

Preserving Mid-Century Water Infrastructure:

CFRP Upgrade of 1949 Cast Iron Pipe Beneath Cedar Springs Road Culvert

IDB APPROACH



**Dallas
Water Utilities**

struc'tural
TECHNOLOGIES

A Structural Group Company



MIKE LARSEN, ASSOC. DBIA

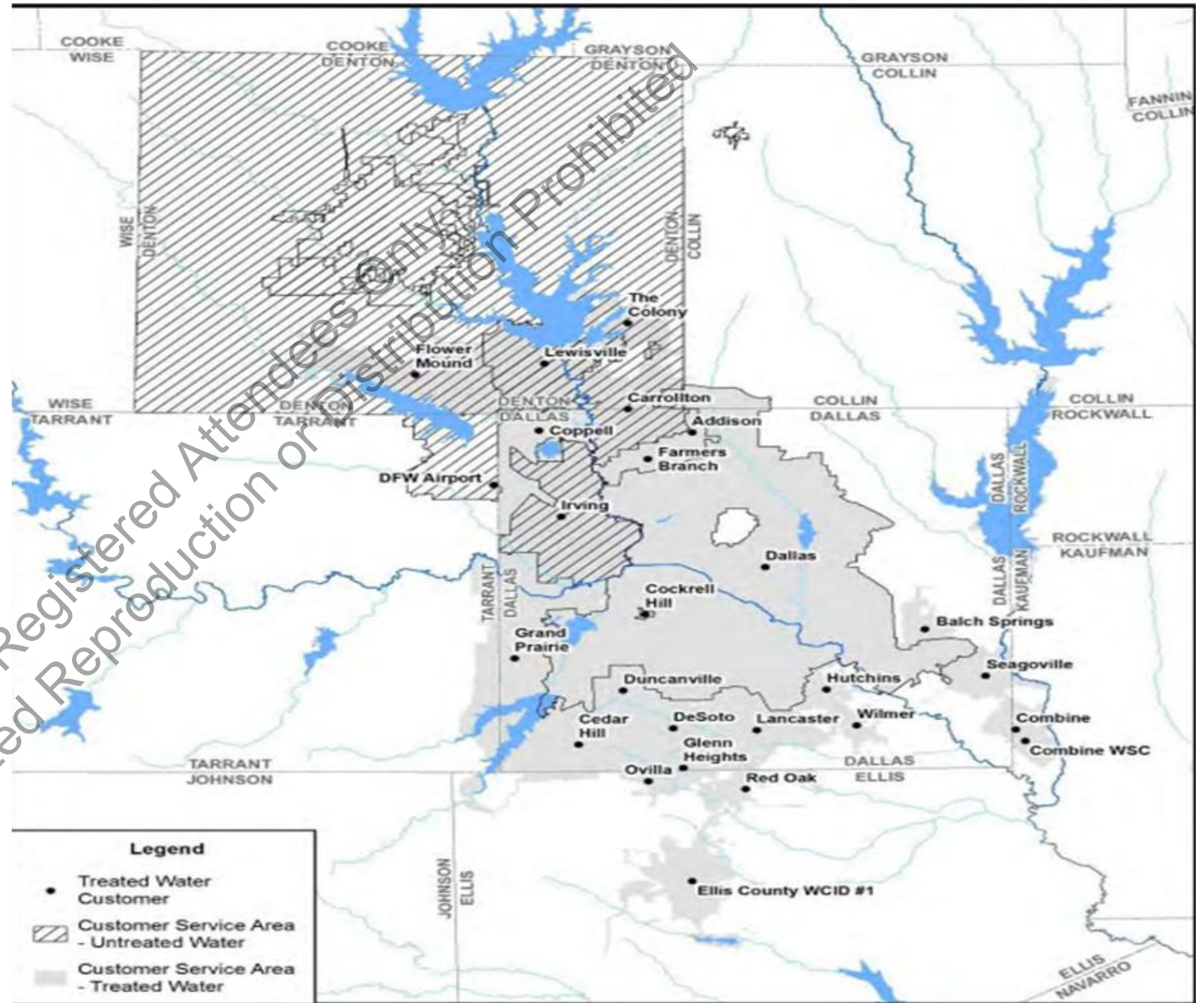
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City of Dallas, Dallas Water Utilities

- 5,000 miles of water mains
- 600+ miles of concrete water lines
- Water mains span 5 counties in north Texas



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Project Purpose

- 💧 Rehab of 42" transmission water main under storm box culvert
- 💧 Minimize disruption
- 💧 Maintain water supply, fire protection
- 💧 Extend service life 50+ years



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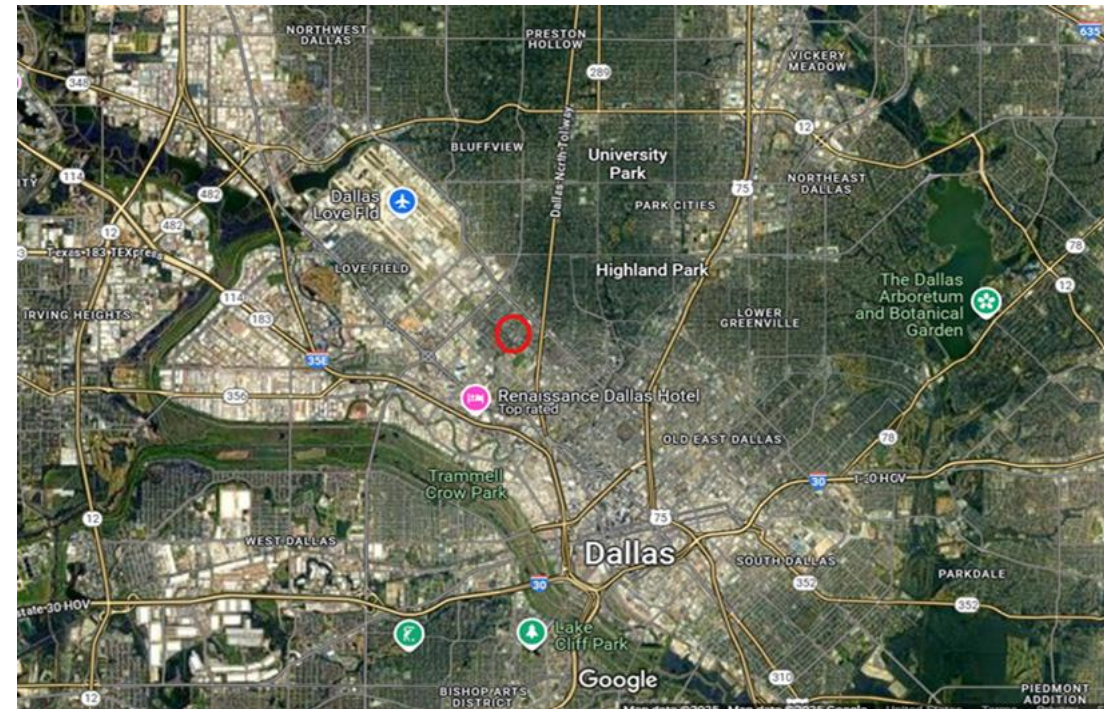
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Project Overview



- Manufactured in 1949
- 42" Cast Iron Pipe (CIP)
- 9/2021 Pure identified leak
- DWU constructed 2 new 24"-diameter manholes



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Access Manway & Valve Installation

Materials & ~costs to create access points and isolate area

- tees 42x24 x2: \$ 54,125
- 42-gate valve: \$ 119,875
- gaskets & bolts x4 : \$ 9,910
- 42" DI pipes (20'): unavailable
- solid sleeves x2: unavailable
- 24" flanges & gaskets x2: \$700
- 4" valves x2: \$ 832
- ~Total: \$257,549.00
- 4" blind flanges x2: \$ 400
- 5' manholes & covers x3: \$6,000
- spool pieces flangedx2: \$ 44,707+
- 6 hrs. crane & operator rental: \$2,000
- Sahara Inspection x2: \$9,500 each
- traffic control: unavailable

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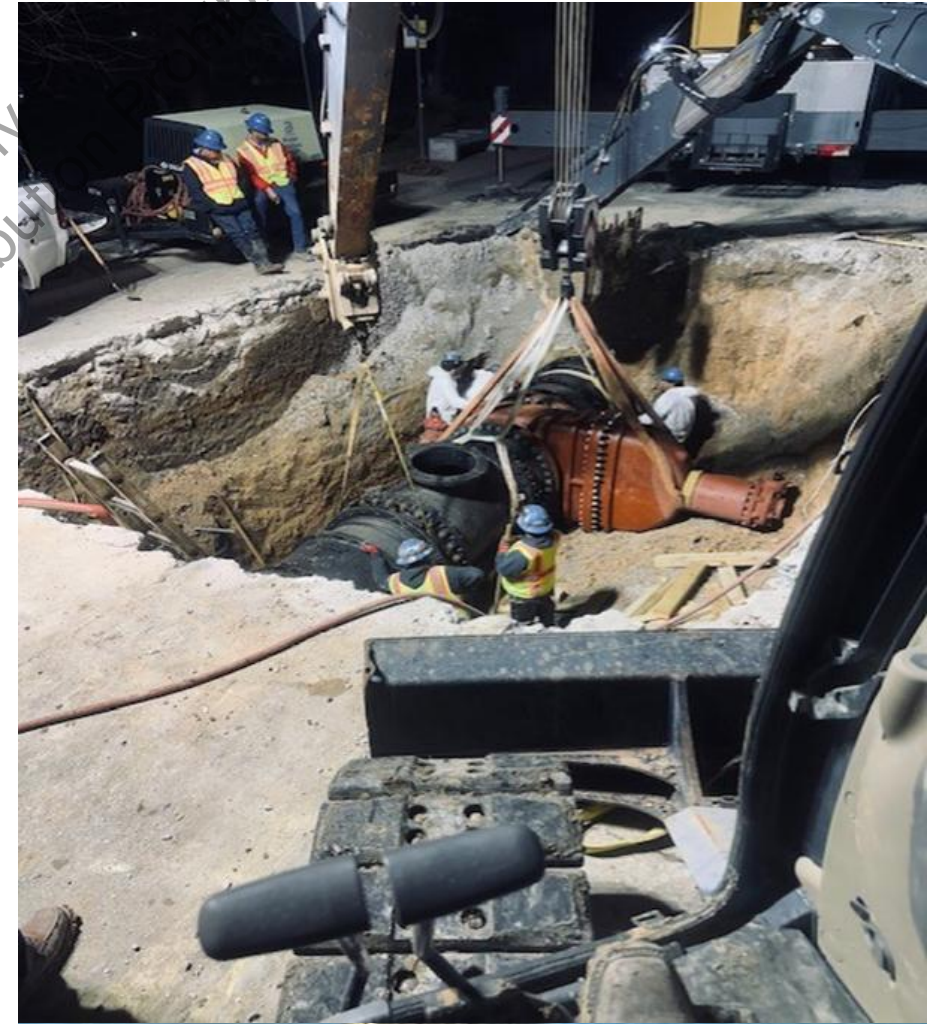
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Access Manway & Valve Installation

Schedule

- 02/24/2025 Traffic control for 4 days (to 02/27/2025)
 - Cedar Springs will be closed for about 5 hours on 02/25/2025.
- 02/25/2025 Install 42-inch valve and a tee
- 02/25/2025 Install 2nd “tee” on the east of the creek
- 02/26/2025 Unforeseen activities (Buffer)
- 02/27/2025 Loading and placing back in service.
- Cleaning
- 03/10/2025 Traffic control and setting for Structural (to 03/30/2025)
- 03/10/2025 Valve operation to isolate and dewater area (3 days)
- 3/10/2025 Heavy repair to remove flanges and continue dewatering and prepare to mitigate leak-by if necessary
- 03/12/2025 Start Carbon Fiber project



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Project Overview: Internal Investigation

- Pipeline drawings indicating joint locations or other features did not exist, probable leak locations could not be established.
- SGH Performed an internal V&S inspection of the pipes to check for signs and potential source(s) of leakage and assist in determining the final repair scope.

Summary of observations:

- Four 45-degree vertical bends, two on each side of the culvert.
- CIP wall thickness is approximately 1 in., lined with an approximately 0.25-in. thick cement mortar lining.
- 8-in. diameter blow-off in Pipe 10.
- Pipes 9 to 11 sounded different from the others, with the sounding characteristics of encased pipes.
- CML had spalled, exposing CIP in small areas in Pipes 16 and 18.
- Pipe joints were not mortared, with joint openings ranging from zero to 4.5 in. wide.
- No signs of active or recent leaks, the joint openings, especially the wider ones, were the most likely location(s) for leakage



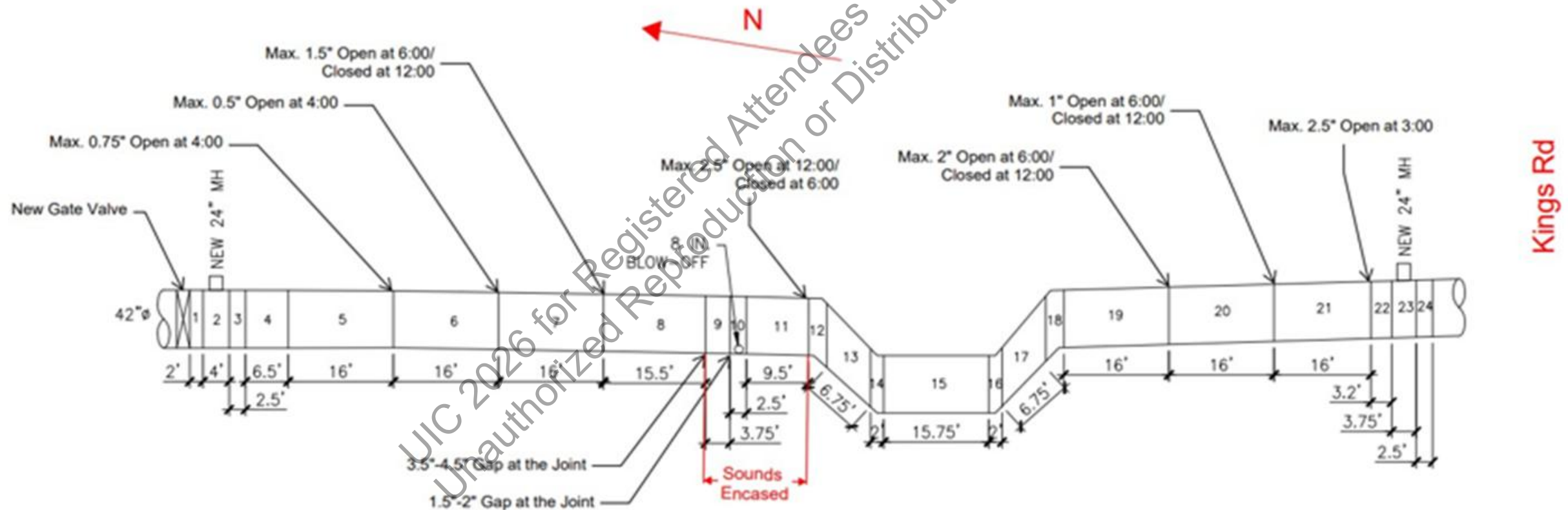
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Project Overview: Internal Investigation

Summary of Initial Condition Inspection of observations



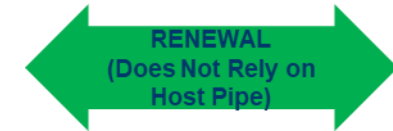
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Renewal Process Begins with how much renewal is needed...

Rehabilitation vs. Renewal



Liner Characteristics	Structurally Interactive		
	Coating	Hole & Gap Span	Hole & Gap Span + Ring Stiffness
	Class I	Class II	Class III
Corrosion protection	✓	✓	✓
Reliable adhesion to host pipe	✓	✓	
Hole & gap span at maximum allowable pressure (MAOP)		✓	✓
Inherent ring stiffness (hydrostatic pressure loads)			✓
Positive connection to service taps and sealed at other discontinuities (water tightness)			✓
Inherent ring stiffness (all external and vacuum loads)			
Pressure rating of liner $\geq$ MAOP of host pipe			
Liner survives host pipe failure			

Structurally Independent
Structural Resistance for All Loads (Internal + External)
Class IV
✓
✓
✓
✓
✓
✓
✓

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Structural Upgrade with V-Wrap™ CFRP Systems

- Light-weight, thin materials; high strength-to-weight ratio
- Rapid installation process
- Code approval - ICC Report (ESR-3261)
- Comprehensive design support
- Fully trained installation crews with extensive experience

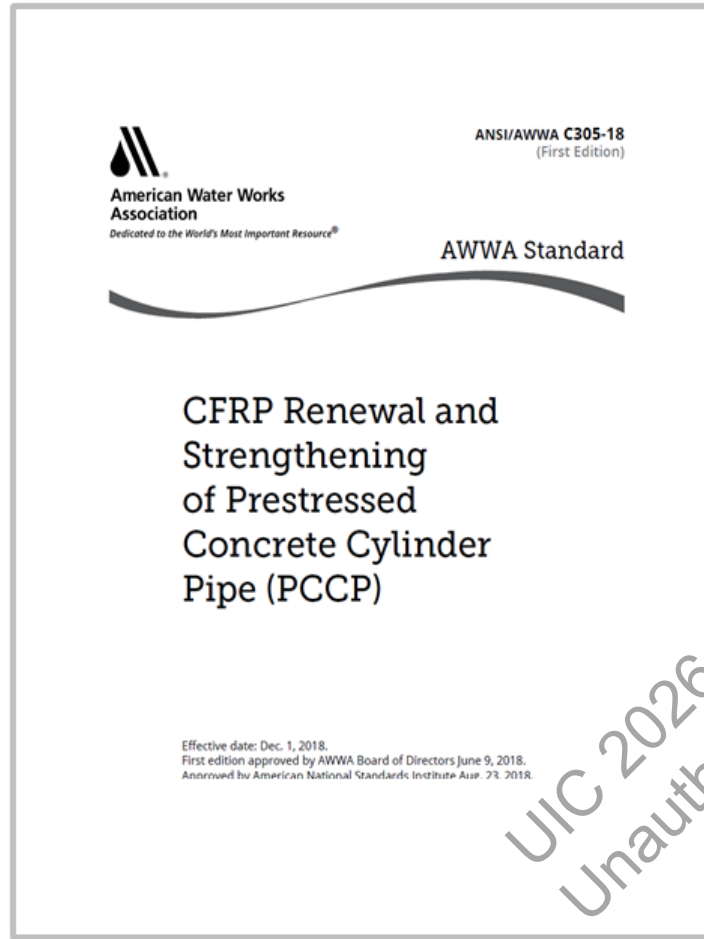


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Repair Design: CFRP Lining



Design Methodology based on AWWA C305: Class IV Standalone System to resist all design loads without relying on strength contribution from the host pipe

- Working pressure = 81 psi.
- Transient pressure = 40 psi.
- Vacuum pressure = -14.7 psi.
- Soil cover = 12 ft (maximum soil cover height per plan and profile drawing).
- Groundwater height above pipe crown = Soil cover height.
- Live Load: HL93 (repair pipes are under a roadway).
- Temperature Differential = $\pm 40^{\circ}\text{F}$.
- Thrust = Calculated according to AWWAM9.

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Installation Steps



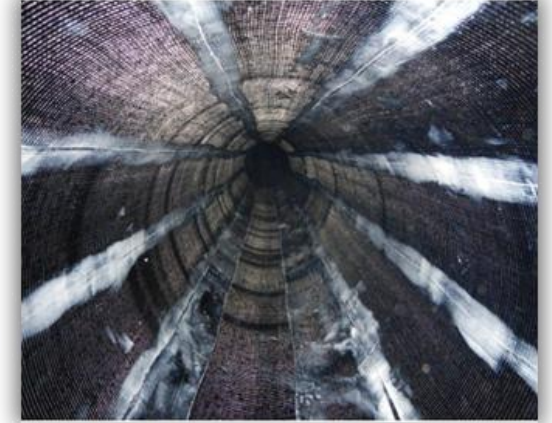
Dewatering



Surface preparation



Primer



Longitudinal layers



Watertightness layer



Hoop layers



Terminations



Topcoat and curing

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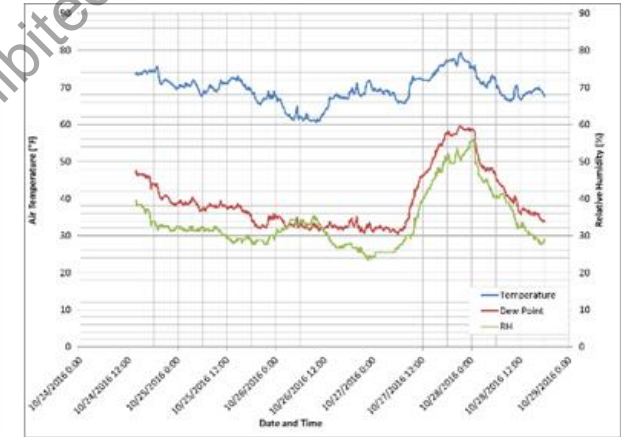
Quality Assurance Inspections



Monitoring material storage and mixing



Saturation



Monitoring environmental conditions inside the pipeline



Verifying surface preparation and terminations



Mockup testing



Verifying all installation details

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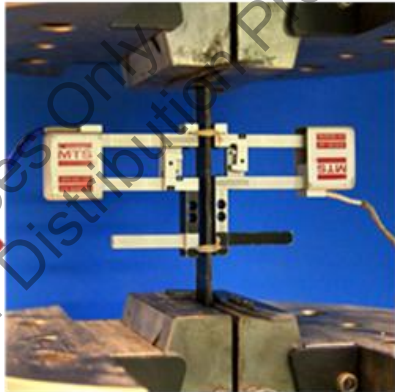
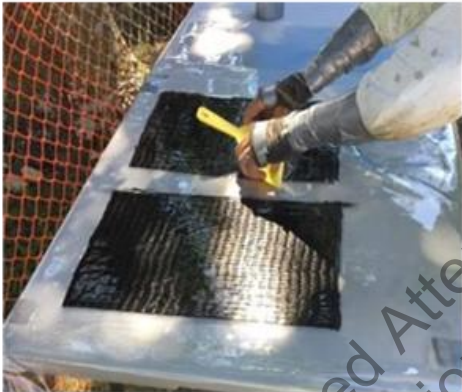
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Laboratory Testing for QA

Tension Tests (ASTM D3039)

Make witness panels in the field and verify tensile properties in the lab



Degree-of-Cure Tests (ASTM E2160)

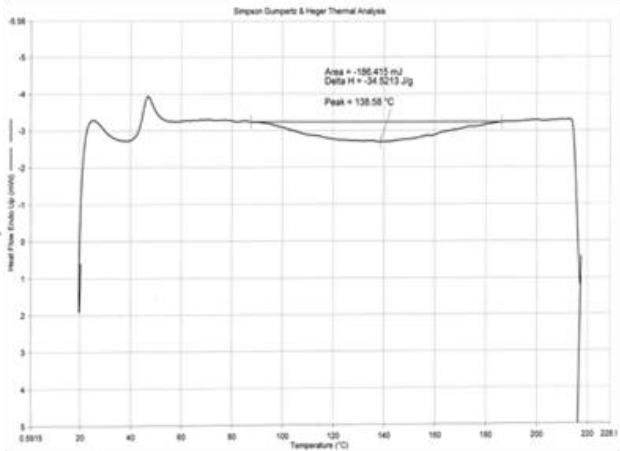
Take samples in field



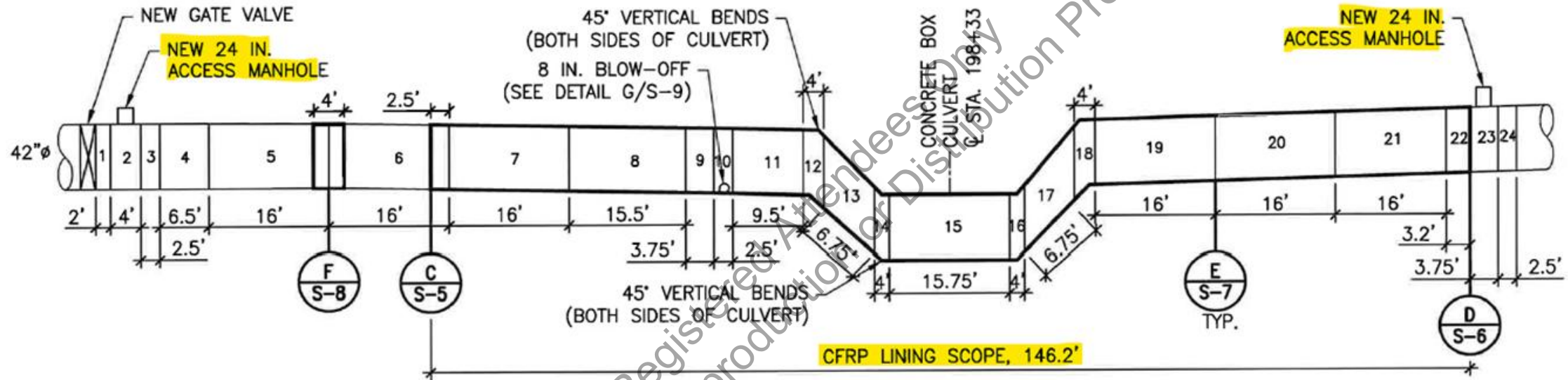
Overnight to lab



Determine degree of cure by DSC



Project Overview: CFRP Repair



- SPS performed the repair 12 March to 27 March 2025.
- 146 LF under culvert on Cedar Springs Road.
- SGH provided onsite engineering support, CFRP Design & QA/QC

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CFRP Composites installation steps in 42" CIP

Topside Generator and Dehumidifier
and waterwall traffic control protection

*New access manholes
in Pipe 2 and 23*



*Mixing & Saturation
Tents*



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CFRP Composites installation steps in 42" CIP

*Surface prep on Cement
Mortar Lining*



*Mockup panel installed
on CML surface*



*Mockup panel installed
on CIP surface*



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CFRP Composites installation steps in 42" CIP

Hoop & Longitudinal layer installation



Watertightness layer & final topcoat & expansion ring termination



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Conclusions

- Collaborative IDB team to develop & implement solution
 - structural requirements met ✓
 - downtime reduced ✓
- Efficient solution for critical pipelines with:
 - difficult-to-access locations
 - short shutdown
 - lack of redundancy

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LUIS BODINGTON P.E.



Questions?

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