HOW TO BUILD A DIGITAL-FIRST RESILIENCY APPROACH

September 19, 2023

ASSOCIATION OF METROPOLITAN WATER AGENCIES

CDM Smith

trinnex

WELCOME

Erica Brown, Chief Policy and Strategy Officer, AMWA

REMINDERS

- Put questions or comments in the chat or unmute yourself.
- The webinar recording and slides will be available after the presentation.

INTRODUCING SPEAKERS

AMY CORRIVEAU

President,
Trinnex

LINDSEY RECHTIN

President/CEO,
Northern Kentucky
Water District

JACKIE JARRELL

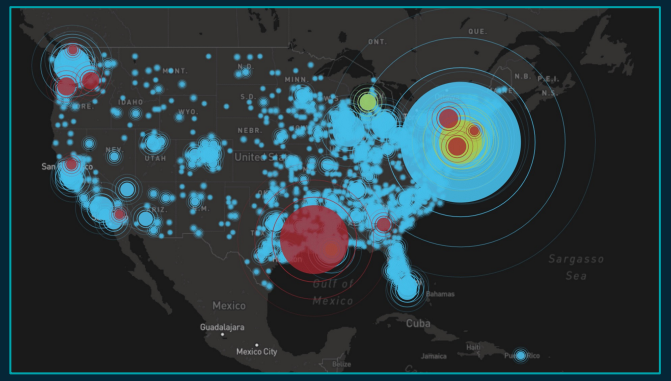
Deputy Director,
Charlotte Water

KATIE DEHEER

Digital Analyst and Machine
Learning Specialist,
Trinnex


“The pace of change has never been this fast, yet it will never be this slow again.”
- Prime Minister Trudeau

The Turbulence of Change



Adapting post-pandemic

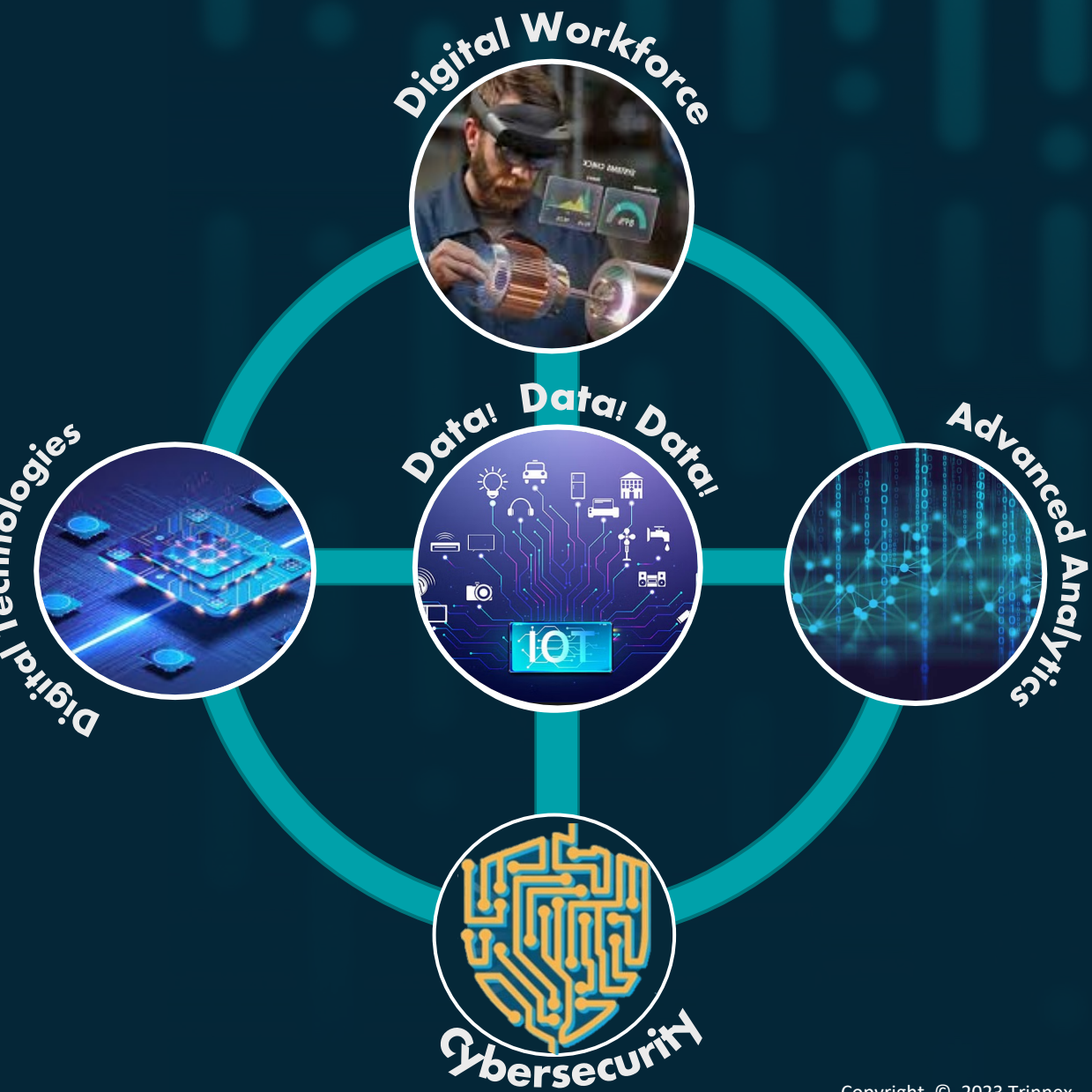
Coping with influx of data

Struggling with resource gaps

"The greatest danger in times of turbulence is not turbulence itself, but to act with yesterday's logic." ***– Managing in Turbulent Times, by Peter F. Drucker***

Digital-first Resiliency

- Strategic approach to safeguard and mitigate risks in digital era
- Integrated focus:
  - Organizing and centralizing access to new (real-time) data sources
  - Simulation/analysis to reveal hidden patterns, predict future outcomes, and promote data-driven decision-making
  - Cybersecurity protocols and infrastructure to detect and protect cyberattacks
  - Application of new digital technologies (cloud, edge computing, robotics)
  - Equipping workforce with tools and mindset to harness actionable insights and data-driven decisions



The Digital and Physical Infrastructure worlds move at different paces

Releases:
weeks - months

Designs:
12 – 30 months

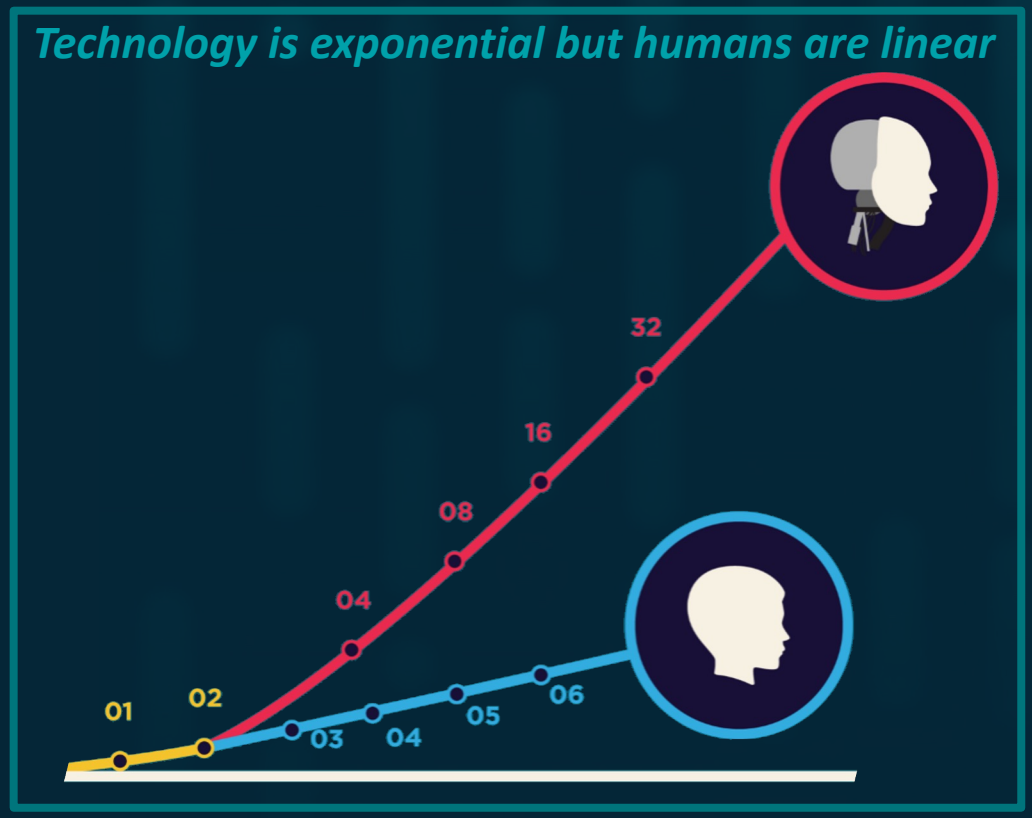
Construction:
2 – 6 years

On the cusp of a new digital-first paradigm

- A post-Covid world expects digital transformation
- New workforce generation demands digital tools
- Solving for the extremes requires a digital-first approach

Achieving a digital-first resiliency

- Increase buy-in with stakeholder engagement and communication
- Embrace Change, Experiment Intentionally, and “Plan to Pivot”
- Follow data across silos
- Network and Collaborate



CASE STUDY #1

NORTHERN KENTUCKY WATER DISTRICT

How to Build a Digital-First Resiliency Approach

NORTHERN KENTUCKY WATER DISTRICT

Presented by Lindsey Rechtin, President/CEO

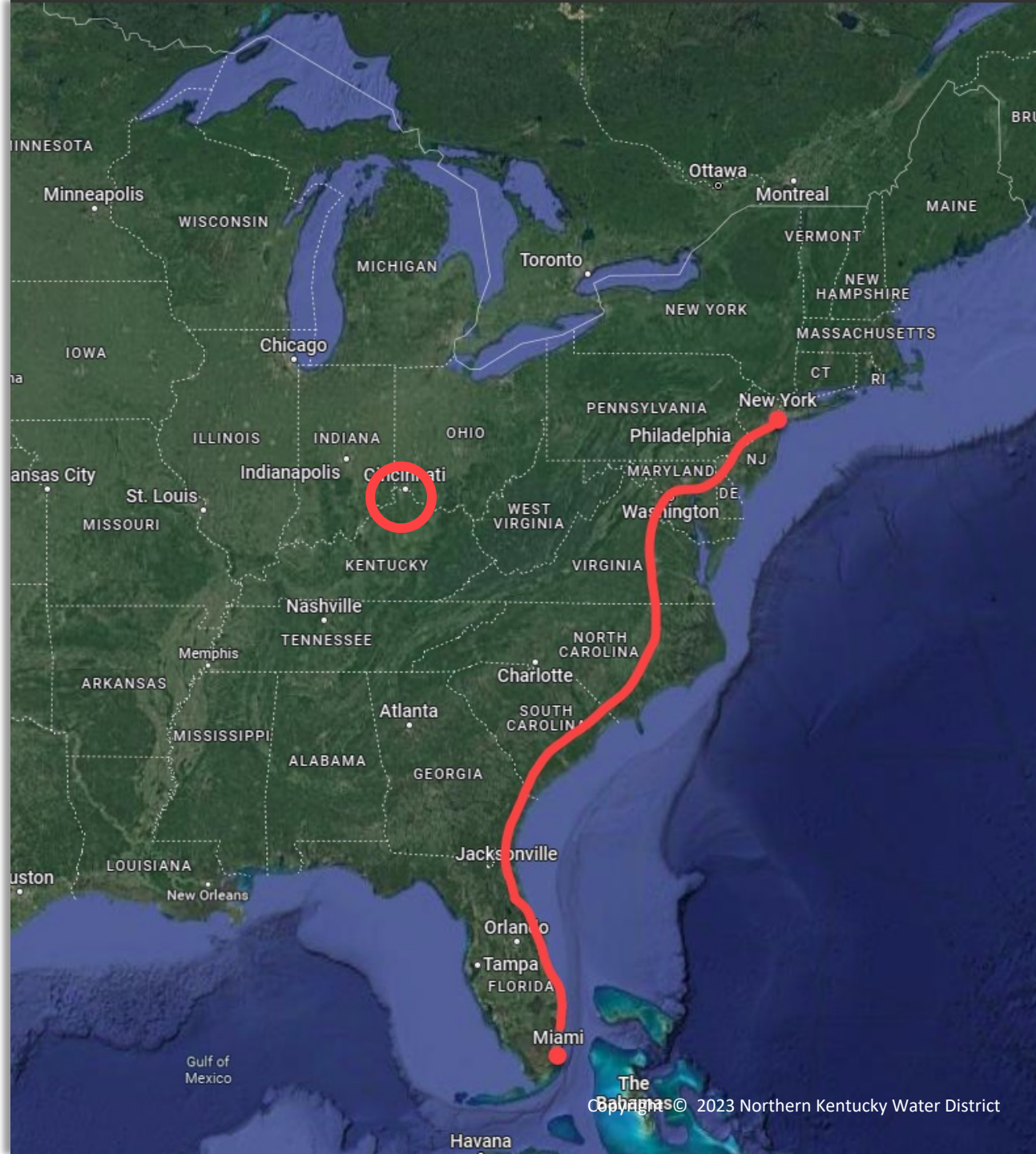
PRESENTATION AGENDA

- Satellite Leak Detection - **FINISHED**
- Advanced Metering Infrastructure (AMI) – **IN PROGRESS**
- Lead & Copper Rule – **BEGINNING STAGES**

Satellite Leak Detection

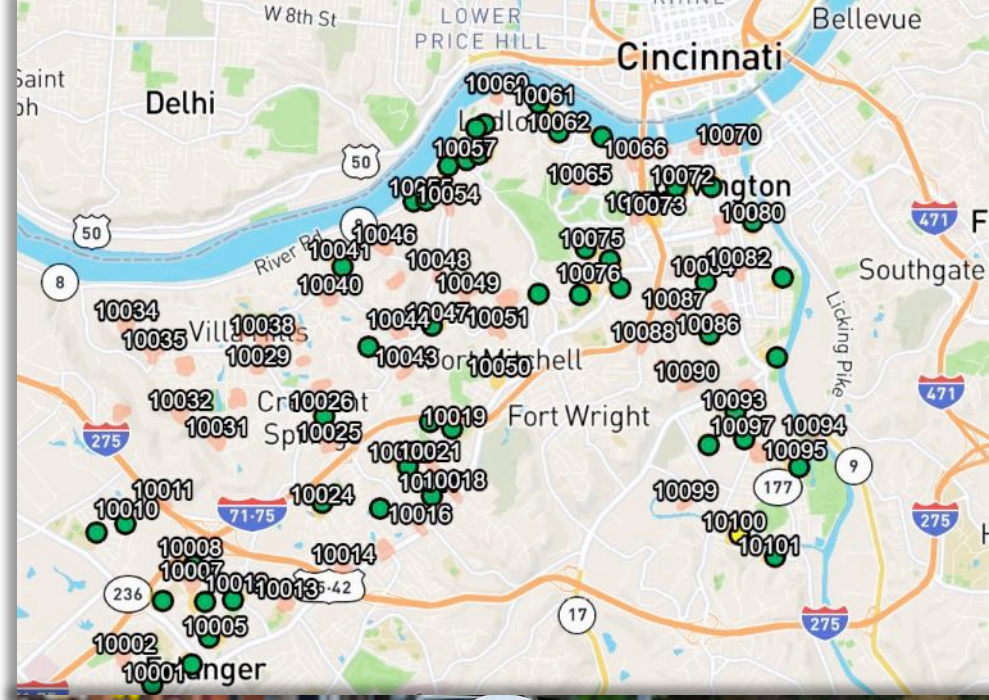
CHALLENGE:

Identifying leaks on **1,325** miles of water main in a **229** square mile service area.



HOW WE RESPONDED

- Found a satellite, leak detection technology.
- Took aerial scans of the entire service area.
- The company provided “points of interest” for our crews to further investigate.



KEY TAKEAWAYS

- Able to survey our entire service area (two phases) within a year
  - Traditionally used contractors to survey entire system; took several years
- In phase one, **101 points** of interest were identified, **70 leaks** were verified
  - Only two of these leaks were surfacing and visible
  - **68 leaks were not visible** and could only be detected with acoustical equipment
  - Annual estimated water loss in detected by this technology in just one phase was over **$60,000.**
- Estimated cost savings of **$665 per leak** using satellite leak detection, compared to prior acoustical survey methods

Advanced Metering Infrastructure

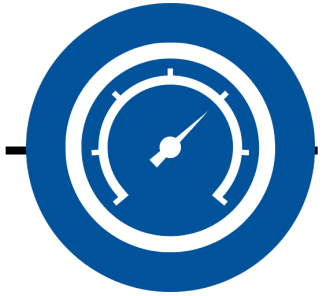
CHALLENGE:

Notified by our previous vendor in December of 2018 that the transmitters for our automated meter reading system were no longer available for purchase.

HOW WE RESPONDED

WHERE WE STARTED

2019

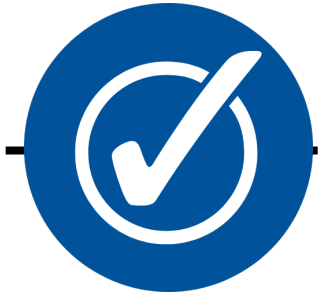


Meter reading study & RFP prep and evaluation

2021

Bid accepted; approved to negotiate contract

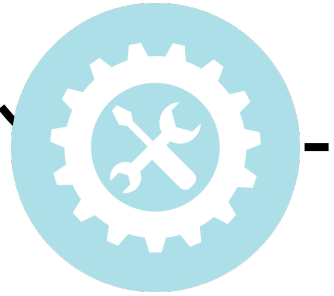
Applied to Public Service Commission for CPCN



Public Service Commission approves CPCN

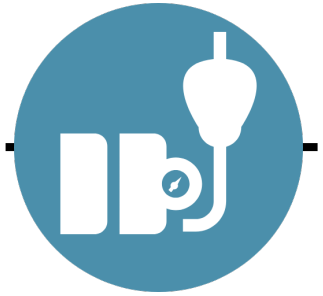
Entered into agreement with vendor

2022



Vendor completes 12 base station installs

NKWD system starts failing at alarming rate; vendor agreed to assist with manpower



NKWD and vendor begin reading system manually since existing system failing and new PO cannot be filled

Met with vendor to discuss installation progress. Transmitters began to become available. Workforce for installation became problem

Vendor acquires second contractor for installations

WHERE WE ARE

KEY TAKEAWAYS

- New meter reading base stations are up and running; primary issue remaining is installation of transmitters on each meter.
  - Akin to a house being wired with electric, but still need to install the lightbulbs.
- Though improving, the reverberations of COVID-19 Pandemic and subsequent supply chain and labor shortages continue to be felt.
- Vendor has been a responsive partner in project and has assisted our staff with manual readings
- Expected Project Completion: **December 31, 2024**

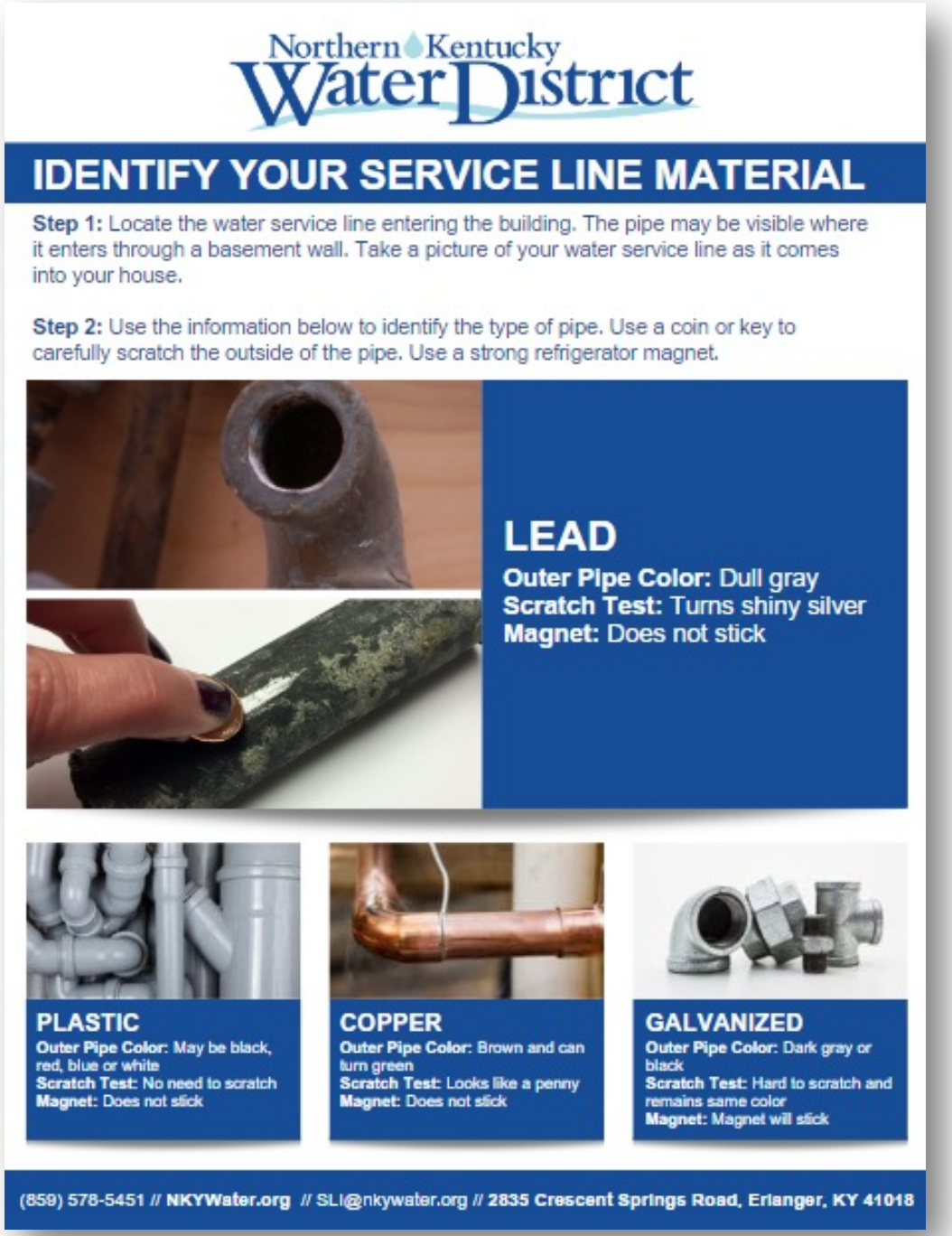
Lead & Copper Rule

CHALLENGE:

As part of the revised Lead & Copper Rule, each utility must submit a service line material inventory for all service line pipes in their system, including the customer side.

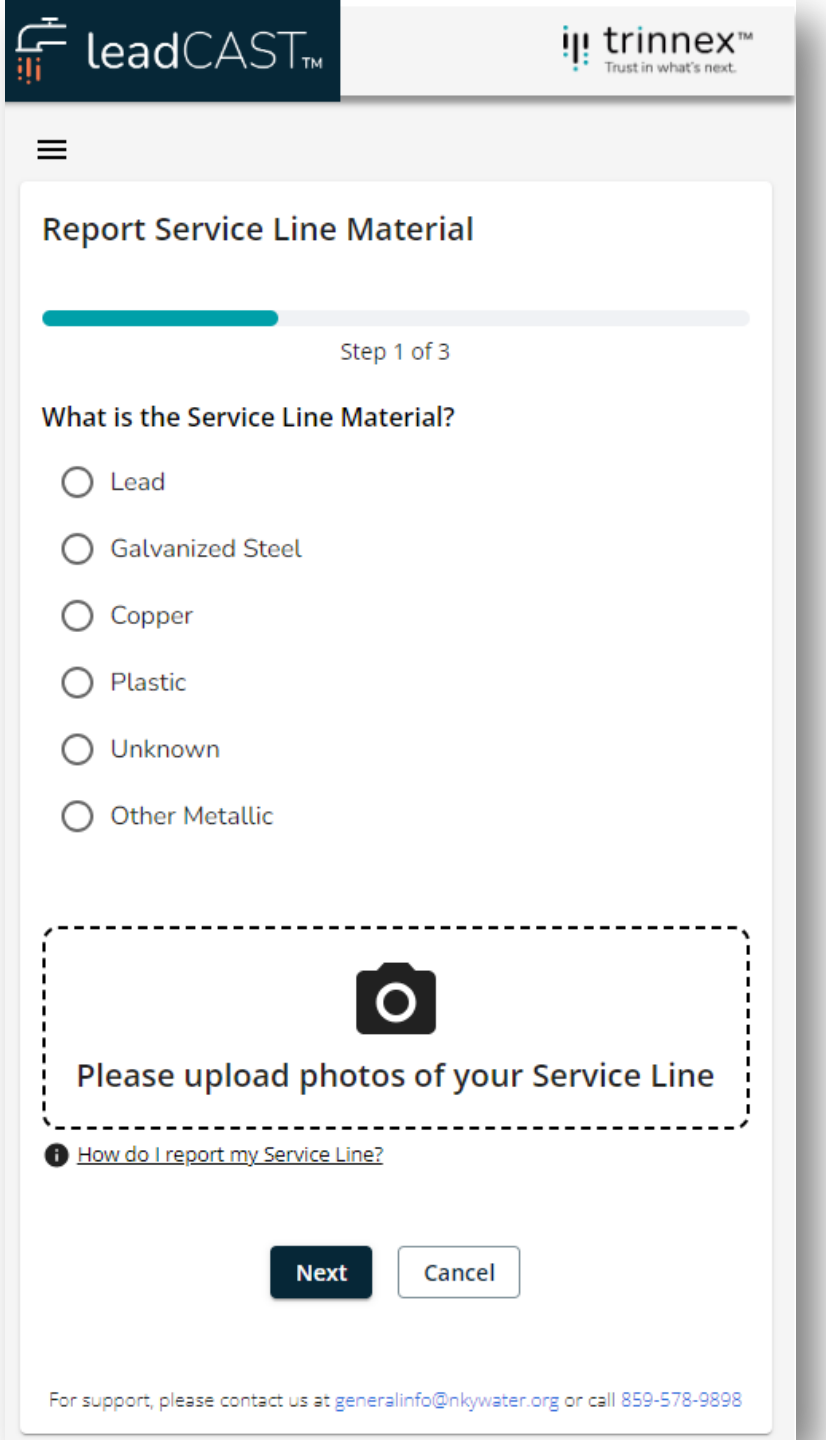
HOW WE RESPONDED

- Needed to find a way to inventory our entire service line system.
  - Over **85,000** active accounts
  - Suspect that as many as **30,000** lead service lines could potentially exist
- Turned to an inventory management system that allows customers to self-report their service line.



KEY TAKEAWAYS

- Final testing and software fixes are underway
  - **Phase 1:** Soft launch internally with employees
  - **Phase 2:** Public launch
- Looking to launch publicly sometime in the next month
- **Going forward:** expect that the inventory system will allow us to eventually meet the Lead & Copper Rule that requires a published inventory on our website available for customer viewing.



CASE STUDY #2

CHARLOTTE WATER

Charlotte Water's Digital Journey

Jacqueline A. Jarrell, P.E. Deputy Director

September 19,2023

Charlotte Water's System

- Two raw water intakes
- Three water treatment plants
- 174 MGD Water Treatment Capacity
- 4,471 miles water mains

- Five major wastewater treatment plants + one in design (2026)
- 123 MGD Wastewater Treatment Capacity + future 15 MGD
- 6 MGD Purchased capacity (12 MGD total)
- 82 pump stations + 2 future
- 4,509 miles sewer mains

- Partnership agreements with most surrounding counties and many towns

Mission & Vision

INFRASTRUCTURE FOR THE FUTURE
Support growth, mobility, accessibility and reliability

SUSTAINABILITY
Regulatory compliance to protect residents and waterways

EQUITY & INCLUSION
Provide services equitably for the benefit of all

Mission

Charlotte Water provides reliable, high-quality services to our community through valued employees, financial stability, and environmental stewardship

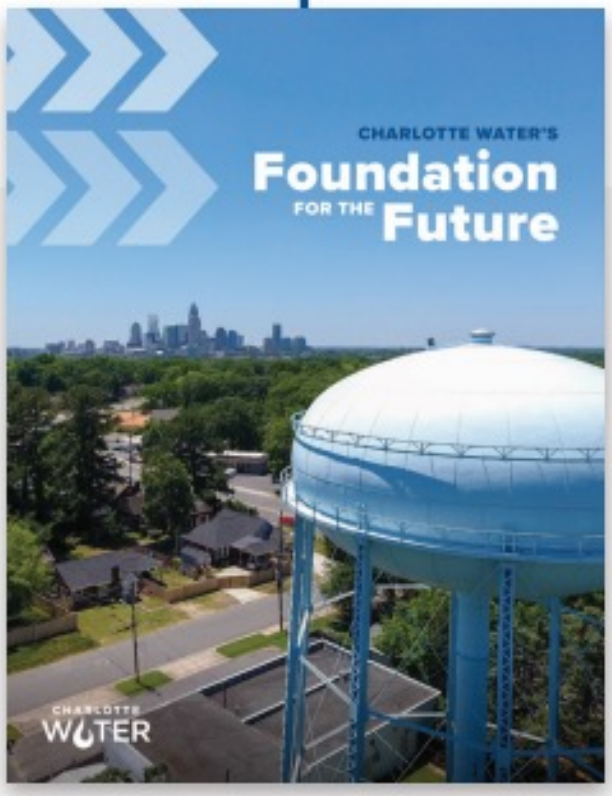
Vision

To be a leading water utility, recognized for excellence and dedicated to our people, community, region, and environment

CHARLOTTE WATER

Charlotte-Mecklenburg STORM WATER Services

ONE WATER

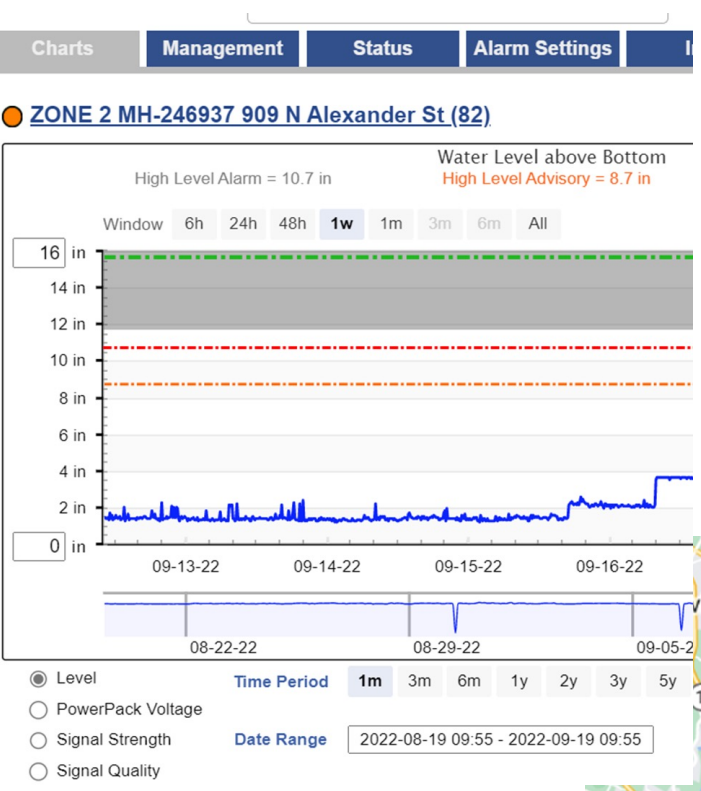


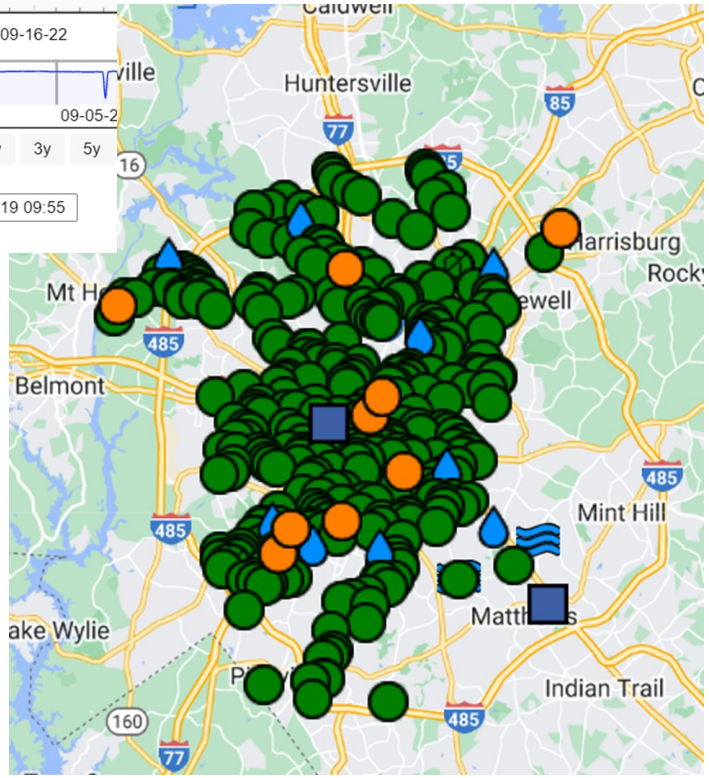
At its core, our Journey to One Water will enhance the customer experience, develop stronger community partnerships, and create efficiencies.

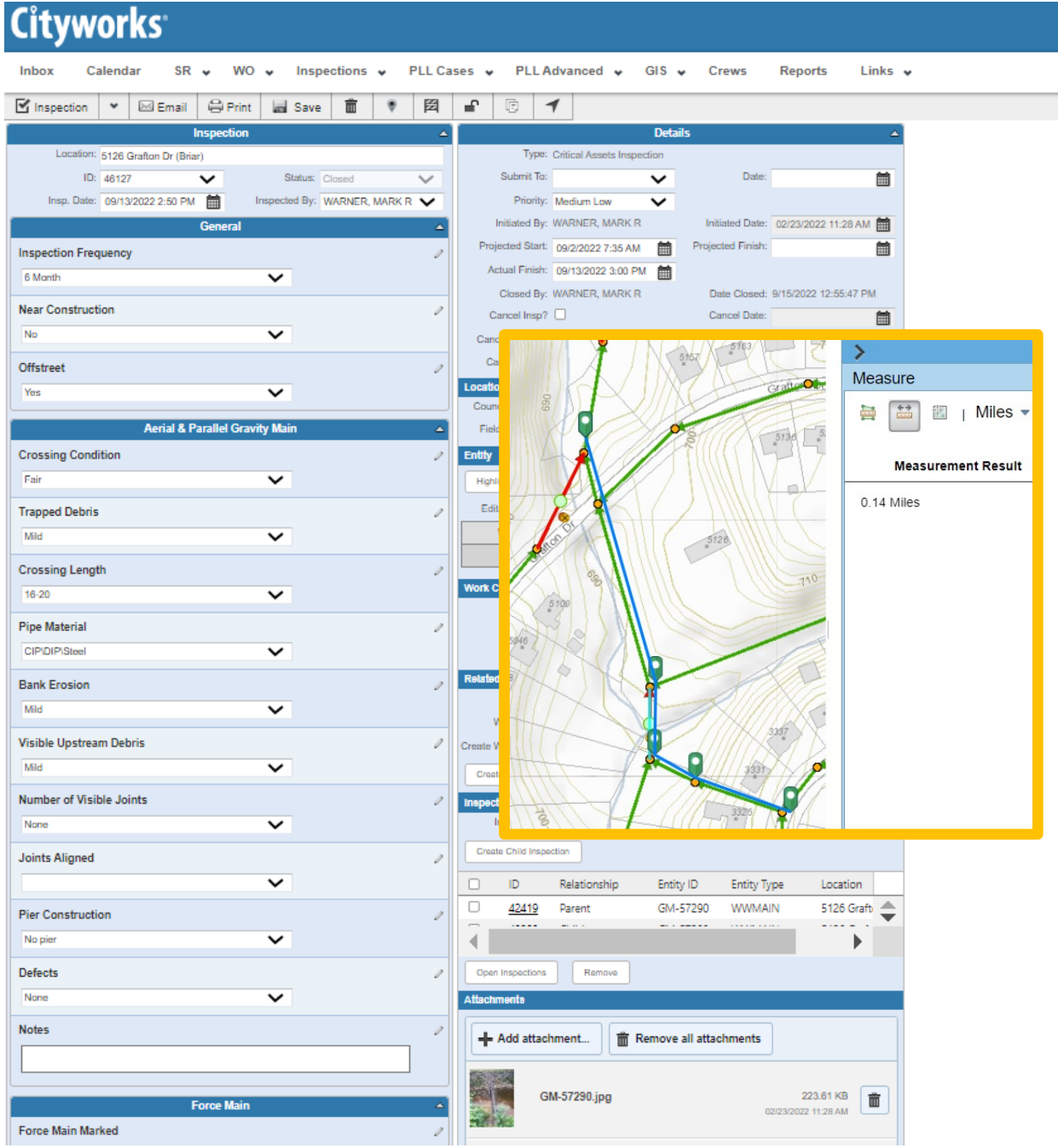
These One Water goals are driven by the strategies and measures within the strategic plans.

CHARLOTTE WATER

Charlotte-Mecklenburg STORM WATER Services

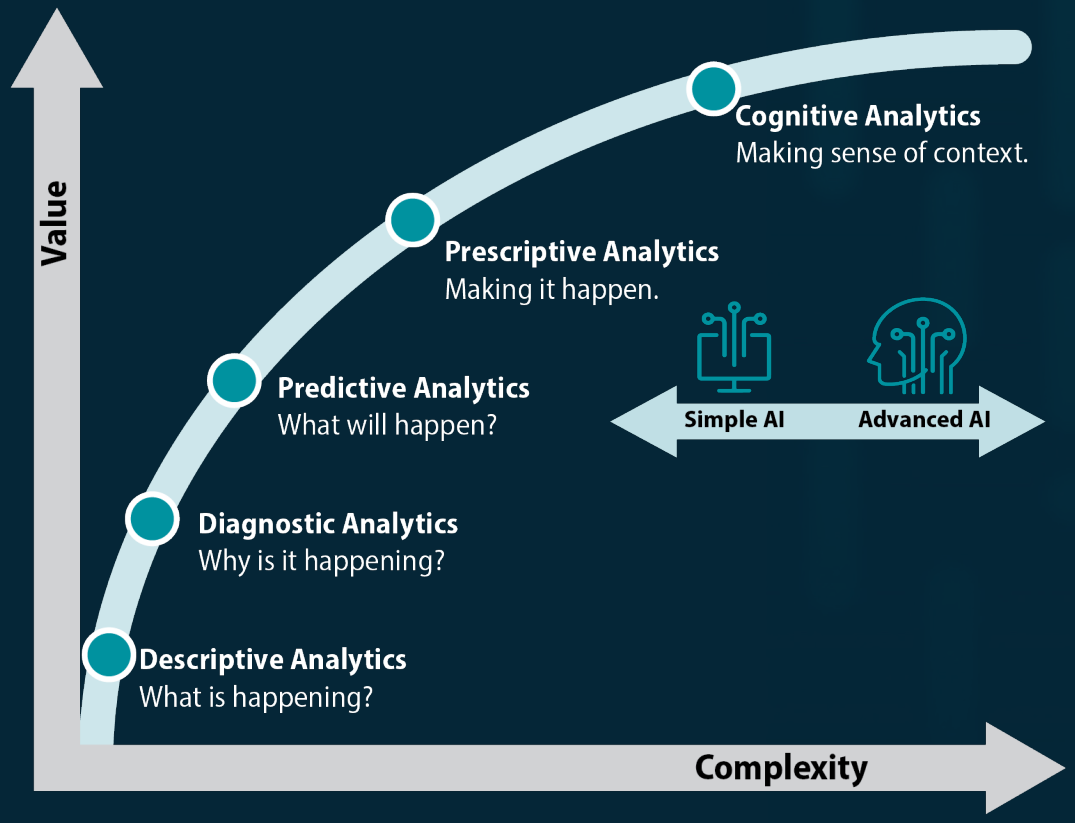




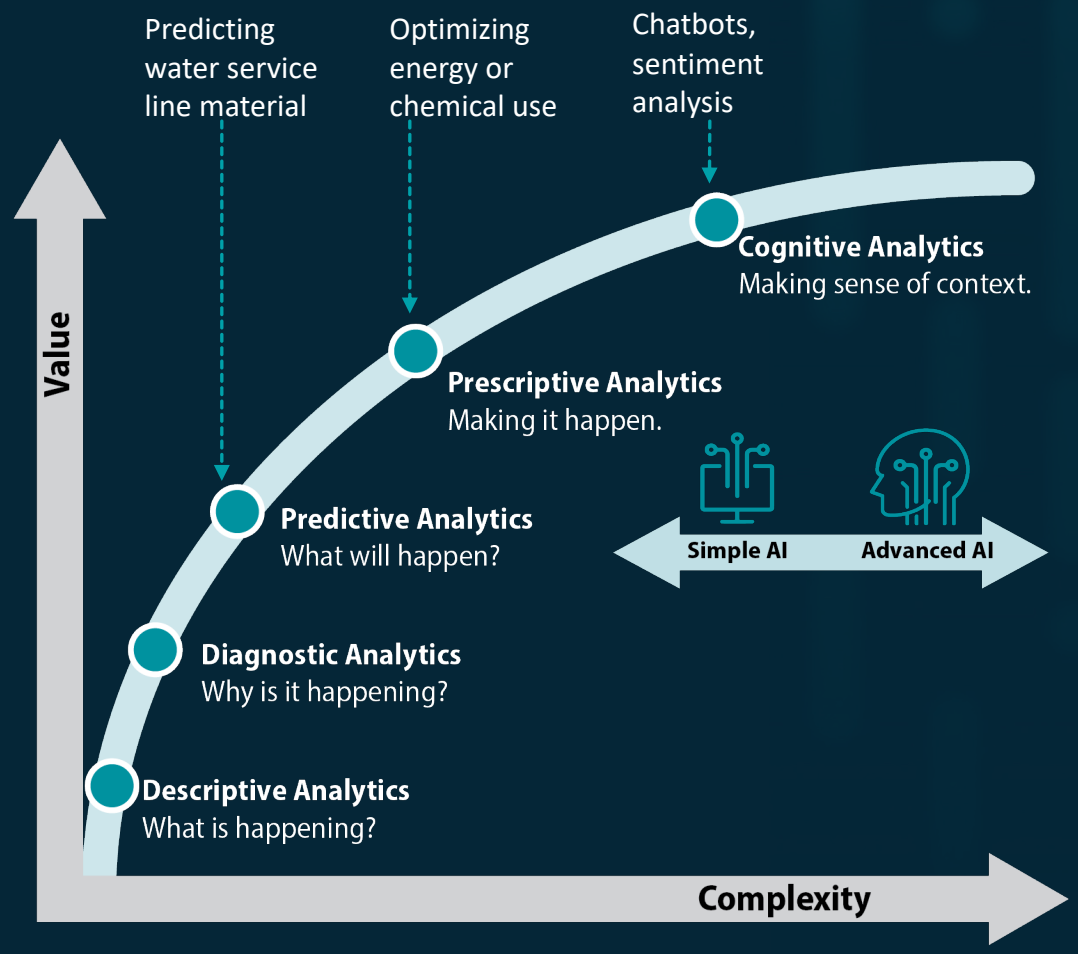


AI/ML TO SOLVE INFRASTRUCTURE PROBLEMS

The way in which we leverage data is evolving



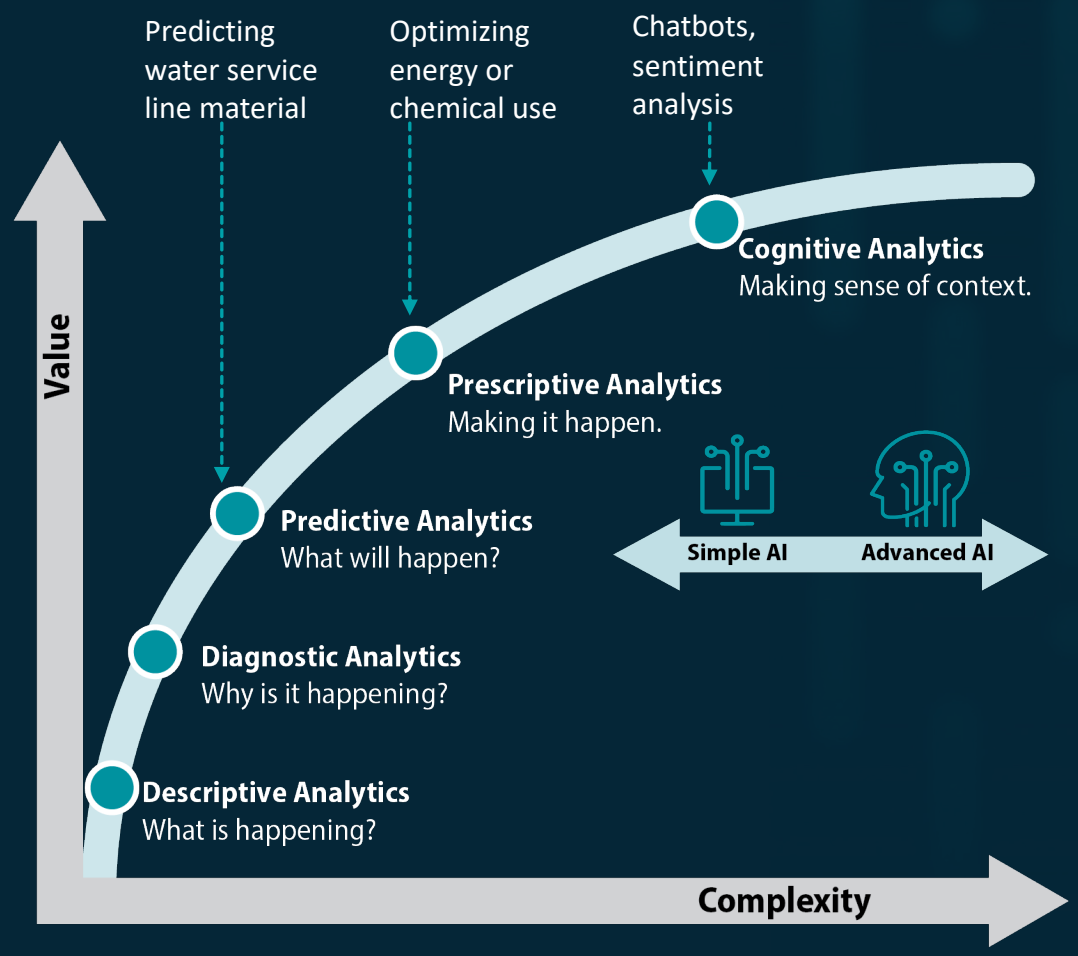
The way in which we leverage data is evolving



The way in which we leverage data is evolving

This does NOT mean you need to apply more complexity to get more value.

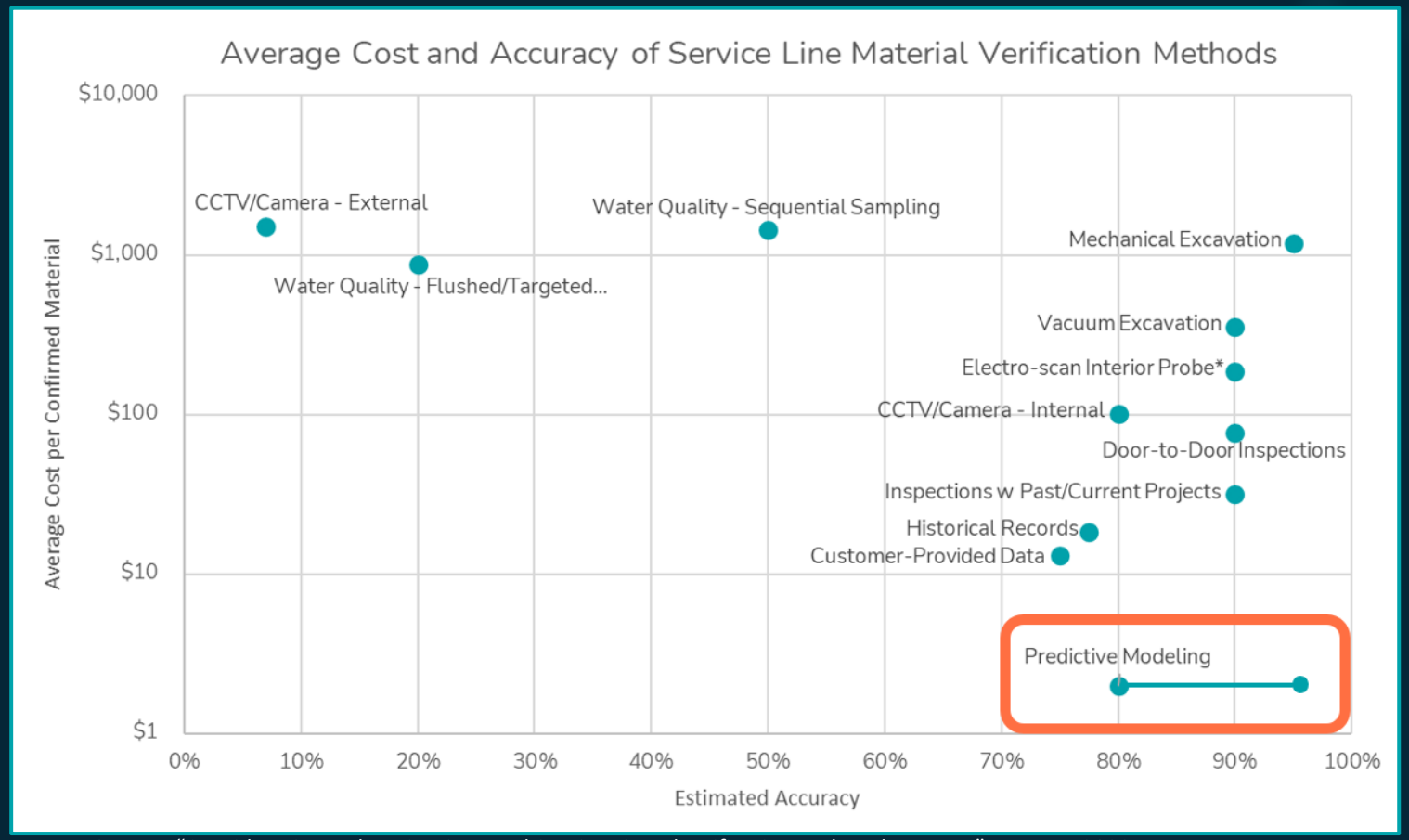
It depends on the problem!



How to take advantage of advanced analytics and AI

- ✓ Justify additional complexity
- ✓ Assess feasibility and data readiness
- ✓ Assess model performance from multiple angles
- ✓ Fail fast, be prepared to iterate
- ✓ Involve subject matter experts

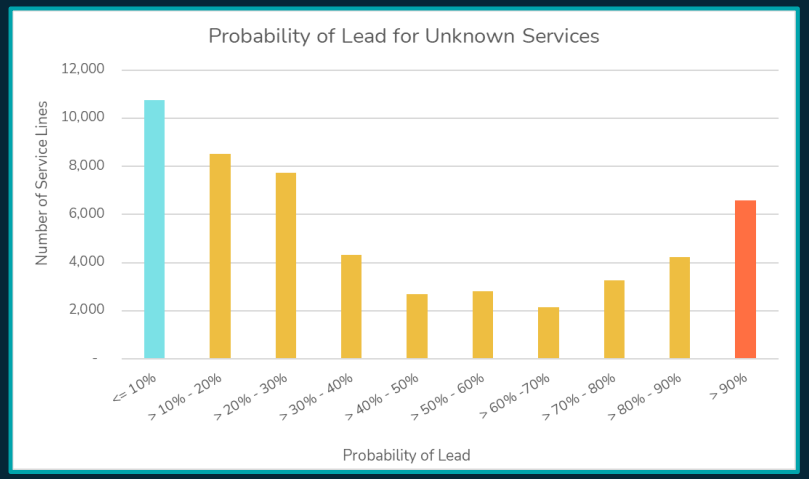
Example 1: Predicting Water Service Line Material



Source: "Considerations when Costing Lead Service Line Identification and Replacement", AWWA, 2022

✓ Justify additional complexity

Example 1: Predicting Water Service Line Material



The model is 93% accurate overall, and it correctly identified 8 out of 10 LSLs.

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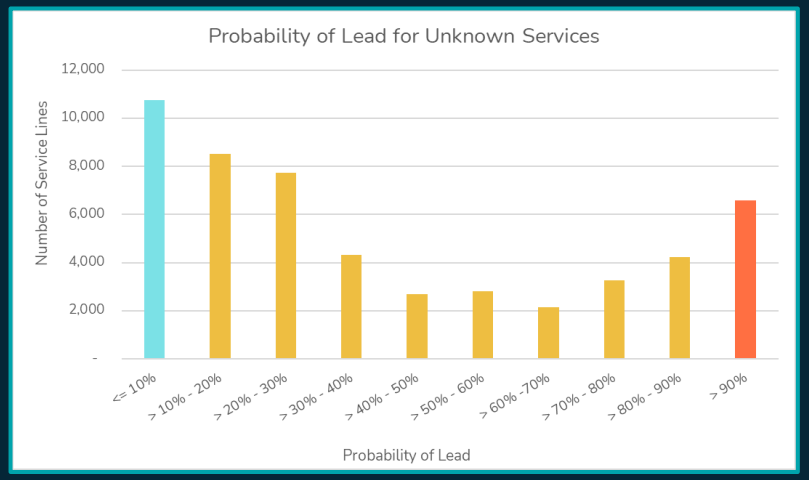

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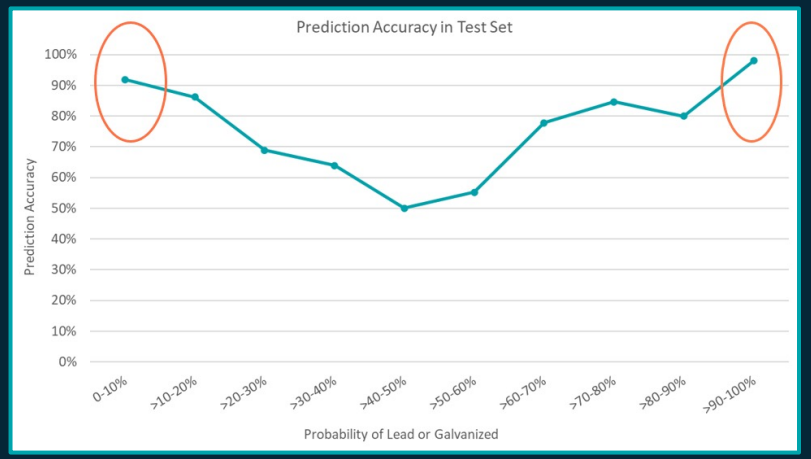
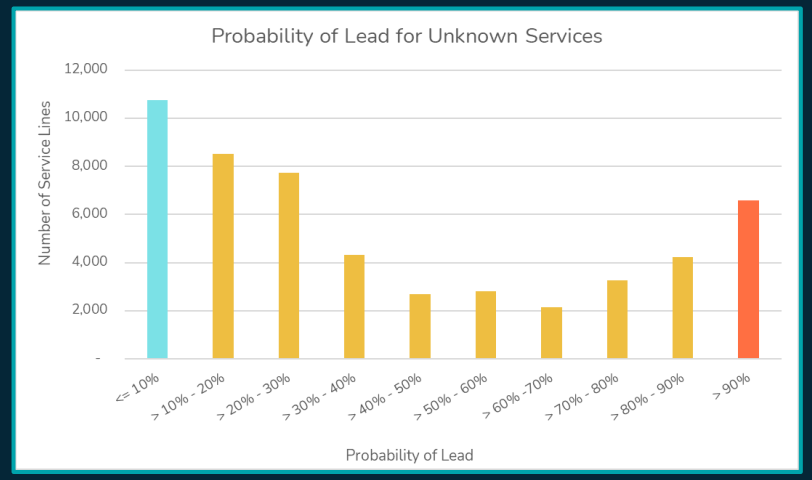
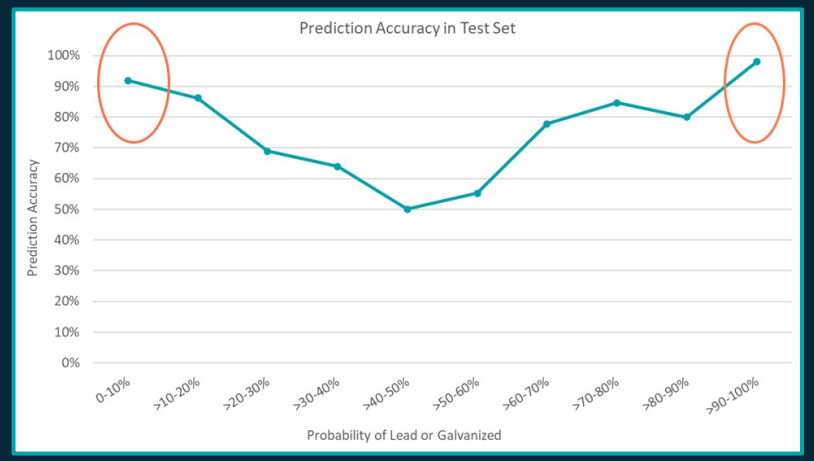


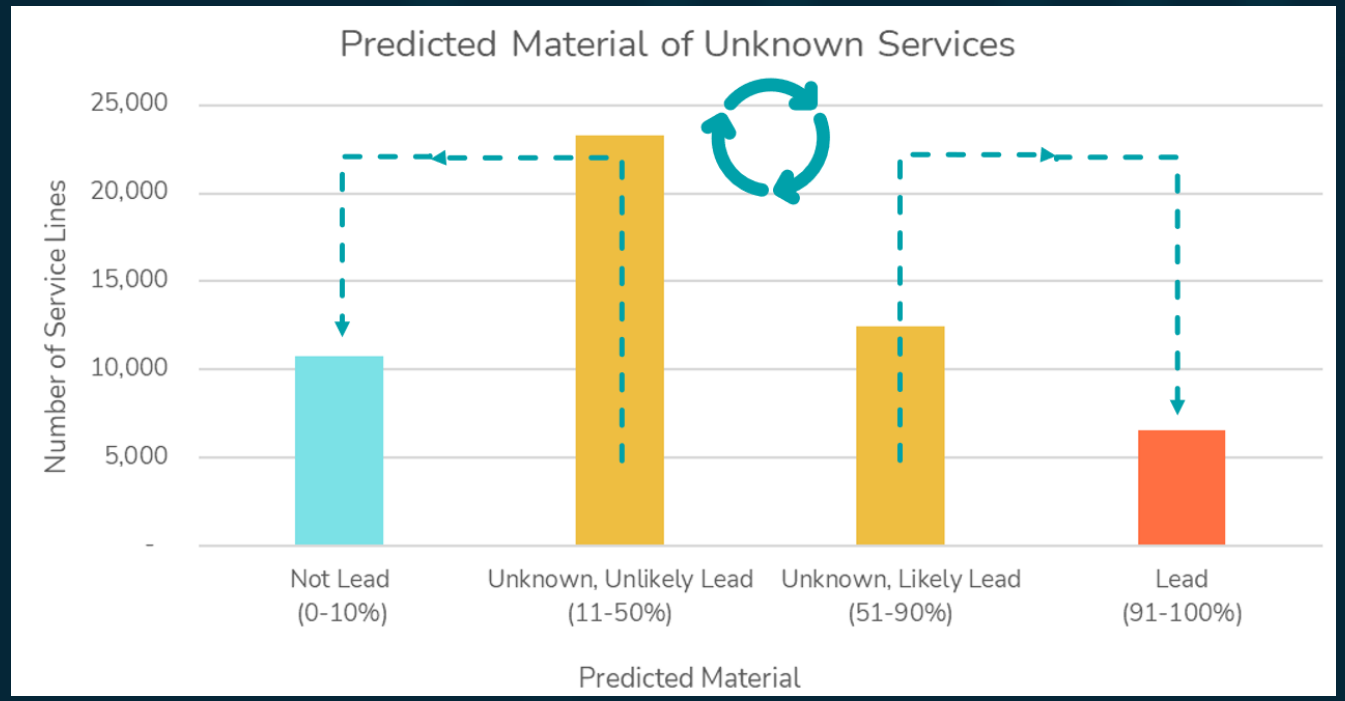
But we should not have a lot of confidence in the predictions in the middle.

✓ Assess model performance from multiple angles

Example 1: Predicting Water Service Line Material

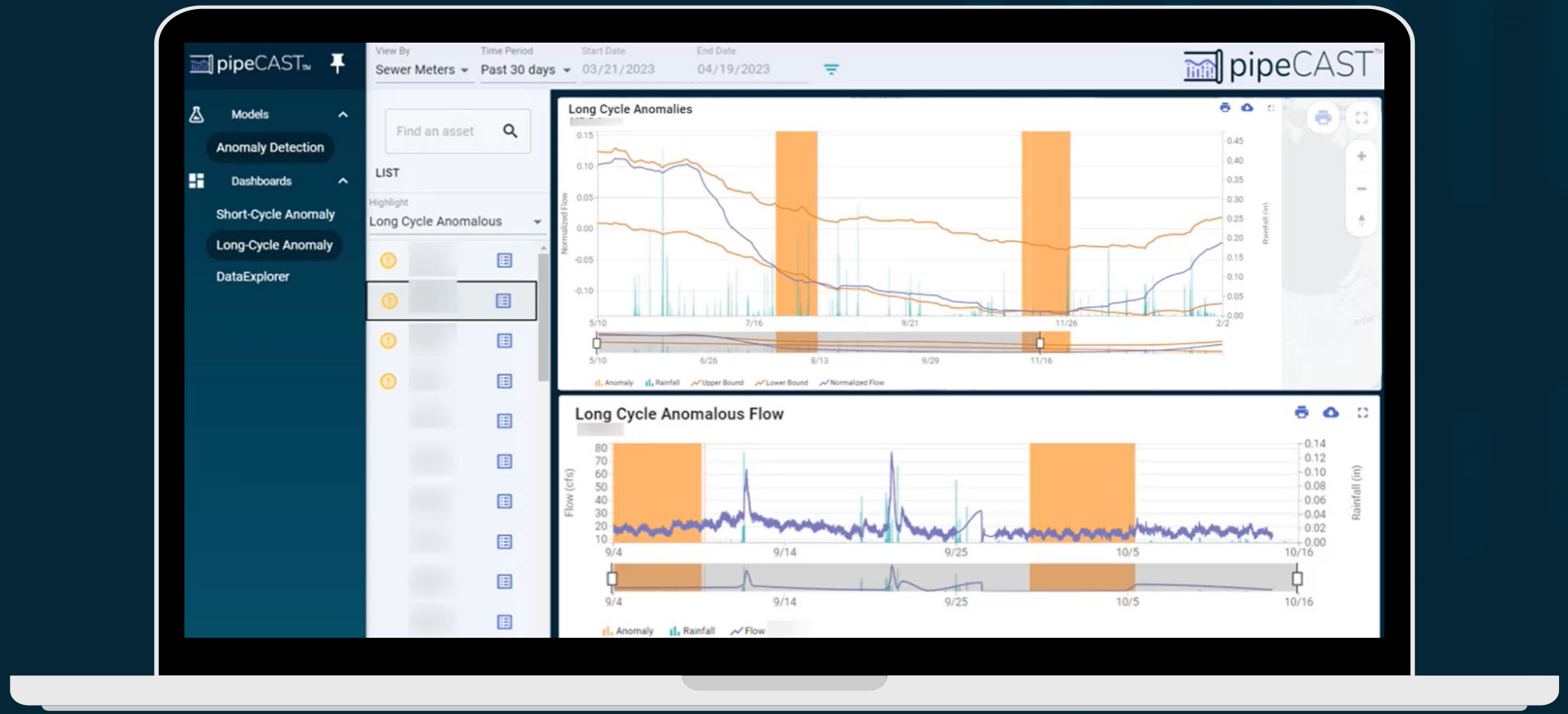






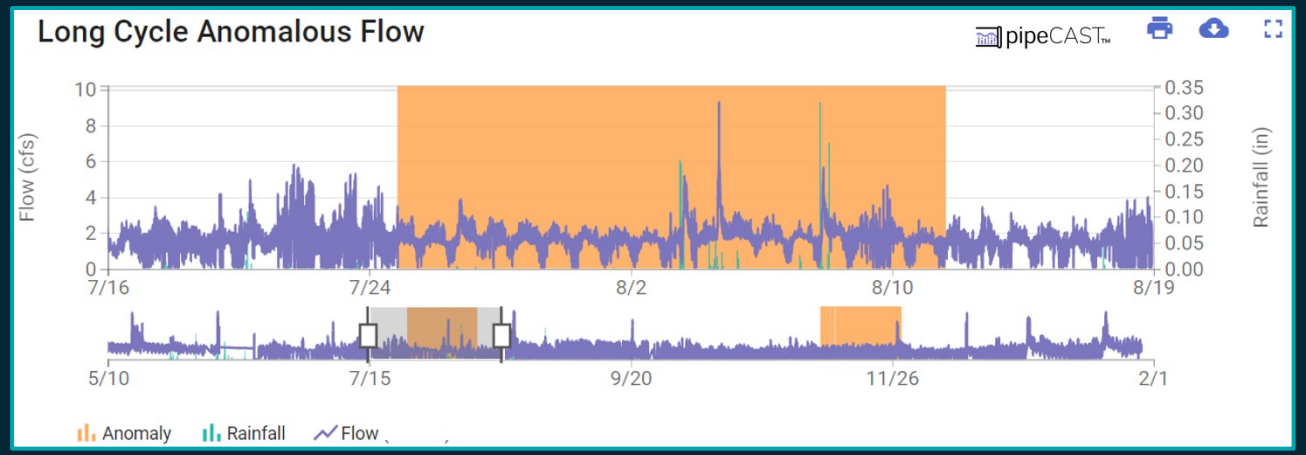
✓ Be prepared to iterate

Example 2: Detecting Anomalies in Sensor Data

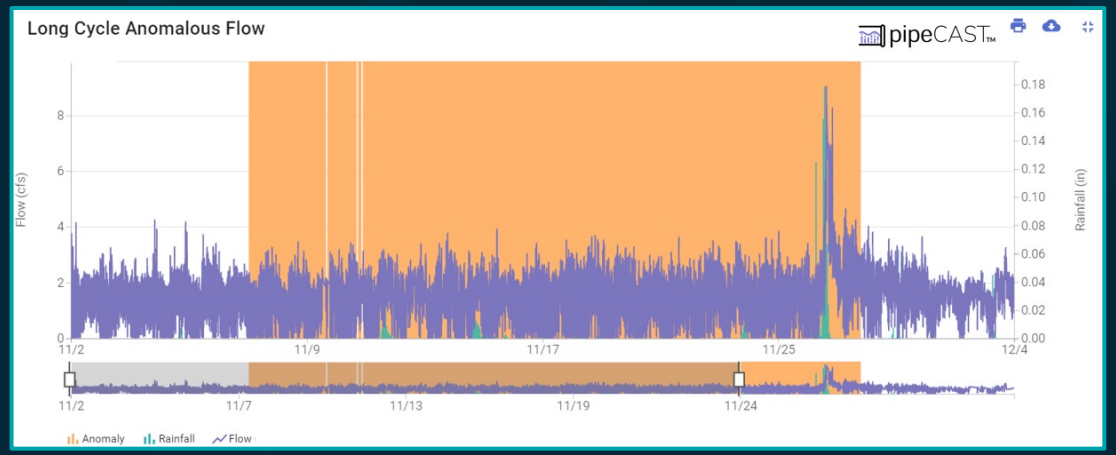


Example 2: Detecting Anomalies in Sensor Data

Does it look like there is a potential issue here?



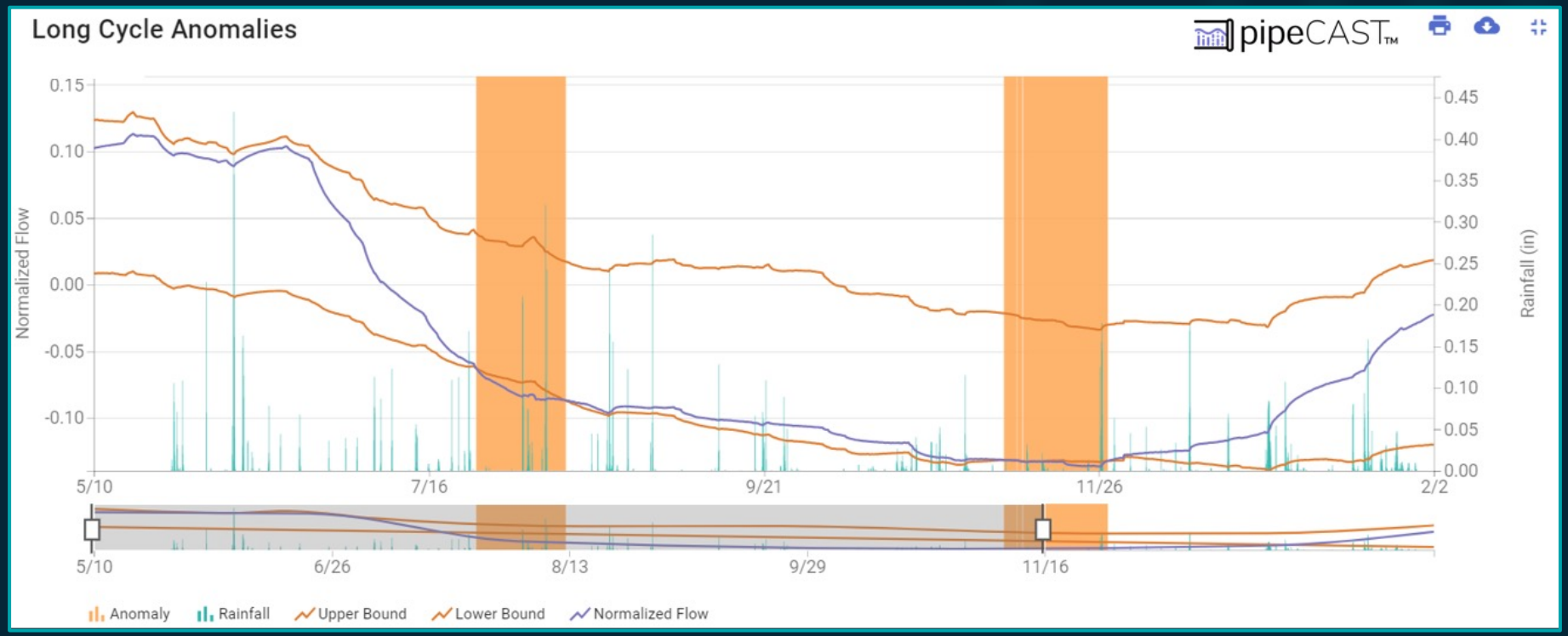
What about here?



Example 2: Detecting Anomalies in Sensor Data

Yes, in both instances, there is a potential problem.

Statistics + Machine Learning illuminate issues that would otherwise be difficult or impossible to see.



Example 2: Detecting Anomalies in Sensor Data

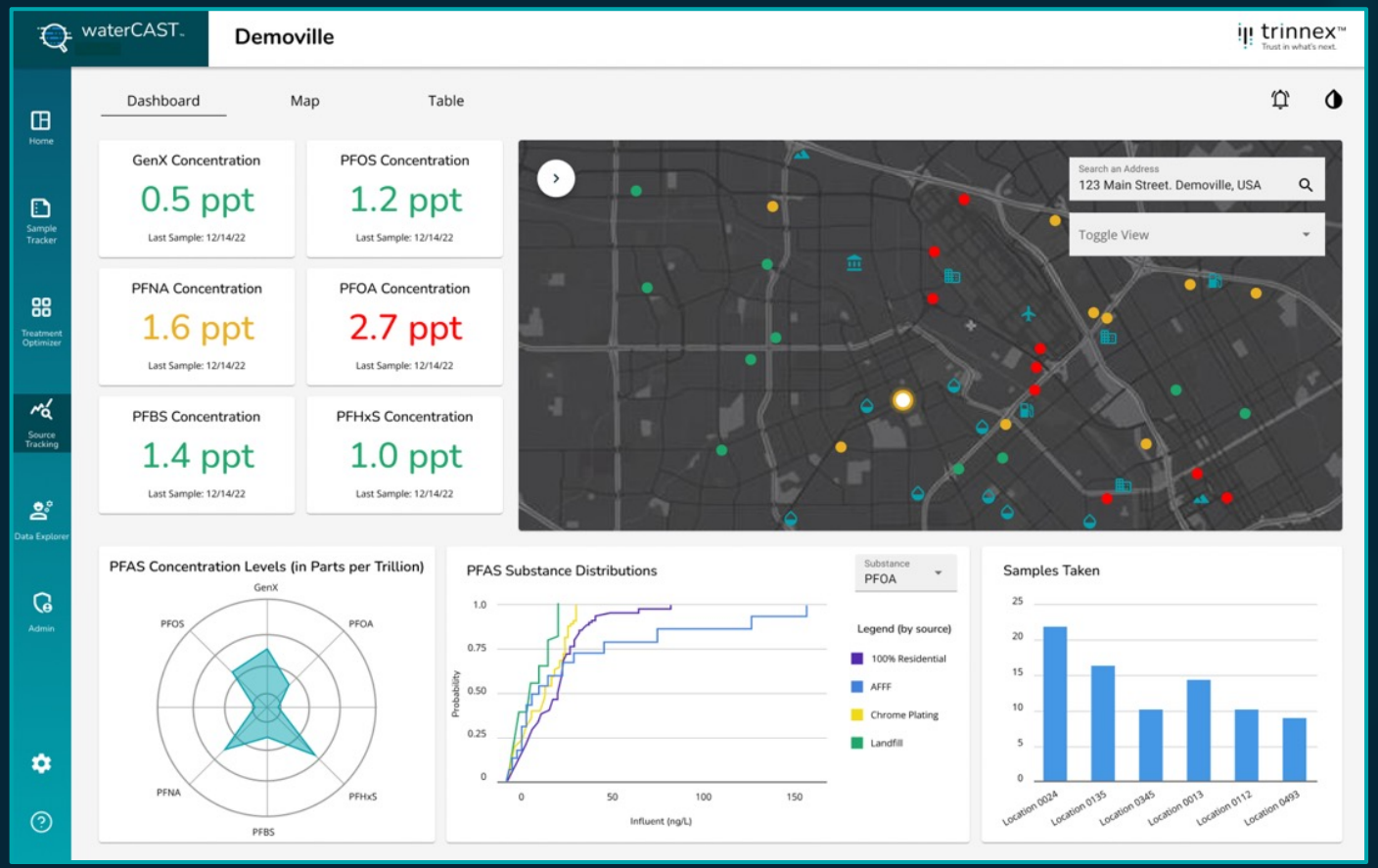
Success Story

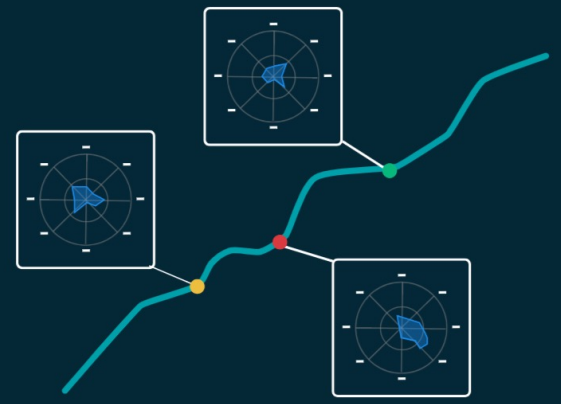
When the sewer was experiencing elevated levels due to river inflow, the AI model detected the issue **several weeks earlier** than it was found in manual review.

Lessons Learned

- ✓ Justify additional complexity
- ✓ Fail fast, be prepared to iterate
- ✓ Involve the right subject matter experts

Example 3: Identifying Sources of PFAS Contamination





Lessons Learned

- ✓ Justify additional complexity
- ✓ Involve the right subject matter experts

Common AI Challenges and Solutions

Utility Challenges	Solutions
Data Quality and Availability	• Robust data pre-processing and cleansing • Handle missing values, inconsistencies, and outliers with water-specific data science • Leverage public datasets to gather more diverse data
Selecting “right” features for the model	• Leverage data science techniques to determine most relevant models • “Sanity-check” with domain experts
Appropriately interpreting model results	• Choose models that provide greater interpretability • Infuse engineering and water + AI expertise into the modeling process for transparency and defensibility
Temporal changes (fluid, evolving data)	• Regularly update models, treat as continuous and iterative, not “one and done” • Set expectations that the model is iterative and performs best alongside continuous field investigation
Imbalanced data	• Use techniques such as resampling, generating synthetic sampling, or class-weighted / cost - sensitive learning (requires data-science expertise) • Consider imbalance when interpreting model results

AI is a complex and evolving field

- Focus and continuous learning are required – it's not a "side project"
- Usually more than one way to achieve the same outcome
- Theoretical vs. practical

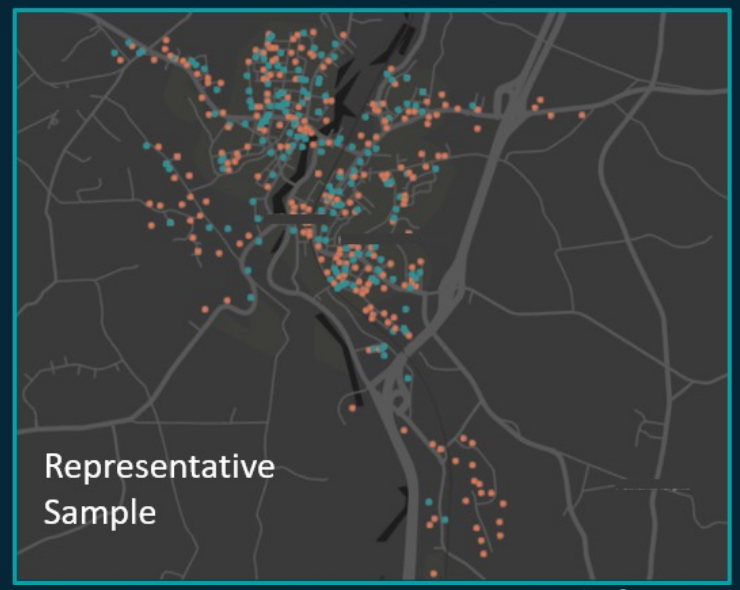
AI is a complex and evolving field

Theoretical vs. practical

Example: Optimizing Inspection Locations for LSL Predictive Model

- Unknowns: 2,500
- Representative Sample Size Needed: 481 (for 95% +/- 4% confidence)
- Existing Inspections Available: 367 (not statistically representative)
  - 301 (85%) used in representative sample
- New Inspections Recommended: 180

Cost Savings: $150,000
Time Savings: 2 months



PANEL DISCUSSIONS

THANK YOU!
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