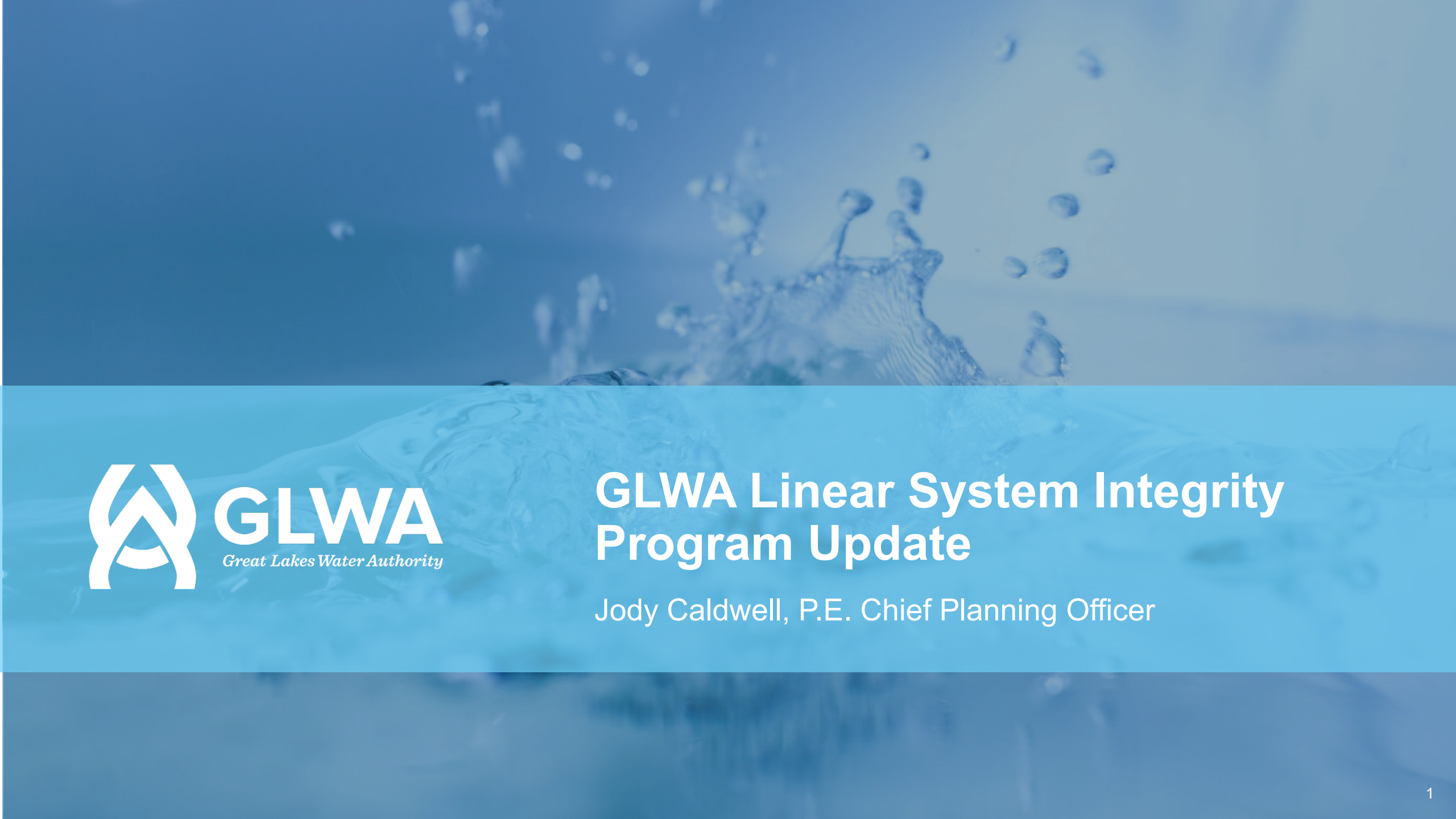


GLWA
Great Lakes Water Authority

GLWA Linear System Integrity Program Update

Jody Caldwell, P.E. Chief Planning Officer

Linear System Integrity Program
Key Take-Aways

- Objective since GLWA inception was to move from reactive to proactive asset management
- Established the Linear System Integrity Program (LSIP)
- Significant analysis occurred following the 54-inch main break in February 2025
- Evolution to a more comprehensive “Water Transmission Main Renewal Strategy” is being developed
- Long-term funding is the biggest challenge (To be continued 10/8)

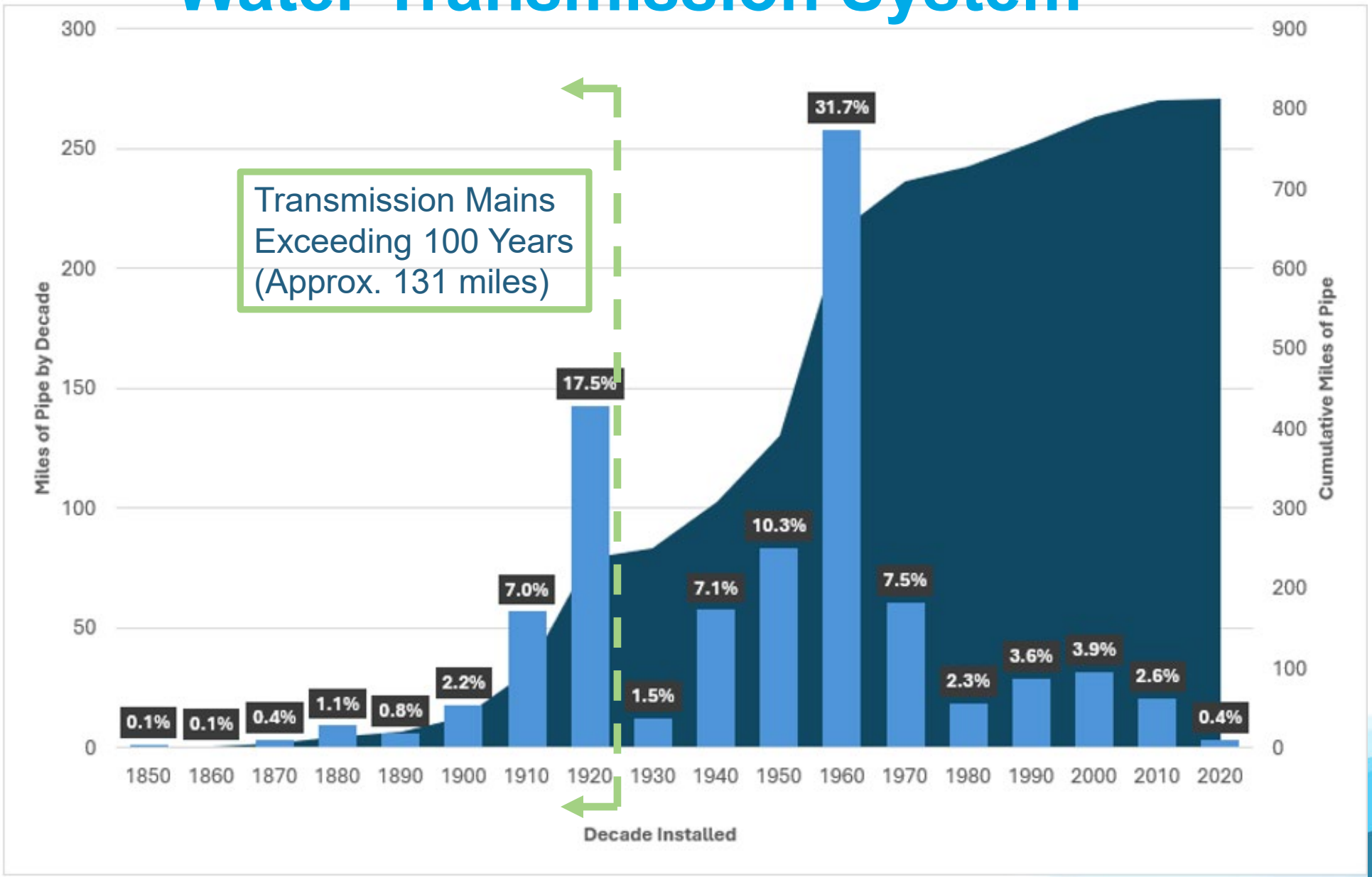
GLWA
Great Lakes Water Authority

Water Transmission System

- Total Transmission Main: 800 miles across eight counties
  - Concrete mains: 500 miles
  - Metallic mains: 300 miles
- Large diameter mains up to 120 inches and under a pressure of 180 pounds per square inch
- Average age: 76 years
- Expected useful Life: 80 – 120 years depending on pipe type

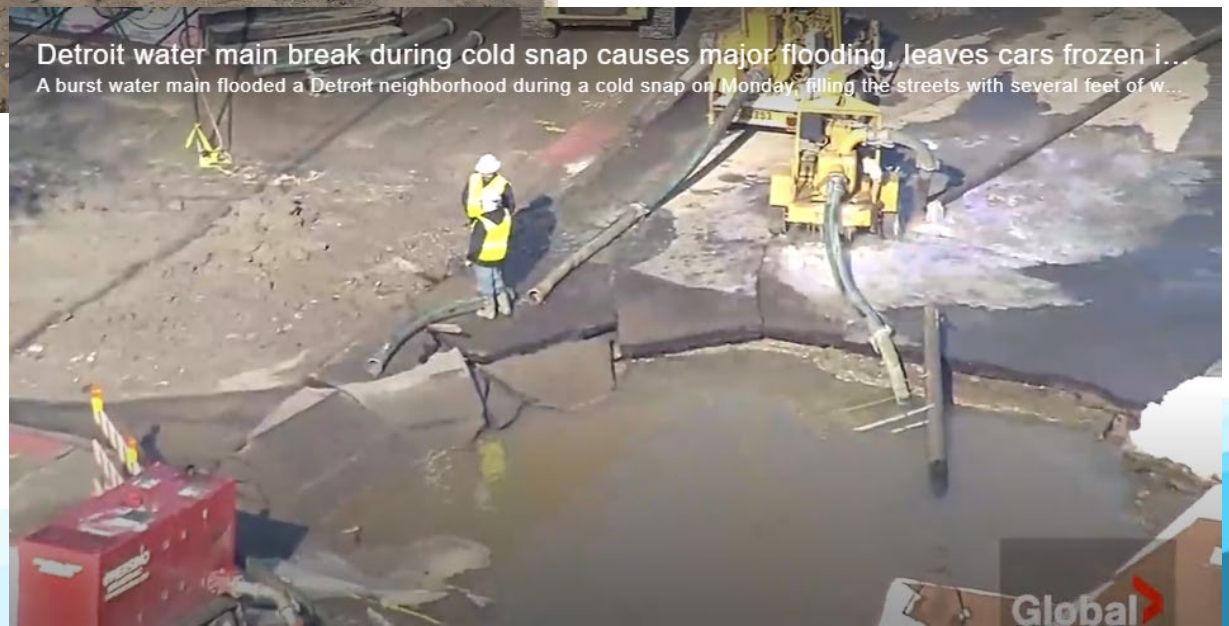
GLWA
Great Lakes Water Authority

Water Transmission System

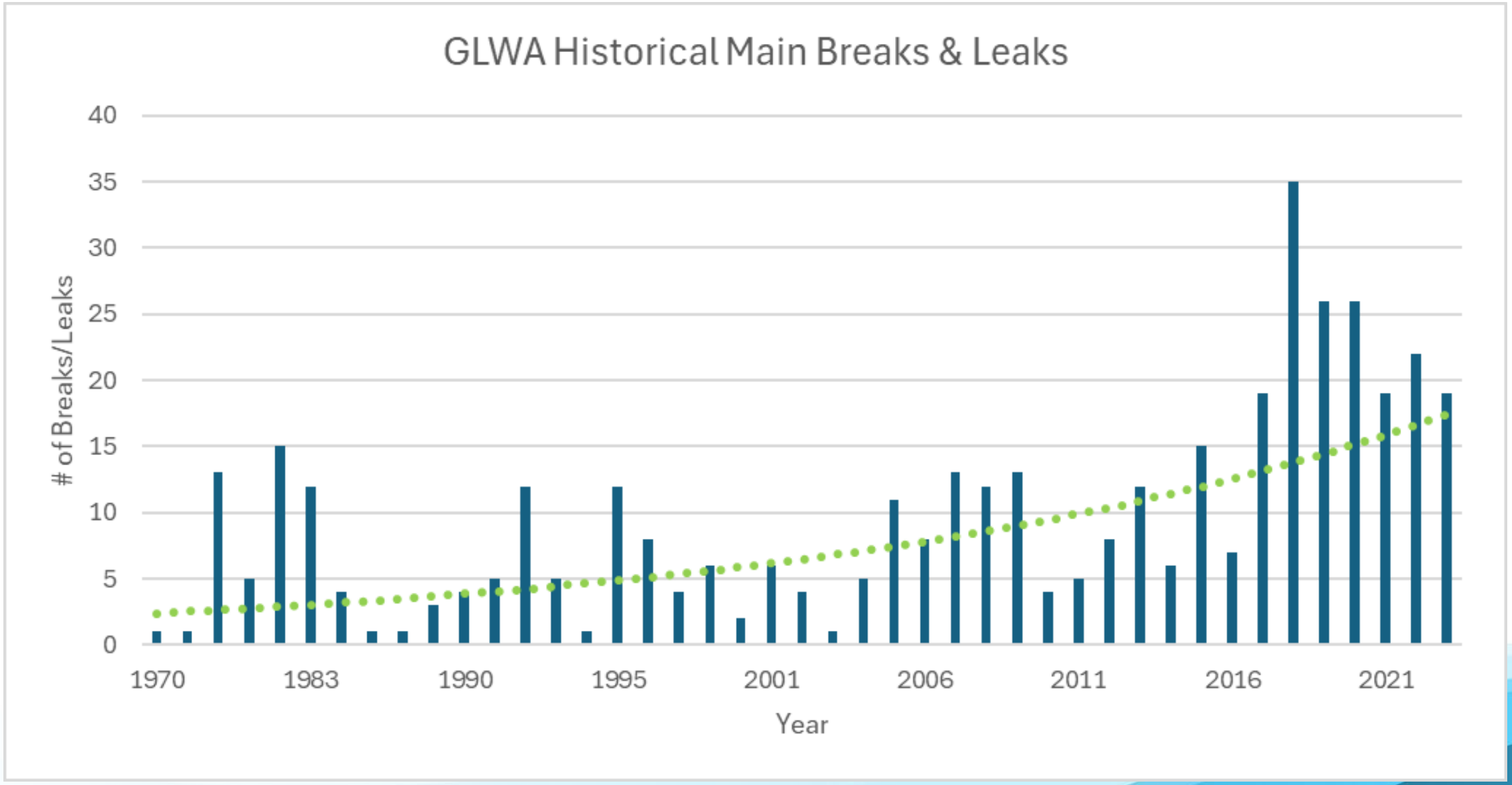


GLWA
Great Lakes Water Authority

The NEED to Proactively Manage Transmission Mains



The NEED to Proactively Manage Transmission Mains



Linear System Integrity Program (LSIP) History

Successful Linear System Management

Successful management, continuing to be affordable and sustainable

Pipeline Risk Management

Scientifically defensible approach to pipeline risk management

Lowest Lifecycle Cost

Use data to drive decision making to manage pipeline risk and optimize maintenance & renewal budgets

GLWA
Great Lakes Water Authority

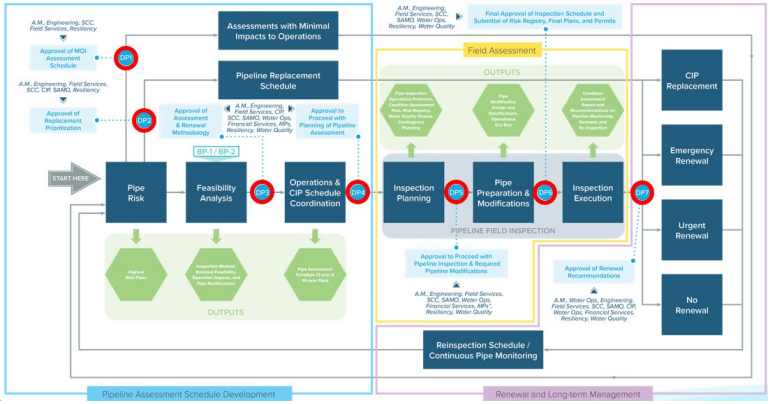
LSIP History

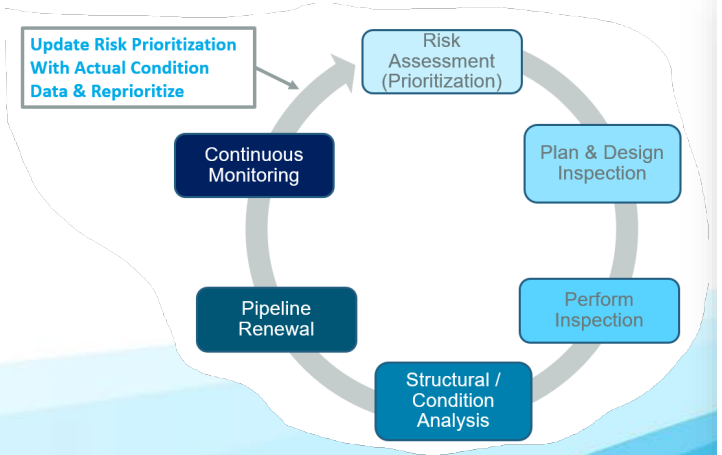
- 2017-2020:
  - Prioritization of transmission main for strategic condition assessment and targeted renewal was developed
  - Developed the strategy to begin “Lean” program:
    - Minimize impacts due to failure of the highest risk mains
    - High resolution condition assessment – In each year, plan one, design one and execute one
    - Approximately 20 miles per year
    - Focus on Prestressed Concrete Cylinder Pipe (PCCP)

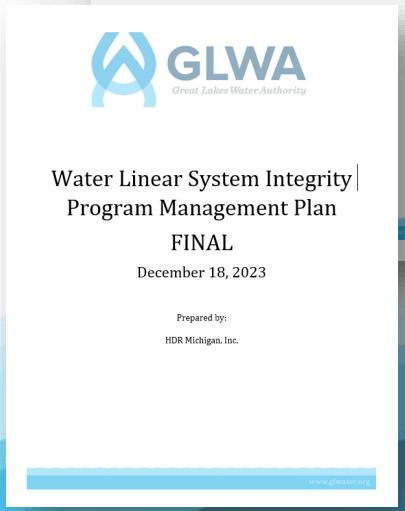
GLWA
Great Lakes Water Authority

LSIP History

- 2021 – To Date:
  - Initiated contract with LSIP Program Manager, HDR of Michigan
  - Updated risk-based prioritization approach
  - Developed program framework, governance and processes
  - Began high resolution condition assessments and renewal

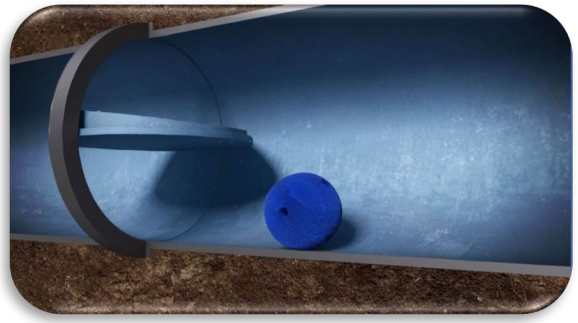




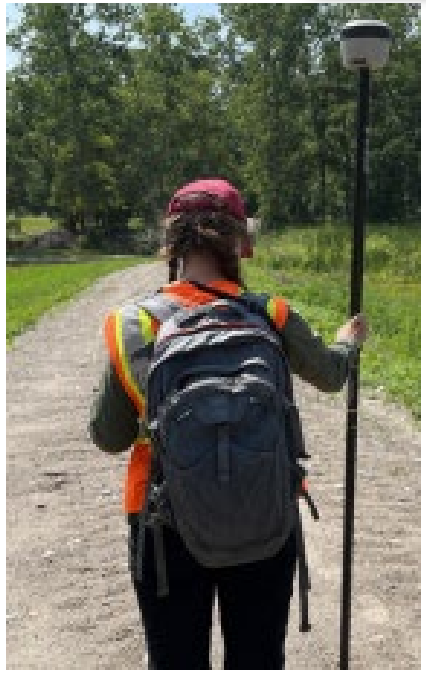


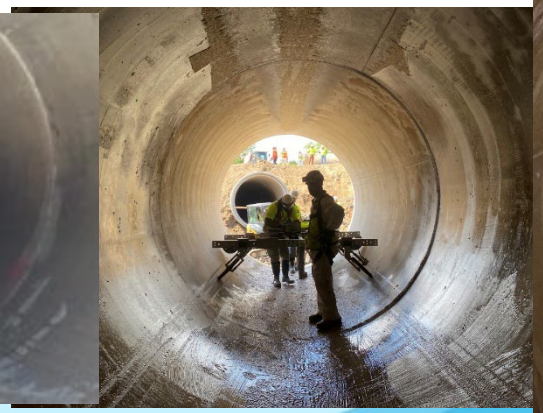
GLWA Great Lakes Water Authority

LSIP Progress

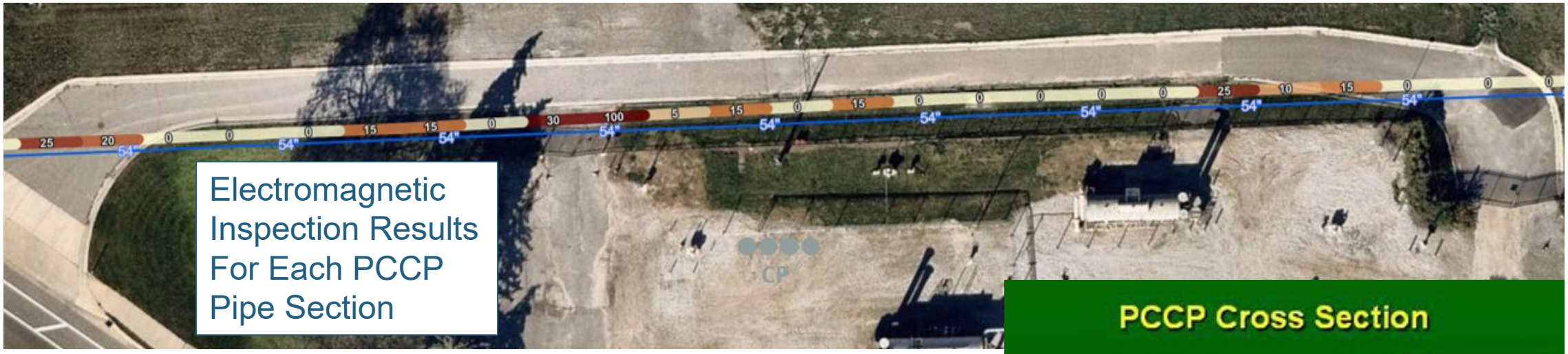


- Condition Assessment Completed
  - Aboveground survey – 37.5 miles
  - High resolution inspection – 52 miles
  - Visual and sounding inspection – 17.5 miles
  - Pilot technologies (external acoustic & internal fiber)– 2.4 mile
  - Opportunistic pipe inspection – 13.2 miles
  - Future planned pipe inspection (through 2027) – 27 miles

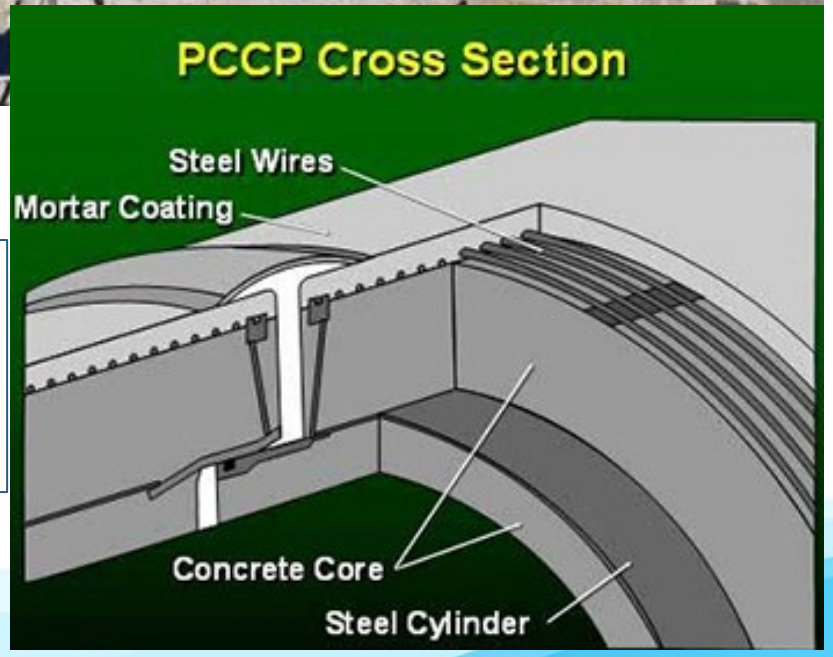




LSIP Progress (Cont'd)



Electromagnetic Inspection Results For Each PCCP Pipe Section



Prestressed Concrete Cylinder Pipe (PCCP) Cross Section

GLWA
Great Lakes Water Authority

LSIP Progress (Cont'd)

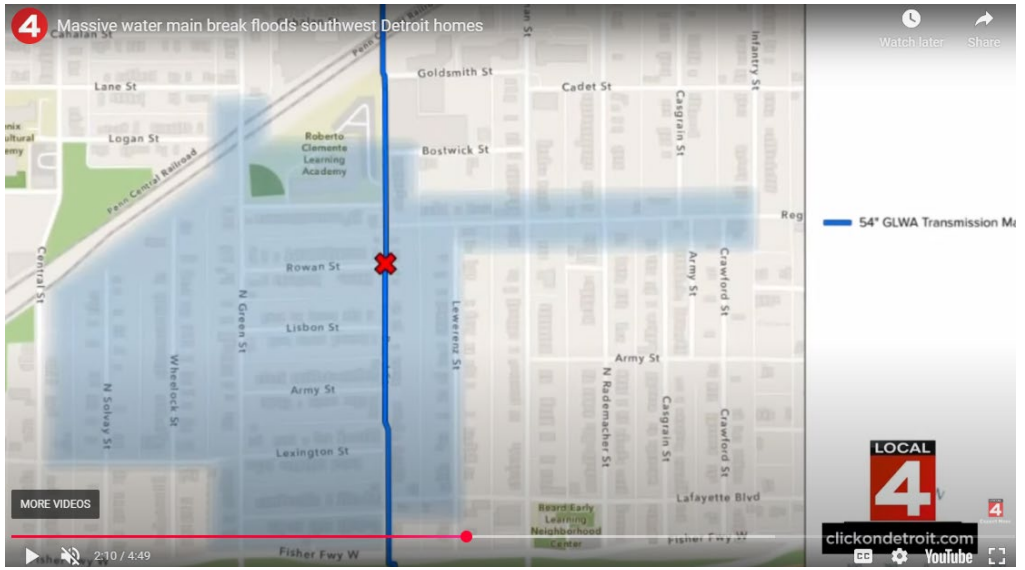
- Pipe segments renewed:
  - Pipes failed (cracks/hollows)– 20 (400 feet)
  - Pipes with significant distressed – 57 (1,043 feet)
  - Pipes nearing or exceeding strength limit– 97 (1,939 feet)
  - Pipes under the influence of cathodic protection system – 33 (632 feet)

LSIP Progress (Cont'd)

- Pipe segments renewed:
  - Primary renewal strategy has been with Carbon Fiber Reinforced Polymer (CFRP) (3,785 feet)

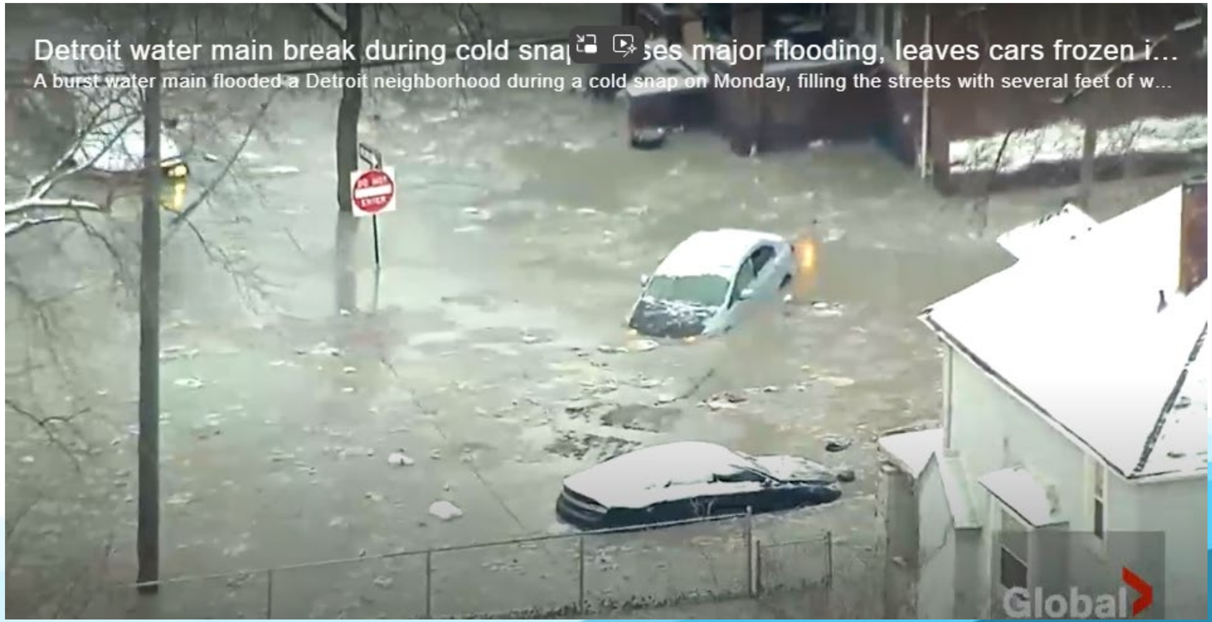
GLWA
Great Lakes Water Authority

Then GLWA's World Changed February 17, 2025



GLWA
Great Lakes Water Authority

Then GLWA's World Changed February 17, 2025



54-Inch Failure Investigation

- Metallurgical Analysis Conclusions:
  - Welding defects
    - Lack of fusion
    - Inadequate penetration
    - Low toughness properties
  - Corrosion causing:
    - Significant thinning of external weld of longitudinal seam
  - Large, discrete, external pits on pipe section – away from the rupture location were observed

DNV

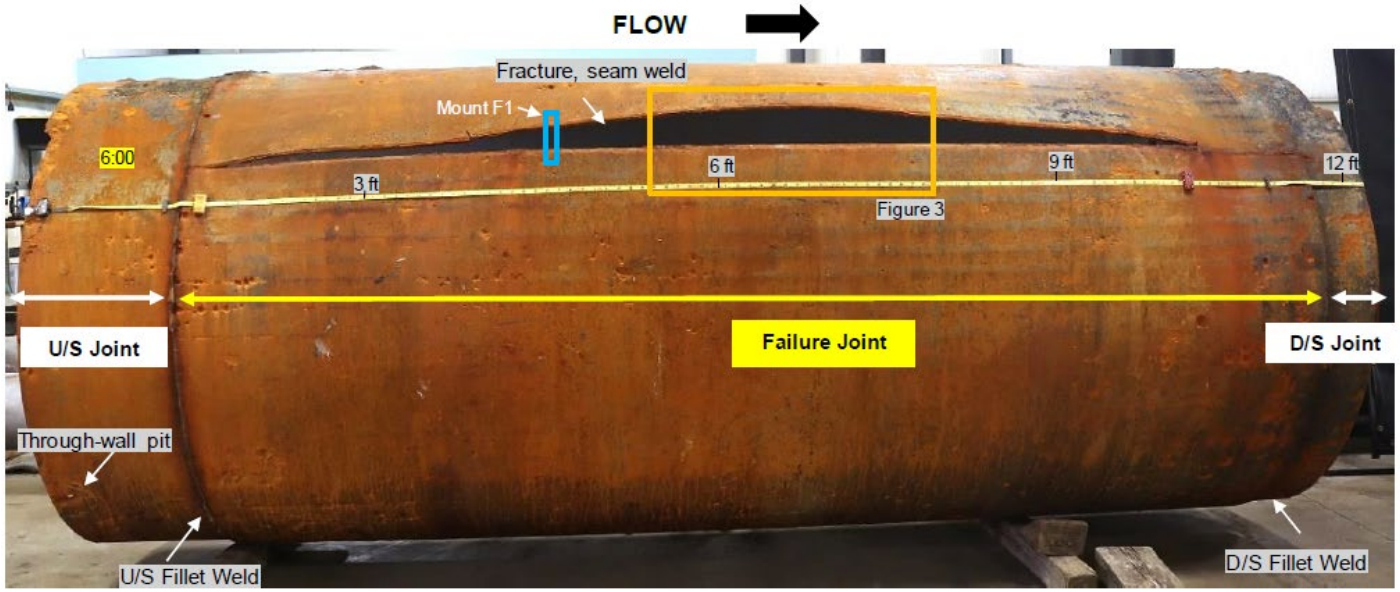
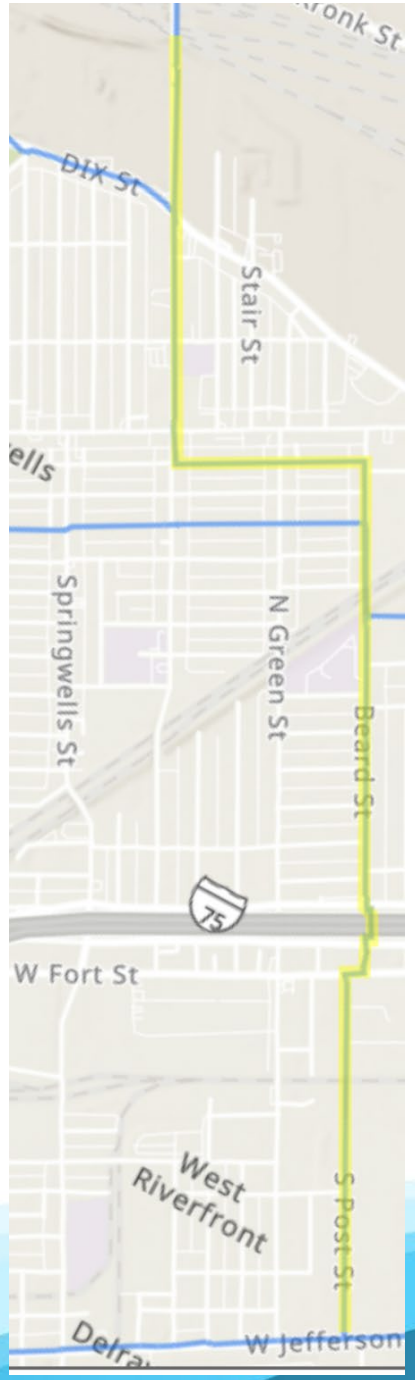


Figure 2. Photograph of the pipe section after removal from the flatbed truck. The tape measure shows the distance, in feet, downstream (D/S) from the upstream (U/S) cut end of the pipe section. The location where a metallographic mount was removed is identified by the blue rectangle.

GLWA Great Lakes Water Authority

Ongoing 54-Inch Renewal Investigation

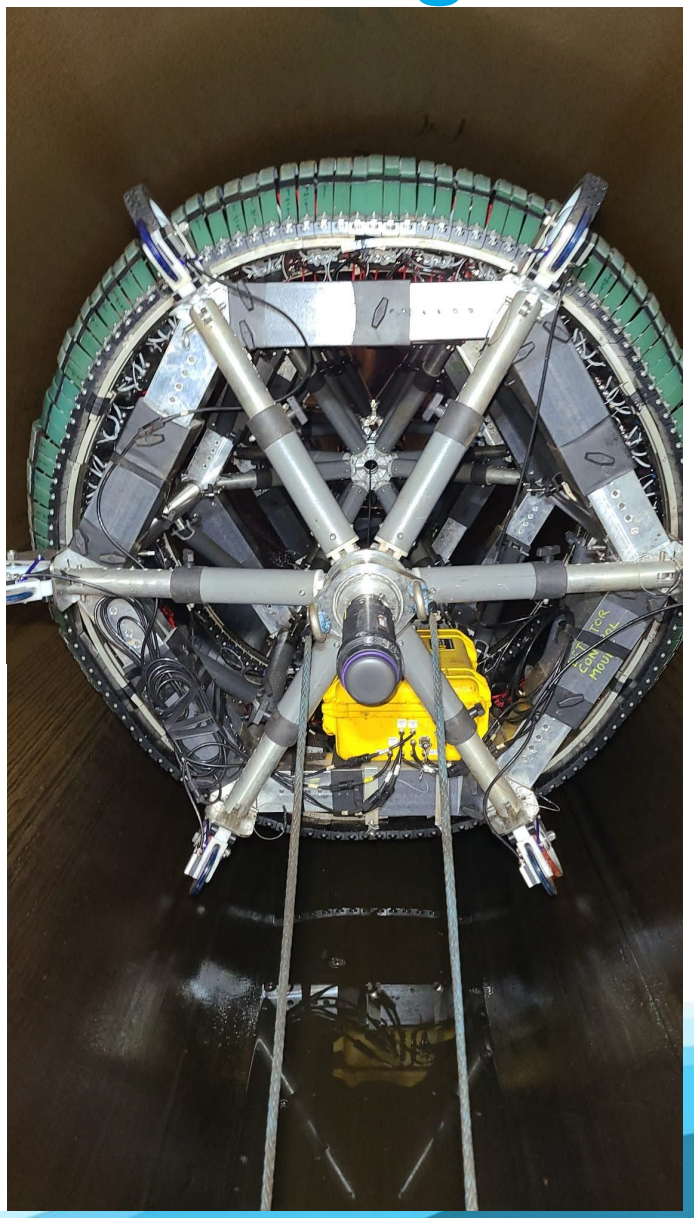
- Inspection and assessment of transmission main for design of the renewal
  - Alternative slip lining approaches being considered
- Hydraulic modeling performed to determine possibility of decommissioning portions of the main
- Multiple field investigations (valve closures) continue to:
  - Determine extent of possible decommission and renewed sections
  - Evaluate redundancy options for water supply
- Initial determination that perhaps not all of this transmission main is needed to meet service levels



GLWA
Great Lakes Water Authority

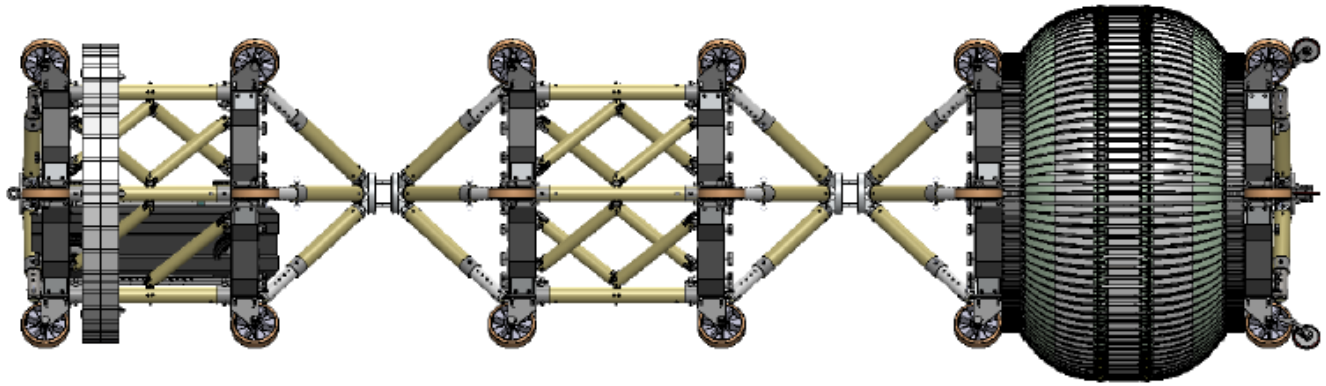
Pilot Electromagnetic Remote Field Testing (RFT) Technology

- RFT technology
  - Technology is only used on dewatered transmission mains
  - The device is brought into the pipe through access manways and reconstructed
  - The device is tethered and pulled through the pipe
  - Measures remaining pipeline wall thickness for metallic pipe
    - Possible identification of defects of the weld



PICA RFT Series

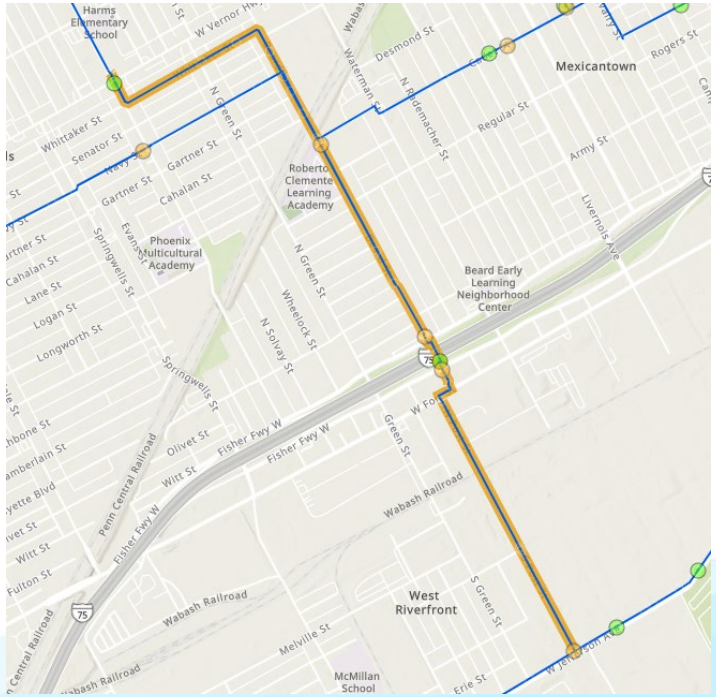
54" HEX EMIT Tool Datasheet – RFT Inspection Tool

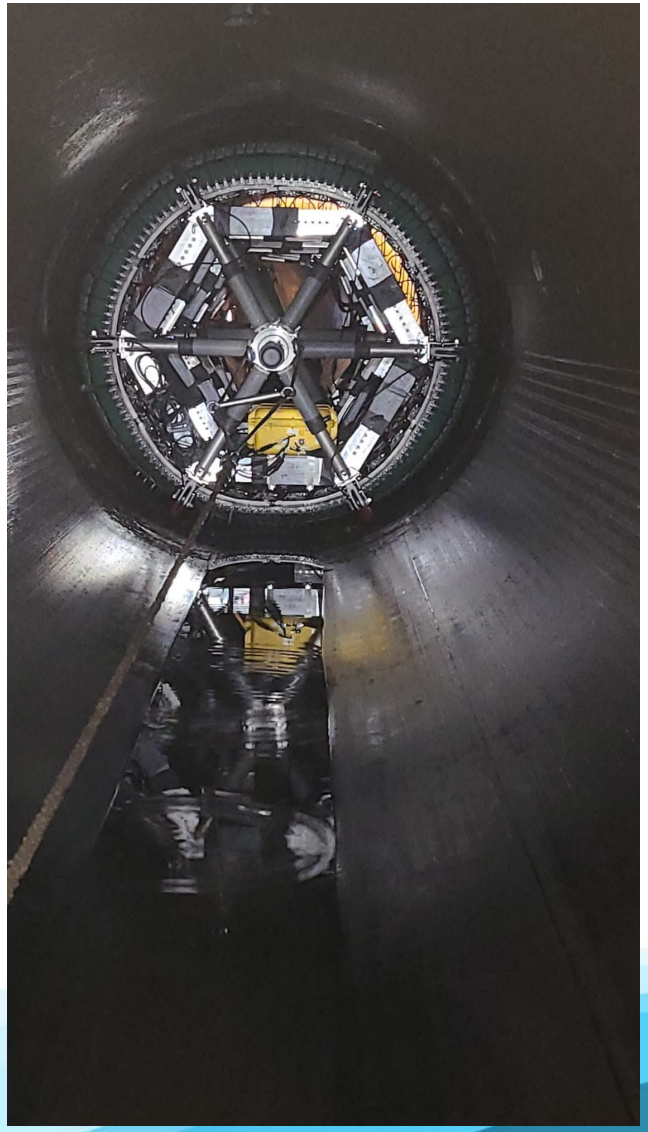


GLWA
Great Lakes Water Authority

Pilot Electromagnetic Remote Field Testing (RFT) Technology

- Currently planning and design of a pilot:
  - ½ mile section the 54-Inch
  - Portion of main currently out-of-service
- Sequencing and schedule still to be determined

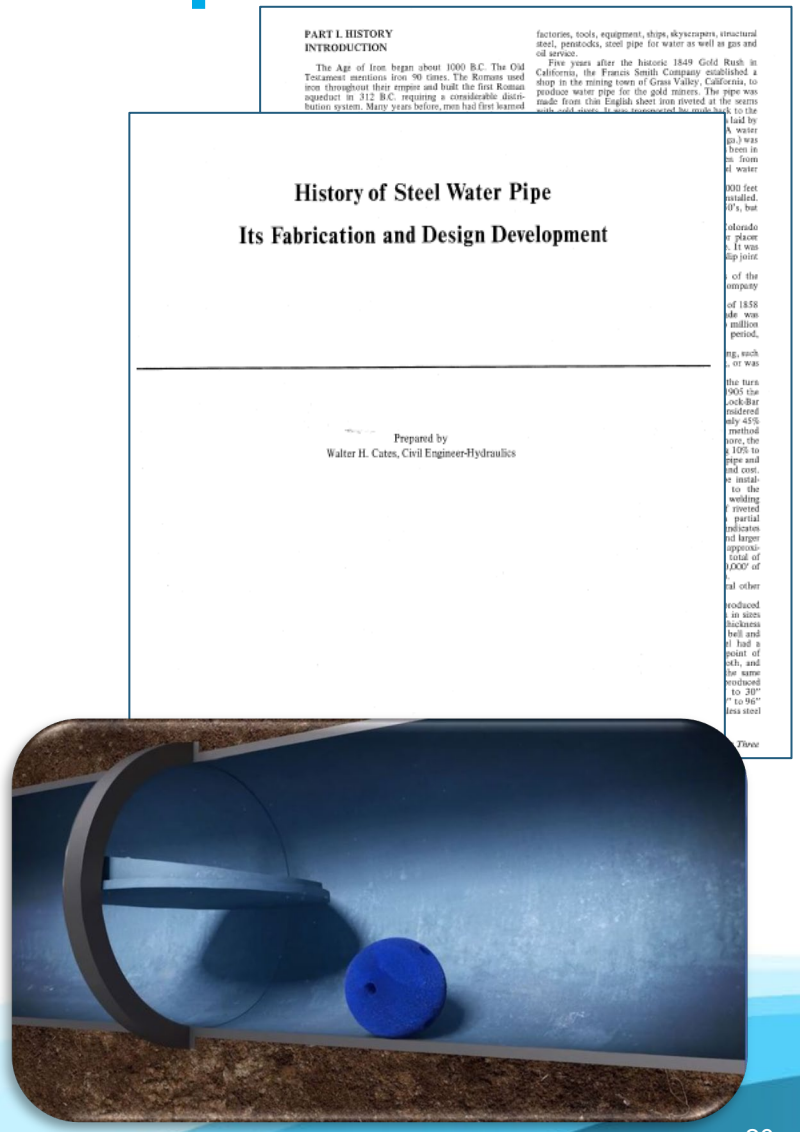




GLWA Great Lakes Water Authority

Identification of Other Welded Steel Pipes

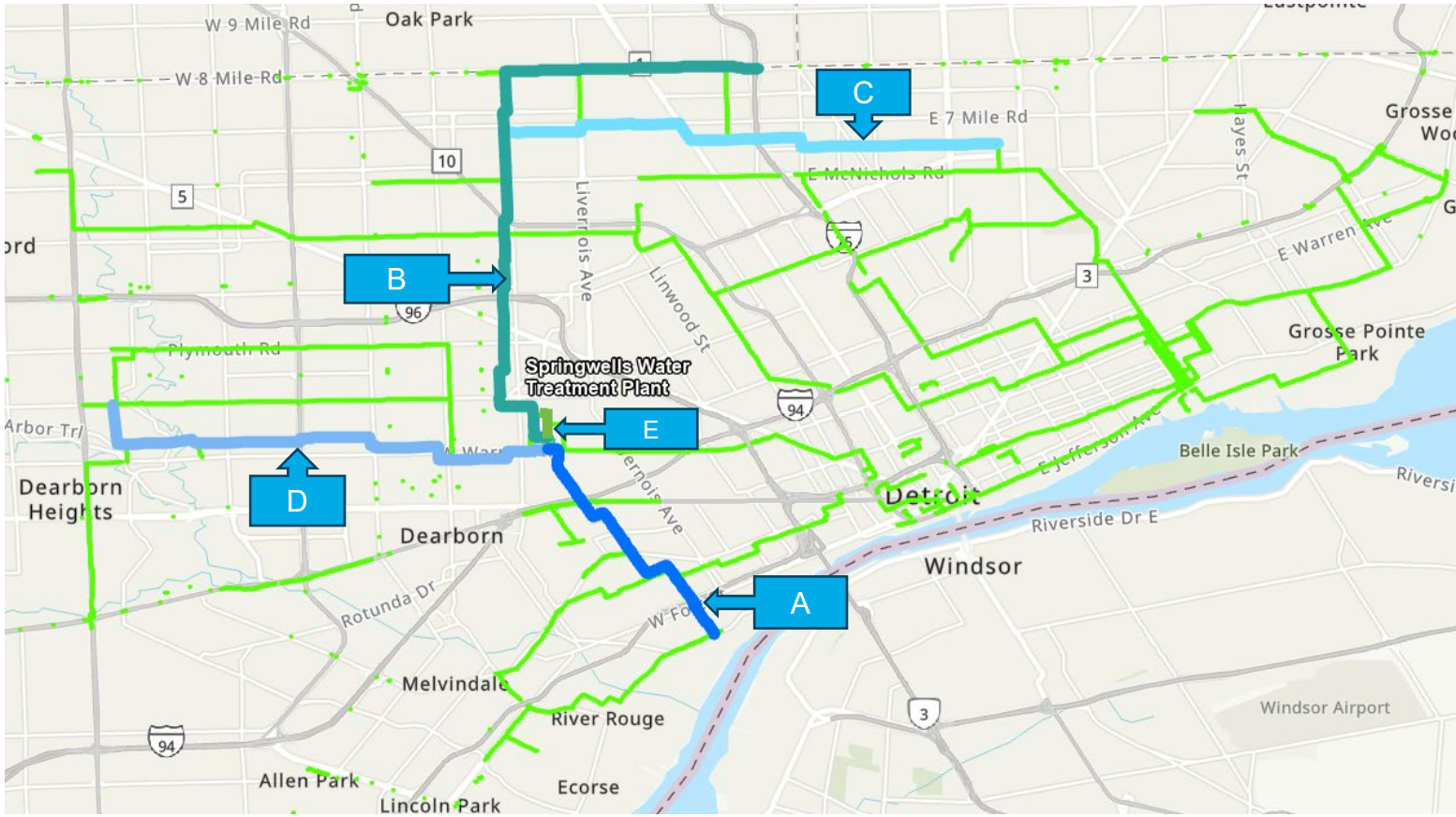
- Identification of other welded steel transmission main
  - Research as-built drawings, field reports and other documentation
  - Research era that welded steel pipelines was the primary method of construction
    - Determined to be between 1928 - 1939
    - It is believed that steel pipelines with unconfirmed construction method that are constructed in this period are welded steel
- Planning & design of condition assessment of these mains
  - Primary technology is inline leak detection
  - Technology will not identify the condition of the weld, but will generally identify the condition of the main
  - As leaks are investigated and repaired, a more detailed assessment of the main can be made



GLWA
Great Lakes Water Authority

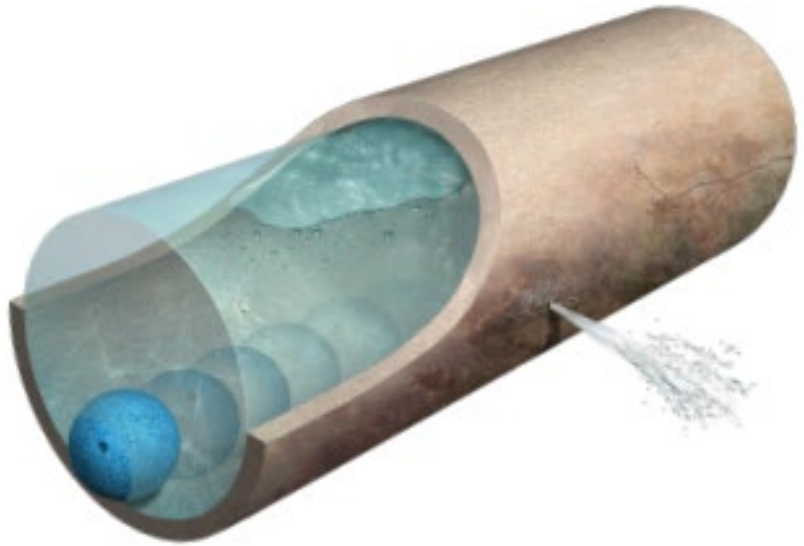
Planned Inline Leak Detection

Welded Steel - 1928-1939	Length (Miles)
A: Springwells Water Treatment Plant to W Jefferson (Beard Street 54")	4.7
B: Springwells Water Treatment Plant to I75 via 8 Mile Road	11.0
C: Clarita/Washburn to Nevada/Carrie	7.2
D: Springwells Water Treatment Plant to Hazelton/Joy Rd	7.3
E: Springwells Water Treatment Plant to Wisconsin/Belton	0.6
Total	**30.8**



54-Inch Renewal Investigation Follow-Up

- Process
  - Requires taps at insertion and extraction locations
  - Insert device into a live transmission main
  - Carried along the pipe with the flow of water
  - “Listens” for leaks in the pipe
  - As the device travels along the pipe, valves at connected mains must be closed
- Coordination and communication strategy will be developed with DWSD
- Inline leak detection is currently under planning and design
- Sequencing and schedule still to be determined



GLWA
Great Lakes Water Authority

Evolution of the Linear System Integrity Plan

- Evolve LSIP to a more comprehensive renewal strategy by considering:
  - Decommissioning 127 miles of candidate water main
  - Renewing/replacing pipelines exceeding their useful life – primarily metallic pipe
  - Continuing Prestressed Concrete Cylinder Pipe inspections and renewal
  - Updating prioritization to better account for flooding impacts to public health & safety

GLWA
Great Lakes Water Authority

Linear System Integrity Program
Key Take-Aways

- Objective since GLWA inception was to move from reactive to proactive
- Established the Linear System Integrity Program (LSIP)
- Significant analysis occurred following the 54-inch main break in February 2025
- Evolution to a more comprehensive “Water Transmission Main Renewal Strategy” is being developed
- Long-term funding is the biggest challenge (To be continued 10/8)

GLWA
Great Lakes Water Authority

Questions & Discussion

GLWA
Great Lakes Water Authority