Sewer Force Main Condition Assessment Approaches Using New Technologies

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Sewer Construction & Rehabilitation

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11:00 – 11:25 a.m.

Room 101C

Why do Forcemains Exist?

- Get wastewater to the plants
- Allows growth with less treatment plants
- Transport wastewater long distances
- Promote economies of scale

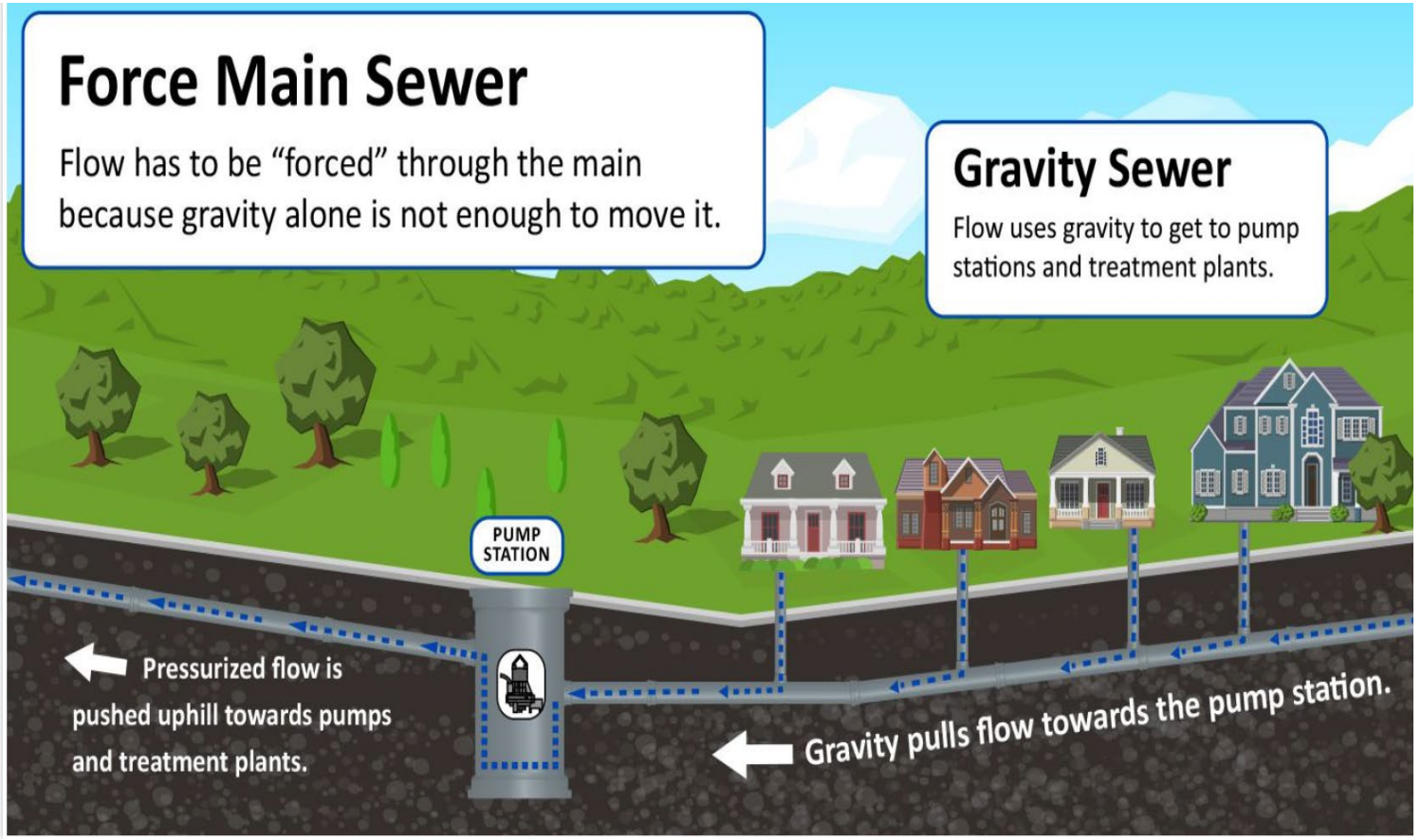


Image Courtesy of Metropolitan St. Louis Sewer District

What Makes Forcemains Difficult to Assess?

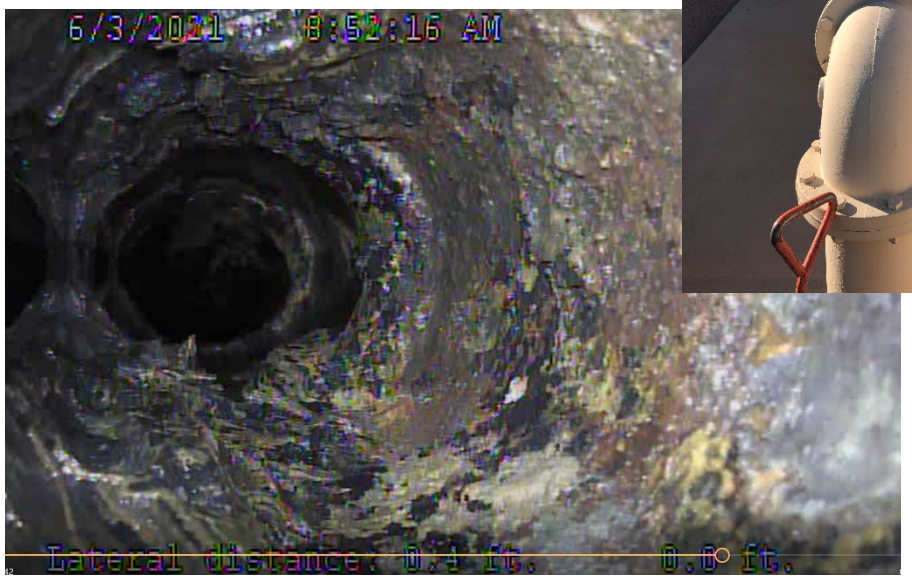
- Designed with water distribution standards & technologies
- Limited pipeline access
- Materials often cannot withstand corrosive media & gasses
- Vaults for air valves often undersized

What Makes Forcemains Difficult to Assess?

- Isolation and air valves not made for wastewater
- Limited isolation valves installed on pipelines
- Pipeline geometry creates inspection and rehabilitation challenges

What Makes Forcemains Difficult to Assess?

- Lift station has limited storage capacity and can't be taken out of service
- Lack of pipeline redundancy
- Bypass or pump-and-dump is usually necessary
- Cameras & human access are typically not an option

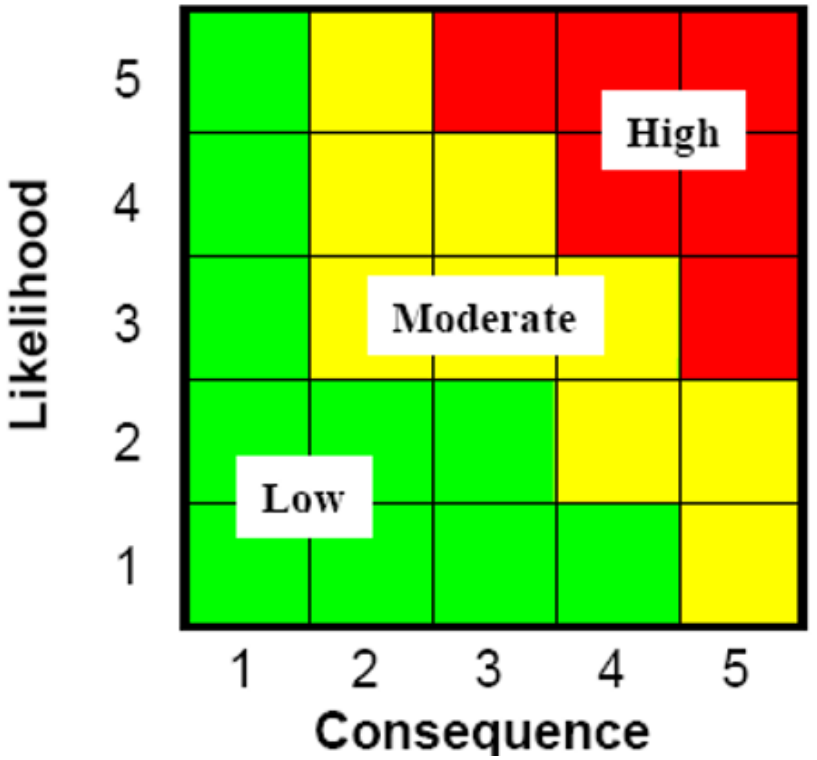


What Goes into a Forcemain Assessment Program?

- Triple Bottom Line
  - ✓ Economic impact
  - ✓ Social impact
  - ✓ Environmental impact
- Pipeline Condition Assessment
  - ✓ Oldest pipe is not always the worst pipe
  - ✓ Installation, operation, and environment

Where do I Start?

- Risk Analysis = Consequence x Likelihood
  - ✓ Consequence – what happens if pipe fails
  - ✓ Likelihood – condition assessment data
- Evaluate technologies available for assessment with the end in mind
- Prioritize system
- Don’t spend more on assessment that what rehabilitation will cost



What Should I be Looking For?

- Internal Issues
  - ✓ Operating and transient pressure
  - ✓ Hydrogen sulfide gas
  - ✓ Joint defects
  - ✓ Corrosion
  - ✓ Tuberculation

- External Issues
  - ✓ Corrosion
  - ✓ Stray current
  - ✓ Subsidence
  - ✓ Third party damage

Assessment Technologies and Techniques

- Considerations:
  - Pipeline shutdown/dewatered or in-service?
  - Available access to inside and outside pipe?
  - Pipeline geometry, isolation/air valves, and access points
  - Cleaning considerations and options
- Internal CCTV Inspection

Assessment Technologies and Techniques

- Internal CCTV Inspection
- Free swimming assessment technology for gas pockets
- Internal and external pipe wall assessment
- Hydrostatic test (it's an option…..)

Internal CCTV Inspection

- Difficult to shutdown, bypass and clean forcemains
- Extremely difficult to traverse pipeline due to bends
- Inside of forcemains look the same throughout unless cleaned

Internal CCTV Inspection

- Many challenges of pigging forcemains for cleaning
  - Pig deployment & retrieval stations never installed
  - Pigs can overpressure pipeline and cause failures
  - Most isolation valves are reduced port plug valves that won't let pipe pigs pass
- Lots of effort for limited information collected

Free Swimming Technologies

- Free swimming data collection spheres
- Deployed in active pipes with wastewater in 3-inch port or larger
- 2 – 3 spheres released in each deployment
- Three companies currently offer this technology; application ability varies

Free Swimming Technologies

- Leak and gas/air pocket detection
- Temperature and pressure sensors
- X/Y/Z geometry of the pipe collected
- Report of findings 3 weeks after deployment
- 24-hour memory / battery life

Free Swimming – Gas Pocket and Leak Noise Data

Gas Pocket Noise

ARV / Leak Noise

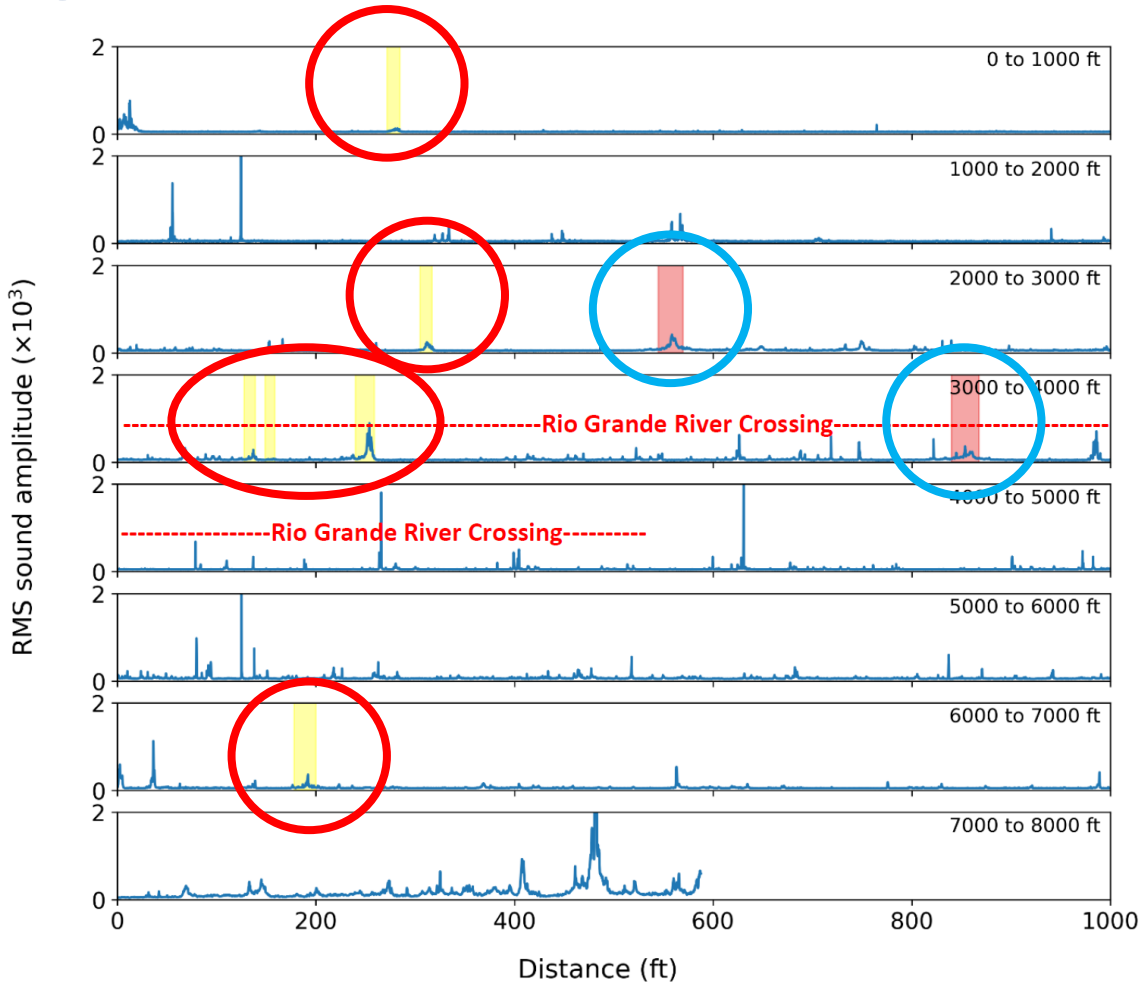


Figure 3: Audio amplitude as a function of distance for run 1. Locations of air pockets are highlighted in yellow. Locations of acoustic anomalies are highlighted in red.

Free Swimming – Pressure Sensor Data

1st Pass Pressure

2nd Pass Pressure

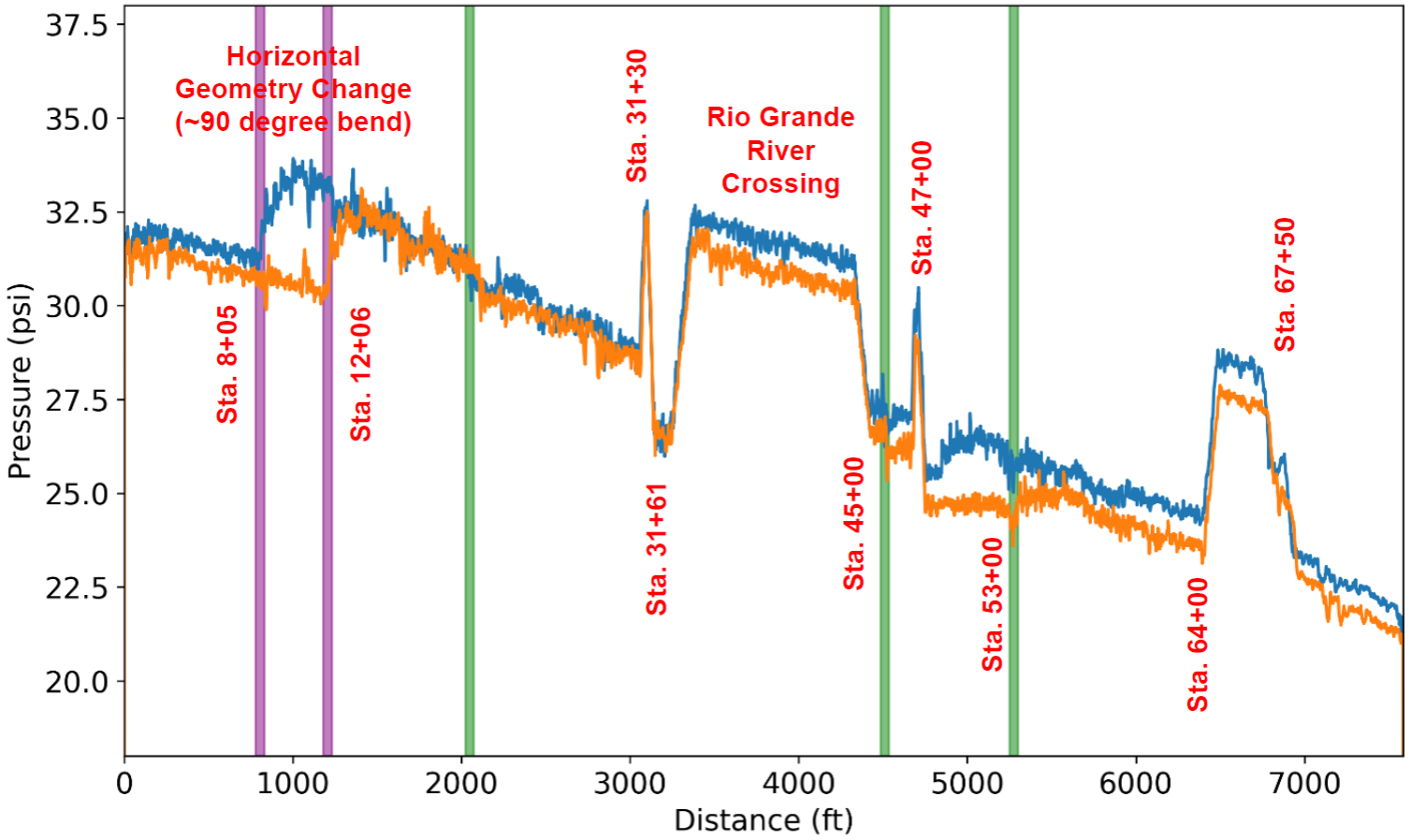
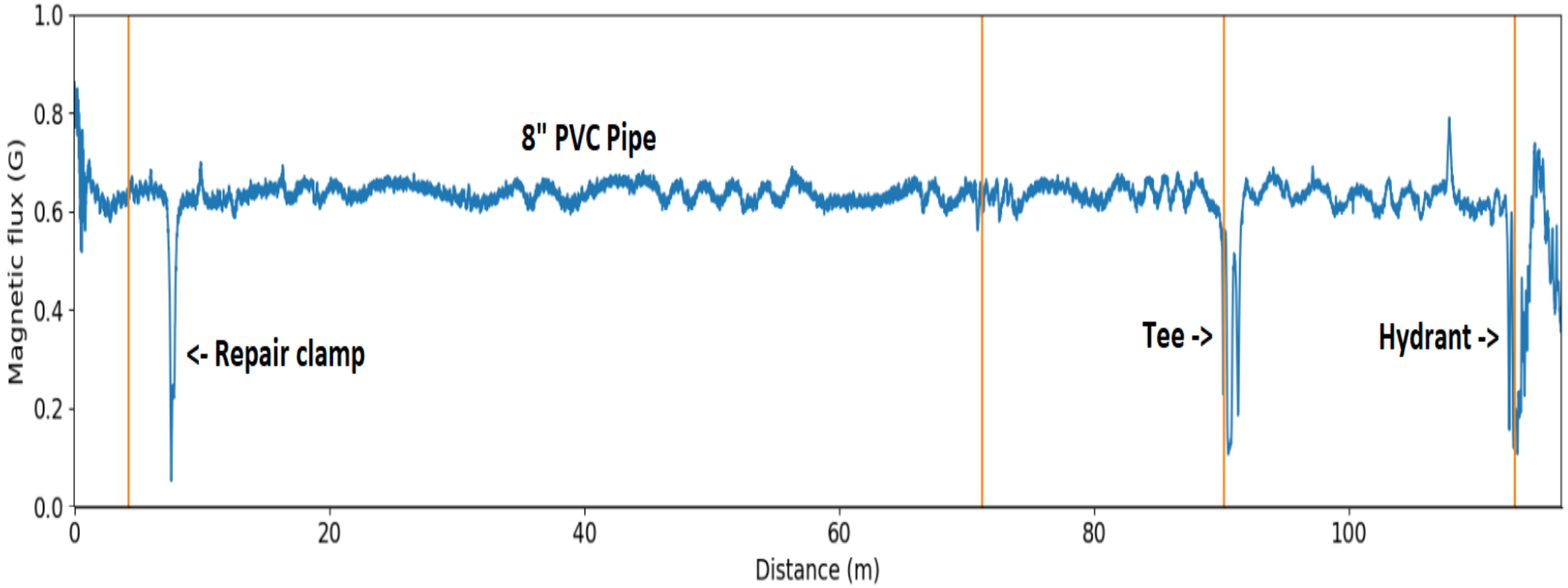


Figure 5: Pressure from both run 1 (blue) and run 2 (orange). The locations with repeated unusual pressure changes are indicated in green, and the locations with non-repeated pressure changes are shown in purple.

Free Swimming – Metallurgy Data

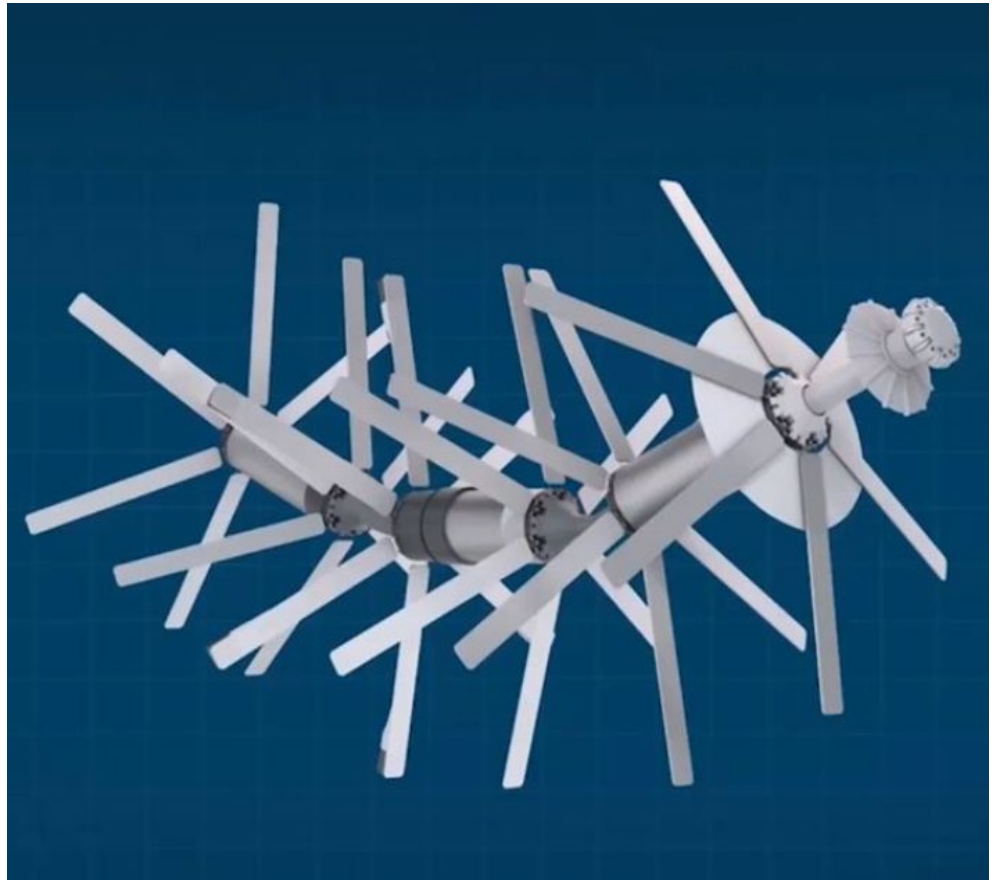


Internal Pipe Wall Assessment

- Electromagnetic technology (near and remote field)
- Pipe must shutdown, flushed & cleaned prior to insertion
- Moved through pipe with winch/cable or free-swimming with flow
- If by flow, water must be potable or raw

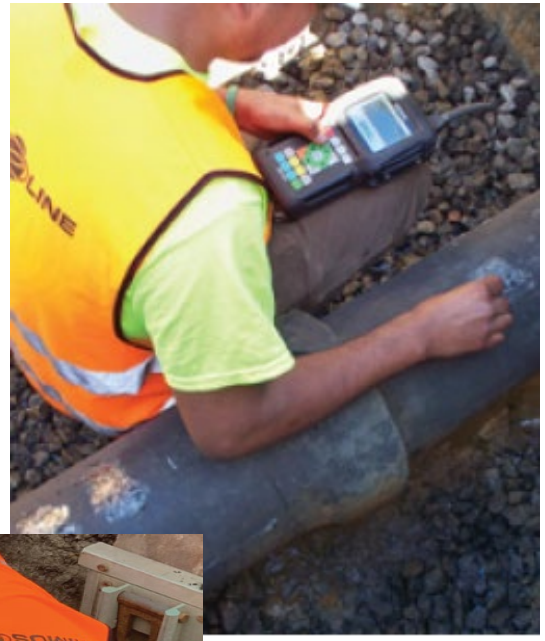
Internal Pipe Wall Assessment

- 360-degree survey of pipe wall
- Identifies remaining pipe wall thickness and localized pitting
- Highly accurate & highly priced



External Pipe Wall Assessment

- Electromagnetic technology
- Pipe can be in normal operation
- Must expose pipe in location where measurement is taken
- Usually just pipe crown is useful data, as corrosion is most common in that location



External Pipe Wall Assessment

- Commonly tested at ARV locations, but also from free-swimming acoustic data
- Ultrasonic measurement for actual wall loss
- Effectively verifies locations where corrosion/deterioration is occurring

Summary and Conclusion

- Forcemain assessment programs are emerging due useful life approaching
- Risk Based Analysis is an efficient approach
- Multiple factors cause deterioration, failure
- Extremely difficult to collect data due to limited access and geometry

Summary and Conclusion

- Materials are not made for harsh wastewater environment
- Phased assessment approach should be implemented
- Once found to be in failure mode, schedule rehabilitation or replacement

Questions?

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