Condition assessment using PIPE PENETRATING RADAR: the Harvard Gulch Interceptor Denver case study

Csaba Ékes, PhD, PGeo
President - SewerVUE Technology Corp.

Jeff Maier, PE
Metro Wastewater Reclamation District

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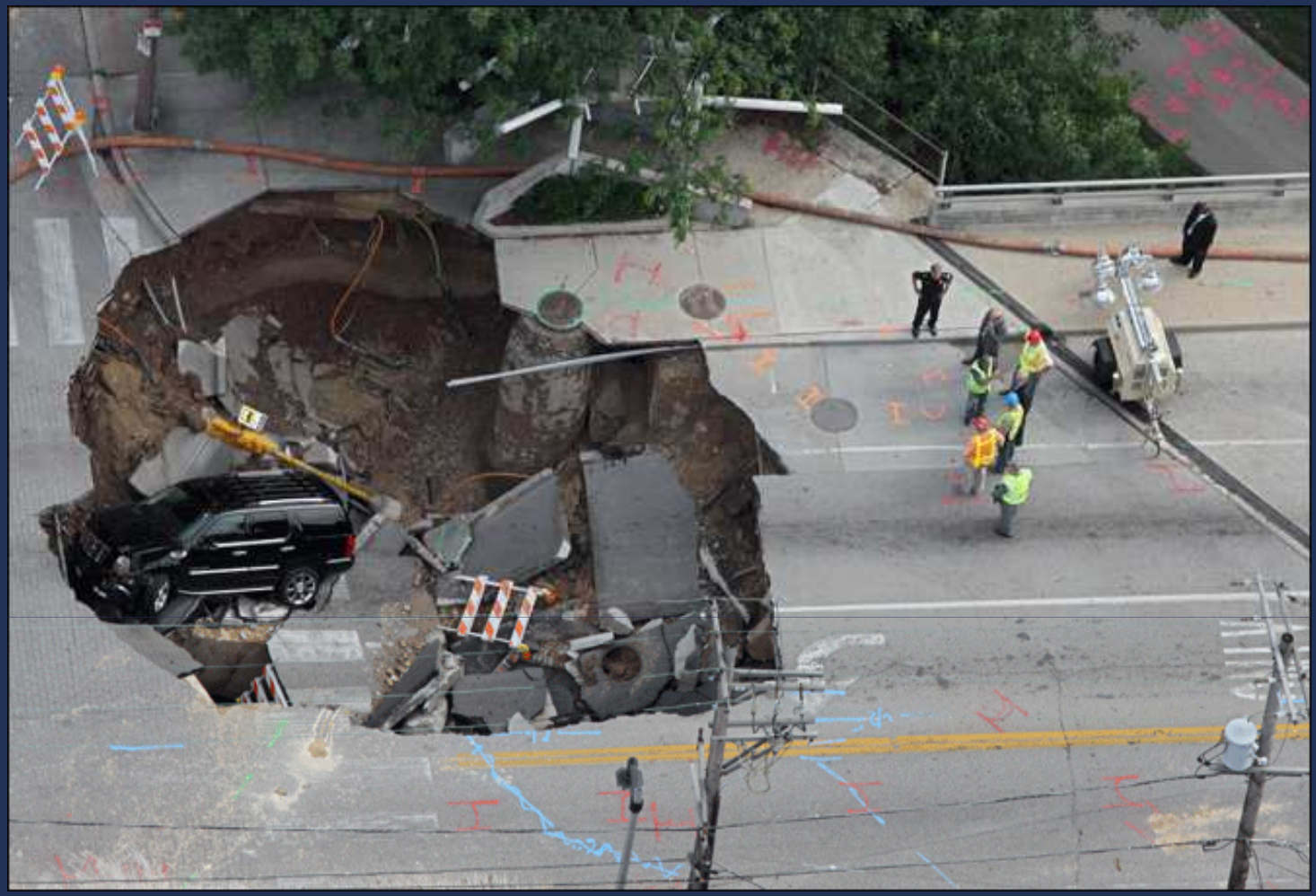
CCTV

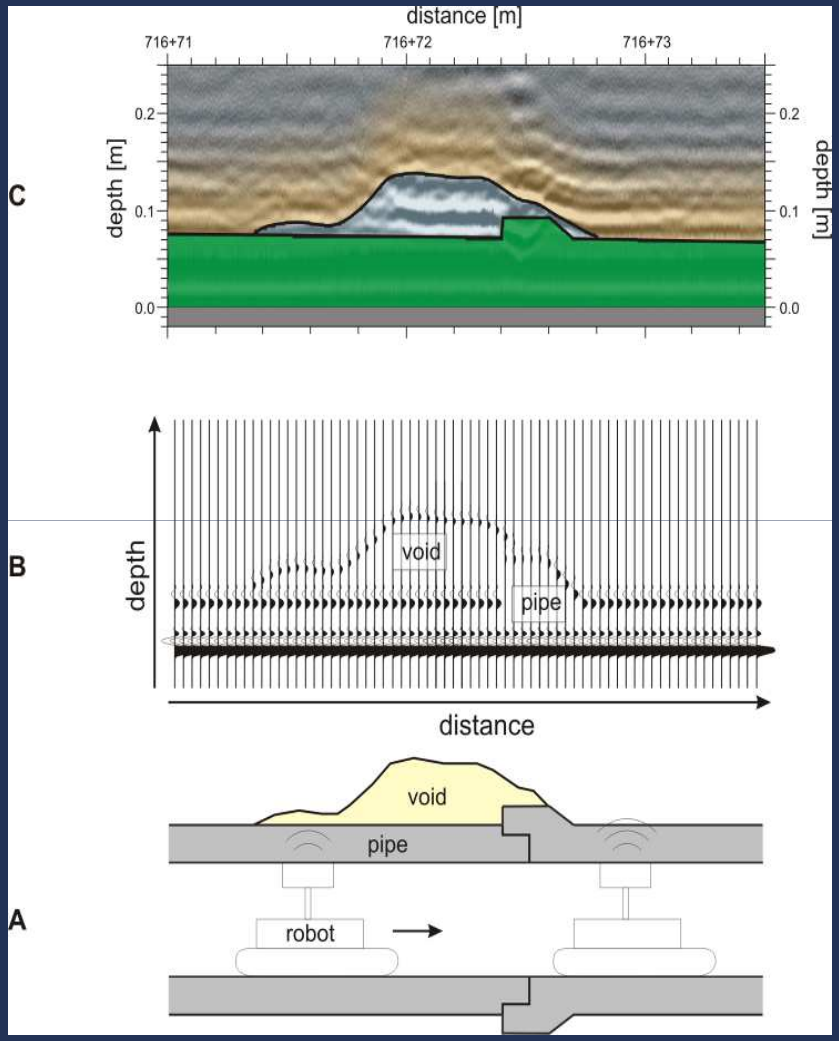
- Visual only
- Qualitative
- Operator dependent
- Often unreliable, especially in large dia. trunks and interceptors
- E.g. 9’ x 8’ outfall sewer collapse in Washington DC in 2010 2 years after CCTV inspection
- Cause of collapse: external corrosion

FERENCE



Is there a technology to see through the pipes and detect voids before they become sinkholes?

PPR Principle

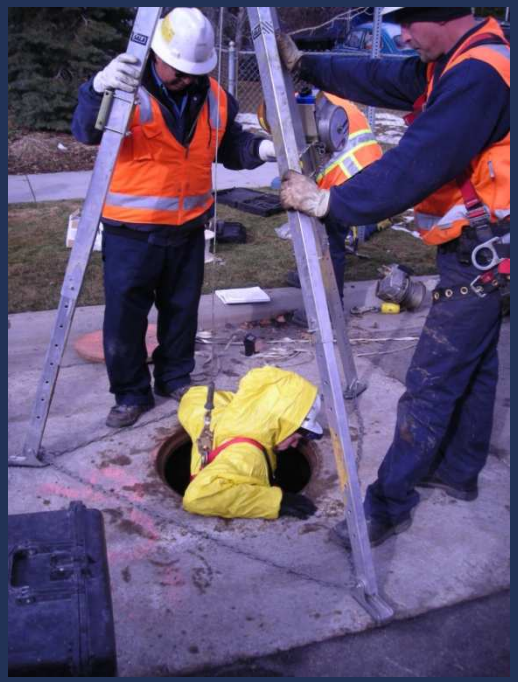


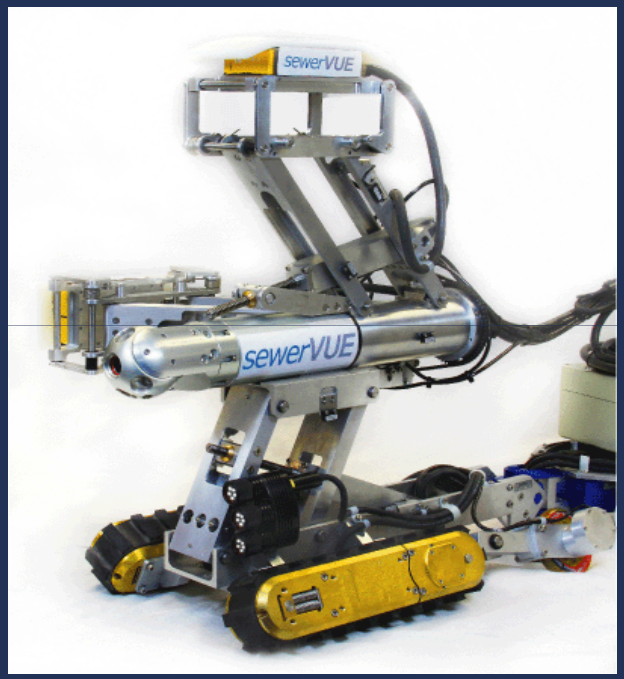
A high frequency EM wave (25 MHz to 2.5 GHz), is emitted via an antenna into the ground or structure under evaluation.

The reflected energy caused by changes in the electromagnetic properties of the material is detected by a receiver antenna and recorded for subsequent analysis.

Antennas have to have direct contact with pipe wall.

PPR Deployment



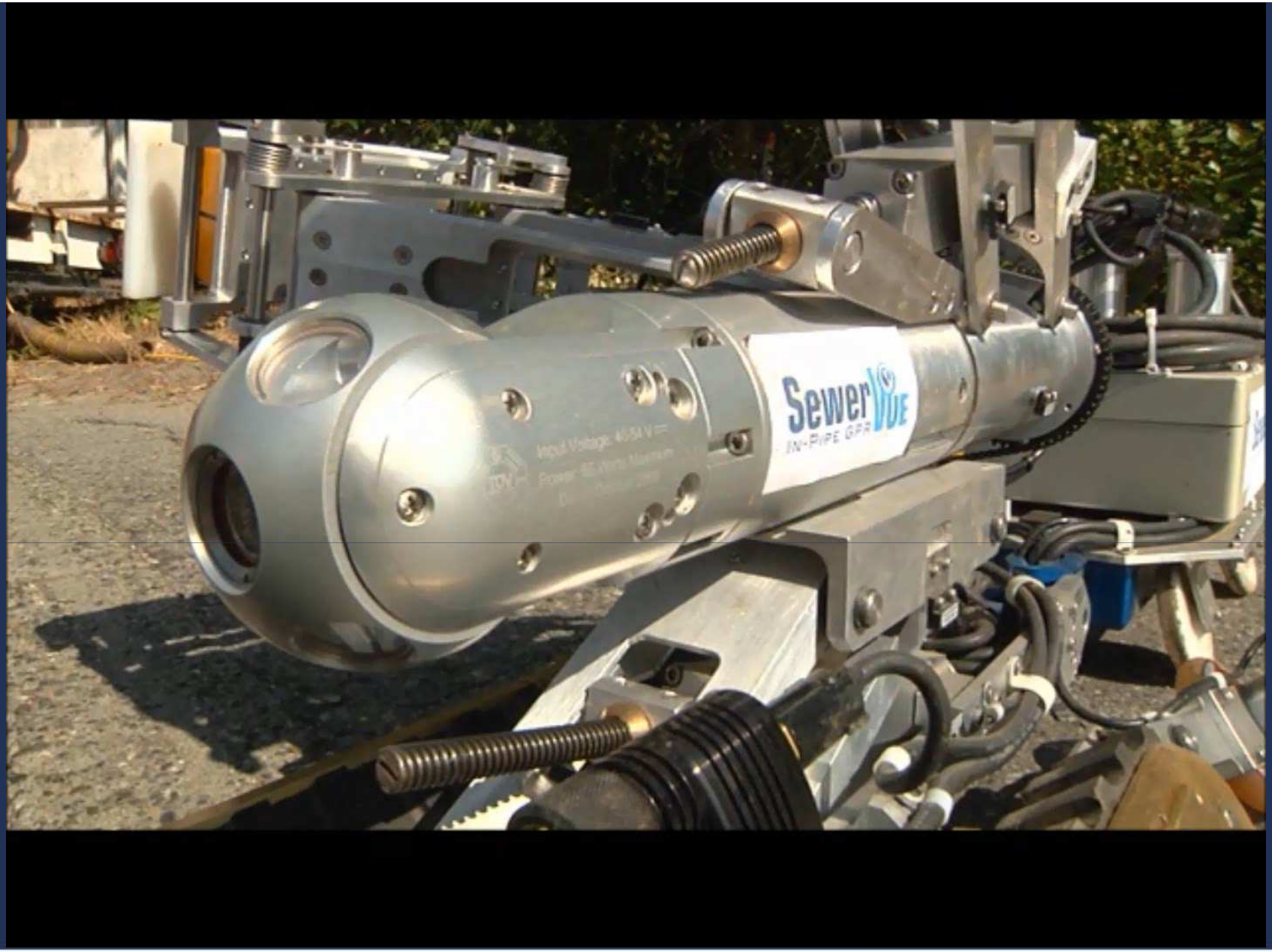


Robotic PPR Inspection

- Remotely operated robot:
- HD CCTV (pan, tilt, zoom)
- 18-42 inch
- 9 to 3 o’clock
- 1500 feet tether (6000 ft optional)
- 2 auxiliary cameras
- LIDAR and sonar
- 3D LiDAR
- Accurate x,y,z coordinates
- 30 ft/min
- “Swiss army knife”

Robotic PPR Inspection

- PPR can confirm visual defects, map voids
- Measure rebar cover and/or concrete thickness
- Provides structural assessment, allows proactive asset management



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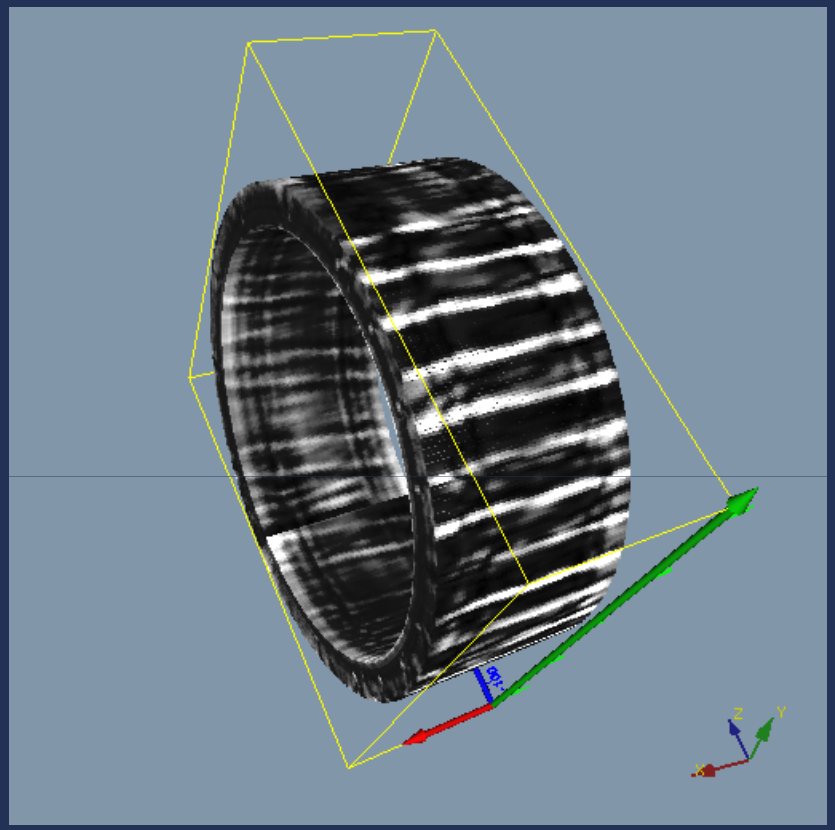
PPR Display and Reporting

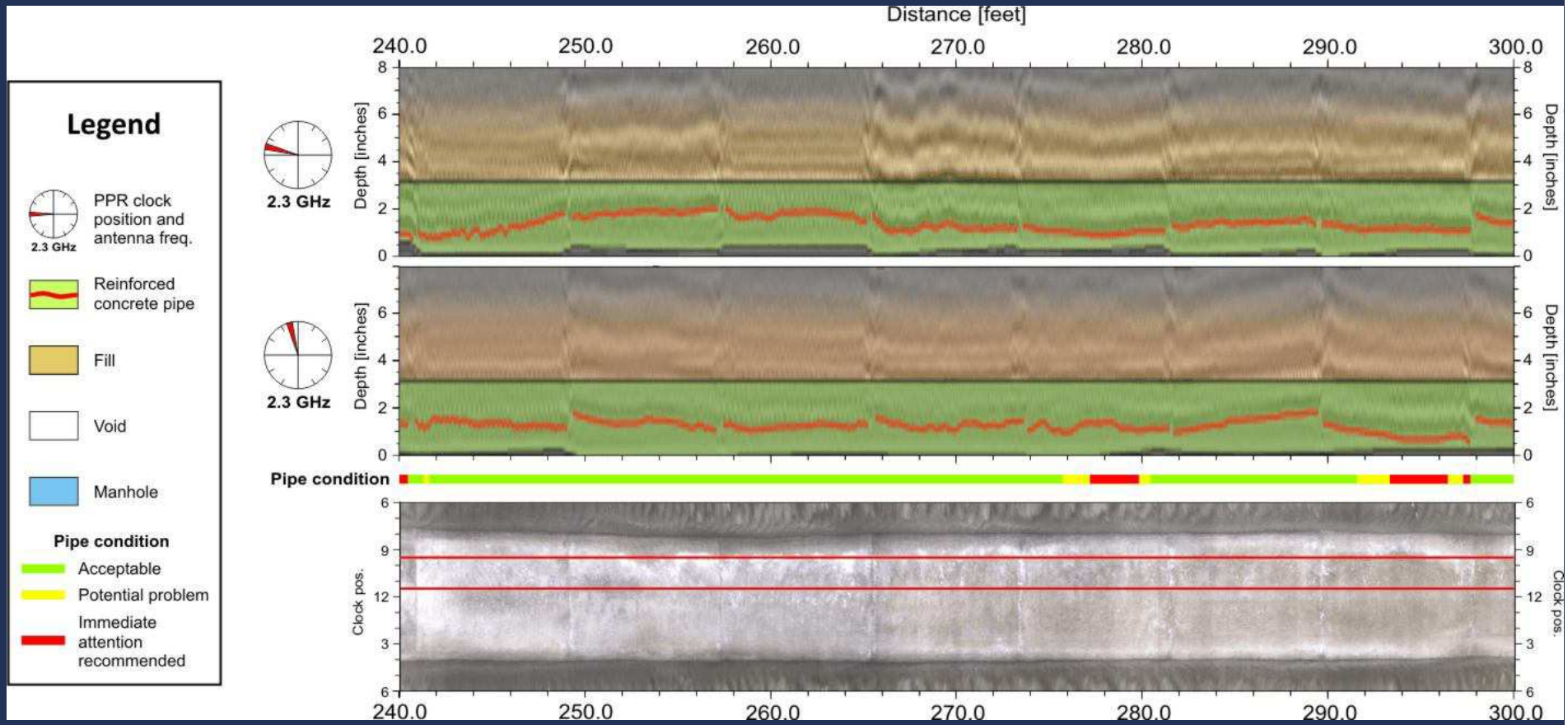


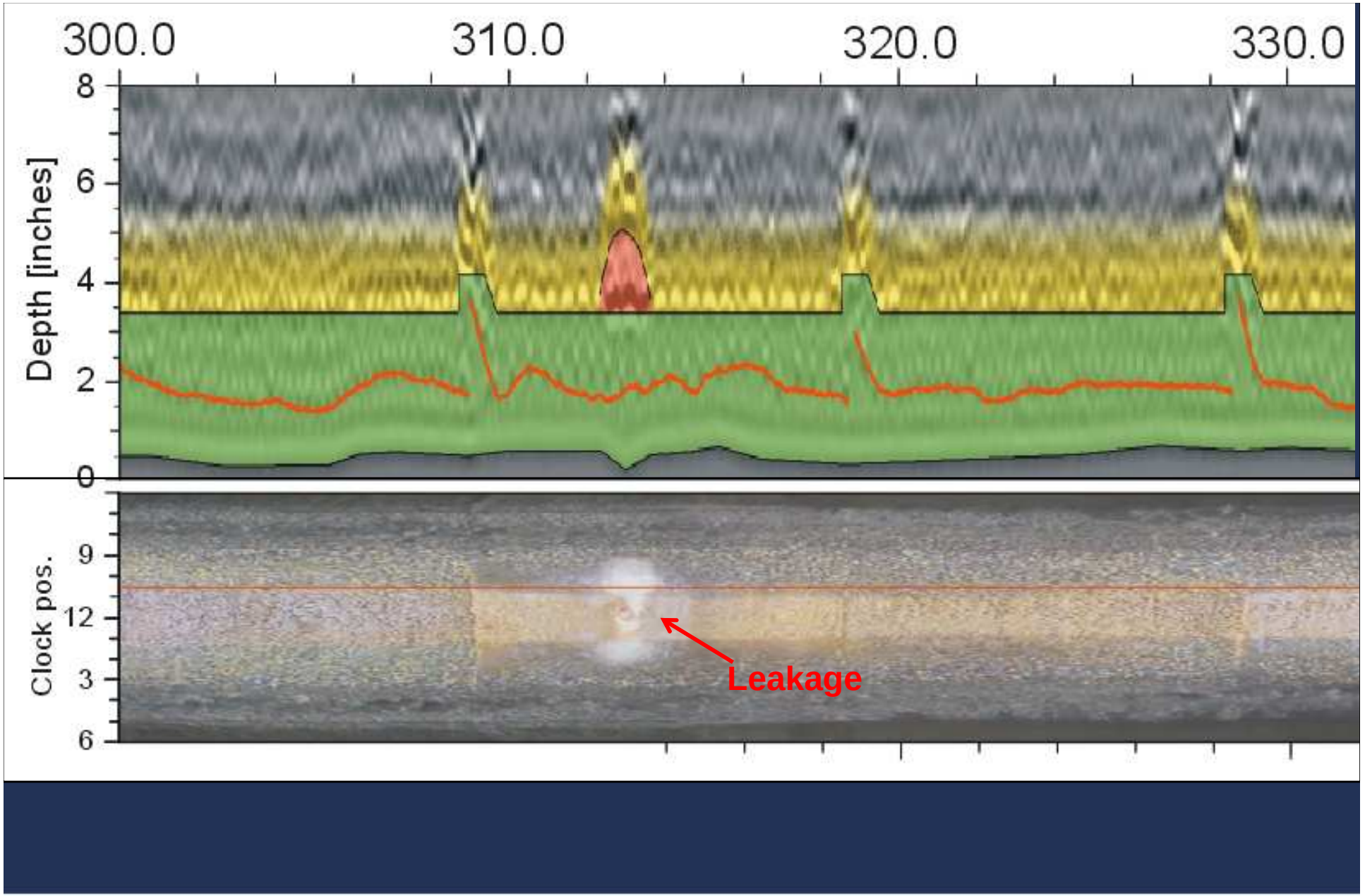
3D Display

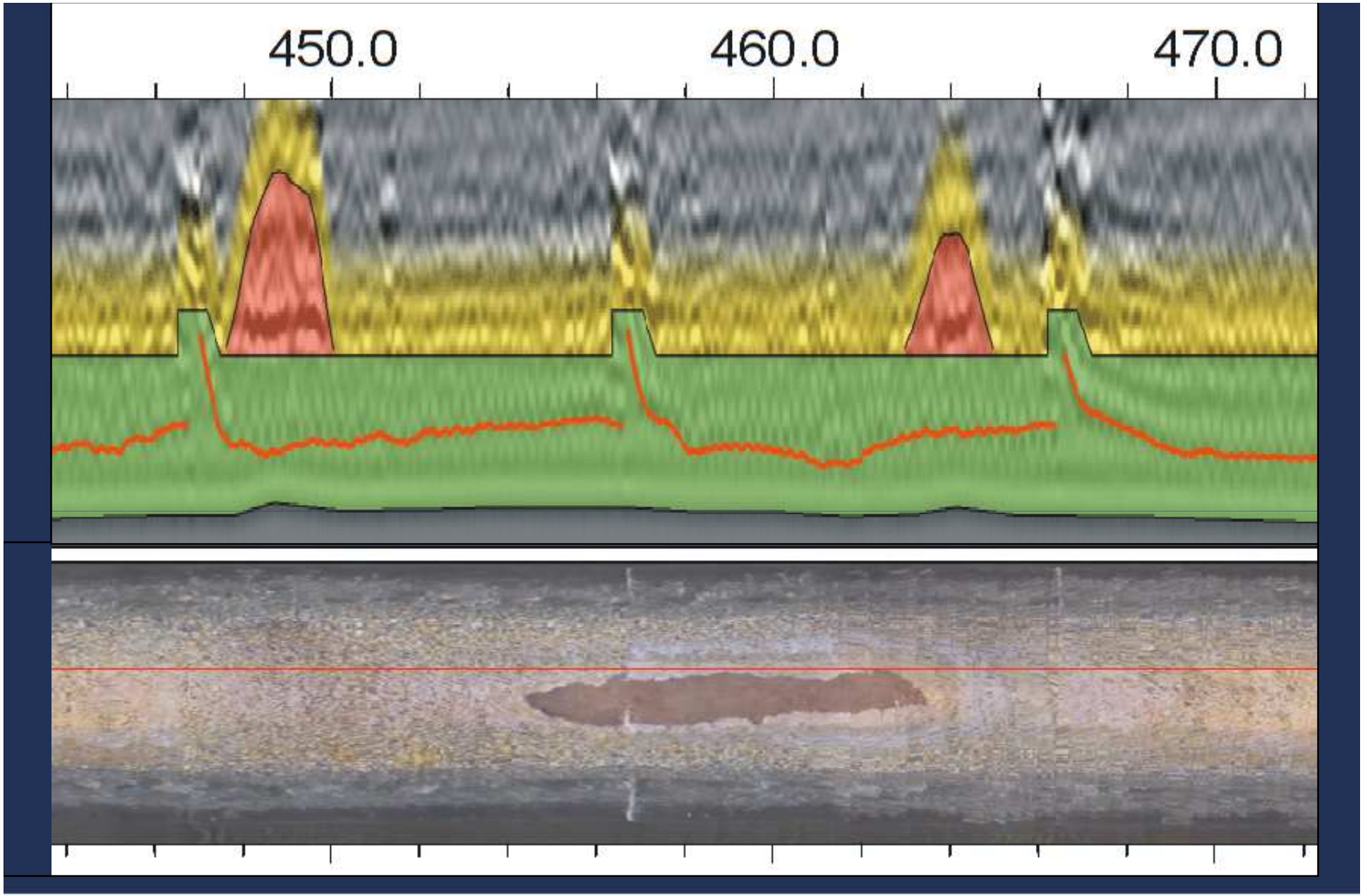
Block views of PPR traces that are recorded at different positions on the pipe surface

3D view of a 42” RC pipe joint, white bands and lines represent rebar.

PPR Display and Reporting




300.0
310.0
320.0
330.0
Depth [inches]
8
6
4
2
0
Clock pos.
9
12
3
6
Leakage


450.0
460.0
470.0

Harvard Gulch Interceptor multisensory robotic pipe condition survey including Pipe Penetrating Radar laser and CCTV Denver, CO

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Metro Wastewater Reclamation District's

Advanced Pipe Condition Assessment Technology Evaluation Program

Multi-Sensor Technologies Demonstrated & Evaluated:

- RedZone Responder
- CleanFlow HD Profiler (now owned by RedZone)
- SewerVue Pipe Penetrating Radar

METRO WASTEWATER RECLAMATION DISTRICT

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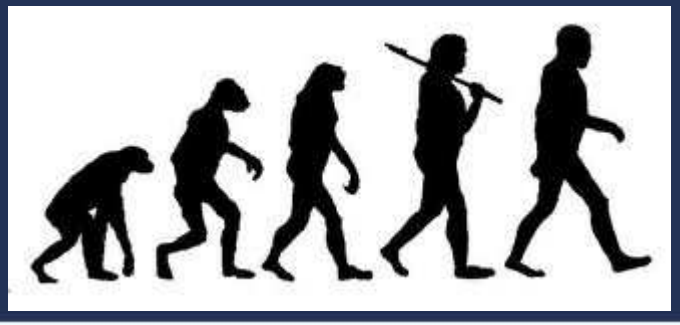
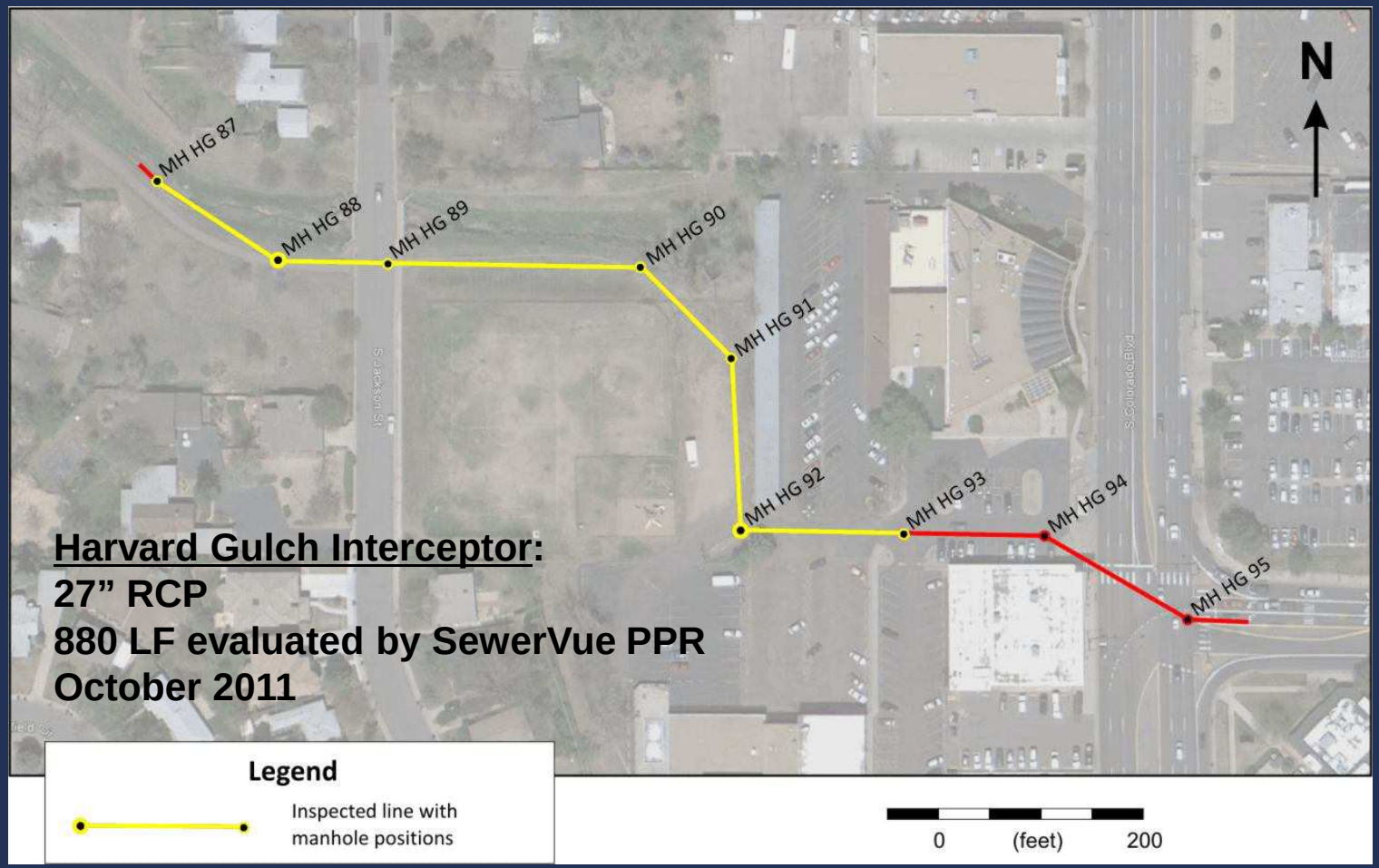
Advanced Pipe Condition Assessment Technology Evaluation Program

Goals:

- Identify technologies that provide better condition assessment info than coring & CCTV
- Evaluation of effectiveness & accuracy
- Better information = Better decision making
- Intelligent prioritization of pipe rehabilitation needs & funding allocation

Evolution of Pipe Condition Assessment Technology





Harvard Gulch Interceptor:
27” RCP
880 LF evaluated by SewerVue PPR
October 2011

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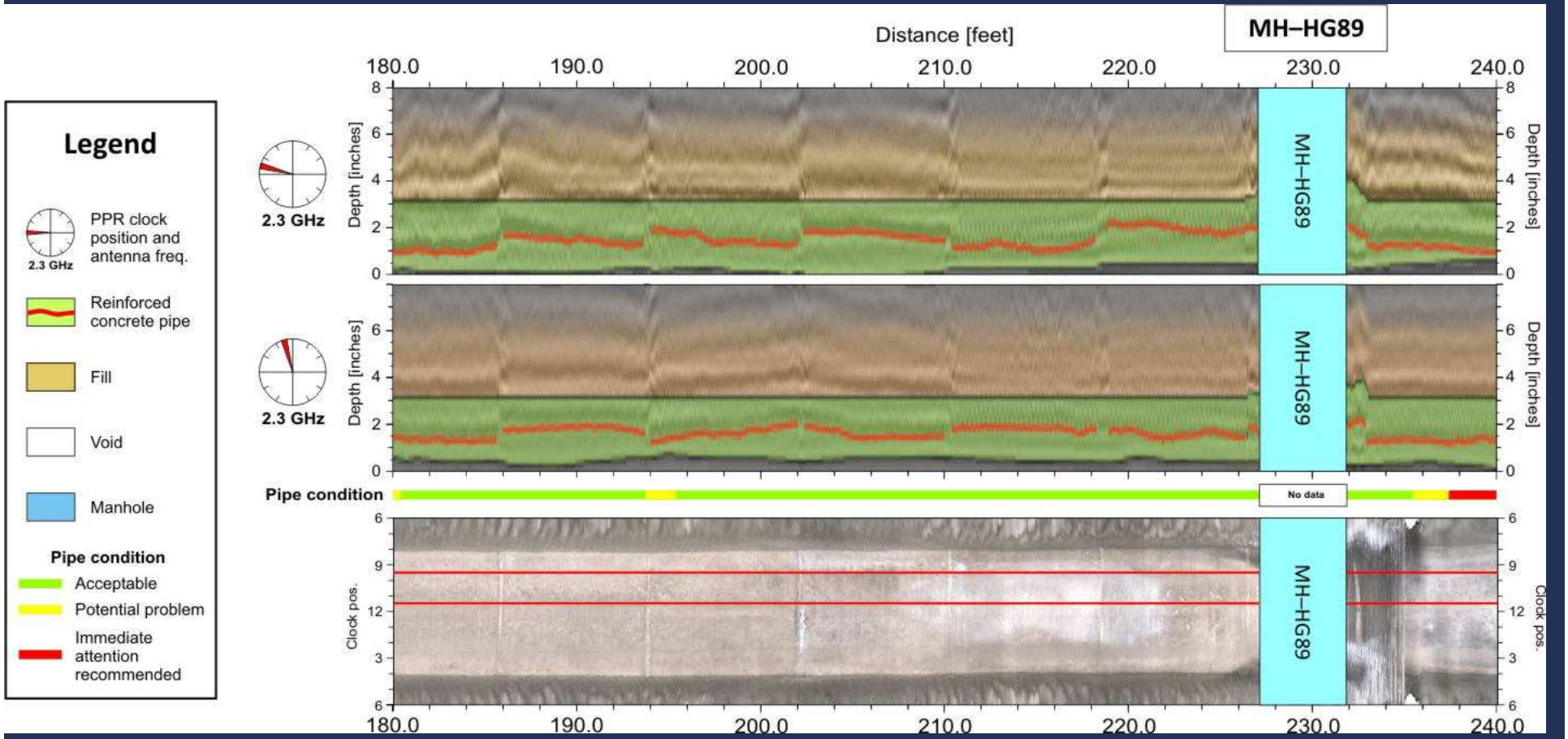
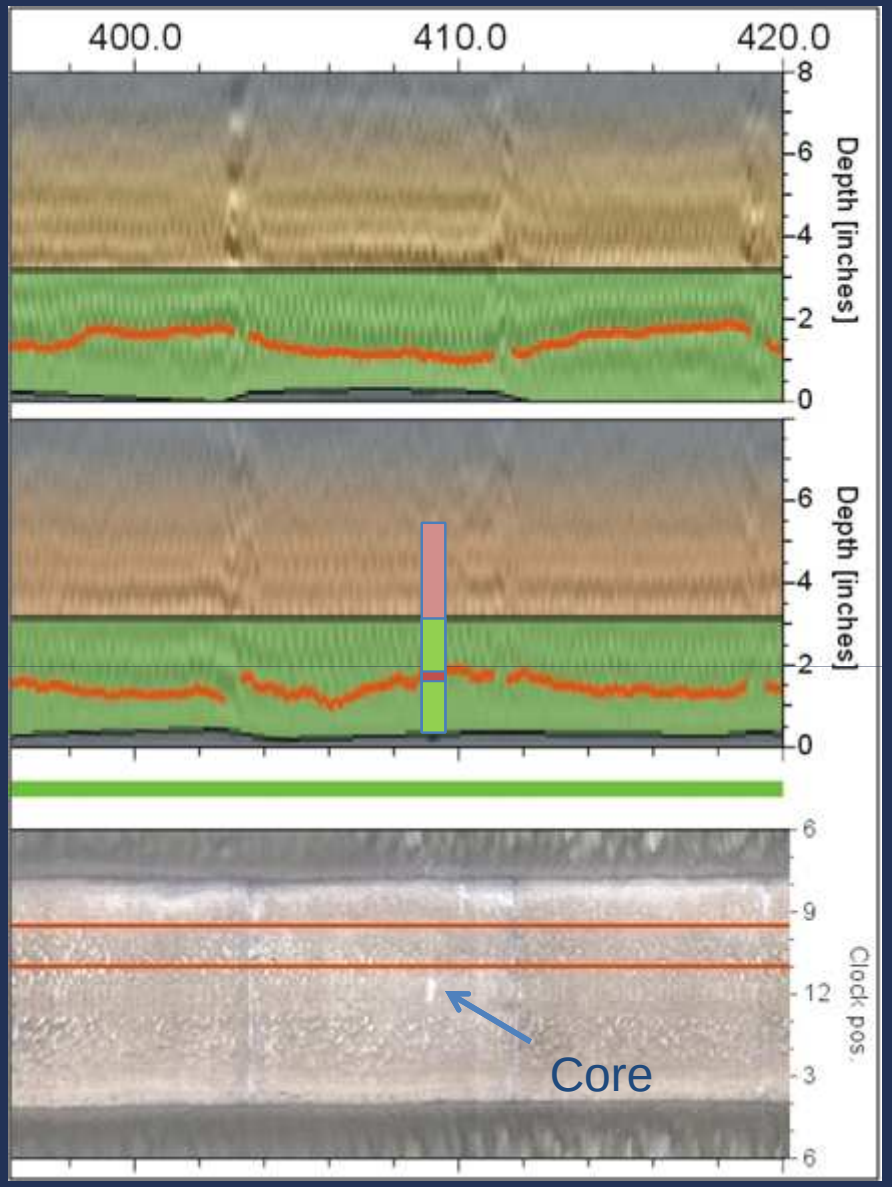
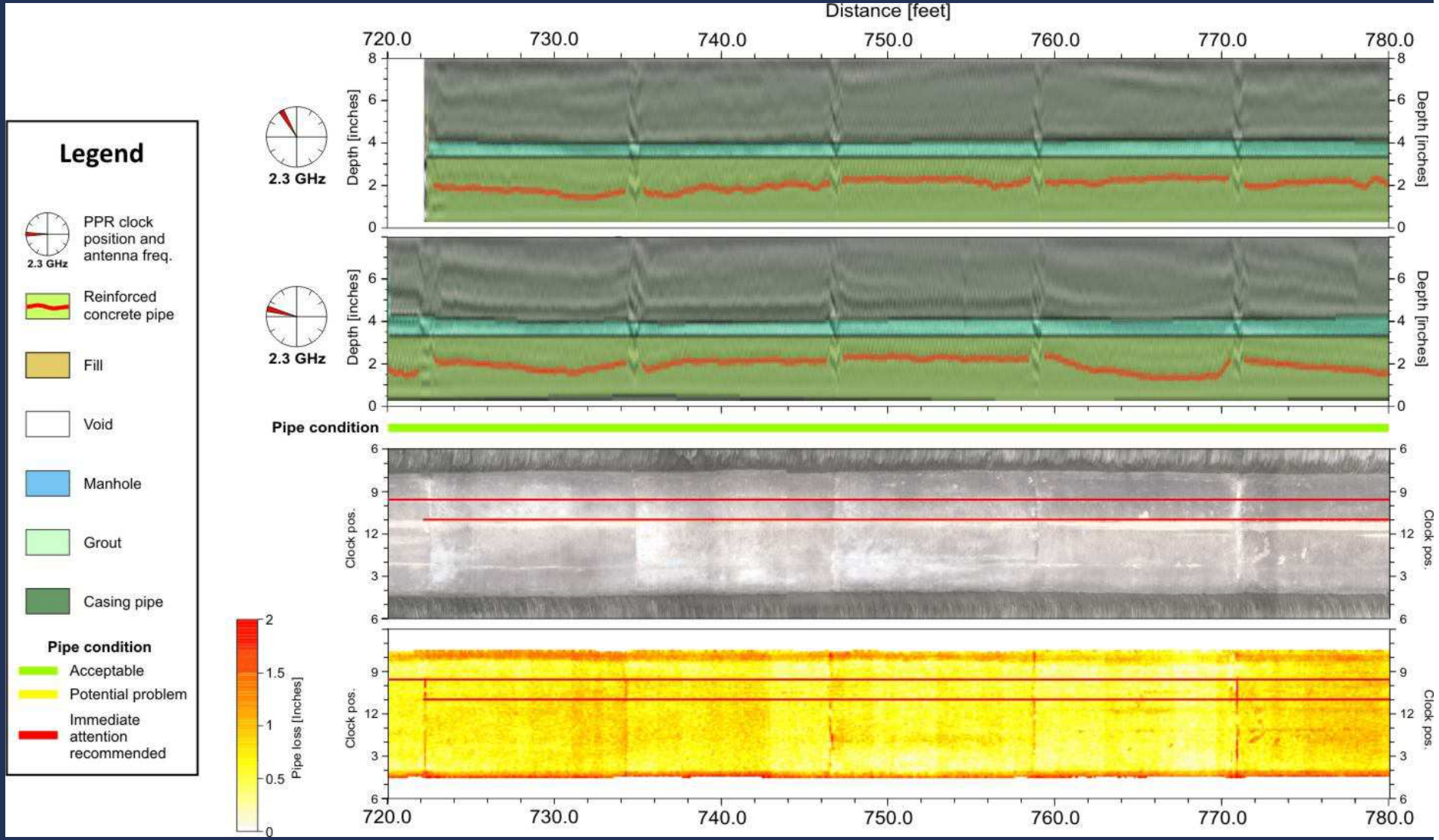
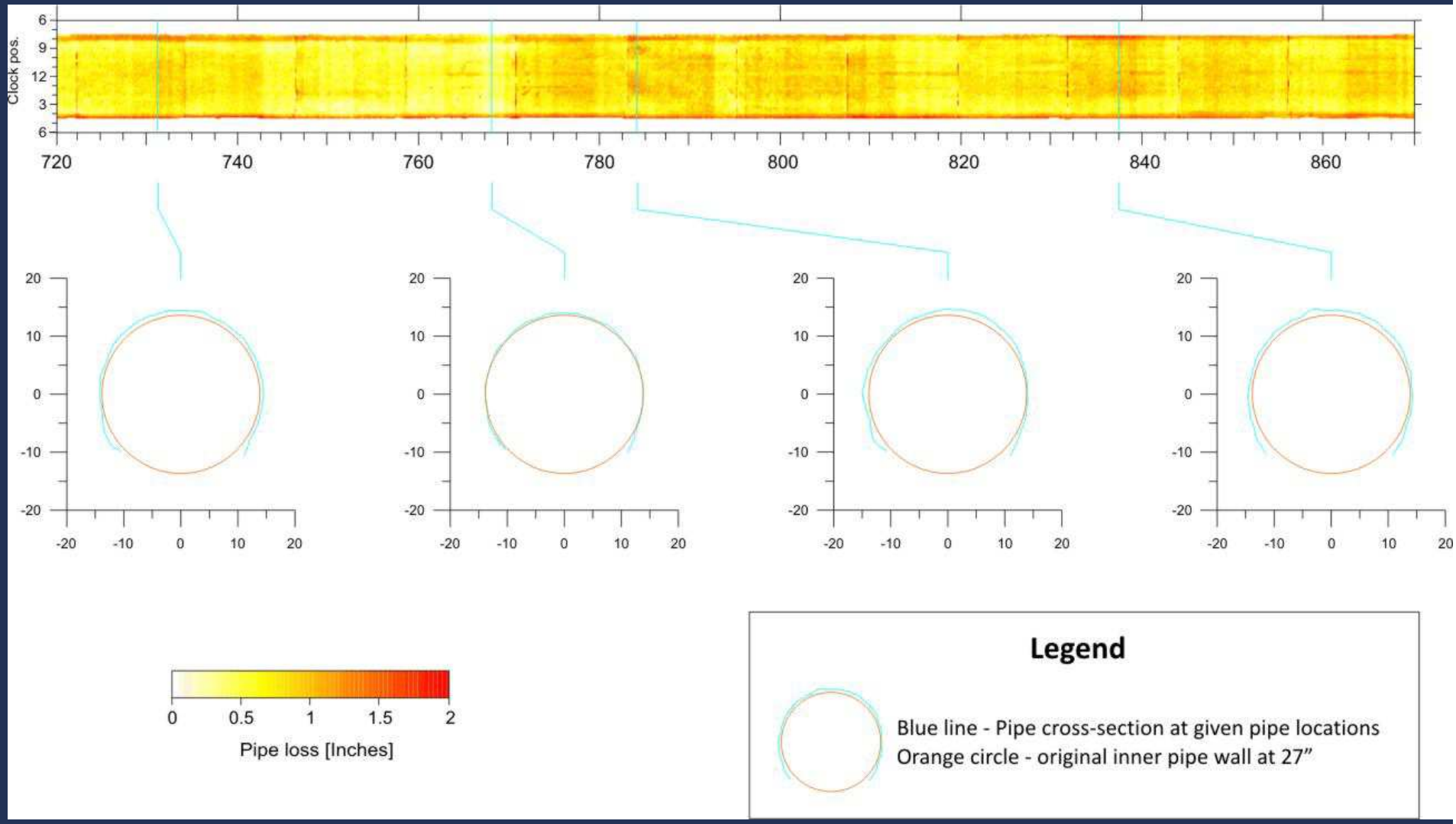
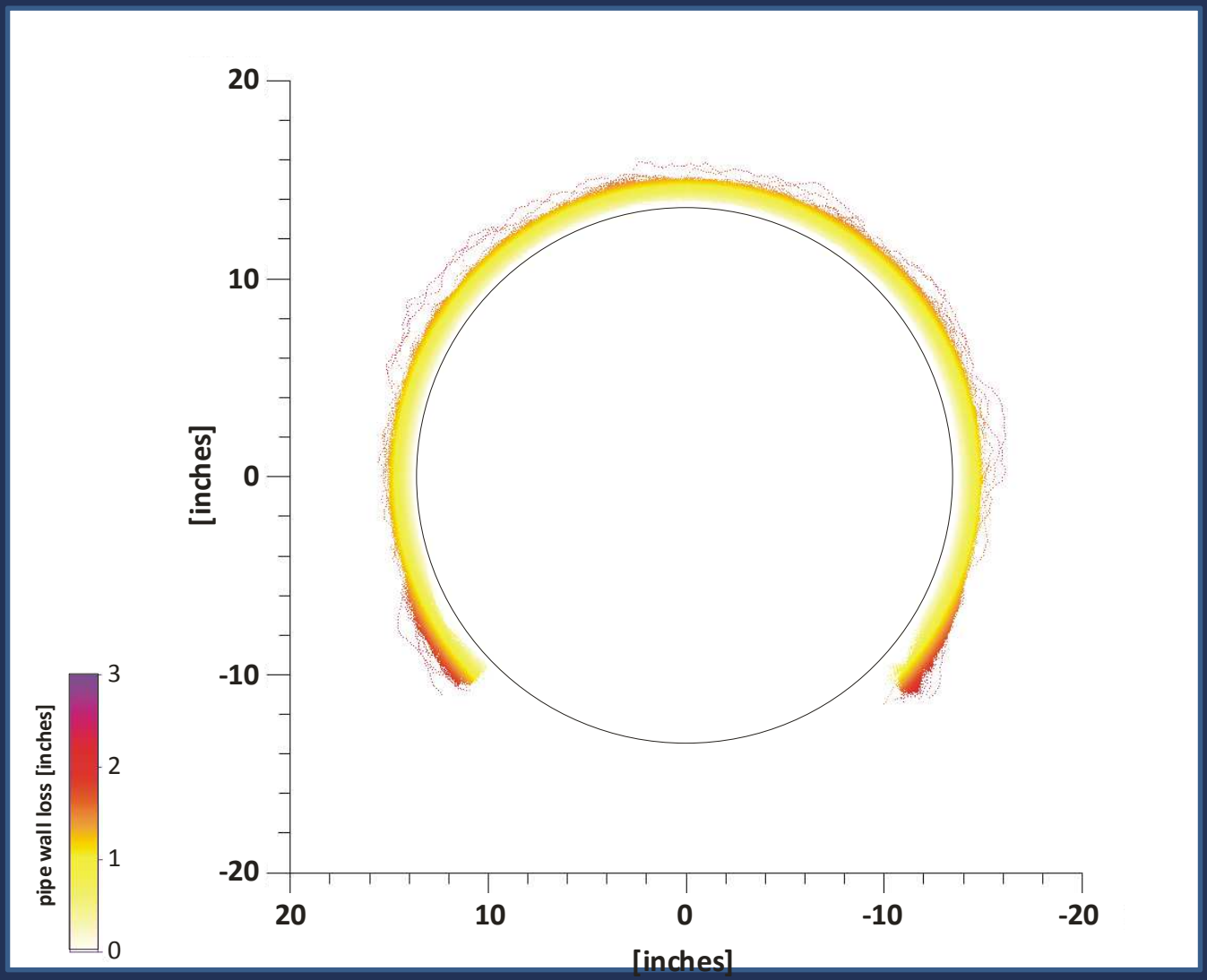

Legend
PPR clock position and antenna freq.
2.3 GHz
Reinforced concrete pipe
Fill
Void
Manhole
Pipe condition
Acceptable
Potential problem
Immediate attention recommended
MH–HG89
Distance [feet]
180.0
190.0
200.0
210.0
220.0
230.0
240.0
2.3 GHz
Depth [inches]
Pipe condition
No data
Clock pos.



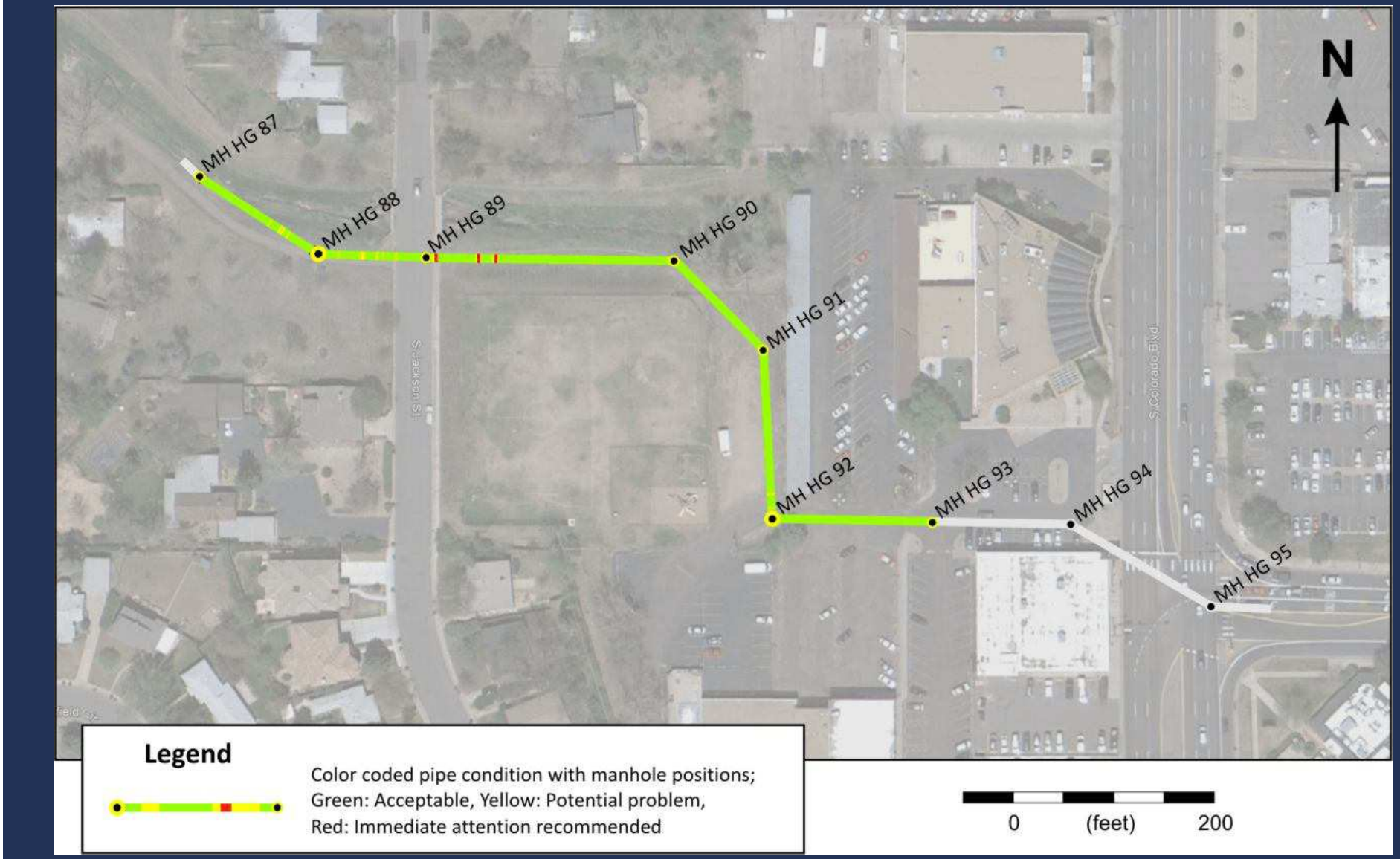
Depth Verification


Legend
2.3 GHz
PPR clock position and antenna freq.
Reinforced concrete pipe
Fill
Void
Manhole
Grout
Casing pipe
Pipe condition
Acceptable
Potential problem
Immediate attention recommended
Distance [feet]
720.0
730.0
740.0
750.0
760.0
770.0
780.0
Depth [inches]
Pipe condition
Clock pos.
Pipe loss [Inches]
0
0.5
1
1.5
2


Clock pos.
6
9
12
3
6
720
740
760
780
800
820
840
860
20
10
0
-10
-20
0
0.5
1
1.5
2
Pipe loss [Inches]
Legend
Blue line - Pipe cross-section at given pipe locations
Orange circle - original inner pipe wall at 27”



- Several 1000 data points (every inch)


N
MH HG 87
MH HG 88
MH HG 89
MH HG 90
MH HG 91
MH HG 92
MH HG 93
MH HG 94
MH HG 95
S Jackson St
S Colorado Blvd
Legend
Color coded pipe condition with manhole positions;
Green: Acceptable, Yellow: Potential problem,
Red: Immediate attention recommended
0
(feet)
200

Summary

Pipe wall thickness

•Uniform, no significant pipe wall loss: 2.5-3.3” with an average of 3.0”

Rebar Cover

- Range of 0.25” and 3.2”
- Locations with less than 0.53” rebar were identified
- Loss of rebar cover due to pipe manufacturing process & not result of pipe wall loss

- PPR mapped grout thickness within the casing pipe
- LIDAR results show significant pipe wall erosion at flow level

Results & Accuracy Correlation

•SewerVue PPR data accuracy levels exceeded 98% when compared directly to physical concrete core sample measurements.

•SewerVue provided MWRD with information about remaining pipe thickness, rebar integrity and the ability to check for corrosion & voids behind the pipe, unique to PPR technology.

•Accuracy comparable to other advanced multi-sensor pipe condition assessment technologies.

Questions and Contact

Booth 207

1 888 9 SEWERVUE
(1 888 973 9378)

www.sewervue.com
info@sewervue.com

Jeff Maier
303 286 3285
jmaier@mwrd.dst.co.us

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