PRESENTED BY:
Vicki McCorkle, PE
T&M Associates

USING DATA TO OPTIMIZE WATER AND WASTEWATER PROCESSES
Outline

1. PROCESS DATA OVERVIEW
2. OTHER SOURCES OF DATA
3. CASE STUDY
4. APPLICATIONS FOR WASTEWATER
# Automation Terminology

<table>
<thead>
<tr>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLC</td>
</tr>
<tr>
<td>HMI</td>
</tr>
<tr>
<td>SCADA</td>
</tr>
</tbody>
</table>
Instruments  Generate Data

Flow Meters  – Pressure Transmitters  – Level Indicators  – Various Switches  – Various Analyzers  – VFDs
PLC Processes Data

Programmable Logic Controller – Input / Output Modules
HMI Displays
Data

Human-Machine Interface
### SCADA Stores Data

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | AA | AB | AC | AD | AE | AF | AG | AH | AI | AJ | AK | AL |
| 2 | 1 | 1/17/18 | 1:25 | 7.6 | 7.6 | 7.5 | 84 | 3.8 | 0 | 0 | 0 | 7.6 | 7.9 | 7.5 | 30.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.5 | 57.5 | 5.9 | 6.8 | 0.0053 | 0.11 | 1.1 | 100.5 |
| 2 | 2 | 1/17/18 | 1:25 | 7.6 | 7.6 | 7.5 | 84 | 3.8 | 0 | 0 | 0 | 7.6 | 7.9 | 7.5 | 30.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.5 | 57.5 | 5.9 | 6.8 | 0.0053 | 0.11 | 1.1 | 100.5 |
| 2 | 3 | 1/17/18 | 1:25 | 7.6 | 7.6 | 7.5 | 84 | 3.8 | 0 | 0 | 0 | 7.6 | 7.9 | 7.5 | 30.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.5 | 57.5 | 5.9 | 6.8 | 0.0053 | 0.11 | 1.1 | 100.5 |
| 2 | 4 | 1/17/18 | 1:25 | 7.6 | 7.6 | 7.5 | 84 | 3.8 | 0 | 0 | 0 | 7.6 | 7.9 | 7.5 | 30.88 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.5 | 57.5 | 5.9 | 6.8 | 0.0053 | 0.11 | 1.1 | 100.5 |

**Supervisory Control and Data Acquisition**
Data from Digital Inputs
Data from Digital Inputs

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>PUMP 1</th>
<th>PUMP 2</th>
<th>PUMP 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/26/2019 8:00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:05</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:15</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:25</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:30</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:35</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:40</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:45</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:50</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 8:55</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:00</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:05</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:15</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:20</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:25</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:30</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:35</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:40</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>6/26/2019 9:45</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Pump Sequencing
Data from Analog Inputs

FLOW METER

Effluent Flow
### Data from Analog Inputs

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/26/2019</td>
<td>8:00</td>
<td>497.04016</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:05</td>
<td>495.7854421</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:10</td>
<td>504.7508741</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:15</td>
<td>501.1373634</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:20</td>
<td>497.2516848</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:25</td>
<td>497.9490425</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:30</td>
<td>498.8701234</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:35</td>
<td>503.7107209</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:40</td>
<td>499.9615703</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:45</td>
<td>504.6618195</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:50</td>
<td>495.3146383</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>8:55</td>
<td>495.013296</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:00</td>
<td>499.1261152</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:05</td>
<td>496.2736214</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:10</td>
<td>496.4791696</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:15</td>
<td>504.6519853</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:20</td>
<td>495.0069653</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:25</td>
<td>503.0830058</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:30</td>
<td>497.3821176</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:35</td>
<td>499.7582099</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:40</td>
<td>503.4255057</td>
</tr>
<tr>
<td>6/26/2019</td>
<td>9:45</td>
<td>500.5839032</td>
</tr>
</tbody>
</table>

![Effluent Flow Chart](chart.png)
How is Process Data Used?

- Monitoring
- Automatic Control
- Automatic Report Generation
- Historical Reference
- Planning
Water / Wastewater Process Data
Sources of Data

- Process
  - Equipment
  - Instruments

- Enterprise
  - Business aspects

- “Other”
  - Human
  - Environment
Enterprise Data

- **Inventory**
  - Chemicals stored on or off site

- **Purchasing**
  - Chemicals, filters, other consumables

- **Scheduling**
  - Personnel
  - Assets

- **Billing**
  - Fixed-based metering
  - Accounting software
Other Sources of Data

Personnel
– Setpoints
– Forms

Weather

Temporary Population Increases
– Holidays
– Football season
SMART OPERATIONS

“Other”

Inventory

Process

Scheduling
PREDICTIVE OPERATIONS

“Other”

Inventory

Process

Scheduling
Issue: Machine for Each Data Station

- PLANT
- PUMP STATION
- MAIN OFFICE
Solution: Single Data Network

- PLANT
- PUMP STATION
- MAIN OFFICE
CASE STUDY

- Midstream Oil Facilities along 200-mile pipeline
- Truck Unloading Process
  - Check-in
  - Unload
  - Print Receipt
- Integrated Systems
  - Site Process – Truck unloading station
  - Scheduling – Expected deliveries
  - Inventory – Volume of oil stored at each facility at any given time
Application to Wastewater

Trucked-in Waste

- Coordinate and schedule deliveries from different providers
- Fast, accurate automated billing
- Improved plant logistics
  - Tank capacities
  - Control of wastewater characteristics
Application to Wastewater

Local weather available via APIs

APIs are snippets of code that provide access to real-time data on the web.
Application to Wastewater

PREDICTIVE COLLECTION PLANNING

HISTORIC COLLECTION

LOCAL WEATHER

SHORT TERM POPULATION SWINGS
Application to Wastewater

Produced
- Water Process
  - Production MGD

Consumed
- Enterprise
  - Fixed Based Metered Water MGD

Dirty
- Wastewater Process
  - Effluent MGD
Application to Wastewater

Total Water Lifecycle

Produced Water

Consumed Water

Dirty Water
Application to Wastewater

Procurement

Chemical purchasing based on manual inventory or schedule

- Time spent performing inventory
- Purchasing department logistics
- Material handling costs
Application to Wastewater

- Active Tank Volume
- Chemical Spend Trends
- Inventory at Plant

- Budget
- Average Time to Delivery
- Historic Purchasing
- Supplier Pricing

PREDICTIVE PROCUREMENT
Countless Opportunities

Most problems and inefficiencies in the Water/Wastewater process can be reduced by integrating data.
DISCUSSION

Vicki McCorkle, PE
Senior Automation Engineer
T&M Associates
vmccorkle@tandmassociates.com  614.408.9218