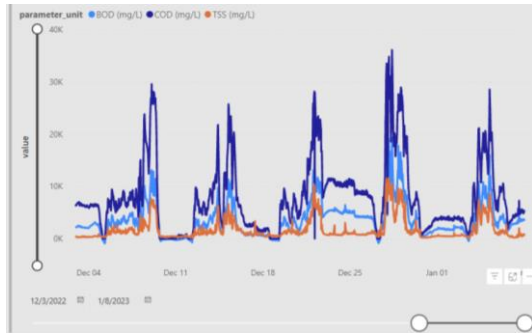


January 23, 2023

# Implementing a Smart Industrial Pretreatment Monitoring Network



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978-983-2040

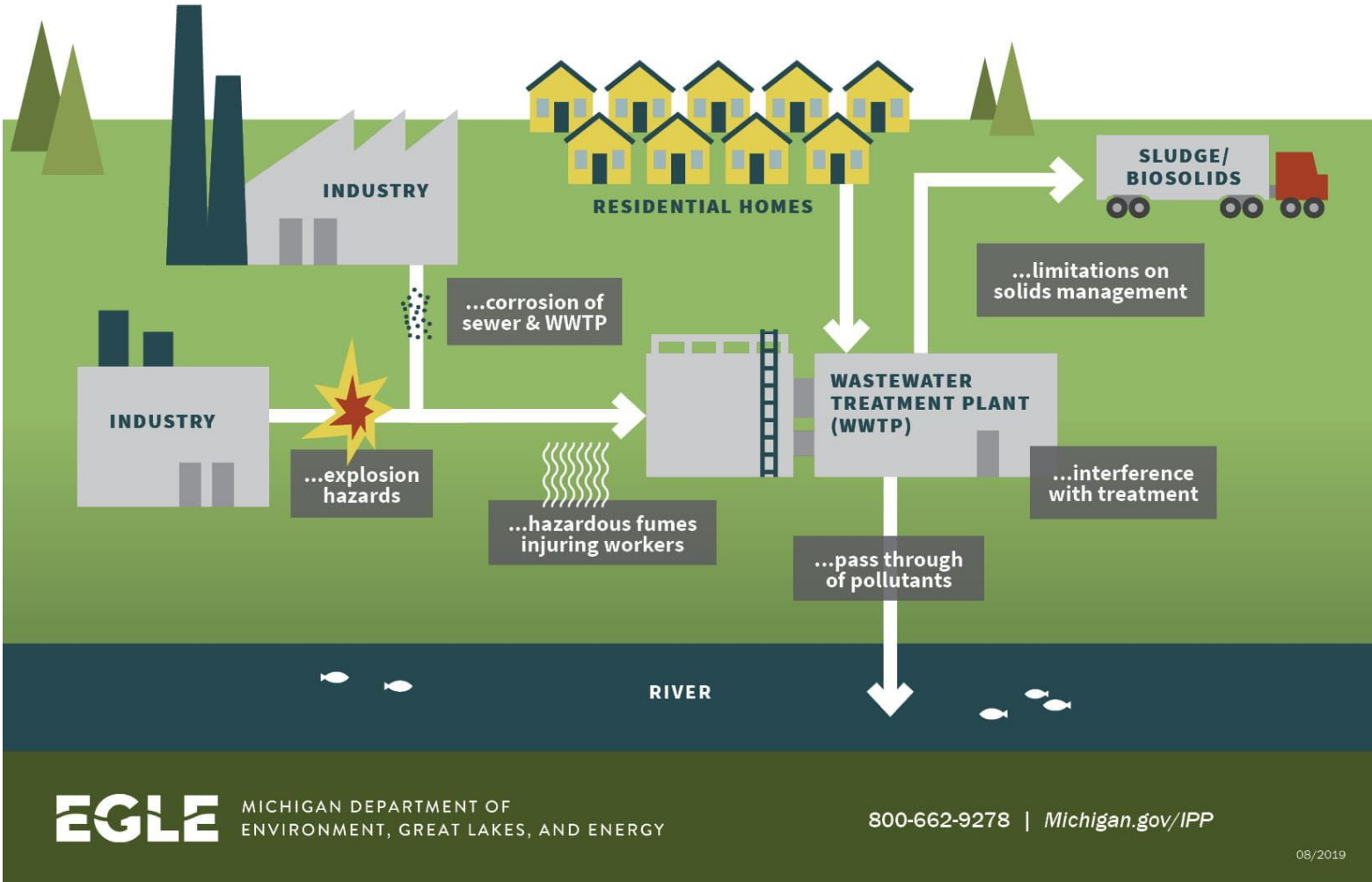
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# Agenda

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

# Enhancing Industrial Pretreatment Programs

# 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

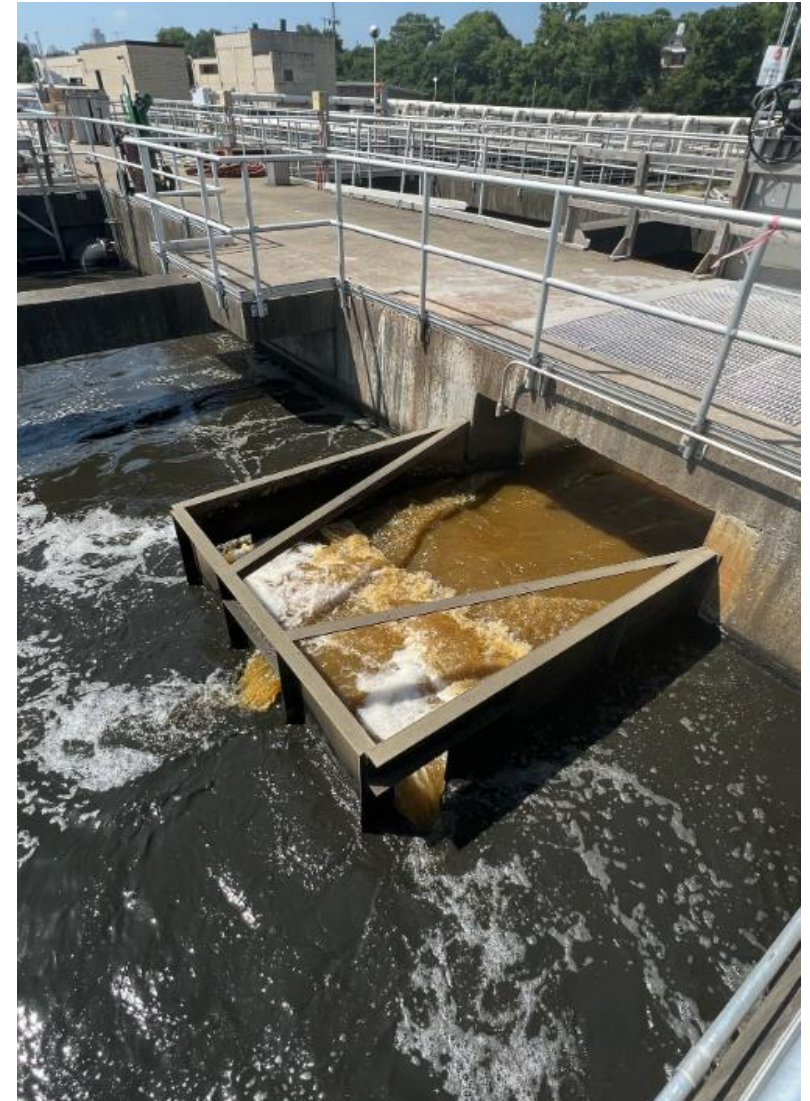
- Occurs undetected
- Results in lost revenue
- Damages infrastructure

## 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

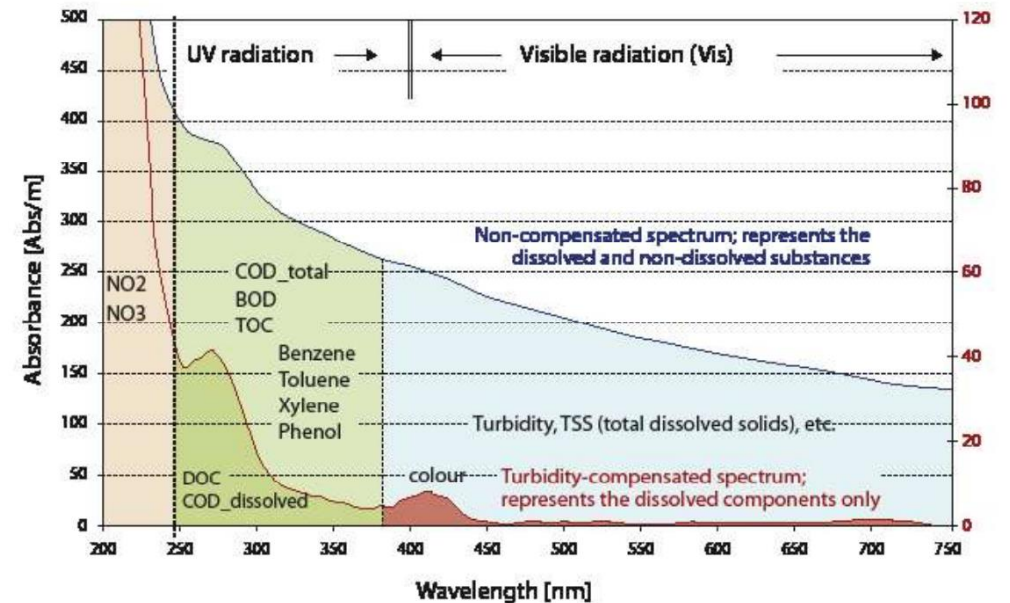


Reduce the pollutant concentrations to the POTW. Enable optimization of the WWTP by characterizing incoming flows and beneficial reuse of valuable byproducts.

- 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

Date/Time	Status Code	200 mm	202.5 mm	205 mm	207.5 mm	210 mm	212.5 mm	215 mm	217.5 mm
6/21/2022 12:35	OK	2481.1712	2117.1810	2115.2534	2023.8579	1997.2254	2028.4977	2098.5327	1956.5648
6/21/2022 13:00	OK	2248.4724	2234.1838	2122.6256	2090.8984	2000.2487	1963.0901	1954.3931	1914.0544
6/21/2022 13:05	OK	2241.0864	2225.3736	2209.2368	2124.3463	2017.8186	2000.2462	1983.9899	1908.8899
6/21/2022 13:10	OK	2263.446	2224.969	2178.3032	2077.8911	2052.1289	2064.6038	1994.745	1933.0504
6/21/2022 13:15	OK	2240.3853	2191.748	2107.6091	2026.627	2002.0022	2015.4194	1968.3179	1923.85
6/21/2022 13:20	OK	2214.8462	2206.497	2148.9052	2064.7464	2054.9091	2062.9738	2010.9665	1946.7189
6/21/2022 13:25	OK	2173.8526	2148.4111	2105.5391	2064.5087	2012.976	1994.4337	1972.3483	1930.6245
6/21/2022 13:30	OK	2158.1292	2118.0663	2095.8591	2012.1052	2042.2299	2077.5022	1981.7024	1909.8979
6/21/2022 13:35	OK	2188.0278	2216.1912	2115.5012	2016.1005	1981.1765	1986.7838	1972.3811	1920.2847
6/21/2022 13:40	OK	2255.4885	2180.9451	2056.4736	2031.0249	1970.1615	1939.9395	1964.4318	1944.327
6/21/2022 13:45	OK	2114.0469	2144.3496	2063.6289	1982.9688	1973.9403	1964.3073	1932.1144	1889.0499
6/21/2022 13:50	OK	2171.7515	2129.0968	2082.8811	2012.1131	1958.2184	1940.4268	1931.0861	1885.7546
6/21/2022 13:55	OK	2153.7942	2097.5725	2054.5032	2014.8879	1970.187	1968.4309	1944.4852	1872.4613
6/21/2022 14:00	OK	2105.7961	2079.1916	2056.8468	2011.8566	1941.2909	1895.8937	1889.4528	1866.6174
6/21/2022 14:05	OK	2117.2729	2129.4619	2084.0244	1983.1424	1904.2839	1893.0222	1867.9951	1866.0041
6/21/2022 14:10	OK	2138.355	2106.9933	2047.3833	1951.7762	1894.7174	1894.2197	1878.7667	1823.8558
6/21/2022 14:15	OK	2096.1038	2118.8506	2039.8783	1986.7628	1928.1543	1877.7018	1881.1265	1823.8932
6/21/2022 14:20	OK	2114.9999	2089.2122	2079.126	1954.8177	1886.7804	1879.6111	1840.4208	1777.9894
6/21/2022 14:25	OK	2172.7349	2112.5496	2108.6206	1999.1892	1893.4058	1851.1391	1828.1895	1786.1978
6/21/2022 14:30	OK	2118.5364	2121.0349	2046.9888	1987.8035	1923.7277	1872.6822	1844.1119	1788.1185
6/21/2022 14:35	OK	2107.7659	2082.7908	1982.7963	1882.8137	1837.0417	1823.5465	1796.5263	1734.5941
6/21/2022 14:40	OK	2085.1196	2045.0806	1990.6509	1883.9038	1804.9131	1794.8547	1762.4188	1707.5804
6/21/2022 14:45	OK	2080.1084	2068.1517	1987.1341	1886.1019	1807.079	1783.1151	1757.1018	1695.2037
6/21/2022 14:50	OK	2122.9463	2074.1316	1998.9845	1892.1278	1800.0086	1788.0085	1742.8156	1679.4603
6/21/2022 14:55	OK	2072.7184	2040.8239	1971.2124	1873.2183	1800.9135	1767.0048	1729.0932	1661.7911
6/21/2022 15:00	OK	2077.6234	2028.8936	1961.0463	1848.0086	1786.8412	1754.9086	1721.1003	1675.3737
6/21/2022 15:05	OK	2077.618	2016.8666	1895.9284	1832.4277	1767.6113	1805.0061	1663.0062	1594.1991
6/21/2022 15:10	OK	2051.9903	1917.2375	1866.4508	1790.8088	1699.7803	1671.6722	1633.5873	1559.2084
6/21/2022 15:15	OK	2054.4209	1980.8071	1883.3599	1792.1202	1723.0005	1690.3009	1668.0443	1555.7788
6/21/2022 15:20	OK	2034.293	1979.0421	1928.8347	1779.2791	1655.4979	1627.9395	1582.4884	1512.0188
6/21/2022 15:25	OK	1997.8973	1944.7618	1870.276	1725.1087	1646.272	1614.1146	1584.9656	1496.2979
6/21/2022 15:30	OK	2006.12	1945.9058	1825.8586	1745.4786	1625.1819	1573.5666	1526.7886	1461.2117
6/21/2022 15:35	OK	2013.3792	1916.9894	1848.2113	1761.4866	1654.131	1573.3329	1521.6278	1451.4012
6/21/2022 15:40	OK	1992.7358	1932.0545	1835.9114	1716.7094	1627.8899	1576.6178	1510.8002	1429.0374

Limits, lab results, scheduling, billing, etc.

## Sensors at industries



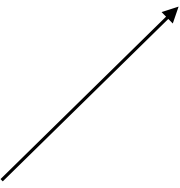
Measure flow and water quality

## Wireless Endpoints

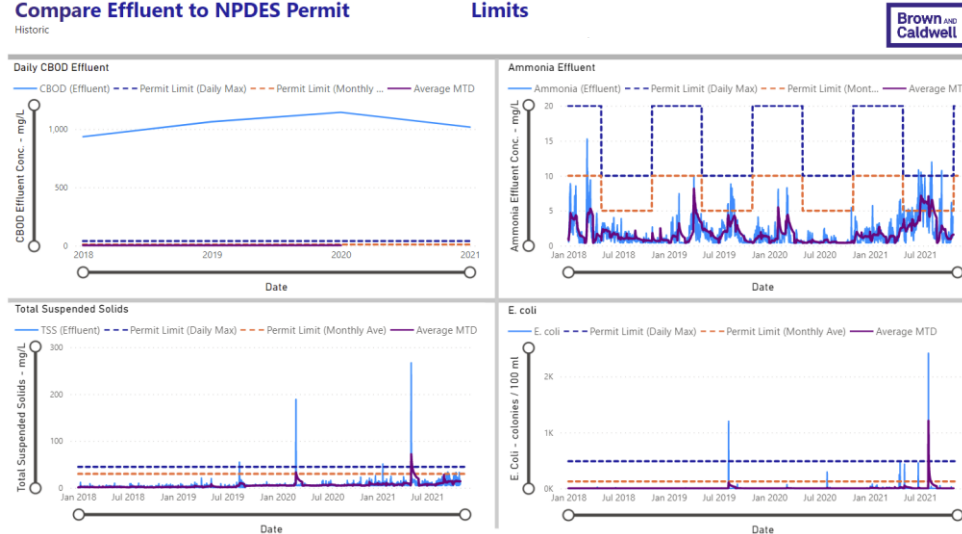


Record and transmit data

+



## Integrated Digital Solution



Integrate, analyze, and visualize



# Successful Adoption Stories and Strategies

# 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 NO<sub>3</sub>-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



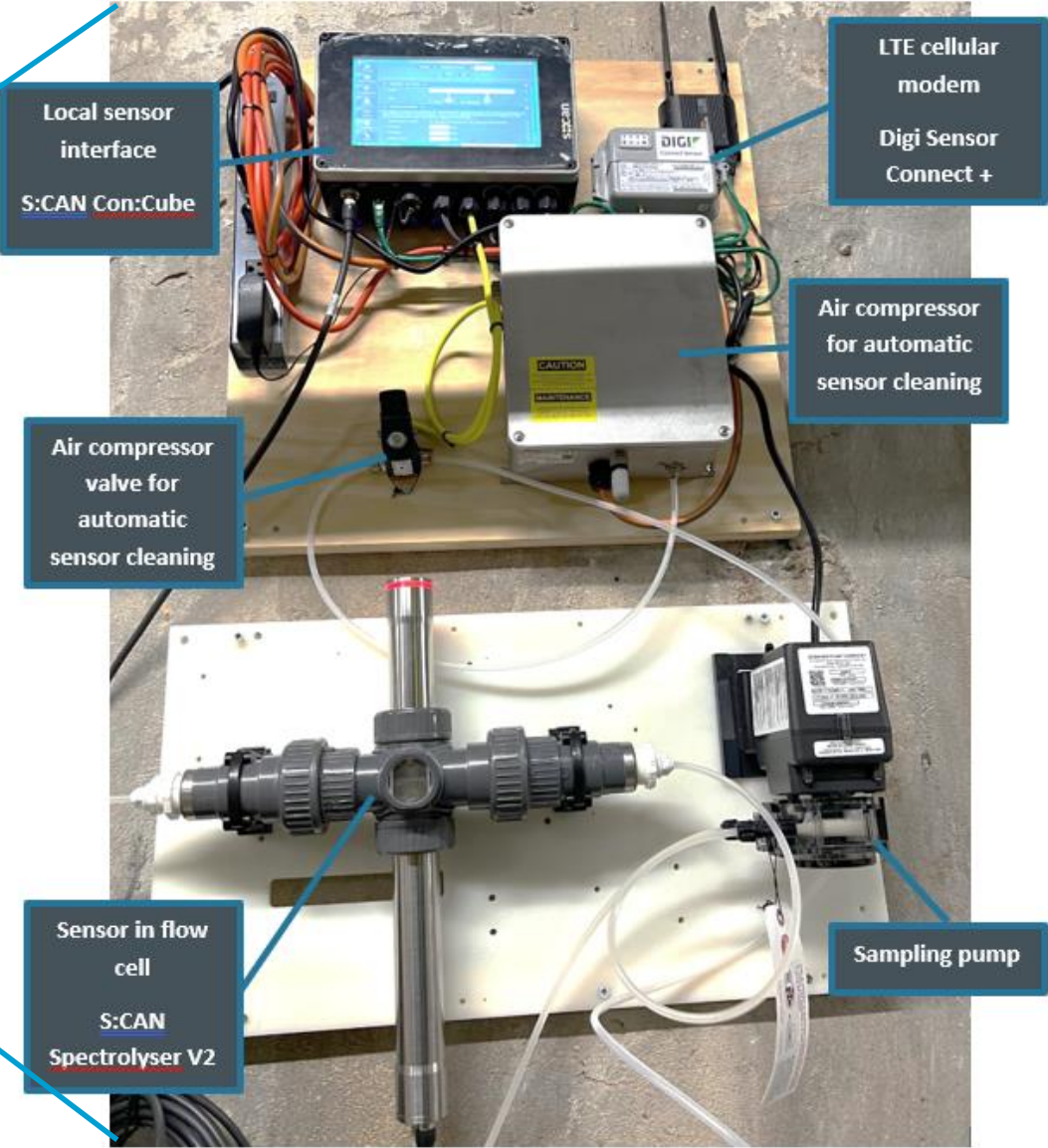
Existing flow sensor

Spectrometer sensor installation

Existing sampling flume

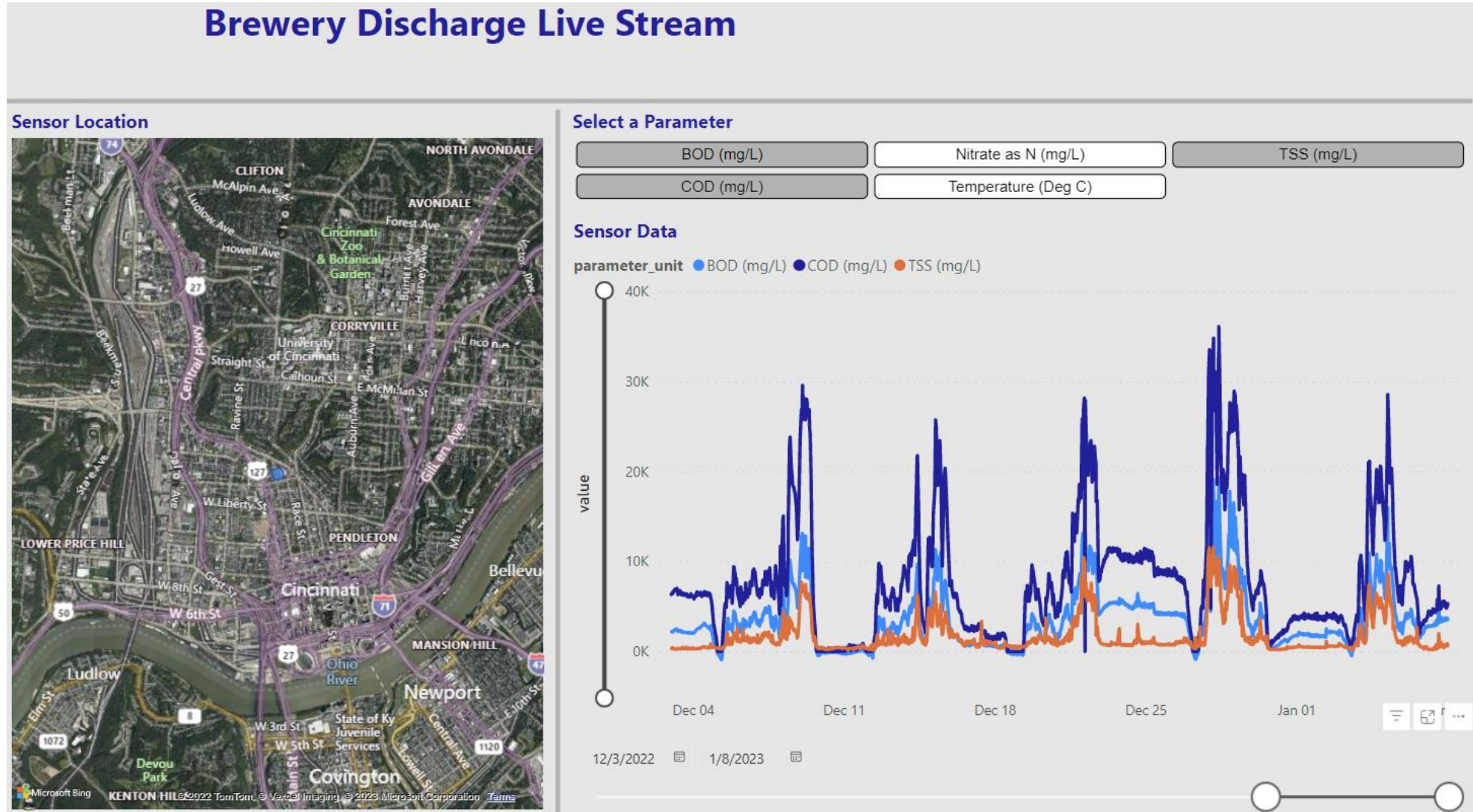


# Cincinnati MSD - Brewery Smart Sensor Installation



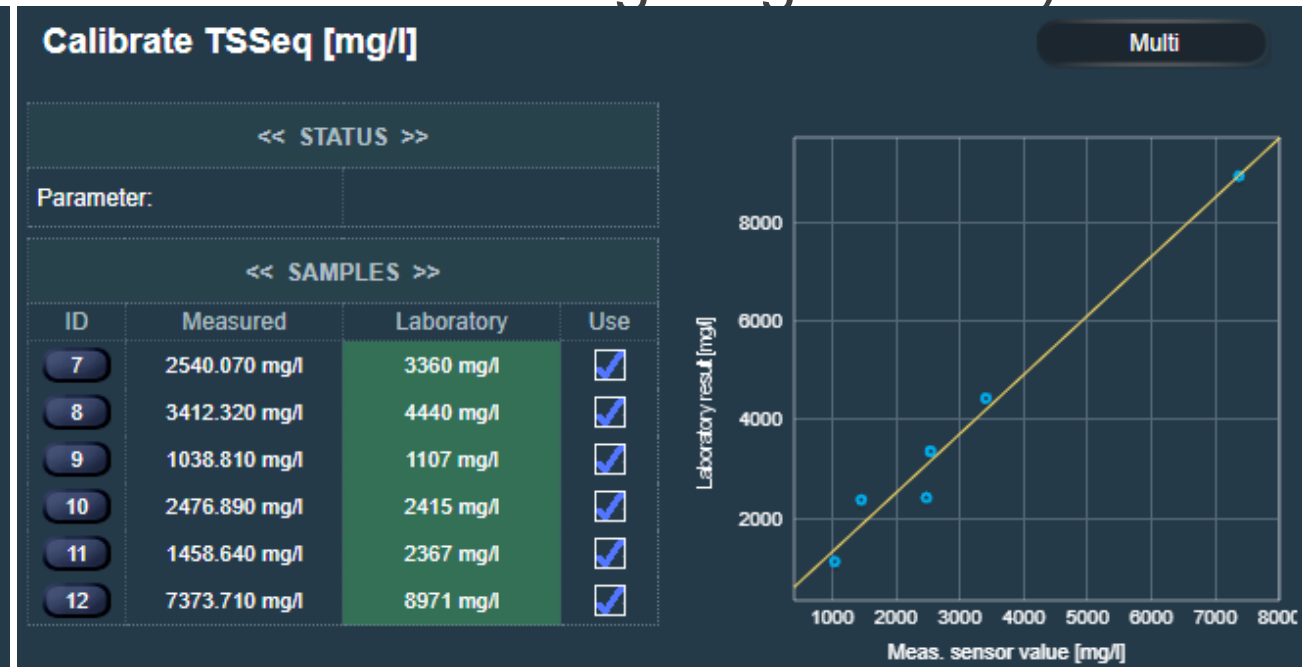
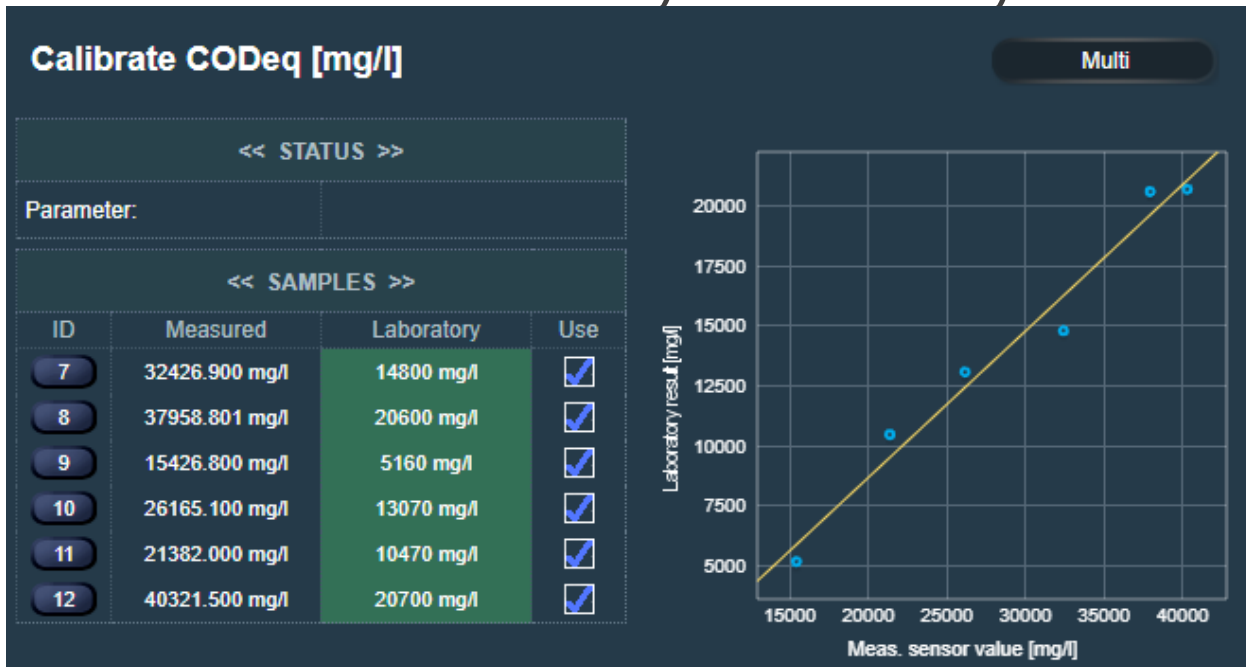


# Cincinnati MSD – Industrial User Dashboard



# 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**



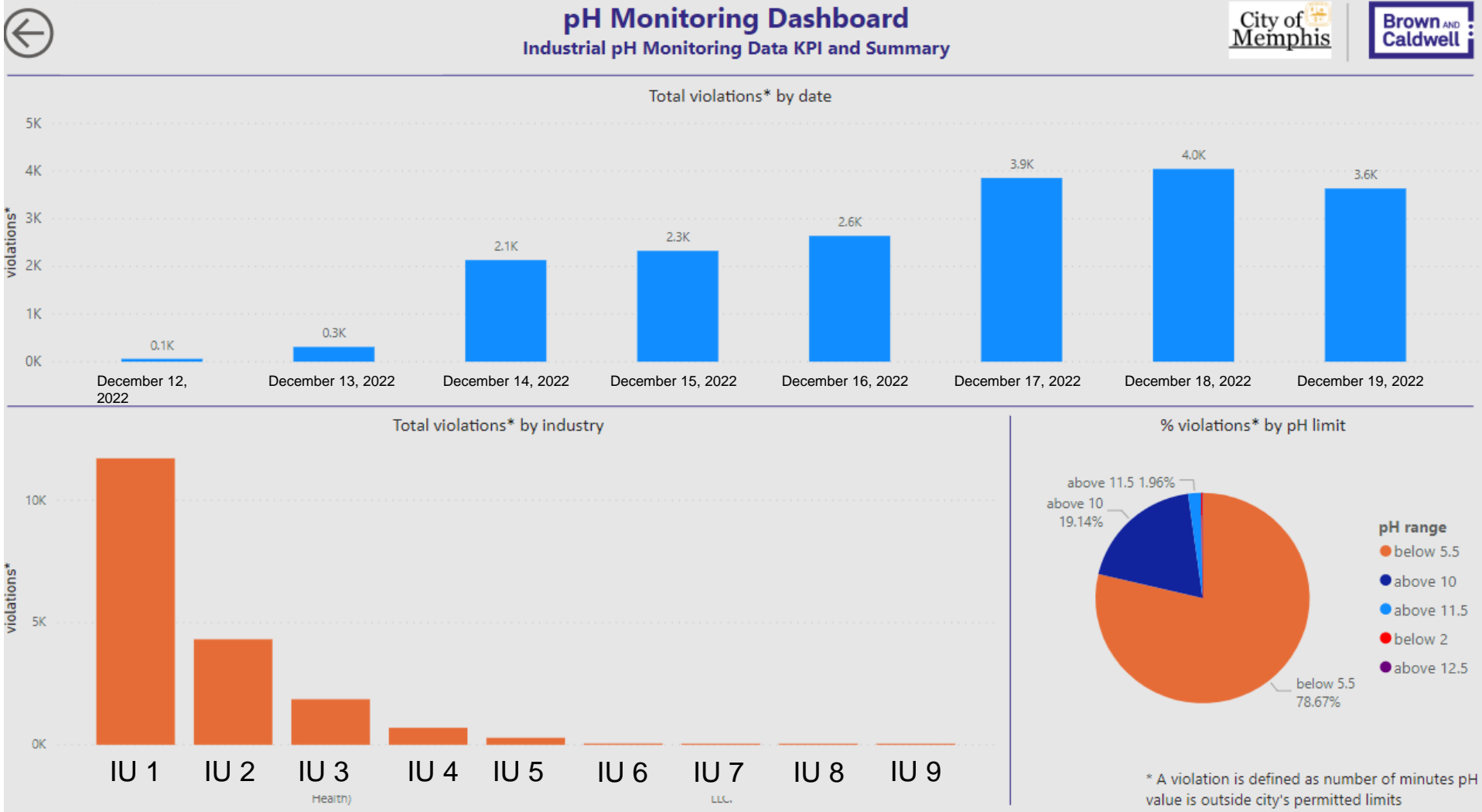
# City of Memphis - Digital Solutions to Physical Challenges



- 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?

- What has the client done historically to address the issue?

How advanced is the client's digital adoption to date?

- IT/OT cybersecurity
- Existing monitoring platform? Ex. Trimble Telog, Ayyeka, Onset, ADS, etc.

How can we maximize the user's interaction with the dashboard?

- Existing workflows
- Data integrations
- KPI's
- Notifications

What's the user experience with equipment O&M?

- Self-sufficient
- Hand holding
- No experience

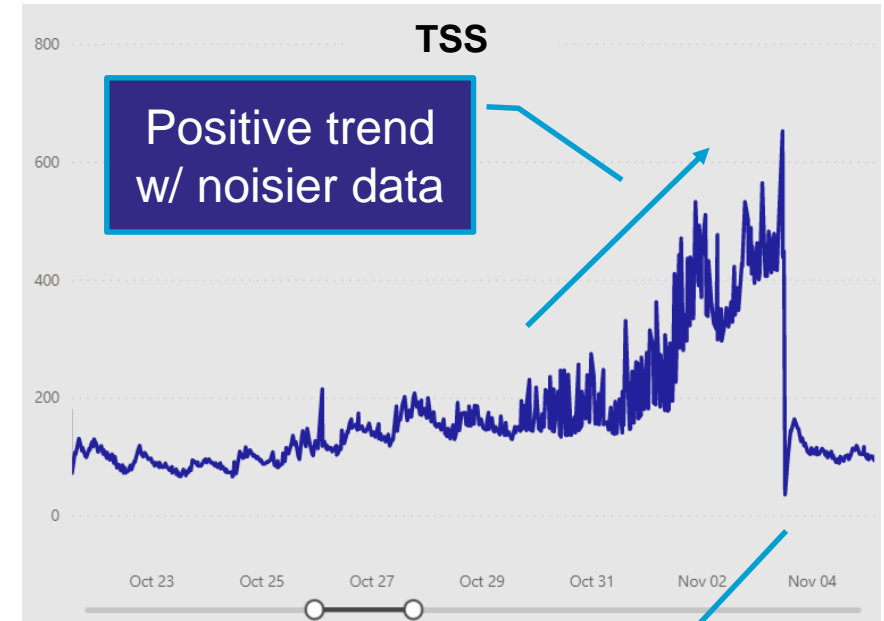
## Agile User Stories:

- **“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

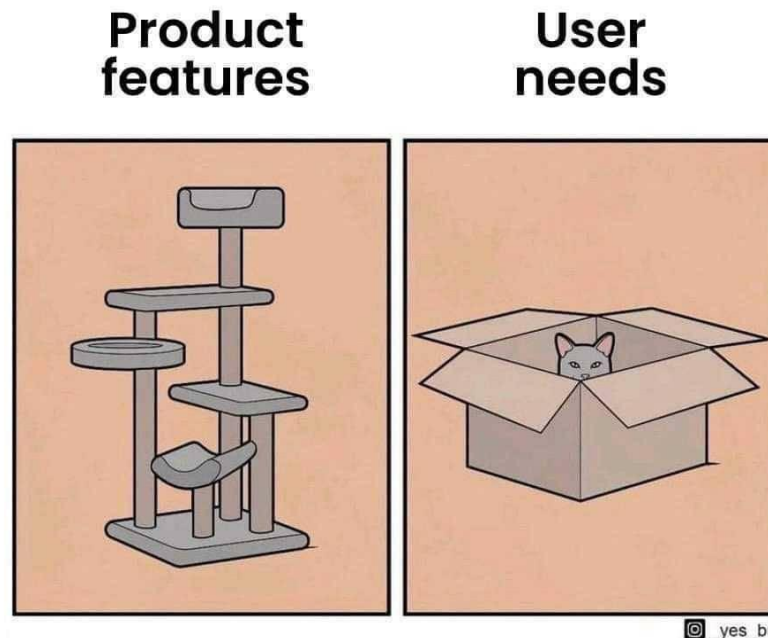


Oil coated sensor



# 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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**Brown** AND  
**Caldwell**