



# Digital Reporting for Capacity Remedial Measures Planning: A Case Study of Houston's Digital Transformation Journey



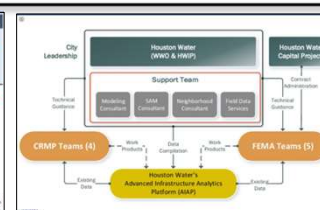
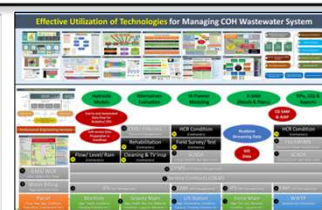
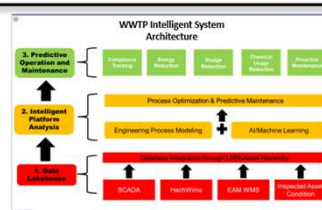
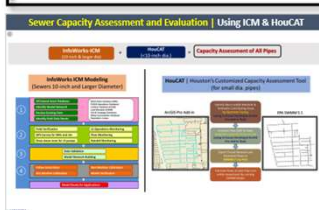
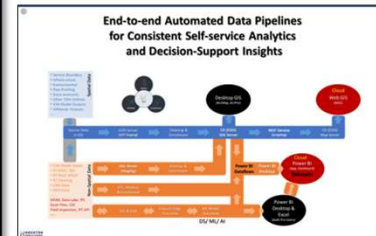
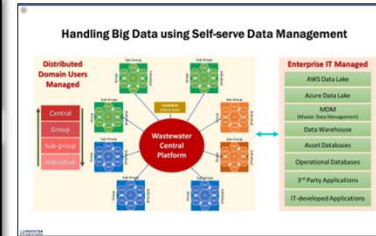
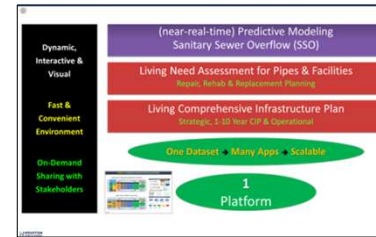
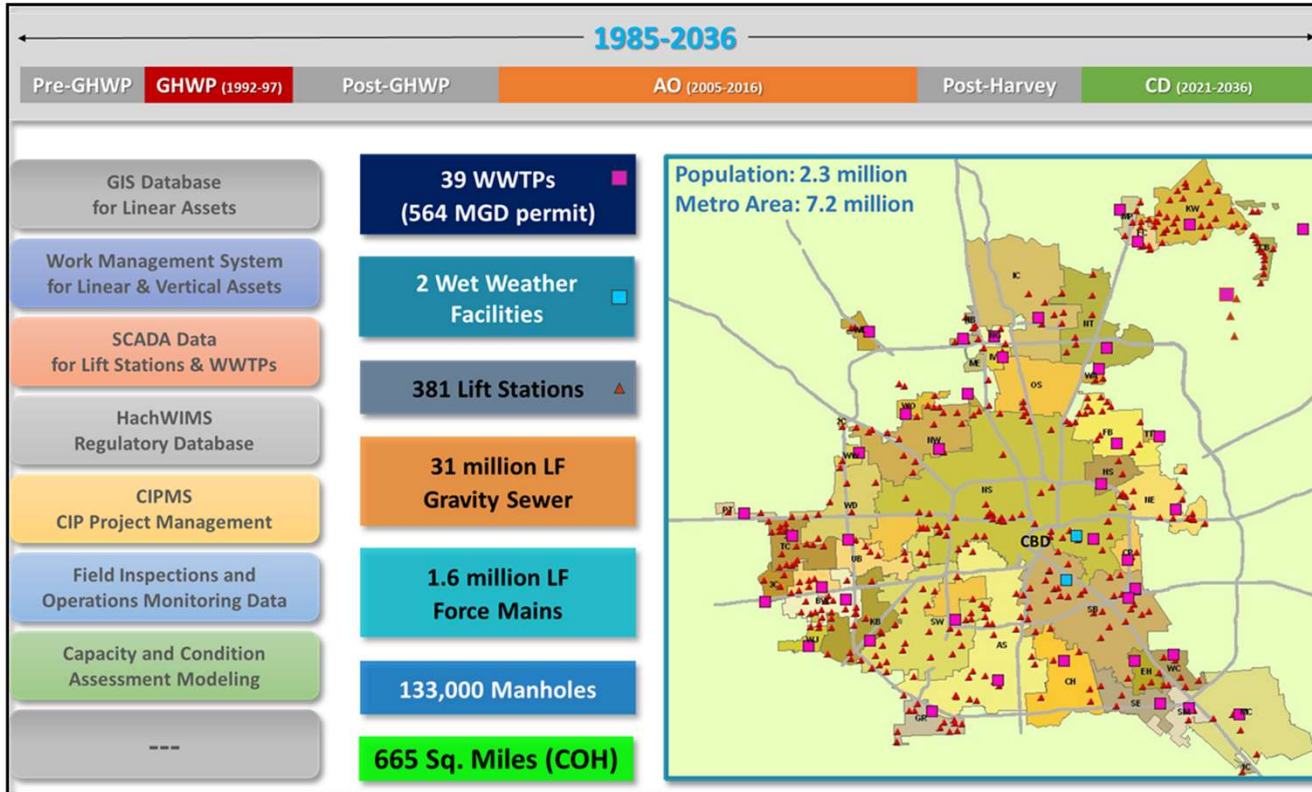
Fazle Rabbi, P.E., Managing Engineer, City of Houston

Alexis (Gathings) Winder, EIT, ENV SP Graduate Engineer, STV





# Houston's Wastewater System and Its Digital Transformation Journey

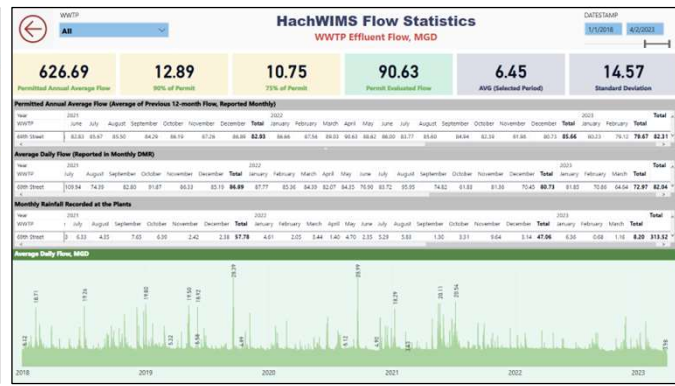
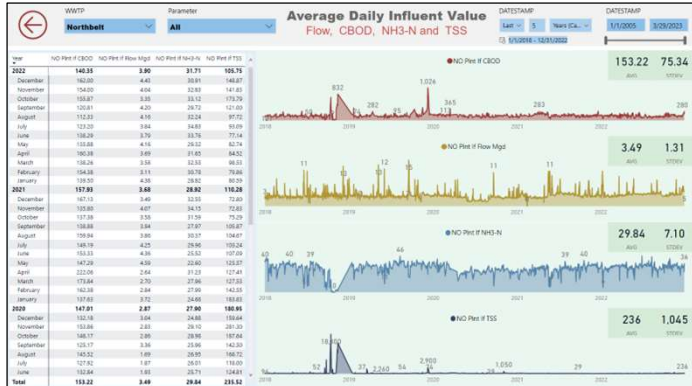
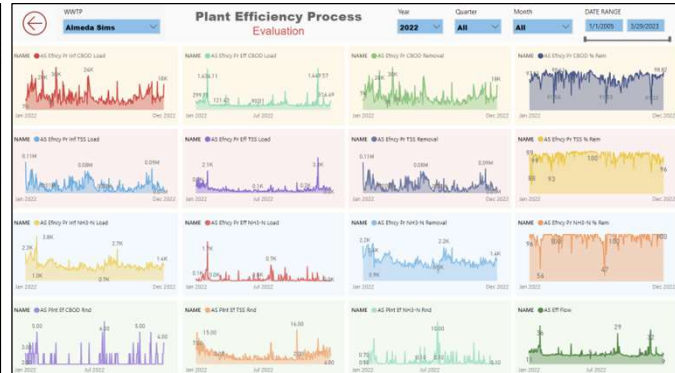
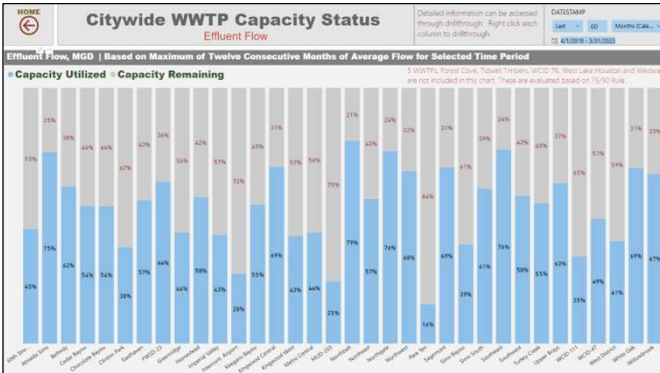


# Sample Reports | HachWIMS Regulatory Data

### WWTP Plant-Intelligence-System

Transforms HachWIMS laboratory and process data into actionable insights

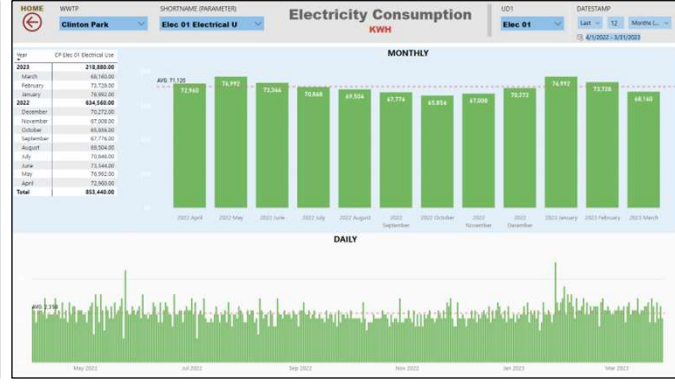
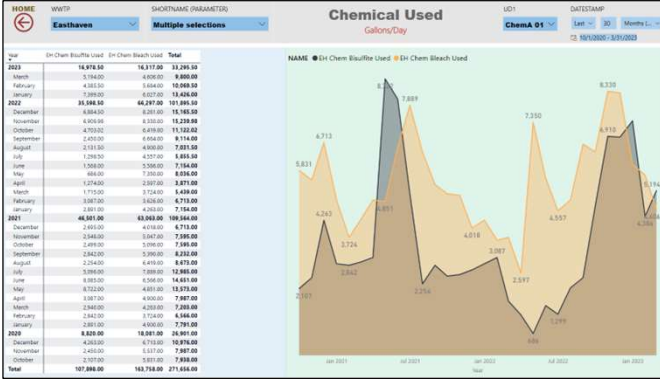
Permit Evaluation Summary Tables	(Table) Annual Average Flow, Monthly	S. Aeration (TSS, VSS, Setbly 30 min %)
At-a-Glance Citywide WWTP Capacity Status	(Table) Monthly Average flow	Clarifier (Blanket Depth & Wasting)
Permit Evaluation, Annual Average Flow	DMR EF Flow (Historical)	SVI (Sludge Volume Index)
Permit Evaluation, 75/90 Rule	DMR EF CBOD (Historical)	RAS 01 (TSS, VSS, Setbly 30 min %)
Comparison of Permit Evaluation, AAF & MAF	DMR EF TSS (Historical)	WAS 01 (TSS, VSS)
Effluent Flow   ADF and 2-hour Peak	DMR EF NH3-N (Historical)	Digester 01 (TSS, VSS)
Flow Statistics	Permitted AAF Vs DMR	DMR Diss Oxygen (Historical)
Regulatory KPI (1/3)	Regulatory KPI (2/3)	DMR CL2 Residual (Historical)
Regulatory KPI (3/3)	Operational KPI	DMR EF CBOD Loading (Historical)
Influent, % Rem & Effluent KPI	DMR EF TSS Loading (Historical)	Explore Data Availability in HachWIMS
Plant Process Efficiency KPI	DMR EF NH3-N Loading (Historical)	Daily INF/EFF Report (Scott L)
(Charts) Influent Daily	DMR E.Coli (Historical)	Daily AERATION Report (Scott L)
Eff Charts w/Limits	Benchmarking Plants	DMR PH Field (Historical)
		Permit Limits



### Daily Report

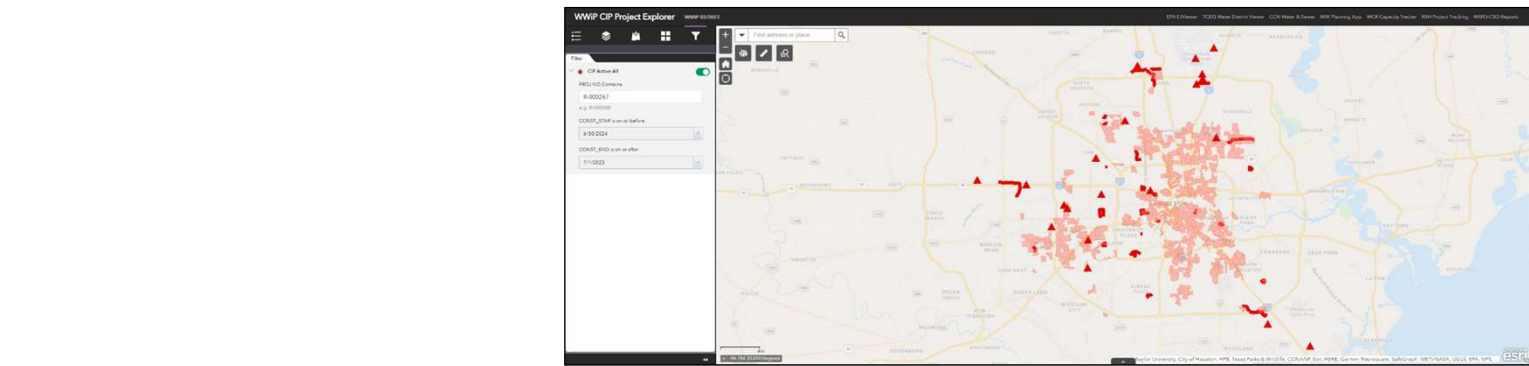
Influent / Effluent

Year	Month	Flow (MGD)	CBOD (mg/L)	NH3-N (mg/L)	TSS (mg/L)	Flow (MGD)	CBOD (mg/L)	NH3-N (mg/L)	TSS (mg/L)
2022	January	140.35	3.90	31.75	106.75	153.22	75.34	3.49	1.31
2022	February	150.00	4.00	32.00	110.00	160.00	80.00	3.60	1.40
2022	March	160.00	4.20	33.00	115.00	170.00	85.00	3.70	1.50
2022	April	170.00	4.50	34.00	120.00	180.00	90.00	3.80	1.60
2022	May	180.00	4.80	35.00	125.00	190.00	95.00	3.90	1.70
2022	June	190.00	5.10	36.00	130.00	200.00	100.00	4.00	1.80
2022	July	200.00	5.40	37.00	135.00	210.00	105.00	4.10	1.90
2022	August	210.00	5.70	38.00	140.00	220.00	110.00	4.20	2.00
2022	September	220.00	6.00	39.00	145.00	230.00	115.00	4.30	2.10
2022	October	230.00	6.30	40.00	150.00	240.00	120.00	4.40	2.20
2022	November	240.00	6.60	41.00	155.00	250.00	125.00	4.50	2.30
2022	December	250.00	6.90	42.00	160.00	260.00	130.00	4.60	2.40



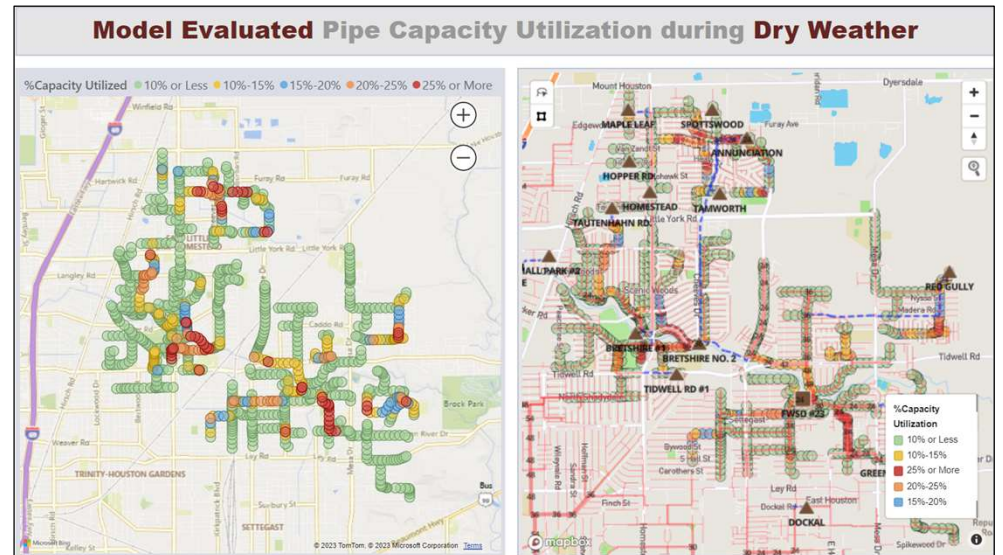
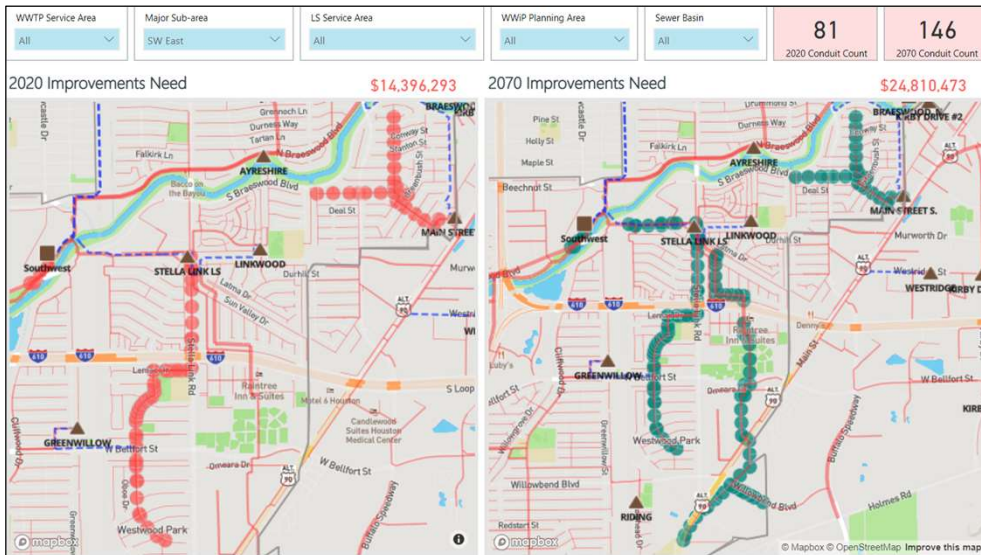
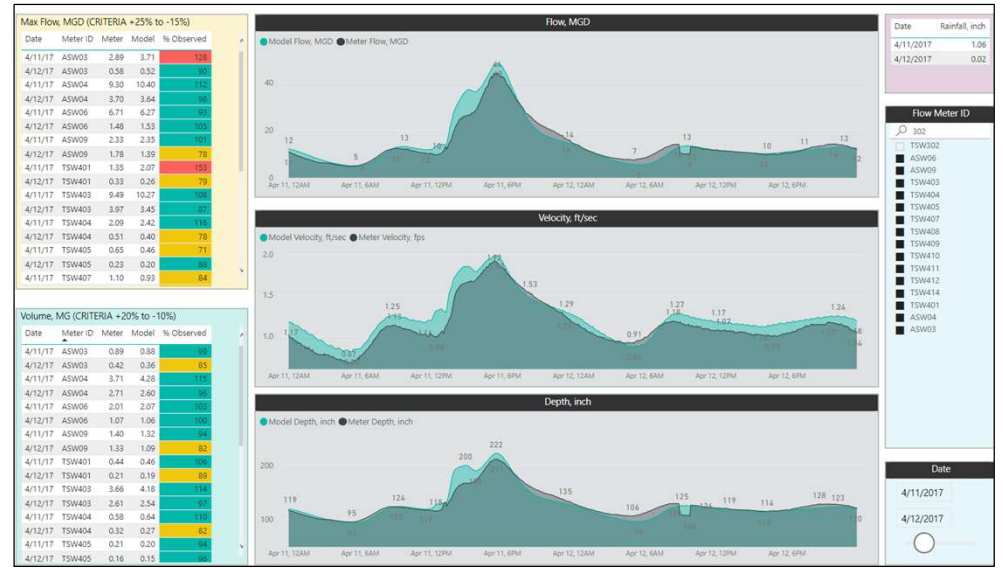
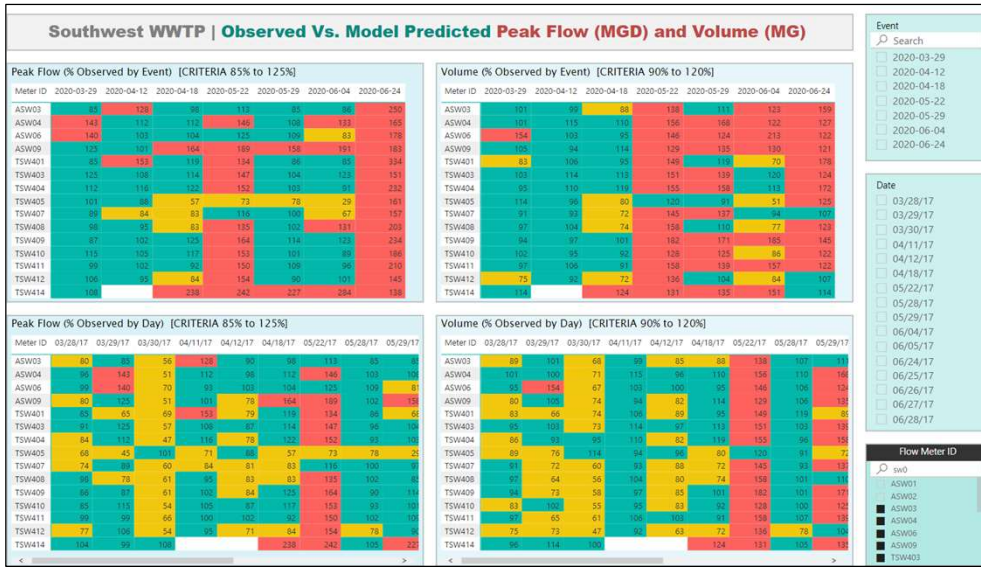


# Sample Customized Reports | CIP Project Management System

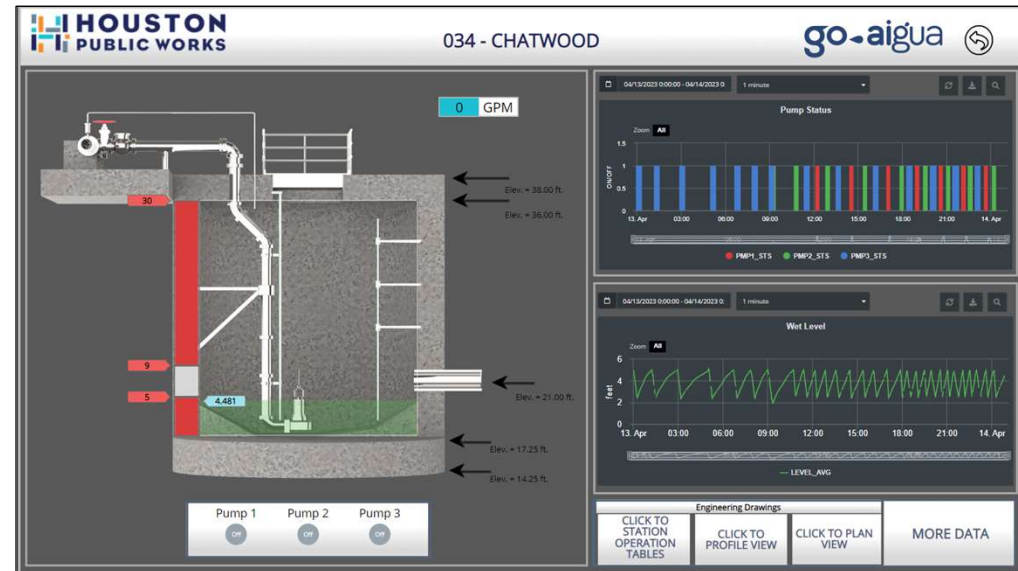
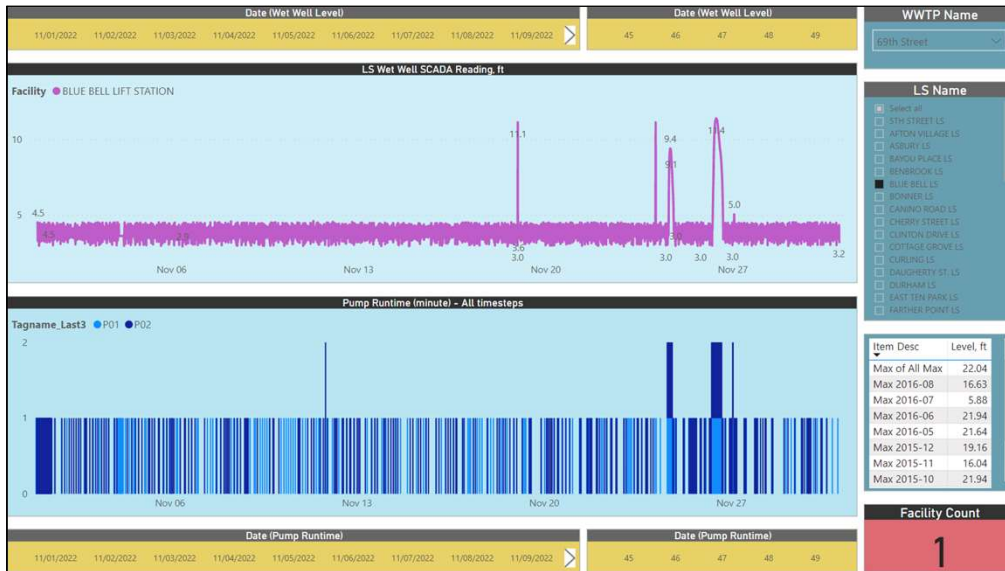




# Sample Reports | ICM Hydraulic Modeling



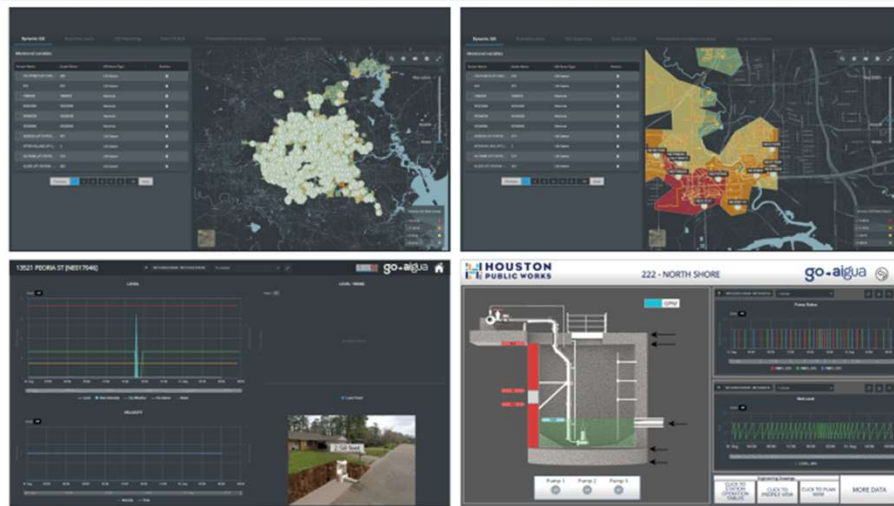
# Sample Reports | SCADA Data Visualization



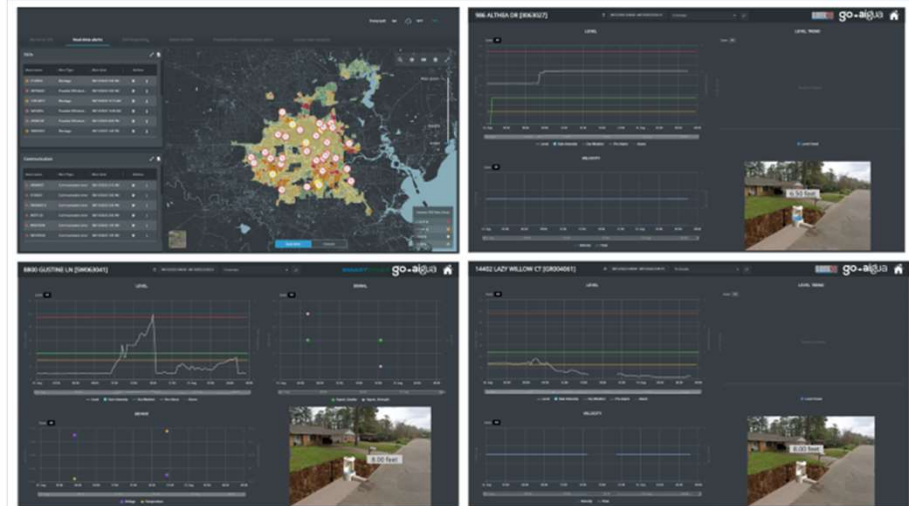


# Real-time Event Monitoring and Prediction | Sample 1

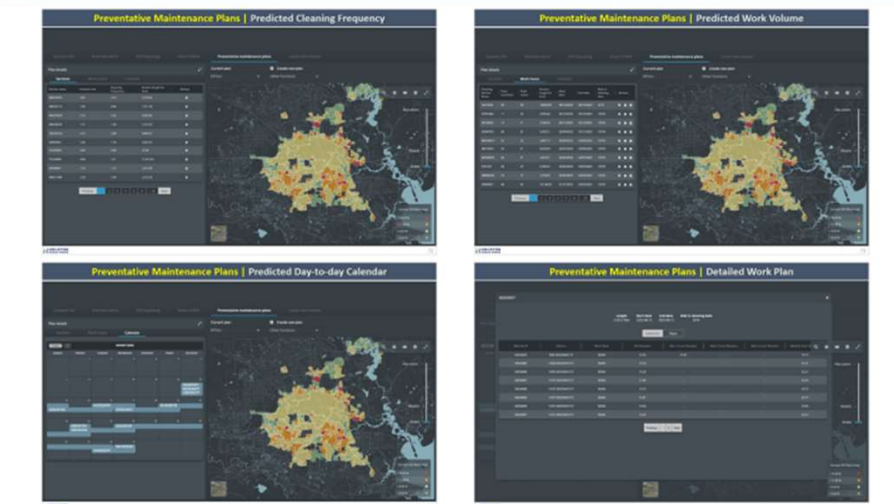
## Real-time Data Visualization | Manhole Sensors & Lift Station SCADA Data



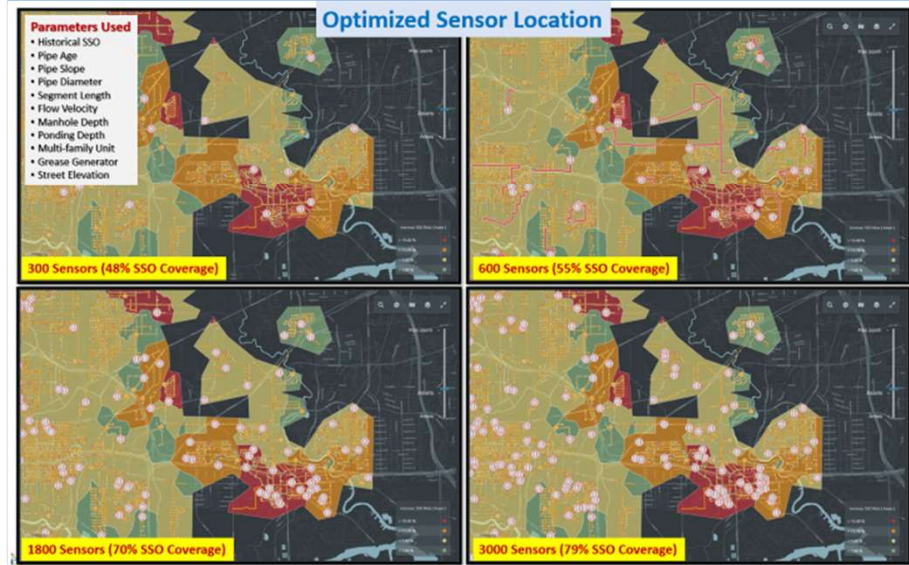
## Real-time Alerts



## Preventive Maintenance Plans | On-Demand

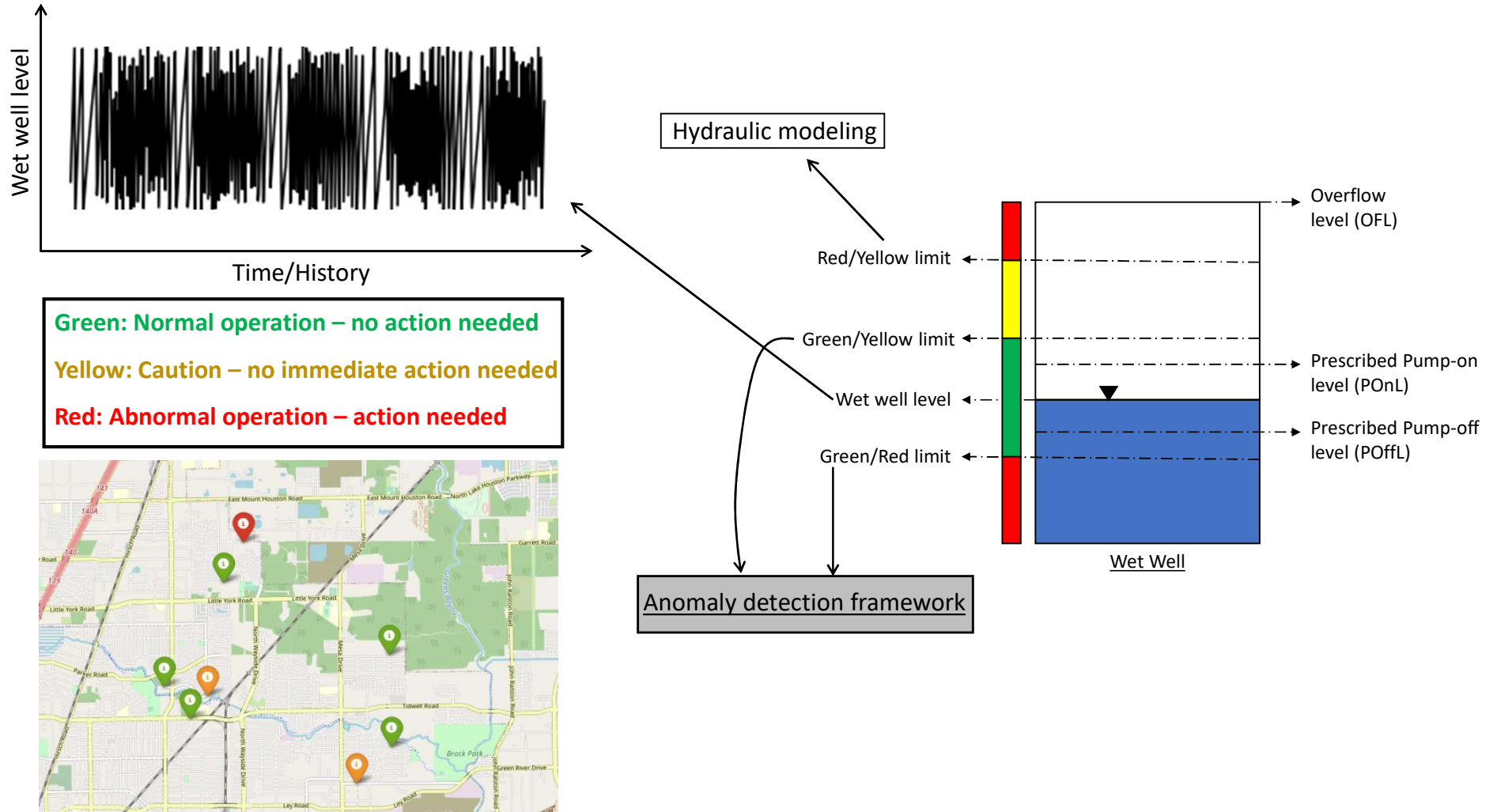


## Optimized Sensor Location



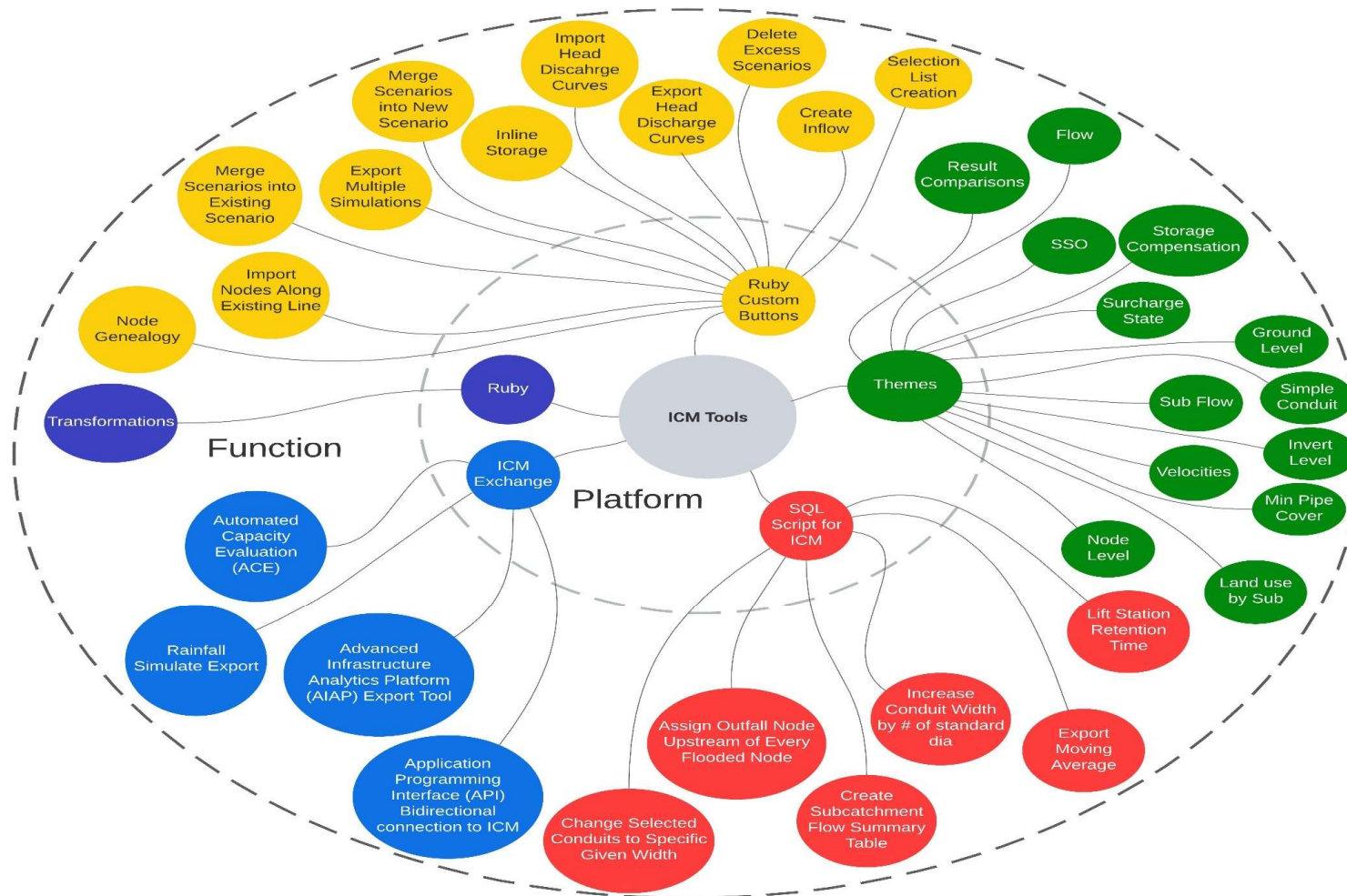
# Real-time Event Monitoring and Prediction | Sample 2

## ML Application of Anomaly Detection for LS Wet Well Levels



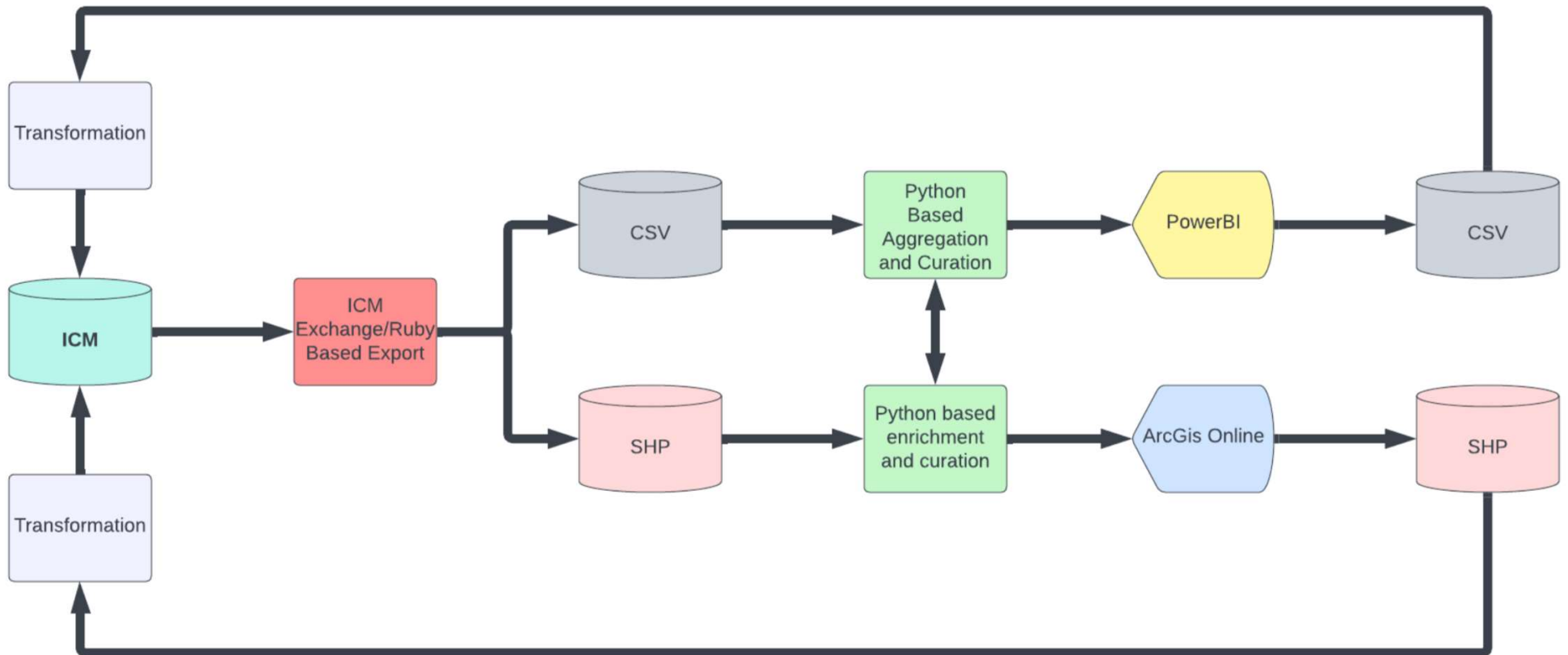


# Productivity Tools | Sample Tools for ICM Modeling



# Automation | Sample Process for Capacity Evaluation

Automation of Collection System Capacity Evaluation & Reporting  
using Hydraulic Model, PBI, Python, & AGOL







# City of Houston Capacity Remedial Measures Plans & the Dynamic, Digital Approach

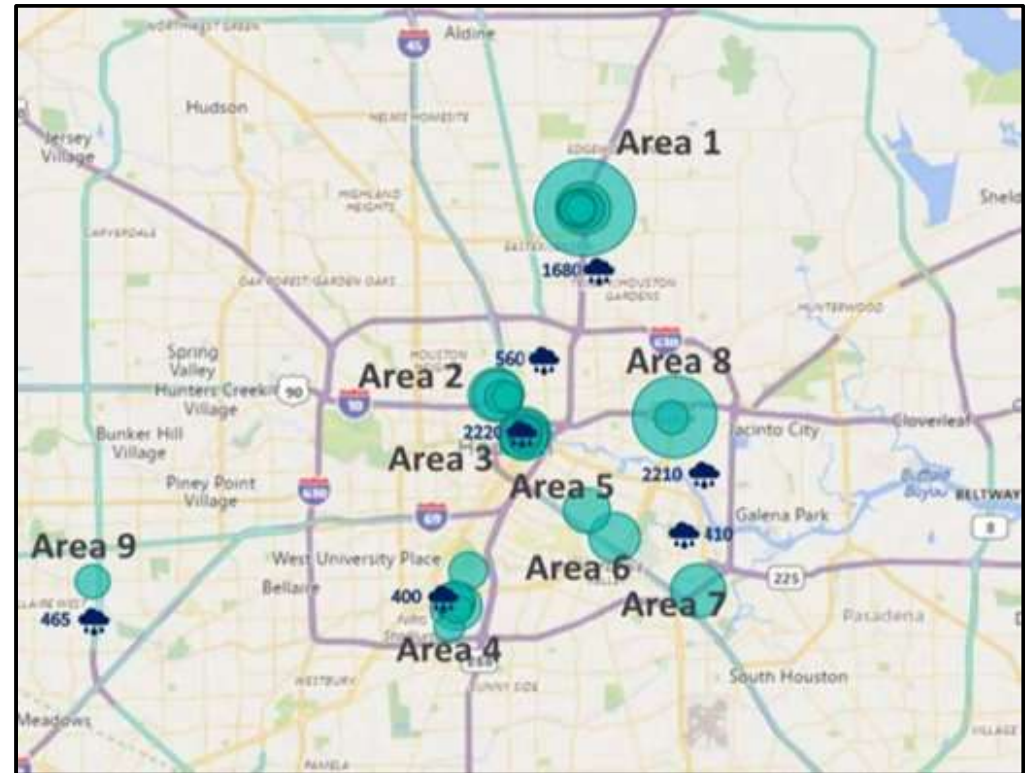


## Capacity Remedial Measures Plans (CRMP) Reports

The CD identified 9 Areas and required CRMP reports to determine cause of wet weather SSOs and develop remedial action design

CRMP Reports were required to be submitted to the EPA within 2 years of the Effective Date

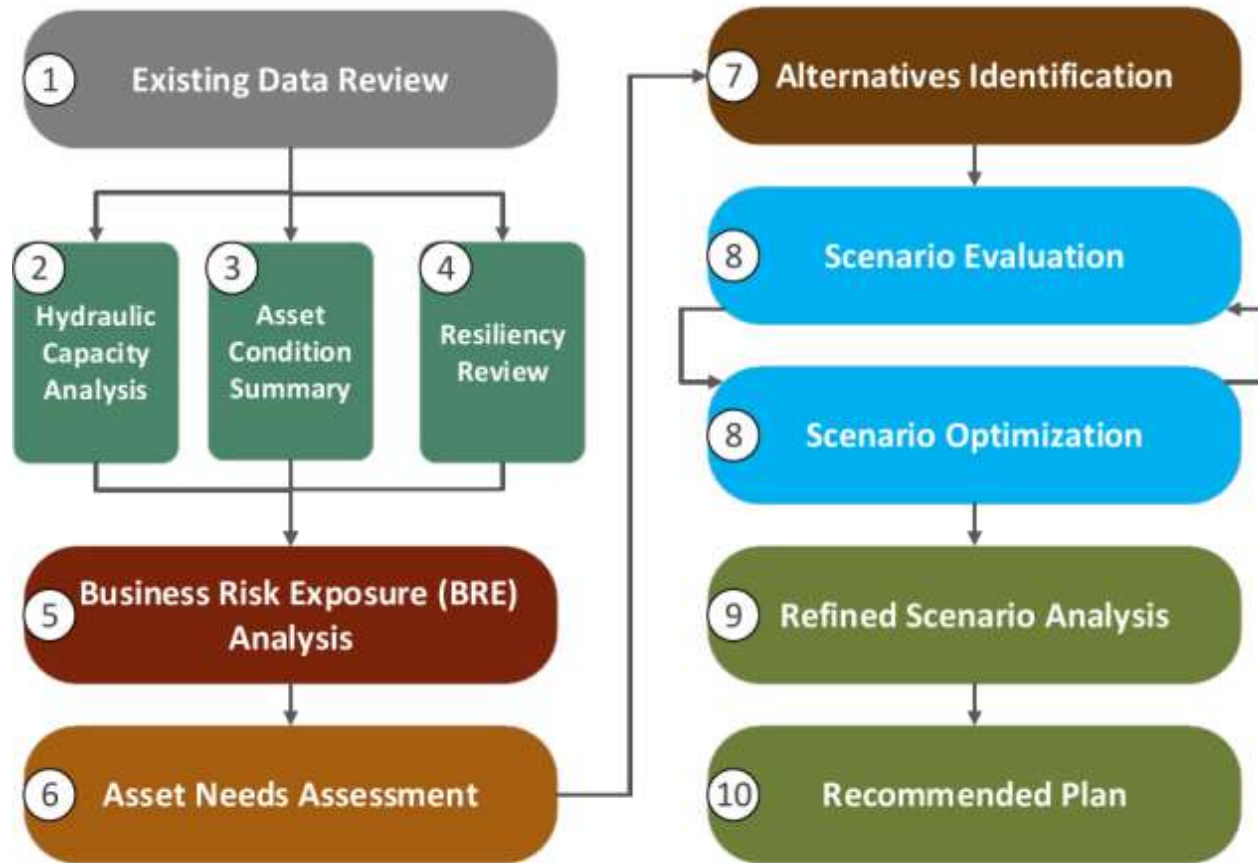
Over the 15-year span of the CD, the City will continue to evaluate wet weather SSOs to identify any additional areas





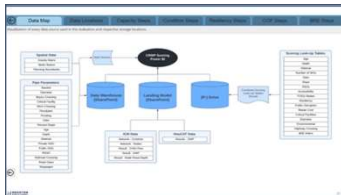


# COH 10-Step Risk-Based Wastewater Planning

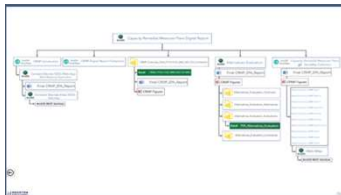




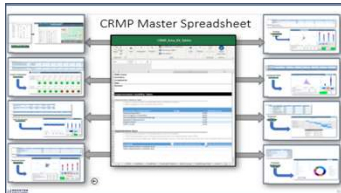
# Documentation and Metadata are Critical for Digital Reporting



Develop pipeline from data source to end-product



Document Content Lineage to facilitate sharing and report maintenance



Establish consistent practice to automate data processing

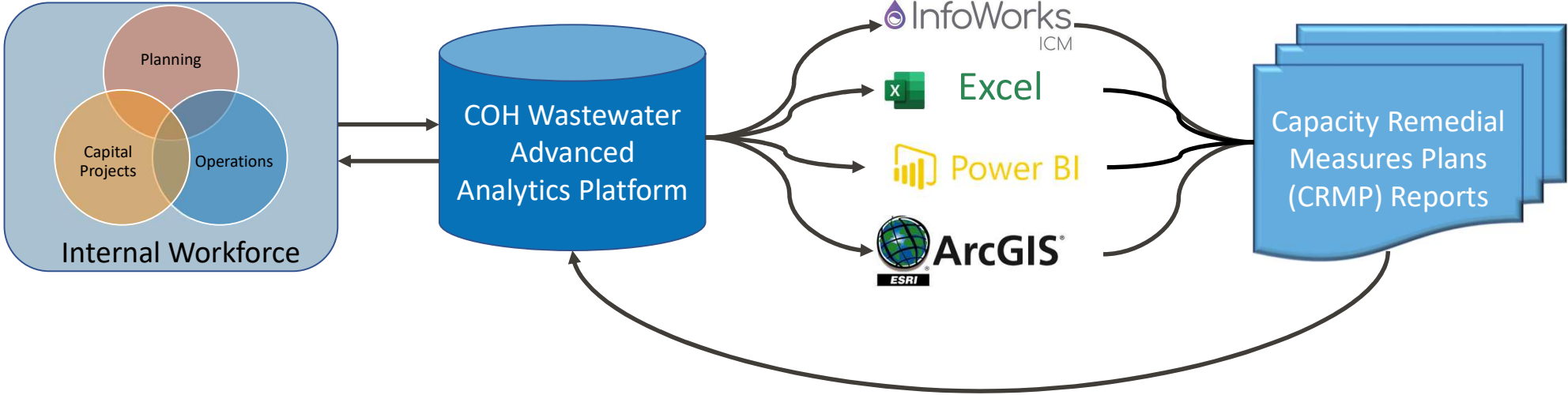


Build self-serve QA/QC capability into your work



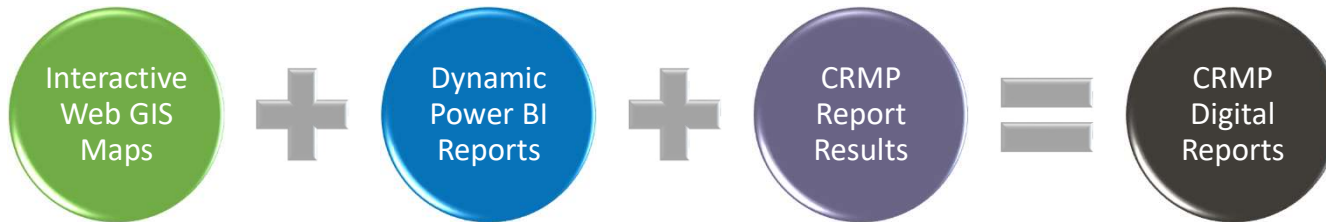


# Integrating Work Products for Continuity





# CRMP Digital Report Components



**ArcGIS Online**

- Instant Apps**  
Choose an app to provide a focused experience using your map.
- Experience Builder**  
Use a template or start from scratch to create the exact web experience you want.
- ArcGIS Storymaps**  
Tell a story by combining maps with narrative text and media.
- Dashboards**  
Create a dashboard with data visualizations that provide key insights.
- Sites**  
Create a tailored website with pages to share information to a specific audience.
- Web AppBuilder**  
Create an app by selecting a theme and choosing from a library of widgets.
- Configurable Apps**  
Create an app by selecting a focused template and configuring its properties.

**Power BI**

- Power BI Desktop
- Power BI Pro
- Power BI Premium
- Power BI Mobile
- Power BI Embedded
- Power BI Report Server

**InfoWorks ICM**

**ArcGIS Pro**

**Office**

W X O P





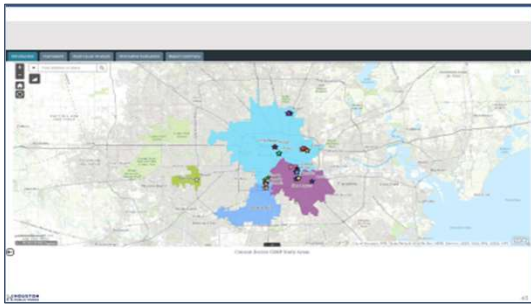


# CRMP Digital Report

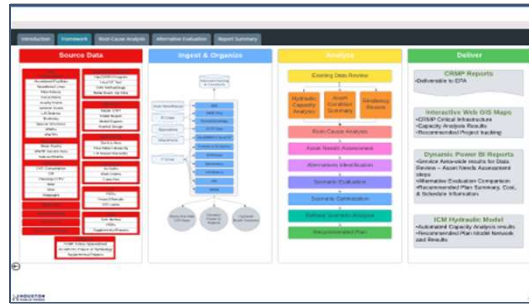


## Capacity Remedial Measures Plans (CRMP) Digital Reports

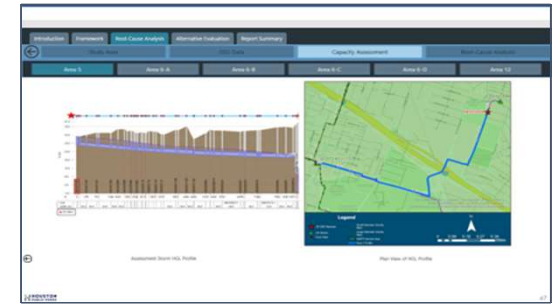
- Introduction
- Framework
- Root-Cause Analysis
- Alternative Evaluation
- Report Summary



CD SSO Live Web Map



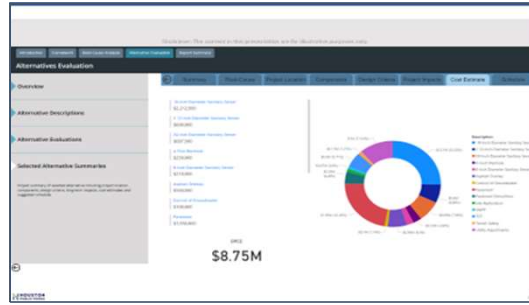
CRMP Methodology



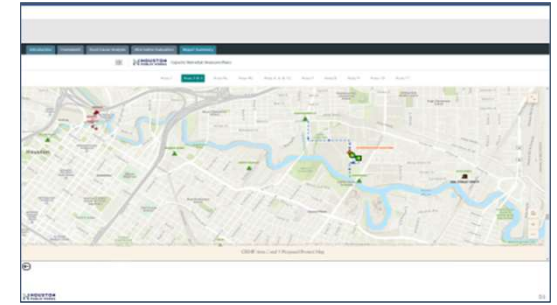
Capacity Analysis



Remediation Alternatives Evaluation



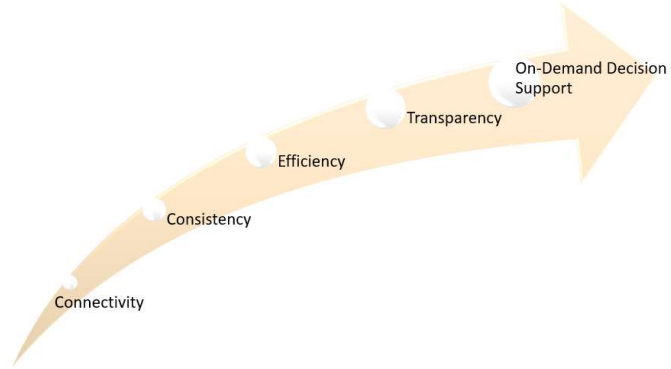
Construction Cost Estimate



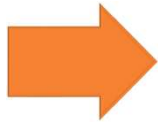
Recommended Project Web Map



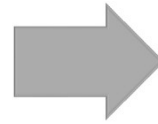
# Take-Aways



## Digital Transformation



## Digital Reporting



## Benefits

- Develop automated pipelines from data source to end-product
- Easily extract and integrate data from different sources
- Supports continuity and consistency

- On-Demand Reports available with live connections
- Digitalize work products for future use
- Platform to provide data for any other use

- Data is authoritative and up-to-date
- Ready to use "data as a product" with actionable insights
- Efficient for data and report sharing
- Information available for reference at-a-glance





Thank you!

Questions?

