The Main Interceptor Project: An Engineered Approach to Innovative Pipeline Rehabilitation

Springfield Water and Sewer Commission
Springfield, Massachusetts

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NEWEA Annual Conference January 25, 2017

Outline

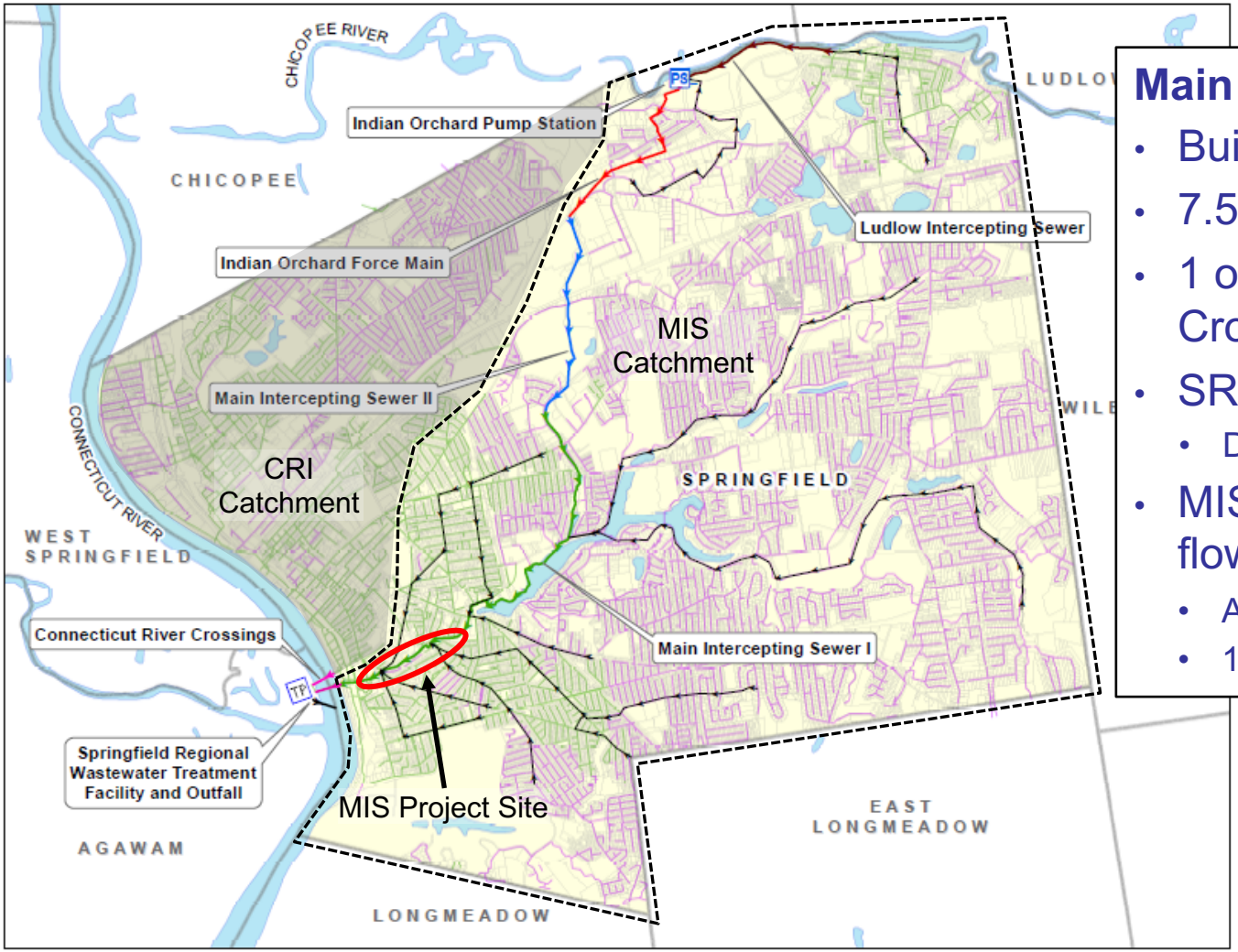
- Project Planning (*Jason*)
  - *Brief history, condition assessments and project development*
- Project Design (*Jonnas*)
  - *Rehab alternative analysis, DWF gravity bypass design*
- Project Construction (*Eric*)
  - *Gravity bypass construction and operation, pipeline rehabilitation*
- Summary and Questions
- Project Photos

History of the Springfield Water and Sewer

- The Springfield Water and Sewer Commission was established in July 1996 to administer, operate and maintain the water and wastewater systems

- SWSC Wastewater Collection System:
  - 37,200+ Customers
  - 151 miles of Combined sewer (33%)
  - 310 miles of Separated sewer (66%)
  - 11,000 Manholes
  - 23 Combined Sewer Overflows (CSOs)
  - 33 Pump Stations

Background on Main Intercepting Sewer



Main Intercepting Sewer

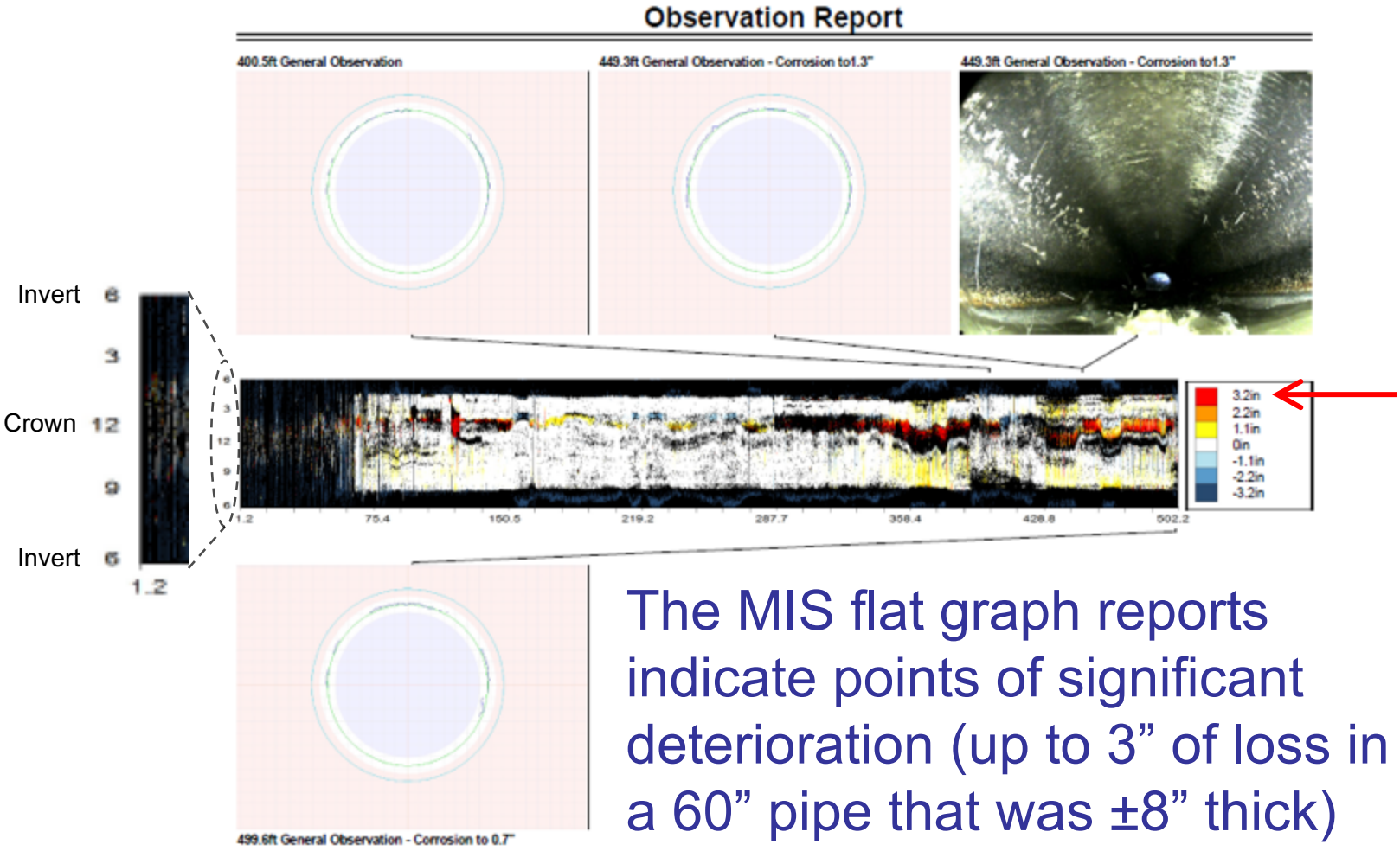
- Built in the 1970s
- 7.5 miles of RCP
- 1 of 2 CT River Crossings to SRWTF
- SRWTF treats 40+ MGD
  - Designed for up to 67 MGD
- MIS Conveys 60% of flows to SRWTF
  - Avg. DWF – 25 MGD
  - 1-Year Peak – 150 MGD

Condition Assessment

2009 and 2014 Multi-Sensor Inspections:

- Laser to identify deformation & corrosion above flow line
- Sonar to detect deposition & debris below flow line

Condition Assessment



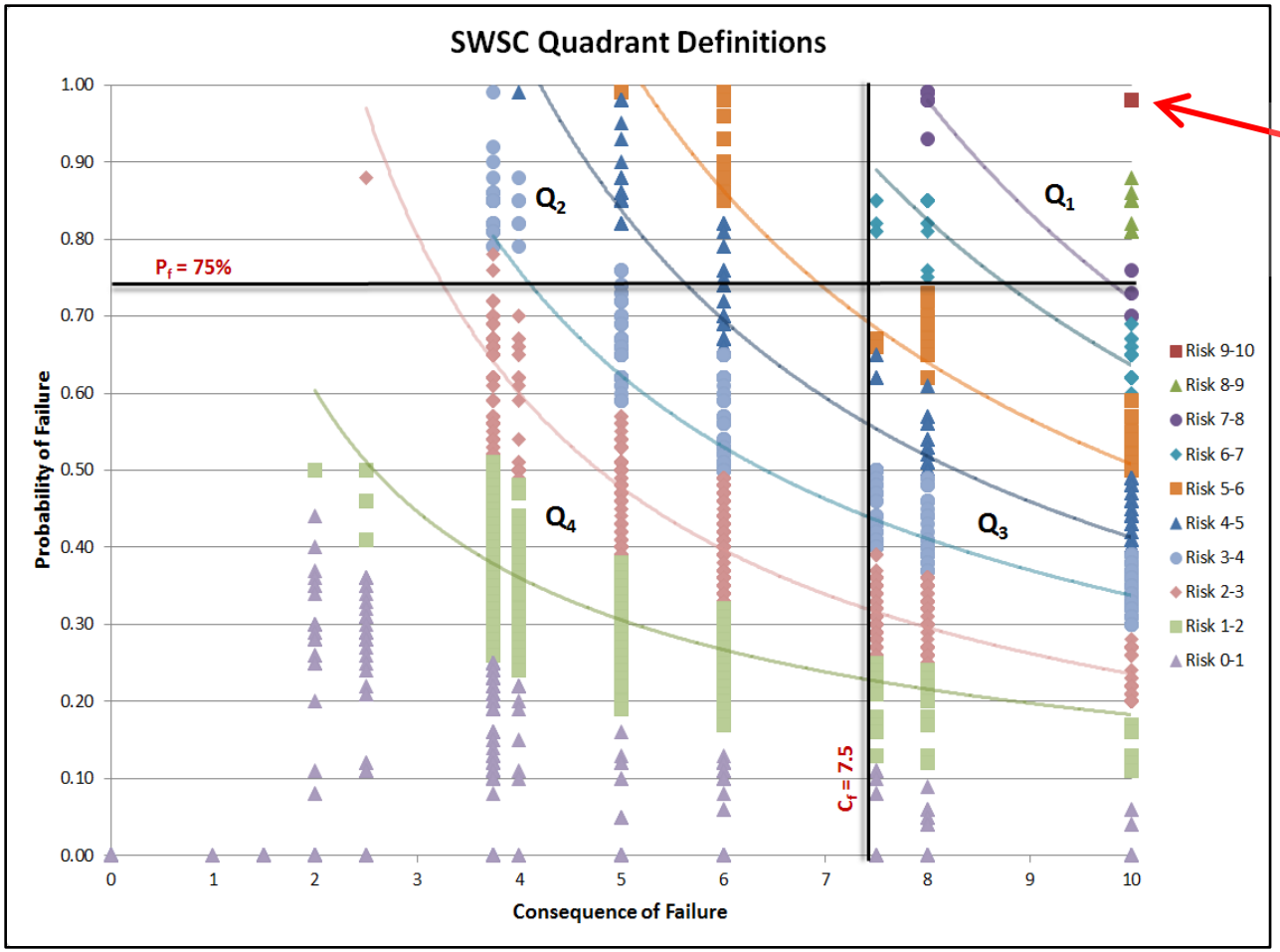
The MIS flat graph reports indicate points of significant deterioration (up to 3” of loss in a 60” pipe that was ±8” thick)

Pipeline and Manhole Condition Assessment

Exposed wire mesh cage from removed section of 60” RCP

Corrosion/Deterioration experienced throughout MIS pipeline MHs as well

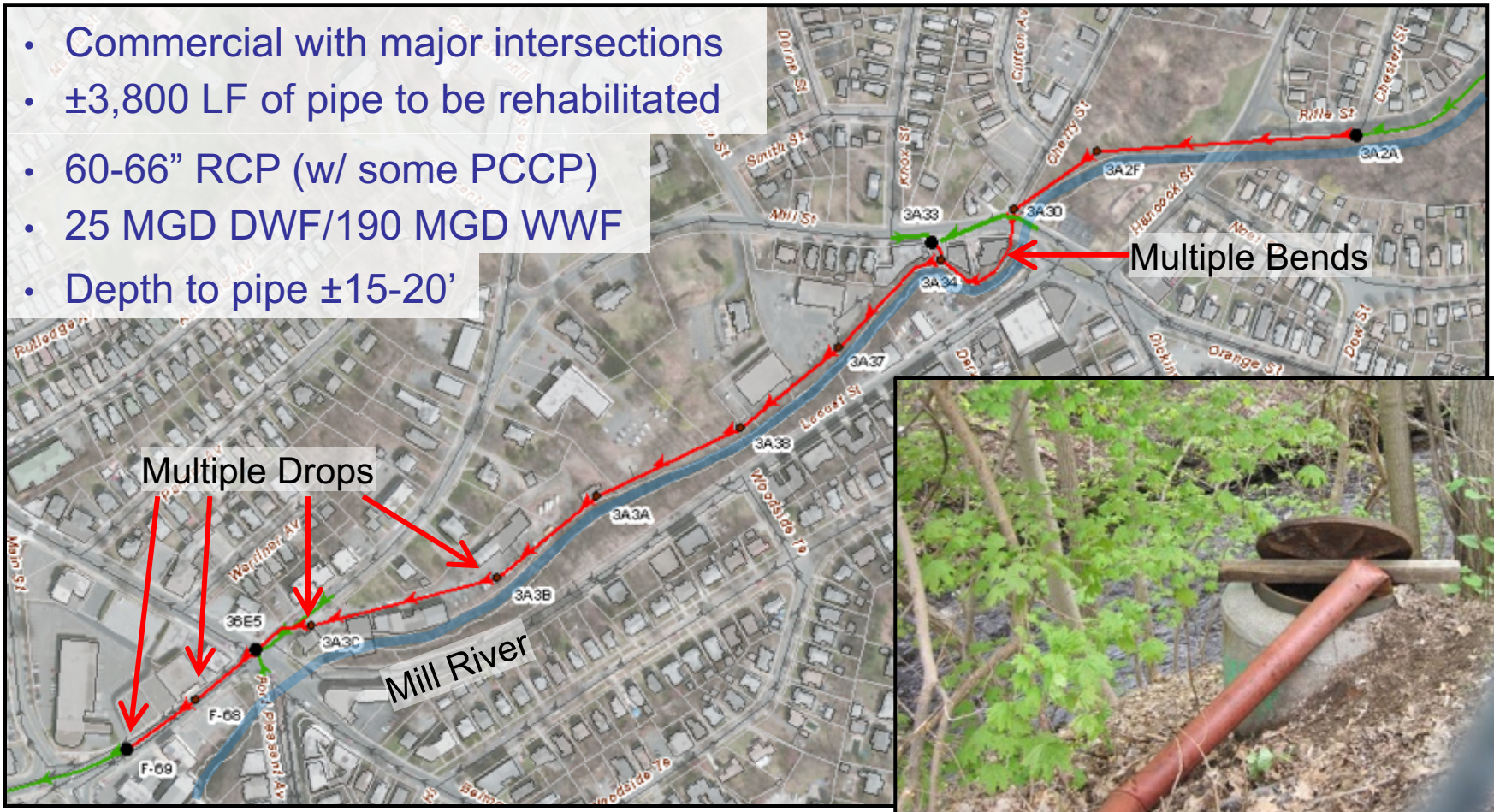
Risk Evaluation – Project Prioritization



Main Intercepting Sewer

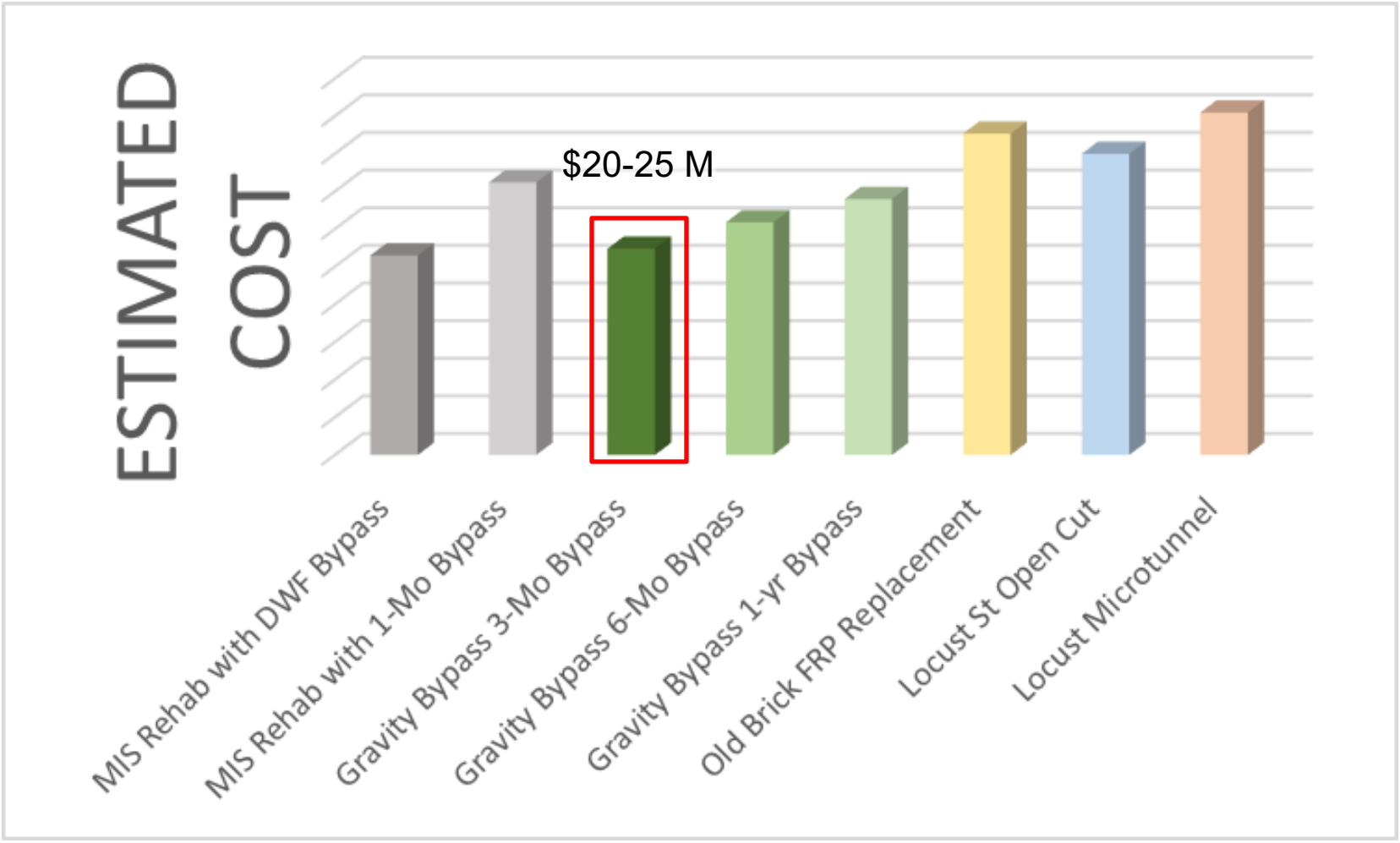
Main Interceptor Project Development

- Commercial with major intersections
- ±3,800 LF of pipe to be rehabilitated
- 60-66” RCP (w/ some PCCP)
- 25 MGD DWF/190 MGD WWF
- Depth to pipe ±15-20’



Existing Main Interceptor Flows

Replacement and Rehabilitation Methods



Trenchless Rehabilitation Design Criteria

Performance

- 50 Year Design Life
- Standalone Pipe
- Corrosion Protection
- Scour Protection

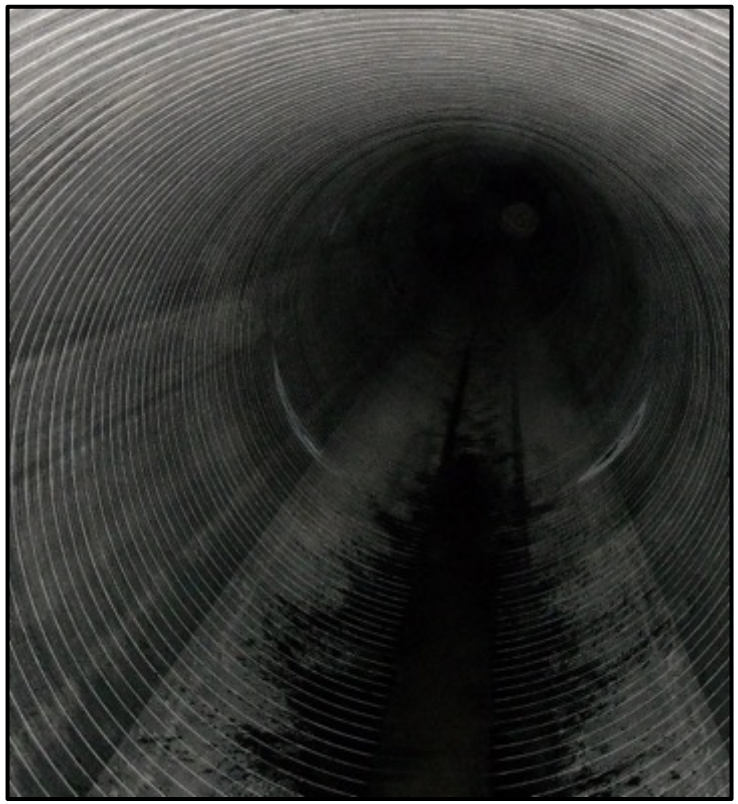
Constructability

- Overall Cost
- Work Production
- Access Requirements
- Flow Bypass Needs

	No.	Criterion	Weight (%, Totaling 100)	
Performance and other General Criteria	1	Bypass of Flow Requirements	4	Total Weight: 55 of 100
	2	Adaptability for Emergency/Wet Weather Flows	6	
	3	Durability Against Scour and High Velocities	7	
	4	Durability Against Corrosion	11	
	5	Hydraulic Performance	8	
	6	Product Pressure Rating	4	
	7	Standalone Pipe Structure	5	
	8	Host Pipe Preparation Requirements	2	
	9	Permitting & Easement Impacts	3	
	10	Previous Use of Technology in SWSC Network	5	
Constructability	11	Cost	16	Total Weight: 45 of 100
	12	Constructability	12	
	13	Production Rate	8	
	14	Impact to Sewer Network Setup	3	
	15	Site Impacts	6	

Trenchless Alternatives Analysis

Spiral Wound Pipe (with PVC or HDPE)



Sliplining (with FRP or HDPE)

Trenchless Alternatives Analysis

Centrifugally Cast Concrete Pipe (CCCP)

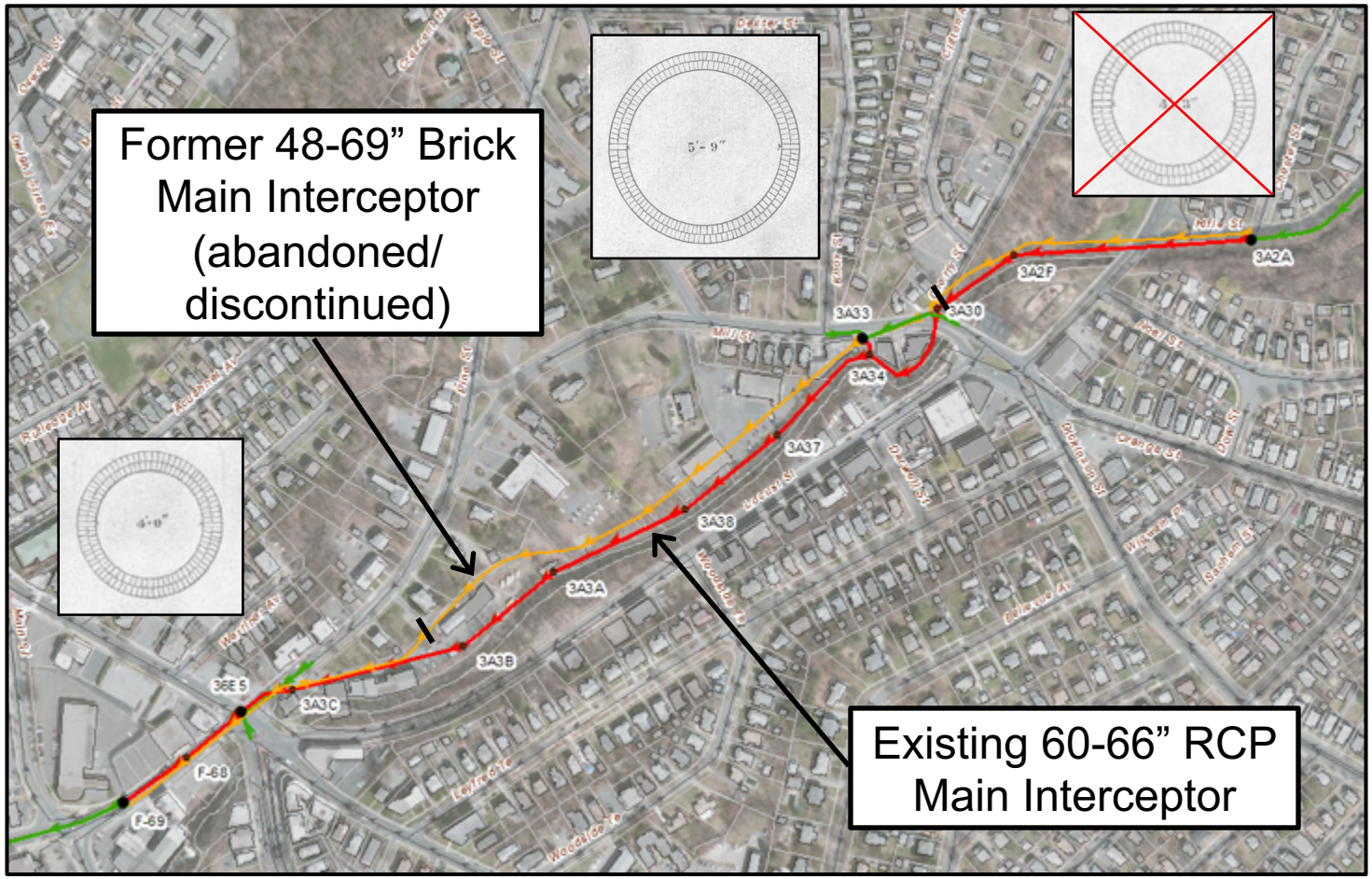
Cured in Place Pipe (CIPP)

Trenchless Rehabilitation Selection

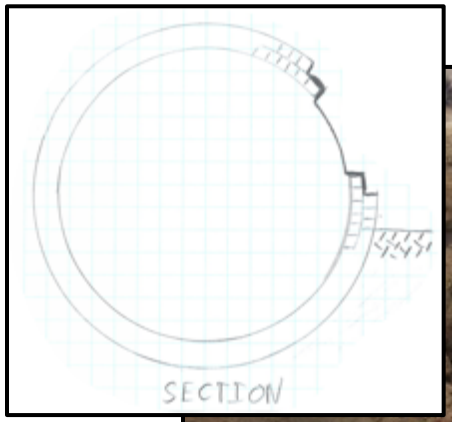
		Weighted Score (out of 1000)			
		FRP SLIP	CIPP	CCCP	SPR
Total Constructability and Performance Score	P1F13	662	670	622	651
	P193B	436	594	563	343
	P213A	555	639	602	536
	P215E	618	648	622	651
	P217C	618	640	622	651
	P219B	618	648	622	651
	P21B8	648	654	622	651
	PS16941	563	627	614	584
	PS16942	560	627	619	648
	PS16943	560	627	619	648

CIPP resulted in consistently high scores in performance and constructability for every segment designated for rehabilitation

Gravity Bypass Concept Development

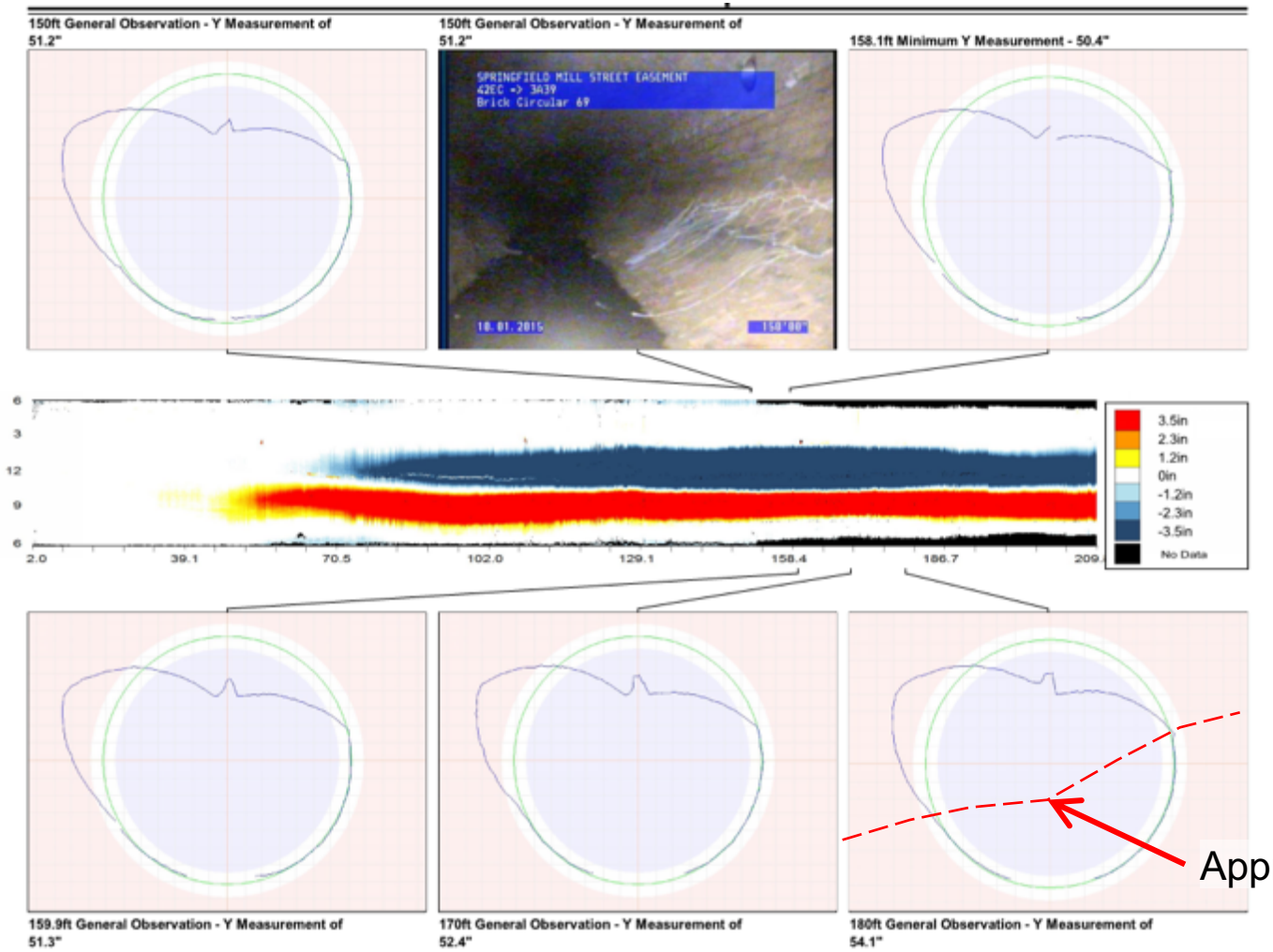


Gravity Bypass Field Investigations



Proper Planning &
Proper Execution

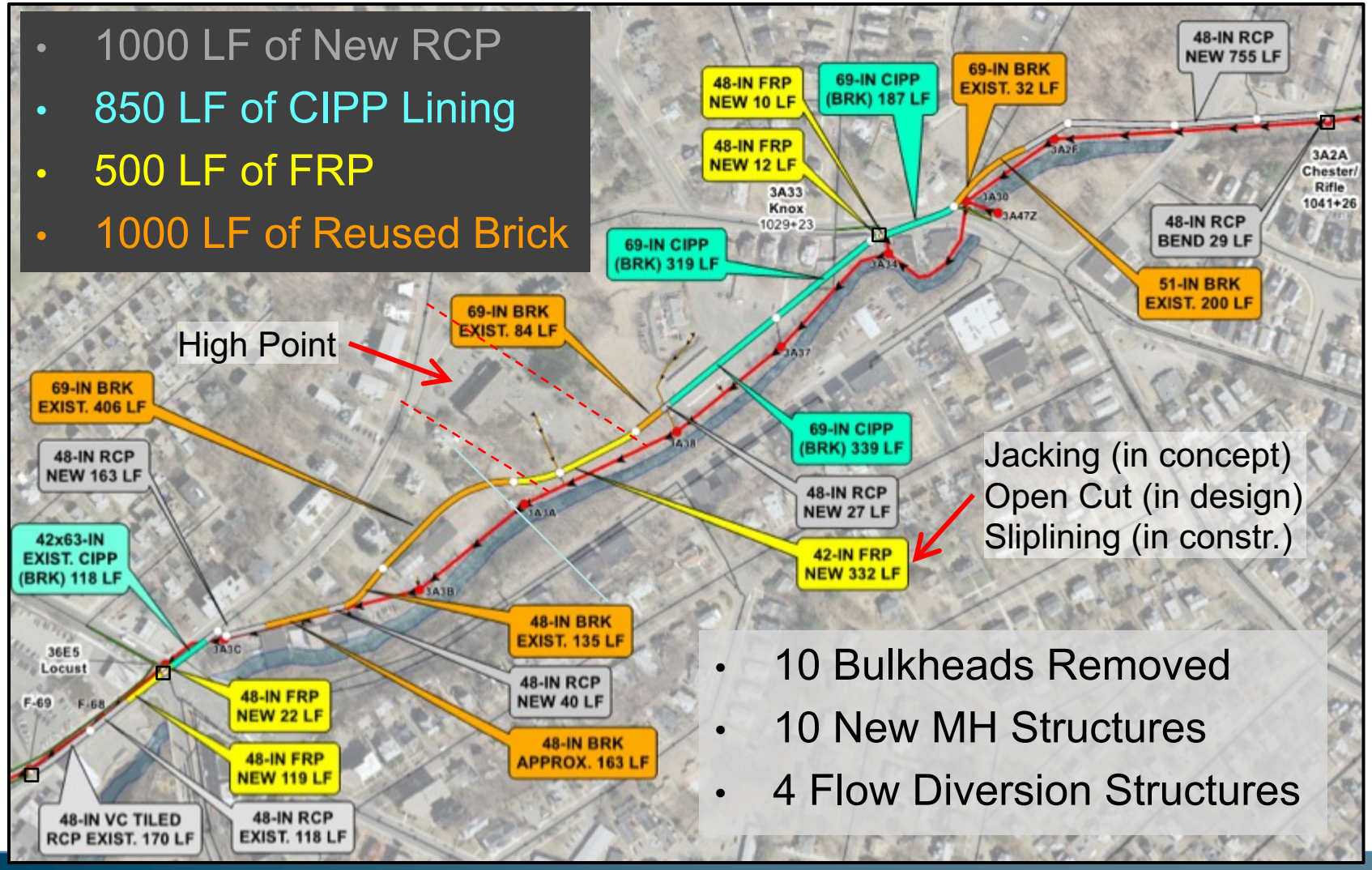
Gravity Bypass Field Investigations



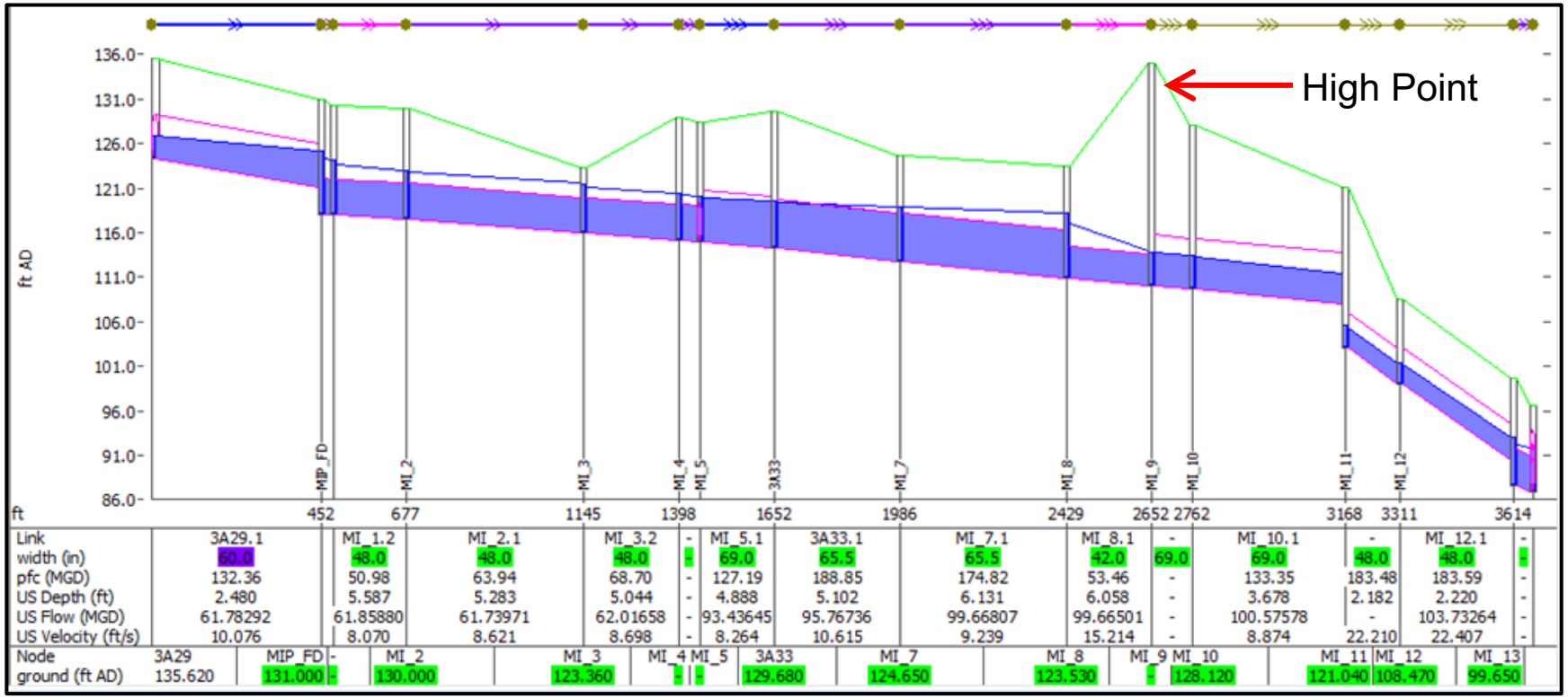
"High Point" 69-in Brick Deformation

- Laser Inspection
- Vertical change: 69" down to 51"
- Excess vertical loading
- Rock Profile may have restrained deformation
- Unsafe for manned entry

Gravity Bypass Concept Development



Gravity Bypass Capacity Modeling

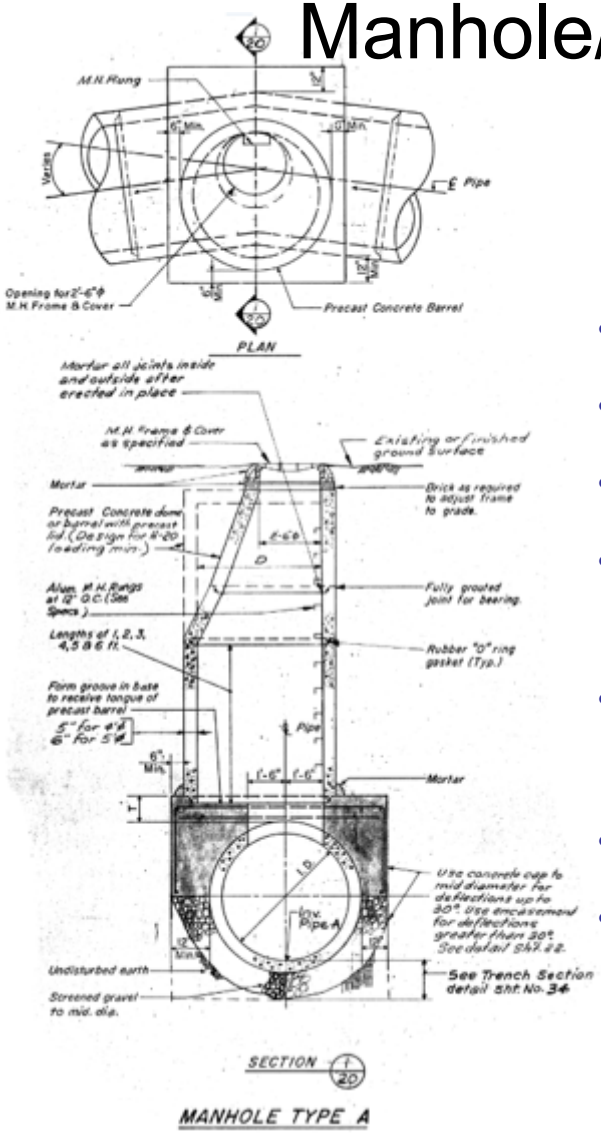


Link	3A29.1	MI_1.2	MI_2.1	MI_3.2	-	MI_5.1	3A33.1	MI_7.1	MI_8.1	-	MI_10.1	-	MI_12.1	-
width (in)	60.0	48.0	48.0	48.0	-	69.0	65.5	65.5	42.0	69.0	69.0	48.0	48.0	-
pfc (MGD)	132.36	50.98	63.94	68.70	-	127.19	188.85	174.82	53.46	-	133.35	183.48	183.59	-
US Depth (ft)	2.480	5.587	5.283	5.044	-	4.888	5.102	6.131	6.058	-	3.678	2.182	2.220	-
US Flow (MGD)	61.78292	61.85880	61.73971	62.01658	-	93.43645	95.76736	99.66807	99.66501	-	100.57578	-	103.73264	-
US Velocity (ft/s)	10.076	8.070	8.621	8.698	-	8.264	10.615	9.239	15.214	-	8.874	22.210	22.407	-

Node	3A29	MIP_FD	-	MI_2	MI_3	MI_4	MI_5	3A33	MI_7	MI_8	MI_9	MI_10	MI_11	MI_12	MI_13
ground (ft AD)	135.620	131.000	-	130.000	123.360	-	-	129.680	124.650	123.530	-	128.120	121.040	108.470	99.650

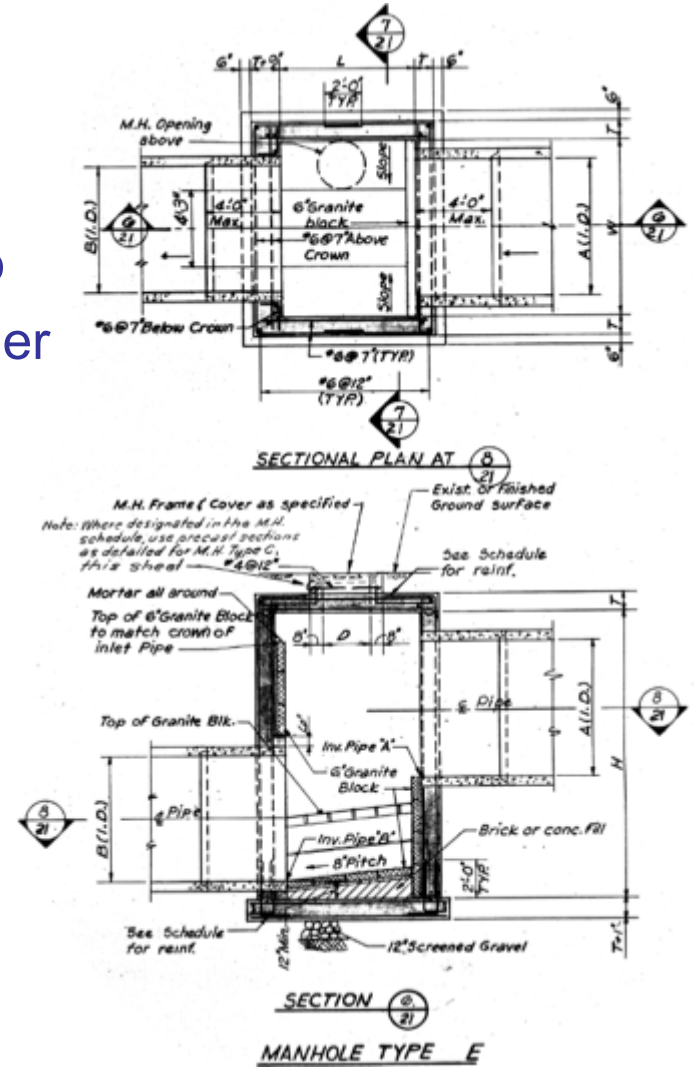
- Modeled Capacity: 3 Month Storm
- Flow Speed: 7-8 ft/s
- 42-in FRP Pipe at “High Point”
- Depth of Water in Pipe: 5-6 ft
- Depth to Water at Locust Overflow: 4ft
- Dickinson Catchment LOS Issues

Manhole/Structure Rehabilitation

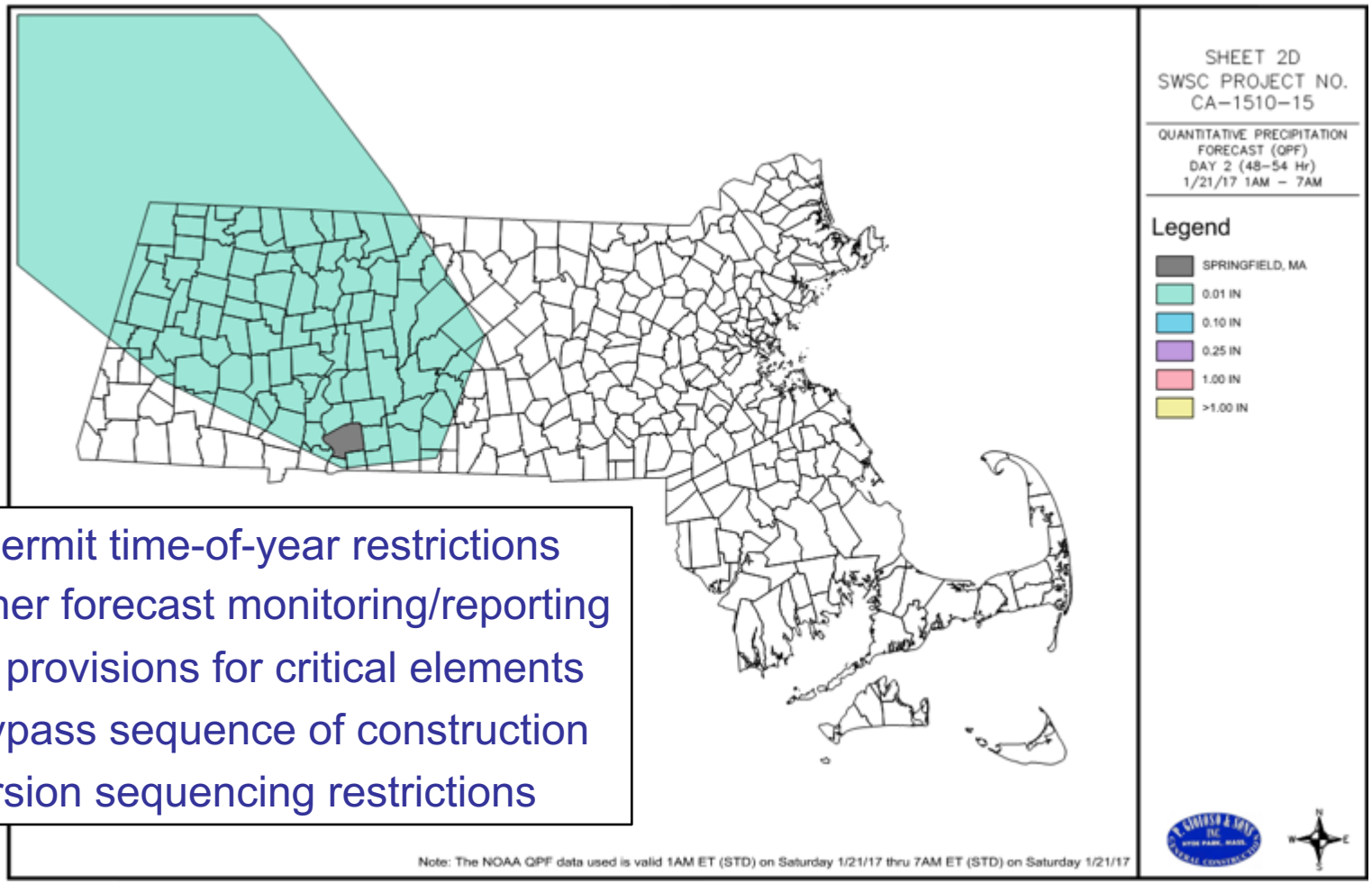


Design Criteria

- Structural Rehab
- Cementitious Liner
- 9000+ psi
- H_2S Admixture Protection
- Compatible with CIPP Lining
- 3 Types of MHs
- 5-yr Bonded Warranty



Construction Schedule/Sequencing Requirements



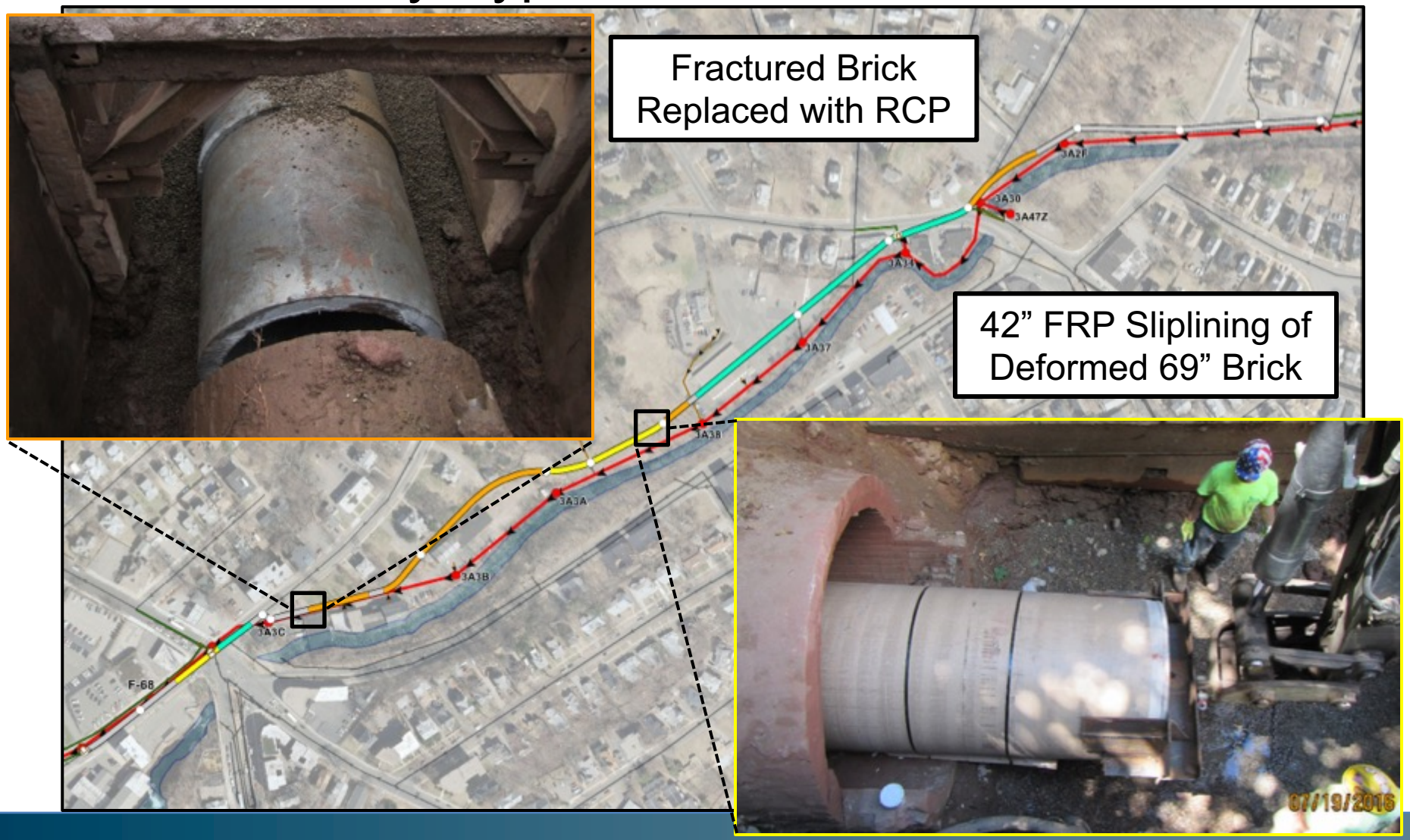
- Wetland permit time-of-year restrictions
- Wet weather forecast monitoring/reporting
- 24/7 work provisions for critical elements
- Gravity Bypass sequence of construction
- Flow diversion sequencing restrictions

Gravity Bypass Construction Issues

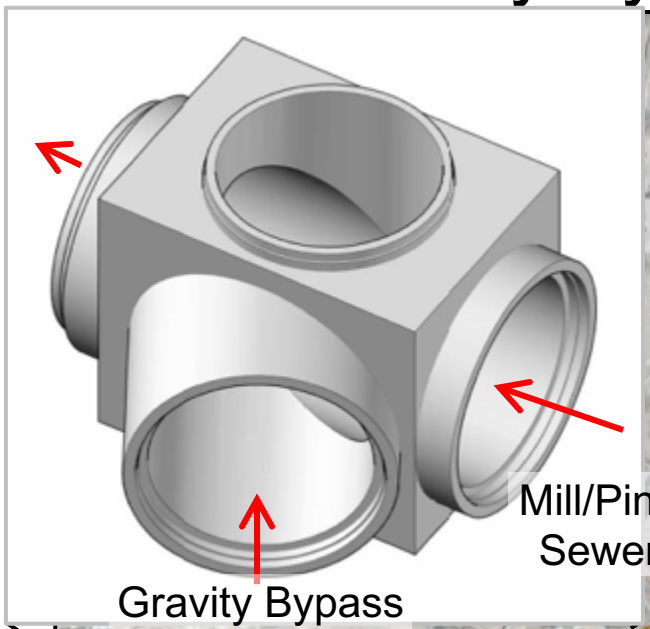
CIPP Splitting of Unrestrained 69” Brick Pipe

Gravity Bypass Conflict with New MIS Alignment

Gravity Bypass Construction Issues



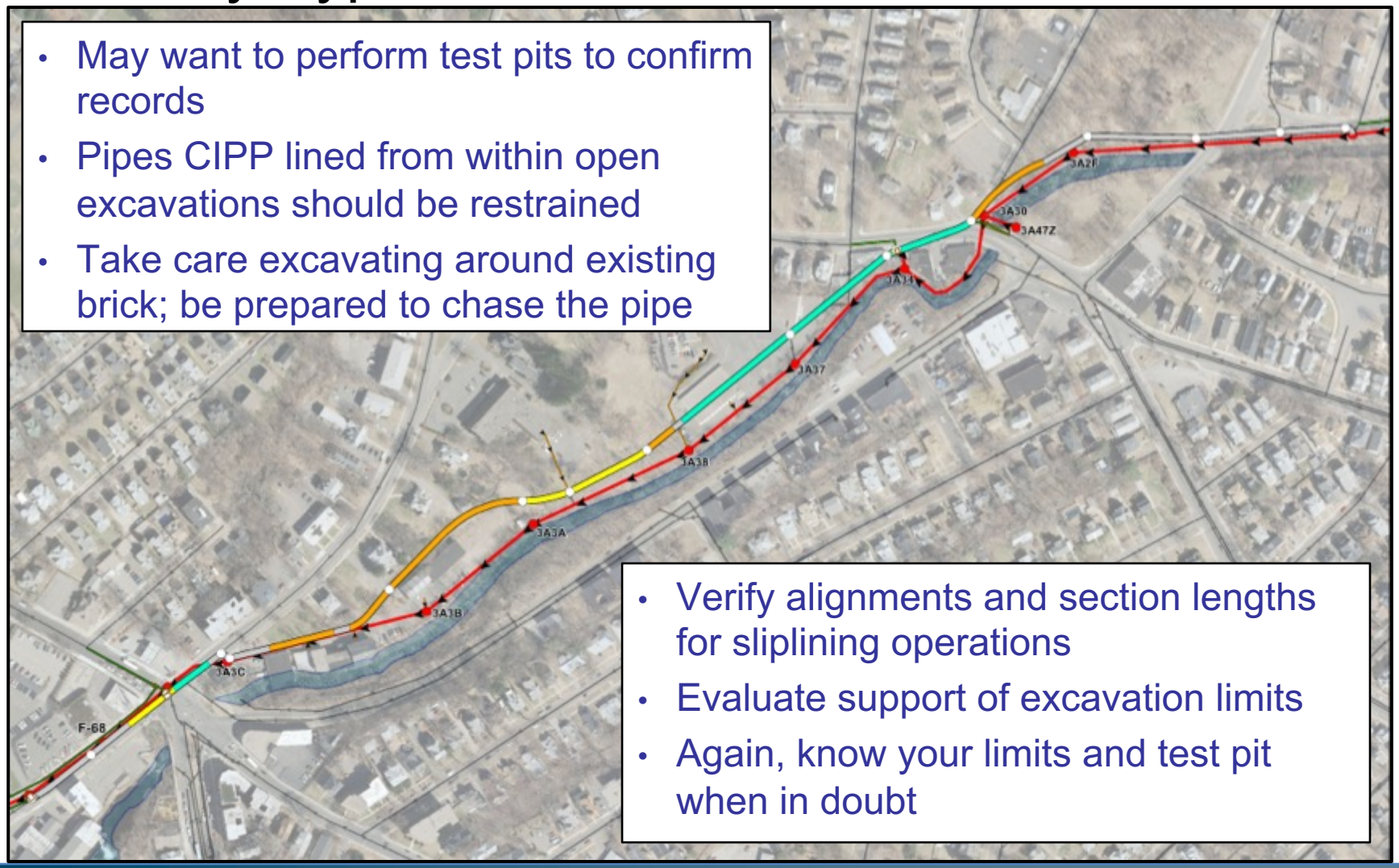
Gravity Bypass Construction Issues



Tee-wye MH for
Tight Installation

Vertical Conflict
with MIS Alignment

Gravity Bypass Construction Lessons Learned



- May want to perform test pits to confirm records
- Pipes CIPP lined from within open excavations should be restrained
- Take care excavating around existing brick; be prepared to chase the pipe

- Verify alignments and section lengths for sliplining operations
- Evaluate support of excavation limits
- Again, know your limits and test pit when in doubt

Gravity Bypass Diversion Structures

4 Diversion Structures

- Interior Modifications/ Annex Structures
- Whipps Stainless Steel Sluice Gates

Gravity Bypass Operations Testing and Inspection

- Crew of certified gate operators
- Lockout/Tagout work procedures
- Only permitted to convey DWF
- Emergency Overflows
- Gravity Bypass inspected after activations to ensure integrity

Dickinson Siphon Hatch

Chester/Rifle Overflow

CIPP Liner Installations

Limited Inversion Length

- up to ±400 ft for a 60” pipe due to weight
- Longer inversions were possible with composite liners

Required Equipment

- Machine used to hoist liner
- Newer steam trucks
- Large staging footprints created impacts to traffic

CIPP Liner Installations

MH Access Constraints

- Removal of MH cones
- Possible damage to risers due to inversion pressures

MH Install/Modifications

- Installed new “doghouse” MHs to facilitate CIPP installation
- Vault structure roof slab modifications

CIPP Testing and Inspection

Testing of Liner

- Restrained samples preferred but difficult in larger diameters
- 20% reduction towards Flat Plate sample flexural modulus results

Inspection of Liner

- Confirm resin used, liner size, length and thickness
- Verify thickness of liner at MHs and from lateral coupons
- Obtain manufacturers recommendations and post-installation reports

Manhole Rehabilitations

Surface Prep for MH Structure Rehab

- Up to 2” of punky concrete removed
- Rebar exposed and wash of corrosion
- MH rehab scheduled around CIPP installations

Summary

- Condition assessment identified a need for improvement
- Capitalize on the reuse or repurposing of existing infrastructure
- There will always be changes between planning, design and construction

Questions???

Thank You!

Acknowledgements

- **Springfield Water and Sewer Commission**:
  - Joshua Schimmel, Bill Fuqua, Bob Stoops, David Szymczakiewicz, Ryan Wingerter
- **Kleinfelder:**
  - Thomas Ritchie, Jason Lavoie, John Struzziery, Mark Chamberlain
- **MWH/Stantec:**
  - Matthew Travers, Matthew Wilson, Eric Morse

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Photos from Construction

Photos from Construction

Under Bridge CIPP
Installation
On Egg-shaped Brick

Photos from Construction

Photos from Construction

CIPP
Inversion Pit

Steam Truck
and Piping

Photos from Construction

Liner entering Manhole

Concrete collar over brick pipe

Photos from Construction

End seals within host pipe

Curing of flat plate sample