Agenda

- About the Speaker
- About Virginia Beach
- About Virginia Beach Public Utilities
- Implementation of Acoustic Technology
- Successes and Challenges
- Other applications for the technology

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About Me

- Virginia Licensed Engineer
- FOG Program Manager Since 2013
- Wet Well Cleaning Program Manager
- Hot-Spot & Acoustic Testing Program Manager
- Construction Project Manager
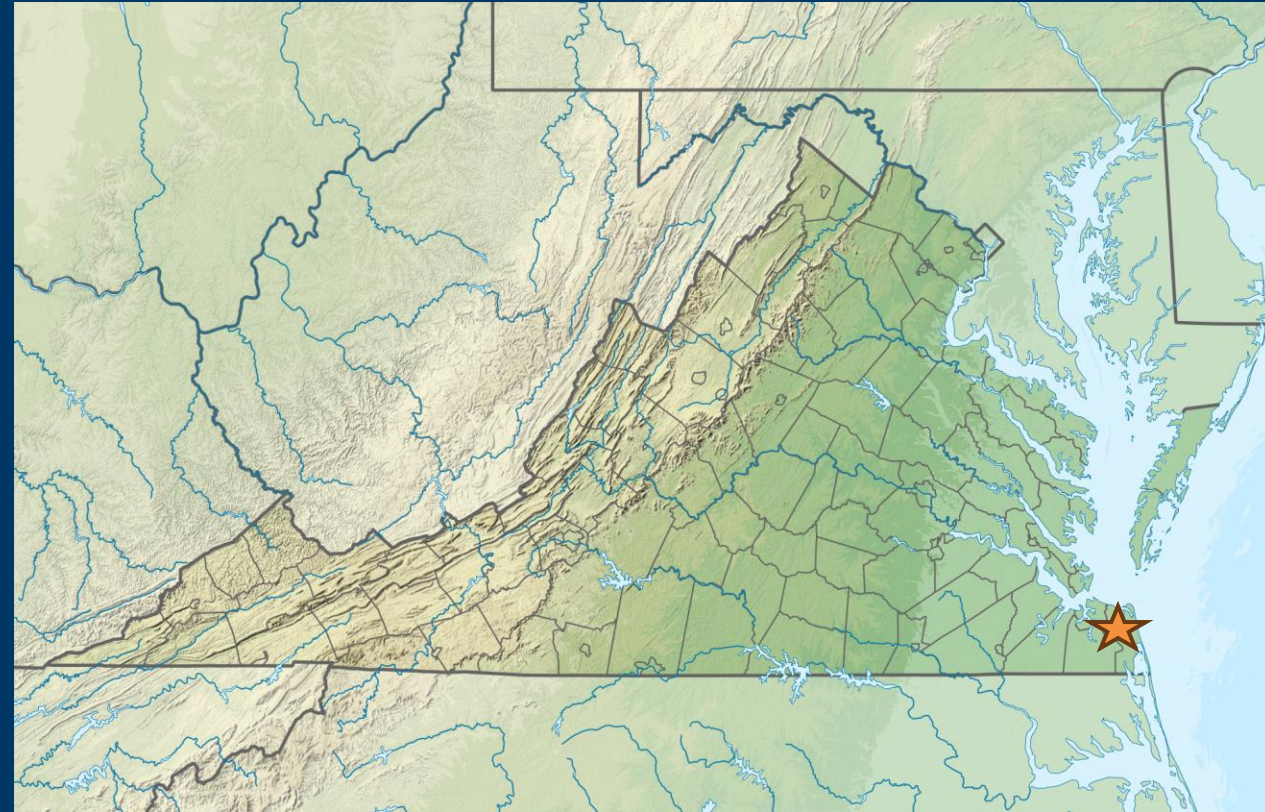- Application Programmer / Creator
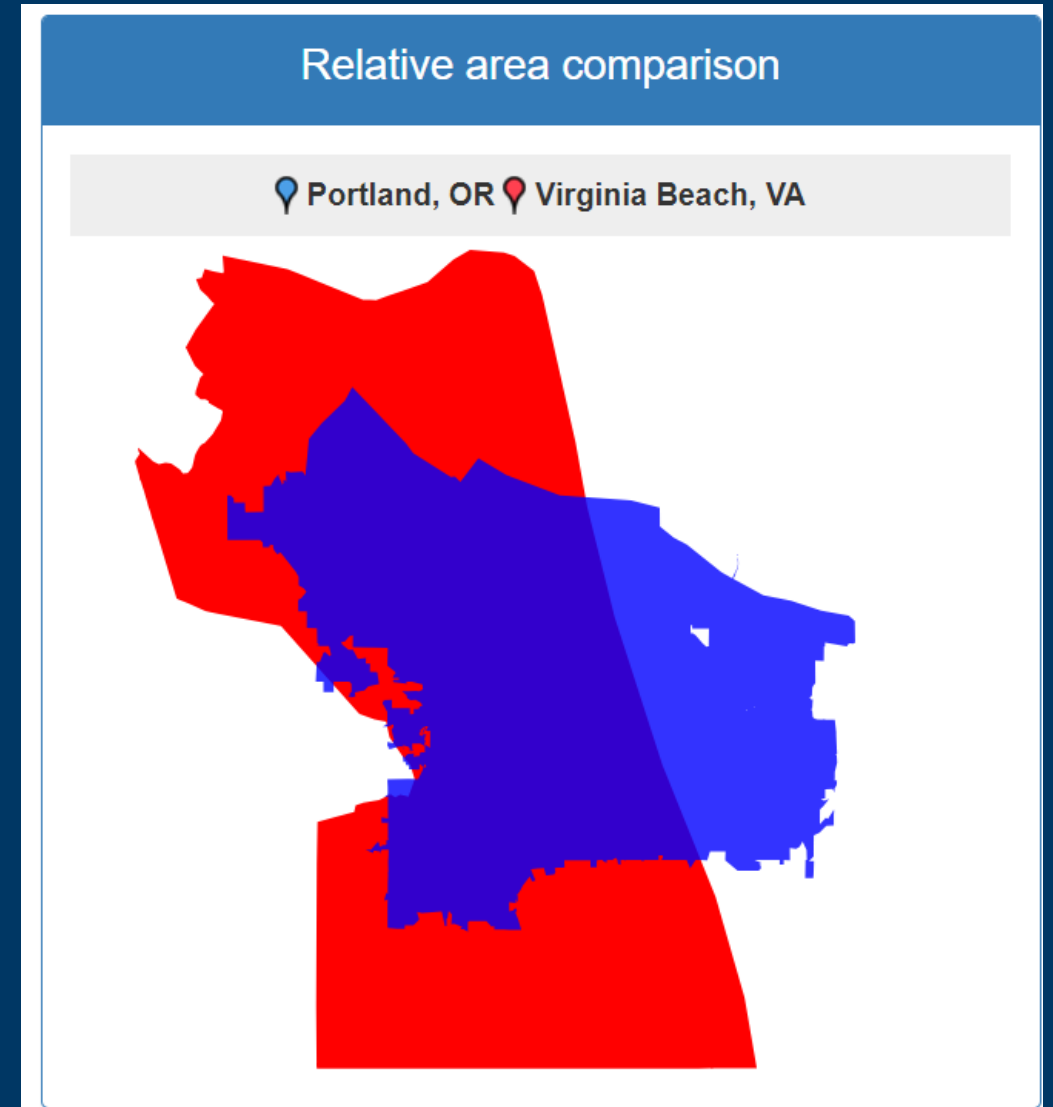
About Virginia Beach

About Virginia Beach

- ❑ Population of 459,000 people, making it the largest city in Virginia
- ❑ More than 190,000 households
- ❑ Median age of 37.1 years old
- ❑ Average commute time of 24 minutes
- ❑ 38 miles of beaches
- ❑ 23,000 acres of farmland

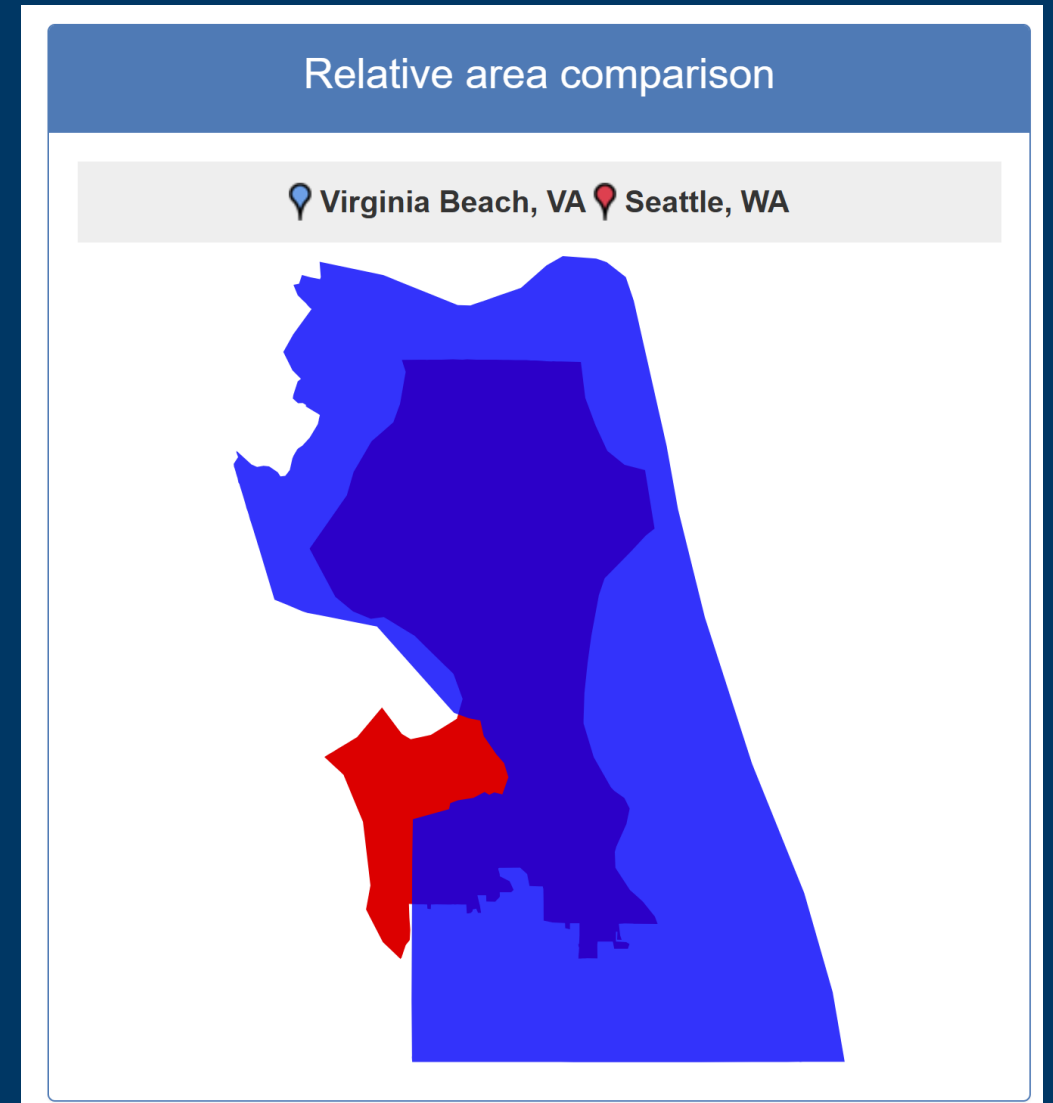CITY OF VIRGINIA BEACH
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About Virginia Beach

- Metropolitan Statistical Area (MSA) has the largest concentration of military personnel outside of the Pentagon representing every branch of the Armed Forces.
- Has 4th oldest lighthouse in the country
  - 1st Light house authorized by the U.S. Government and authorized by George Washington.
- English Settlers first landed where on the beaches where the lighthouse is built on their way to settle Jamestown.

Relative area comparison

📍 Portland, OR 📍 Virginia Beach, VA

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Relative area comparison

📍 Virginia Beach, VA 📍 Seattle, WA

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Virginia Beach Public Utilities

- 414 sewer pumping station
- 1,800 miles of sewer mains
- 32,000 sewer manholes

- 11 potable water storage tanks
- 8 potable water pump stations
- 2 raw water pump stations
- 1,700 miles of water distribution pipes
- 76 miles of Lake Gaston Water Supply Pipeline

- Do not own any drinking or wastewater treatment plants
- Distribution and collection system only

- CMOM Program Began in 2008

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Virginia Beach CMOM

- Capacity
- Management
- Operations
- Maintenance

Virginia Beach ~~C~~MOM

- ~~Capacity~~
- Management
- Operations
- Maintenance

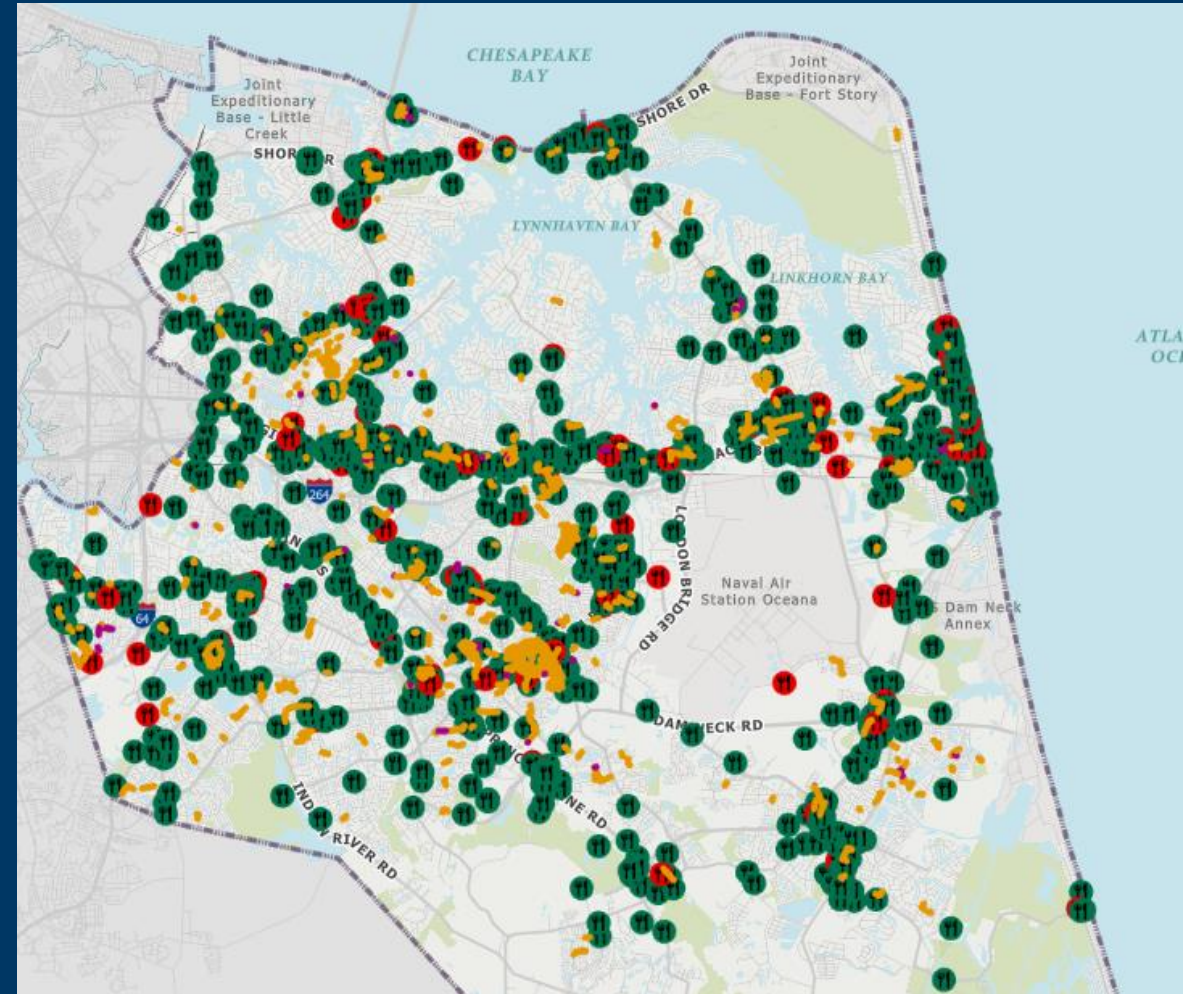CITY OF VIRGINIA BEACH
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Virginia Beach MOM Program

- SSO Resolution Program
- FOG Program
- Hot Spot Cleaning Program
- Root Control Program
- Sanitary Sewer Evaluation Survey (SSES) Program
- Wet Well Cleaning Program
- Force Main Assessment Program
- Flow Monitoring Program
- Odor Control Program

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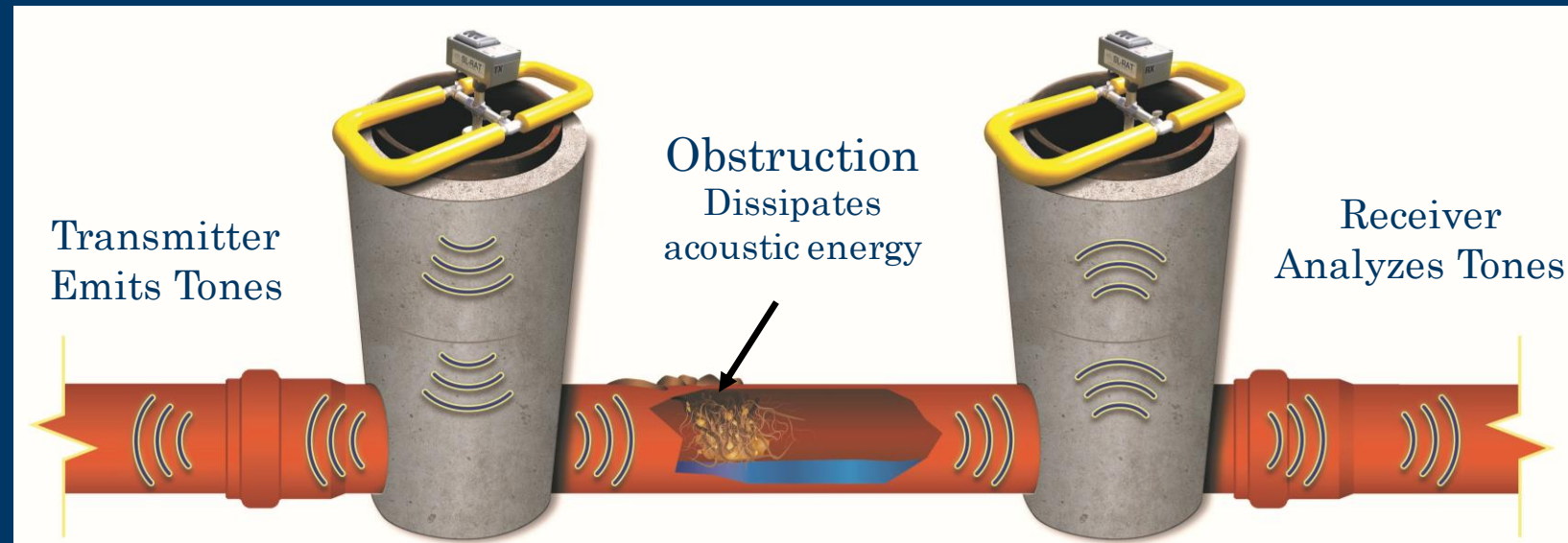
Virginia Beach FOG & Hot Spot Programs

- 1,500 FSEs

- 5 Cleaning Frequencies
  - 30,60,90,180,365 days
- About 910,000 linear feet (172 miles) cleaned per year from 1,578 segments
  - >75,000 linear feat per month (14.2 miles)
- Segments added but not removed
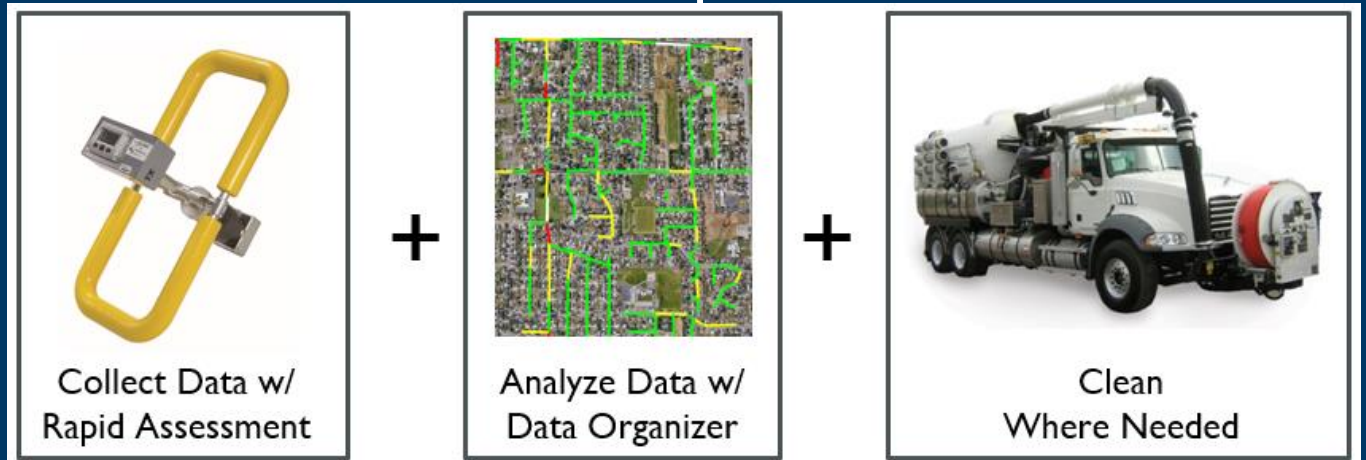- Not achievable or sustainable

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CITY OF VIRGINIA BEACH
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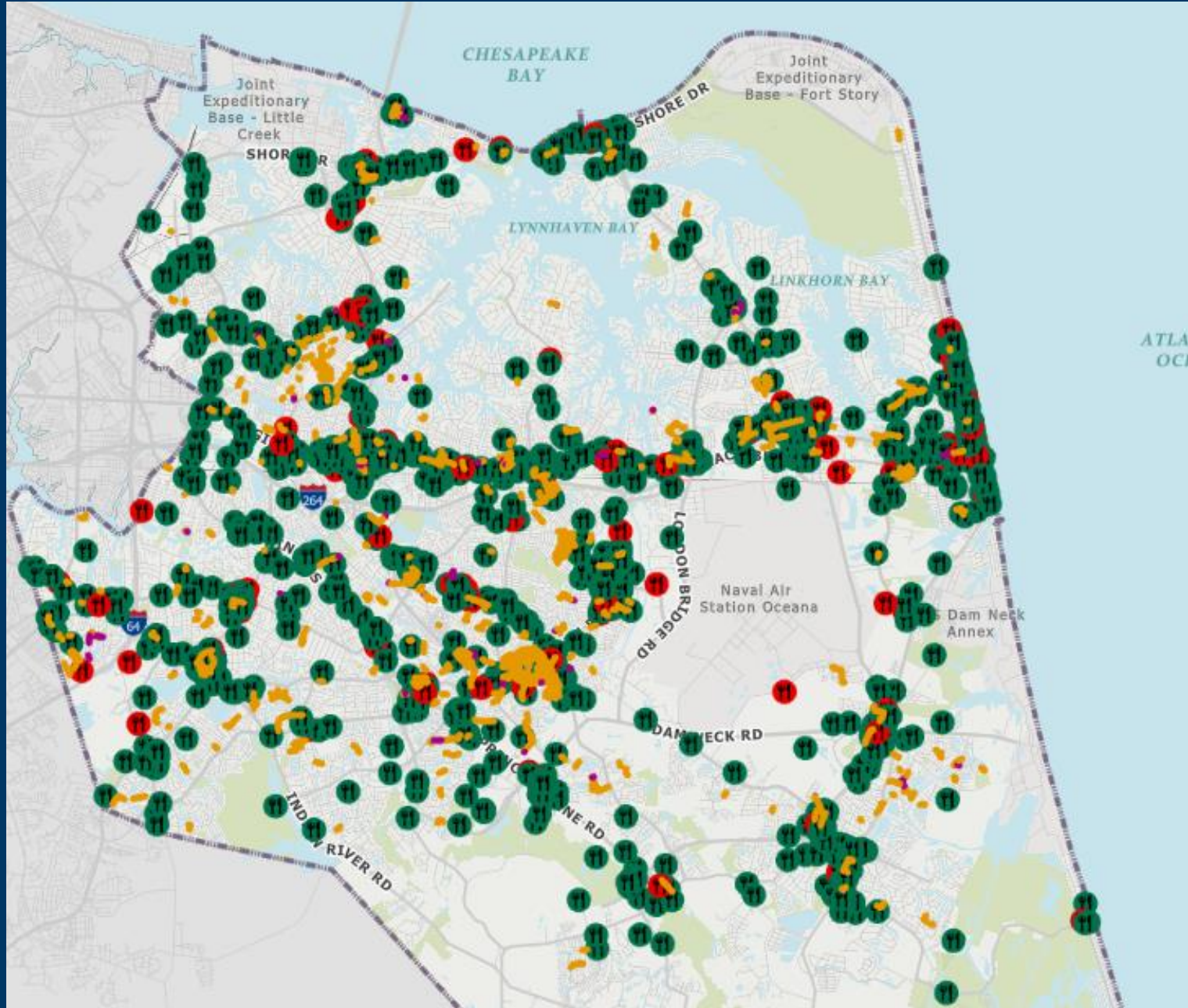
Virginia Beach Implements Acoustic Inspection Technology

- Acoustic Inspection → Clean → Acoustic Inspection ("clean" score)

- Monitor with Acoustic testing on cleaning frequency

- Set initial monitoring frequencies and only clean when needed

- Creates a score with a range from 0 to 10

- Began baselining in 2020

- Completed baselining 2022

Transmitter Emits Tones

Obstruction
Dissipates acoustic energy

Receiver Analyzes Tones

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Public Utilities

Goals from Acoustic Inspection

- Optimize Resources (Manpower and Equipment)
- Data collection and evaluation, to determine optimal frequencies
- Reduce Workload (Attain Monthly metrics)
- Maintain Regulatory Compliance
- Standardize Procedures
- Provide Analytical Evidence for Grease Interceptor Installation or Replacement

Collect Data w/
Rapid Assessment

+

Analyze Data w/
Data Organizer

+

Clean
Where Needed

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Initial Results

- >90% linear footage cleaning reduction
  - 910,000 to 60,000 per year
  - < 5,000 linear feet per month
  - 94 segments
- Nearly 500,000 linear feet moved from cleaning to acoustic monitoring
  - 1,383 segments
- 101 sewer segments removed form program
- Some Frequencies were adjusted

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Field Evaluation Process

- Run Inspection

- Decision Matrix
  - Appropriate action is determined by comparing the measured SL-RAT score to the previously established baseline.

- Enter value into CMMS Software

Previously Established Baseline Value	SL-Rat Reading										
	0	1	2	3	4	5	6	7	8	9	10
3											
4										B	
5											
6	A										
7									D		
8			C								
9											
10											

Procedure	
A	If First Reading, perform follow-up test and verify that the distance is correct, and devices are not too close together. If it is follow-up reading, call in line stoppage request to basecamp
B	If First Reading, perform follow-up test and verify that the distance is correct, and devices are not too close together. If it is follow-up reading, enter value into workorder
C	Enter value into workorder, create hotspot cleaning workorder for segment.
D	Record the score, move to next segment.

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Previously Established Baseline Value	SL-Rat Reading										
	0	1	2	3	4	5	6	7	8	9	10
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5											
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Office Evaluation

- Data collected in the field is uploaded to our CMMS.

- Power BI Dashboard linked to CMMS asset data.

- More user—friendly interface with individual sewer segment Information.

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EMPLOYEE ASSIGNED	Group Project	Reading Action	Total Work Orders Not Complete (Blank)
All	89015	Multiple selections	

Group Project #	WO #	Frequency	UNITID	UNITID2	EMPLOYEE ASSIGNED	Actual Pipe Length	SL-Rat Length	Created Date	Closed Date	BASELINE	SL-RAT SCORE	Reading Action
89015	2892039	180	504-160-C	504-159-M	3701	160.00	150	01-Jun-23	08-Jun-23	9	10	No Action Needed
89015	2892040	180	504-159-M	504-158-M	3701	300.00	350	01-Jun-23	08-Jun-23	5	6	No Action Needed
89015	2892041	180	504-013-U	504-161-M	3701	8.00	50	01-Jun-23	12-Jun-23	8	7	No Action Needed
89015	2892042	90	571-094-U	571-002-U	3701	123.00	150	01-Jun-23	05-Jun-23	8	8	No Action Needed
89015	2892045	90	571-003-M	571-094-U	3701	107.00	150	01-Jun-23	05-Jun-23	8	2	Create Cleaning Work Order
89015	2892047	90	120-003-U	120-002-U	3701	231.00	250	01-Jun-23	25-Jun-23	7	5	No Action Needed
89015	2892048	90	120-094-N	120-002-U	3701	150.00	150	01-Jun-23	25-Jun-23	6	7	No Action Needed
89015	2892050	90	546-008-M	546-0116-M	3701	16.00	50	01-Jun-23	06-Jun-23	7	6	No Action Needed
89015	2892052	90	243-0168-C	243-0180-U	21773	163.00	150	01-Jun-23	25-Jun-23	2	9	No Action Needed
89015	2892053	90	120-002-U	120-0107-M	3701	30.00	50	01-Jun-23	25-Jun-23	8	8	No Action Needed
89015	2892054	180	504-148-M	504-0235-U	3701	153.00	150	01-Jun-23	25-Jun-23	7	7	No Action Needed
89015	2892056	30	517-0314-M	517-0313-U	3701	27.00	50	01-Jun-23	25-Jun-23	5	1	Main Line Stoppage Call in Cleaning
89015	2892057	30	517-026-U	517-0314-M	3701	149.00	150	01-Jun-23	25-Jun-23	9	5	Create Cleaning Work Order
89015	2892059	180	504-170-U	504-0259-M	3701	13.00	50	01-Jun-23	25-Jun-23	7	7	No Action Needed
89015	2892060	180	504-0259-M	504-0258-M	3701	446.00	450	01-Jun-23	25-Jun-23	8	6	No Action Needed
89015	2892061	180	504-153-M	504-230-U	3701	66.00	150	01-Jun-23	25-Jun-23	10	9	No Action Needed
89015	2892062	180	504-230-U	504-152-U	3701	227.00	250	01-Jun-23	25-Jun-23	9	6	No Action Needed
89015	2892063	180	504-152-U	504-151-M	3701	166.00	250	01-Jun-23	26-Jun-23	9	8	No Action Needed
89015	2892065	90	530-004-U	530-056-M	3701	150.00	150	01-Jun-23	26-Jun-23	8	0	Main Line Stoppage Call in Cleaning
89015	2892066	90	120-0138-U	120-002-U	3701	191.00	250	01-Jun-23	25-Jun-23	8	6	No Action Needed
89015	2892068	90	120-045-C	120-0143-U	3701	221.00	250	01-Jun-23	25-Jun-23	8	7	No Action Needed
89015	2892070	90	345-354-M	345-353-M	3701	149.00	150	01-Jun-23	25-Jun-23	8	8	No Action Needed
89015	2892071	90	345-356-M	345-355-M	3701	45.00	50	01-Jun-23	25-Jun-23	7	8	No Action Needed

The Data

- Individual Sewer Segment Historical Data
    - Ability to drill-down and evaluate the inspection history of each individual sewer segment.
    - Example of how we have been able to avoid unnecessary cleaning. 90-day segment that hasn't needed cleaning over the past year.
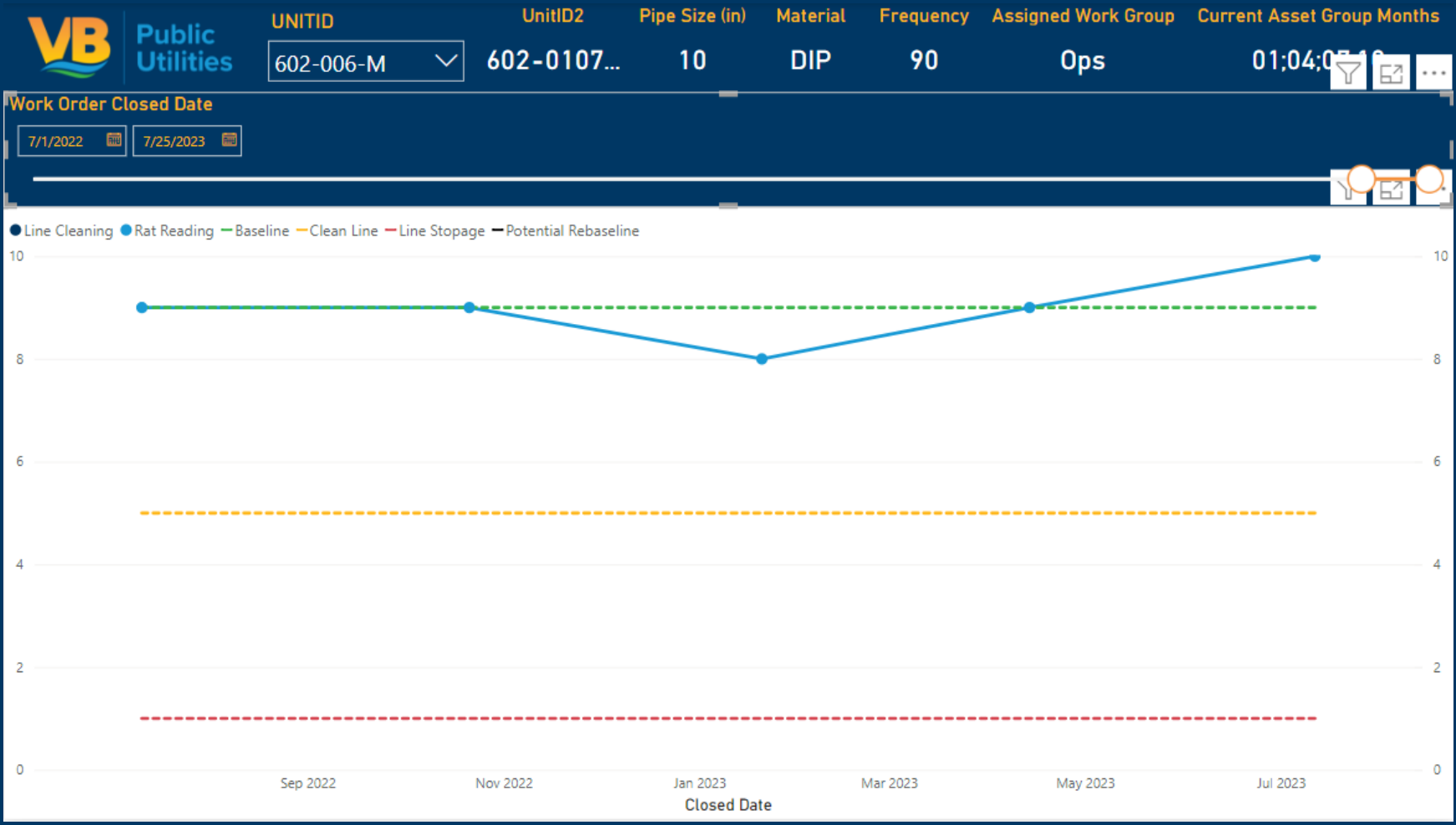
▸ Green – Baseline score

▸ Blue – Acoustic Inspection score

▸ Yellow – Schedule cleaning
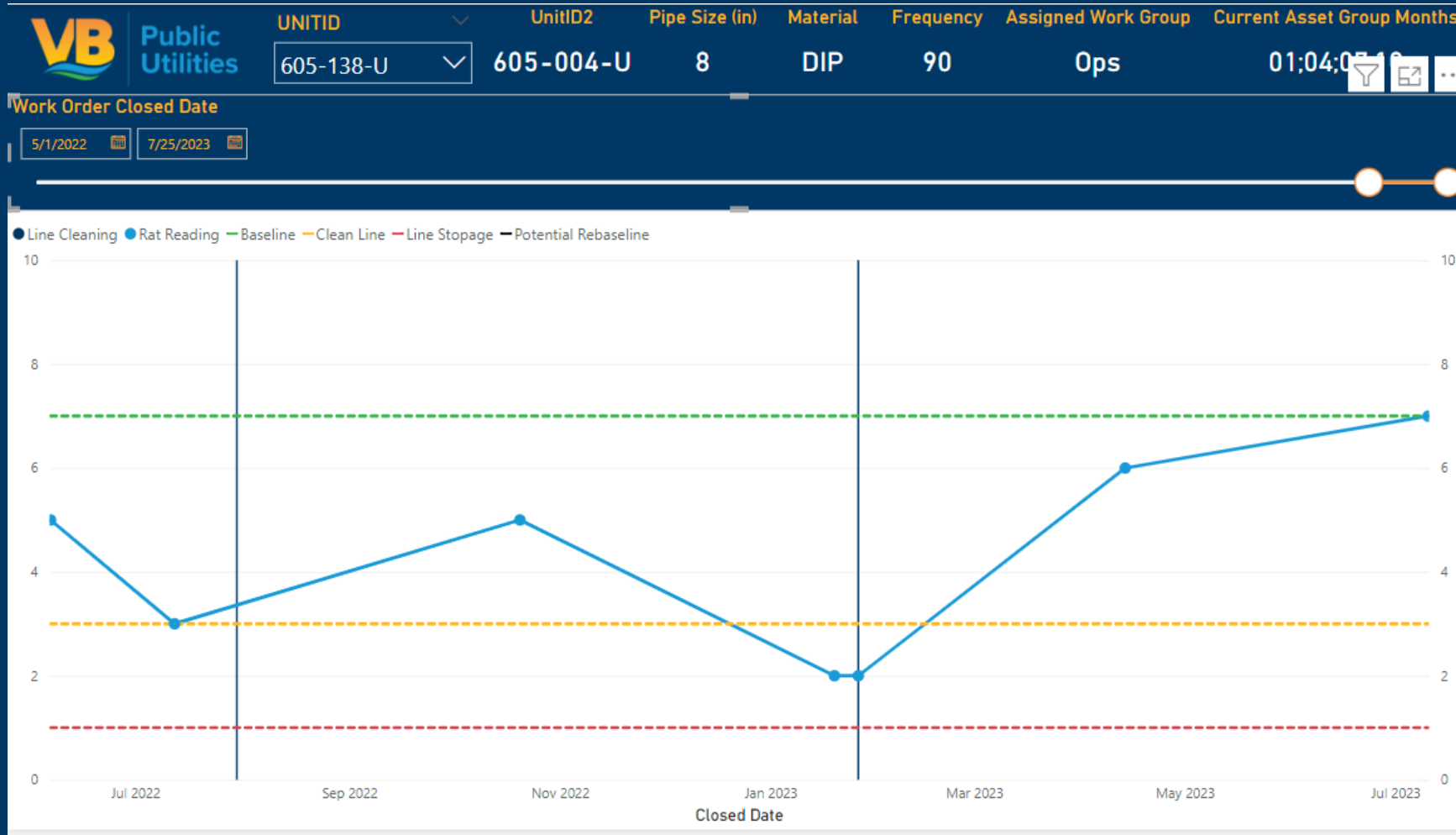
▸ Red – Mainline stoppage
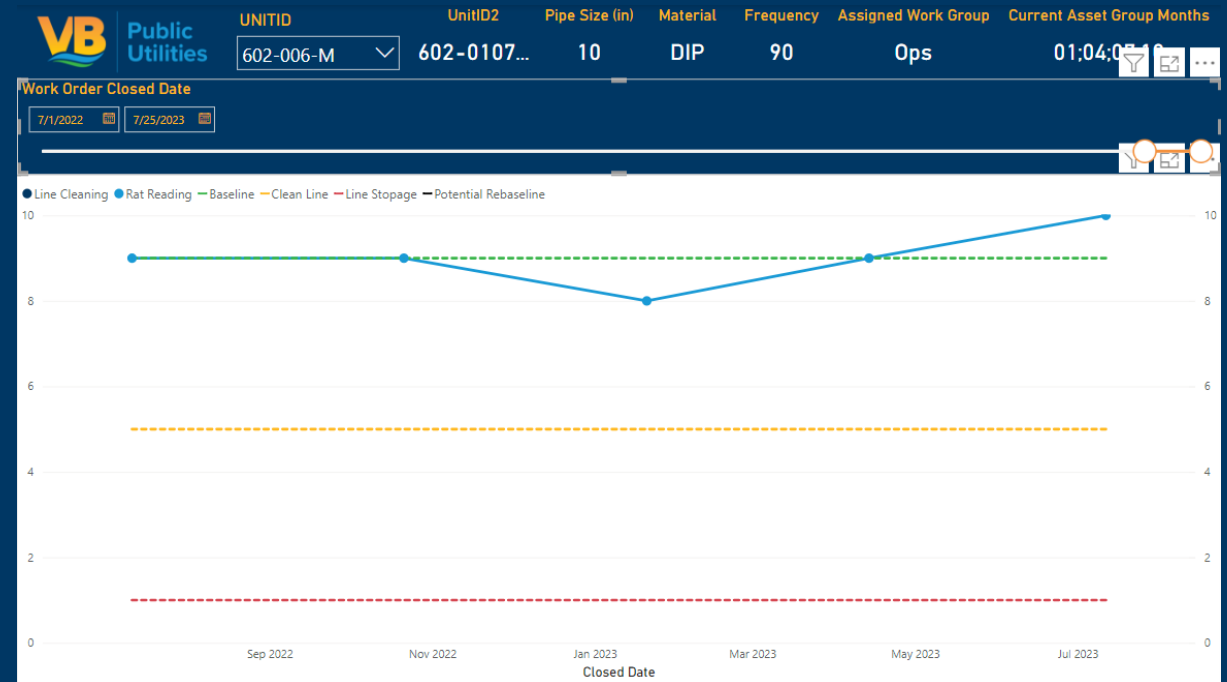
Green – Baseline score   Blue – Acoustic Inspection score

Yellow – Schedule cleaning   Red – Mainline stoppage

The Data

➤ Cleaning When Needed
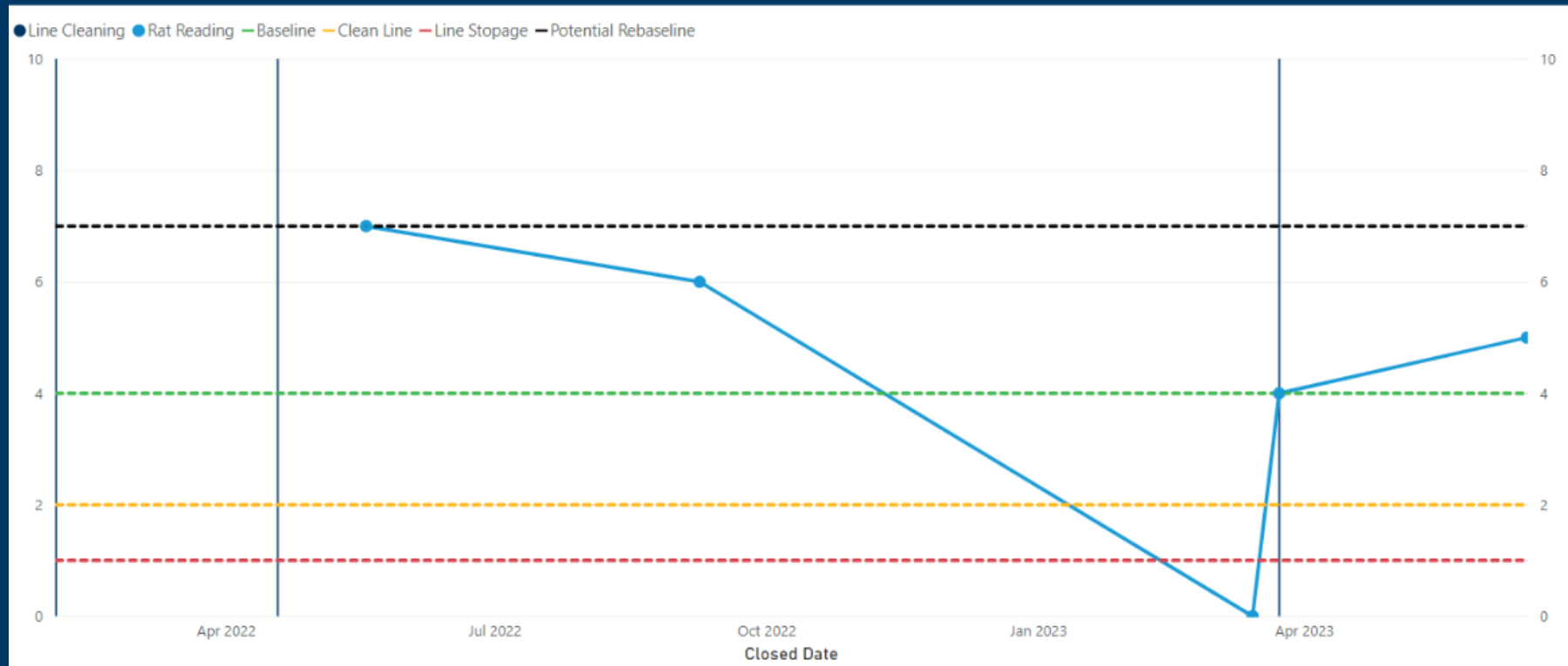- Vertical line indicates when a cleaning was performed

The Data

▸ Preventing SSOs

◦ Mainline Stoppage call made to Operations for immediate cleaning

The Data

Group Project #	Responsible Party	WO #	Frequency	UNITID	UNITID2	EMPLOYEE ASSIGNED	Actual Pipe Length	SL-Rat Length	Created Date	Closed Date	BASELINE	SL-RAT SCORE	Reading Action
89015	Ops	2892028	180	212-003-U	212-002-U	3701	309.00	350	01-Jun-23	20-Jun-23	7	0	Main Line Stoppage Call in Cleanir
89015	Ops	2892029	180	244-034-M	244-033-M	3701	298.00	350	01-Jun-23	20-Jun-23	9	0	Main Line Stoppage Call in Cleanir
89015	Ops	2891926	30	345-036-M	345-015-U	3701	237.00	250	01-Jun-23	15-Jun-23	10	0	Main Line Stoppage Call in Cleanir
89015	Ops	2891942	180	515-103-U	515-007-U	3701	239.00	250	01-Jun-23	08-Jun-23	2	0	Main Line Stoppage Call in Cleanir
89015	Ops	2892056	30	517-0314-M	517-0313-U	3701	27.00	50	01-Jun-23	25-Jun-23	5	1	Main Line Stoppage Call in Cleanir
89015	Ops	2892065	90	530-004-U	530-056-M	3701	150.00	150	01-Jun-23	26-Jun-23	8	0	Main Line Stoppage Call in Cleanir
89015	Ops	2892021	90	546-005-M	546-004-U	3701	234.00	250	01-Jun-23	08-Jun-23	6	1	Main Line Stoppage Call in Cleanir
89015	Ops	2892022	90	546-006-M	546-005-M	3701	243.00	250	01-Jun-23	06-Jun-23	7	0	Main Line Stoppage Call in Cleanir
89015	Ops	2892023	90	546-007-M	546-006-M	3701	257.00	250	01-Jun-23	06-Jun-23	8	0	Main Line Stoppage Call in Cleanir

Indication of where a sewer rehab project may be needed to prevent future blockages.

End of Year One Results

- Data confirms the initial positive results.
- Significant Cleaning Reduction
  - 90.4% - No Action Needed/Potential Re-Baseline/Baseline Needed
  - 5.2% - Mainline Stoppage
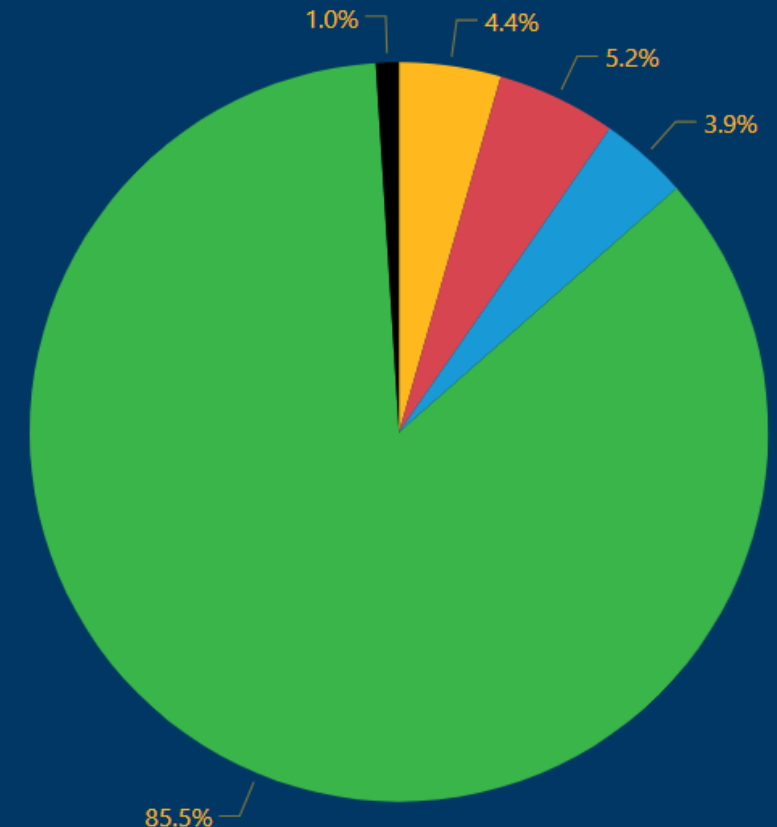 - 4.4% - Create Cleaning Work Order

Number of Work Orders Completed by Operations
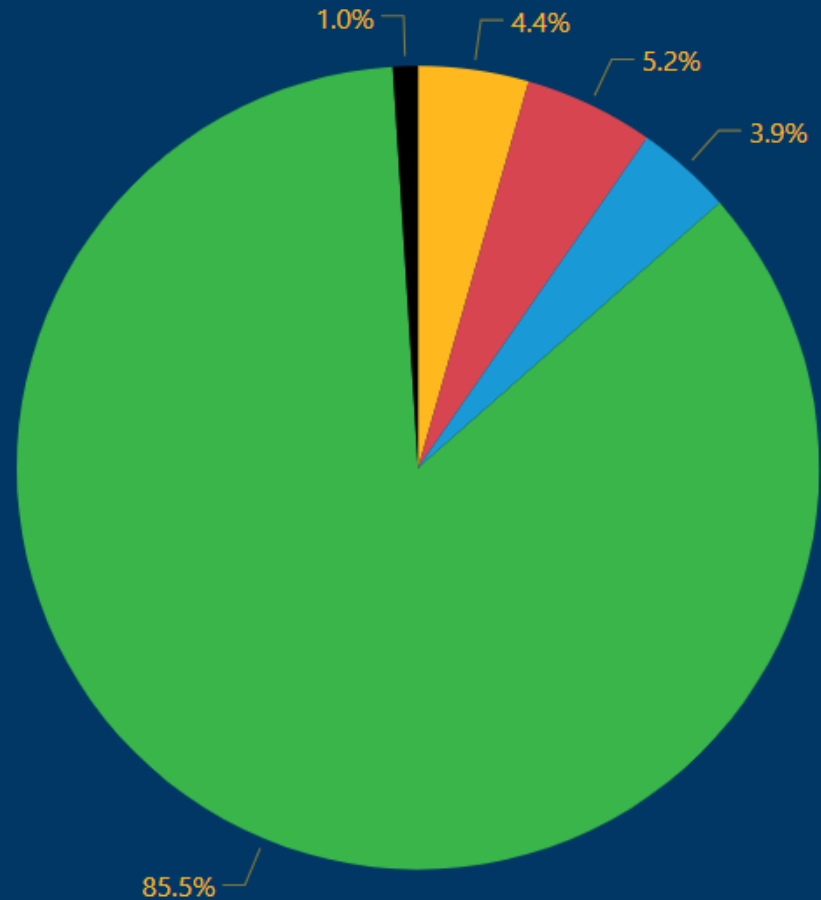
3465

Work Order Outcome

Reading Action
- No Action Needed
- Main Line Stoppage Call in Cleaning
- Create Cleaning Work Order
- Need Baseline
- Potential Rebaseline

Pie chart values: 85.5%, 1.0%, 4.4%, 5.2%, 3.9%

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Number of Work Orders Completed by Operations

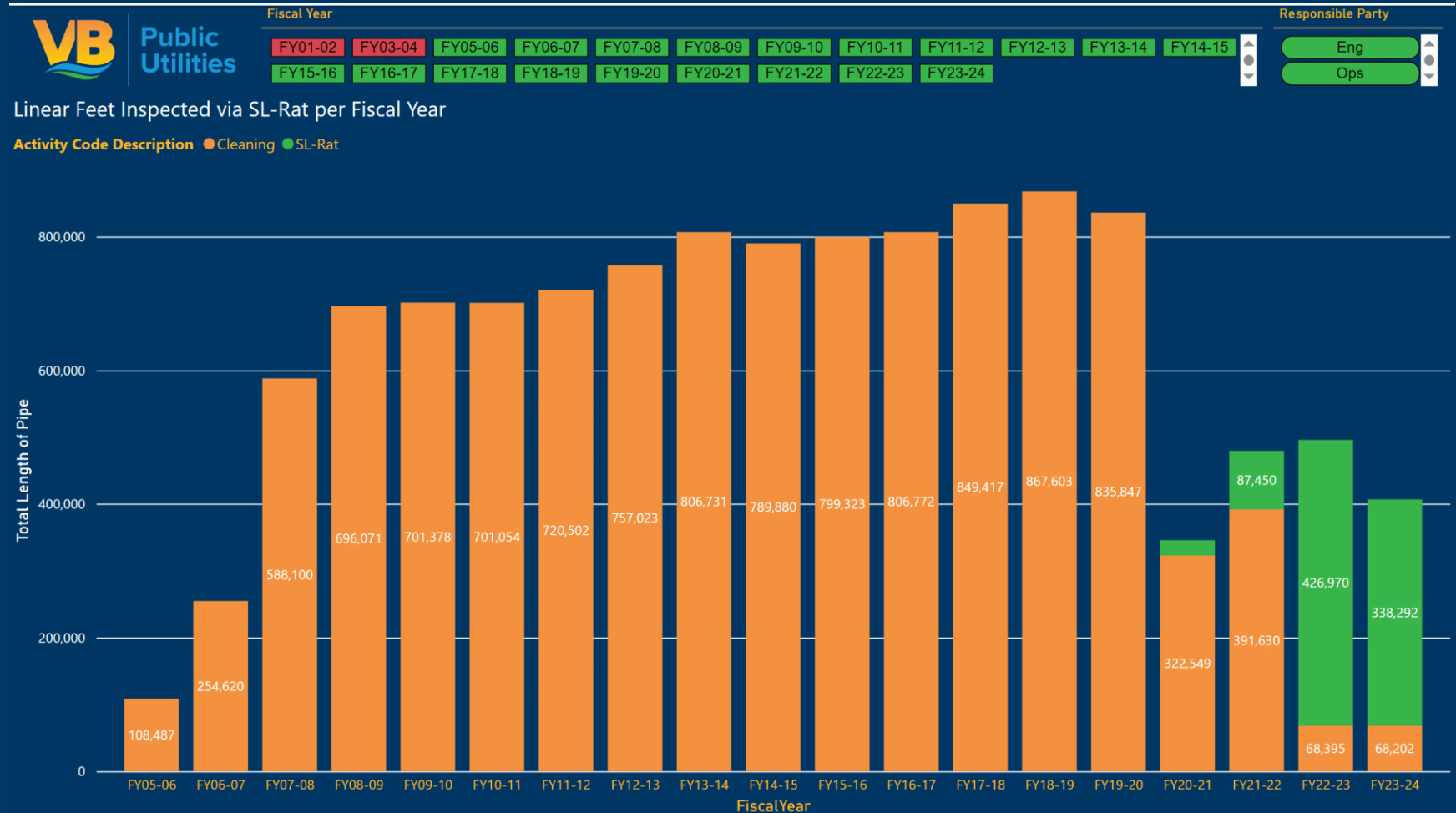**3465**
Work Order Outcome

1.0%   4.4%   5.2%   3.9%

85.5%

Reading Action
- No Action Needed
- Main Line Stoppage Call in Cleaning
- Create Cleaning Work Order
- Need Baseline
- Potential Rebaseline

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End of Year One Results

Activity Code Description ●Cleaning ●SL-Rat
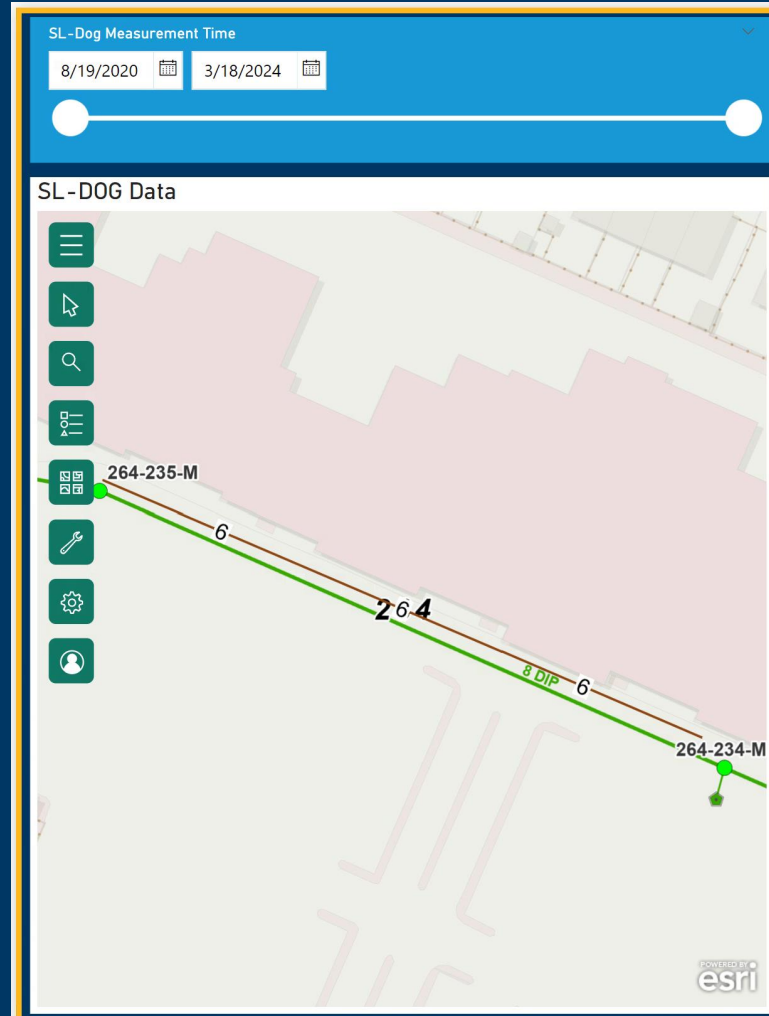
- Significant Resource Reduction

Year 2 Results so far

- Continued Reduction in cleaning
- More Find and Fix projects discovered
- Some segments changed back to cleaning only
  - Sags
  - Bad Hydraulics
- Reduced Reading Frequency
  - Current Potential
    - 92 segments for 39,000 LF

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QA/QC

- Used to ensure confidence in our data

- Used to also correct any data entry errors

SL-Dog Measurement Time

8/19/2020   3/18/2024

Hansen WO Closed Date

9/13/2023   4/2/2024

UNITID

264-234-M

SL-Rat Unit Number

All

SL-DOG Data

264-235-M

6

2 6 4

8 DIP   6

264-234-M

Hansen SL-Rat Work Orders

UNITID	UNITID2	WO #	Closed Date	SL-Rat Reading Number	SL-Rat Unit	SL-Rat Score	Actual Pipe Length	SLRat Eval Length
264-234-M	264-235-M	2955380	3/7/2024 3:49:41 PM	3,306		6	380	450
264-234-M	264-235-M	2948820	2/7/2024 8:49:01 AM	704	001184	7	380	450
264-234-M	264-235-M	2919745	10/10/2023 2:22:50 PM	2,973	001282	6	380	450
264-234-M	264-235-M	2930463	11/7/2023 1:59:34 PM	3,119	001282	6	380	450
264-234-M	264-235-M	2933949	12/4/2023 2:36:21 PM	3,218	001282	6	380	450
264-234-M	264-235-M	2942481	1/3/2024 8:42:34 AM	535	001282	6	380	450

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SL-Dog Measurement Time

8/19/2020 — 3/18/2024

Hansen WO Closed Date

9/13/2023 — 4/2/2024

UNITID

264-234-M

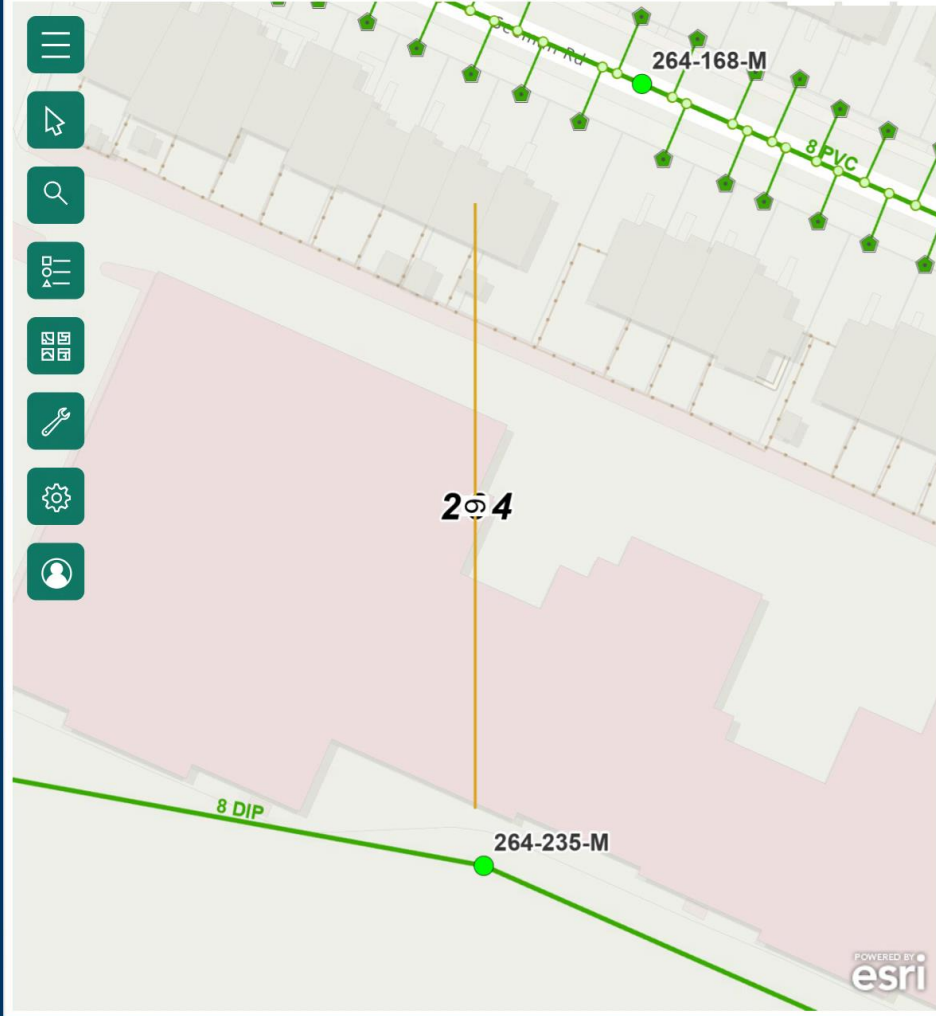## SL-Rat Unit Number

All

SL-DOG Data

264-168-M

8 PVC

264

8 DIP

264-235-M

POWERED BY esri

Hansen SL-Rat Work Orders

UNITID	UNITID2	WO #	Closed Date	SL-Rat Reading Number	SL-Rat Unit	SL-Rat Score	Actual Pipe Length	SLRat Eval Length
264-234-M	264-235-M	2955380	3/7/2024 3:49:41 PM	3,306		6	380	450
264-234-M	264-235-M	2948820	2/7/2024 8:49:01 AM	704	001184	7	380	450
264-234-M	264-235-M	2919745	10/10/2023 2:22:50 PM	2,973	001282	6	380	450
264-234-M	264-235-M	2930463	11/7/2023 1:59:34 PM	3,119	001282	6	380	450
264-234-M	264-235-M	2933949	12/4/2023 2:36:21 PM	3,218	001282	6	380	450
264-234-M	264-235-M	2942481	1/3/2024 8:42:34 AM	535	001282	6	380	450

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SL-DOG Data

622-002-U
10 DIP
8 DIP
10 DIP
8 DIP
8 DIP
6 8 2
622-003-U

Powered by esri

Hansen SL-Rat Work Orders

UNITID	UNITID2	WO #	Closed Date	SL-Rat Reading Number	SL-Rat Unit	SL-Rat Score	Actual Pipe Length	SLRat Eval Length
264-234-M	264-235-M	2955380	3/7/2024 3:49:41 PM	3,306		6	380	450
264-234-M	264-235-M	2948820	2/7/2024 8:49:01 AM	704	001184	7	380	450
264-234-M	264-235-M	2919745	10/10/2023 2:22:50 PM	2,973	001282	6	380	450
264-234-M	264-235-M	2930463	11/7/2023 1:59:34 PM	3,119	001282	6	380	450
264-234-M	264-235-M	2933949	12/4/2023 2:36:21 PM	3,218	001282	6	380	450
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Successes & Challenges

- Successes
  - Operations Staff Buy-in
  - ~90% Cleaning Reduction
  - Only Cleaning when Needed
  - Minimize SSOs – No Repeat SSOs

- Challenges
  - CNA/CNL Manholes & Traffic Control
  - Wet Well Influent Lines
  - Data QA/QC:
    - Curious results (low baseline – high scores)
    - Data Transfer Issues (field application to CMMS)
    - Data Entry (human error)

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Success is leading to other use cases

- Used to verify that a Wet Well Wizard device does not negatively impact our gravity system

- Potential to use for Root Control QA/QC

- Operations wants to use this as periodic service area preventative maintenance

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Questions