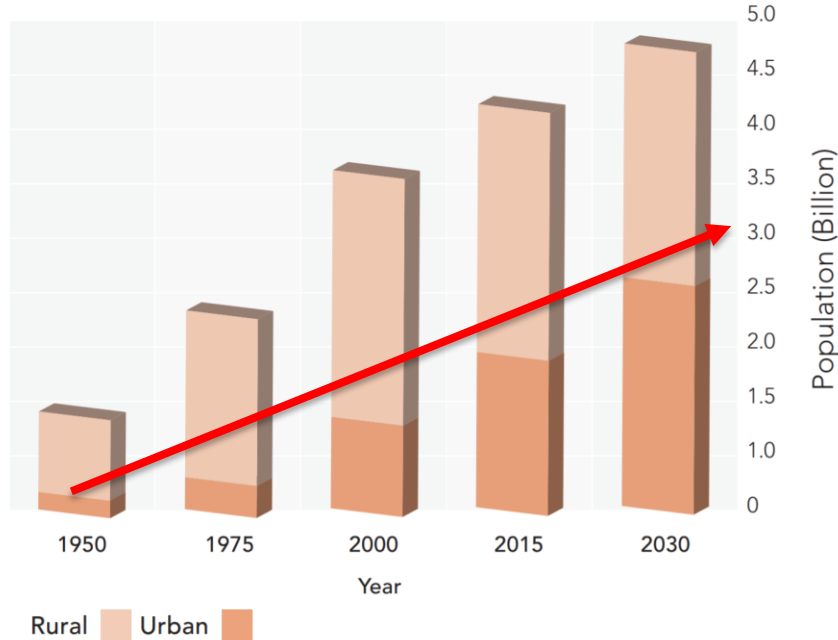# Addressing Water Infrastructure Challenges with Advanced Technologies and Data Analytics

Hugh Chapman

April 2, 2019

Water Infrastructure Challenges + Growing Water Demands

- Two thirds of Asia population urbanized by 2015; additional 1.1B people

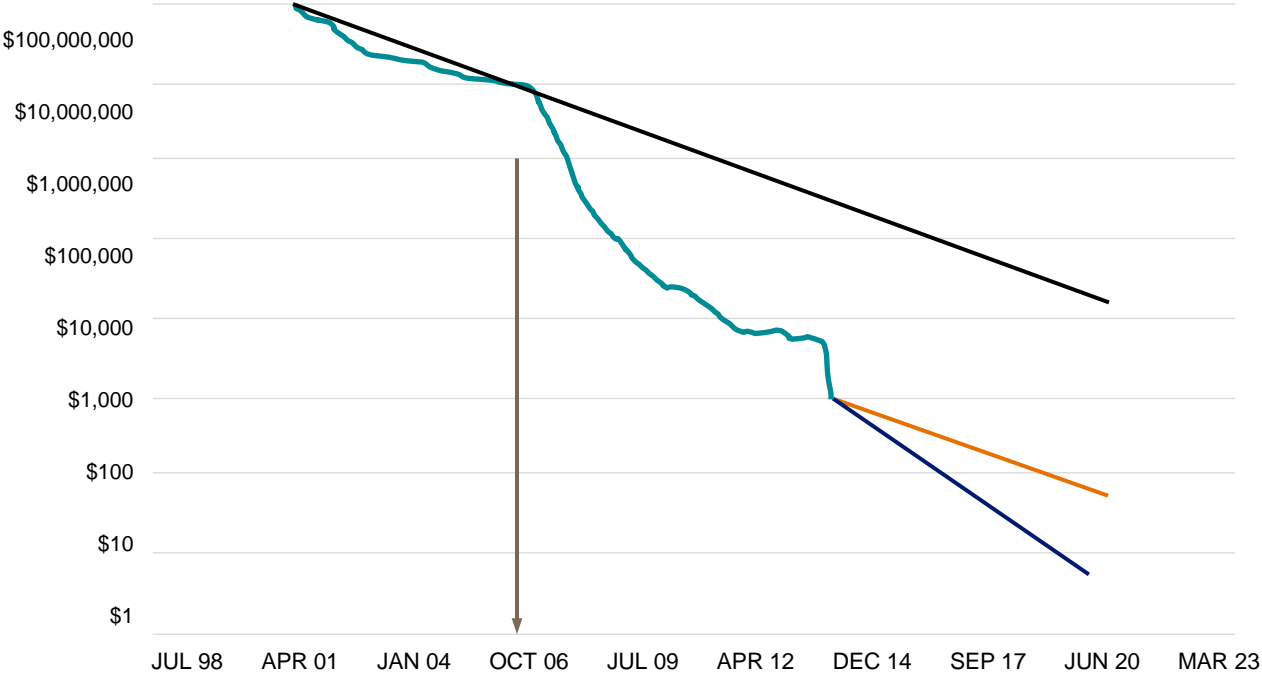- Coupled with inadequate planning / investments of past decades + competing demands for water + climate change

Source: ADB : Managing Asian Cities

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Changes in 10 years: Computing

40X

Source: Brookings, Wikimedia

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Changes in 10 years: Computing

1MX

Cost Declines of Genome Sequencing

- Historic Cost Per Genome
- Moore's Law
- Moore's Law Forecast
- Historic Rate Forecast

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Changes in 12 years: Water

Changes in output per hour by sector, 2000–2010

Legend:
- Wholesale trade
- Retail trade
- Mining
- Utilities
- Transportation and warehousing
- Manufacturing
- Information
- Other services
- Accommodation and food services

Index (2000 = 100)

Source: NewWorld Capital Partners, US Bureau of Labor Statistics

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Changes in 12 years: Water

Changes in output per hour by sector, 2000–2010

Average annual percentage change

Legend: Hours, Output, Productivity

Sectors (top to bottom): Nonfarm business, Information, Manufacturing, Retail Trade, Wholesale trade, Transportation and warehousing, Accommodation and food services, Utilities, Other services, Mining
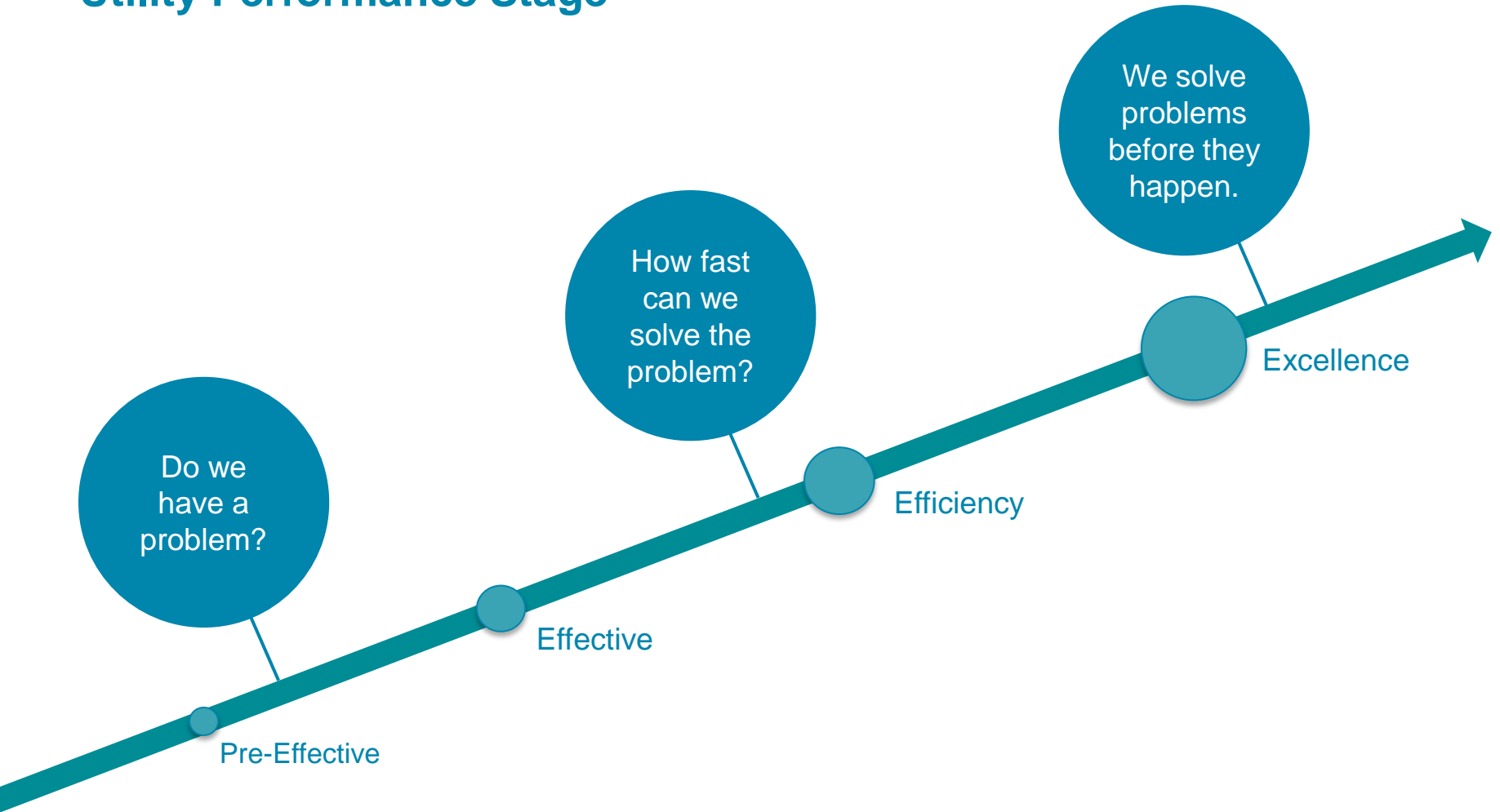
Source: NewWorld Capital Partners, US Bureau of Labor Statistics

Source: NewWorld Capital Partners, US Bureau of Labor Statistics

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Utility Performance Stage

Do we have a problem?

How fast can we solve the problem?

We solve problems before they happen.

Pre-Effective

Effective

Efficiency

Excellence

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Emergence of Analytics – Drives Efficiency

- Greater **temporal, spatial,** and **parametric** data density

- Increasing **interoperability** of applications

- Shift from **situational awareness** to **decision support**

- Less capital and operating intensity

- Lower variability

- Improved customer outcomes(incl. health/env)

Agenda: The Power of Advanced Technologies and Data Analytics

1   **Pipeline Condition Assessment**

Innovative pipeline inspection solutions and advanced analytics to extend the life of critical buried pipeline infrastructure.

2   **NRW & Pipeline Management**

Reducing water loss using innovative inline leak detection tools to accurately identify water pipeline leaks. Understanding opportunities to reduce non-revenue water (NRW) in real-time with existing and supplementary sensor data.

3   **Decision Support Tools**

Combining real-time sensor information, applying artificial intelligence to optimize asset performance. Using real-time scalable data-driven situational analytics tools to better manage buried pipeline networks.

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The Buried Water Infrastructure Challenge

- Aging infrastructure is a key concern

- The best-in-class renewal programs only address 1% of the system per year.

- **Most pipes are in good condition**

- Large Diameter Pipes are high risk and high replacement value
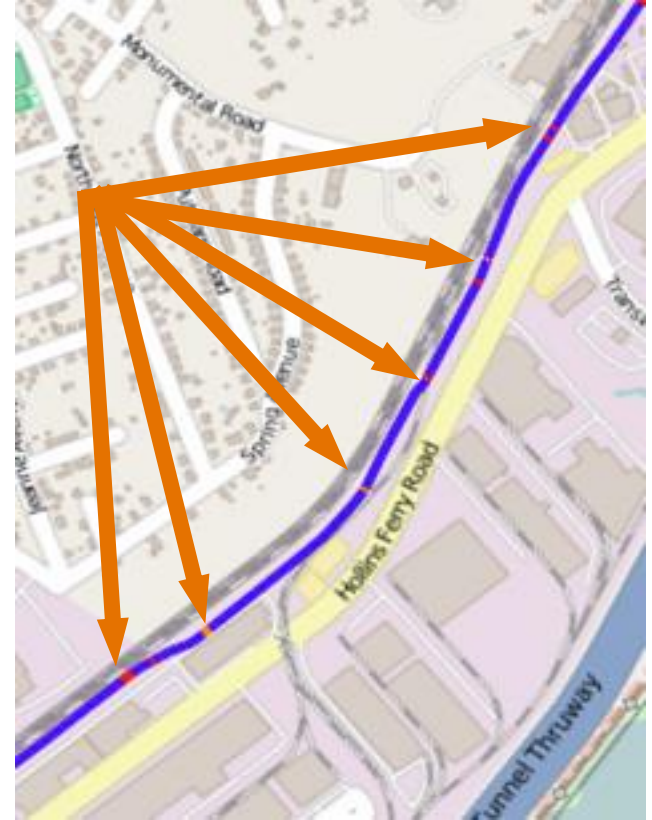
- **We can defer 90% of CAPEX while reducing risk.**

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Focus capital on the assets with highest risk of failure
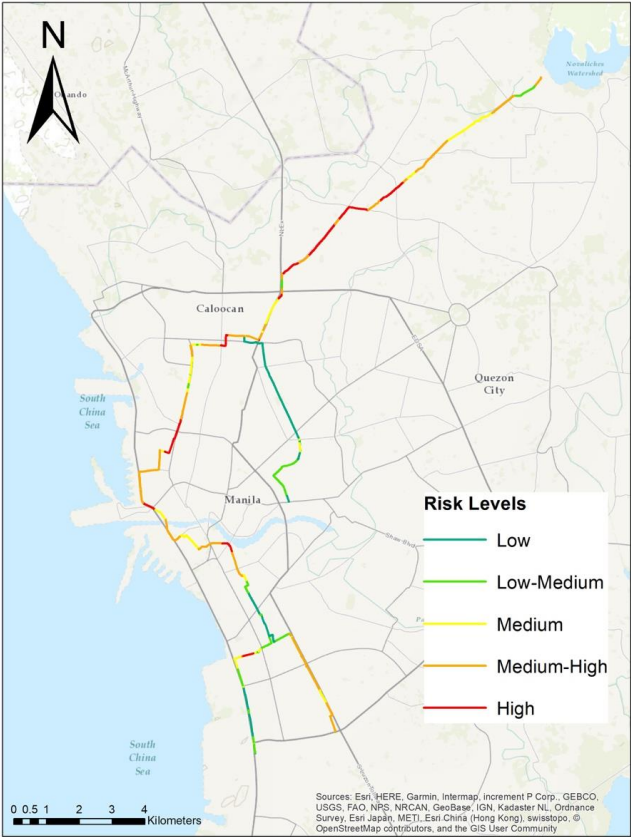
# Maintain asset reliability with lower capital expense

Desktop Risk

Risk Post Inspection

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Condition Assessment Solutions

- Inline inspection tools for accurate and precise data on ACTUAL condition

- Pressure monitoring and transient mitigation. Reduce risk of failure and extend asset life.

- Specialized engineering to understand effects of damage and determine remaining useful life

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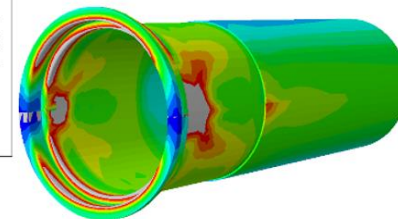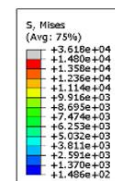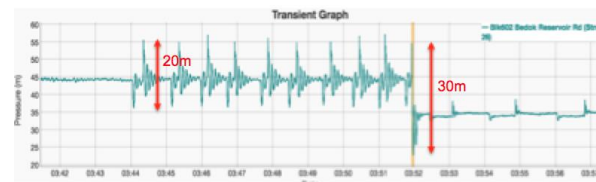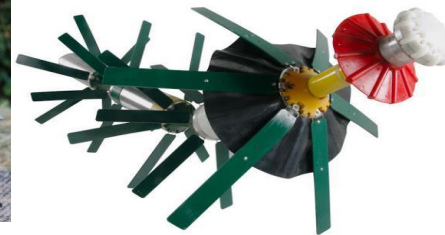
Pipeline Condition Assessment Technologies

- Inline Leak Detection
- Pipe Wall Assessment
- Electromagnetic Inspection
- Acoustic Monitoring

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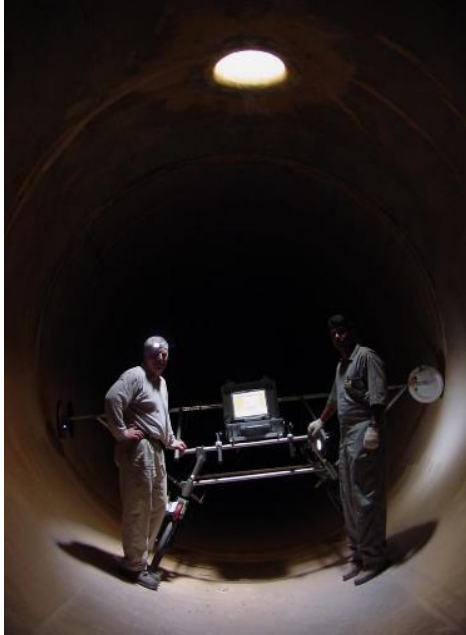
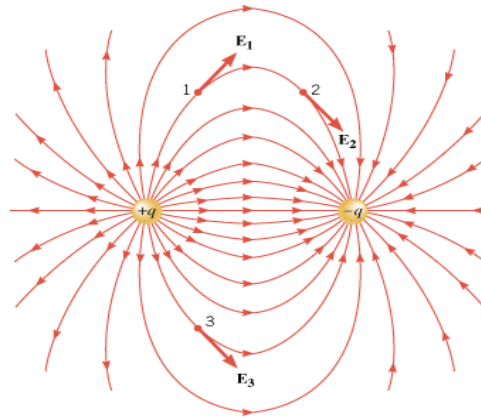# Free Swimming - No Shutdowns or Disruption to Service

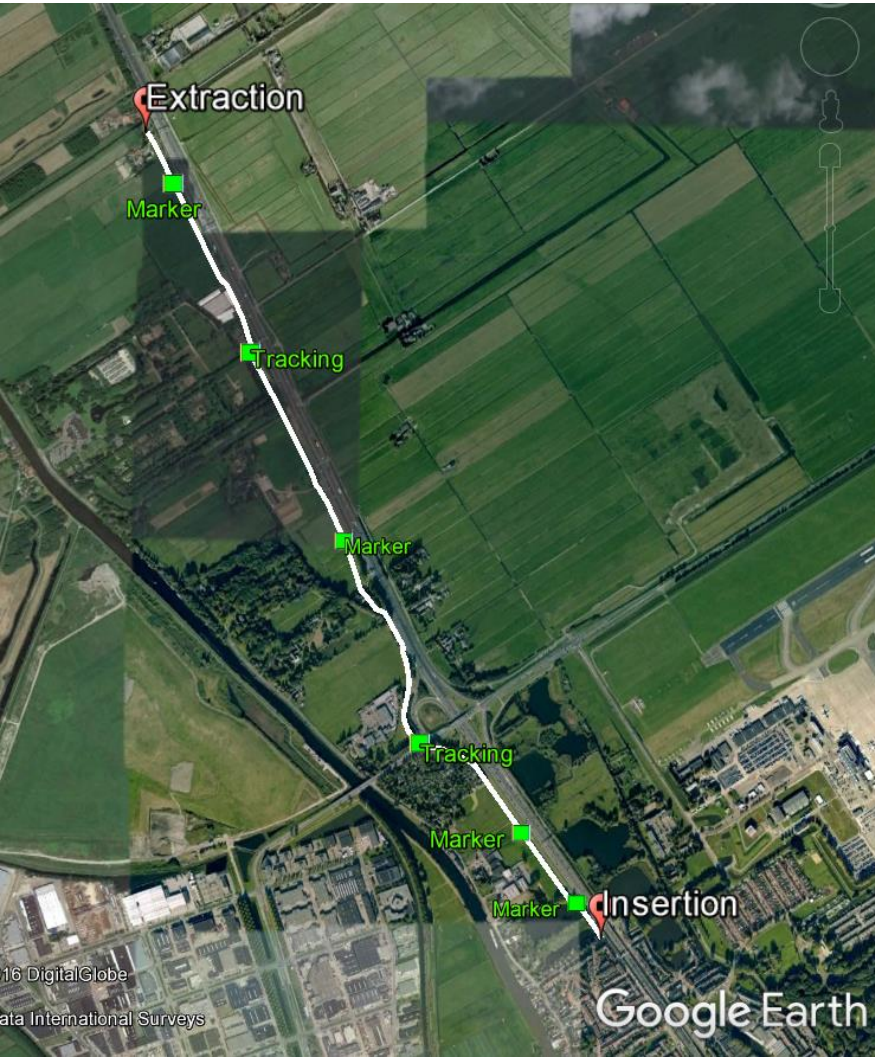Over **1500 Kilometers** of
Pipeline Inspected

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Case Study – Free Swimming Condition Assessment

- Electromagnetics identify defects in metallic pipe wall.

- Measures relative wall thickness
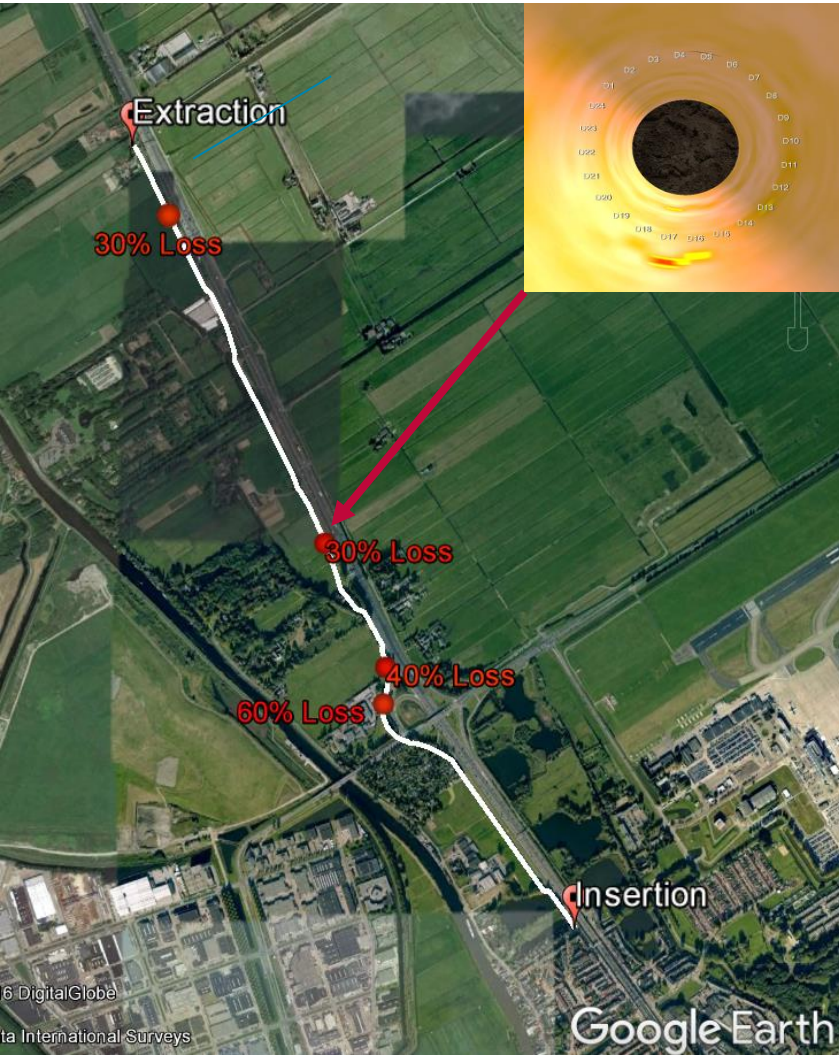
- Understand the general condition of the pipe.

xylem
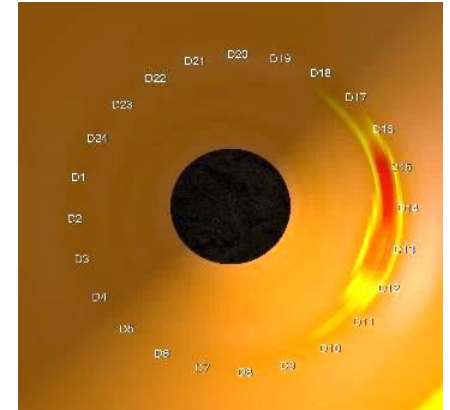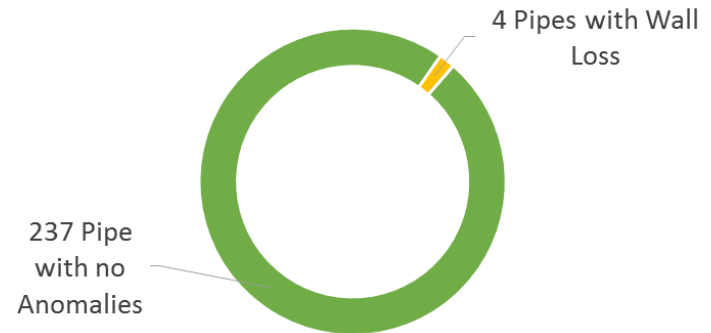
Case Study – Free Swimming Condition Assessment

- 800mm Mild Steel
- Critical Water Main
- 2.8 km
- High consequence beside major road

Case Study – Free Swimming Condition Assessment

- Only 4 pipes identified with wall loss

- 30% to 60% wall loss

- Rest of the pipe in good condition

- No replacement required – huge cost savings

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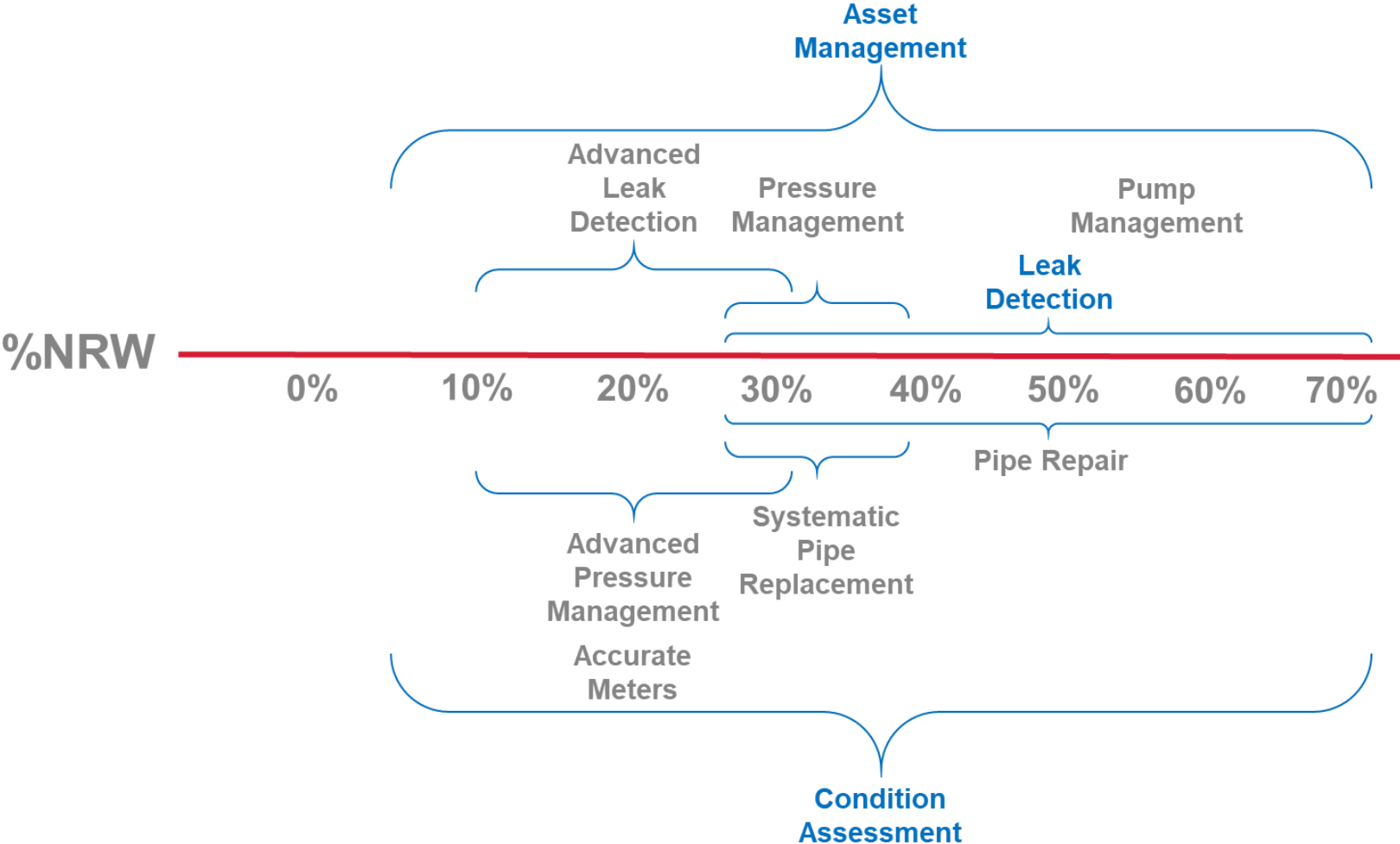
3 Decision Support Tools

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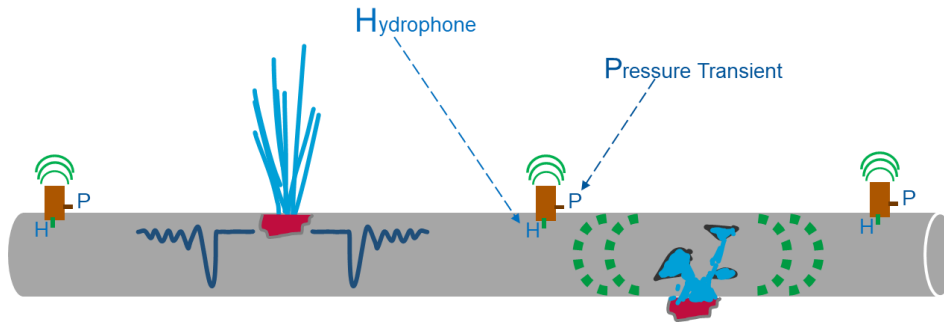
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NRW Management – From Source to Tap
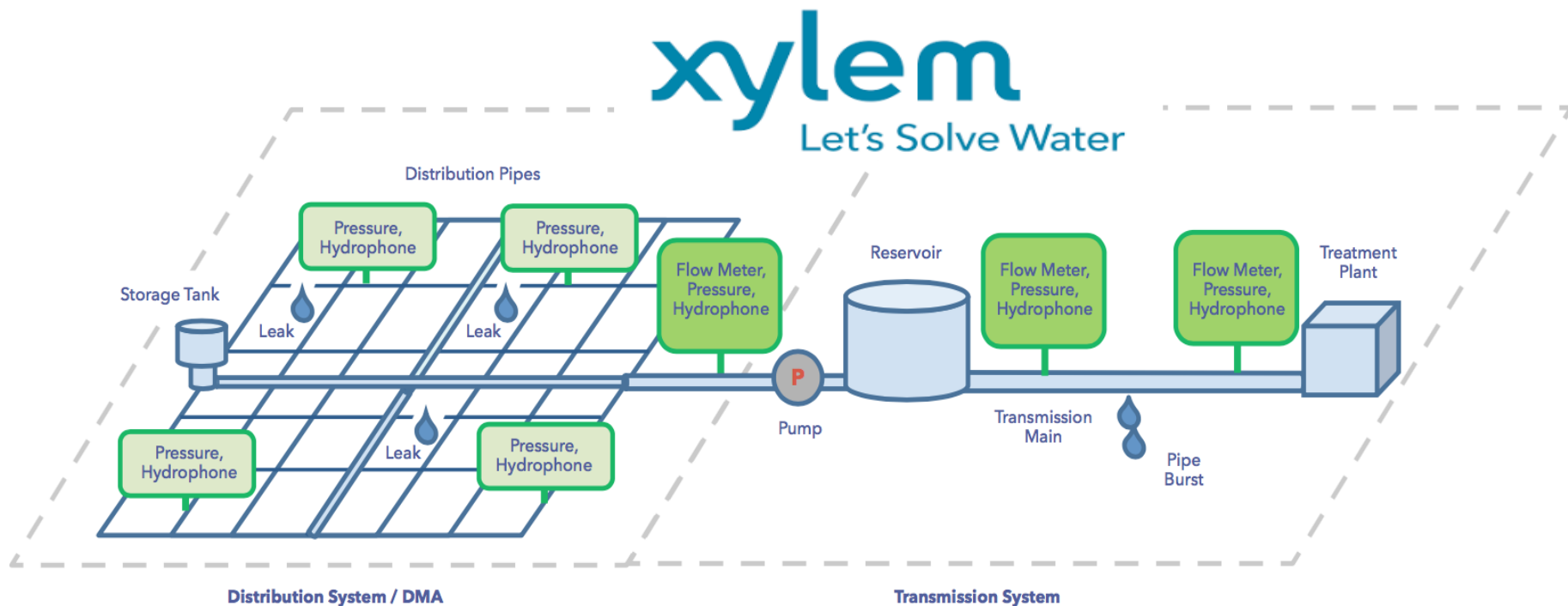
No Single Solution Solves NRW

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NRW Management in Distribution Systems
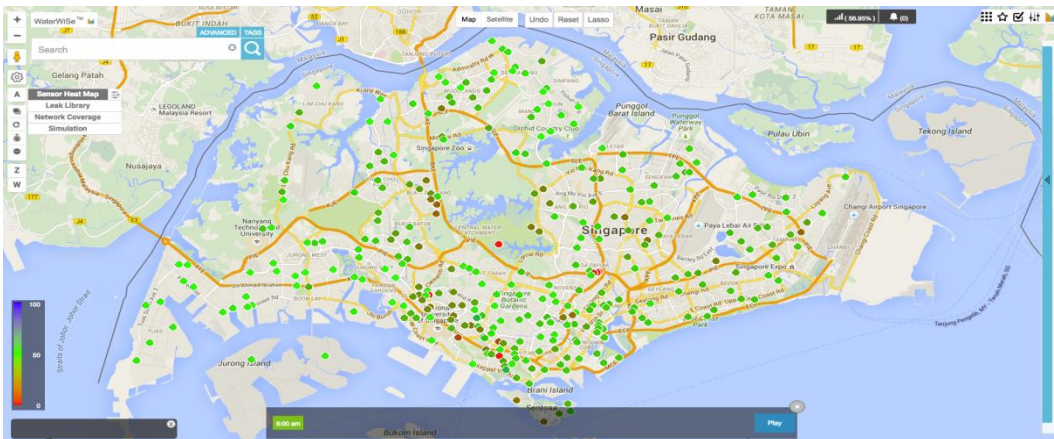

Pressure Sensors

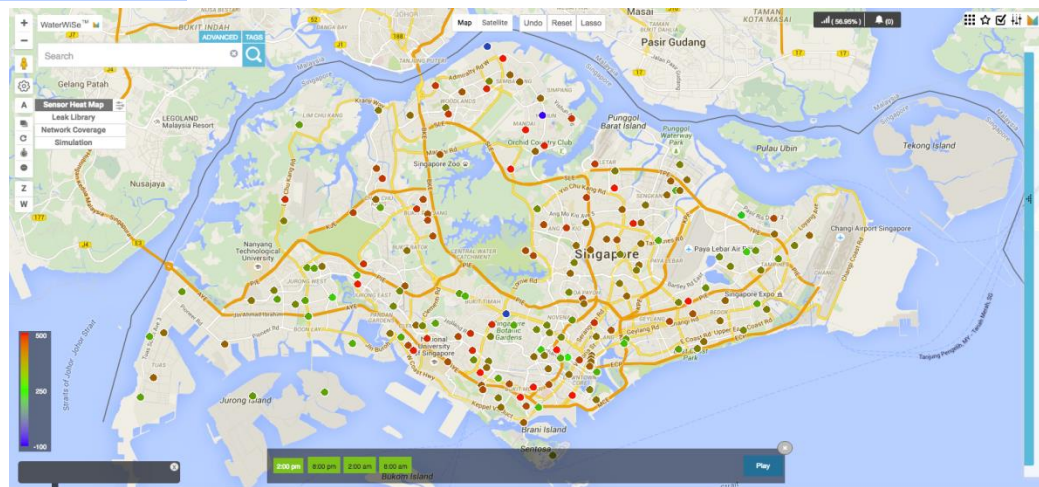**Detect and Localize Bursts**

Hydrophones

Detect Growing Leaks

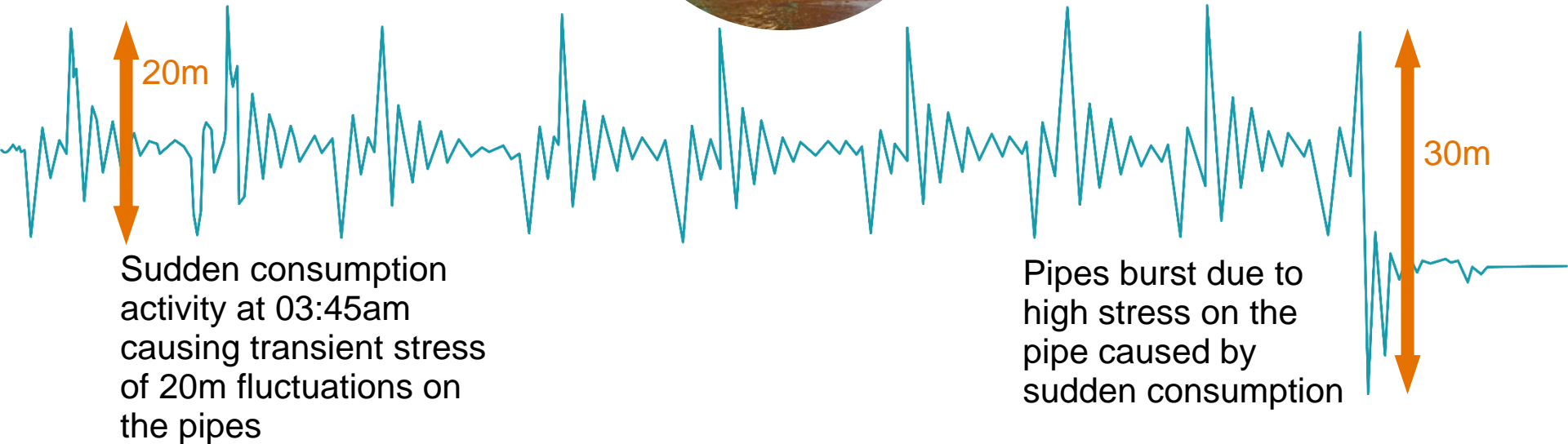xylem

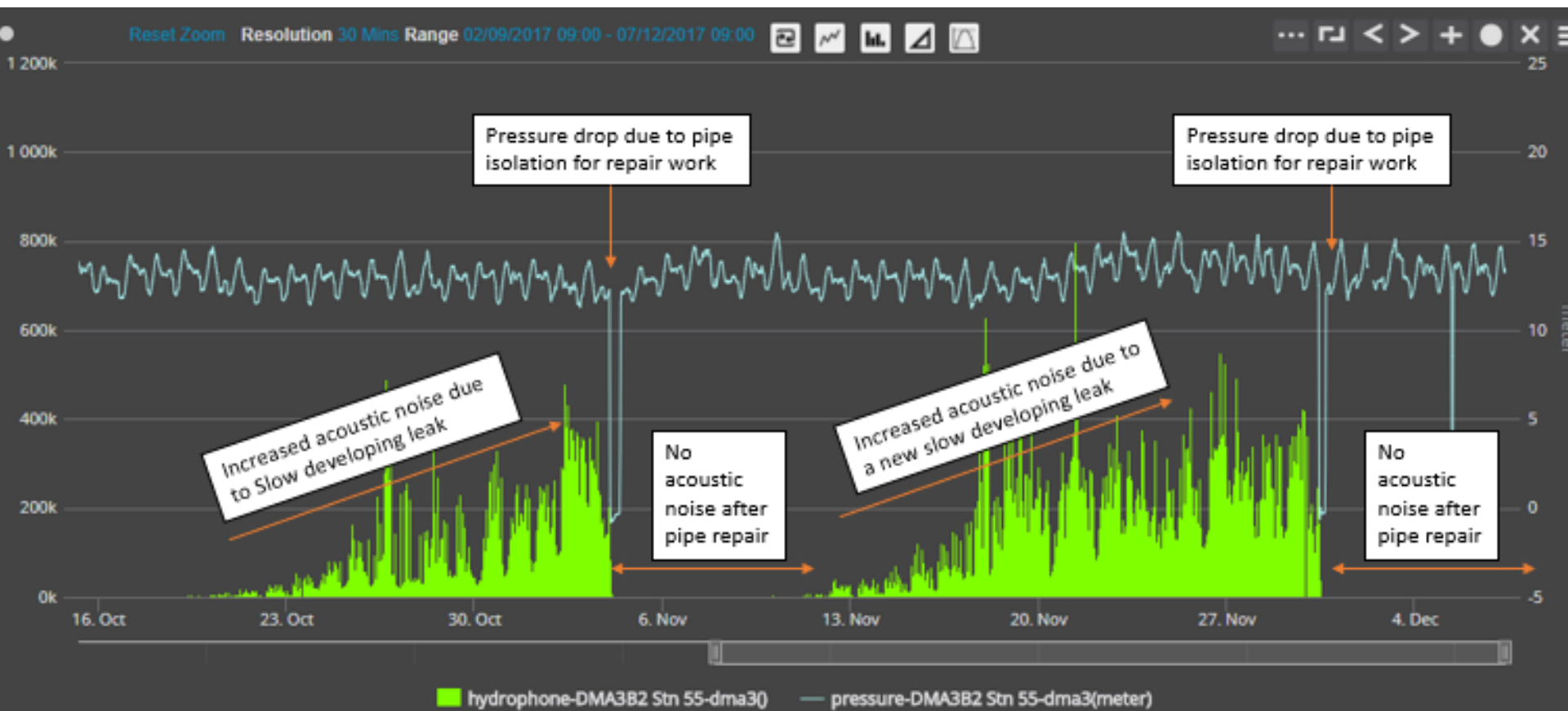# Monitor Distribution Networks – Real Time Alarms

Pressure

Water Quality

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Detect events in real-time with greater sensor density

20m

30m

Sudden consumption activity at 03:45am causing transient stress of 20m fluctuations on the pipes

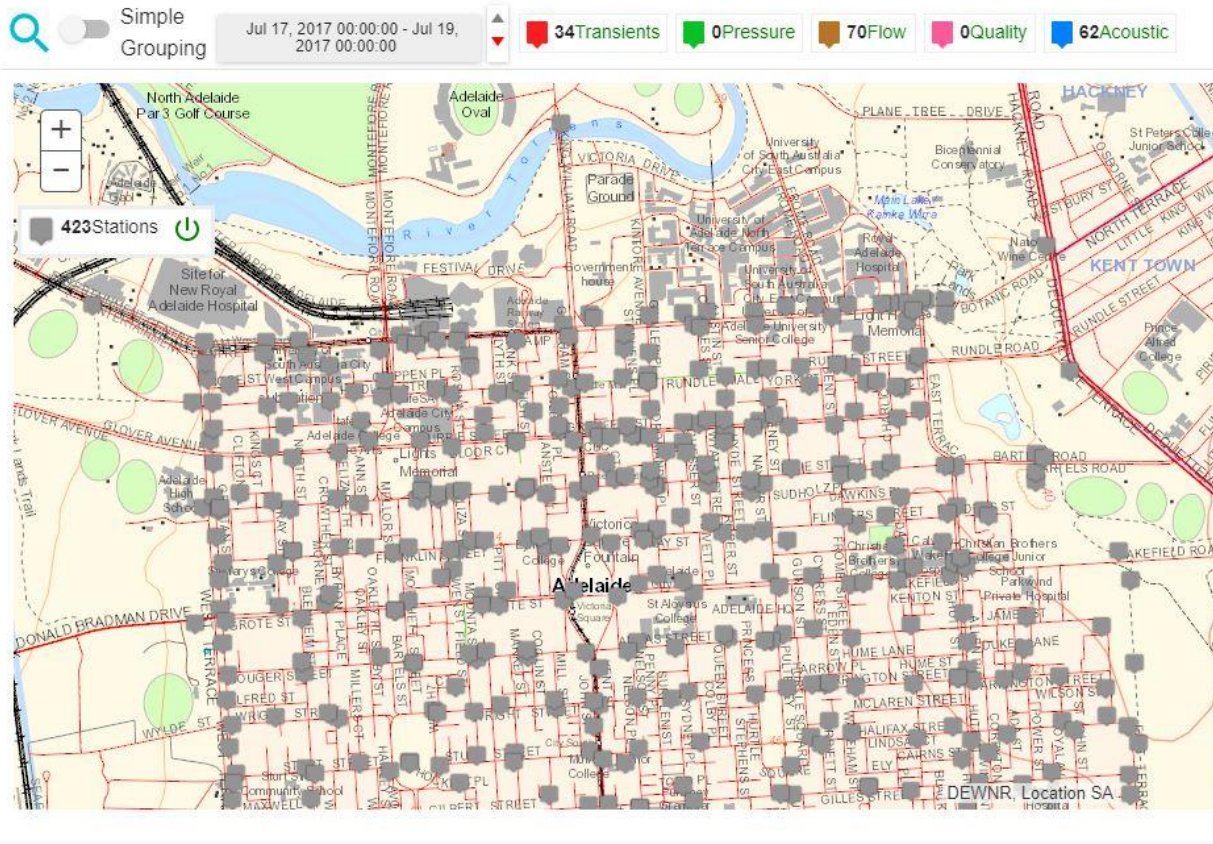Pipes burst due to high stress on the pipe caused by sudden consumption

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Monitor Distribution Networks – Real Time Leak Alerts

Monitor Distribution Networks – Real Time Burst Alerts

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Case Study (Australia) – Overall Network Management

Integrate disparate data streams into one unified platform

Protect the water network, especially high risk assets
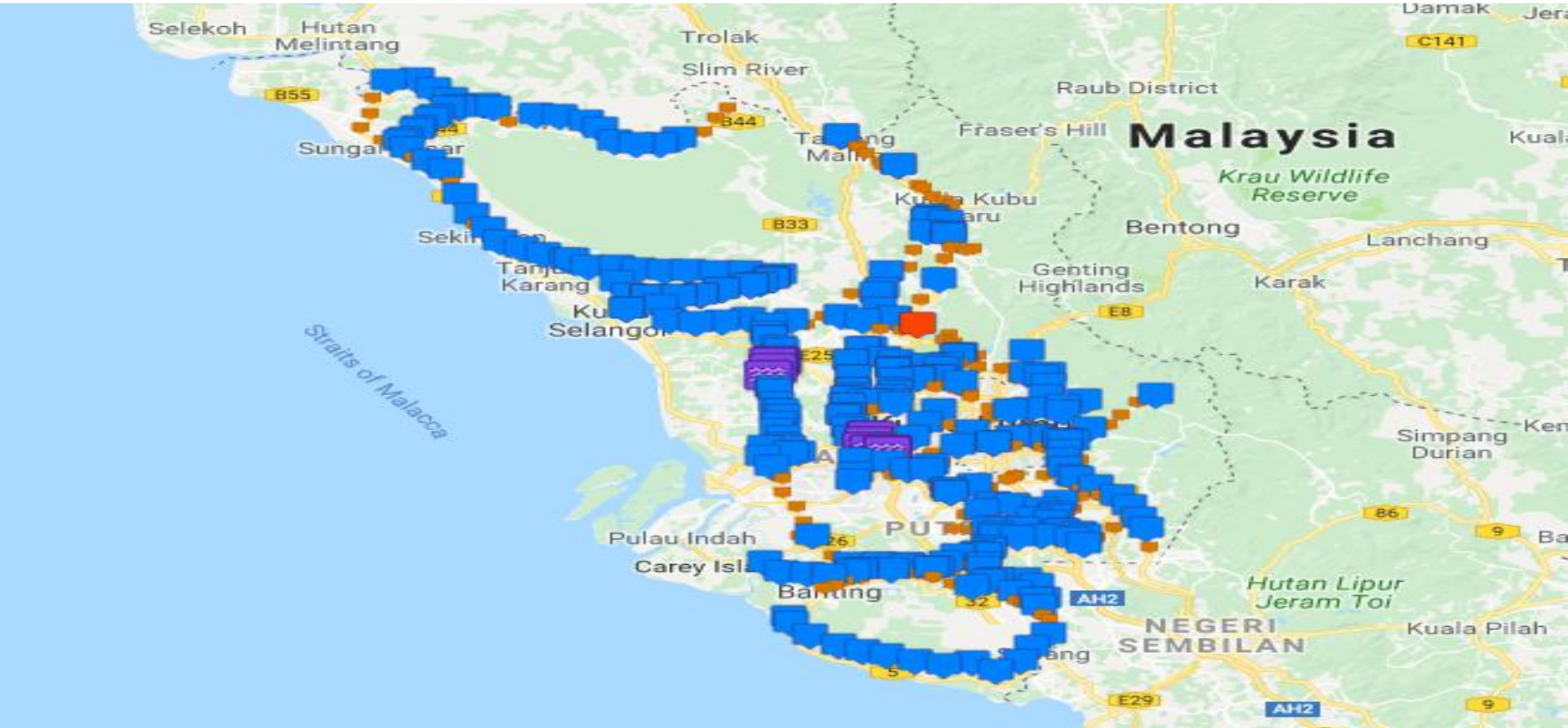
Recover lost revenue due to NRW

Permanently installed sensor network

Intelligent alerts management: alert crews to leaks, assets about to fail, etc.

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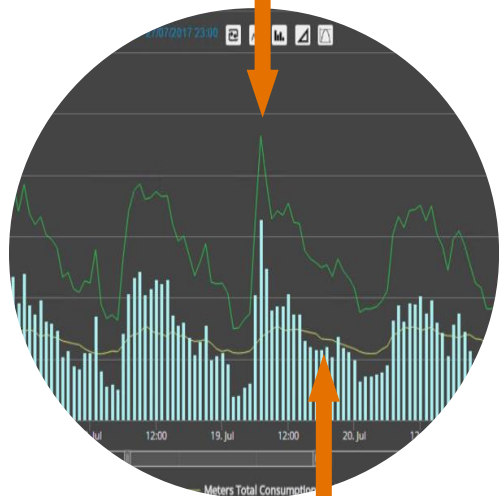# Case Study (Shanghai) – Distribution Network Monitoring

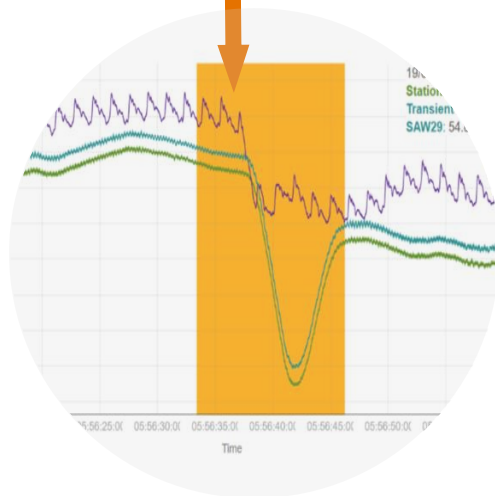# Case Study (Malaysia) – Trunk Network Monitoring

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Drive to root cause with data integration and analytics
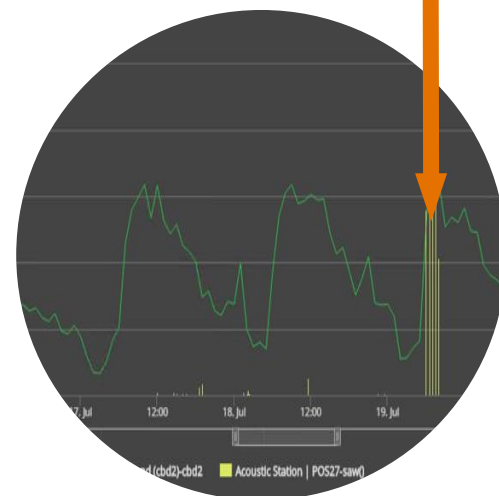

DMA inflow increase detected

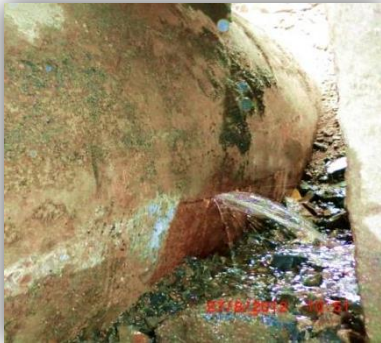Stable customer consumption detected

Pressure transient detected

Increased acoustic noise detected

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NRW Management – Trunk Mains

- Leaks on large diameter pipelines are a major source of NRW

- Leaks are precursors to catastrophic failures

- Failures have major impact on customers and network

"Total costs of large-diameter pipe breaks ranged from
$6,000 to $8.5 million, with an average cost of $1.7 million"
~ *Water Research Foundation*

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NRW Management – Trunk Mains

- Large diameter pipes need inline tools to detect all leaks

- Inline tools bring the sensor to the leak while pipe is in operation

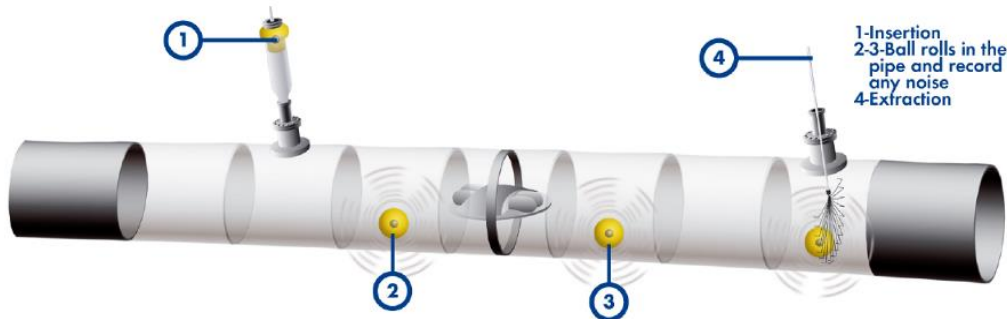Pin Hole Leak

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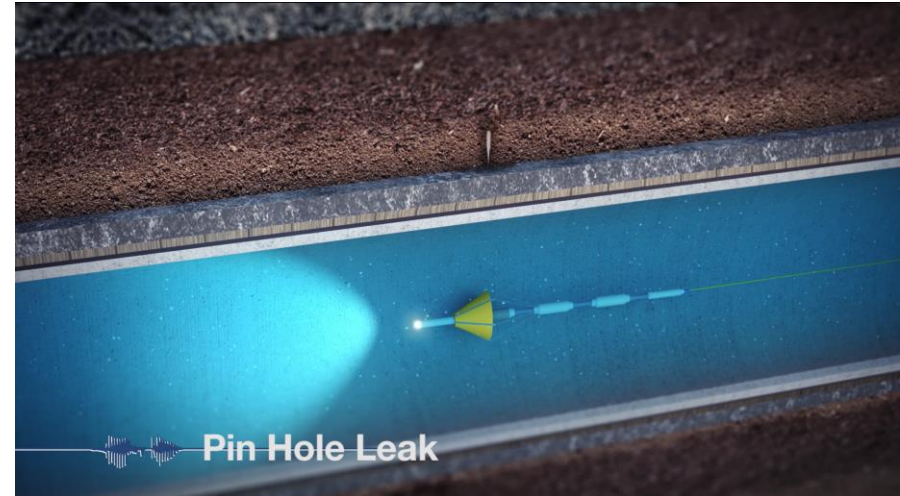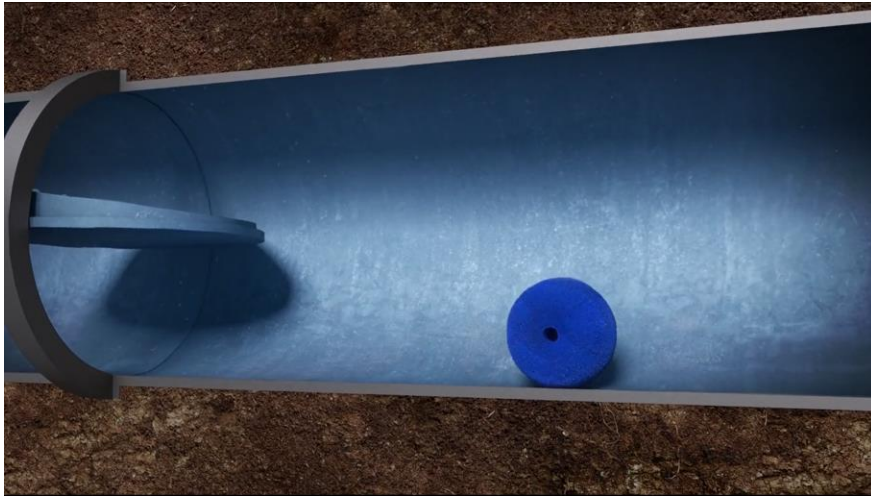
NRW Management – Trunk Mains
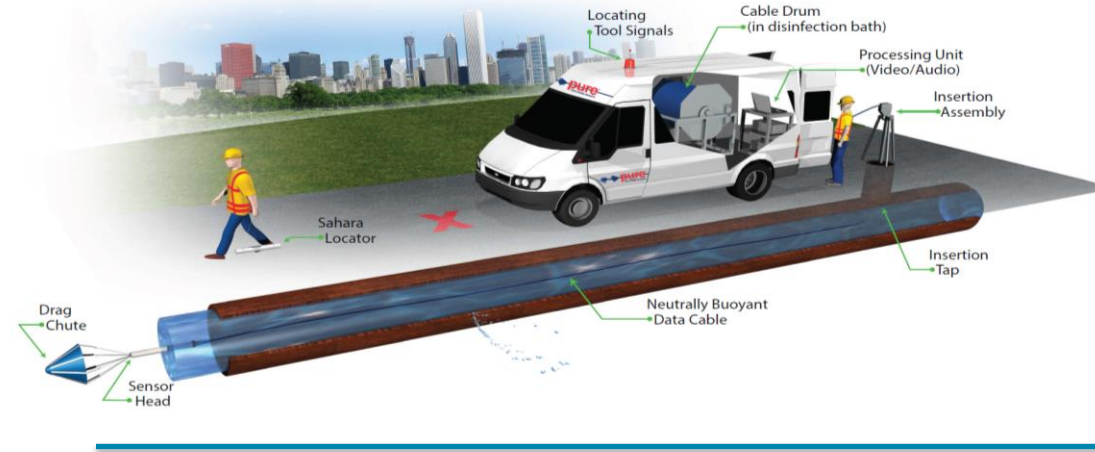
Tethered Leak Detection

- Ideal for complex networks
- Worldwide since 1999
- 1000's of km inspected
- Used in Hong Kong

Free Swimming Leak Detection

- Ideal for long transmission mains
- Worldwide since 2005
- Over 30,000 km inspected
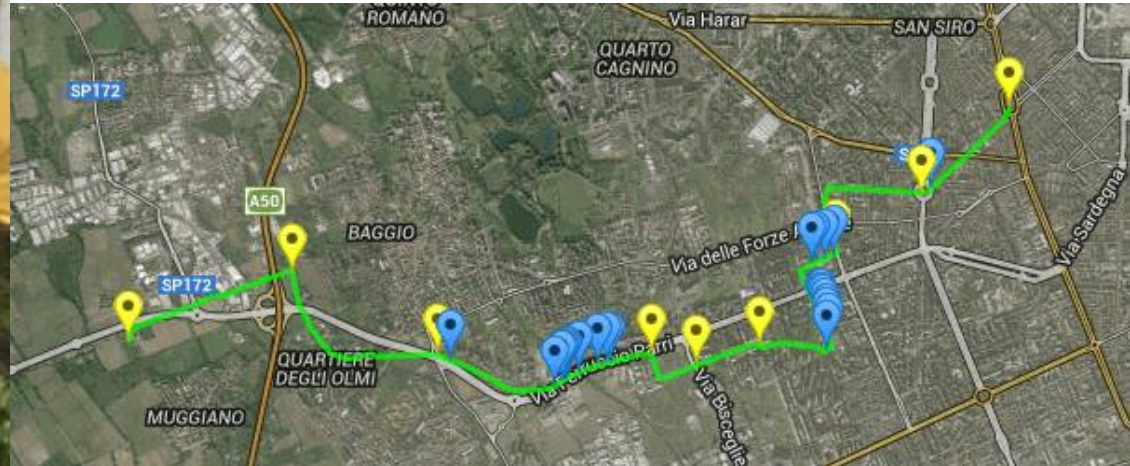- Used in Hong Kong

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Example of Leaks Found

XYLEM PROPRIETARY / CONFIDENTIAL

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Case Study – Free Swimming Leak Detection

- 9 km

- 1200mm steel transmission main

- 24 leaks detected

- Most grouped in 3 zones

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Decision Support Tools

The Internet of Things

Big Data Analytics

Machine Learning

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Data and Analytics – Helping Us Solve Water

- Rapid urbanisation has coincided with rapid digital improvements

- Underinvestment in asset maintenance in past decades=

- With solid foundations, we can make our water utilities more efficient

- Benefits are so significant, they cannot be ignored

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Thank you