PROVIDING VALUE IN REAL-TIME FOR WATER TREATMENT AND ACROSS THE ORGANIZATION
Colorado Springs Utilities – 4 Service Utility

**Electric**
- 217,273 Meters
- 4 Hydro Electric Plants
- 2 Gas Plants
- 2 Coal Plants
- Contracted Solar
- Generating Capacity 1164MW's

**Gas**
- 192,872 Meters
- 7 Gate Stations
- Net Volume Throughput 269.8 MCF's

**Water**
- 137,619 Meters
- 6 Water Plants
- Treatment Capacity 286 MGD’s

**Wastewater**
- 2 Treatment Facilities
- 1 Solids Handling Facility
- 19 Lift Stations
- Treatment Capacity 38 MGD’s
The Challenge

- New Water Treatment Infrastructure
- Antiquated Reporting System

But we did have:
- Physical Infrastructure in Place
- Technical Infrastructure in Place

Now the business needs help...what do you do?
Providing Value in Real-Time

- What did it take?

- Each Plant needed 20 reports for:
  - Conveyance
  - Compliance
  - Process
  - Management Analytics

  Based on their individual permits, treatment capacity, specific treatment processes and existing instrumentation

- Mobile Device Capability

- Adhoc Analytics & Excel Reporting Capabilities – what other CSU groups are doing

- Energy Monitoring and Management for WW
Hydraulic Model
Enterprise Information Infrastructure

The PI Collective

PI Data Warehouse Primary
PI Data Warehouse Secondary

PI Asset Framework
PI Asset Framework
PI Notifications
PI Abicus

PI WebServer
PI Coresight
PI Manual Logger
PI Webparts Integrator
PI To GIS Integrator

PI SDK & PI System Management Tools for Discovery, Failover, Failback and Load Distribution Services
Source PI Servers

- H2O PI Server
- Remotes Server
- Drake PI Server
- Drake EP PI Server
- Nixon PI Server
- Front Range PI Server
Data Flow from Water Treatment Plants – Mesa, UP & NG

PLC’s at each Plant

RSLINX

RSVIEW

RSVIEW Data Logging

RW API – RSLINX and PI OPC Interface
H2O PI Server & 17 Interfaces

- LVWTP – OPC Interface
- JDP – OPC Interface
- CSR – OPC Interface
- MCPV – OPC Interface
- Ute Pass – OPC Interface
- Northgate – OPC Interface
- Fountain Valley – OPC Interface
- MESA – OPC Interface

RDBMS Interfaces
- LIMS
- TP
- WEIRS
- MCPV –TP
- DOMSAT
- WIS Manual
- NG to TP
- LVWTP to TP
- WSI – Weather

H2O PI Server
Water Treatment Real-Time Assets

- Mesa Data Streams = 1275
- McCullough Data Streams = 719
- Pine Valley Data Streams = 599
- Ute Pass - Data Streams = 379
- Bailey Data Streams = 3664
- Fountain Valley – PI Tags = 382
- RTU’s/SCADA Data Streams = 14078

Total Water Treatment Data Streams = 20,714
Wastewater PI Assets

- LVWTP PI Tags = 1866
- JDP PI Tags = 2908
- CSR- PI Tags = 854

Total Waste Water Treatment PI Tags = 5,628
SDS Reporting

- 5 Compliance Reports, 1 Water Conveyance Report and 14 Process & Performance Reports

State Compliance Reports:
- State MOR
- Disinfection Profile Benchmark Calculator
- 15 Minute Turbidity Report
- Filter Backwash Recycling Rule Recordkeeping Form
- Monthly Percent Backwash Report

Water Conveyance Reports:
- SDS Daily Flows

Process & Performance Reports:
- Daily Treatment Report which includes:
  - Plant Overview Summary
  - Flow Summary
  - Energy Summary
  - Filter Performance
  - Chemical Usage for 9 areas
  - Filter Backwash
  - Monthly Chemical Usage Report
  - Monthly Treatment Report
  - Lab Analysis Report
  - Lab Analysis for 9 areas
  - Lab/Online Comparison Report
  - Lab analysis online vs manual reads with % variance
  - Raw Water Report
  - Daily, Weekly, Monthly and YTD production with Avg and Max values.
  - Daily Filter Summary Report
Ad-Hoc Trending

- Web-based client
  - Users to analyze enterprise data
  - Empowering end-users
  - Increased ownership of the data and autonomy
- Ability to access real-time data
  - Displays that meet business needs
  - Mobile accessibility
  - Device agnostic
  - Improves field decision
  - Reduces operational cost
Operational Intelligence for Wastewater Treatment Innovators
JDP UV FILTER BUILDING kW vs FLOW

Year Ago    | Yesterday    | Current
-----------|--------------|---------
100-90 kW  | 100-90 kW    | 100 kW  
-80-70 kW  | -80-70 kW    | -80 kW  
-60-50 kW  | -60-50 kW    | -60 kW  
-40-30 kW  | -40-30 kW    | -40 kW  
-20-10 kW  | -20-10 kW    | -20 kW  
0-10 kW    | 0-10 kW      | 0 kW    
40.73 kW   | 51.34 kW     | 57.04 kW

UV BLDG vs FLOW

2/5/2018 8:00:23 PM  7d  2/12/2018 8:00:23 PM
Reservoir Water Quality Display

Rampart Reservoir

Waldo Canyon Fire Study

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<tr>
<th>Sample Date</th>
<th>pH</th>
<th>Temp</th>
<th>Turbidity</th>
<th>Conductivity</th>
<th>Alkalinity</th>
<th>DO</th>
<th>Chlorophyll TOC</th>
<th>Ammonia</th>
<th>Fluoride</th>
<th>Nitrate</th>
<th>Nitrite</th>
<th>Iron</th>
<th>Magnesium</th>
<th>Manganese</th>
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<td>Temp</td>
<td>Turbidity</td>
<td>Conductivity</td>
<td>Alkalinity</td>
<td>DO</td>
<td>Chlorophyll TOC</td>
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<td>Fluoride</td>
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<td>1440</td>
<td>7.62</td>
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</table>

Reservoir Level: 172 FT

TOP
Secchi Depth: 22 FT

MIDDLE

BOTTOM
Utilization Real-Time Data

Maintaining operational efficiency

- Proactively identify treatment plant zone of influence and system disruptions
- Optimize system control by decreasing water age
- Reduce treatment plant effluent chlorination usage

Lead to Improved operational efficiencies

- Accessibility to data
- Heightened internal and external customers service
- Sustain operational needs
## WQSG Sample Site Historical Trends

<table>
<thead>
<tr>
<th>SAMPLE SITE ID</th>
<th>Chlorine (mg/L)</th>
<th>pH (4.0-9.0)</th>
<th>TEMP (°C)</th>
<th>Cond (μS/cm)</th>
<th>HPC (CFU/mL)</th>
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<tr>
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</table>
Providing Real-Time Value for Water Quality
Treatment Source Trace Dynamic Mapping

- Centralized data source
- Leverage Data Sources
- Visualization Data
- System awareness
  - Event Analysis
  - Understand
  - Predict
  - Mitigate
- Operational Efficiency
- Creates Training opportunities
Providing Real-time Value for Water Treatment and Water Distribution
Providing Value to Raw Water Monitoring & FERC for Rampart Dam
Operational Intelligence for Wastewater Lift Stations
Situational Awareness meets Operations
Providing Value to Waste Water Lift Stations

<table>
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<tr>
<th>station</th>
<th>gpm</th>
<th>level</th>
<th>height</th>
<th>start</th>
<th>stop</th>
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<td>Chapel Hills L.S.</td>
<td>0</td>
<td>1</td>
<td>3.88164 ft</td>
<td>4.5 ft</td>
<td>2.6 ft</td>
</tr>
<tr>
<td>Cheyenne L.S.</td>
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<td>2</td>
<td>3.29674 ft</td>
<td>4.5 ft</td>
<td>2.6 ft</td>
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<tr>
<td>Coronado L.S.</td>
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<td>1</td>
<td>3.91331 ft</td>
<td>4.1 ft</td>
<td>2.2 ft</td>
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<tr>
<td>Drennan L.S.</td>
<td>0</td>
<td>1</td>
<td>2.60343 ft</td>
<td>3.6 ft</td>
<td>2.5 ft</td>
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<tr>
<td>Janitell L.S.</td>
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<td>2.7579 ft</td>
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<td>2.1 ft</td>
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<td>2.08069 ft</td>
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<td>2 ft</td>
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<tr>
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<td>4</td>
<td>4.5467 ft</td>
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<td>4.2 ft</td>
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<tr>
<td>Middle Tributary L.S.</td>
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<td>4.27007 ft</td>
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<td>Middle Monument L.S.</td>
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<td>5.14481 ft</td>
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<tr>
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<tr>
<td>Peregrine L.S.</td>
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<td>3.92666 ft</td>
<td>4.5 ft</td>
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<td>2.17491 ft</td>
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<td>Stratton Meadows L.S.</td>
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<td>3.61157 ft</td>
<td>10 ft</td>
<td>6 ft</td>
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</table>
Providing Value to Wastewater Treatment
# Bradley Pump Station SKF Vibration

## Williams Creek

### Juniper Pump

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>PMP-1100-Vib - Bradley PS Pump 1 Vibration Motor Top X-Axis Vibration</td>
<td>0.0013423</td>
<td>in/s²</td>
</tr>
<tr>
<td>PMP-1100-Vib - Bradley PS Pump 1 Vibration Motor Top Y-Axis Vibration</td>
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<td>in/s²</td>
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<tr>
<td>PMP-1100-Vib - Bradley PS Pump 1 Vibration Motor Top Z-Axis Vibration</td>
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<td>0.0013423</td>
<td>in/s²</td>
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<td>PMP-1100-Vib - Bradley PS Pump 1 Vibration Motor Bottom Y-Axis Vibration</td>
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<td>PMP-1100-Vib - Bradley PS Pump 1 Vibration Tachometer</td>
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</tr>
<tr>
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<table>
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<td>RPM</td>
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<tr>
<td>PMP-1300-Vib - Bradley PS Pump 3 Vibration Motor Bottom X-Axis Vibration</td>
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<td>in/s²</td>
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<tr>
<td>PMP-1300-Vib - Bradley PS Pump 3 Vibration Motor Bottom Y-Axis Vibration</td>
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<td>in/s²</td>
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<table>
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<th>Description</th>
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<td>RPM</td>
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<tr>
<td>PMP-1400 - Bradley PS Pump 4 Running</td>
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</table>

[Graphs showing vibration levels and trends over time]
PI Manual Logger &
SKF Microlog Inspector

**Operator Driven Reliability**
- Improve Maintenance Management and Reliability
- Great for Inspection Programs

**Compare Manual Data with Real-Time DCS/SCADA Data (online data)**
- Use manually collected data with automatically collected PI System data for comprehensive analysis and a complete operational picture.

**Consistency in Data Collection**
- Task Instructions
  - Route can include task instructions for data collection.
  - Can attach PDF's, JPEG's and Hyperlinks

**Barcodes & RFID**
- Use Barcodes and RFID to guide the user through Data Collection points and prompts for appropriate data.

**Data Validation During Data Entry**
- Performs automatic data validation and supports limit checks including High, HIHI, LoLo and Delta.

**Conditional Data Entry**
- Conditional expressions can be used to specify if an item is due for collection.

**Lower Cost Data Collection**
- These Systems do not require customized software programming. Both System are fully configurable. This is an inexpensive way to gather Manual Data for performance comparisons.

**Requires Plant/User Ownership**
- In Order for your Operator Driven Reliability Program to be successful the Plants and Users must OWN their program and be committed to its success.

**Future - WIFI**
- Depending on appropriate placement of Access Points
- These systems are WIFI Capable
Putting the Data to Work!
What does the Data Mean?
Just Ask The PI Team...
Drake Rebuild
Providing Value to Transmission System Operations
Sharing Mobility & Lessons Learned across the organization
The Value We Gained...

- Lead to Convergence with IT and OT
- Transformation of business processes and utilization of KPI’s
- Eliminate the need for assistance from other operating areas
- Identify System disruptions
- Improved decision quality
- Disaster Recovery and Event Analysis
- Quick access to critical data with the ability to visualize data in real-time

Leveraging data has truly revolutionize our company dynamics and our impact on decision making with the use of Real-Time Operational data

Transformed Operations from a static and reactionary to everyone can be a SOLUTION based team
Water Quality

**Financial Gains Realized**

- Significant O&M Reductions Realized
  - 29% Reduction in resource allocation for online Instrumentation Inspections
  - 30% Reduction in Vehicle Usage Annually
  - 58% Reduction in Overtime

- Saving has helped with reallocation of O&M dollars
  - To expand our Water Quality Instrumentation Program
    - Pre PI System utilization we had only 6 operating WQ systems
    - Compared to 18 now

**COLLABORATION, TEAMWORK AND INFRASTRUCTURE**
What is in our Future?

- Depending on Budget & resources – PI for Water Treatment – Reporting & Analytics
- Pilot Integrations with AMI
- System Capability Forecasting
- Energy Optimization for CSU’s Assets
- PI Event Frames
- PI To Maximo
- PI to GIS
- PI & SKF for SDS
- Drake Scrubbers
How to Contact the PI Team

- Call 8Help put in a case
- Case Self Service
- Call After hours
- Call the PI Team
So What is Pi?

- Pi is Power to the People!

- It’s the infrastructure and the integrations that connects people with the information from Control Rooms & SCADA and other data sources about CSU Operations to make critical operational decisions.