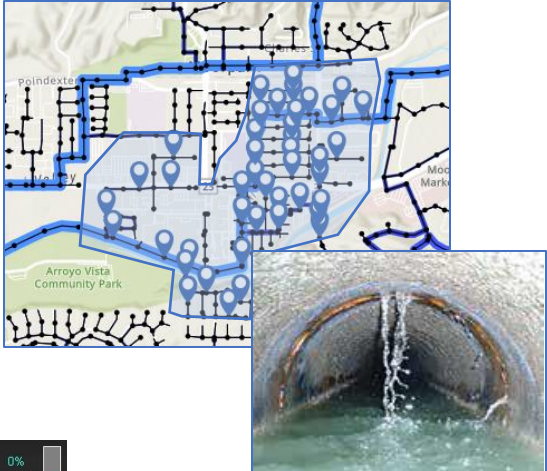


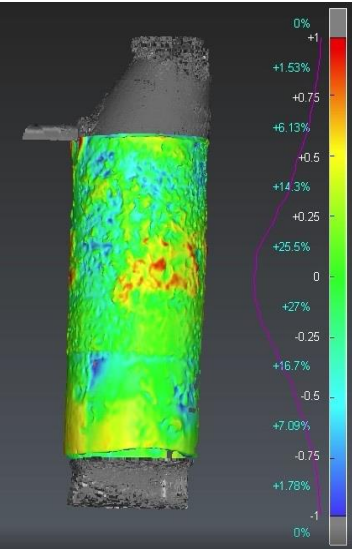
# Technology in Collection System Management



Acoustics Assessment

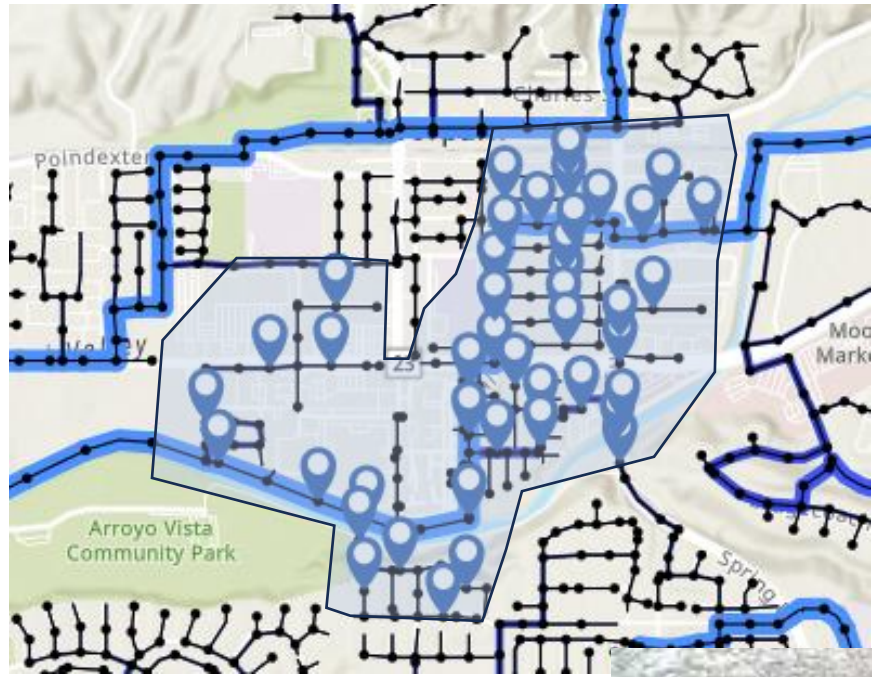


I&I Assessment



Manhole Virtualization

Condition - Based  
Collection System Maintenance



# I&I Detection Collection System Maintenance

## RH Borden I&I Assessment Services

# Why I'm Excited for This Presentation



# Why I'm Excited for This Presentation

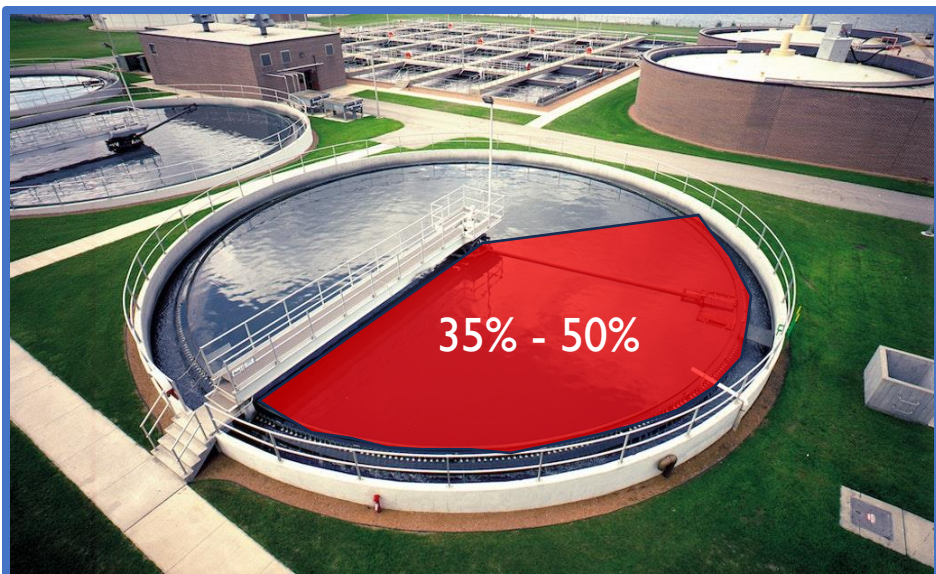
“We’ve been working on  
our I&I problem since 2004”

“We’ve been ordered  
to spend \$1.25 million on this every year”

“It would be really good if  
the new data confirms  
the data we’ve collected over the past 20 years”

# Inflow and Infiltration (I&I)

## What is the Cost?



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



**Fines and Orders: \$1 Million +  
Treatment Cost: \$500,000/100 Million Gallons**

The goal is NOT to  
eliminate I&I...

...the goal is to  
eliminate spills from I&I

# Sources of I&I

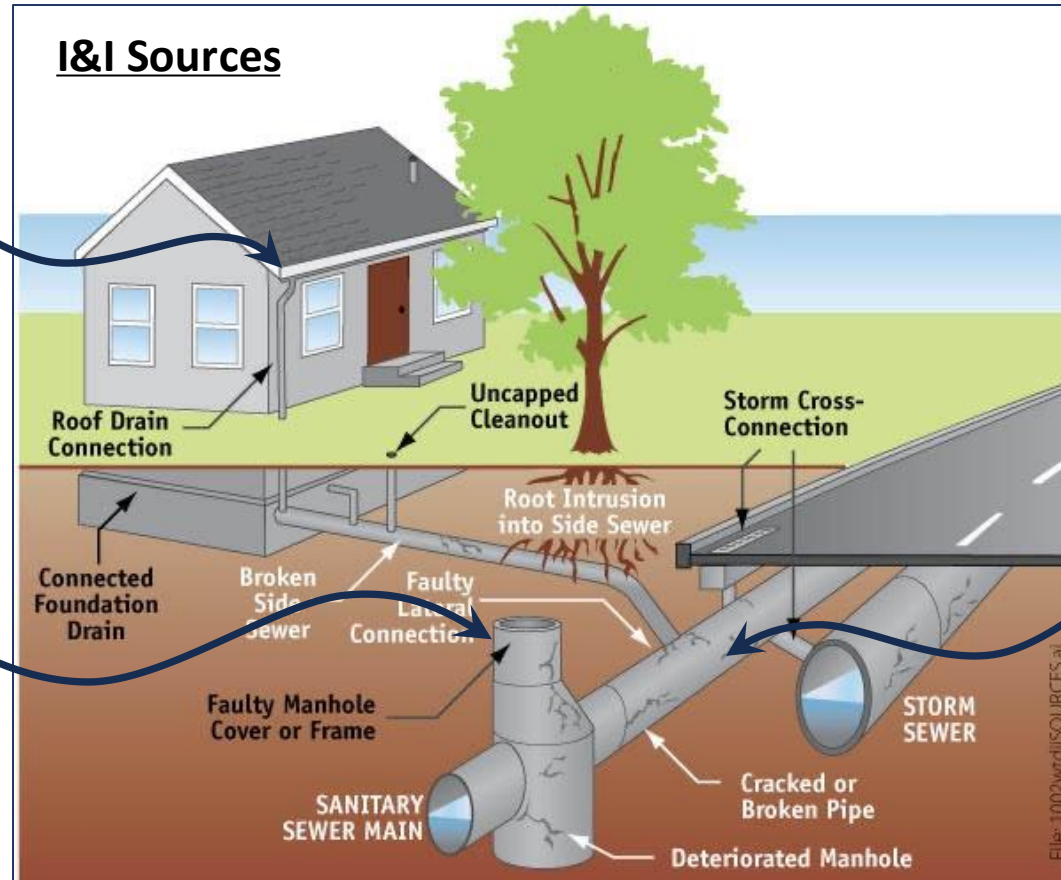
## Traditional Tools Require Targets



**Smoke Testing**  
Target: 4-5 houses

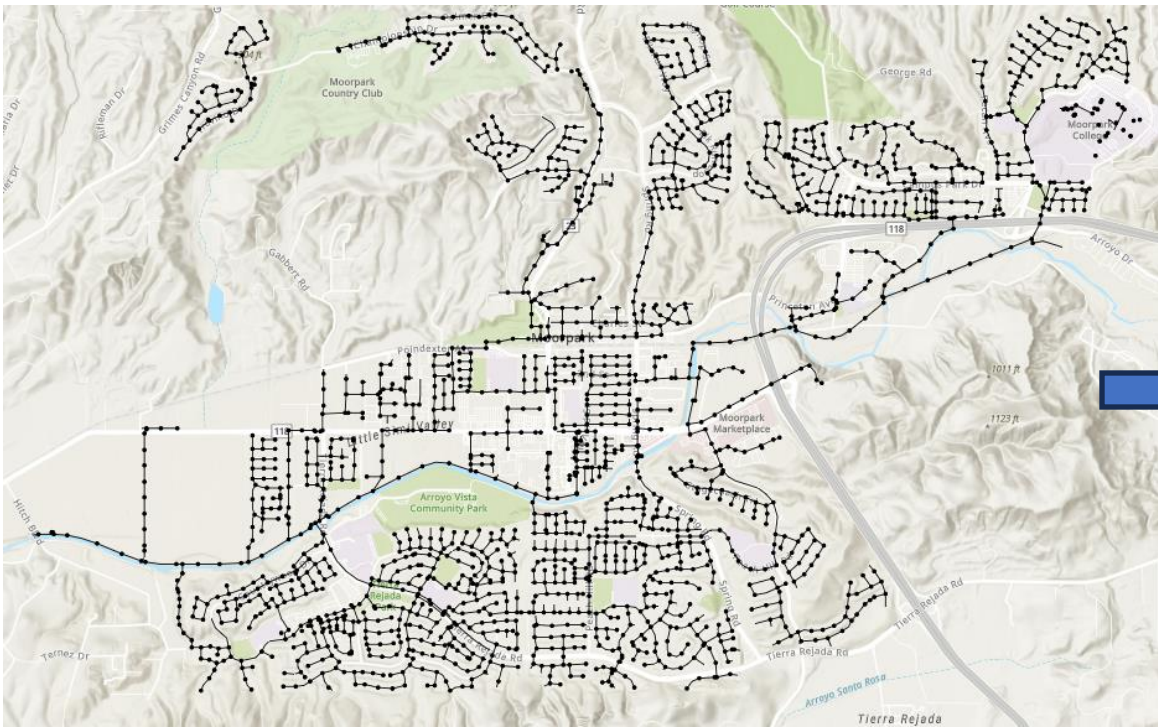


**Manhole Inspection**  
Target: Single Manhole

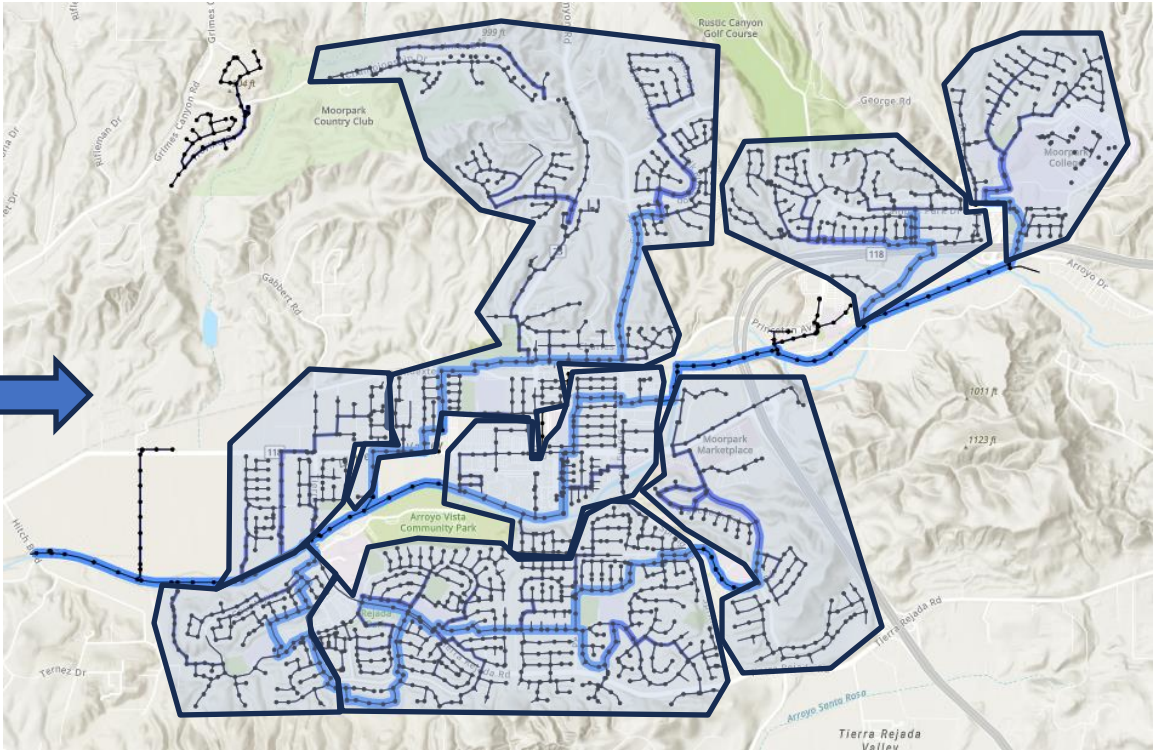


**CCTV**  
Target: Single Pipe

# Understanding Basins

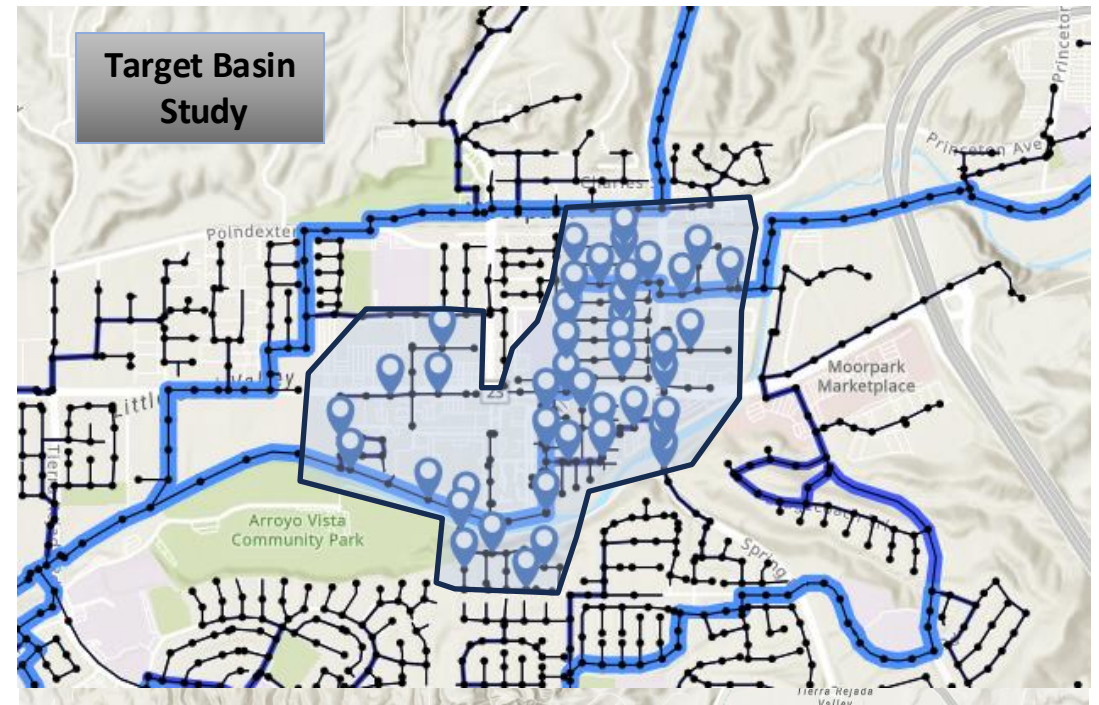
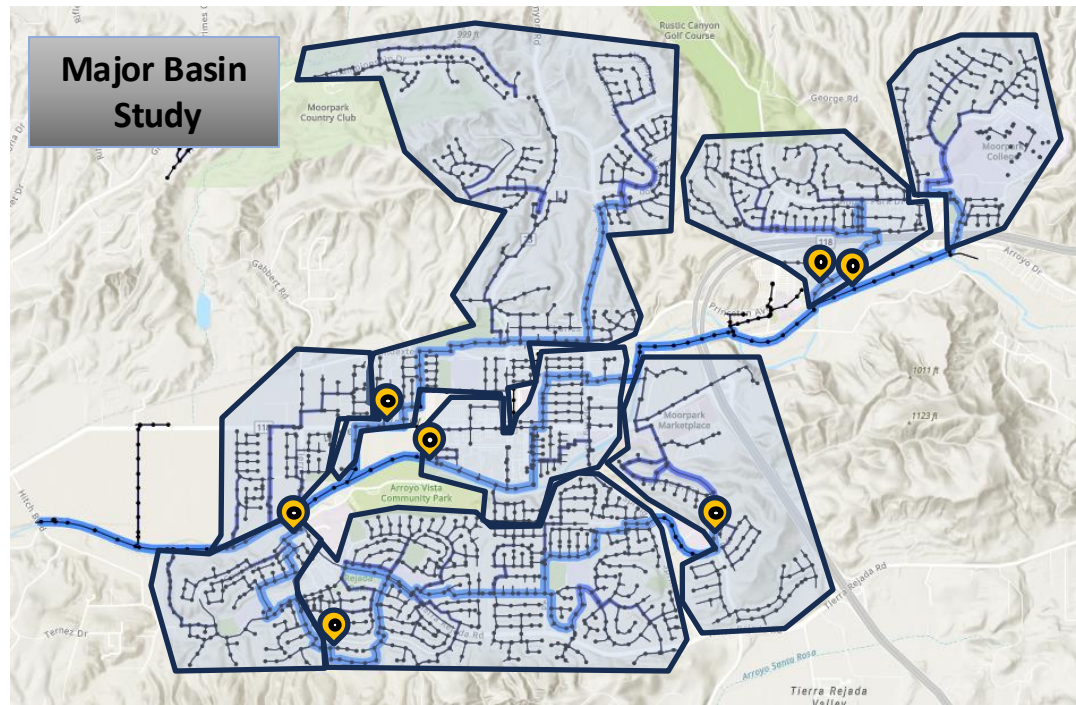


Traditional System View



Basin View

# Basin Studies for I&I Assessment



# Major Basin—San Rafael

# Target Basin—Sutter Creek

# Establishing Flow Baseline

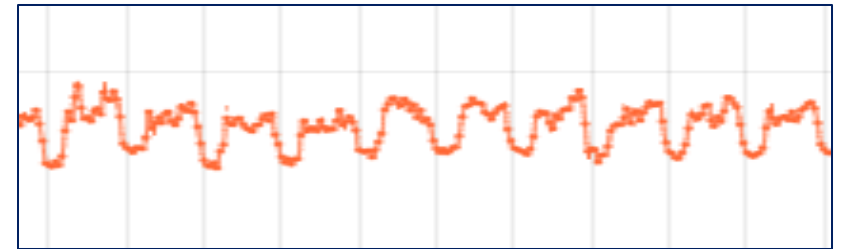


Water Level Monitoring  
Over Time

+



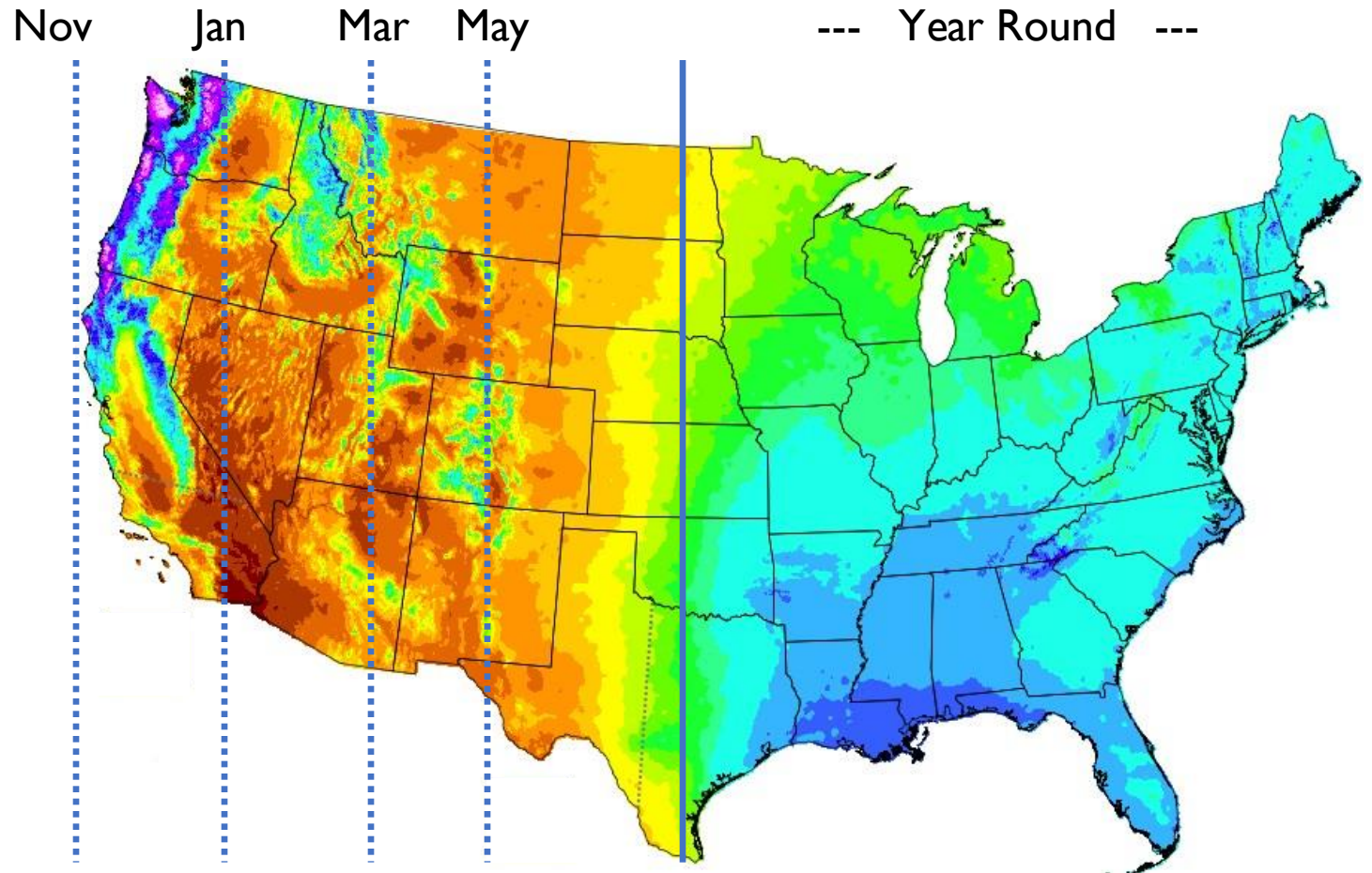
Manhole Virtual Model (MVM™)  
(Diameter, Elevations, Material)



Convert Level  
to  
Daily Flow Pattern

# Monitoring Weather

## Best Times To Detect I&I



**BARON**  
WEATHER

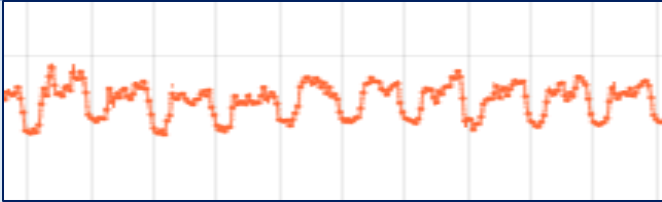
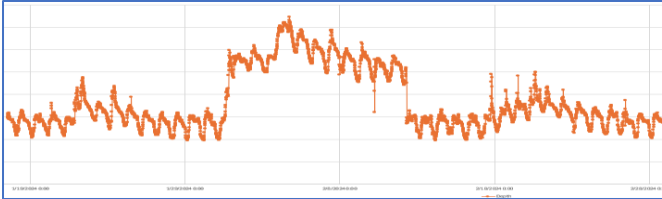
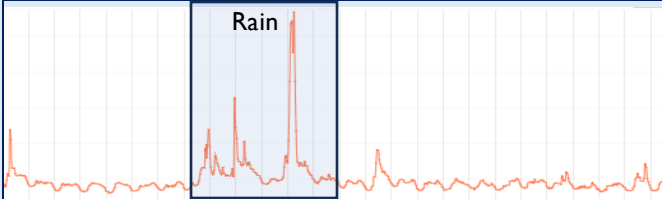
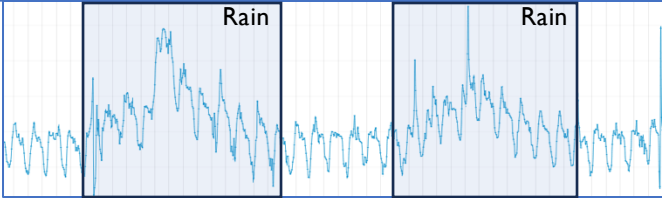
**High-density, Real-time Weather Network**

Gage Types: Satellites + Surface Gauges

Resolution: ½ mile updated every 4 minutes

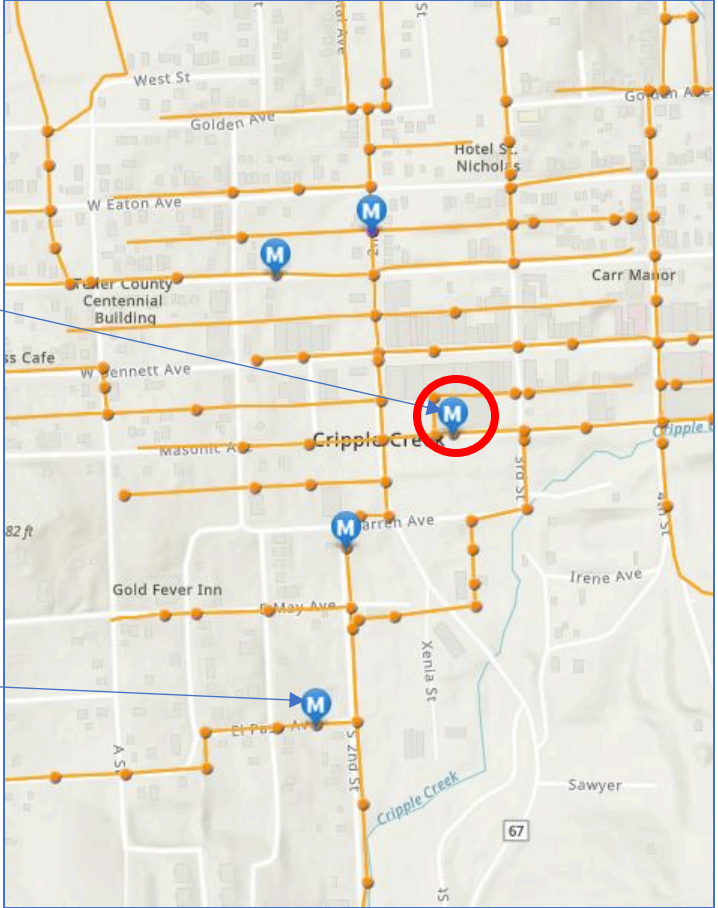
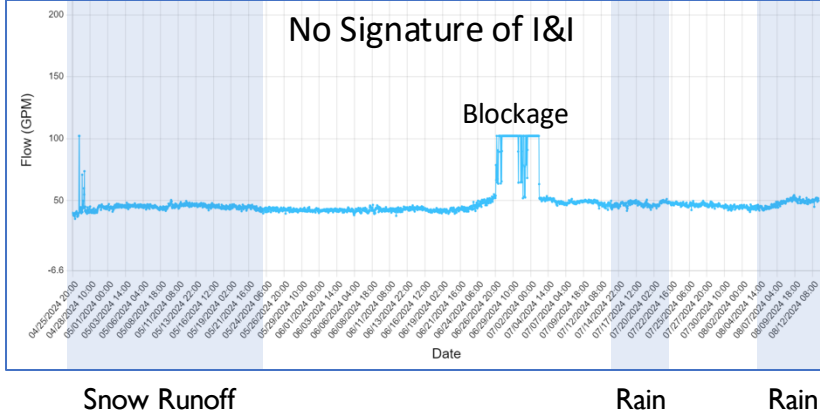
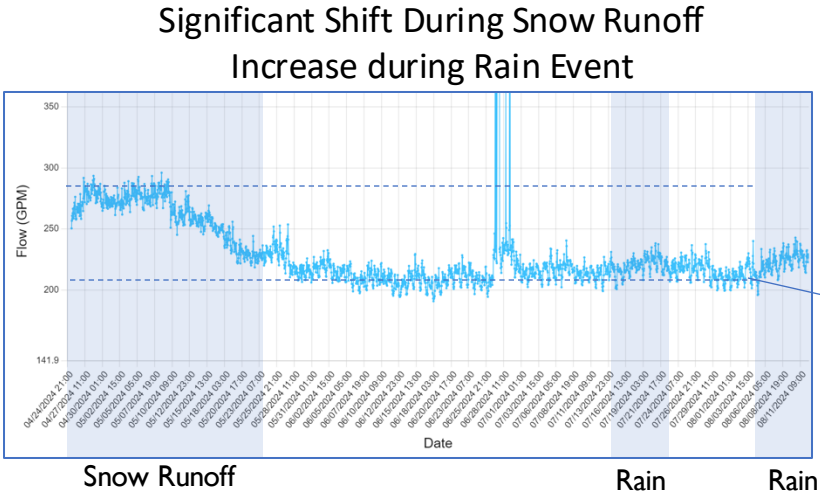
Used by: NASA, Airlines, Garmin, ESRI, Verizon

# Identifying Inflow and Infiltration

Flow Condition	Level Signature	Actions Required
<p><b><u>Regular Flow:</u></b> Daily Diurnal Pattern of Flow</p>		-
<p><b><u>Blockage:</u></b> Sharp Increase / Decrease in Diurnal Pattern</p>		Jet Cleaning
<p><b><u>Inflow (Open to Sky):</u></b> Spike in Level During Rain Event</p>		<p>Walk-About Smoke Testing CCTV During Rain Event</p>
<p><b><u>Infiltration (Underground):</u></b> Gradual Increase in Level During Rain Event</p>		CCTV After Rain Event

# Major Basin Deliverables

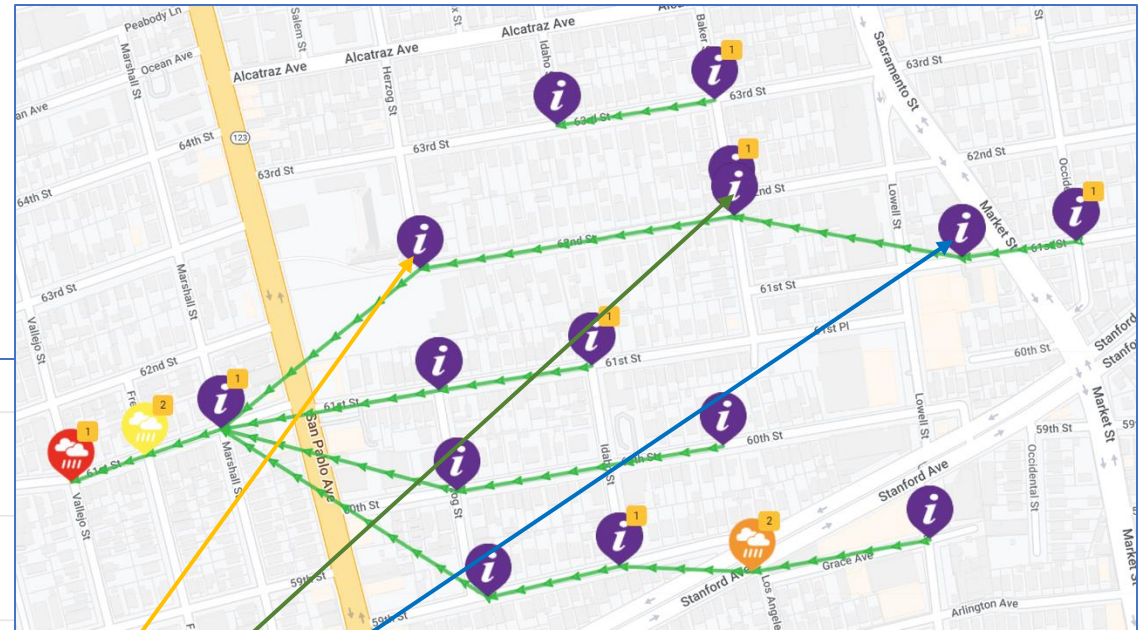
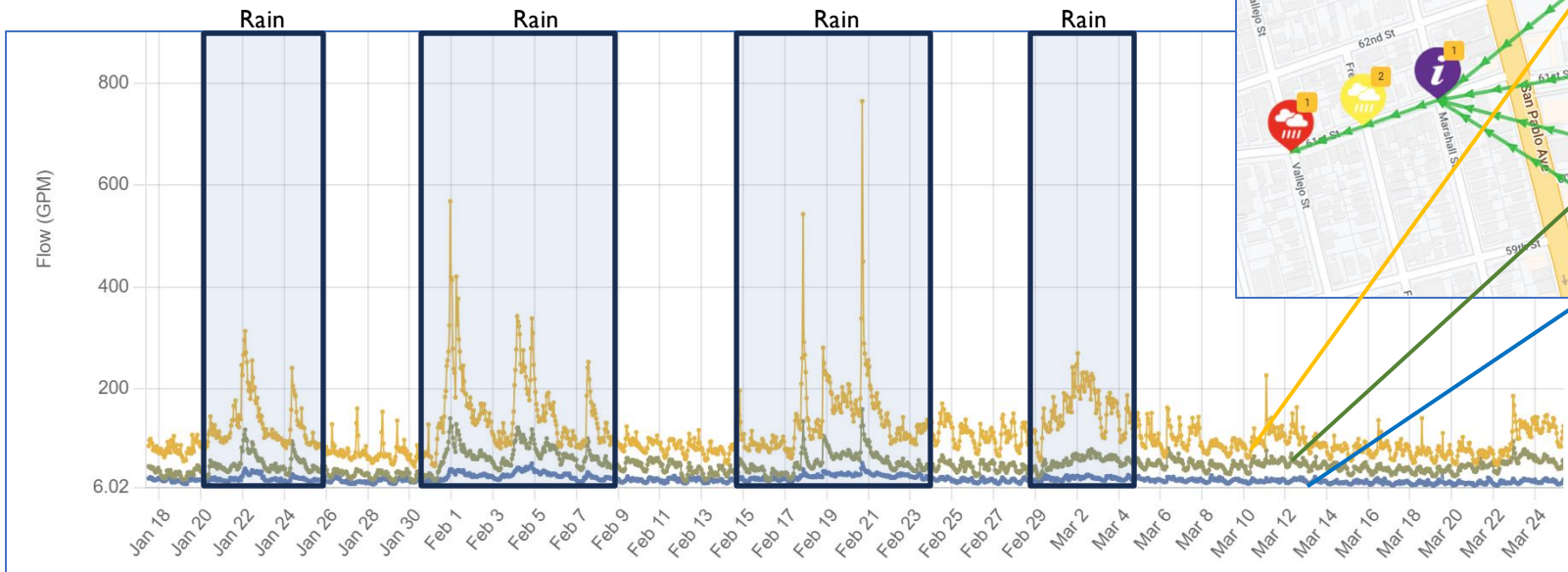
## Primary Contributor

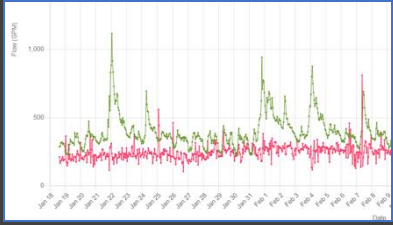


# Target Basin Deliverables

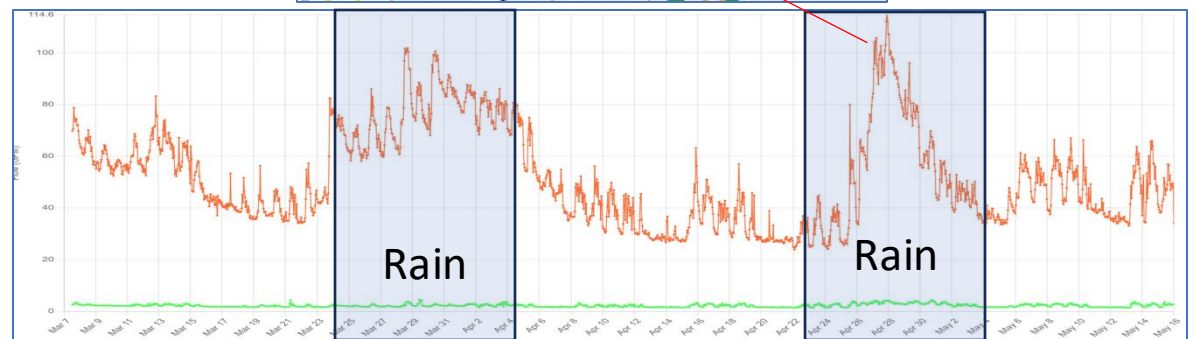
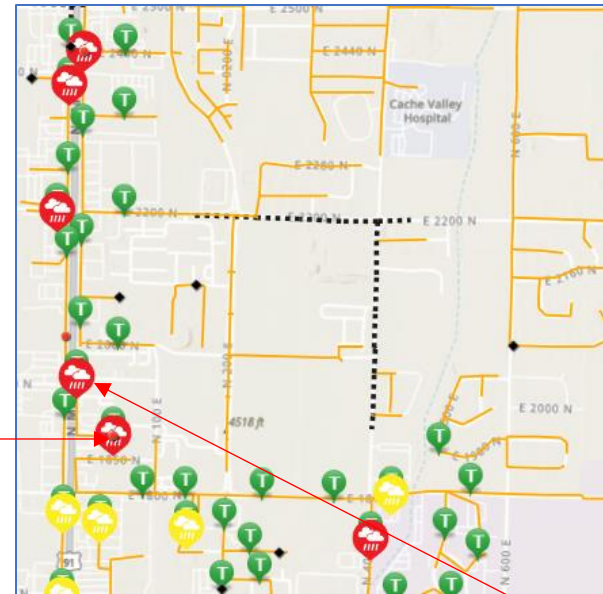
## Hydrograph Analysis

Moderate shifts to Diurnal Pattern





# Target Basin Assessment South Basin





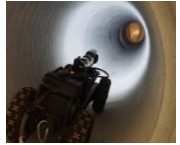













# Benefits Identified by East Bay MUD

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- Installing sensors can be performed prior to the rain
- Installation does not require confined space entries;
- Sensors can remain installed and collect data for weeks/months,
- This may provide a more consistent assessment of the impacts of I&I.

-East Bay MUD Sr. Engineering Staff

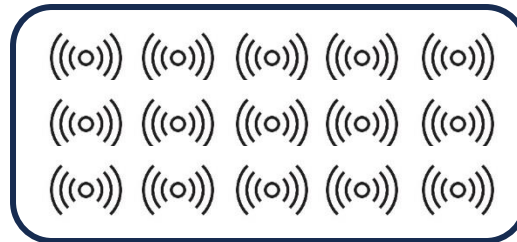
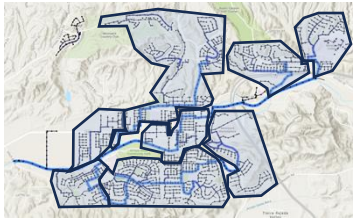
# I&I Assessment Method Comparison

	RH Borden I&I Assessment 	Flow Meters 	Systemwide CCTV 	Flow Isolation 	Systemwide Smoke Testing 
Conduct Target Basin Assessment		-	-		-
Overlay Impact of Weather		-	-		-
Capture months of data			-	-	-
No Confined Space Entry		-		-	
Scale Across Collection System		-	-	-	-
Cost		-	-	-	-

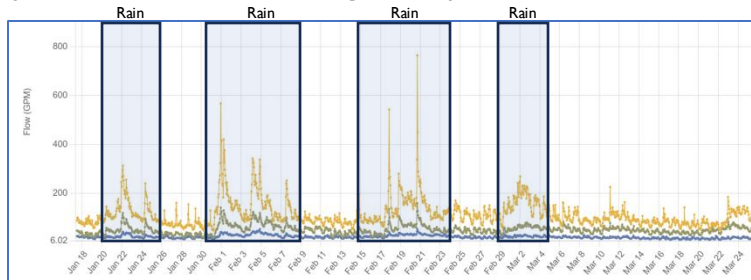
# Cost / Quality Comparison

	Traditional I&I Study 	RH Borden I&I Assessment Services 	
Study Type	<b>Major Basin</b>	<b>Major Basin</b>	<b>Target Basin</b>
Duration	6-12 Months	2-3 Weather Events	2-3 Weather Events
Weather Data	Single Rain Gauge	Baron Network	Baron Network
Sensor Count	4	10	100
<b>Total Cost</b>	<b>\$115,000</b>	<b>\$49,000</b>	<b>\$98,000</b>

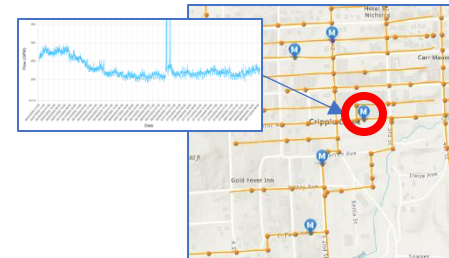
# RH Borden I&I Detection Services



1) Basin / Flow map    2) Simultaneous Sensor Network    3) Weather Event



4) Analytics



5) Data Visualization