OPTIMIZING CSO REDUCTION THROUGH THE SHUFFLED FROG LEAPING ALGORITHM

Greg Brenner, CH2M
Vinta Varghese, PE, CH2M
Andrew Erikson, PE, CH2M
Dingfang Liu, PE, Ph. D, BCEE, CH2M

Overview

Optimization

- How it works
- Process
- Value of Automation
  - Increased system understanding
- Decision making process

CH2M HILL's SimLink Framework

- Shuffled Frog Leaping Algorithm
- Applications

Case study: New Haven, CT

- Optimizing in system storage

Optimization

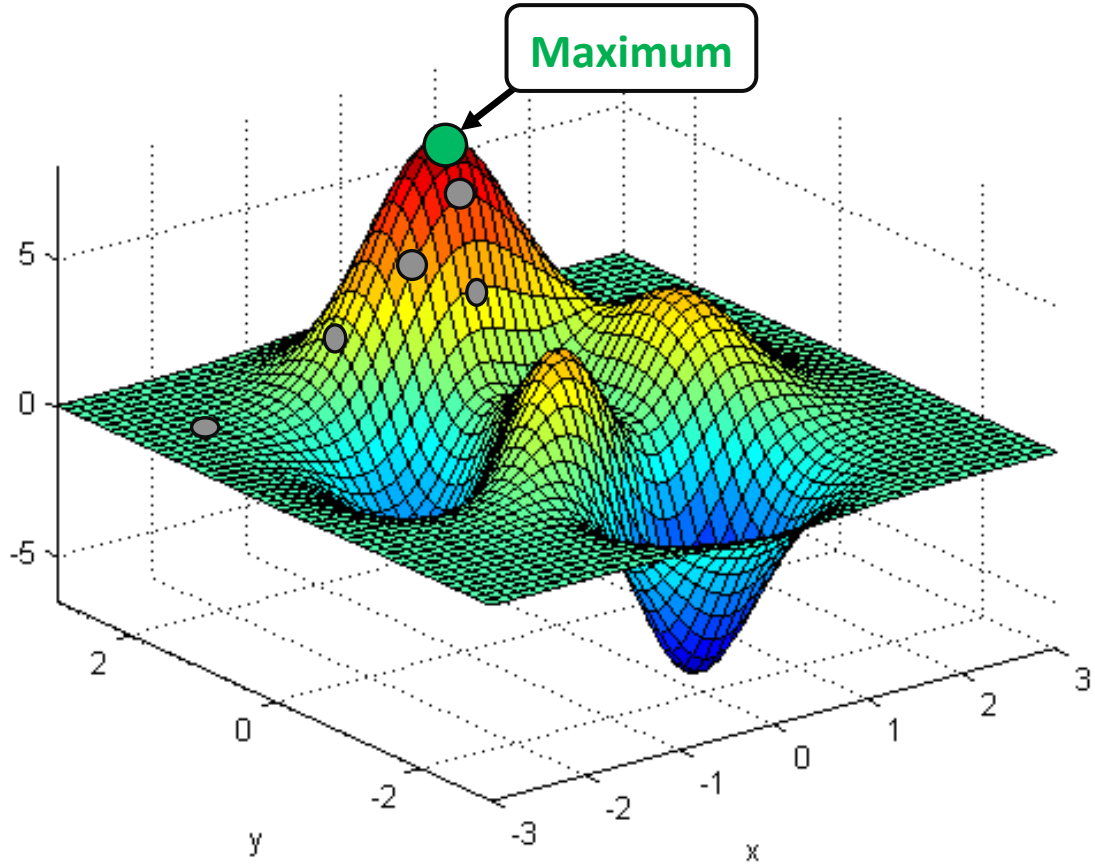
Process of making a system as fully perfect, functional or effective as possible

Process

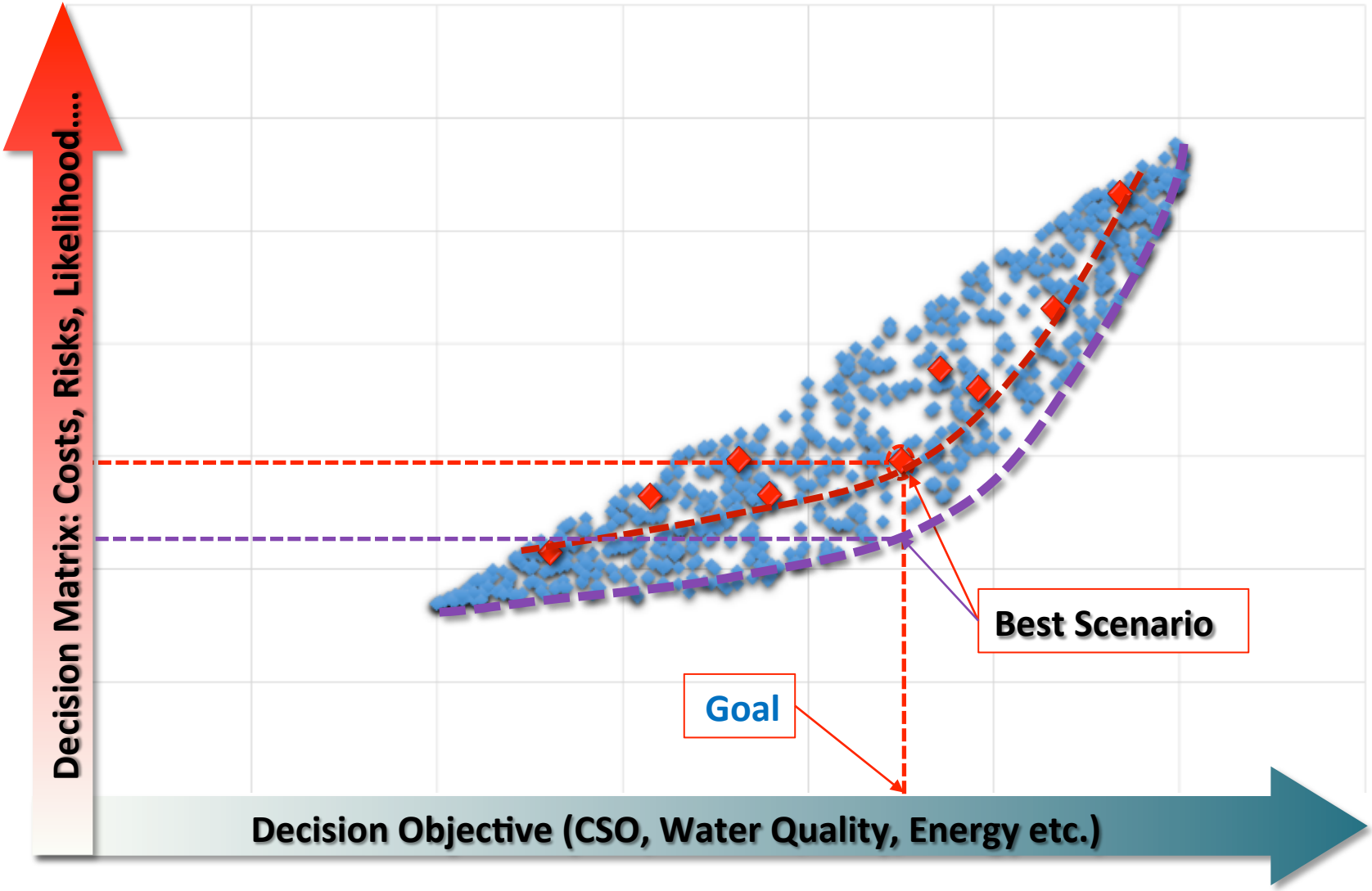
- Similar to finding a Maximu Minimum
- Educated guess and check leading to best option

Drive for Automation

- System Complexity
- Unclear tradeoffs
- Large number of possible solutions
- Development of a deeper understanding of the system



Decision Making Processes



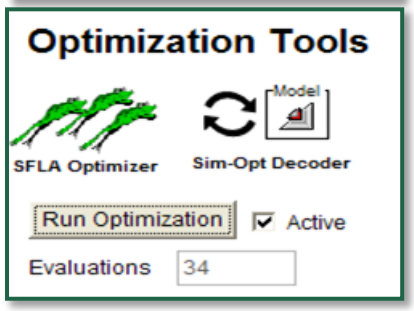
SimLink

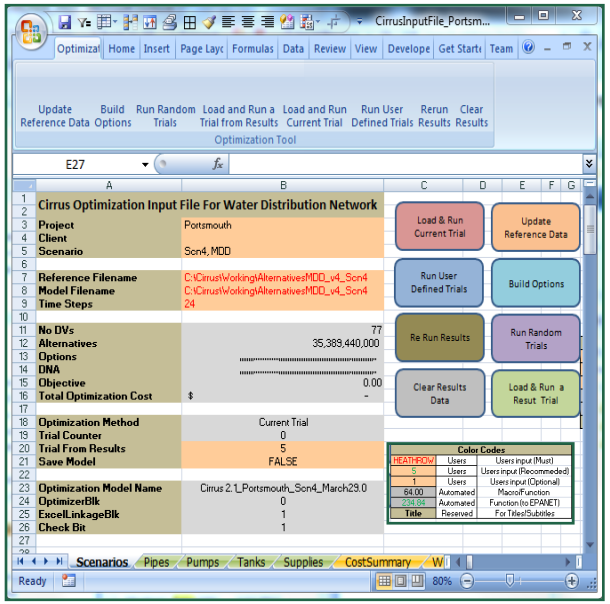
Automation techniques for searching through a decision space for a more cost-effect solution

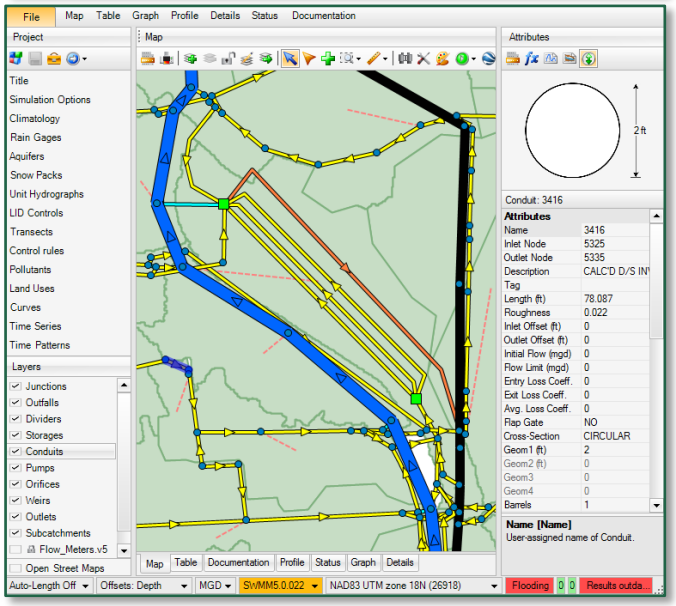
Benefits

- Specify features to change, adverse effects
- Ability to read output files, write input files, and run simulations
- SFLA to skip non desirable simulations

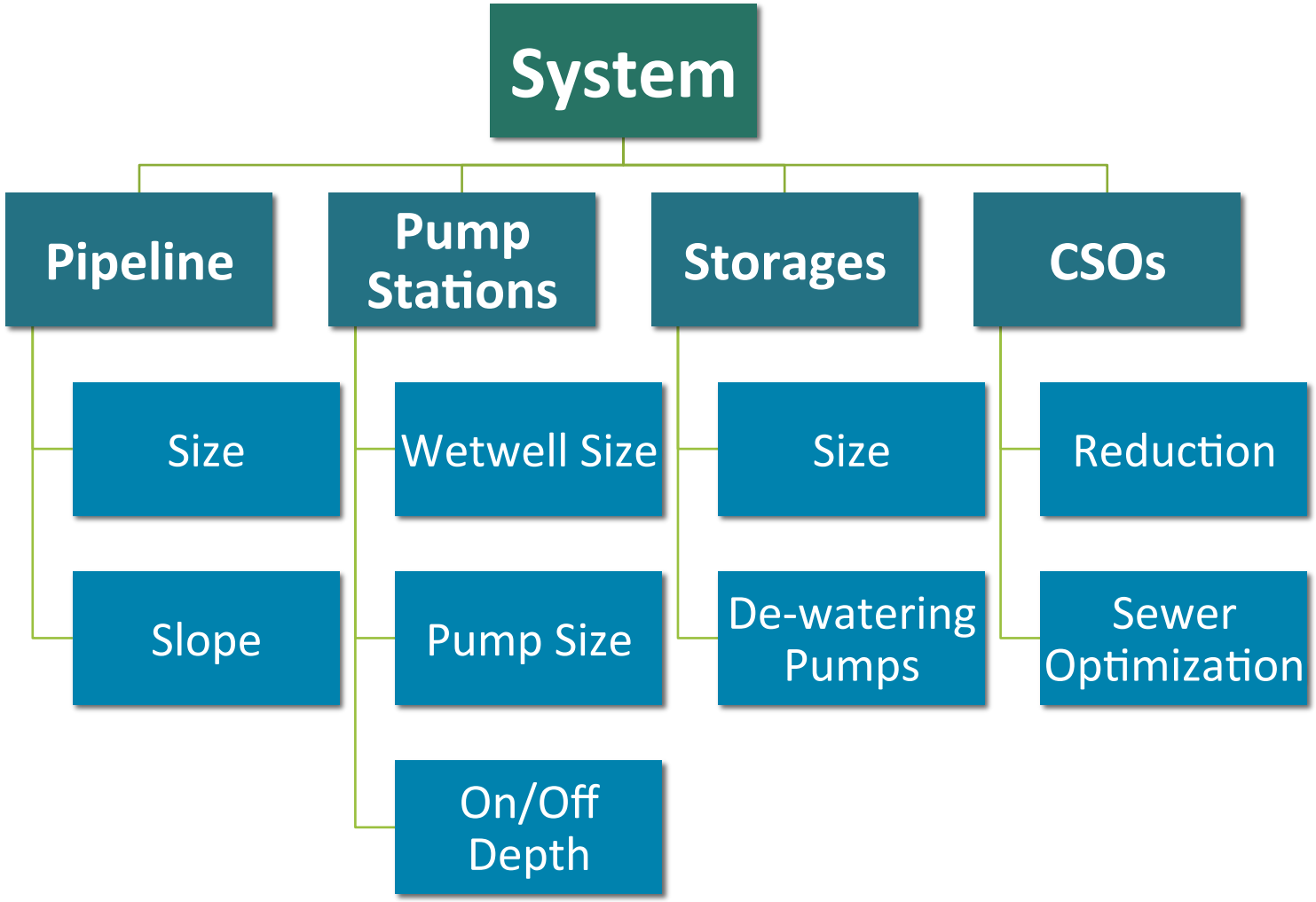
Algorithm ⟷ **User Interface** ⟷ **Model**







Water Distribution System Optimization



Case Study

New Haven, CT

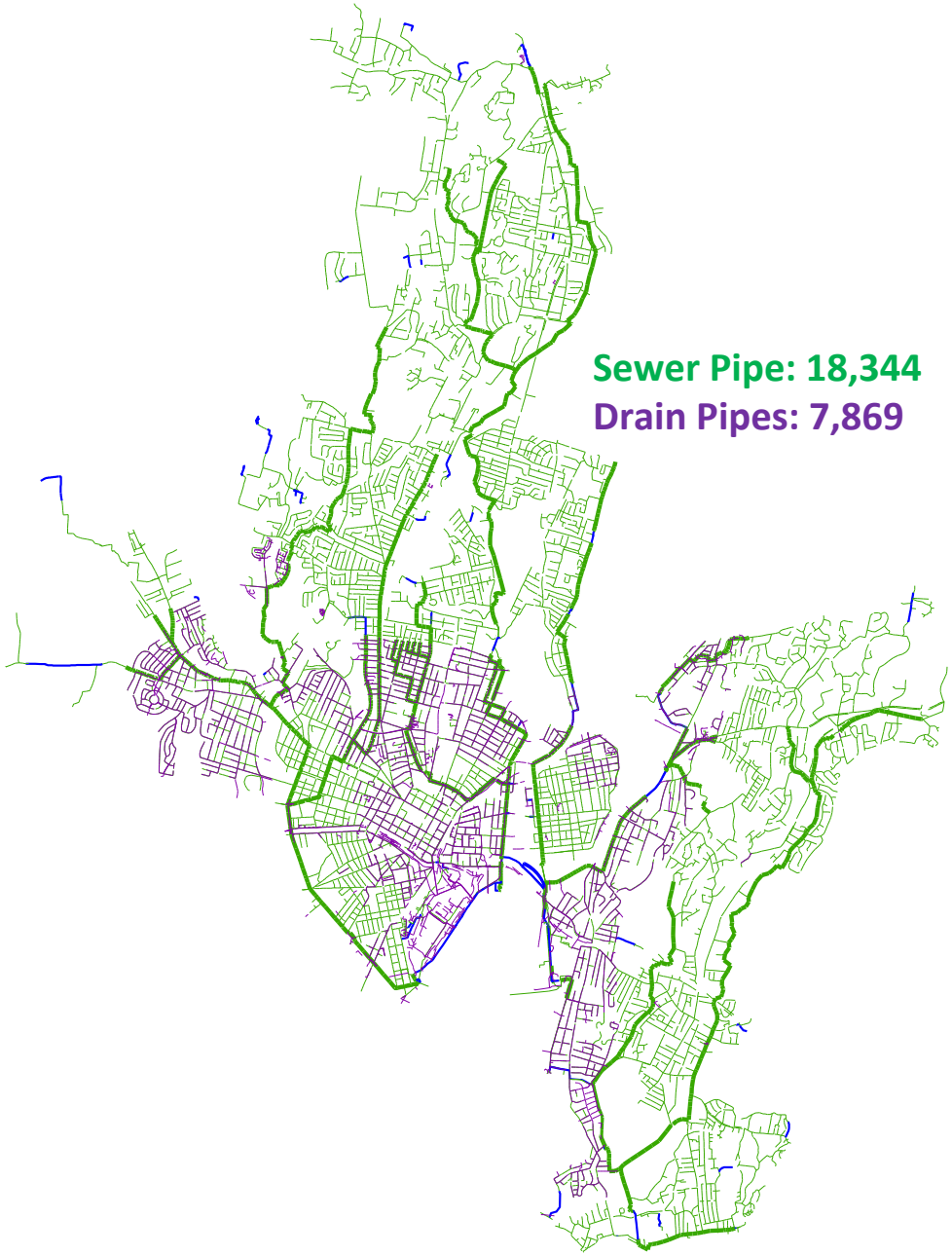
Greater New Haven Water Pollution Control Authority (GNHWPCA)

- Build, calibrate and validate a hydrologic/hydraulic model of the sewer system
- Develop a CSO Long Term Control Plan (LTCP)
- Investigate sewer **optimization** for short term CSO reduction while the LTCP is implemented

Model Development

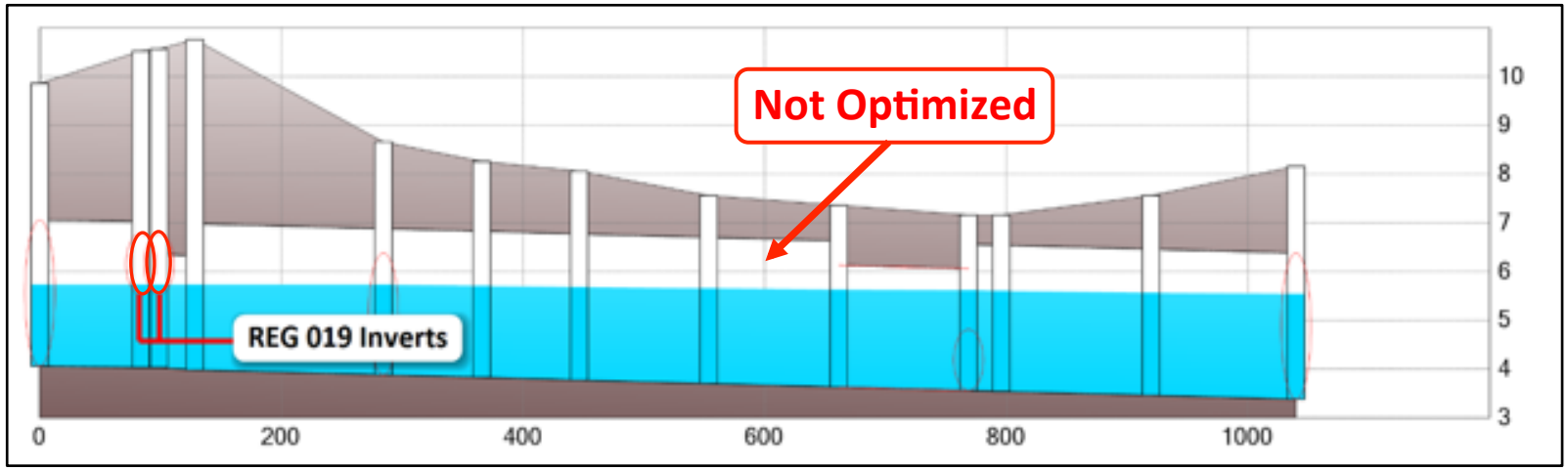
Sewer System

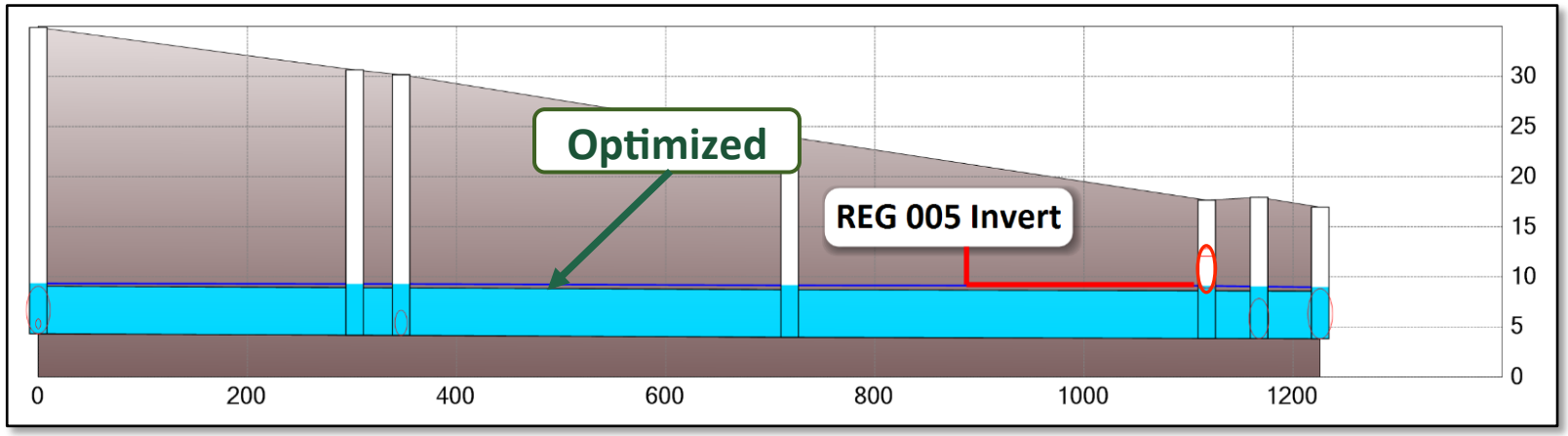
- 1,285 acres of Combined Area
- 555 miles of pipeline
- 30 pump stations
- WWTP capacity of 50 MGD
- 25 CSOs with 32 regulator elements
- Model Calibrated and Validated to > 50 flow meters



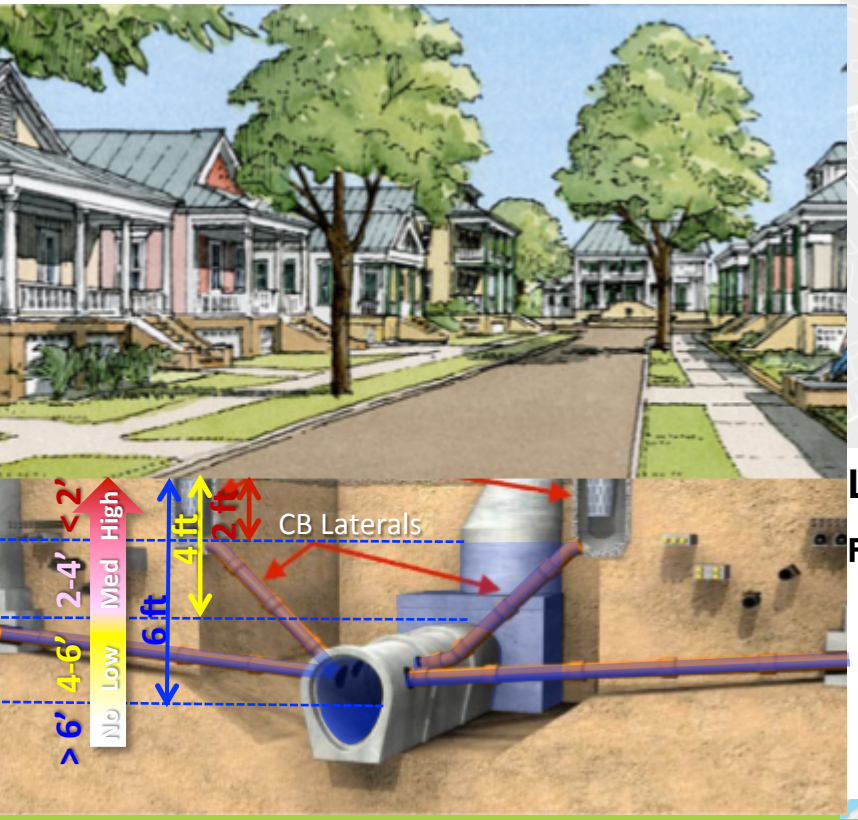
Sewer Optimization

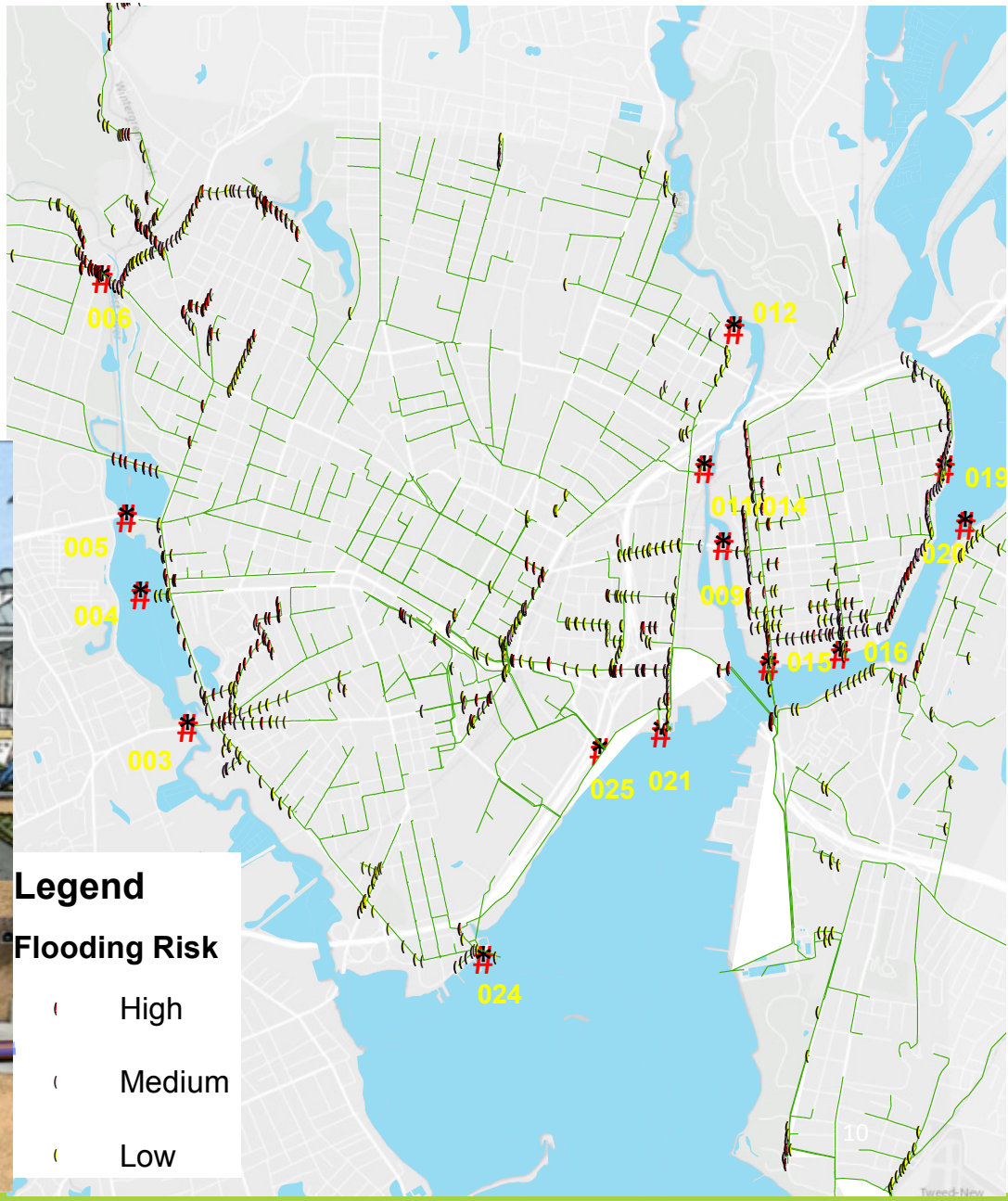
Utilize all in system storage
before CSO spill occurs



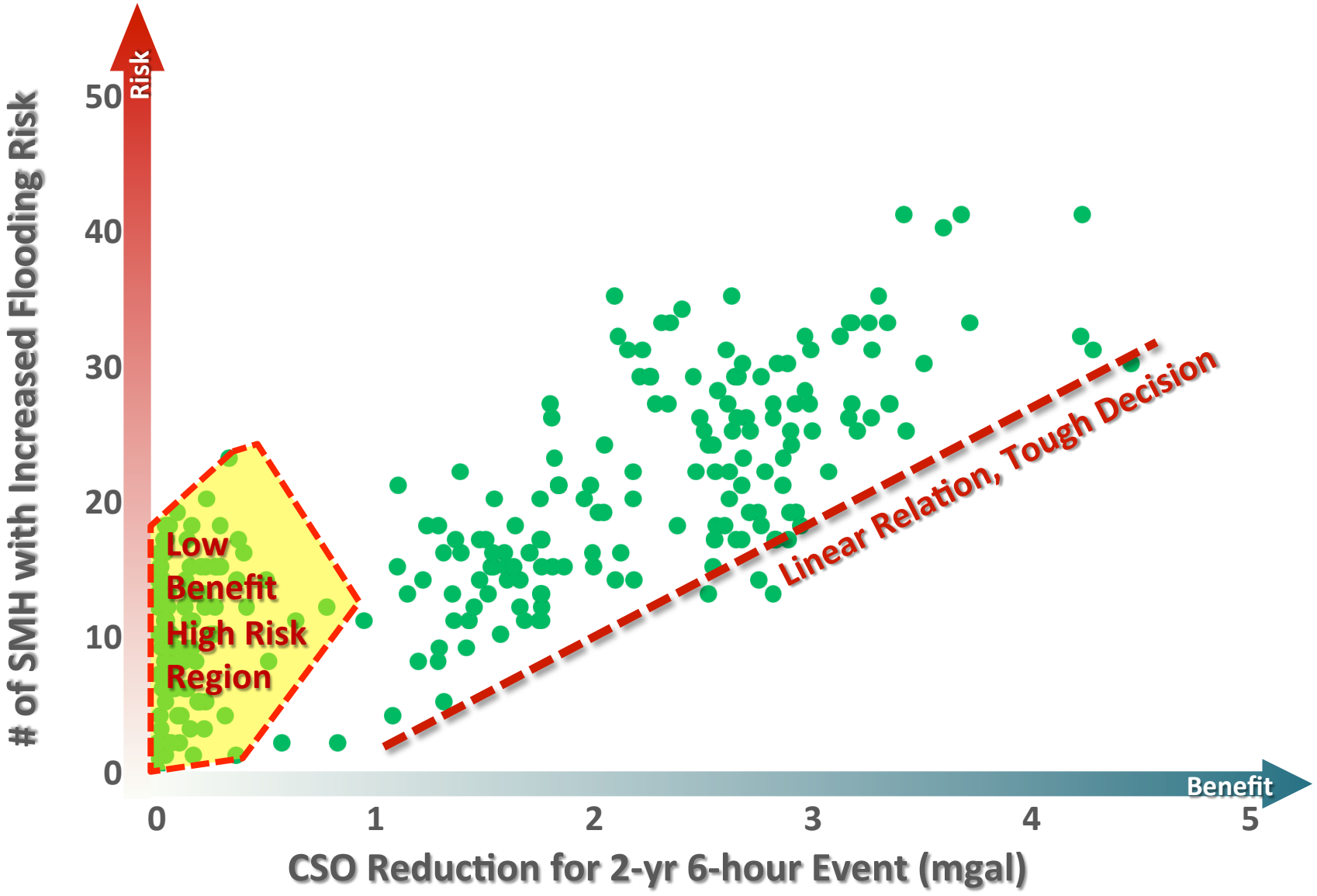


Risk vs Benefit

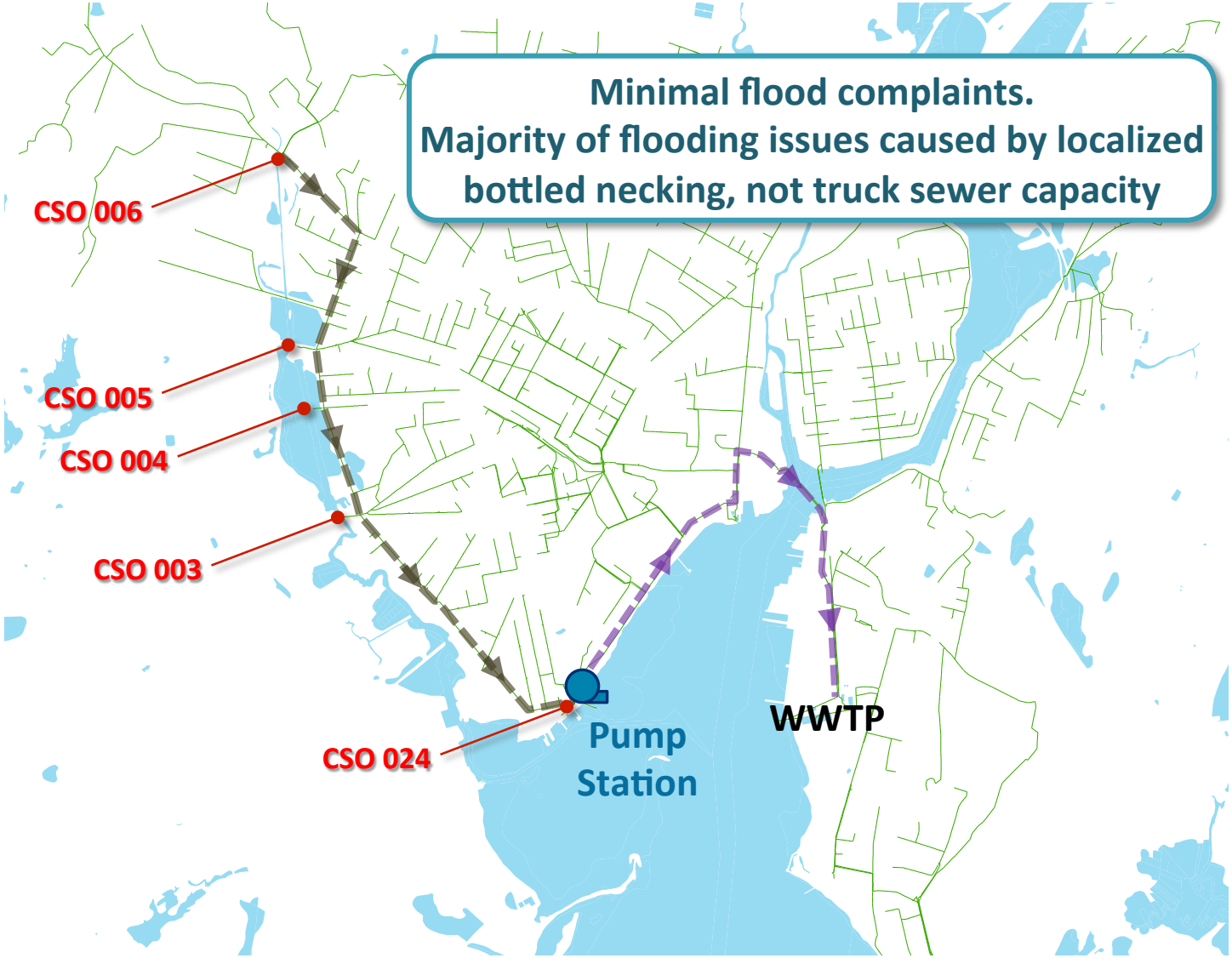




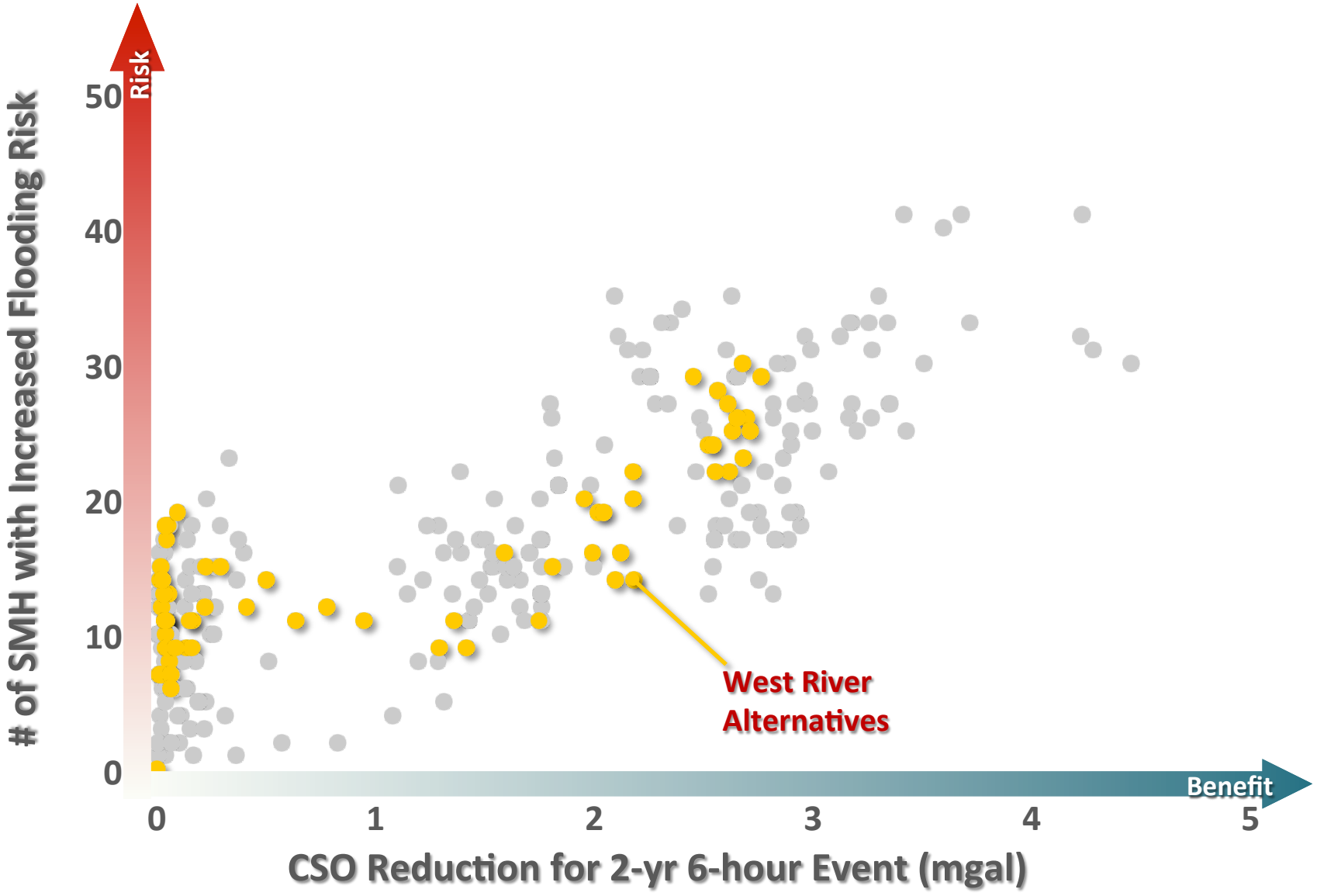
System Optimization: Risk vs Benefit



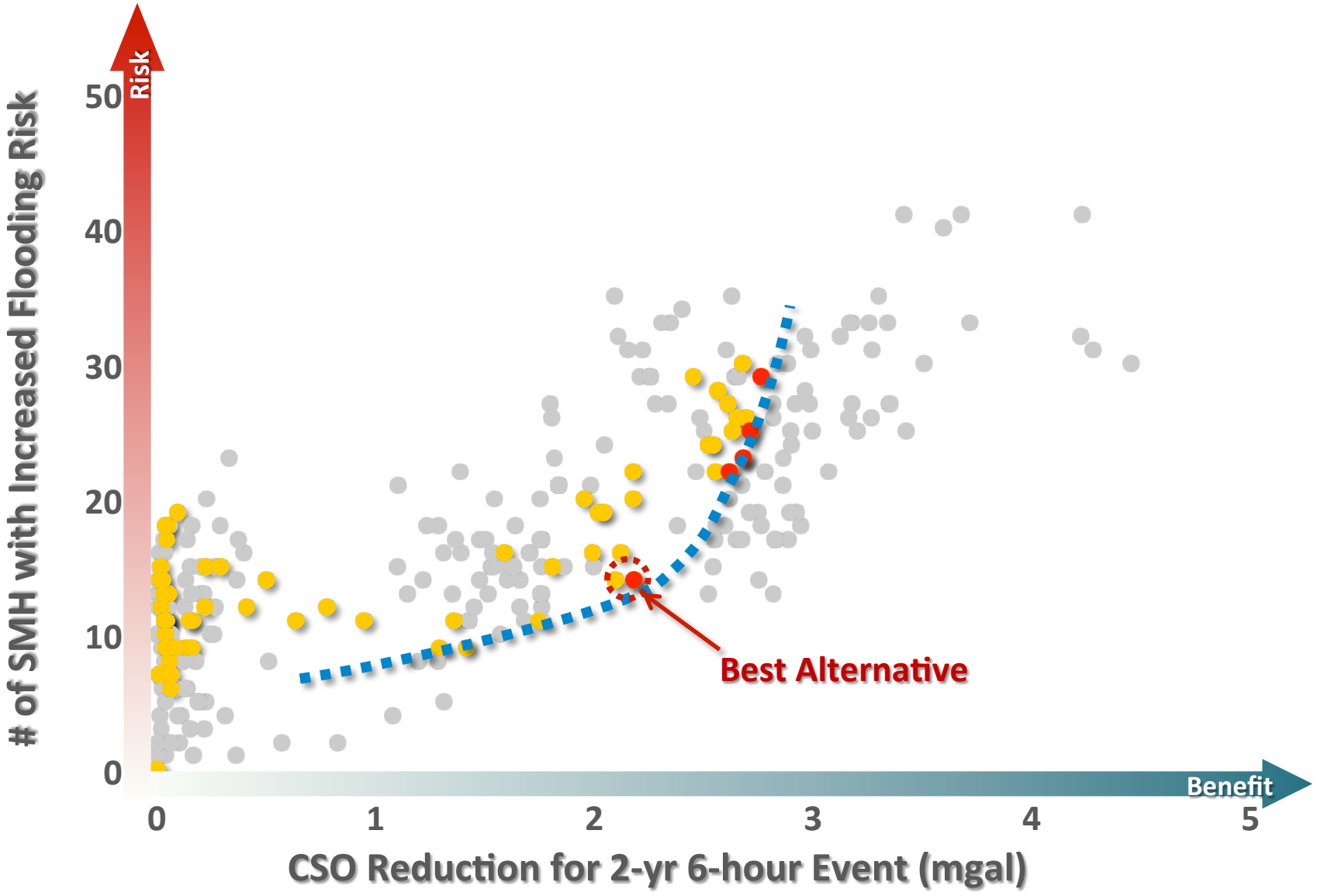
Boulevard Trunk Sewer



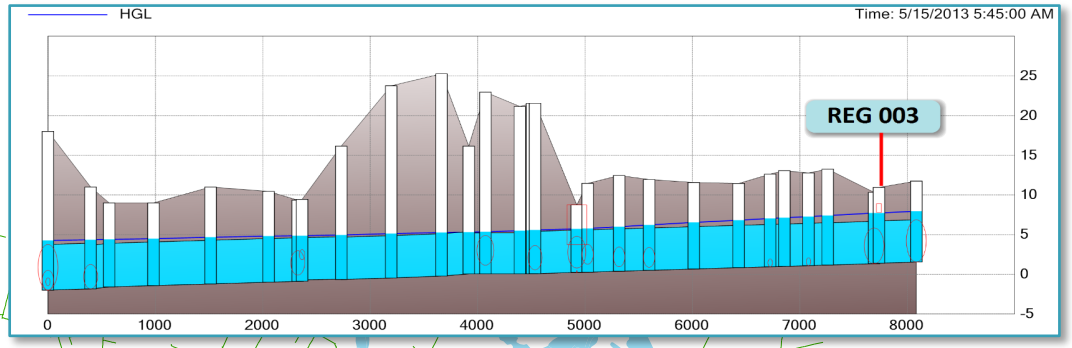
West River Alternatives



Optimal West River Alternatives



Final Results



Raise REG 006
0.82 MG Reduction

CSO 005
0.55 MG Increase

Raise REG 004
0.66 MG Reduction

Raise REG 003
0.36 MG Reduction

Raise REG 024
1.35 MG Reduction

2.6 MG of CSO Reduction
From 7.0 MG to 4.4 MG
14 Manholes at increased risk

Pump Station

WWTP

Conclusions

- Optimization is a power tool
- With advances in technology, even more understanding of complex systems can be achieved
- Through automated optimization a 30% reduction in CSO achieved at a much more cost effect solution opposed to a capital project

Questions?

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Greg Brenner

gregory.brenner@ch2m.com
Phone: (617) 626 7003