DUKE'S ROOTED IN INNOVATION℠

Precision I&I Microdetection

Principles, Execution and Information

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What We Already Know

1. We spend more time looking for I&I than we do fixing it.

2. We get into a “paralysis by analysis” where we are in a seemingly constant state of inspection.

3. We seem to only get a 1-sided view of our system from the data.

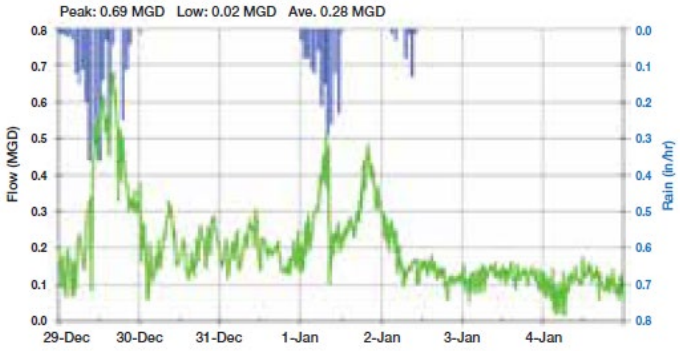
4. Our key stakeholders are constantly pressuring us to be more efficient ($$) and effective when it comes to finding and prioritizing our I&I.

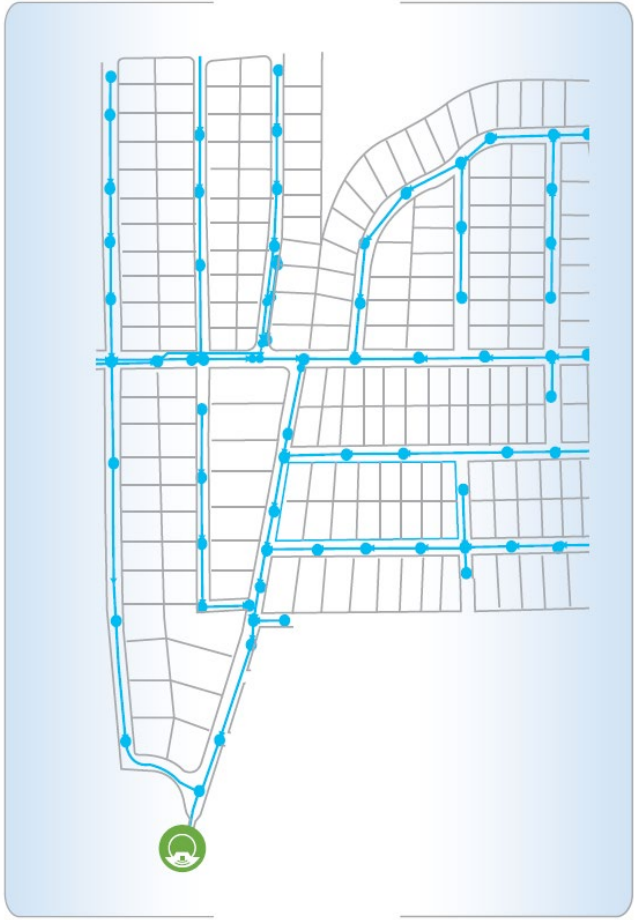
FLOW METERS

Major Basin Monitoring

Portable flow meters monitor operating conditions in major basins in order to quantify the extent of inflow and infiltration.

Hydrographs are then created for each major basin showing increases in wastewater volume during periods of wet weather



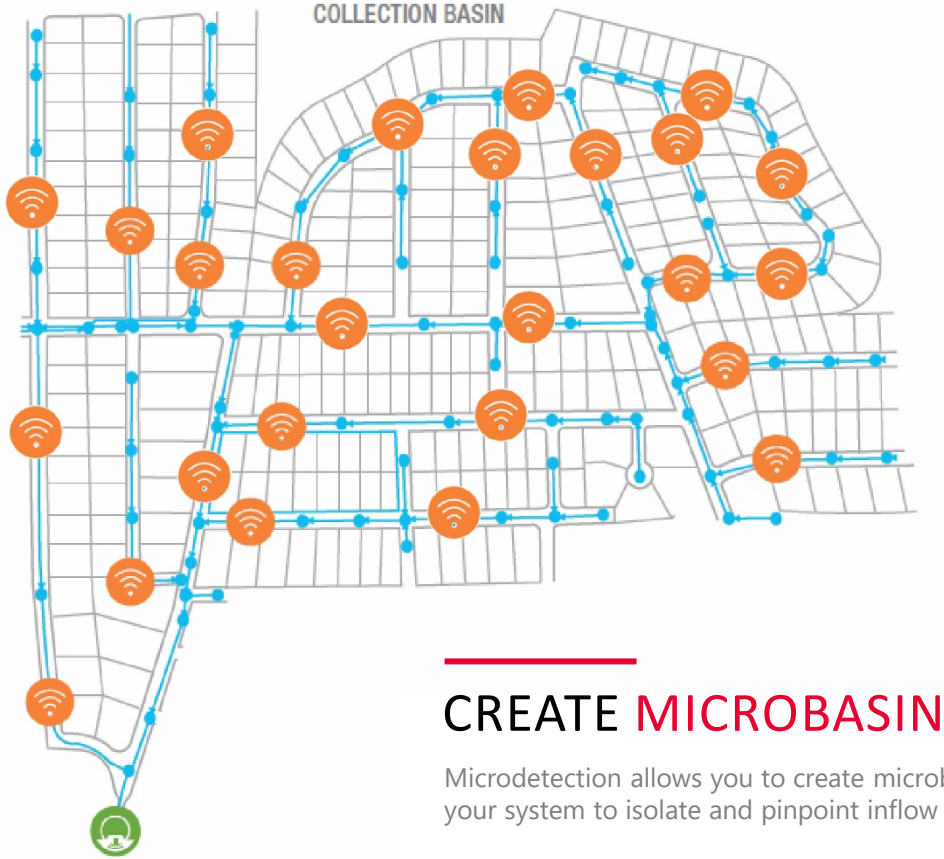


Flow Meter

Monitors major basins for signs of I&I

iTracker

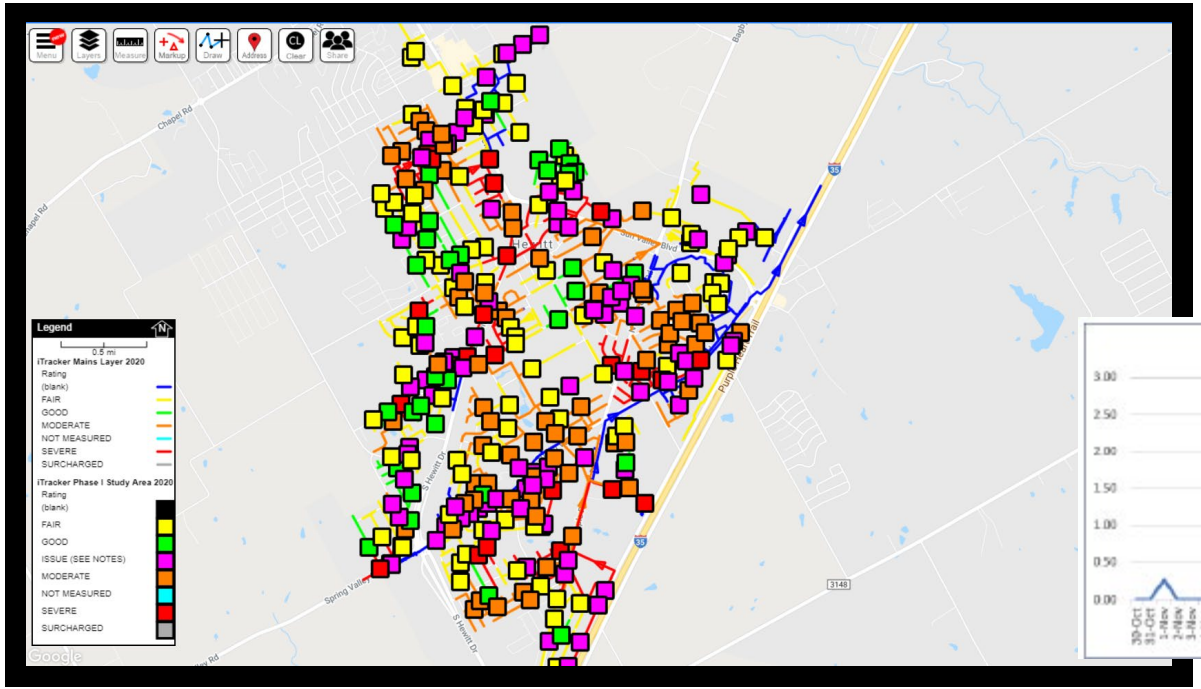
Pinpoints I&I down to mini and micro-basins



CREATE MICROBASINS

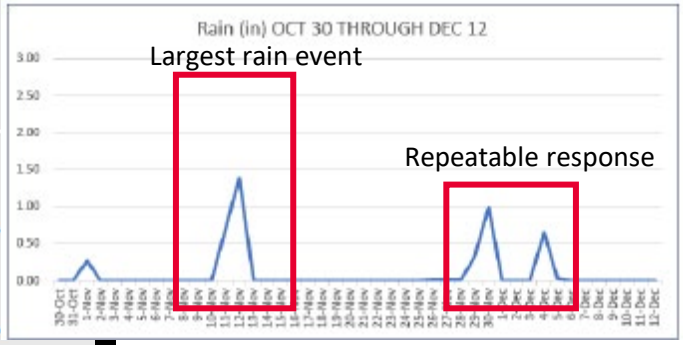
Microdetection allows you to create microbasins within your system to isolate and pinpoint inflow and infiltration

PRECISION I&I MICRODETECTION– MASS DEPLOYMENT STRATEGY



Keys to success:

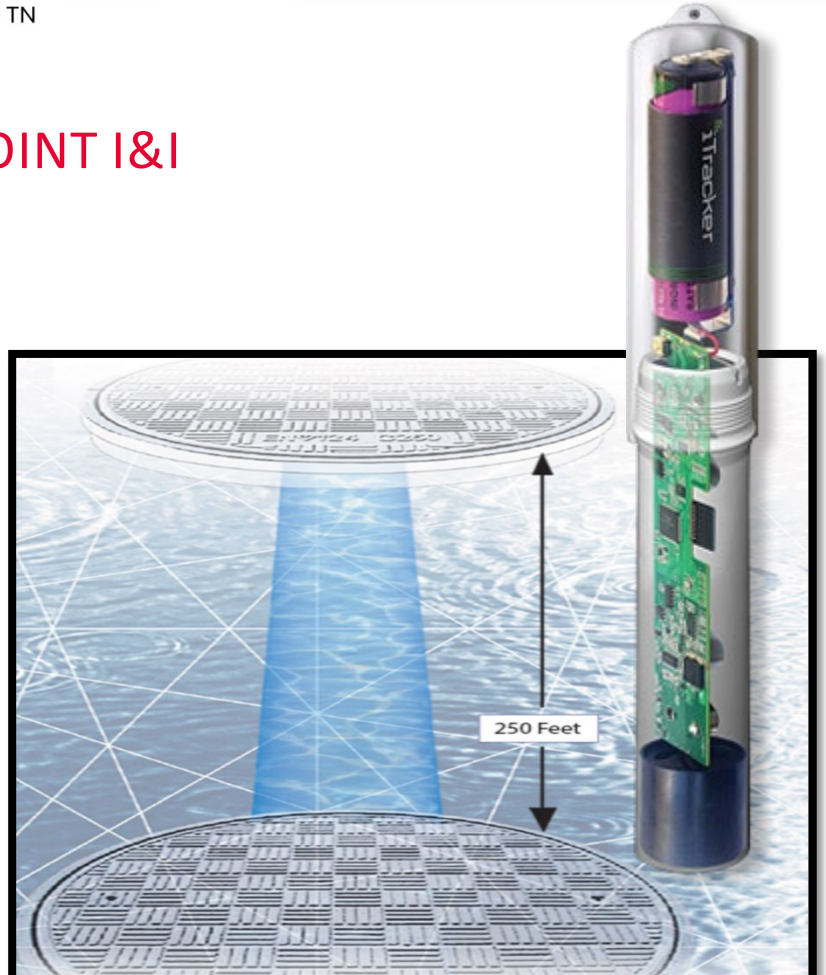
- Rapid deployment of units
- Measures RDII in same rain event
- Rain gauges deployed to create local climate
- 30-60 day studies
- Installations approximately every 800LF
- Linking units to each other to pinpoint I&I sources



PRECISION I&I MICRODETECTION– PINPOINT I&I

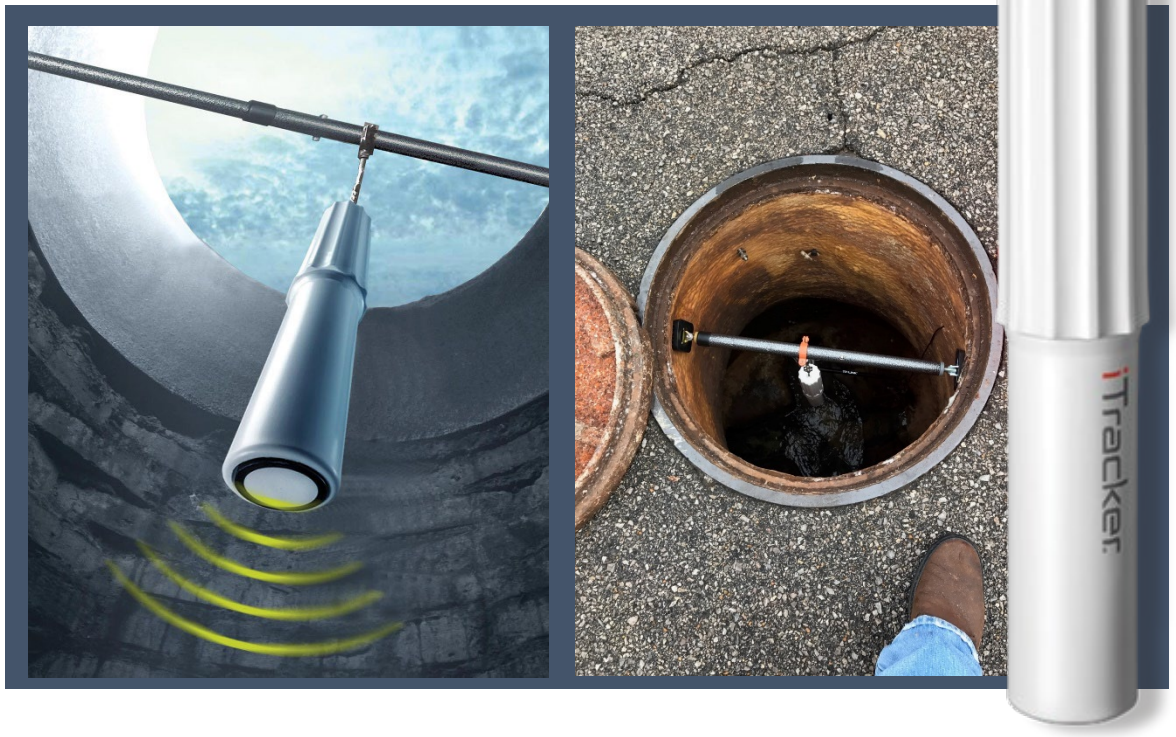
Purpose: Pinpoint the contributors of inflow and infiltration within adjacent manholes utilizing precision sensors and auto analytics platform to determine RDII and produce actionable results

WHERE	WHAT	WHEN
Where is the Inflow and infiltration coming from specifically? Which pipes are showing increased RDII?	Is the increase in RDII related to inflow or infiltration related sources? Is it private or public?	When are we seeing the RDII occur? Is it after a 1" or 2" or consecutive rain event pattern?



PRECISION I&I MICRODETECTION– PINPOINT I&I

- iTrackers® monitor and record changes in wastewater volume as small as 1/10”
- Rapid deployment (20 units installed per day per crew)
- No confined space entry, no drilling into structures to install
- No sensor fouling due to debris build up over sensors
- Bridges the gap between flow meters and inspection CCTV camera equipment to determine RDII patterns in collection system and normally low volume points in the system.

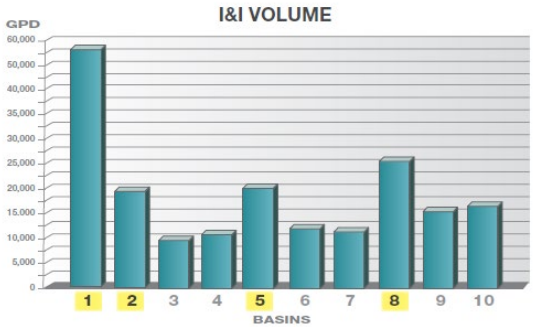


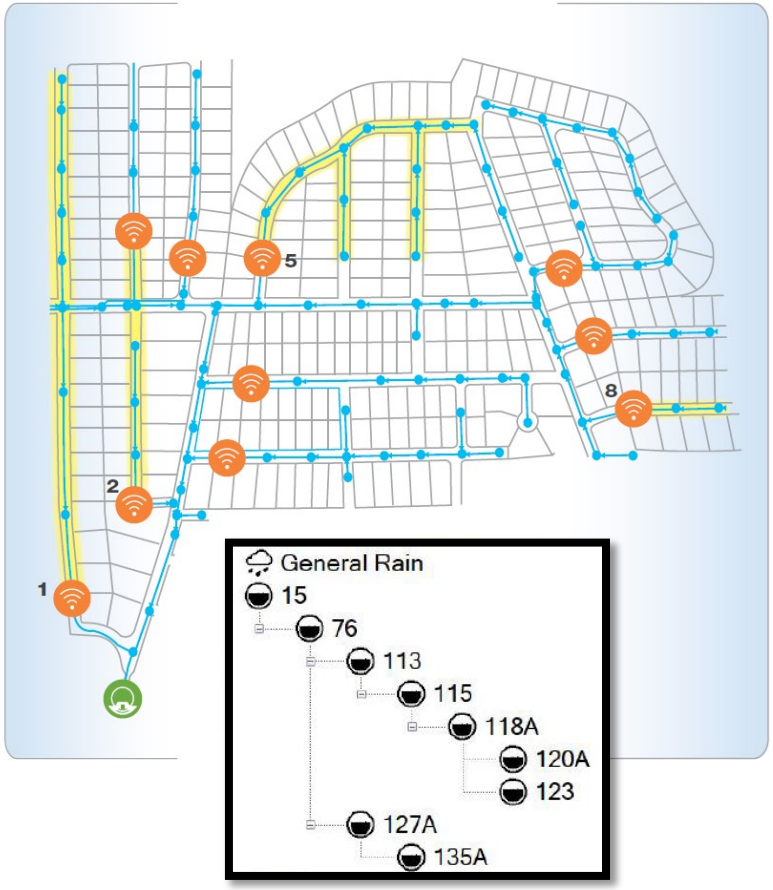
ITRACKING

Micro Basin Monitoring

Microdetection sensors are strategically distributed within each major basin responsible for allowing the entry of excess volumes of ground and storm water.

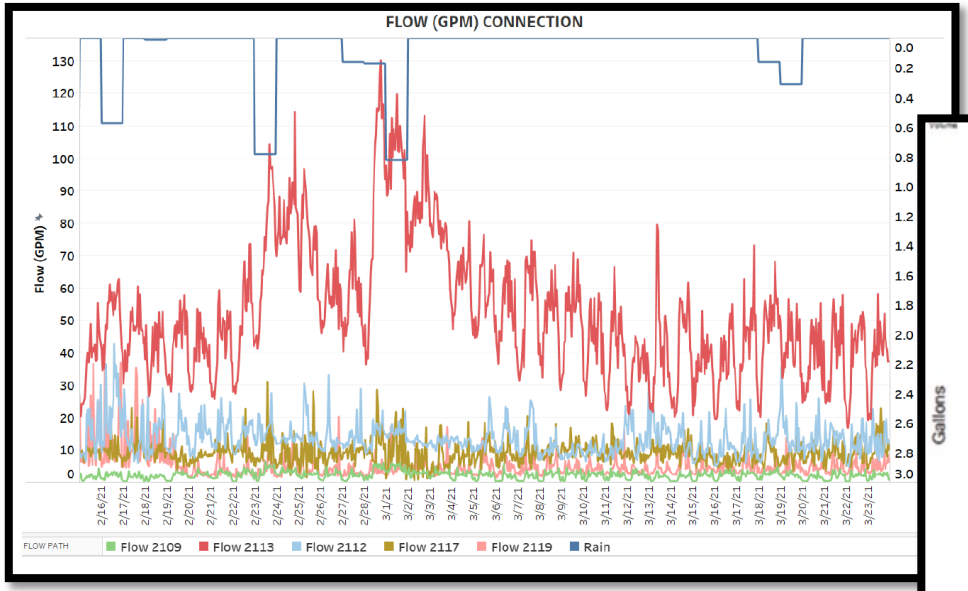
"At a glance" microdetection analytics automatically identify the mini basins (1, 2, 5 & 8) responsible for contributing the highest percentages of I&I



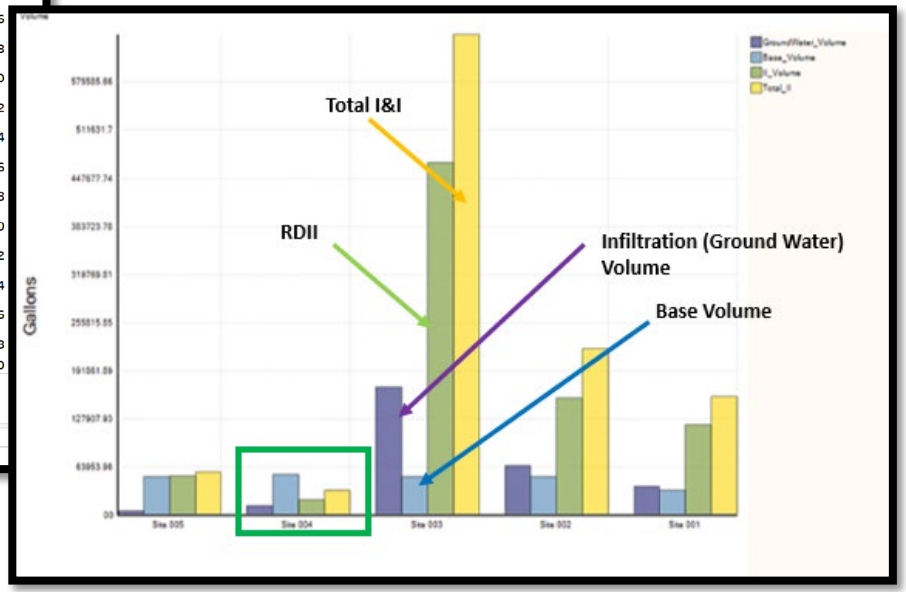


ITRACKING

Micro Basin Monitoring

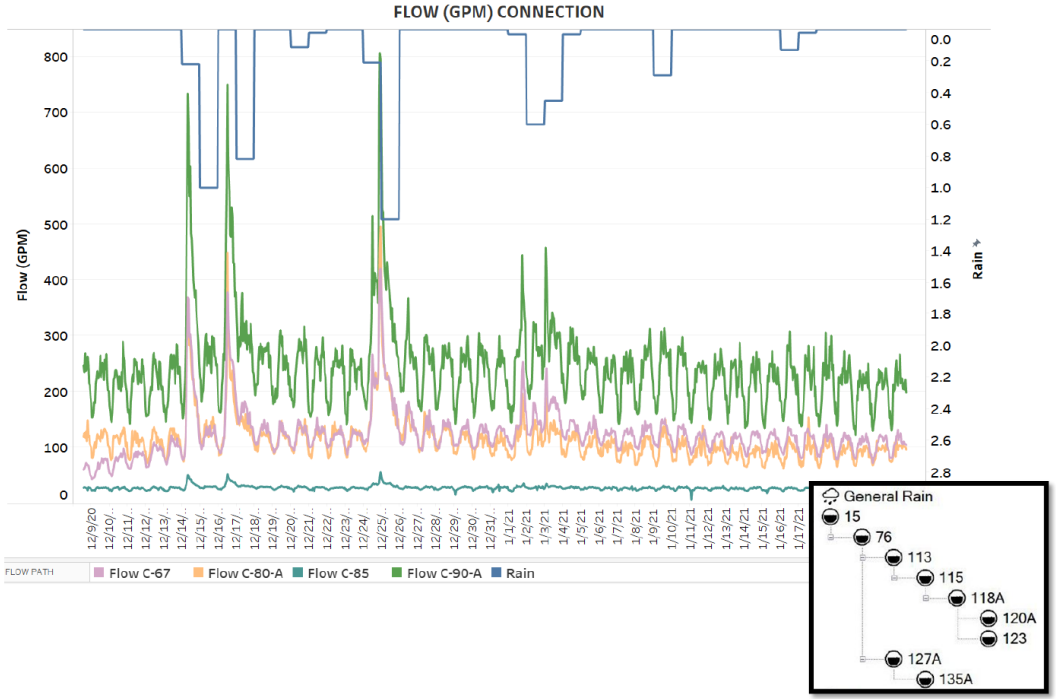


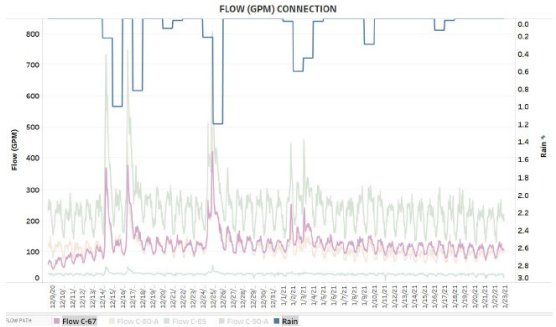
Linked analytical tools show individual line segment RDII contribution in volume and dollars

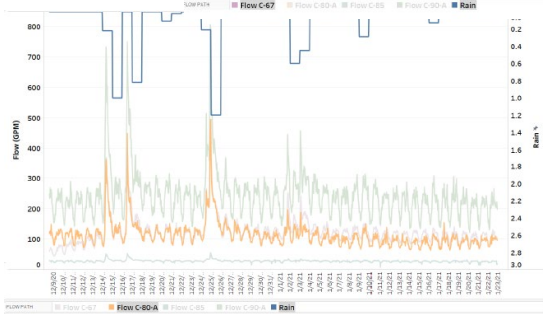


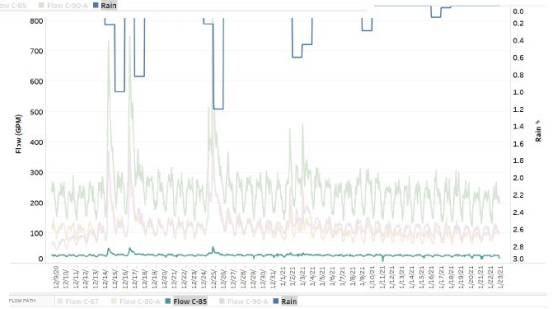
CHARTS / GRAPHS

Flow Connection Analysis





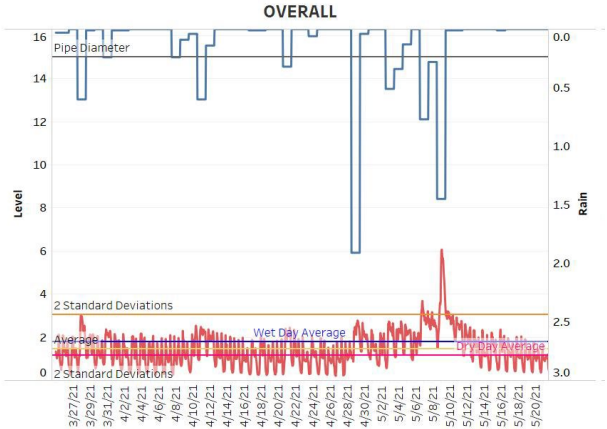


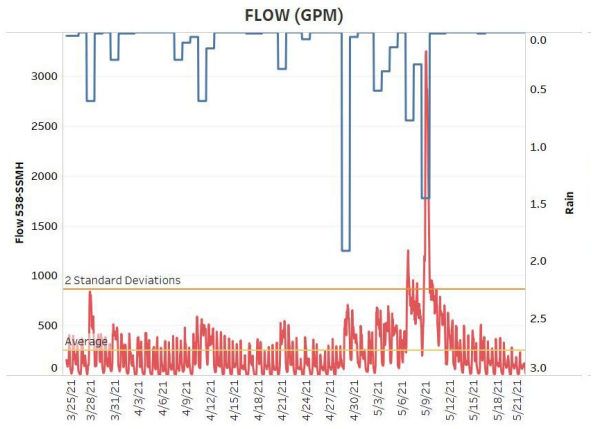


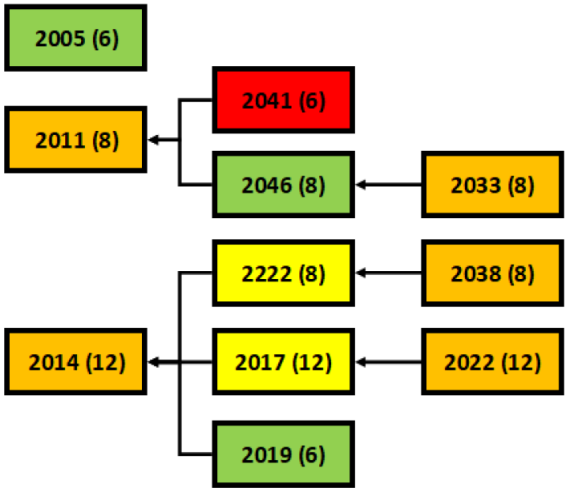
ITRACKING

Auto Analysis

Zone	Manhole ID	Pipe Size	Individual Population	Cumulative Population	Total Observations	Minimum Level (in)	Average Level (in)	Peak Level (in)	Difference Average to Peak (in)	Standard Capacity (in)	Percent Observed Over Standard Capacity	Surcharged	Over Standard Capacity	25% Over Capacity	I&I	Final Rating
7	3287	8	15	65	3,703	0.92	2.09	5.71	3.62	2.67	3.24%		✓		✓	Moderate
7	3479	8	15	50	3,705	0.00	1.69	15.70	14.01	2.67	0.32%	✓			✓	Severe
7	3261	8	15	15	3,705	0.00	0.68	1.25	0.57	2.67	0.00%				✓	Fair
7	3259	8	12	20	3,705	0.00	0.64	1.16	0.51	2.67	0.00%				✓	Fair
7	3254	8	8	8	3,705	0.00	0.51	0.79	0.28	2.67	0.00%					Good



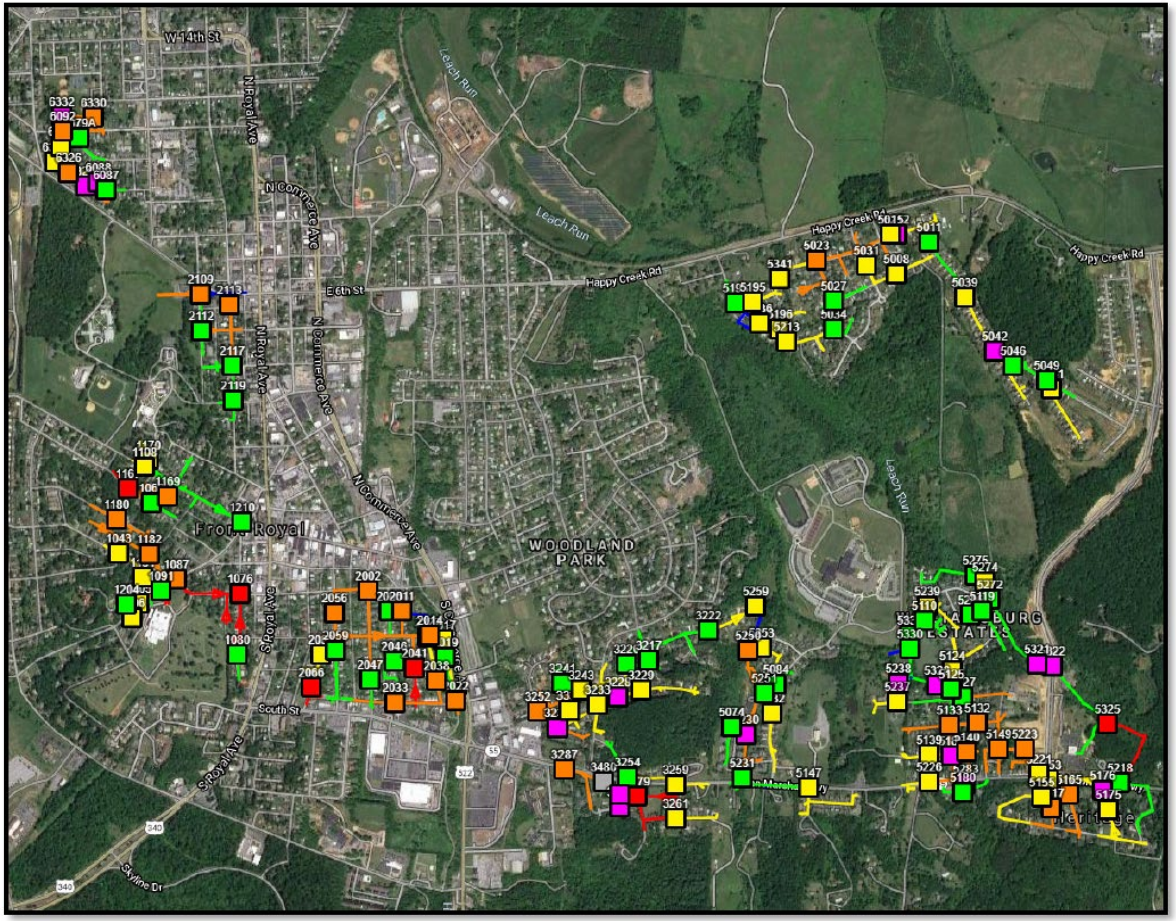




FINAL MAP

Dynamic graphs and charts help narrow down data to determine key pipelines contributing I&I

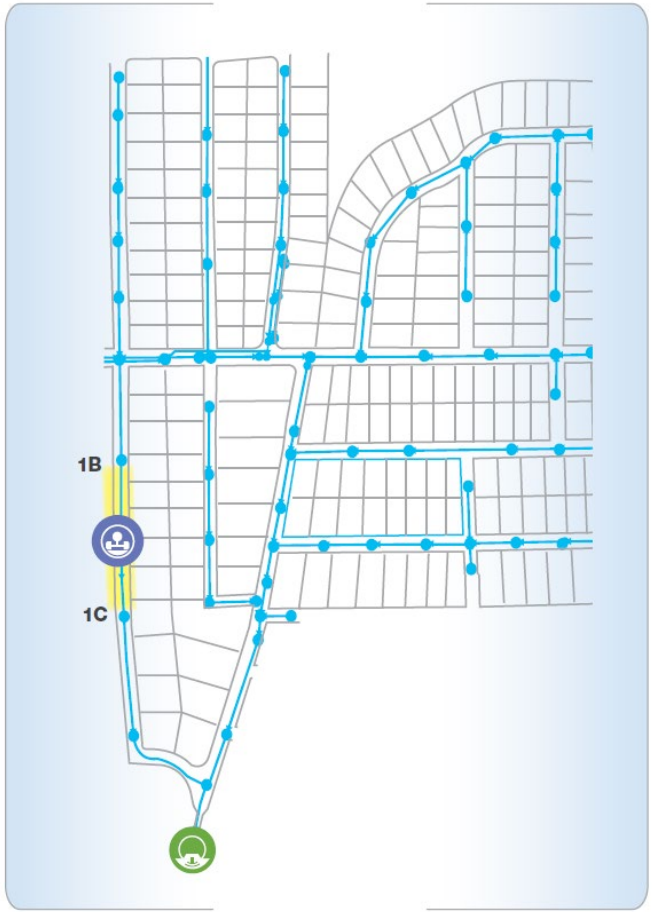
GIS integration of data for post field inspection data processing and storage



POST INSPECTION

I&I Confirmation

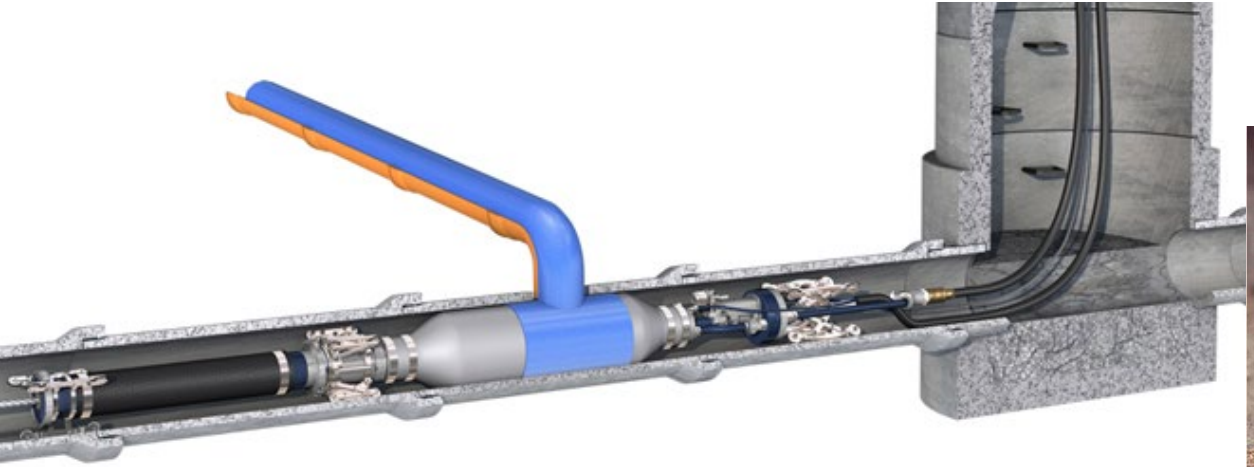
Post inspection technology such as CCTV inspection, smoke/dye testing, manhole inspections or private building inspections are used to ascertain the exact cause of the Rain Derived Inflow & Infiltration (RDII) entering micro basin 1C



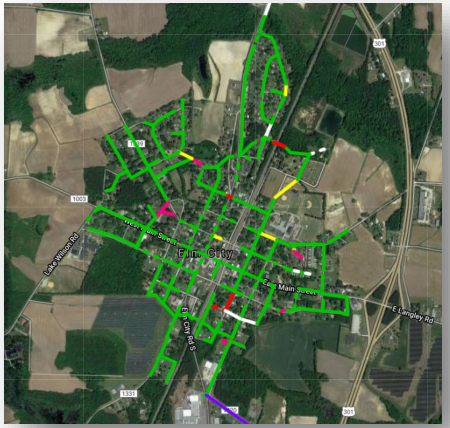
REHABILITATION

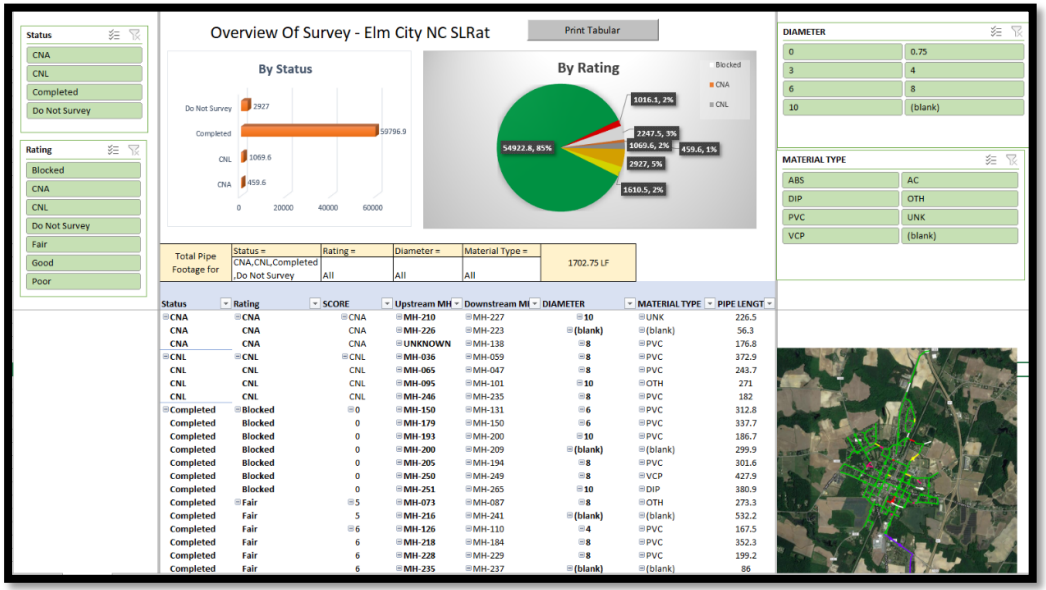
I&I Remediation

Do the right repair that makes the biggest impact to your system.



ACOUSTIC INSPECTION





Collapsed pipe

Root Blockage

PROOF: ITRACKING® I&I

Micro Detection Technology

WHAT: Three-Phase Pilot Project Data Collection Indicated:

- Utility had appropriated funds for CIPP lining due to surcharging in basin during rain events
- Data demonstrated that RDII was due to inflow directly during rain events
- Follow up smoke testing was performed and determined cause of excess I&I was from private illegal tie-ins.
- Those tie-ins have been remedied and utility has noticed significant reduction in capacity impacts during rain events

ANNISTON, ALABAMA

Microdetection Program
Completed May 2020