19-1788 - OPERATIONAL DATA MANAGEMENT SYSTEM STAFF REPORT

RPU Staff Report
Power Resources Division
Resource Planning & Technology Integration Unit
April 30, 2019

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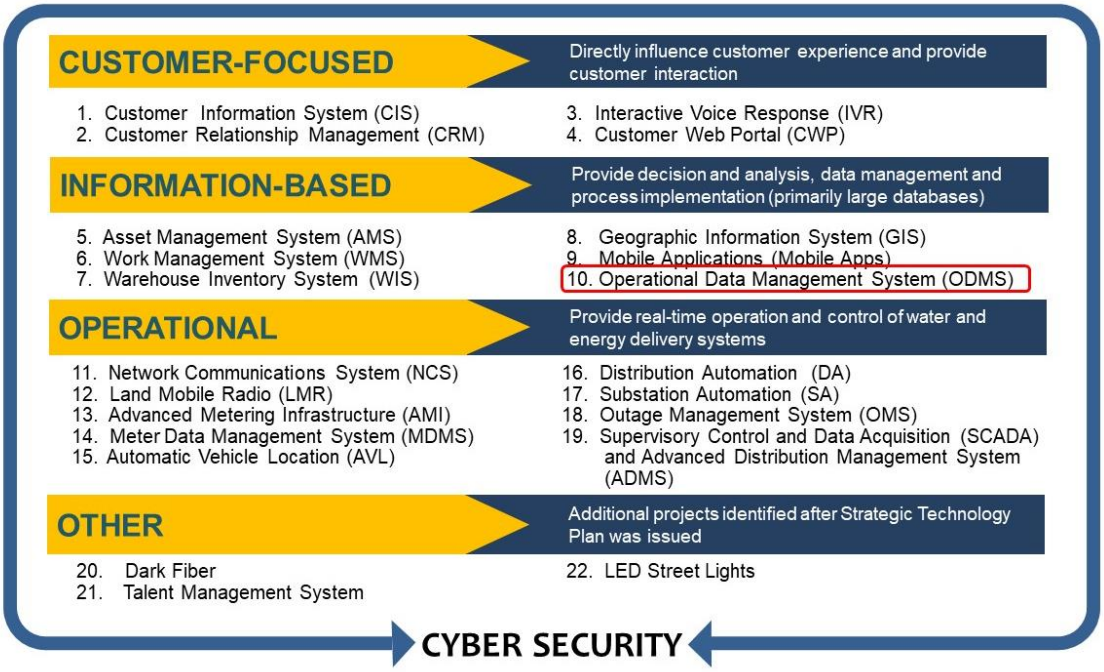
Staff Summary Report

In early 2015, Riverside Public Utilities (RPU) issued a Strategic Technology Plan (Plan) that outlined strategic investments in new operational technologies (OT) as shown in Figure 1 below. Twenty-two OT projects were identified, with the intent of implementing the projects over the next 10 years.

One of the most critical and foundational projects outlined in the Plan is the Operational Data Management System (ODMS). The ODMS is foundational for advancing the Utility 2.0 Strategic Plan, as it serves as a "data hub" or central repository for collecting, analyzing and visualizing operational data. An effective ODMS manages large amounts of data across multiple systems and workgroups and helps staff turn the data into actionable information to drive critical business decisions.

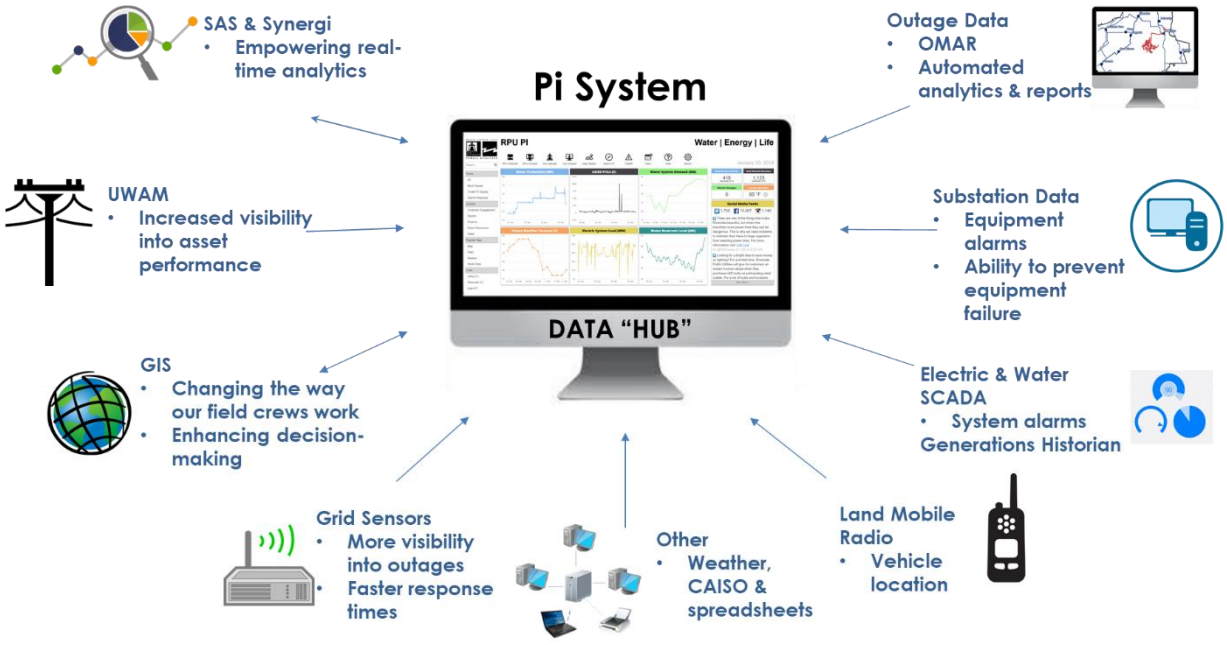
FIGURE 1 – Strategic Technology Plan.



All RPU divisions rely on data to make operational and fiscal decisions. Thousands of data points are collected daily from field equipment and monitoring devices, electric and water meters, customer interactions and financial transactions. As staff continues to implement the OT systems outlined in the Plan, RPU will continue to accumulate larger amounts of data. Therefore, staff recognized the need to move away from storing data in various formats and disparate systems to a streamlined system of collecting, analyzing, visualizing and sharing large amounts of historical, real-time and time series data from multiple sources with people and systems across all operations.

In April 2016, the Board of Public Utilities (Board) approved implementation of the OSIsoft Pi System (Pi) to serve as RPU's ODMS. Pi integrates previously nonintegrated data and transforms it into meaningful information that can be displayed and consumed through visual tools such as dashboards and reports (as represented in Figure 2 below). In addition to providing readily available and easy to consume information, Pi provides an enhanced analytics platform that RPU can leverage to improve operational performance. Twenty-eight separate software systems have been integrated with Pi thus far (as listed in Table 2 on page 5).

FIGURE 2 – PI System Data Hub.



Utilizing Pi, RPU has been able to significantly improve operational efficiencies, reduce staff time and operating costs, and improve asset management and system reliability. Additionally, RPU has benefited in several other ways, including:

- Increased visibility into systems and assets
- Improved ability to monitor and track performance to support operating decisions
- Improved ability to analyze incidents to determine cause and effect for establishing corrective actions
- Better enterprise-wide decision making, driven by real-time data
- Automation of multiple manual workflow processes
- Reduced risks and costs associated with potential equipment failure
- Optimized operational processes
- Improved asset maintenance and field workforce management

- Increased proactive (predictive) operations to optimize the cost of operating the distribution system
- Improved analytics of historical data for better capital improvement and resources planning
- Improved ability to capture data and produce timely and accurate mandatory compliance reports (required for utilities by North American Electric Reliability Corporation, United States Environmental Protection Agency, California Independent System Operator, etc.)
- Improved real-time methods for monitoring market activity and optimizing bidding strategies

RPU has invested a total of $4,907,000 into implementing and deploying the Pi System. This investment includes the purchasing of hardware and software; a comprehensive enterprise license and services agreement with OSIsoft; City Innovation and Technology Department labor to support back-end implementation of the system; and professional contract services to support system integration, data migration and the development of dashboards and reports. The annual enterprise services fee is $347,000 per year through July 2019, and then reducing to $225,026 until July 2021, at which time RPU will request approval from the Board to extend the OSIsoft enterprise services agreement.

Since implementing Pi, RPU has achieved a return on investment (ROI) of nearly $673,000 per year as shown in Table 1. This far surpasses the annual enterprise service cost of the OSI-Pi system. Additionally, a significant amount of new development is concurrently underway that should increase the ROI to over $800,000 in the next year.

TABLE 1 – Total Annual Return on Investment (ROI) to date.

DASHBOARD	ANNUAL ROI
Water Operations Work Order and Preventative Maintenance Dashboards	$112,589
Water Operations / System Demands Dashboards	$62,161
Water Lab Data Dashboard	$4,605
Blend Summary Dashboard	$46,049
Water Well Flow Rates Dashboard	$25,393
Water Wells Mobile	$11,248
Physical Security Maps	$4,599
SCADA Validation Report	$12,580
Booster Station Dashboards	$31,293
Water Field Work Order Map	$95,859
Water Field Service Request Map	$47,240
Outage Map	$18,157
Electric Grid Sensor Map and Dashboards	$21,243
Volt-VAR Analysis Dashboard	$58,248
SCADA Data in Synergi	$7,310
Electric Substation Map	$3,956
Streetlight Service Requests Dashboard	$6,132
Real-Time Spreadsheet	$66,060
Vista Load and Generation Dashboard	$16,744
Call Center Dashboards	$3,360
Overtime Reports and Dashboards	$18,017
TOTAL RETURN ON INVESTMENT	**$672,843**

The remainder of this staff report provides a status update of the Pi implementation process to date. It includes an overview of the many dashboards, reports and alerts that have been created for various RPU working groups, and the ROI that has been achieved in each instance. These ROI calculations are based on quantitative factors. The primary quantitative factor in each instance is the reduction in staff time to complete tasks. The ROI is calculated using an average hourly rate of the staff position responsible for the task adjusted by a payroll burden multiplier[1] for water and electric of 1.693 and 1.656, respectively. The adjusted total hourly value of the staff position is then multiplied by the hours saved in a year.

It should be noted that other quantitative benefits have also been realized that are not specifically calculated in the ROI, such as reduced truck rolls to investigate problems, reduced operating costs and reduced paper waste. Staff currently cannot assign an exact value to these benefits, even though these benefits are believed to be material. Also, there are numerous qualitative benefits being derived from the system, which are more difficult to calculate as tangible savings. These savings include increased visibility into system status, avoided costs of potential regulatory fines or lawsuits, reduced length of system outages, fewer customer complaints and improved system planning.

Over the next several years, RPU plans to continue developing and expanding the use of Pi for additional operational benefits, efficiencies and ROI. One area that will be developed is the use of Pi Manual Logger. This is a "mobile forms" application in Pi that is used to manually enter data from the field into the Pi server. RPU's facilities have significant amounts of data that cannot be collected automatically from instrumentation and control systems. Currently, field staff collects this data on paper and then returns to their work location to enter the data into the Oracle Utility Work and Asset Management (UWAM) system, in addition to other systems. Utilizing Pi Manual Logger, these antiquated paper processes can be replaced with a more streamlined and automated process of collecting data. The data will automatically populate in the Pi system for analysis, and from there be automatically sent to other systems where the data is needed, such as UWAM.

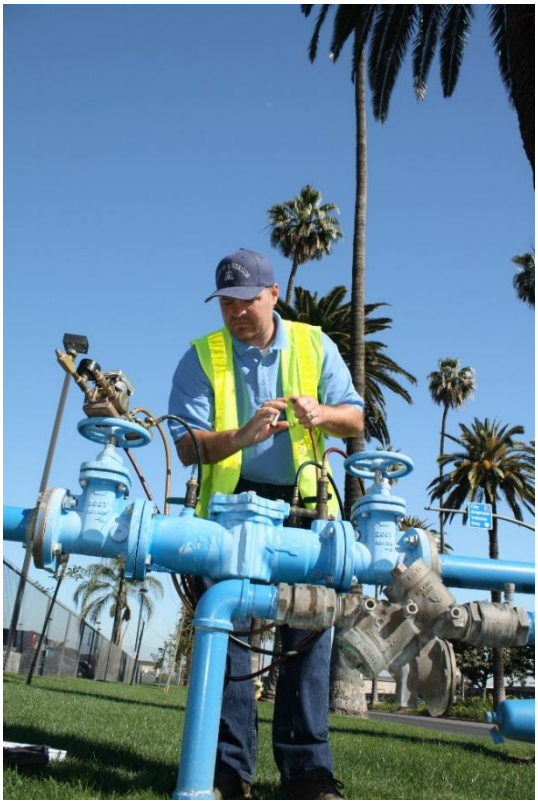
In addition, there are many new dashboards and reports that will be developed using the data from the existing integrations, such as in-depth grid sensor multi-phase reporting and real-time renewables analysis. Staff also plans to integrate the Customer Information System and the new Advanced Meter Infrastructure (AMI) system with Pi during the AMI roll-out process, to facilitate improved reporting and analysis of meter data, system performance and customer interaction metrics.

[1] Payroll burden multipliers for electric and water provided by Finance and Administration based on the fiscal year 2017-2018 Summary of Overhead Rate information.

TABLE 2 – System Integrations performed to date.

INTEGRATION	DESCRIPTION / DATA
Kapsch Dynac Water Supervisory Control and Acquisition (SCADA)	Water operations data
Oracle Utility Work and Asset Management (UWAM) – 2 separate integrations	Work order, service request and asset data
WaterTrax Data and Compliance Management Software	Water quality data
Ingenu Grid Sensor Devices	Grid sensor data
National Oceanic and Atmospheric Administration (NOAA) website	Weather data for Riverside Municipal Airport and March Air Reserve Base
California Irrigation Management Information System (CIMIS) website	Weather data for University of California, Riverside (UCR)
Delta-X Research Transformer Oil Analyst (TOA)	Substation transformer test data
ENOSERV PowerBase	Substation switch gear and relay maintenance data
Midtronics Celltraq System	Substation battery test data
Open Systems International Electric SCADA / Chronus Historian	Electric operations data
Outage Management and Reporting Database	Electric outage data
Statistical Analysis Software (SAS)	Data analytics
SettleCore DealCapture - 3 separate integrations	Load data, natural gas consumption, and Operational Flow Order (OFO) notices
California Independent System Operator OASIS website	Real-time and day-ahead price and load market data
Avaya Call Management System	Real-time call center data
Integrated Financial and Administrative Solution (IFAS)	Payroll data (replaced by One Solution)
One Solution	Payroll data
Motorola Radio/CompassCom	Hand-held and mobile radio location data
DNV-GL Synergi	Power distribution system and electrical simulation
Oracle Seibel Customer Relationship Management (CRM)	Service request data
WonderWare Generation SCADA and Historian	Generation operations data
Happy or Not	Customer satisfaction data
ESRI ArcGIS Portal	Map data
ESRI ArcGIS Online	Map data
Microsoft SQL	Data integration

Appendix 1 - Water Division



RPU's Water Division is responsible for providing high quality and reliable water to the City of Riverside. The Water Division consists of Water Operations, Water Engineering and Water Field. Each group plays a vital role in ensuring that RPU delivers affordable and reliable water to its customers.

Water Operations is responsible for the production, treatment, management, storage, and distribution of domestic water to meet the demands of RPU's water system. This group also oversees the distribution of irrigation and recycled water. Water Operations workgroups include Environmental and Regulatory Compliance, System Operations, Water Supervisory Control and Data Acquisition (SCADA), and Asset Management and Maintenance.

Water Engineering is responsible for long-range capital improvement program (CIP) planning, budgeting, grant writing, design, construction, management, and mapping/archiving of constructed CIP projects. Water Engineering also handles coordination of all development-related activity and infrastructure.

Water Field is responsible for the construction and maintenance of water transmission and distribution systems, irrigation/canal systems as well as handling all water main replacements, system connections, fire hydrant installations, and installations of new and replacement water services. Water Field installs, replaces and maintains water meters, and tests new and existing meters for accuracy. Water Field workgroups include Administration, System Construction, Maintenance, and the Water Meter Shop.

1.1 Water Operations Work Order and Preventative Maintenance Dashboards

Water Operations issues emergency, routine and preventive maintenance work orders through the UWAM system. This process allows them to track work orders and costs associated with specific assets in the water system.

The Water Operations Work Order and Preventative Maintenance dashboards extract work order data from UWAM along with Water SCADA and geographic information system (GIS) data to display work orders on a map. With this information, managers can more effectively and efficiently direct resources to high priority items, while considering geographic locations. The graphs and charts on the dashboards help them to quickly view work order status and assess priorities.

Prior to implementing Pi, this was a time consuming manual process. Now work can be scheduled more efficiently to ensure timely completion of critical tasks. By ensuring proper preventative maintenance and timely repair of system assets extends the life of equipment, reduces the length of service outages and increases efficiency.

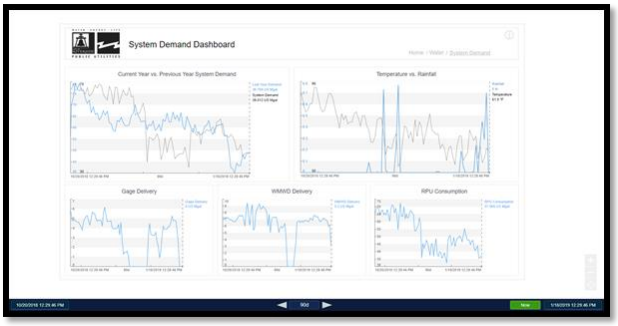
The total ROI for the Water Operations Work Order and Preventative Maintenance Dashboards is $112,589 per year as shown in the table below:

Water Operations Work Order and Preventative Maintenance Dashboards					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Chief Wtr Sys Oper Salary	$106,404	1.693	$180,142
Hours/Year	1300	Hours/year			2080
Total Cost/Year	$112,589	Hourly Cost	$51.16		$86.61

1.2 Water Operations / System Demands Dashboards

The Water Operations group manages water production and distribution throughout RPU's service territory. It is important for staff to monitor the system demand, water storage, and basin production and delivery targets.

The Water Operations and System Demands Dashboards were created using data that is extracted through Pi from Water SCADA. Using various graphing tools, these dashboards display system demand, production, water storage, and deliveries. They enable staff to pull up real-time information at any point throughout the day, providing information on basin production and wheeling targets. In addition, managers receive alerts when water levels are too low and when system demands are high, so that they can take immediate action to remedy the situation before the problem escalates.



Prior to the development of the Water Operations and System Demands Dashboards in Pi, staff had to manually extract data from Water SCADA into Excel and reorganize the data to create reports which were then emailed out on a daily basis. This manual process required staff time of 3 hours per day. In addition, this process was based on the previous day's information, so no immediate action could be taken to correct issues identified in these reports. In Pi, this same information is now updated in real-time and can be viewed by any staff at any point during the day. The process now takes less than 1 minute to complete.

The total ROI for the Water Operations / System Demands Dashboards is $62,161 per year as shown in the table below:

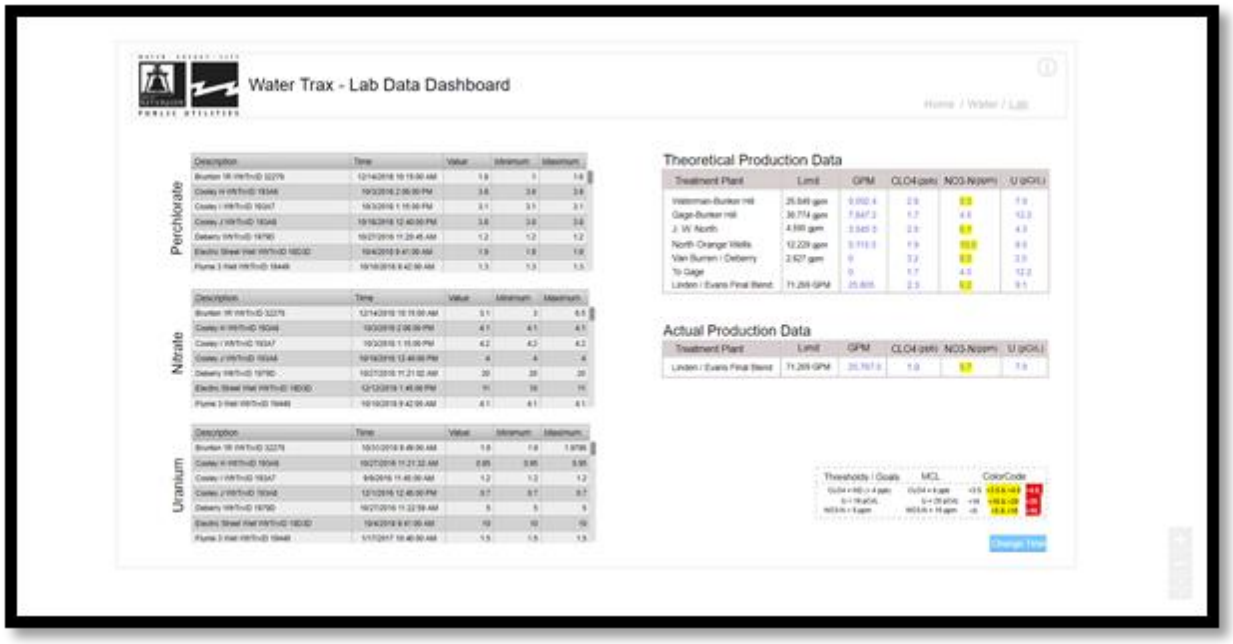
Water Operations / System Demands Dashboards

			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Pr Analyst Salary	$108,798	1.693	$184,195
Hours/Year	702	Hours/year			2080
Total Cost/Year	$62,161	Hourly Cost	$52.31		$88.56

1.3 Water Lab Data Dashboard

The Water Division is required by the United States and California Environmental Protection Agencies to comply with both the federal and state Safe Drinking Water Acts and environmental laws pertaining to drinking and environmental water quality. The water division collects over 25,000 water samples for laboratory testing from its drinking water sources, treatment plants, distribution system, and non-potable sources. The testing results from these samples are required to be reported to various regulatory agencies by a state certified laboratory.

In order to more effectively capture, monitor and report on water quality data, the Water Lab Data Dashboard was created in Pi to automatically pull lab data from WaterTrax, which is the system where water lab data is captured. This dashboard now gives staff real-time visibility on water constituents such as perchlorate, nitrate, and uranium to ensure they do not exceed Maximum Contaminant Levels (MCLs) set by the state and federal government.



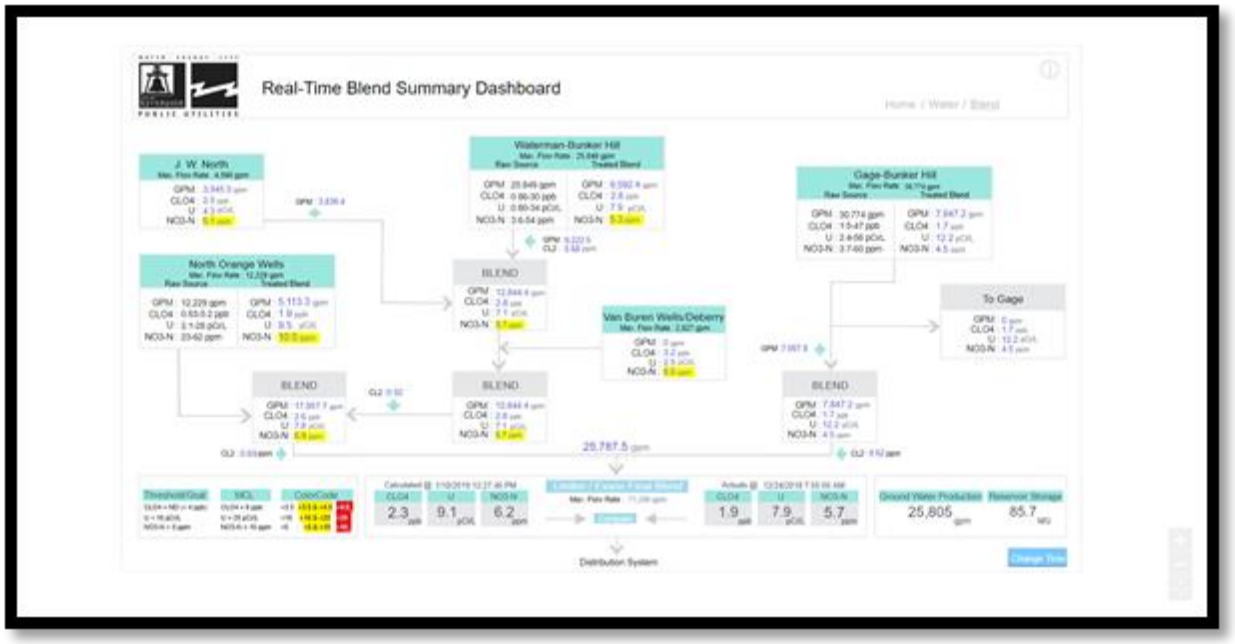
The total ROI for the Water Lab Data Dashboard is $4,605 per year as shown in the table below:

Water Lab Data					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Pr Analyst Salary	$108,798	1.693	$184,195
Hours/Year	52	Hours/year			2080
Total Cost/Year	$4,605	Hourly Cost	$52.31		$88.56

1.4 Blend Summary Dashboard

The Water Operations group manages the quality of water delivered to customers using various pumping and treatment strategies.

The Blend Summary Dashboard uses water flow rates, online analyzer data, and laboratory data of known contaminants from Water SCADA and WaterTrax to calculate concentrations of contaminants along different sections of the pipelines and to the entry point of the distribution system. This dashboard allows staff to monitor real-time water quality data to make any necessary treatment adjustments and to better respond to water outages or other system interruptions throughout the day. Managers also receive text and email alerts whenever a parameter goes outside of a predetermined range, allowing them to quickly respond to issues before they escalate.



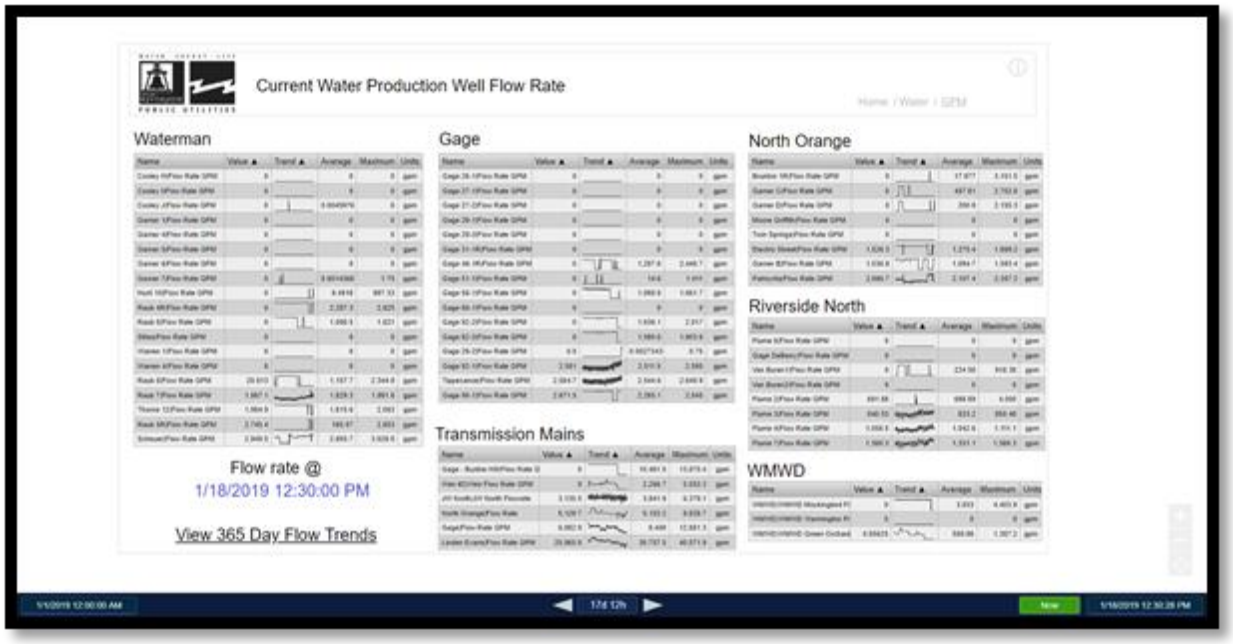
Prior to the development of the Blend Summary Dashboard in Pi, staff had to manually read flow data and enter it into an Excel spreadsheet, then manually calculate the blend on a daily basis. This manual process took approximately 10 hours per week to complete and the data analysis was not performed in real-time, so no immediate action could be taken to remedy a situation.

The total ROI for the Blend Summary Dashboard is $46,049 per year as shown in the table below:

		Blend Dashboard			
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Pr Analyst Salary	$108,798	1.693	$184,195
Hours/Year	520	Hours/year			2080
Total Cost/Year	$46,049	Hourly Cost	$52.31		$88.56

1.5 Water Well Flow Rates Dashboard

Water Operations uses Water SCADA to view well flow rates. For security, Water SCADA access is limited to licensed users and is only available on secure computers. The Water Well Flow Rates Dashboard allows staff who needs this information, but do not have access to Water SCADA to see flow trends in real time. The user can also select a source and timeframe to view flow trends over specified periods.



Prior to utilizing Pi, the Water System Operators would extract data from Water SCADA into Excel and reformat the data for reporting purposes. It took approximately 7-8 hours per week for the Water System Operators to create this report.

Water Engineering has benefited from this dashboard by using the data to prioritize well rehabilitation projects. Prior to implementing Pi, staff had to drive to the Utility Operations Center (UOC) and work with someone who had secure direct access to the Water SCADA system every time they needed this information.

The total ROI for the Water Well Flow Rate Dashboard is $25,393 per year as shown in the table below:

Water Well Flow Rates Dashboard					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Wtr Sys Oper II Salary	$79,994	1.693	$135,430
Hours/Year	390	Hours/year			2080
Total Cost/Year	$25,393	Hourly Cost	$38.46		$65.11

1.6 Water Wells Mobile

The Water Quality Technicians are responsible for collecting source water samples from wells and the distribution system.

To complete this task more effectively, the Pi team created a mobile platform where Water Quality Technicians can view which wells are online and which are not. This allows real time decisions to be made in the field during sampling routes. If a well that was scheduled to be sampled goes offline due to an outage or other reasons, then an alternative well can be immediately selected for sampling.

Prior to implementing the Water Wells Mobile, the Water Quality Technicians would receive a print out from the office of all the sample locations. If a well was not available for sampling that day, they would not know until they arrived to the well location, thus having to unexpectedly reschedule their route. The mobile solution saves the Water Quality Technicians 30 minutes to an hour and a half each day.

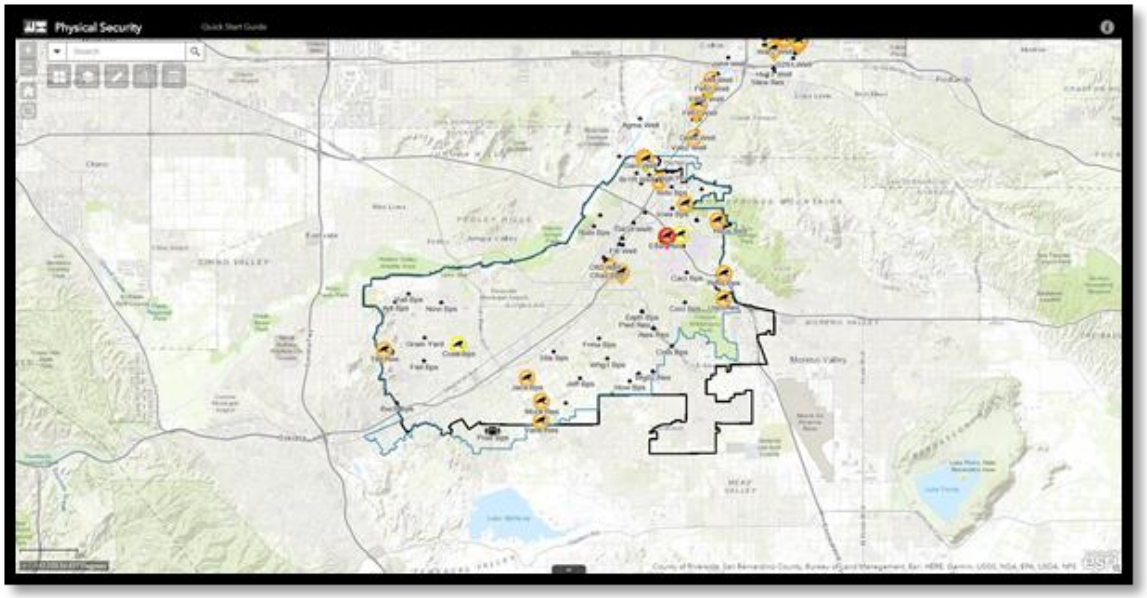
The total ROI for the Water Wells Mobile is $11,248 per year as shown in the table below:

Water Wells Mobile					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Wtr Quality Tech Salary	$66,435	1.693	$112,475
Hours/Year	208	Hours/year			2080
Total Cost/Year	$11,248	Hourly Cost	$31.94		$54.07

1.7 Physical Security Maps

The Water Operations group manages and maintains physical security devices, such as cameras, digital video recorders, video transmitting radios, and internet routers that are located at critical water facilities throughout RPU's service territory. It is important for staff to have visibility into the status of these devices for repairs and preventative maintenance.

The Physical Security Map was created using data extracted through Pi from UWAM. Using color coded and easy to identify symbols, the map displays all open work orders on the physical security devices. Displaying the location of these devices on a map helps staff assign work based on priority and physical location, and to better understand where problems are occuring and how long they have been in need of repair or maintenance.



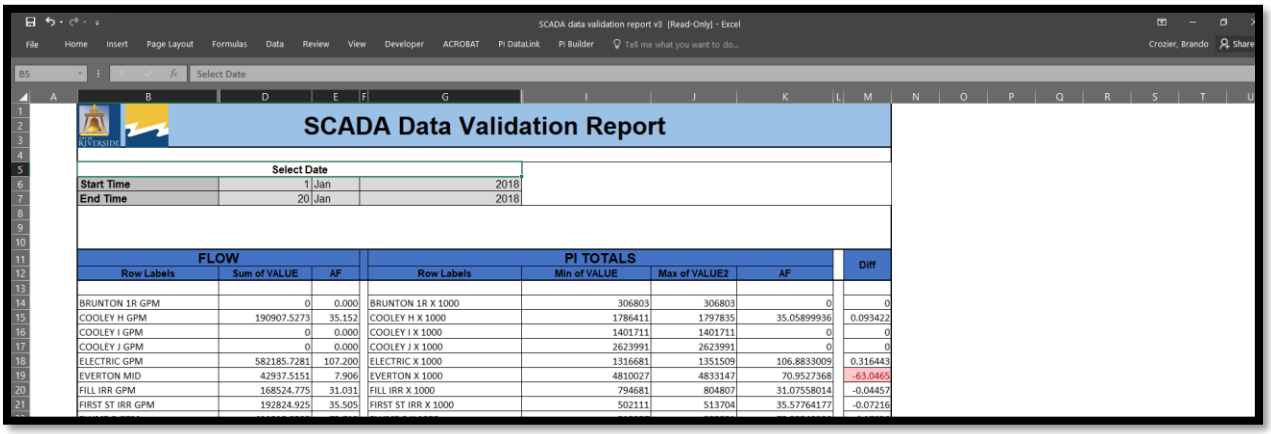
Prior to creating the Physical Security Map in Pi, staff had to manually search for work orders in UWAM and then search for information on each asset associated with the work order. This process originally required 15 minutes for each asset and is now available at the click of a button. An additional benefit is that additional data can now be captured directly in Pi that currently cannot be captured in UWAM due to the limited availability of User Defined Fields (UDF).

The total ROI for the Physical Security Maps is $4,599 per year as shown in the table below:

Physical Security Maps					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Sr Engrng Aide Salary	$57,134	1.693	$96,727
Hours/Year	99	Hours/year			2080
Total Cost/Year	$4,599	Hourly Cost	$27.47		$46.50

1.8 SCADA Validation Report

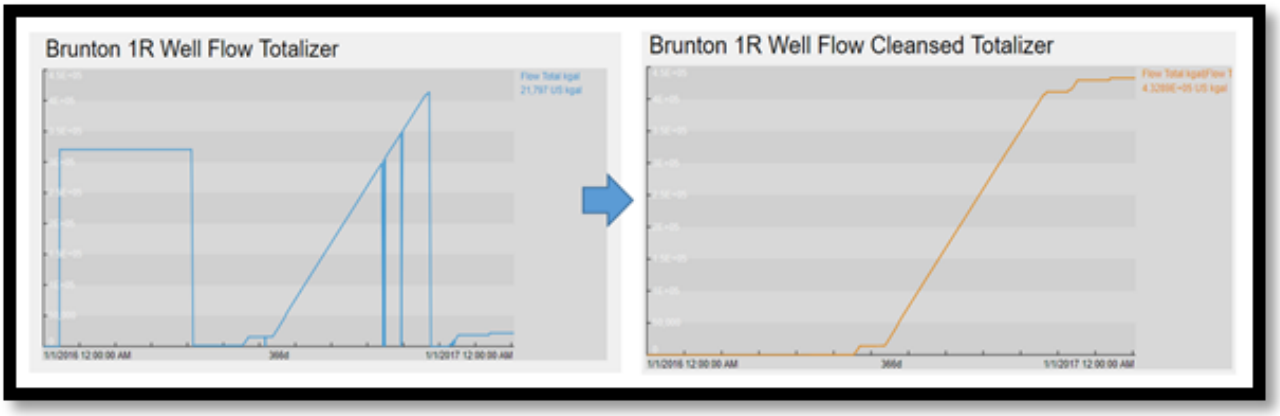
An accurate accounting of water production and distribution system pumping is critical to regulatory reporting, water extraction reporting, billing, and asset monitoring. The SCADA Validation Report was created in Pi Datalink using Water SCADA system data. The report is used to verify the accuracy of the volume of water recorded and transmitted via the Water SCADA system.



SCADA Data Validation Report

Select Date			
Start Time	1	Jan	2018
End Time	20	Jan	2018

FLOW			PI TOTALS			Diff
Row Labels	Sum of VALUE	AF	Row Labels	Min of VALUE	Max of VALUE2	AF	
BRUNTON 1R GPM	0	0.000	BRUNTON 1R X 1000	306803	306803	0	0
COOLEY H GPM	190907.5273	35.152	COOLEY H X 1000	1786411	1797835	35.05899936	0.093422
COOLEY I GPM	0	0.000	COOLEY I X 1000	1401711	1401711	0	0
COOLEY J GPM	0	0.000	COOLEY J X 1000	2623991	2623991	0	0
ELECTRIC GPM	582185.7281	107.200	ELECTRIC X 1000	1316681	1351509	106.8833009	0.316443
EVERTON MID	42937.5151	7.906	EVERTON X 1000	4810027	4833147	70.9527368	-63.0465
FILL IRR GPM	168524.775	31.031	FILL IRR X 1000	794681	804807	31.07558014	-0.04457
FIRST ST IRR GPM	192824.925	35.505	FIRST ST IRR X 1000	502111	513704	35.57764177	-0.07216



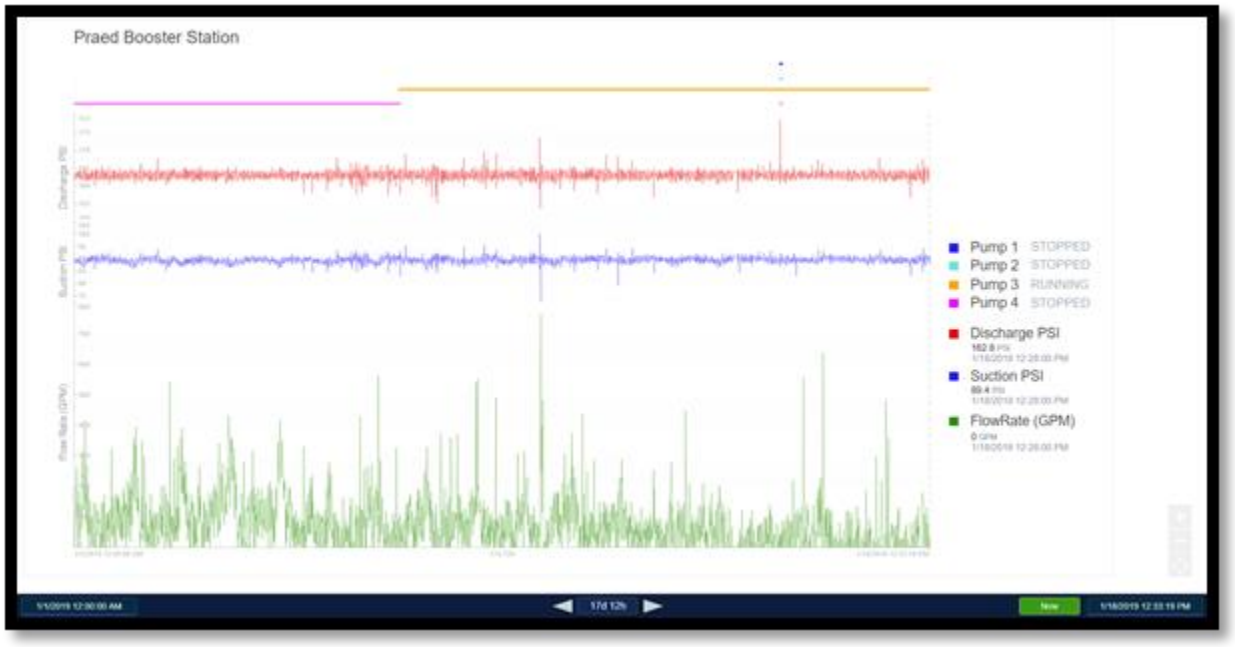
Past practice required daily reading and weekly verification of the system's 130 production and distribution meters, which took approximately 6 hours per week. Automating this report in Pi has allowed staff to quickly review the accuracy of the data being recorded to make real-time instrumentation adjustments and corrections, if necessary.

The total ROI for the SCADA Validation Report is $12,580 per year as shown in the table below:

SCADA Validation Report					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Data Tech Salary	$49,920	1.693	$84,515
Hours/Year	310	Hours/year			2080
Total Cost/Year	$12,580	Hourly Cost	$24.00		$40.63

1.9 Booster Station Dashboards

The Water Engineering Planning group is responsible for researching pressure and flow complaints from customers in RPU's service territory. Booster Station Dashboards for each of RPU's 38 booster stations were developed in Pi. These dashboards allow staff to access Water SCADA data, view pump booster station data, monitor pump status, view pressure and flow fluctuations, and receive email alerts when pressure or flow exceeds a specified threshold. This information allows Water Engineering Planning staff to monitor the system periodically throughout the day and notify Water Operations if there are any issues. This increases staff's ability to correct issues before receiving customer complaints.



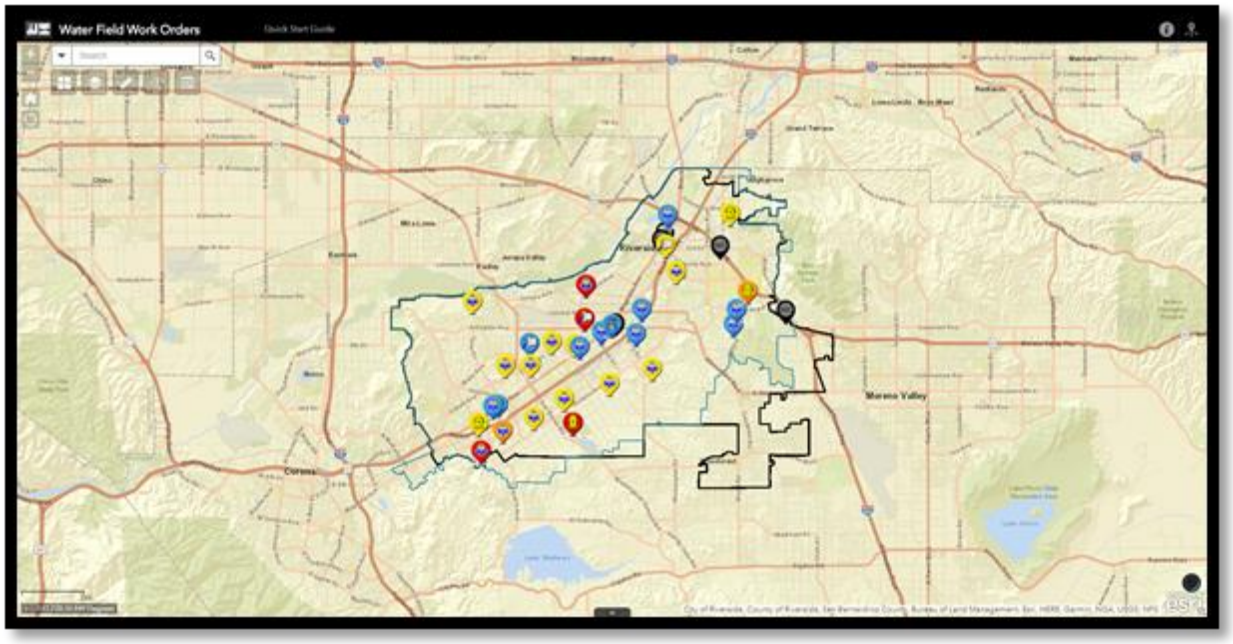
Prior to the creation of the Booster Station Dashboards in Pi, engineering staff would have to download system operation data from Water SCADA and plot it in Excel for each of the 38 stations. This process was done on a weekly basis and would take approximately 4 hours to complete. Additionally, the team spent another 4 to 5 hours per week graphing and reporting other Water SCADA data for ad-hoc report requests.

The total ROI for the Booster Station Dashboards is $31,293 per year as shown in the table below:

Booster Station Spikes & Additional SCADA Data					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Assoc Wtr Eng Salary	$95,637	1.693	$161,913
Hours/Year	402	Hours/year			2080
Total Cost/Year	$31,293	Hourly Cost	$45.98		$77.84

1.10 Water Field Work Order Map

The Water Field Work Order Map displays work order data from UWAM and infrastructure data, including all 1,000 miles of pipeline from CADME/ArcGIS in a map view. When work orders are created in Oracle UWAM, the work order information is automatically extracted and displayed on the Water Field Work Order Map. Custom icons are used to display the type and criticality of work to be performed. This allows managers to quickly prioritize work based on criticality and time length of the open order, while considering proximity to other pending work orders. This is especially useful for emergency work orders that require immediate action.



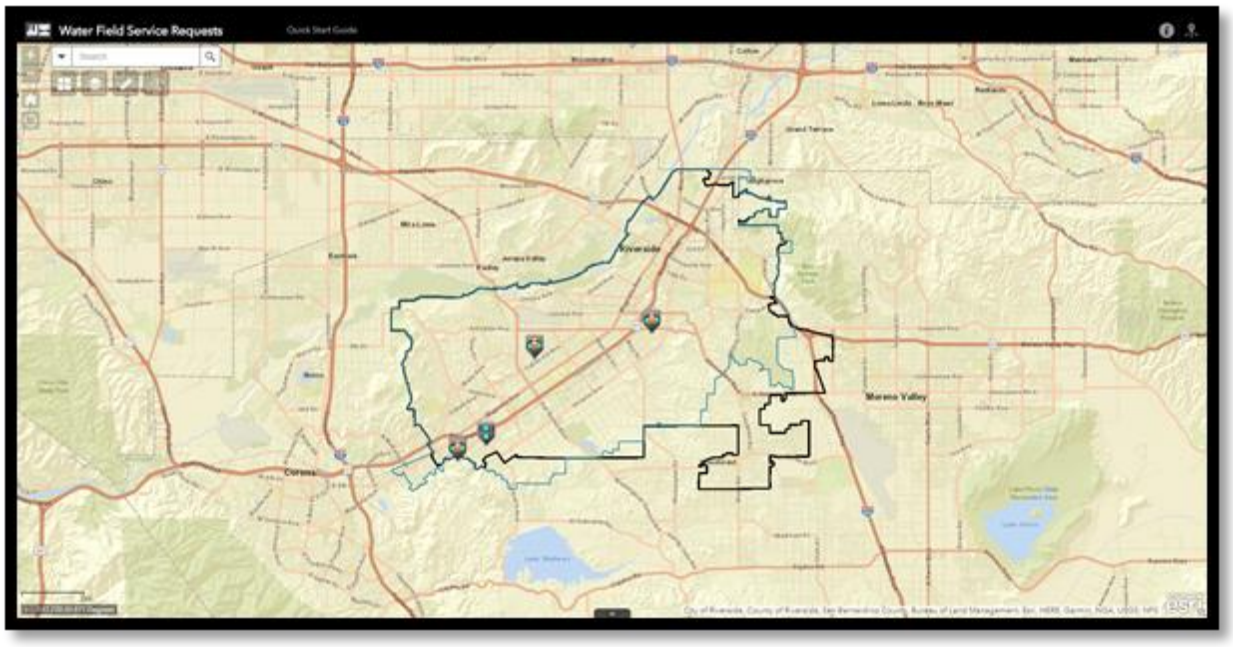
Prior to creating the Water Field Work Order Map, Water Field staff had to search for information in multiple systems and paper documents to plan and complete their work. The Water Field Work Order Map creates a single point of reference for supervisors and staff to view open work orders by priority, criticality and location. This efficiency improvement has saved 10 Water Field Supervisors and 16 Pipefitters each 15 minutes a day and all crews have benefitted daily from improved visibility into the work order status.

The total ROI for the Water Field Work Order Map is $95,859 per year as shown in the table below:

Water Field Work Order Map					
			Average	Multiplier for Payroll Burden	Total Average
		Util Wtr Supv Salary	$93,948	1.693	$159,054
	Average	Util Waterwrks Pipeftr Salary	$77,592	1.693	$131,363
Supervisor Hours/Year	540	Hours/year			2080
Pipefitter Hour/Year	864	Supervisor Hourly	$45.17		$76.47
Total Cost/Year	$95,859	Pipefitter Hourly	$37.30		$63.16

1.11 Water Field Service Request Map

The Water Field group is responsible for responding to all water-related issues reported by customers such as leaks or problems with water service. The request is captured by Customer Service/311 Call Center as a work order in RPU's Customer Information System, which then automatically generates a service request in UWAM. When the service request is created in UWAM, Pi retrieves the data and displays it on the Water Field Service Request Map. There are 15 different categories of service requests that are displayed as custom icons on the map.



The Water Field Service Request Map allows the Water Troubleshooter to quickly view and organize the workload, which is beneficial especially in times of heavy call volume. The comprehensive map includes historical service requests, work orders and all 1,000 miles of water infrastructure. This provides the Water Troubleshooter a single source work environment, rather than having to view and sort information from multiple locations and resources. This has led to better response and routing abilities by saving four Water Troubleshooters each 30 minutes a day.

The total ROI for the Water Field Service Request Map is $47,240 per year as shown in the table below:

		Water Field Service Request Map			
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Wtr Troubleshooter Salary	$79,505	1.693	$134,602
Hours/Year	730	Hours/year			2080
Total Cost/Year	$47,240	Hourly Cost	$38.22		$64.71

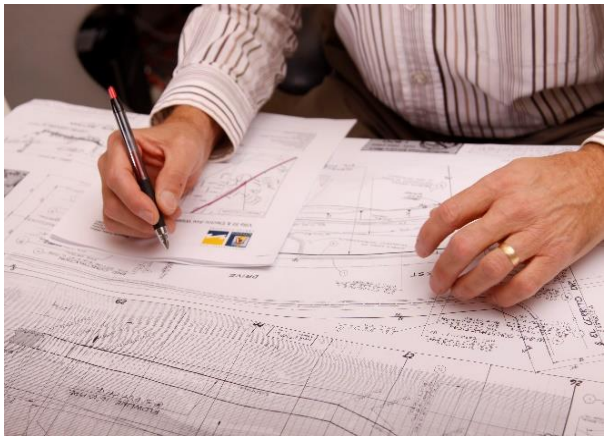
Appendix 2 - Energy Delivery Division

The Energy Delivery Division is responsible for providing high quality, safe, and reliable energy to its customers. Energy Delivery consists of three groups – Electric Engineering, Electric Field, and Electric Operations.

Electric Engineering is responsible for system planning, system protection, capital budgeting, maps and records, and design of all system improvements and updates. Electric Engineering workgroups include Customer Engineering, Major Projects, System Planning, GIS/Maps & Records, Substation Engineering, Contract Administration, System Protection, and Communications.

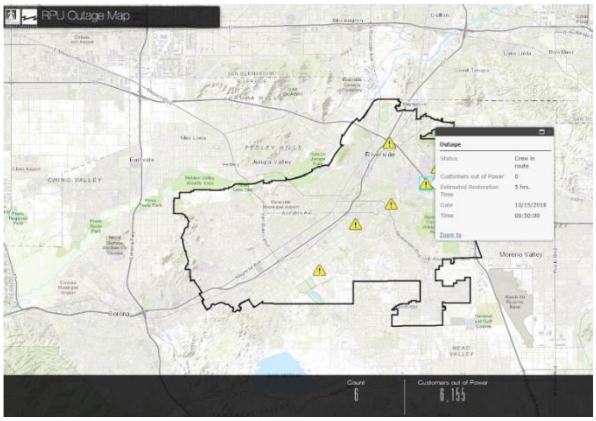
Electric Field is responsible for construction and maintenance of the overhead and underground transmission and distribution electric lines, electrical emergency response, and outage response and maintenance of the City's street light system. Electric Field workgroups include Line Construction, Line Maintenance, Troubleshooters, Streetlight Maintenance, and Inspection.

Electric Operations continuously monitors for electric outages, as well as maintaining operations of the system, electric meters, substation construction and maintenance, testing, and central stores. Electric Operations workgroups include Grid Control Center, Substation Construction and Maintenance, Test Shop, Meter Shop, and Central Stores.



2.1 Outage Map

RPU developed an outage map that is used by Electric Operations to manage electric outages and is accessible to customers through the RPU website. In the event of an outage, Electric Operations can access the map, which includes customer circuit and other system information from GIS. When staff determines the general location of the outage, then a polygon is drawn around the area on the map. The customer-facing map then automatically displays a symbol in the general area of the outage. Customers can toggle over the symbol to see information about the outage including status, number of customers out of power, and estimated restoration time. As Electric Operations updates information on the internal map, the information is automatically populated on the customer-facing map, so customers can view up-to-date information.



Prior to developing the Outage Map, Electric Operations relied on paper circuit maps. In the event of an outage, they had to search to locate the map or maps for the substation/circuit being investigated. This tedious process made the outage investigation very time-consuming and inefficient, since they were simultaneously receiving calls from customers and internal stakeholders requesting information about the outage.

In addition, prior to publishing the customer-facing outage map on the RPU website, the only way customers could obtain information about an outage was to call RPU. The Outage Map has helped reduce customer calls into the 311 Call Center, Customer Service, and Dispatch. In addition, city management and elected officials can also view this information and remain better informed of outages throughout the city.

The total ROI for the Outage Map is $18,157 per year as shown in the table below:

Electric Dispatch Outage Map					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Elec Pwr Sys Dispt II Salary	$109,642	1.656	$181,566
Hours/Year	208	Hours/year			2080
Total Cost/Year	$18,157	Hourly Cost	$52.71		$87.29

2.2 Electric Grid Sensor Map and Dashboards

Grid Sensor devices are deployed on distribution lines at strategic locations throughout RPU's electric system. The data from the Grid Sensors assists RPU with locating faults, monitoring circuit load, responding to outages, and reducing outage times.

Using Pi and the integration with the Grid Sensor head-end system, Ingenu, Grid Sensor data is now received in Pi once a day, or when a fault occurs. Through the GIS integration, the data is displayed on the Electric Grid Sensor Map, which also shows the location of distribution circuits, location of crews in the field, and other information needed to investigate and respond to an outage. There is also a dashboard view of the data that includes a dropdown list, so specific Grid Sensor data can be viewed and analyzed.

The Electric Grid Sensor Map and Dashboards provide a central location for the Grid Sensors to be viewed and managed and alerts can be sent to users when a fault occurs. Prior to implementing the map and dashboard in Pi, the Grid Sensor data was viewed on a third party website, so the information was not overlaid with any other distribution system information and multiple disparate systems had to be viewed to investigate an outage.

The total ROI for the Electric Grid Sensor Map and Dashboards is $21,243 per year as shown in the table below:

Electric Grid Sensor Map & Dashboards					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Elec Eng Salary	$95,637	1.656	$158,374
Hours/Year	279	Hours/year			2080
Total Cost/Year	$21,243	Hourly Cost	$45.98		$76.14

2.3 Volt-VAR Analysis Dashboard

The Electric System Planning group frequently conducts studies of circuits and capacitor banks in the electric distribution system for capacity levels, imbalances, power factor, and voltage fluctuations. The results of the study help the Electric System Planning group determine if load needs to be shifted from one phase or circuit to another, if system settings need to be updated, or if engineers need to add or move capacitors within the distribution system.

To effectively conduct these studies, the Electric System Planning group needs to be able to view capacitors, imbalance, low and high voltage, and total power all in one screen. The Volt-VAR Analysis Dashboard in Pi provides all four of these graphs in one view. The transformer and circuit data is extracted directly from Electric SCADA into the Pi dashboard, which displays real-time power factor and trend information. Power factor is not a value in the Electric SCADA, so it is calculated in Pi. The data can then be pushed into Synergi through the Pi integration for further modeling and analysis, as well as to populate the distribution model.

Prior to implementing Pi, historical data had to be extracted from Electric SCADA Historian and Chronus, then manually calculated. Chronus was not user friendly and could not process data streams with time periods greater than 3 months. In addition, power factor calculations were not available and there was no way to show capacitors, imbalance, low and high voltage, and total power all in one view. The Volt-VAR Analysis Dashboard has eliminated the need for Electric System Planning to manually extract and calculate data. The Pi Dashboard can now retrieve data within seconds and has reduced staff time in collecting data for system studies by 0.5 to 2 days.

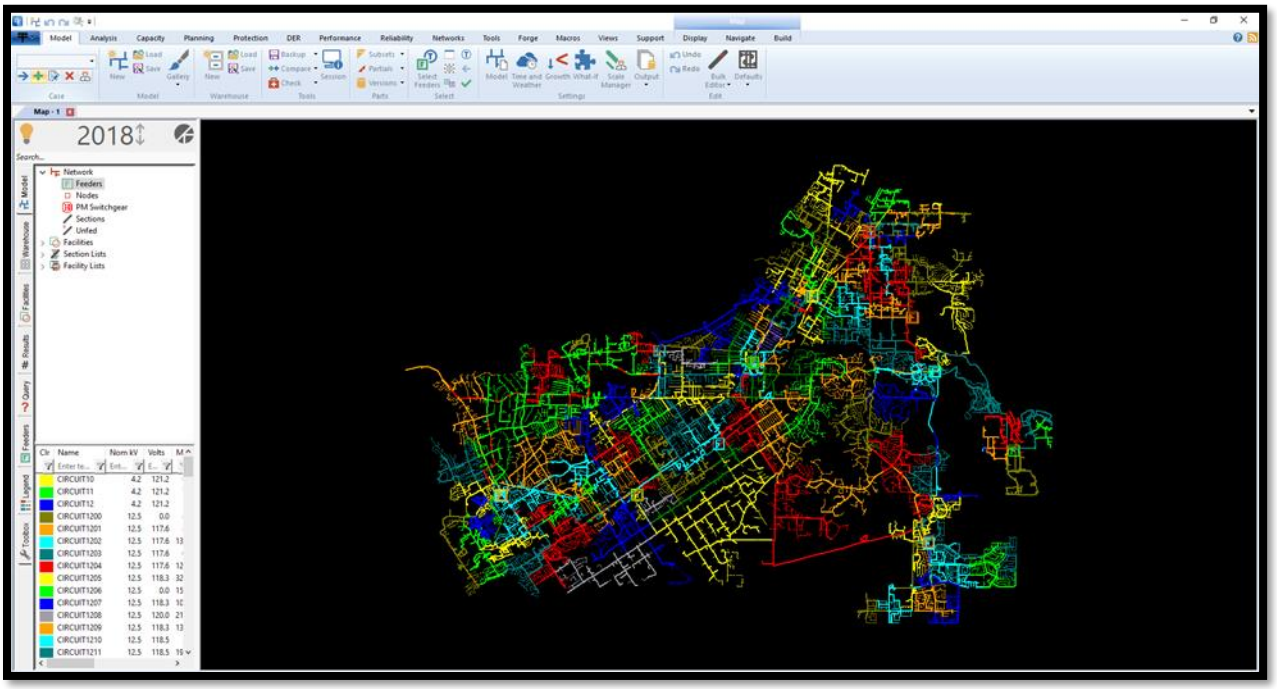
The total ROI for the Volt-VAR Analysis Dashboards is $58,248 per year as shown in the table below:

Volt-VAR Analysis Dashboard (Chronus Replacement)					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Elec Eng Salary	$95,637	1.656	$158,374
Hours/Year	765	Hours/year			2080
Total Cost/Year	$58,248	Hourly Cost	$45.98		$76.14

2.4 SCADA Data in Synergi

Synergi is the software used by Electric System Planning to conduct power distribution system studies and simulation. Multiple data sets must be inputted into Synergi to provide reliable results. Electric System Planning would gather the data from Chronus and manually input it into Synergi one data point at a time. The process took a day when applied to the whole distribution system.

The Pi to Synergi interface has automated this data collection process. This integration now automatically populates 130 distribution circuits in Synergi with SCADA values. Having access to more frequent data allows the system planning group to analyze the electric network under different loading/voltage scenarios, leading to more accurate and reliable simulation studies. In turn, this provides better analysis for determining more economical capital improvement projects.



The automated Pi process has significantly reduced the time it takes Electric System Planning to conduct system studies. Historically this process was very tedious and time consuming that it was often only done twice a year, but should have ideally been performed more frequently. Now that the process is instantaneous, it can be done at any time with the click of a button.

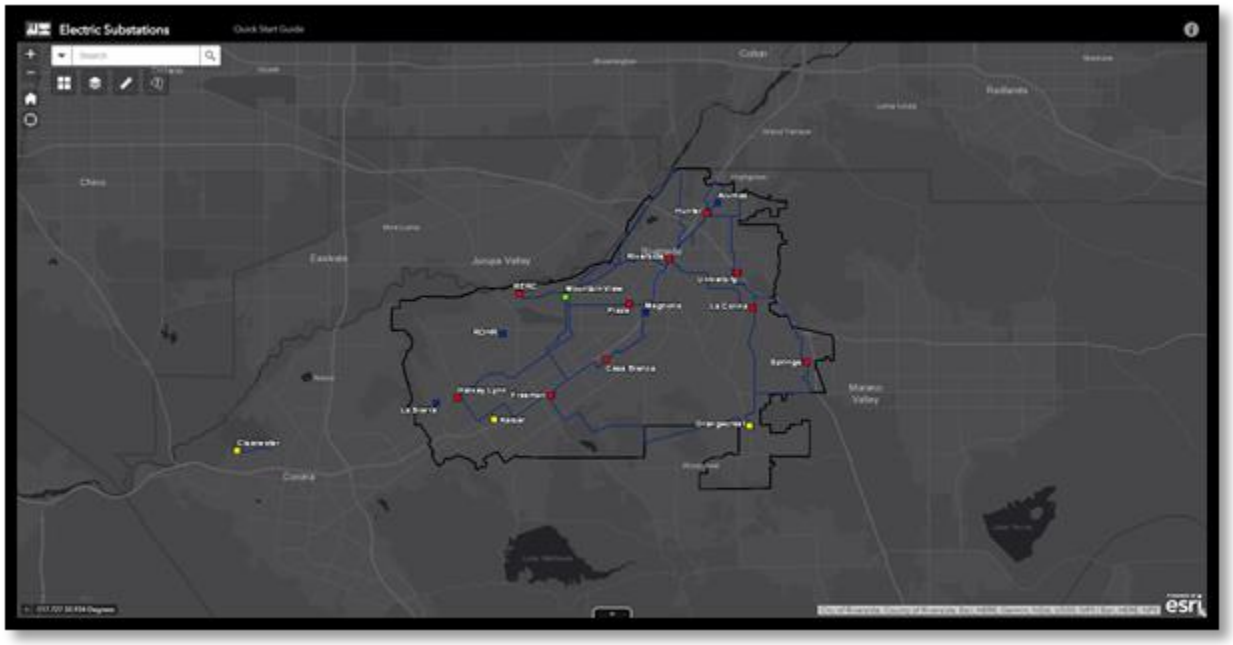
The total ROI for this process is $7,310 per year as shown in the table below:

SCADA Historian - PI - Synergi Interface					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Elec Eng Salary	$95,637	1.656	$158,374
Hours/Year	96	Hours/year			2080
Total Cost/Year	$7,310	Hourly Cost	$45.98		$76.14

2.5 Electric Substation Map

The Substation Engineering Group oversees the 14 electric substations in RPU's service territory. Staff from various departments frequently request ad hoc reports from the Substation Engineering Group. In response to these requests, staff would have to pull the data from Electric SCADA, reformat the data into reports, and then email the report to the requestor.

The Electric Substation Map in Pi automatically populates substation information from the Electric SCADA system. Now anyone that needs substation information on megawatts (MW), megavolt amperes (MVA), and mega VARs (MVAR) can obtain the information directly from the map.



Substation Engineers spent approximately 1 hour each week responding to ad hoc requests for substation data. These requests are now directed to the Electric Substation Map, which provides visibility for all groups to the substation information.

The total ROI for the Electric Substation Map is $3,956 per year as shown in the table below:

Electric Substation Map					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Elec Eng Salary	$95,637	1.656	$158,374
Hours/Year	52	Hours/year			2080
Total Cost/Year	$3,956	Hourly Cost	$45.98		$76.14

2.6 Streetlight Service Requests Dashboard

Electric Field is responsible for the maintenance and repair of the streetlights in Riverside. When a customer reports that a streetlight is out, Electric Field crews must respond within 72 hours. This turnaround time is a Key Performance Indicator (KPI) and is tracked and reported to management on a regular basis.

By integrating with UWAM, the Streetlight Service Request Dashboard displays the status of open service requests for streetlight repairs with a focus on accurately monitoring the KPI to improve responses to streetlight issues. The dashboard allows supervisors and managers to track field crew efforts throughout the month and reassign personnel as needed when the average repair time increases. It has also led to crews taking the initiative to actively check progress and put in extra effort, if necessary, to meet the 72-hour KPI goal.

Prior to developing the Streetlight Service Request Dashboard in Pi, it took one Utility Analyst an entire day each month to create an equivalent report in Excel. Additionally, only historical data could be analyzed and no immediate action could be taken to remedy repair time slippages.

The total ROI for the Streetlight Service Request Dashboard is $6,132 per year as shown in the table below:

Streetlight Service Requests Dashboard					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Analyst Salary	$74,778	1.656	$123,832
Hours/Year	103	Hours/year			2080
Total Cost/Year	$6,132	Hourly Cost	$35.95		$59.53

Appendix 3 – Power Resources

The Power Resources Division is responsible for procuring, developing, managing, and marketing RPU's wholesale power and interstate transmission resources to serve Riverside's citizens with reliable electricity. Power Resources consists of five units. Three of these units are responsible for providing, maintain and managing RPU's wholesale power resources. A fourth unit manages and maintains all of the internal generation assets and a fifth unit manages and administers all of the public benefits programs.

Resource Planning & Technology Integration is responsible for assessing RPU's long-term power needs (i.e. integrated resource planning, production cost modeling), load forecasting, economic and econometric analyses, general analytical support services, and the integration of new software and hardware technologies.

Power Projects/Contracts/Settlement is responsible for RPU's generation and transmission projects, negotiating and administering the utilities' power supply contracts and tariffs, and reviewing/certifying all power supply transactions, including central market purchases, sales and trades, and after-the-fact payments and invoicing.

Market Operations is responsible for optimizing RPU resources, including all day-ahead and real-time billing, and scheduling and trading activities to meet RPU's electric needs. Market Operations is also responsible for procuring power and gas in compliance with RPU's Risk Management hedging policies and directives.

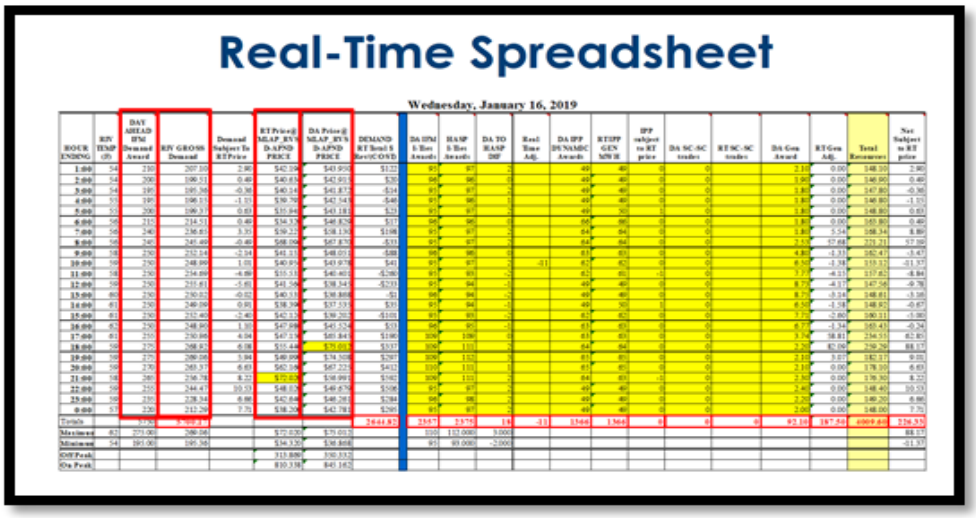
Power Generation is responsible for all aspects of management and maintenance of RPU's internal system generation resources, including construction, operations, safety, regulatory compliance, and adapting resources to the changing power industry. The Generation Facilities Group oversees the Springs, Riverside Energy Resource Center (RERC), and Clearwater Cogeneration Electric Power Plants.

Customer Engagement is responsible for developing and implementing energy and water efficiency programs, low-income assistance programs, and demand management activities. This unit also coordinates customer communications and public information outreach activities, in addition to supervising all education and sustainability programs and activities.

3.1 Real-Time Spreadsheet

Market Operations uses the Real-Time Spreadsheet to monitor market activity, evaluate Riverside's position from a load and resources perspective, optimize its bidding strategy for upcoming hours, and record real-time data. The Real-Time Scheduler uses this spreadsheet to make hourly decisions on whether it is best to buy/sell into the California Independent System Operator (CAISO) markets or transact in the bilateral markets.

Historically, the Real-Time Schedulers had to pull load data from multiple disparate systems, including load data from the Electric SCADA, generation data from Generation SCADA, weather data from the National Oceanic and Atmospheric Administration (NOAA), and renewables and external load data from SettleCore, then manually input the values into the spreadsheet to calculate real-time load and generation. The spreadsheet had to be created on a daily basis and then updated hourly during a very short time window in order to make hourly scheduling decisions.



Using Pi Data Link, Market Operations has been able to automate this process by pulling data automatically from all four data sources through system integrations. Now the real-time temperature readings, day-ahead load schedules, day-ahead prices, real-time prices, and generation output values are automatically populated into the spreadsheet. The integration of the Pi Data Link into the Real-Time Spreadsheet eliminates human error and allows more time for the scheduler to analyze and evaluate market data.

The total ROI for the Real-Time Spreadsheet is $66,060 per year as shown in the table below:

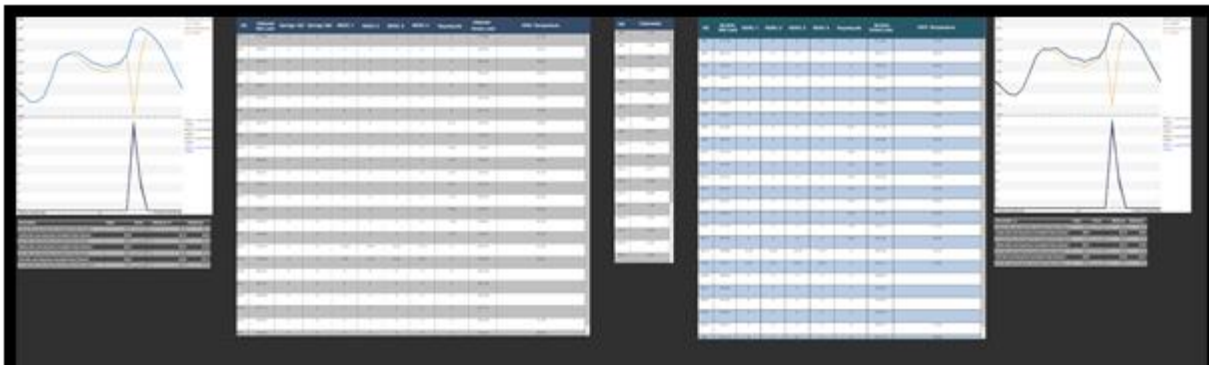
Real-Time Spreadsheet

			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Pwr Sched/Trader Salary	$115,242	1.656	$190,841
Hours/Year	720	Hours/year			2080
Total Cost/Year	$66,060	Hourly Cost	$55.40		$91.75

3.2 Vista Load and Generation Dashboard

Accurate load and generation data is crucial to Market Operations, since these values are used to update the load forecast for current and subsequent days. Accurate forecasts lead to accurate scheduling of internal generation, as well as protect the City's financial positions in the wholesale power markets.

The Vista Load and Generation Dashboard created in Pi automates gathering of this data into a central location. The dashboard automatically pulls data from Electric SCADA, Generation SCADA and NOAA, allowing the Market Operators to view the status of the seven transmission lines that feed Riverside. This information also shows when generation units start up, the total load of the RPU system, peak values, and trend data. The displays generated in the Pi dashboard help the schedulers identify any abnormalities in the data.



The integration of the Vista Load and Generation Dashboard has fully automated the process of viewing load and generation data, replacing a prior semi-manual process that took an average of 30 minutes a day.

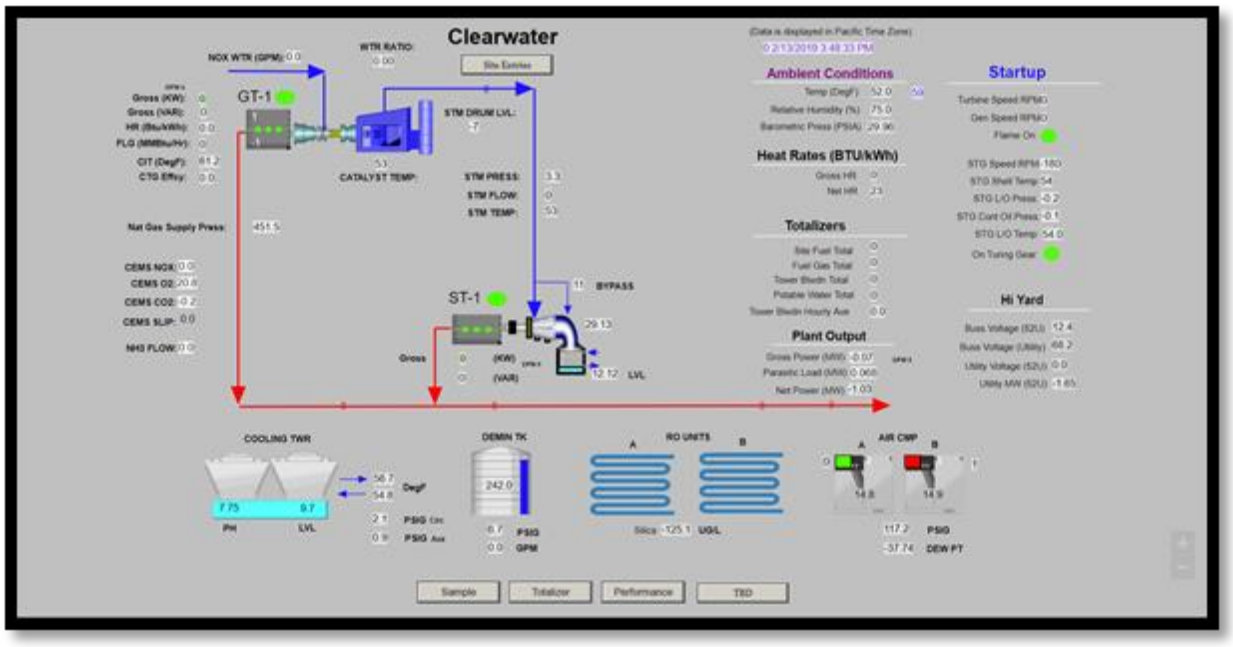
The total ROI for the Vista Load and Generation Dashboard is $16,744 per year as shown in the table below:

Vista Load and Generation Dashboard					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Util Pwr Sched/Trader Salary	$115,242	1.656	$190,841
Hours/Year	183	Hours/year			2080
Total Cost/Year	$16,744	Hourly Cost	$55.40		$91.75

3.3 Clearwater Dashboard

The Clearwater Power Plant was purchased by the City of Riverside from the City of Corona in September 2011. The plant is located in the Reclamation Facility located at 2201 Railroad Street in Corona. RPU leased out an Administration Building to support the plant since no building was available onsite. This building is located approximately one mile from the plant at 1700 Railroad Street. This is where the Plant Manager's office resides, meetings are conducted, and storage location of plant parts, drawings and documents.

Power Generation staff had been working for years with the Generation SCADA vendor on a way to view the plant status from the Administration Building, as well as from the Gateway office where the Market Operations team is located. They were unable to find a secure way to do this until Pi was integrated with the Generation SCADA system. Once this integration was completed, a Clearwater Dashboard was developed displaying all of the pertinent plant operation information, which allowed the Plant Manager to view and monitor the plant remotely.



The Plant Manager now has a secure and reliable way to remotely monitor from any location of the plant start up and operation along with troubleshooting issues after hours. This allows the Plant Manager to make real-time decisions whether to dispatch personnel immediately if an issue is identified.

Although no simple ROI can be calculated for this dashboard, there are numerous quantitative and qualitative benefits being derived from this integration. These benefits include increased visibility into the plant system status from any location, the ability to receive alerts when any production parameters go outside of predetermined ranges, and reduced traveling time from remote office locations to the plant.

3.4 Generation Operations Dashboard

South Coast Air Quality Management District (SCAQMD) regulations limit the number of times power generators can start up per day and per month. RPU's permits allow two starts per generator per day and a total of 40 starts per generator per month. In order to ensure the starts do not exceed the allowable number, the starts need to be carefully monitored for each generator. If the number of starts exceeds the permitted amount, a report must be filed and fines may be assessed.

The Generation Operations Dashboard was developed in Pi to automatically track generator starts. The dashboard utilizes integration with the Generation SCADA system to display daily and monthly start counts for each generator. Alerts are automatically generated when the number of monthly starts approaches the start limits.

Prior to creating the dashboard in Pi, this information was tracked with handwritten notes on a white board at the Riverside Energy Resource Center (RERC). There were notes on the board to remind the operators to contact management when limits were close to being reached. This manual and antiquated process allowed for human error, which has been mitigated with the Pi dashboard.

Again, although no simple ROI can be calculated for this dashboard, there are numerous quantitative and qualitative benefits being derived from this integration. These benefits include automated tracking of generator starts, alerts, and reduced risk of fines.

Appendix 4 - Finance and Administration

The Finance and Administration group is primarily responsible for the financial stability of Riverside Public Utilities and provides all aspects of customer service, both internal and external. The division is comprised of Finance/Accounting, Rates/Billing, Customer Service/311 Call Center, Field Services, Administration, and Business Systems Support.

The Finance/Accounting group is responsible for all utility financial reporting, budget administration, debt management, and financial planning, in collaboration with City Finance. They also develop RPU's Annual Financial Report.

The Rates group is responsible for cost of service studies, monitoring and developing rates, conducting rate comparisons, and approval and implementation of rate plan proposals. This group also includes the Utility Billing team, which is responsible for all utility billing activities for Electric and Water, as well as Public Works Sewer and Refuse.

The Customer Service Group provides the first point of contact for residential customers in Riverside. They handle approximately 347,000 calls and 224,000 walk-in customers annually. Customer service supports requests for electric, water, sewer, and sanitation services as well as credit and collections, write offs, Utilicare (medical assistance), Sharing Households Assist Riverside's Energy (SHARE) program and Home Energy Assistance Program (HEAP) for low-income assistance, as well as payment option programs such as the Level Pay Program. They also handle calls for street light repairs, dispatch emergency calls, and oversee the City's 311 Call Center for non-emergency calls and emergency referrals.

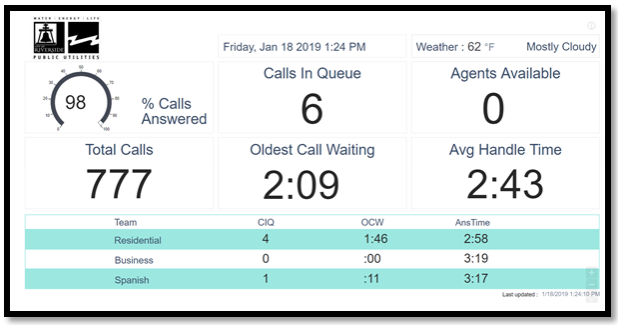
Field Services is responsible for the initiation and termination of meter services, as well as meter reading for billing purposes. They are also responsible for providing meter and billing related delivery notices to customers and investigating meter related issues, such as potential diversion of electricity.

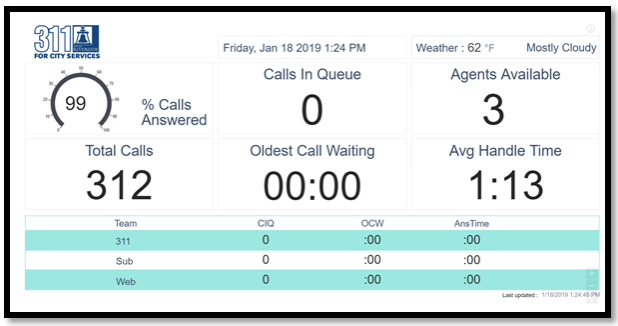
The Administration group is responsible for property and facility management, including the ownership of the Mission Square building. They oversee professional services contracts, signing authorities, and communicate purchasing policy changes. They also coordinate staffing related activities with the Human Resources Department.

Business Systems Support manages day-to-day operations of RPU systems, such as the Customer Information System (CIS). They offer help desk support to RPU staff for system use issues and train RPU staff on proper use of the CIS. This group collaborates with Information Technology (IT) on system configuration, interfaces, disaster recovery plans, and security.

4.1 Call Center Dashboards

RPU tracks customer call statistics and displays them on monitors at the Customer Service and 311 Call Center work locations. The call data is tracked through the Avaya Call Management System and includes calls in queue, available agents, total calls, oldest call waiting, and average handling times. Historically, to display the data from Avaya on the monitors, RPU used a third party software platform, Spectrum Nexource. This system was not customizable and was frequently down with long recovery times. Using Pi, RPU was able to connect directly to the Avaya system to display the same information in an improved format on the Call Center Dashboards.





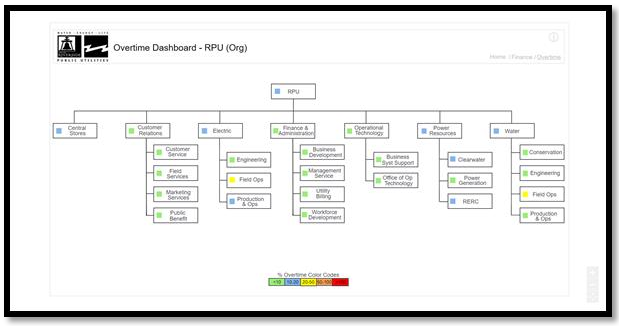
Using Pi, there is no longer a need for an annual subscription with Spectrum Nexource. RPU can now customize the call displays and provide more timely information. This system is more stable and has minimal downtime and quick recovery times in the rare instances that it does go off-line. Customer Service can now display this information at any location, such as the Customer Resource Center (CRC) payment location. The Customer Service Representatives at the CRC can monitor call volume and place themselves in the queue when the call volume is high.

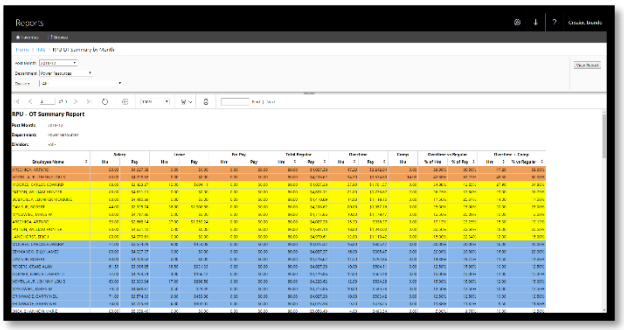
The total ROI for the Call Center Dashboard is $3,360 per year based on the cancellation of the Spectrum Nexource annual subscription.

4.2 Overtime Reports and Dashboards

RPU supervisors and managers consistently work with staff to ensure work tasks are completed efficiently during normal business hours. However, the nature of work that is conducted at a utility includes after-hours emergencies and other work that cannot be completed during normal business hours. In addition to ongoing management of staff overtime hours, the RPU management team reviews a report that provides the year-to-date overtime amounts for each employee, along with comparison data for prior years.

The Pi Overtime Reports and Dashboards automatically extracts data from the payroll system (formerly IFAS/ currently OneSolution) and displays overtime data for each RPU employee. The data is grouped and color-coded to quickly identify employees with higher percentages of overtime. It also shows the overtime to budget tracking and compares the data to prior years.





Prior to creating the Overtime Reports and Dashboards in Pi, the data had to be exported from the payroll system to update an Excel report on a bi-weekly basis. This was a manual and time consuming process that took one analyst more than two days per month to complete.

The total ROI for the Overtime Reports and Dashboard is $18,017 per year as shown in the table below:

Overtime Reports and Dashboards					
			Average	Multiplier for Payroll Burden	Total Average
	Average	Principal Mgmt Analyst Salary	$108,798	1.656	$180,169
Hours/Year	208	Hours/year			2080
Total Cost/Year	$18,017	Hourly Cost	$52.31		$86.62