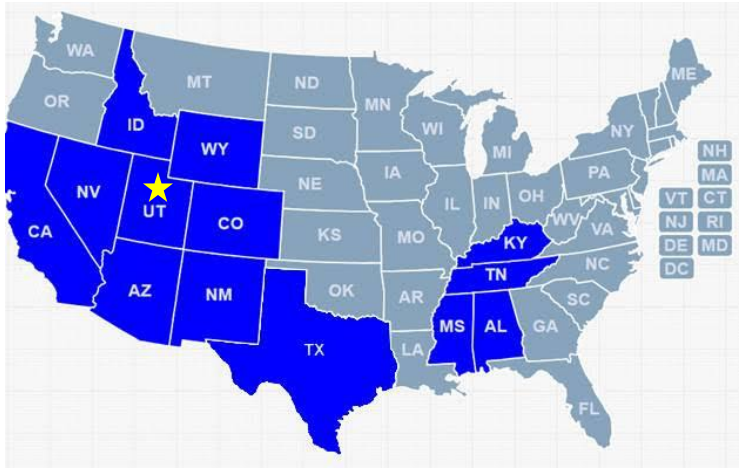
RH Borden and Company LLC



RH BORDEN
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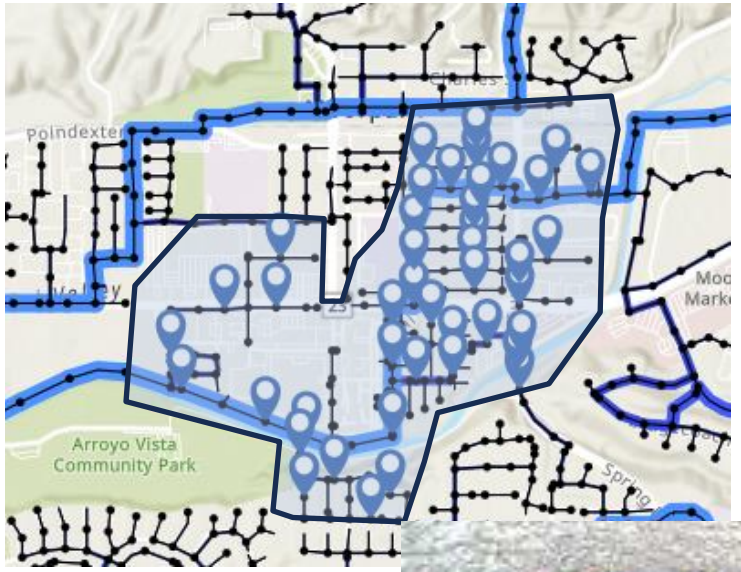
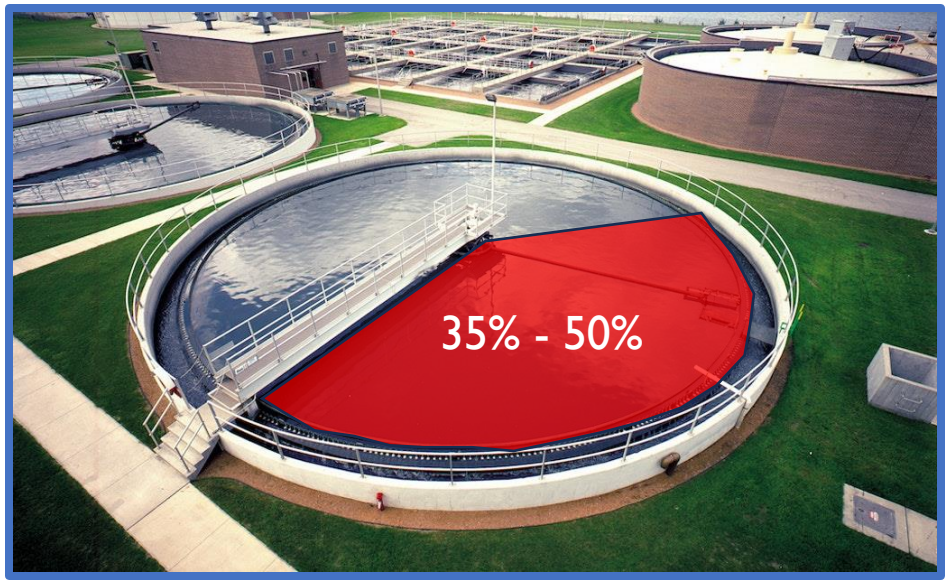
I&I Detection

Collection System Maintenance



RH Borden I&I Assessment Services

Inflow and Infiltration (I&I)
What is the Cost?



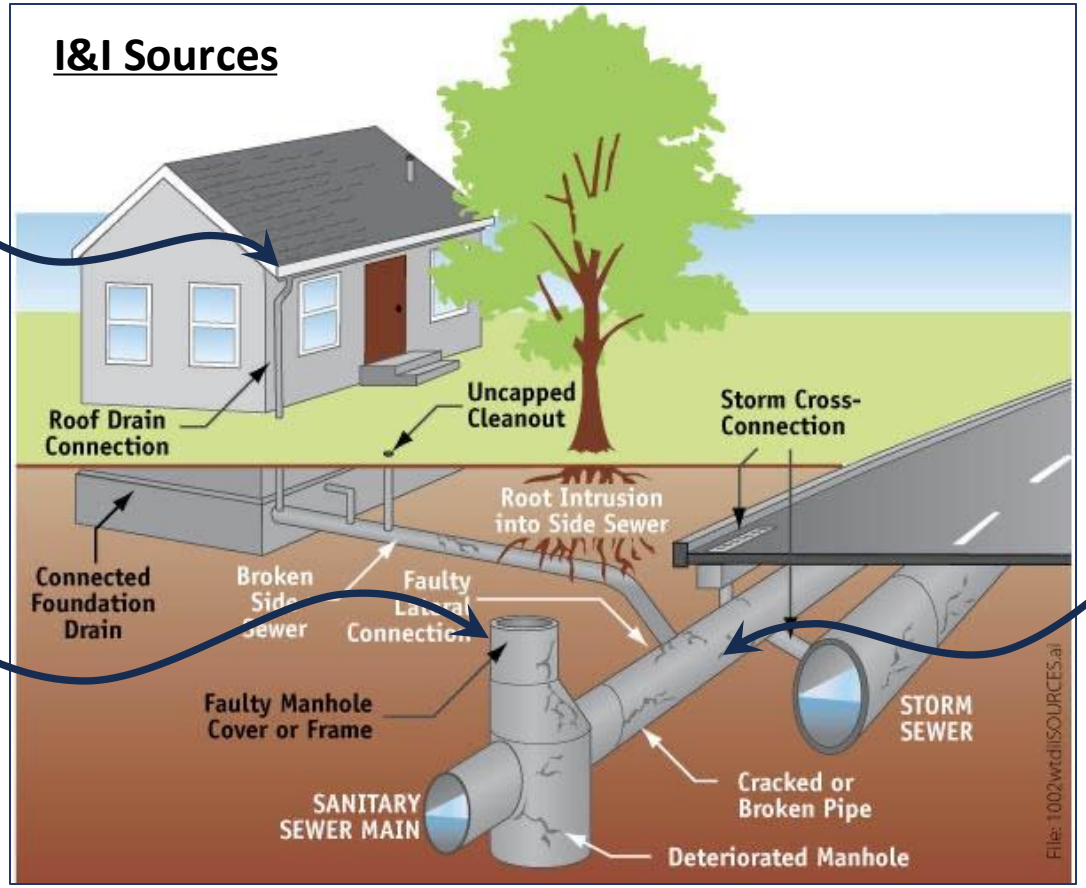
35% - 50% of all Treated Wastewater comes from I&I

EPA Fines: $1 Million +
Treatment Cost: $500,000/100 Million Gallons

Sources of I&I
Traditional Tools Require Targets

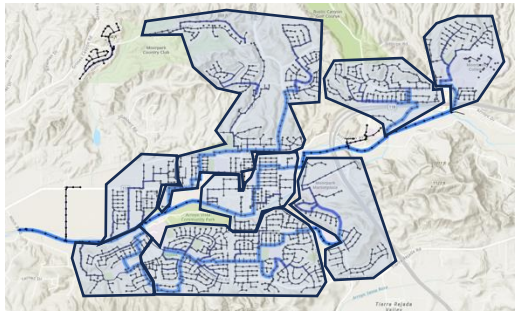
Smoke Testing
Target: 4-5 houses

Manhole Inspection
Target: Single Manhole



CCTV
Target: Single Pipe

What do you need for I&I Identification Program

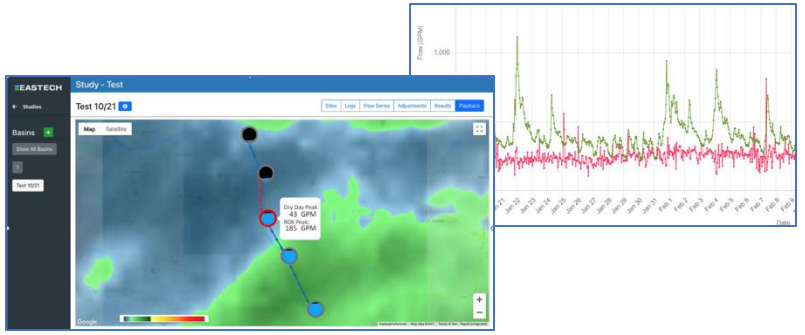


1) Basin / Flow map

2) Simultaneous Sensor Network

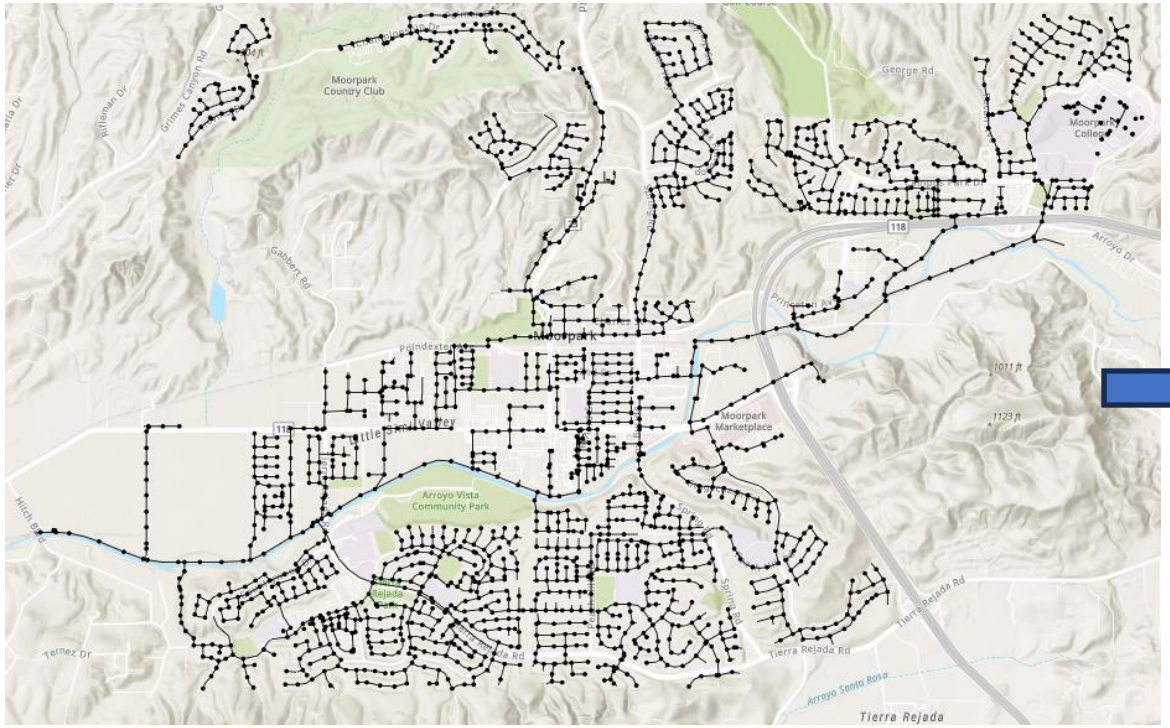
3) Weather Event

4) Analytics

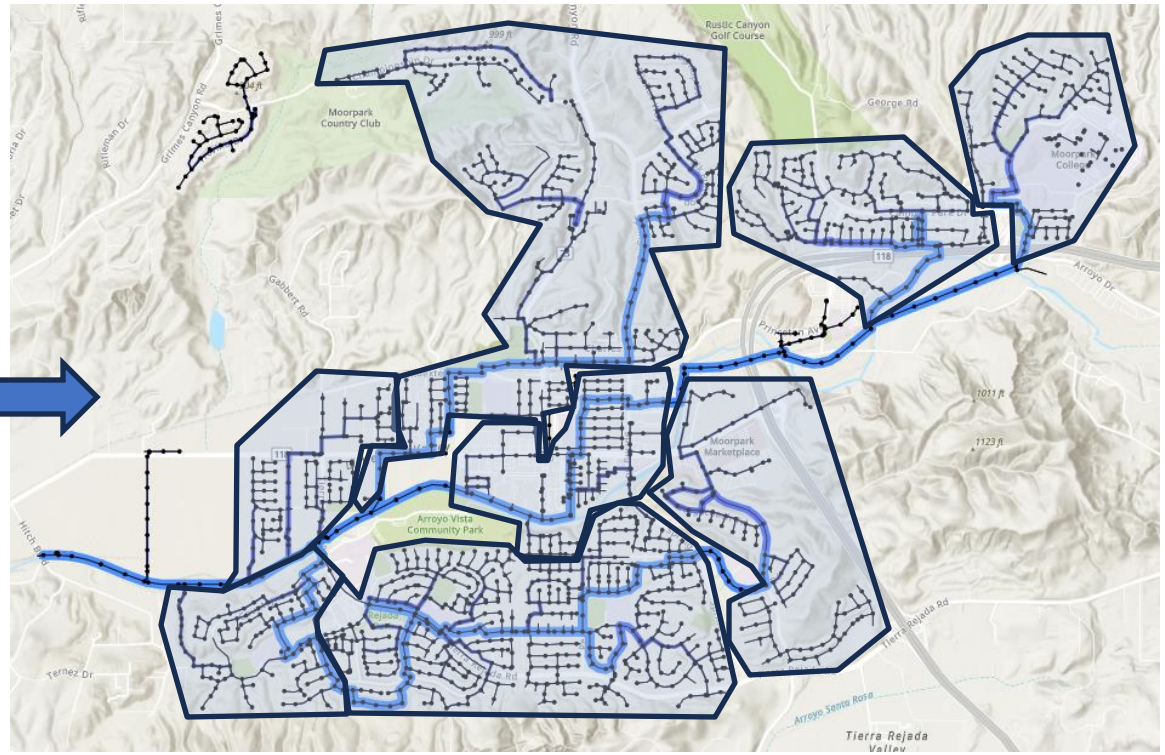


5) Data Visualization

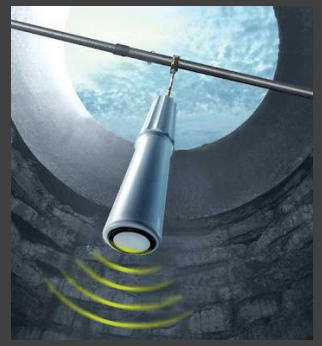
Understanding Basins



Traditional System View



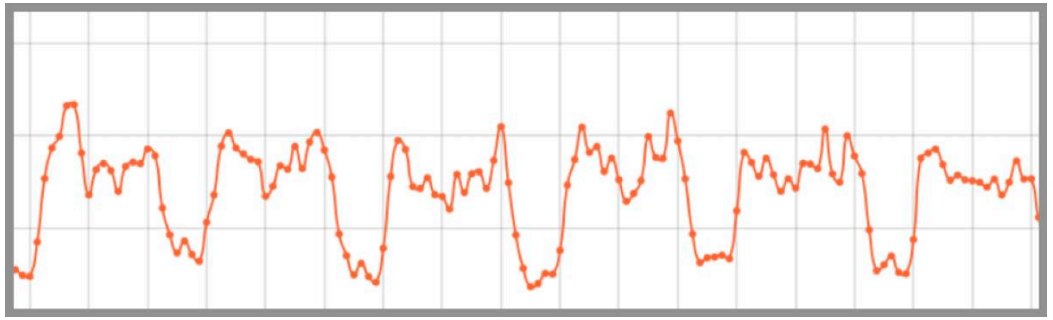
Basin View

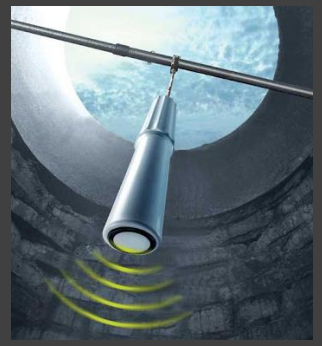


Simultaneous Sensor Network

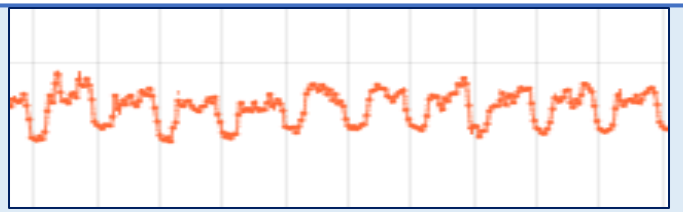
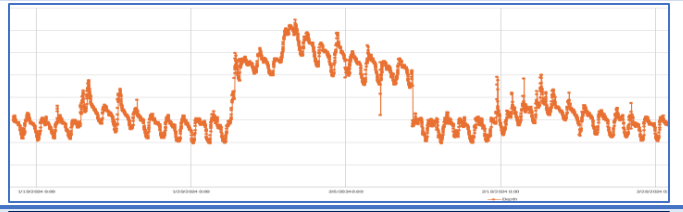
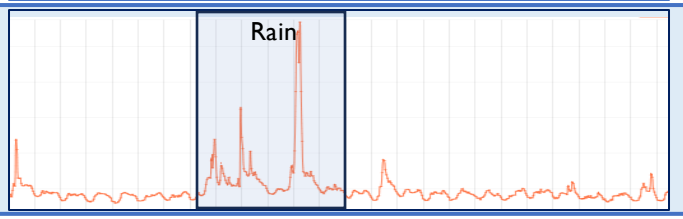
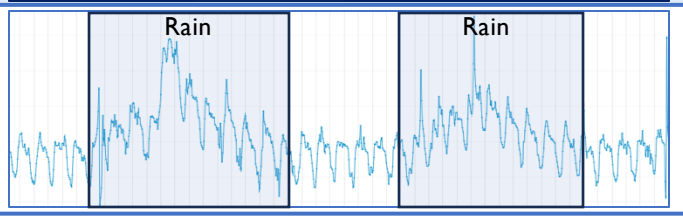
iTracker Sensors :

- ✓ Deployed as a network (20-200 sensors)
- ✓ 24X7 Monitoring of flow
- ✓ Measures every 15 minutes
- ✓ Generates baseline diurnal pattern



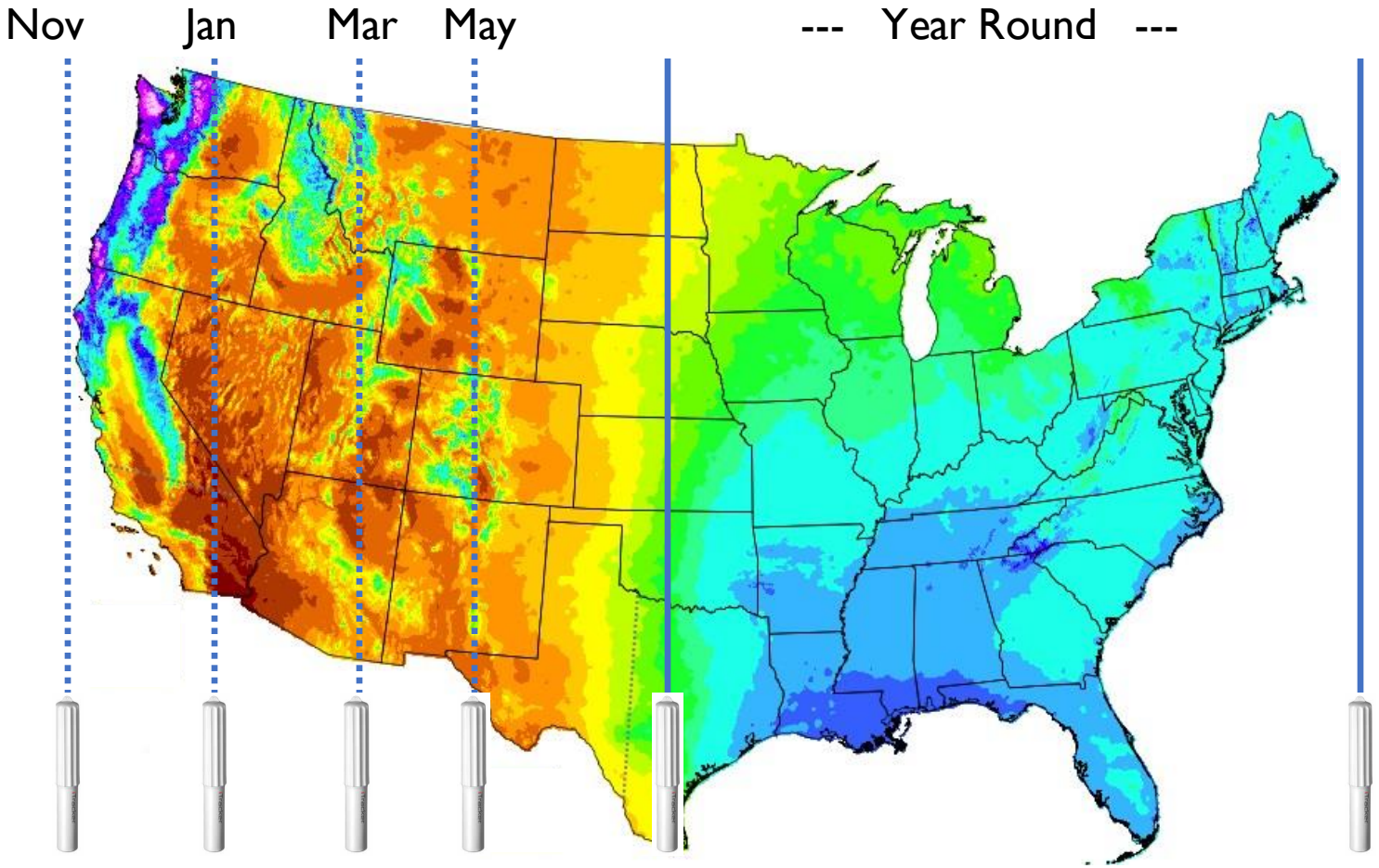


Level Monitor Signatures

Flow Condition	Level Signature
Regular Flow: Daily Diurnal Pattern of Flow	
Blockage: Sharp Increase / Decrease in Diurnal Pattern	
Inflow (Open to Sky): Spike in Level During Rain Event	
Infiltration (Underground): Gradual Increase in Level During Rain Event	

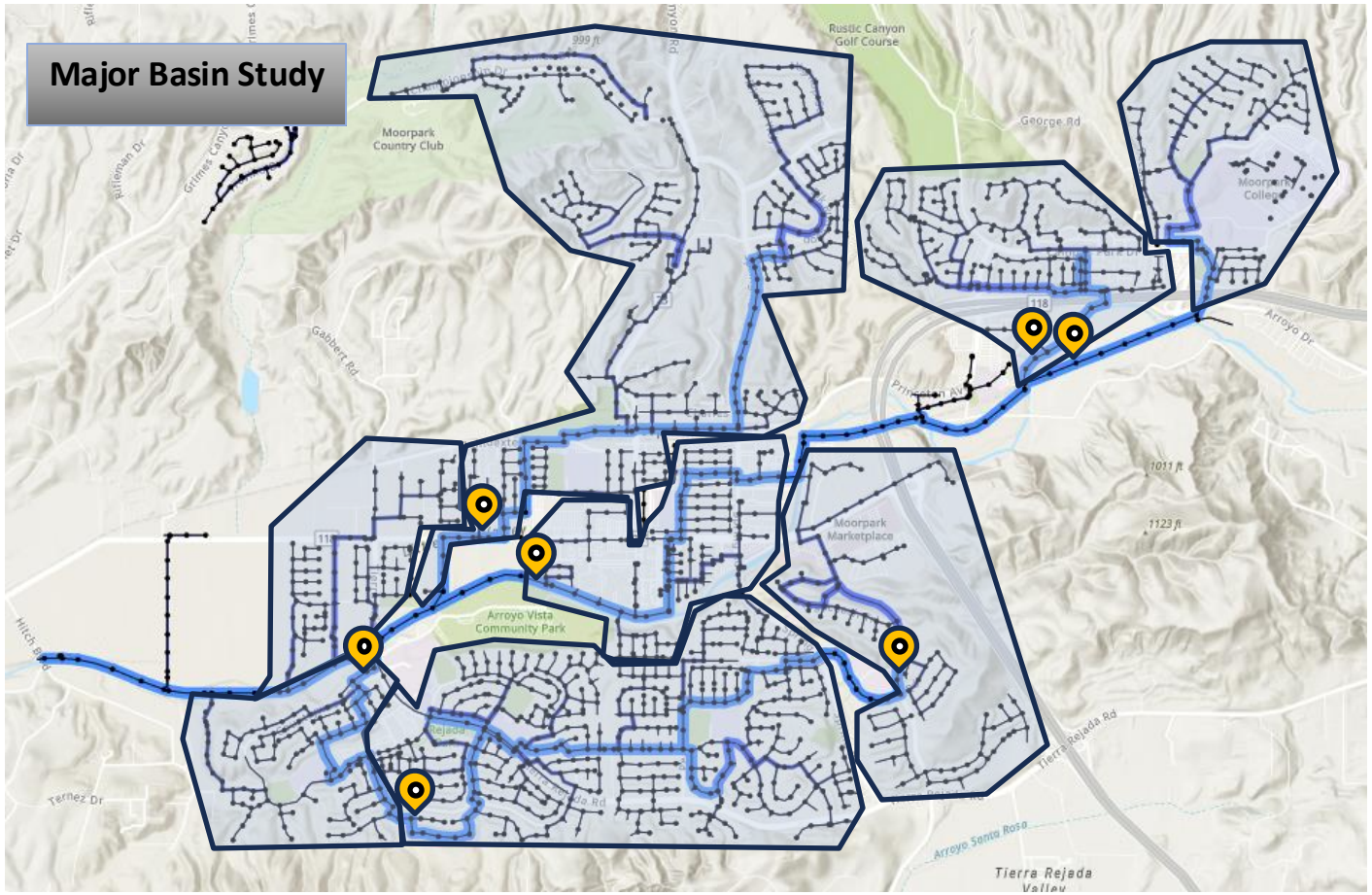
I&I Detection Schedule

Best Times To Detect I&I



Note:
iTrackers remain installed until sufficient wet weather data is collected

Major Basin Studies

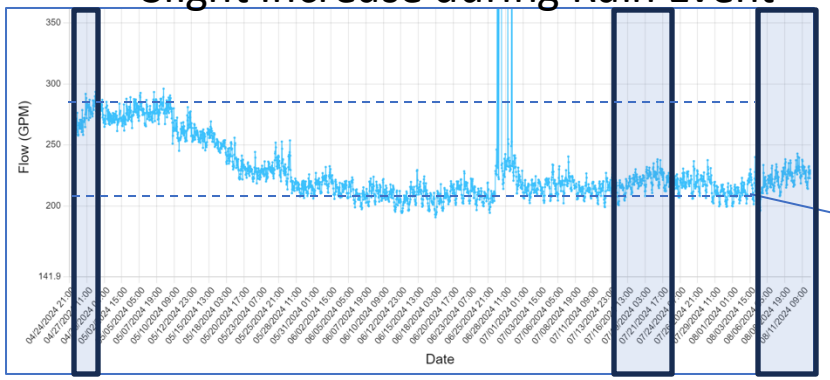


Major Basin Deliverables

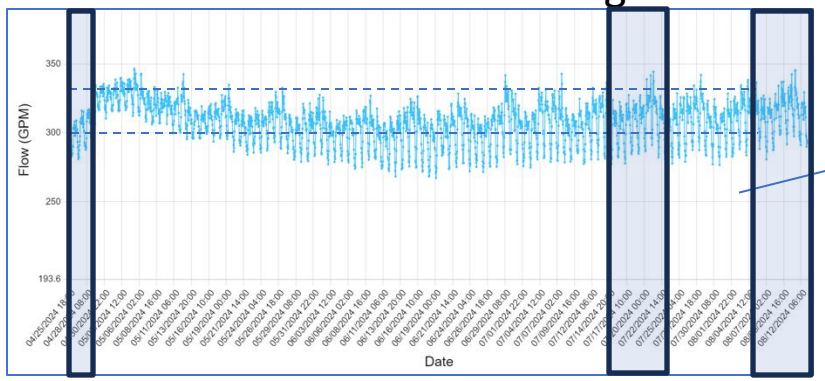
Primary Contributor

Significant Shift During Runoff

Slight Increase during Rain Event

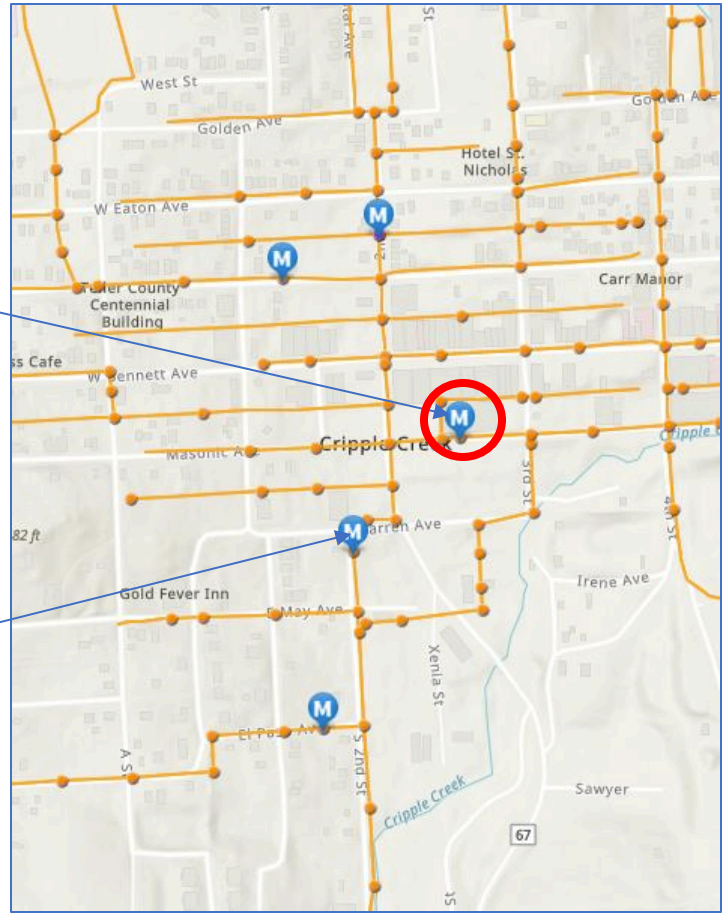


Downstream Shift During Runoff



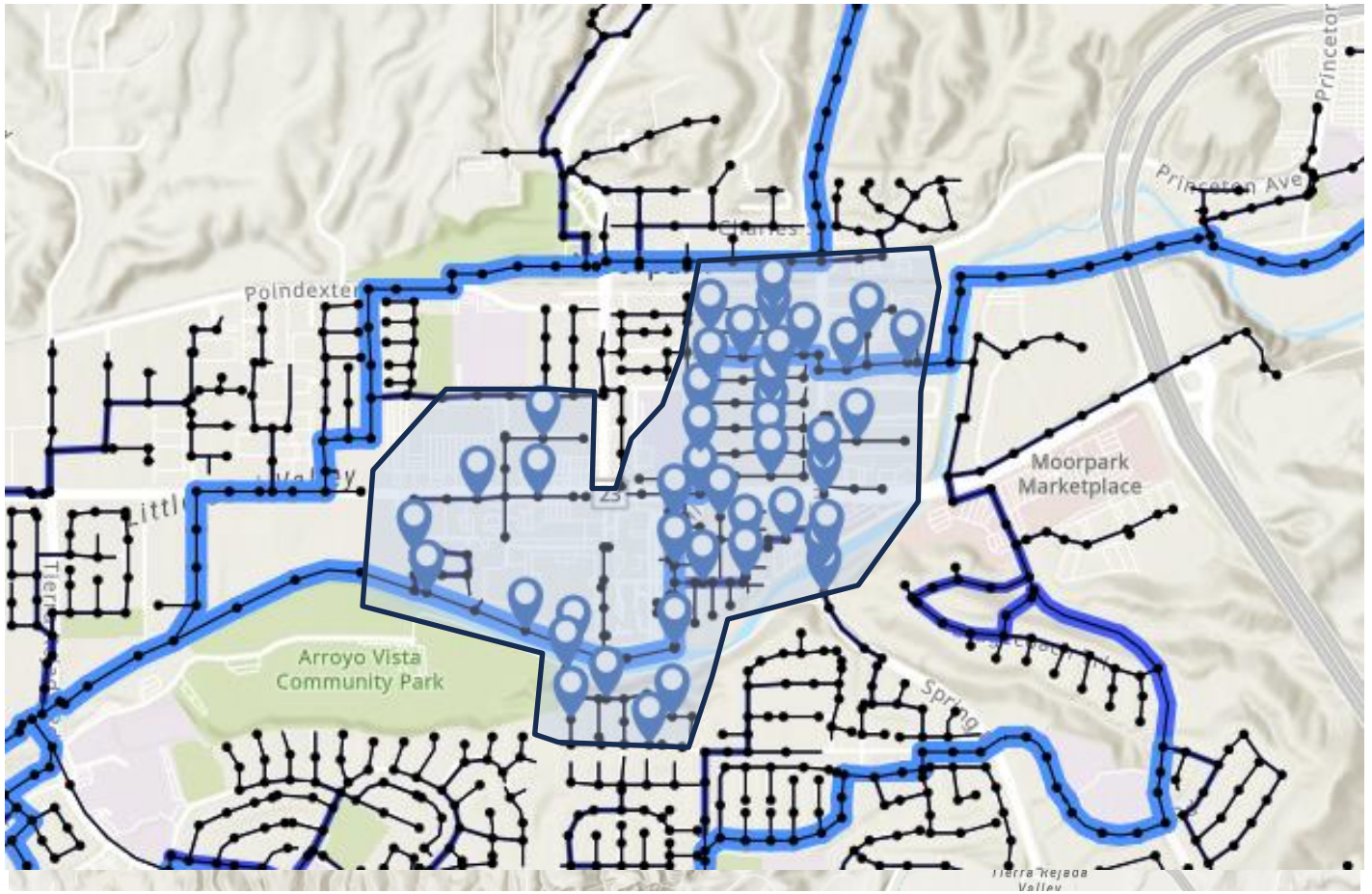
Rain

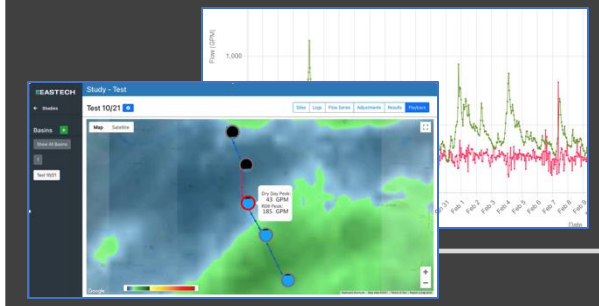
Rain



Target Basin Studies

Target Basin Study

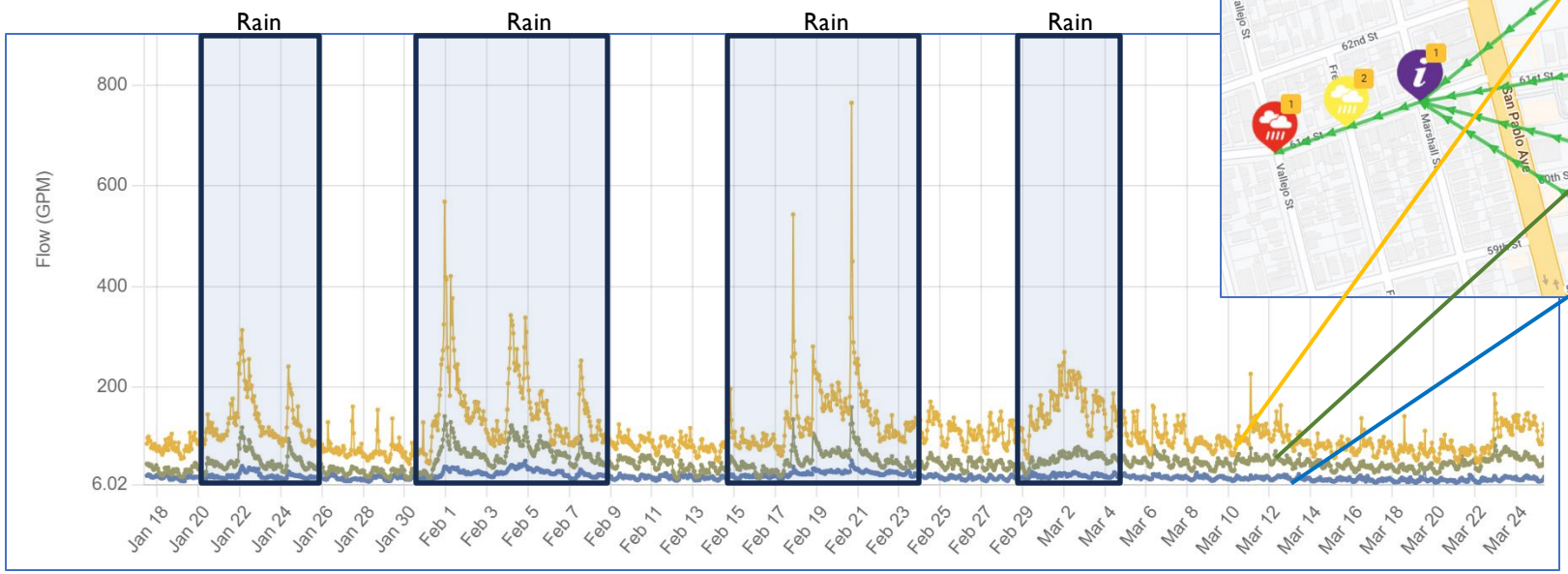


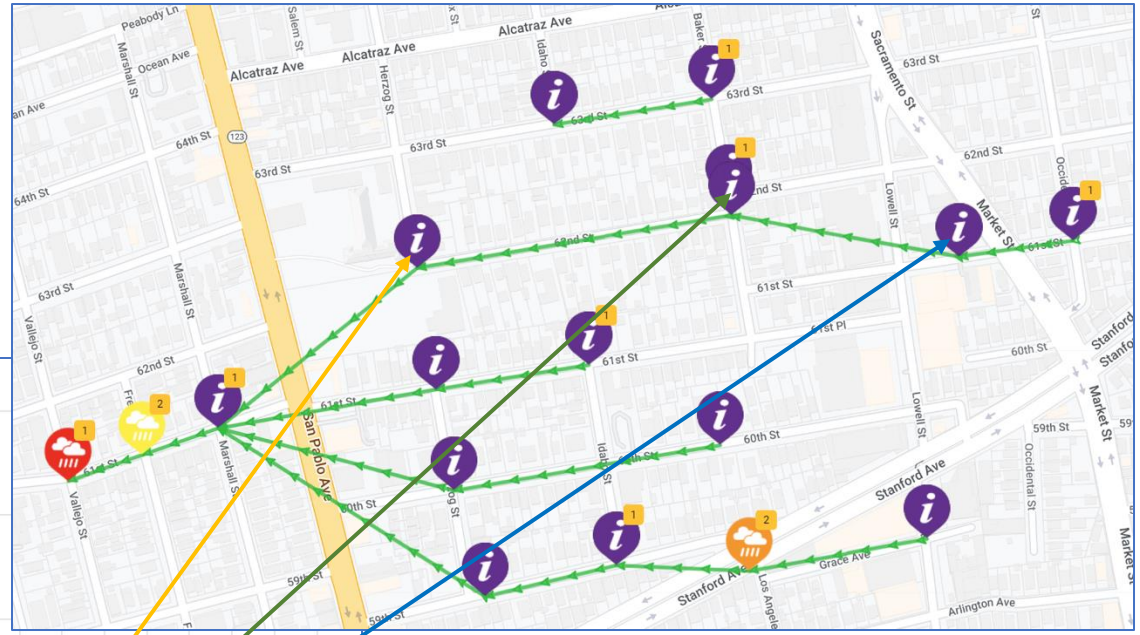


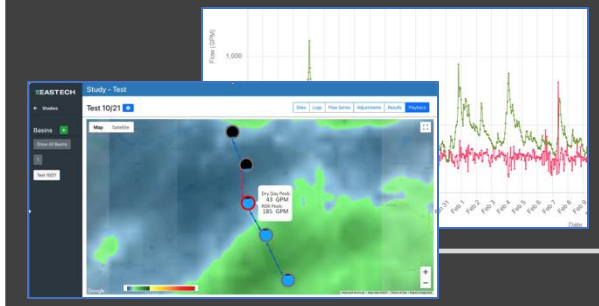
Target Basin Deliverables

Hydrograph Analysis

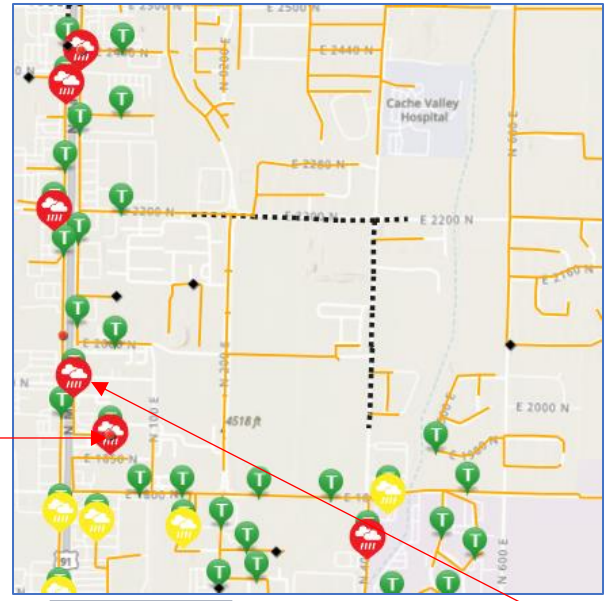
Moderate shifts to Diurnal Pattern

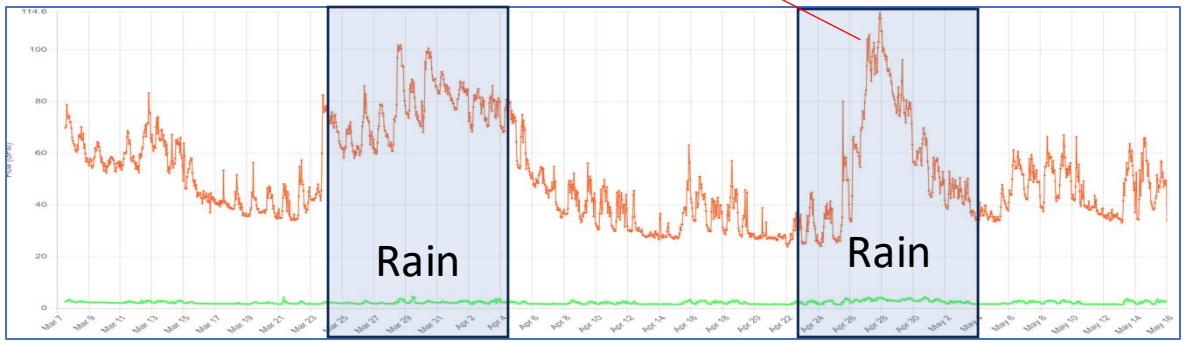






Target Basin Assessment
South Basin





EASTECH

Studies

Study - Test

Test 10/21

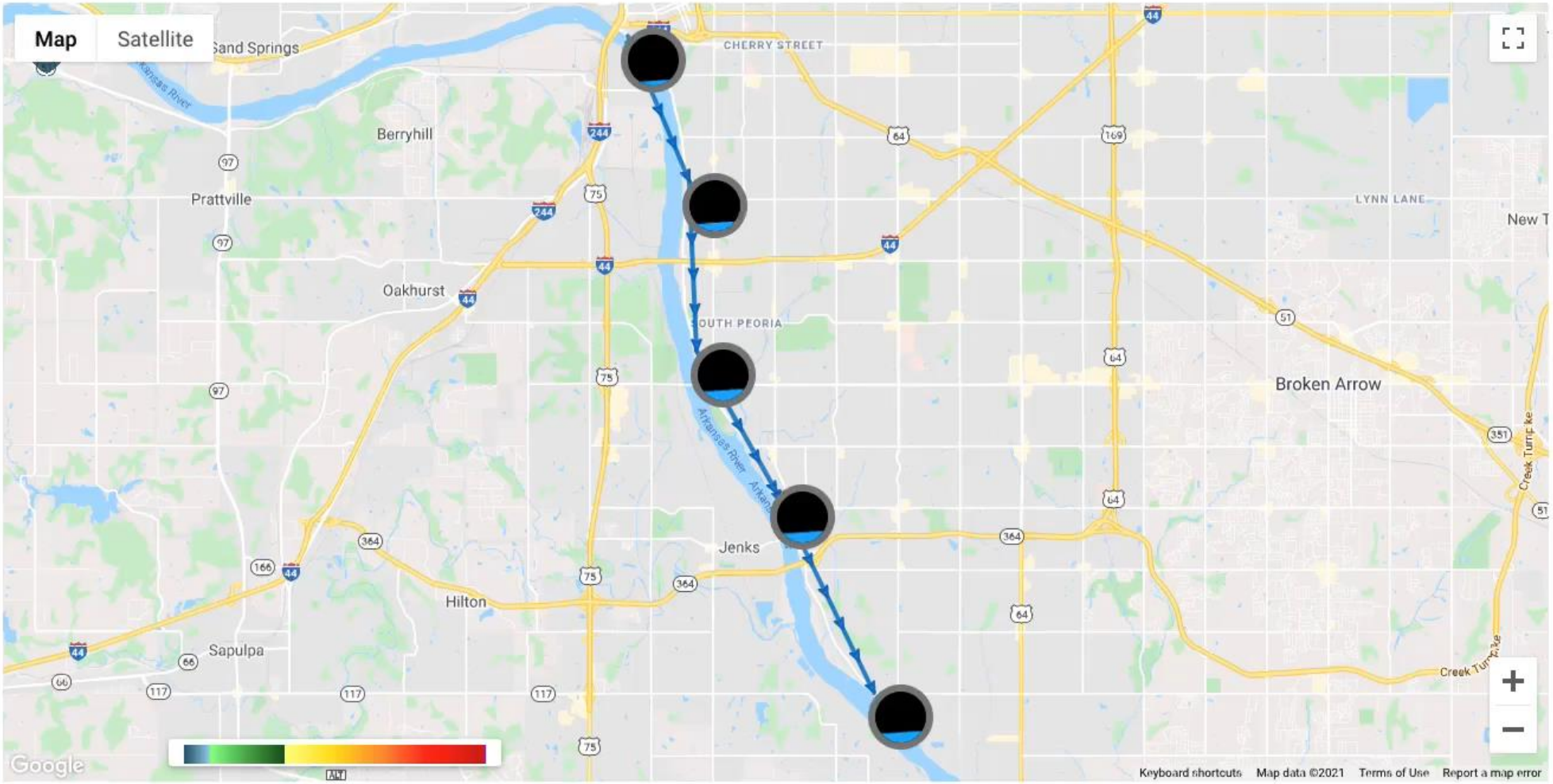
Sites | Logs | Flow Series | Adjustments | Results | Playback

Basins

Show All Basins

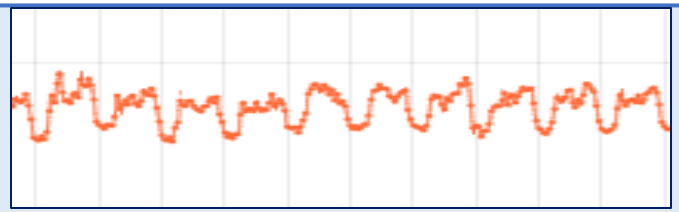
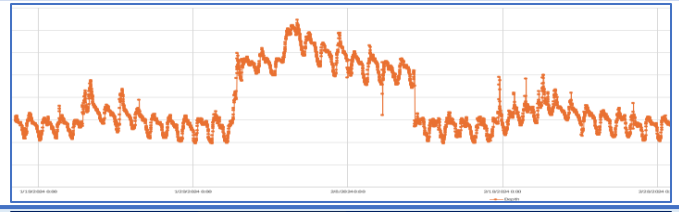
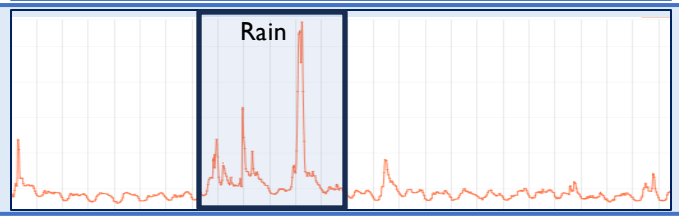
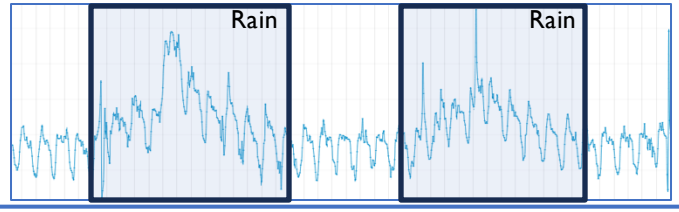
1

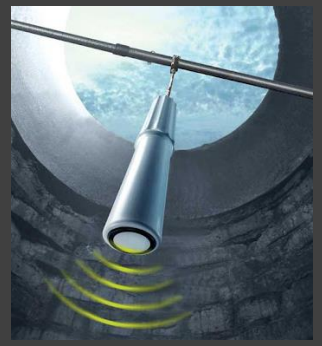
Test 10/21



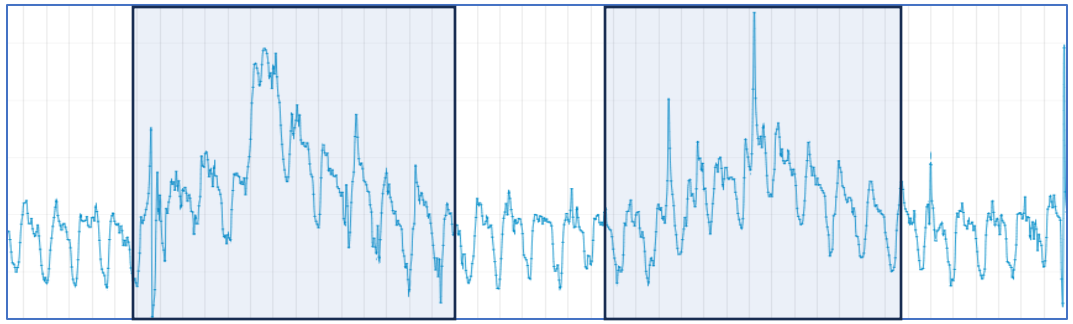
10/13/2021 — 10/20/2021 Update

I&I Monitor Signatures

Flow Condition	Level Signature
Regular Flow: Daily Diurnal Pattern of Flow	
Blockage: Sharp Increase / Decrease in Diurnal Pattern	
Inflow (Open to Sky): Spike in Level During Rain Event	
Infiltration (Underground): Gradual Increase in Level During Rain Event	



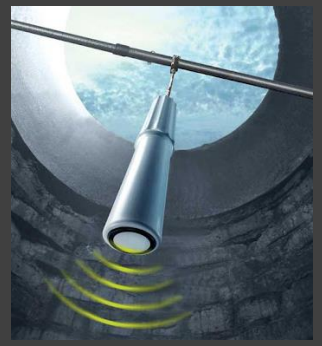
Infiltration Signature



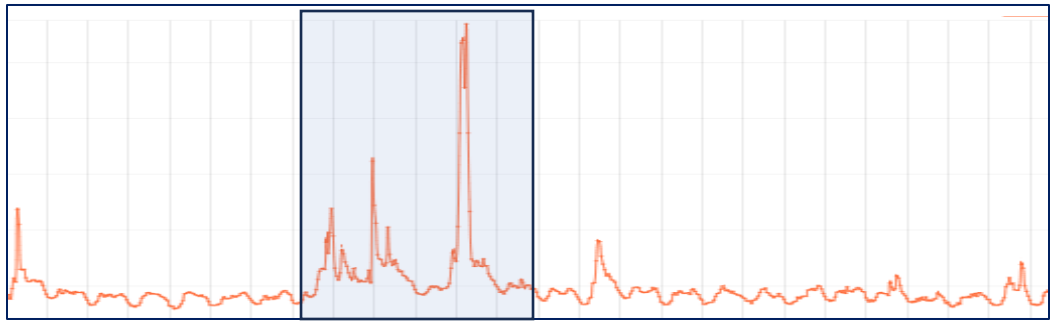
The infiltration signature shows that water is entering the system through the ground during and for a period of time after the event.

From the Toolset:

- ✓ CCTV during and after the event
- ✓ Nighttime Flow Isolation



Inflow Signature



The inflow signature shows that water is entering the system from the surface and during the weather event.

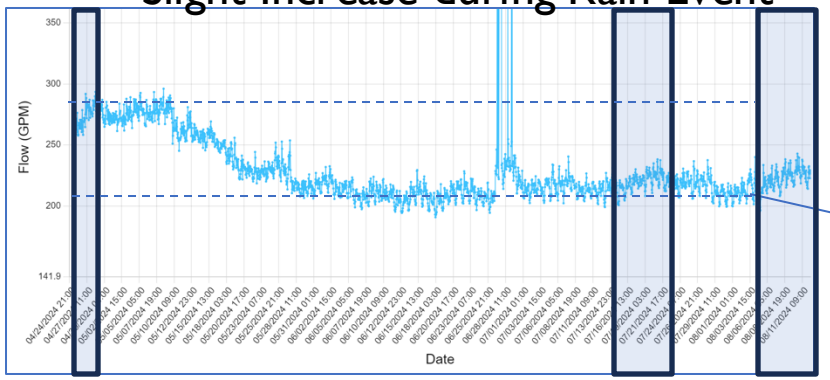
From the Toolset:

- ✓ Neighborhood walkabout
- ✓ CCTV during the event
- ✓ Flow isolation
- ✓ Smoke testing

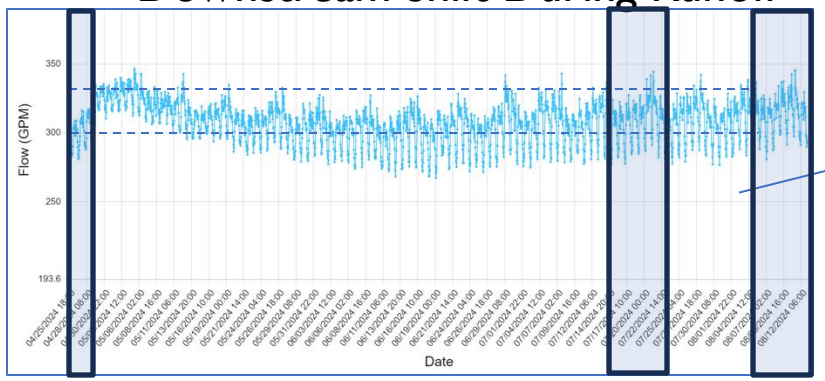
Major Basin Assessment Summary

Primary Contributor

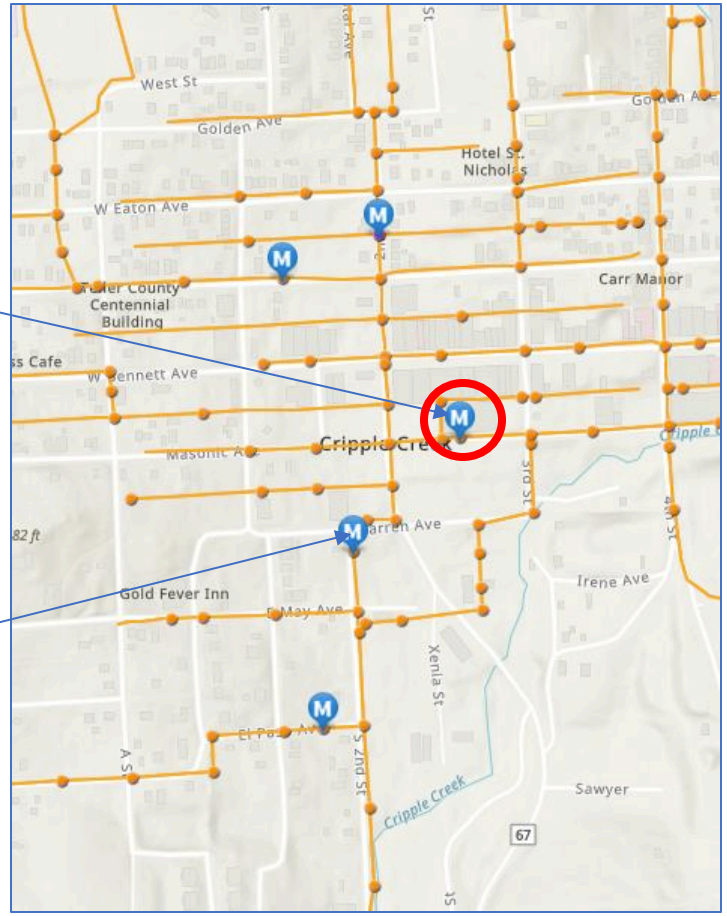
Significant Shift During Runoff
Slight Increase during Rain Event



Downstream Shift During Runoff

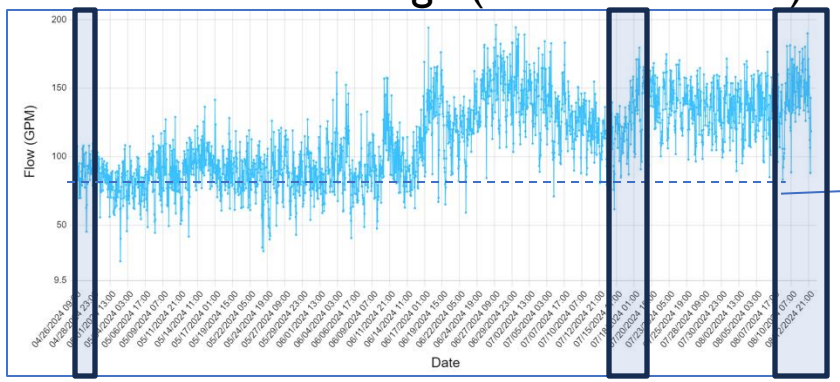


Rain Rain Rain

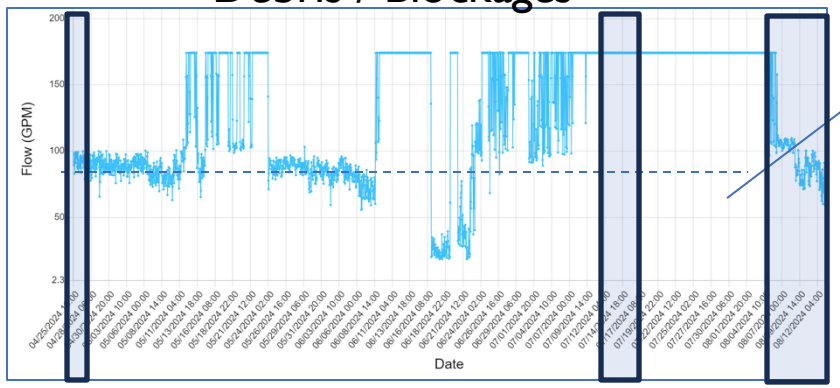


Major Basin Assessment Summary

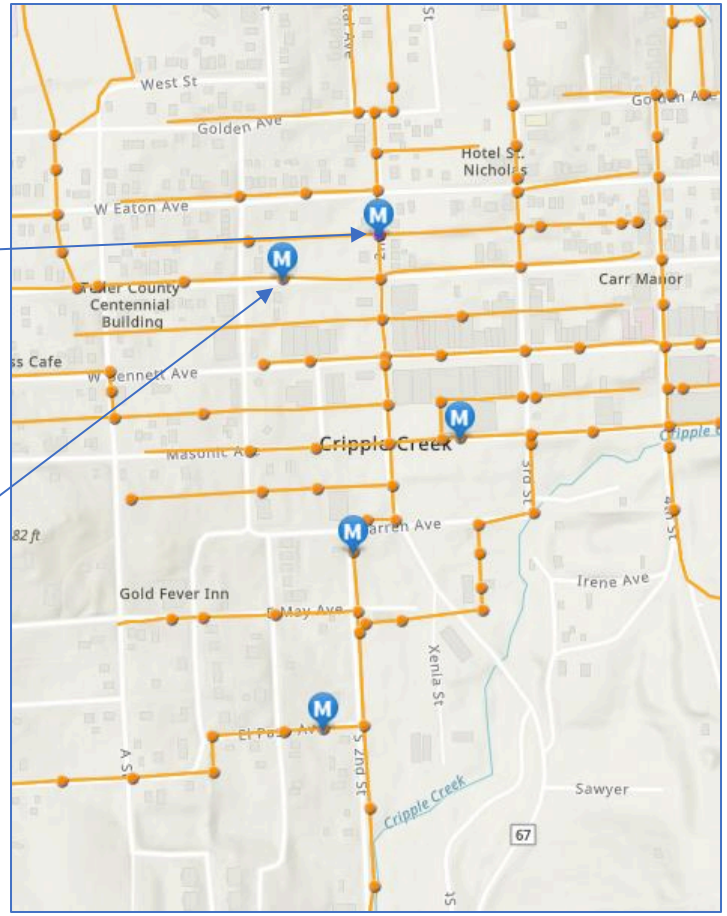
Debris / Blockage (Low Flow Level)



Debris / Blockages

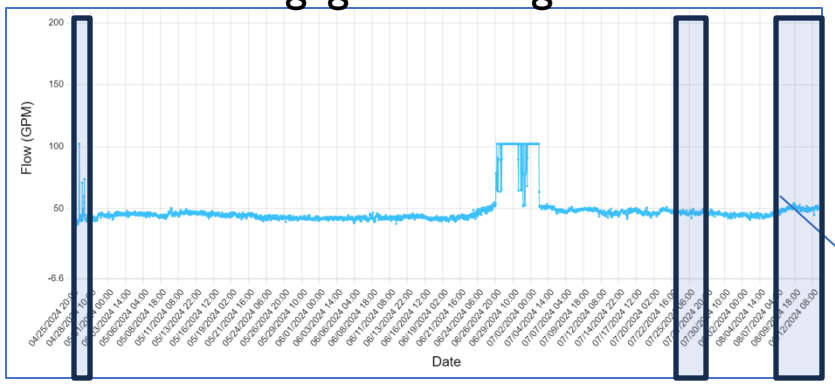


Rain Rain Rain



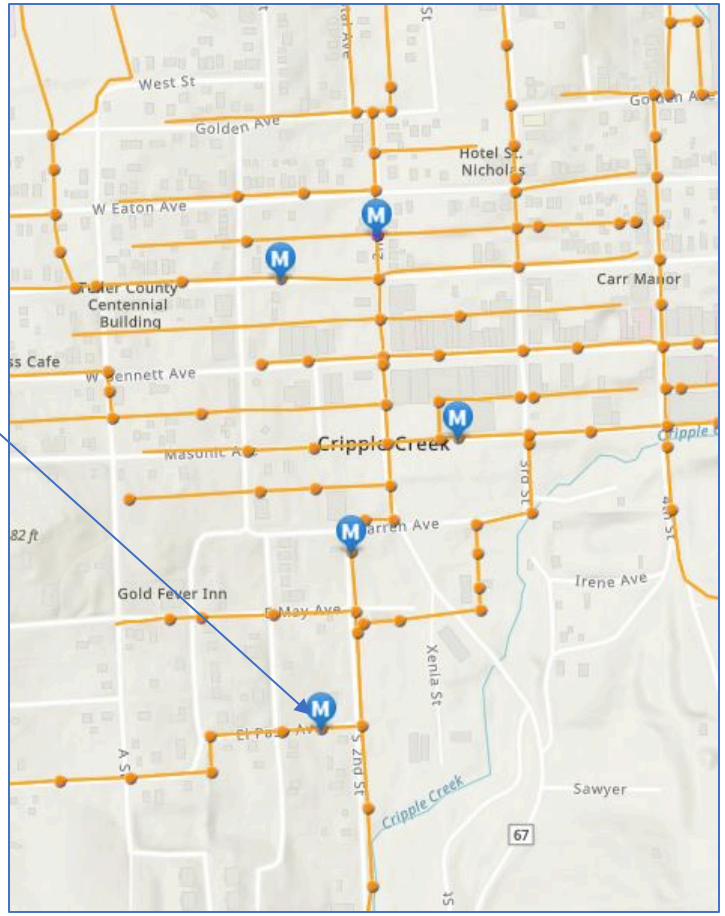
Major Basin Assessment Summary

Negligible Changes



Rain

Rain



RH Borden GIS Dashboard

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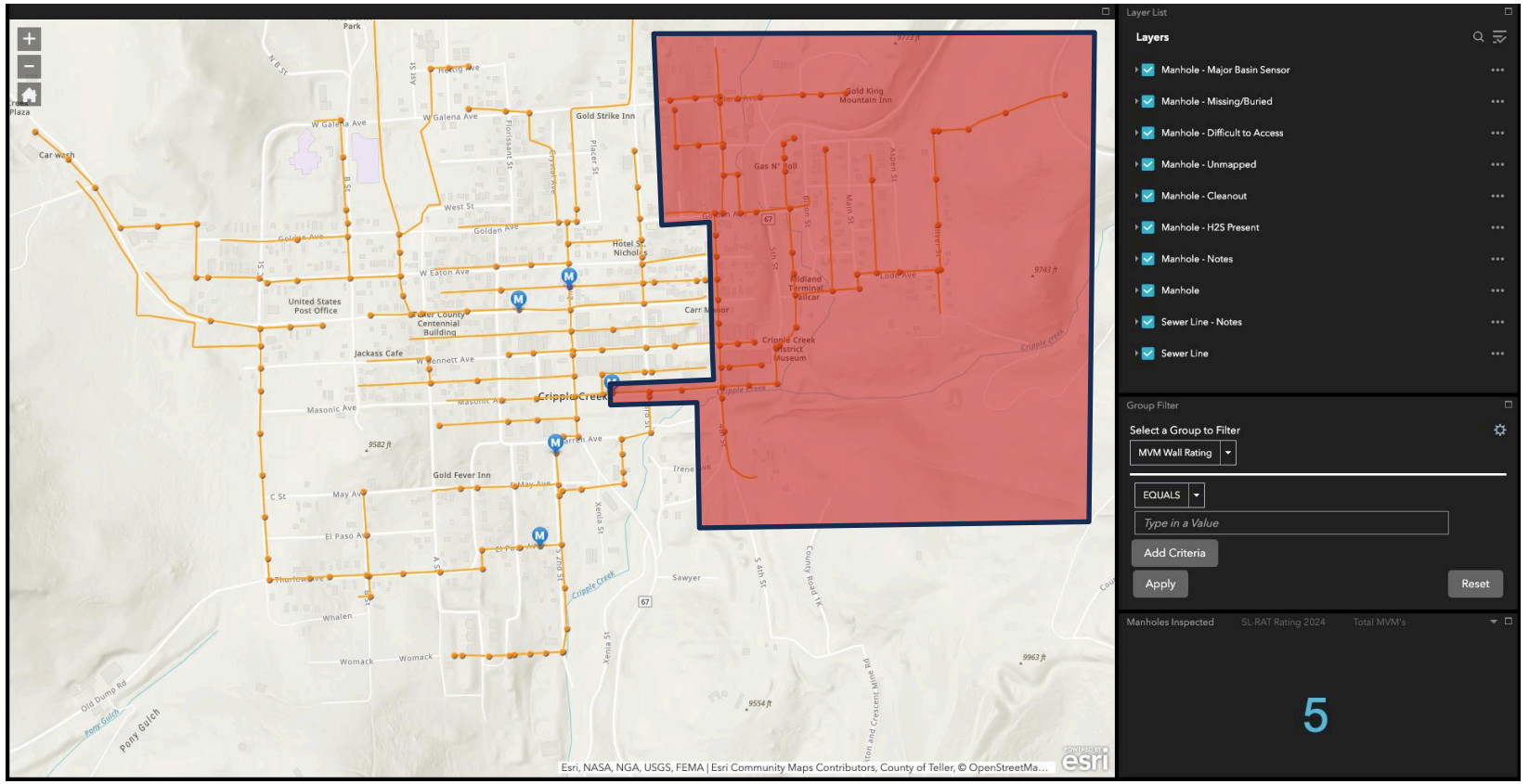
Conclusions Recommendations

The most significant detected I&I was in the highlighted basin. A target basin I&I study in this basin is recommended.

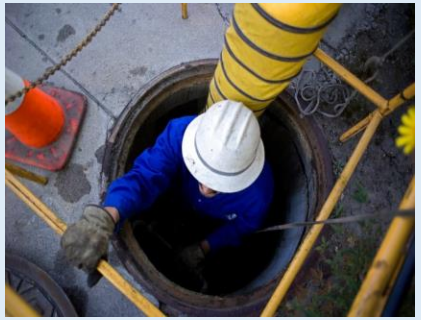


Benefits Identified by East Bay MUD

1. Timing for installing sensors can be performed either prior to the rainy season or in between storm events;
2. Sensor installation may be less labor-intensive as it likely does not require confined space entries;
3. Sensors can remain installed and collect data for weeks/months, providing the ability to evaluate multiple storm events;
4. *iTracker may provide a more consistent assessment of the impacts of I&I.*

-East Bay MUD Sr. Engineering Staff

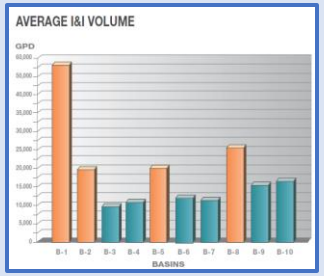
Scalable Tool For Targeting I&I

	iTracker w/Analytics	Flow Meter	Flow Isolation
			
Data	Flow (Calculated) + Weather	Flow (Measured)	Single Storm Visual
Density Limit	1-150 Per Basin	1 Per Basin	Staff Size
Deployment	Simple	Complex Confined Space	Confined Space
Program Strategy	Full System	Basin Level	Sections

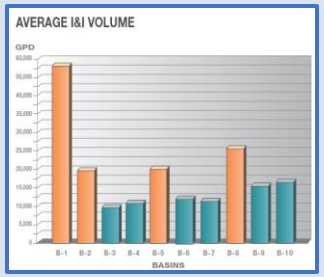
I&I Assessment Method Comparison

	iTracker with Analytics 	Flow Meters 	CCTV 	Flow Isolation 	Smoke Testing 
Conduct Target Basin Assessment	✓	–	–	✓	–
Overlay Impact of Weather	✓	–	–	✓	–
Capture months of data	✓	✓	–	–	–
No Confined Space Entry	✓	–	–	–	✓
Scale Across Collection System	✓	–	–	–	–
Cost	✓	–	–	–	–

Major Basin Assessment - Cost Comparison

Per Manhole Costs	 **Traditional I&I Flow Study**	  **RHB I&I Assessment Service**
Features	✓ Purchase and Install Flow Meters ✓ See major basin I&I comparison ➢ **Duration: 12 months**	✓ RHB Service Team Conducts Assessment ✓ See major basin I&I comparison ➢ **Duration: After 1-3 wet weather events**
Weather Data	Single Rain Gauge	Baron Weather Network High Fidelity Radar, Satellite, Sensor Network
I&I Assessment Size	Major Basin	Major Basin
Sensor Count	4	6 (Major Basin Assessment)
Equipment Cost	$35,000	-
Professional Services	$80,000	$29,000
Total Cost	**$115,000**	**$29,000**

Target Basin Assessment - Cost Comparison

Per Manhole Costs	 **Traditional I&I Flow Study**	  **RHB I&I Assessment Service**
Features	✓ Purchase Flow Meters ✓ See major basin I&I comparison ➢ **Duration: 12 months**	✓ Service Team Conducts Assessment ✓ Pinpoint I&I to within 2 manholes ➢ **Duration: After 1-3 wet weather events**
Weather Data	Single Rain Gauge	Baron Weather Network High Fidelity Radar, Satellite, Sensor Network
I&I Assessment Size	10 Miles	10 Miles
Sensor Count	4	70
Equipment Cost	$35,000	-
Professional Services	$80,000	$68,000
Total Cost	**$115,000**	**$68,000**

For more information

Iron Woman
An Employee-Owned Company

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