographic surveys
  - Groundwater monitoring



TORONTO Water

Basement Flooding Study Area 28 (Willowdale)

QUESTIONNAIRE

Please take a few minutes to complete this voluntary questionnaire, which will provide the City of Toronto with additional information on flooding conditions in your area.

The purpose of this preliminary questionnaire is to identify properties that experienced basement flooding resulting from **the storm events on August 1 and August 4, 2014**. City staff are looking to complete a more extensive questionnaire/survey with residents of properties that flooded, either in person or by phone, to determine potential causes of flooding.

You are encouraged to go to this webpage and fill the survey online: http://tinyurl.com/o6gk9ls

1. Please identify your street address: _____ Postal Code: __M2_____

   Contact Name: _____

   Phone: _____

2. Did your basement flood on the following dates?

   a) August 1, 2014

   ❒ YES
   ❒ NO

   b) August 4, 2014

   ❒ YES
   ❒ NO

3. Have you experienced basement flooding at your home prior to August 1, 2014?

   ❒ YES
   ❒ NO

Post-Construction Investigations

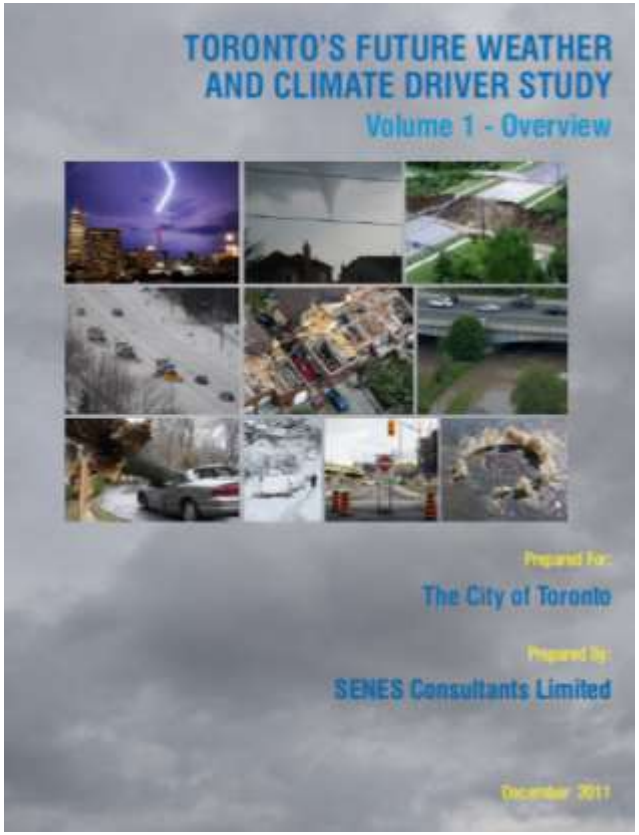
Conclusions:

- Sewer system upgrades worked as designed
- High groundwater and private side drainage issues a contributing flooding factor
- More education needed regarding foundation drainage maintenance.

Climate Change Initiatives

City's efforts to create a more resilient Toronto:

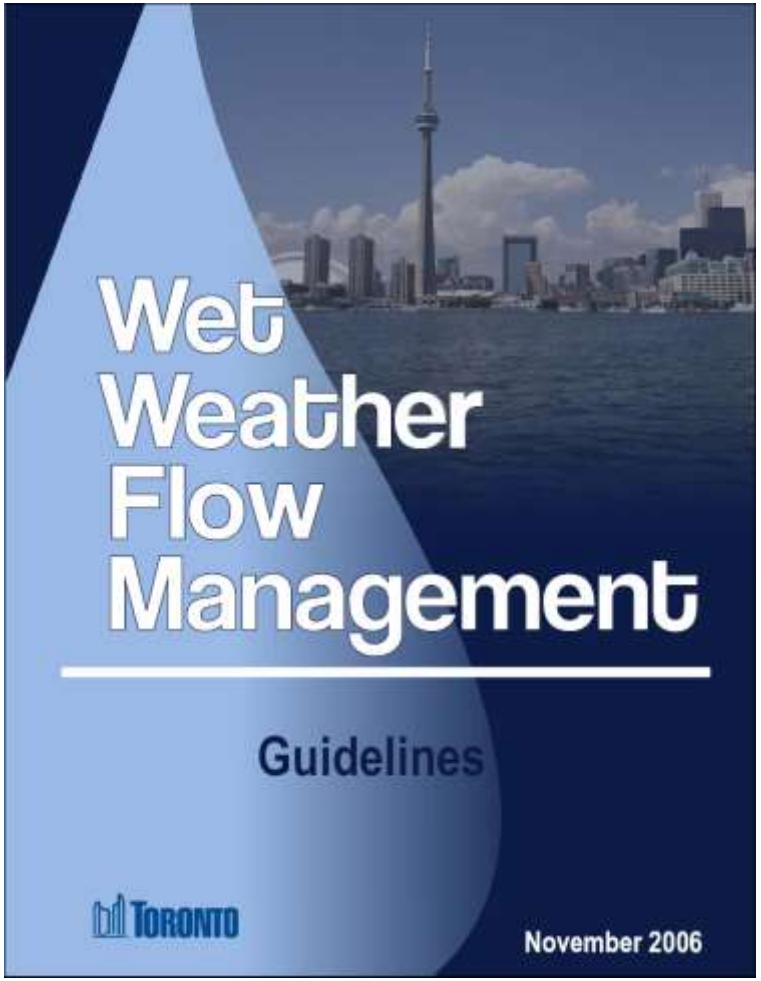
- Climate Change Action Plan – 2008
- Climate Adaptation Strategy, Ahead of the Storm: Preparing Toronto for Climate Change – 2008
- Resilient City: Preparing for Extreme Weather Events - 2013
- Resilient City – Preparing for a Changing Climate - 2014



In the works…

Wet Weather Flow Management Guidelines

- Requires developments to manage stormwater onsite
- Incorporated into the City's Green Development Standard for approvals of new development and redevelopment
- Being updated for 2016



In the works…

Green Streets

- Development of Green Streets Design Guidelines
- Green infrastructure projects at intersections across the City
- Changes how City streets are designed to:
  - Better manage stormwater runoff
  - Help mitigate flooding and enhance water quality
  - Promote infiltration

Coxwell Ave/Fairford Ave Bioretention Parkette

Stormwater Charge

In the works…

- Dedicated charge to fund the stormwater management capital program is being developed
- To better link generators of runoff with the costs of managing runoff
- Fees would likely be based on the amount of impervious area
- Next Step – Complete Research & Report back to City Council on stormwater charge implementation options

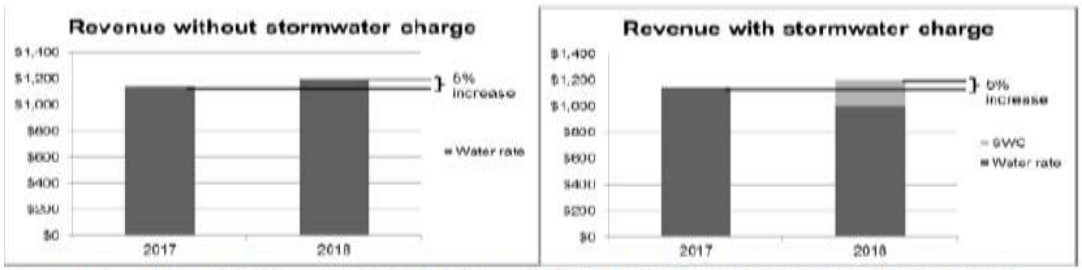


Figure 1 – Anticipated revenue ($ millions) for Toronto Water in 2018 with (left box) and without (right box) the introduction of a stormwater charge (SWC)

Summary

Pressures & Challenges

- Public versus private responsibilities – Often the contributing factors to flooding are beyond direct control of the City.
- How do we address flooding risks associated with groundwater?
- Climate Change – Where do we draw the line between the elimination of flood risk and acceptance of flood risk?

Summary

Pressures & Challenges

- How do we address inflow/infiltration – should we be sizing our sanitary sewers for even bigger storms?
- Can't build infrastructure large enough for all extreme storm events - physical limits to construction
- "Shoehorning" large infrastructure in a built-up urban environment = huge community disruption

Summary

Pressures & Challenges

- How do we verify that completed Basement Flooding Protection Projects have worked?
- How to best prioritize projects going forward?
- As the program accelerates, can the consulting and construction industry deliver?

Summary

Pressures & Challenges

- Assessing the cost of adapting versus the losses that can be expected if we don't.

TORONTO

Summary

Final Thoughts

- Tremendous Progress has been and is being made.
- It took over 100 years to build Toronto, it will take decades to achieve enhanced service targets.
- Several storm events can be expected to test the City's drainage systems before the task is complete.
- For success, everyone must chip in… The City, property owners, builders and developers, industry and businesses.

Summary

Final Thoughts (cont'd)

- Long term vision and commitment is needed.
- Customer Service - each story is unique and each solution requires careful consideration. In our efforts to move mountains quickly, we need to remember this.

Final Thoughts (cont'd)

- **Resident appreciation** - Assess the social benefits of reducing flood risks

Reducing Flood Risk in Toronto

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