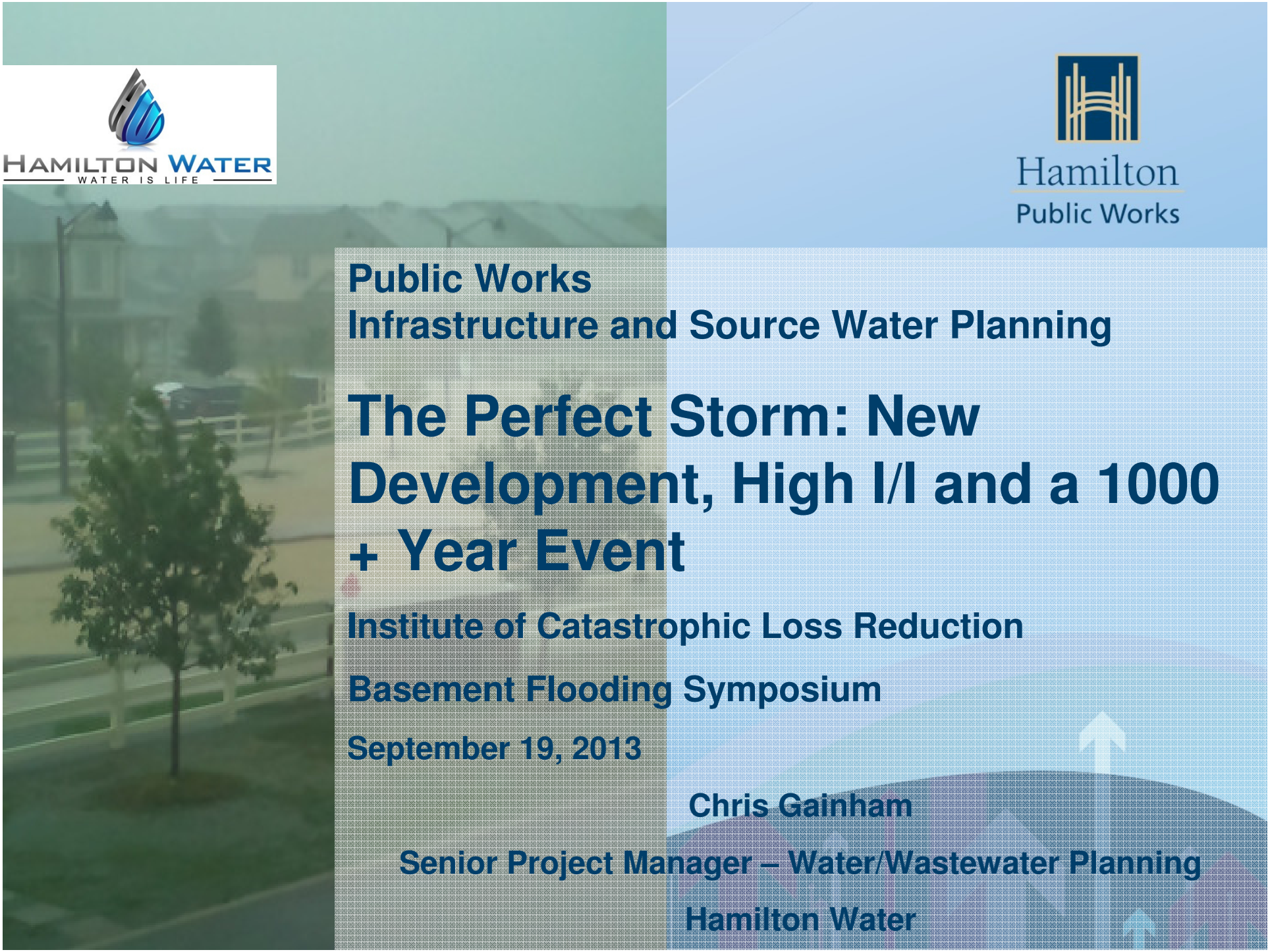


HAMILTON WATER
WATER IS LIFE

Hamilton
Public Works

Public Works
Infrastructure and Source Water Planning

The Perfect Storm: New Development, High I/I and a 1000 + Year Event

Institute of Catastrophic Loss Reduction

Basement Flooding Symposium

September 19, 2013

Chris Gainham

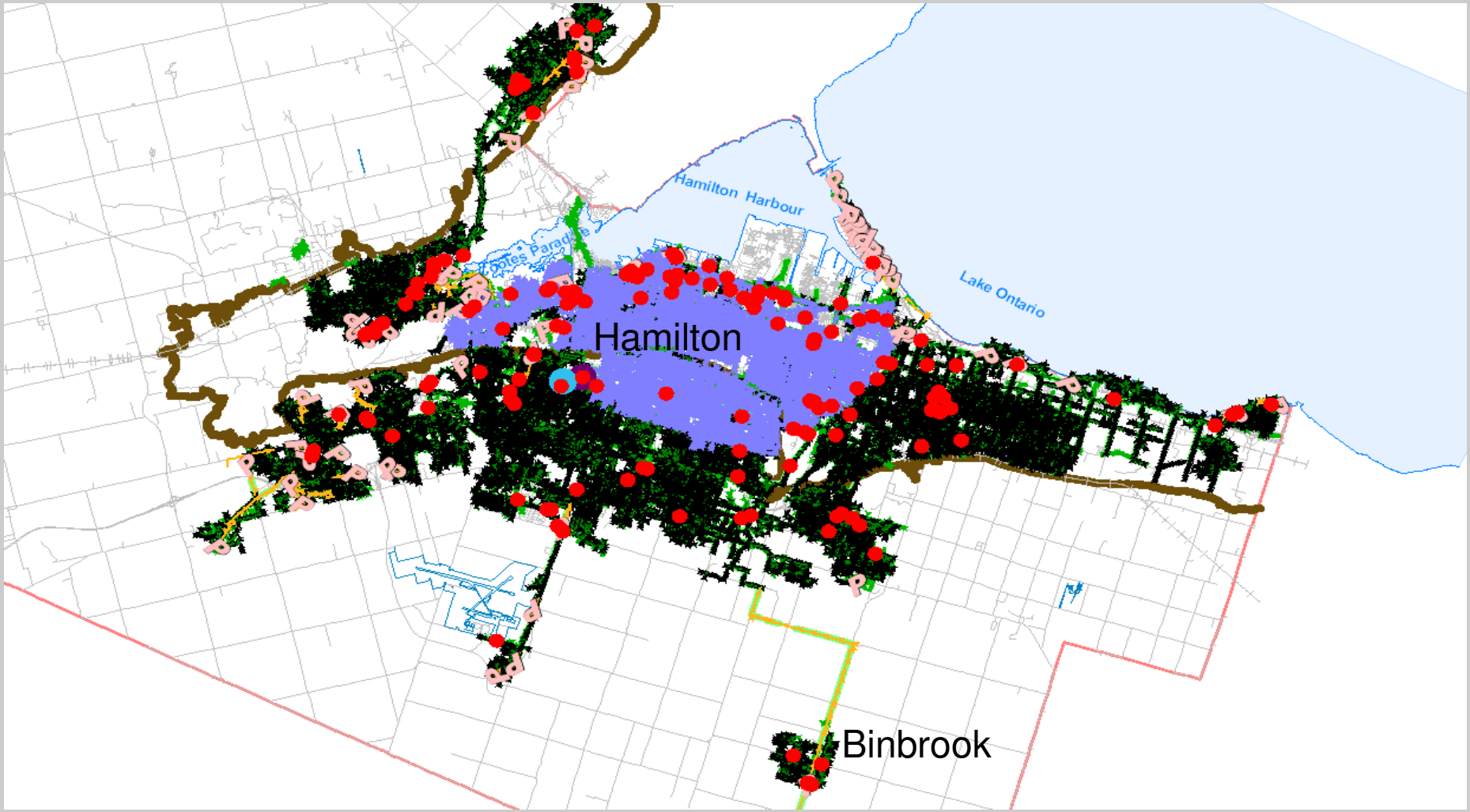
Senior Project Manager – Water/Wastewater Planning

Hamilton Water

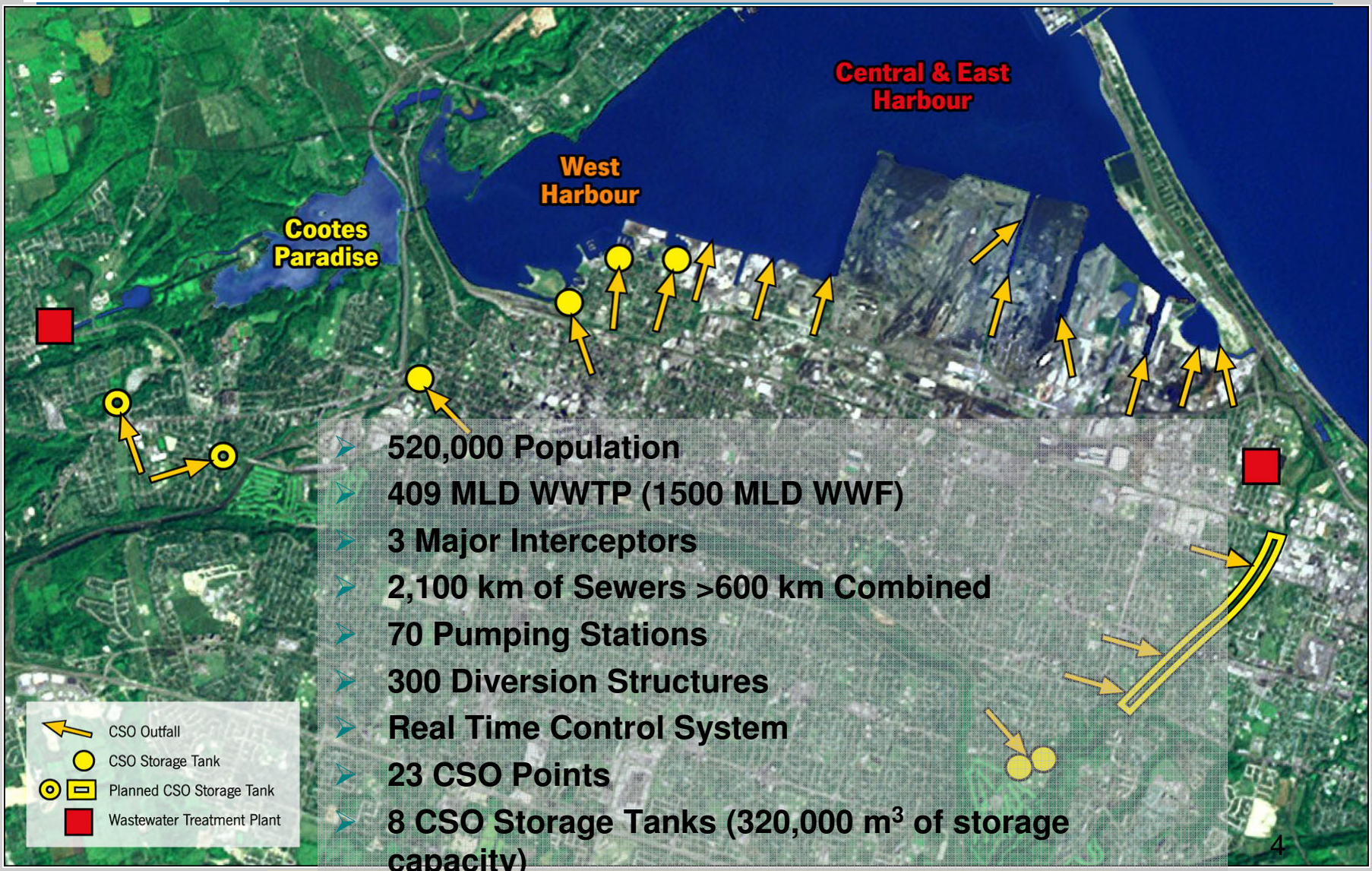
Presentation Overview

- Background
- Approach to Infiltration/Inflow (I/I)
- 1000+ yr storm
- Flooding Forensics
- Remedial and Adaptive Measures

Combined & Sanitary Service Areas



Background Information
City of Hamilton



- 520,000 Population
- 409 MLD WWTP (1500 MLD WWF)
- 3 Major Interceptors
- 2,100 km of Sewers >600 km Combined
- 70 Pumping Stations
- 300 Diversion Structures
- Real Time Control System
- 23 CSO Points
- 8 CSO Storage Tanks (320,000 m^3 of storage capacity)

What is Infiltration/Inflow

- I/I refers to unintended rainwater and groundwater entering a separated sanitary sewer system
- Results in increased conveyance, treatment costs, treatment plant upsets (bug washout), sanitary sewer overflows, surcharge and basement flooding in the worst cases
- Direct and indirect sources:

<u>Private Property Sources</u>

illegally connected downspouts, foundation and area drains, uncapped cleanouts, leaky household laterals

<u>Public Right of Way Sources</u>

improperly connected catchbasins, open grid manhole lids, cross connections to the storm system, manhole, chamber & pipe defects

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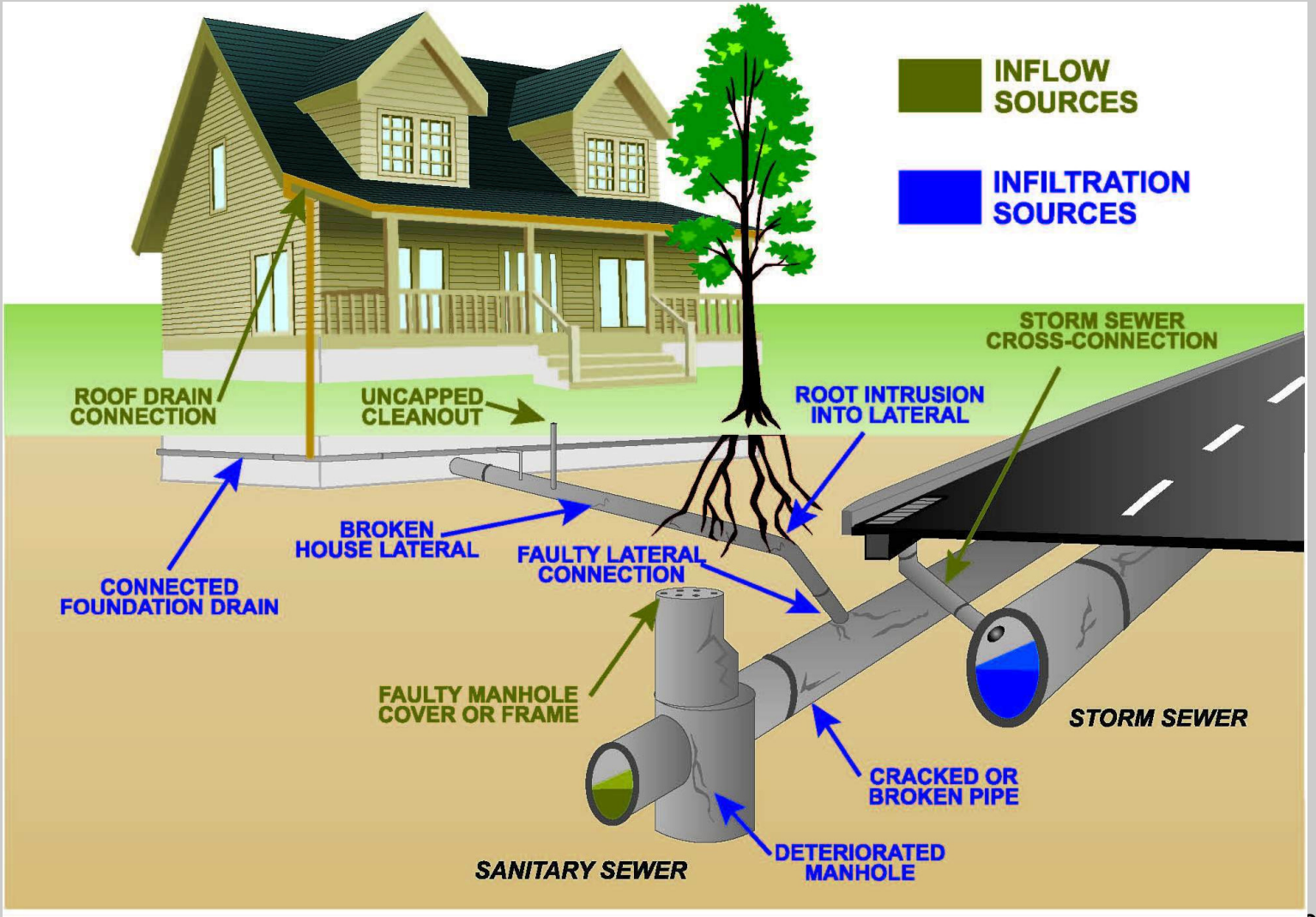
Sources of Infiltration/Inflow



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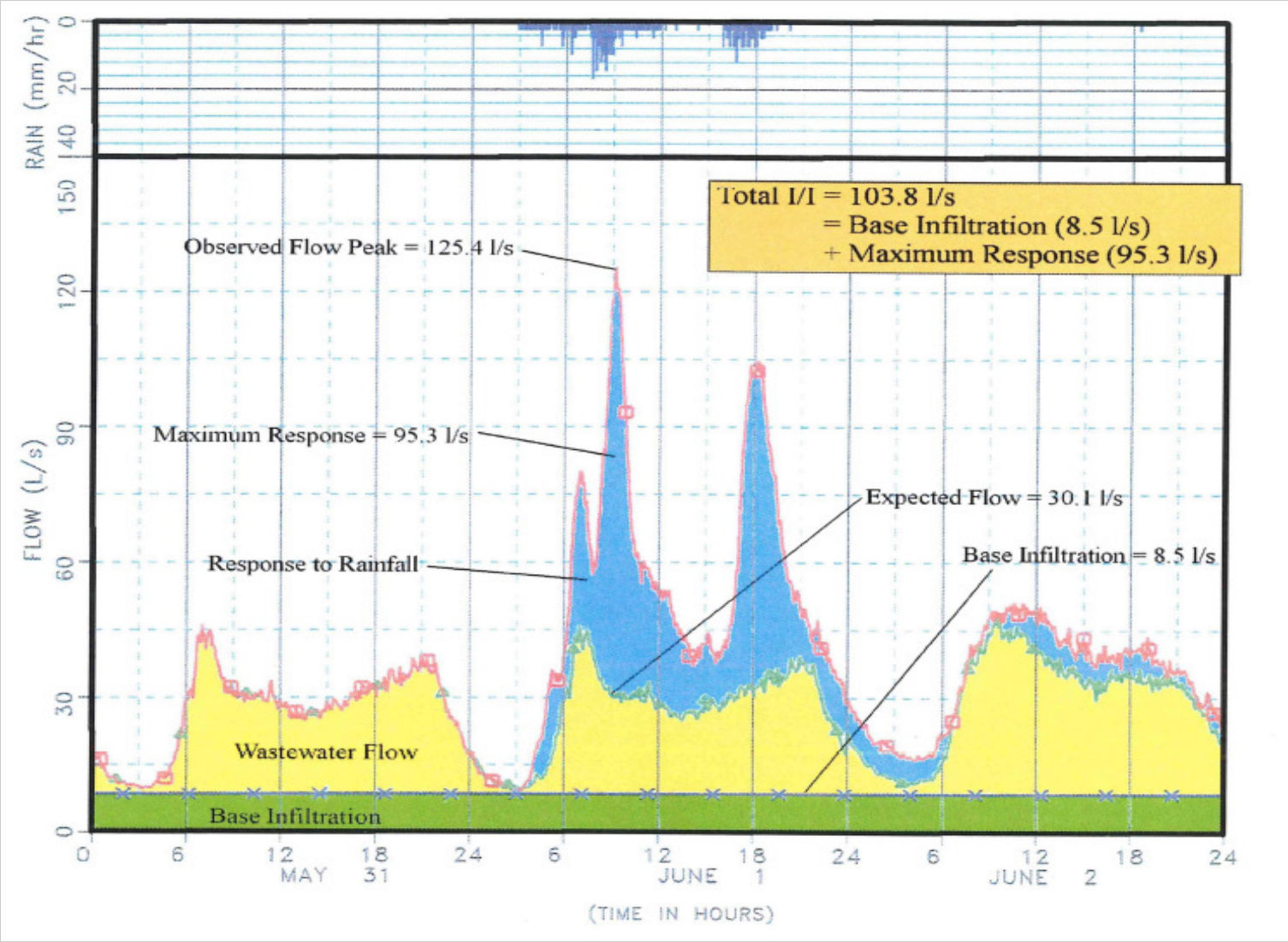
Components of Infiltration/Inflow



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Approach to I/I

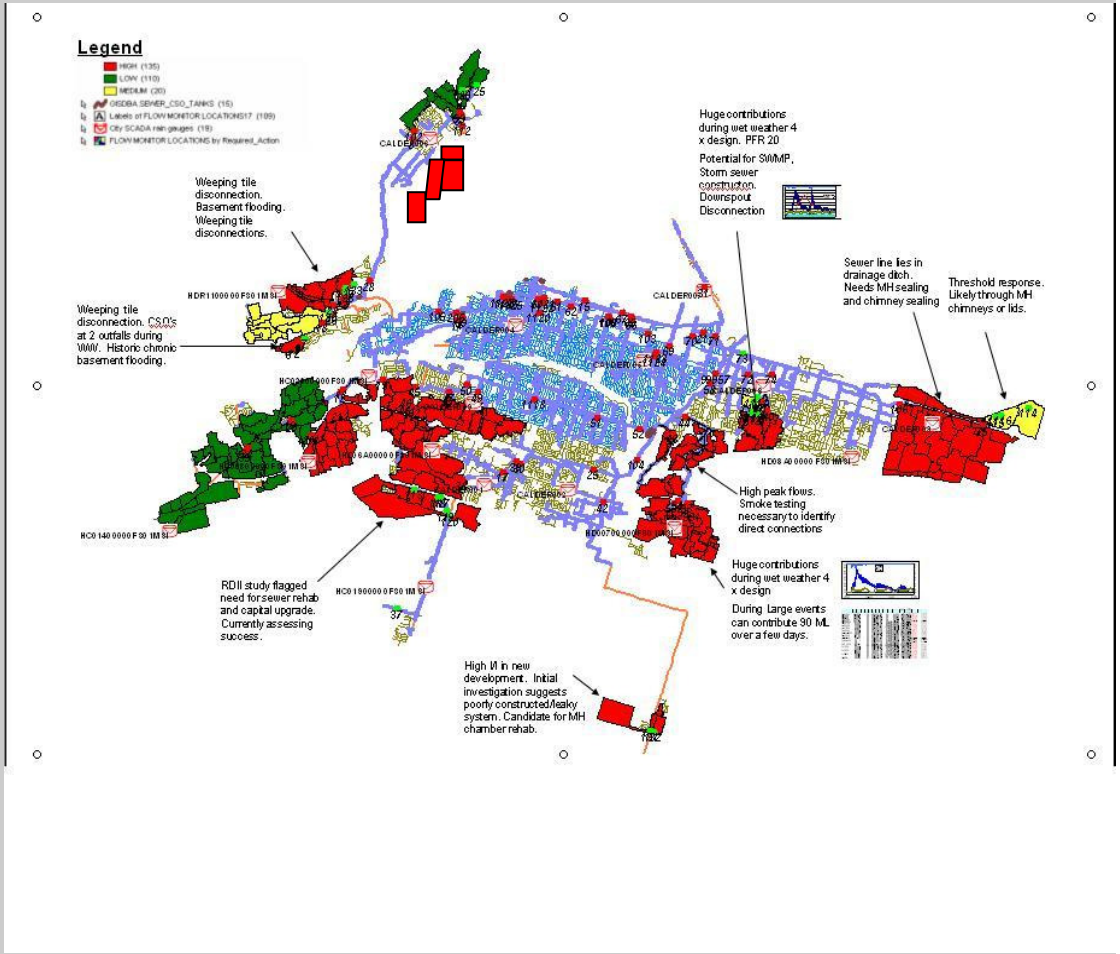
-Design allowance of 0.2 L/s/ha to 0.4L/s/ha depending on storm sewer level of service

-200 flow monitors, 30 raingauges

-Post event gauge adjusted RADAR forensics for big events

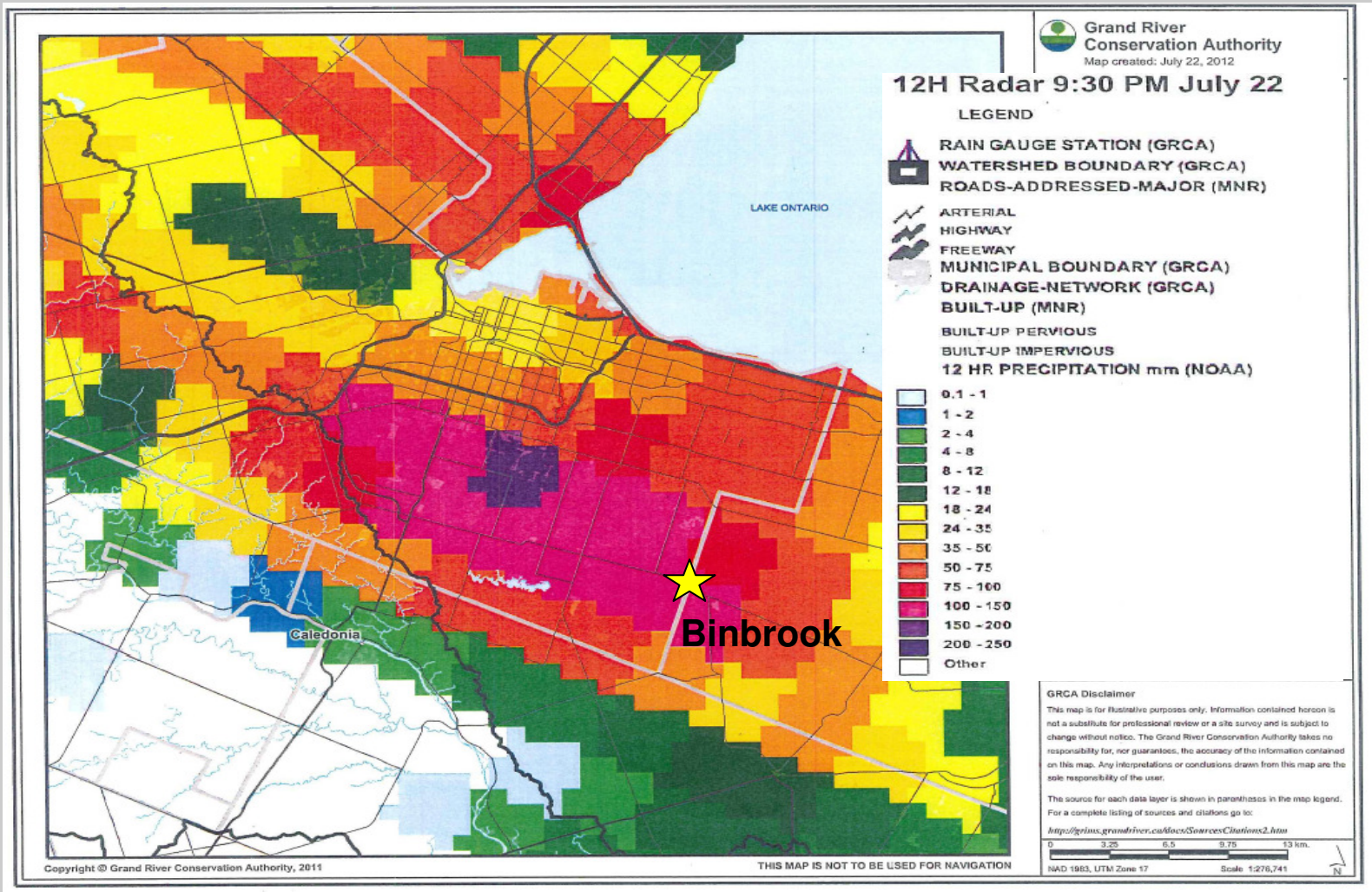
-Smoke testing, wet weather inspections, CCTV, zoom, dye testing

-Past 8 yrs 18 storms
severe enough to cause flooding
(50 – 100 yr storms)



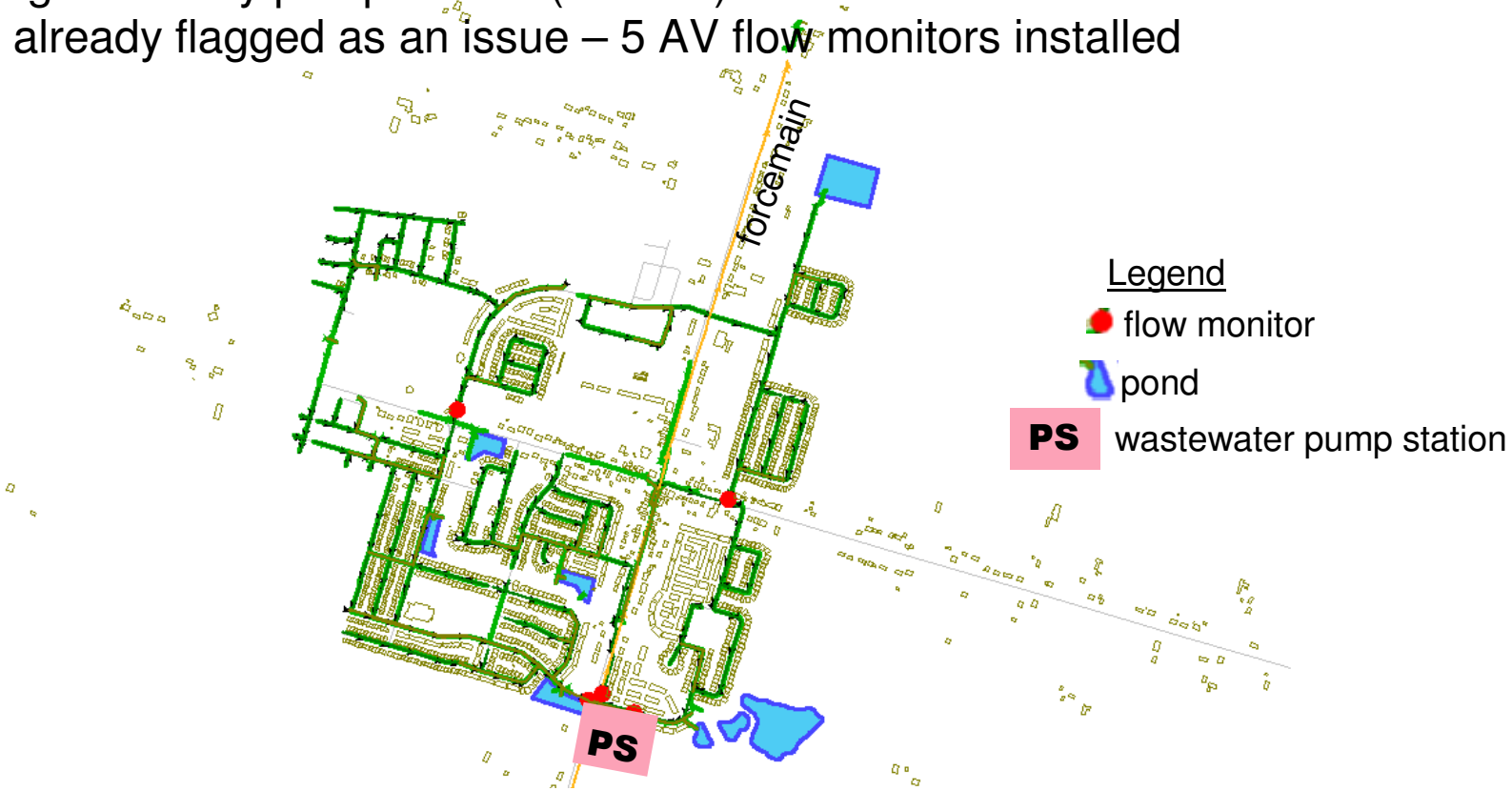
The Big Storm

July 22, 2012 - persistent slow moving thunderstorms, heavy rain, large hail and unofficial reports of tornadoes



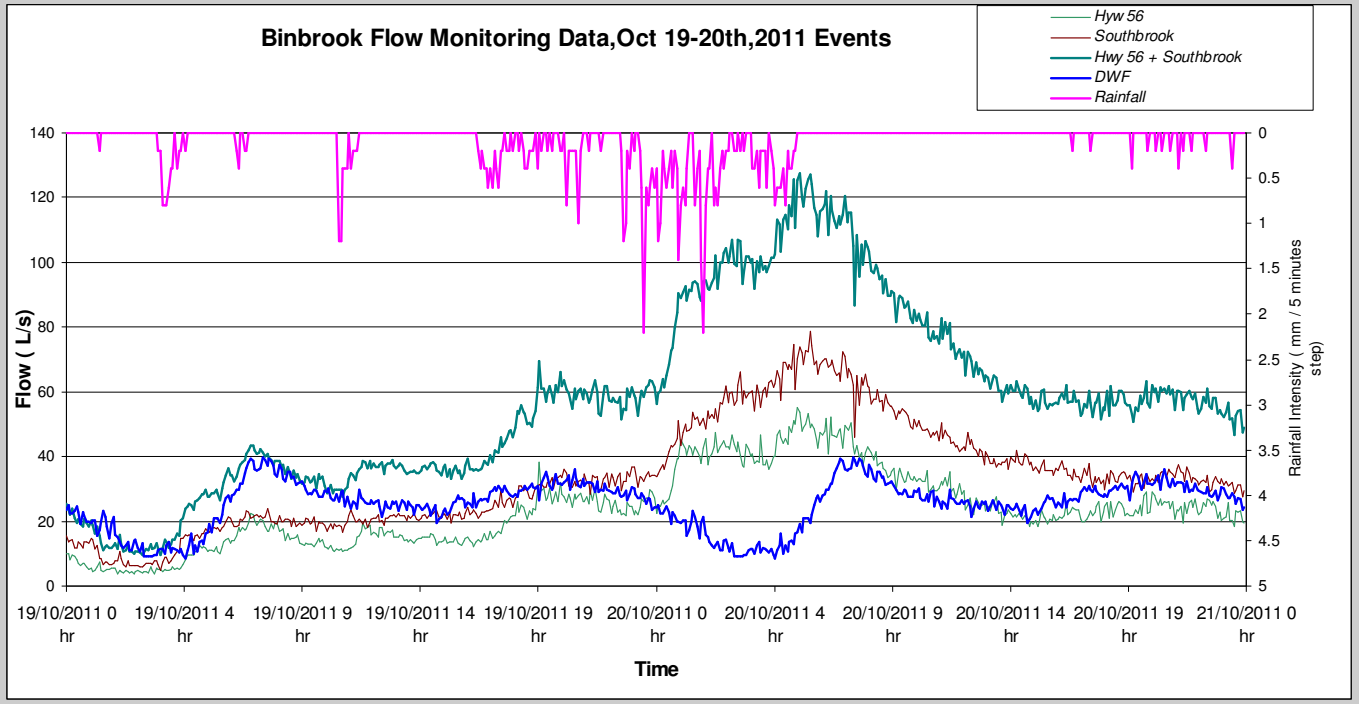
The Binbrook Urban Area

-Pop'n ~ 6000 – Full build-out ~14,000
-Most subdivisions built in the 2000's
-Single sanitary pump station (140 L/s) with no overflow and 10 km forcemain
-I/I already flagged as an issue – 5 AV flow monitors installed



Previous I/I Assessment in Binbrook

- Typical flows in the range of 40 L/s + I/I = 140 L/s
- 0.75 L/s peak I/I
- Flows matching firm capacity of pumping station years in advance of planned pump station upgrade and forcemain twinning



The Big Storm – Flooding Calls

~ hundreds of reported flooding calls, many more likely unreported

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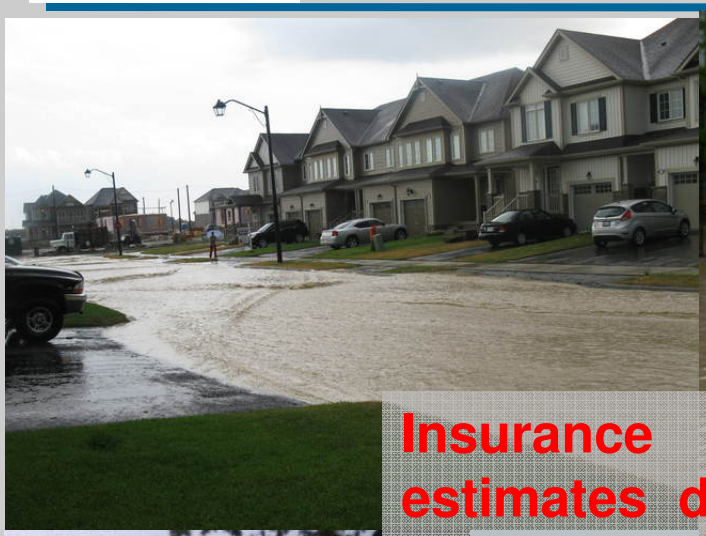
The Big Storm



Insurance Bureau of Canada estimates damage across Ontario from a combination of torrential rains, overland and basement flooding, large hail and unofficial reports of tornadoes, at ~$80 M

Post Event Assessment

-140 to 250mm of rain in about 3 hours, return period estimate 1000+ years

-I/I completely overwhelms system & sewers surcharge as much as 8 m with peak flows of 530 L/s (~ 4.0 L/s/ha I/I rate or 10 x design)

-Based on information gathered from residents, it appears that approximately 60% of basement flooding is believed to have occurred as a result of back-up of the sanitary sewer system while the remaining 40% is more associated with the intrusion of foundation water primarily from the sump pits.

Flooding Triage Response

-Rainfall and sanitary flow monitor analysis

-Smoke testing and wet weather MH inspections

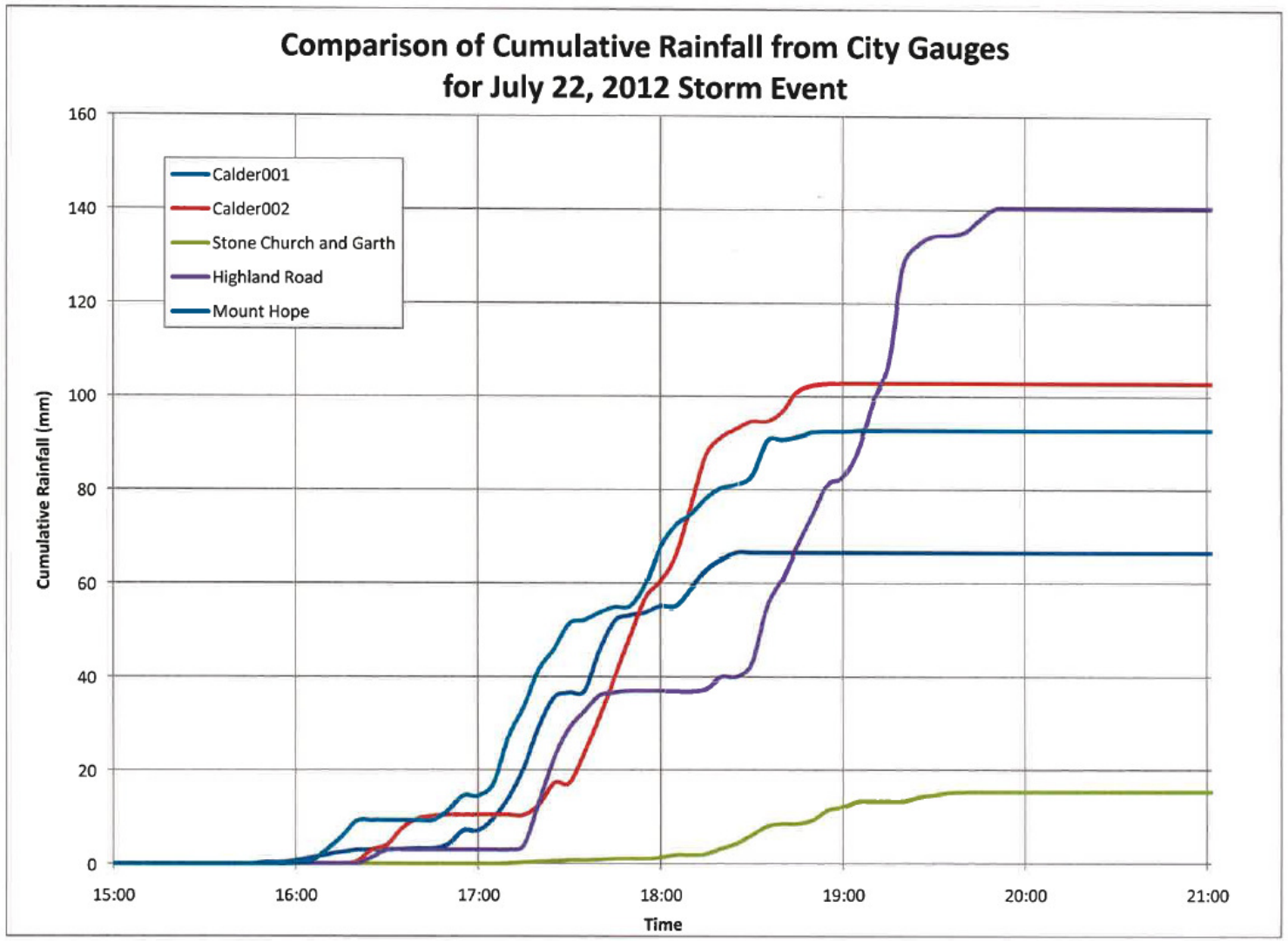
-Interviews with residents

-CCTV and ZOOM camera investigations

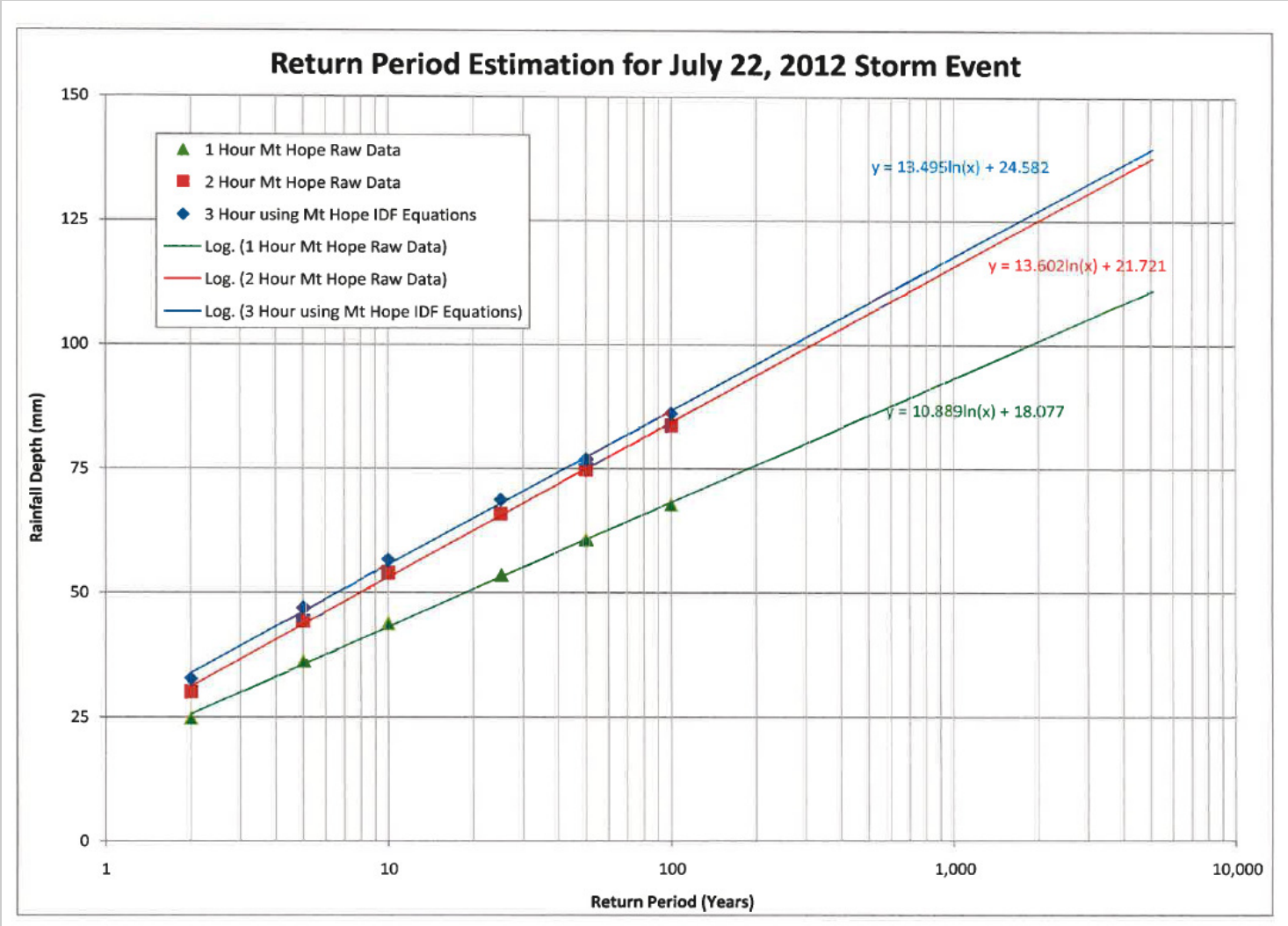
-Engineering review of major and minor storm conveyance and storage

-Reassessment of Master Plan specified pump station and forcemain capacity/conveyance upgrades

Rainfall Analysis
Or
My Storm is Bigger Than Your Storm

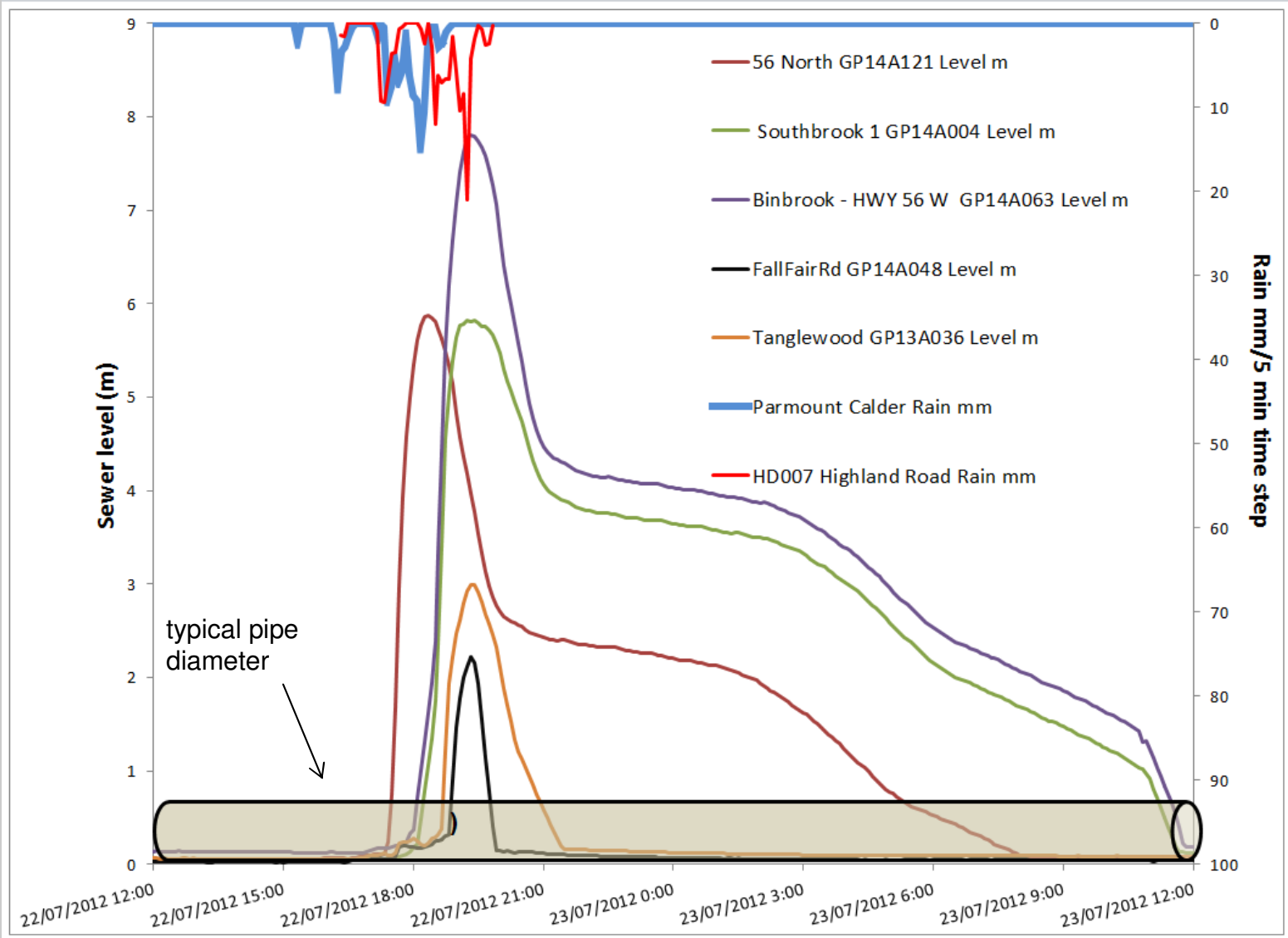


Rainfall Analysis IDF

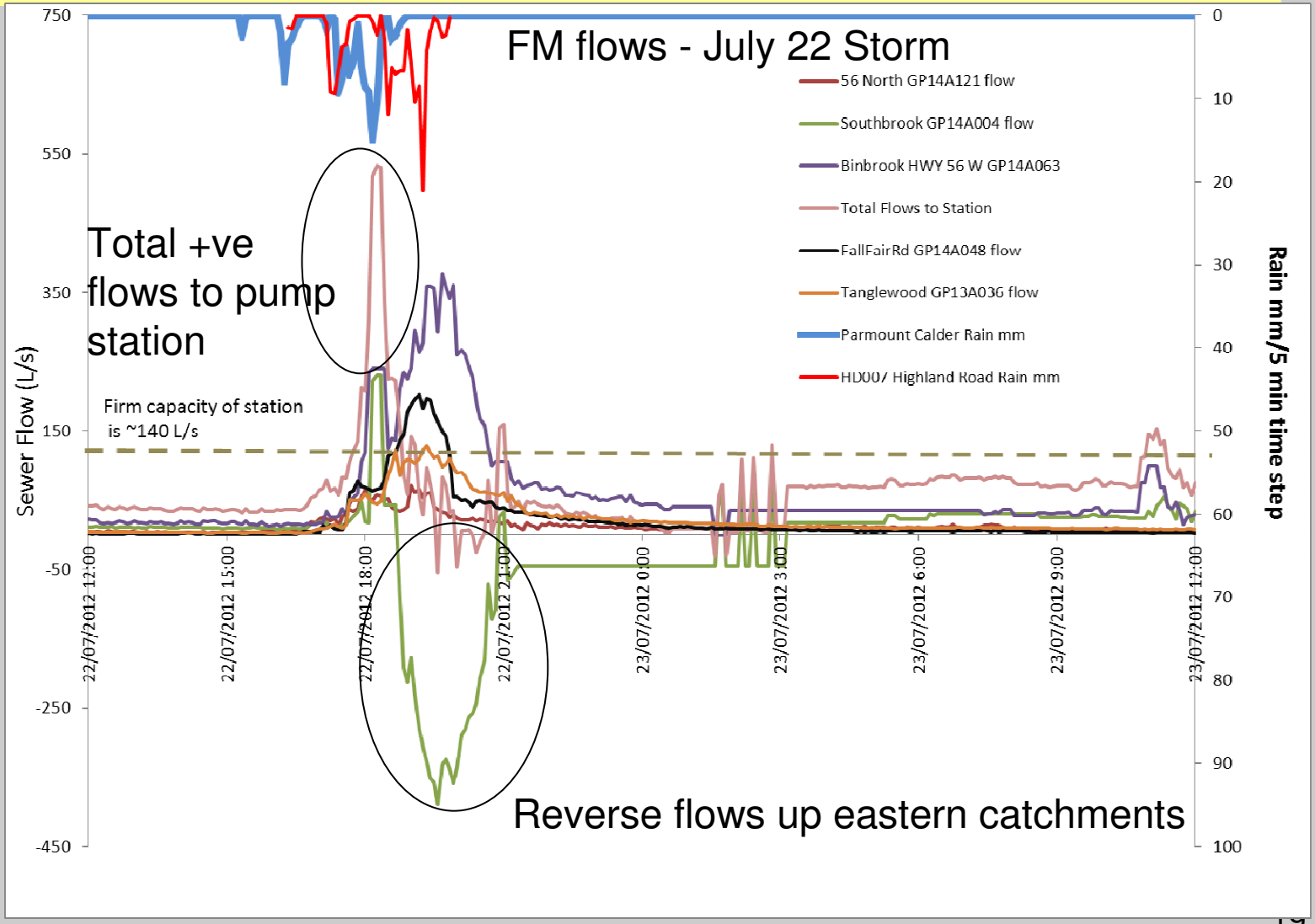


Post Event Flow Monitor Assessment
Analysis of System Surcharge

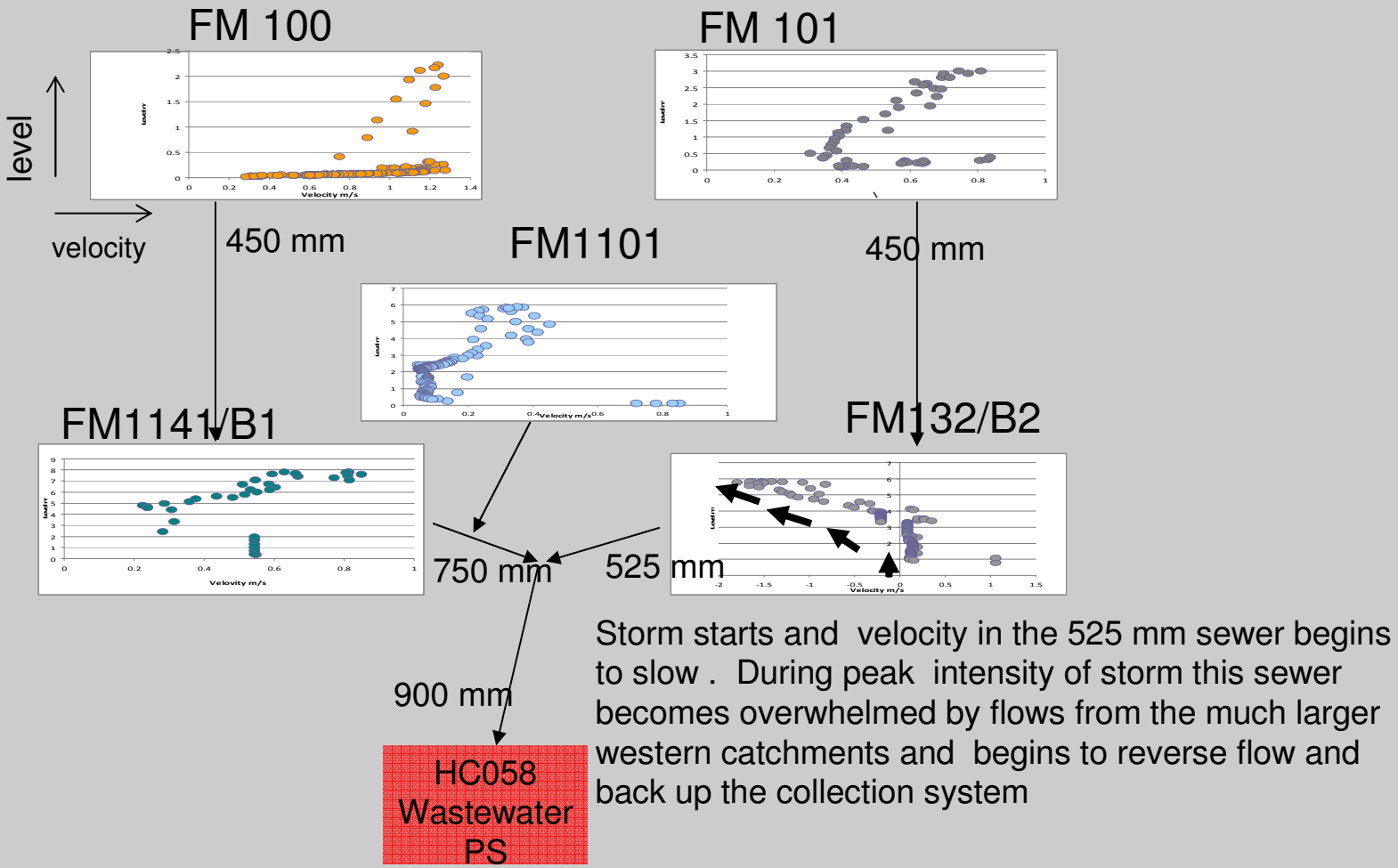
Level Measured in Sanitary Pipes During July 22, 2012 Storm



Post Event Flow Monitor Assessment



Post Event Assessment –Level/Velocity Scattergraphs



Storm starts and velocity in the 525 mm sewer begins to slow . During peak intensity of storm this sewer becomes overwhelmed by flows from the much larger western catchments and begins to reverse flow and back up the collection system

Smoke Testing and Reconnaissance – Inflow Sources

Open grid storm lid on sanitary

Catchbasins not yet commissioned & covered in geotextile

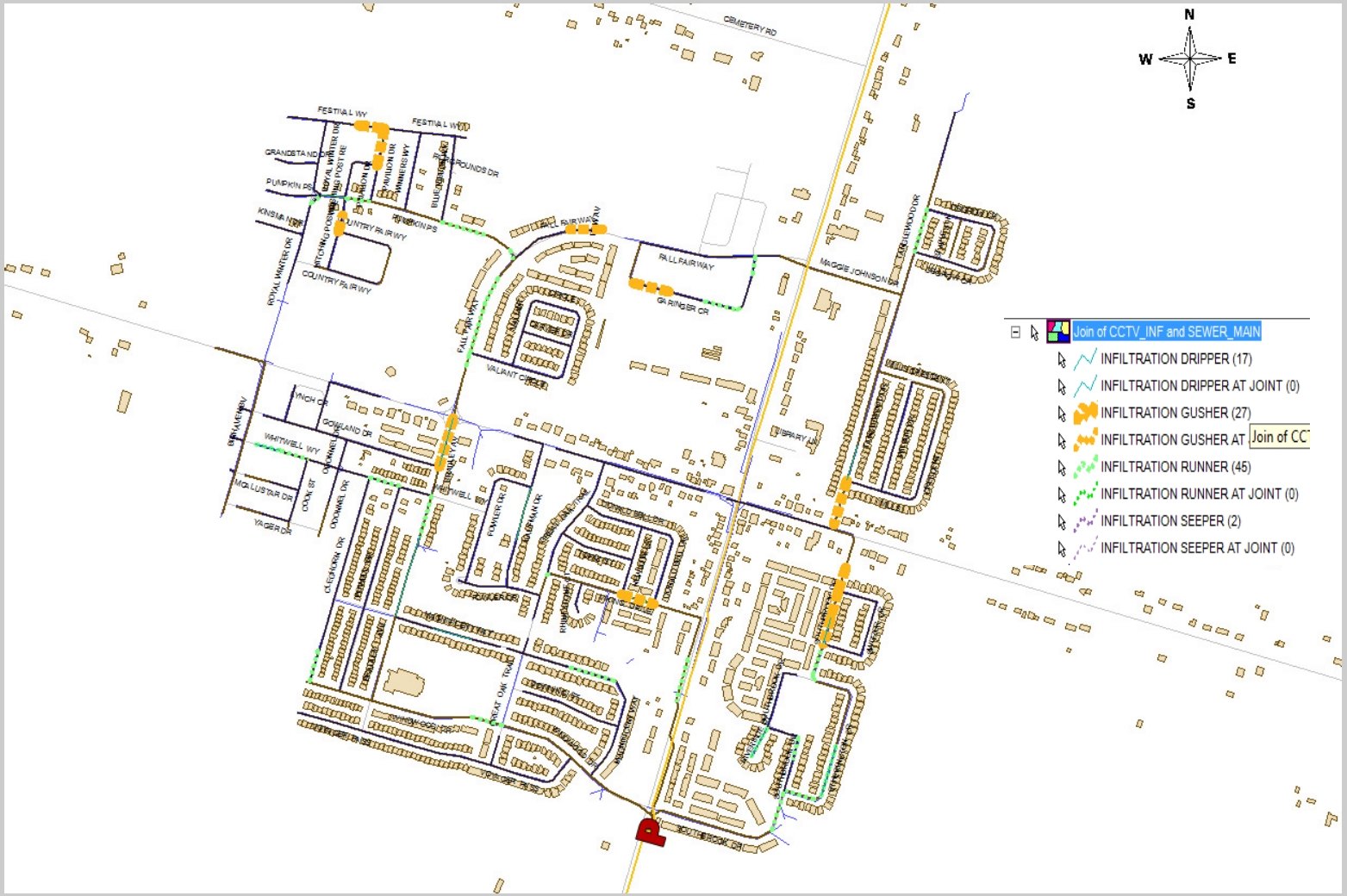
Low lying manholes

Unfinished manholes

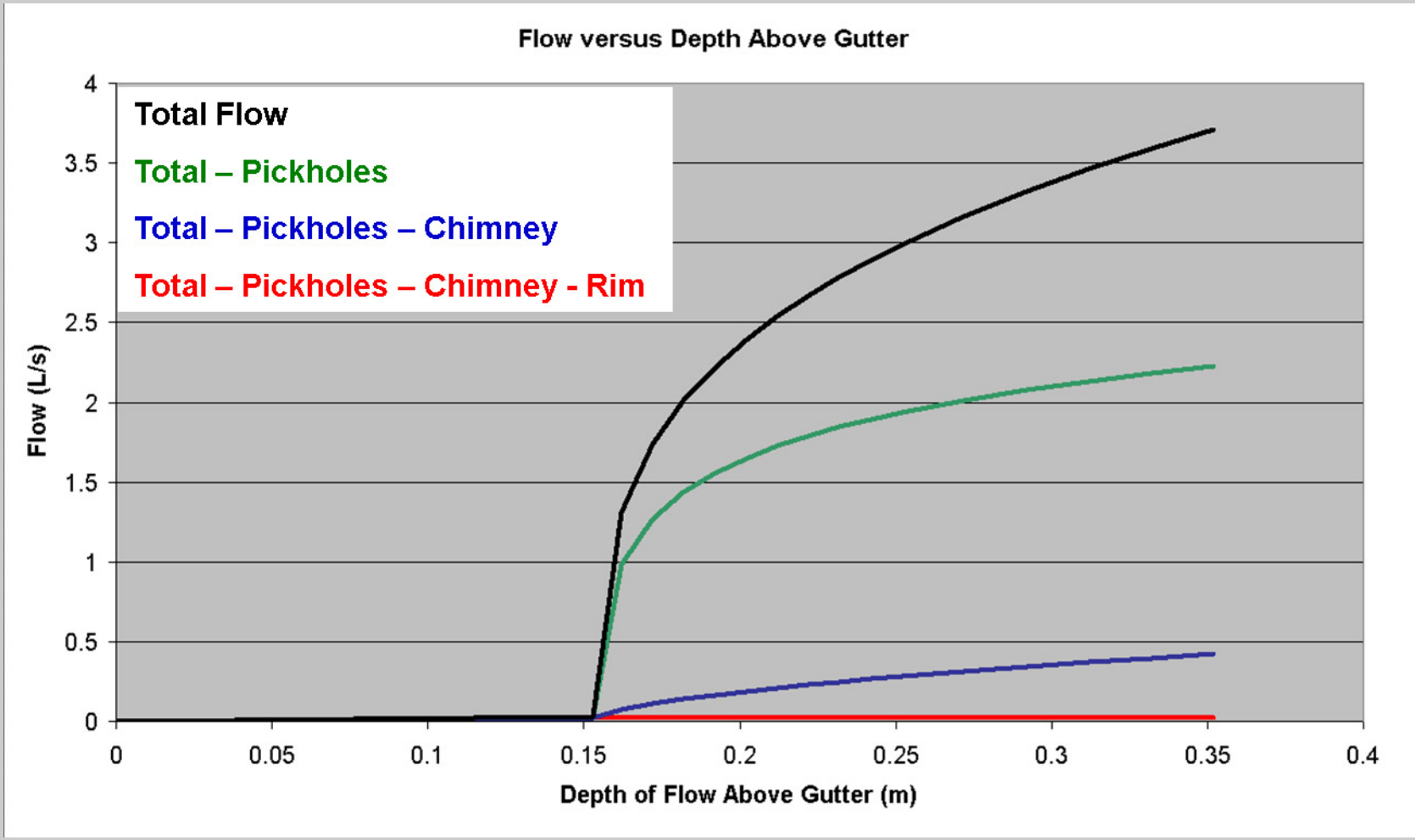
Wet Weather Manhole Inspections – Infiltration Sources

Wet Weather Manhole Inspections – Infiltration Sources

CCTV Infiltration Defect Mapping



Manhole Pickholes as a Source of Inflow



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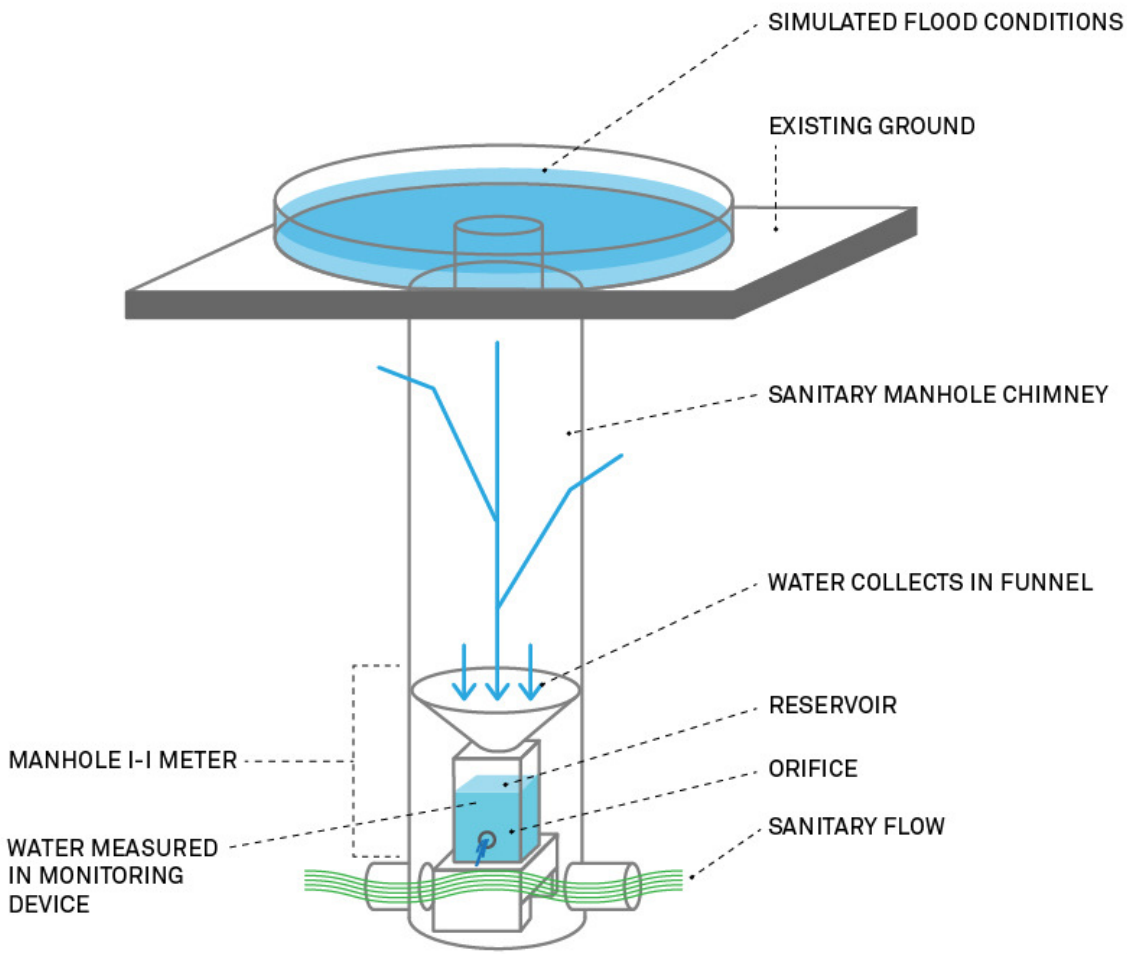
Field Measurement of MH Inflow



Experience Enhancing Excellence

Hamilton

Field Measurement of MH Inflow

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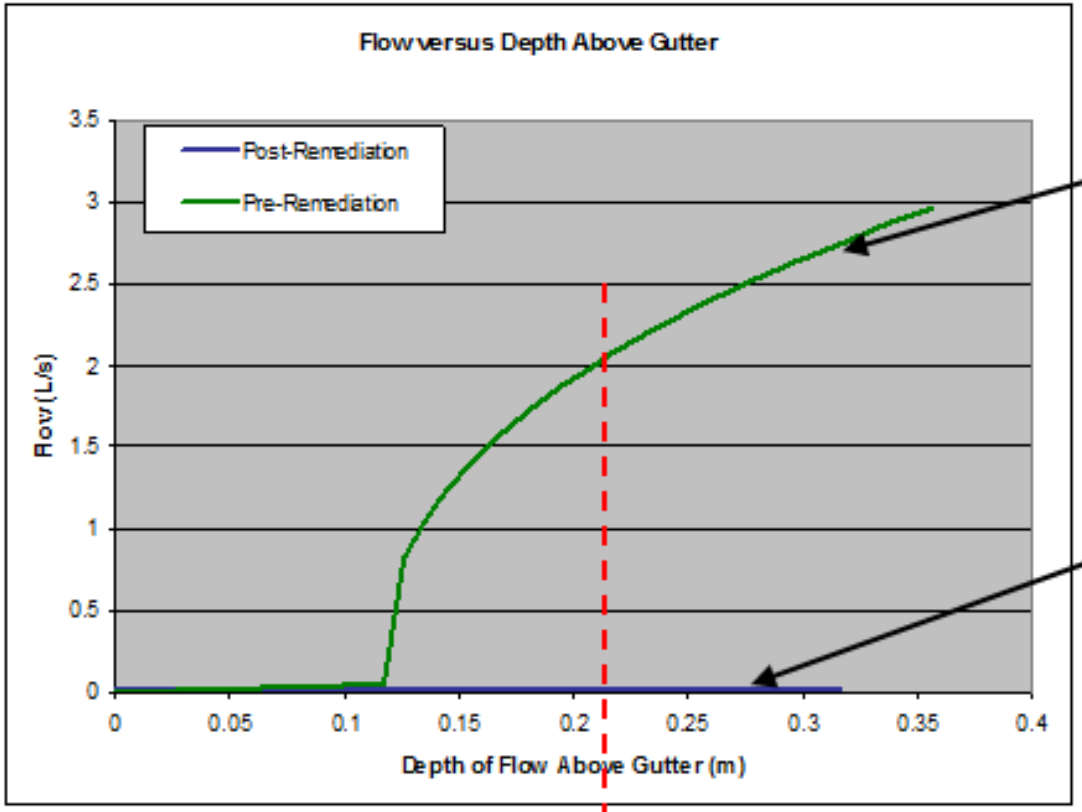
MH Sealing – Near Complete Removal of Inflow in Field Testing



Pre-Remediation

Post-Remediation

Remediation Elements:

-Chimney Seal

-Solid Manhole Cover

-LID Gasket

2 L/s I-I Reduction

for 10cm of head over the manhole

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Lessons Learned

-Ok, so we're used to 100 yr storms…they happen all the time, but a 1000+ year storm; that's impressive and a great snapshot of maximum I/I potential!

-Expect major system flows and potential sanitary inflow more frequently

-Identified MH pick holes as a major source of inflow to the system during major storms with road ponding

-Flow monitoring new developments

-Mainline backwater valves now required in all newly constructed homes?

City Actions

-Solid MH lids to address inflow from the major system - potential removal of 200+ L/s of direct inflow. Simple, cheap and reliable.

-Wet weather reconnaissance critical in identifying defects. Follow up chemical grouting and MH rehabilitation

-Understanding wet weather vulnerabilities unique to new development

-Investigating feasibility of an emergency gravity overflow for the pump station

-Reassessing Master Planned upgrades to pumping station and forcemain capacity & timing. Can we successfully reduce I/I?

-Upcoming City Wide Flooding and Drainage Master Plan

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