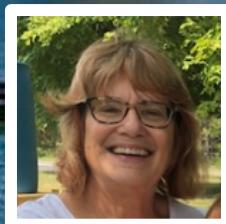
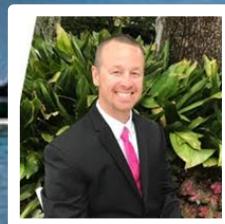


# Open-Storm Detroit Dynamics

## Utility-University Team



Wendy  
Barrott



Christopher  
Nastally



Gregory  
Ewing



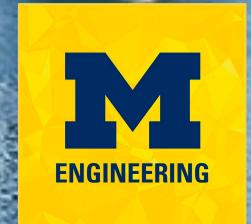
Abhiram  
Mullapudi



Sara  
Troutman



Branko  
Kerkez



# The Problem

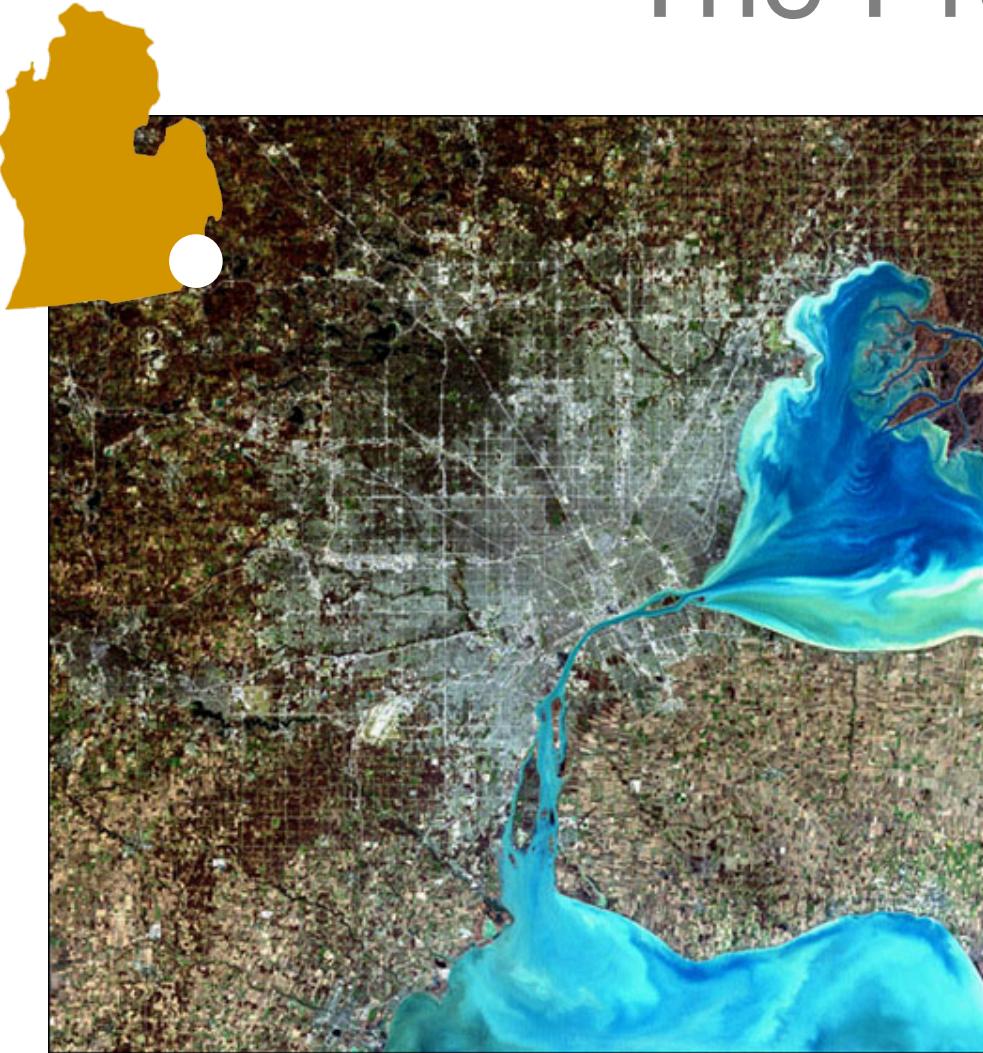
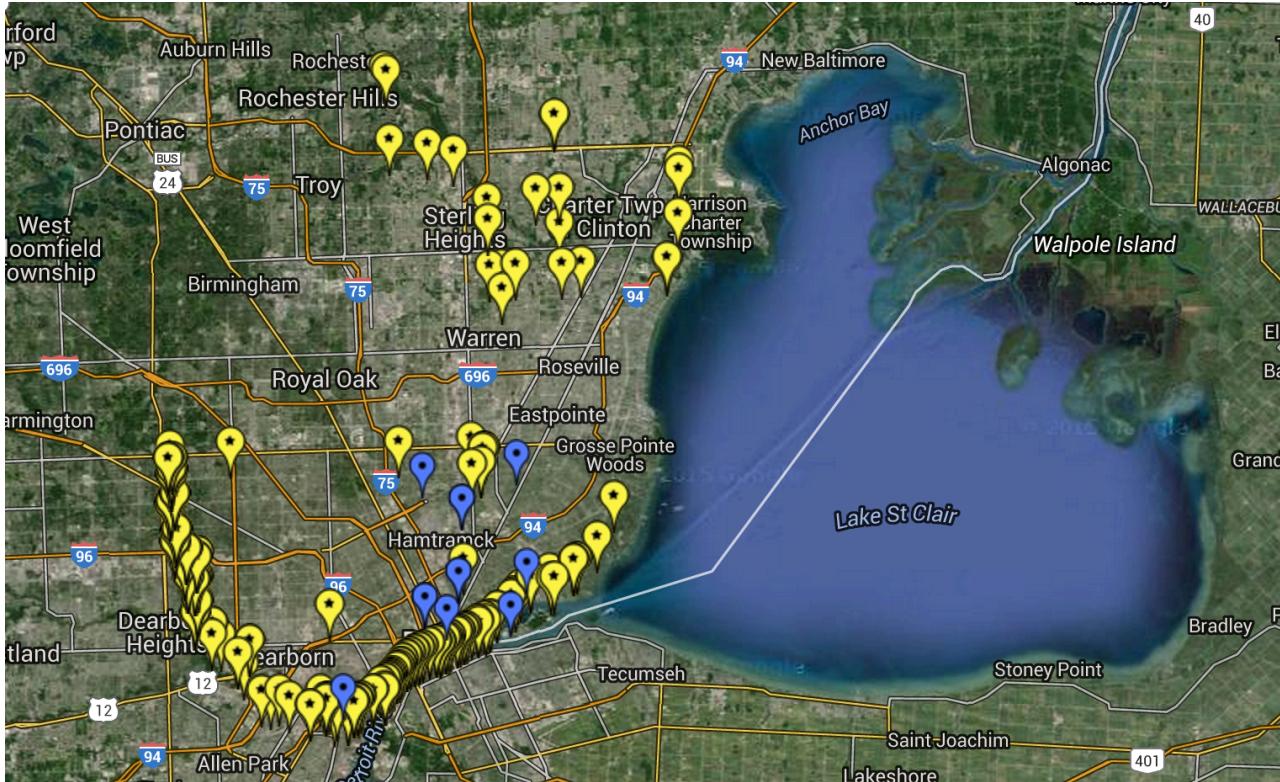




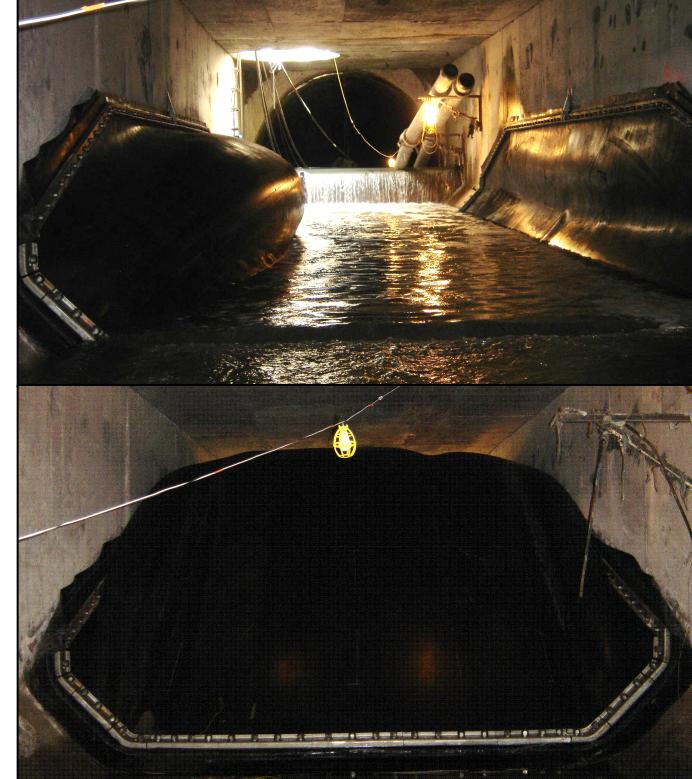
Image NOAA  
Image Landsat / Copernicus

Google Earth

# The Opportunity



100+  
Sensors



20+ Control  
Points

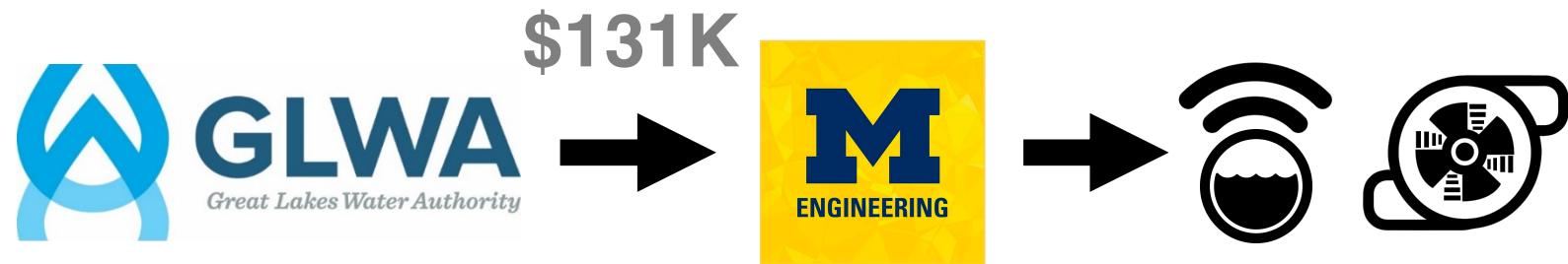
# The Plan



# The Plan

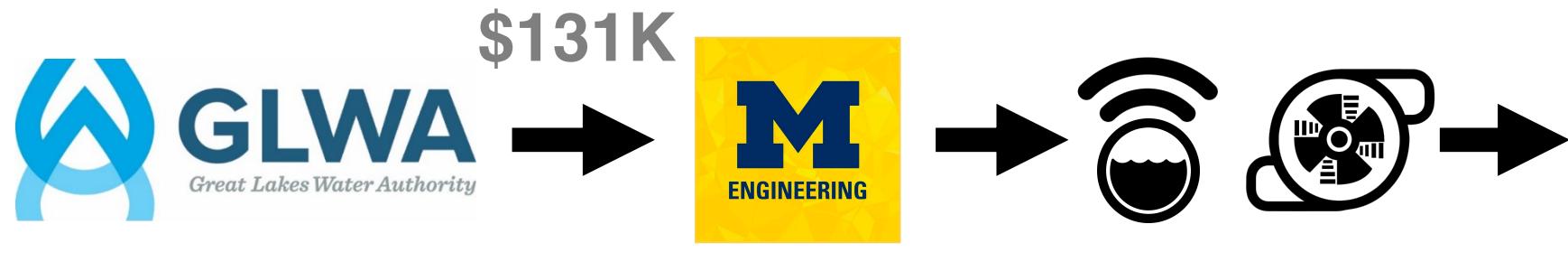


# The Plan



# The Plan

## Nov 2017 – Nov 2018



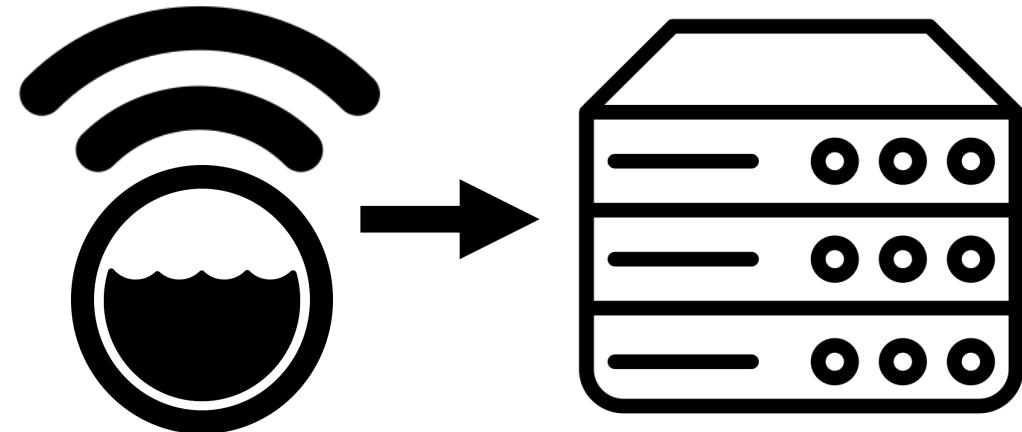
- Outcomes & Considerations
1. No New Construction
  2. Maximize Storage
  3. Reduce CSOs
  4. Equalize Flows

# Existing SCADA Workflow



Sensors

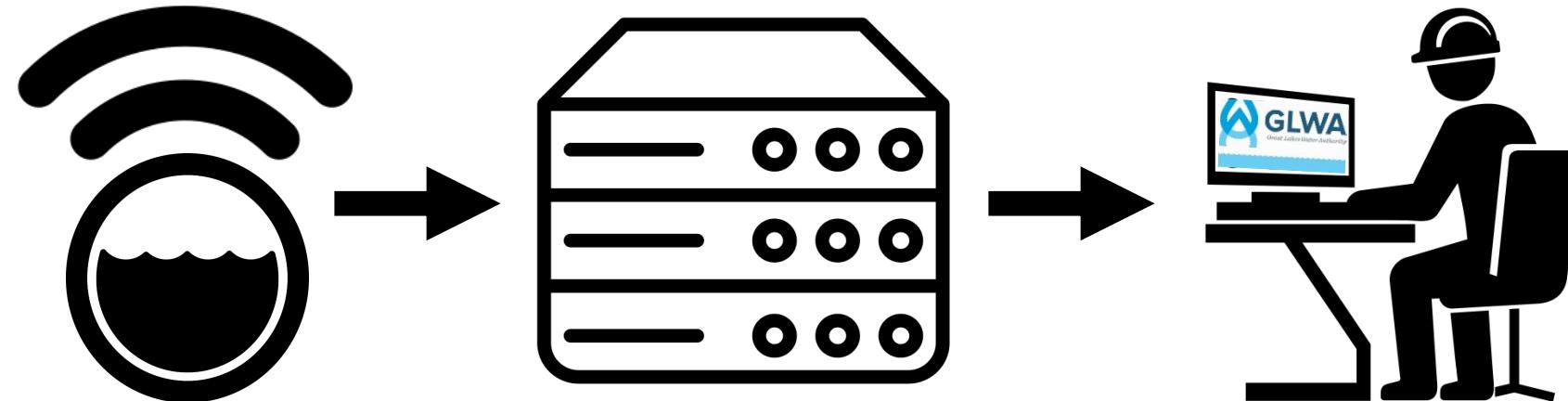
# Existing SCADA Workflow



Sensors

Utility  
Server

# Existing SCADA Workflow

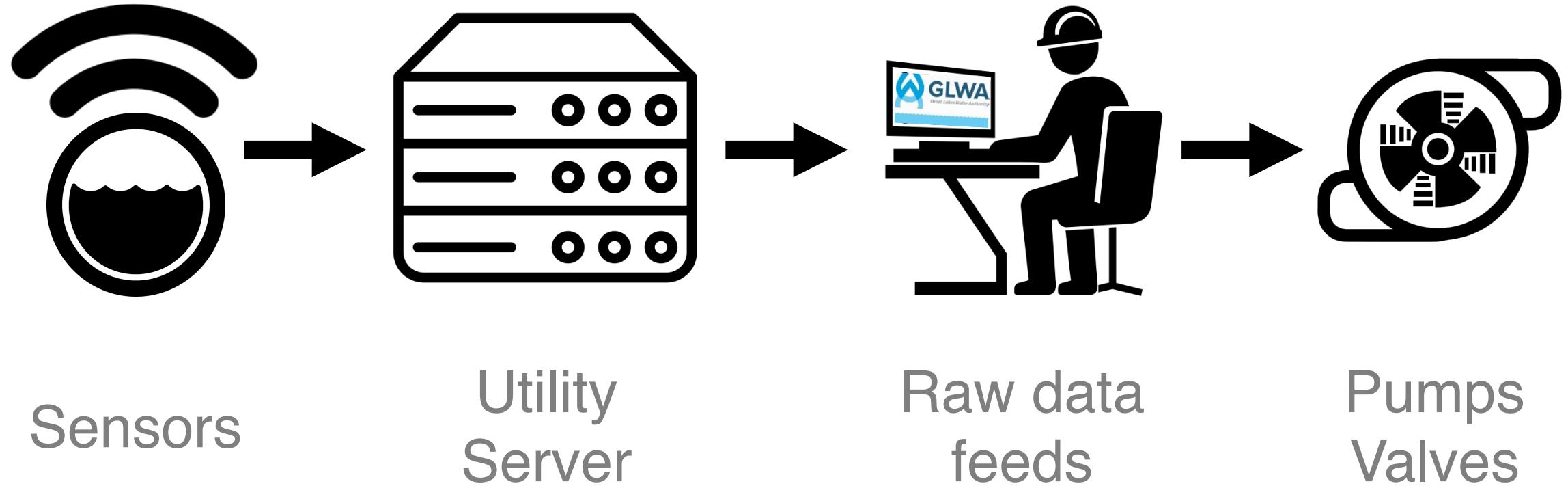


Sensors

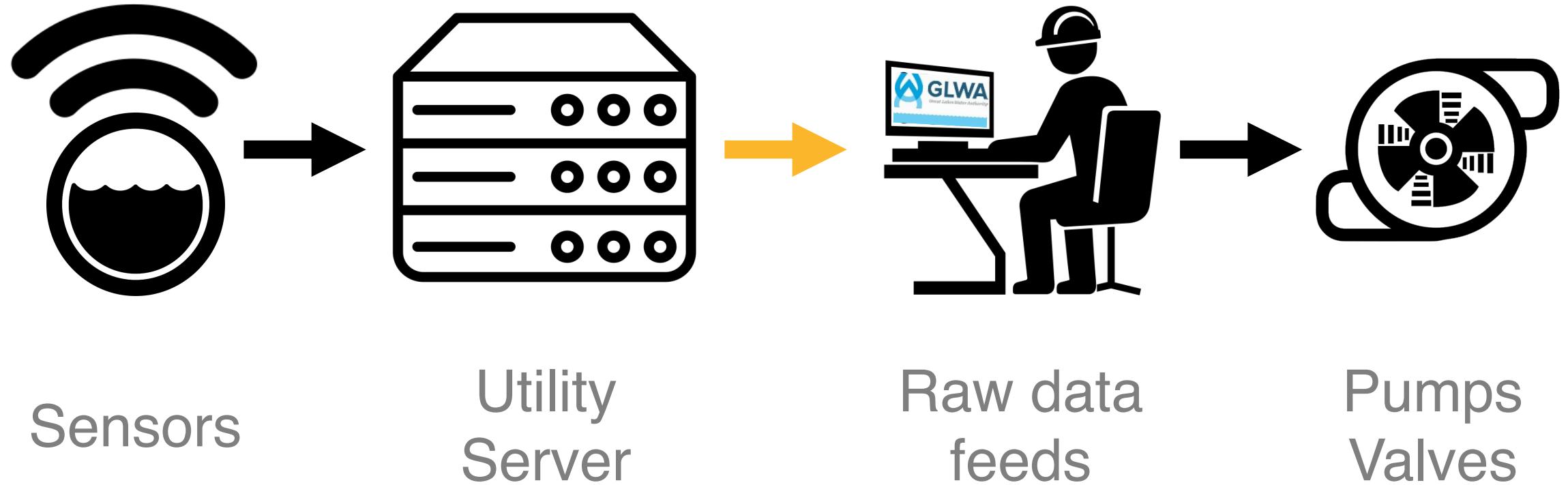
Utility  
Server

Raw data  
feeds

# Existing SCADA Workflow



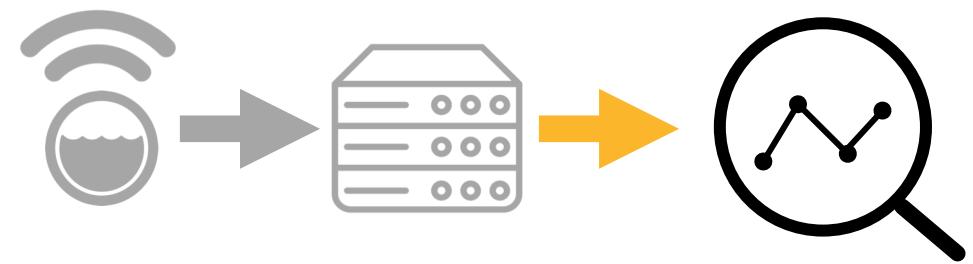
# Existing SCADA Workflow



# Description of Smart Water System

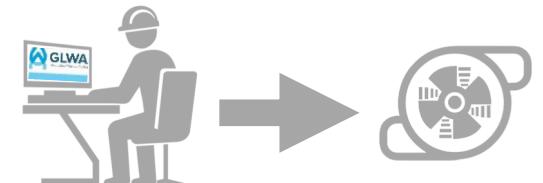


# Description of Smart Water System



Sensors      Utility Server

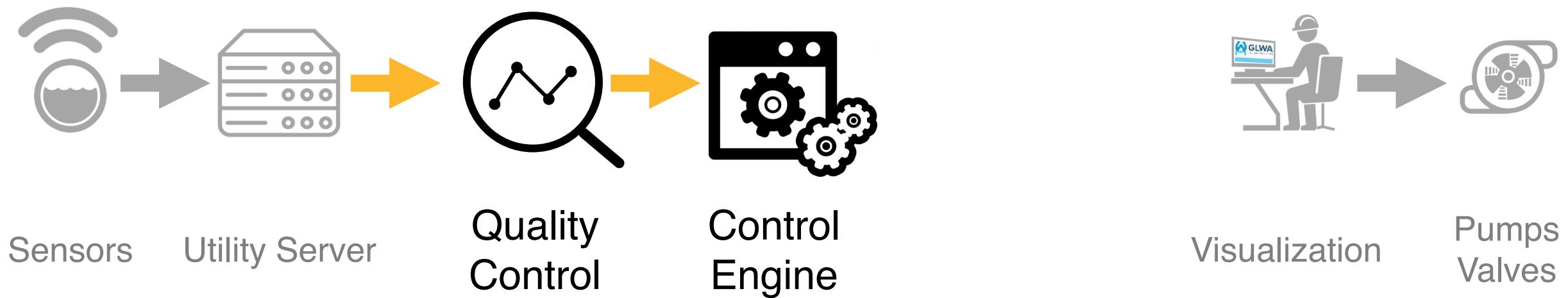
Quality  
Control



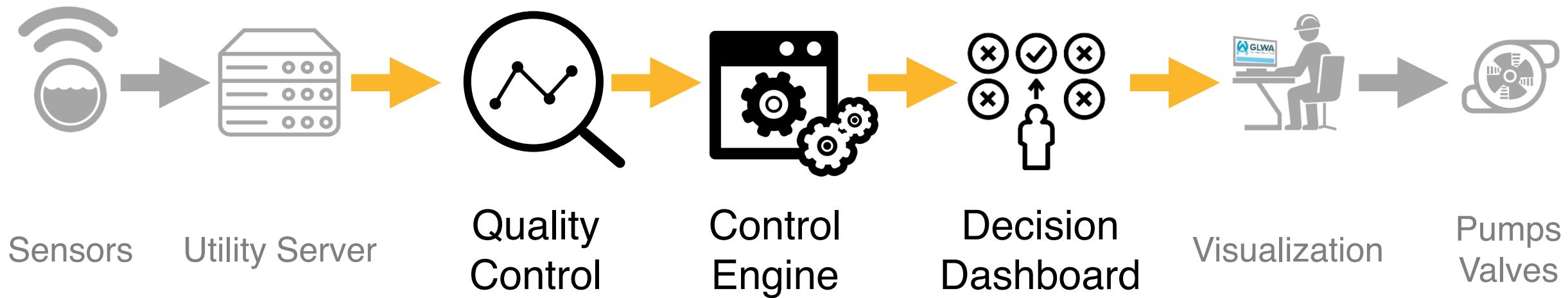
Visualization

Pumps  
Valves

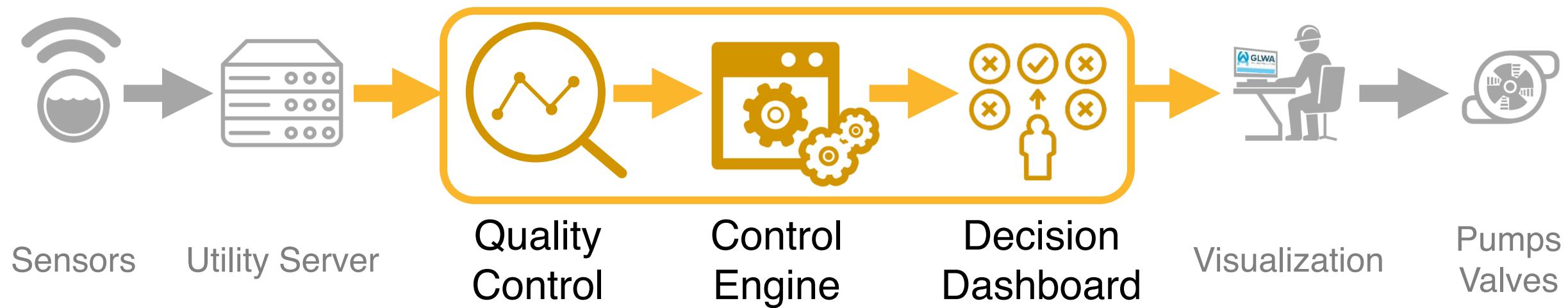
# Description of Smart Water System

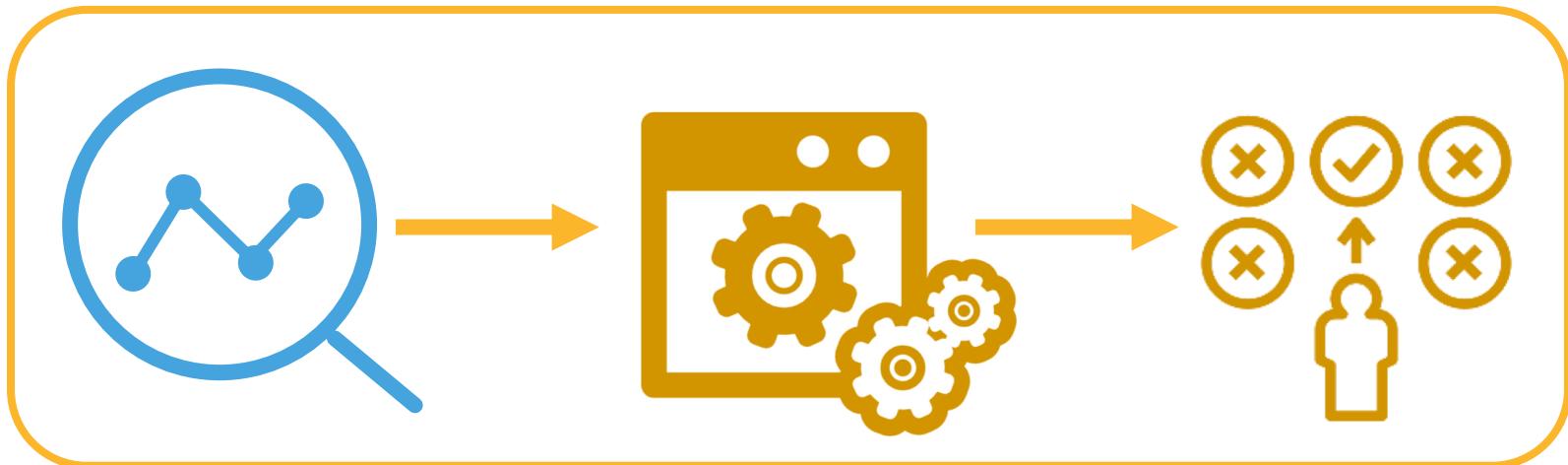


# Description of Smart Water System



# Description of Smart Water System

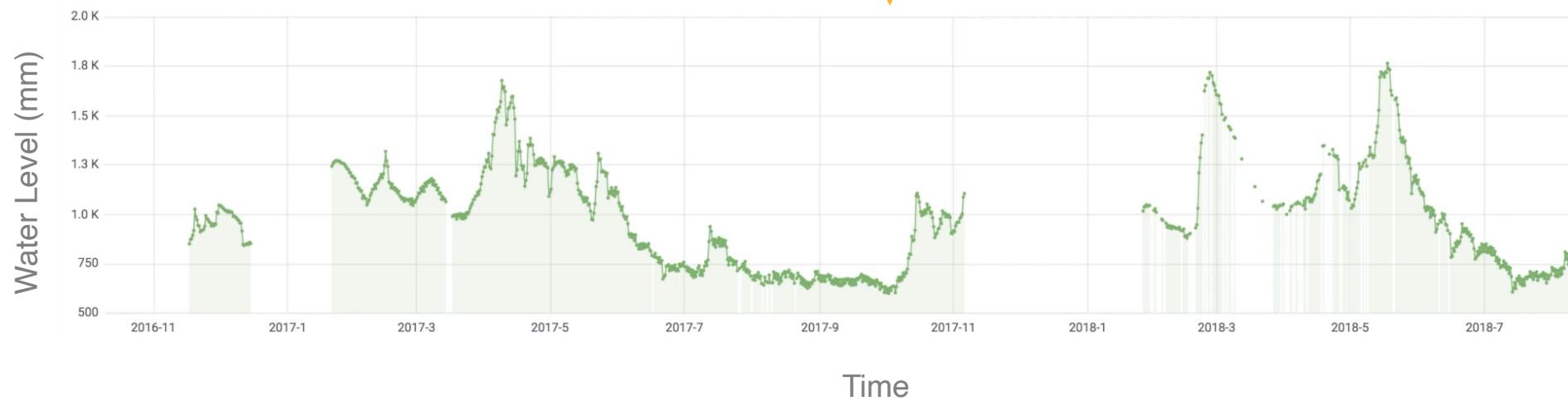




## RAW WATER LEVEL DATA

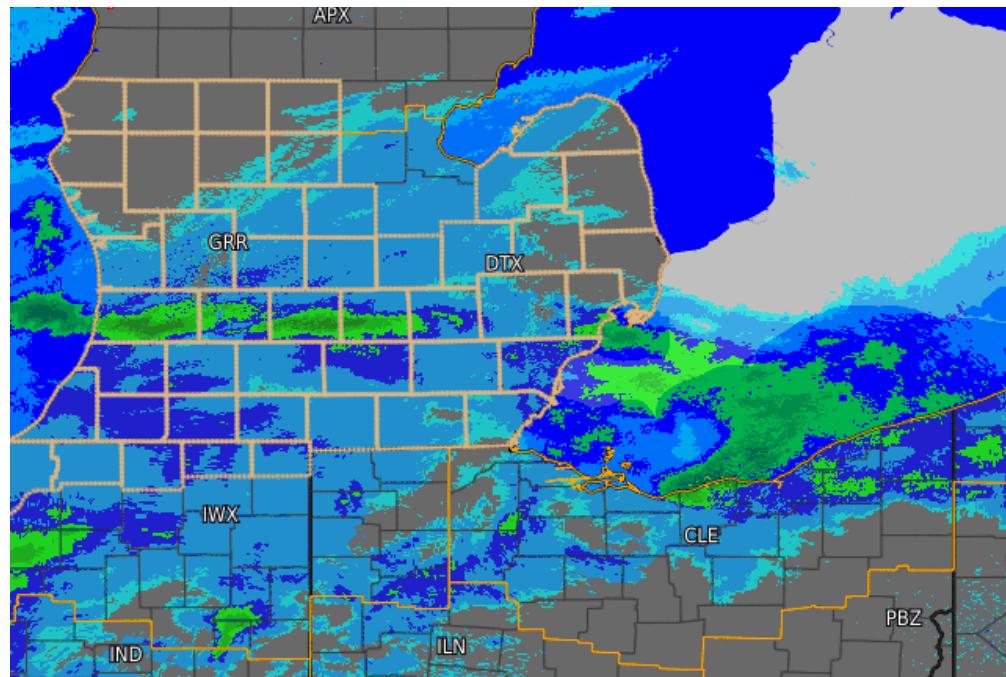


Real-time QA/QC

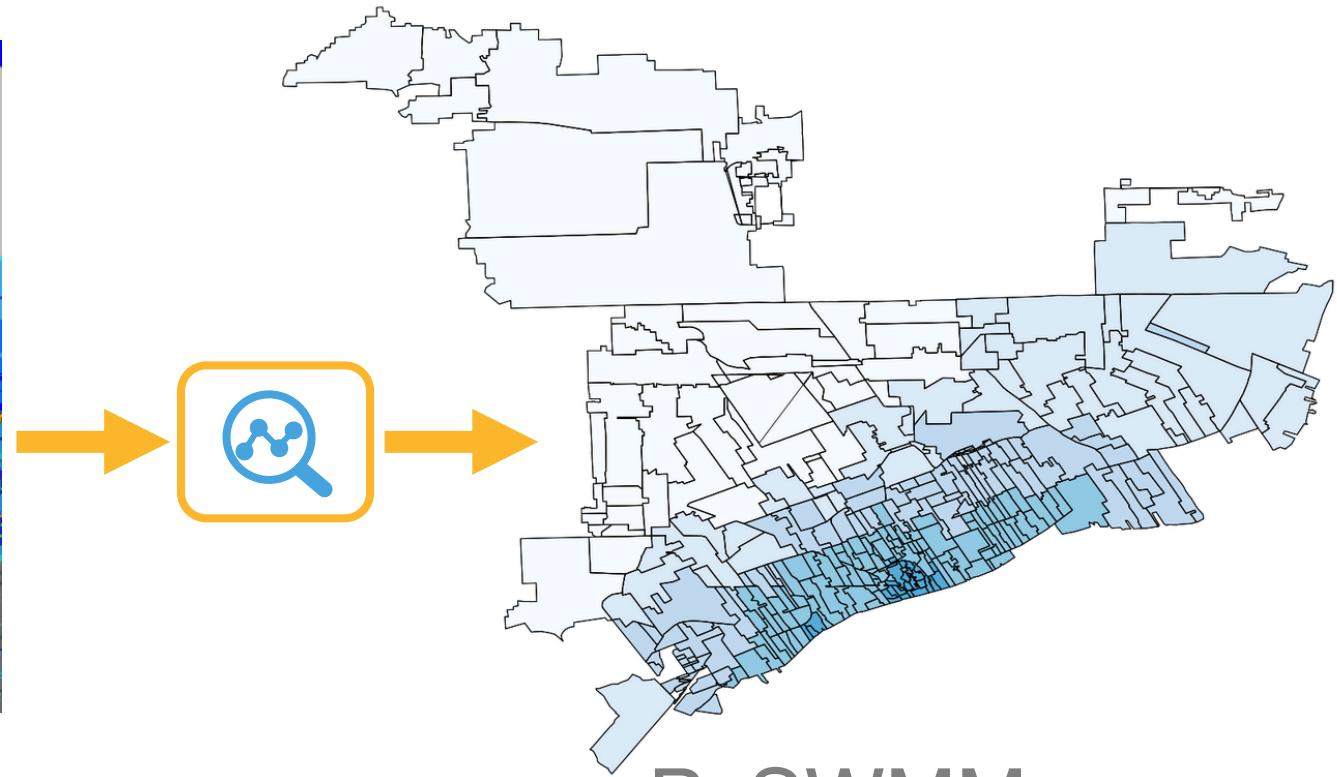




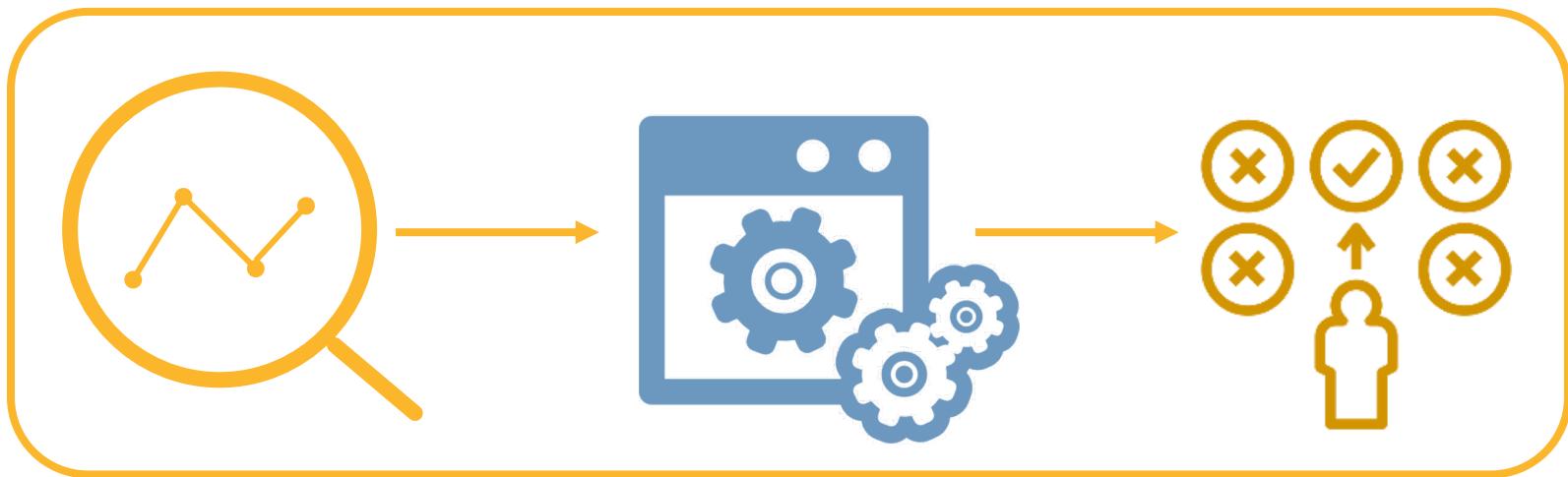
# Real-Time Forecasting



RADAR

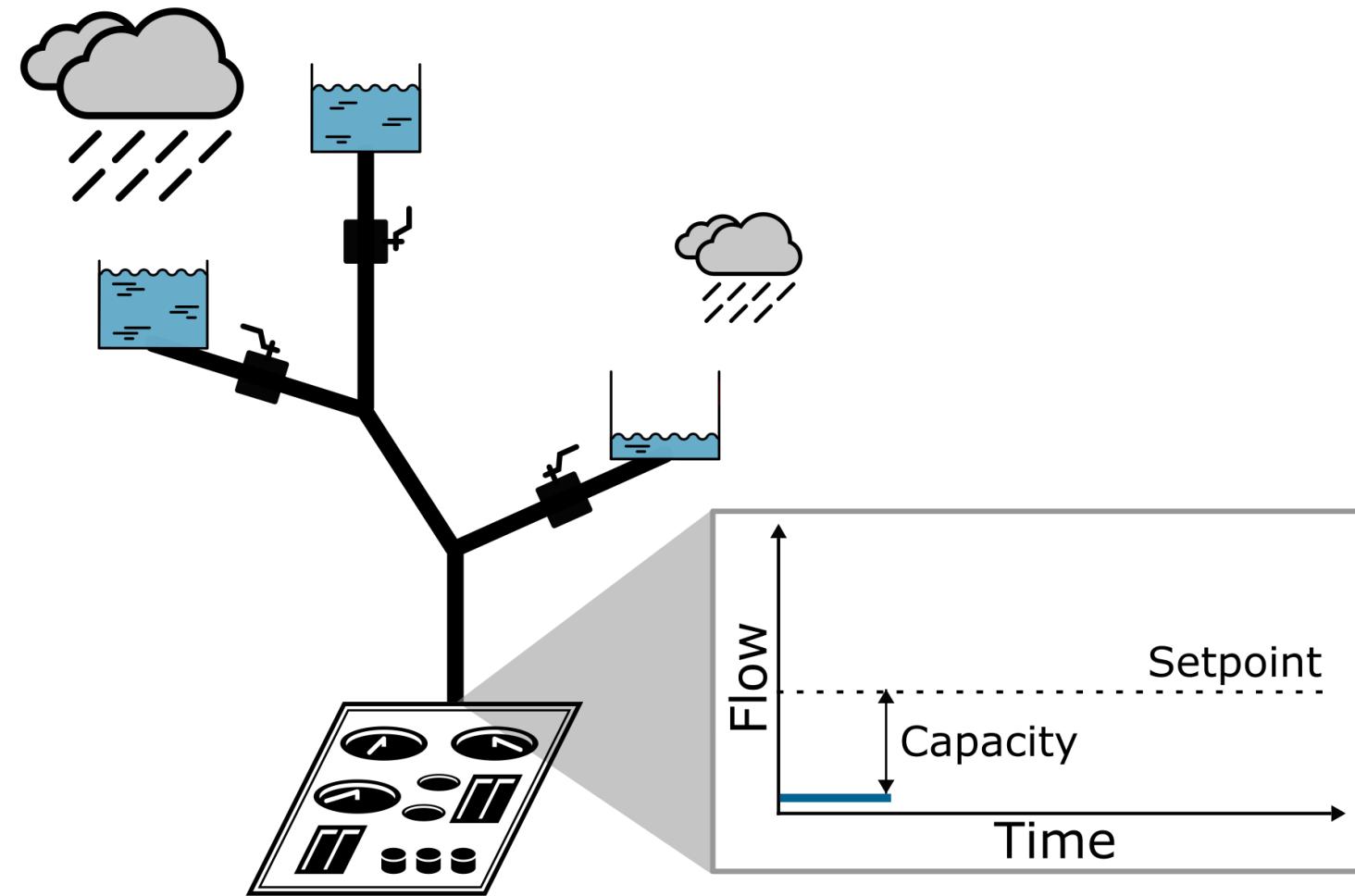


PySWMM  
Hydraulic Model



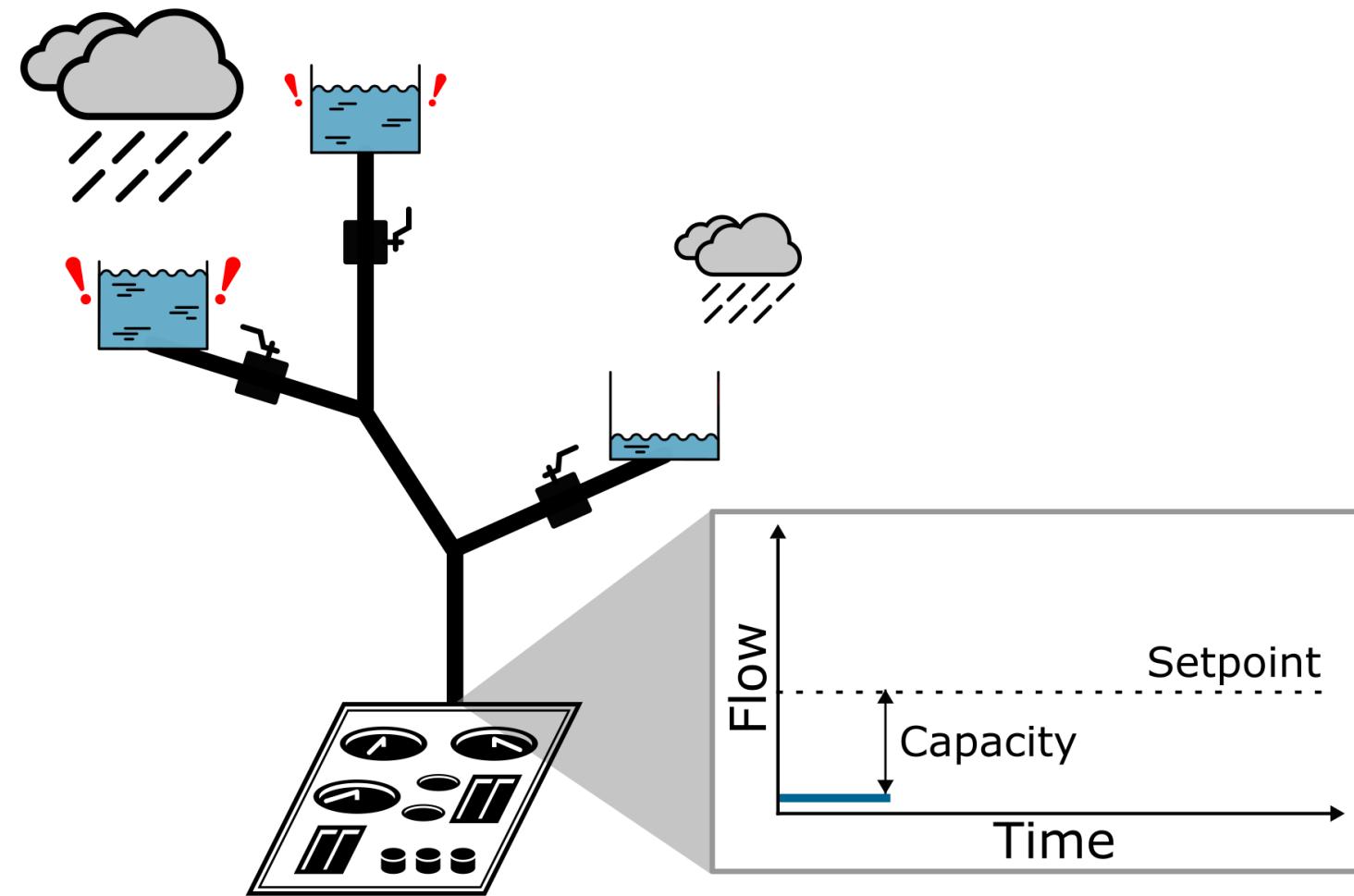


# Existing Challenge



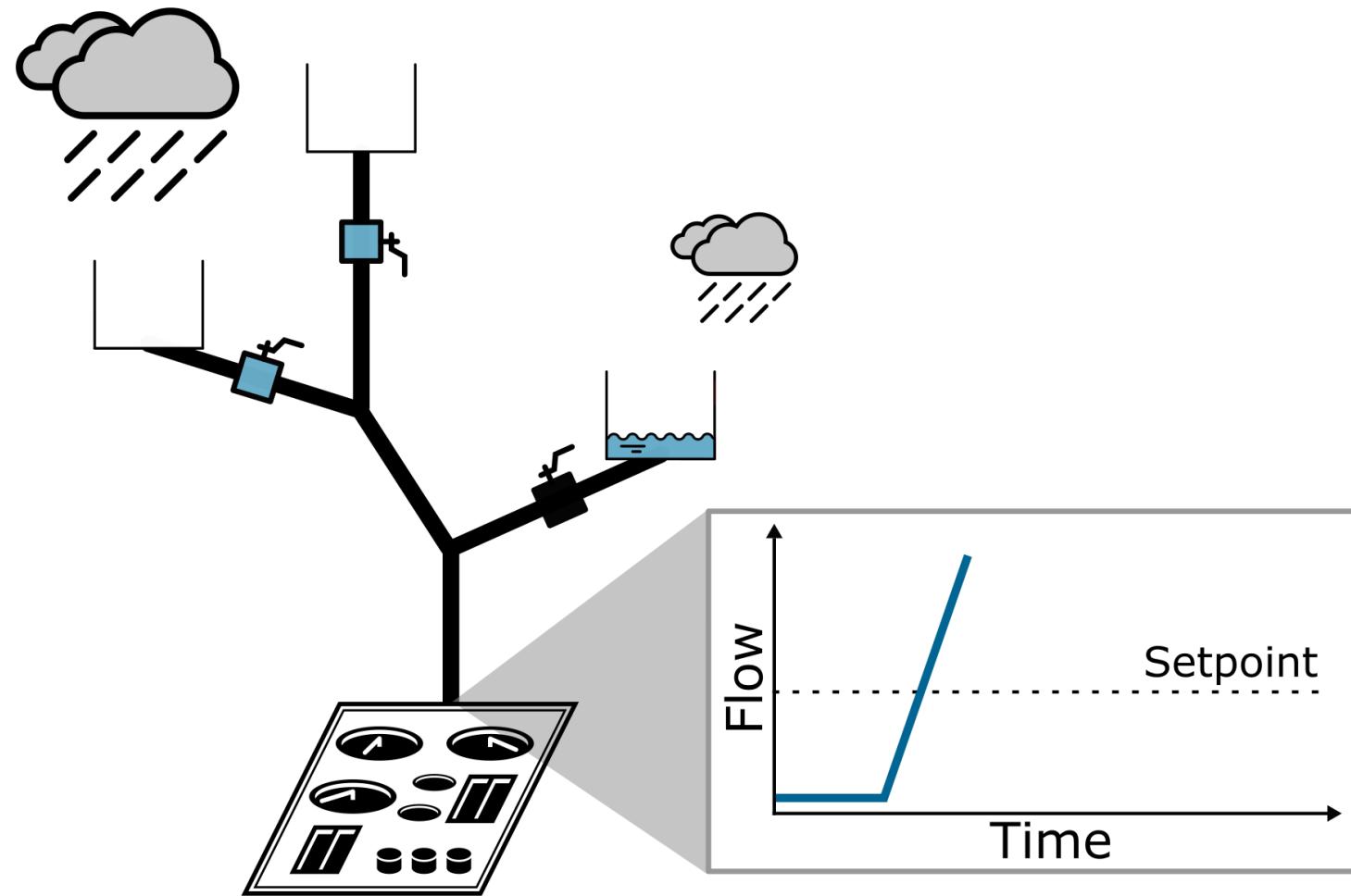


# Existing Challenge



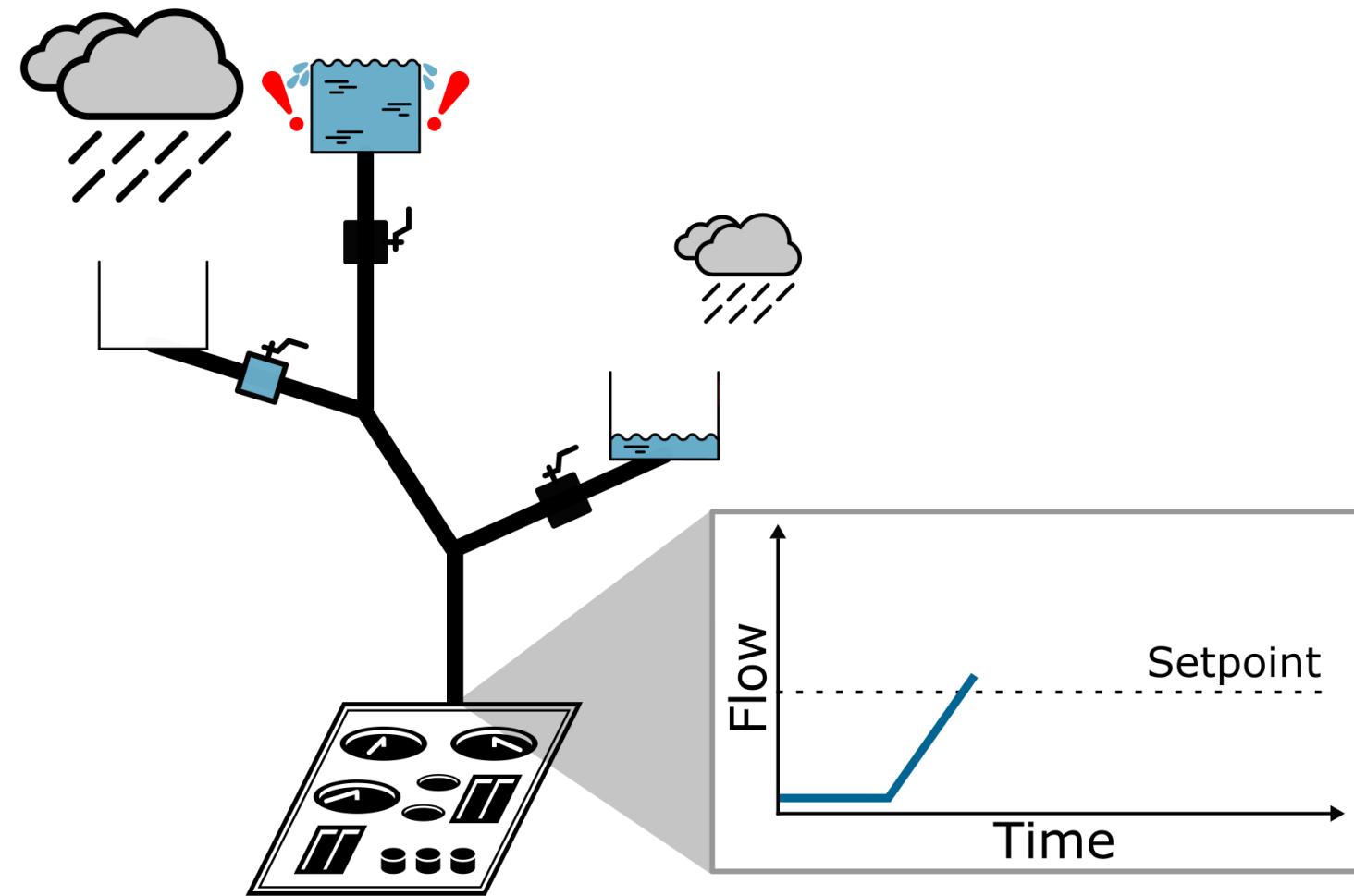


# Existing Challenge



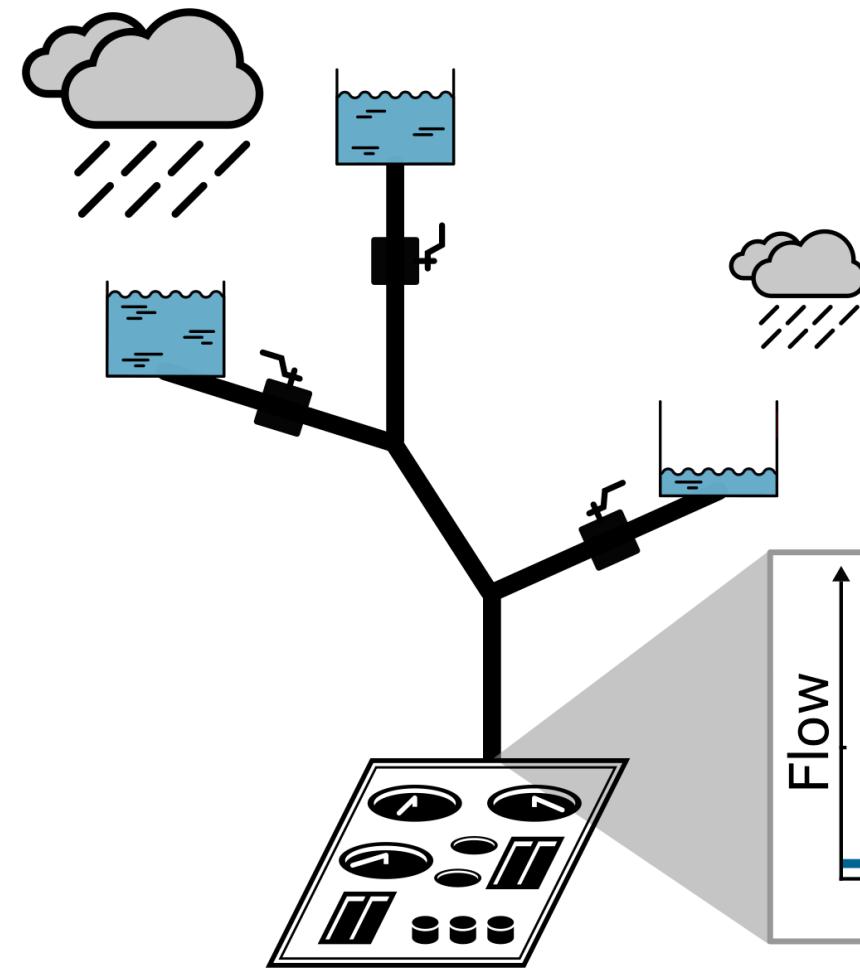


# Existing Challenge





# Implementation



$$P_i = \beta_i \cdot V_{up,i}$$

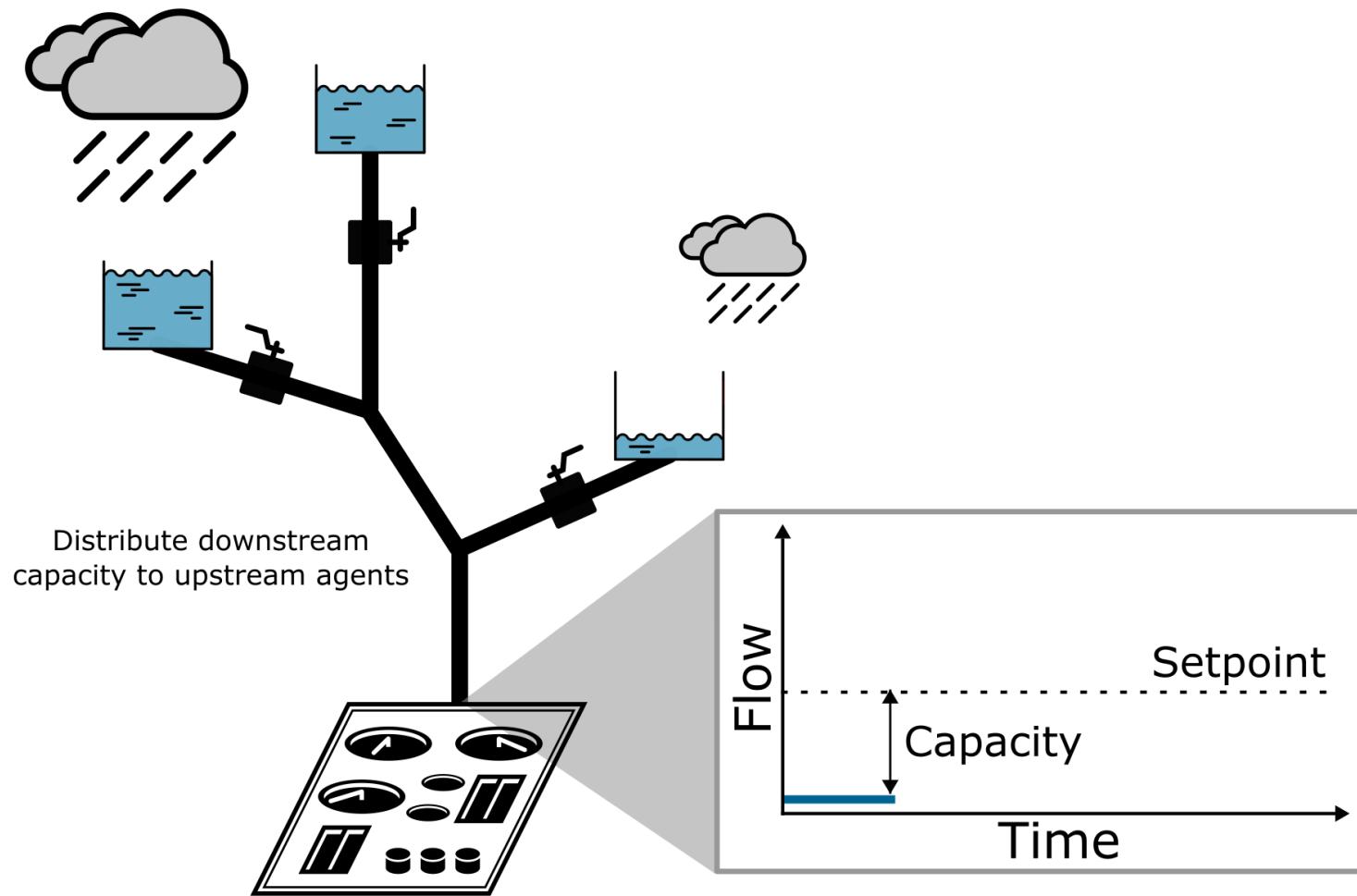
$$D = (V_{down} - setpoint) \cdot \varepsilon$$

$$p = \frac{1}{n+1} \left[ \sum_i P_i + D \right]$$

$$Q_{goal,i} = Q_{available} \cdot (P_i - p)$$

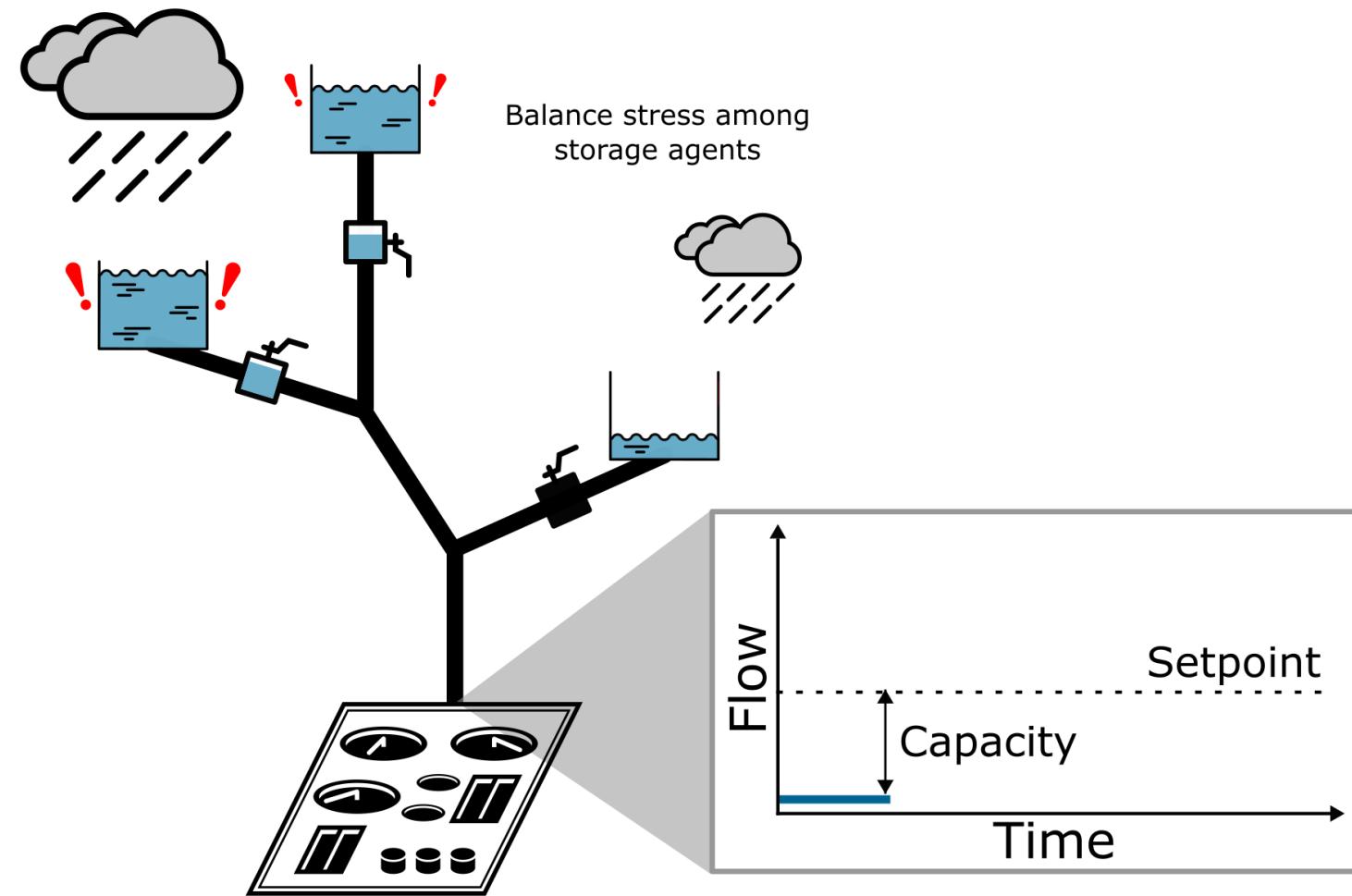


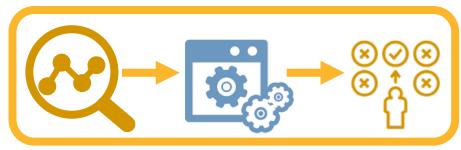
# Implementation



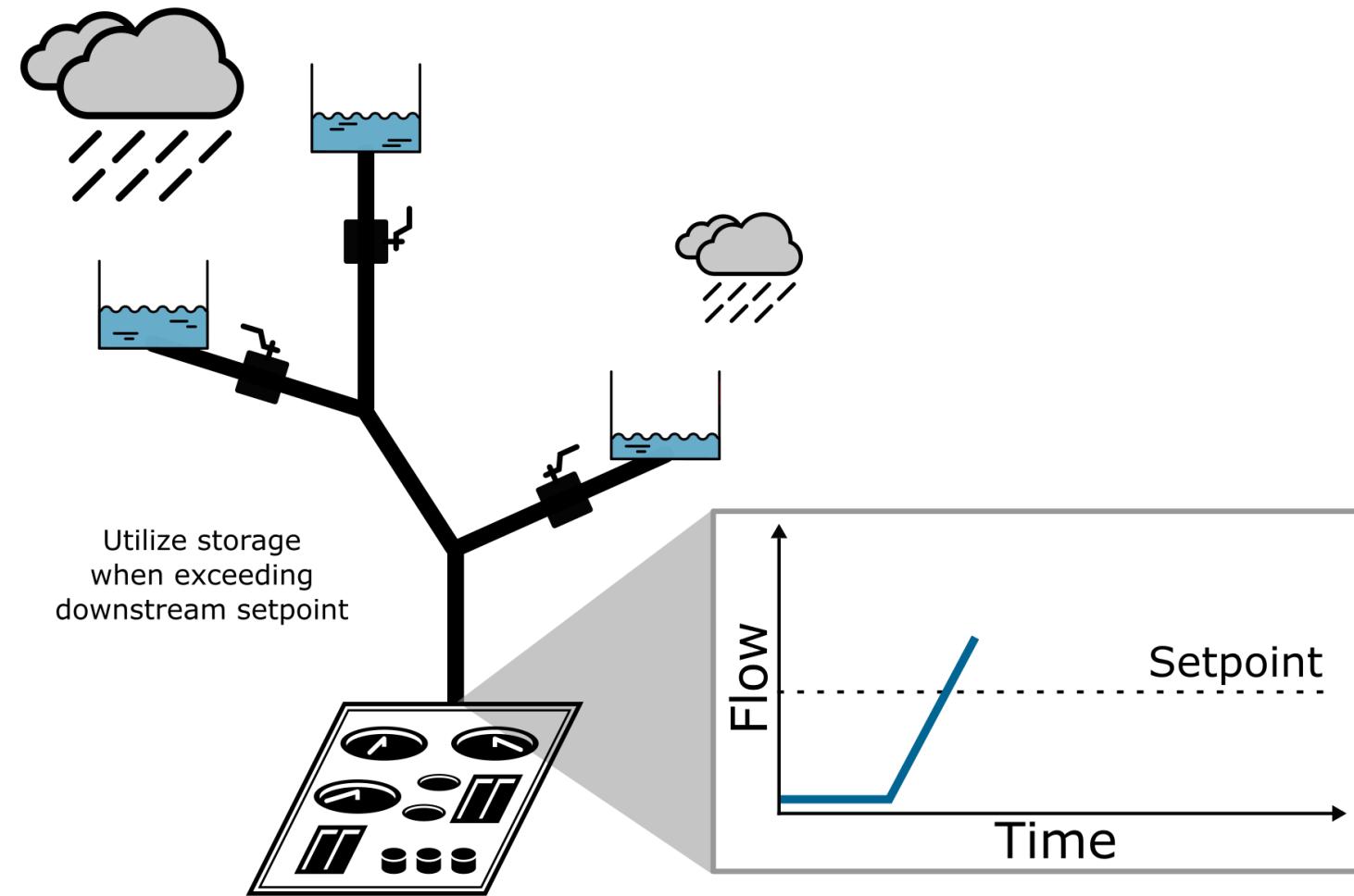


# Implementation



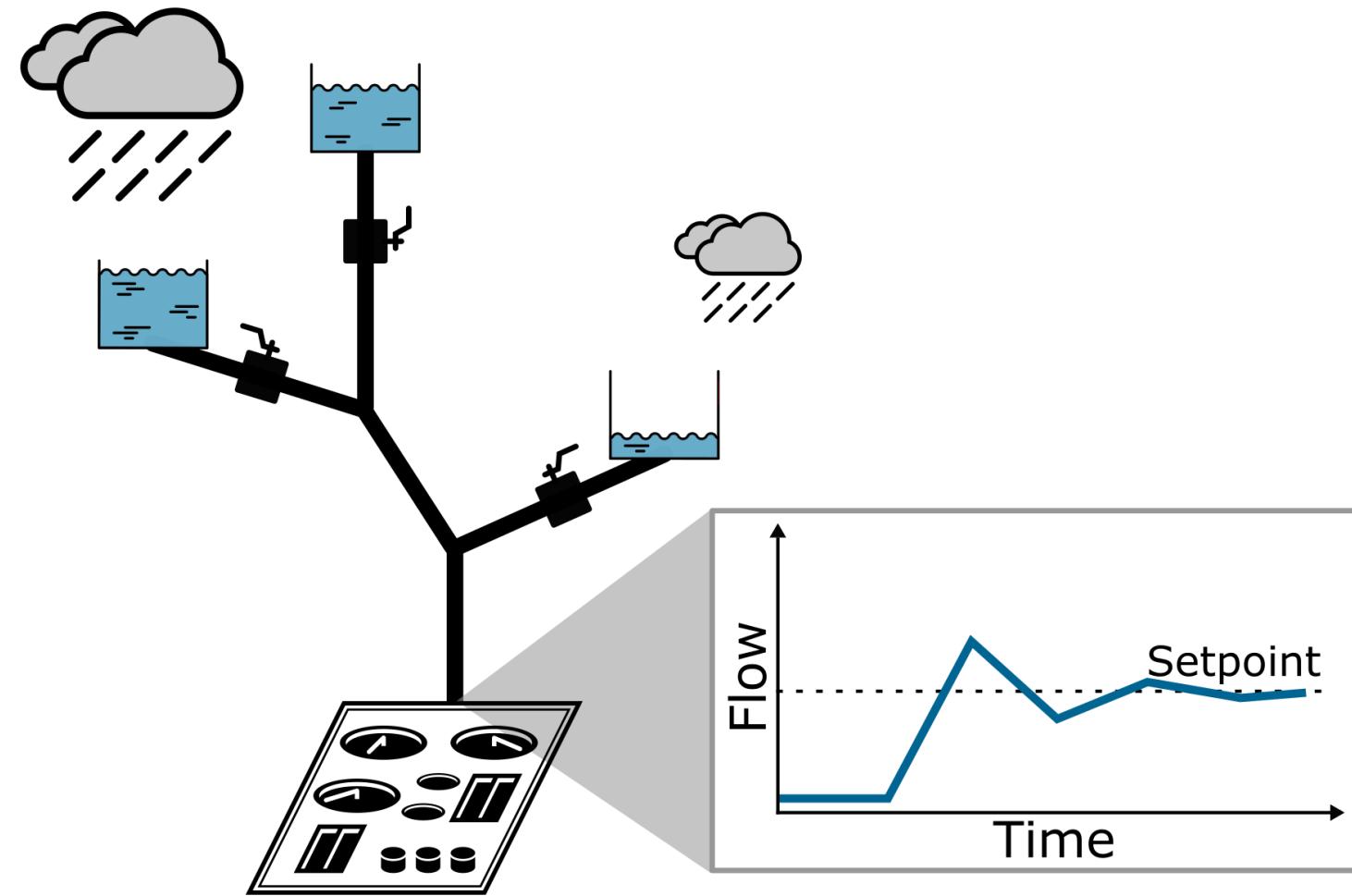


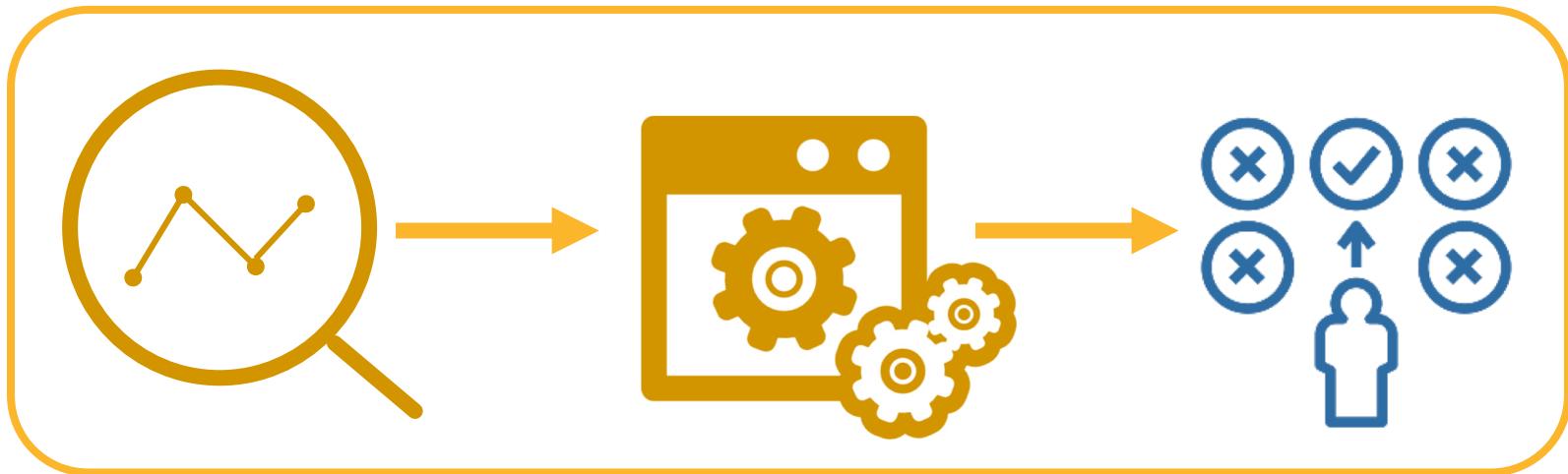
# Implementation

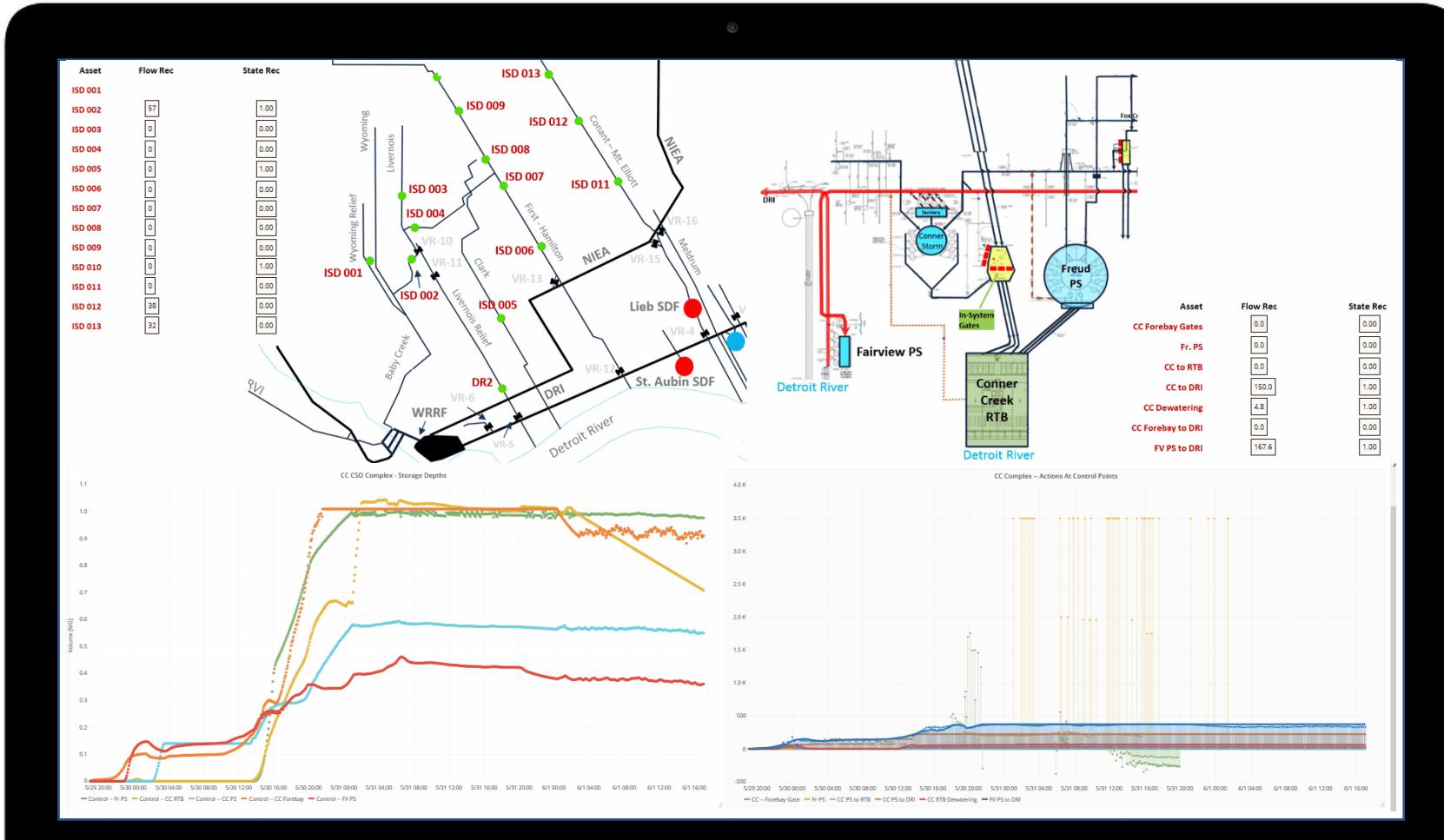




# Implementation

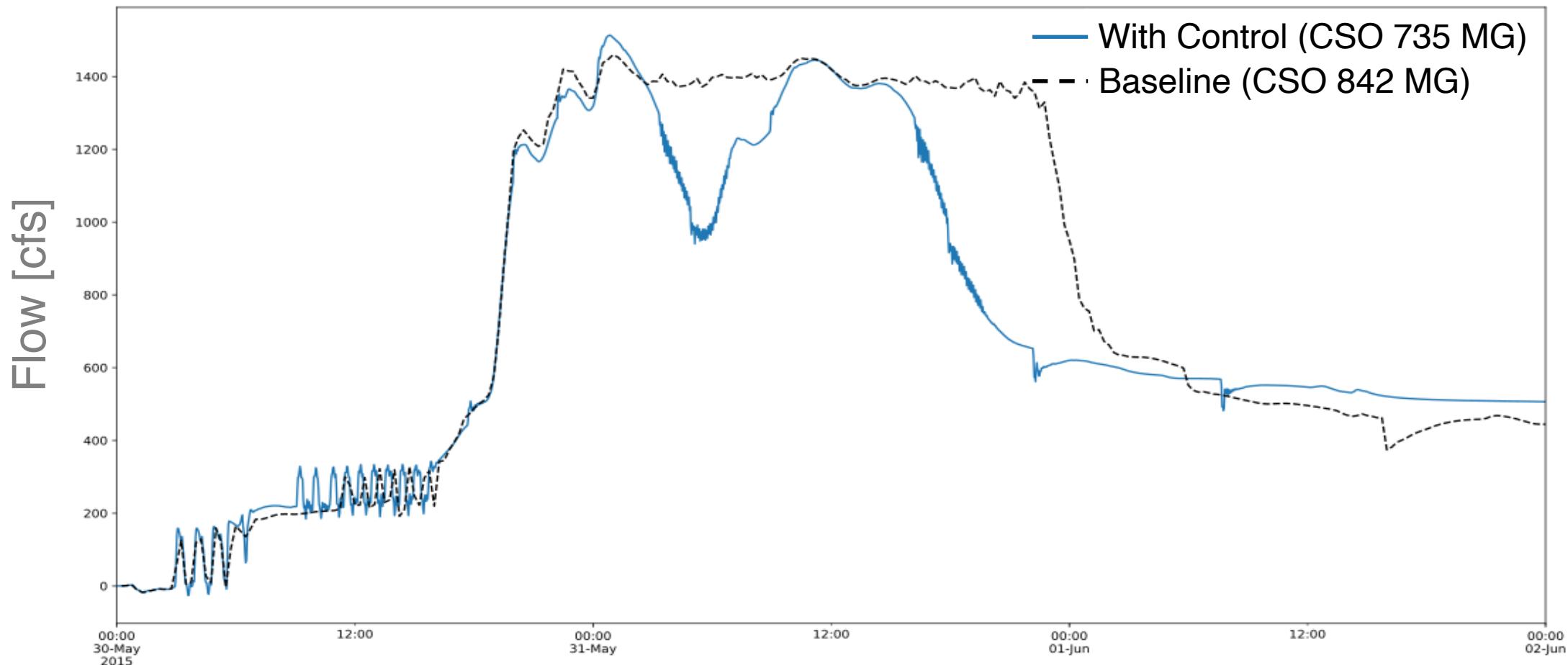






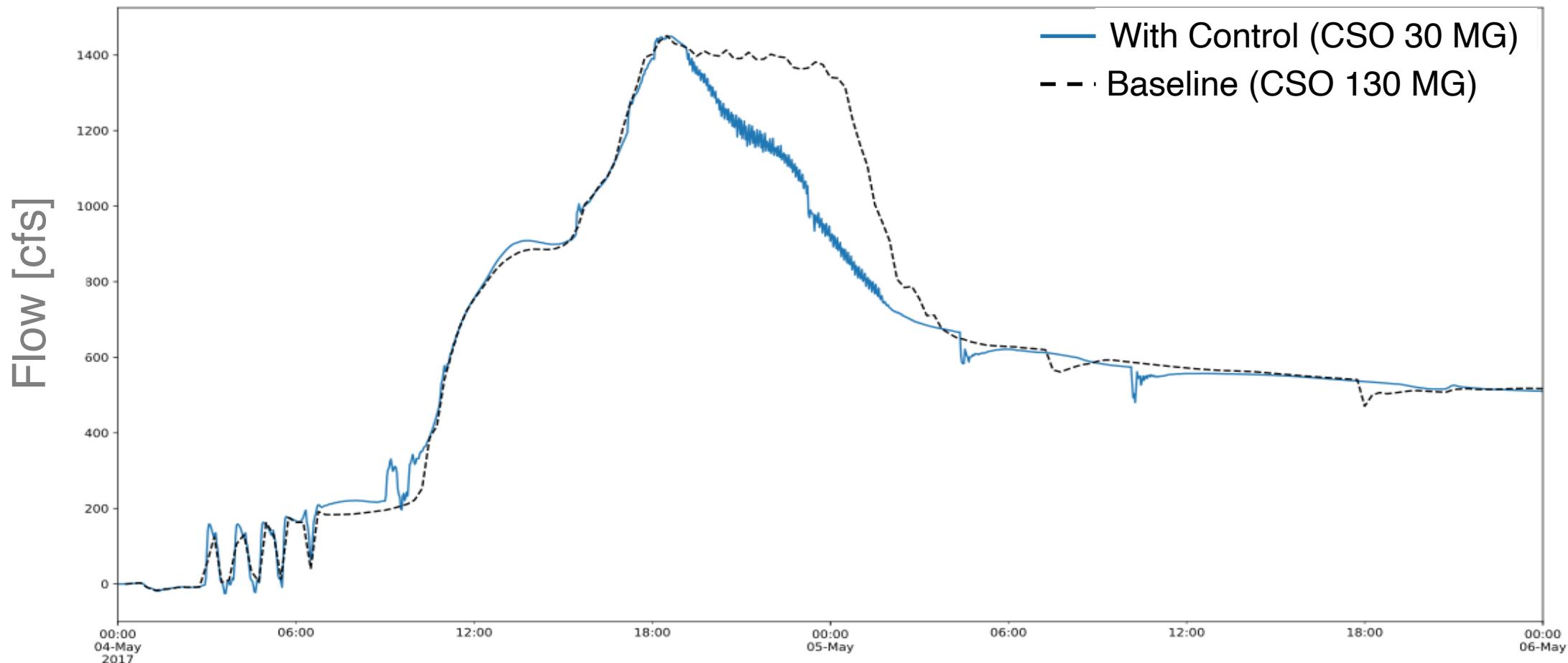
# Analysis and Implementation

## Inflow to Treatment Facility (without forecasting)



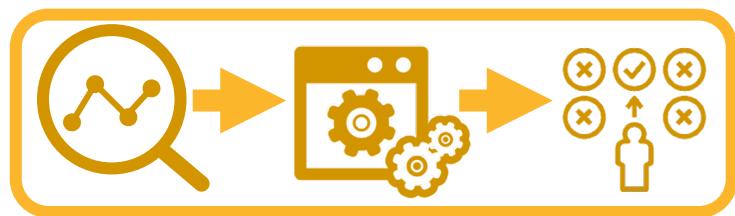
# Analysis and Implementation

## Inflow to Treatment Facility (with forecasting)



# Value Added

Smart System



**100 MG CSO Reduction  
Per Event**

Capital Improvements

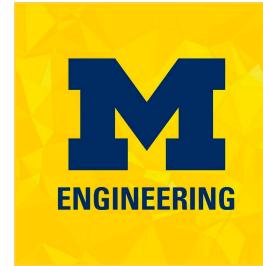


VS

**100 MG Storage  
for \$500 Million**

# Next Steps

1. Operator Demo
2. Open Source Implementation



[open-storm.org/LIFT](http://open-storm.org/LIFT)





The Noun Project Images  
Analytics Graph by Alexander Mravcak from the Noun Project  
search analytics by Aneequ Ahmed from the Noun Project  
database by icon 54 from the Noun Project  
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