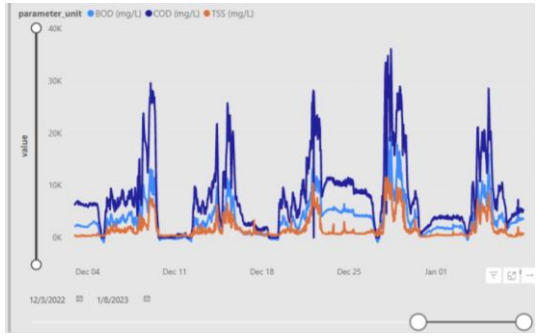
January 23, 2023

Implementing a Smart Industrial Pretreatment Monitoring Network



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Agenda

1. Enhancing industrial pretreatment programs
2. Smart sensors and industrial pretreatment
3. Successful adoption stories and strategies

Enhancing Industrial Pretreatment Programs

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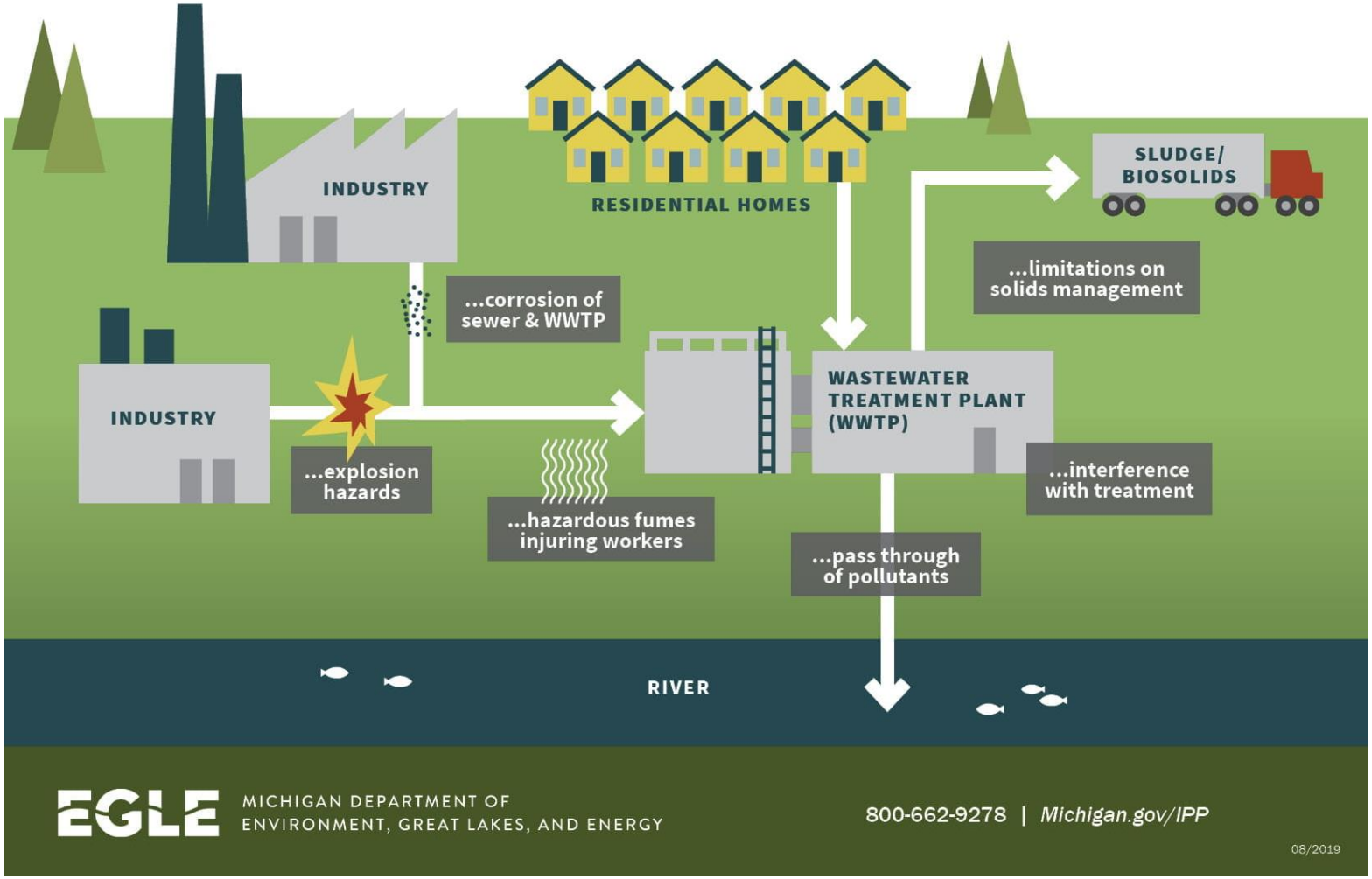
Industrial Pretreatment Programs Protect Against…



Industrial Pretreatment Status Quo

- Control Authority performs handful of sampling events per year
- Industrial users self-perform more frequent sampling
- Sampling used for compliance
  - Grab samples
  - 24-hour composite samples
  - Discrete samples (12 or 24 bottles)

Industrial Pretreatment - Missed Opportunities

Noncompliant discharge

- Occurs undetected
- Results in lost revenue
- Damages infrastructure

Lab testing

- Too infrequent to infer trends and short-term spikes
- Too slow to be actionable for operations
- Requires interpretation and context for operational decision making

Limited staff responsible for large geographic areas

- Limits enforcement
- Staff burnout

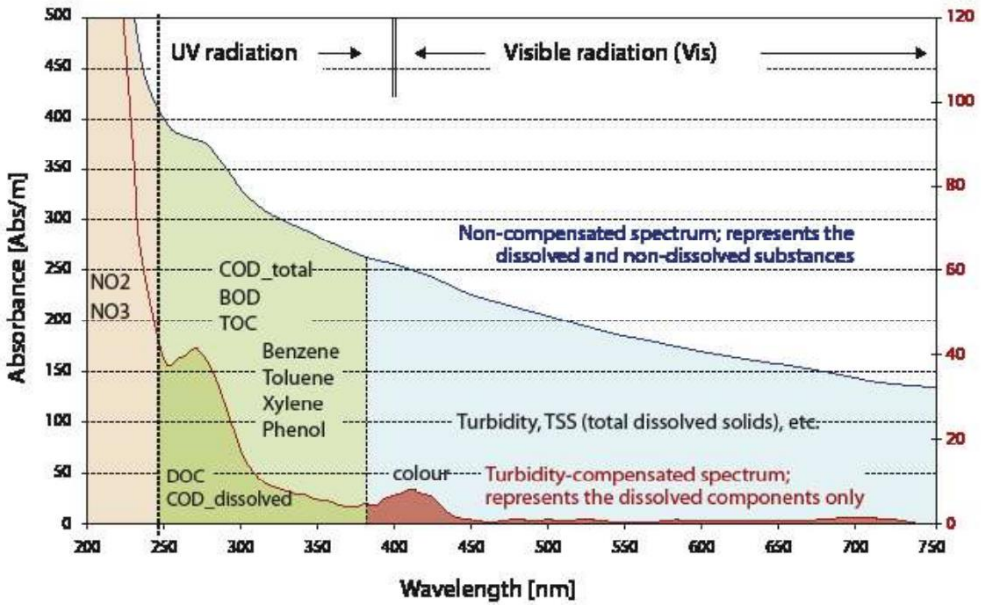
Enhancing Source Control

Reduce the pollutant concentrations to the POTW. Enable optimization of the WWTP by characterizing incoming flows and beneficial reuse of valuable byproducts.

- Public outreach program
- Monitoring industries more frequently for more parameters
- Monitoring for pollutants and emerging contaminants
- Assessing the fate of pollutants in the treatment system
- Pollutant inventory/tracking
- **Installing smart sensor network at industries**
- **Installing smart sensor network in the collection system and WWTP**

Smart Sensors

- Smart sensor: sensor with wireless connection to cloud or on-premises data storage & visualization
- Recommend using a “sensor agnostic” wireless endpoint.
  - If cloud-based, ensure it has well supported external API
- Calculate loading using flow rate and water quality concentration sensors
  - pH and temperature are common
  - In situ spectrometer sensors provide surrogate readings for BOD, COD, NO3-N, etc.



Smart Sensors at Industrial Users

Identify and act on noncompliant discharge as it occurs

- Verify compliance
- Recover revenue
- Protect infrastructure

Optimize WWTP processes

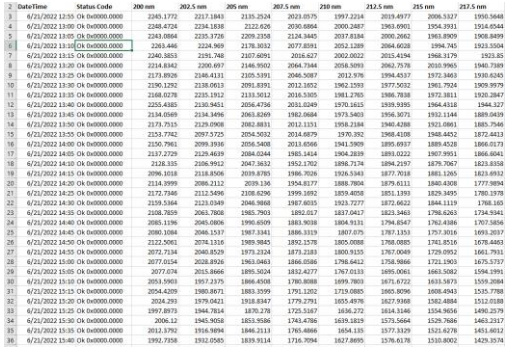
- Early warnings of damaging inflows
- Chemical feed optimization

Staff empowerment

- Remotely accessible information, in actionable format
- Respond proactively vs reactively

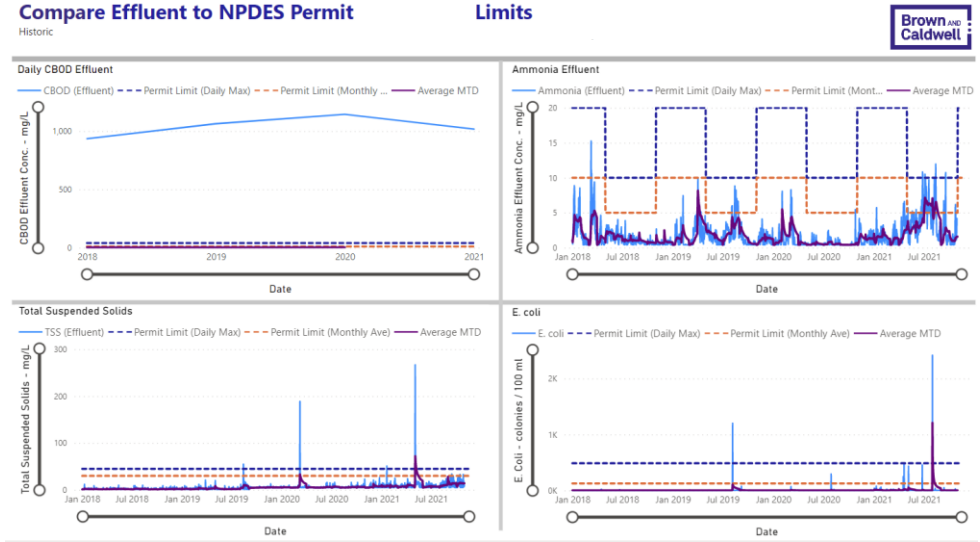
Integrating Smart Sensors into Industrial Pretreatment Programs

Existing IPT workflows



Limits, lab results, scheduling, billing, etc.

Integrated Digital Solution



Integrate, analyze, and visualize

Sensors at industries

Measure flow and water quality

+

Wireless Endpoints

Record and transmit data

Successful Adoption Stories and Strategies

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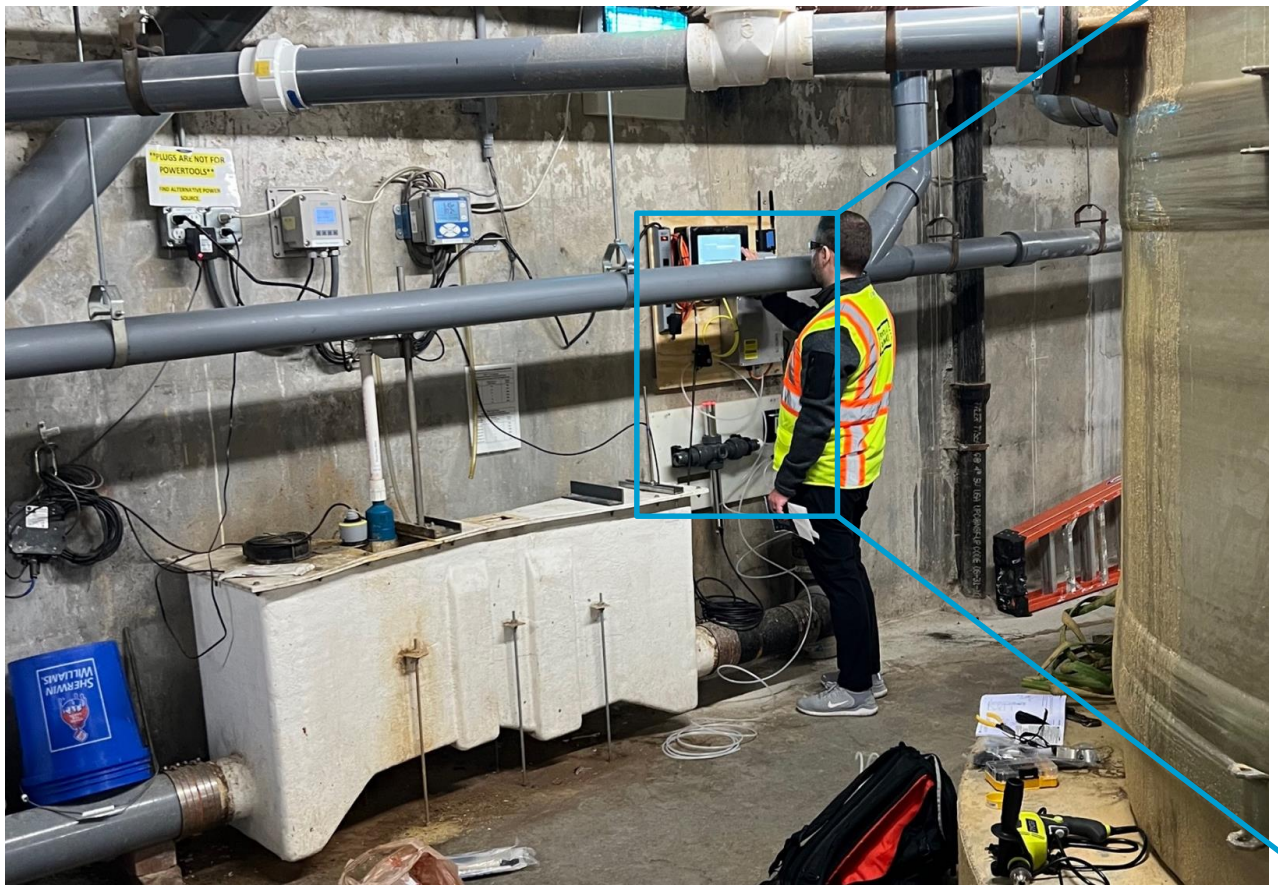
Greater Cincinnati MSD (MSDGC)

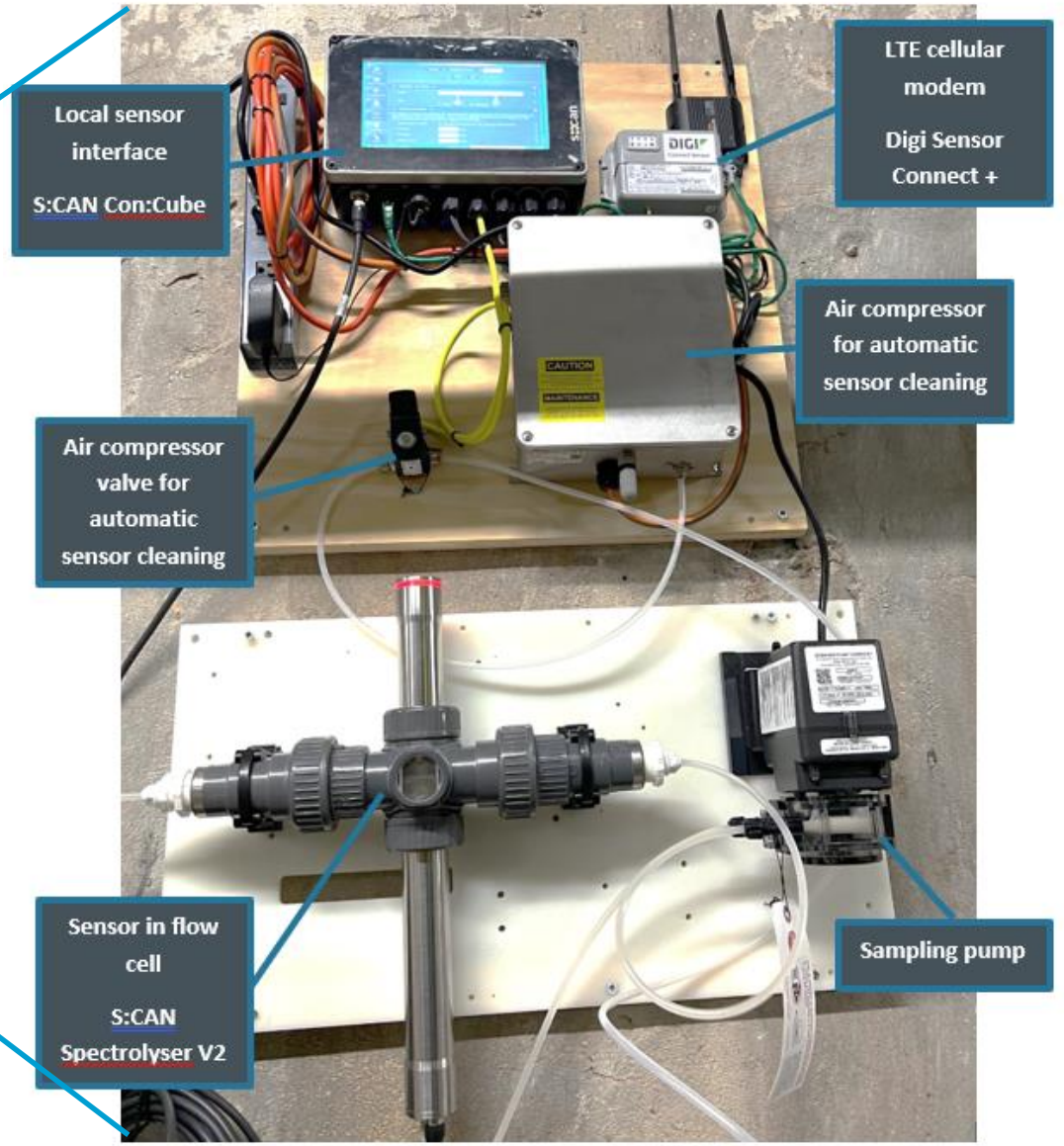
- 180+ industrial users
- Compliance sampling 2-4x per year
- MSDGC already monitors industrial user discharge flow rate
- Long-term objectives
  - Monitor industrial user discharge water quality. Calculate real-time loading
  - Use loading data for surcharge billing
  - Work more closely with industries to collaboratively clean up discharge
  - Investigate potential future BOD limits
  - Reduce wastewater sample collection effort

Cincinnati MSD - Brewery Smart Sensor Installation

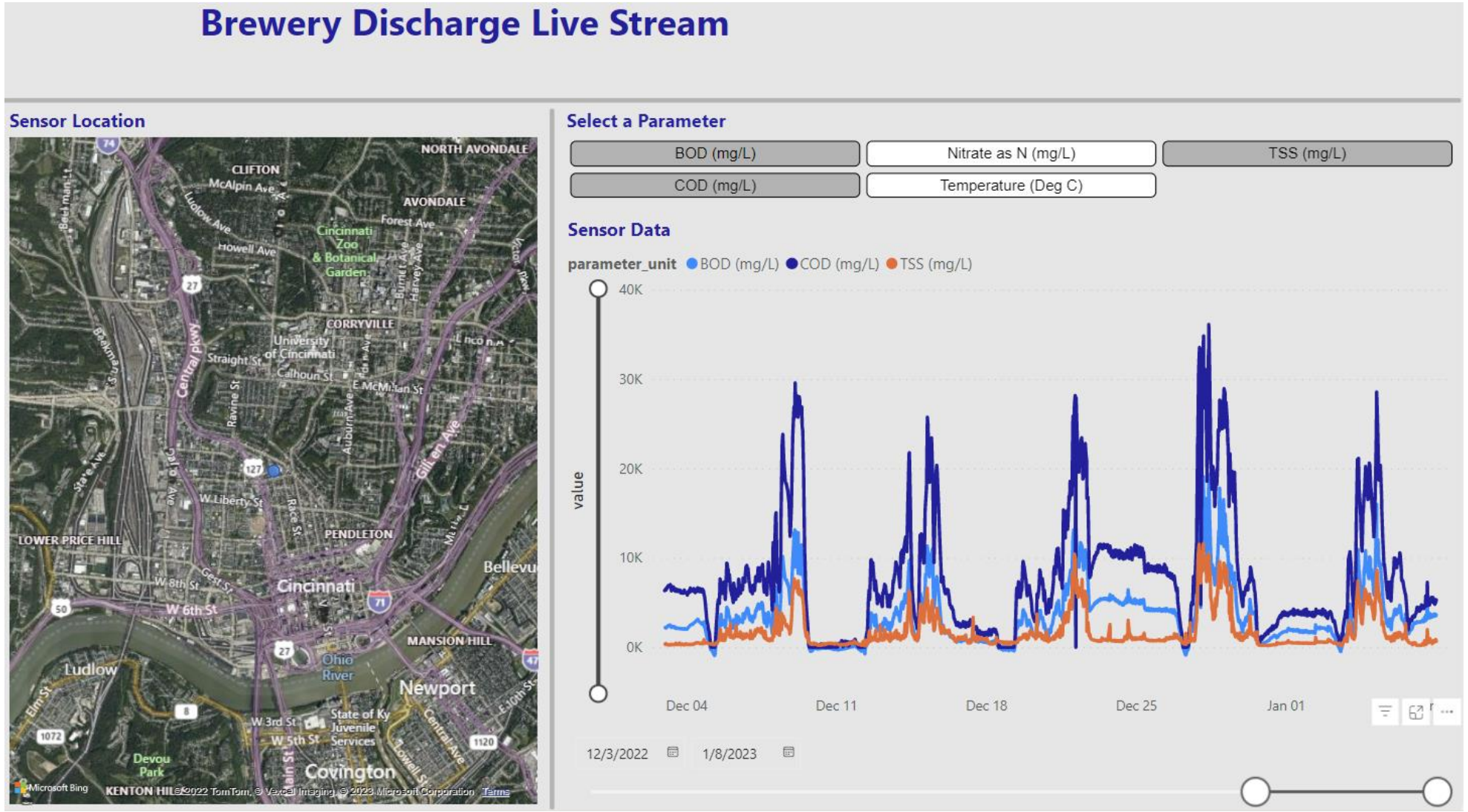
- In situ spectrometer sensor
  - Real-time BOD, COD, TSS, and NO3-N
  - Online dashboard to view current and historical data
- Goals
  - Vet sensor performance and O&M at high-strength organics industrial discharger
  - Begin integrating data into staff workflows

Cincinnati MSD - Brewery Smart Sensor Installation



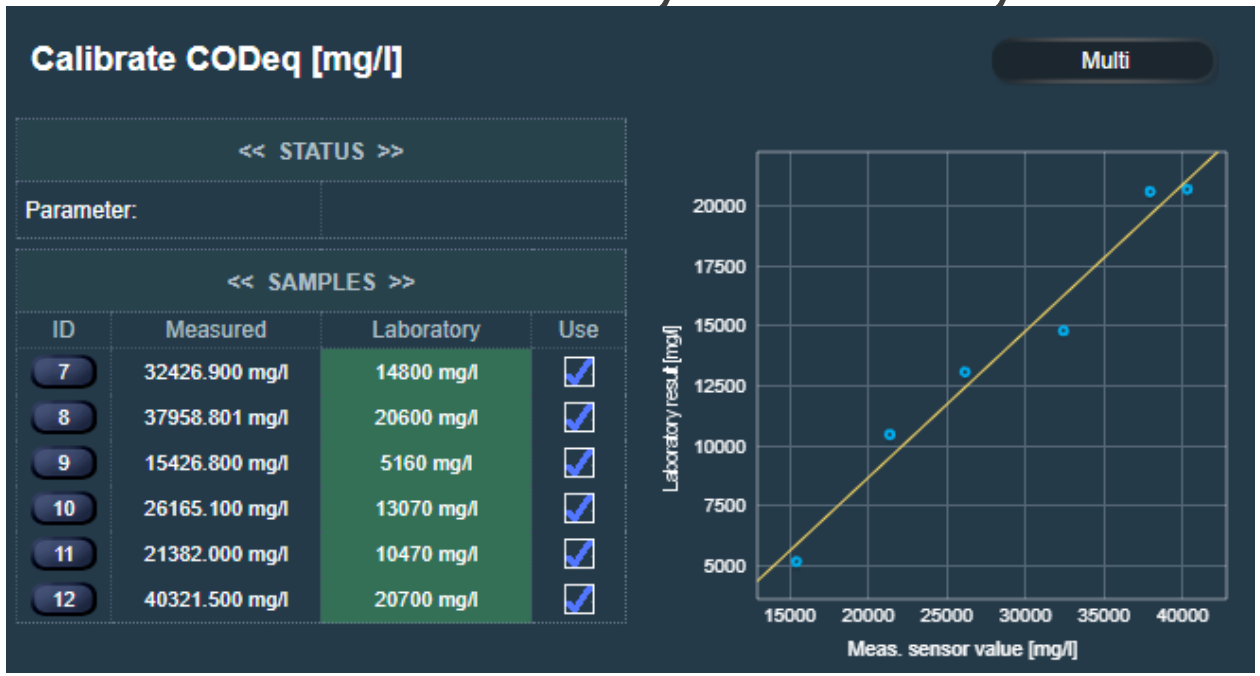


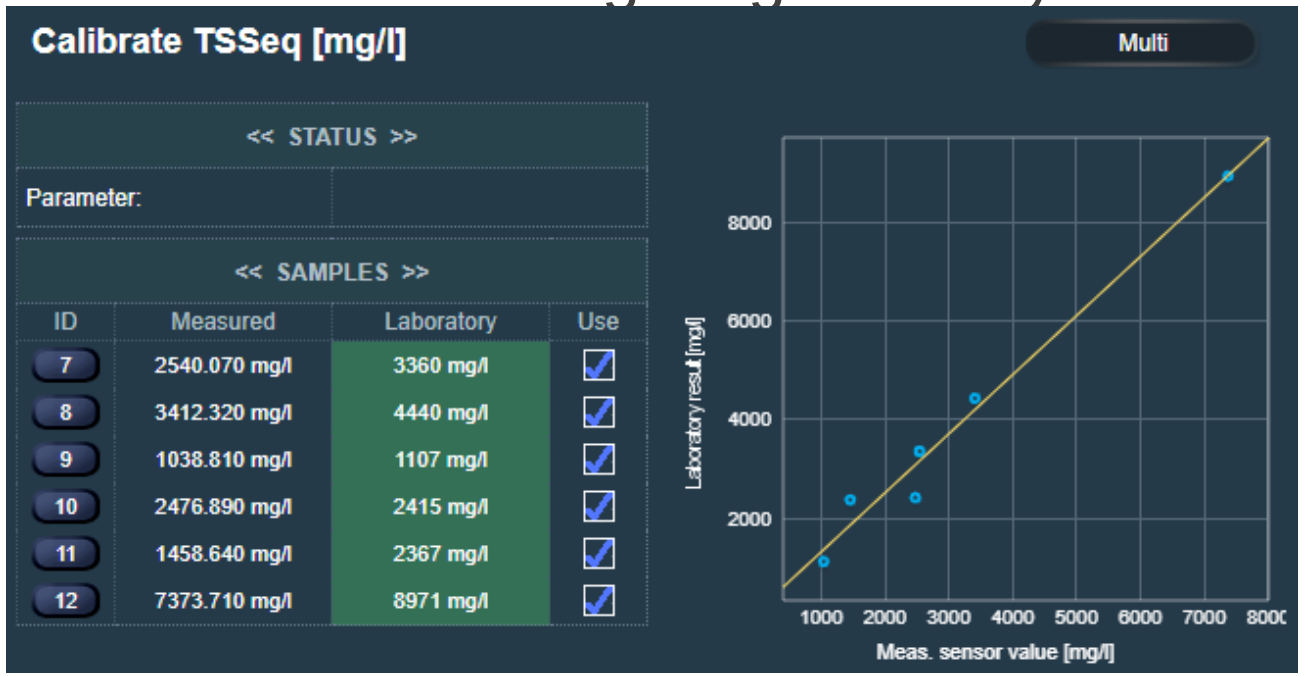
Cincinnati MSD – Industrial User Dashboard



Cincinnati MSD – Spectrometer Sensor Calibration

- 6 samples sent to lab for analysis, covering expected range of measurements
  - Used sensor data to determine calibration sampling events
- Recalibration only necessary if characteristics of discharge significantly





Cincinnati MSD – Spectrometer Sensor O&M

Inside the discharge flume

1 month since last cleaning

Sensor measurement window, 1 month since last cleaning

Cincinnati MSD - Next Steps

- Expand discharge quality monitoring to more industries
- Integrate with existing industrial user discharge flow rate monitoring
  - Automatically calculate real-time loading
    - Bill industries more accurately
  - Provide industries with resources to improve discharge water quality. Collaborate, track, and validate outcomes

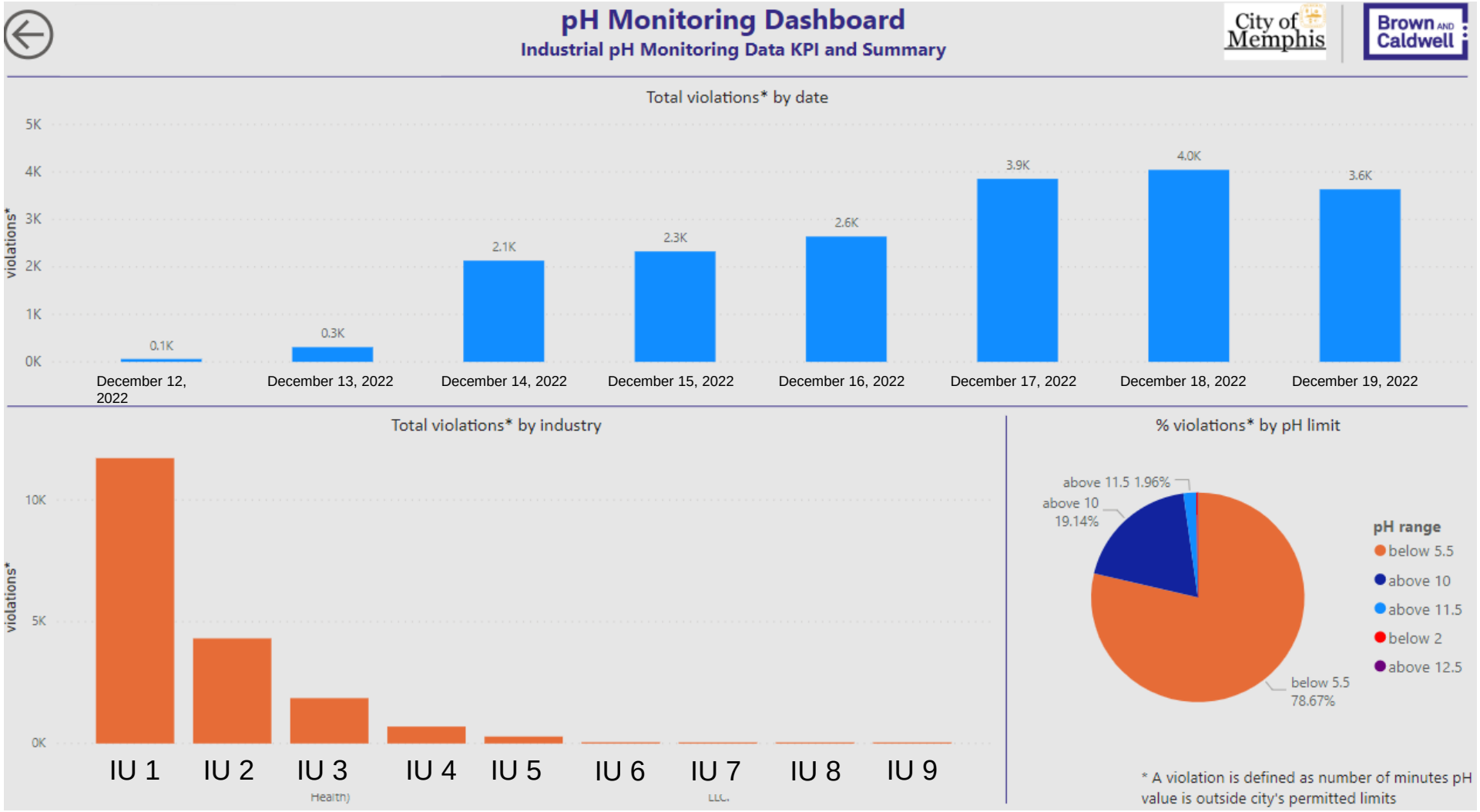
City of Memphis

- 100+ permitted industrial users
- Industrial users contribute 50-90% of BOD and TSS loading
- Challenges
  - Noncompliant industrial discharge is damaging pipes and disrupting WWTP treatment
  - Noncompliant discharge is going undetected with existing sampling regiment
  - 4-6 staff responsible for monitoring hundreds of industrial users

City of Memphis - Digital Solutions to Physical Challenges

- Integrated with Memphis's existing industrial pretreatment Linko software
- Real-time pH monitoring installed at 17+ industries
  - Real-time pH compliance reporting
- Real-time spectrometer sensors measure BOD, COD, and TSS at largest industrial users and WWTP influent/effluent
  - Peracetic acid chem feed optimization

City of Memphis - pH Compliance Dashboard



City of Memphis - Outcomes

Reduced pH noncompliance by

79%

- Dashboard integrated into daily operations
- Increases collection system lifespan by reducing corrosive events
- Increased revenue from industrial dischargers
- WWTP gained 2-6 hour early notification of incoming corrosive flows

Planning for Successful Digital Solution Adoption

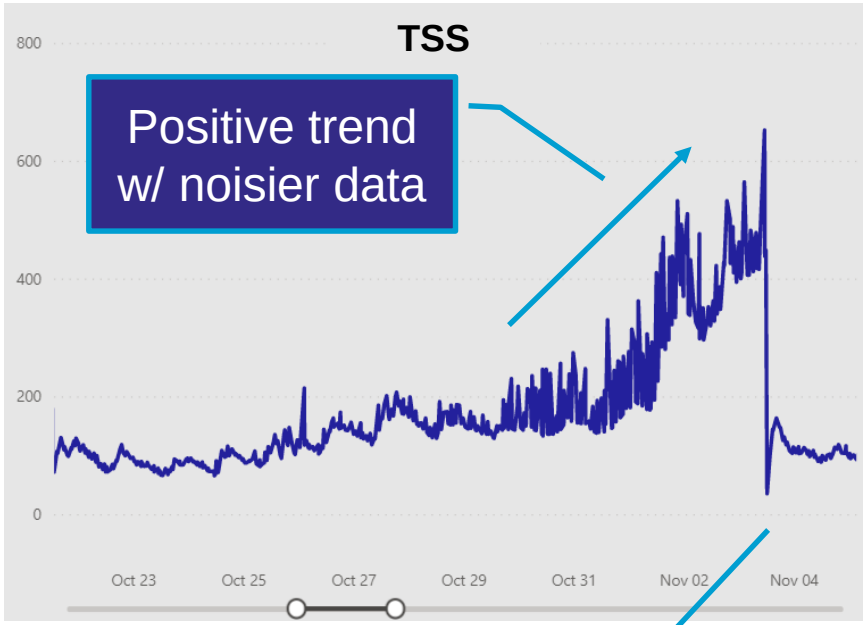
What is the problem the client is trying to solve for?	How advanced is the client's digital adoption to date?	How can we maximize the user's interaction with the dashboard?	What's the user experience with equipment O&M?
• What has the client done historically to address the issue?	• IT/OT cybersecurity • Existing monitoring platform? Ex. Trimble Telog, Ayyeka, Onset, ADS, etc.	• Existing workflows • Data integrations • KPI's • Notifications	• Self-sufficient • Hand holding • No experience

Agile User Stories:

- **"As a [type of user], I want [an action] so that [a benefit/value]."**
- **Ex: "As an industrial pretreatment compliance manager, I want to view lab results and sensor data in the same place to validate the information I make enforcement decisions on."**

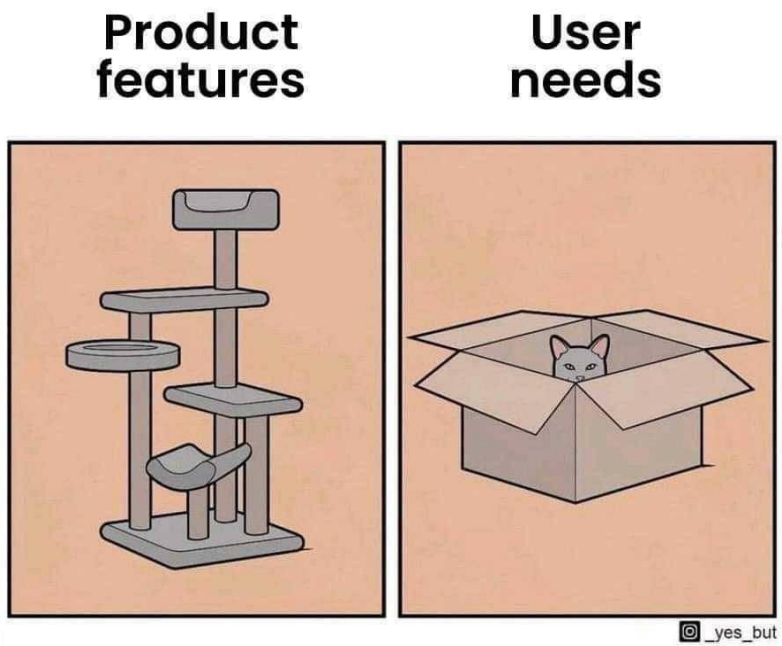
Sensor and Equipment O&M – A Common Adoption Stumbling Point

- Cultural O&M shift
  - From reactively responding to faults to proactively ensuring data is trustworthy
- Dirty sensors = garbage data
  - Make equipment accessible, safe, and easy to maintain
  - Specify self-cleaning sensors
  - Ensure submerged sensors always stay wetted
  - Leverage data science to make life easier
    - TSS trends can indicate cleaning needs



Digital Solution Adoption is Make or Break

- Ongoing service rather than a one-time static deliverable
  - Training, documentation, and (at least) initial support are essential
  - Ensure equipment O&M is considered and incorporated while planning/designing
- Digital solutions build or



Thank you.

Questions?

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