

Actionable Results- Risk Driven Condition Assessment (Leak Detection +)

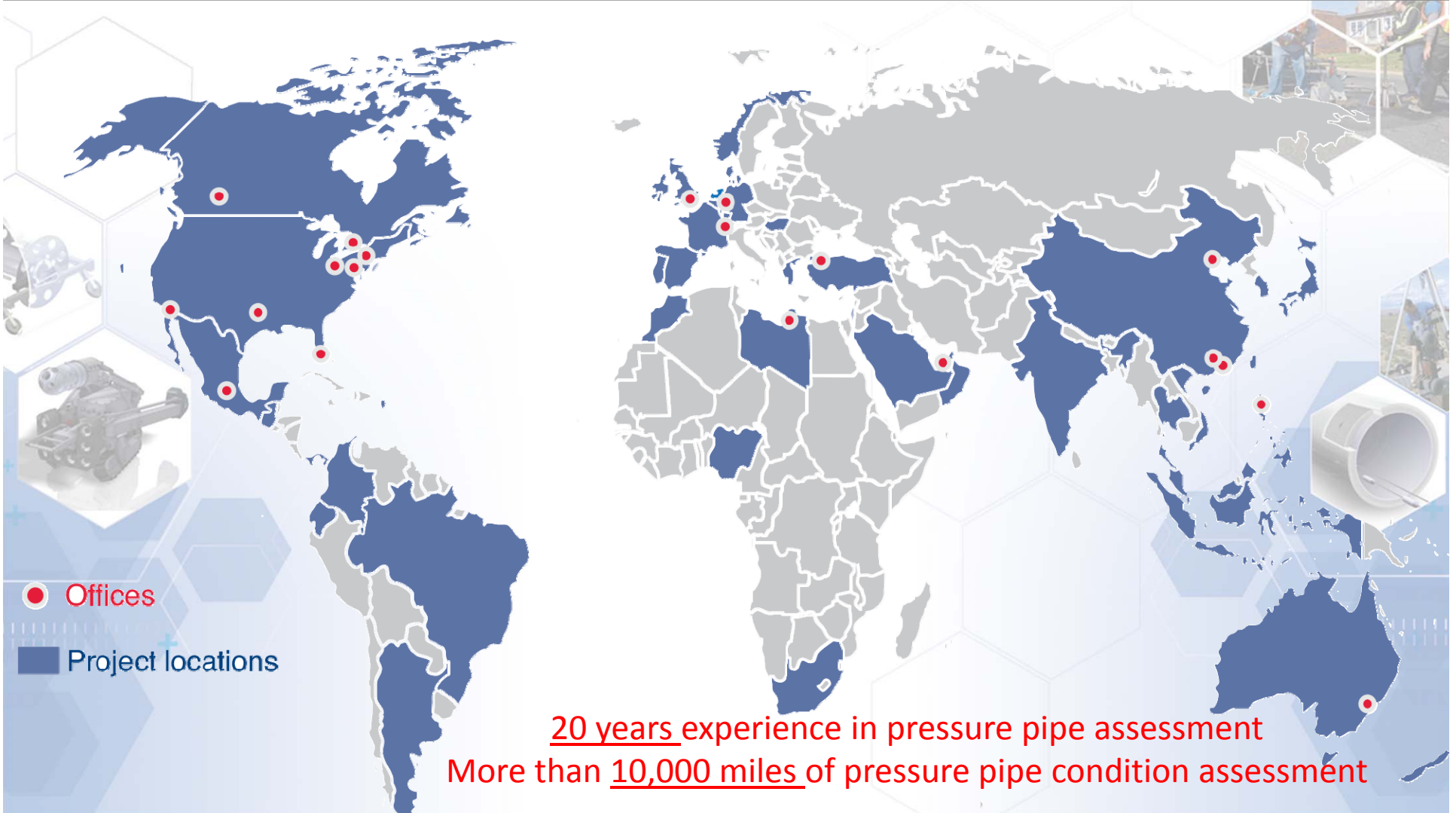
May 30, 2013

Logan Fesenmair
May 2014



Global Footprint

Infrastructure management needs are a global issue



What Does Pure Do?

Pipeline Owner Concerns

- Leaks
- Water Loss
- Pipe Line Failures
- Missing Features
- Asset Management

Technologies

- MFL
- Electromagnetic
- Acoustic
- Visual
- Pressure Monitoring
- 3D Inertial Survey

Engineering

- Structural Analysis
- History
- Op- Conditions
- Manufacturing Details

Actionable Results

- Verify
- Repair
- Replace
- Monitor
- GIS

Pure provides **Condition Based Engineering** services



Technology Portfolio

Further information on each technology, including video and photos, can be found at www.puretechltd.com

	Continuous Monitoring Technology	Leak Detection	Inspection / Condition Assessment	Water / Wastewater Pipelines	Oil & Gas Pipelines	Bridges, Buildings & Structures
soundprint Acoustic Monitoring	✓			✓		✓
soundprint Acoustic Fibre Optics	✓			✓		✓
smartball		✓	✓	✓	✓	
sahara		✓	✓	✓		
pureEM			✓	✓		
pureMFL			✓	✓	✓	
pipediver			✓	✓		
purerobotics			✓	✓		

The REAL Cost of Pipeline Failure

Direct and Indirect Costs

The average cost of a large diameter pipeline failure ranges from **\$500K - \$1.7M**

- Property damage
- Effects on human health
- Environmental damage
- Loss of production
- Repairs
- Cleanup and remediation

- Litigation
- Contract violations
- Customer dissatisfaction
- Political / Media reaction
- Loss of market share
- Government fines and penalties



Approaches to Pipeline Management

1. Run to Failure

- a) \$500k to \$1.7M per failure
- b) Safety and political concerns
- c) Lost Revenue / Industrial Users
- d) Bad PR, loss of confidence in with the community

2. Capital Program (Pipe Replacement)

- a) Typical urban costs of \$1600 to \$2500/foot
- b) Scheduled replacement based on age and failure history

Finding the “Weak Links”

Not All Old Pipe is Bad Pipe



4%

1. Find the weak links

2. Repair

3. Manage pipeline

Approaches to Pipeline Management

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2. Capital Program (Pipe Replacement)

- a) Typical urban costs of \$1600 to \$2500/foot

3. Proactive Condition Assessment Program

- a) Total approach lifetime costs of 2% to 15% of Capital Program
 - Inspection, preparation, repair and monitoring

Proactive Pipeline Management

Condition Assessment

Baseline Inspection

Current condition of the pipeline

Engineering Evaluation

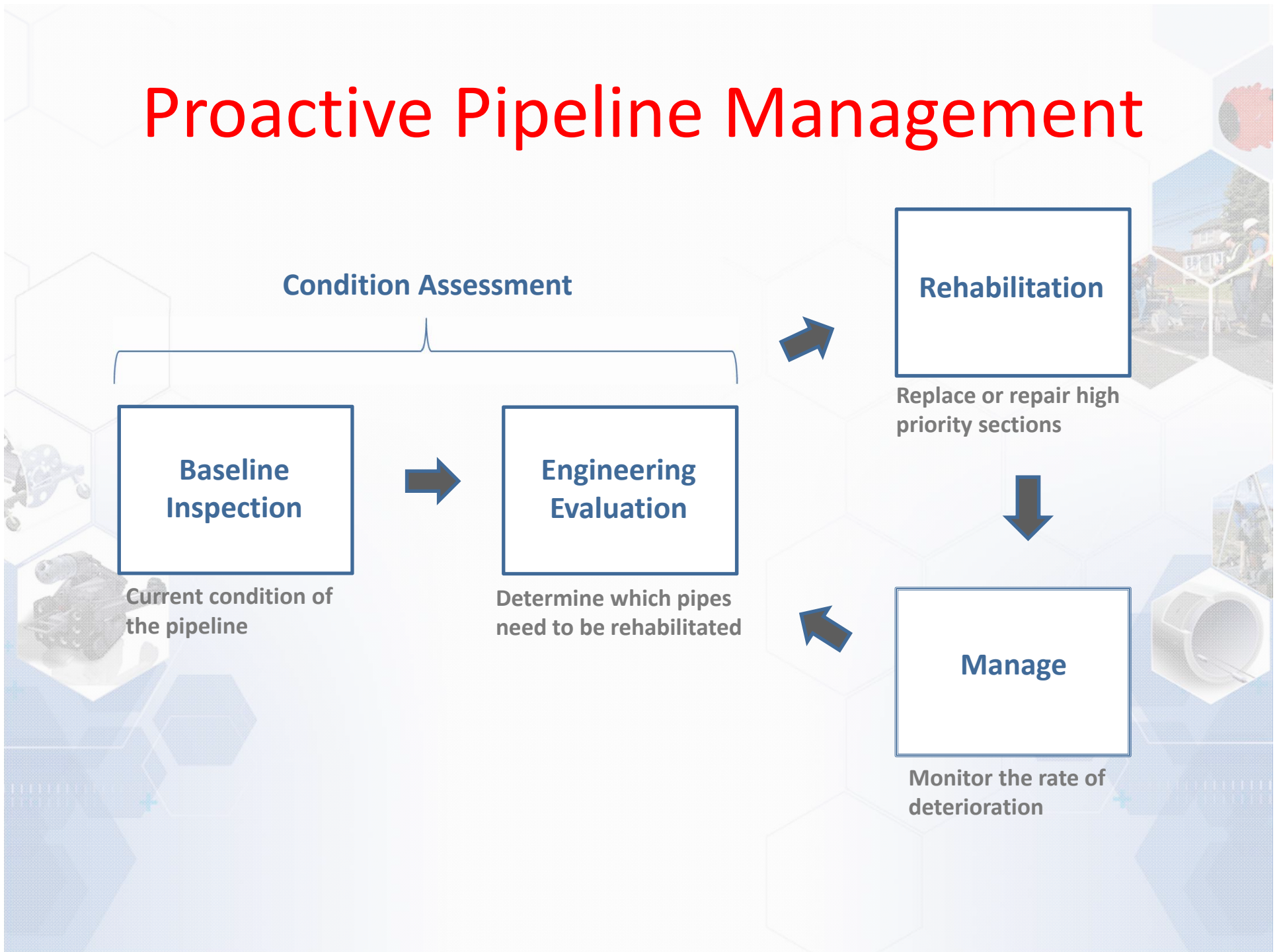
Determine which pipes need to be rehabilitated

Rehabilitation

Replace or repair high priority sections

Manage

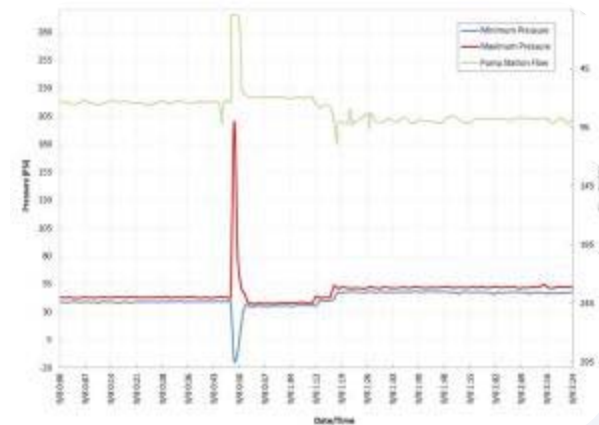
Monitor the rate of deterioration



Initial Prioritization Risk Based Assessment

Understanding Pipeline Inventory & Risk:

- *Likelihood of Failure (LoF)*



- *Consequence of Failure (CoF)*



Proactive Pipeline Management

Condition Assessment

Baseline Inspection

Current condition of the pipeline

Engineering Evaluation

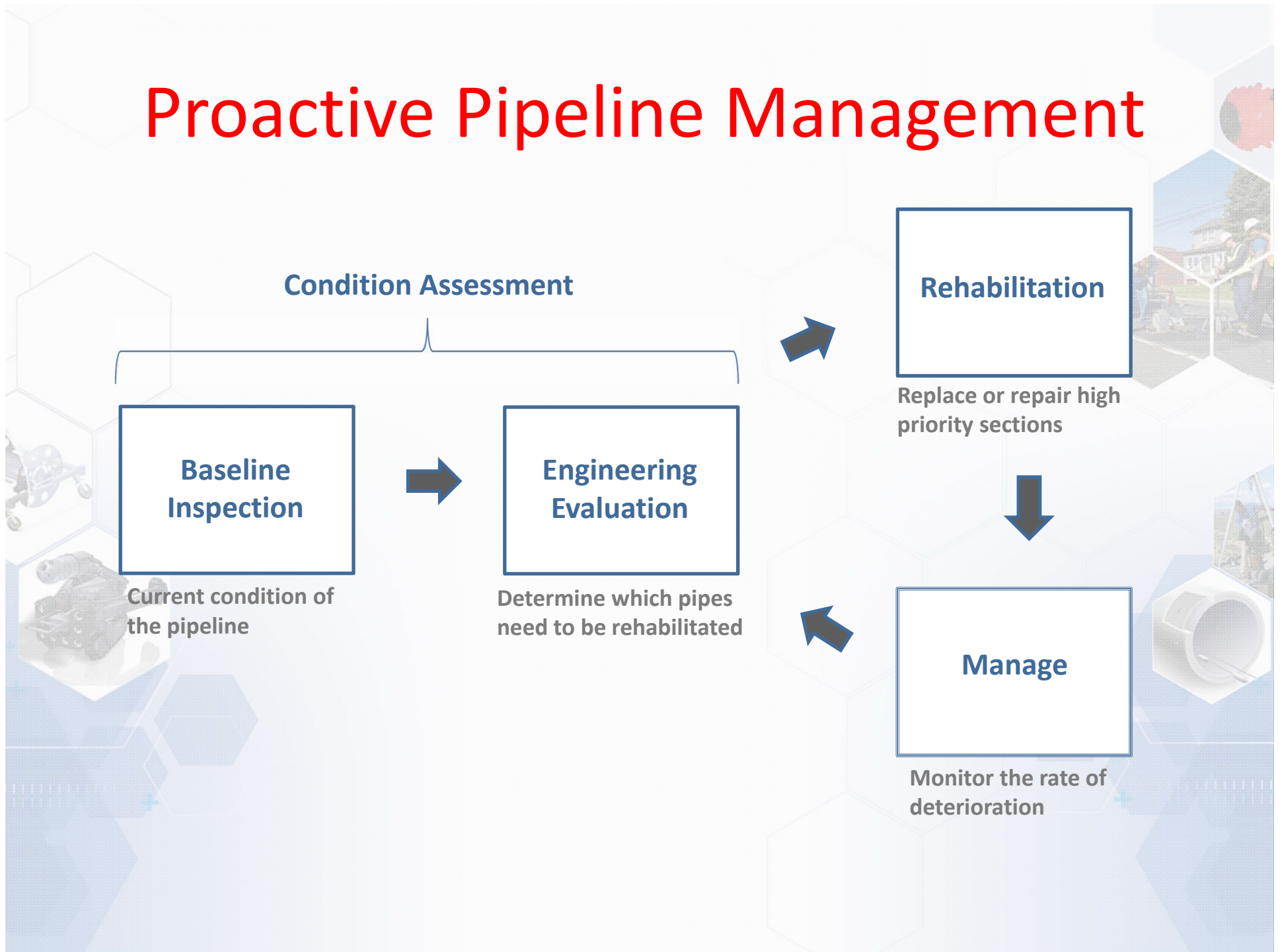
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Rehabilitation

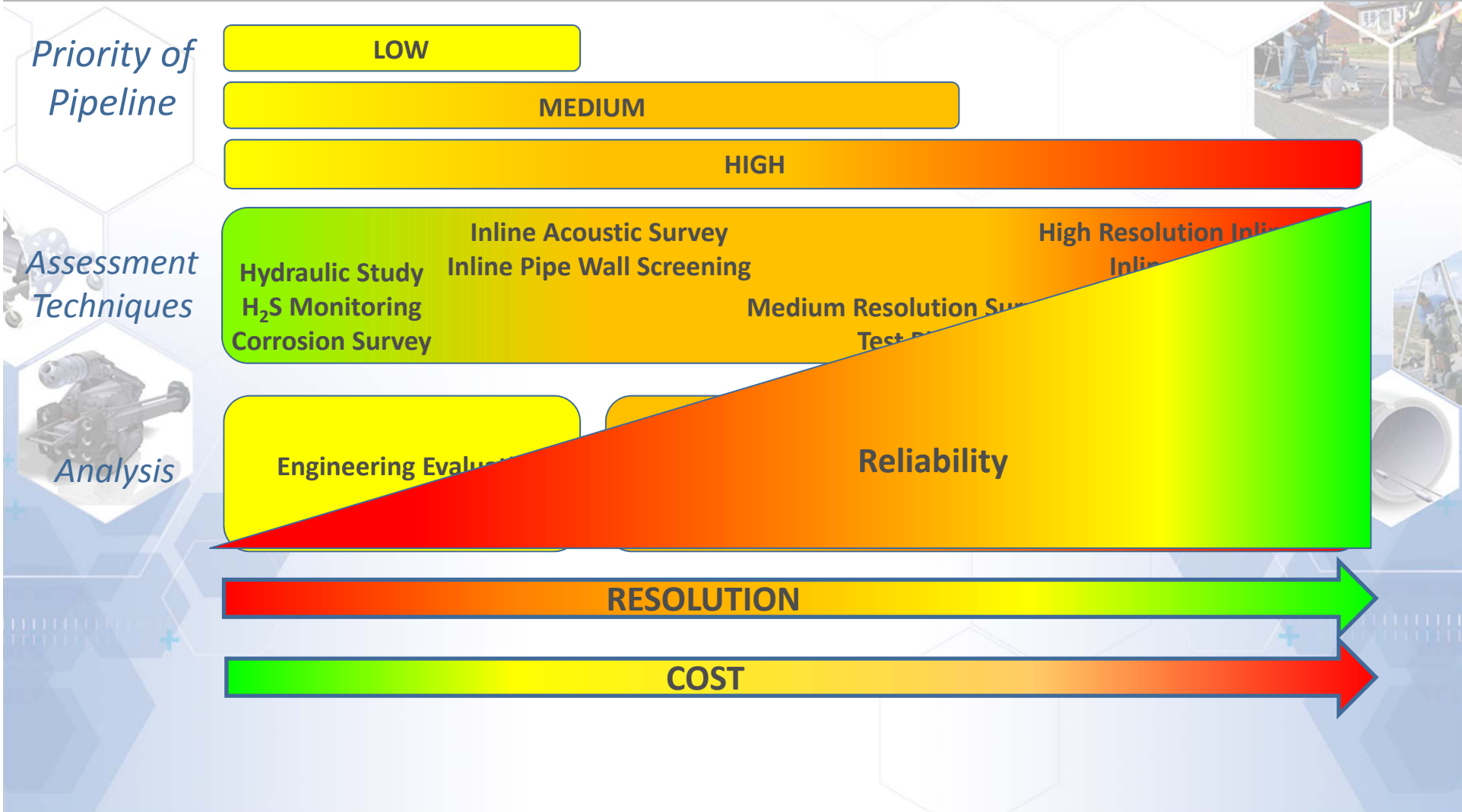
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Manage

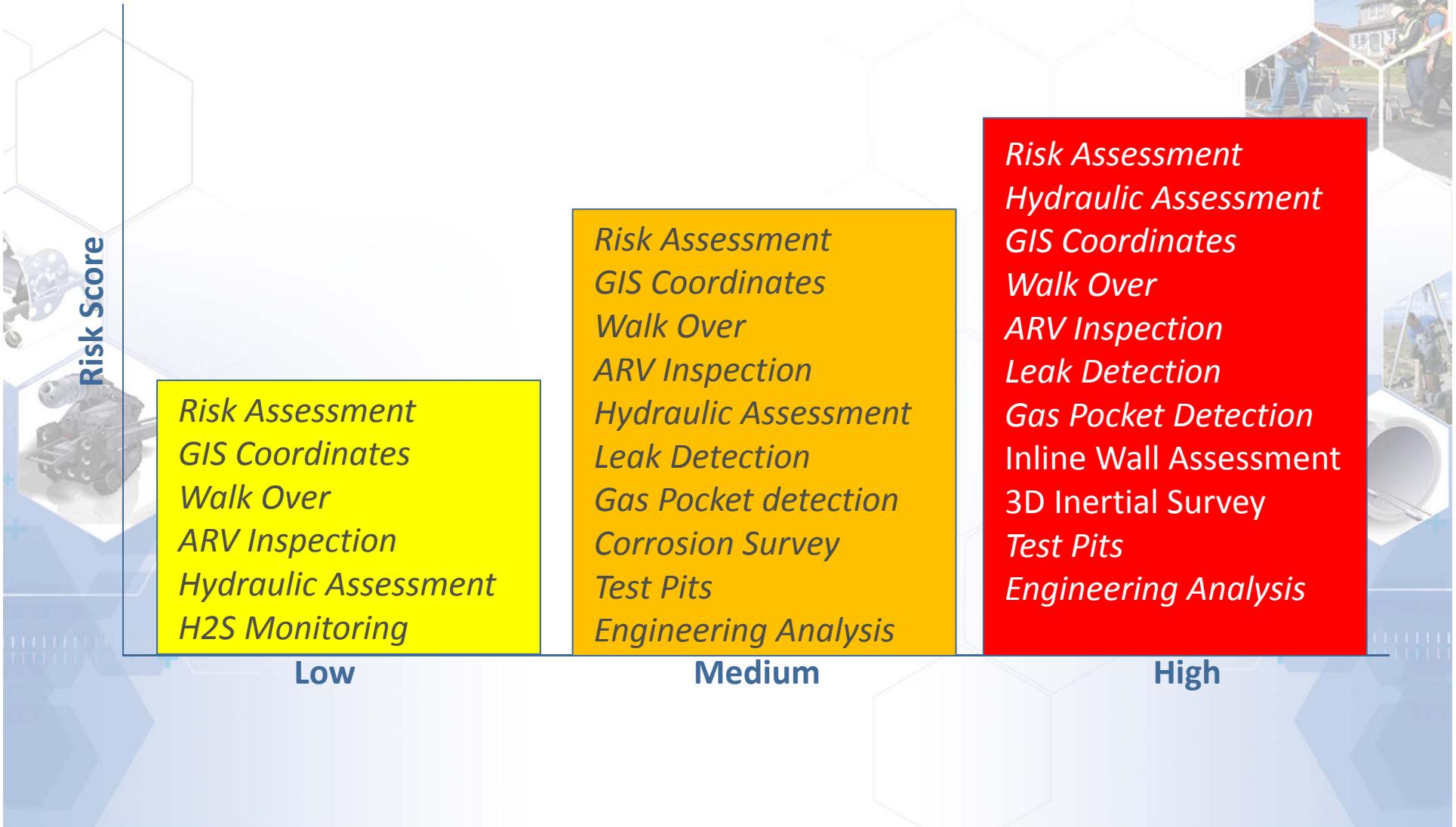
Monitor the rate of deterioration



Risk Based Technology Selection



Assessment Based on Risk



Assessment Based on Risk

Risk Score

Risk Assessment
GIS Coordinates
Walk Over
ARV Inspection
Hydraulic Assessment

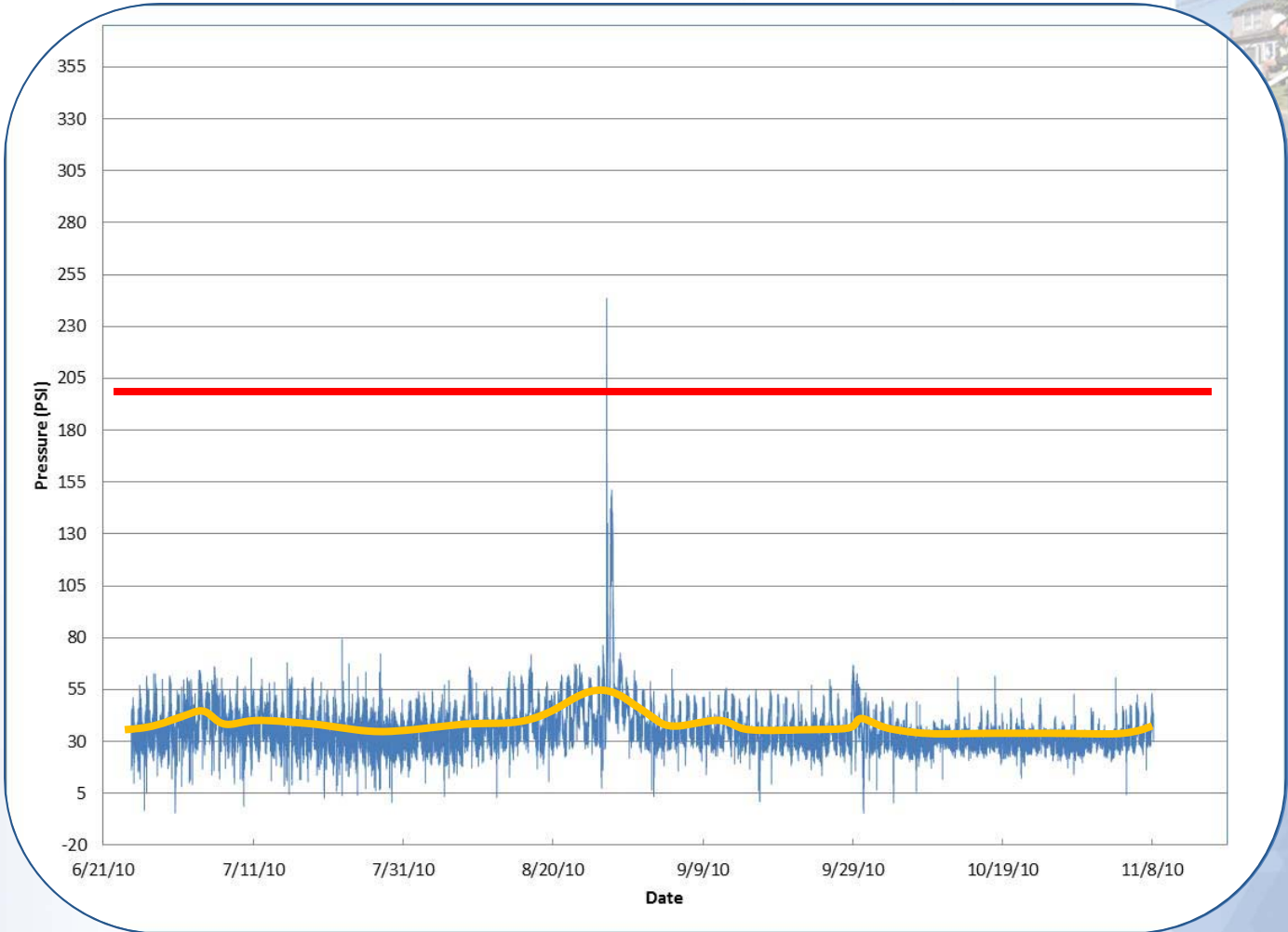
Low

Medium

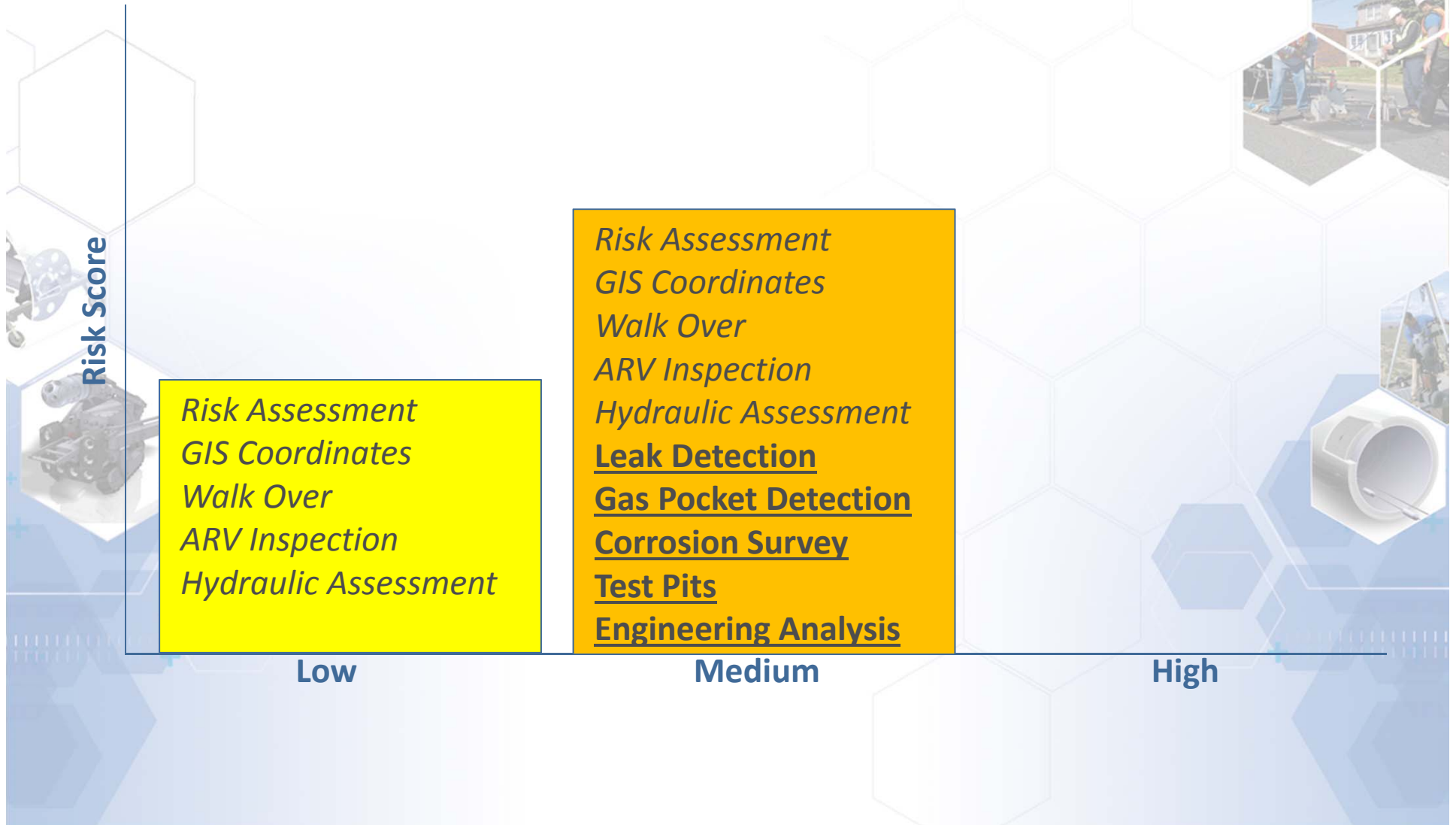
High



Pressure Transient Monitoring



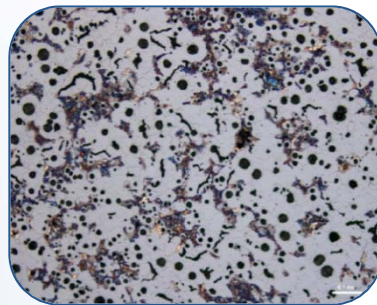
Assessment Based on Risk



Test Pits

Excavation and external assessment techniques

- *Visual inspection, pit depth measurements, concrete/mortar testing*
- *Metallurgical testing*
- *Ultrasonic testing – Metallic pipe*
- *Pulsed eddy current or broadband electromagnetic testing*
- *Impact/Echo – Concrete pipe*



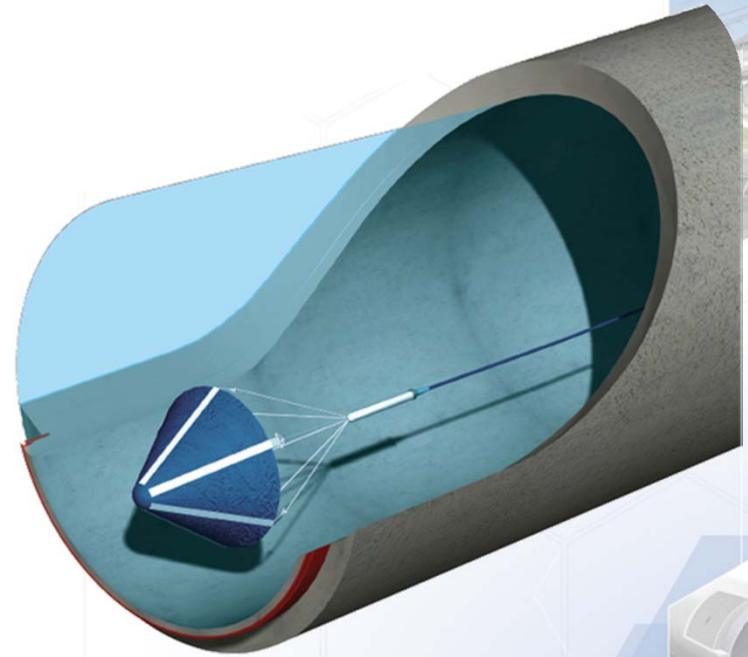
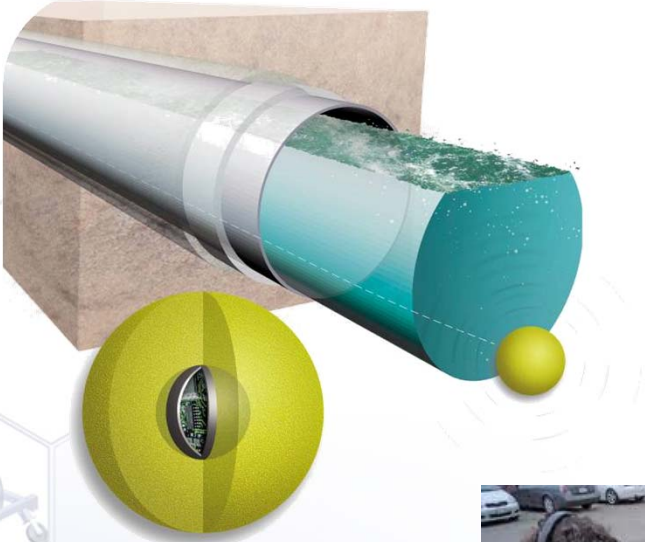
Leak and Gas Pocket Detection

-Leaks are often precursors to failures

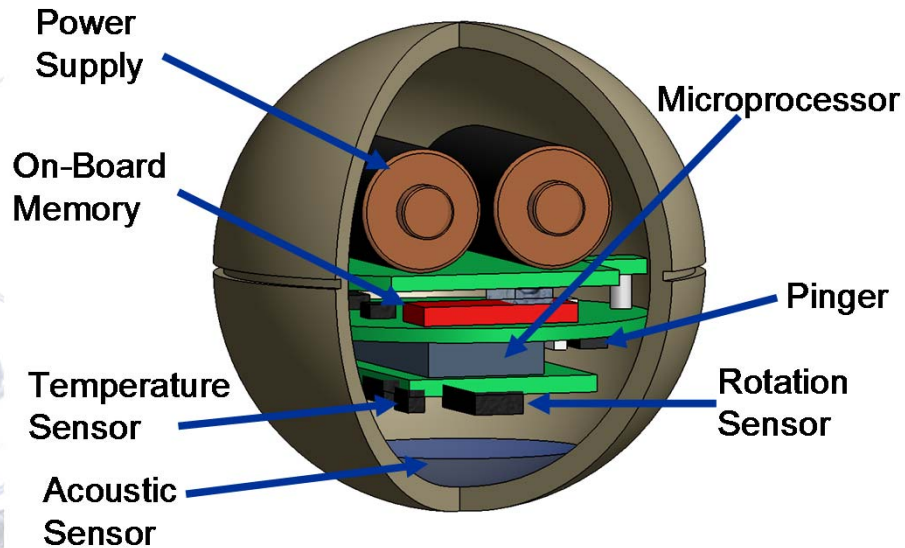
-Gas pockets may compound the effects of hydraulic transients, reduce capacity, flag areas of future failure in both water and wastewater lines



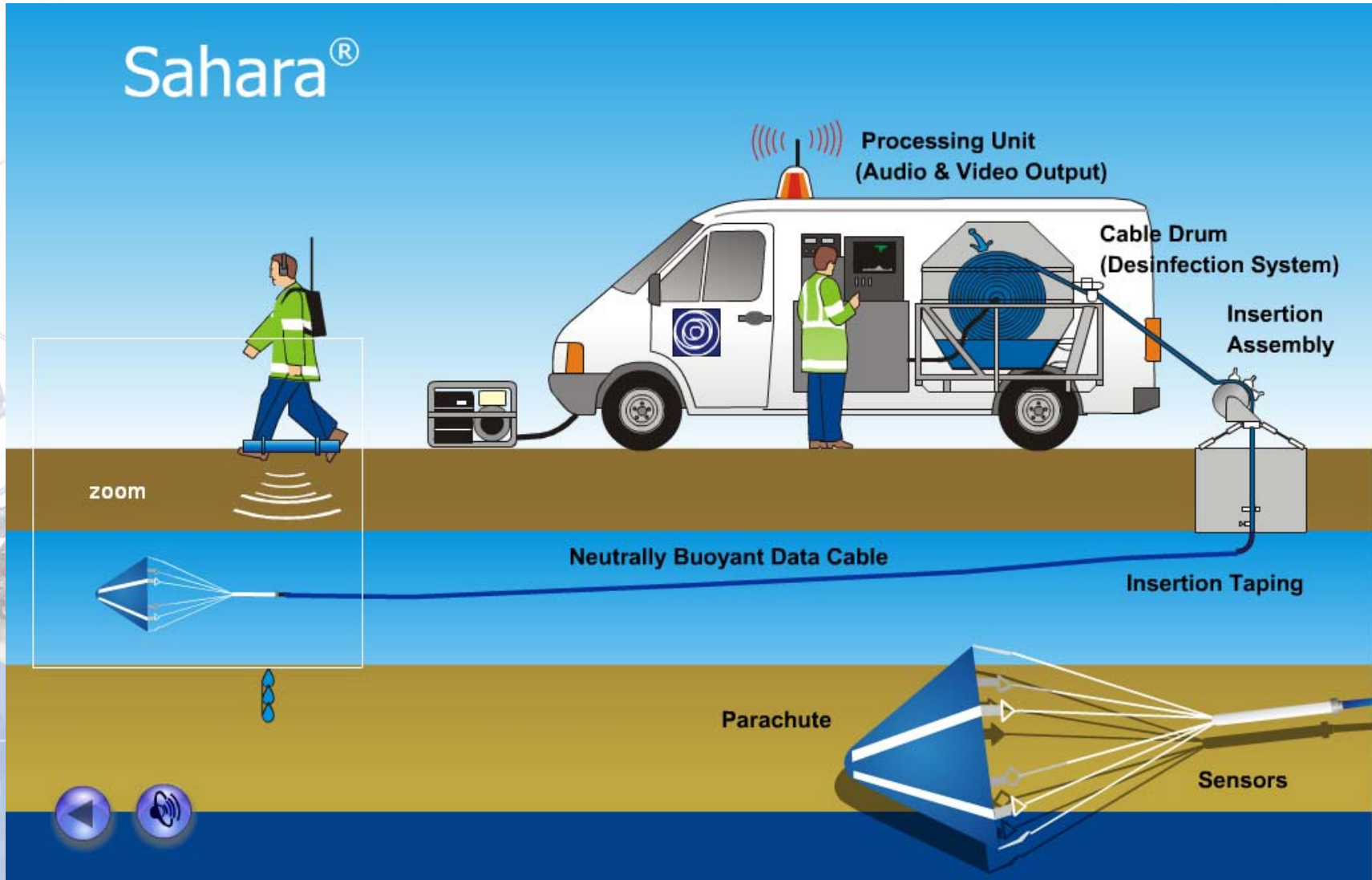
Acoustic Surveys



SmartBall[®]

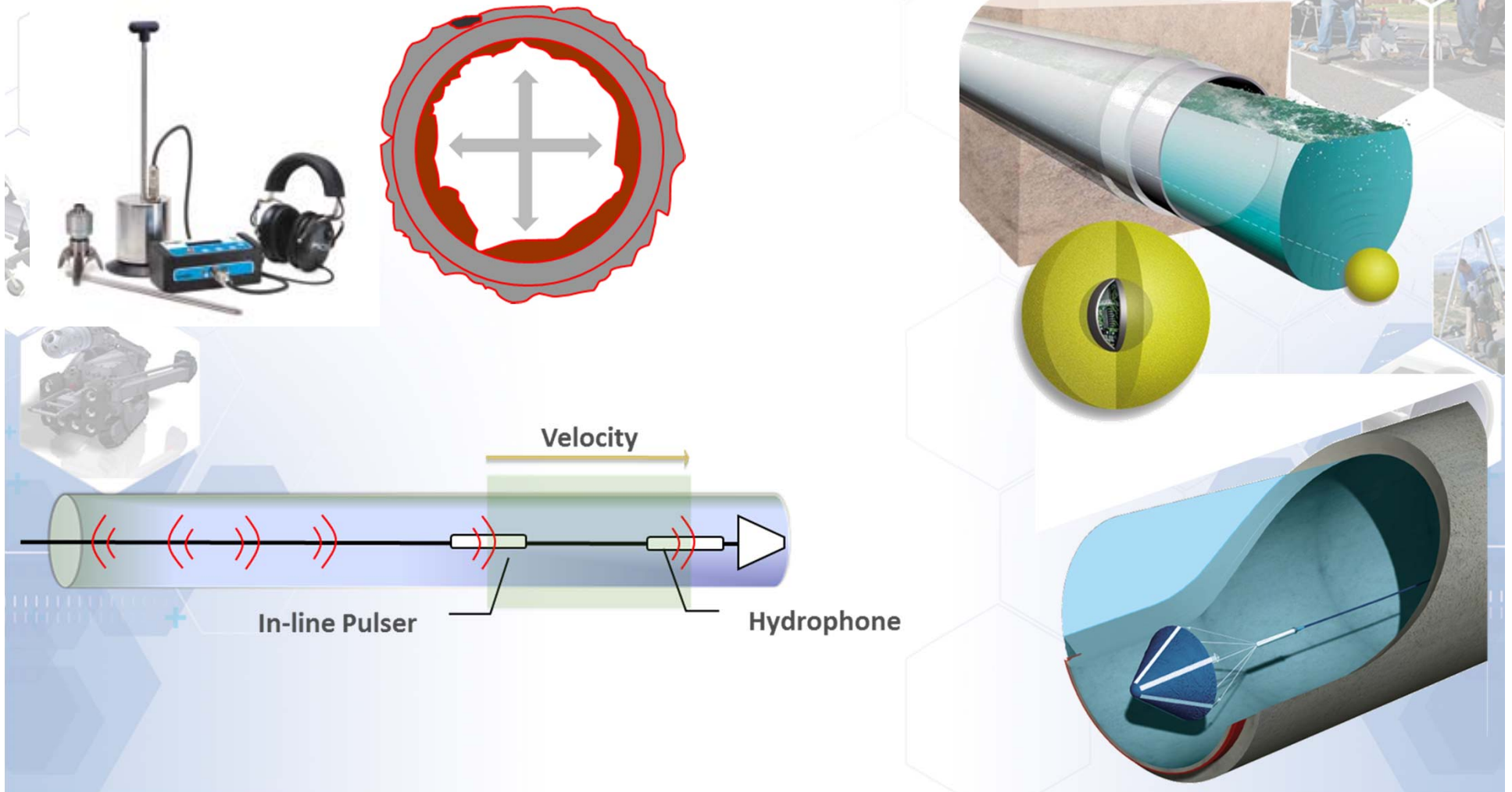


- Leak location accuracy (within 3 feet)
- Highly sensitive to leak noise (0.25 gallon per minute)
- Operates in all kinds of pressure pipes (DI, Steel, GRP, PVC,..)
- 5psi and above
- 1ft/sec and above
- Operates through 4 inch valve openings

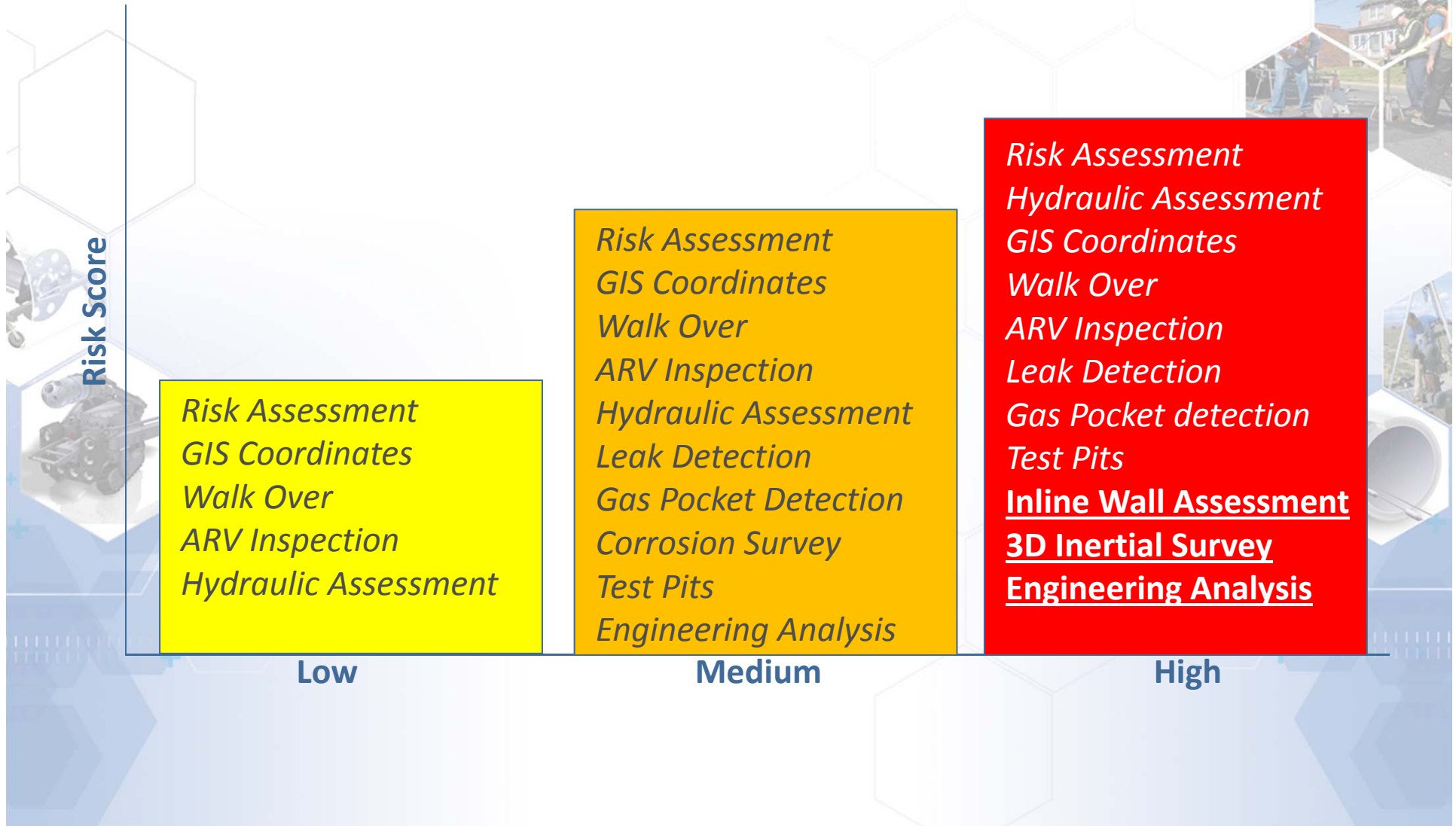


Pipe Wall Assessment

Pipe Wall Thickness Assessment- All pipe types



Assessment Based on Risk



Electromagnetic tools for different field conditions

Manned-Entry



Diameter: 36"+

Dewatered or
Depressurized Pipeline

Robotics



Diameter: 18"+

Depressurized
(Dewatering not required)

Free-Swimming

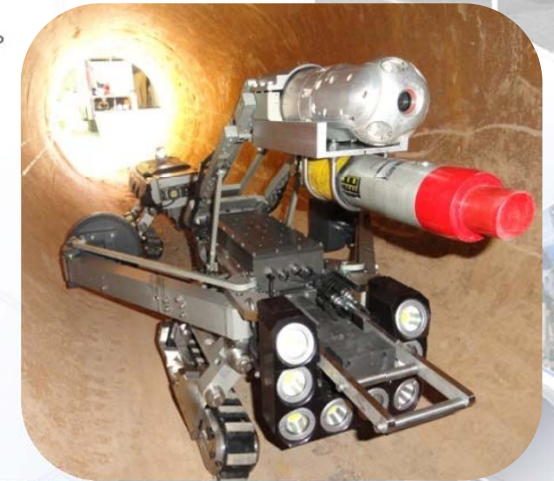
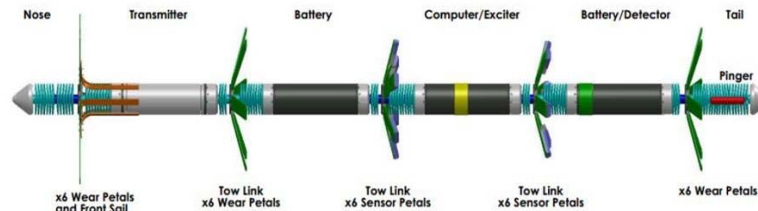


Diameter: 16"+

Ideal for long distance
inspections

Inline Wall Assessment

Electromagnetic – Metallic Pipe-BWP & PCCP



Pure Robotics



Technologies

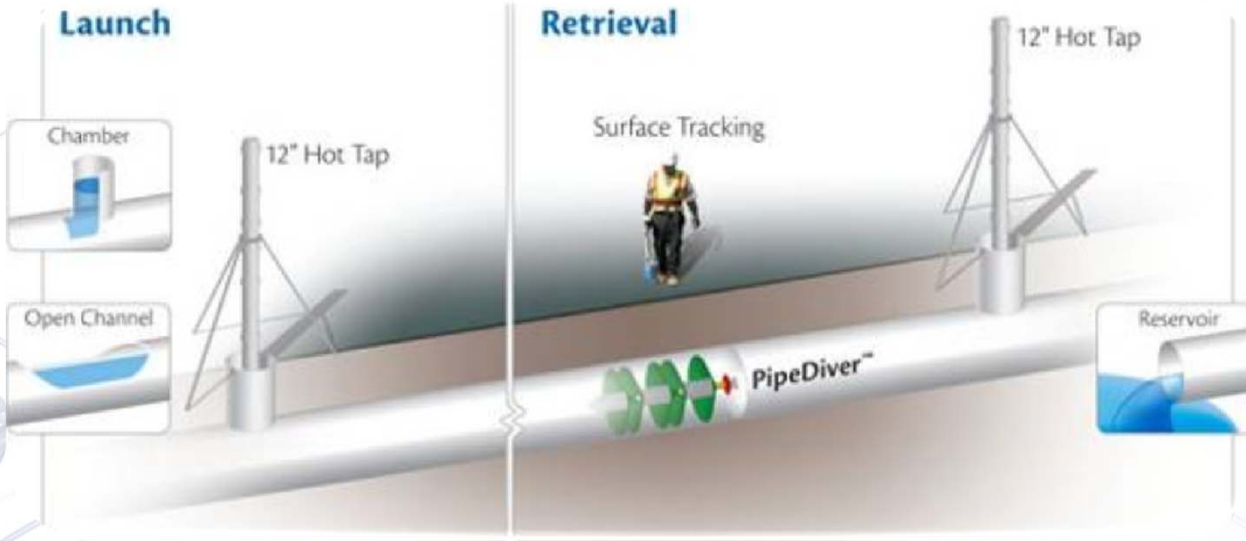
- P-Wave Electromagnetic
- Enhanced EM
- HD CCTV
- Laser profiling
- SONAR
- 3D mapping

Robot Specs

- Water and Wastewater units
- Fits in a 18 inch access
- Distance depends on conditions
 - 1 to 1.5 miles is typical
 - Line must be depressurized



PipeDiver



Technologies

- P-Wave Electromagnetic
- Enhanced EM
- Leak Detection (in development)
- SONAR mapping-detects collections of debris and reports out of round

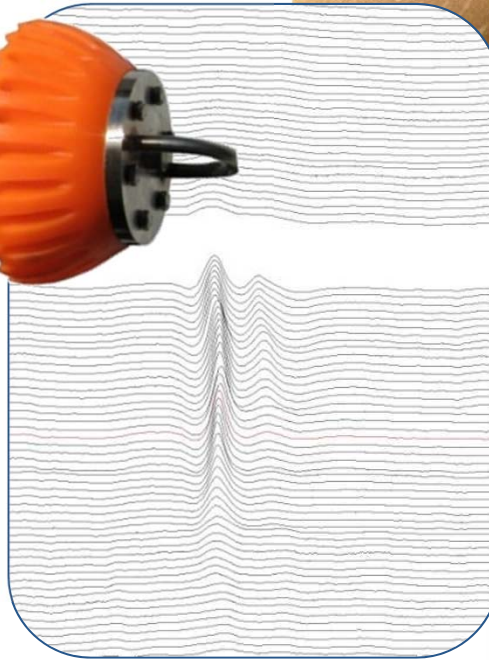
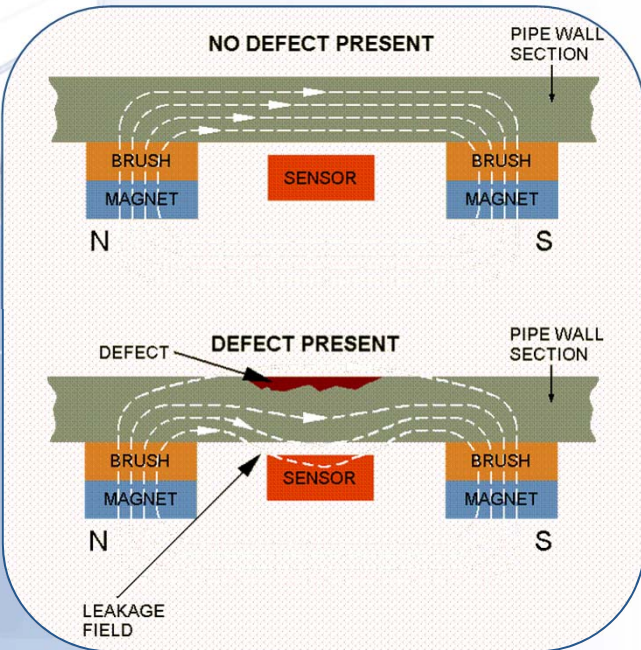
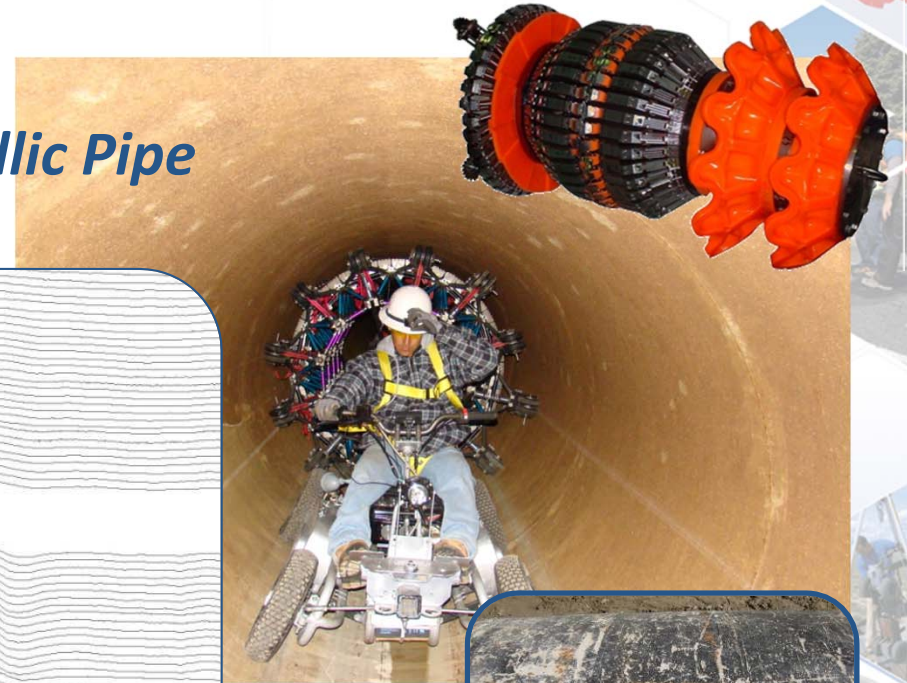
PipeDiver Specs

- Inspect w Line in service
- All pipe diameters
- Launch and Retrieval
 - Special tubes
 - Tanks
 - Temporary depressurization
- Flow rates 0.5 feet/s to 4 feet/s
- Shut off branches larger than 6 inches

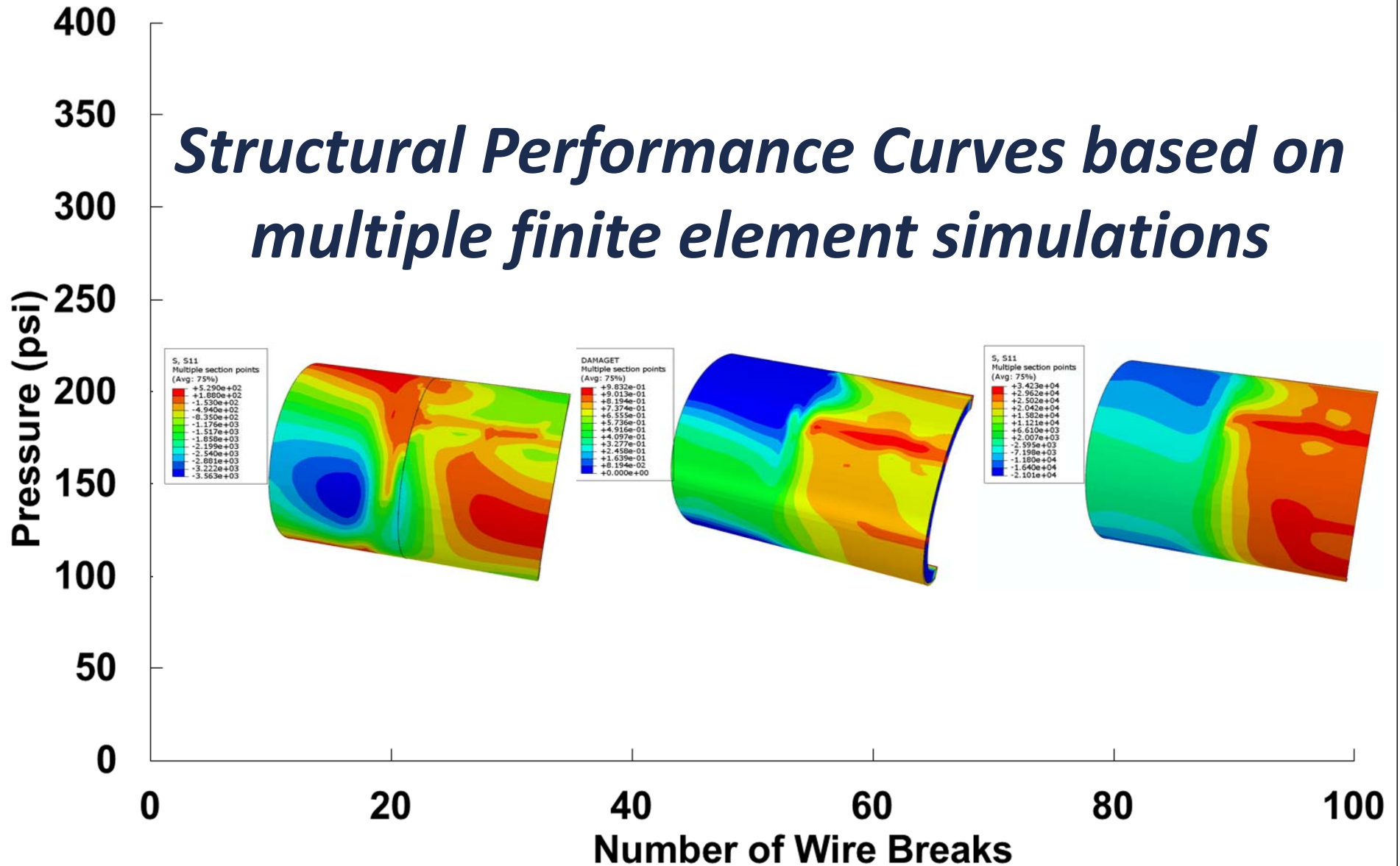


Inline Wall Assessment

Magnetic Flux Leakage (MFL) – Metallic Pipe



How much deterioration before pipe fails?



Engineering Analysis

Structural Modelling

PCCP (C301/C304) – FEA

BWP (C303) – FEA

Metallic Pipe – Steel, Ductile Iron, and Cast Iron

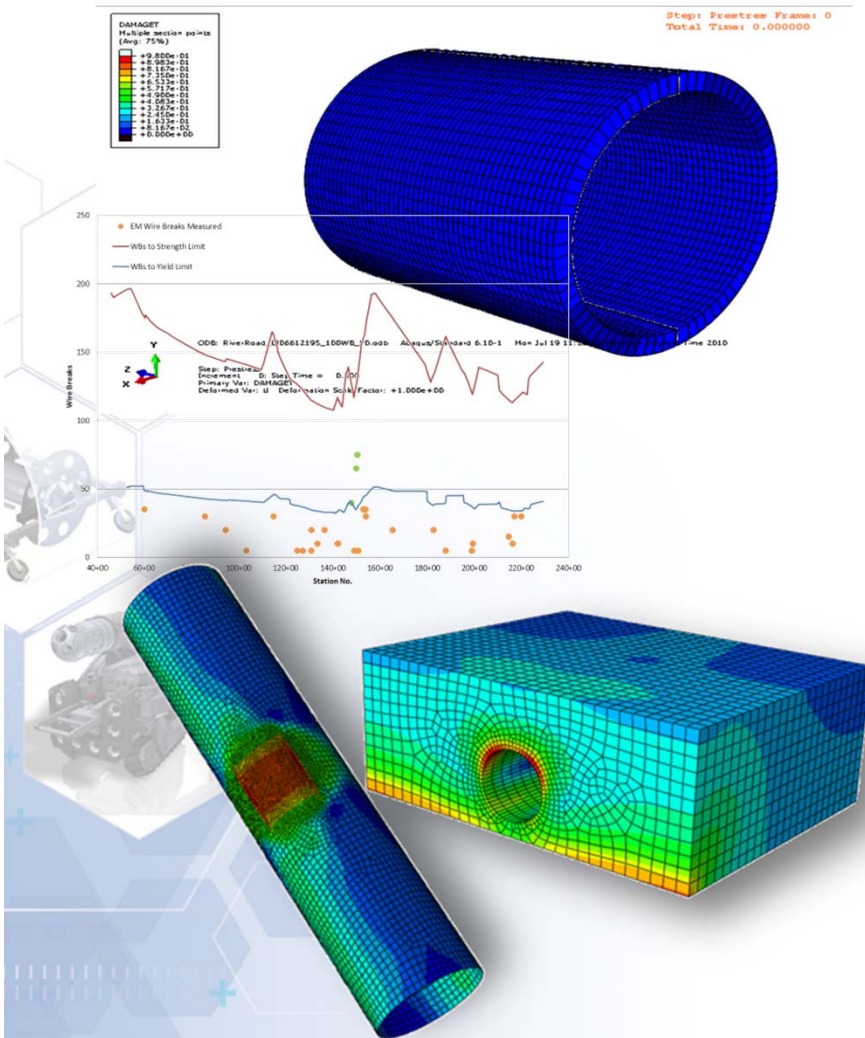
Statistical Analysis

Risk Models

Re-inspection Intervals

Remaining Useful Life

Development of long term management strategies



Actionable Results

Provide immediate and long term main management strategies

Isolated repairs

Anode installation

Large scale rehabilitation/replacement (Capital program)

Re-inspection strategies

Monitoring Program



Questions?




Pure Client Website

Pipe Chart

96+88.36	97+08.36
10-36	10-37
D1	E
35+1=36	0+0=0
1	0
97+28.45	97+48.45
10-38	10-39
E	E
10+0=10	10+0=10
0	0
97+68.45	97+88.45
10-40	10-41
F	F
0+0=0	0+0=0
0	0
98+08.45	98+28.94
10-42	10-43
F	F
20+7=27	40+3=43
7	3
98+48.85	98+68.85
10-44	10-45
F	F
30+0=30	0+5=5
0	5
98+88.85	99+09.02
10-46	10-47
F	F
5+0=5	40+3=43
0	0

Google Earth

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Section 10-47 - 99+49.02

Wirebreaks:

Acoustic	2
Electromagnetic	40
Total	42

[Further details...](#)