



Long Term Maintenance Done Right: Inspection, Assessment, & Construction Activities

Steve Perdios & Miles Bateman

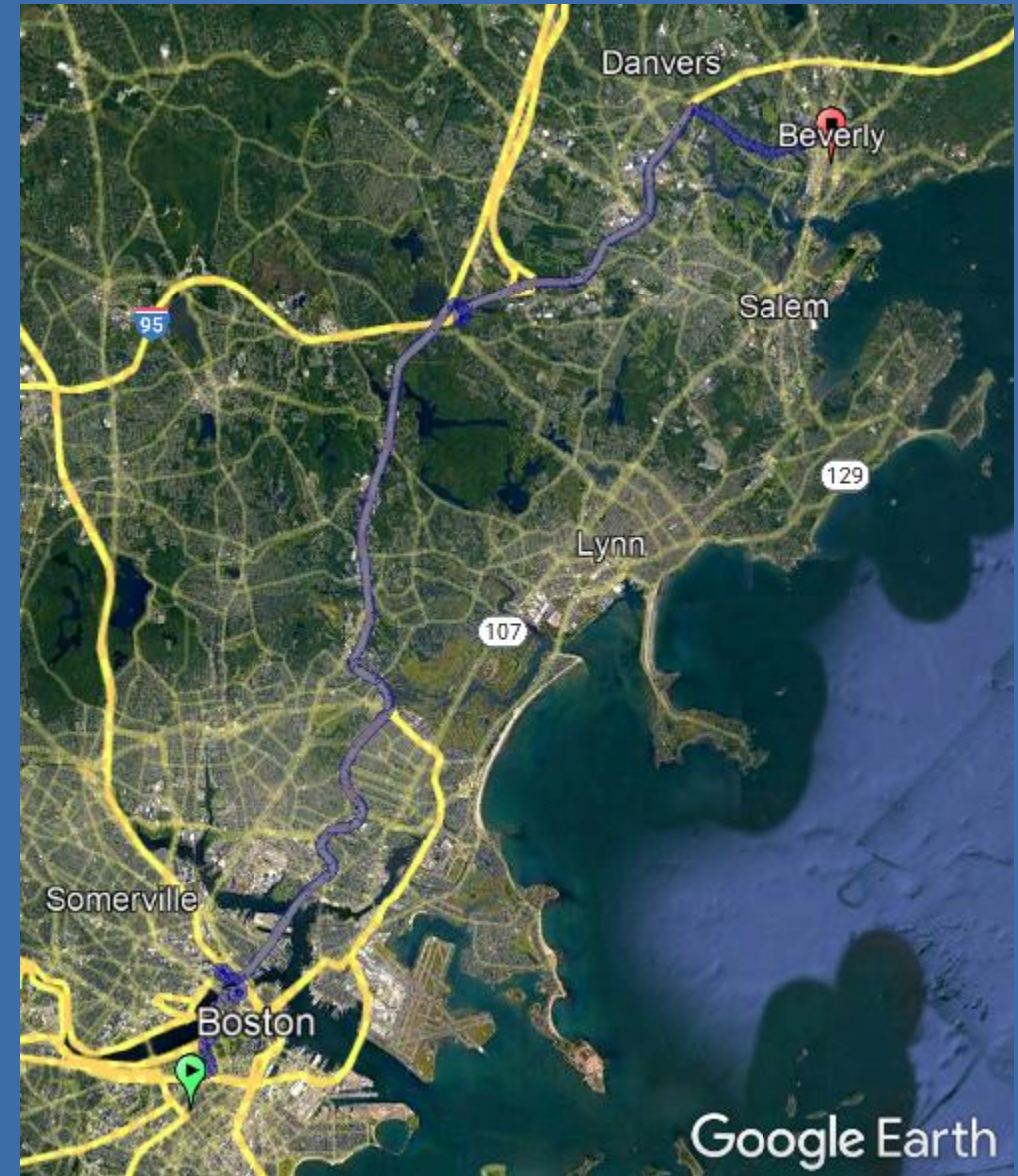
January 2023

Partners

- City of Beverly, Massachusetts
- Mike Collins, PE – Commissioner of Public Services and Engineering
- Eric Barber, PE – City Engineer
- National Water Main
- Flow Assessment Services

Location Description

- City of Beverly, Massachusetts
- Located in NE Massachusetts
~23 miles North of Boston
- Population: 42,000
- Size: 22.6 sq mi
- Population Density: 2,800/sq mi
- City incorporated in 1668



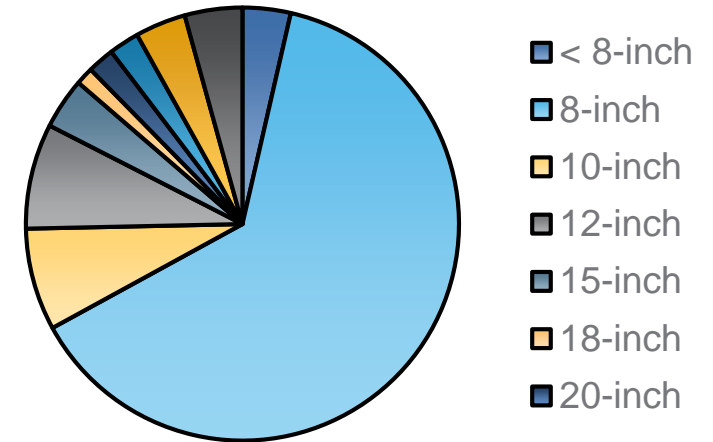
Agenda

- Background Information
- Approach - Data Collection, Design, and Construction
- Sewer Improvement Plan Development
- Recently Completed and Ongoing Projects
- Next Steps & Conclusion
- Q/A

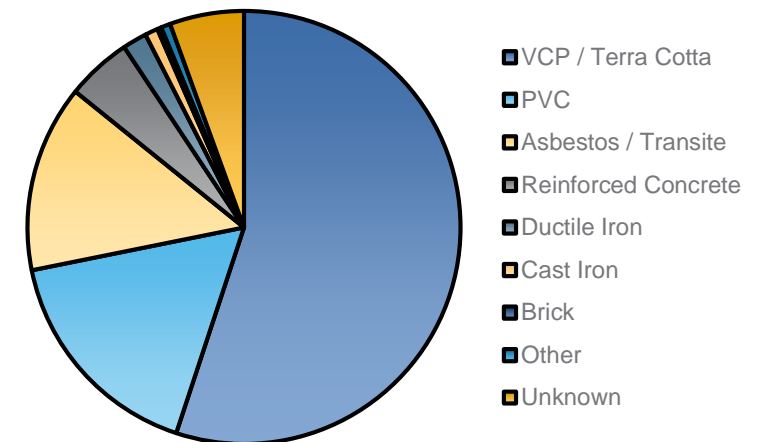
Sewer System Description

- Separated System
- Gravity Main – 743,000 LF
- Manholes – 4,160
- Service Laterals – 11,000+
- Subsystems – 29
- Mostly Installed in Early-1900s
- Aging Infrastructure

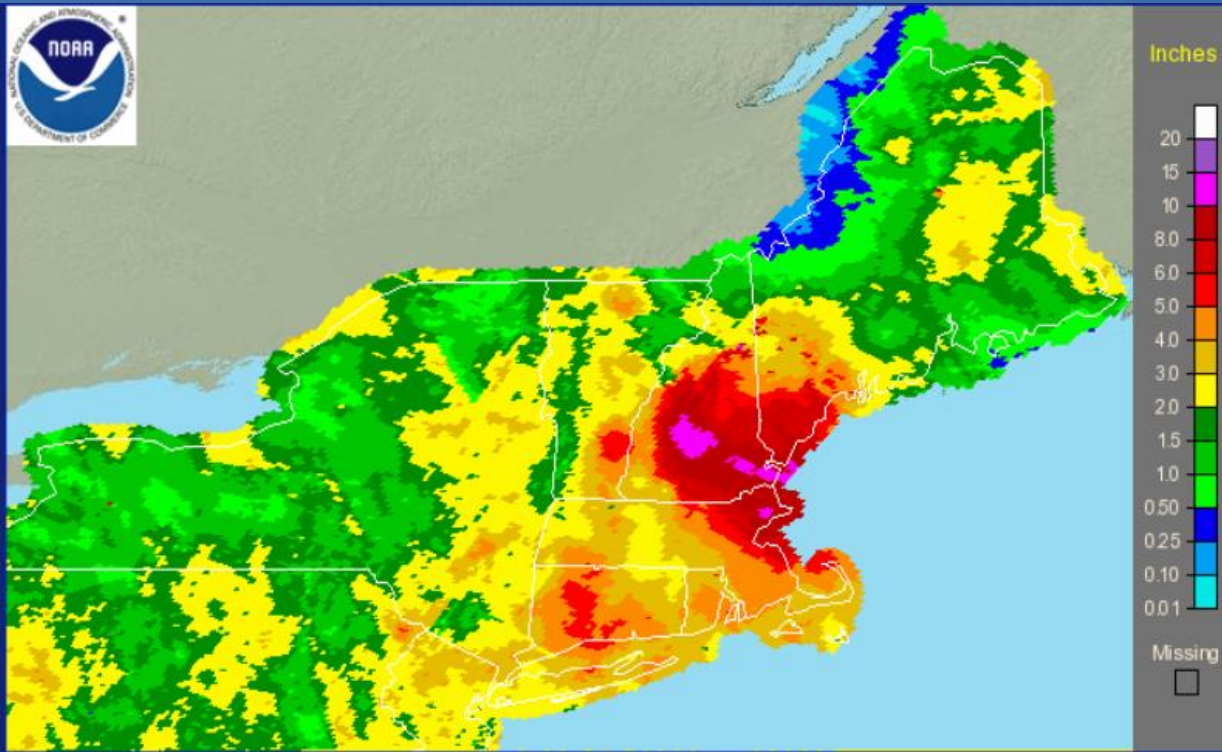
Gravity Main
Size Breakdown



Gravity Main
Material Breakdown




Mother's Day Storm



- Major Flood Event for New England, especially North Shore
- May 12-15, 2006
- Additional Rainfall on May 17th
- Total Precipitation in Beverly: 11+ inches
- 4 - 40

New England Deluged by Worst Flooding in Decades

 Give this article



By **Katie Zezima**

May 16, 2006



After days of record rainfall in Maine, Massachusetts and New Hampshire, thousands of residents have evacuated their homes. In Peabody, Mass., north of Boston, a couple relied on the buddy system.

Brian Snyder/Reuters

City of Beverly Hit Hard



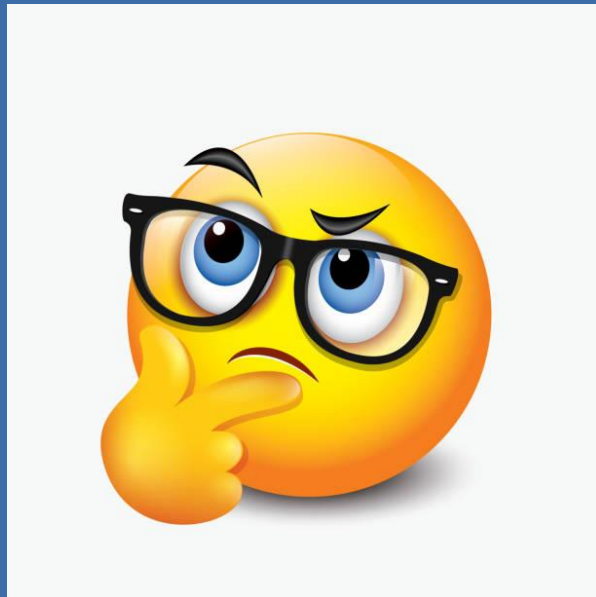
- Major Impacts to City's Sewer & Drainage System
 - Sanitary Sewer Overflows (SSOs)
 - Residential Backups
 - Street & Basement Flooding
- Subsystem M completely overwhelmed

Response in Subsystem M

- Field Investigations
 - Manhole Inspections
 - Flow Isolation
- Construction Contract
 - Clean & CCTV Sewer Mains & Laterals in Subsystem
 - Rehabilitate Sewer Mains, Laterals, and Manholes
- Private Inflow Inspections



Where to Next?



Inflow/Infiltration Capital Improvements Program:

- Partial SSES completed in 1995
- MassDEP Directive
 - 314 CMR 12.00 (revised April 2014)
 - Required sewer authorities to submit an I/I plan by December 31, 2017
- Goals:
 - Prevent sanitary sewer overflows
 - Reduce inflow and infiltration
 - Increase service reliability

City of Beverly, Massachusetts



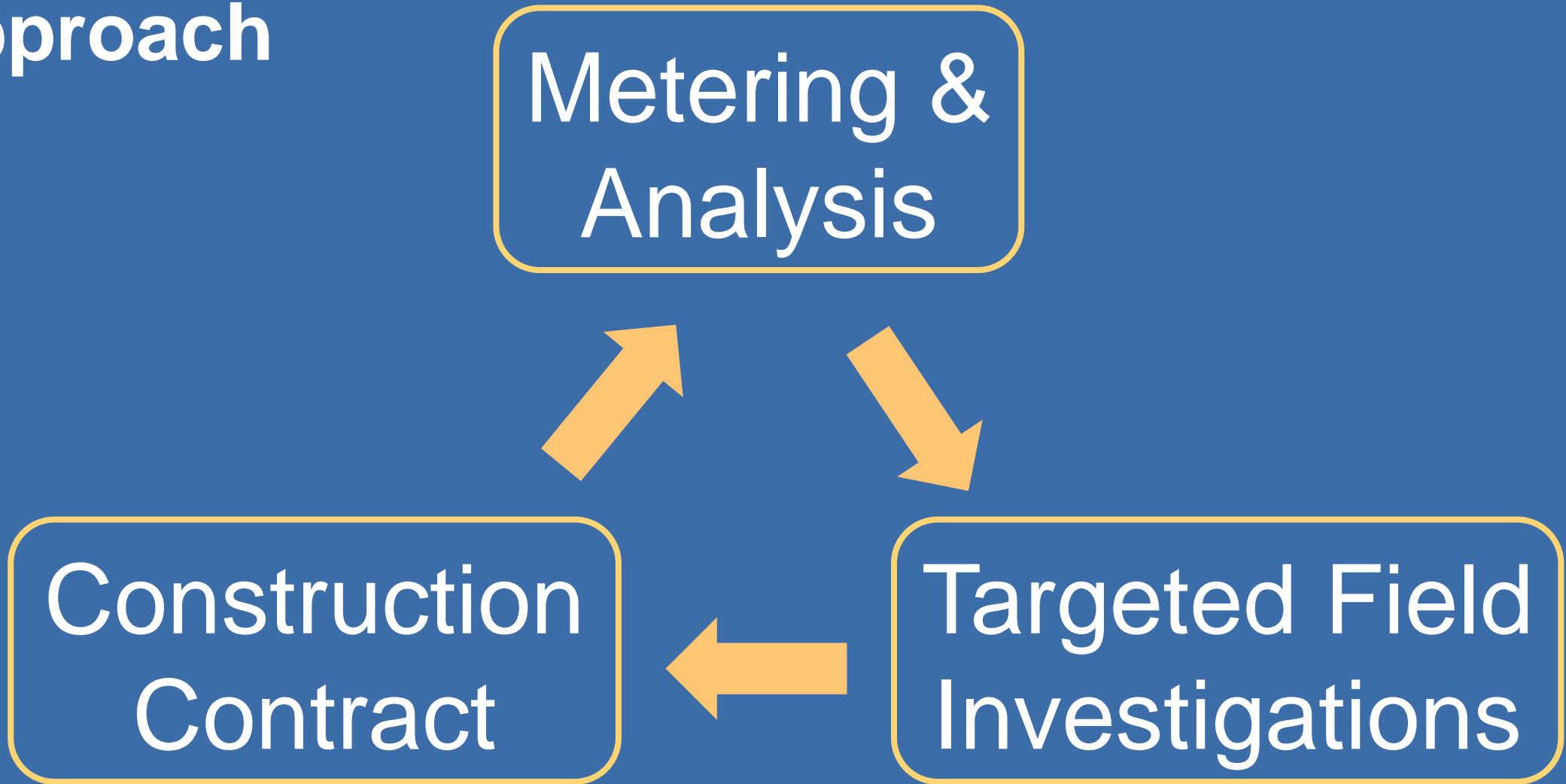
Report on Recent and Proposed Infiltration and Inflow and Sewer System Evaluation Activity

Submitted to:

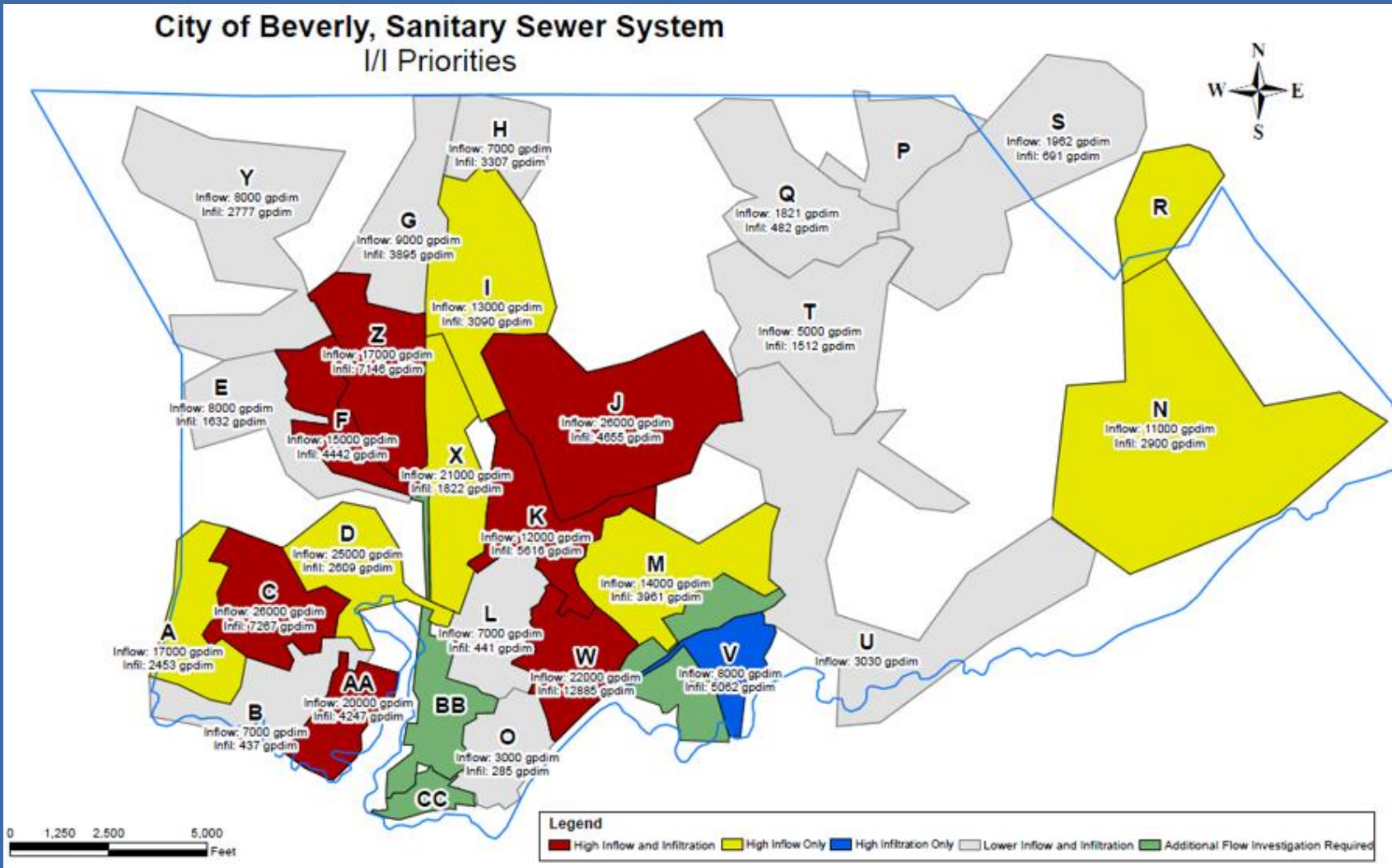
Massachusetts Department of Environmental Protection

December 2017

Approach



Step 1: System-wide Flow Monitoring



Step 2: Subsystem Ranking

Metered Subsystem	Infiltration Rank	Infiltration GPD/IDM	Inflow Rank	Inflow GPD/IDM
W	1	12,885	5	22,231
V-2	2	11,450	6	21,117
C	3	7,267	2	26,192
BB-2**	4	7,200	26	5,353
Z	5	7,146	10	17,248
V-1	6	6,829	1	39,706
K	7	5,616	14	12,218
CC-2	8	5,420	17	8,113
V	9	5,062	21	7,606
J	10	4,655	3	26,067
F	11	4,442	11	14,992
AA	12	4,247	8	19,775
M	13	3,961	12	13,956
G	14	3,895	16	9,460
H	15	3,307	23	6,533
I	16	3,090	13	12,959

Metered Subsystem	Infiltration Rank	Infiltration GPD/IDM	Inflow Rank	Inflow GPD/IDM
N	17	2,900	15	10,514
Y	18	2,777	18	7,902
D	19	2,609	4	24,845
A	20	2,453	9	17,337
U	21	1,991	19	7,805
X	22	1,822	7	21,003
BB-1**	23	1,779	27	3,948
E	24	1,632	20	7,631
T/P	25	1,512	25	5,413
CC-1	26	771	31	N/A
S	27	691	29	1,962
Q	28	482	30	1,821
L	29	441	24	6,524
B	30	437	22	7,017
O	31	285	28	2,593

Step 3: Take Action

Metered Subsystem	Infiltration Rank	Infiltration GPD/IDM	Inflow Rank	Inflow GPD/IDM	Clean and CCTV	MH Inspections	Flow Isolation	Smoke Testing	Private Inflow Investigation*	Design Sewer Rehabilitation	Construct Sewer Rehabilitation
W	1	12,885	5	22,231	Complete 2019-2020	Complete 2018	Complete 2018	Complete 2018	Partial Complete 2019-2022	Complete 2018	Ongoing
V-2	2	11,450	6	21,117	Ongoing	Ongoing		Complete 2020			
C	3	7,267	2	26,192	Complete 2019-2020	Complete 2020	Complete 2020	Complete 1993	Partial Complete 2019-2022	Ongoing	
BB-2**	4	7,200	26	5,353	Ongoing	Ongoing					
Z	5	7,146	10	17,248							
V-1	6	6,829	1	39,706	Ongoing	Ongoing		Complete 2020			
K	7	5,616	14	12,218	Complete 1994	Complete 1993	Complete 1993				
CC-2	8	5,420	17	8,113							
V	9	5,062	21	7,606	Ongoing	Ongoing		Complete 2020			
J	10	4,655	3	26,067	Complete 1994	Complete 2017	Complete 2017	Complete 1993	Partial Complete 1993-1994		
F	11	4,442	11	14,992	Complete 1995	Complete 1993	Complete 1993	Complete 1993	Partial Complete 1993-1994		
AA	12	4,247	8	19,775	Partial Complete (Bass St PS Area) 2020						
M	13	3,961	12	13,956	Complete 2015-2016	Complete 2014	Complete*** 2021	Complete 1993	Partial Complete 2016-2019	Complete 2014-2015	Complete 2015-2017
G	14	3,895	16	9,460		Complete 1993	Complete 1994				
H	15	3,307	23	6,533							
I	16	3,090	13	12,959	Complete 1994	Complete 1993	Complete 1993				

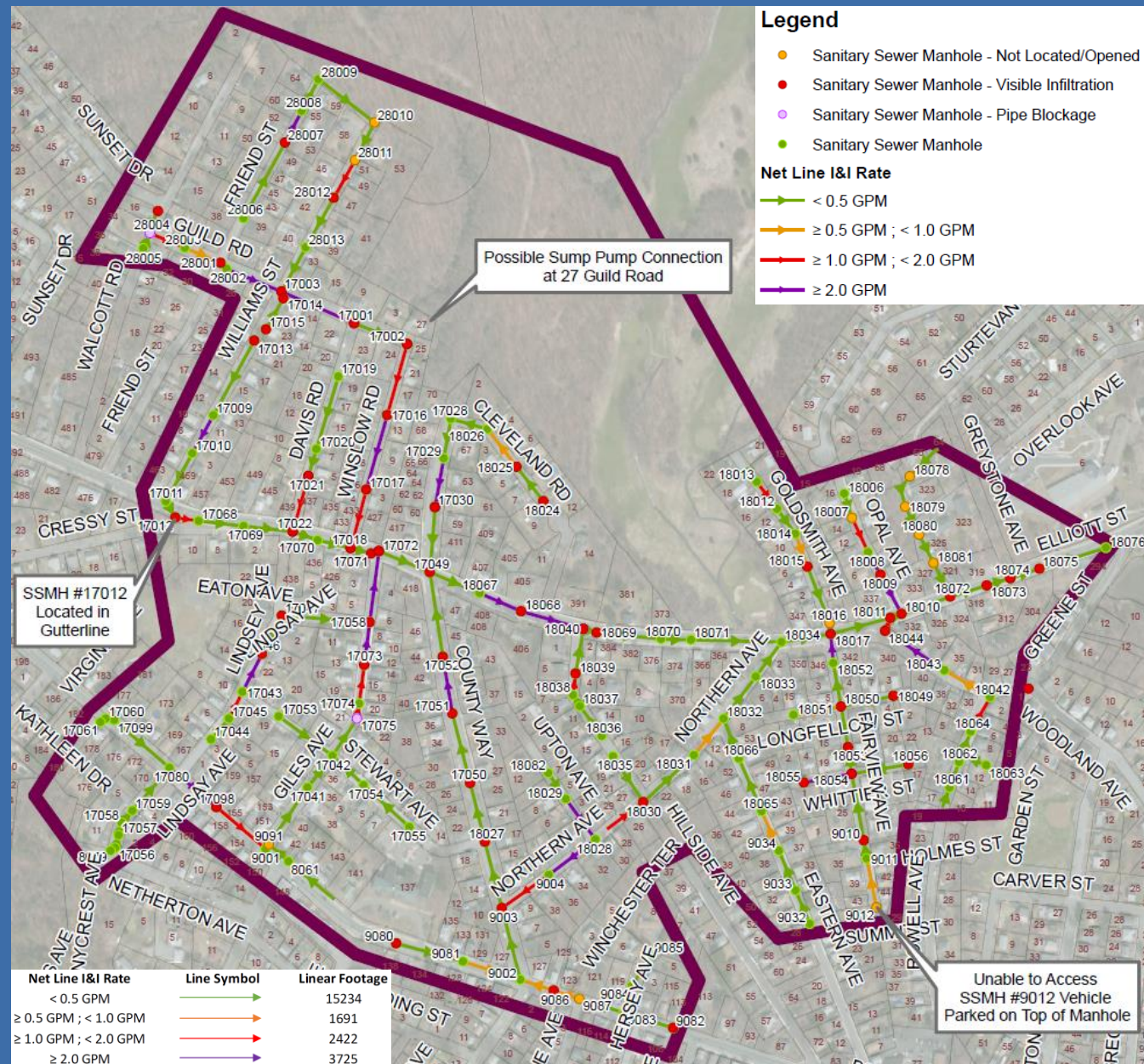
Data Collection

- Sewer Cleaning & CCTV Inspections
 - Mainlines & Laterals
- Manhole Inspections
- Flow Isolation
- Smoke Testing
- Private Inflow Property Inspections



Design

- Assess Field Data – Manholes & Pipes
- High Inflow & Infiltration
- Structural Defects
- Develop Construction Documents for Public Bid



Construction



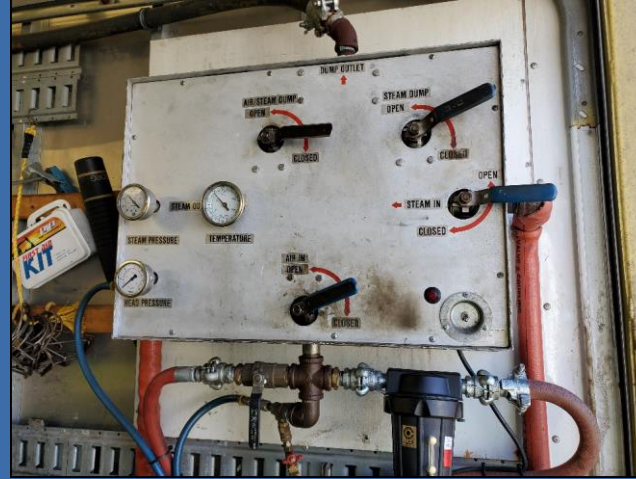
- Spot Repair Contracts
- Rehabilitation Contracts
 - Including mainline lining, lateral lining, and manhole rehabilitation
- Clean & CCTV Contracts

Subsystem C – Open-cut Spot Repairs

- Bid on February 19, 2021
- Awarded at \$460,000
- Contractor: N. Granese & Sons
- Completed April 2, 2021
- 16 Spot Repairs
 - Max Depth = 21ft
 - Size Range = 8in - 20in
- 1 Catch Basin Redirection



Subsystem W – Rehabilitation



- Bid on September 26, 2018
- Awarded at \$2.6M
- Main Components:
 - 15,500 LF of CIPP Mainline Liner
 - 235 CIPP Lateral Liners
 - 1,050 VF of Manhole Rehab
 - Clean & CCTV
 - 51,000 LF of Mains
 - 1,100 Sewer Laterals



Subsystems V & BB – Sewer Cleaning & CCTV Investigation

- Bid on May 10, 2022
- Awarded at \$795,000
- Main Components:
 - 68,000 LF of Mainline CCTV
 - 1,025 Lateral CCTV Inspections
 - 975 Private Inflow Inspections
 - 395 Manhole Inspections

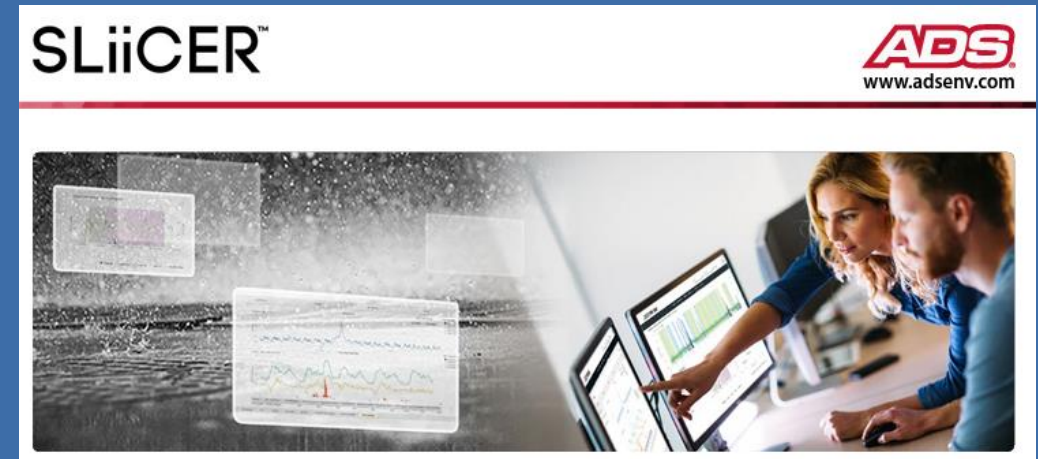


Project Challenges

- Homeowner Coordination for Lateral Lining & Private Inflow Inspections
- Lateral Lining Restrictions at Mainline Connection Point
- CCTV Data Management
- Measuring Success of Rehab Efforts

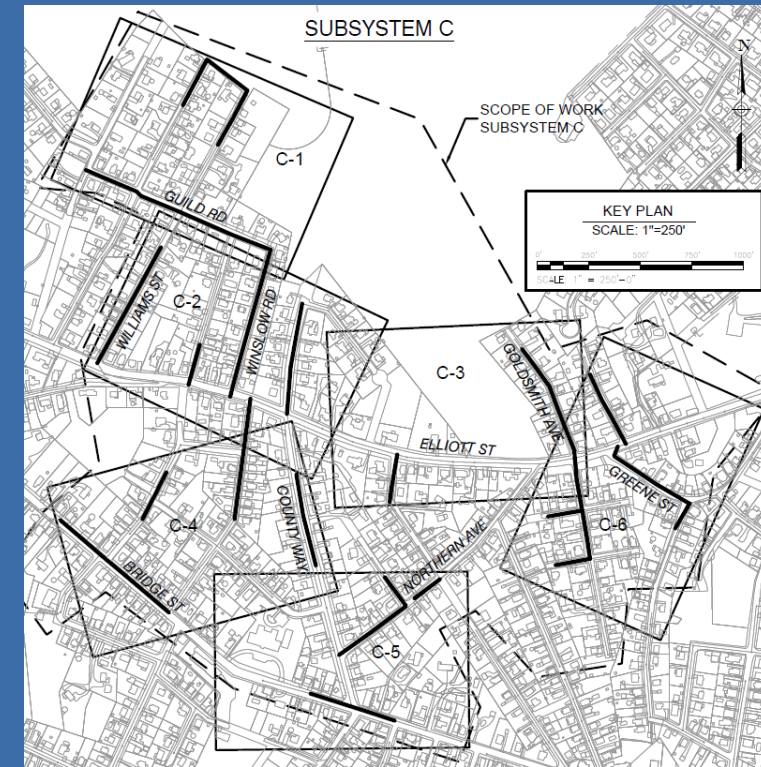


NAME	UPDATED ↓	SIZE
OCTOBER 2022	Dec 1, 2022 by Mat	73 Files
LOTHROP_RE-TV	Nov 11, 2022 by Mat	6 Files
Video Request	Nov 10, 2022 by Mat	3 Files
Missing data from Sept 2022	Oct 25, 2022 by Mat	7 Files
AUGUST 2022	Oct 14, 2022 by Mat	209 Files
SEPT 2022	Oct 4, 2022 by Mat	12 Files
JULY 2022	Sep 7, 2022 by Mat	48 Files
APR 2022	Jun 15, 2022 by Mat	12 Files
OCT 2021_TO_MAR 2022	May 4, 2022 by Mat	604 Files
MAR 2022	Mar 29, 2022 by Mat	2 Files
FEB 2022	Mar 29, 2022 by Mat	20 Files



Next Steps

- Metering Subsystem W with a Control Subsystem
- Data Assimilation into City's Asset Management Program
- 2023/24 Spot Repair Contract
- Subsystem C Rehabilitation
 - Includes Additional Rehab Work in Subsystem M
- 2027 Re-meter Subsystems



Conclusion

- Capital Improvements Plan Targets High I/I Subsystems
- Three Phase Approach:
 - Metering & Analysis
 - Targeted Field Investigations
 - Construction Contract
- Success through Determination & Steady Funding
- Increasing Service Reliability & Decreasing I/I

Q/A

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