PNCWA 2009
SHARING SOLUTIONS
Technology and the Workforce ♦ Sept. 13-16 ♦ Boise ID

BROWN AND CALDWELL

LASER PROFILING AND IT'S USE IN PIPE ASSESSMENT AND REHABILITATION

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Brown and Caldwell

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Brown and Caldwell

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City of Portland

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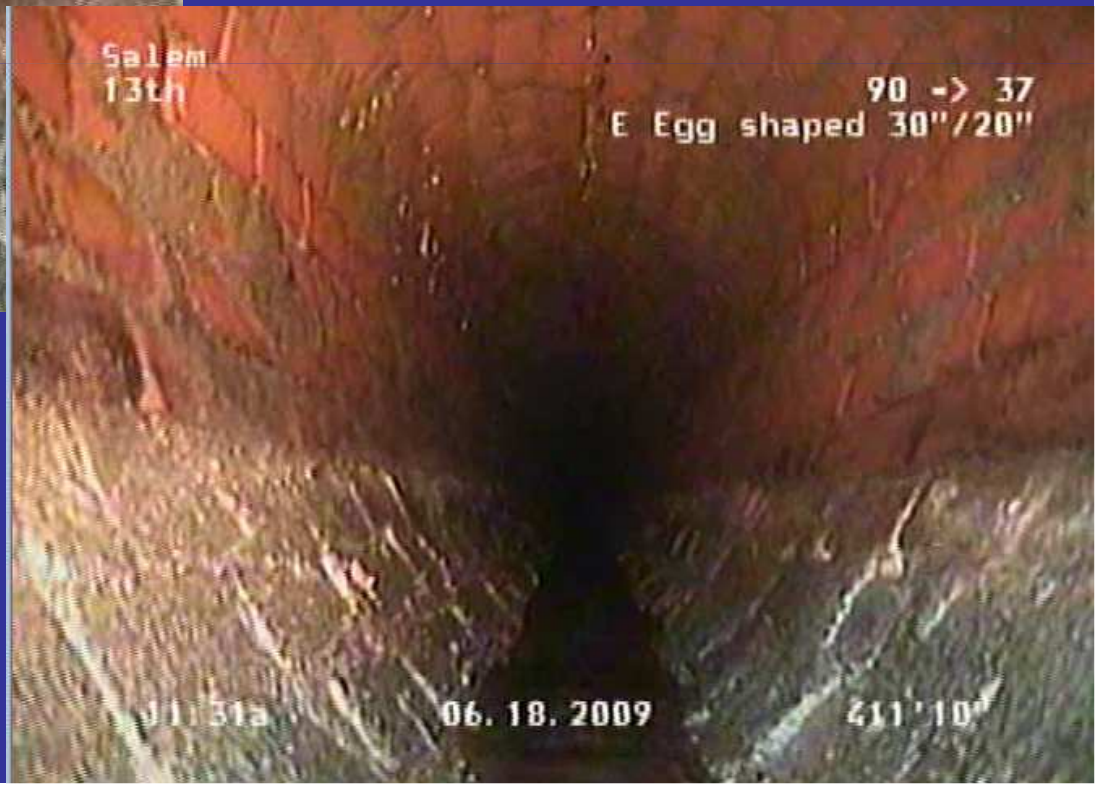
CCTV vs Profiling



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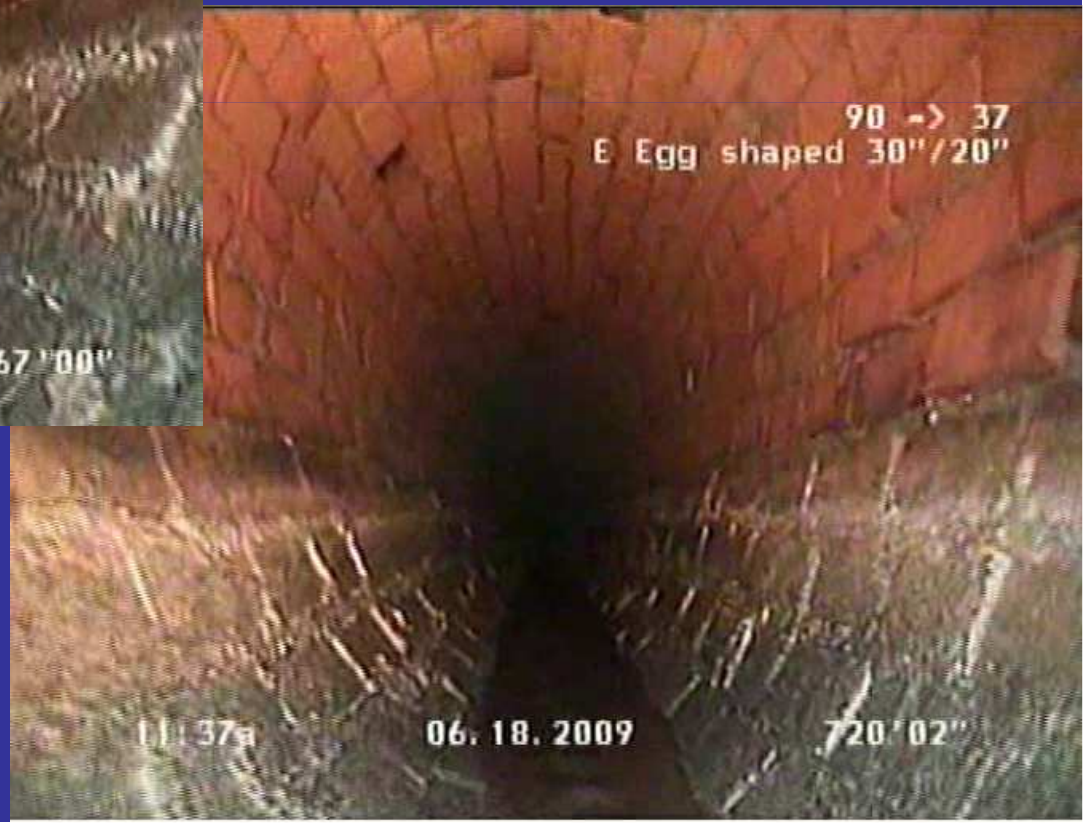
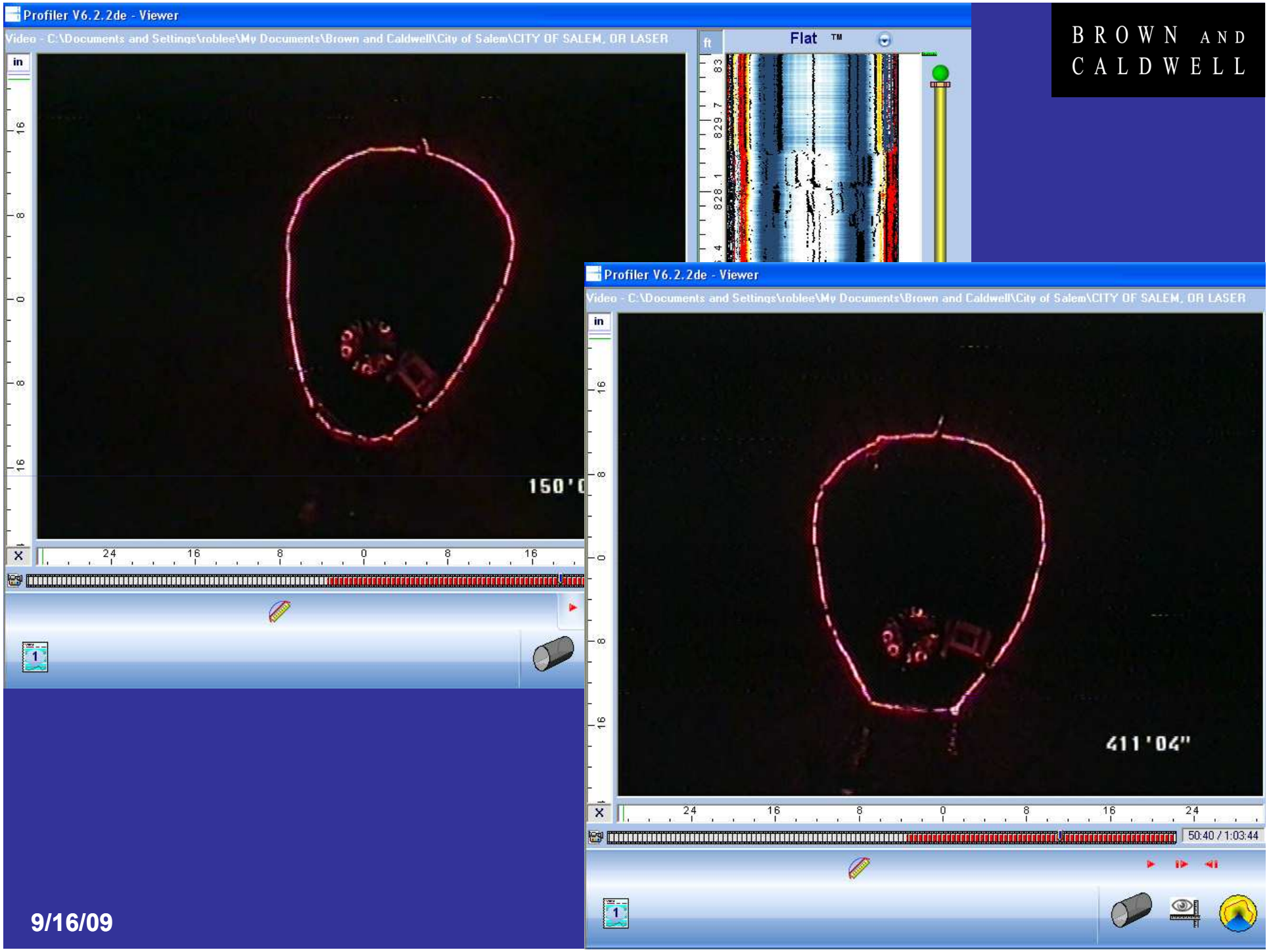
CCTV vs Profiling




Profiler V6.2.2de - Viewer
Video - C:\Documents and Settings\roblee\My Documents\Brown and Caldwell\City of Salem\CITY OF SALEM, OR LASER
Flat ™
Profiler V6.2.2de - Viewer
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411'04"
50:40 / 1:03:44
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Circumference varied from 74.5 inches to 78.6 inches

9/16/09

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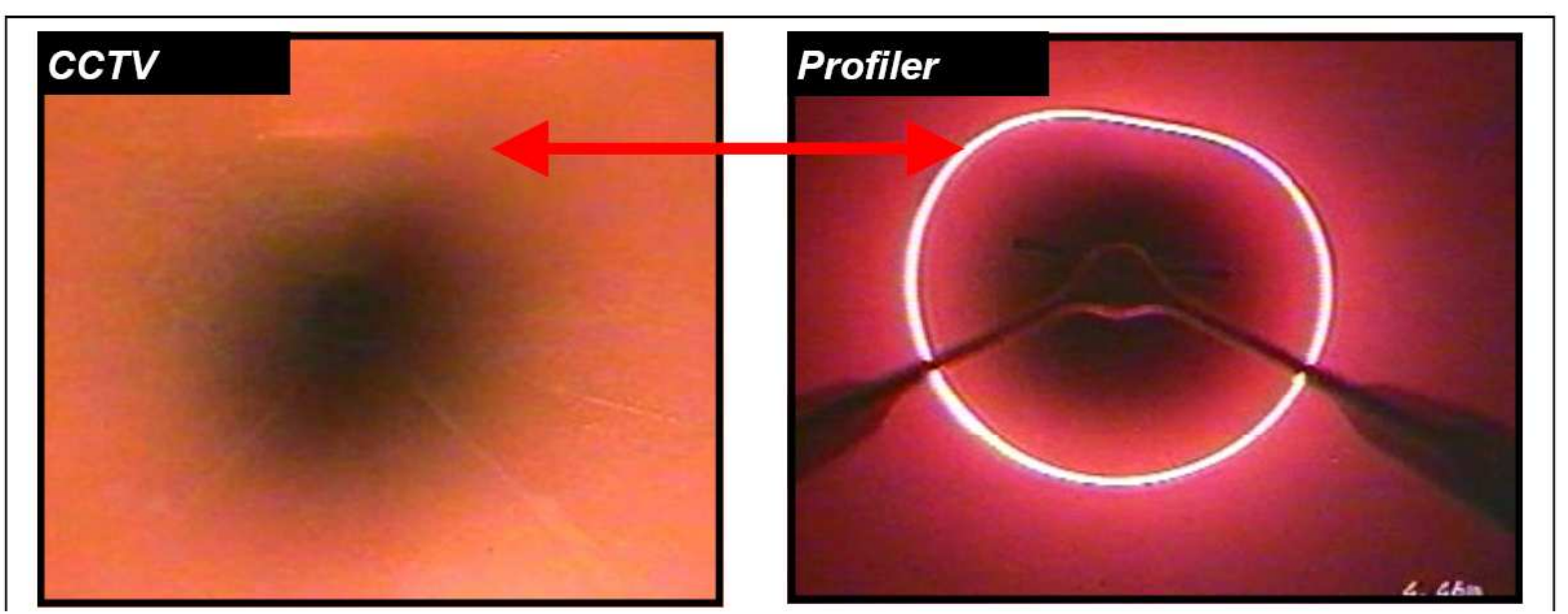
Intro to Laser Profiling

- Projected ring of laser light
- Laser image in conjunction with CCTV
- Analysis is performed on the laser light ring to build a digital profile via dimensional measurements



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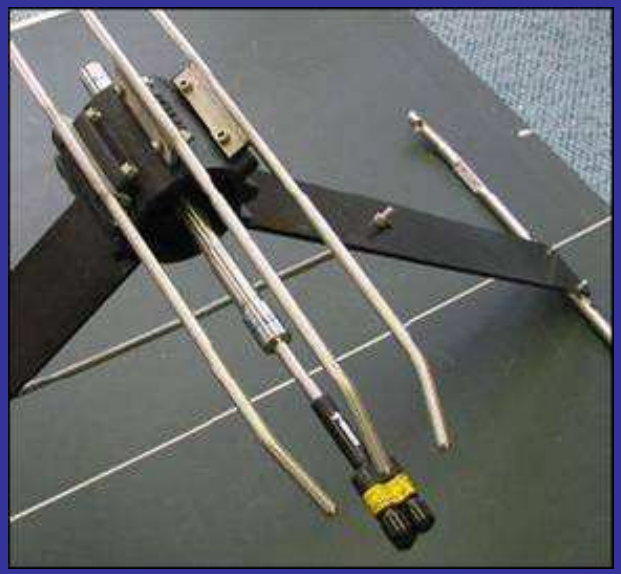
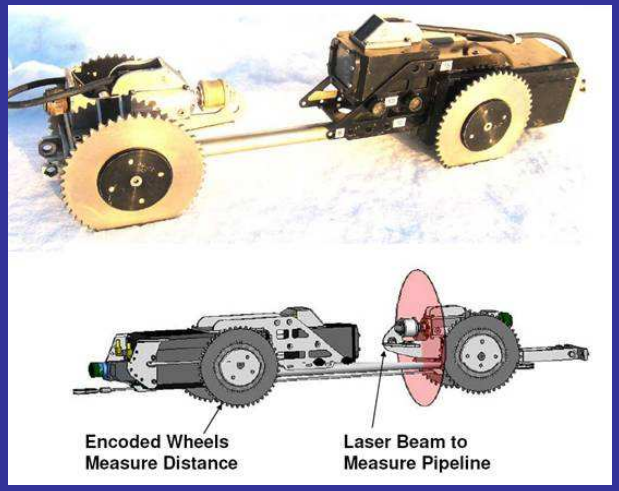
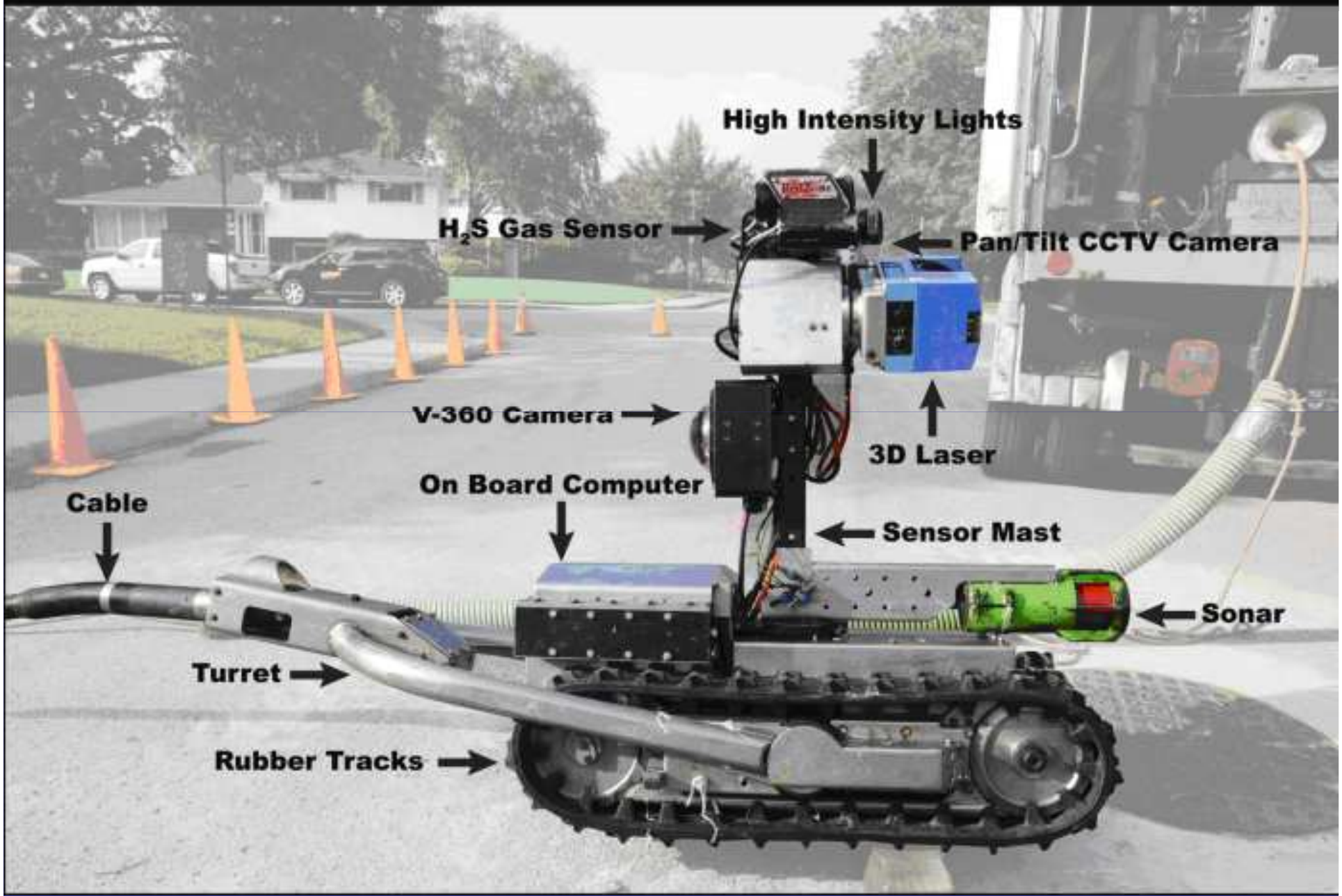
Examples of Laser Profilers

- Separate Unit (Towed)
- Camera Mounted
- Multi-Sensor





REDZONE MULTIPLE SENSOR ROBOT



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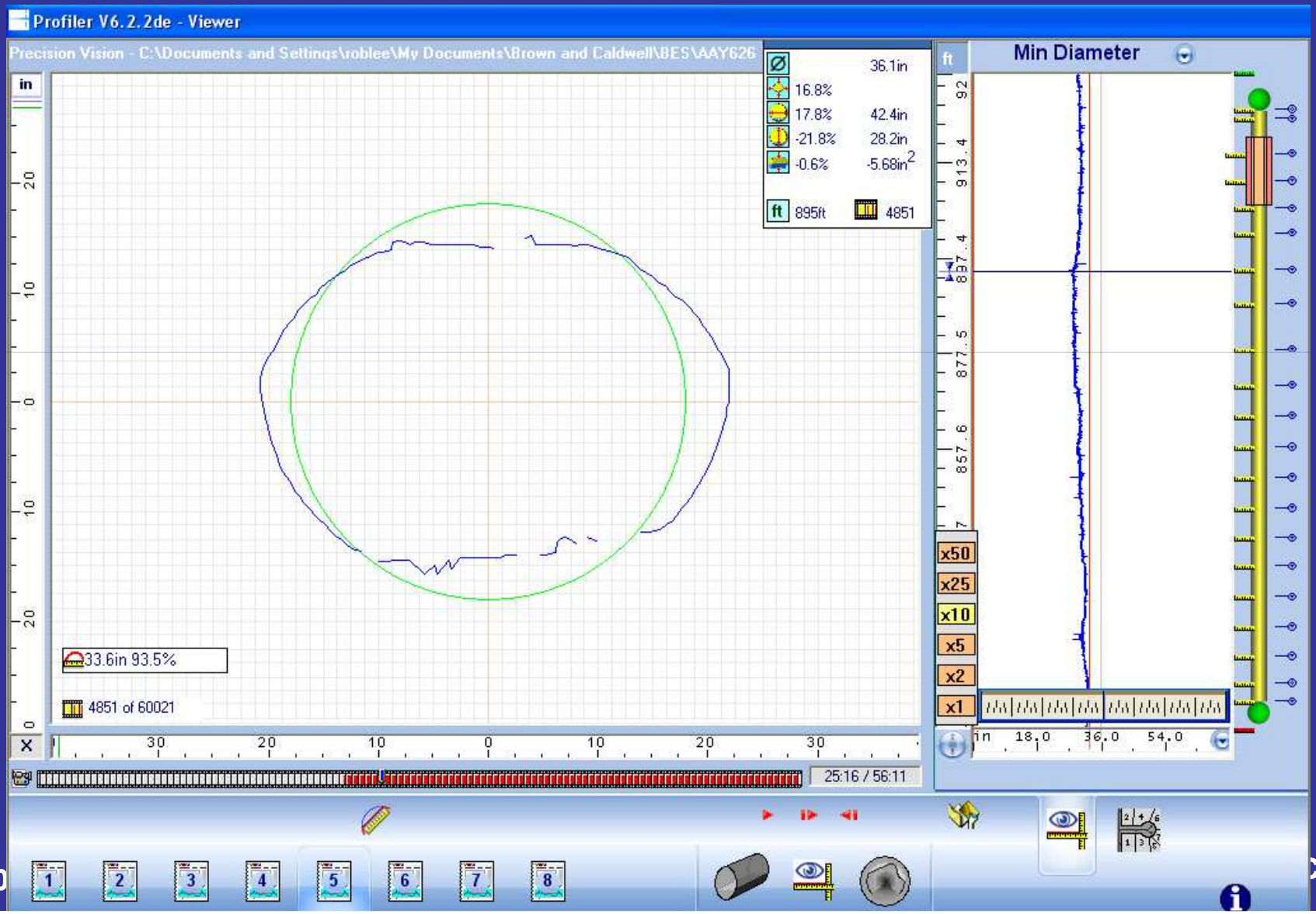
Laser Profiling Output



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Limitations

- Inspection above the flow or debris surface
- Some units need clear access from MH to MH
- Radius of curvature required (i.e., box culverts and horseshoe conduits)

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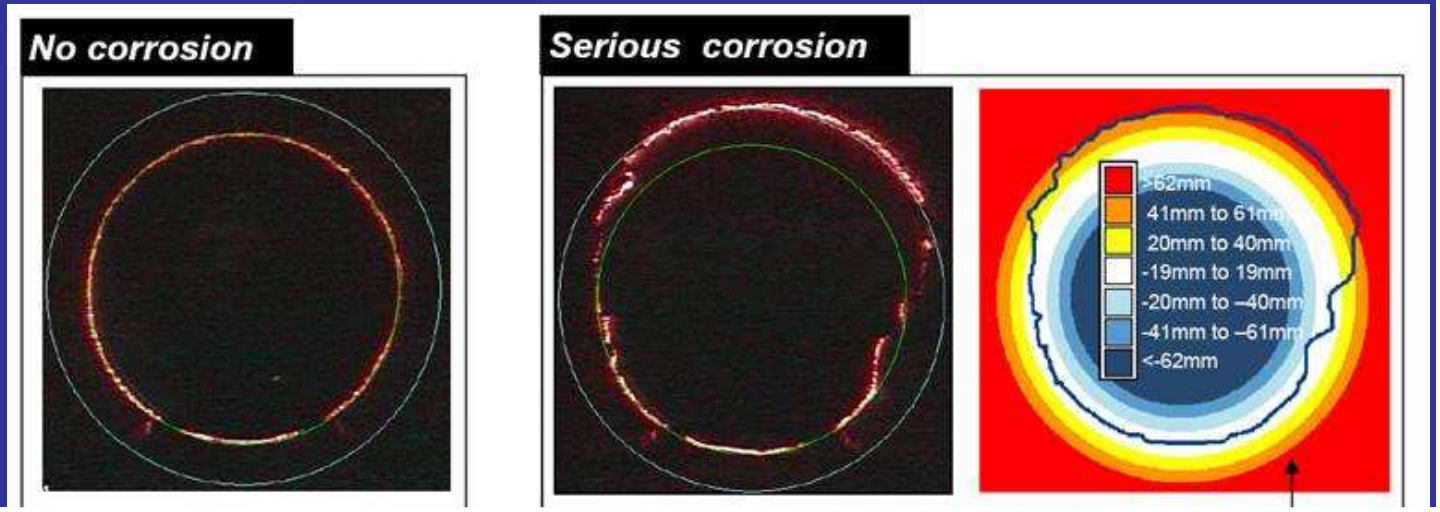
Applications

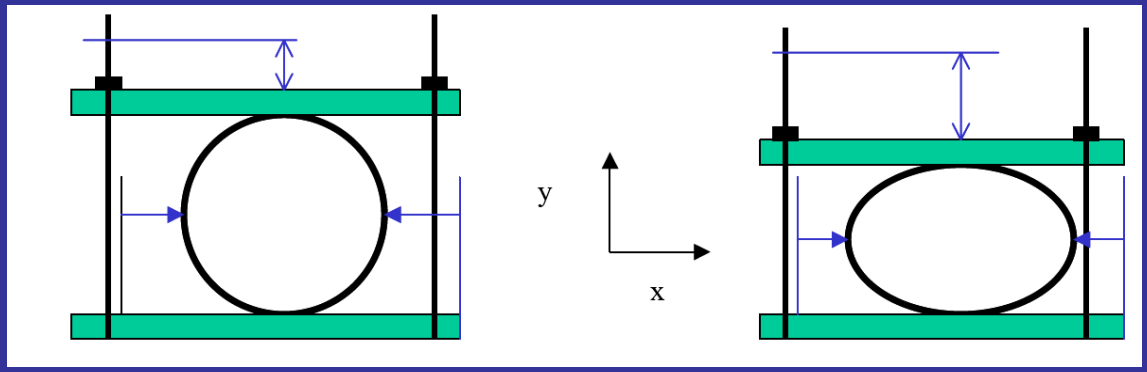
- Ovality and deformation (Arizona and Florida DOTs)
- Flow capacity and pipe size
- Pipe corrosion and surface spalling
- Lateral and hole sizing
- Quantify debris/Water level
- CIPP condition (i.e., defects) and thickness



Ovality

- Key Parameter in Pipe Design
  - Long-Term Design Life
  - Rehabilitation and New Construction
- Defined by F1216

$$Percent\ Ovality = 100 \cdot \left(\frac{Mean\ Inside\ Diameter - Minimum\ Inside\ Diameter}{Mean\ Inside\ Diameter} \right)$$



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Case Study 1

- City of Portland, OR
- NE 60th Avenue
- 36” Cast-in-Place Monolithic Concrete
- 25 to 35 feet deep
- Residential Neighborhood
- Perpendicular Crossing under Sandy Blvd.

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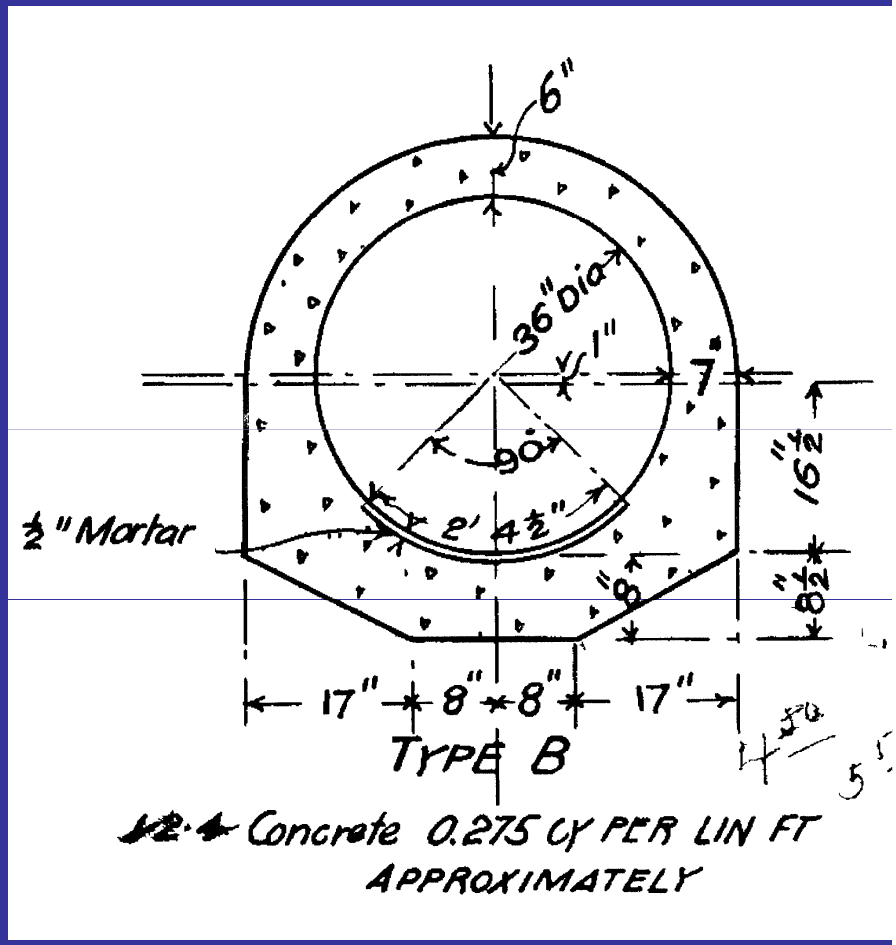
Project Drivers

- Hydraulic Modeling revealed 36” line had excess capacity
- Question of Rehabilitation versus Replacement
  - Sliplining
  - CIPP
  - Other?



AMY775 to AAY659
Sta. 0+45

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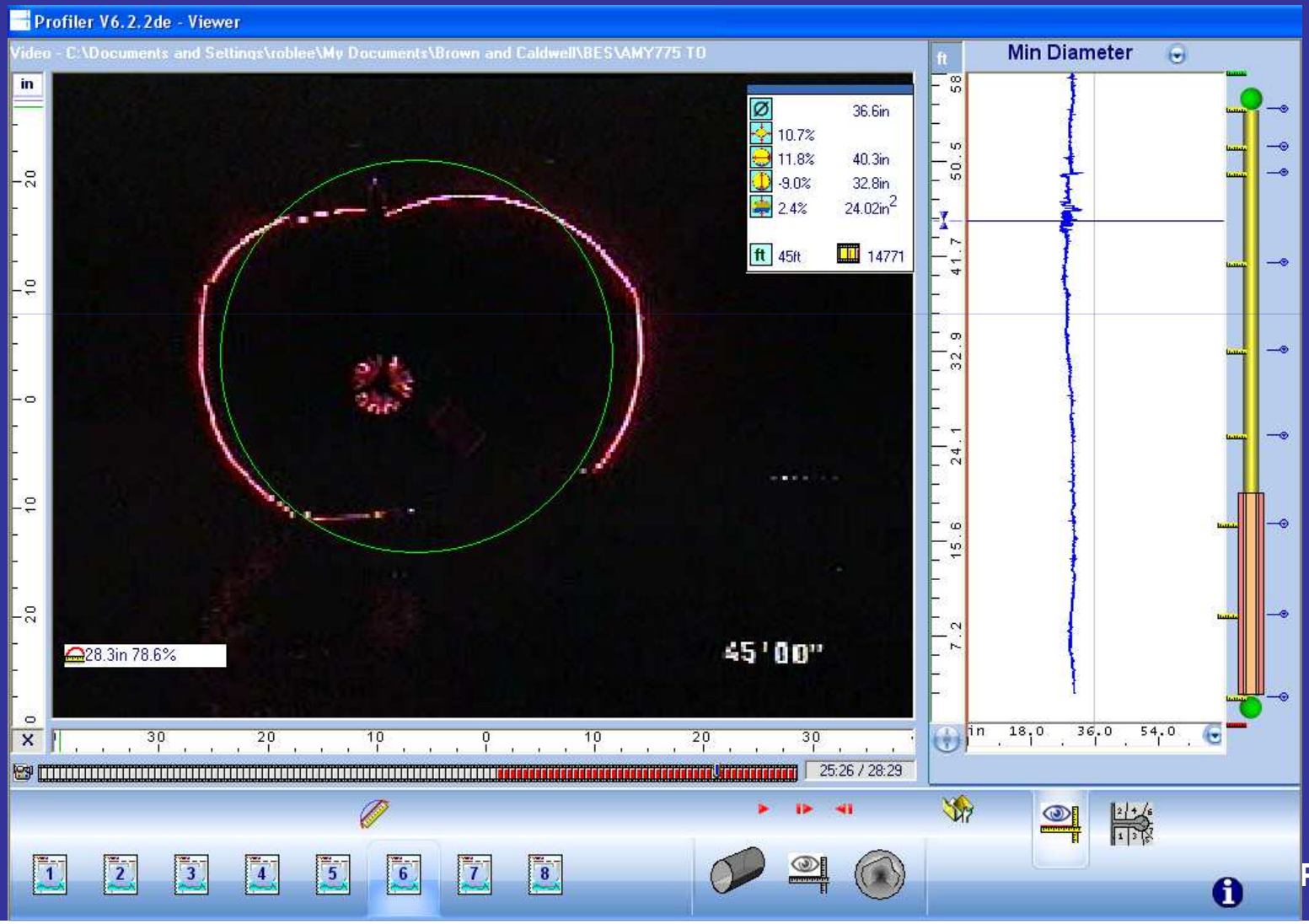
AMY775 to AAY659
Sta. 0+45



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AAY626 to AAY640
Sta. 5+16

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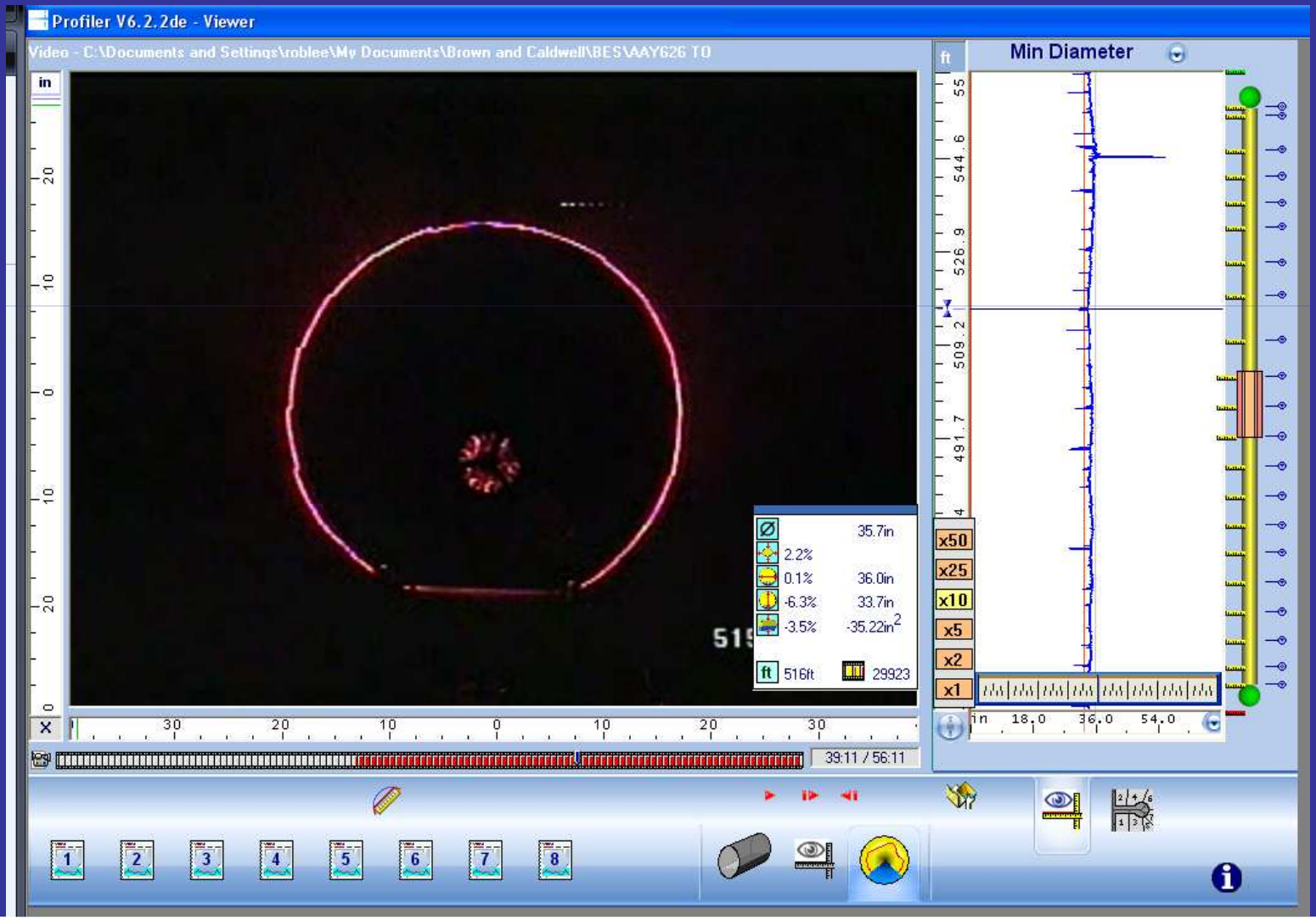
AAY626 to AAY640
Sta. 5+16



AAY640 to AMY775
Sta. 8+92

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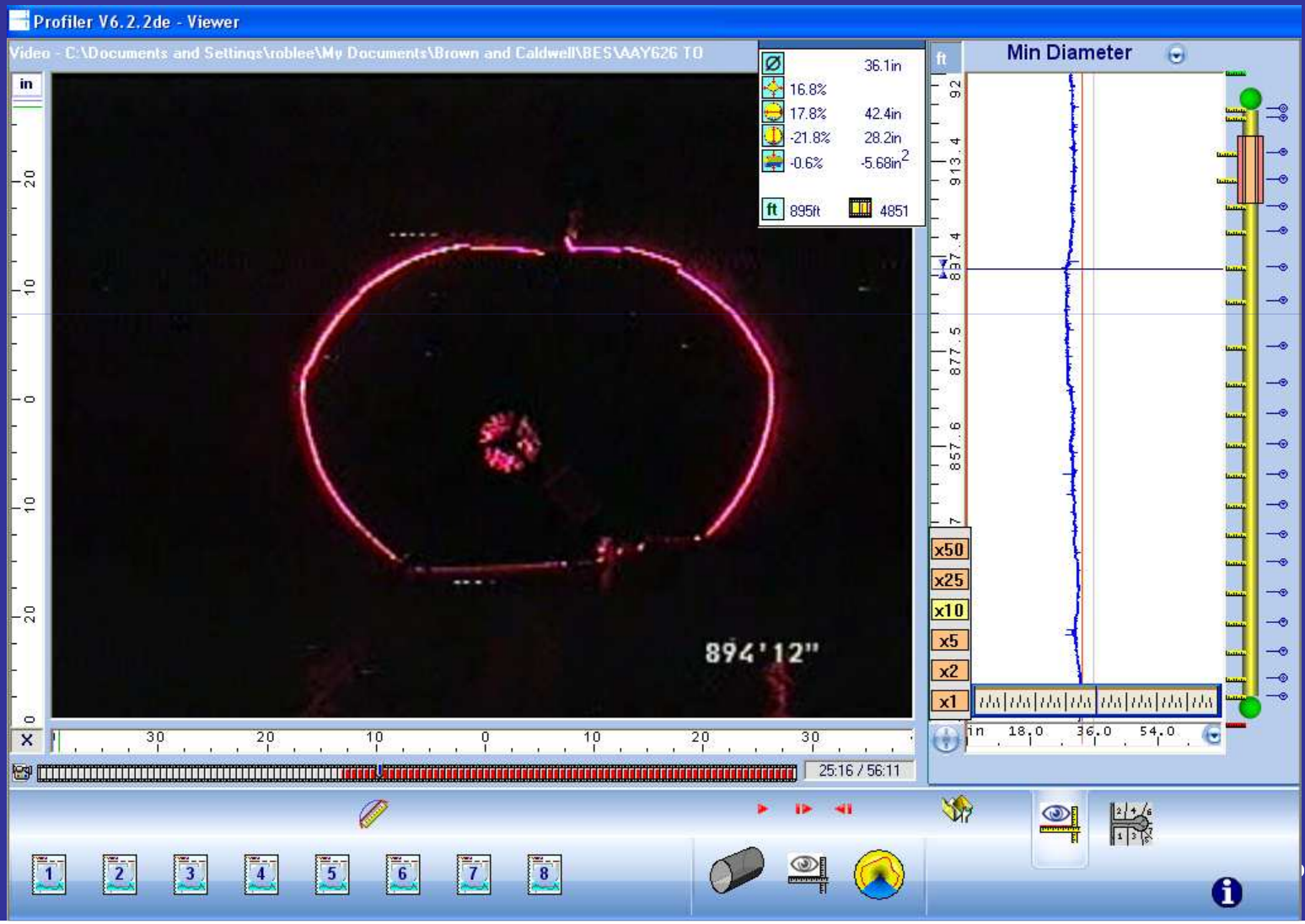
AAY640 to AMY775
Sta. 8+92



AAY640 to AMY775
Sta. 8+92

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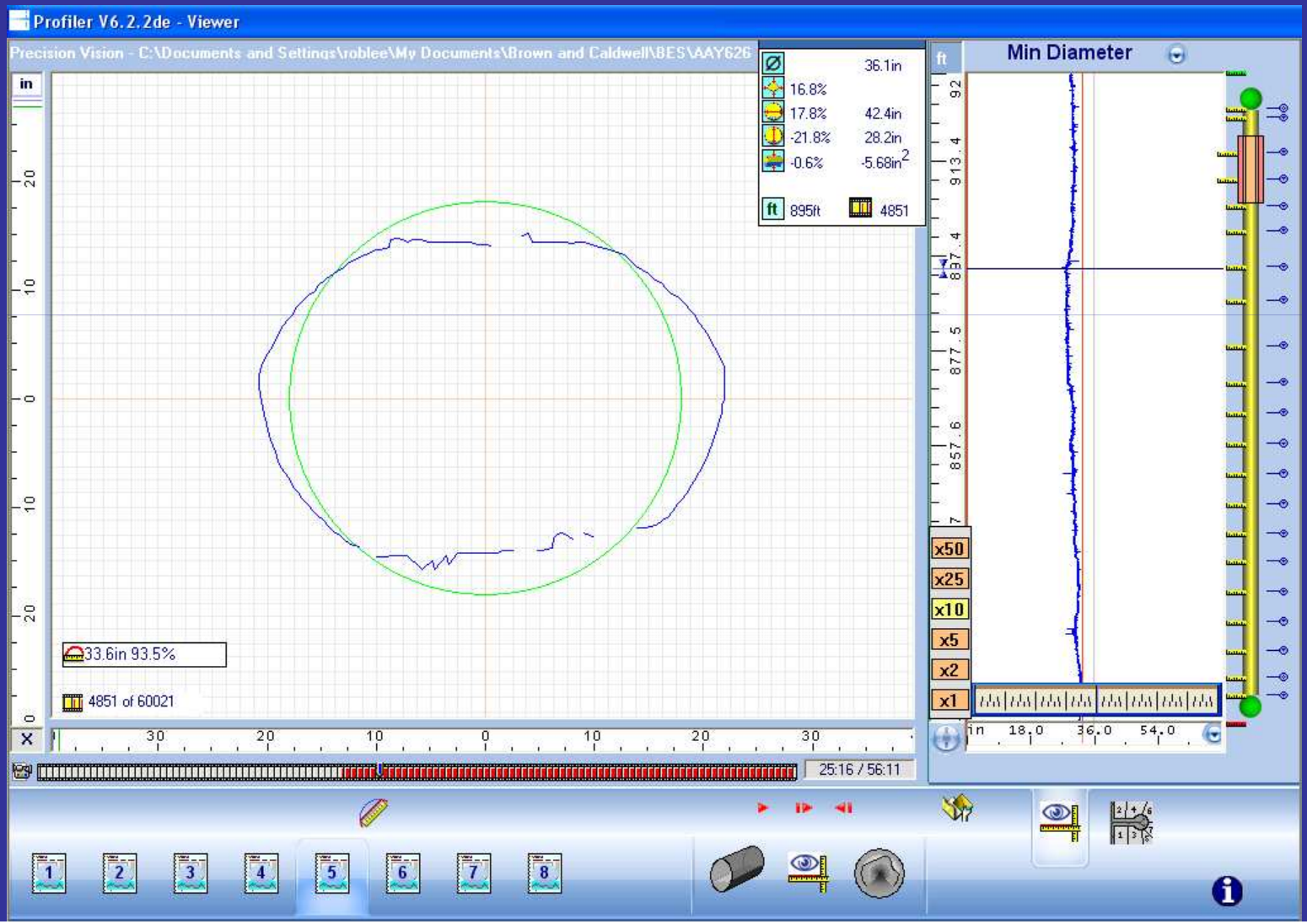

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ACJ627 to ACJ520
Hole at Crown @ Sta. 1+10

ACJ627 to ACJ520
Hole at Crown @ Sta. 1+10

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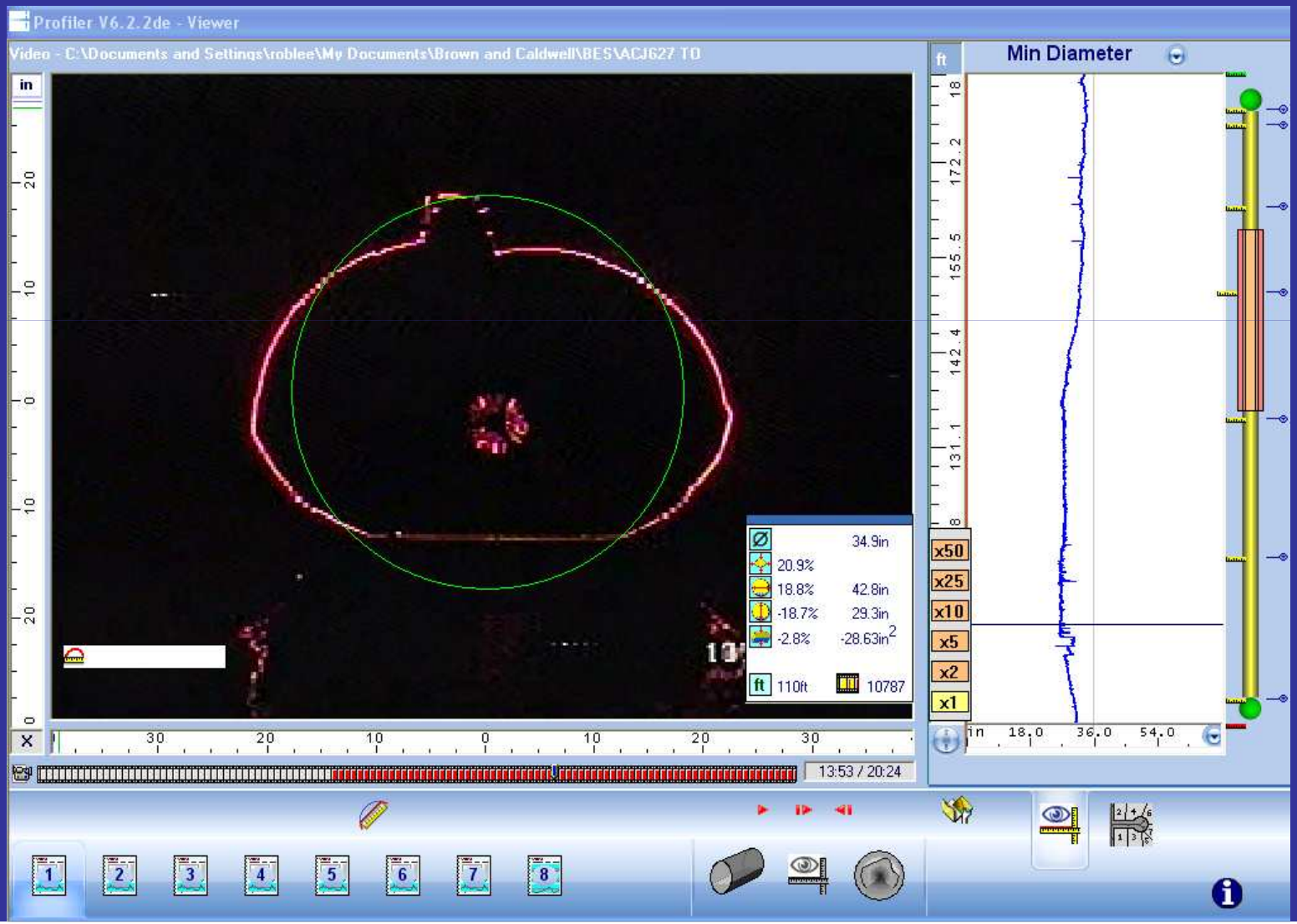

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Path-Forward

- Final Decision still pending
- City of Portland has critical information to make informed decision

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Case Study 2

- Fairfax County, VA
- Stormwater Inspection and Rehabilitation Program
- 304 LF, 21-inch CSP
- Easements through private property
- 14-feet deep at downstream end

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Structurally Compromised Pipe

- Trenchless Repair Preferred
- Existing IDQ with CIPP Contractor
- “On-screen” measurements revealed number of sections with ovality > 10%

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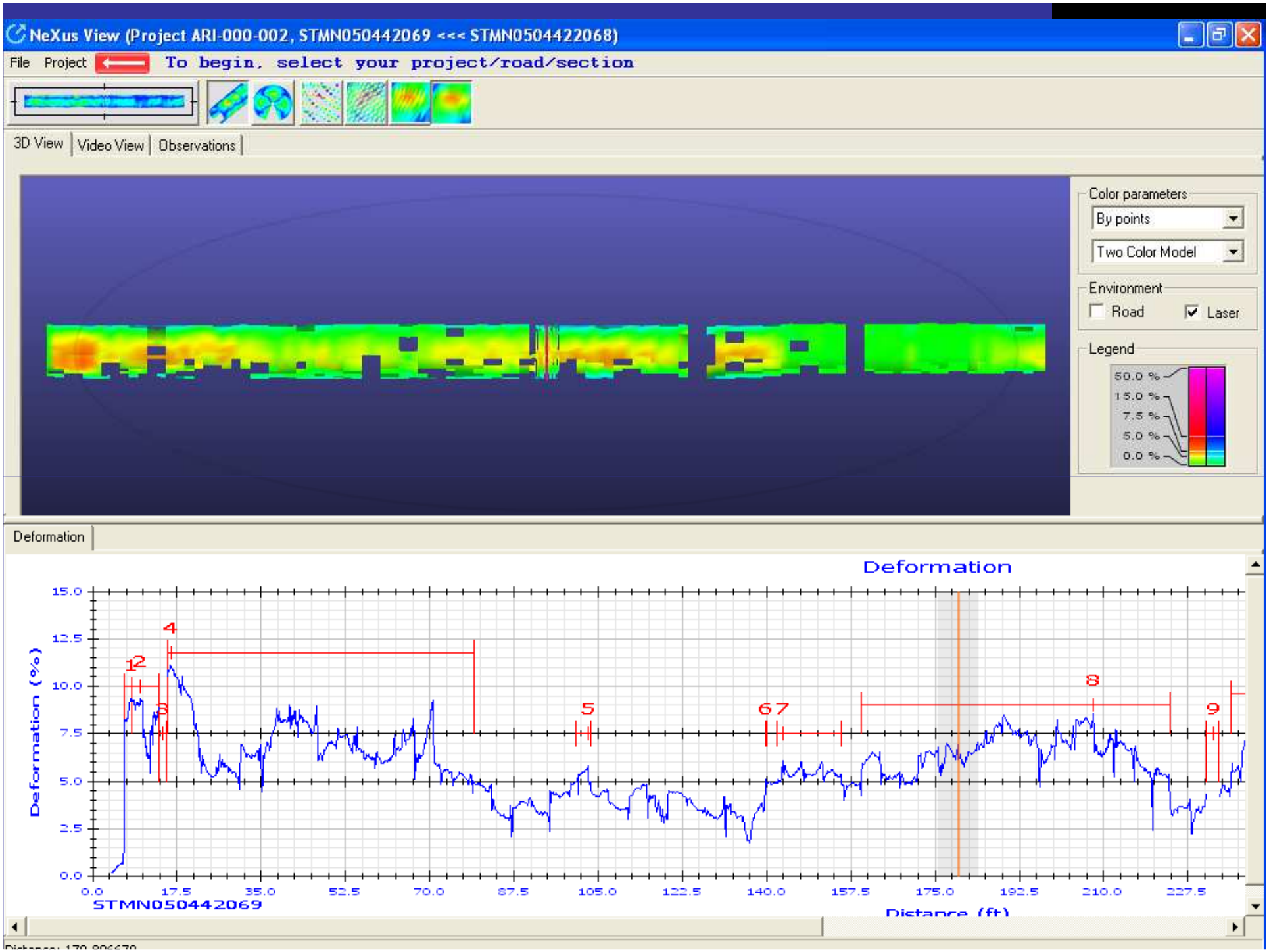
CIPP Design

- ASTM F1216 limits design to circular pipes
- Used WRc Type II design for non-circular pipe (oval)
- Assume fully deteriorated (added soil and live loads to design head)
- 22.5mm thickness
- Installation and hydraulic concerns with thickness 1” thickness for 21” pipe
- Needed true ovality…


NeXus View (Project ARI-000-002, STMN050442069 <<< STMN0504422068)
File
Project
To begin, select your project/road/section
3D View
Video View
Observations
Color parameters
By points
Two Color Model
Environment
Road
Laser
Legend
50.0 %
15.0 %
7.5 %
5.0 %
0.0 %
Deformation
Deformation
Deformation (%)
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1
2
3
4
5
6
7
8
9
0.0
17.5
35.0
52.5
70.0
87.5
105.0
122.5
140.0
157.5
175.0
192.5
210.0
227.5
STMN050442069
Distance (ft)

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CIPP Redesign

- 4-foot section with ovality > 10% (11.5%)
- Next worst is 9.5% (error is ± 0.25%)
- Fully segmental CIPP = 15.0 mm (per F1216-07b)
- Worst section structurally reinforced with cured-in-place point repair prior to full CIPP
- Win-Win-Win Situation

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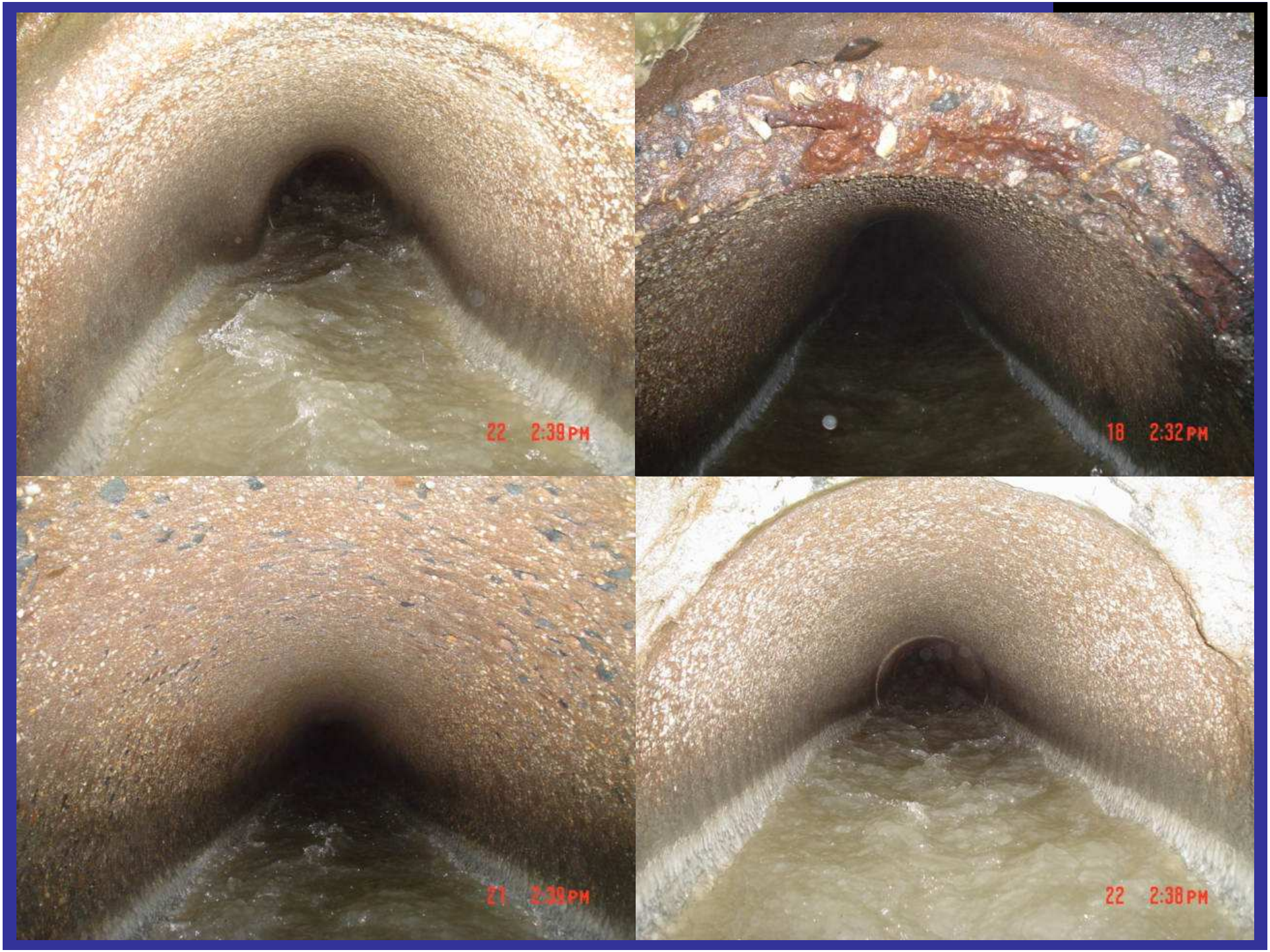
Case Study 3

- Department of Special Services, New Castle County, Delaware
- Existing 21” and 24” parallel interceptors


22 2:38 PM
18 2:32 PM
21 2:38 PM
22 2:38 PM


18 11:44 AM

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Replacement Design

- Replace with single 42” pipe
- New alignment under minor 4-lane highway

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Pipe Material

- Multiple Materials Specified
  - VCP
  - Polymer Concrete
  - CCFRPM
- CCFRPM selected

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Specified CCFRPM Deflection

- County desired 100-year design life
- Published 50-year deflection of 5%
- Contract specified 3% deflection 30-day after initial backfill
  - Future DOT Paving
  - Traffic Loading
  - Safety Factor of 2.0

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Actual Deflection

- First two segments overly deflected
- Hand Measurements = 5%

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Owner Options

- Accept overly deflected pipe
- Re-excavate and reinstall pipe
- Determine actual design life based on actual deflection
  - NEED TRUE OVALITY!

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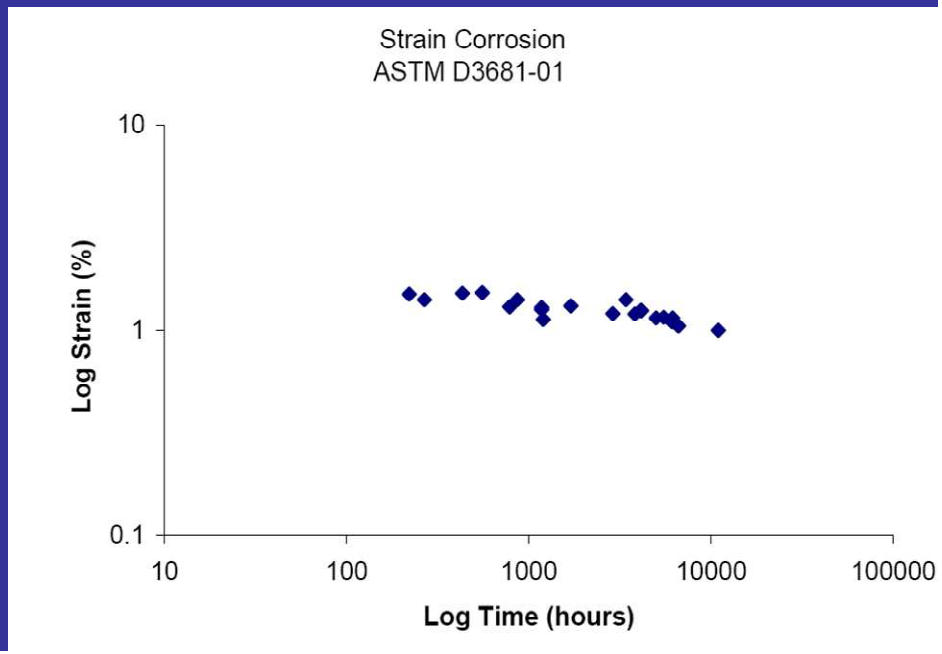
Design Life

- ASTM D3681, Strain-Corrosion Test
- Pipe subjected to 1.0 N sulfuric acid in deflected condition
- Time-to-failure interpolated by regression analysis

$$\log\left(\%\ strain\right) = -0.051186 \cdot \log\left(time\right) + 0.262316$$



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Laser Profiling

- 100-year strain = 4.5% long-term deflection allowable (SF=2.0)
- 6.1% allowable if SF reduced to 1.5
- Laser profiled prior to end of 30-day initial-backfill

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Laser Profiling

- 5.5% at worst location
- Reprofiling required at warranty inspections (2-years past Substantial Completion)
- Sections greater than 6% will need structural enhancement (i.e., CIPP) at no cost to Owner

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Conclusions

- Many types of laser profilers
- Understand limitations
- Accurate data for decision-making
- Long-term designs

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Thank You

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City of Portland, Oregon

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Variations in Circumference

- Circumference key for sizing CIPP
- Man-entry not realistic option
- Measurements at MHs not representative
- 74.5 inches to 78.6 inches

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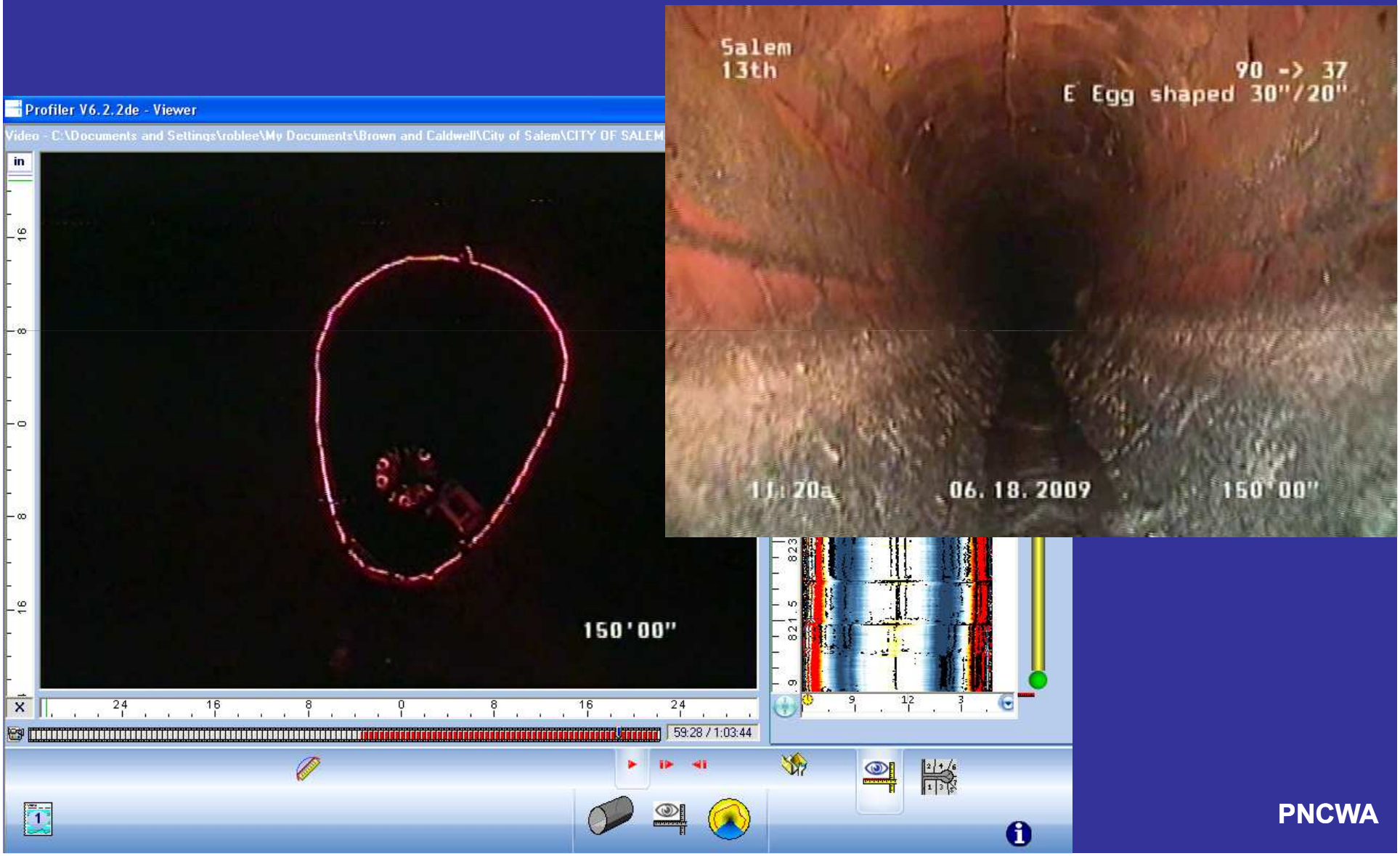
Station 1+50



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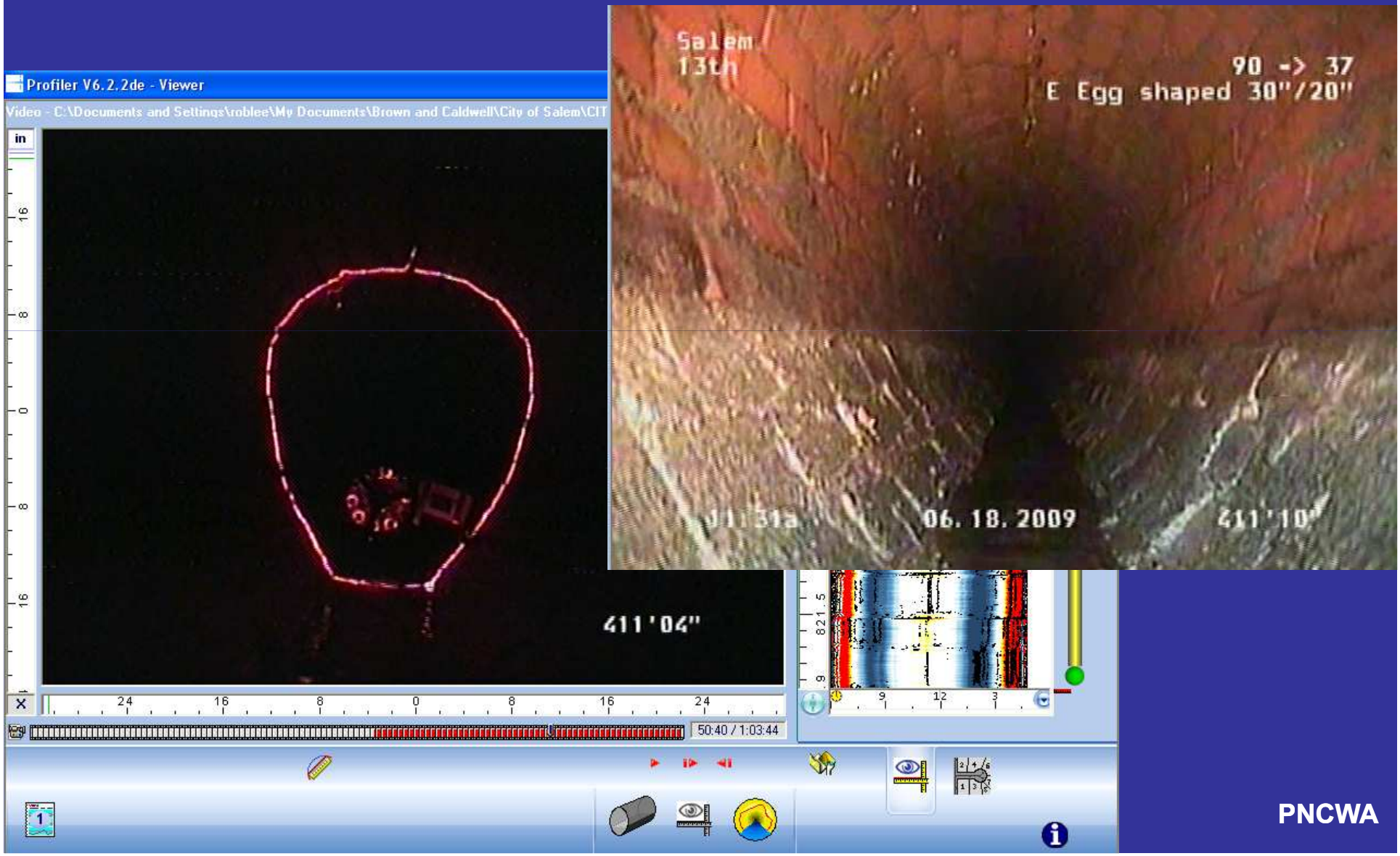
Station 4+11



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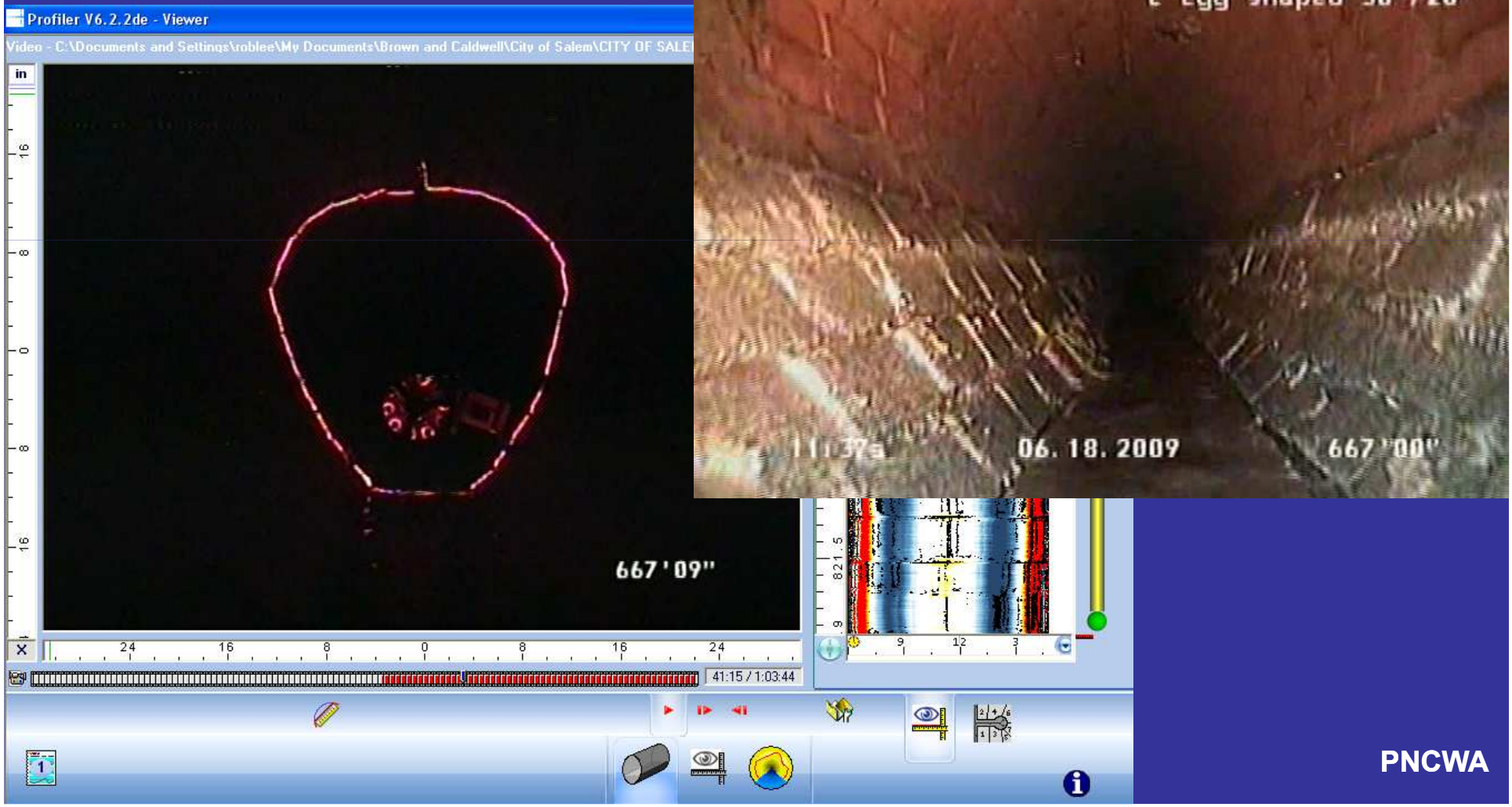
Station 6+67



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Station 7+32

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