April 2022

Optimize Water Distribution Pipes and Water Loss With Digital Solutions (WRF 4917)

Making the most of your water distribution.

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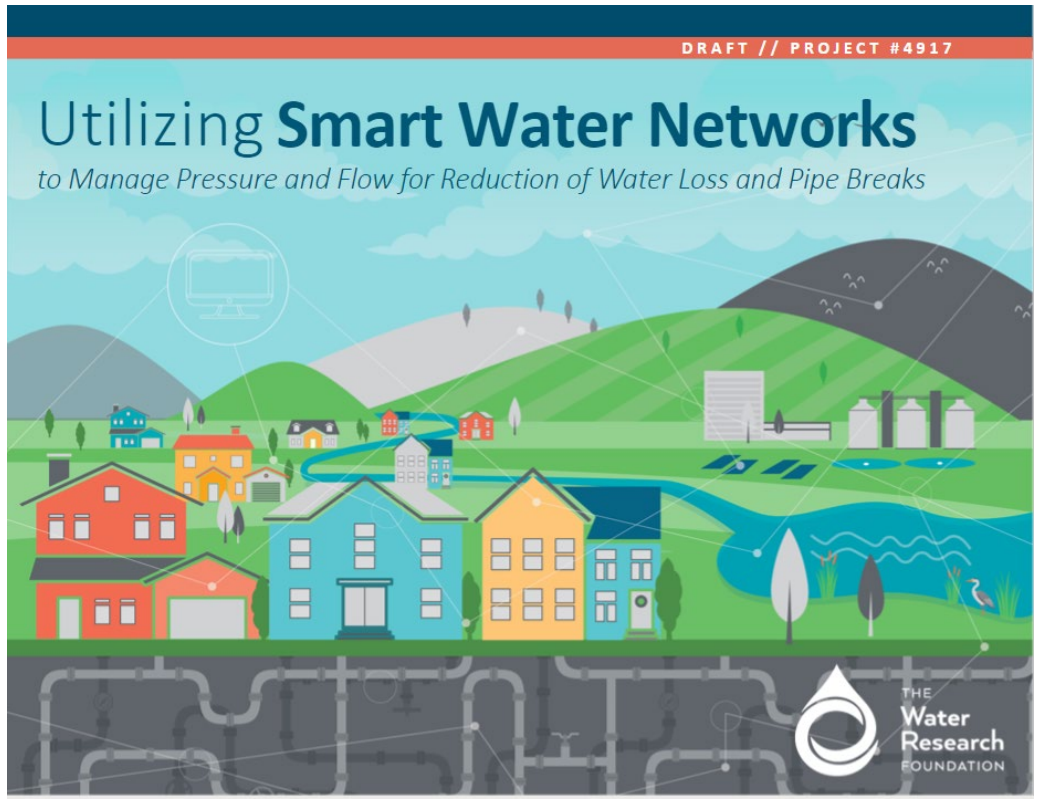
Optimize Water Distribution Pipes and Water Loss With Digital Solutions - WRF 4917

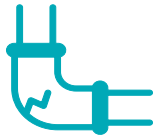


AGENDA

1. WRF 4917 Overview
2. Pilot Information
3. Key Takeaways


Our infrastructure is in dire need of an upgrade

Water infrastructure problems are becoming increasingly urgent…



- 27% increase in water main break rates over the last six years
- Water main break every 2 minutes

- $7.6 billion of water lost in U.S. due to leaks in 2019
- $1 trillion of financial burden

- Concerns over water quality and public health
- Lack of resiliency due to climate change

Deteriorating water infrastructure and associated repair and replacement costs are among the top concerns for water utilities around the world.

As aging pipelines are more prone to leaks and catastrophic failures than newer and well-maintained pipe, better management of pressures and flows in water distribution networks should be a top priority for the water utility industry.

In NW...

Utilities were surveyed to understand their Smart Water needs…

"We need to establish a business case for making decisions regarding **replacement, rehabilitation and repair**"
—Halifax Water, Canada

"We have limited staff availability to monitor data (i.e., databases are separate and **not easily accessible in single platform**"
—Contra Costa, CA

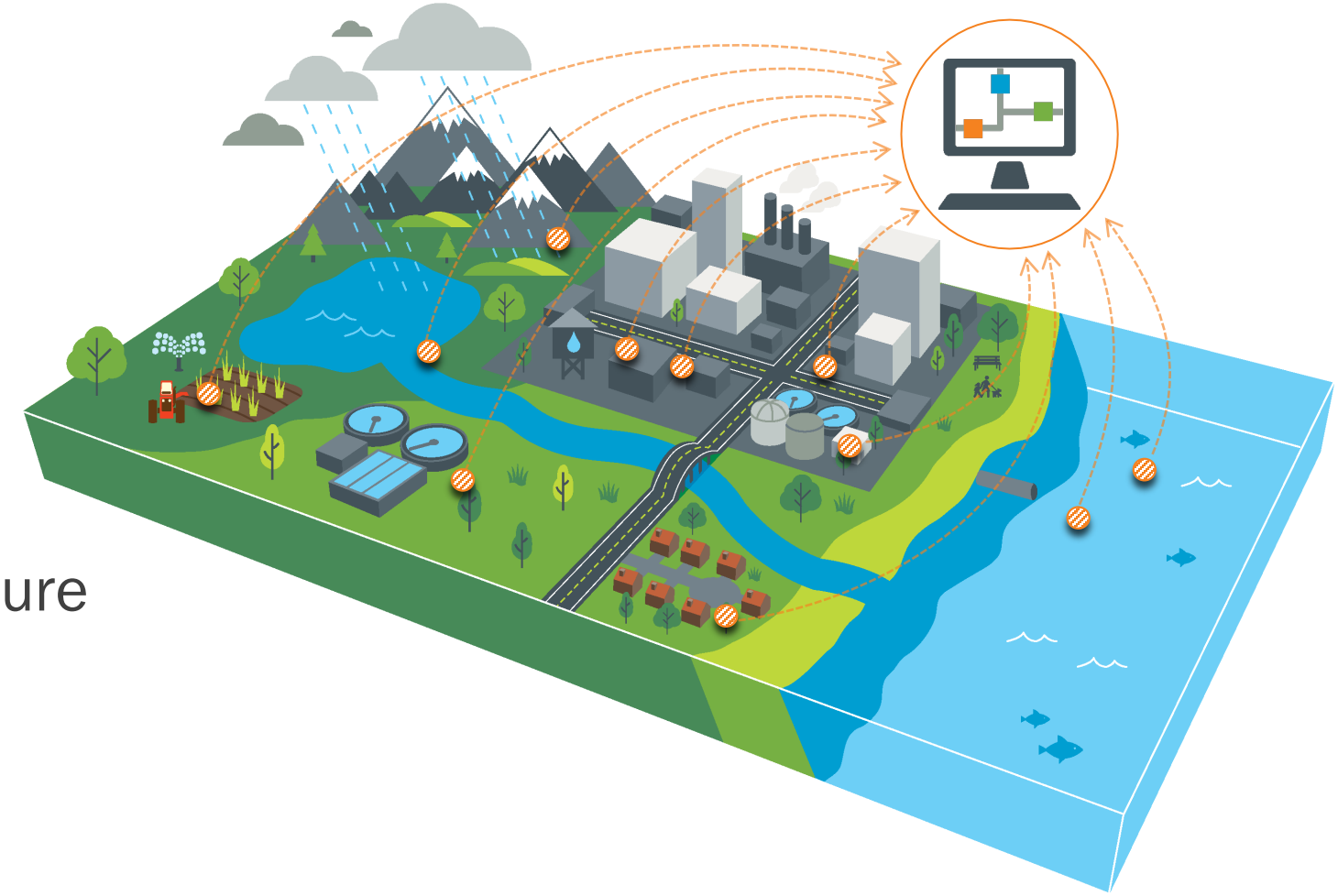
"We have **limited knowledge** of technology **options** available"
—Great Lakes Water Authority, MI

"We have **difficulty understanding the business case** or ROI for applying smart water technologies"
—Seattle Public Utilities, WA

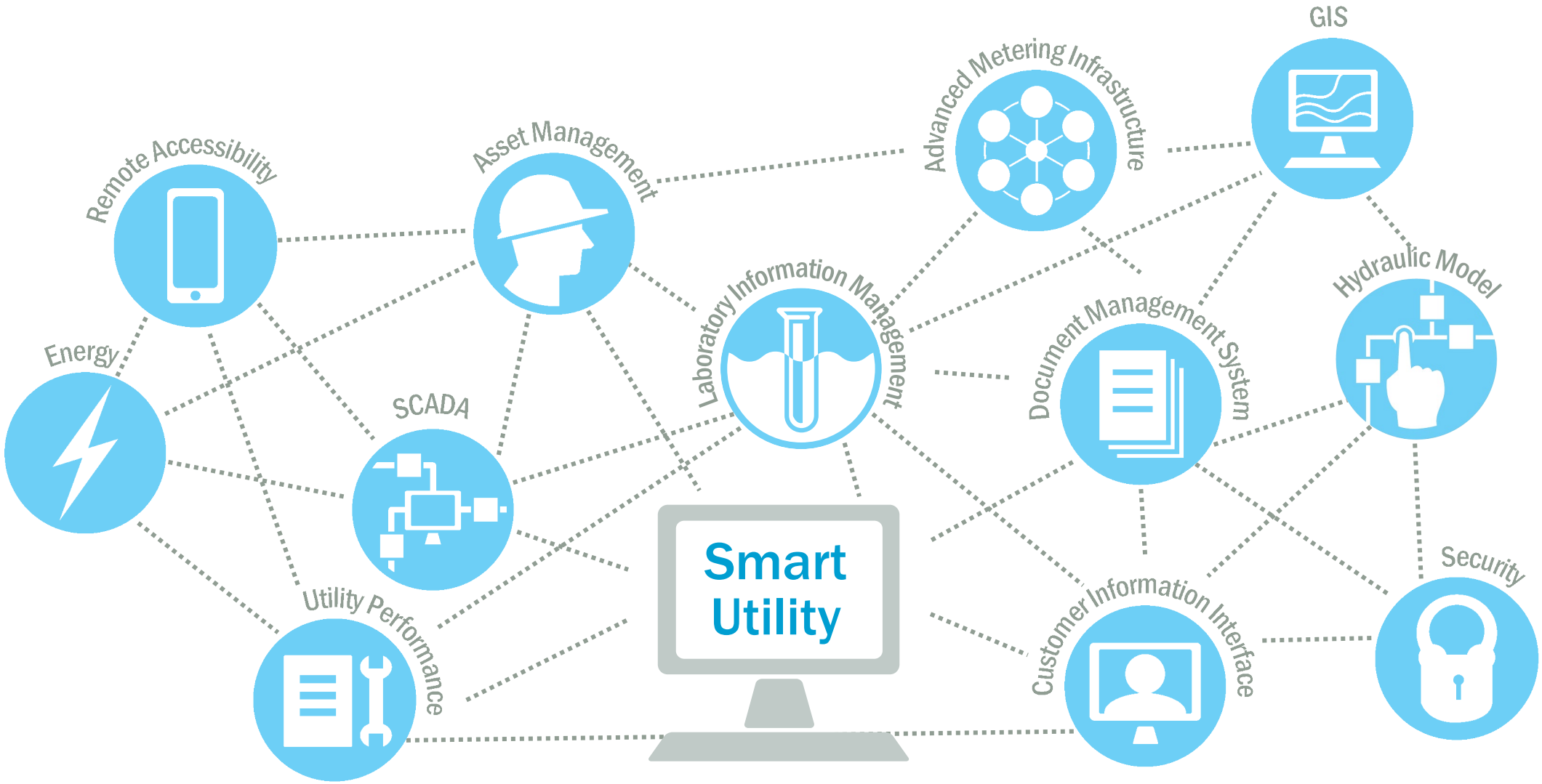
"The City decided to remove fast-closing valves, which were believed to have caused **transients and main breaks**. After removing those valves, there has been a downward trend in main breaks per year" —City of Boulder, CO

Technologies that help identify the *actual* problem

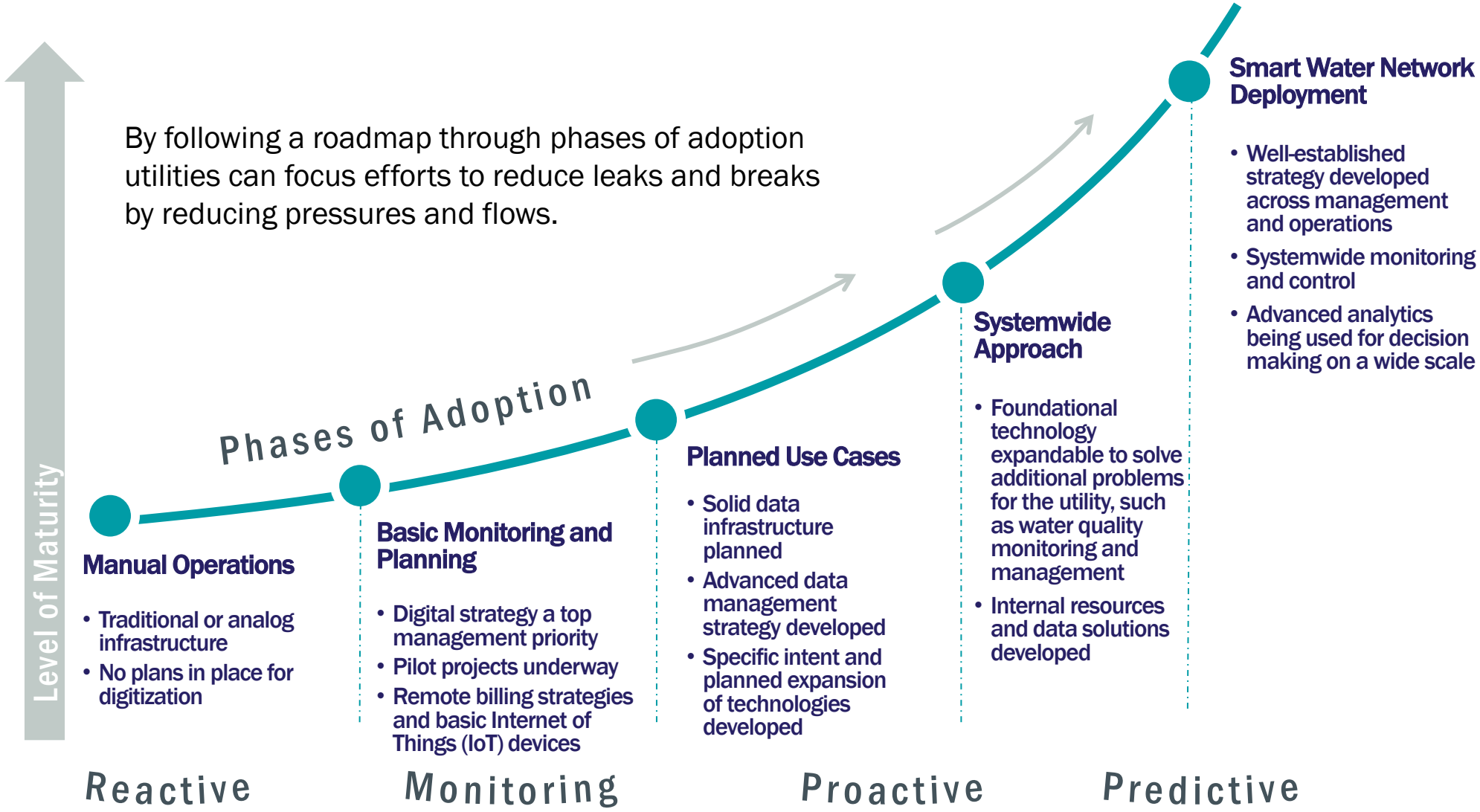
- Hydraulic Models
- Transient Models
- Pressure Sensors (IoT/SCADA/Loggers)
- Demand Management Areas
- Leak Detection Sensors
- Advanced Metering Infrastructure (AMI)
- Condition Assessment



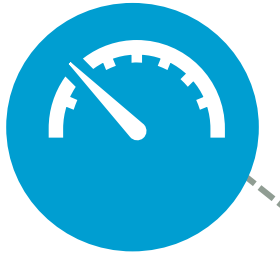
Smart Water Networks “evolve” when applications are connected with context



Development of successful smart water networks is a journey....



A Sampling of Solutions…



Transient Pressure Sensors

Deploy IoT based transient pressure sensors to analyze pressure transients and alert on pipe burst

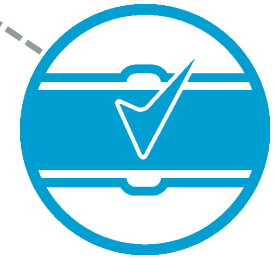
Advanced Water Model

Leveraging real time modeling to support optimization of PMA's and DMA, implement dynamic pressure management

Water Loss

Pressure Management Reduction

Leverage pressure management solutions to reduce pressure, reducing pipe fatigue and water loss



Daily Water Loss Monitoring

Use production information from SCADA and combine it with consumption information from AMI to calculate water loss.

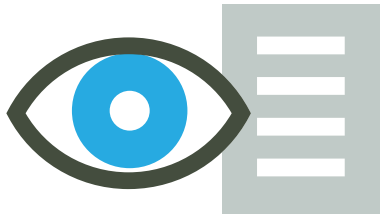
Minimum Night Flow

Leverage **SCADA** System to perform minimum night flow analysis per pressure zone and create dynamic alerts for changes

Objective: Develop Smart Water Network Guidance

Case Studies and Pilot Projects

Managing and developing case studies for at least four water utilities using smart water network technology. This effort involves providing grants as well as guidance to non-grant, self-managed pilot studies.



Guidance Manual

Developing a guidance manual of best practices and a step-by-step approach for implementing smart water network technology and systems to address identified challenges.


What is the root cause problem?
How can technology help?

Each pilot project allowed the researchers to document lessons learned and test the guidance developed as part of the project.

These solutions employed a variety of hardware and software that allowed these utilities to evaluate effectiveness in meeting their pilot project goals.

Case Studies

1 WATER AND WASTEWATER AUTHORITY OF WILSON COUNTY, TENNESSEE, US

This pilot used pressure transient monitors from Xylem (Visenti) to detect and locate leaks before they turned into larger main breaks.

2 WATER CORPORATION

This pilot implemented a digital twin within a district metered area using Info360 from Innovyze® that integrated SCADA to identify and pinpoint leaks and main breaks.

3 CITY OF LAKEWOOD, CALIFORNIA, US

This pilot tested systemwide pressure monitoring using Mueller Water Products to analyze pressure in the City's network around simulated and actual main breaks to study impacts of pressure reduction on consumption/leakage and to track pressure variations around main breaks.

4 SYDNEY WATER, SYDNEY, AUSTRALIA

This pilot created an interactive smartphone app to track customer behavior around leaks/consumption and deployment of customer meters with pressure and vibration sensors to detect and pinpoint leaks and main breaks.

Type 1 Pilot - Water and Wastewater Authority of Wilson County, TN (WWAWC)

- Mostly PVC Pipe
- 23 active DMAs with flow and pressure monitoring
- 1 active Pressure Management Area (PMA)
- Active water loss testing through minimum nightly flow though SCADA

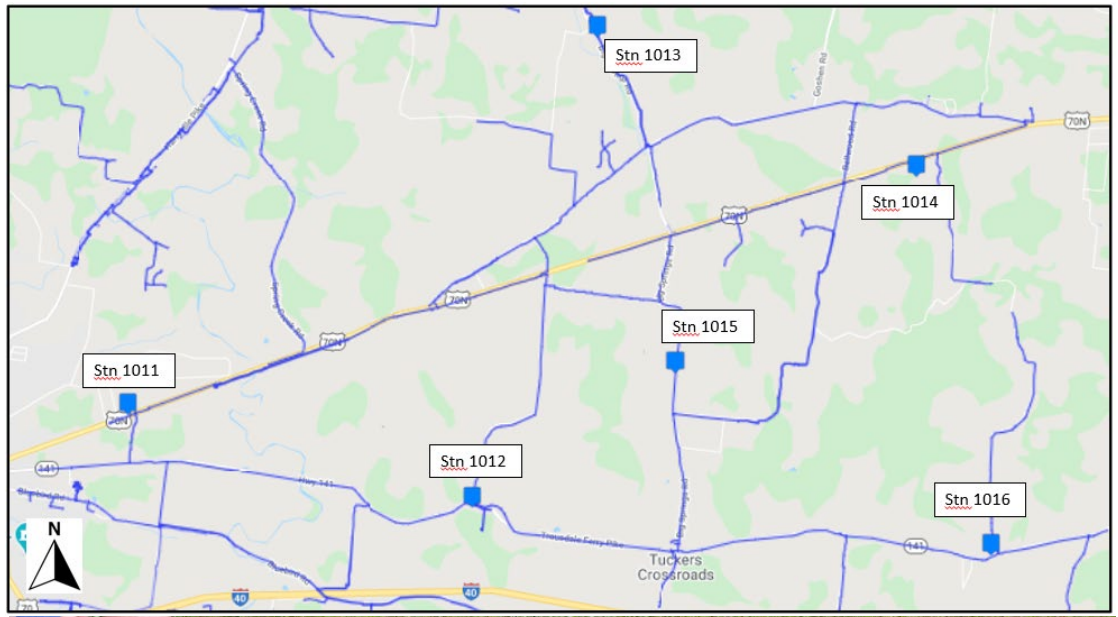
- Provides drinking water to eastern portion of Wilson Co, TN
- Average daily production: 1.2 MGD
- ~7,700 connections
- 345 square miles
- 16 pressure zones

WWAWC – Pilot summary

GOAL: To understand transient pressure events in the selected DMA.

SCOPE:

- Install six (6) Xylem Visenti SentinelX pressure sensors with high-rate data sampling capacity
- Use Xylem Visenti SurgeView for monitoring
- Monitor up to a year
- Two (2) fatigue analysis reports

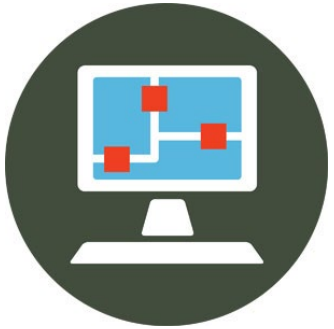


Type 1 Pilots - Water Corporation of Australia

- DMA and PMA program
- Developed detailed hydraulic models for various areas of system
- Standardized designs for flow and pressure monitoring and PRV sites
- Leak detection acoustic loggers
- AMI in various parts of network
- Flow modulated PRVs in various DMAs

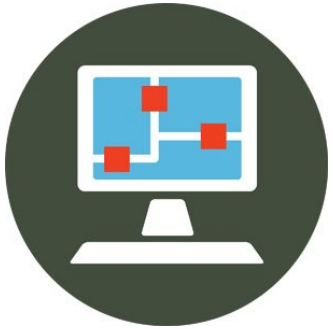
- Manage the Integrated Water Supply Scheme (IWSS) - Perth, Goldfields, and Agricultural Region
- > 800,000 customer connections (in Perth alone)
- Avg Daily Production (2018): 760 MGD

Water Corporation AU - Pilot Approach



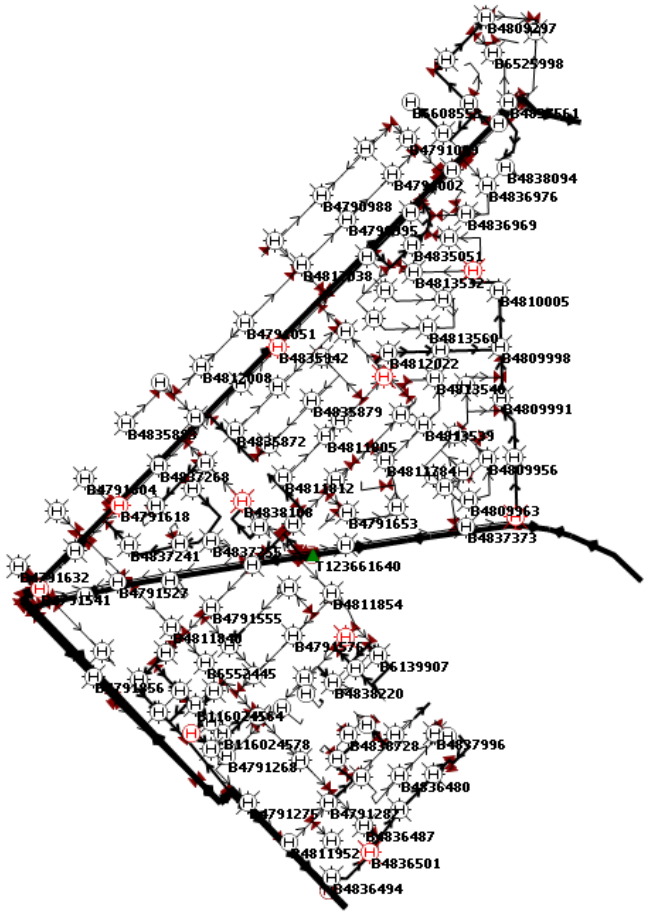
- **Implement real time hydraulics modeling and analytics within two water zones**
- IWLive Pro software and Info360 (Innovyze)
- Two pilot areas chosen
  - Beckenham PMA
  - Mandurah Water Zone

Water Corporation AU - Goals



- Real time and predictive map view of water network (flows, pressure, tank levels, pumps, PRVs, PMA/DMAs, etc)
- Analyze hydraulic behavior in real time
- Reduce NRW from 13% to 10%
- Reduce ILI from 1.73 to 1.5

Model Calibration - Temporary Monitoring



- 10 temporary pressure loggers were installed in trial areas (Mandurah and Beckenham) to train the software with additional data to
  - Detect likely location of a leak event
  - Detect likely location of PMA events

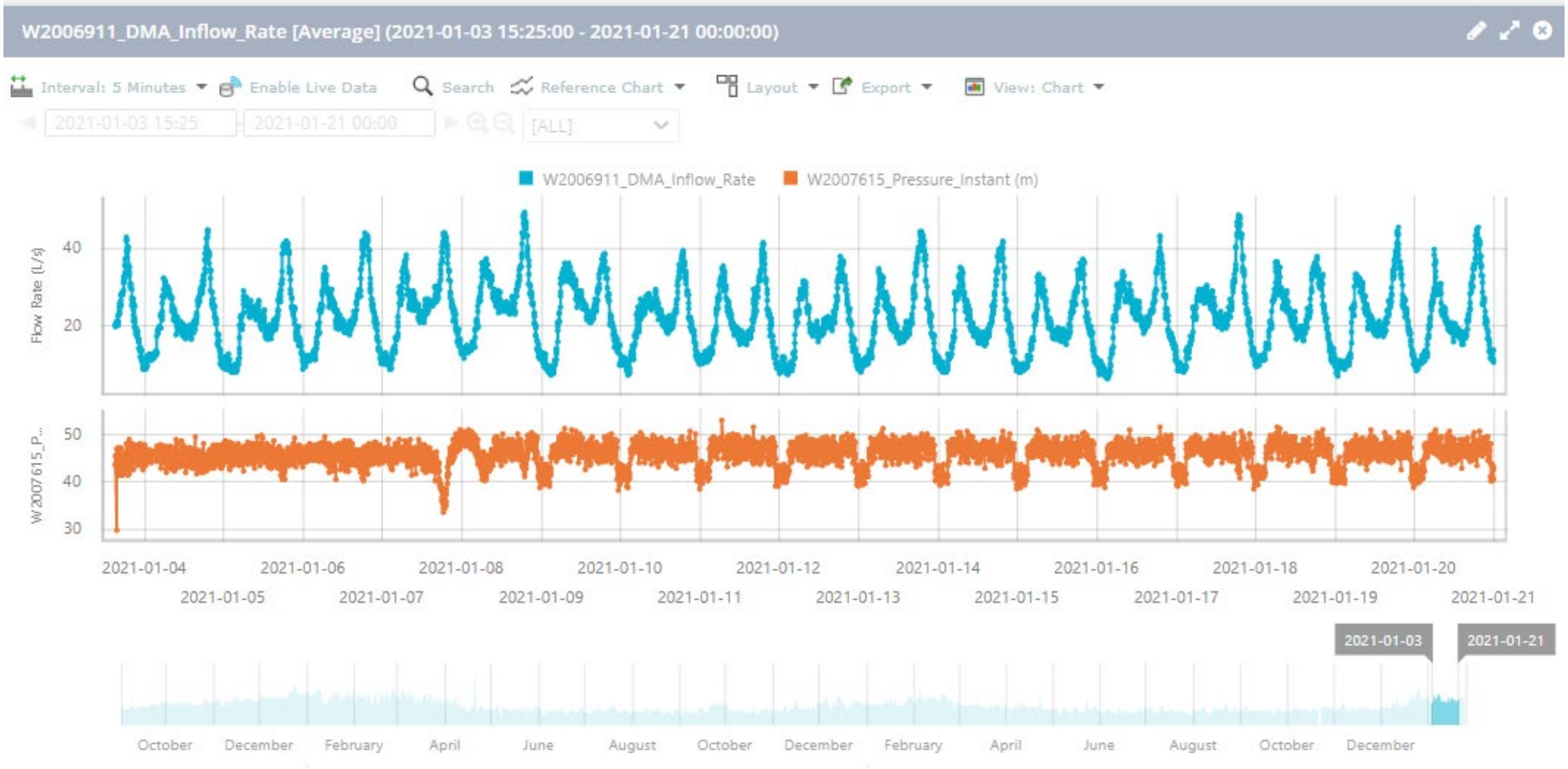
Simulated Event Detection

Operational Trial - PRV Flow Modulation Based Pressure Reduction Test

Objectives of the reduced pressure operation were:

- Reduction of background leakage in PMAs
- Reduce pipe break flows in the event of bursts
- Decreased levels of stress for the water distribution system pipes
- Opportunity to challenge Water Corporation's corporate philosophy for a "35 meter (49.7psi)" minimum pressure criteria at customer metered connections for pressure reduced zones

Pressure Reduction



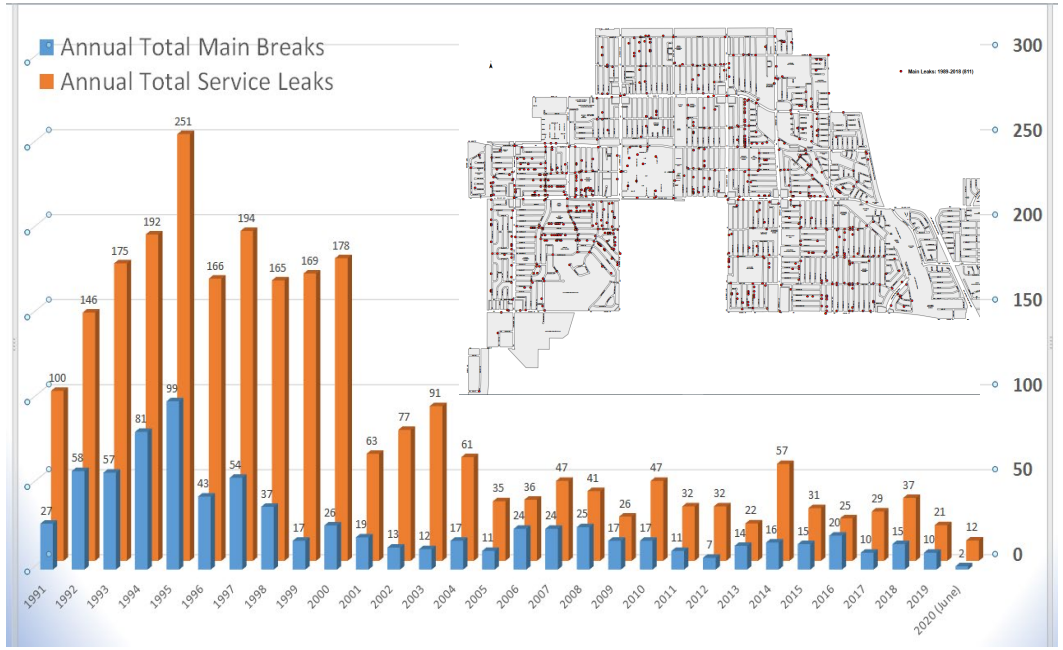
Type 1 Pilot - City of Lakewood (CA)

- Pressure and flow monitoring at facilities
- Full system AMI network
- SCADA, CMMS, and GIS
- Piloted various leak detections technologies
- Piloted machine learning for replacement prioritization

- City of Lakewood, CA is 20 miles southeast of LA
- 10 square miles service area
- ~20,000 service connections
- 8.5 MGD production
- Single pressure zone

City of lakewood, CA pilot approach

- Goal: Vary pressure to better understand optimum operating pressures during peak and non-peak times with the goal of minimizing leakage and consumption.
- Evaluated Trimble and Matchpoint solutions
- Selected Mueller for implementation of pressure monitoring equipment and data platform

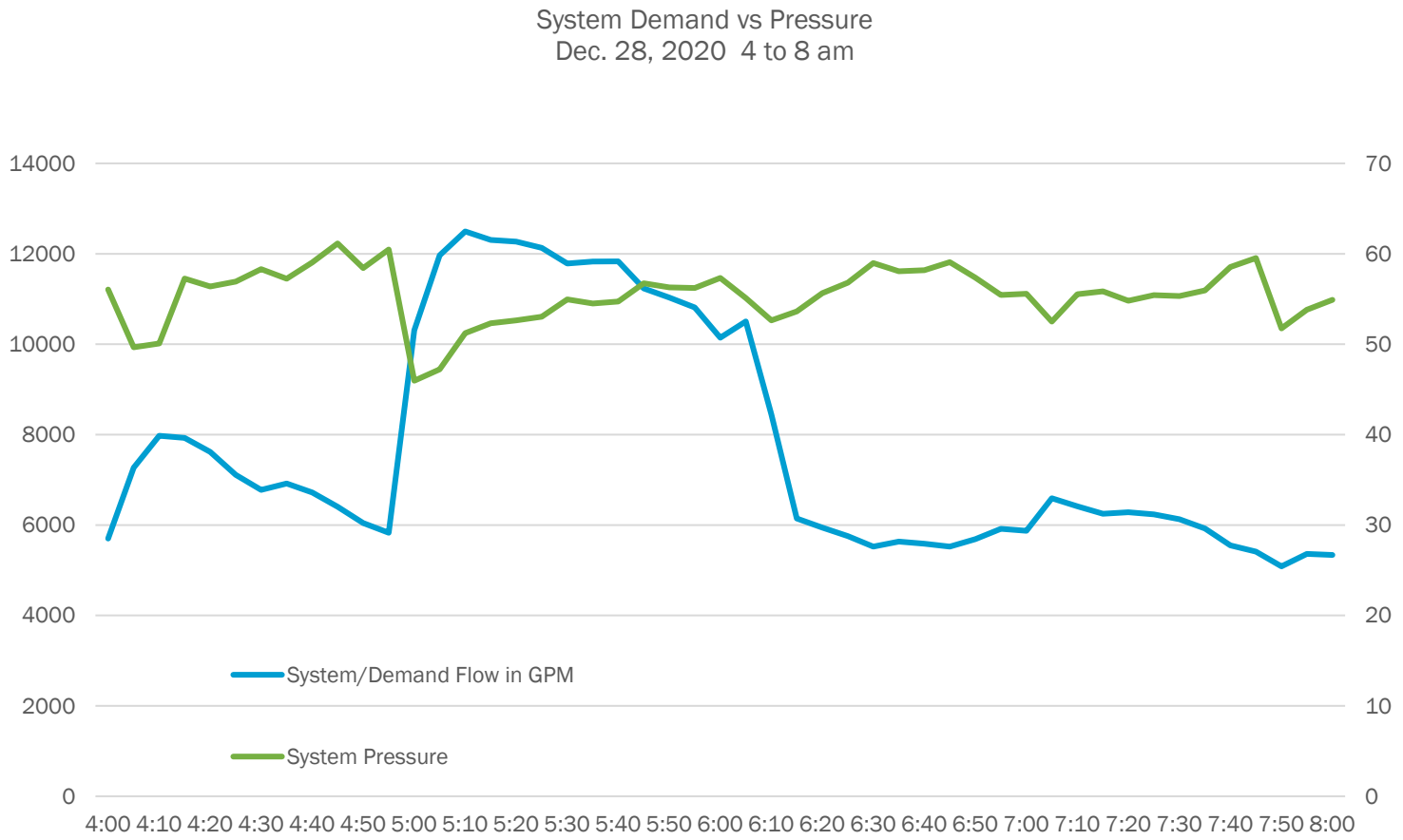


LAKEWOOD PILOT - FACTS, PROBLEMS AND APPROACH

- Low water loss, not many breaks/leaks
- Flat topography/single pressure zone system
- Utilization of smart meter and advanced technologies

1. Simulate break events with fire hydrant flushing
   - Test flow at various flowrates
   - Collect pressure, supply, demand, and energy data
   - Study data and identify issues and possible solution
2. Change system pressure (± 5 psi) and evaluate the impacts on:
   - Fireflow Irrigation impact
   - Energy impacts
   - Demand/supply impact

LAKEWOOD PILOT – LARGEST MAIN BREAK



- Monday Morning (Holiday)
- 10” Main
- Saved about 500,000 Gallons

LAKEWOOD PILOT – LARGEST MAIN BREAK

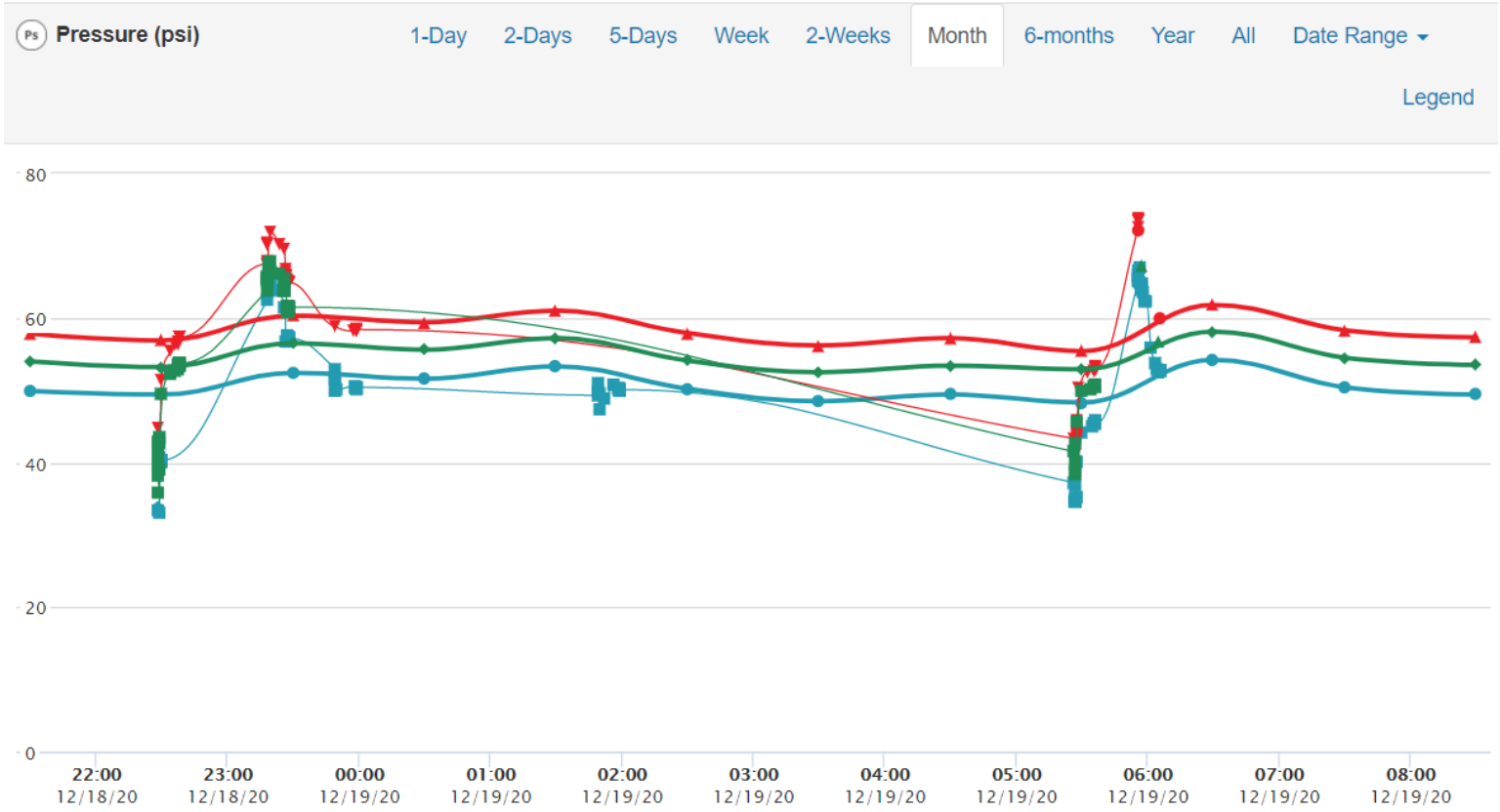


Figure 4-5a. Data form three Pressure Sensors from the Two Events Of Sheared Fire Hydrants.

- Monday Morning (Holiday)
- 10” Main
- Saved about 500,000 Gallons

Pilot Study Results - **Wilson County**

High-rate transient pressure monitoring and analytics help find and decrease main breaks and leakage.

Identified location area for multiple main breaks

Provided insight to system-wide pressure monitoring for leakage identification

Identified pressure transients from pump station on/off

Pilot Study Results – **Water Corporation**

A real-time (live) modelling platform is useful in helping prepare and implement operational change.

Determine real time KPI's such as infrastructure leakage index (ILI)

Detect transients and losses of about 10% minimum nightly flow

Helpful in deploying real time pressure reduction strategies

Pilot Study Results – **Lakewood**

Transient pressure monitoring can provide timely alerts for main breaks or the shearing of fire hydrants and reduce response time.

Field pressure sensor alerts to breaks decreased response time and water loss

Impact on energy consumption

Data, Data, Data!

Next steps in the research…

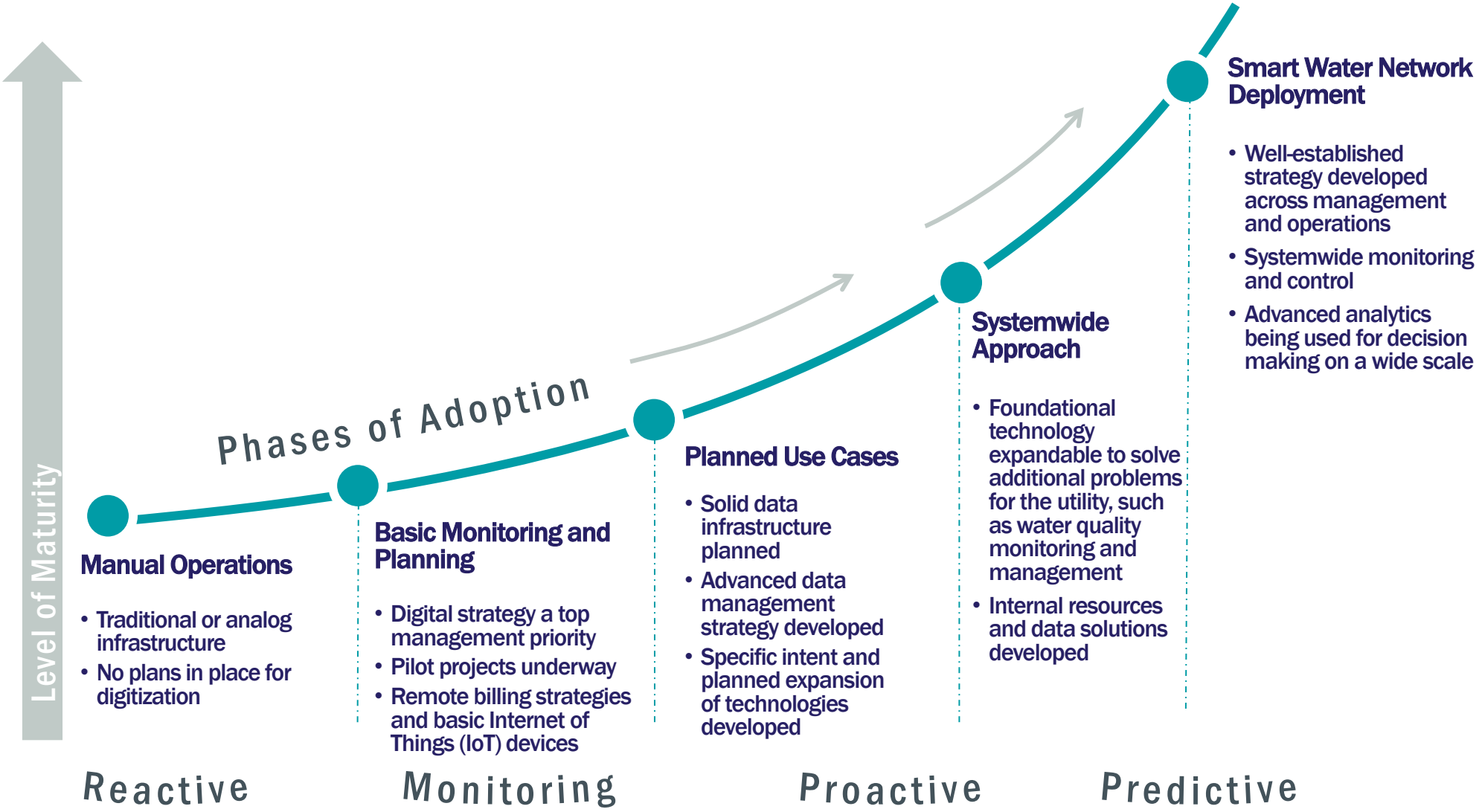
1. Additional research to give **guidance for deployment of pressure monitors** within a water system network to **locate main breaks.**

2. Additional study to see if **lowering water pressure results in lower power usage** due to pumping.

3. Continued study of **acoustic technology included in customer smart meters** to determine accuracy of leak location.

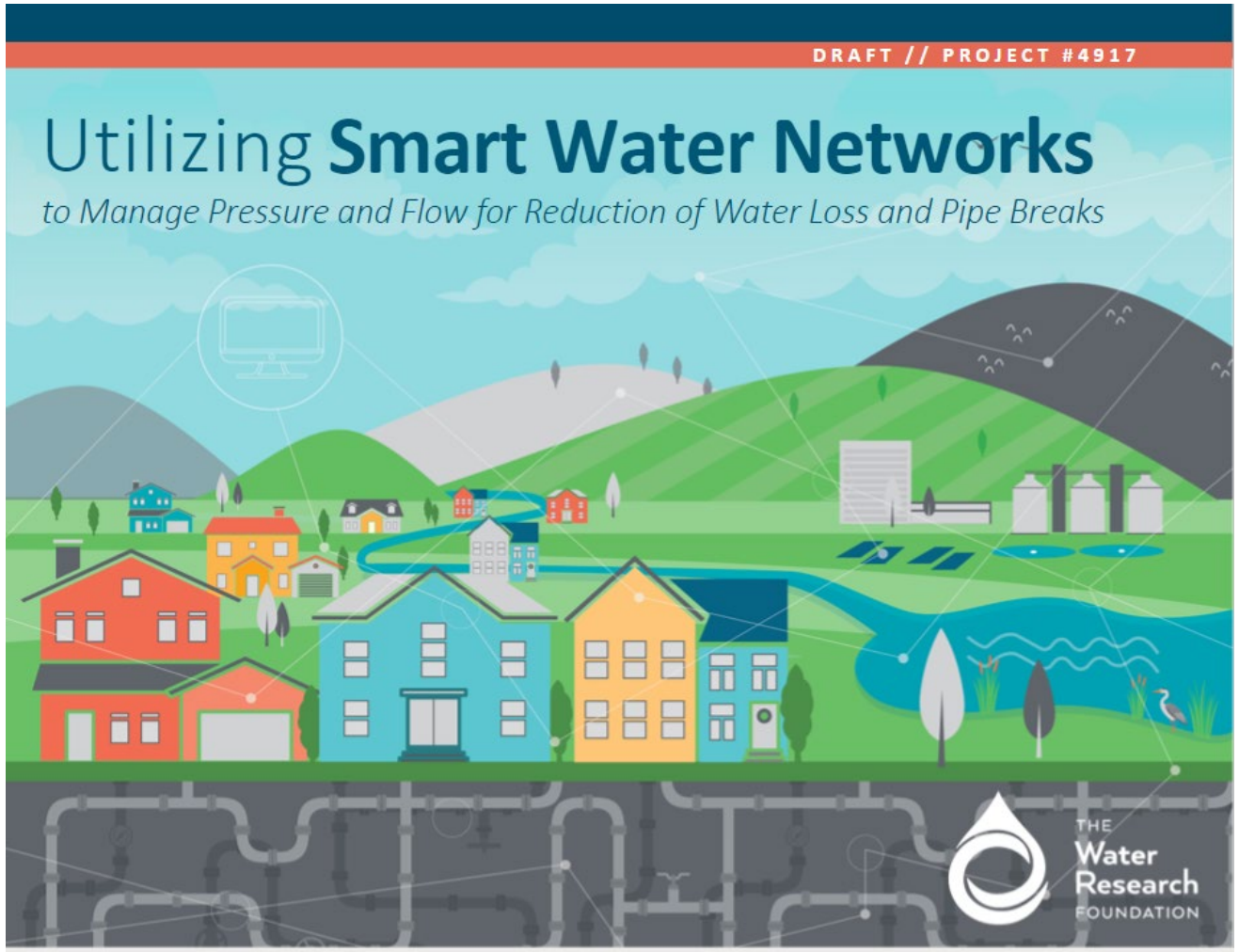
4. Determine optimized **offset profiles of PRV settings** for integrated modeling and background leakage reduction.

Where to from here?



Back to North West...

Water Research Foundation Project #4917



SECTION 1

Background + Emerging Trends in Smart Water Networks

SECTION 2

Step Wise Approach for Utilizing Smart Water Networks

SECTION 3

Case Studies

SECTION 4

Moving Forward

Appendices

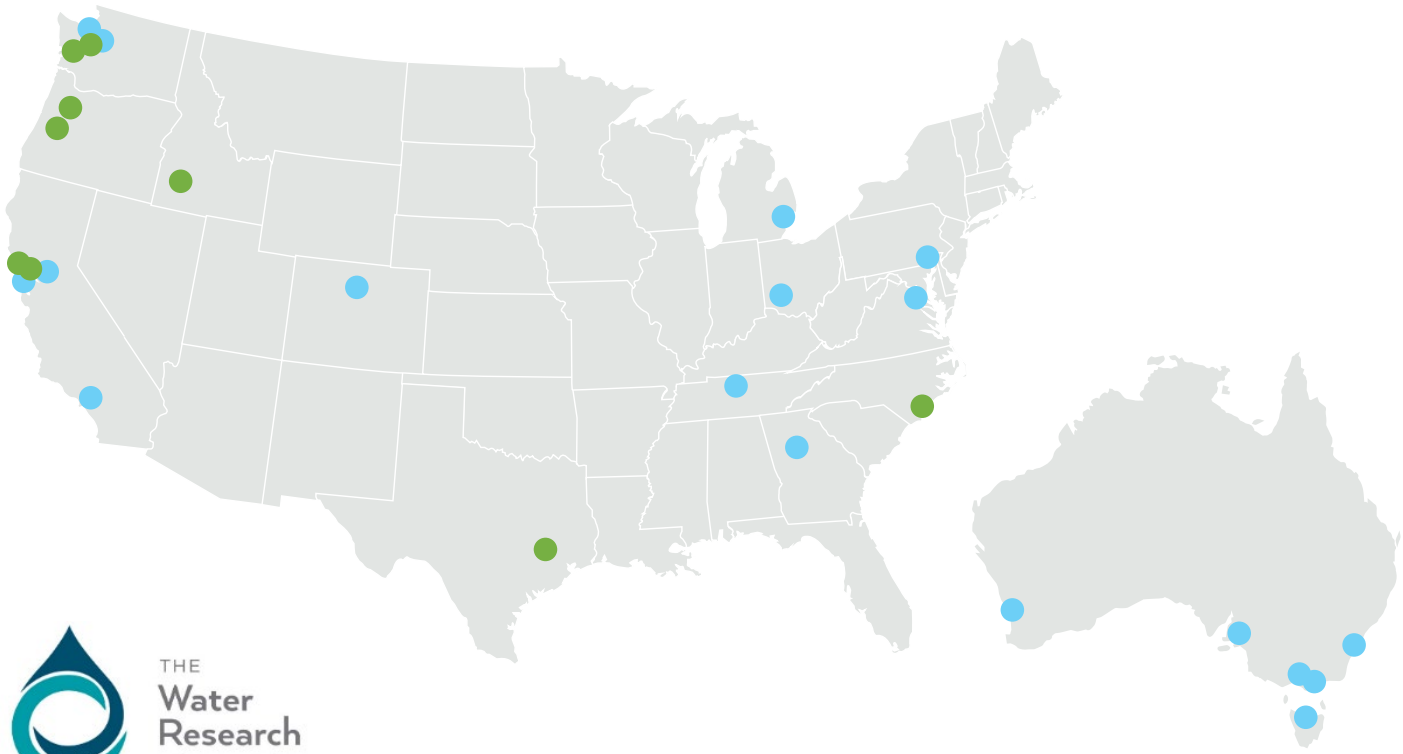
Appendix 1: Background and Literature Summary

- This document provides a broad view of information on technical approaches to using smart water network for pressure and flow reduction. The primary benefit of reaching broadly into the literature is to understand the full spectrum of considerations. This summary allows the reader to:
  - Understand lessons learned
  - Capture the state of the industry and its development roadmap
  - Gain familiarity with new sensor technology, asset life, and risk management

Appendix 2: Pilot Case Studies

- The research project team worked with pilot utilities to develop four case studies. This appendix presents the four case studies and results in detail.

Research team includes over 17 utilities and 9 vendors



THE Water Research FOUNDATION

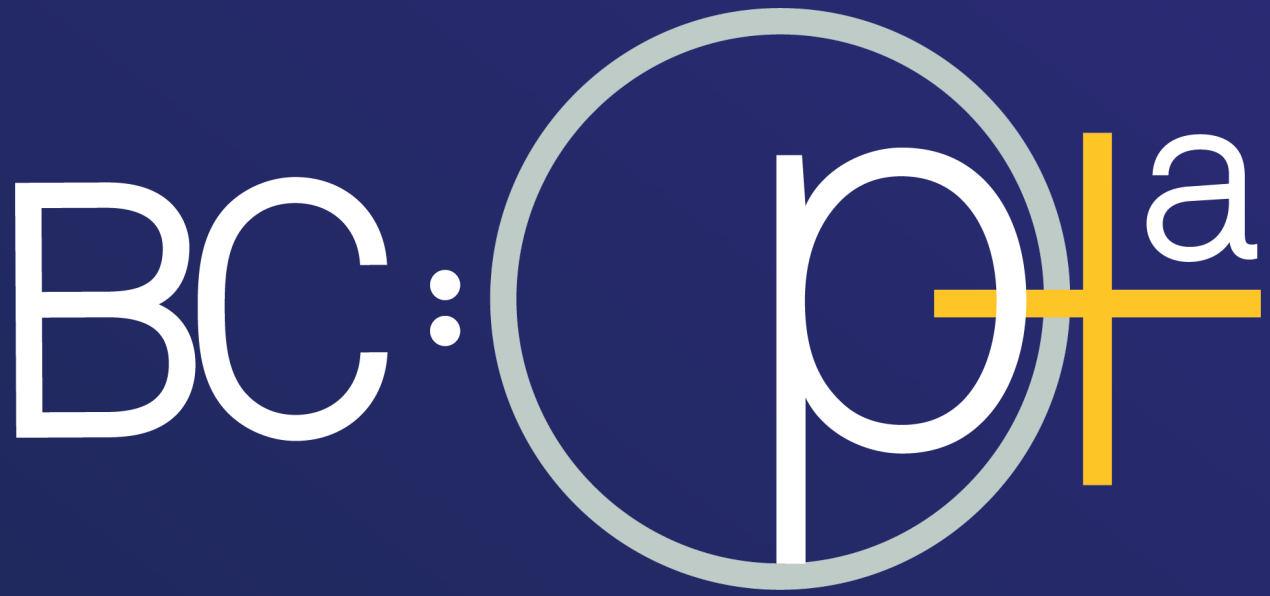
Brown AND Caldwell

Utilities

- Aqua America
- City of Boulder, Colorado
- Contra Costa Water District
- District of Columbia Water and Sewer Authority (DC Water)
- Great Lakes Water Authority
- Greater Cincinnati Water Works
- Gwinnett County
- City of Lakewood (CA)
- South Australia Water Corporation
- Seattle Public Utilities
- San Francisco Public Utility District
- South East Water (Australia)
- Tasmanian Water and Sewerage Corporation
- US Environmental Protection Agency
- Water Corporation (Australia)
- Water Services Association of Australia
- Water and Wastewater Authority of Wilson County (TN)
- Sydney Water

Vendors

- Aveva (Schneider Electric)
- Fracta, Inc.
- Innovyze
- Matchpoint Water Association Management, Inc.
- OSIsoft
- SEEQ
- XYLEM
- ESRI
- Trimble



Optimization = people + technology + adoption

Thank you. Questions?

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Why Control Pressure?

Contamination	Pressure loss can cause contamination of a distribution system
Pipe Integrity	Pressure fluctuations can affect the physical integrity of pipes
Infrastructure Life	Pressure surges can create leaks, breaks and reduce infrastructure life
Energy	Pressure reductions can save pumping energy costs
Reduce Leak Volume	Real-time Pressure data can allow operators to reduce leakage volume,