O&M Optimization via a Living Hydraulic Model

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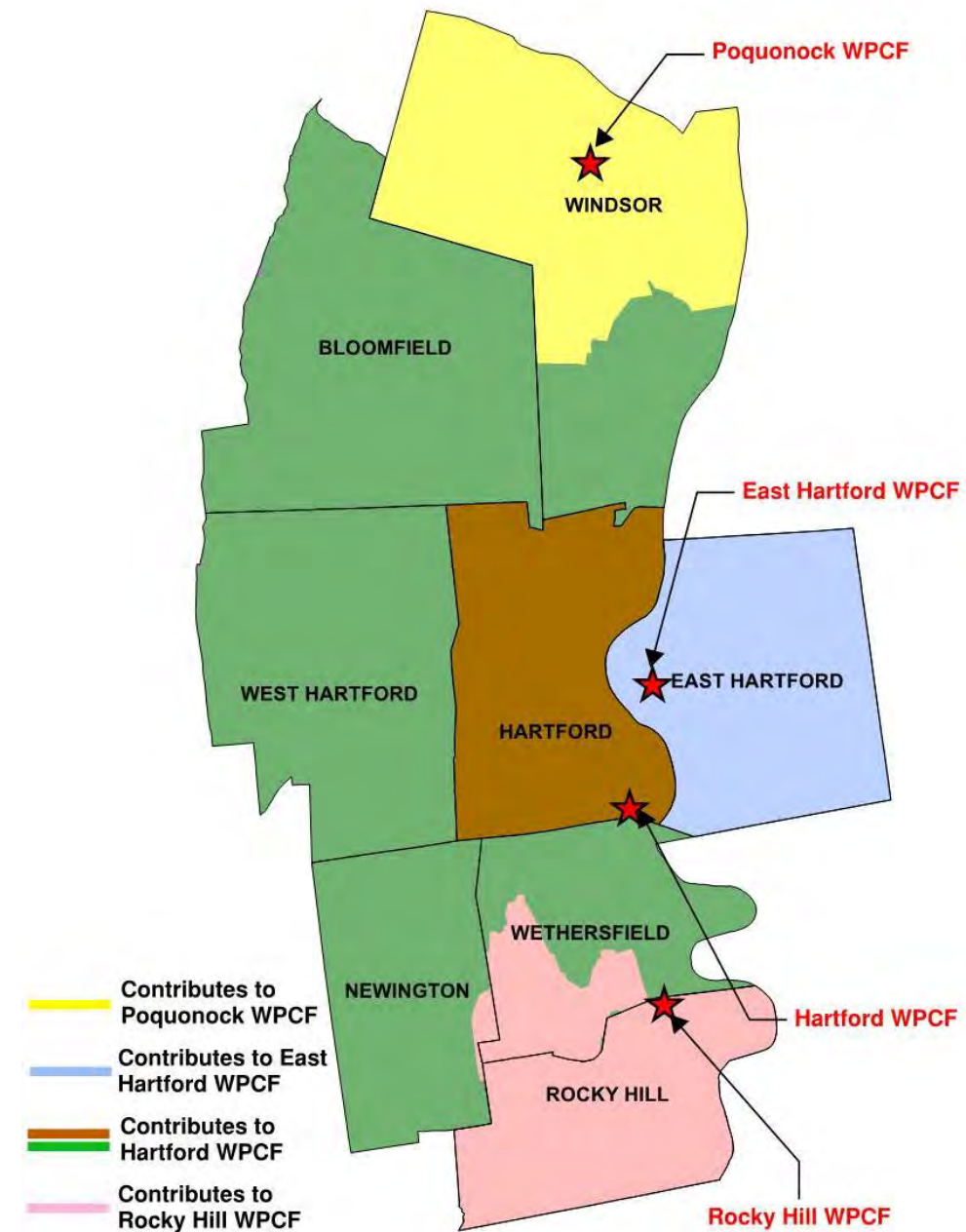
NEWEA – 2020 Annual Conference & Exhibit

Presentation Overview

- Introduction

- MDC CMOM program

- Hydraulic model

- Living model

- Examples of living model use

- Future uses being explored

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Introduction

- MDC is a nonprofit municipal corporation chartered by the Connecticut General Assembly in 1929

- Mission is to provide customers with safe, pure drinking water, environmentally protective wastewater collection and treatment and other services

- Provide water, sewer and household hazardous waste collection to its member towns and treated water to portions of non-member towns

- 4 water pollution control facilities (WPCF), ~1,200 miles of sewer (of which ~187 miles are combined)


Legend:
- Contributes to Poquonock WPCF (yellow)
- Contributes to East Hartford WPCF (blue)
- Contributes to Hartford WPCF (brown)
- Contributes to Rocky Hill WPCF (pink)

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CMOM Program

- Capacity, Management, Operations, and Maintenance **(CMOM)** Program – fulfills requirement of 2006 Consent Decree from USEPA
- Program where the needs of the collection system are continually identified and then addressed via maintenance activities and data collection:
  - Sewer cleaning
  - Sewer inspections (CCTV and Sonar)
  - Structure inspections
  - Flow monitoring (CSO and SSO)
  - Dye & smoke testing
  - Easement maintenance
  - SCADA Data (CSO, SSO, treatment plant)

Perform Maintenance Activity

Collect Data

CMOM

Identify Maintenance Need

Analyze Data

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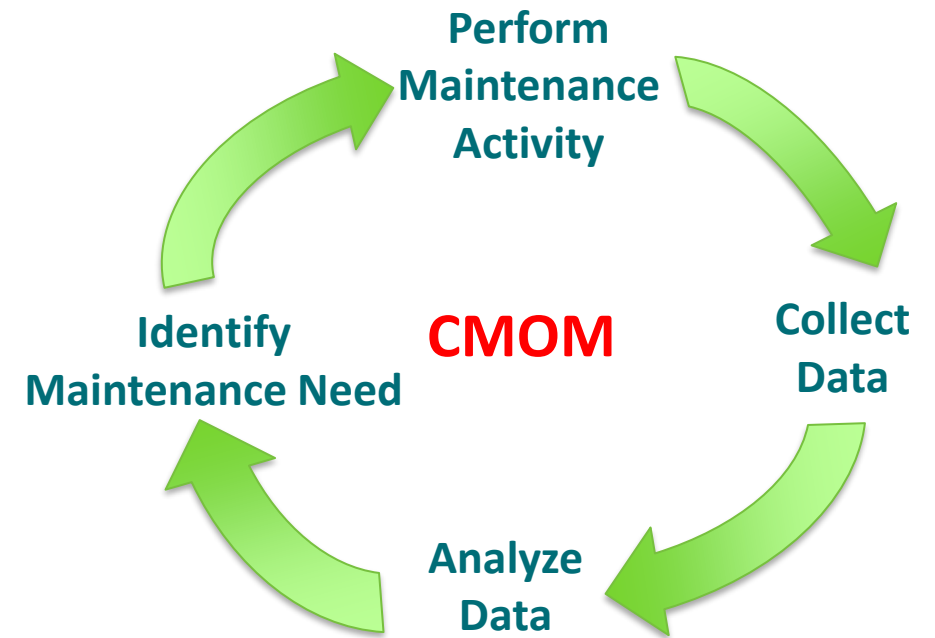
CMOM Program - Sewer Inspections

- Inspections include CCTV and sonar of sewers
- Sonar allows for critical trunk sewers, often with high flow to be inspected. Profiles sediment, grit, debris below flow
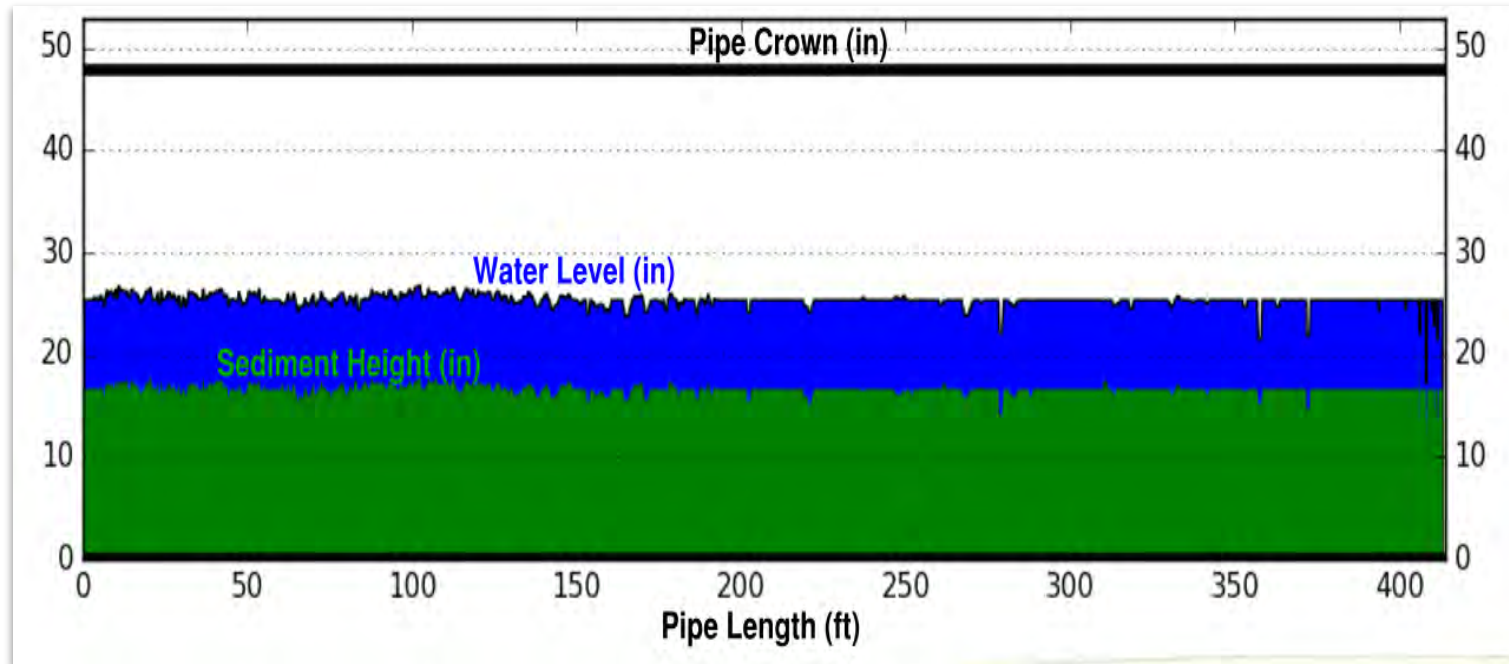

- **Provides critical data for understanding sewer system**, especially when stumbling upon things like….

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CMOM Program - Sewer Inspections

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Hydraulic Model

- Developed to support the MDC wastewater collection system:
    - Facilities planning
    - Capacity analysis
    - Designs
- Refined continuously utilizing the extensive data collected via the CMOM program
- Relies on SCADA Data
    - Overflow level sensors
    - Treatment plant influent
    - River and rain gauges
   - Permanent flow meters

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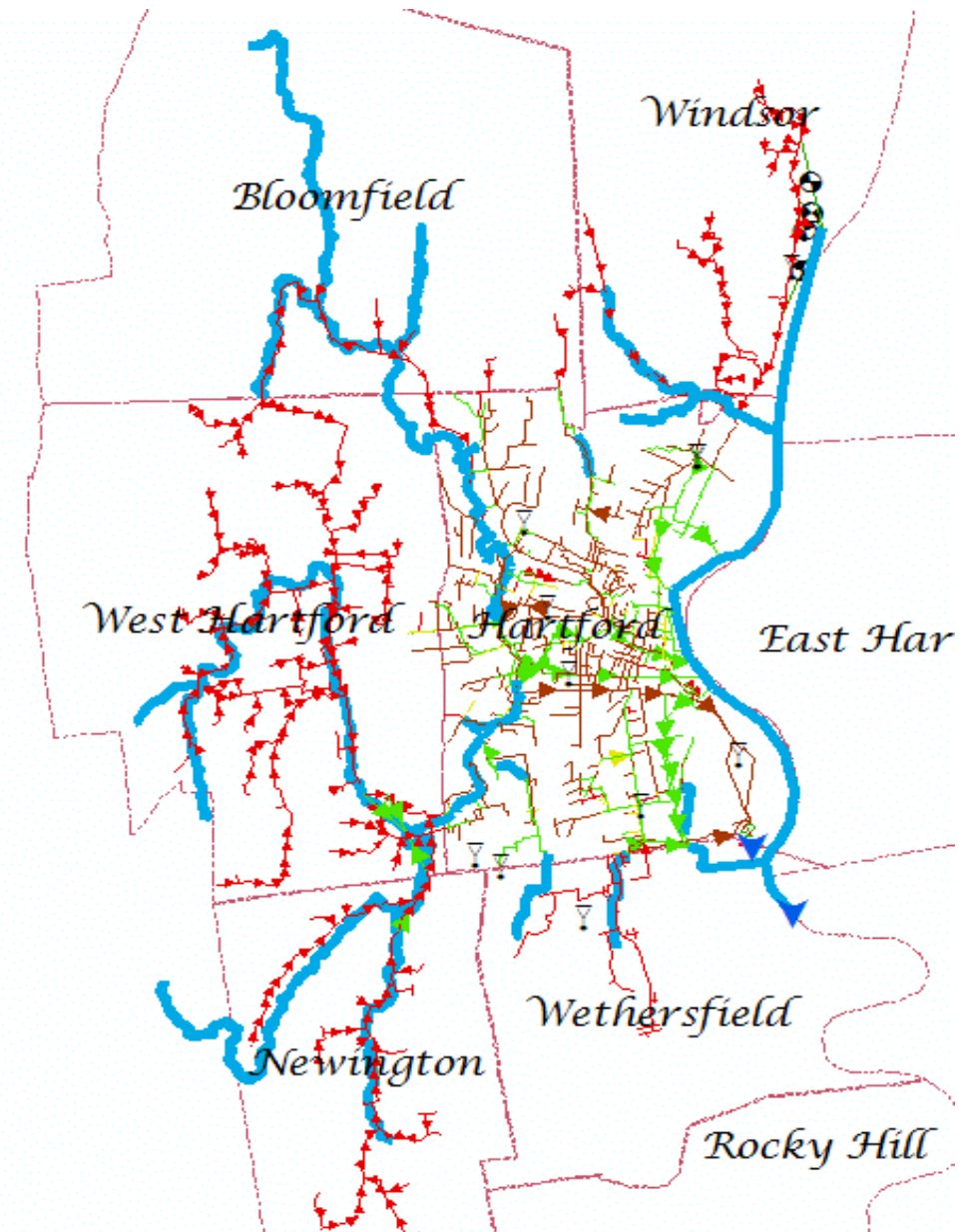
How to Improve the Hydraulic Model

- Desire to better utilize the hydraulic model, namely for:

  - Improved system understanding across a range of storm events **in real-time**

  - Provide O&M guidance, including recognizing and address system O&M issues faster

  - Measure the effectiveness of system improvements

  - Manage risk in design of planned facilities or proposed development

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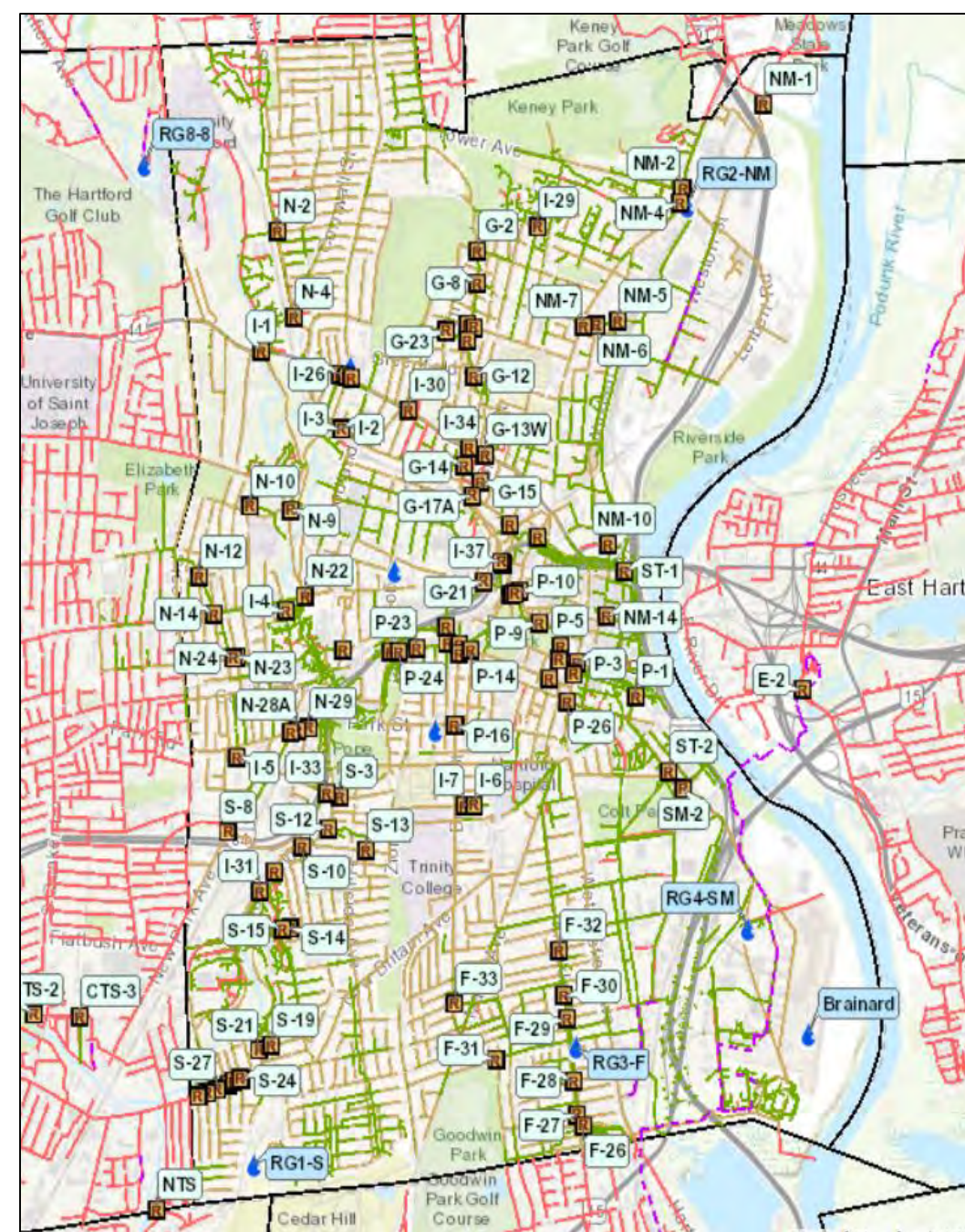
Living Model

- Continuous feed of information into MDC's hydraulic model allows for comparison of **expected** vs. **observed** performance in near real-time (digital twin)

- Maximizes value of **SCADA** and **CMOM Data** as well as **hydraulic model** for improved "real-time" system understanding

- **PipeCAST** is the web platform that displays this critical information and Living Model

Interactive Web viewer

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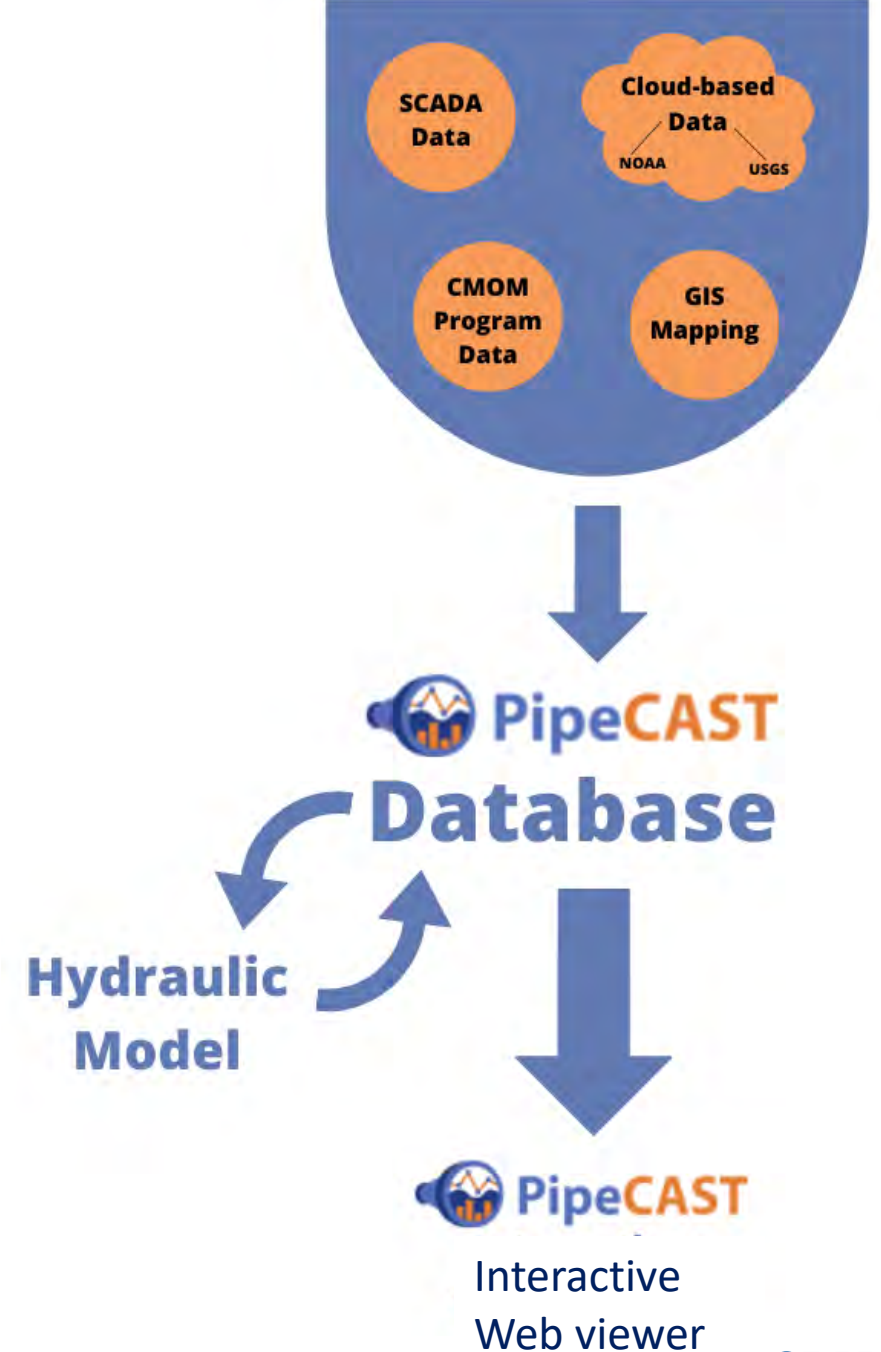
Benefits of Living Model

- Maximizes value of **CMOM Data** and **hydraulic model** for improved "real-time" system understanding
- Identify & analyze system issues quickly:
  - O&M issues
  - Unexpected CSO/SSO discharges
  - Flooding
  - Effectiveness of sewer cleaning/O&M effectiveness
  - Average Recurrence Interval
- Streamlines model requests/analysis
- Proactive vs reactive maintenance
- Forecast future build-out scenarios vs. current weather conditions
- Can provide alarms/"flags" for Users
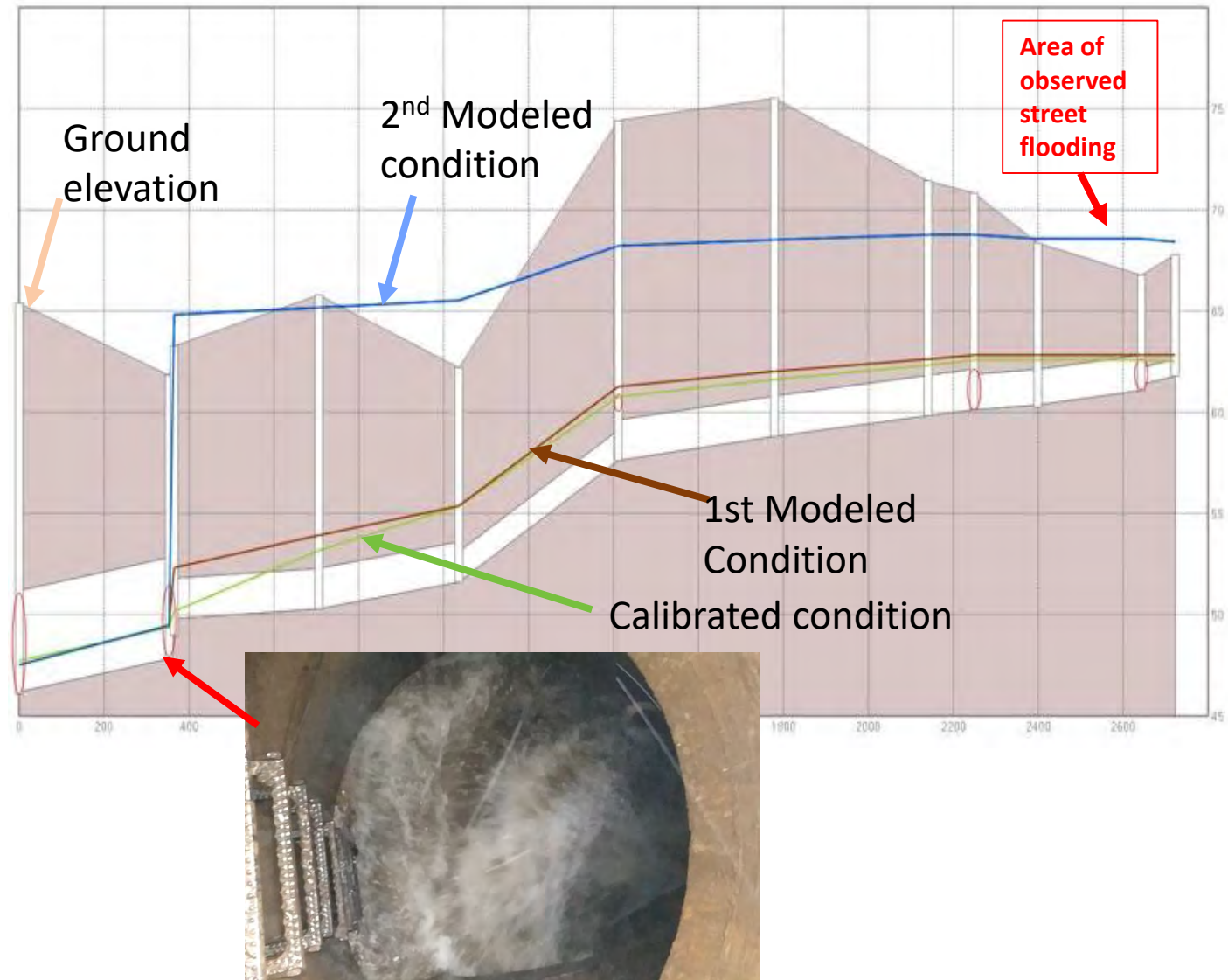
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PipeCAST platform
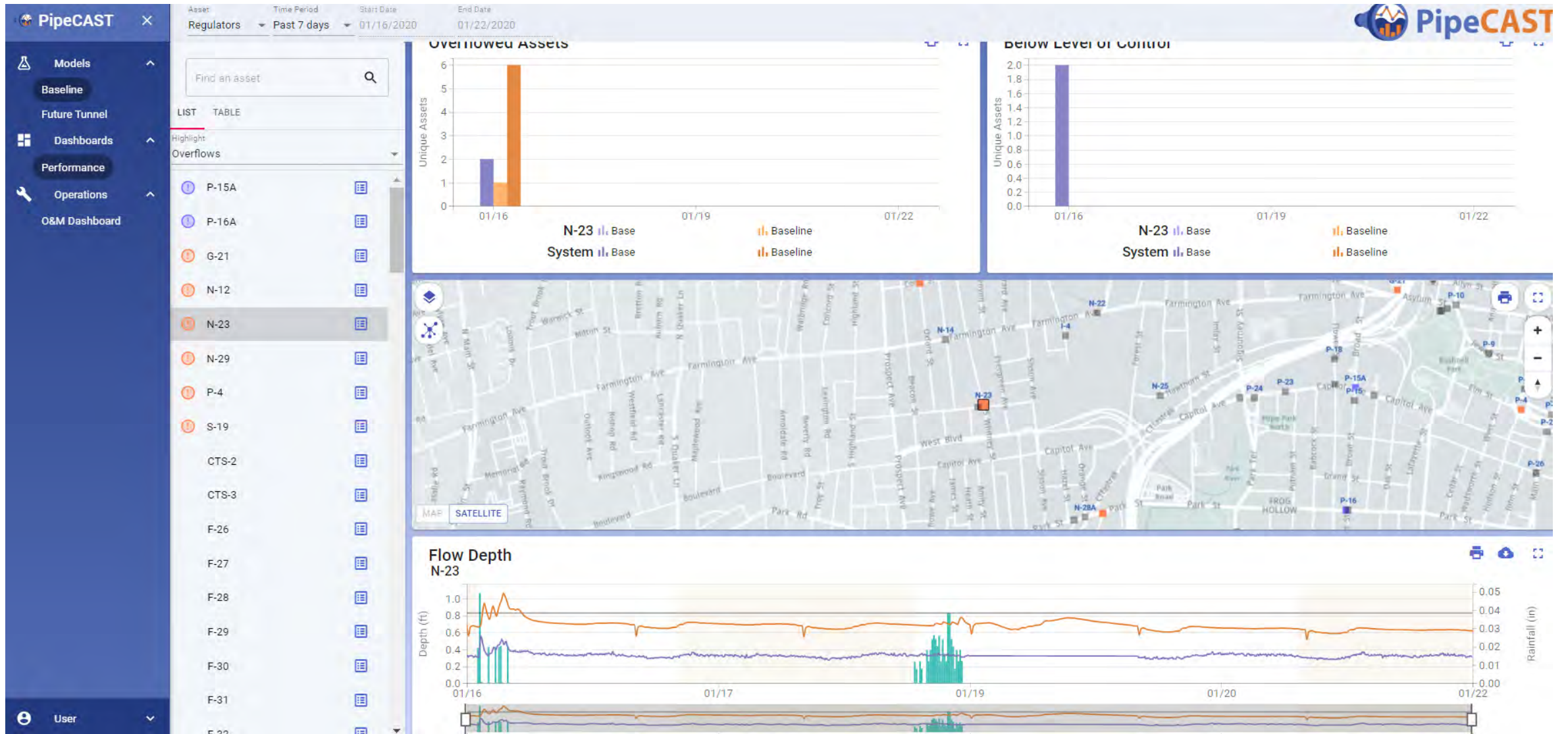
Example Living Model Use: Flooding

- Large storm event caused street flooding; complaint from resident suggested issue with combined sewer

- Living model matched nearby CSO level sensor peaks reasonably well, and well below surcharge conditions

- Follow-up investigation discovered defective catch basins as cause

Peak level is ~ 3 to 3.5 feet in observed and model, MH depth is **~16 feet**
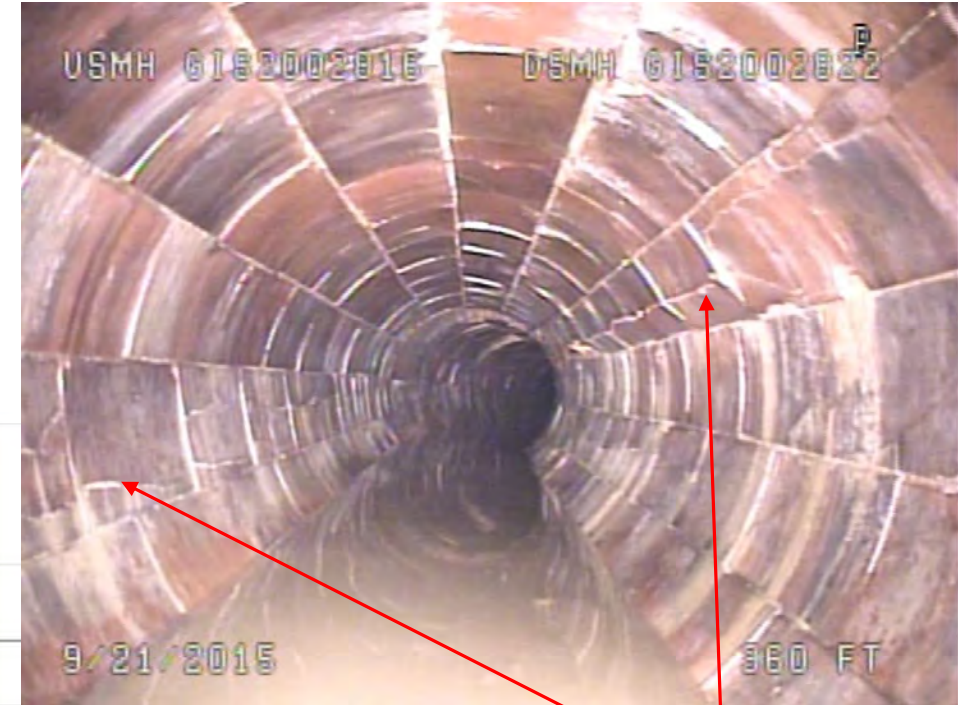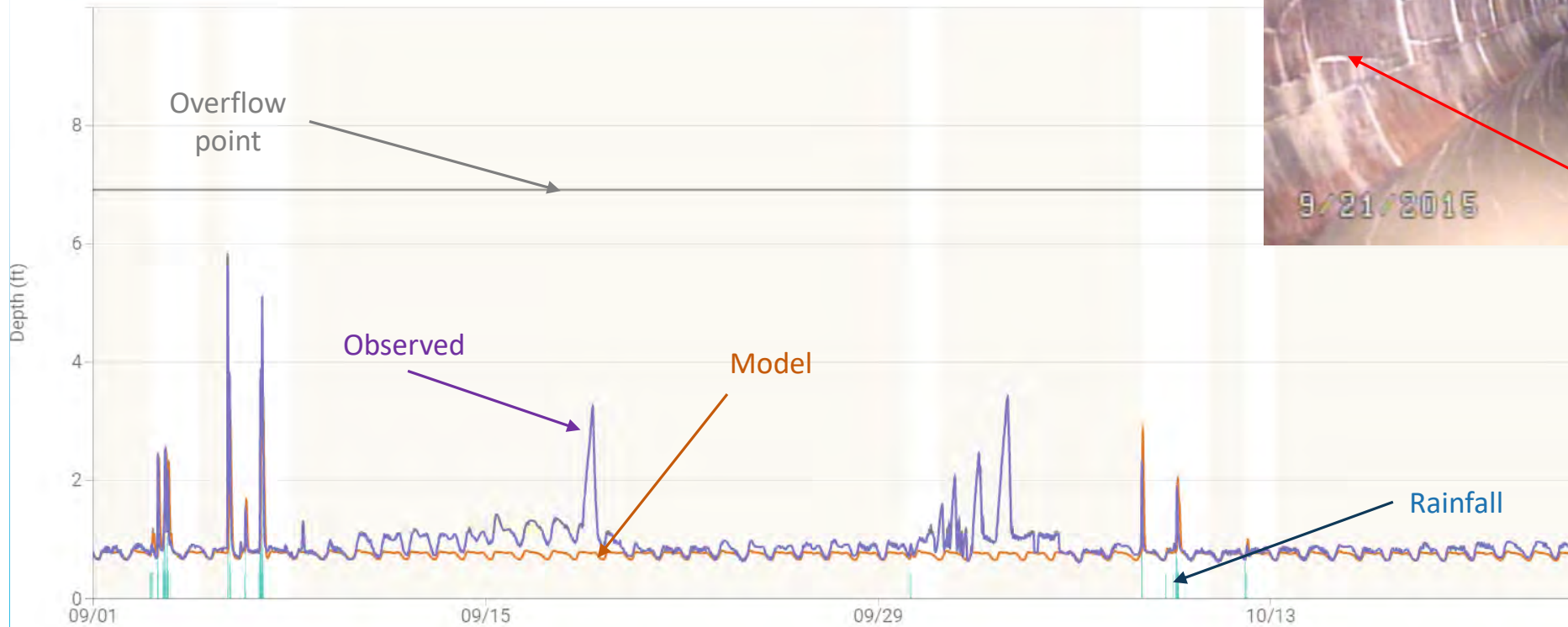
Model

Observed

Rainfall

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Example Living Model Use: Flooding

- Street flooding was reported in a neighborhood

- Living model did NOT show flooding, prompting investigations

- Updated model post-investigations still did NOT meet field observations

- Additional investigations underway, continually monitored in Living Model via nearby permanent sensors

- Unnecessary structural fix was avoided

Ground elevation

2nd Modeled condition

Area of observed street flooding

1st Modeled Condition

Calibrated condition

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# Example Living Model Use: Sewer Inspections

- Unusual DWF trend noticed, coming close to dry weather overflow

- Recent CCTV showed fractures but not severe

- Prompted follow up investigations


Light fractures showing

Example Living Model Use: Sewer Inspections (cont.)

- Follow up CCTV found collapse in critical interceptor
- May have otherwise been not as apparent due to concrete road base
- Extensive repair needed but could have been worse if undiscovered

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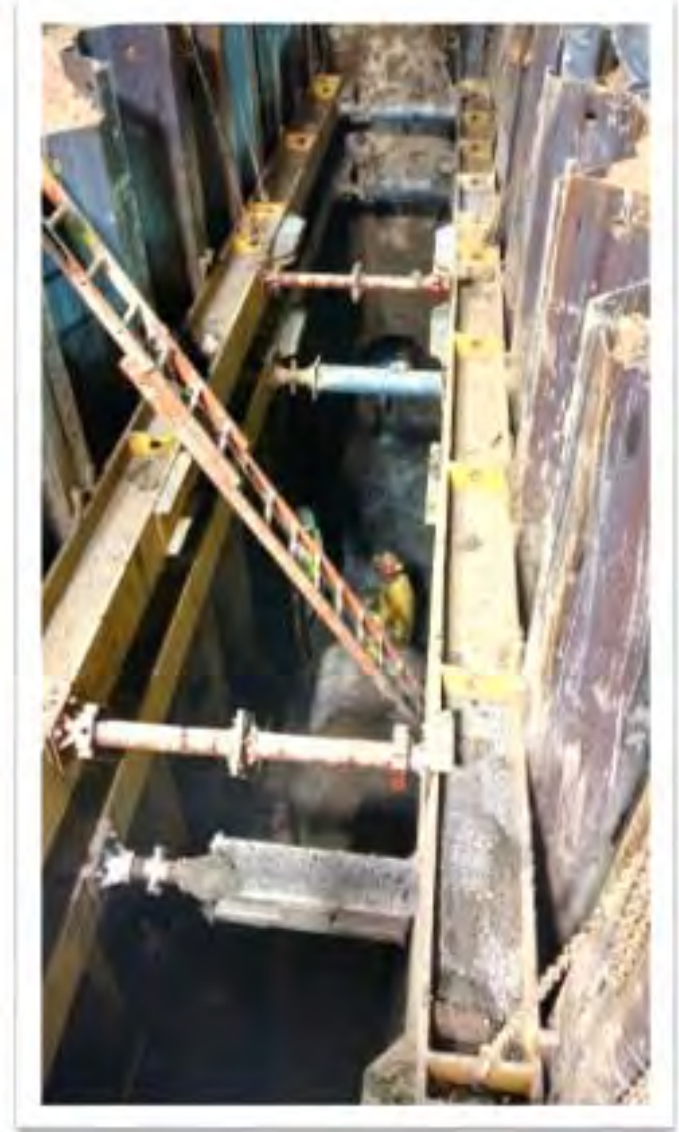
Example: Post-Cleaning Analysis

Post-Inspection but Pre-Cleaning

Living model simulates an overflow would have occurred if cleaning was not performed, and nearly overflown other times

Overflow point

Model

Observed

Rainfall

Post-Cleaning

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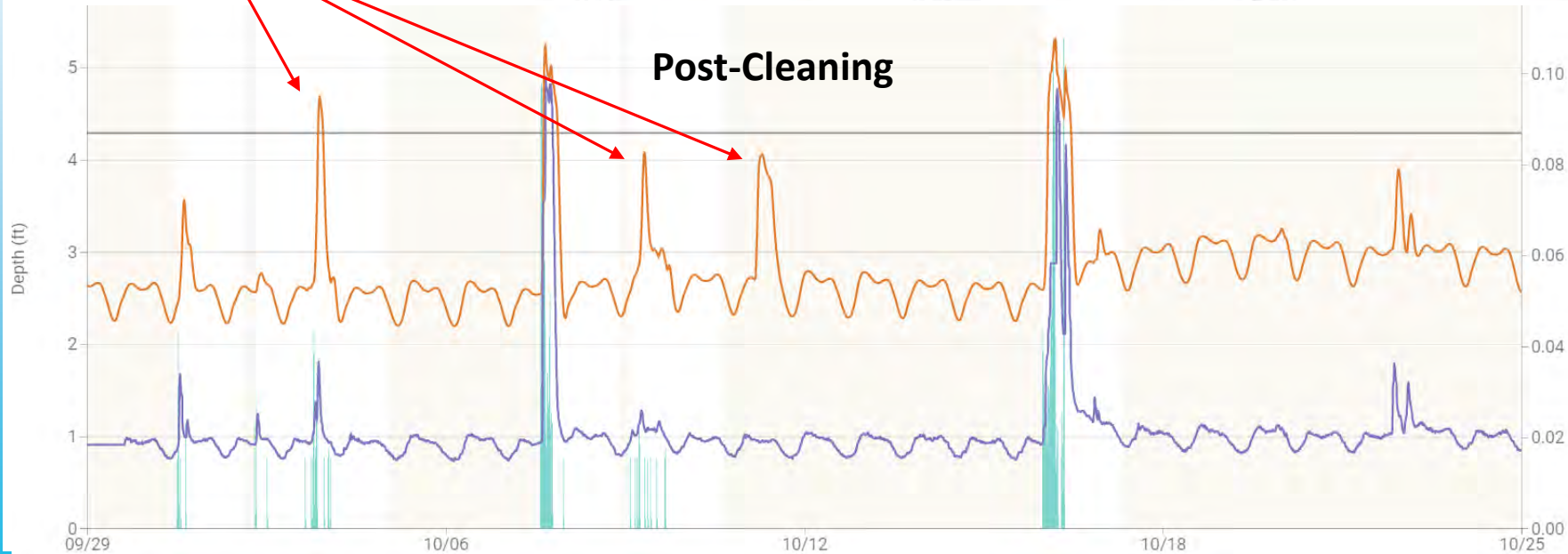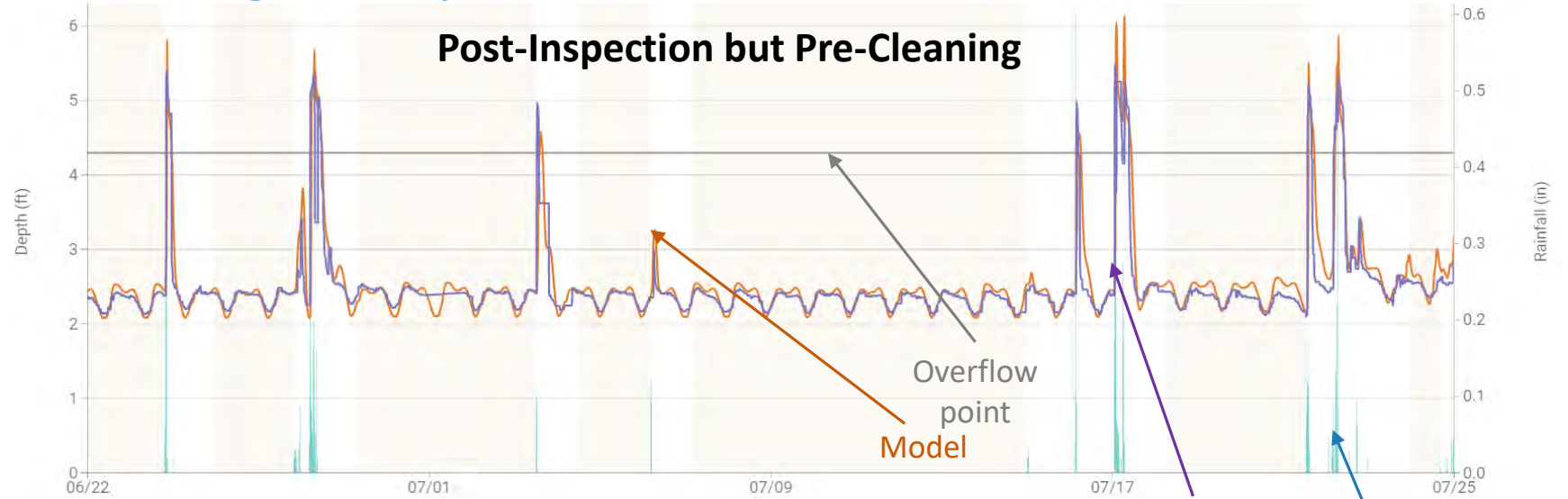
Example: Capitol Savings

- Extensive (~200,000 LF) large diameter multi-sensor inspection program performed by MDC

- Lead to follow-up cleaning of nearly 56,000 LF

- Living model will be used to track levels in interceptors, and reduce the amount of inspections required in the next inspection/cleaning cycle, **saving $**

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Future Use

- Plan future meter/sensor deployment, i.e. where is more data needed?

- Provide forecasting before a wet weather event

- Evaluate **level of control** at CSO regulators to support MDC's CSO Long Term Control Plan

  - Baseline recommendation of Plan - 90% capacity (cleaning) and 10% I/I reduction. Living model will be used to monitor.

- Evaluate conditions in future planned scenarios or development work

- Evaluate other sewer improvements effectiveness (ex: rehabilitation)

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