Institute for Catastrophic Loss Reduction (ICLR)

"Monthly Series"

September 17, 2010

Hamilton
Public Works

Hamilton's Stormwater Management

Lower East End Storm Drainage Study

"Combined Sewers and Urban Flooding Case Study"

City of Hamilton, Public Works
Infrastructure and Source Water Planning

Nahed Ghbn

Overview

- Background Information
- Hamilton's Stormwater System
- Study Area
- Stormwater Infrastructure/ Combined Sewers
- Problems / Issues
- Strategies / Methodology/ Solutions / Plans

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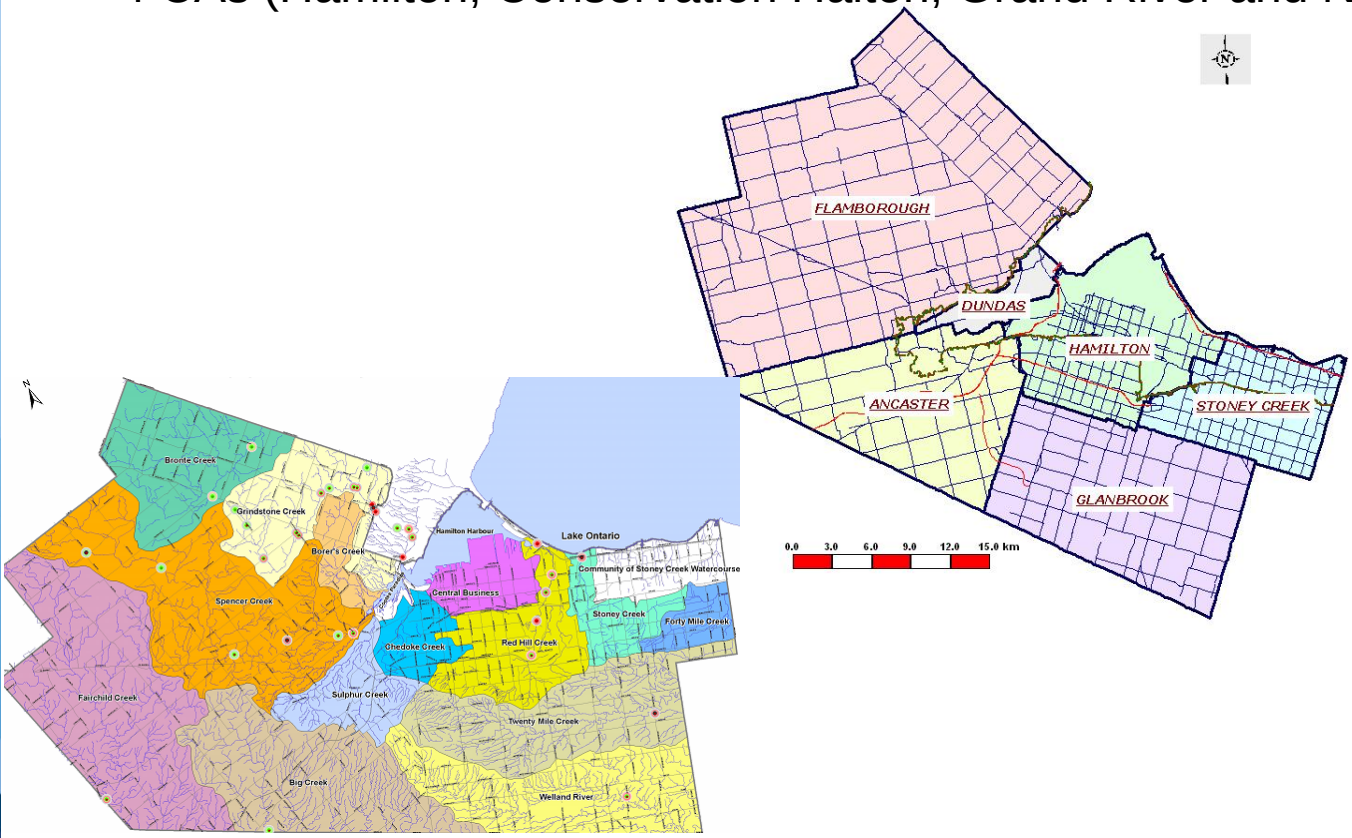
Background Information
City of Hamilton

- 2001 - City of Hamilton (Region of Hamilton, Ancaster, Dundas, Flamborough, Glanbrook and Stoney Creek) were amalgamated
- Population of 504,599 (2006 census)
- 4 CAs (Hamilton, Conservation Halton, Grand River and Niagara)



- Community
- People
- Processes
- Finance

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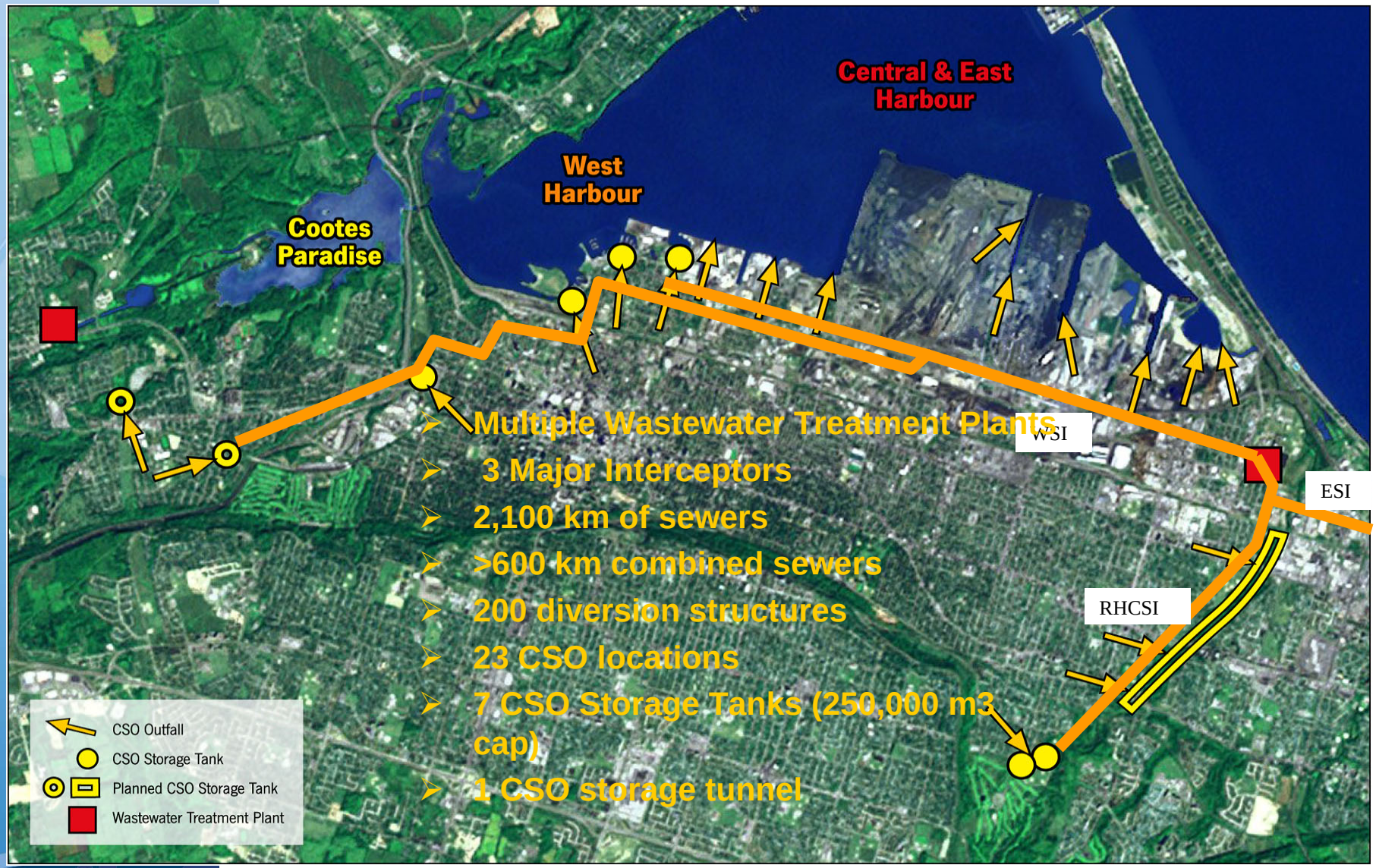
Background Information
Hamilton WW Collection System



- Multiple Wastewater Treatment Plants
- 3 Major Interceptors
- 2,100 km of sewers
- >600 km combined sewers
- 200 diversion structures
- 23 CSO locations
- 7 CSO Storage Tanks (250,000 m3 cap)
- 1 CSO storage tunnel

Background Information
Area of Combined Sewer System

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- People
- Processes
- Finance

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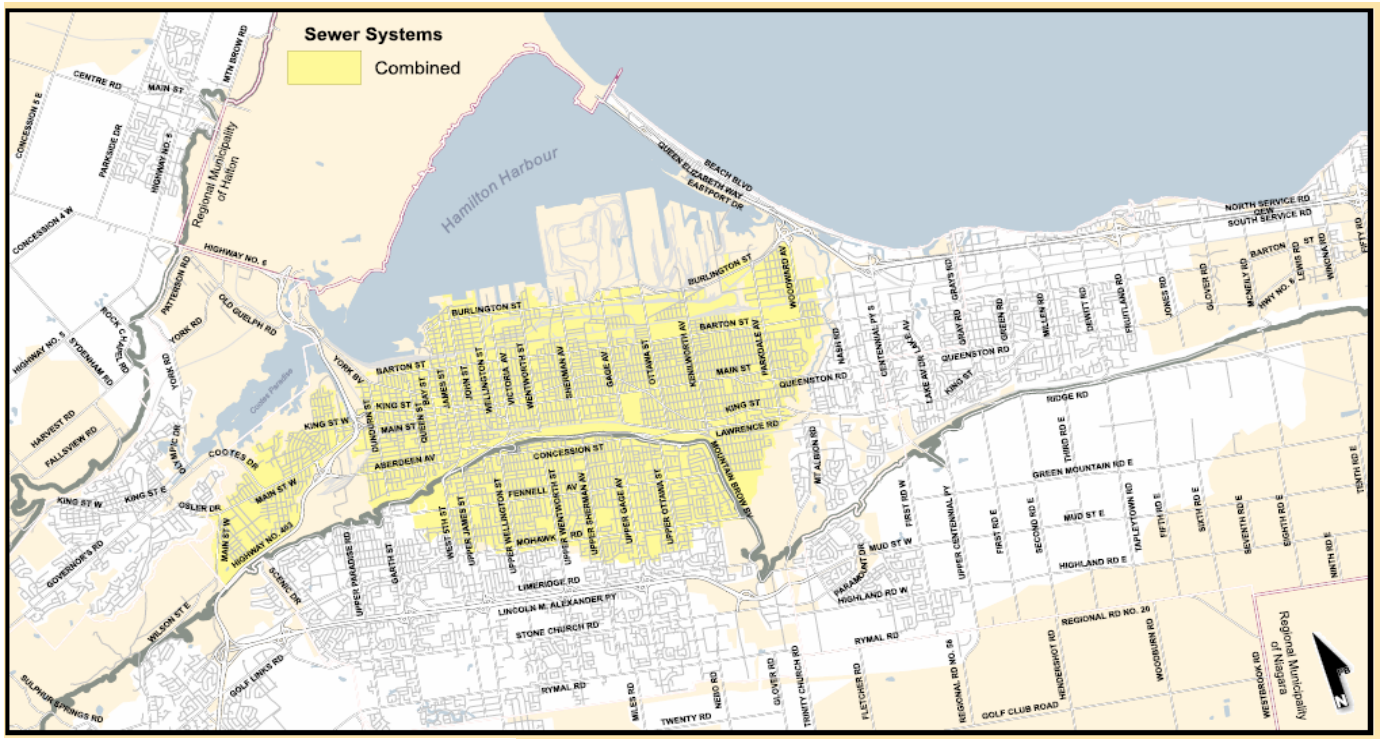
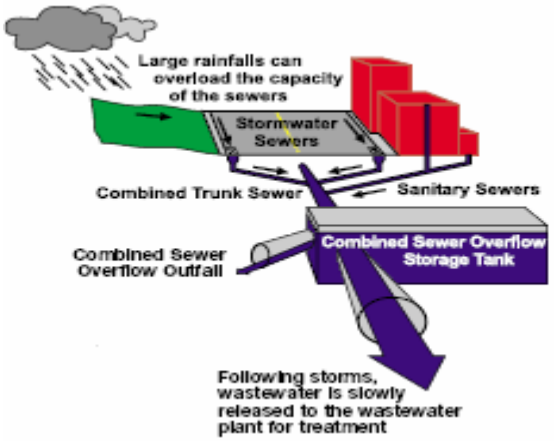
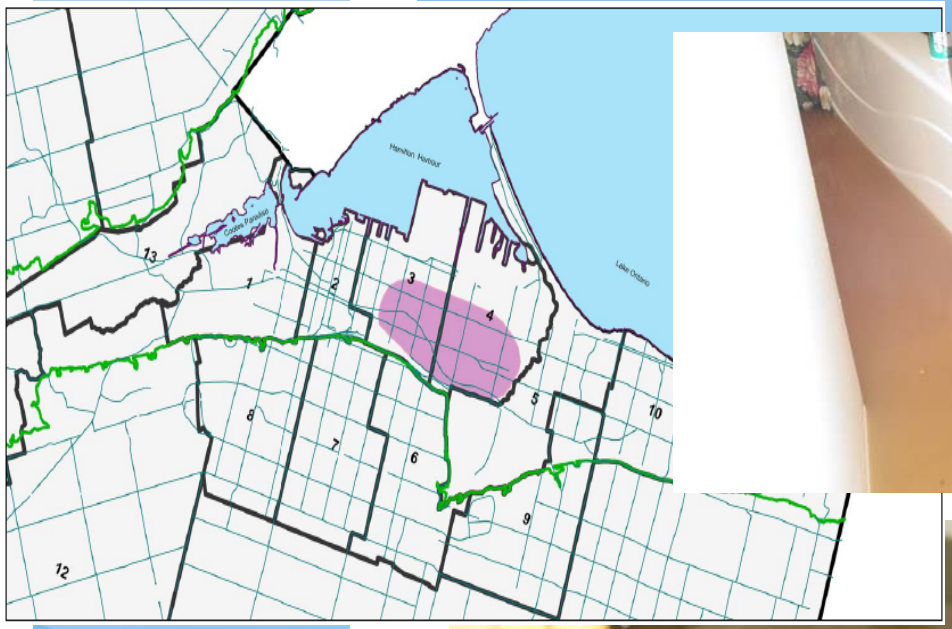
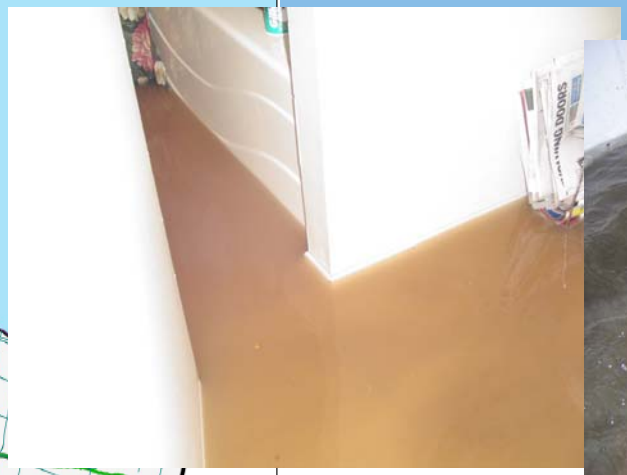




Flooding Problems

Repeated Reported Flooding (2004 – 2010)





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Study Area
Lower East End Storm Drainage Study

- Community
- People
- Processes
- Finance

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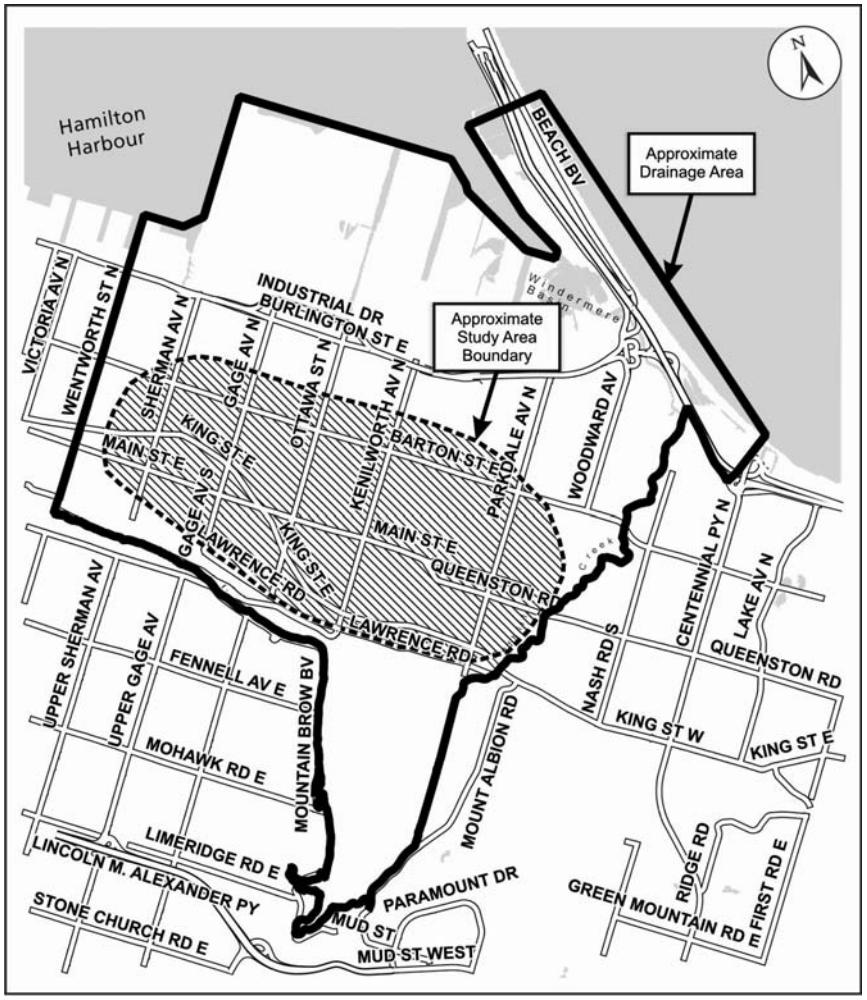

Lower East End Storm Drainage Study

Purpose

- Community
- People
- Processes
- Finance

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Purpose of the Study

- Investigate problem areas with respect to the capacity of the combined sewer system as well as the overland flow route
- Understand the causes of the flooding problems
- Identify and test flood mitigation measures
- Recommend potential remedial measures and solutions

Causes of Flooding

- Climate change conditions. Increase in Rainfall Intensities, Frequencies and Magnitude
- Aging Infrastructure, insufficient sewer capacity/ old sewers were not designed to convey significant Wet Weather Flow
- Diff. historical design standards
- Difference in elevation between sewers and basements
- Overland Flow Path Challenges
- Blockage along the drainage system/stormwater inlets
- Excessive flows
- Private drain connections- single pipes
- Population growth
- Others

Local Sewer System

- Community
- People
- Processes
- Finance

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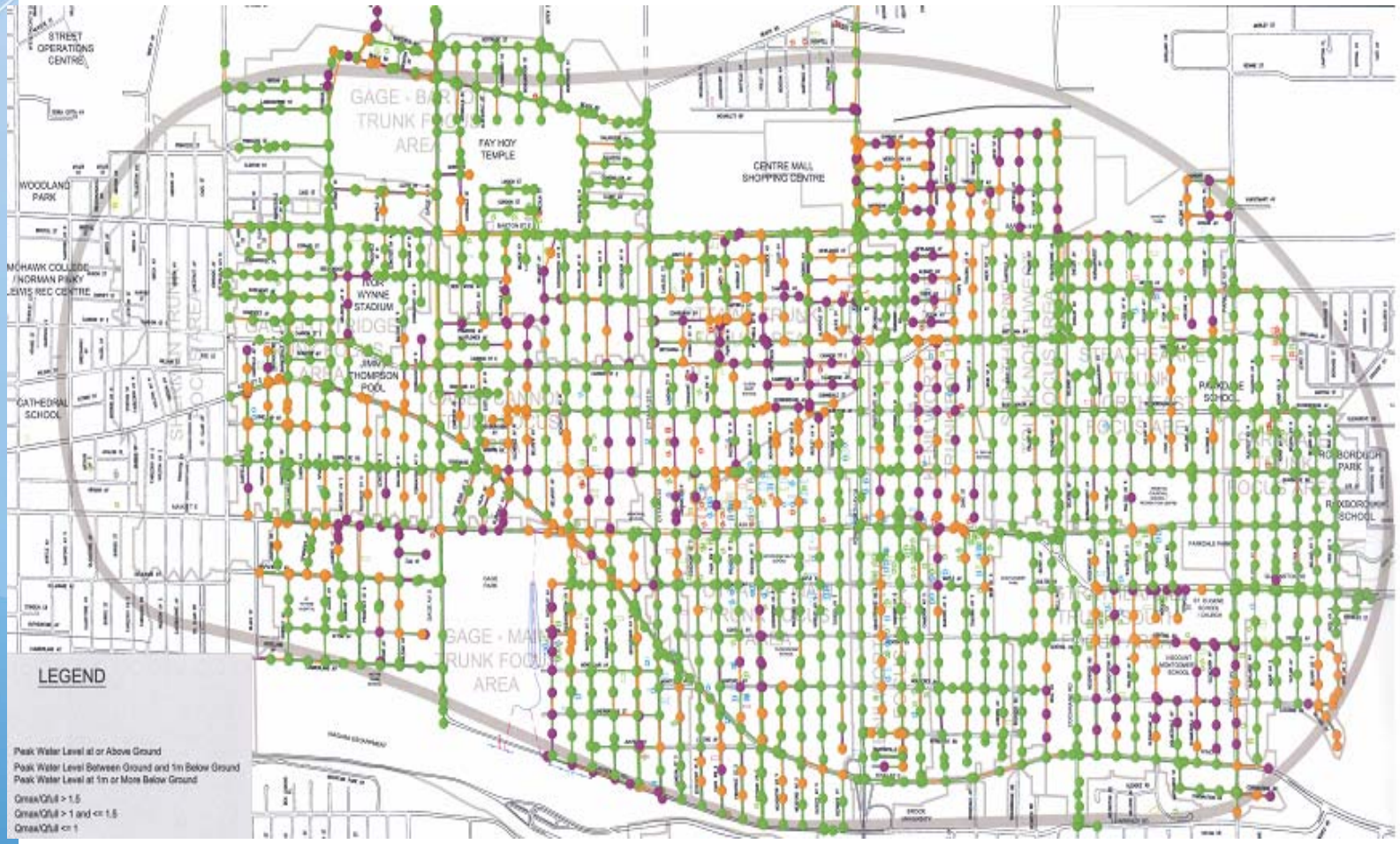
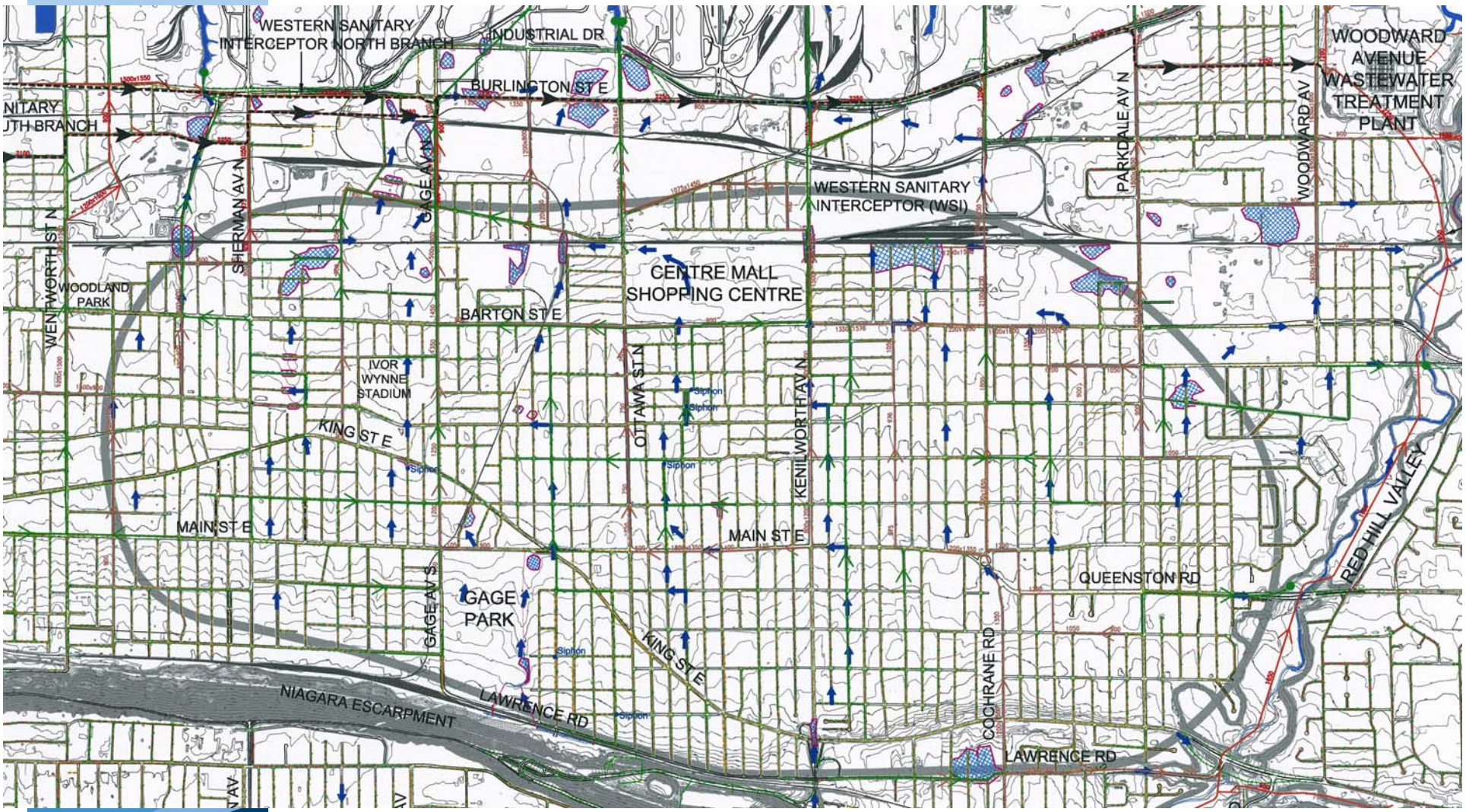


Drainage System
Primary Overland Routes- Depression areas



Lower East End Storm Drainage Study

Methodology of the Study

- Data Collection
- Site Investigations
- Develop “All-Pipes” Model (Mike Urban/Mouse)
- Identify Problems and Focus Areas
- Define Potential Causes of Flooding
- Develop Potential Remedial Measures for each Focus Area
- Investigate the Upstream and Downstream Effects
- Evaluate and Screen Options
- Recommend Appropriate Remedial Measures

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➔ People
➔ Processes
➔ Finance

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Lower East End Storm Drainage Study
Data Collection & Assessment

- City of Hamilton HANSEN Database
- Rainfall data & Analysis of storm events
- Historical maps and sewer information
- Inspection of sewers, inlets, outlets, CSO regulators
- Inspection of overland flow paths
- Sewer video inspections, smoke and dye testing of sewers
- Review of Master plans, drainage systems, capacity analysis, historical design, past sewer connections and flood relief projects
- Onsite observations

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➔ Processes
➔ Finance

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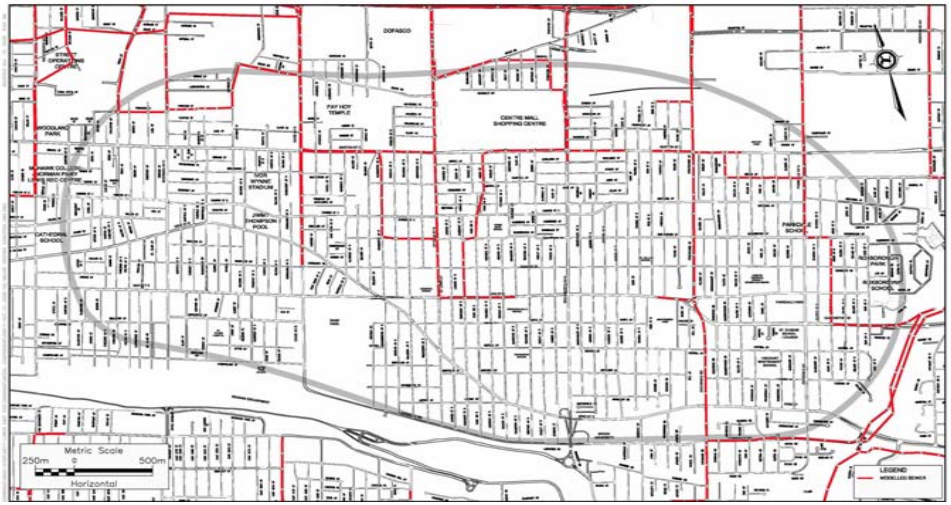
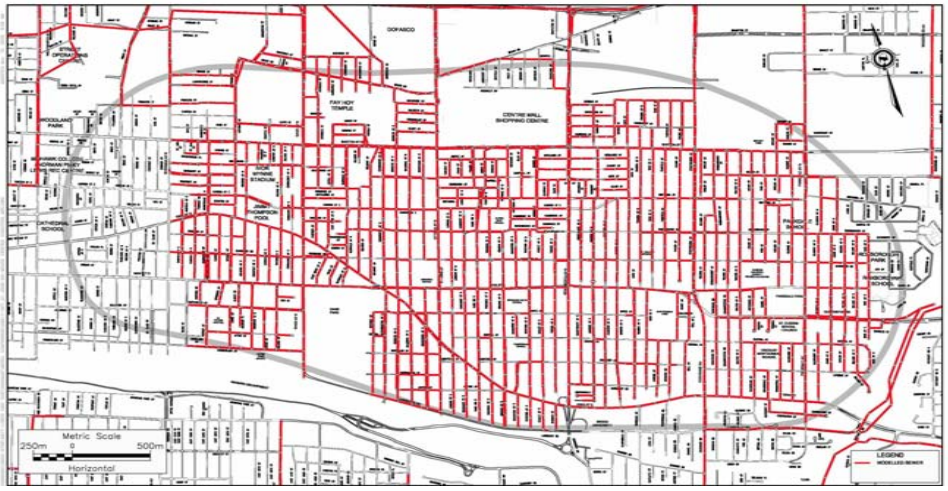
Lower East End Storm Drainage Study
Development of “All-Pipes” Model

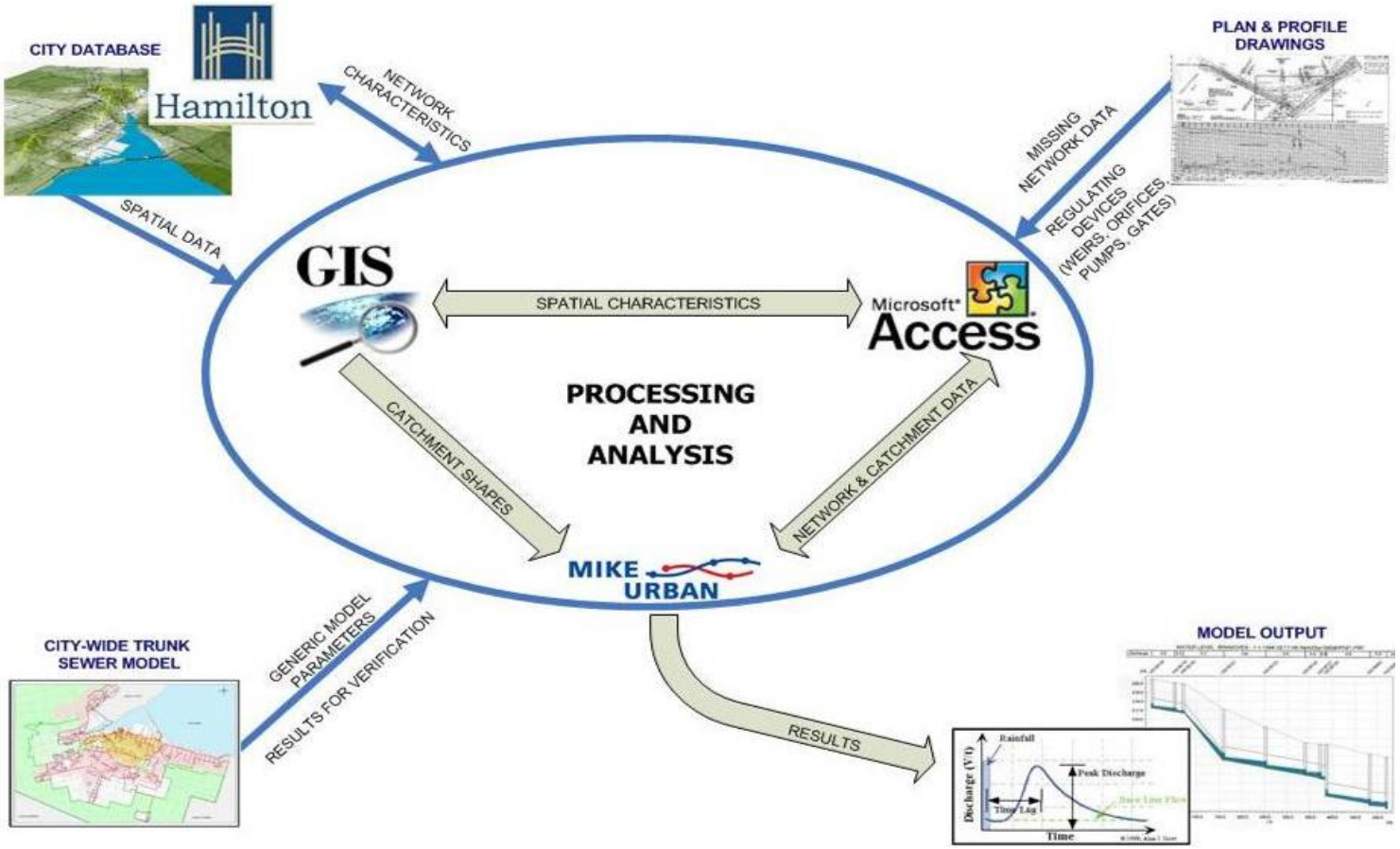
- **“All-Pipes” model includes all combined and storm relief sewers and connections**
- **Catchments split to direct flows to combined sewers and storm relief sewers**
  - **Includes weirs, orifices and gates**
  - **Includes significant dry-weather flow “channels” in manholes**
- **1100 ha area modelled**
- **2760 pipes / 2120 catchments**
- **182 km of sewer**





Lower East End Storm Drainage Study

MODEL WORK FLOW SCHEMATIC



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Lower East End Storm Drainage Study
Potential Solutions

1 - Local Remedial Measures:

Over 90 potential remedial measures/options (designed to a conceptual level) were developed and investigated

- Upgrade/increase capacity of the combined/storm sewers and remove hydraulic bottlenecks
- Extend storm relief sewers
- Modify or provide sewer connections
- Restrict catch basins / disconnect roof leaders
- Incorporate stormwater detention storage into the drainage system to control downstream flow rates

Lower East End Storm Drainage Study
Potential Solutions

- Incorporate additional storm sewers or combined sewers to provide additional flow capacity
- Modify overland flow routes to increase capacity or to redirect flows
- Modify weirs, orifices, gate settings
- Eliminate siphons
- Block sewer connections
- Provide additional catch basins

2 - Large-Scale Storage/Conveyance Tunnel

- Investigated different alignments across the study area
- Cost/benefit analyses (local measures vs tunnel)

3 - Onsite/Widespread Measures

- backwater valves
- inflow reduction (CB restriction, rain barrels, roof leader disconnection)

Lower East End Storm Drainage Study
All-Pipes Model Area- Focus Areas

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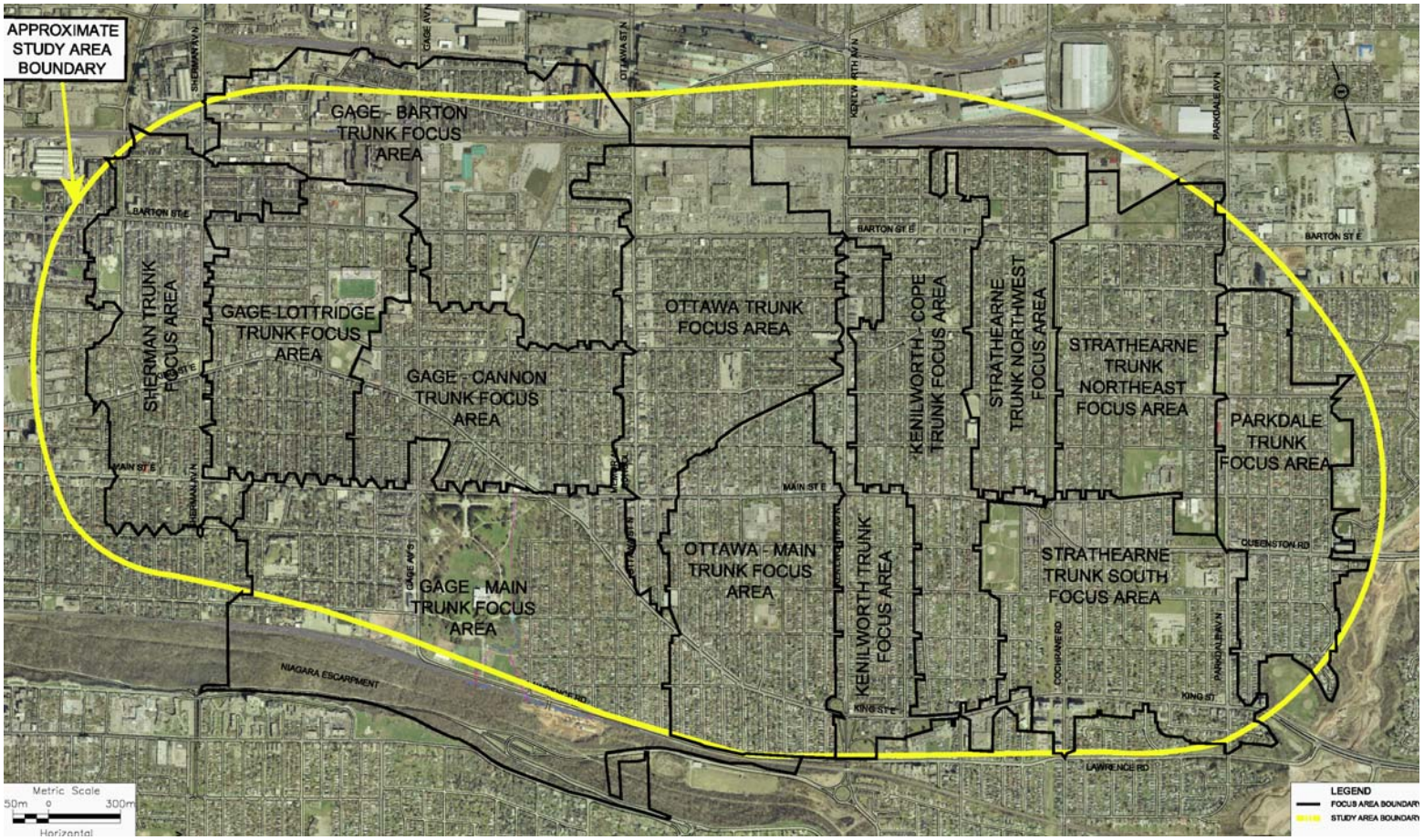
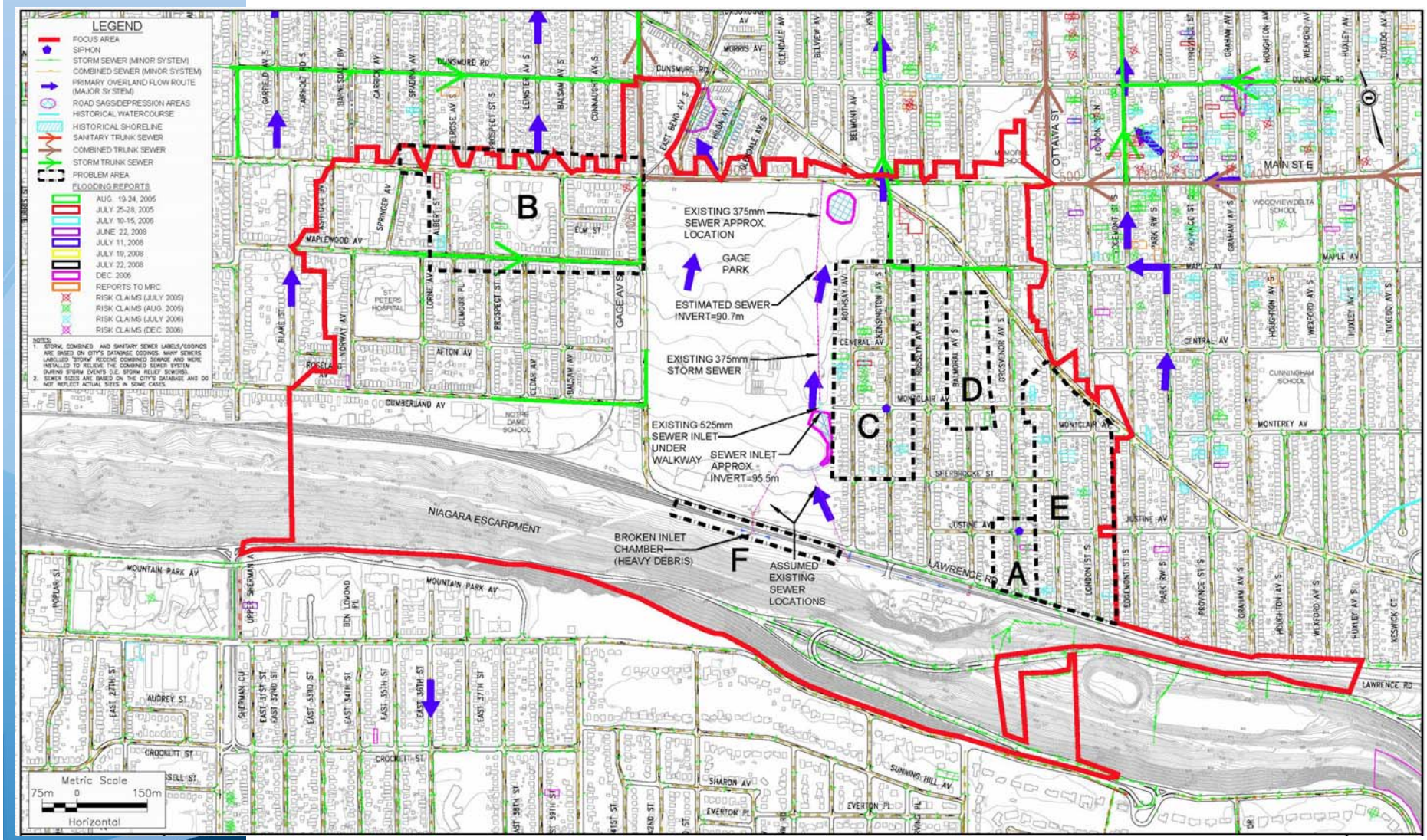


For Assessment Purposes the study area was broken into thirteen (13) focus areas (Due to the size and complexity of the sewer system)

Example: Local Remedial Measures

Detailed Focus Area Analysis



Example: Gage Main Trunk Focus Area Alternative Solutions & Screening

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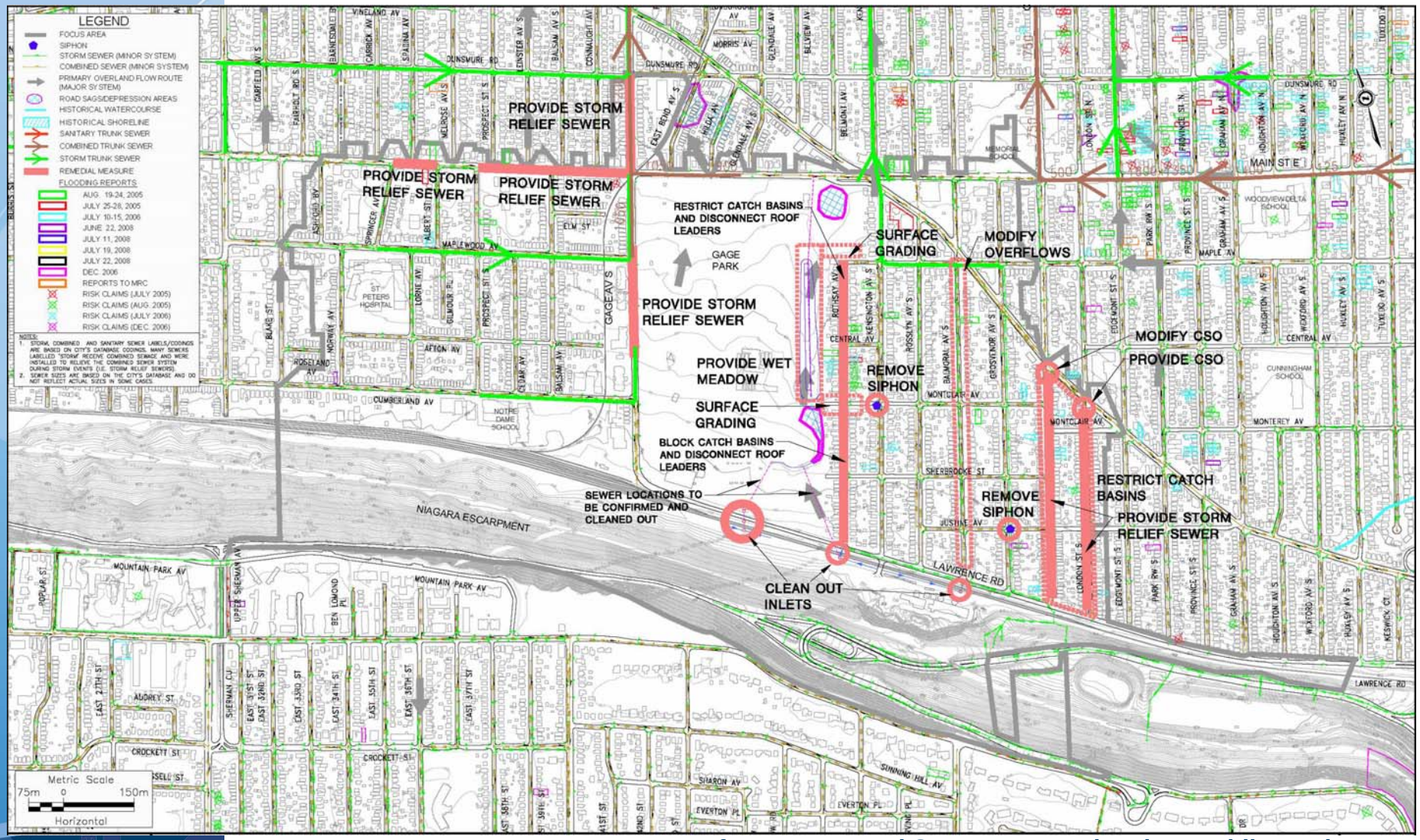
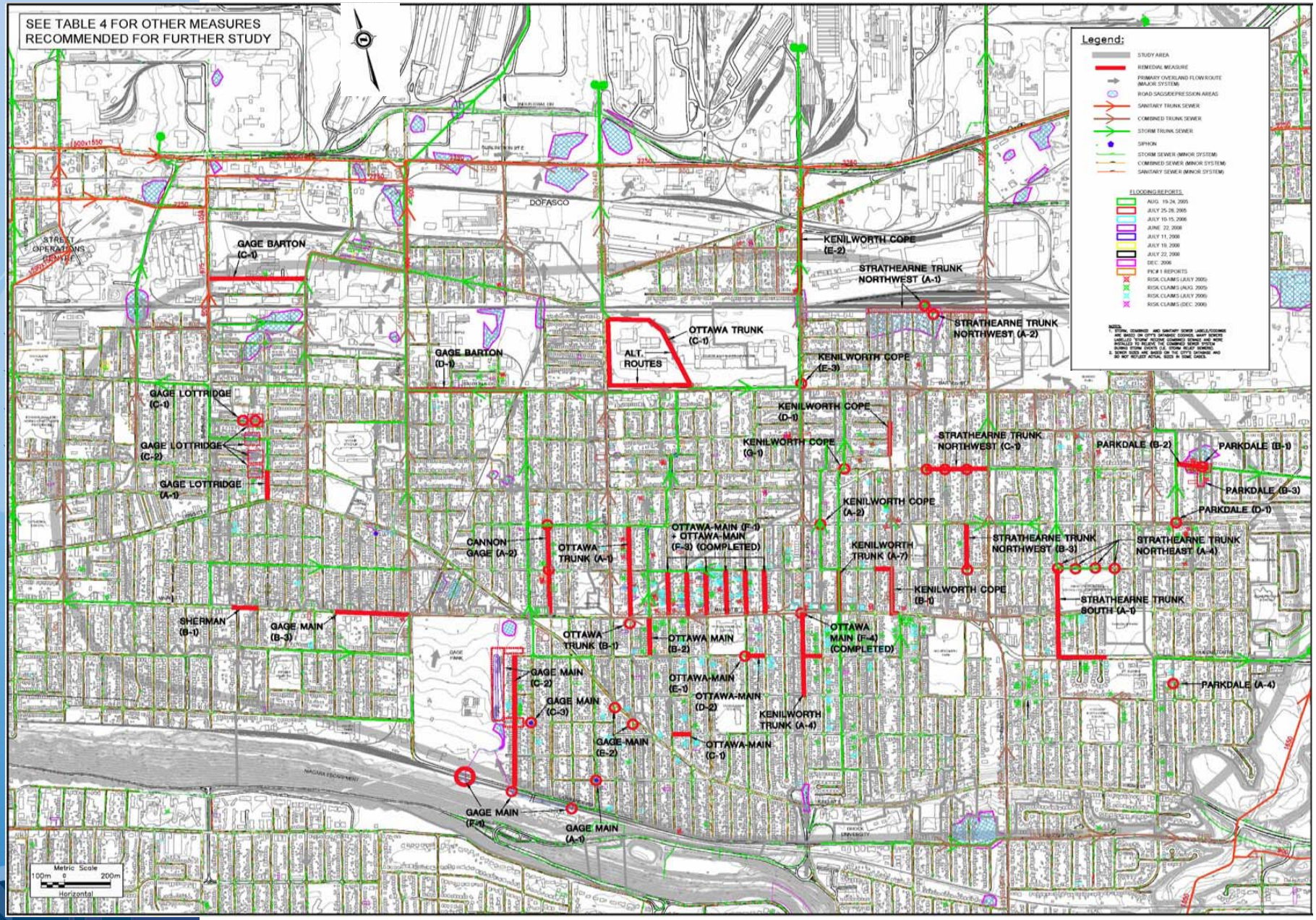
Problem Area	Remedial Measure		Analysis			Recommendation	Selected for Cost-Benefit Comparison with Tunnel?
	I.D.	Description	Benefits	Risks	Costs		
Gage Main Trunk Focus Area							
A	1	Remove the existing siphon at Grosvener Avenue and Justine Avenue by lowering the watermain within the intersection.	Minor	Minor	Low	Recommended (next time road is reconstructed)	No
B	1	Provide new storm relief sewer on Gage Avenue from Main Street to Dunsmure Road to connect the existing storm relief sewers.	Significant	Moderate	Medium	Not Recommended	No
	2	Provide new storm relief sewer on Gage Avenue from Afton Avenue to Maplewood Avenue to connect the existing storm relief sewers.	Significant	Severe	Medium	Not Recommended	No
	3	Provide new storm relief sewer on Main Street from Prospect Street to Gage Avenue to connect the existing storm relief sewers.	Minor-Moderate	None	Medium	Recommended	Yes
	4	Provide new storm relief sewers on Main Street from Spadina Avenue to Albert Street and from Prospect Street to Gage Avenue.	Moderate	Moderate	Medium	Not Recommended	No
	5	Provide three new storm relief sewer segments as described in remedial measures 1, 2 and 3.	Significant	Severe	High	Not Recommended	No
C	1	Restrict catch basins and allow water to flow overland to a new storm sewer on Montcair Avenue. The new sewer will convey flows to a new wet meadow within Gage Park.	Minor-Moderate	Minor	Medium	Not Recommended	No
	2	Restrict catch basins on Rothsay Avenue and allow water to flow overland to Montcair Avenue and Maple Avenue and then direct to new detention facility (wet meadow) in Gage Park. Minor surface grading on the road and within Gage Park will be required to convey flows to the new wet meadow within Gage Park.	Moderate	Minor	Low-Medium	Recommended	No
	3	Remove the existing siphon at Kensington Avenue and Montclair Avenue by lowering the watermain within the intersection.	Minor	None	Low	Recommended (next time road is reconstructed)	No
D	1	Modify connections between the combined sewer and storm relief sewer on Balmoral Avenue between Montclair Avenue and Maple Avenue to ensure that the storm relief sewer is being used to its maximum potential.	Minor	Minor	Low	Not Recommended	No
	2	Same as 1 plus eliminate CSO on Balmoral Avenue south of Maple Avenue	Minor	Minor	Low	Not Recommended	No
	3	Disconnect roof leaders from combined sewer along Balmoral Avenue (encourage and/or fund disconnection).	Minor - Moderate	Minor	Low	Further Study	No
E	1	Restrict catch basins on Ottawa Street and London Street and allow water to flow overland to King Street.	Minor	Minor	Low	Further Study	No
	2	Add CSO to storm relief sewer at London Street and King Street and modify CSO at Ottawa Street and King Street.	Moderate	Minor	Low	Recommended	Yes
	3	Provide storm relief sewers on London Street and Ottawa Street south of King Street.	Significant	Moderate	Medium	Further Study (do after Measure 2 if necessary, confirm no PDCs to storm relief)	No
F	1	Cleanout inlets on Lawrence Road south of Gage Park.	Minor	None	Low	Recommended	No

Example: Detailed Focus Area Analysis Remedial Measures



Recommended Local Remedial Measures



Benefits of Preferred Local Remedial Measures

Storage/Conveyance Tunnel Options

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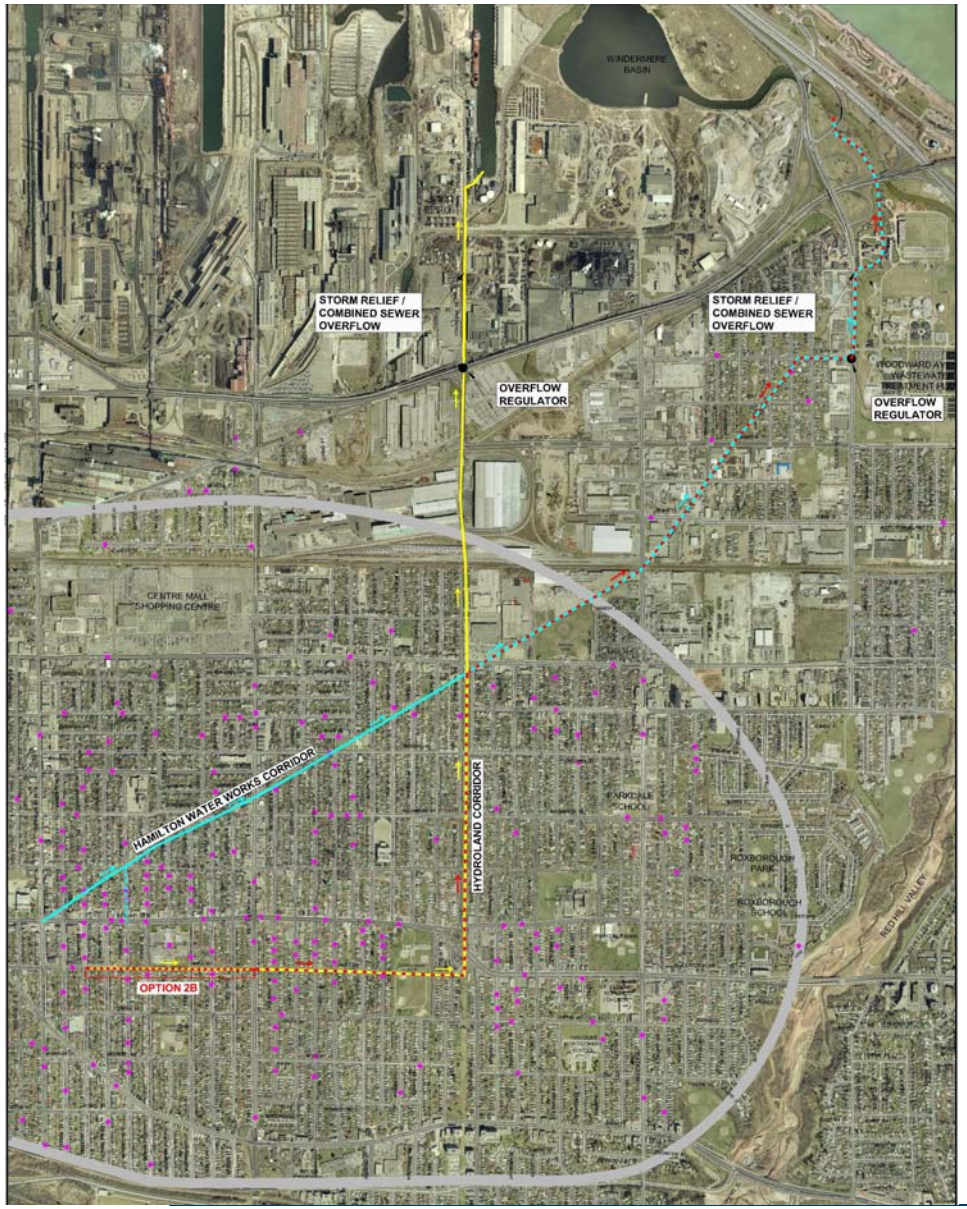
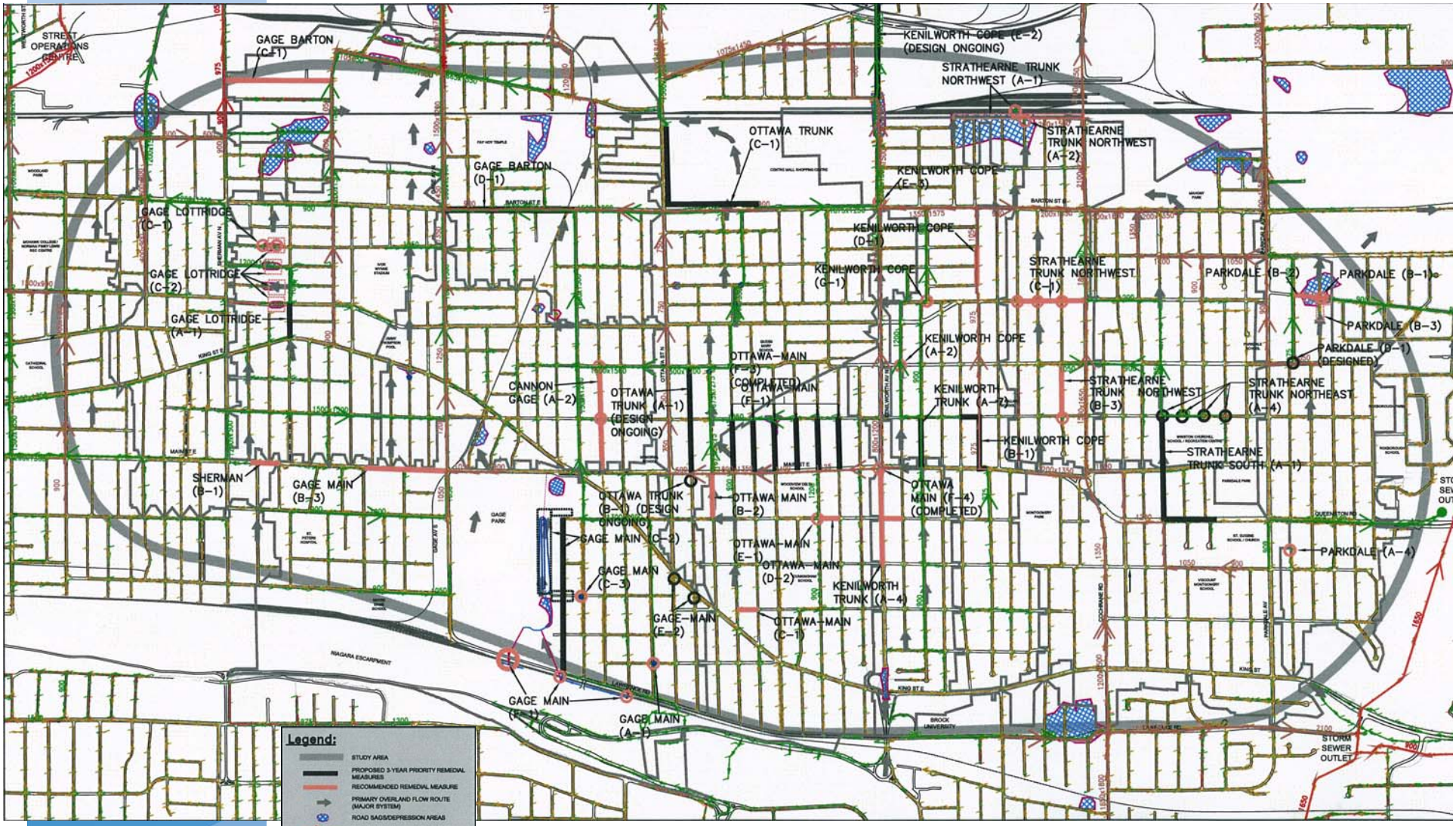


Recommended Local Remedial Measures-3-Year Priority Plan (Highlighted in Black)



Sample: Kenilworth Underpass – Hydraulic Grade Line Comparison

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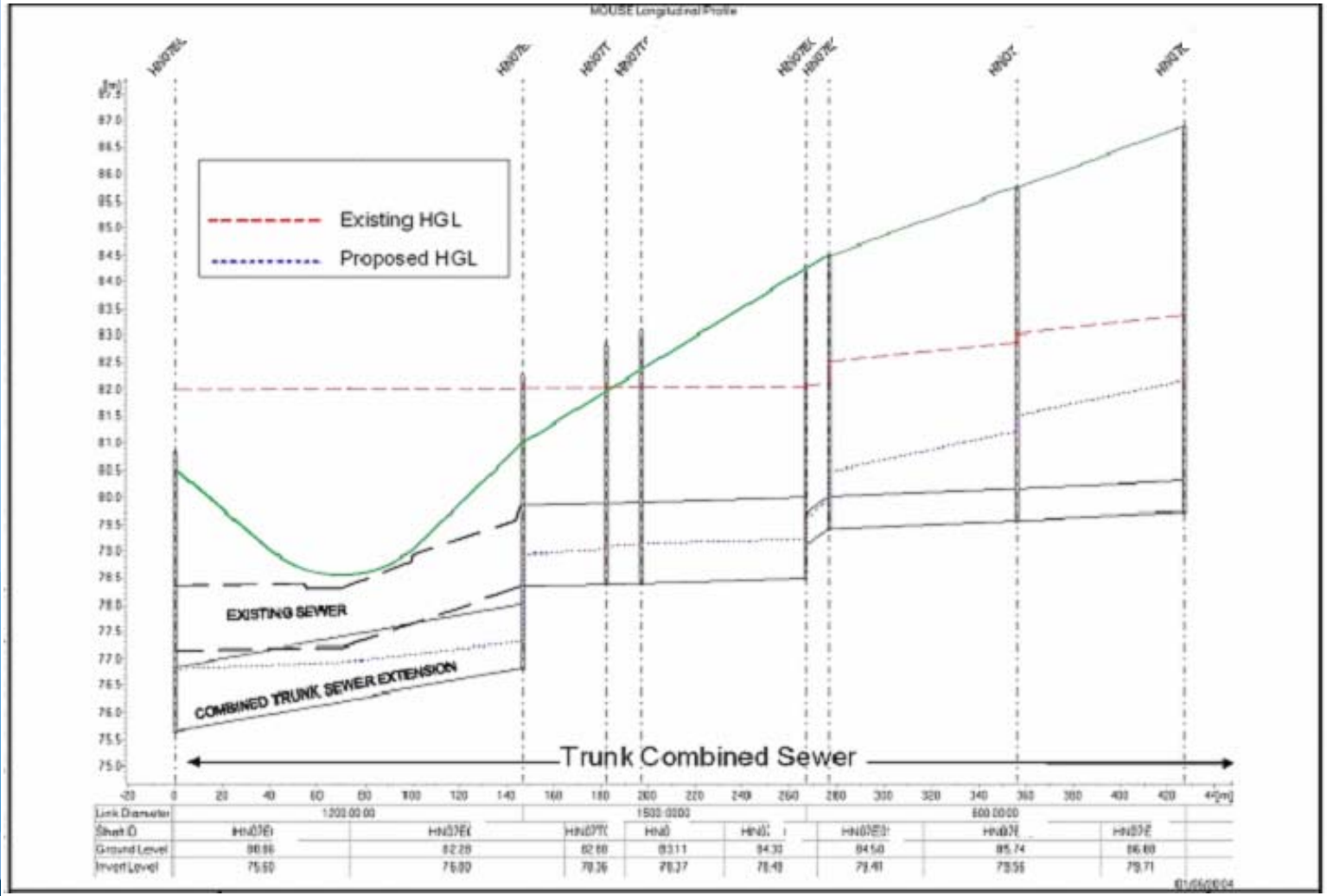
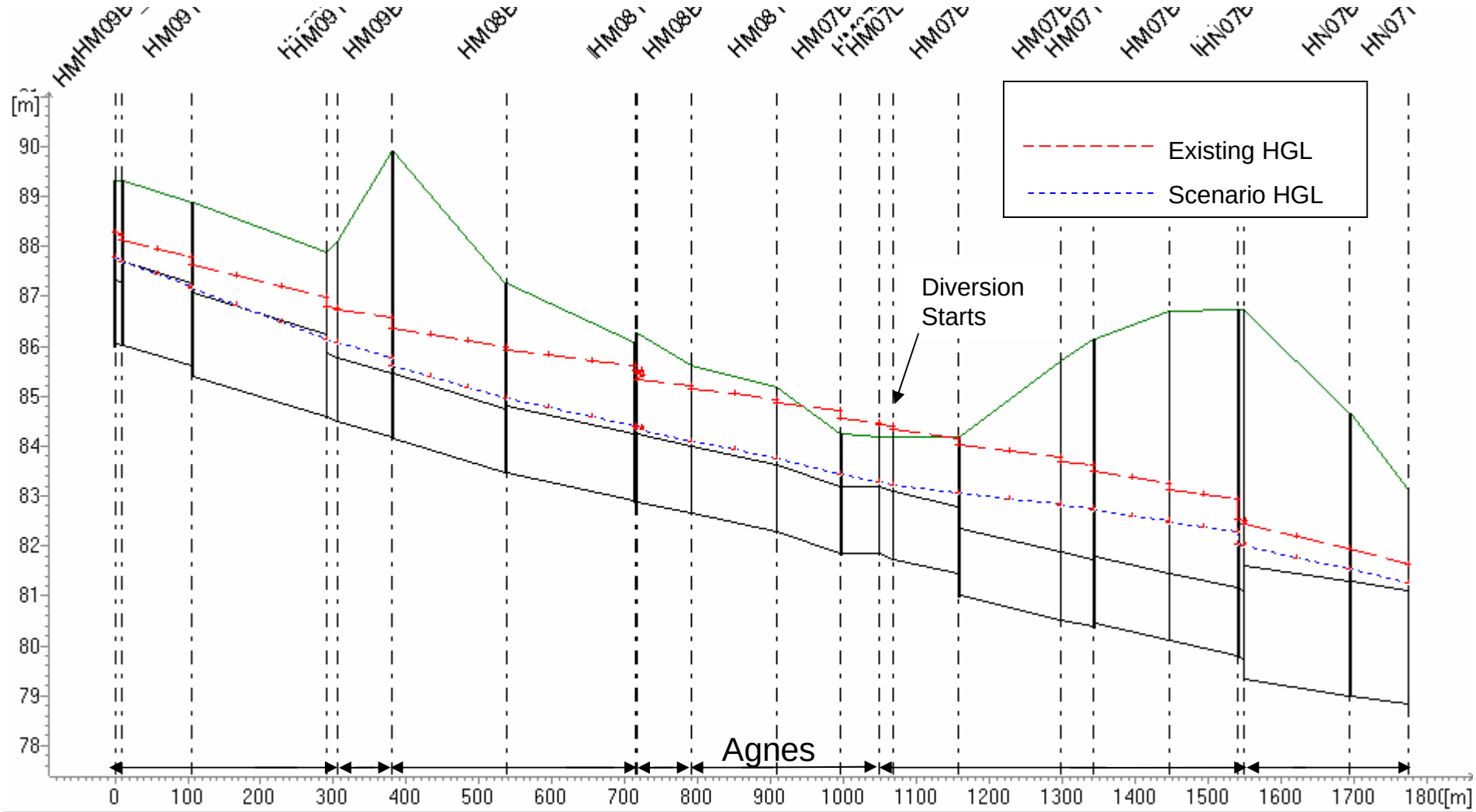


Sample: Centre Mall Diversion – Hydraulic Grade Line Comparison



Link Diameter	1675.0000		1275.0000		1350.0000											2280.0000		
Shaft ID	HM09T004			HM08B025														
Ground Level	88.88	87.89	89.90	87.27	86.09	85.62	85.19	84.25	84.17	85.71	86.15	86.71	86.74	84.66				
Invert Level	85.39	84.56	84.16	83.46	82.89	82.64	82.27	81.83	80.99	80.51	80.37	80.10	79.30	79.00				

01/06/2004

Lower East End Storm Drainage Study
Conclusions / Next steps

- Recommended remedial measures for each focus areas (completed)
- Established priority works (completed)
- Confirm details and prepare design works (ongoing)
- Fulfil the Municipal Class Environmental Assessment requirements (ongoing).
- Fulfil the MOE requirements (ongoing)
- SERG/ LEED Capital Work coordination (Ongoing)
- Implementation of the Real Time Control Program (RTC) to manage wet weather flows and optimise the use of the existing sewer system, CSOs and investment projects (ongoing).
- Investigate to mitigate any Negative Impact on the Sanitary Interceptor WSI, CSO strategies and WWTP (ongoing).
- City-Wide Plumbing Protective Program, 3P (ongoing)
- Continue to develop and refine Social Marketing materials and programs such as Flood Aware Preparedness Program (ongoing).

Lower East End Storm Drainage Study
Conclusions / Next steps

- Initiated the Independent Community Panel (ICP) in 2006 to review and assess the Hamilton's stormwater management programs/activities and make recommendations. The ICP was reconvened again in 2008/09 for a second peer review process and follow up. In process to implement the recommendations.
- Consideration to investigate/ assess the Climate Change impact on the infrastructure.
  - Investigate the impact of different range of storms (2-year 24h, 2- year 6 h, 5- year 24 h, 5-year 6 h, 10-year… etc) on the existing infrastructure.
  - Evaluate the hydraulic performance of the system in Hamilton.
  - Coordinate and cooperate with other parties.
  - Development of appropriate adaptation actions/ risk mitigation at the local level.

Lower East End Storm Drainage Study
Conclusions / Next steps

- Update the stormwater policy to enhance implementation of LID measures in Hamilton.
- Bridge the LID concepts, techniques into the OP/ zoning in Hamilton along with awareness/ education/ promotion actions.
- Consider flooding control measures on a source and watershed prospective.
- Provide overland modeling in conjunction with sewers modeling 1D-2D.
- Continue the regulate sewers inspections/ cleaning/ capacity increase.
- Define the next Areas for detailed investigation and implementation in accordance with the City standards and plans.